Lyne Water Catchment - Natural Capital Opportunities Plan



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Report prepared for:

Dr Andy Tharme, South of Scotland Enterprise, Natural Resources Manager, Natural Capital Team, Selkirk, Scottish Borders.

Report prepared by:

Dr Derek Robeson B.Sc, M.Sc, Ph.D, CEnv, MCIEEM, FRAgS & Hamish Robertson B.Sc,
Tweed Forum, Old Melrose Dairy Steading, Melrose, Roxburghshire,
TD6 9DF.

Tel: 01896 849723

E-mail: info@tweedforum.org **Web:** www.tweedforum.org

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Annex 4b - Lyne Water Catchment Peak Flow Analysis and Climate Change estimates at gauging stations at Lyne Station, March Street and Peebles (JBA)

Footnote

Tweed Form was appointed in January 2026 by South of Scotland Enterprise (SOSE), on behalf of the Regional Land Use Partnership (RLUP), under the Regional Economic Partnership, to provide Phase 2 of the Lyne Water Natural Capital Innovation Plan. This has been developed to contribute to the South of Scotland Reginal Land Use Framework (RLUF), produced under the Regional Land Use Partnership (RLUP).

Tweed Forum was awarded a grant under SOSE's Natural Capital Innovation Fund (SOSENC6001), to deliver nature-based solution measures in the catchment, guided by a natural flood management tool, developed under the grant.

Lyne Water Catchment - Natural Capital Opportunities Plan

(Phase 2 Completion Report - March 2026)

Background to Tasks

Phase 1:

During January to March 2025, Tweed Forum commissioned JBA Consulting (JBA) to assist in undertaking a Lyne Water Innovation Plan Review, which was funded by South of Scotland Enterprise (SoSE). This was largely desk based and examined the physical characteristics of the catchment, namely: Land Use, Geology, Flood Risk, Hydrology & History. Although the main driver was Natural Flood Management (NFM), other objectives of the review were to gather information which could be used to assess the potential to deliver Nature-based Solutions (NbS) across the wider catchment. This would be the subject of a Phase 2 grant application proposal and subsequent approval (below).

Phase 2:

Phase 2 comprised undertaking nine items of work, between September 2025 and March 2026 to help develop a Natural Capital Opportunities Plan for the Lyne Water.

Items 1-4 below, were funded through an award of £99,999 from SoSE's Natural Capital Innovation Fund (NCIF). Items 5-9, through an award of £25,100 from SoSE's Regional Land Use Partnership (RLUP) Fund.

Summary of Outputs:

1. To create an NFM/NbS Visualisation Tool (JBA).
2. To develop the NFM Visualisation Tool to include wider opportunities for Nature Based Opportunity mapping (JBA).
3. To calibrate a new Dynatop Model (JBA).
4. To facilitate a range of practical works on the ground (TF).
5. Compile a Hydrological Technical Note (JBA).
6. To carry out Landowner Engagement, Site Visits & NFM Mapping opportunities (TF).
7. To hold a Community Engagement Workshop (TF/Southern Upland Partnership).
8. To compile a Written Completion Report by mid-March 2026 (TF/JBA).
9. To undertake a Peak Flow analysis and climate change estimates at gauging stations at Lyne Station, March Street and Peebles (JBA).

Lyne Water Catchment - Natural Capital Opportunities Plan

There are 9 Completion Report Items:

1. **Create an NFM/NBS Visualisation Tool – JBA** (please refer to Annex 1 for JBA Report describing the methodology & outputs in more detail).

The Aim - JBA were tasked with creating an NFM Visualisation Tool for the Lyne Water catchment. The tool would be a web-based application, designed to visually portray the existing Natural Capital, Nature-based Solutions and Natural Flood Management potential within the catchment. The tool would include these layers as standard, which can be further updated in the future as required. The Tool was created in December 2025.

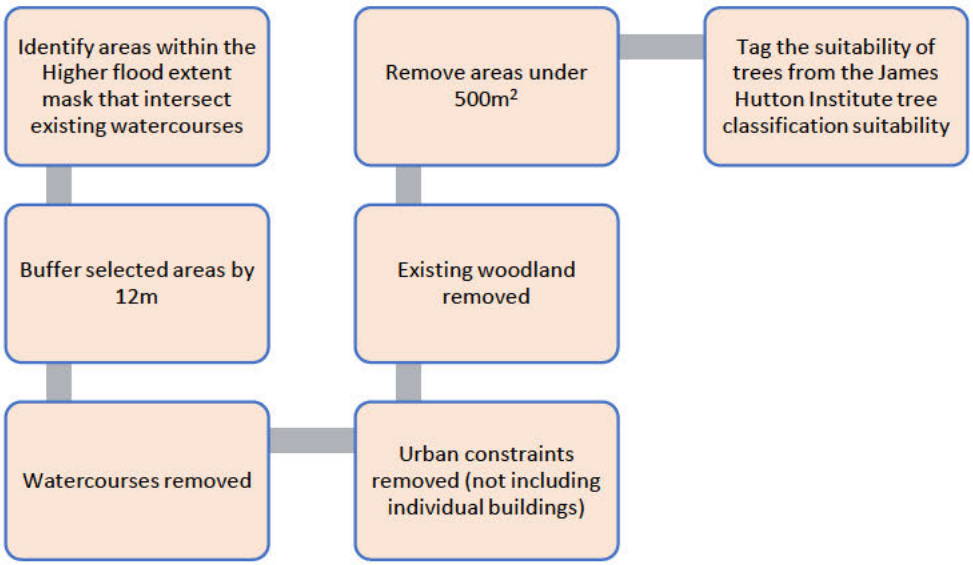
Methodology & Output - The Nature-based Services opportunity mapping Tool has been developed in order to provide the basis for information to enable opening a dialogue with key stakeholders as to potential future resilience options for the Lyne Water catchment, especially in response to climate change pressures. The tool showcases the opportunities available allowing the user to examine parcels of land for potential opportunities. The selected natural capital approach aims to explore the delivery of multiple benefits for water management, people and nature in the Lyne Water catchment, at a time of a rapidly changing environment due to climate change (e.g. water quality, carbon storage, and flood / drought resilience). To support this assessment, a qualitative ecosystem services assessment was undertaken previously to determine the sorts of benefit that could be unlocked through natural capital/NbS delivery. This assessment is used to determine who benefits from NbS.

The approach used combined national water depth and velocity models' (three return-period scenarios) with a set of spatial constraints (exclusion buffers for roads, buildings, freshwater, existing watercourses and sensitive woodland/peat areas) to mask out non-feasible locations. From the remaining area, a series of simple, repeatable indicator analyses were run to generate opportunity layers: runoff risk and land-suitability metrics to prioritise wider woodland; topographic wetness index and soil type to flag wetlands; flow-path and slope analysis to locate offline storage and floodplain reconnection sites; combined flood depth/velocity masks to find sites for leaky barriers and attenuation features; and land-cover filters to target peat restoration, and soil and land-management interventions.

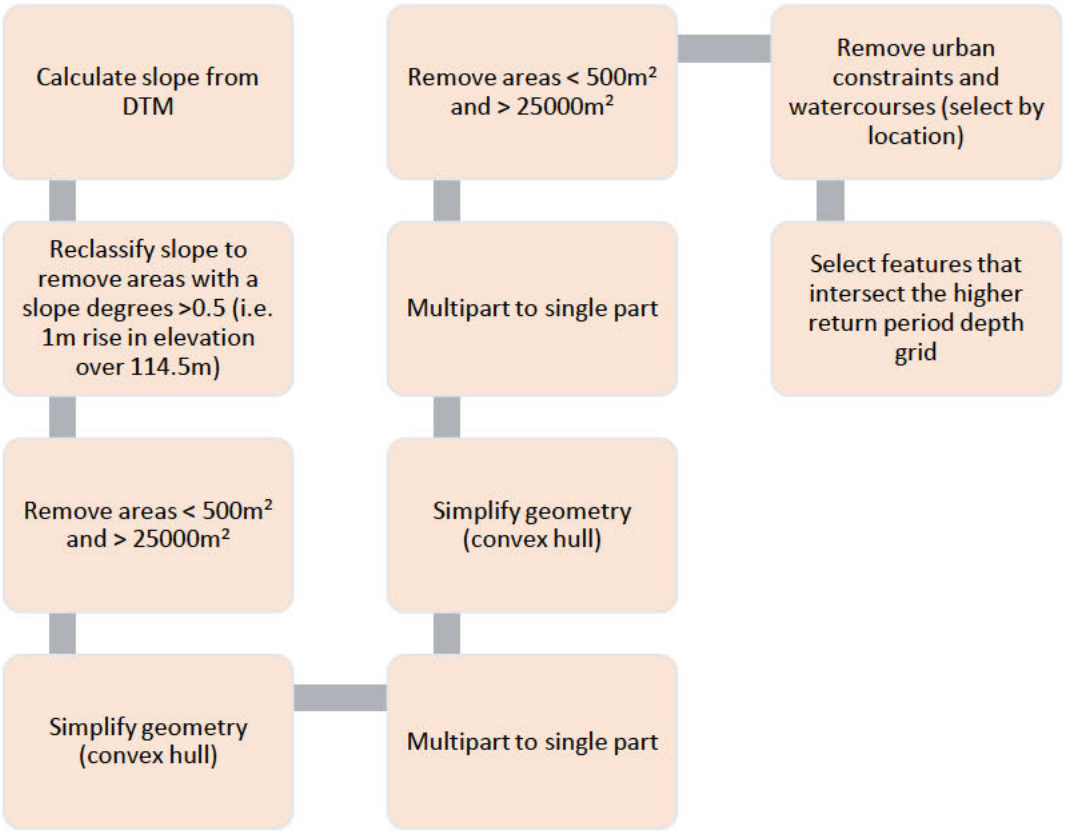
The method emphasised combining best-available national datasets, applying clear exclusion criteria, deriving simple suitability indicators, and producing opportunity maps to guide further investigation.

The Tool was generated. The intention is that the tool will be further developed in due course.

During December, January and February, Tweed Forum was given access to the evolving NbS Tool during a two-month Development Phase (see Element 2).



Example of Riparian and Floodplain Woodland layer generation methodology



Example process used to identify areas of potential offline storage (by slope)

2. Develop the NFM Visualisation Tool to include wider opportunities for Nature-based Opportunity mapping – JBA

(NB – Time limited access to the Tool can be obtained by project partners, via a password protected link, through a direct request to JBA Consulting).

The Aim - JBA continued to develop the Tool. Tweed Forum provided feedback on the Tool's appearance, functionality and overall usefulness. The tool was altered and adapted, following feedback comments.

Methodology & Output - The tool was relatively attractive. The Tool was easy to use. Twelve opportunity layers were available to view. These included: Wet Woodland, Floodplain Restoration, Leaky barriers, Offline Storage, Peatland Restoration, Online Storage, Recharge Areas (Superficial), Recharge Areas (Aquifer), Recharge Areas (Bedrock), Riparian Water Quality, Agriculturally Enclosed Fields, Wetland Creation.

All twelve layers offered insight into where habitat creation opportunities existed. Combined with site visits, this has the potential to be helpful.

Specific feedback by Tweed Forum: The following comments on the Tool were made:

1. The tool was fairly intuitive and easy to use, with layers added and removed without too much delay or difficulty.
2. It would be good to have an aerial view layer built in…with a scroll bar to aid user experience.
3. The twelve opportunity layers were useful (more can be added in time and with additional development funding).
4. Some explanatory text would be useful to explain what each layer is showing and what data was used to generate any given layer.
5. The Tool has some value at the moment (i.e. for targeting NFM Measures largely) but could be made significantly more useful in time, if widened out to wider Nature Based Services interventions (comparisons should be made with the NatureScot Natural Capital Tool).
6. The 1 in 20 year Flood extent layer and also a 1 in 200 year flood extent layer were useful. It was suggested that the following **Background Information** dataset layers would be useful (in future), if built into the Tool as standard:

- Modern OS Map Layer
- Historic First Edition (1857) OS Layer
- Latest Aerial View
- Geology Map
- Soils Map
- Soil Carbon Map
- Peatland Map
- SciMap- Water flow pathways and Erosion Risk
- LiDAR
- Scheduled Monuments
- All Designates Sites (SSSI/SAC/SPA/NSA/NVZ /etc)
- Phase 1 Habitats Layer
- Service Lines (Gas, Electric, Water, etc)
- Core Path Network
- Land Capability for Agriculture
- Land Capability for Forestry

It was suggested that all the following **Opportunity Layers** would be useful if built into the Tool in future:

- Native Woodland planting opportunities (Floodplain, Riparian & Hillslope)
- Mixed Amenity Woodlands
- Scrub Creation
- Commercial Conifer plantations
- Peatland Restoration (peatland over 50cm deep for ditch blocking, Hag reprofiling, Forest to Bog conversion, etc)
- Hedgerow planting
- Waterside margin fencing/planting
- River re-meandering
- Grassland conservation Grazing
- Pond & Scrape Creation
- Wetland Creation
- Wildflower grassland Management/Creation
- Grass Buffer strip Creation
- Individual Landscape Tree planting
- Arable infield Conservation Opportunities (such as winter cover crops/ wildbird cover crops)
- Improved Grassland infield Conservation Opportunities (such as winter grazing management).

3. **Calibrate a new Dynatop Model -JBA** (please refer to Annex 2 for JBA Report on Dynatop Model Methodology & Outputs).

The Aim - JBA were to calibrate a new Dynatop model to the Lyne Water flow gauge, across 2 flood event periods (which could be several months in duration to capture a range of events) and be able to represent the implications to peak flow or volume reductions from a range of NbS scenarios. This would be an important element which will reflect the ambitious plans to slow, store and infiltrate more flood water within the catchment. JBA were to identify locations where the hydrograph can be monitored with and without NbS scenarios for change, and report on the most effective locations.

Methodology & Output - The Dynatop Model has been built to assess the potential benefits of implementing proposed Nature-based Solutions. Benefits to flood risk, water resources and drought resilience have been assessed.

Water resources are a key concern within the catchment, meaning that long term trends in climatic conditions of the catchment are of interest for long term ecological and water resources planning. Gauges located within the Lyne Water catchment have been tested for non-stationarity (or changes in the mean flow over time).

This report examined the current hydrological status of the catchment, reviewing its:

- Land use
- Geology
- Hydrology including water management

The Dynamic TOPMODEL was used to assess the relative effectiveness of storage, targeted roughness and land use management enhancements in different sub-catchments in the Lyne Water catchment.

Dynamic TOPMODEL offers a fully distributed representation of the hydrological processes influenced by NbS - incorporating outputs such as through-time soil storage deficits. The model provides the capability to not only represent surface runoff processes but also infiltration, throughflow and wet canopy evaporation processes which may be influenced by NbS interventions. Here we used dynatop, an enhancement of Dynamic TOPMODEL (Smith and Metcalfe, 2023). Dynatop is open-source and was recently noted for its advancement in distributed hydrology in the England Environment Agency evaluation of open hydrology methods.

A fundamental principle of dynatop is the division of the landscape into hydrologically similar parcels, known as Hydrological Response Units (HRUs). The HRU represents an area of the catchment which is characterised by similar properties; for example, topography, soil, and land use; which are indicative of a similar hydrological response. The representation of a HRU comprises of 4 zones arranged vertically which can transfer water between each other. The surface and saturated zones also receive inflows from upslope HRUs and pass outflows downslope. The routing of flows between HRUs is topographically driven.

The use of HRUs allows dynatop to account for spatial and temporal variability in runoff processes. Using land use Section properties with the HRU classification allows differences; such as changes in subsurface hydraulic conductivity or different surface roughness's; to be represented by changes in the HRU parameters. Appropriate parameter ranges associated with environmental classifications (e.g. soil type) are defined from literature and past modelling experience. Based on these ranges a Monte-Carlo simulation approach is used to select an ensemble of plausible parameterisations to improve confidence of model outputs

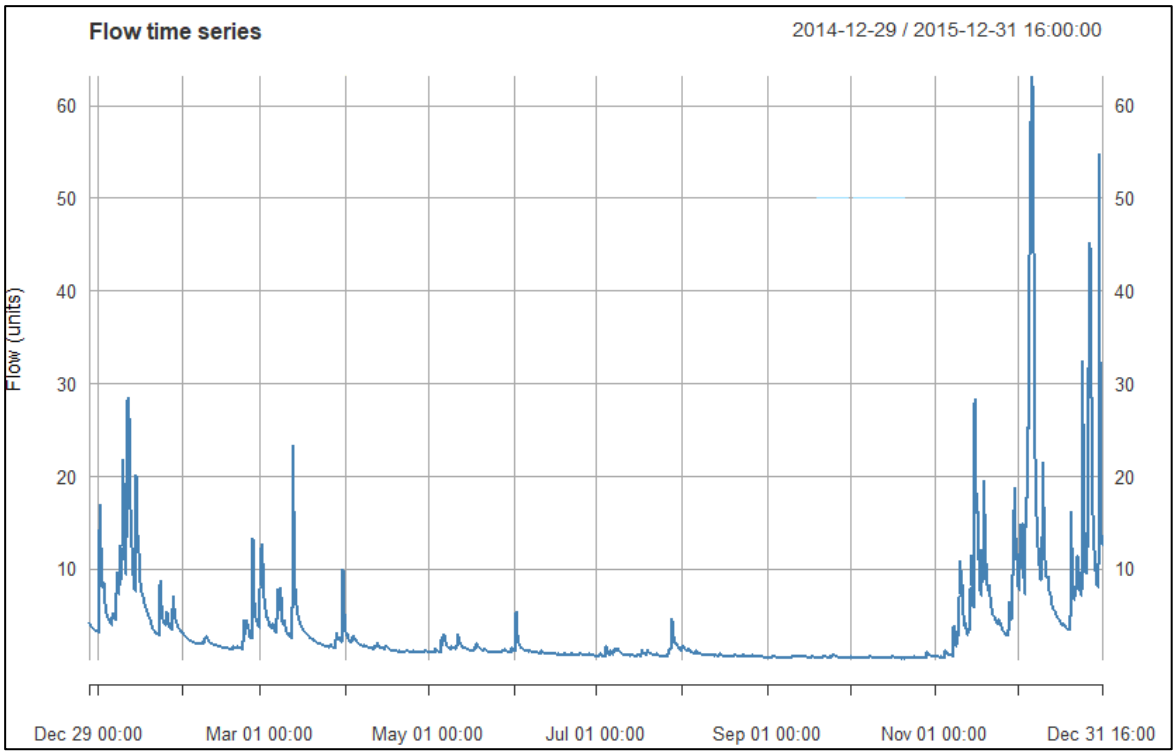
In addition, if timeseries data was available on reservoir levels and spills, their outflows and storage dynamics could be directly handled. However, these operational data were not available for the reservoirs in Lyne Water. Therefore, their function must be estimated and parameterised based on assumptions of their storage and outflows. These assumptions on reservoir behaviour introduce uncertainty into dynatop model predictions and deviation between simulated and observed flows are expected where modelled reservoir behaviour differs from actual reservoir operations.

In the dynatop model, both reservoirs were represented using a similar method to how runoff attenuation features are represented. For the HRU representing the reservoir, the surface excess storage parameters were set to produce a large storage, with a maximum storage estimated from the reservoir surface area. The outflow from the reservoir storage is controlled by a power law and has a constant outflow. Mean flow is estimated from the maximum compensation flow conditions for each reservoir, provided by SEPA, i.e.

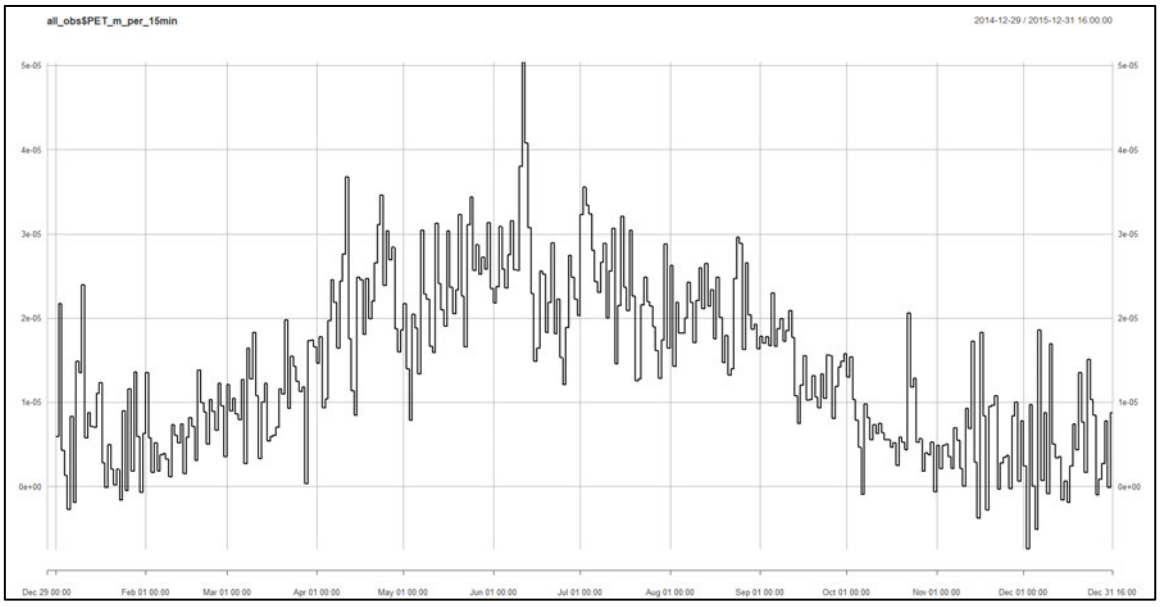
- West Water: 1 May - 30 Sept 2,864m³ day
- Baddinsgill: 1 May - 30 Sept 4,091m³ day

This information is used to assess the potential to take a natural capital approach to addressing key issues in the Lyne Water catchment, primarily through NbS.

JBA's Report in Annex 2, describes the implementation of Dynatop, a semi-distributed hydrological model that has a proven track record in NFM studies.



Example Lyne Water flow timeseries for 2015, showing regular storm events early in the year, followed by a low flow period through the summer and rewetting in November before large storm events in December (incl. Storm Desmond).



Lyne Water Catchment averaged daily Potential Evapotranspiration for 2015 (there is much more evapotranspiration in summer than winter - as expected).

4. Facilitate a range of practical works on the ground – TF

The Aim - Tweed Forum were awarded funding to deliver a range of practical conservation measures on the ground, focussed on NFM measures such as:

- Creation of Water Retention/Wildlife Ponds.
- Fencing off Watercourses to Cool Rivers.
- Planting Riparian Trees and creating buffer Strips.
- Planting Hedgerows to form Habitat Networks.

Methodology & Output - The following works were undertaken on the following Farms:

Farm	Pond/Scrape created	Trees Planted	Metres of Hedge Planted	Metres of Bank Protection	Metres of Livestock Fencing
Baddinsgill	5				
Stonypath	15	240			486
Wakefield	13	180			191
Drochill	1	120	220	120	300
South Slipperfield		1070	660		600
Lyne Farm			340		680
West Mains	3				
Total	**37**	**1,610**	**1,220m**	**120m**	**2,257m**

(NB- All fencing was funded under the NCIF grant, as a standalone item and not part funded with any other statutory support scheme, such as the Forestry Grant Scheme or Agri-Environment scheme).

The NFM visualisation tool (alongside desk based information gathered under Phase 1 of the project) was utilised to help target areas where conservation works could be suitable. The tool was most useful for targeting sites for wetland creation and tree planting. If developed further, the tool has scope to be useful at a catchment and landscape scale.

All the conservation works implemented will help mitigate against flood risk by slowing the overland flow of water. They will also deliver a range of multiple benefits including Enhanced Biodiversity, improved water quality and an increase in habitat diversity.

This project has tried hard to maximise the capital works income to benefit the local economy as much as possible, through using only local contractors and suppliers. This has not only had a beneficial impact for these local businesses but helped upskill and educate the local community about some of the challenges faced by climate change and some of the solutions available to mitigate its impacts.

Practical works have been undertaken by a wide range of local contractors from groundworks operations to planting and sourcing materials.

Five different groundworks contractors were used for all sites where ponds and scrapes were excavated. This was to increase efficiency of outputs in the short time period, while helping upskill and share the economic benefits of this project as far as possible within the local community and South of Scotland. All groundworks operators were based within 30 miles of West Linton, predominantly hailing from Peebles, Innerleithen and Eddleston.

Labour to install fences was either undertaken by the farms themselves or through a local contractor in Eddleston. Almost all fencing materials were sourced from local suppliers such as Treeline, a supplier located within the Lyne Water catchment and McVeigh Parker, a national business with anabranch in Biggar.

Plants and materials for all of the standard tree planting and tree protection, were sourced from Alba trees, a supplier located 30 miles away from West Linton. A number of local suppliers and contractors were used in this project.

Only one supplier has been used which sits out with the South of Scotland, Cactus Ltd, based in Cumbria, for their spikey Cactus Tree Guards, something that is not yet produced by a company in the South of Scotland. This means that of the £74,400 worth of capital works money given by SoSE, the bulk has remained in the South of Scotland and the vast majority of this staying within the Scottish Borders.

Wakefield: (13 Water Retention / Wildlife Ponds, 180 Trees, 191m Fencing)

The works at Wakefield came about as a result with the landowner, who had an interest at trying to diversify his land (predominantly comprising young commercial forestry) in order to gain wider biodiversity benefits. Upon a site walkover and discussion, creating ponds and scrapes alongside some clumps of native broadleaves were the agreed measures to be undertaken.

After a tendering process, local contractor Graham Irvine (Peebles) was employed for the groundworks, Stuart Aitken (Eddleston) for the fencing, and JD Forestry (Hawick) for the planting works. Fencing materials came from Robertsons in St Boswells and tree plants and protection from Alba in East Lothian.

The works saw the creation of 13 water retention and wildlife ponds, 180 native broadleaved trees planted and 191m of stock exclusion fencing installed.



Aerial View of Ponds at Wakefield



Aerial view of Ponds at Wakefield



Ground level view of Ponds at Wakefield



Ground level view of Ponds at Wakefield

Stonypath: (15 Ponds, 240 Native Trees, 486m of Fencing)

The landowner at Stonypath was already known to Tweed Forum and has worked with us in the Eddleston catchment on biodiversity and natural flood management projects previously. It was not known however about his ownership of Stonypath until this project came about, and which was identified through the landowner identification task.

Stonypath has a hillside that is predominantly used for the overwintering and summer grazing of cattle, the main concern of the landowner, in relation to climate resilience, was the lack of a range of habitats on this hillside, as well as the concern over water scarcity in drought periods. After a site walkover, ponds were discussed and sites identified to help increase farm biodiversity, while providing a potential water source for livestock in the summer months.

Local contractor Jason Card (Peebles) was used for the groundworks, Stuart Aitken (Eddleston) for the fencing and JD Forestry (Hawick) was used for the planting.

In the end, 15 wildlife ponds and scrapes were created, alongside 240 low density native broadleaved trees and 486m of stock exclusion fencing.



Ponds and Native Trees at ground level



Fenced off Ponds at Stoneypath



Aerial view of pond and wetland mosaic at Stoneypath. Fenced off and planted with small clumps of native trees.



Wetland Mosaic at Stoneypath

Baddinsgill: (5 Ponds)

The landowners at Baddinsgill were also known to Tweed Forum and acted as the initial point of contact for the Forum to engage with local famers and landowners. Again, their concerns focussed on the lack of biodiversity within their holding, highlighting riparian corridors and ponds. The farmer has always had an ambition to create a number of ponds and wetlands themselves but never had the capital funds to do so. After a walkover, a number of pond locations were identified and, in an attempt to spread the NCIF funds across as many landholdings as possible, 5 sites were identified as being possible under this round of funding.

The 5 ponds were excavated at 3 different locations, providing a valuable pond network across the farm while linking into a further 28 newly created ponds at neighbouring farms including Stoneypath and Wakefield. This has created a valuable water retention and wildlife habitat resource in a landscape where ponds are not that common.



Pond Creation at Baddinsgill



Pond creation at Baddinsgill

West Mains: (3 Ponds)

On finding out about the NCIZ within the Lyne catchment, the farmer was keen to find out how he could help with the project and tackle some known concerns on his farm, at the same time. Tweed Forum helped him apply for a Borders Tree Grant Scheme application and plant 300 trees (not NCIF funded) and conducted a site walkover alongside in the company of the farmer.

After a site visit and further discussion, a wet corner of a field was identified by the farmer as being of little agricultural benefit to himself and he was willing to enhance the biodiversity benefits of this area as much as possible. Despite the wetland area already providing some level of biodiversity, diversifying the habitat further, with the creation of some open water areas, would further enhance this site as a habitat for wildlife.

The contractor we used to create these scrapes, was Ewen Irvine (Peebles), who created 3 scrapes in this field corner.

Drochil: (1 Pond, 120 Trees, 220m of hedgerow, 120m Bankside protection, 300m Fencing)

Drochill and Stevenson were engaged to the project as a result of a farmer engagement event held at the Tontine in Peebles back in December. The farmer was keen to hear more about the Lyne Water project and see what we could do on his farm to help his farm resilience.

On the initial site visit, the farms main concern was a around riverbank erosion on his best inbye fields which was resulting in a huge amount of sediment and high nutrient soil ending up in the SAC designated water course. There was a further worry that if the river was to erode further then there was a risk of it undercutting some historic rock riprap and posing serious risk to the farm's best fields. A discussion was had with the farmer about how Nature Based solutions could be used to resolve this issue while having wider benefits for the environment.

The solution created was a series of willow stakes along the riverbank, set a few meters back from the water's edge and protected with cactus guards. The aim being that the willows will establish and prevent further erosion beyond the point of the planting. As the trees grow, they will also provide dappled shade for the river. This work was carried out by Scott Speed located in Ettrick Valley.

Upon a further walkover, a cross-contour hedgerow and pond were also identified as further possibilities to improve the farm water resilience. This resulted in 220m of hedgerow being installed by Scott Speed and a large biodiversity/flood mitigation pond being excavated by Ryan Bertrum from Eddleston.



Cactus guarded willow stakes planted to reduce riverbank erosion



Cross contour hedgerow installed at Drochill

South Slipperfield: (1,070 Trees, 660m of Hedgerow, 600m Fencing)

Contact details for the landowner at South Slipperfield were obtained during a site visit with one of the other project locations. The landowner was called and agreed to a site visit to see what measures he could implement on his farm. After an initial chat and site walkover tree and hedgerow planting was deemed as the most desirable features.

A boundary fenceline was identified as the best location for a scrubby wide hedgerow which would act as a wind break for his livestock while creating a valuable wildlife corridor across 660m of the Lyne catchment, linking into a wider hedge network. In total, 1,770 plants have been planted in this hedgerow with a mix of Hawthorn, Hazel, Blackthorn, Cherry, Aspen, and Crab apple. In order to try and reduce plastic in protecting the trees, an innovative spray, Trico, has been applied to the saplings which uses emulsified sheep fat to deter browsing from deer.

An existing fenced off area of 0.9ha was identified to the North of the farm, which has the West Water running through, as a great site for some riparian planting. This site has been planted with 1,020 native trees including Hazel, Cherry, Aspen, Oak, Alder, Birch, and Willow which will help buffer 530m of the West Water, part of the River Tweed SAC. Planting work for both sites was undertaken by Treeline Woodlands of West Linton, who are based less than a mile from the site at South Slipperfield.

Neidpath Farms: (340m Hedgerow, 800m Fencing)

The landowner and farm manager at Neidpath farms, were already known to Tweed Forum and have carried out a number of woodland creation and biodiversity enhancement projects prior to this NCIF project. Initially, we wished to target farmers we had not engaged with before. (NB- Also, due to their location within the lowermost section of the Lyne water catchment, effort was made to prioritise and work with other landowners and farmers further up the system, before working with Neidpath).

Towards the end of the project and after working with several other farms, Neidpath was approached, to see if the NCIZ fund could help their business become more resilient to climate change. After several suggestions, the farm was most keen on hedgerows and identified a number of field boundaries where hedgerows could be installed to improve biodiversity, habitat connectivity and provide shelter and shading for livestock. Due to having a limited (remaining) budget, a stretch of 340m of fenceline was identified, as having the potential to produce a high number of multiple benefits, if it was planted as a hedgerow. Not only did it connect areas of woodland, but it would also create a cross-slope hedgerow, which are good at slowing overland flows of water in periods of heavy rain. It would also act as a barrier for sediment and nutrients, preventing them from entering the nearby Watercourse.

The double fencing that was required, was installed by the farmers themselves, with the planting being undertaken by JD Forestry of Hawick. All materials being sourced from Mcveigh Parker in Biggar or Alba Trees in East Lothian.

Around 340m of cross contour hedge was created using a mix of Hawthorn, Hazel, Willow and Blackthorn.

5. Compile a Hydrological Technical Note - JBA (please refer to Annex 3 for more detail).

The Aim - JBA were to generate a hydrological technical note illustrating climate change related peak flow increases for Lyne Water. They were to use hydrological calculations such as Flood Estimation Handbook (FEH) techniques, following the latest SEPA guidance. Tweed Forum sees this as a really important piece of information with which to grab the attention of landowners/land managers and others within the catchment.

JBA were to undertake an evidence review for the potential '*Do-Nothing implications for the catchment*' by reviewing the latest literature and linking back to the hydrological technical note, including for increased drought risk through climate change. This will be suitable for any future NFM business case development. The Hydrological Technical Note was completed in March.

Methodology & Output - The report provided a comprehensive catchment overview, including land use, soils, geology, hydrology, and environmental designations. Soils are largely well-drained but highly susceptible to compaction and erosion, particularly in areas of peat, which have been shown to be extensively modified through drainage, burning, and grips. These characteristics influence runoff generation, groundwater recharge, water quality, carbon storage, and ecological resilience. Several nationally and internationally designated sites are present within the catchment, including West Water Reservoir (RAMSAR, SSSI, SPA), and the Lyne Water forms part of the River Tweed Special Area of Conservation.

Current ecological status, as reported in the River Basin Management Plan for Scotland (2021–2027), ranges from moderate to good ecological potential. Pressures are largely linked to agricultural drainage, water industry infrastructure, and diffuse pollution. While some mitigation measures (e.g. riparian planting, re-meandering, and improved fish passage) are identified as beneficial, implementation is constrained by land use and the need to maintain public water supply.

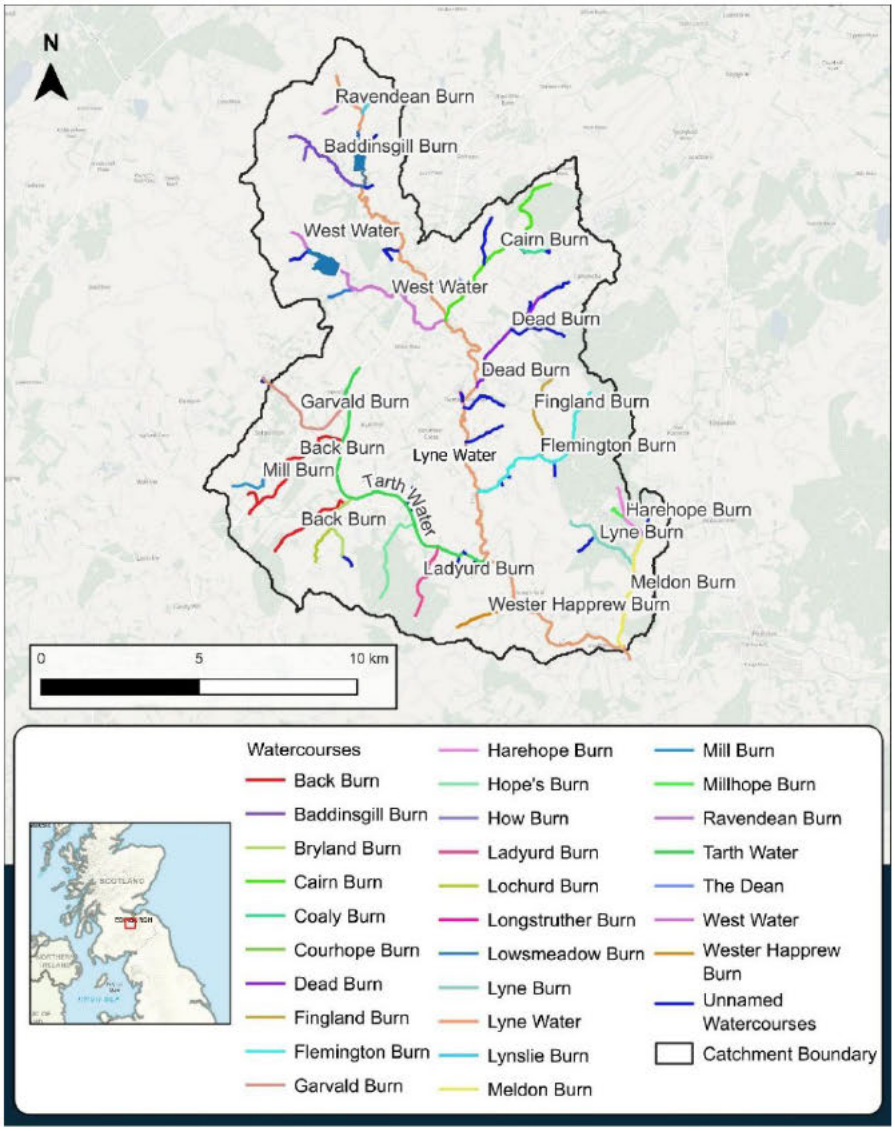
To support hydrological modelling, the report reviewed available flow, rainfall, and reservoir data, assessing their suitability and quality. A key outcome is the derivation of catchment-averaged rainfall and potential evapotranspiration (PET) time series, which are required inputs for Dynamic TOPMODEL. An observed period from January 2015 to January 2016 was selected to represent drying, drawdown, and re-wetting processes, capturing a significant summer drought followed by intense rainfall later in the year (including Storm Desmond). Rainfall inputs were derived using a weighted approach based on the spatial influence of five local gauges, while PET was derived from Environment Agency gridded datasets.

A key addition to this update is the inclusion of non-stationarity testing on both high flows and low flows using methods consistent with the Environment Agency interim guidance for non-stationary flood frequency analysis. Three tests were applied: Mann-Kendall (testing for a consistent trend), Pettitt (single change point in mean), and PELT (change points in mean and variance with minimum segment length). For annual maximum (AMAX) flows, the Mann-Kendall test identified (i) no statistically significant trend at Lyne and Tweed @ Peebles and (ii) a statistically significant but weak positive trend at Tweed @ Lyne Ford indicating a modest increase in peak flows over the record. The Pettitt test for AMAX corroborated this by detecting a significant upward step change around 1998 at Tweed with no significant change points at the other gauges. However, the PELT test detected no statistically significant change points in AMAX at any gauge, suggesting that the apparent shift may reflect a more gradual change or insufficient post-change stationarity to meet PELT segmentation requirements.

For annual minimum (AMIN) flows (derived from available 15-minute records), the results differ from the high-flow findings. The Mann-Kendall test identified a statistically significant weak negative trend at Lyne @ Lyne Station indicating that low flows have been decreasing over time at this gauge. No significant AMIN trends were found at Tweed @ Peebles or Tweed. The Pettitt test on AMIN further identified a significant downward change point around 2011 at Lyne consistent with the observed negative low-flow trend; no significant low-flow change points were detected at the Tweed gauges. As with AMAX, the PELT test did not identify statistically significant change points in AMIN series for any gauge.

Overall, the trend analysis indicates no uniform regional signal across gauges for either high or low flows; where trends are detected, they are site-specific. This pattern suggests that local controls, such as reservoir operations, abstraction, land use and drainage, and channel morphology, may be as important as (or more important than) broad climatological forcing in shaping observed changes.

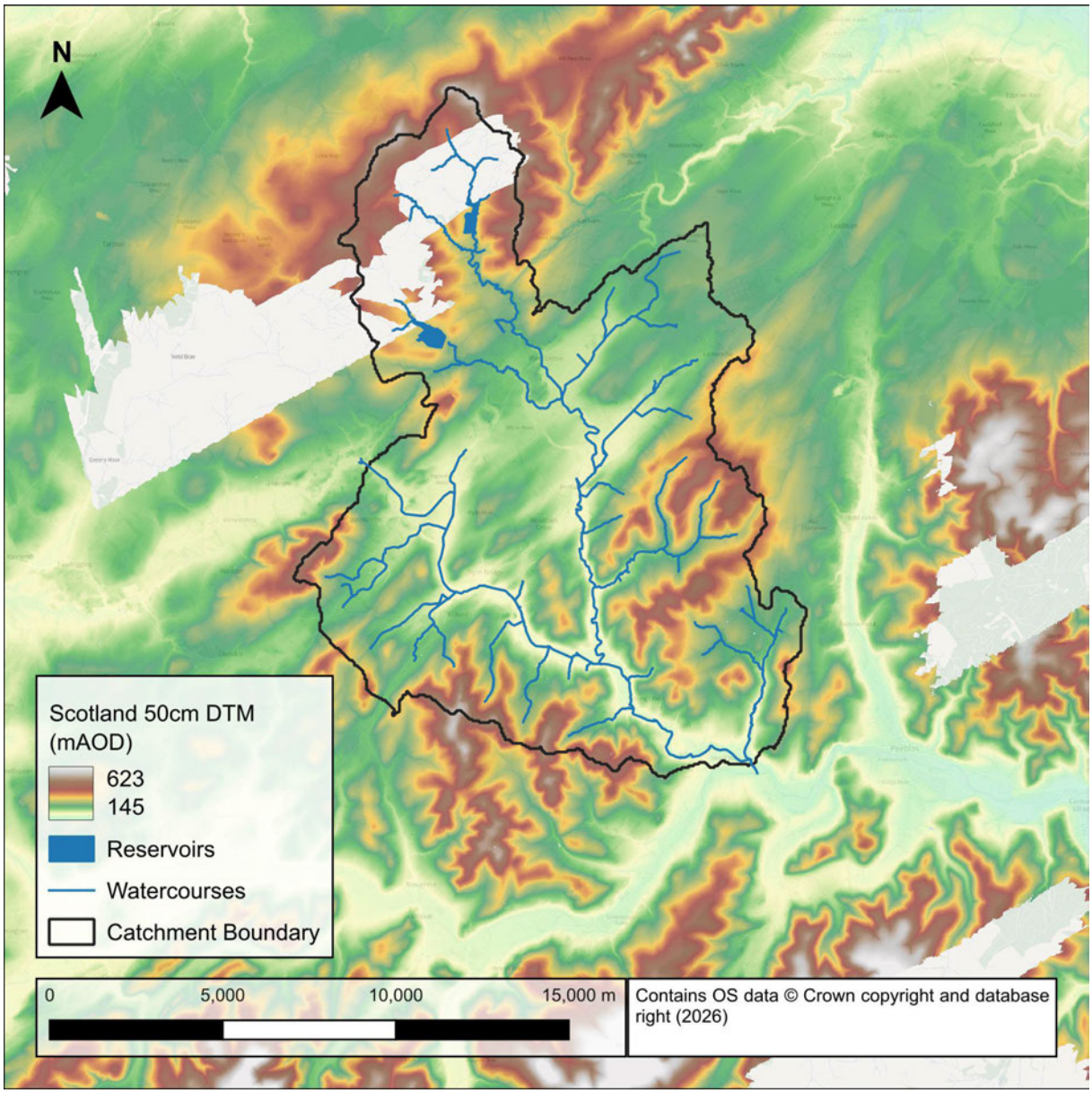
The report also contextualises these findings within wider evidence on future Scottish water scarcity. National projections indicate that water scarcity is expected to become more frequent, more prolonged, and more seasonally and spatially concentrated, with the greatest risk in eastern and central Scotland and during late spring to early autumn (May–September). The observed weak but statistically significant decline in low flows at Lyne Station is consistent with this direction of travel, while the absence of consistent high-flow trends across nearby gauges reinforces the need to consider high- and low-flow behaviours separately. The datasets and findings presented here provide a robust platform for the next modelling stage, where Dynamic TOPMODEL can be used to explore the drivers of wetting/drying dynamics and evaluate how proposed NBS might improve flood and drought resilience while delivering broader natural capital benefits (see Annex 3).



Main watercourses within the Lyne Catchment (included within the Hydrological Technical Note for illustrative purposes).

Land use type	Percentage catchment coverage
Deciduous woodland	1.6%
Coniferous woodland	14.7%
Arable farmland	2.7%
Grassland/pasture	66.0%
Shrubland	14.0%
Inland water	0.4%
Built up areas	1%

Main Land Use Types in the Lyne Water Catchment (included within the Hydrological Technical Note for illustrative purposes).

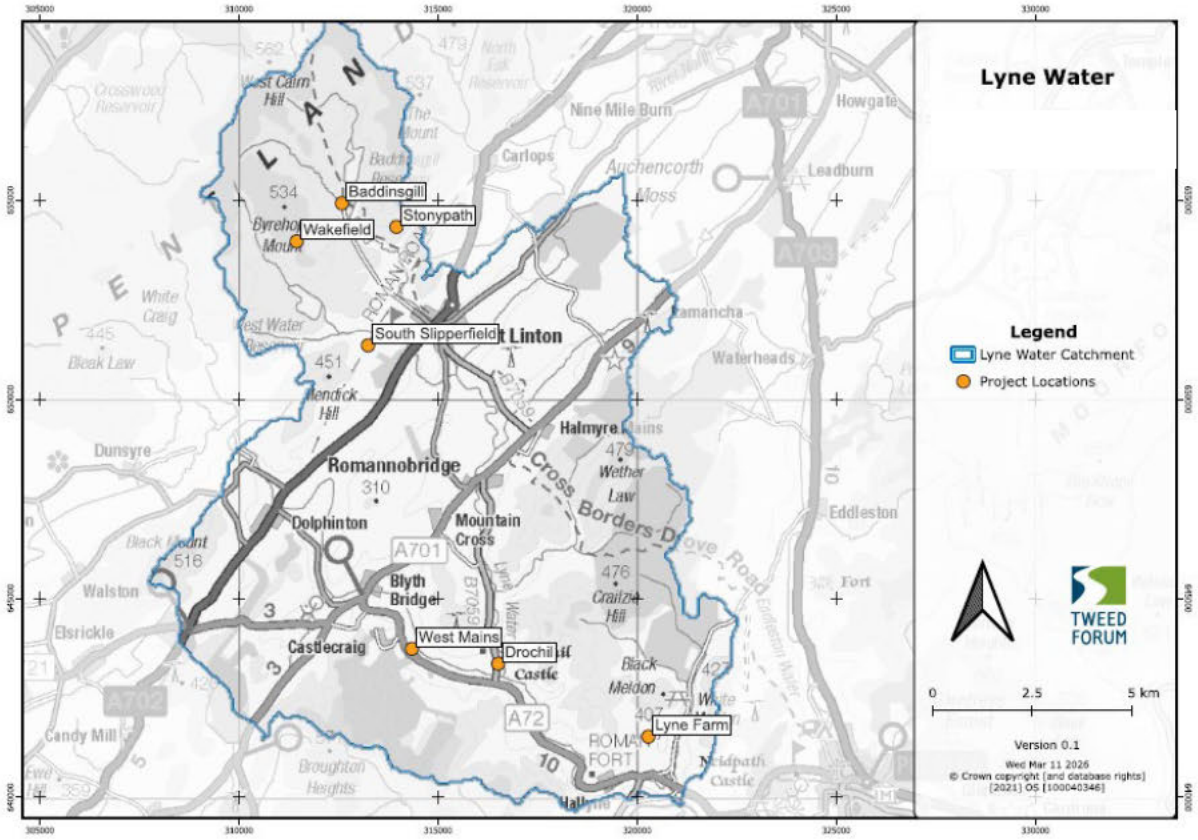


Topography of the Lyne Water Catchment (included within the Technical Note).

6. Carry out Landowner Engagement, Site Visits & NFM Mapping opportunities - TF

The Aim - Tweed Forum were to undertake an exercise in identifying and mapping existing landowners and land managers within the Lyne Water catchment. Effort was to concentrate on gaining farmer interest in the project by carrying out one to one meetings of the key landowners. Arrangements were be made to visit potential sites for optimum NFM and NBS delivery. In association with JBA, Tweed Forum would pull together and map out, a number of site specific NFM and NBS conservation scenarios.

Methodology & Output - Tweed Forum carried out 12 farm and site across the catchment. This was partly influenced by usage of the Nature Based Services Tool. Farmer engagement was very positive and led to practical conservation works being done on the ground (see Programme Item 5). This led to practical works being delivered on 7 farms. This exercise showed that there is significant opportunity for further land manager engagement and delivery of conservation measures across the wider catchment in future. (NB- seven of the twelve farmers engaged with, which undertook conservation measures are highlighted on the map below (see section 5 for more detail).



Map showing locations of the 7 farms where conservation works have been undertaken.

7. Hold a Community Engagement Workshop -TF, SUP & SoSE

The Aim – As part of the Natural Capital Innovation Plan, Tweed Forum in association with Southern Uplands Partnership and South of Scotland Enterprise were to organise a Community Engagement workshop, to raise awareness of the need to look after our natural assets and the importance of building resilience and how this might be done. JBA would prepare findings from the (largely) desk-based analysis (Phase 1) to help inform the meeting of stakeholders and the Forum can give early feedback on landowner appetite for hosting such measures. The purpose of the meeting would be to introduce the project and collect observations and perceived constraints from the community. This would shape our understanding of local priorities and how they might be addressed.

Methodology & Output -

A successful community engagement meeting was organised and held, on the evening of Tuesday 24th February, in West Linton Village Hall. A total of 17 local residents (including land managers) attended.

The format consisted of several short presentations, introducing the roles of the various partners (SoSE, TF & SUP) and what the aim of the Lyne Water Natural Capital Innovation Plan was. SoSE highlighted the project, as being part of ongoing works within the Regional Land Use Framework and the relationship of the Framework to the National Land Use Strategy. Tweed Forum showed examples of conservation works undertaken across the wider Tweed catchment and also more recent examples, from within the Lyne Water Catchment. SUP highlighted where communities could add value to the programme. This was followed by round table discussions on what the community thought the key land and water management opportunities were. SUP kindly summarised the main opportunities that people raised (below):

Riparian corridor planting

- Big push for a catchment wide attempt to plant trees along all the water courses so the *wooded riparian banks create a landscape linear corridor.*
- There was felt to be lots of opportunities for riparian tree planting in the area.
- Link the riparian corridor idea with a **network of green footpaths** – so, join up the communities and key areas with a network of footpaths that mirror the tree planting proposals (but not necessarily always together).

Meadows

- Don't forget **meadows and tie work on flower-rich meadows into a focus on butterfly conservation** – good *opportunities for volunteers and for community locations*. Priority species include Northern Brown Argus and Green & Purple Hairstreaks. Got five sites so far close to West Linton. There was a wish for more opportunities for expanding wildflower grasslands near the village.

Agroforestry and productive native woodland

- Can we work to make planting of native tree species a form of 'productive' woodland management such that landowners can make money from this over time?

Specific locations mentioned included:

- Broomlee (just south of West Linton)
- Deadwater burn / Cairn burn area of very flat and wet land southeast of West Linton
- *Check old maps for past wetland areas and old woodlands*
- West Linton itself – the Orchard and Loan areas, including the community woodland (John Birchmore, chairman of sustainable West Linton) and the patch owned by the Woodland Trust here.

Deer control

- One attendee said they would wish to see more deer control (in the catchment) as there would be little point in planting trees without addressing this.

Peatland restoration

- Thought to be positive where possible for multiple benefits upstream.
- There is potential cross over between similar nature restoration work happening in the Pentlands. The community in the Pentlands, in the experience of the contractor present, express a clear sense of ownership of the landscape, the hills are theirs and a lot want to do good and help with the restoration work. However, it takes a lot of work to make this volunteer effort effective- they have a co-ordinator in place.

Volunteering opportunities

- Is there scope for citizen science projects in the catchment? Who could co-ordinate this? Thinking of water quality monitoring / testing projects perhaps.
- Can the distribution of Water Crowfoot be monitored by the community, as part of a relatively simple 'ecological health indicator' for the river?
- It was discussed that **volunteering opportunities shouldn't displace work** for paid work/ contractors e.g. tree planting
- A **full-time volunteer coordinator role** was discussed – with a need for this to be long term to ensure there aren't gaps in delivery or loss of momentum. This role would increase the potential impact of volunteer time – and would be therefore worth the investment. There is a funding issue for this type of role, particularly linked to short term project funding. FIRNS was discussed as a potential funder.
- It was noted that **you do not facilitate the whole community when you rely on solely volunteer led working**/ volunteer groups, there is exclusion for younger people of working age or with families, for example. A paid role would enable wider participation.

Relationships and online engagement

- Trust, or lack of trust, between land managers and people living in the area was discussed. This was felt to be amplified online where social media comments and posts can exacerbate or give a false sense of the schism between these groups. More real, face to face communication would support discussion and new opportunities.
- The idea of a digital ranger was discussed, to help engage people online, manage comments and share factual posts from a neutral standpoint- to help grow the 'brand' for what we want to achieve with nature restoration works.
- It is important to understand what landowners need and recognise the community for their concerns around climate/biodiversity crises.

Approaches to changes in land use

- How can we recognise new uses for land as well as celebrating historical methods, approaches or land uses?
- Very few people would disagree with the principle of the proposed work in the community- but people may disagree with the process/steps to get there.

Flooding

- Is there any data available from the water companies to show the effects of the reservoirs in holding back rainwater … and can the reservoirs be drawn down more often to alleviate flooding?
- There is river erosion on the riverbanks south east of West Linton. Can this be looked at perhaps? (W3W- Rehearsed.Orchid.Downhill).

Invasive Non-Native Species

- What is the distribution of INNS in the catchment? There seems to be areas where American Skunk Cabbage exists.



Community engagement at the event in West Linton Village Hall on 24th February



Community discussions at the event in West Linton Village Hall on 24th February

Promotional flier for the Community Engagement Event at West Linton

TWEED FORUM

southern uplands partnership
living land, living community

SOUTH of SCOTLAND ENTERPRISE

JBA consulting

Climate Resilience and Nature Based Opportunities in the Lyne Water Catchment



Join us for an engaging evening exploring how Natural Processes can help us respond to Climate Change.

Date & Time: Tuesday 24th February (Starting at 7.30pm & finishing at 9.00pm)

Location: West Linton Graham Institute (Lower Green, West Linton, EH46 7EW)

Potential Opportunities: Climate Change is already affecting our communities — from floods, droughts and extreme weather events, to impacts on farming, forestry, wildlife and landscapes. This meeting will focus on **climate resilience** and **nature-based solutions**, looking at practical, locally relevant ways we can work with Natural Processes, to build a more resilient future.

What to Expect:

- An introduction to climate resilience and nature-based solutions with examples of works undertaken within the Tweed catchment.
- Discussion on local challenges and potential opportunities.
- Ideas for farmer, land manager & community-led action.
- An open conversation.

Teas, Coffees and Light Refreshments will be available from 7.00pm. **More information is available from Tweed Forum by emailing: info@tweedforum.org**

8. Compile a Written Completion Report by mid-March 2026 - TF & JBA

The Aim - Tweed Forum & JBA Consulting were to write up the Aims, Methodologies & Outputs from the Lyne Water Natural Capital Opportunities Plan- Phase 2 funding. This was to be completed and submitted to SoSE by end March 2026.

Output - This Report is the result of Programme Element 8.

9. (A) Undertake a Peak Flow analysis and climate change estimates at gauging stations at Lyne Station, March Street and Peebles) and (B) Discuss Peak Flow & Climate Change Data (see Annex 4a and 4b for more detail).

The Aim - JBA were to undertake peak flow analysis at 3 SEPA gauging stations.

Methodology & Output - JBA undertook statistical analysis of peak flows and flood frequency curves at 3 SEPA gauging stations: Lyne Station, March Street, and Peebles. Climate change allowances were applied for the 2050's and 2080's. This would allow an estimate in the change of flood frequency to be made e.g. today's 200 year event could become more frequent by the 2050s.

1. JBA Consulting obtained up to date hydrometric information from SEPA.
2. JBA Consulting run statistical flood frequency analyses at gauged locations to record baseline conditions. Enhanced single site flood frequency curves using a single statistical distribution (e.g. Generalised Logistic) would be used.
3. JBA Consulting run statistical flood frequency analysis at gauged locations offering climate change scenarios for 2050's and 2080's. Climate change estimates were obtained from the CEH website on climate change impacts on flood peaks https://cc-flood-impacts.ceh.ac.uk/ and reference made to current SEPA guidance (NB- Note that the current SEPA guidance does not provide estimates for peak flow climate change uplifts for the 2050's, therefore the CEH information was used as a guide).

Outputs - (see Annex 4a and 4b)

The purpose of this work element was to provide up to date peak flow estimates for:

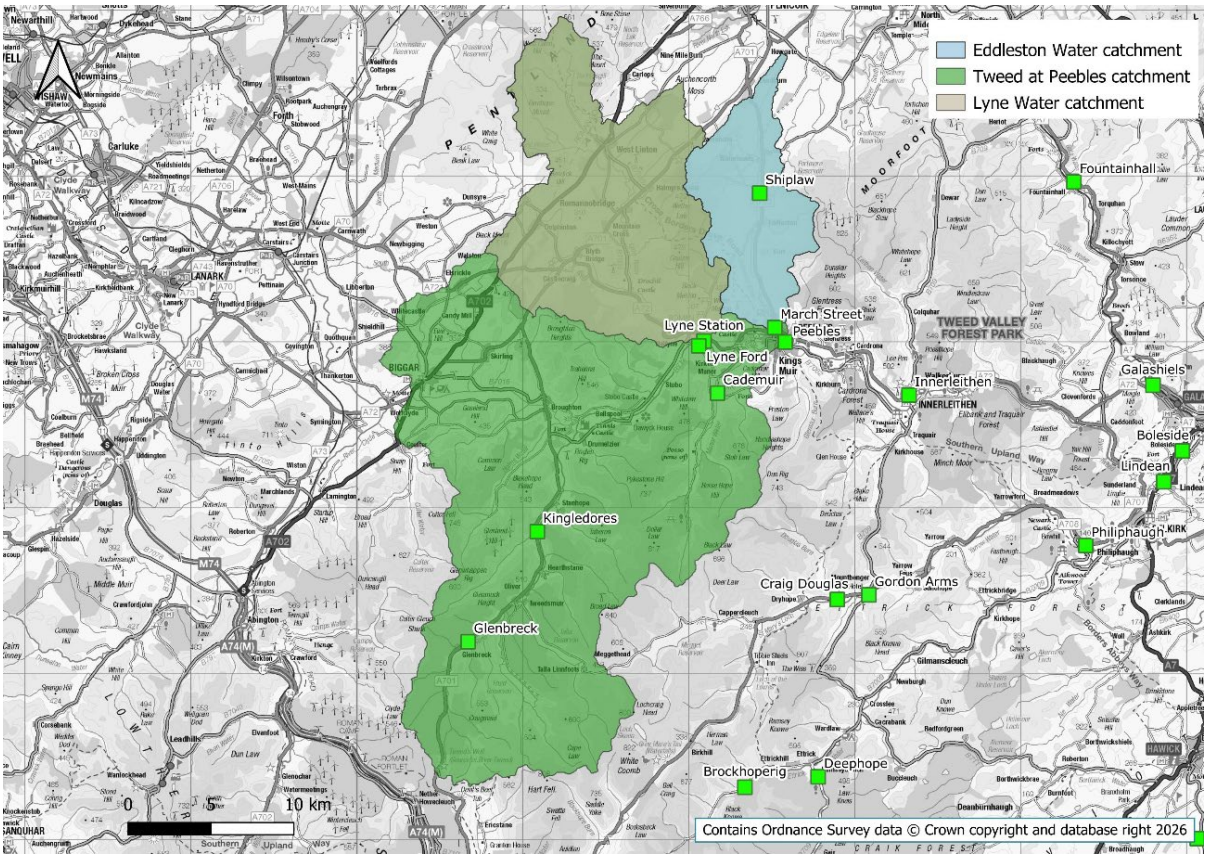
- Tweed at Peebles
- Eddleston Water at March Street
- Lyne Water at Lyne Station

The resulting hydrology estimates would be used to inform hydrological studies in the area.

Baseline flood frequency estimates were made initially using the FEH Statistical method, the type of Statistical method being determined by the data quality and quantity at each gauge. Climate change estimates were then applied to the baseline peak flow estimates. For consistency with current SEPA guidance, the UKCP18 RCP 8.5, 67th percentile outputs were used. The CEH web portal on climate change impacts on flood peaks was used to obtain estimated percentage increases in peak flows through 2039, 2069 and 2099. After consideration of alternative values, the percentage uplifts applied were 26%, 37% and 59%, respectively.

Application of the uplifts to the baseline flood estimates resulted in an increase in flood frequency at all three locations. For example, the present day 200 year event estimated was estimated to become a 25 year event (at Lyne Station) and 30 year event (at March Street), respectively by 2099. At Peebles, the present day 200 year event was estimated to become just over a 50 year event by 2099. Today's 75 year event (which can be important for insurance purposes) was estimated to become a 27 year event at Lyne Station; 29 years at March Street and 38 years at Peebles by 2039 and a 10 year event at Lyne Station, 12 years at March Street) and 19 years at Peebles by 2099.

Further context was provided by the consideration of notable flood events in the observed record. For example, the 1994 event at Lyne Station was estimated to be just under a 70 year event under current conditions but could become just under a 10 year event by 2099. Similarly, the December 2015 event at Peebles was currently estimated to be just under 60 year event but could become a 14 year event by 2099. Overall, the results highlight that flood risk has the potential to become more frequent in the future until the end of the century.



Catchment overview showing SEPA gauging stations

The data showed that while the flood frequency results for the Eddleston Water are broadly similar to those estimated in the 2017 study (e.g. the 0.5% AP, 200 year, event was estimated to be 78 m^3/s in 2017 and 73 m^3/s in 2026), the 2026 estimates for the Tweed at Peebles are considerably larger than those estimated in 2017. For example, the 0.5% AP, 200 year, event was estimated to be 717 m^3/s in 2017 and 973 m^3/s in 2026. The main reasons for this are:

1. The Tweed at Peebles AMAX record has been extended back to 1947 by merging the record with AMAX data from the Priorsford gauge. The Priorsford flows were estimated using hydraulic modelling and contain two very large events (in 1949 and 1954). This extended record was not available at the time of the 2017 study. The 77 years of record now available are a larger data sample than was previously available, suggesting that, of the two single site analyses (from 2017 and 2026), the 2026 analysis should be preferred statistically (purely from sample size and disregarding potential uncertainties in the historical data which has been added using a modelled rating).
2. The largest events in the Peebles AMAX record (e.g. December 2015) have been re-estimated using hydraulic modelling. The flows associated with those events are now generally larger than in the dataset available in 2017.
3. Additional data (from 2017 to 2023) has become available.

Taken together, these reasons explain the larger flow values estimated in 2026. In addition, the recommended climate change allowance has increased from 33% to 59% resulting in even larger flows when climate change is considered (see Annex 4a and 4b for more detail).

Suggested recommendations for future work included: continuing to improve hydrometric data (e.g. through further high flow gaugings and identifying the maximum recordable stage at gauging stations); spatial modelling of flood risk to identify effects upon receptors (e.g. through use of the existing Eddleston Water and Tweed models and development of a model for the Lyne Water); continuous rainfall runoff simulation and consideration of other climate change scenarios and uncertainties.

End of Report

Annexes:

Annex 1 - Lyne Water Catchment Natural Capital Tool (JBA)

Annex 2 - Lyne Water Catchment Dynatop Model Report (JBA)

Annex 3 - Lyne Water Catchment Hydrological Report (JBA)

Annex 4a - Lyne Water Catchment Flood Estimation Report (JBA)

Annex 4b - Lyne Water Catchment Peak Flow Analysis and Climate Change estimates at gauging stations at Lyne Station, March Street and Peebles (JBA)