JBA consulting

Lyne Water Natural Capital

Development of a natural capital innovation plan for the Lyne Water Catchment.

Final Report

April 2025

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TWEED FORUM

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This report describes work commissioned by the Tweed Forum, by an instruction dated 20th January 2025. The Client's representative for the contract was Luke Comins of the Tweed Forum.

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This report was funded by SOSE to support delivery of the Regional Land Use Framework (RLUF).

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Abbreviations

5m	5 metre resolution
AEP	Annual Exceedance Probability
DTM	Digital Terrain Model
LiDAR	Light Detection and Ranging Data
NBS	Nature Based Solutions
NFM	Natural Flood Management
RAF	Runoff Attenuation Feature
RP	Return Period
RLUF	Regional Land Use Framework
SEPA	Scottish Environment Protection Agency
SOSE	South of Scotland Enterprise
TF	Tweed Forum
WFD	Water Framework Directive
WwNP	Working with Natural Processes

Definitions

Within this report, JBA have used these terms within a natural capital approach to aid addressing key land and water management issues in the catchment. We appreciate that not all natural capital related options have to be Nature Based Solutions (NBS). As there may well be non NBS measures that will deliver catchment improvement as effectively (or better).

This specific report focuses on these natural capital intervention methods and we have used the following terms interchangeably, including:

- Working with Natural Processes (WwNP)
- Nature Based Solutions (NBS)
- Natural Flood Management (NFM)

WwNP focuses on managing, restoring, and emulating a more naturally functioning catchment and river system.

NFM applies the WwNP approach to implement specific features across catchments to intercept, slow and store floodwaters.

Nature Based Solutions in this context are interventions that mimic natural processes and include restoring hydrological function of soils, tree planting, NFM structures, attenuation features, woodland management, mire restoration, floodplain reconnection and potentially beavers.

This report quotes the frequency of a flood in terms of an Annual Exceedance Probability (AEP), which is 100/return period (years). A return period (RP) is defined as the average time between years with at least one larger flood. AEPs can be helpful when presenting results to members of the public who may associate the concept of return period with a regular occurrence rather than an average recurrence interval. The table below is provided to enable quick conversion between return periods and annual exceedance probabilities.

Table 1-1: AEP/Return Period Conversion

Return period (years)	2	5	10	20	25	30	50	75	100	200	1000
AEP	0.5	0.2	0.1	0.05	0.04	0.033	0.02	0.013	0.01	0.005	0.001
AEP (%)	50	20	10	5	4	3.3	2	1.3	1	0.5	0.1

Executive Summary

This report provides an overview of the Lyne Water catchment. Lyne Water is a tributary of the River Tweed which is located in southern Scotland. Whilst the Lyne Water is important in it's own right in terms of natural capital and the provision of supporting services to the local community and environment, there are several communities downstream of the Lyne Water catchment (in particular Peebles) that would benefit from natural capital improvements in terms of flood risk reduction.

This report examines the current status of the catchment, reviewing its:

- Land use.
- Geology.
- Flood risk.
- Hydrology including water management.
- History.

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.

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). This report focuses on Nature-based Solutions (NBS but they are not the only types of solutions that need to be considered when addressing integrated water resource and land management (IWRM) challenges. Regenerative farming, for example is an agricultural option, rather than an NBS.

Of the six main river reaches in the Lyne Water catchment four are classed at moderate status and two at high ecological status (under the Water Framework Directive).

- Several rivers are designated as heavily-modified waterbodies, due to the continuing impact of the West Water and Baddinsgill reservoirs upstream. Such classifications cannot be addressed without significant impact on water storage for public drinking water, (i.e. removal of the reservoirs) in Lyne Water (Source to Tarth Water confluence) and West Water. ***The operation of these reservoirs will have an impact on flows and flow patterns within the Lyne catchment during drought and flood conditions. It is important to understand this operation procedure, including the resulting transfer and removal of water out from the Lyne system.***
- Dead Burn, Tarth Water and Cairn Burn have bad status for hydromorphology. This is related to significant modification for drainage of agricultural land. SEPA have undertaken WFD assessment of these watercourses in 2015. ***Fencing, riparian planting, re meandering and enhancement of fish passage is considered the mitigation option of choice. However, such actions could be unlikely, and would anyhow depend on the agricultural land classification.***

Pateshill Water Treatment Works (WTW) treats water from the two impounding reservoirs to approximately 45,800 customers. The catchment upstream of this location has been ***observed to have significant peat erosion (within the data from the WTW).*** Peat in this catchment has been reviewed from satellite imagery. It appears to be heavily modified and intensively managed, with burning, grips, and artificial drainage. This can have the opposite effect on promoting groundwater recharge and improving drought resilience. As well as increased flood risk and poor water quality.

A review of farmer decision-making behaviour, influences and barriers to effective deployment of NBS measures by Tweed Forum identified that to do so in the Lyne Water catchment will require:

- Accurate characterisation of the catchment (soils, topography, hydrology, habitat and climate);
- Detailed local knowledge of flood risk - technical & farmer knowledge accumulated over decades – and other natural capital opportunities
- An understanding of landowner 'types' - motivations, management systems and financial constraints which private and public land owners have the ability (farming system that offers an opportunity for NFM to be integrated); are engaged (have a clear understanding of what is expected) & are willing (recognise the underpinning environmental issues).
- A bottom-up partnership – the inclusion of local knowledge and engagement of local people that shares an overarching vision for the long-term sustainability of the catchment
- Effective engagement – engaging landowners in a manner which is inclusive, using their knowledge to inform the assessment of NFM opportunities.
- Availability of trusted advice and support – including a dedicated Advisor/Support officer to assist with government paperwork/processes
- Finance to secure implementation of NFM measures, maintain and monitor:
    - Capital grants to design and install measures
    - Long-term financial incentives that compliment other farm payments
    - to fund and support the work of a Catchment Advisor

As part of the NBS assessment process a site walkover was conducted on Friday 28th March 2025.

In summary the NBS options include:

- Peatland/Moorland restoration.
- Soil and land management / regenerative farming practices (in grazed fields), including woodland planting in areas of surface water flow paths and preexisting saturated ground.
- Soil management measures within location of commercial forestry to reduce risk of soil erosion after felling.
- River Restoration options across the Tarth Burn and Dead Burn.

1 Introduction

1.1 Purpose of this report

This report provides an overview of the Lyne Water catchment. Lyne Water is a tributary of the River Tweed which is located in southern Scotland. This report examines the current status of the catchment, reviewing its:

- Land use.
- Geology.
- Flood risk.
- Hydrology including water management.
- History.

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. This project is funded through South of Scotland Enterprise (SOSE) to support delivery of the Regional Land Use Framework (RLUF), along with support from the Facility for Investment Ready Nature in Scotland (FIRNS). JBA Consulting have been commissioned via the Tweed Forum to undertake this assessment.

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 is undertaken to determine the sorts of benefit that could be unlocked through natural capital/NBS delivery. This assessment is used to determine who benefits and/or dis-benefits from NBS.

The outcomes from this study will be used to help:

- Provide the basis of information to enable opening of a dialogue with key stakeholders as to potential future resilience options for the Lyne Water catchment, especially in response to climate change pressures.
- Inform the development of projects to increase the resilience to receptors at risk of flooding and drought in vulnerable areas of Lyne Water catchment.
- Inform the potential enhancement of the natural capital of the river valley to benefit the local community, water management and local ecology.
- Identify and prioritise sites for actions to enhance delivery of desired ecosystem services.
- Extend and disseminate learning from work undertaken in the Eddleston Water catchment and elsewhere across Tweed and the South of Scotland. This includes future landowner engagement (necessary throughout any additional phases of work), which is highly recommended to start early in this process.

2 Desk Based Assessment

2.1 Catchment overview

A desk-based assessment was conducted using data obtained from LiDAR, historical maps, information on geology and soils, relevant reports and local knowledge provided by Tweed Forum from their many years of working in the region.

Lyne Water has a catchment area of 174 square kilometres and originates upstream of Baddinsgill Reservoir in the Pentland Hills, situated at an elevation of approximately 381 meters above sea level (Figure 2-1). The tributary is positioned 1km from the Midlothian border and flows south-eastward for approximately 30km. Its course navigates through the boundaries of several parishes (e.g. West Linton and Romanno Bridge), before it descends nearly 213 meters where it joins the River Tweed 5km west of Peebles.

The Lyne Water catchment is composed of many smaller tributaries, including Baddinsgill Burn, Longstruther Burn, West Water, Cairn Burn, Dead Burn, Flemington Burn, and Tarth Water. There are two reservoirs in the upper catchment including Baddinsgill and West Water.

2.1.1 Historical trend analysis

Urban expansion has increased in West Linton, Rommano Bridge, and Blyth Bridge, as well as wider rural expansion across the catchment (e.g. Netherurd, Kirkdean, Millside, West Mains) when compared to the 1885-1900 maps.

Riparian and tree cover has reduced across the catchment compared to 1885-1900 maps (e.g. near Spathangth, Castlelaw and South Slipperfield). Hedgerow losses and increased field sizes are also visible across the catchment.

Two drinking water reservoirs are found in the catchment, West Water Reservoir which opened in 1969 and Baddinsgill Reservoir built in 1926. ***The operation of these reservoirs will have an impact on flows and flow patterns within the Lyne catchment during drought and flood conditions. It is important to understand this operation procedure including the resulting transfer and removal of water out from the Lyne system.***

The Sustainable Land Management and Abstraction (SLM&A) team (within Scottish Water) visited the source water catchment for Pateshill Water Treatment Works (WTW) in March & April 2024. This WTW treats water from the two impounding reservoirs which it supplies to approximately 45,800 customers.

The aim of the SLM&A team visit was to assess the condition of the catchment and identify any land management activities which could adversely affect source water quality. The visit is part of a proactive catchment assessment programme which is focused on natural organic matter[1]. In summary, they noted that:

1 - Sustainable Land Management: Catchment Assessment Pateshill WTW - Scottish Water - 28/03/2024

- Recreational trout fishing occurs on both reservoirs where boat and bank fishing is permitted.
- Hill walking appears to be a popular activity along the Southern Upland Way path which is contributing to peat compaction/erosion in rainfall events. Heather burning for grouse shooting is also contributing to this poor peat condition in places.
- Peat erosion is being observed within recordings at Pateshill Water Treatment Works. Eroded peat was also observed upstream from the South Medwyn Raw Water Intake (RWI). The West Water River is being badly eroded on the Bawdy Moss area of the catchment.
- A small section of the Rough Syke burn a tributary of the South Medwyn River was also observed to be suffering from peat erosion.
- The Lyne Water from source to reservoir has several sections of eroded banks exposing peat for erosion and increasing colour affecting Raw Water Quality.

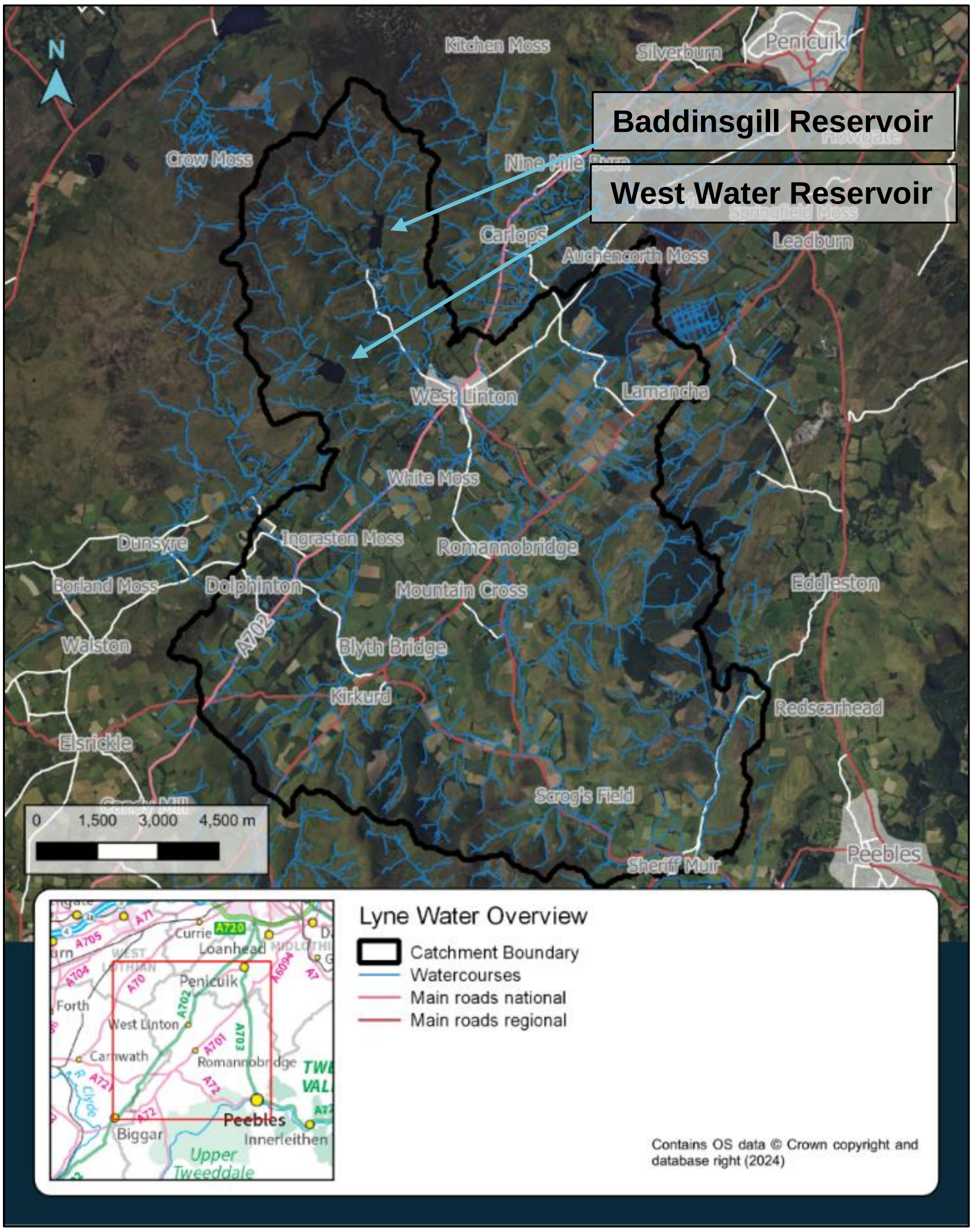

Figure 2-1 Catchment Boundary Overview

2.2 Soils and geology

2.2.1 Soils Data (Figure 2-2)

The hydrological response of the Lyne Water catchment is influenced significantly by both soil types and underlying geology, with brown soils comprising 48% of the area. These soils, combined with a high percentage of well-drained soils (52%), are likely to facilitate efficient infiltration and groundwater recharge, which are crucial for maintaining water levels in streams and rivers and ***mitigating against the risks of droughts***. This infiltration capability helps mitigate surface runoff, thereby reducing the risks of flooding during moderate rainfall events. The presence of organic-rich peat and peaty podzols, known for their exceptional moisture retention capacities, further enhances soil moisture levels and supports base flow during dry periods, ***contributing to the overall hydrological resilience and ecological health of the catchment***.

Peat soils are highly susceptible to erosion, especially when bare, due to factors like wind and rain, and this can lead to significant environmental consequences, including carbon loss, increase surface runoff and habitat degradation. This increased surface runoff can also be prevalent in areas characterised by poorly drained soils (11% of the Lyne Water catchment) and very poor drainage (3%), especially during intense rainfall events.

2.2.2 Superficial Data (Figure 2-3)

Superficially, diamicton (formed from glacial activity) covers 55% of the study area, it comprises a mix of clay, silt, sand, and pebbles. This heterogeneous material creates a complex and varying permeable landscape. While diamicton can create relatively low-permeability zones that may lead to increased surface runoff, it can also contain pockets of higher permeability where water may accumulate, contributing to localised saturation and potentially enhancing groundwater recharge in certain areas. The varying texture and composition of diamicton means that its drainage capacity can differ significantly across the catchment, influencing the flow paths and where water ultimately drains. In addition to diamicton, the catchment also features substantial coverage of sand and gravel (23%), which are crucial in enhancing both drainage capabilities and groundwater recharge. These materials generally exhibit high permeability, allowing for rapid infiltration of rainwater, thereby reducing surface runoff and flood risk during periods of intense rainfall. ***This also increases aquifer recharge to support the Lyne Water in drought conditions.***

Approximately 11% of the superficial deposits consist of various mixtures of clay, silt, sand, and peat. Peat, known for its high organic content and moisture-retentive properties, plays a critical role in supporting biodiversity and ecological stability within the catchment. It acts as a significant water store, releasing moisture gradually and providing vital habitat for various flora and fauna, particularly in wetland areas. ***This will also improve the Lyne Water resilience within drought conditions.***

The clay component, characterised by fine particles, tends to retain moisture and can slow water movement, potentially leading to the formation of temporary waterlogged areas. This can foster the development of important wetland habitats but may also contribute to flooding risks if water accumulates more rapidly than it can be drained away. The silt can contribute to soil fertility, but it can also affect drainage by creating finer layers that impede water flow in certain conditions.

All types of soil in this catchment are susceptible to soil compaction, where soil particles are tightly packed due to pressures from machinery and/or livestock. This leads to a denser, more impermeable soil structure that hinders water and air movement, reducing the soil's ability to absorb water and allowing less oxygen to reach plant roots. In this situation a mixed permeable soil formation can become impermeable with significant implication for the catchment including:

- Increased surface water runoff

- Reduced aquifer recharge
- Increased sediment erosion
- Reduced water quality

2.2.3 Bedrock data (Figure 2-4)

The underlying bedrock geology is predominantly characterised by wacke (41%), a rock type known for its relatively high porosity and fracture networks that facilitate effective water movement and groundwater recharge, thereby enhancing the overall hydrological response. The presence of interbedded sandstone and conglomerate (33%) further supports this by allowing for both water storage and transmission, maintaining a balance between sediment transport and infiltration. The influence of mafic lava and tuff (7%) introduces variable permeability, depending on its structural characteristics, which can significantly affect water flow patterns within the catchment. The more minor components, such as the sedimentary rock cycles from the Clackmannan and Strathclyde groups, along with small amounts of mudstone and siltstone, contribute to a landscape that exhibits complex drainage patterns due to differing weathering rates and hydraulic properties.

The majority of the lower catchment of the Lyne Water is classified as "Low" productivity aquifer with limited groundwater in near surface weathered zone and secondary fractures. The upper catchment is a "Moderately" productive aquifer with yields up to 12 L/s.

2.2.4 Summary

The hydrological response of the Lyne Water catchment is influenced significantly by both soil types and underlying geology, with brown soils comprising 48% of the area. These soils, combined with a high percentage of well-drained soils (52%), are likely to facilitate efficient infiltration and groundwater recharge, which are crucial for maintaining water levels in streams and rivers and ***mitigating against the risks of droughts***. This infiltration capability helps mitigate surface runoff, thereby reducing the risks of flooding during moderate rainfall events. The majority of the lower catchment of the Lyne Water is classified as "Low" productivity aquifer with limited groundwater in near surface weathered zone and secondary fractures. The upper catchment is a "Moderately" productive aquifer with yields up to 12 L/s.

Approximately 11% of the superficial deposits consist of various mixtures of clay, silt, sand, and peat. The presence of organic-rich peat and peaty podzols, known for their exceptional moisture retention capacities, further enhances soil moisture levels and supports base flow during dry periods, ***contributing to the overall hydrological resilience and ecological health of the catchment (in good condition).***

All types of soil in this catchment are susceptible to soil compaction, where soil particles are tightly packed due to pressures from machinery and/or livestock. This leads to a denser, more impermeable soil structure that hinders water and air movement, reducing the soil's ability to absorb water and allowing less oxygen to reach plant roots. Peat soils are highly susceptible to erosion, especially when bare, due to factors like wind and rain, and this can lead to significant environmental consequences, including carbon loss, increase surface runoff and habitat degradation. ***This can have the opposite effect on promoting groundwater recharge and improving drought resilience. As well as increased flood risk and poor water quality.*** Peat in this catchment has been reviewed from satellite imagery. It appears to be heavily modified and intensively managed, with burning, grips, and artificial drainage seen.

Such knowledge is crucial for informing effective NBS strategies that enhance infiltration (improve drought resilience), mitigate flooding risks, and ultimately support the health and resilience of ecosystems within the catchment. Studies on the Eddleston Water catchment, for example have shown that the effectiveness of tree planting and woodland cover as natural flood management measures is heavily influenced by the underlying soil type and surface geology (Peskett et al 2023).

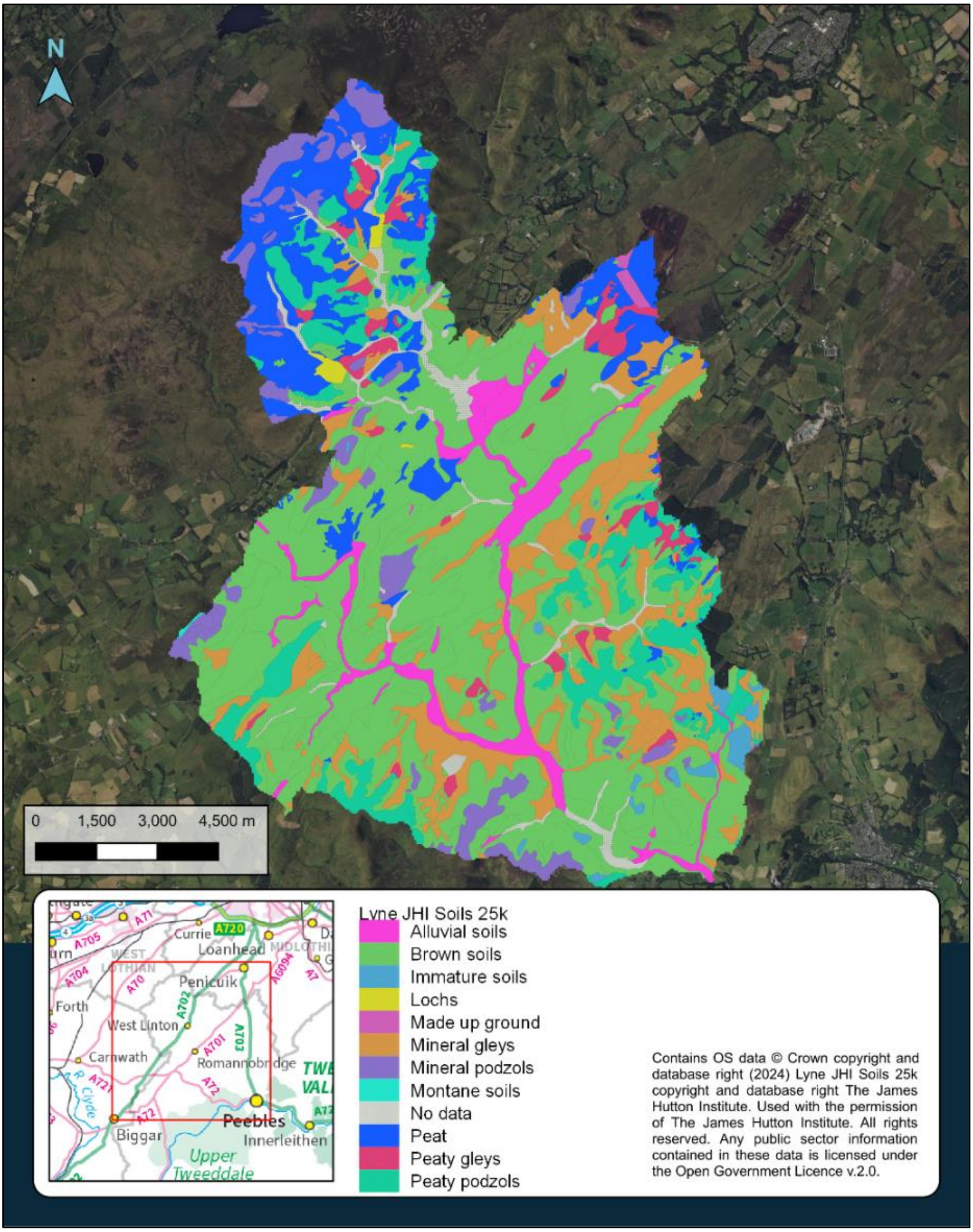

Figure 2-2: Lyne Water Soils 25k (Source: James Hutton Institute)

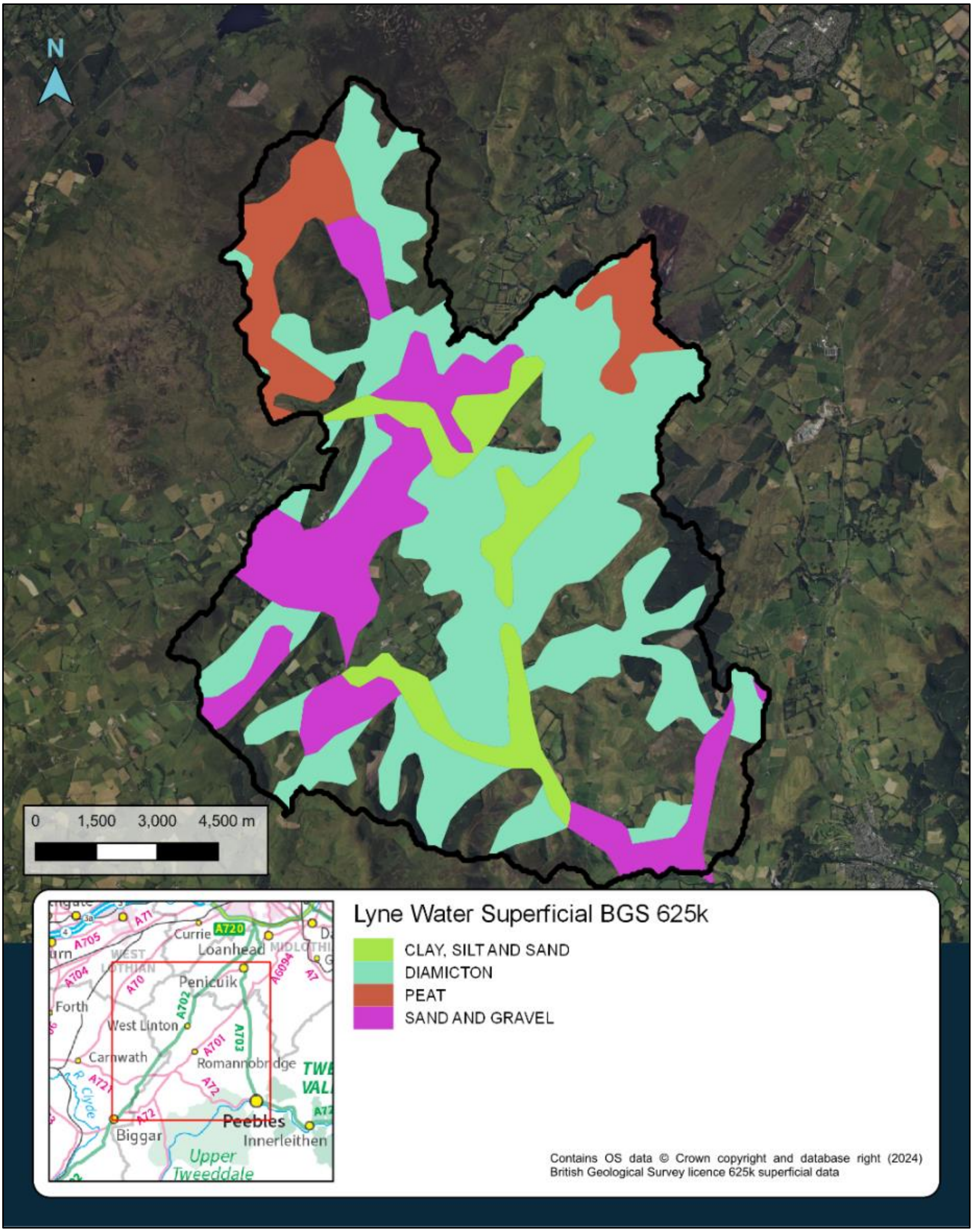

Figure 2-3 Lyne Water Superficial geology (Source: BGS 625k)

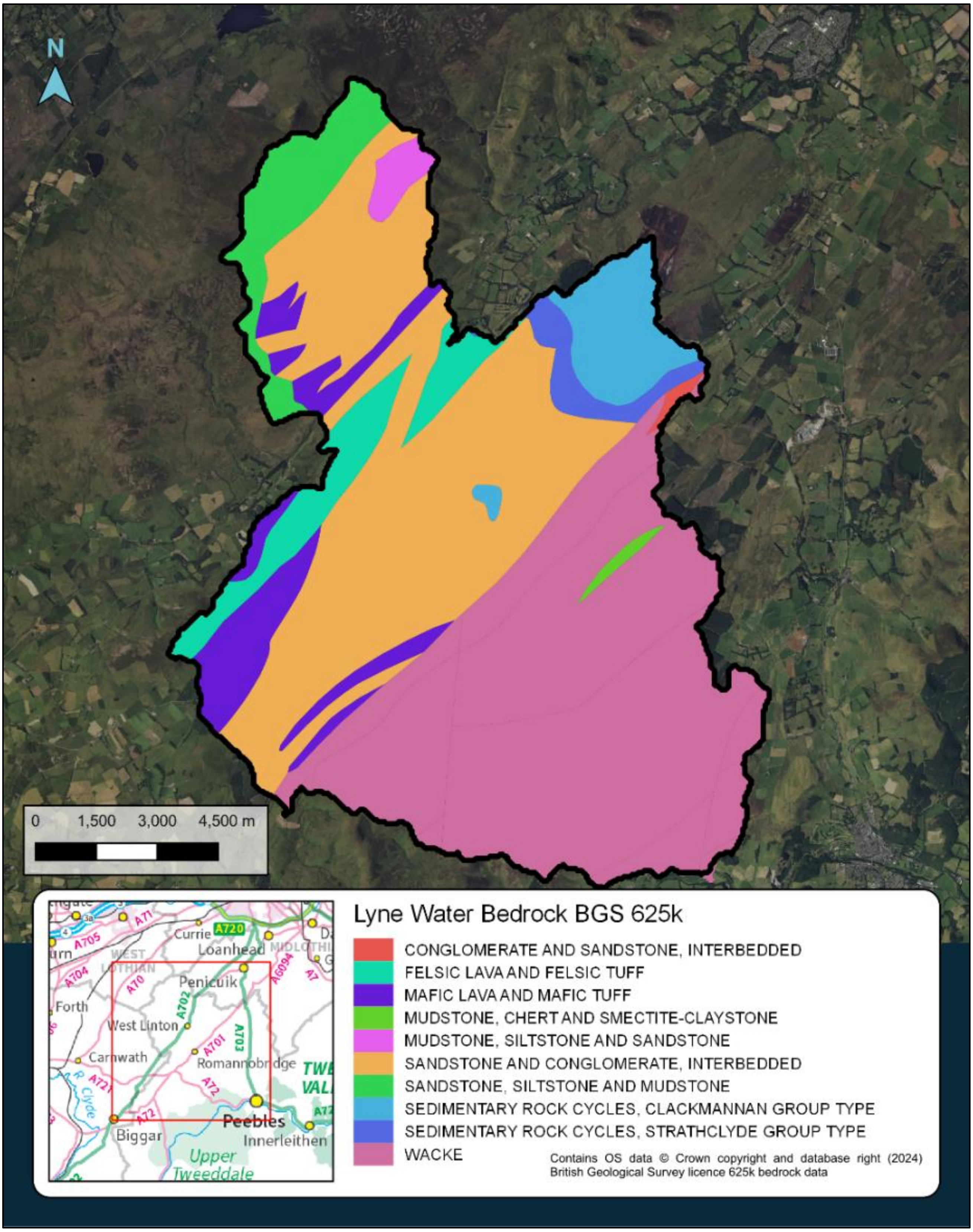

Figure 2-4: Lyne Water Bedrock geology (Source: BGS 625k)

2.3 Land use (Figure 2-5)

Land use in the Lyne Water catchment significantly impacts its hydrological function through the distinct characteristics and management practices associated with each land cover type. The predominant improved grassland, covering 39% of the area, is managed for agriculture and livestock, most likely artificially drained to enhance sub surface runoff. Intensive grazing can lead to soil compaction and therefore increased surface runoff during rainfall events.

Acid grassland (26% coverage) supports diverse vegetation that improves soil structure and water retention, helping to maintain a balanced hydrological regime. This is a somewhat similar condition to that found with regenerative farming practices known to be being undertaken in the lower catchment, where soil structure and water-holding capacity is greatly enhanced. Heather grassland (over the peat soils in the upper catchment), covering 10% of the catchment, retains moisture and enhances infiltration (in good condition) but can contribute to erosion if not managed properly (including livestock poaching and compaction). From aerial imagery, it appears to be heavily modified and intensively managed, with burning, grips, and artificial drainage seen. ***This is therefore likely contributing to peat erosion and increased surface runoff[1].***

Coniferous plantation (15% coverage) plays a critical role by capturing rainfall, delaying its entry into the soil and stream systems, which can mitigate flood risks and promote groundwater recharge in wet conditions. ***However, in drought conditions coniferous plantations have the potential to decrease summer mean flows*** (Collins, et al., 2023)***.*** In addition, it is likely that coniferous plantations will be artificially drained to promote fast growth of a single species. This will increase surface water runoff in rainfall events rather than delaying its entry into the soil and stream systems. Once the commercial trees have been felled it is also high likely that these bare spoils will become vulnerable to erosion and surface runoff until a new vegetation cover is established.

The presence of two drinking water reservoirs, West Water and Baddinsgill, further influences hydrological dynamics by capturing and storing water, regulating peak flows, and affecting local evaporation and groundwater interactions[1] (Section 2.1.1 - Historical trend analysis).

Together, these land uses create a complex hydrological system in the Lyne Water catchment, with each type influencing water retention, infiltration rates, and runoff patterns. Effective management is essential for maintaining this balance and ensuring sustainable water resource outcomes. Sustainable farming such as regenerative farming practices (which are present in the lower catchment) could potentially have significant benefits for soil quality, soil retention, water quality, wildlife, flooding and drought resilience.

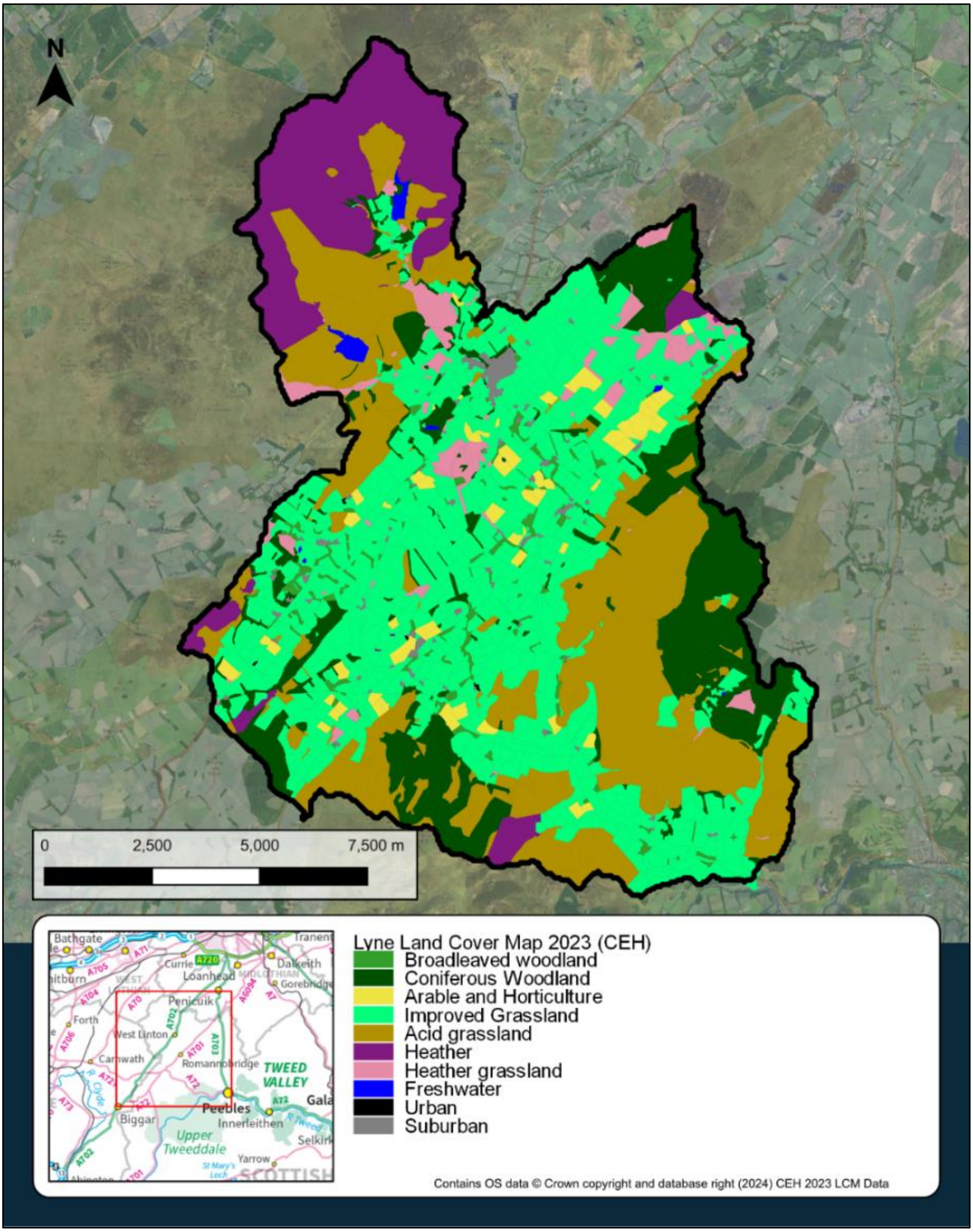

Figure 2-5: Lyne Water 2023 Land Cover (CEH)

2.4 Flood Risk - Local

West Linton is in a potentially vulnerable area (26km^2) area with a maximum of 10 residential and non-residential receptors at risk of flooding as assessed in September 2022 by Scottish Borders [2]. This assessment estimated annual average damages at £4,200 and also shows that flooding is assumed to be 45% derived from river sources and 55% from surface water flow routes. One major road is at a high risk of flooding during a 1 in 10 flood, and at a medium risk during a 1 in 200 flood event. For a more extreme 1 in 1000 flood event, there is a low likelihood of flooding, but an A road, and a B road at three locations would be likely to be impacted. ***This could be critical to the local community and emergency response.*** The damages from floods are most likely to impact agriculture (loss of productivity/livestock) at lower return periods (1-in-10), with residential properties (and emergency evacuation in times of flood linked to roads being cut off) most likely to be affected at extreme return periods (1-in-1000 year).

Climate change will also exert a significant impact, leading to a 59% uplift in peak flows in the Tweed catchment by 2100. Over time the larger events will become more frequent potentially increasing flood damages to agriculture, properties and infrastructure.

2.5 Flood Risk – Regional

The Lynn Water is a key contributing catchment to flood risk on the River Tweed and properties at risk in Peebles, Innerleithen, Walkerburn and other communities downstream. Analysis by Scottish Borders Council in 2018[3] highlighted that the Lynn Water is an important contributor to flood flows upstream of Innerleithen and would be a key catchment to concentrate NFM works on. The Lyne Water is estimated to contribute 25% of the median annual maximum flow at Peebles (Figure 2-6).

Peebles and other Tweed communities have suffered from a number of large flood events in recent years. Notable flood events have occurred in December 2015, December 2013, November 2009, January 2005, October 1949 and 1937. The most regularly flooded areas in Peebles are on the left bank downstream of Tweed Bridge including Tweed Green, Tweed Avenue and Gytes Leisure centre sports pitches which all lie directly on the River Tweed floodplain without formal means of flood protection.

Scottish Borders Council Peebles Flood Study[4] suggests that there are 181 properties at risk of flooding from the River Tweed in Peebles, with an additional 32 at risk with future climate change.

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2 Tweed Local Plan District – Local Flood Risk Management Plan Final Report. Scottish Borders Council. September 2022. https://www.scotborders.gov.uk/downloads/file/11779/tweed_local_flood_risk_management_plan-_final_report.pdf ; https://www2.sepa.org.uk/frmstrategies/pdf/pva/PVA_13_01_Full.pdf

3 Scottish Borders Council, 2018. The River Tweed Natural Flood Management and River Basin Management Plan Report: Peebles and Innerleithen, Final Report. Report by JBA Consulting & Mott MacDonald.

4 Scottish Borders Council, 2019. Peebles Flood Study - River Tweed. Appraisal Report. Report by JBA Consulting & Mott MacDonald.

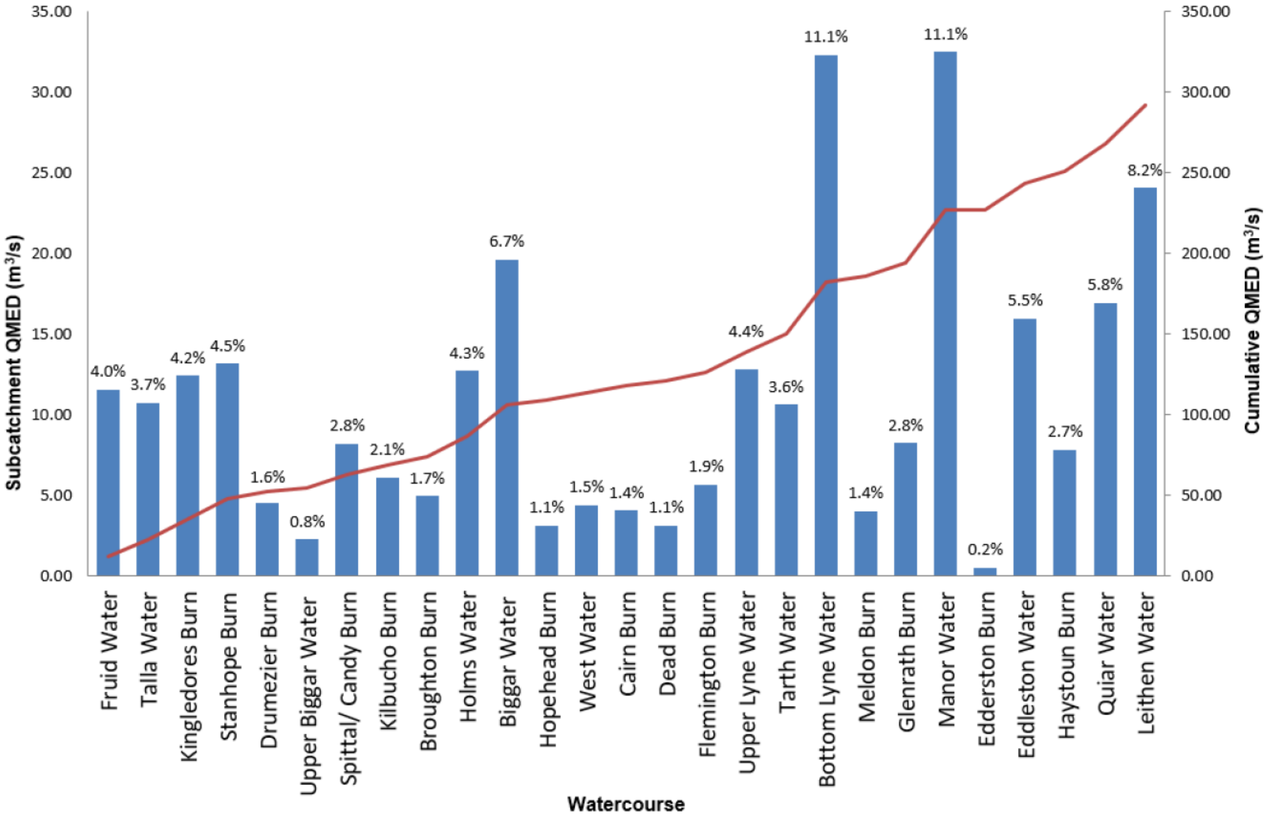

Figure 2-6: QMED contributors on the River Tweed upstream of Innerleithen

Whilst the Scottish Borders Council study proposed a range of flood protection options for the town, the height of defences needed to protect the town to a high standard of protection may detract the social amenity and landscape benefits of the riparian land/property of Peebles. Thus, the importance of using Nature Based Solutions in the upper catchment including the Lyne Water, may help to counteract the impact of climate change on increased river flows on the River Tweed, and minimise the need for excessively high and expensive flood defences through Peebles. Any in terms of flood flow reductions would also benefit communities further downstream.

2.6 WFD waterbody classifications

Of the six main river reaches in the Lyne Water catchment four are classed at moderate status and two at high ecological status. Table 2-1 summarises the WFD waterbody classifications for the study area.

Several rivers are designated as a heavily-modified waterbodies. This is due to the impact of West Water and Baddinsgill reservoirs and artificial drainage of agricultural land. The classifications cannot be addressed without significant impact on water storage for public drinking water, (i.e. removal of the reservoirs) in Lyne Water (Source to Tarth Water confluence) and West Water.

Dead Burn, Tarth Water and Cairn Burn have bad status for hydromorphology, and morphology as summarised below (Table 2-1). This is related to significant impact of the drainage of agricultural land. SEPA have undertaken WFD assessment of these watercourses in 2015[5]. In summary,

- Tarth Water has been modified for productive agricultural land.
  - Remeandering is considered the mitigation option of choice, however, could be unlikely depending on the agricultural land classification.
  - Failure due to reduction in morphological diversity relating to plane channel bed and eroded banks.
  - Failure due to disconnected floodplain.
  - Failure due to change to channel length.
- Dead Burn has been modified for productive agricultural land.
  - Fencing, riparian planting and fish passage is considered the mitigation option of choice, however, could be unlikely depending on the agricultural land classification.
  - Failure due to reduction in morphological diversity relating to plane channel bed and eroded banks (poaching of livestock).
  - Failure due to disconnected floodplain.
  - Failure due to barriers to fish.
- Candy/Cairn Burn has been modified for productive agricultural land.
  - Fencing, riparian planting, re meandering and fish passage is considered the mitigation option of choice, however, could be unlikely depending on the agricultural land classification.
  - Failure due to reduction in morphological diversity relating to plane channel bed and eroded banks (poaching of livestock).
  - Failure due to disconnected floodplain.
  - Failure due to barriers to fish.

Table 2-1: WFD waterbody classifications for the five main rivers in Lyne Water [6].

River waterbody reach classification area	Length (km)	Classification (2023)	Comments
Lyne Water (Source to Tarth Water confluence)	22.5	Moderate overall status Moderate water quality, hydromorphology, overall hydrology, physico-chem status.	Heavily modified water body on account of physical alterations that cannot be addressed without a significant impact on water

5 SEPA - Lyne Water WFD survey's - 2015

6 Scotland WFD River waterbody classifications 2022. https://www.arcgis.com/apps/mapviewer/index.html?layers=61fad1ed76264f39b099189ceffa88b0

River waterbody reach classification area	Length (km)	Classification (2023)	Comments
			storage for public drinking water.
Flemington Burn	7.4	Good overall status Good for hydromorphology, morphology, and overall ecology. Higher for all other categories.	
Dead Burn	5.4	Moderate overall status **Bad overall ecological status, hydromorphology and morphology.** High for all other classifications – overall hydrology, fish and fish barriers.	Heavily modified water body on account of physical alterations that cannot be addressed without a significant impact on the **drainage of agricultural land**.
West Water	9.7	Good overall status Moderate status overall ecology, hydromorphology and overall hydrology. Good status for morphology. High status for biological elements.	Heavily modified water body on account of physical alterations that cannot be addressed without a significant impact on water storage for public drinking water and protected habitats and species.
Cairn Burn	6.5	Moderate overall status Good status or above for overall hydrology, water quality, and physico-chem status. **Bad status for overall ecology, hydromorphology and morphology.**	Heavily modified water body on account of physical alterations that cannot be addressed without a significant impact on the **drainage of agricultural land**.

River waterbody reach classification area	Length (km)	Classification (2023)	Comments
Tarth Water	11.4km	Moderate overall status Moderate status for biological elements and water quality. **Bad status for hydromorphology and morphology.**	Heavily modified water body on account of physical alterations that cannot be addressed without a significant impact on the **drainage of agricultural land**.

3 Natural Capital Opportunities

3.1 Catchment nature-based options

Potential NBS measures have been identified within the Lyne Water catchments using the JBA Risk Management 5m pluvial flood maps and GIS analysis (Figure 3-1). Since this analysis the updated SEPA pluvial flood maps (2025) have been released at a higher resolution which could be used to update this analysis in the future. The pluvial flood maps have been used to identify the key flow pathways across the catchment.

In addition, Tweed Forum have produced NFM opportunity maps for woodland, riparian planting, leaky barriers, floodplain reconnection, gully blocking, gully storage areas, and bunds (7).

Both opportunity maps identify catchment tree planting as an extensive option available across both catchments. The potential for riparian woodland is also extensive, with the possibility of planting along the entire length of all major and minor watercourses in Lyne Water and its tributaries. There are sections available for floodplain tree planting, predominately in the lower section of both catchments. However, these are likely to require fundamental changes to the farming system such as removal of livestock. Both opportunity maps identify similar areas of opportunity. It is important to consider the condition of the grassland immediately behind the riparian buffer zone across the floodplain which could offer similar benefits for water retention and flow control. Riparian woodlands help provide a number of other really important ecosystem services: water purification, wildlife corridors and reducing river temperatures to name a few.

In addition, there were minor areas possible for RAFs identified from the potential maps. There are also some areas where floodplain reconnection would be possible, primarily along the main channels in both catchments, identified in both mapping opportunities.

In addition to the NBS opportunity maps there are additional data set useful for identifying potential measures. These are summarised in Table 3-1.

Table 3-1: Additional Nature Based Solutions potential datasets.

NFM Type	Comment	Data source
Wetlands for water quality, carbon storage, flood resilience and urban wellbeing	No coverage	Wildfowl and wetlands trust https://wetland-data-explorer.wwt.org.uk/

7 Land Use Strategy NFM Opportunity Map - Scottish Borders Council (SBC) - 2021 Appendix A

<table>
<tr><th>NFM Type</th><th>Comment</th><th>Data source</th></tr>
<tr><td>Land capability for Forestry</td><td>Mostly limited flexibility across the catchment, some moderate flexibility and good flexibility areas.
<table>
<tr><th>Class</th><th>Area (km2)</th></tr>
<tr><td>Good flexibility for trees</td><td>2.2</td></tr>
<tr><td>Land unsuitable for trees</td><td>8.2</td></tr>
<tr><td>Limited flexibility for trees</td><td>70.1</td></tr>
<tr><td>Moderate flexibility for trees</td><td>44.5</td></tr>
<tr><td>Very limited flexibility for trees</td><td>48.5</td></tr>
<tr><td>Water</td><td>0.4</td></tr>
</table></td><td>The James Hutton Institute https://www.hutton.ac.uk/soil-maps/</td></tr>
<tr><td>Soil Risk of Runoff</td><td>Soils at risk of Standard percentage runoff:
High: >40%
Medium: 20-40%
Low: <20%
<table>
<tr><th>Class</th><th>Area (km2)</th></tr>
<tr><td>High</td><td>49.0</td></tr>
<tr><td>Med</td><td>99.0</td></tr>
<tr><td>Low</td><td>24.0</td></tr>
</table></td><td>The James Hutton Institute https://www.hutton.ac.uk/soil-maps/</td></tr>
<tr><td>RAMI the river anthropogenic modification index</td><td>Effectively calculates MIMAS scores for every 1 km of water body, to express the degree of modification as a proxy for geomorphic condition.</td><td>SE Web - SEPA</td></tr>
<tr><td>Riparian vegetation condition</td><td>Shows where the riparian margin is good or not.</td><td>SE Web - SEPA</td></tr>
<tr><td>Priority for woodland planting</td><td>Based on riparian condition and recovery potential, with the idea that we should plant areas of higher energy as these are more likely to be eroded.</td><td>SE Web - SEPA</td></tr>
</table>

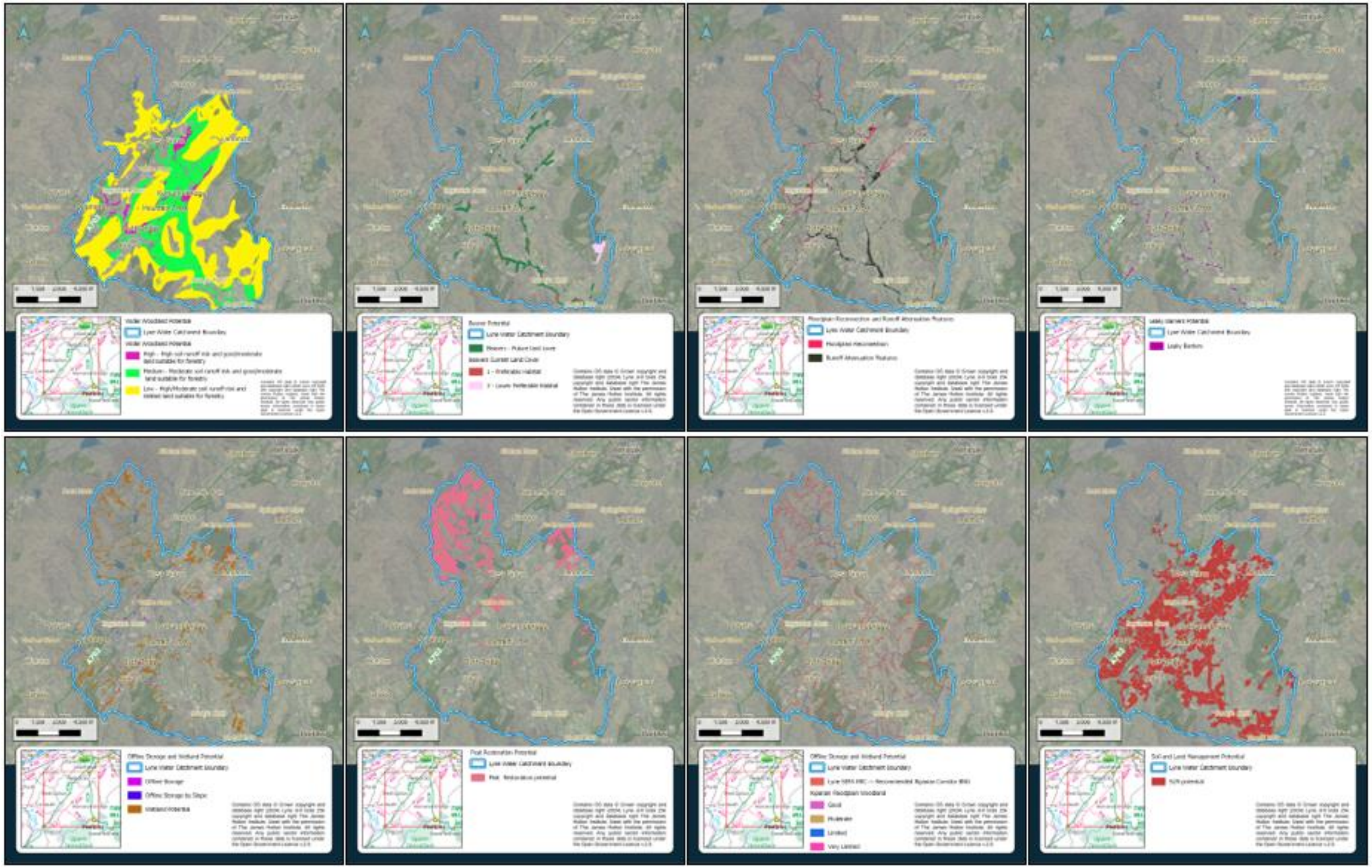

Figure 3-1: NBS potential maps - JBA Consulting (Appendix A).

There are various NBS options in the area like tree planting, riparian woodlands, ponds, soil management improvements, riverbank restoration, leaky barriers, and bunds (etc.), which may be used to lower the present flood risk within the catchments, alongside providing wider ecosystem service benefits including promoting drought resilience.

Woodland Features

Tree planting across the catchment as highlighted in Figure 3-1 would likely increase interception, evaporation and transpiration in the catchment, reducing the hydrological inputs reaching the catchment surface and lowering flood risk. Trees would additionally likely increase the infiltration and permeability of the area, reducing the likelihood and incident of rapid surface hydrological pathways (depending on the permeability of soils on which they are planted - Section 2.2 - (Peskett, et al., 2023)).

Trees would also provide wider ecosystem benefits including improvements to biodiversity by providing habitat or food for a range of species due to the current lack of tree cover. Tree species could be targeted to be particularly beneficial to improve areas of priority habitat for native woodland.

Trees would additionally benefit water quality due to the reduction in surface hydrological pathways and may also help to bind soil and retain nutrients and pollutants. The shade and shelter provided by the trees would also benefit livestock in the area, and if planted close to streams could assist in the Keeping Rivers Cool initiatives. To allow trees to be established in the area, these will almost certainly need to be fenced off to protect them from grazing.

The encouragement of rough vegetation growth is another NBS option which could be explored as being suitable. This could involve planting vegetation throughout the improved grassland areas but could additionally involve planting in riparian zones and hedgerow improvements. Rough vegetation will likely increase interception, evapotranspiration, localised permeability and infiltration (influencing soil water holding and infiltration capacities), as well as elevate surface roughness which could intercept and interrupt surface and near-surface hydrological pathways. Planting riparian zones with rough vegetation may intercept these rapid hydrological pathways before they reach the stream network, reducing flood risk, and likely improving water quality and soil retention. This rough vegetation may also provide additional ecosystem services, such as benefits to carbon capture and biodiversity. If implemented, this rough vegetation may need protecting from grazing, possibly only temporarily while becoming established.

Bunds, Leaky Barriers, Runoff Attenuation Features (RAFs) and Floodplain Reconnection

Bunds could additionally be used in both catchments, particularly useful on sloping fields where runoff exits the field in one location or the low corner of fields, and used to enhance floodplain storage where large runoff is currently occurring. These can act as a barrier and store runoff (including soil erosion), which support slower runoff through the structures.

Leaky barriers may also be a valid option in the smaller tributaries. Leaky barriers can pool water behind them during flood periods and slow water reaching downstream locations, potentially reducing flood risk, whilst allowing water and fish to pass unhindered during non-flood conditions. These may encourage water out-of-bank in certain locations, further reducing flood risk in downstream locations. Nonetheless, such features can be counterintuitive to some people, as they promote out of channel flow. Utilising in-channel wood, like brash bundles, can have similar effects than less formal leaky barrier structures. An example of successful channel restoration using large, wooded debris barriers is shown in Figure 3-2. Channel reprofiling and re-meandering is an additional channel measure that could be suitable. This could be used to reduce channel-side slope gradients to reduce the speed of hydrological inputs and encourage floodplain reconnection and out-of-bank flow in certain locations. It is likely that these numerous interventions can be combined and used concurrently.

Figure 3-2: Example Channel Restoration through Large Woody Debris

The creation or restoration of localised wetlands and ponds which have some storage potential for flood events may also be useful and can benefit flood risk by attenuating flood peaks due to the storage element. Wider benefits may include improvements to water quality by allowing pollutants to degrade and biodiversity due to habitat creation.

Gully blocking and creating gully storage are opportunities are identified in both catchments. Gully blocking acts to trap water and sediments, slowing the flow of water, and/or raising the water table.

Further sediment traps could be used within the catchment. These primarily target improvements to water quality and maybe unlikely to have significant flood benefits on their own. However, when used in conjunction with other runoff management techniques (e.g., ponds) they can help to control the release of sediment and pollutants into river, which thus maintains the capacity of rivers to convey flood waters.

Given the appearance of straightened channels throughout the catchment, river morphology and floodplain restoration techniques could also be considered. These measures could reconnect current rivers with floodplains. Restoring the channel morphology can usually naturally increase flood storage and lower the volume and speed at which flooding arrives to downstream locations. In certain areas, sediment dynamics can be positively affected which may improve the river's ecology. This may improve aquatic habitats and target the present WFD improvements. Full floodplain restoration or Stage Zero could also be an option. The philosophy of Stage 0 restoration is to work with natural processes to rehabilitate a modified and incised, or aggrading, channel network and restore the water connection to its floodplain[8].

Wider land management
Additional wider land management improvements could also be used including regenerative agriculture. These seek to influence flood generation through lowering the level of surface runoff that reaches the river network. These primarily target improving soil structure (e.g., improving soils porosity), increasing infiltration and ultimately allowing increased capacity of the land to store water. These measures may also lower soil erosion and the transfer of sediment and pollutants to rivers which could act to improve both catchments water quality. As the use of heavy machinery is associated with higher risk of soil erosion and soil compaction, NBS techniques like cover crops, soil aeration, runoff control features like in-field buffers strips or hedges, and relieving compaction where possible could act to lower flood risk and improve water quality.

In general, the largest constraints will be agricultural pressure and cost for the restoration scheme (including future maintenance and monitoring) which can only be assessed in future stages with early landowner engagement.

4 Natural Capital Beneficiaries Assessment

As part of the desk-based assessment, a natural capital beneficiaries assessment was also undertaken. This was undertaken in 3 stages:

- Qualitative natural capital assessment to assess the potential ecosystem services which could be delivered by different land and water management options focussed on nature-based solutions.
- Scoring exercise to help prioritise which options and ecosystem services to focus on for the beneficiaries assessment.
- Beneficiaries assessment of prioritised ecosystem services.

4.1 Qualitative Natural Capital Assessment

The potential options identified as part of this desk study included:

- Leaky barriers.
- River restoration.
- Floodplain and wetland restoration.
- Peatland restoration.
- Runoff attenuation features.
- Offline storage areas.
- Woodland planting.

8 https://www.jbaconsulting.com/2023/10/12/jba-designed-river-aller-floodplain-reconnection-scheme-now-complete/

- Hedge planting.
- Soil and land management.

These were assessed qualitatively (see Appendix B) to understand their potential ecosystem services delivery. This was undertaken using a scoring system whereby:

- 0 - No delivery of ecosystem service.
- 1 - Moderate delivery of ecosystem service.
- 2 - Some delivery of ecosystem service.
- 3 - Significant delivery of ecosystem service.

4.2 Scoring exercise

This qualitative assessment enabled each:

- NBS to be scored to understand which ones deliver the greatest amount of ecosystem service benefits.
- Ecosystem service to be scored to understand which services benefit the most from NBS delivery.

From this assessment it was possible to identify the following NBS have the potential to deliver the largest number of ecosystem service benefits:

- Floodplain wetland restoration.
- Beaver reintroduction.
- Peatland restoration.
- Woodland planting.
- Soil and land management.

These NBS were prioritised for inclusion in the beneficiaries' assessment. This scoring exercise also helped to prioritise ecosystem services for inclusion in the beneficiaries' assessment. This resulted in prioritising:

- Climate regulation.
- Water regulation.
- Erosion regulation.
- Water purification.
- Education and science.
- Habitat and biodiversity.

Figure 2-6 maps the prioritised NBS against their potential ecosystem service delivery.

4.3 Beneficiaries assessment

To deliver a beneficiaries assessment, the ecosystem services prioritised above were taken one by one and the benefits and disbenefits which result from this ecosystem service were listed (see Table 4-1and Appendix C). The beneficiaries and dis-beneficiaries (Table 4-2) associated with each ecosystem service's delivery were then summarised across the following groups:

- Local community. Including local farm diversification/production and business resilience.

- Wider society.
- Public sector.
- Private sector.

This list of beneficiaries was further refined by undertaking a desk-based search to establish specific names of organisations represented by these beneficiaries.

The full natural capital beneficiaries assessment is presented in Appendix D. For each of the six priority ecosystem services the assessment shows:

- Which nature-based solutions deliver the ecosystem service.
- Which connected ecosystem services are delivered alongside the priority ecosystem service.
- The benefits and disbenefits which result from delivery of the ecosystem service.
- The organisations which benefit or don’t benefit from the ecosystem service's delivery.

Table 4-1: Benefits and disbenefits from ecosystem service delivery

Ecosystem Service	Benefits	Disbenefits
Climate regulation	Removal of CO_2 from the atmosphere Carbon absorption Creation of a carbon offset market	Loss of agriculturally productive land Transfer of farming activity elsewhere (leakage)
Water regulation	Improved water quality and water resource Improved health Improved habitat for biodiversity Improved agricultural productivity (enhanced resilience) Reduced risk of flooding or wildfire	Loss of land available for agriculture
Erosion regulation	Improved water quality Improved agricultural productivity Improved habitat and species diversity Less farmland lost to erosion	
Water purification	Improved water quality Improved habitat for biodiversity Improved agricultural productivity	
Education and science	Academic research opportunities Volunteering opportunities Learning outside the classroom Apprenticeship opportunities	
Habitat and biodiversity	Species existence Pollination Habitat Wildlife watching	Loss of farmland habitat

Table 4-2: Beneficiaries and dis-beneficiaries

Groups	Beneficiaries/Dis-beneficiaries
Wider society	Charities/Volunteer Groups Tourists/Visitors Universities
Local community	Community groups Fishermen Local population regionally Local residents Residents in neighbouring catchments Schools and colleges
Public sector	Emergency Services Local Government Local Healthcare Providers National Government Nature Scot NHS Scottish Forestry SEPA/SOSE/FLS
Private sector	Businesses in neighbouring catchments Developers Farmers Fisheries Insurance industry Landowners/Land managers Local businesses Offset Market developer Private Investors Water Company

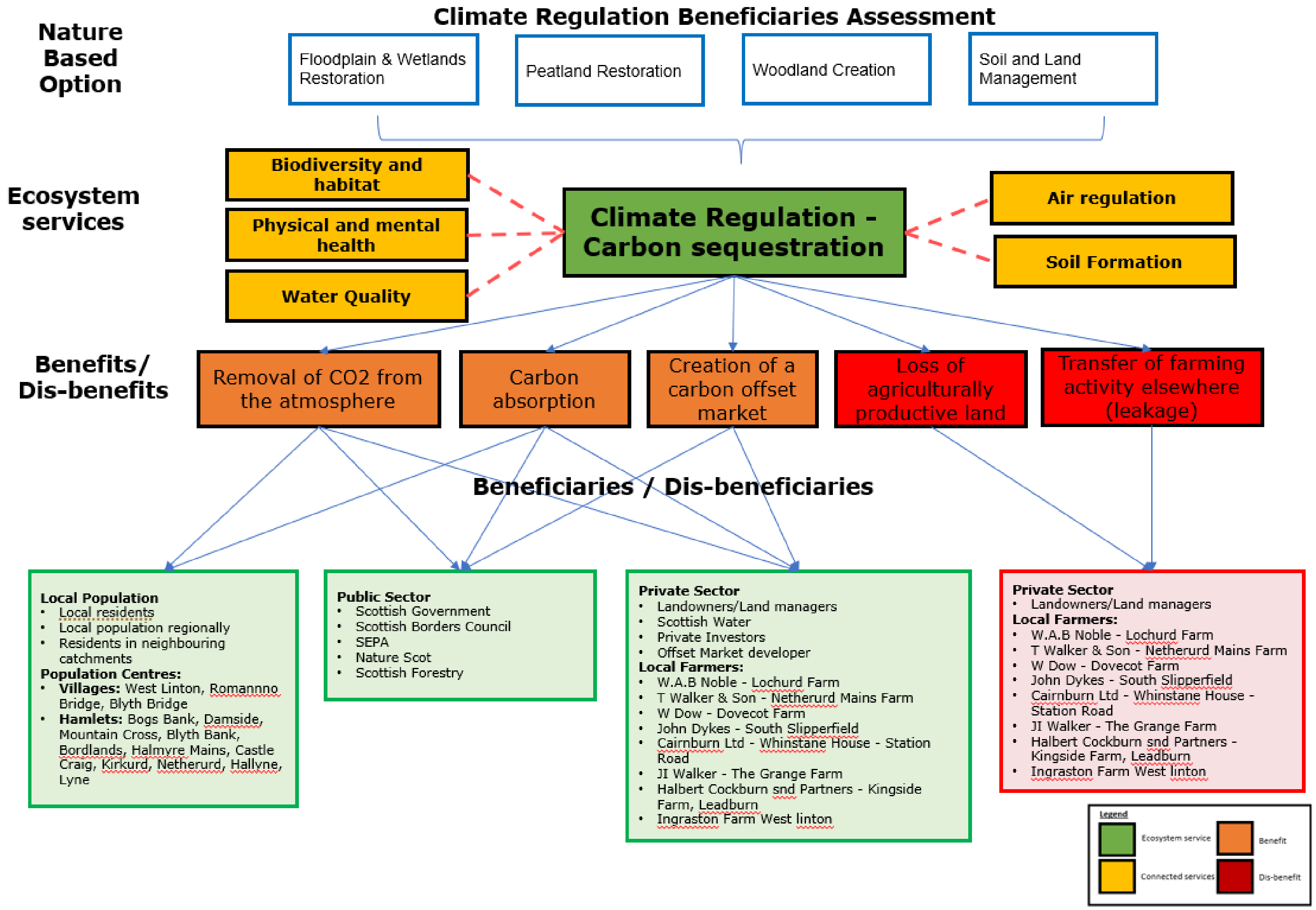

Figure 4-1: Assessing key ecosystem services delivered by potential NBS - Appendix C - Climate Regulation Example

5 Identification of the main drivers of land use decision-making and challenges facing the development of an optimum balance of natural capital.

Review of farmer decision-making behaviour, influences and barriers to uptake of NFM by Tweed Forum (Appendix E). To summarise the challenges are:

- Farmers often struggle to access and interpret the vast amount of information needed to make informed decisions regarding crop selection, pest management, and market trends.
- Unpredictable weather patterns due to climate change can significantly impact crop yields and make planning challenging.
- Fluctuations in market prices can create significant financial risks for farmers, making it difficult to manage income and plan investments.
- Difficulty in finding and retaining skilled agricultural labor can hinder farm operations and timely decision-making.
- Rising costs of fertilizers, pesticides, and other farm inputs can put pressure on profit margins and limit options for farmers.
- New technologies and digital tools can be challenging to adopt and integrate effectively, especially for smaller farms.
- Navigating complex regulations related to environmental protection, food safety, and animal welfare can be burdensome for farmers.
- Balancing the need for profitability with environmental sustainability can be a complex decision-making process.
- Access to credit and funding for necessary investments can be a significant hurdle for many farmers.
- Farmers may be hesitant to adopt new practices or technologies due to the perceived risk of potential losses.

How to address these challenges:

- Utilize technology to access real-time information and make data-driven decisions.
- Seek expert advice and training from agricultural extension agents to stay updated on best practices.
- Understand market trends and diversify crops or livestock to mitigate price fluctuations.
- Explore and implement environmentally friendly practices to enhance long-term farm viability.

- Advocate for policies that provide financial assistance and address challenges faced by farmers.

Effective deployment of NFM measures in the Lyne Water catchment will require:

- Accurate characterisation of the catchment (soils, topography, hydrology, habitat and climate);
- Detailed local knowledge of flood risk - technical & farmer knowledge accumulated over decades – and other natural capital opportunities
- An understanding of landowner 'types' - motivations, management systems and financial constraints which private and public land owners have the ability (farming system that offers an opportunity for NFM to be integrated); are engaged (have a clear understanding of what is expected) & are willing (recognise the underpinning environmental issues).
- A bottom-up partnership – the inclusion of local knowledge and engagement of local people that shares an overarching vision for the long-term sustainability of the catchment
- Effective engagement – engaging landowners in a manner which is inclusive, using their knowledge to inform the assessment of NFM opportunities.
- Availability of trusted advice and support – including a dedicated Advisor/Support officer to assist with government paperwork/processes
- Finance to secure implementation of NFM measures, maintain and monitor:
    - Capital grants to design and install measures
    - Long-term financial incentives that compliment other farm payments
    - to fund and support the work of a Catchment Advisor

6 Site Walkover Summary

As part of the NBS assessment process a site walkover was conducted on Friday 28th March 2025. The walkover was conducted under variable weather conditions with some rain and hail throughout the day. There had been overnight rain prior to the visit but otherwise the walkover followed a relatively sunny and dry spell for the Scottish Borders. Ground conditions were generally wet but not saturated, some fields had ponding surface water from the previous night (Appendix F - NBS Site Walkover report - March 2025 - JBA/Tweed Forum). In Summary:

- Lyne Water to Baddinsgill reservoir catchment is more generally related to wider peatland restoration to reduce erosion, surface water runoff and improve water quality.
- Downstream from the Baddinsgill reservoir outfall there are opportunities for further floodplain woodland, regenerative farming and riparian planting buffers for the areas between Baddinsgill House and Donkey Wood.

- There are areas of commercial forestry with trees actively being felled leaving bare soil vulnerable to erosion. Here management practices can be put in place to limit soil erosion once the trees are felled such as replanting and sediment traps/wetland creation.
- The Dead Burn watercourse is heavily modified, straightened for most of its course and largely disconnected from its floodplain. GIS mapping shows that approximately 50% (1.7km) of its course has no sinuosity at all/ is completely straightened (between NT 17875 50599 and NT 16690 49383).
- The reach of Dead Burn visited during the walkover would be a good candidate for river restoration to reconnect the reach with the floodplain and add diversity to the channel form.
- Similar conditions were noted for the Tarth Water as per the Dead Burn watercourse.
- It should be noted that the main gas pipeline runs through part of the catchment and will form a major constraint in places.

7 Summary and Recommendations

This report provides an overview of the Lyne Water catchment. Lyne Water is a tributary of the River Tweed which is located in southern Scotland. 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 is undertaken to determine the sorts of benefit that could be unlocked through natural capital/NBS delivery. This assessment is used to determine who benefits and/or dis-benefits from NBS. NBS are focused on in this report, but they are not the only solutions to integrated water resource and land management (IWRM) challenges. Regenerative farming, for example is an agricultural option, rather than an NBS.

The outcomes from this study will be used to help:

- Provide the basis of information to enable opening of a dialogue with key stakeholders as to potential future resilience options for the Lyne Water catchment, especially in response to climate change pressures.
- Inform the development of projects to increase the resilience to receptors at risk of flooding and drought in vulnerable areas of Lyne Water catchment and further downstream to Peebles.

- Inform the potential enhancement of the natural capital of the river valley to benefit both the local community, water management and local ecology, including informing the potential use of NatureScot's developing natural capital tool.
- Identify and prioritise sites for actions to enhance delivery of desired ecosystem services.
- Extend and disseminate learning from work undertaken in the Eddleston Water catchment and elsewhere across Tweed and the South of Scotland. This includes future landowner engagement (necessary throughout any additional phases of work), which is highly recommended to start early in this process.

The hydrological response of the Lyne Water catchment is influenced significantly by both soil types and underlying geology. In summary:

- Brown soils comprising 48% of the catchment are likely to facilitate efficient infiltration and groundwater recharge, which are crucial for maintaining water levels in streams and rivers and ***mitigating against the risks of droughts***.
- The presence of organic-rich peat is known for their exceptional moisture retention capacities, further enhances soil moisture levels and supports base flow during dry periods, ***contributing to the overall hydrological resilience and ecological health of the catchment (in good condition).***
    - ***Peat in this catchment has been reviewed from satellite imagery. It appears to be heavily modified and intensively managed, with burning, grips, and artificial drainage seen.***
- All types of soil in this catchment are susceptible to soil compaction, where soil particles are tightly packed due to pressures from machinery and/or livestock. ***This can have the opposite effect on promoting groundwater recharge and improving drought resilience. As well as increased flood risk and poor water quality.***

Of the six main river reaches in the Lyne Water catchment four are classed at moderate status and two at high ecological status.

- Several rivers are designated as a heavily-modified waterbodies. This is due to the impact of operation of the West Water and Baddinsgill reservoirs. The classifications cannot be addressed without significant impact on water storage for public drinking water, (i.e. removal of the reservoirs) in Lyne Water (Source to Tarth Water confluence) and West Water. ***These will have an impact on flows and flow patterns within the Lyne catchment during drought and flood conditions. It is important to understand this operation procedure including the transfer and removal of water out from the Lyne system.***
- Dead Burn, Tarth Water and Cairn Burn have bad status for hydromorphology. This is related to significant modification for drainage of agricultural land. SEPA have undertaken WFD assessment of these watercourses in 2015. ***Fencing, riparian planting, re meandering and fish passage is considered the***

mitigation option of choice, however, could be unlikely depending on the agricultural land classification.

Pateshill Water Treatment Works (WTW) treats water from the two impounding reservoirs for delivery to approximately 45,800 customers. The catchment upstream of this location has been ***observed to have significant peat erosion (within the data from the WTW)*** from footpath management and Grouse, Duck and Pheasant Shooting. In addition:

- The West Water River is being badly eroded on the Bawdy Moss area of the catchment.
- A small section of the Rough Syke burn a tributary of the South Medwyn River was also observed to be suffering from peat erosion.
- The Lyne Water from source to Baddinsgill reservoir has several sections of eroded banks exposing peat for erosion and increasing colour affecting raw water quality.

Land use in the Lyne Water catchment creates a complex hydrological system, with each type influencing water retention, infiltration rates, and runoff patterns. Effective management is essential for maintaining this balance and ensuring sustainable water resource outcomes. ***Sustainable farming such as regenerative farming practices (which are present in the lower catchment could potentially have significant benefits for soil quality, soil retention, water quality, wildlife, flooding and drought resilience.***

There are various NBS options in the area like tree planting, riparian woodlands, ponds, soil management improvements, riverbank restoration, leaky barriers, and bunds (etc.), which may be used to lower the present flood risk within the catchments, alongside providing wider ecosystem service benefits including promoting drought resilience. ***In general, the largest constraints will be agricultural pressure and cost for the restoration scheme (including future maintenance and monitoring) which can only be assessed in future stages with early landowner engagement.***

A review of farmer decision-making behaviour, influences and barriers to effective deployment of NBS measures by Tweed Forum identified that co-creation of potential options for the Lyne Water catchment will require:

- Accurate characterisation of the catchment (soils, topography, hydrology, habitat and climate);
- Detailed local knowledge of flood risk - technical & farmer knowledge accumulated over decades – and other natural capital opportunities
- An understanding of landowner 'types' - motivations, management systems and financial constraints which private and public landowners have the ability (farming system that offers an opportunity for NFM to be integrated); are engaged (have a clear understanding of what is expected) & are willing (recognise the underpinning environmental issues).
- A bottom-up partnership – the inclusion of local knowledge and engagement of local people that shares an overarching vision for the long-term sustainability of the catchment

- Effective engagement – engaging landowners in a manner which is inclusive, using their knowledge to inform the assessment of NFM opportunities.
- Availability of trusted advice and support – including a dedicated Advisor/Support officer to assist with government paperwork/processes
- Finance to secure implementation of NFM measures, maintain and monitor:
    - Capital grants to design and install measures
    - Long-term financial incentives that compliment other farm payments
    - to fund and support the work of a Catchment Advisor

As part of the NBS assessment process a site walkover was conducted on Friday 28th March 2025. The walkover was conducted under variable weather conditions with some rain and hail throughout the day. There had been overnight rain prior to the visit but otherwise the walkover followed a relatively sunny and dry spell for the Scottish Borders. Ground conditions were generally wet but not saturated, some fields had ponding surface water from the previous night. In summary the NBS options include:

- Peatland/Moorland restoration.
- Soil and land management / regenerative farming practices (in grazed fields). Including woodland planting in areas of surface water flow paths and preexisting saturated ground.
- Cross slope hedgerows to intercept overland flows.
- Soil management measures within location of commercial forestry to reduce risk of soil erosion after felling.
- River Restoration options across the Tarth Burn and Dead Burn.

The next steps for the further development of a natural capital innovation plan within the Lyne catchment will need to include the engagement of landowners, local communities and relevant stakeholders to test the outputs of this study. In doing so a greater insight will be gained for the appetite of Nature Based Solutions and Natural Capital enhancement within the catchment and will help provide a better understanding of the potential opportunity for a catchment scale initiative.

A Appendix A

A.1 JBA NFM Potential Maps

Supplied as Separate PDFs

A.2 Tweed Forum NFM Potential Maps

Supplied as Separate PDFs including:

- Opportunities for habitats to reduce Flood Risk
- Natural Woodland opportunity
- NFM Opportunities
- Water Quality Enhancement Opportunities
- Riparian Woodland Planting opportunities

B Appendix B

B.1 Qualitative Natural Capital Assessment

Supplied as Separate Excel Document

C Appendix C

C.1 Identifying Beneficiaries

Supplied as Separate Excel Document

D Appendix D

D.1 Natural Capital Beneficiaries Assessment

Supplied as Separate PDFs

E Appendix E

E.1 Identification of the main drivers of land use decision-making and challenges facing the development of an optimum balance of natural capital.

Supplied as Separate PDFs - Dr Chris Spray (2025)

F Appendix F

F.1 NBS Site Walkover report - March 2025 - JBA/Tweed Forum

Supplied as Separate PDFs

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State of Natural Capital Report for England 2024: Risks to nature and why it matters

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