Woodland Water Benefits: Tackling Diffuse Pollution, Flooding and Water Cooling

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Role of Woodland in Water Protection

- Semi-permanent land cover, protecting soils and water from disturbance;
- Tight cycling of nutrients, yielding good water quality;
- Canopy provides physical shelter, moderating rainfall inputs and water temperature, although potential risk for water resources;
- Well structured soils increase rainfall infiltration and water storage, reducing rapid runoff;
- Riparian woodland improves river channel form and connectivity, increasing habitat diversity and slowing the flow;
- But water benefits are dependent on good forest design and management!

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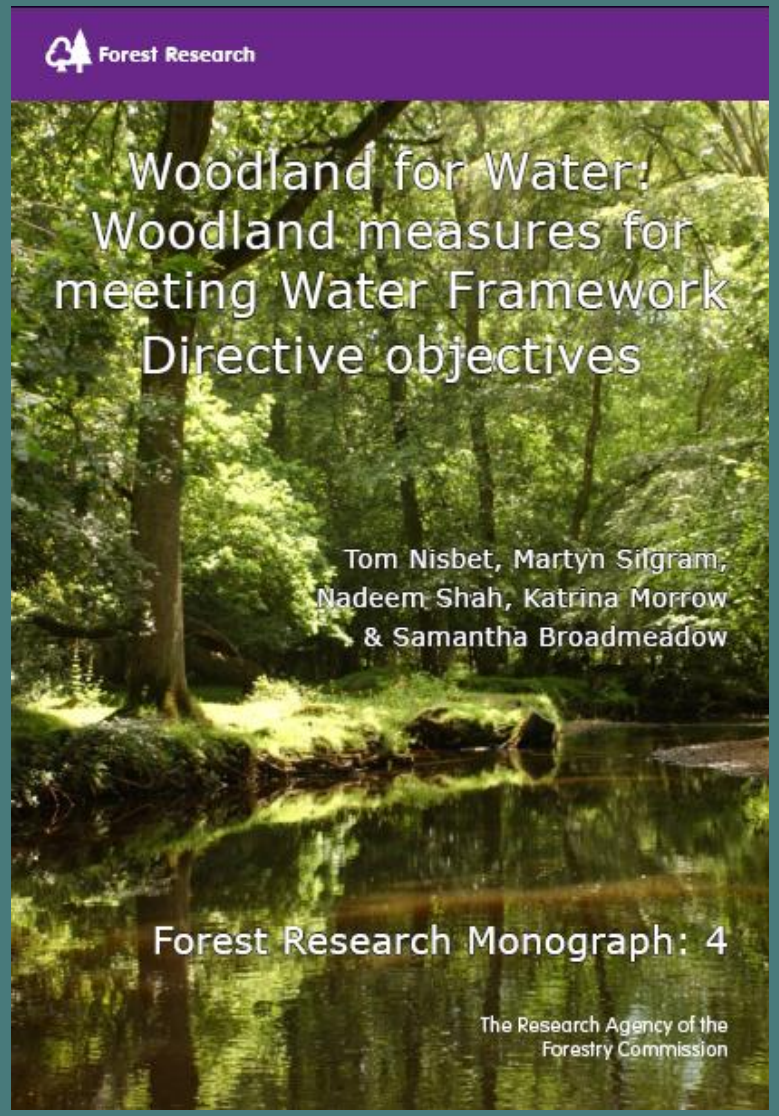
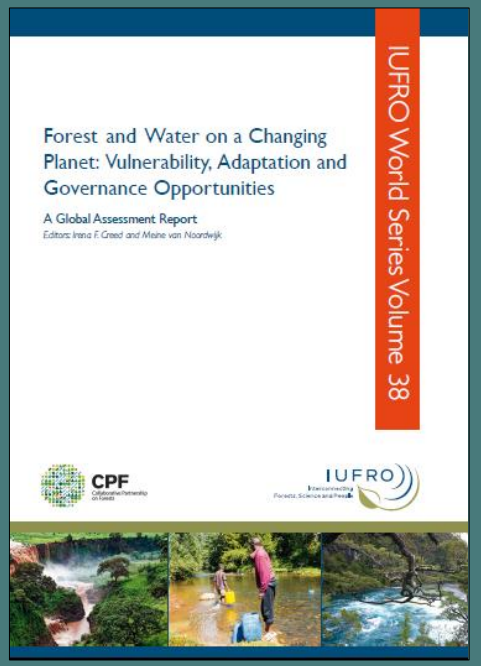
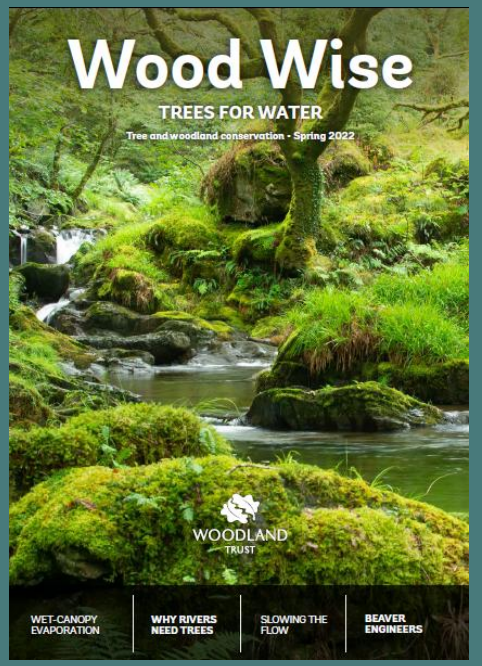
Evidence Base:



"There is strong evidence to support forest planting in appropriate locations to achieve water management and water quality objectives"





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Growing Demand for Water Services:

- Water environment and ecological status remain severely impacted by diffuse pollution; woodland can reduce sediment delivery, nutrient inputs, pesticide runoff and FIO load;
- Freshwater environment under increasing thermal stress; woodland can provide effective cooling;
- Flood risk appears to be increasing and FRM more expensive; woodland can reduce flood peaks and help stabilise slopes;
- Woodland creation provides a secure and sustainable measure to tackle these pressures;
- Effectiveness depends on location, scale, design and management.

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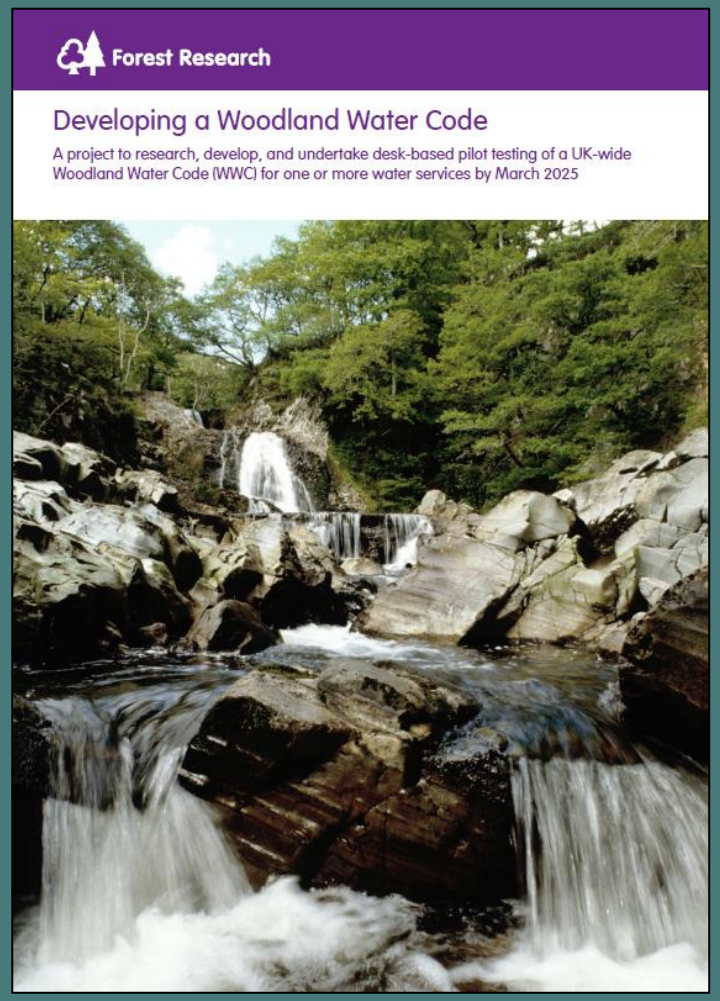
Developing a Woodland Water Code:



Funded by Defra – Nature for Climate Fund and Forestry R&D

A private finance mechanism to better value woodland water benefits to drive investment in woodland creation.

Phase 1: Designing and developing a Woodland Water Code (WWC)

(April 2023 – March 2025)

Phase 2: Validating WWC metrics and methodologies

(April 2025 – March 2026)

Focus on three water benefits:

Tackling diffuse pollution, flooding and water cooling.

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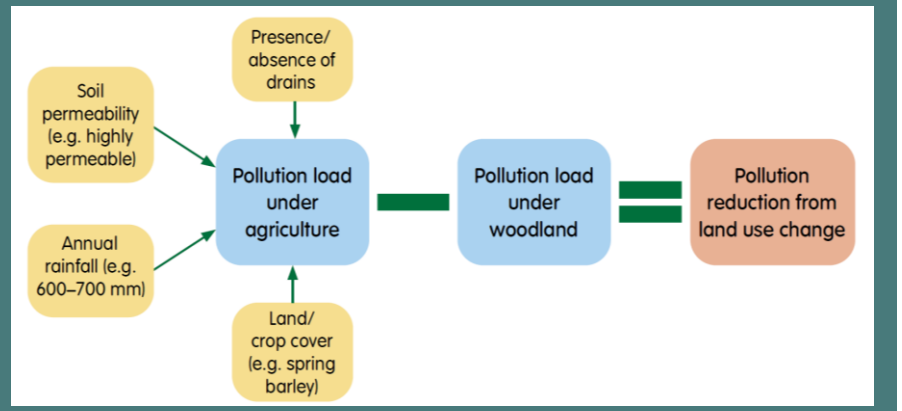
Diffuse pollution reduction calculation:

Quantifies the reduction in diffuse agricultural pollution due to woodland creation using a Farmscoper-based calculator.

<u>The calculator estimates the delivery of the following pollutants at the field scale (per ha) to water:</u>

- Nitrate-nitrogen (kg)
- Total phosphorus (kg)
- Suspended sediment (kg)
- Pesticides (dose units)
- Faecal indicator organisms (10^9 cfu)

The overall process can be summarised as:



Output

Water Pending Issuance Units (WPIUs)

Pollutant	Reduction from land use change	Reduction from woodland buffer	Total reduction	Unit
FIOs	36	0	36	10^9 cfu
Nitrate-N	322.2	0.0	322.2	kg
PPPs	3.11	0.00	3.11	dose units
Total P	17.42	0.00	17.42	kg
Sediment	12,309	0	12,309	kg

Pollutant	Standard Woodland Water Units	
FIOs	100	10^9 cfu
Nitrate-N	1	kg
PPPs	0.01	dose units
Total P	0.1	kg
Sediment	100	kg

	Total WPIUs		
	Reduction from land use change	Reduction from woodland buffer	Total reduction
FIOs	0	0	0
Nitrate-N	322	0	322
PPPs	311	0	311
Total P	174	0	174
Sediment	123	0	123

The calculated pollutant reduction can be potentially marketed as Water Pending Issuance Units (WPIUs) and transferred to Woodland Water Units (WWUs) on project verification.

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Targeting priority areas

Water quality pressure (agriculture) maps are provided by water regulators based on the measured status of the water environment.

Red areas denote catchments that drain to a waterbody that is at less than good status or deteriorating due to the contribution of diffuse pollution from agriculture. These areas would be targeted/eligible for the WWC.

Nitrate

Phosphate

FIOs

Sediment

Pesticides

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Flood alleviation calculation

Project information	
Field location	Block 1
Project start date	01 January 2025
Site location	
X (Easting)	480331
Y (Northing)	142783
Closest coordinates in JULES database	
X (Easting)	480500
Y (Northing)	142500
FID Return	206015

Site information

Enter net area to be converted to woodland (ha)	
Total	10.0

Enter proportions of baseline land cover (decimal)	
Grass	0.3
Crops	0.3
Shrubs	0.4
Total	1.0

Enter proportions of woodland type (decimal)	
Broadleaf	0.5
Conifer	0.5
Total	1.0

Land use change to woodland

Results	
Soil water content under baseline land cover (m^3 per ha)	12762.20
Soil water content under future woodland cover (m^3 per ha)	12450.15
Will the woodland creation take place in part or wholly on an active floodplain?	No
Area of woodland on the active floodplain (ha)	0.00
Woodland flood benefit	
Woodland flood benefit per hectare (m^3 per ha)	312.05
Additional flood water storage generated by hydraulic roughness from woodland creation in the active floodplain (m^3)	0
Total woodland flood benefit (m^3)	3120.50

Results

- Uses data from the **Joint UK Land Environment Simulator (JULES)** to model the potential reduction in flood volume due to storm day (>25 mm rain) canopy evaporation and average daily soil water storage (2006-2015) for broadleaved and conifer woodland vs low shrubs, grass and crops on 1 km grid across GB;
- The total woodland flood benefit for a woodland creation scheme represents the sum of these water use-based elements, plus where relevant, the additional estimated flood storage contributed by hydraulic roughness within the active floodplain.
- 100 (m^3) Flood Benefit = 1 flood WWU

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Flood risk priority maps

England – high priority areas for reducing fluvial and surface water flooding by Natural Flood Management (NFM), including by land use change or management.

Wales – catchments draining to communities at risk of fluvial flooding with NFM potential (including riparian woodland creation).

Scotland - areas draining to one or more downstream 'Potentially Vulnerable Areas', defined as high-risk communities.

Northern Ireland – a lack of climate data currently prevents application of the JULES-based calculator.

Red areas denote locations potentially eligible to apply for the WWC flood benefit – maps will continue to evolve, particularly in Scotland.

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Water cooling/shade calculation & mapping

Input

Site Characteristics	
Location	Block 1
Project start date	31 January 2025
Reach length to plant (m)	250
Avg. channel width (m)	1
Number of banks planted	2
Baseline Canopy Area (m^2)	0

Planting Characteristics	BANK 1	BANK 2
Average distance planting to the watercourse (m)	1	1
Dominant bank orientation	East	West

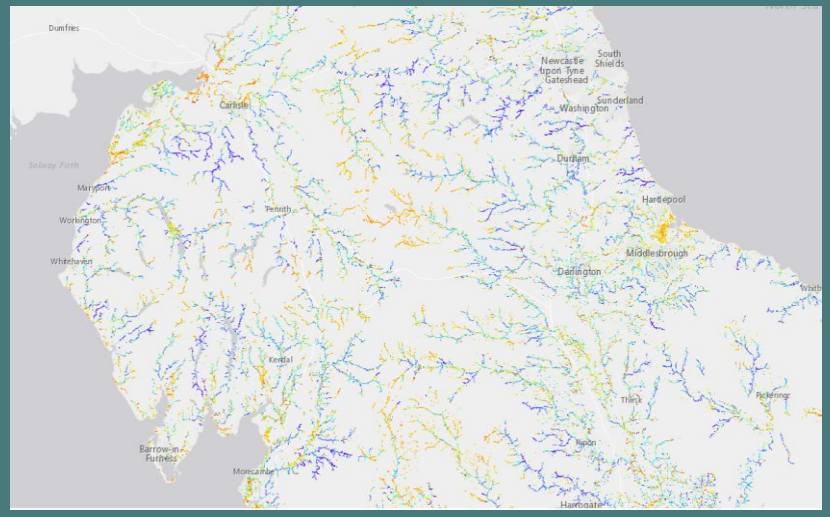
Output

Total stems per ha	1,140	1,140

Canopy cover from the project (not including baseline canopy cover)	
Reach area (m^2)	250
Canopy cover over watercourse (m^2)	102.54
Percentage canopy cover	41%

Final predicted canopy cover over the watercourse (with baseline removed)	
Canopy cover over watercourse (m^2)	102.54
Percentage canopy cover	41%

- Estimates area of tree canopy cover (m^2) created over a watercourse by riparian woodland planting.
- Utilises National Forest Inventory data on tree canopy radius.
- 100 m^2 water shade = 1 shade WWU
- Uses LiDAR data to prioritise streams



England – Classification of relative shade using the Keeping Rivers Cool map. Blue and red watercourses have the highest and lowest levels of existing shade, respectively.

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Next steps for the WWC

Ongoing validation of the WWC by the Soil Association, testing with the Woodland Carbon Code team and alignment with BSI Flex 704.

Producing a finished, piloted and validated Version 1 of the WWC by March 26, comprising the three water benefit calculators plus associated methods and rules.

Next steps:

- Operationalising the WWC
- One option is to integrate the WWC within the WCC, initially as an explicit bundle of water benefits alongside carbon prior to developing a market for WWUs.
- Adapting the UK Land Carbon Registry to include WWU.

Other options include the direct adoption of the water benefit calculators by existing schemes (e.g. Nutrient Mitigation or woodland creation grant schemes), or developing a stand alone WWC. Much will depend on future policy development on green finance and water regulation. Potential to stack water benefits in longer-term.

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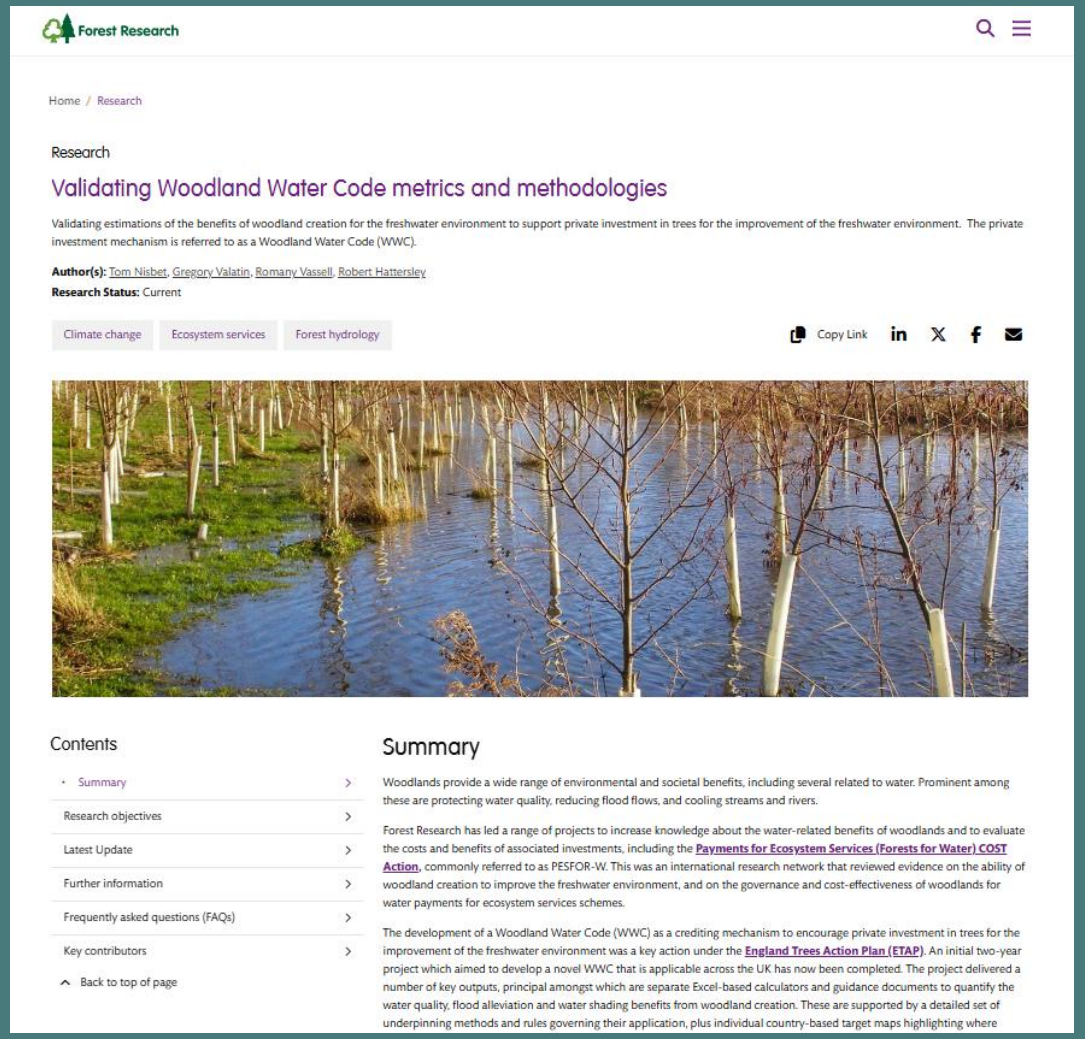
Thank You

Find out more at:
https://www.forestresearch.gov.uk/research/developing-a-woodland-water-code/



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