

# *United Utilities' SCaMP Project*

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Monitoring the effects of upland habitat restoration on hydrology, water colour and carbon at three blanket bog sites

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Associates Ltd  
CONSULTANT ECOLOGISTS



# *Introduction*

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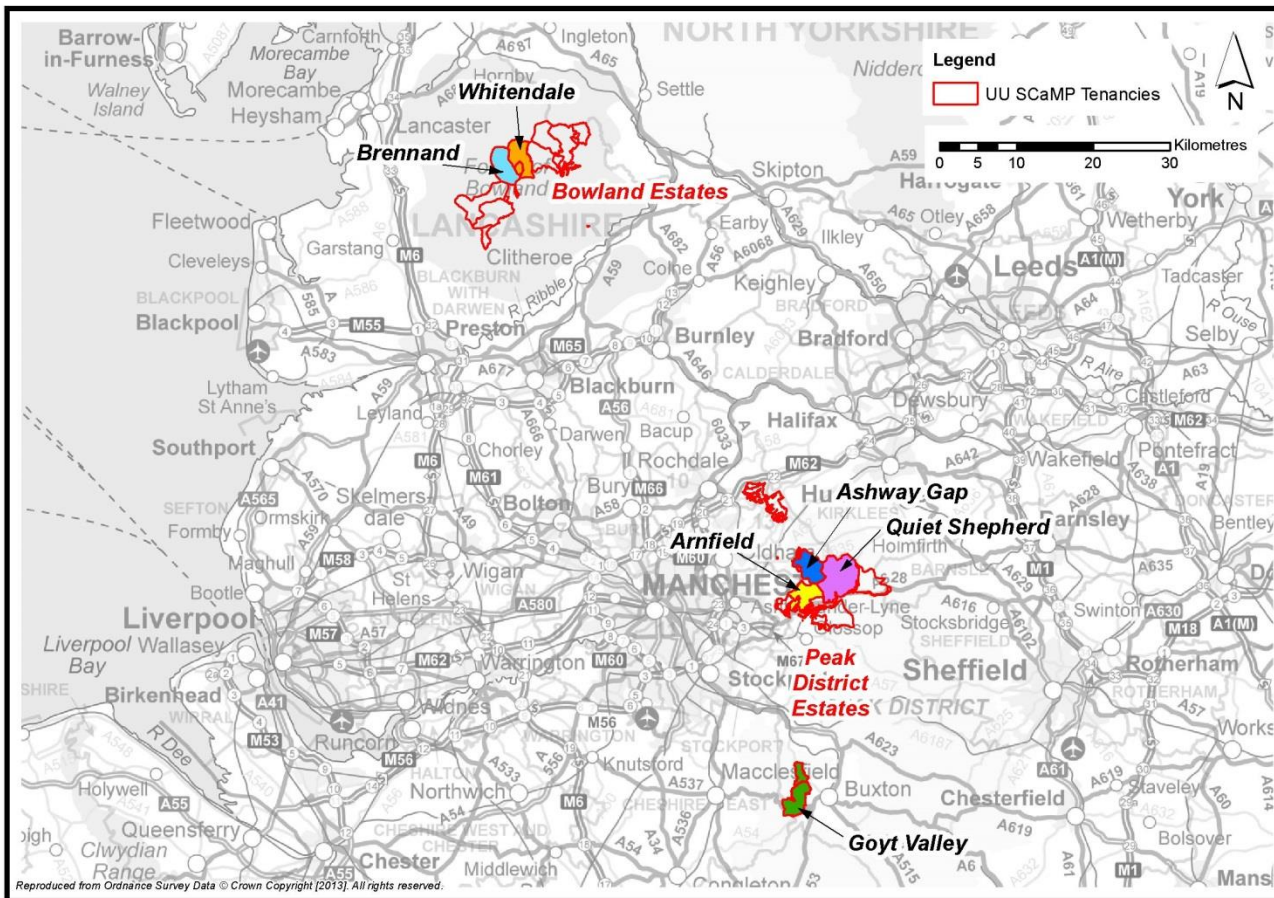
- PAA has been working with United Utilities to monitor blanket bog restoration at sites across NW England under the Sustainable Catchment Management Programme (SCaMP).
- The projects began in 2005/06 and continues to 2020.
  - Phase 1a = focused on restoring habitat condition across wide range habitats
  - Phase 1b = broader remit of habitat functioning but focused on blanket bog
  - Phase 1c = more emphasis on understanding trajectories and processes
- Presentation aims to provide an overview of key results on blanket bog sites up to 2015 (end of Phase 1b) and looks forward to the next 5 years.

# *Sustainable Catchment Management Programme (SCaMP)*

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- SCaMP is an innovative and large scale project designed to:
  - Improve catchment quality
  - Meet nature conservation objectives
  - Improve raw water quality
  - Ensure a sustainable future for agricultural tenants
- Key aims are:
  - To restore habitats towards target condition
  - To improve water quality, particularly colour
  - To help manage run-off rates, sediment load and downstream flooding
  - To improve carbon retention and reduce carbon loss

# Sites Assessed



## Phase 1b Sites

- Southern:
  - Goyt Valley
  - Longdendale
- Bowland:
  - Brennard
  - Whitendale

## Phase 1c Sites

- Longdendale
- Brennard
- Goyt (reduced)

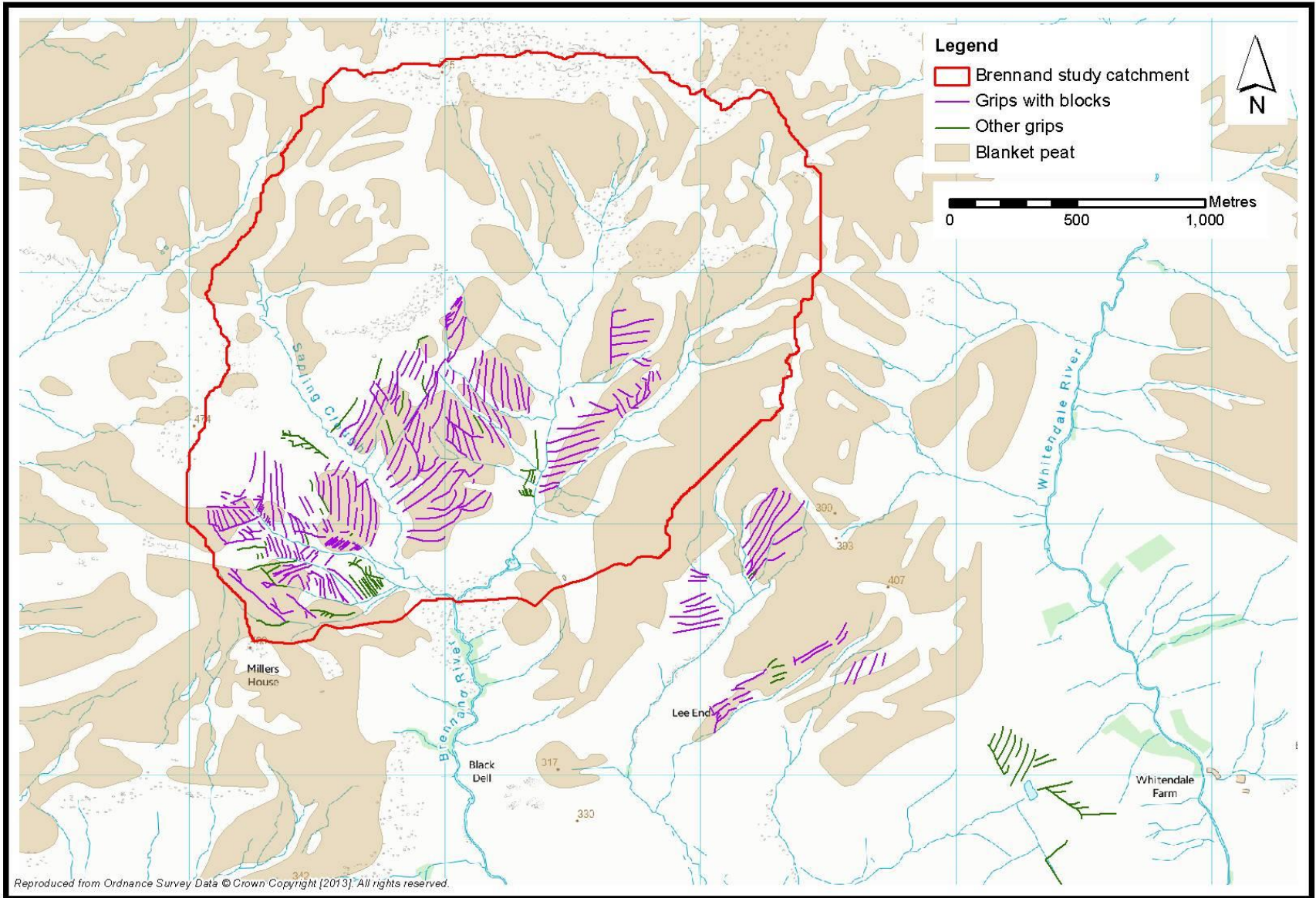
# *Prior to Restoration*

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- Areas of extensive bare peat.
- Significant artificial drainage and gully erosion.
- Poor vegetation condition and loss of peat from the moorland.
- Effect of grazing and burning regimes over decades.





# Restoration Measures

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Across 12,300ha blanket bog:

85km grips blocked with peat or plastic dams.

470ha eroding bare peat treated with 'nurse' crop, heather brash, geojute textile.

'novel' coir roll installation.

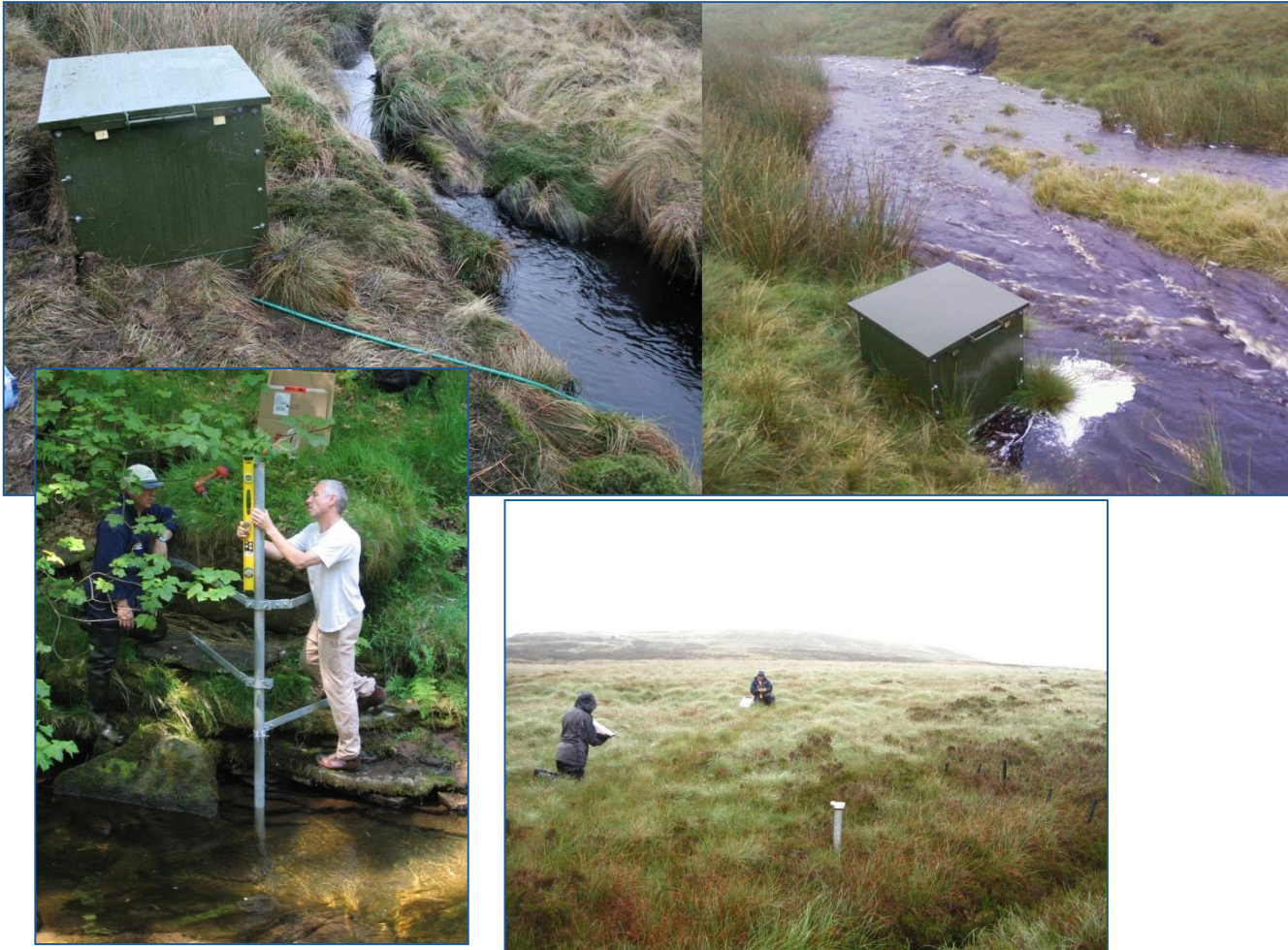
# *Assessment of Restoration Measures*

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- Grip blocking (peat and plastic dams) – Brennand, Goyt Valley & Whitendale sites.
- Bare peat restoration (lime, grass seed ‘nurse’ crop & fertiliser +/- geojute textile) – North Longdendale sites.
- Gully blocking with stone dams – North Longdendale
- Coir roll installation – localised area on Ashway Gap.
- In combination with changes to grazing and burning regimes (either removed or reduced) across all sites.



# Monitoring Approach



- Hydrology - peat water levels, stage discharge, rainfall gauges.
- Water colour (DOC), turbidity (POC). Spectrolyser deployed in the field.
- Vegetation quadrats within plots, including reference plots, fixed point photography

# *Analysis and Interpretation*

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- Vegetation and hydrological datasets held in the SCaMP databases.
- Vegetation data analysed using a range of statistical tests to identify trends or changes in individual or grouped plant species over time, in relation to different restoration measures.
- Hydrological data subject to a variety of analyses, including time-series analysis. Additional statistical investigations used to detect and quantify key changes in flow variability and hydrograph response pre- and post-restoration using single event hydrograph responses.

# Results

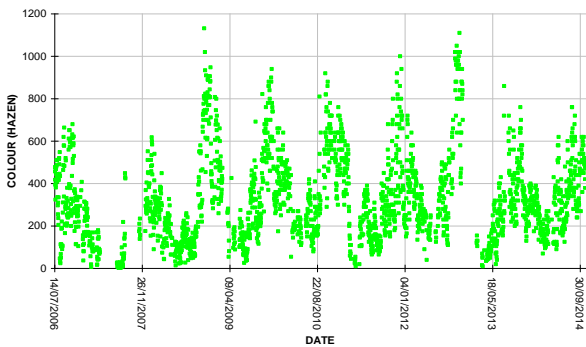
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- Present the effects of (1) grip blocking at Brennand and Goyt (Whitendale), then (2) bare peat restoration at North Longdendale:
  - What did we observe on the ground? (photos)
  - What changes did we record in the vegetation? (bar graphs)
  - What changes did we monitor in terms of hydrological change? (time series graphs of peat water levels, raw water colour and turbidity)
- Beginning to explore potential trajectories / processes.

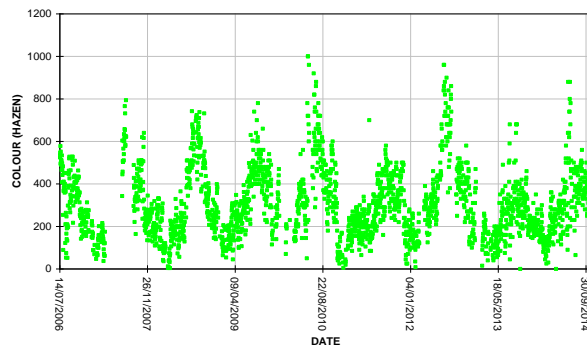
But from the outset, need bear in mind differences between the catchments in terms of degree of degradation...

### Type 1 Colour Pattern (Catchment Response) - Extensively Degraded Catchments with Gullyng and Haggng

Ashway Gap Chew Clough - Raw Water Colour July 2006-Oct 2014



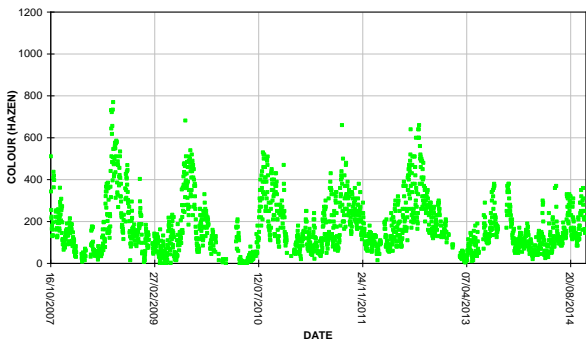
Ashway Gap Small Clough - Raw Water Colour July 2006-Oct 2014



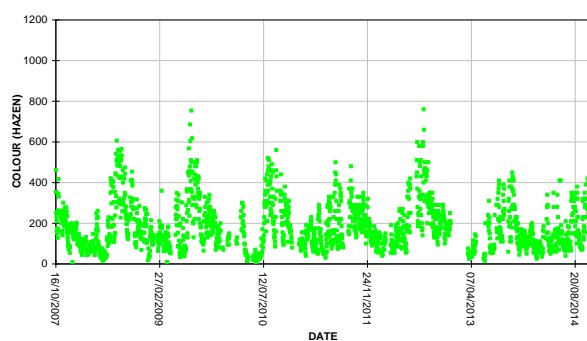
Time Series Plots of Raw Streamflow Colour Delivery across the SCaMP Catchments (2006 to Oct 2014).

### Type 2 Colour Pattern (Catchment Response) - Extensively Grippped Catchments with Cutting, Burning and Grazing

Brennard Bield Field Stream - Raw Water Colour 2007 - Oct 2014



Brennard Brown Syke Stream - Raw Water Colour 2007 - Oct 2014

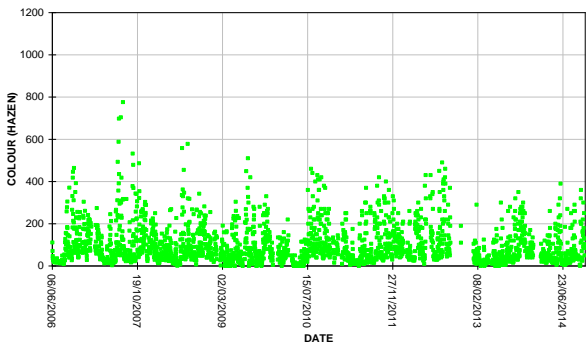


Extremely high colour levels in the degraded Longdendale catchments at Ashway Gap, where peak colour frequently exceeds 1200 hazen...

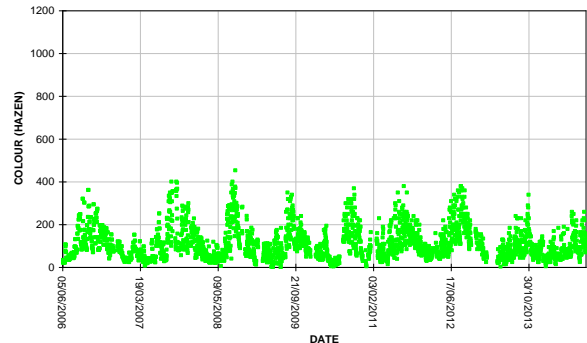
moving down to Brennard (lower and less variable)...

### Type 3 Colour Pattern (Catchment Response) - Gipped, Burnt and Grazed Catchments

Goyt Upstream of Errword Reservoir - Raw Water Colour 2006 - Oct 2014



Whitendale Intake Stream - Raw Water Colour 2006 - Oct 2014



with the lowest colour levels and variation in the Goyt and Whitendale with peak colour at 400 hazen.



# Key Results: Grip Blocking



On [Goyt](#) (above Derbyshire Bridge) there is clearly visible evidence of the benefits of blocking grips.



# Key Results: Grip Blocking

Many of the trends on well-vegetated blanket bog are difficult to detect through fixed point photography, but are still discernable – [Brennand](#) (Bield Field).



# Key Results: Grip Blocking



May 2007



Feb 2009



Oct 2012



June 2013

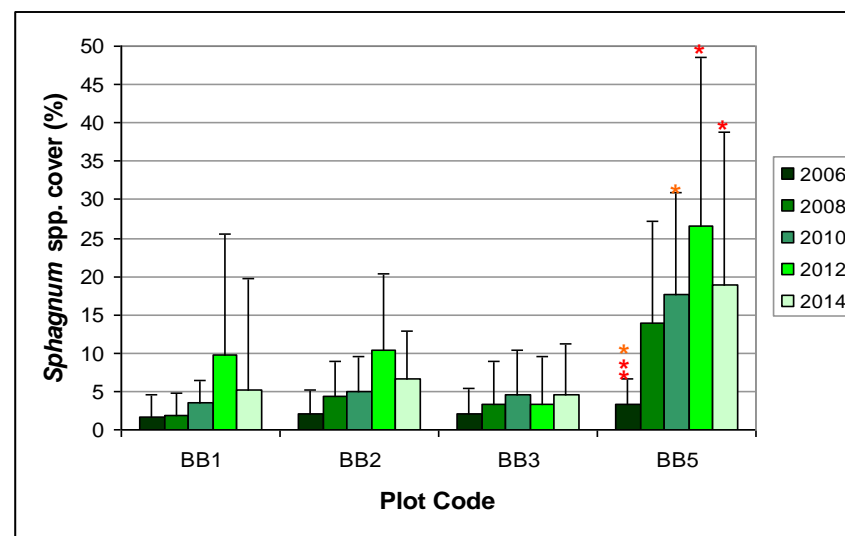
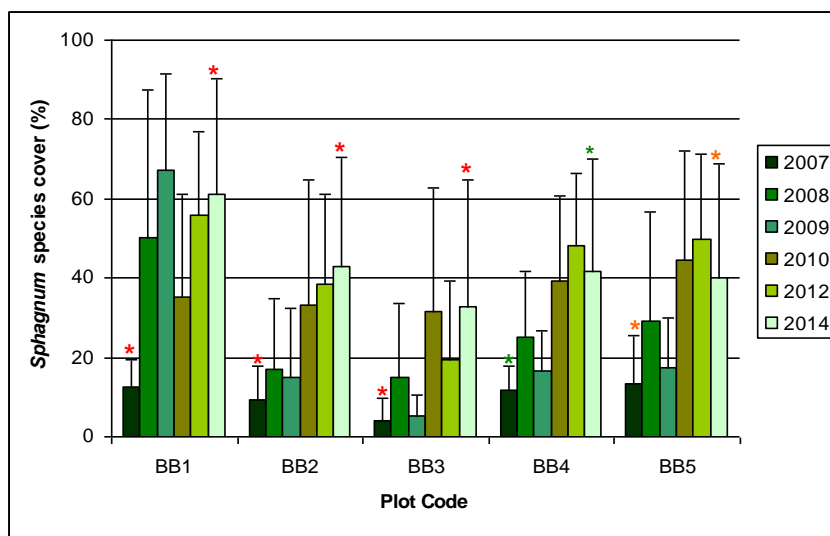


June 2014

On [Brennand](#) (Brown Syke) there is also visible evidence of the benefits of blocking grips, even on large drains/grips.

# Key Results: Grip Blocking

Significant increases in *Sphagnum* cover: **Brennand** (L) & **Goyt** (R)



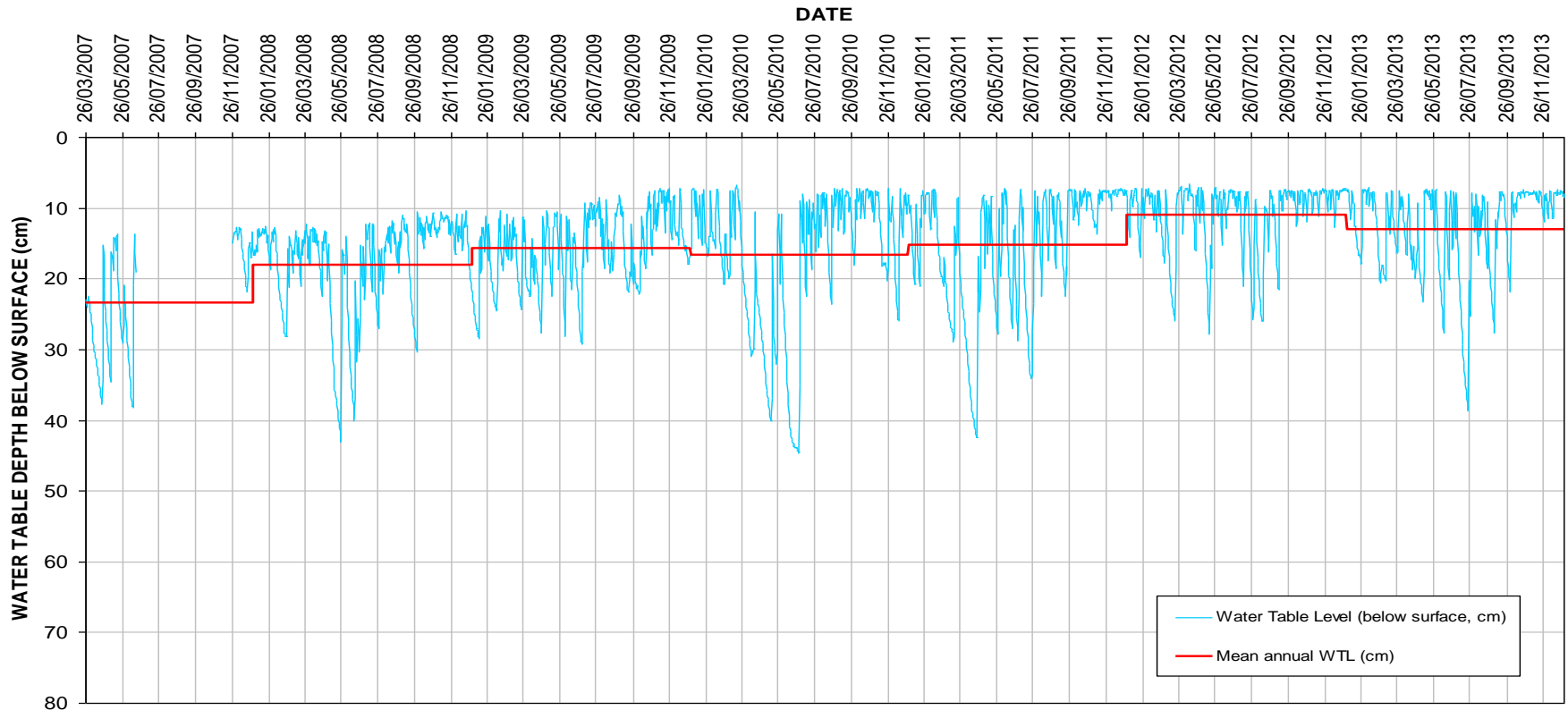
- BB1 = no grips
- BB2 – BB5 = grips blocked 2010, peat
- 2007 = baseline
- 2008 = grazing changed, grips not blocked
- 2009 – 2012 = post blocking

- BB1 & BB2 = grips blocked 2006, peat
- BB3 = grips blocked 2010, peat
- BB5 = grips blocked 2006, peat & plastic



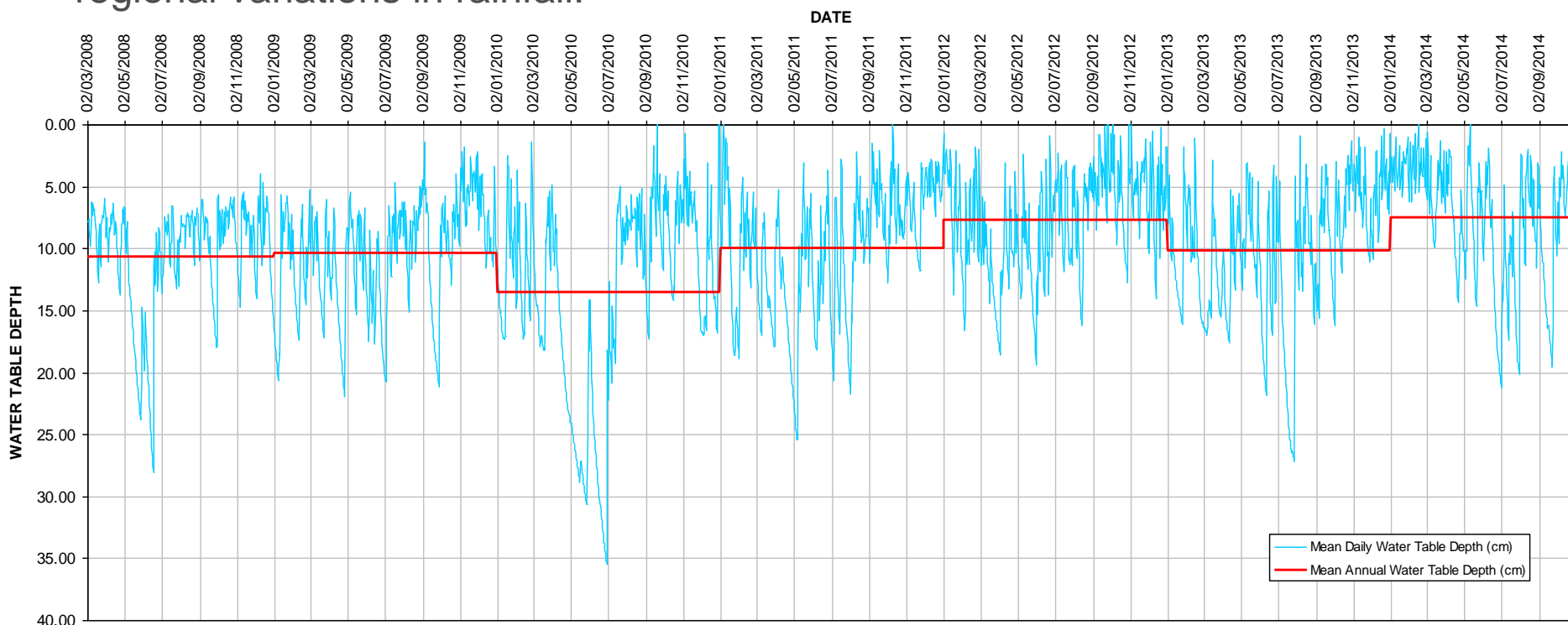
# Key Results: Grip Blocking

Consistent trend towards higher and more stable **peat water levels** over time at **Goyt** (Dipwell 1 Raven's Clough) mean annual trend line (2006-2014).



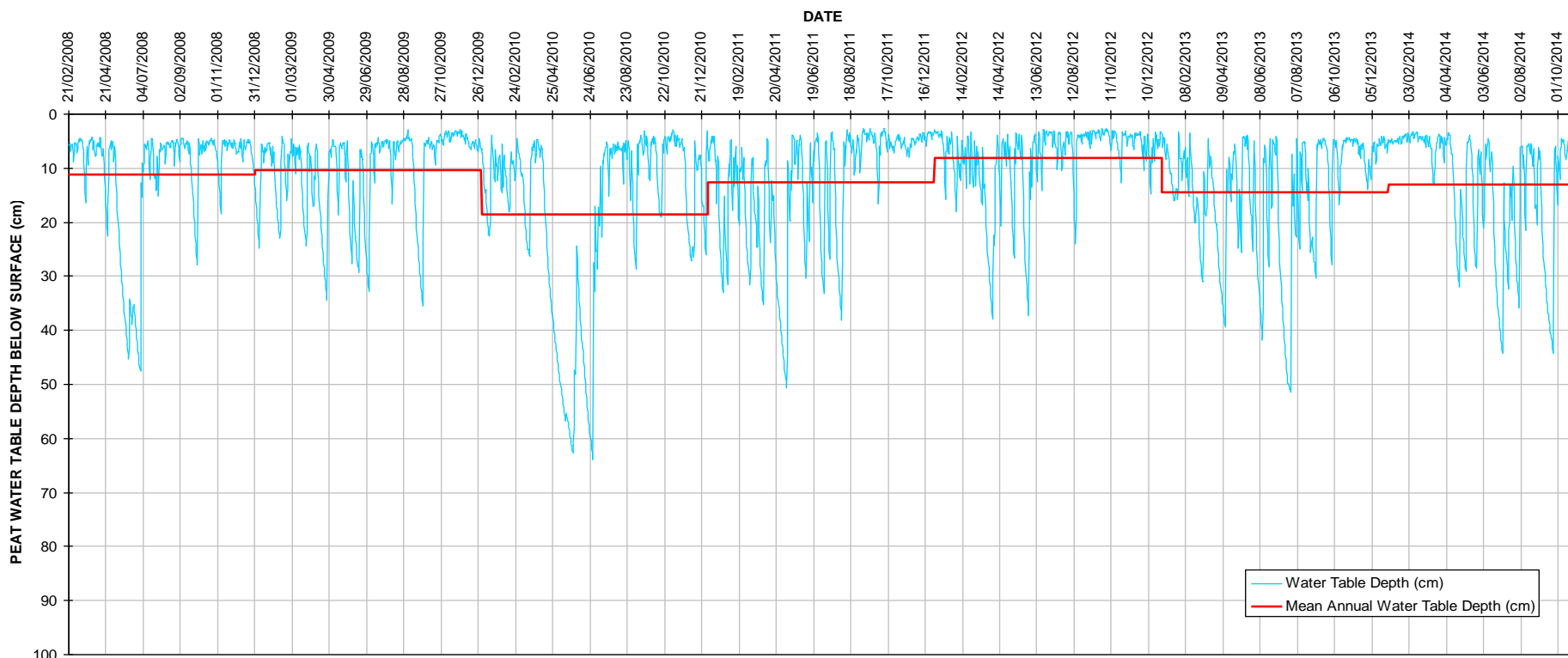
# Key Results: Grip Blocking

Peat water levels show similar results at [Whitendale](#), with general trend towards increasing annual mean, although some variation over time due to regional variations in rainfall.



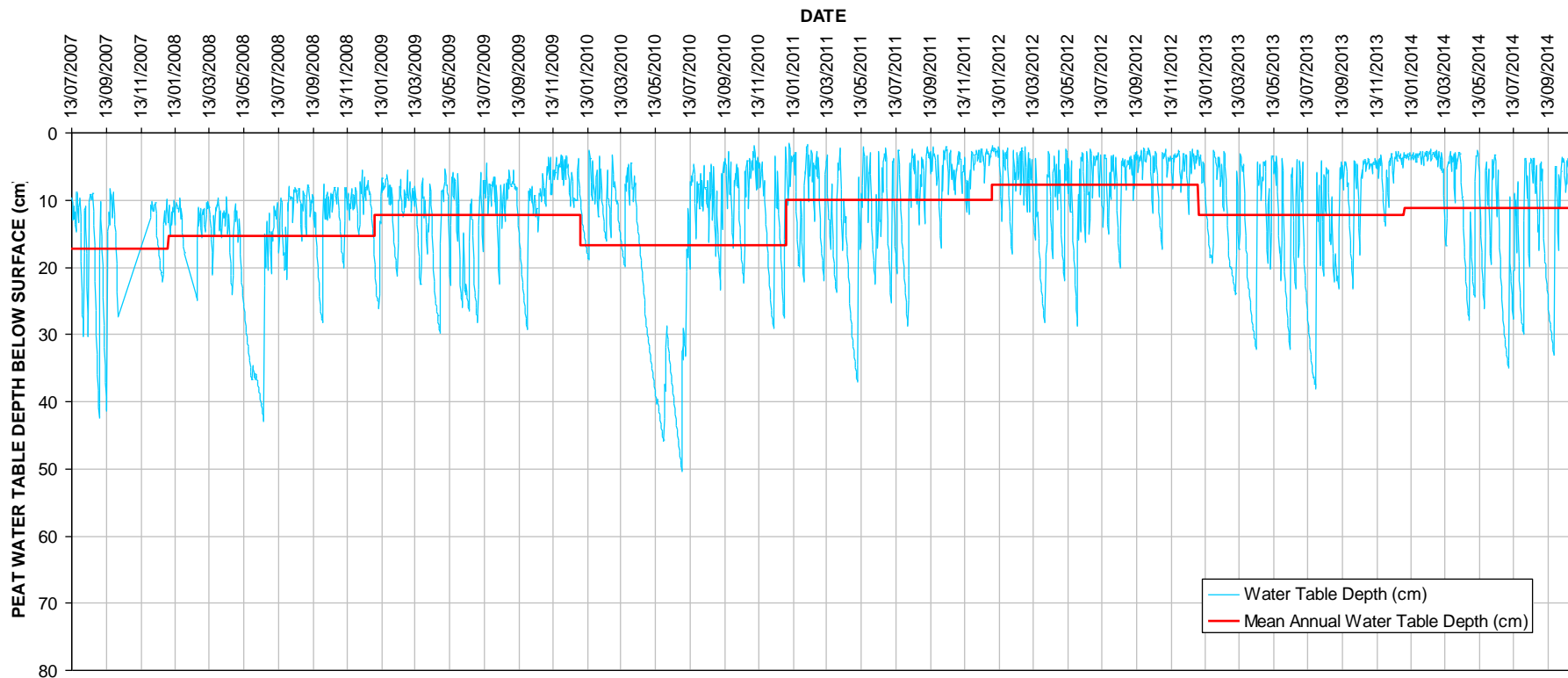
# Key Results: Grip Blocking

Peat water levels show similar results at **Brennand** (Dipwell 3 – Bield Field) as seen at Whitendale with general trend towards increasing annual mean, but some variation over time possibly related to local rainfall patterns.



# Key Results: Grip Blocking

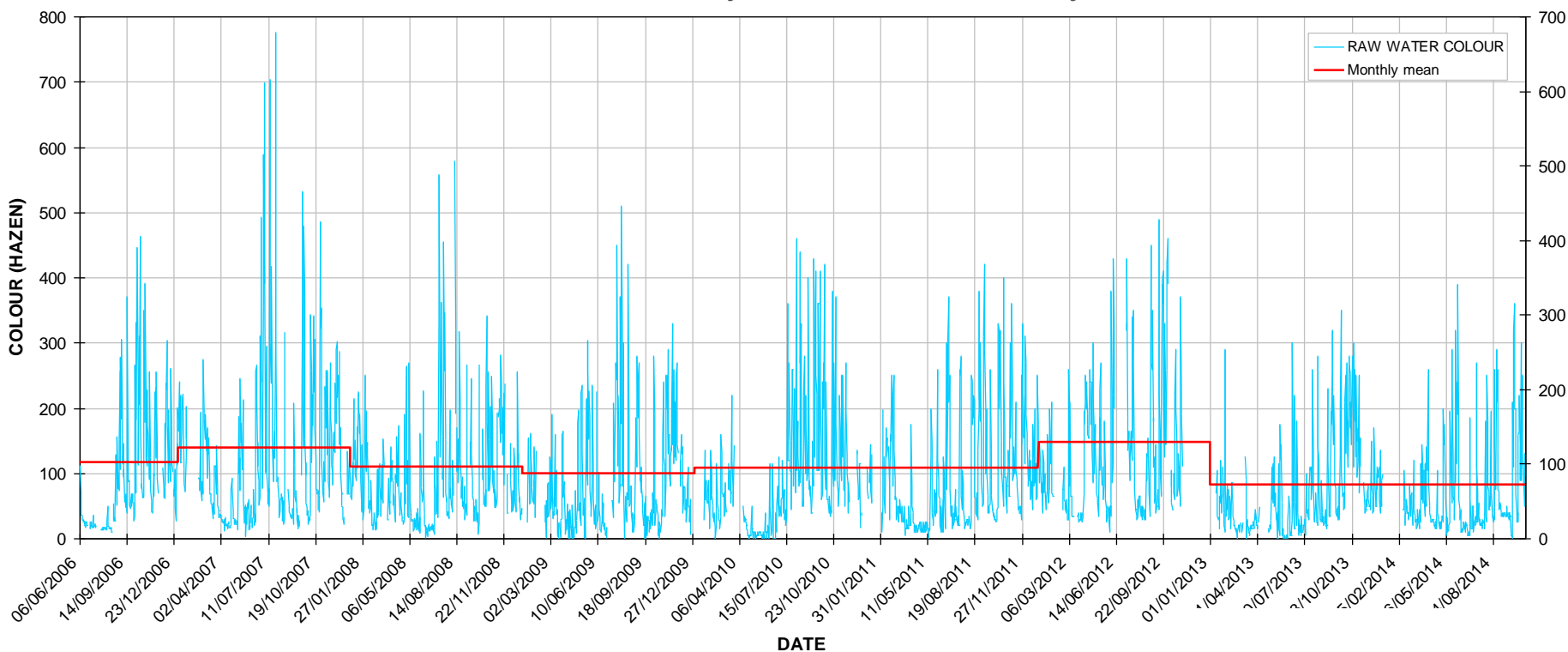
Peat water levels show similar results at **Brennand** (Dipwell 2 Brown Sykes), with general trend towards increasing annual mean.





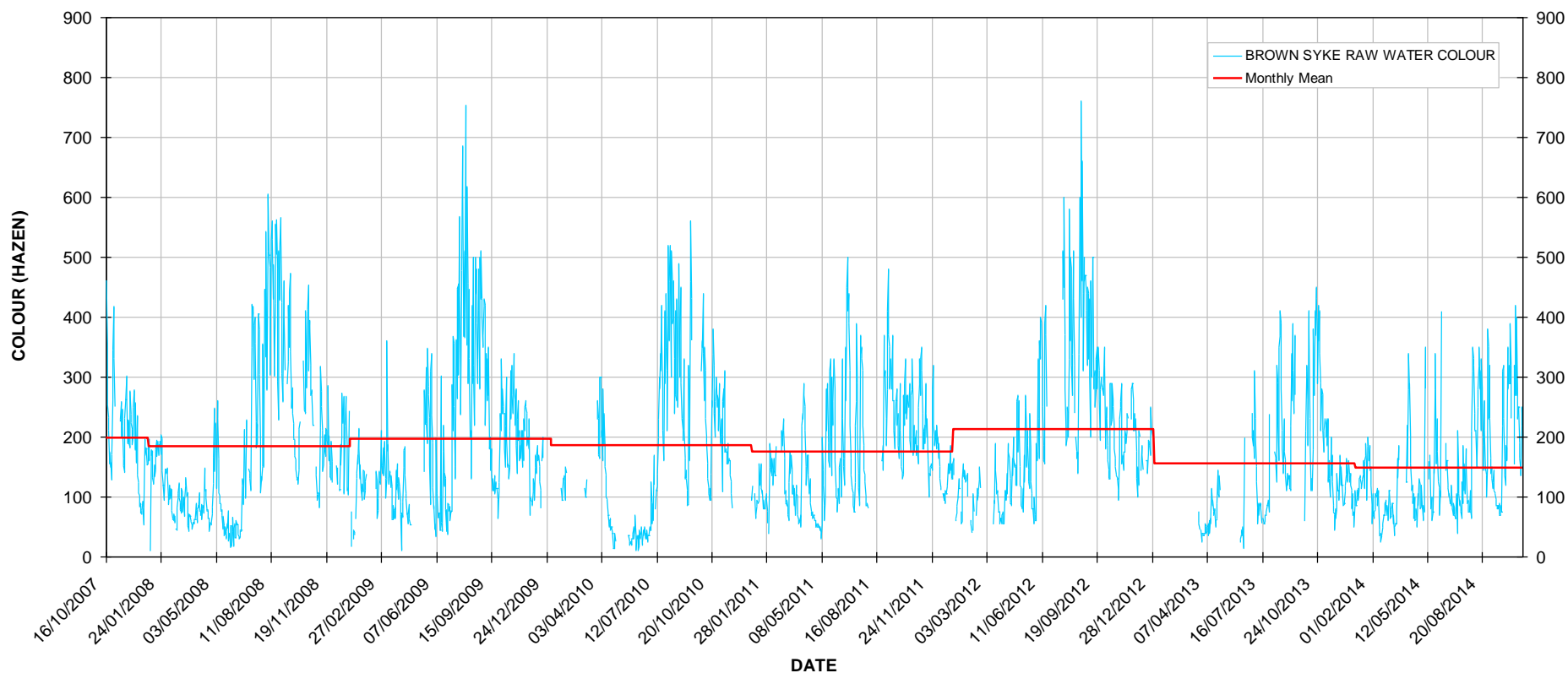
# Key Results: Grip Blocking

Small but significant reductions in raw water **colour** over time – Goyt (below) & Brennand show similar trends, notably reduced variability



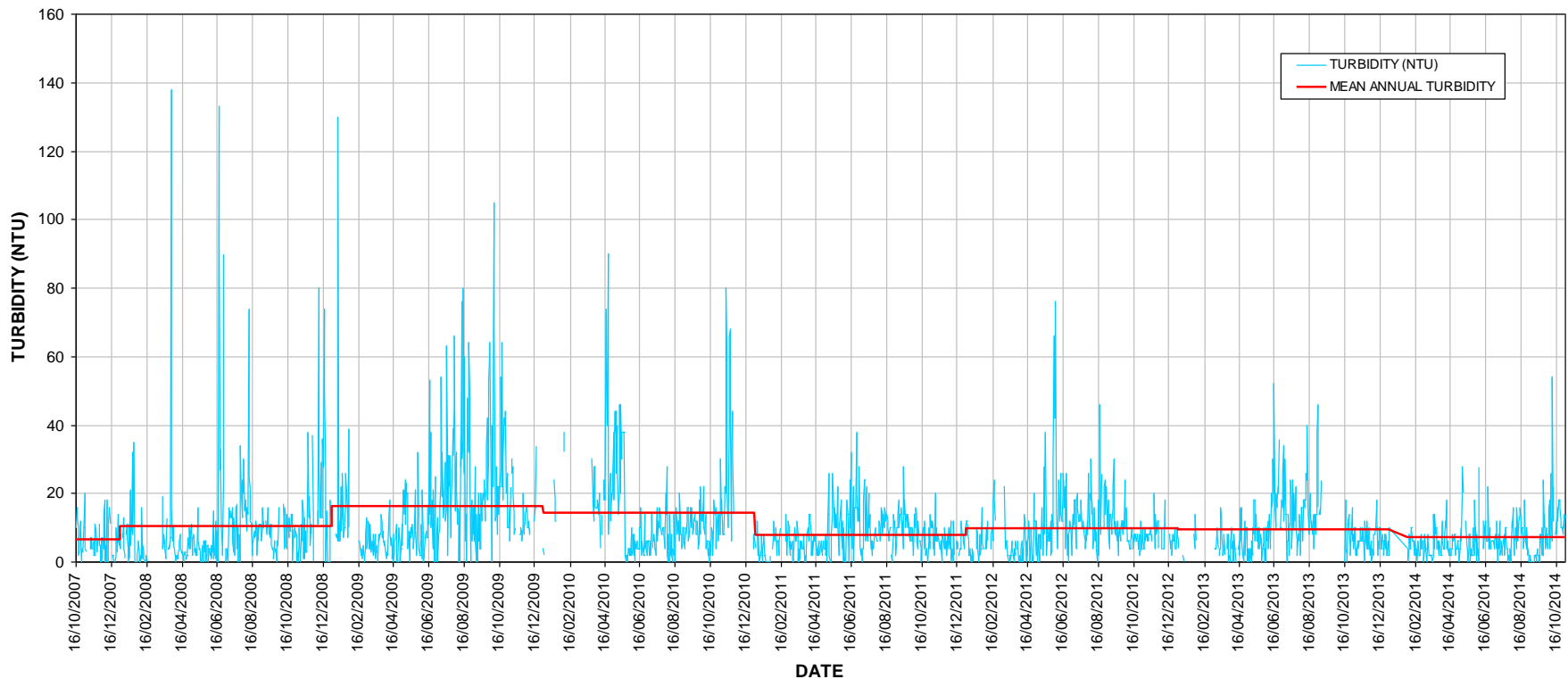
# Key Results: Grip Blocking

Similar reduction in **raw water colour** values and variability over time at **Brennard** (Brown Syke), note higher values compared to Goyt

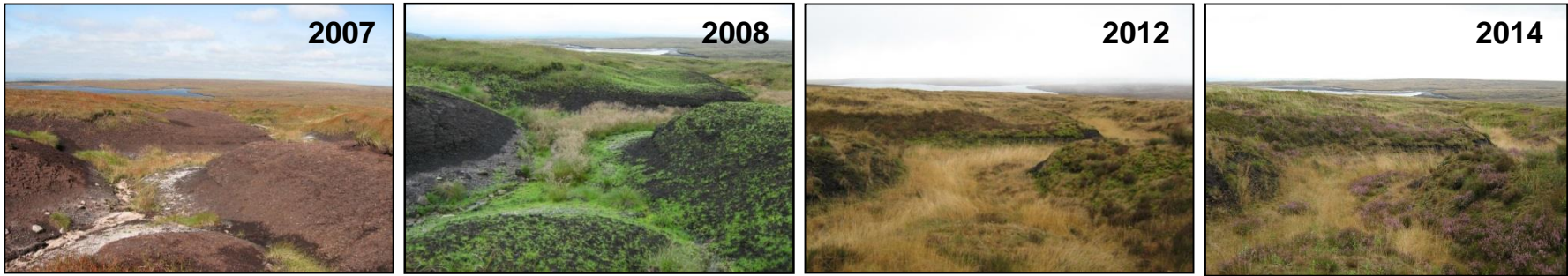


# Key Results: Grip Blocking

More or less stable raw water **turbidity Brennand** (Brown Syke) reduced to a practical minimum, with variation reducing over time. Similar across all sites.



# Key Results: Bare Peat Restoration



- Ashway Gap BB1 = mounds of bare peat with lime, 'nurse' grass seed and fertiliser (LSF)

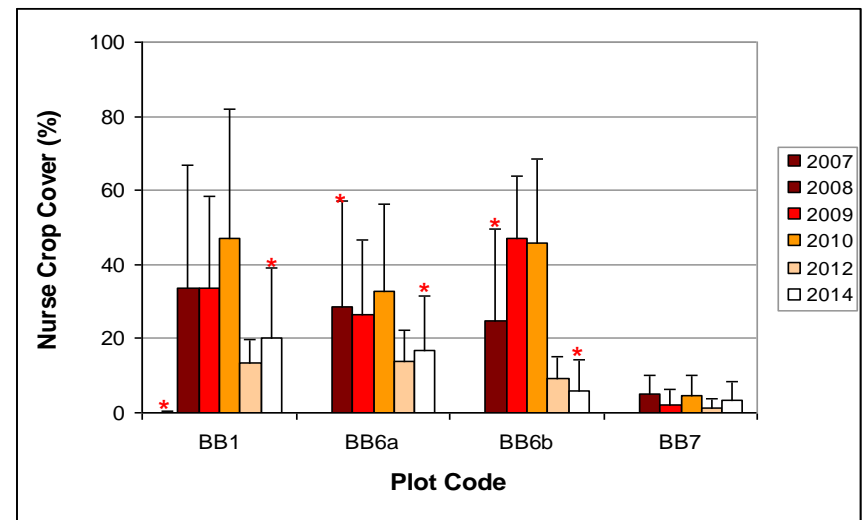
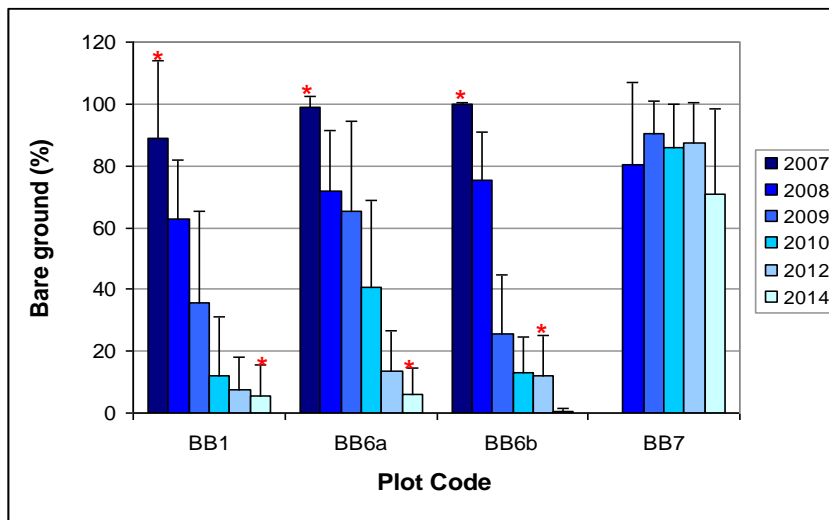


- Quiet Shepherd BB6 = bare peat slopes with LSF, brash (a – geojute; b + geojute)



# Key Results: Bare Peat Restoration

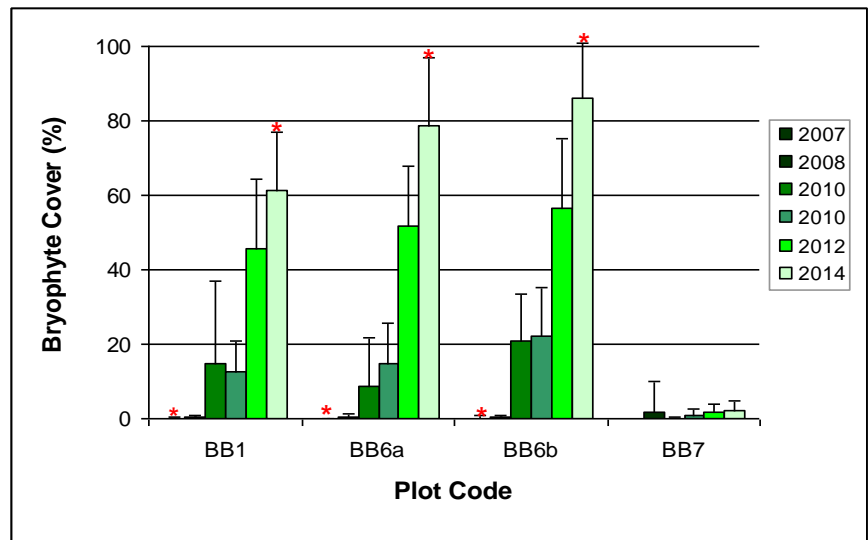
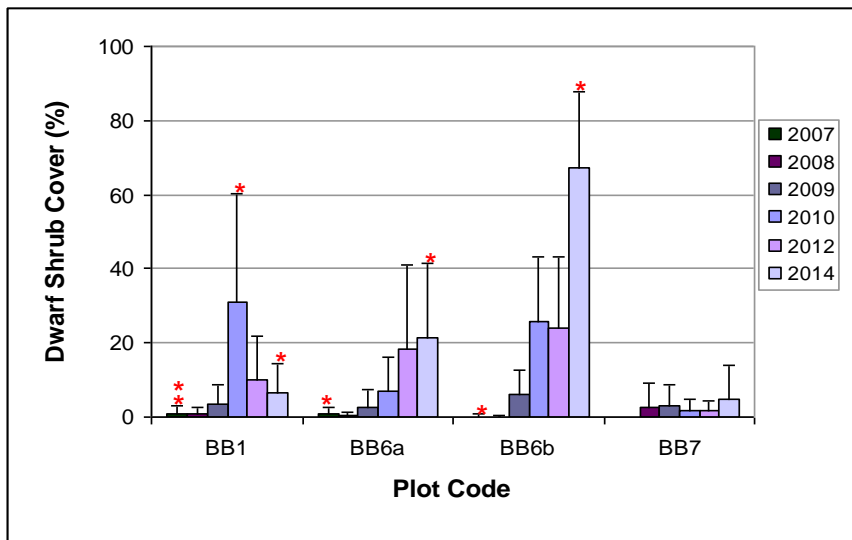
Significant decrease in bare ground across treated plots on North Longdendale (L). Nurse crop (largely Highland bent, *Agrostis castellana*) establishes quickly then reduces in cover (R).



- BB1 = mounds of bare peat with lime, 'nurse' grass seed and fertiliser (LSF)
- BB6 = bare peat slopes with LSF, brash (a – geojute; b + geojute)
- BB7 = untreated bare peat slopes

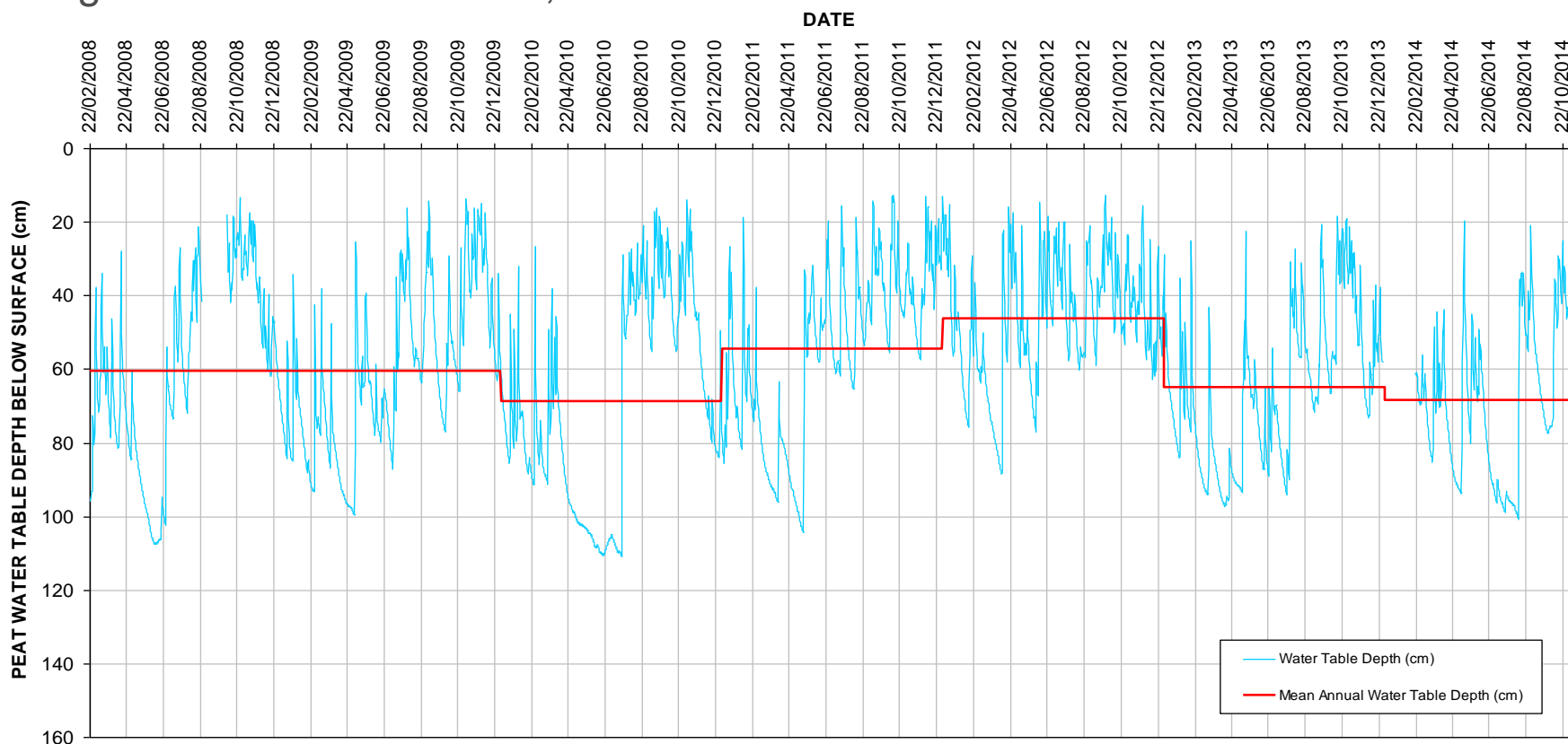
# Key Results: Bare Peat Restoration

Dwarf shrubs (largely heather, *Calluna vulgaris*) begin to establish.  
Along with mosses *Campylopus introflexus* and *Hypnum jutlandicum*.



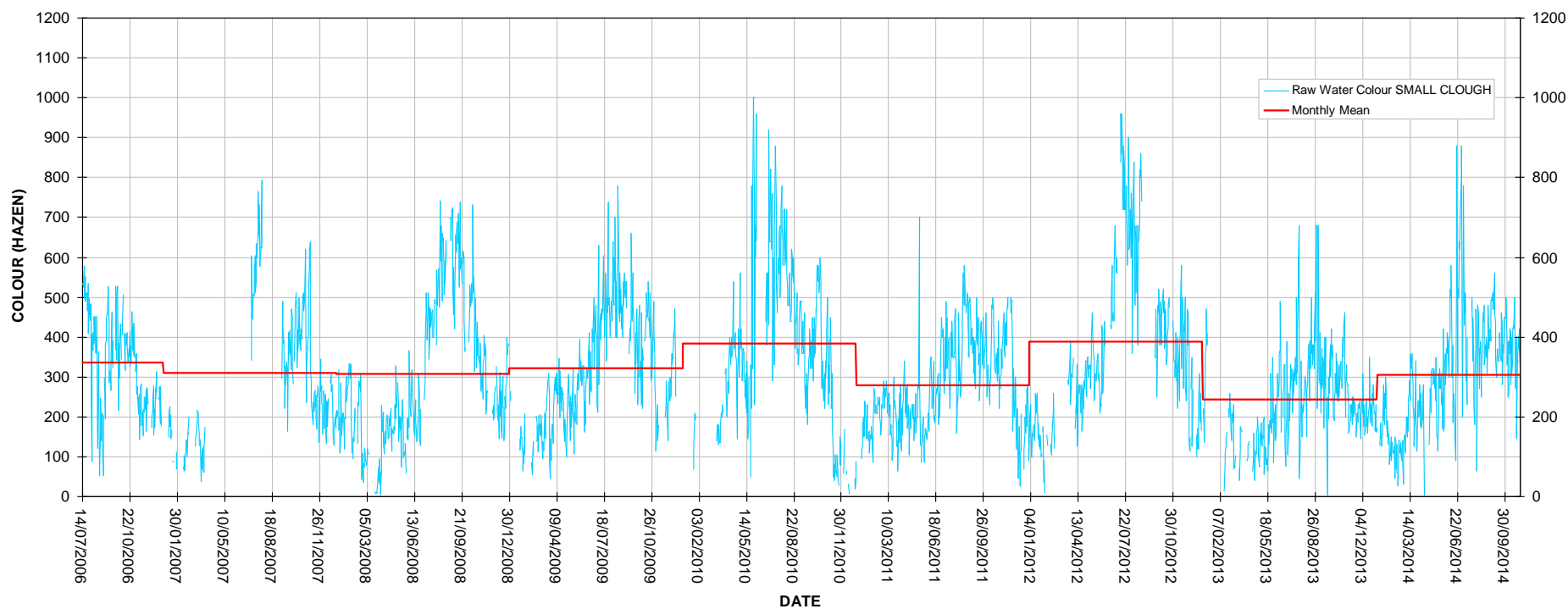
# Key Results: Bare Peat Restoration

The **peat water levels at Ashway Gap** remain compromised due to highly degraded nature of the site, and vulnerable to local weather conditions.



# Key Results: Bare Peat Restoration

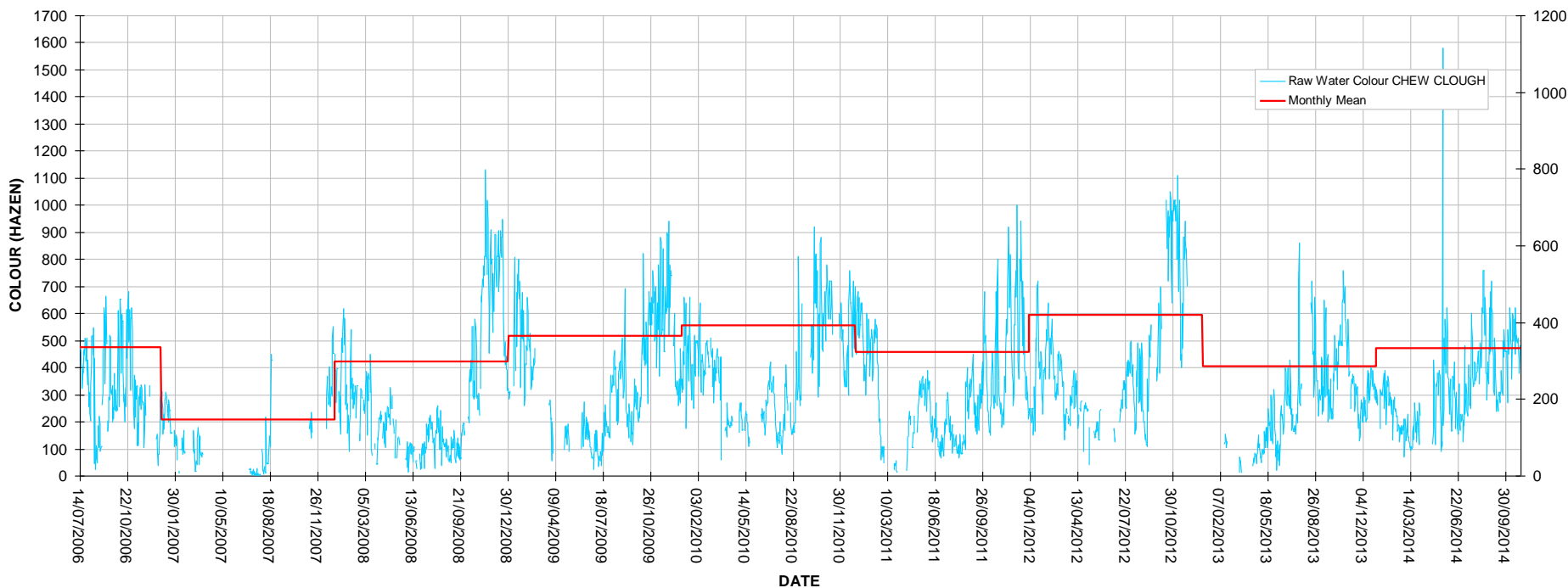
Trend towards stabilised **colour** over time at **Ashway Gap** (Small Clough), but still regularly occurring high peaks of colour generation





# Key Results: Bare Peat Restoration

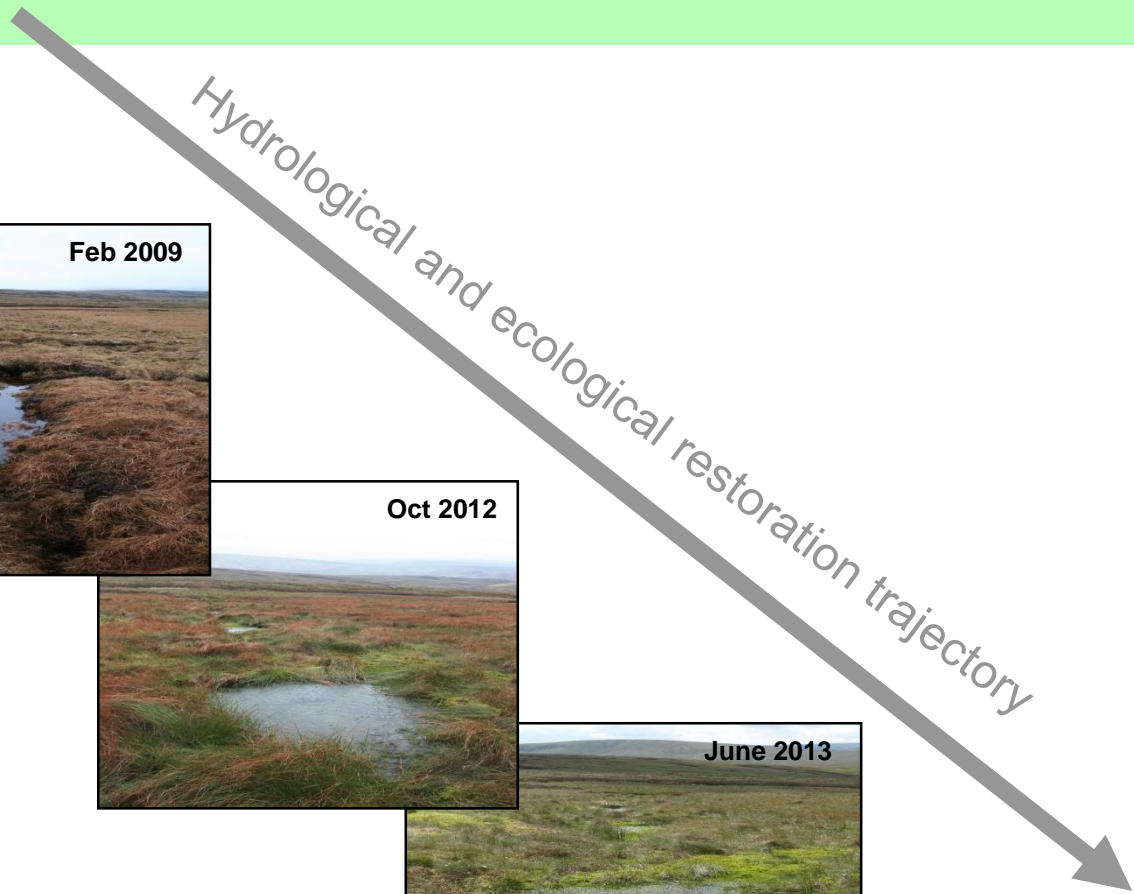
In contrast there is increasing **colour** over time at **Ashway Gap** (Chew Clough), but still regularly occurring high peaks of colour generation



# Summary

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- Significant reductions in bare peat and increases in vegetation cover.
- *Sphagnum* cover is increasing where present, responds quickly if greater cover remains.
- Removing/reducing grazing and burning alone results in positive change, in some areas.
  
- Stabilising bare peat important in re-vegetation of bare peat.
- Nurse crop treatment is effective.
- Additional heather brash and geojute encourages more rapid re-vegetation of slopes, geojute important on steeper slopes.
  
- Water quality is improving with reductions in colour (and turbidity), although still problematic on severely eroded catchments.
- Water table levels are generally increasing and stabilising, except where severe degradation has occurred.



### GRIP BLOCKING EFFECTS...

- Slowing the flow
- Re-wetting of peat body
- Restoration of hydrological function
- Vegetation changes and improvements
  
- Raw water colour – changes in rate of colour production and release, including reductions
- Turbidity reductions/stabilisations



## RE-VEGETATION EFFECTS...

- Slowing the flow
- Structural changes and improvements to peat body
- Some observed re-wetting over time
- Restoration of hydrological function...?

- Vegetation changes and some improvements
- Raw water colour – stabilisation in rate of colour production and release, also some increases...?
- Turbidity reductions/stabilisations



# *Restoration and Water Quality Trajectories – the value of being big*

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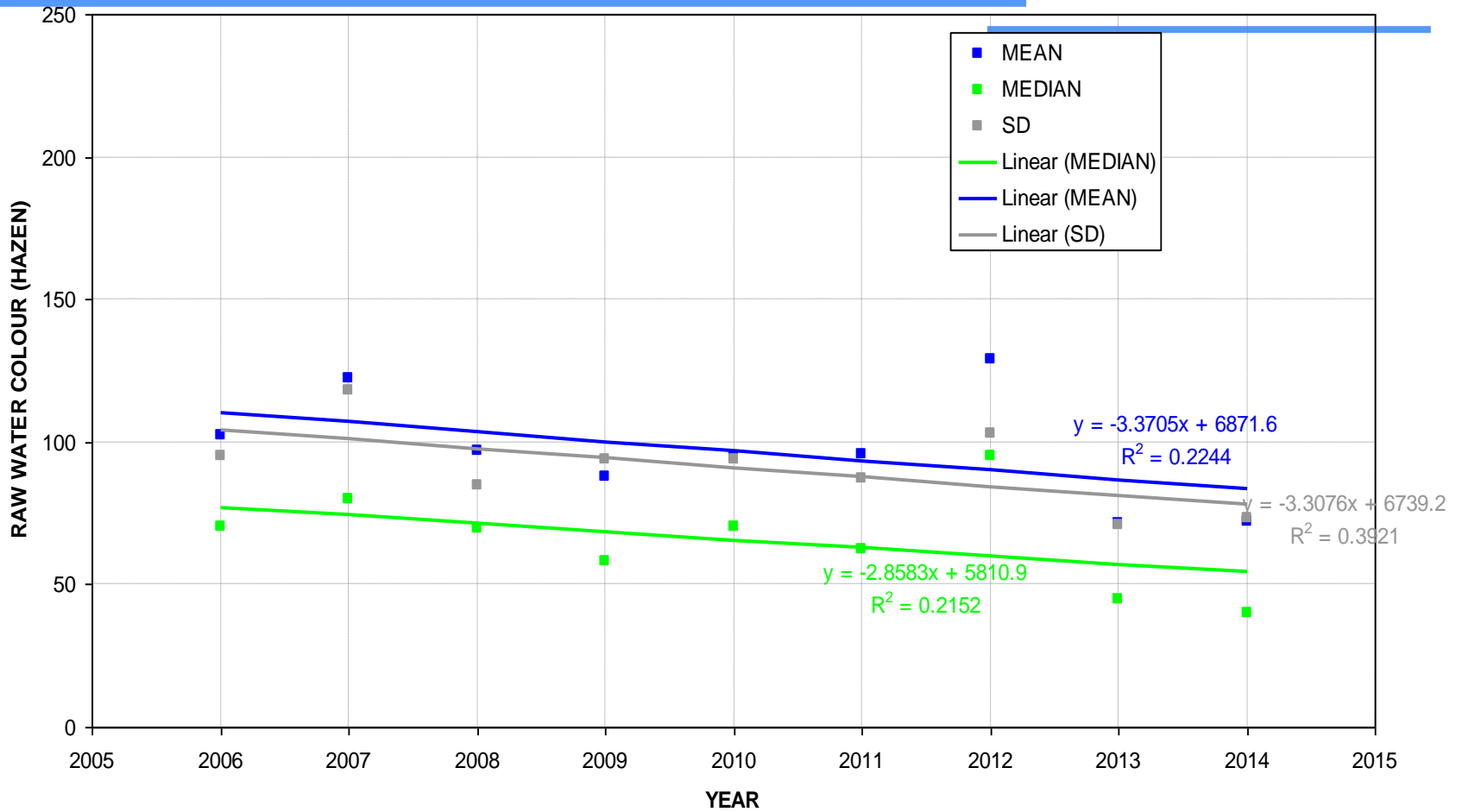
SCaMP trajectories can now be compared to UK control sites to assess the results obtained from SCaMP monitoring against those from un-restored and untreated control catchments.

Undertake a national comparison between upland blanket bog moorland managed for restoration and water quality, compared to similar areas outside SCaMP management.

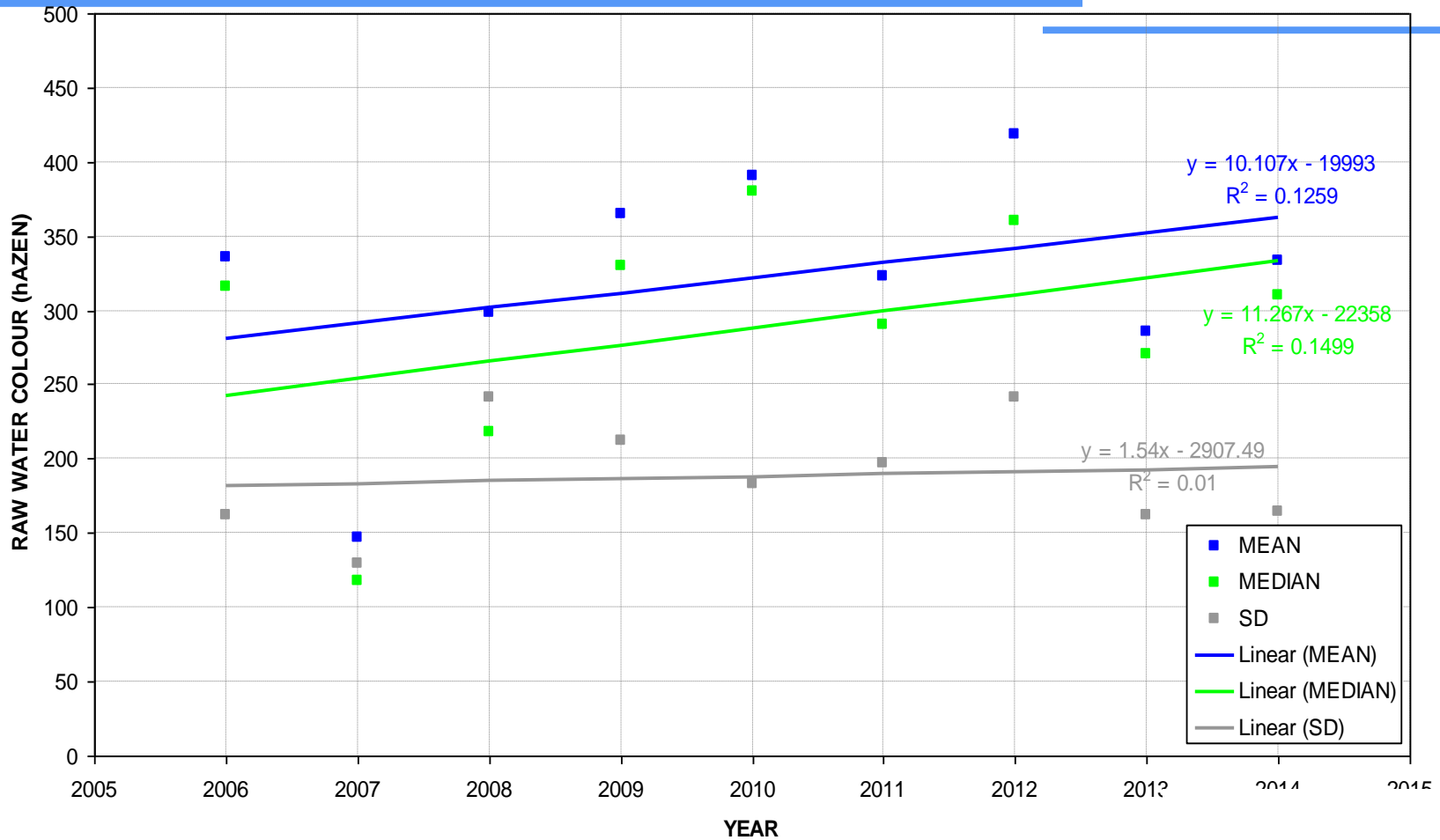
In the latest SCaMP report, trajectories of raw water colour have been compared to the colour trend at the UK Upland Waters Monitoring Network on the River Etherow in Derbyshire, in order to gauge the magnitude and direction of colour trends on the SCaMP catchments.

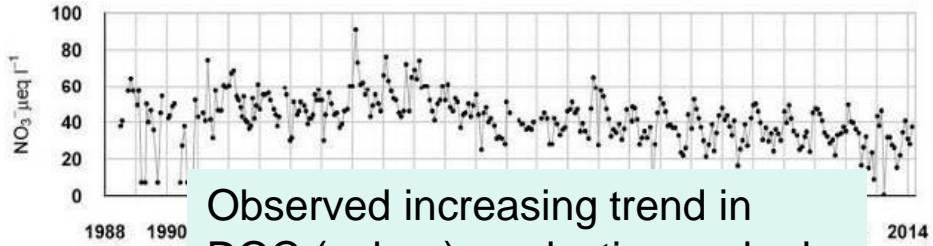
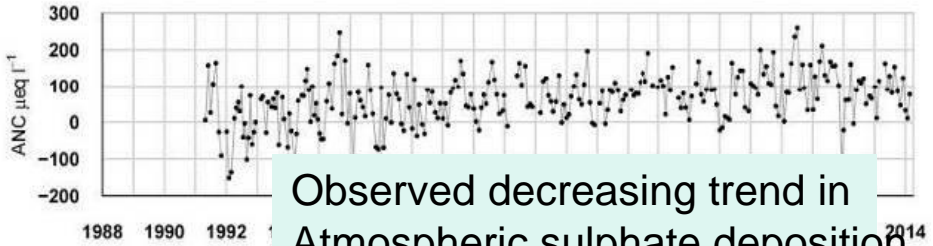
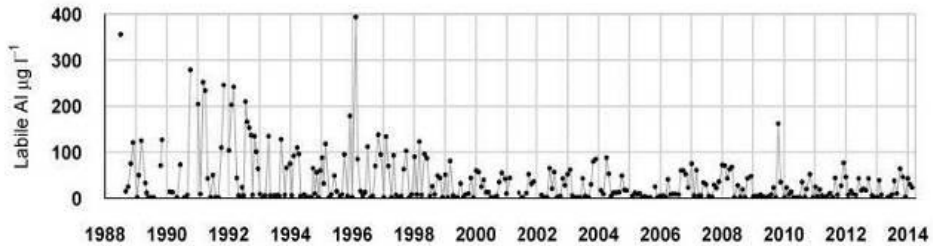
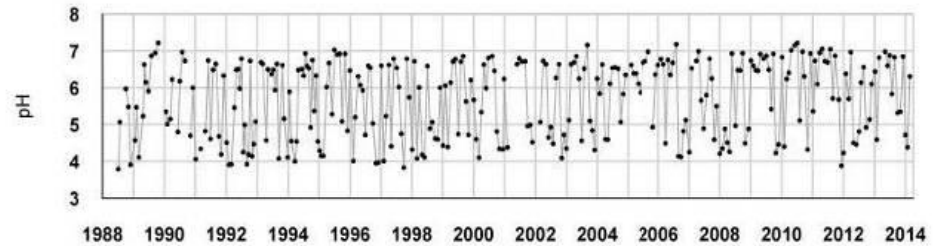
See graphs below...

**RAW STREAMWATER COLOUR TRAJECTORY FOR RIVER GOYT,  
BASED ON MEAN ANNUAL DATA (2006-2014)**



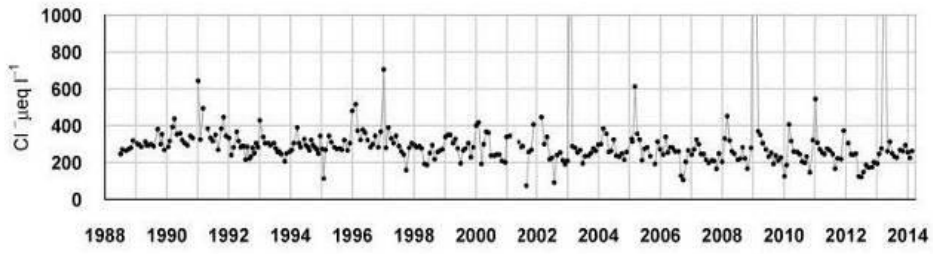
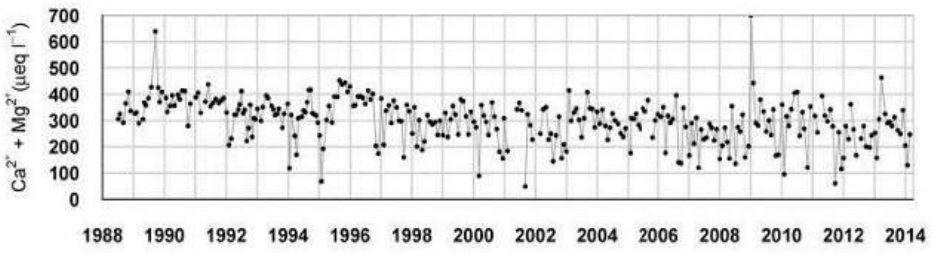
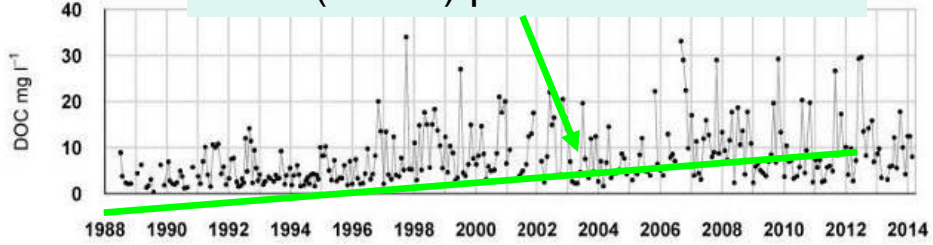
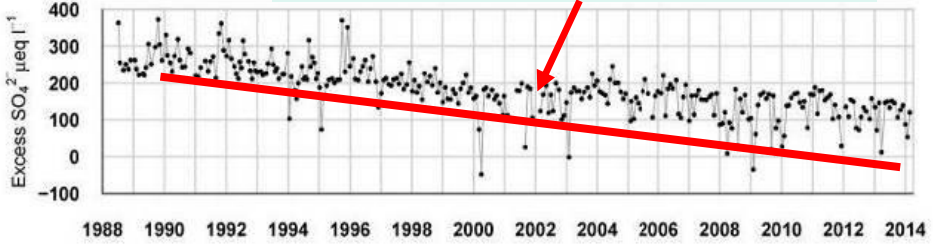
RAW STREAMWATER COLOUR TRAJECTORY, ASHWAY GAP CHEW CLOUGH,  
BASED ON MEAN ANNUAL DATA (2006-2014)





Observed decreasing trend in Atmospheric sulphate deposition

Observed increasing trend in DOC (colour) production and release



$\mu\text{eq l}^{-1}$ , $^*\mu\text{g l}^{-1}$ , $^{**}\text{mg l}^{-1}$	pH	ANC	Ca <sup>2+</sup>	Mg <sup>2+</sup>	Na <sup>+</sup>	K <sup>+</sup>	<sup>*</sup> Soluble Al	<sup>*</sup> Labile Al	Cl <sup>-</sup>	<sup>*</sup> SO <sub>4</sub> <sup>2-</sup>	xSO <sub>4</sub> <sup>2-</sup>	NO <sub>3</sub> <sup>-</sup>	<sup>**</sup> DOC
Mean 1 <sup>st</sup> 5 yrs	5.44	7.84	180.29	173.15	303.50	19.99	150.94	80.09	319.24	295.30	261.65	44.77	4.57
13-14 mean	6.00	89.59	149.95	132.85	360.62	19.85	89.91	24.64	379.45	144.78	114.34	27.19	8.84
13-14 std dev	0.94	48.40	43.61	37.07	362.37	5.70	57.44	21.10	419.46	46.42	43.46	10.82	4.50

Stream water chemistry trends for baseline UK UWMN site on the River Etherow at Woodhead, Derbyshire

## *Restoration and Water Quality Trajectories... in it for the long term...*

SITE	SLOPE	RATE (HAZ PA)	TREND	YEARS BEFORE 100% CHANGE
GOYT	-0.004	-1.460	DECREASING	68.49
WHITENDALE	-0.001	-0.365	DECREASING	273.97
B BROWN SYKE	0.000	0.000	STATIONARY	
B BIELD FIELD	0.007	2.550	STATIONARY	39.22
AG SMALL CLOUGH	0.000	0.000	STATIONARY	
ETHEROW CONTROL*	0.290	3.480	INCREASING	28.74
AG CHEW CLOUGH	0.057	20.805	INCREASING	4.81

Calculated Trajectories for Raw Water Colour/DOC across SCaMP Monitoring Catchments and the River Etherow Control Site:

Number of Years before 100% Improvement / Degradation in Colour Level



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Thank you for listening!

Penny Anderson  
Associates Ltd  
CONSULTANT ECOLOGISTS

