

Upper Borrowdale Valley

Section 19 Flood Investigation Report

Flood Event 30 September 2022

Cumberland Council as a Lead Local Flood Authority under Section 19 of the Flood and Water Management Act 2010 have produced this flood investigation report.

Version	Undertaken by	Reviewed by	Approved by	Date
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Executive Summary

It should be noted at the time of the incident Cumberland Council was the LLFA for the area, since then and during writing of this report, Local Government Reform (LGR) has been undertaken, meaning Cumberland Council has been replaced by the unitary authority of Cumberland Council.

Cumberland Council as Lead Local Flood Authority has prepared this report with the assistance of other Flood Risk Management Authorities as it considers necessary to do so under Section 19 of the Flood and Water Management Act 2010.

Local authorities: investigations

(1) On becoming aware of a flood in its area, a lead local flood authority must, to the extent that it considers it necessary or appropriate, investigate—

(a) which risk management authorities have relevant flood risk management functions, and

(b) whether each of those risk management authorities has exercised, or is proposing to exercise, those functions in response to the flood.

(2) Where an authority conducts an investigation under subsection (1) it must—

(a) publish the results of its investigation, and

(b) notify any relevant risk management authorities.

Cumberland Council's LLFA team has used information from a wide range of sources to compile this report. This includes details from individuals, other authorities, the Upper Borrowdale Valley community, and on-site observations. Whilst best endeavours have been made to be factual, to understand the full scope of the flooding that occurred and the mechanisms influencing it, some information is from secondary sources. If this has resulted in incorrect reporting, please inform the LLFA on tel. 01228 221330 or email **LFRM@cumberland.gov.uk** stating 'Upper Borrowdale Valley' in the title.

1. Scope and Aims of this Report

The purpose of this report is to report the facts of the event (as best as can be established), explore the reasons why this was a non-typical event, make recommendations for localised flood management measures to reduce the impact of the flooding, better protect properties and investigate the possibility of better flood warning services for those in the locality. It also looks at the National Trust Riverlands Project, a long-term project across Cumbria delivering catchment restoration, from peat bogs to river restoration, with the aim of creating a resilient and healthy landscape for people and nature. This includes projects which re-naturalise rivers and better connect them to the flood plains to provide natural flood management.

The factual account will include analysis and records of:

- Rainfall data.
- Flood outline and extent.
- Flow routes.
- Local accounts of the event and consequences (redacted)

The scope of the recommendations will focus on:

- Preventing flood water from entering property and instead directing it away from property.
- Removing barriers to flow, especially along the roadsides.
- Removing surface water flowing down roads into adjacent watercourses more effectively.
- Possibility of more timely and more accurate flood warnings for this area of the valley based on river level and rainfall gauges.
- Opportunities for river restoration

2. Flooding Incident Overview

The Borrowdale Valley catchment experienced a prolonged (6hr) rainfall event during the daytime of 30th September 2022. Whilst the duration of the event was not unusual or extreme, the rainfall intensity over the 6hrs was unusually high which led to flooding of the fields and roads in the valley.

The upper Borrowdale Valley is renowned for being 'the wettest place in England' with typical annual rainfall of around 3,500mm. Large parts of the valley, especially around and downstream of the village of Seathwaite are in Flood Zone 3 (EA flood mapping) and the valley does flood on a regular basis.

The difference with this event compared to 'usual' flooding is that the extent and duration of the flooding was not predicted in the forecasts.

No properties within the study zone flooded internally during the rainfall event but this was partly due to reactive measures taken by residents to divert river exceedance flows and deploy property flood protection measures.

However, fifty-eight sheep drowned from Seatoller Farm, having become trapped in a field with roads in the valley being flooded for several hours preventing access and egress. There were also reports of sheep being lost at Stonethwaite Farm.

The flood outline below is based on the 1:30yr Surface Water Flood Risk map from modelling.

Speaking with local residents who witnessed the flooding, the theoretical risk area, closely resembles the extent of the actual flood. The flood outline is, however, an approximation and a snapshot in time. Since every flood event is different and the depth, flow and extent vary throughout the event, it is not possible to show an exact or definitive outline.

More detailed plans are included which show the flood mechanisms, flow routes and records the observations of those who provided comments in the consultation event held at the Borrowdale Institute on 11th November 2022.

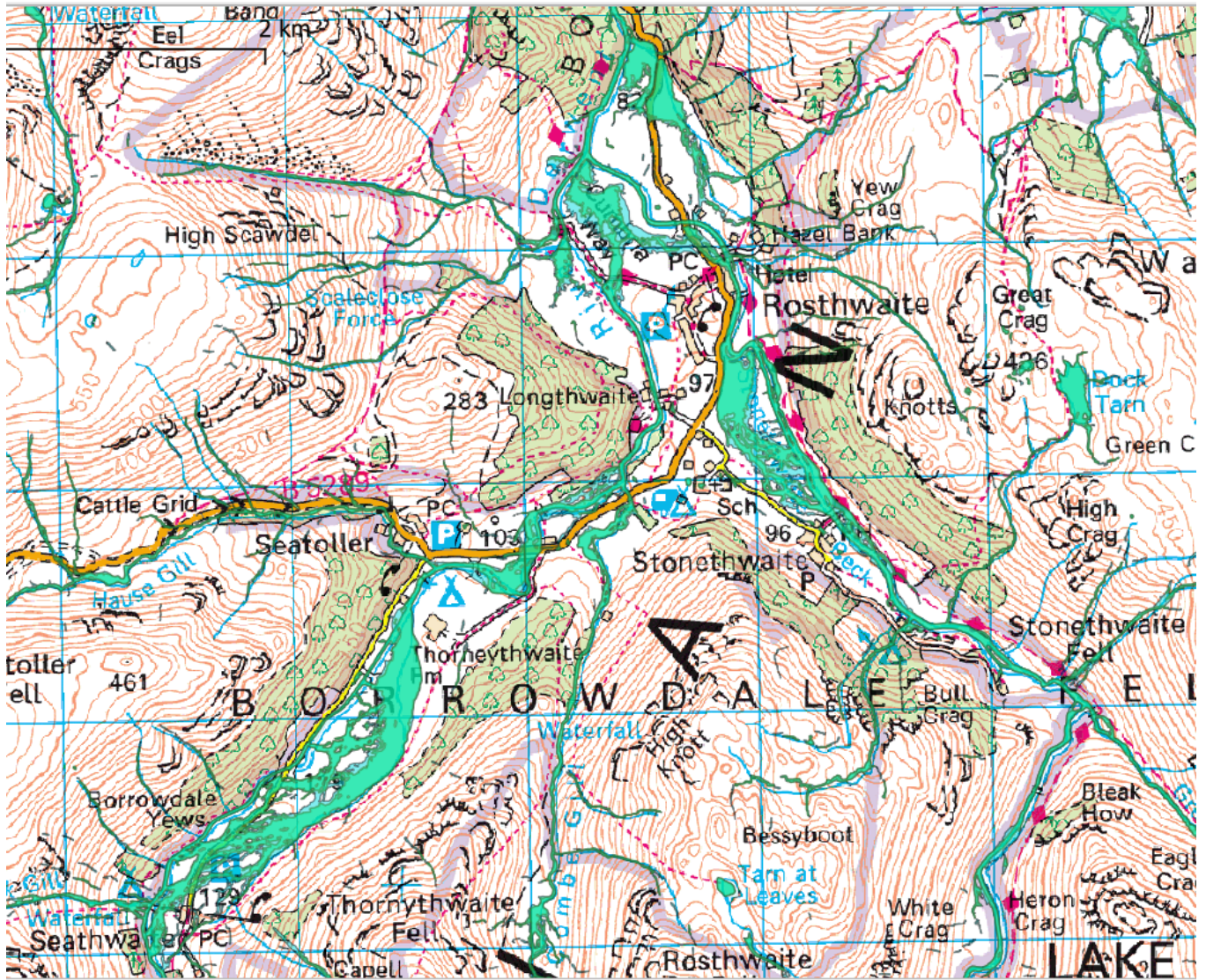


Figure 1: Location Plan & Approximate Flood Outline

3. Investigation

Rainfall Event (for full details see Appendix 4)

The Environment Agency has produced the table below which shows the rainfall amount at Seathwaite Farm (a significant catchment and one of the main contributors to the flood water in the valley) over the duration of the storm on 30th September 2022 alongside the equivalent data for Storm Desmond on the 4th & 5th Dec 2015.

As can be seen from the 6 hr cumulative totals, there was more rain over this period in Sept 2022 compared to Storm Desmond. Storm Desmond however, continued for two days solidly and resulted in a much higher average 24hr flow.

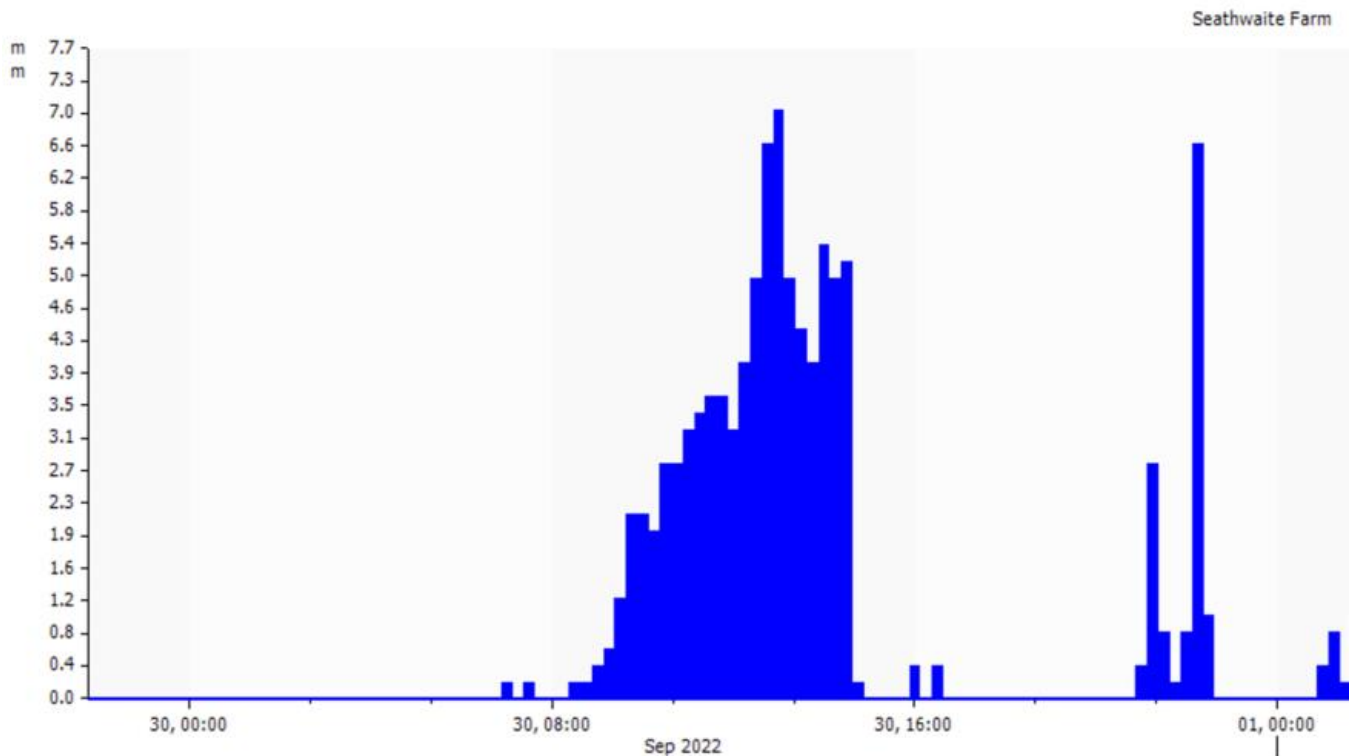


Table 1:
Rainfall Histogram (Seathwaite Farm) showing that the storm lasted from 9am – 3pm (6 hours)

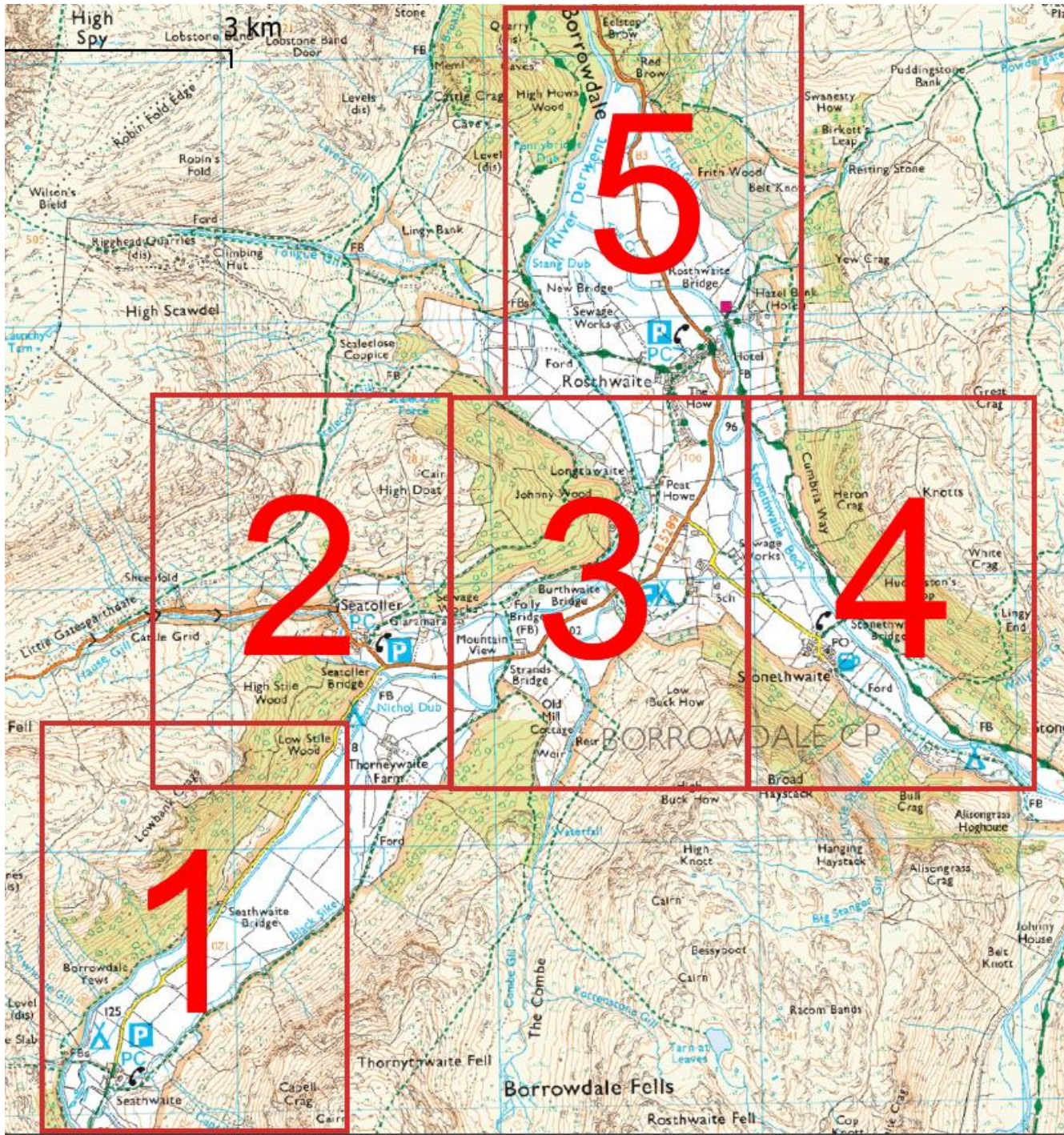
	Seathwaite Farm 30/09/2022	Seathwaite Farm 04/12/2015 – 05/12/2015	Seathwaite Farm 30/09/2022	Seathwaite Farm 04/12/2015 – 05/12/2015
Time Period (hrs)	Max Period Rainfall (mm)	Max Period Rainfall (mm)	Return Period (1 in n years)	Return Period (1 in n years)
1	23.6	17.0	3	2
2	42.6	31.2	4	2
3	58.4	43.0	6	2
4	71.4 ¹	53.2 ²	7 ³	2 ⁴
5	80.6	64.8	6	2
6	83.0	76.0	4	3
12	86.8	129.8	1	8
24	101.6	214.0	n/a	24

Table 2:
UK Centre for Ecology and Hydrology Flood Estimation Handbook Webservice – FEH22 - cumulative totals of rainfall and return period for each hour. Note, after 4 hours the total rainfall was 34% higher than Storm Desmond.

Notes:

1. 71.4mm total rainfall in the 4hr storm for event on 30 Sept 2022
2. 53.2mm total rainfall for equivalent 4hr max rainfall period in Storm Desmond
3. & 4. Return Period (i.e., risk of flooding) 1:7 yrs. event compared with 1:2 yr. event.

4. Detailed Maps Overview



5. Flood Maps showing observations

Key:



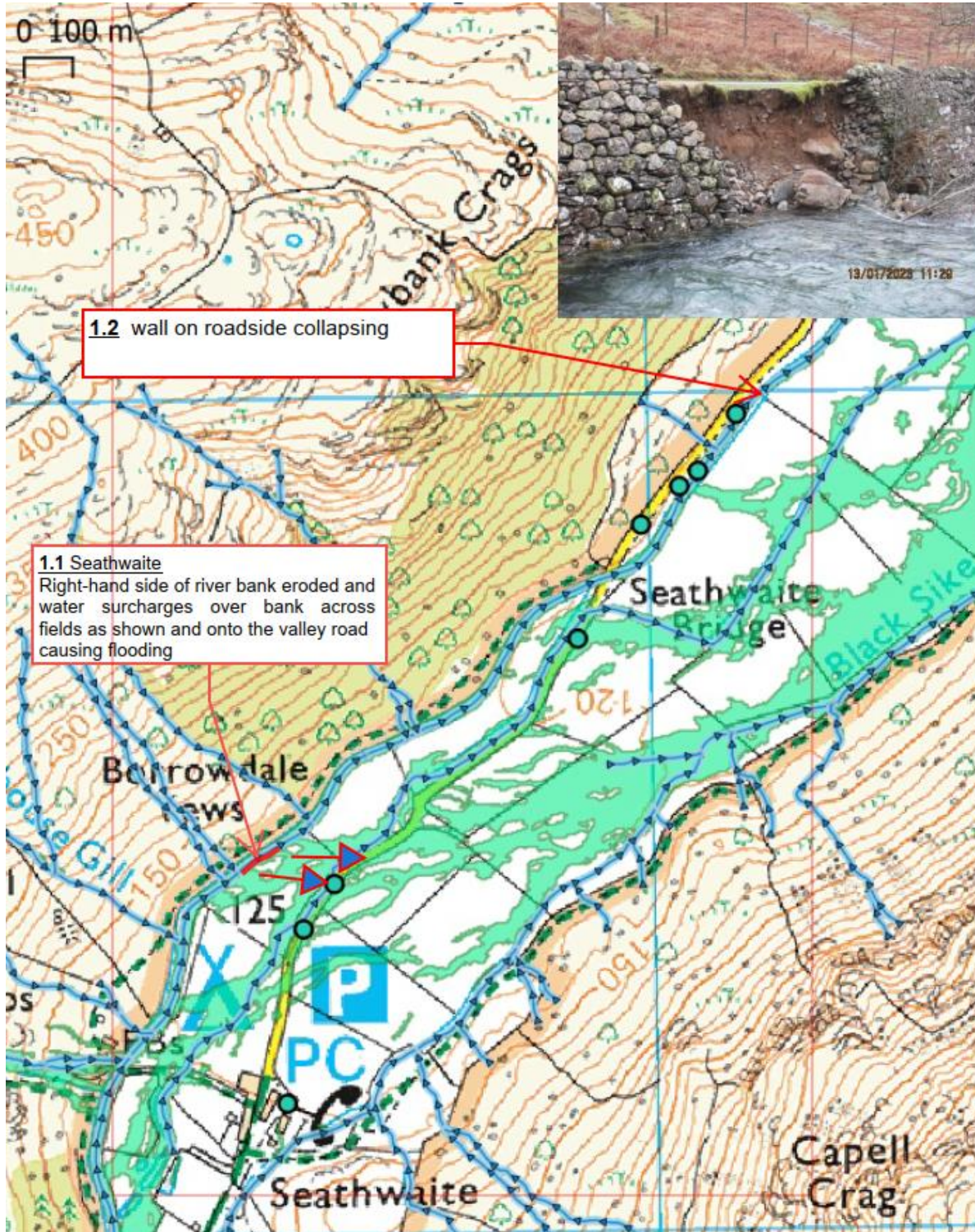
Gully



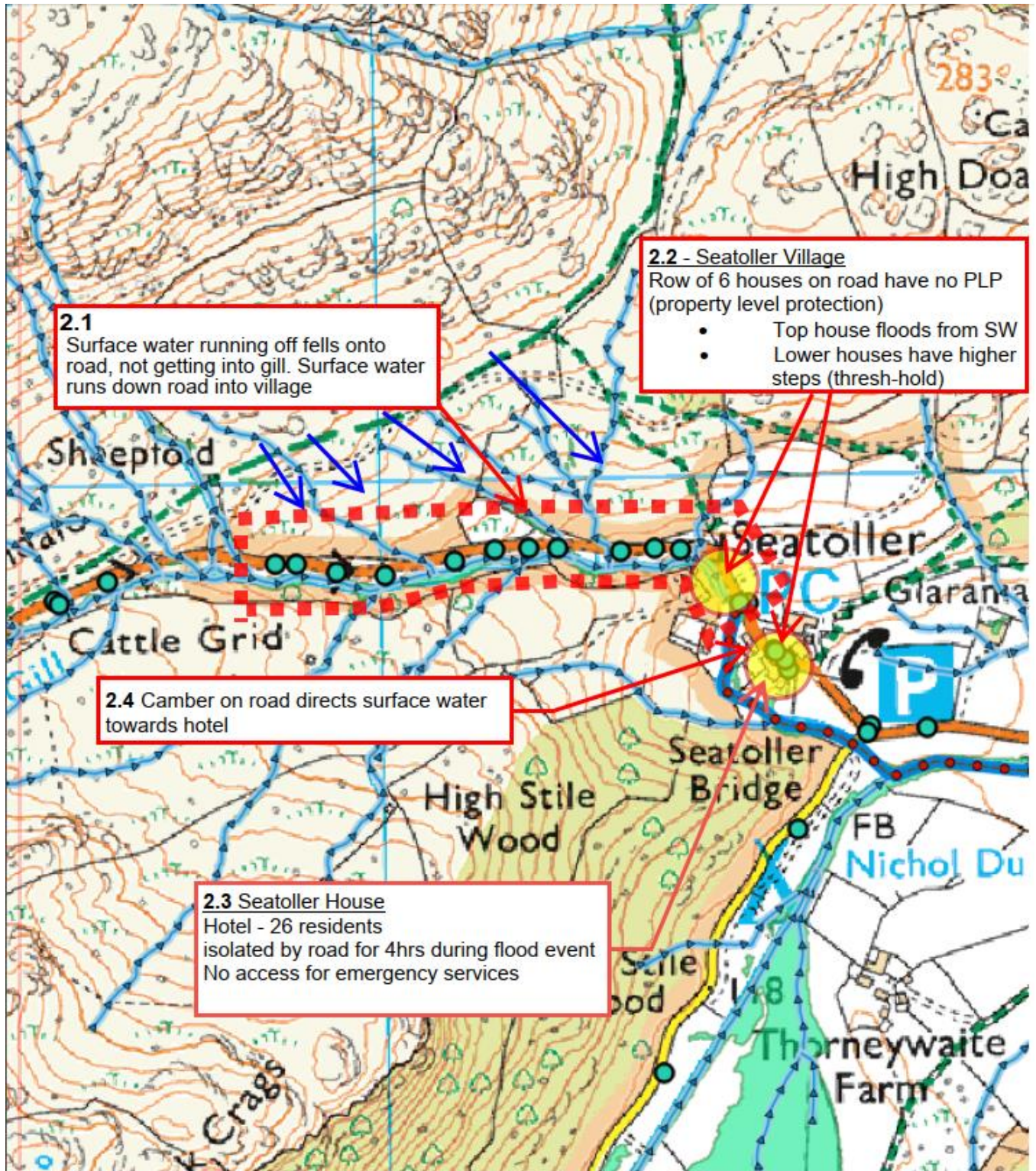
Ordinary Watercourse



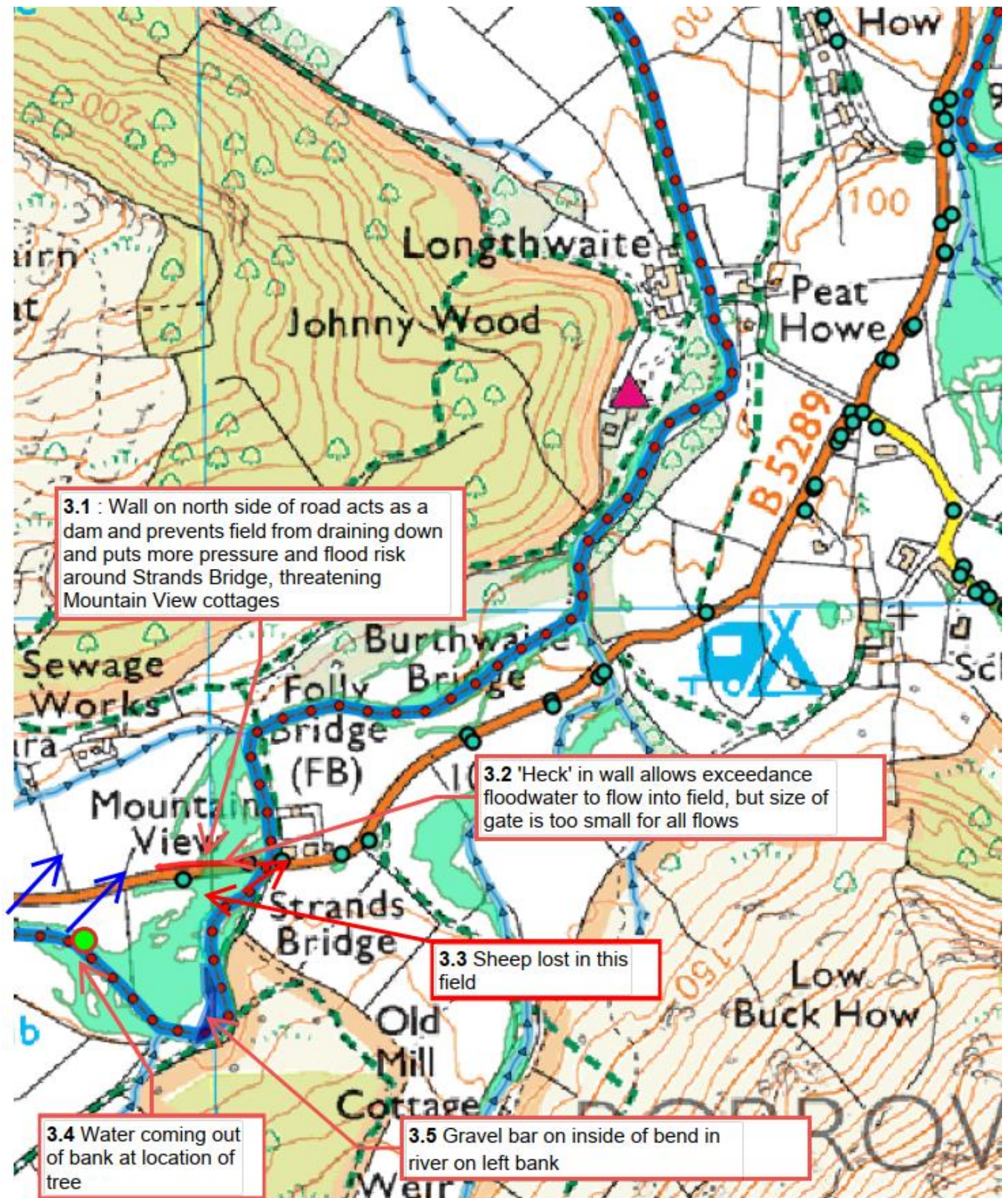
Main River



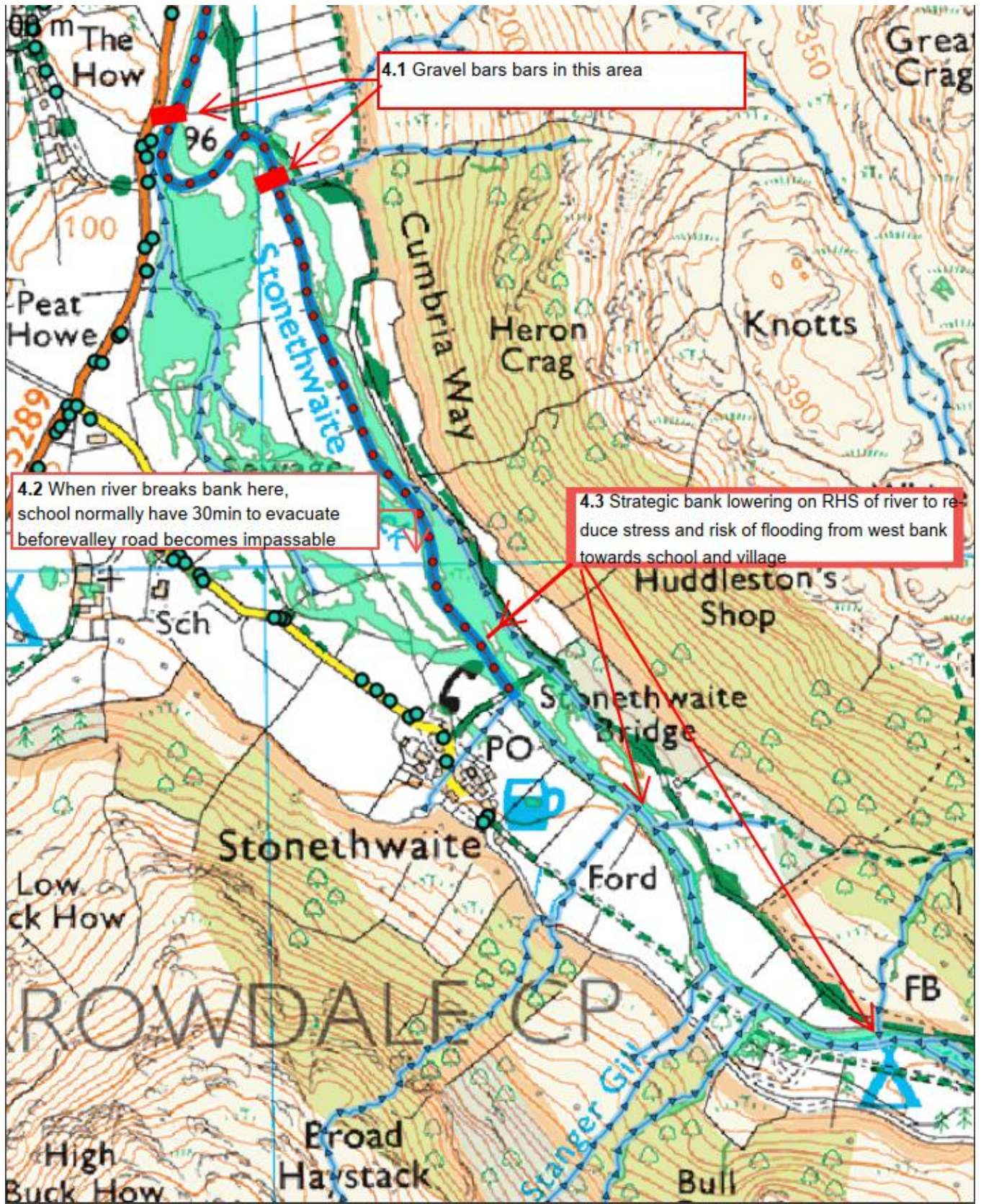
Flood Map Detail Area 1 - Seathwaite



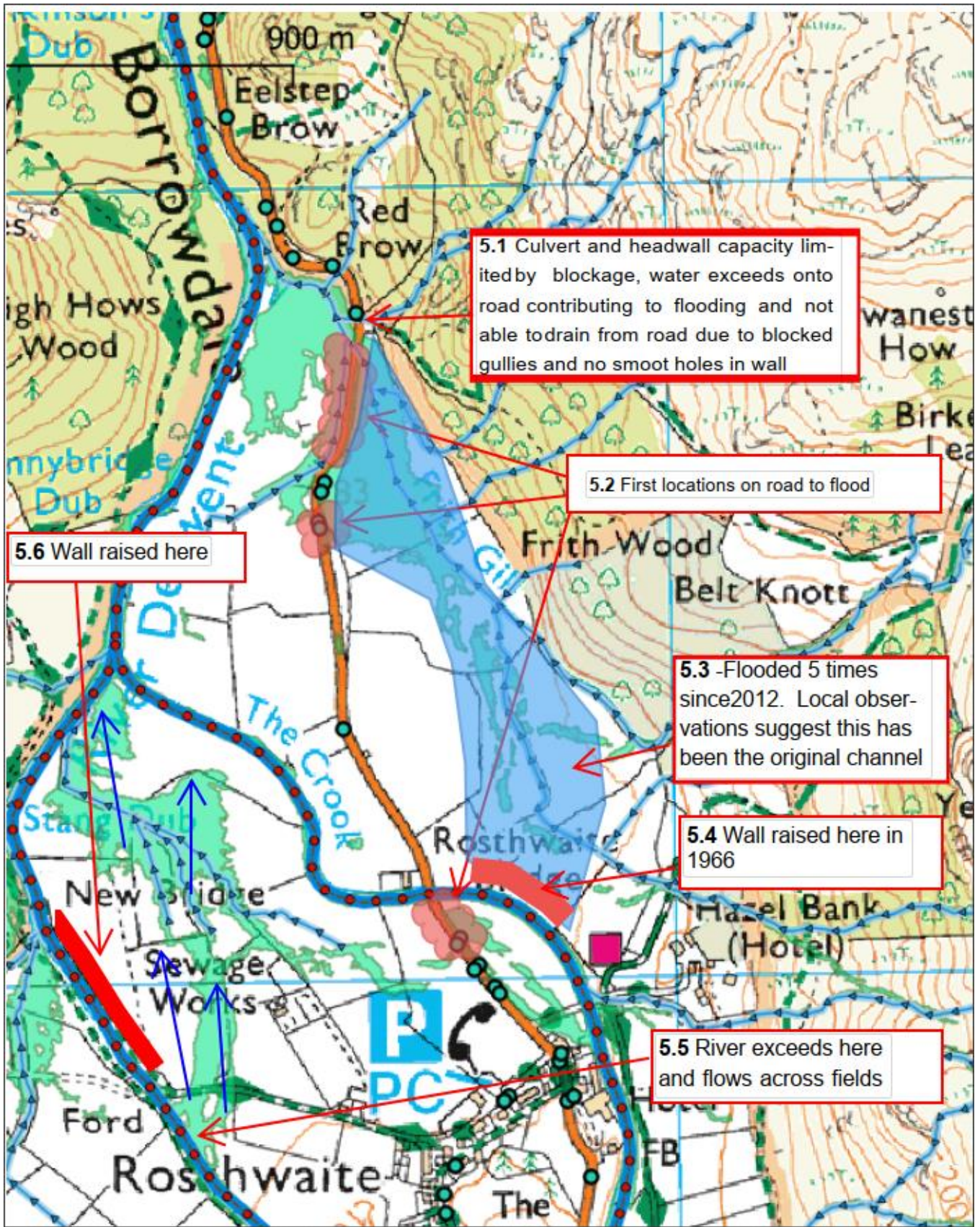
Flood Map Detail Area 2 - Seatoller



Flood Map Detail Area 3 – Strands Bridge and Mountain View

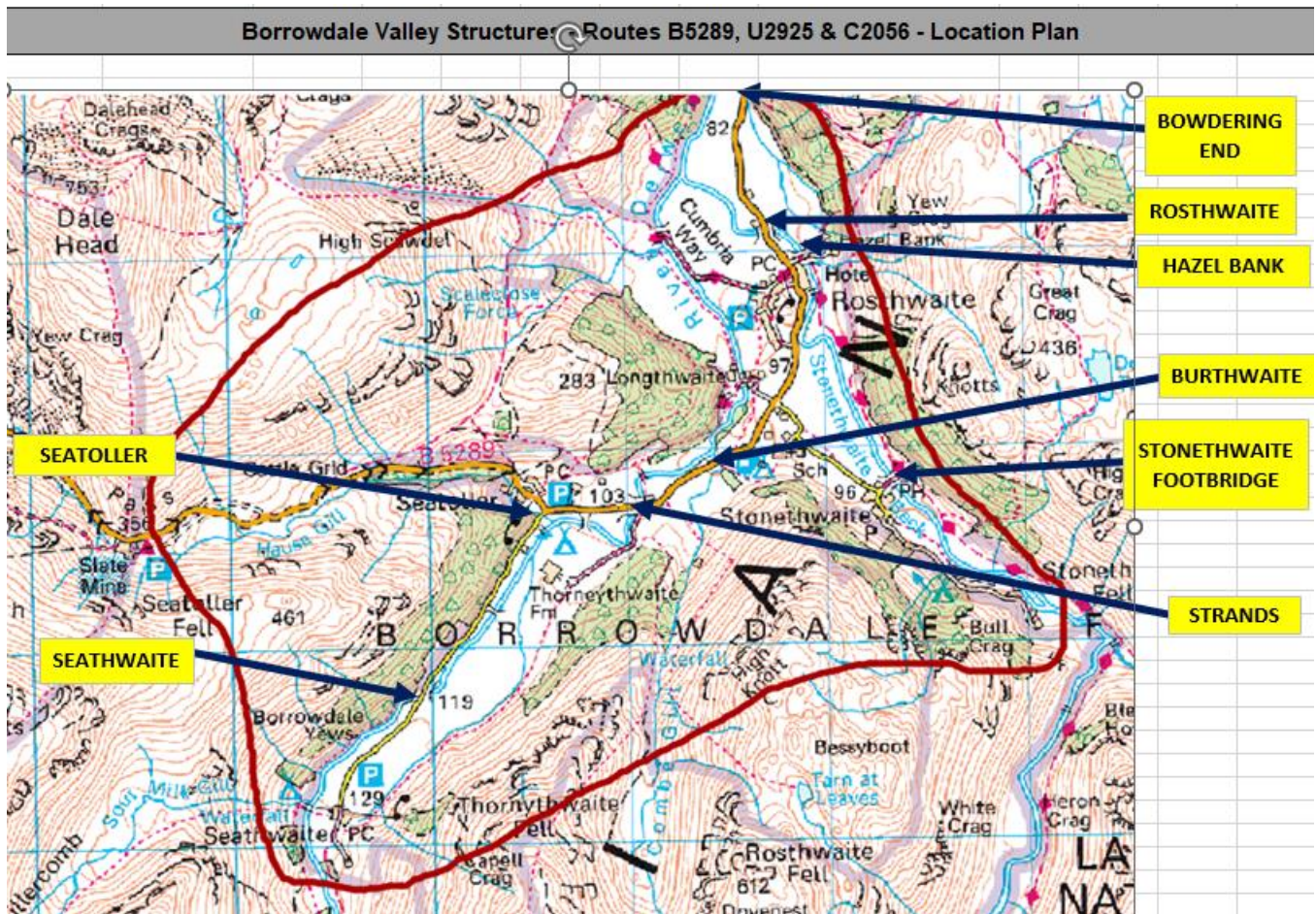


Flood Map Detail Area 4 – Stonethwaite



Flood Map Detail Area 5 – Rosthwaite to Red Brow

6. Local Highway Authority Bridges



- All County bridges are inspected every two years and remedial measures programmes where necessary. Underwater surveys when necessary.
- All bridges on the valley roads (shown above) have been assessed to take full C&U Traffic Loading (in excess of quarry wagons)
- Local repair and maintenance works recently completed or programmed:
 - **Hazel Bank Bridge** – Works completed 19/06/23. Grout bags, masonry and Rockbond used to repair undermining to East apron. Local repair.
 - **Strands Bridge** – Due to start 03/07/23. Expected to finish 04/07/23. Sapling removal from the southeast retaining wall (upstream). Grout bags, masonry and Rockbond used to reinstate wall. Local repair.
 - **Bowdering End Bridge** – Replace missing masonry in abutment. Remove tree roots and possibly some trees. General repointing and vegetation removal. Local repairs.
 - **Grange Bridge** – Apron repairs. No repairs currently planned.

None of the above works would alter flow routes or affect flood risk upstream or downstream.

7. Possible Improvements, Further Studies and Investigations

Highways

1. Drainage improvements at the bottom of Honister pass just upstream of Seatoller. Improvements / maintenance recommendations:
 - Cleaning gullies and drains under road out falling into Hause Gill.
 - Modifying roadside dished channel to direct more water into roadside streams.
 - Cutting 'grips' into the southern verge to allow more water to flow from road into Hause Gill

These minor interventions and better maintenance will ensure that flood exceedance water from the fellsides will be more likely to be routed to the river than using the road as a flow route and thus will reduce the volume of water entering the village on the road which increase flood risk to the properties. It will also reduce the likelihood of damage to the road itself and gravel and silt blocking of gullies.

However, it is important to note that highway drainage infrastructure has limited hydraulic capacity and will have a limited effect for longer storms or more intense periods of rain where they will still become overwhelmed. It is important to note that highway drainage infrastructure is only designed to deal with water falling onto the highway and it would be impracticable to design a system to deal with all the exceedance flows from the fellside.

Also, it is worth noting that the ongoing performance of highway drainage infrastructure relies on regular maintenance and ad-hoc intervention when the feature becomes damaged or blocked. The best way to ensure that any blockages or damage is attended to is to report these defects and maintenance requests via the Highways Hotline where the calls and incidents are logged and can be tracked:

https://cumbria-chhost.onmats.com/w/webpage/highwaysenquiry?context_record_id=82364849&webpage_token=77ccf100d21952067cea69b8e2df9c45201678e8b884f442fe38a75767625442

Impact on Valley Flooding

In the overall picture of flood risk to the valley, these highway measures will have a small-scale effect and be most noticed on short return-period events and be most effective at reducing flood risk to properties and the road itself.

National Trust

1. Hecks to replace sections of wall.

Investigate the possible removal of a section of field boundary wall on the northern side of the road upstream of Mountain View cottages and replace with a longer heck or railing type fence. This will allow flood exceedance water to flow across fields not down the road which endangers Mountain View Cottages and increases flood water level in the field adjacent to the river.

This intervention will have a small-scale effect in the wider valley-wide context, but will open up the flood plain by removing artificial barriers to flow and will help reduce the depth in 'upstream' fields and help speed of drain-down times of fields bounded by walls.

2. Riverlands Project (for full Details see Appendix 5)

The National Trust's and Environment Agency's Riverlands project is currently undertaking several pieces of work in Borrowdale, and across Cumbria. These pieces of work are summarised below, along with some outputs of studies and projects which have already been completed.

Riverlands is a partnership programme between The National Trust and the Environment Agency with numerous projects operating nationally. The programme aims to deliver projects and initiatives which result in river catchments which are clean, healthy, and rich in wildlife. This is done through identifying projects which will deliver water quality and biodiversity improvements, restore natural processes, and create systems which are resilient to climate change. This work is done alongside engagement and volunteering opportunities.

Riverlands in the Lake District began in 2017 and has delivered several projects across the Derwent and Ullswater catchments, including:

- Re-meandering of Goldrill Beck, Hartsop
- Assisted natural recovery of Kirkstone Beck, Hartsop and Stonethwaite Beck, Stonethwaite
- Access improvements and wet woodland restoration through The Ings, Keswick
- Access improvements and peat restoration on Armboth Fell
- Large scale pond creation at Kirkhouse Farm, Isel.

Borrowdale Valley Projects

1. Completed Work in Stonethwaite valley:

In Summer 2022 works were completed on Stonethwaite Beck to allow the natural recovery of the river channel from historic modifications, in addition to encouraging flood flows to the right side of the valley, reducing the pressure on the more productive agricultural land to the left of the valley.

This work included lowering sections of embankment to various levels to encourage water onto the floodplain at different flows. The lowering furthest upstream was the smallest, to allow the larger flows to access the floodplain, whilst the lowering furthest downstream was to floodplain level, which has encouraged a very regular flow through this area. The work also included the creation of several seepage ponds. These ponds collect water at the break of slope between fell side and valley floor, holding water in the landscape, creating valuable habitat, and providing a sustainable drinking source for stock.

There have been several floods since the works were completed and the river has responded as expected. It was anticipated that the fields on the right bank would flood more rapidly and earlier in a flood event, and this has happened in the events we have seen.

2. Rosthwaite:

The LiDAR shows the river Derwent, through the centre of the Rosthwaite valley, to be perched above the valley bottom, putting significant pressure on the right-hand bank, increasing the risk of failure. The embankments shown on the LiDAR, disconnect the river from the floodplain, pushing water and sediment downstream at a faster rate compared to a natural system. Because of the natural bedrock restriction downstream, this puts additional pressure on Grange, where the valley widens again, and flow energy dissipates.

The flooding patterns shown above indicate the current areas where water is held in the landscape in flood and shows us where flood water is held behind embankments following a flood, where natural drainage is impeded.

Over the coming years, the national Trust will be collaborating with their tenants and the local community to look at these studies and the outputs of the river assessment in more detail, identifying opportunities for restoration of natural flood management which will reduce the speed at which water and sediment are moving downstream. The National Trust are committed to identifying and delivering opportunities which provide benefits to downstream flood risk, river and floodplain habitat and farm businesses.

3. Seathwaite

Over the past 5 years the National Trust has studied the hydrology of the Seathwaite Valley in depth, through field work, drone flying, analysing real flood events, and modelling. This work has shown the current primary river channel, The River Derwent, to be heavily modified, moved to the left of the valley floor prior to the first OS maps being drawn.

The river would naturally occupy a stable boulder cascade above the hamlet of Seathwaite, flowing into a meandering channel across the valley bottom. The primary natural channel can still be located when analysing the topography of the valley using LiDAR and is shown to flow along the course of the existing Black Syke channel.

The modified channel, through the valley bottom, is confined to the left-hand side of the valley and is significantly embanked. Because of the significant forces on this channel there is a continuous threat of the channel breaking through these embankments, seeking the lowest part of the floodplain (this is highlighted on Flood Map Detail Area 1 – Seathwaite). The effects of this straightening and the embankments mean the riverbed has become perched above the valley, impacting drainage, and making the channel itself unsustainable in the long term, especially when climate change projections for rainfall volume and intensity are considered.

Proposals

Over the coming years, The National Trust is committed to working with our tenants and the local community to develop a sustainable plan for Seathwaite, which considers the river alongside a host of other topics such as transport, parking and habitat restoration.

Impact on Valley Flooding

Should the River Derwent be restored to its natural course across Seathwaite and Thorneythwaite land, the time to flood peak would likely be reduced due to the water spreading onto the floodplain more readily. In a similar project in Ullswater, monitoring post-restoration has shown a 1-2 hour delay to flood peak between the up and downstream monitoring stations. In addition, water would be held in the valley bottom landscape, potentially slowing its rate of release and reducing the flood peak. Importantly, restoring the river would also restore the sediment regime, allowing more sediment of all sizes (silt, pebbles, gravels, cobbles and boulders) to be stored in the river and its immediate banks. In Ullswater, monitoring post restoration shows over 2000m³ of sediment has been stored in the restored reach over 2 winters. This is material which would previously have moved downstream rapidly, adding to local pressures on communities and infrastructure.

It should be noted that whilst flooding cannot be eliminated by these schemes, they can make a large difference in terms of increasing local resilience and preparedness.

It should also be noted that water currently runs rapidly off the fell land surrounding Borrowdale, significantly speeding the rate and frequency with which the rivers flood. Peat bog and vegetation restoration on the fell is vital for responding to climate change and tackling flood events.

River Level Monitoring

In May 2023, The National Trust installed a number of sensors in the River Derwent and Stonethwaite beck which provide real time river level data. The sensors are located:

1. River Derwent, immediately down stream of Stockley Bridge
2. River Derwent, Seatoller campsite footbridge
3. Stonethwaite Beck, upstream of the campsite
4. River Derwent, downstream of the confluence with Stonethwaite Beck.

In the coming weeks a data networks will be set up and an app created which will allow users to view river levels in real time as well as them receiving notifications when the river level exceeds a certain pre-determined point (this is not a flood warning, it is a river level

notification). There will also be a digital display in the local area. The Riverlands team will undertake user testing, with local community members, over the coming 12 months to understand the usefulness of the data and refine app display and any river level notifications.

Environment Agency

- Undertake gravel removal at Grange Bridge. Discussions with contractor and Natural England on-going. The timetable for this will be communicated with the community when agreed.
- Review what localised improvements could be made to further reduce flood risk, using modelling, observations and evidence to inform this.
- On-going consideration of formal Environment Agency river level gauge and how improvements to the flood warning service could be made.
- Explore opportunities for Property Flood Resilience for affected properties in partnership with the community and wider partners.
- Review recommendations of Glen Maas report and validate against model evidence.

8. Conclusion

There are short term / quick-win measures that can be implemented that would make a difference to flooding extent and impact short duration or low-return period storms. These include the highway interventions mentioned above and possible changes to roadside and riverside barriers to flow. However, it must be remembered that the upper valley catchment has one of the highest annual rainfalls in England.

No amount of flood mitigation measures can prevent valley flooding and the fields that are historically flood plains (as indicated on flood risk mapping) will continue to flood into the future. It is important to recognise that with climate change the rainfall events that can cause flooding to the valley are likely to become more regular, more extreme and less predictable.

Flooding of upstream flood plains (and retaining water in upper catchments) plays an important role in flood water attenuation, slowing the flow and flattening the flood peak so it has a less damaging impact downstream.

A combination of short-term 'quick-wins' and longer term measures as described in this report are planned which will have several benefits with respect to predicting and reducing the impact of the flooding to the local community (and further afield downstream) that will continue to occur in the valley.

9. Recommended Actions & Review

Action Ref:	Action by:	Actions	Timescale:
1	Highways	Seatoller / Honister Pass highway drainage improvements Bowdering End culvert / bridge maintenance	2023/24
2	National Trust / Tenant Farmers	Remove walls / increase number / length of 'hecks' in strategic locations	To be agreed with tenant
3	National Trust	Riverlands Project	ongoing
4	Environment Agency	Explore opportunities for Property Flood Resilience.	
5	Environment Agency / National Trust	Implement early warning system / river level monitoring system	Autumn 2023
6	Members of the Public / residents	Report highways defects and infrastructure requiring maintenance to the Highways Hotline https://www.cumberland.gov.uk/parking-roads-and-transport/streets-roads-and-pavements/road-maintenance-closures-and-improvements/report-problem-street-or-road	As and when required
7	National Trust	River level monitoring	2023/ 24
8	Community	Development of a Community Resilience Plan with wider partners	
9	Environment Agency	Review available modelling outputs, project deliverables and Glen Maas recommendations as part of a strategic catchment approach.	
10	Environment Agency	Environment Agency to support landowners/tenants with Permits for in-river works if and when required	As necessary / on request
11	Environment Agency	the Environment Agency will work with landowners, tenants and the National Trust to understand the economic impact of flooding on farming businesses and the local community".	

Review of Actions

A progress review of the actions will be carried out after 12 months by Cumberland Council, The National Trust and The Environment Agency.

Appendices

1. Glossary
2. Summary of Relevant Legislation and Flood Risk Management Authorities
3. Local Accounts and Feedback of the 30th of Sept Flood Event
4. Environment Agency Rainfall Information
5. National Trust Riverlands Project
6. NFU (Glen Maas Report) & Review
7. Useful contacts and links

Appendix 1: Glossary

Acronyms

EA	Environment Agency
CC	Cumberland Council
UU	United Utilities
LLFA	Lead Local Flood Authority
LFRM	Local Flood Risk Management
MSfWG	Making Space for Water Group
FAG	Flood Action Group
FWMA	Flood and Water Management Act 2010
LDA	Land Drainage Act 1991
WRA	Water Resources Act 1991

Appendix 2: Summary of Relevant Legislation and Flood Risk Management Authorities

The Flood Risk Regulations 1999 and the Flood and Water Management Act 2010 (the Act) have established Cumberland Council (CC) as the Lead Local Flood Authority (LLFA) for Cumbria. This has placed various responsibilities on CC including Section 19 of the Act which states:

Section 19

- (1) On becoming aware of a flood in its area, a lead local flood authority must, to the extent that it considers it necessary or appropriate, investigate—
- (a) which risk management authorities have relevant flood risk management functions, and
 - (b) whether each of those risk management authorities has exercised, or is proposing to exercise, those functions in response to the flood.
- (2) Where an authority conducts an investigation under subsection (1) it must—
- (a) publish the results of its investigation, and
 - (b) notify any relevant risk management authorities.

A 'Risk Management Authority' (RMA) means:

- (a) the Environment Agency,
- (b) a lead local flood authority,
- € a district council for an area for which there is no unitary authority,
- (d) an internal drainage board,
- € a water company, and
- (f) a highway authority.

The table below summarises the relevant Risk Management Authority and details the various local source of flooding that they will take a lead on.

	Risk Management Authority			
Flood Source	Environment Agency	Lead Local Flood Authority (Cumberland Council)	Water Company (UU)	Highway Authority
RIVERS				
Main river				
Ordinary watercourse				
SURFACE RUNOFF				
Surface water				
Surface water on the highway				
OTHER				
Sewer flooding				
The sea				
Groundwater				
Reservoirs				

The following information provides a summary of each Risk Management Authority's roles and responsibilities in relation to flood reporting and investigation.

Government – Defra develop national policies to form the basis of the Environment Agency's and Cumberland Council's work relating to flood risk.

Environment Agency has a strategic overview of all sources of flooding and coastal erosion as defined in the Act. As part of its role concerning flood investigations this requires providing evidence and advice to support other risk management authorities. The EA also collates and reviews assessments, maps, and plans for local flood risk management (normally undertaken by LLFA).

Lead Local Flood Authorities (LLFAs) – Cumberland Council is the LLFA for Cumbria. Part of their role requires them to investigate significant local flooding incidents and publish the results of such investigations. LLFAs have a duty to determine which risk management authority has relevant powers to investigate flood incidents to help understand how they happened, and whether those authorities have or intend to exercise their powers. LLFAs work in partnership with communities and flood risk management authorities to maximise knowledge of flood risk to all involved. This function is conducted at CC by the Local Flood Risk Management Team.

Water and Sewerage Companies manage the risk of flooding to water supply and sewerage facilities and the risk to others from the failure of their infrastructure. They make sure their systems have the appropriate level of resilience to flooding and where frequent and severe flooding occurs, they are required to address this through their capital investment plans. It should also be noted that following the Transfer of Private Sewers Regulations 2011 water and sewerage companies are responsible for a larger number of sewers than prior to the regulation.

Highway Authorities have the lead responsibility for providing and managing highway drainage and certain roadside ditches that they have created under the Highways Act 1980. The owners of land adjoining a highway also have a common-law duty to maintain ditches to prevent them causing a nuisance to road users.

Flood risk in Cumbria is managed through the Making Space for Water process which involves the cooperation and regular meetings of the Environment Agency, United Utilities, and CC's Highway and LFRM Teams to develop processes and schemes to minimise flood risk. The MSfWGs meet approximately four times per year to cooperate and work together to improve the flood risk in the vulnerable areas identified in this report by completing the recommended actions. CC as LLFA has a responsibility to oversee the delivery of these actions.

Where minor works or quick win schemes can be identified, these will be prioritised and subject to available funding and resources will be conducted as soon as possible. Any major works requiring capital investment will be considered through the Environment Agency's Medium-Term Plan or a partners own capital investment process.

Flood Action Groups are usually formed by residents who wish to work together to resolve flooding in their area. The FAGs are often supported by either CC or the EA and provide a useful mechanism for residents to forward information to the MSfWG.

Appendix 3: Photographs of flooding (some of other flooding events prior to 30 September 2022)



Bottom of Honister Pass, just north of Seatoller village. These photos show that during intense rainfall events, the road acts as a conduit / flow route for the excess run-off from the fellsides. The existing highway drainage infrastructure is not coping with this scale of deluge.



Downstream of Strands Bridge at Mountain View Cottages showing flood water at property thresholds



Downstream of Strands Bridge at Mountain View Cottages looking up the valley road with 'heck' in wall on the right-hand side of the road



Downstream of Grange Bridge showing gravel bar looking towards Derwentwater



Under Grange Bridge showing gravel deposits



Downstream of Grange Bridge showing gravel deposits

Appendix 4: Environment Agency Rainfall Data & Analysis

Weather Forecast Preceding Event

IMFS Hydromet Guidance 28/09/2022 06:00

A frontal system will move into western England and Wales on Friday morning. This system will bring widespread heavy rain to much of the northwest and southwest of England and across Wales through the day, with high ground anticipated to experience the highest and most intense rainfall rates due to orographic enhancement. There may be a risk of surface water and fluvial flooding from this rainfall. This front moves quickly south-eastwards across England and Wales, clearing these areas by the end of Friday. However, there is some uncertainty as to how quickly this will clear the far south of England and it may persist into Saturday there.

IMFS Hydromet Guidance 29/09/2022 06:00

A frontal system will move into western England and Wales on Friday morning. This system will bring widespread heavy rain to many western parts of England and across much of Wales through the day, with high ground anticipated to experience the highest and most intense rainfall rates due to orographic enhancement. Inland impacts are possible. This front moves quickly south-eastwards across England and Wales, clearing these areas by the end of Friday.

IMFS Hydromet Guidance 30/09/2022 06:00

Most places are dry at first on Friday, before a frontal system moves in from the north-west around mid-morning. This system will bring a reasonably short period of widespread and intense rain to many western parts of England and across much of Wales. High ground is likely to experience the highest and most intense rainfall rates due to orographic enhancement. Inland impacts are possible. This front moves quickly south-eastwards across England and Wales, bringing lower totals elsewhere and largely clearing by the end of Friday.

Met Office Flood Guidance Statement 10:30 Wednesday 28 September

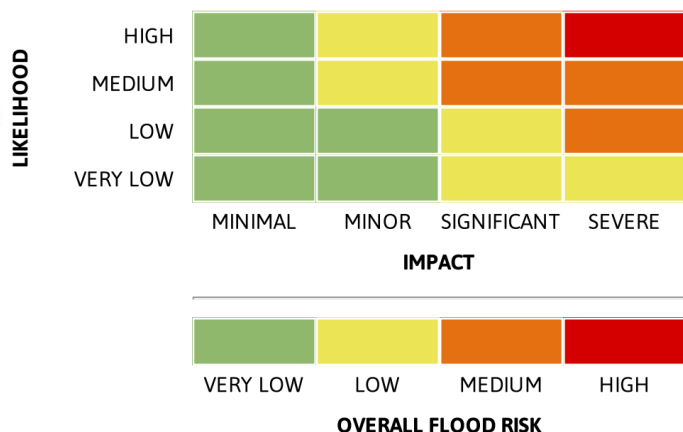
Headline: Minor inland flooding impacts are possible but not expected in parts of the north and west of England and Wales on Friday. The overall flood risk is very low.

Rivers: Isolated minor river flooding impacts are possible but not expected for parts of Wales and the West Midlands and parts of the north and west of England on Friday. This is due to widespread heavy rain throughout the day.

Surface Water: Isolated minor surface water flooding impacts are possible but not expected for parts of Wales and the West Midlands and parts of the north and west of England on Friday. This is due to widespread heavy rain throughout the day.



Flood risk matrix



Friday
30 Sep 2022

Increased ↑

Met Office Flood Guidance Statement 10:30 Thursday 29 September

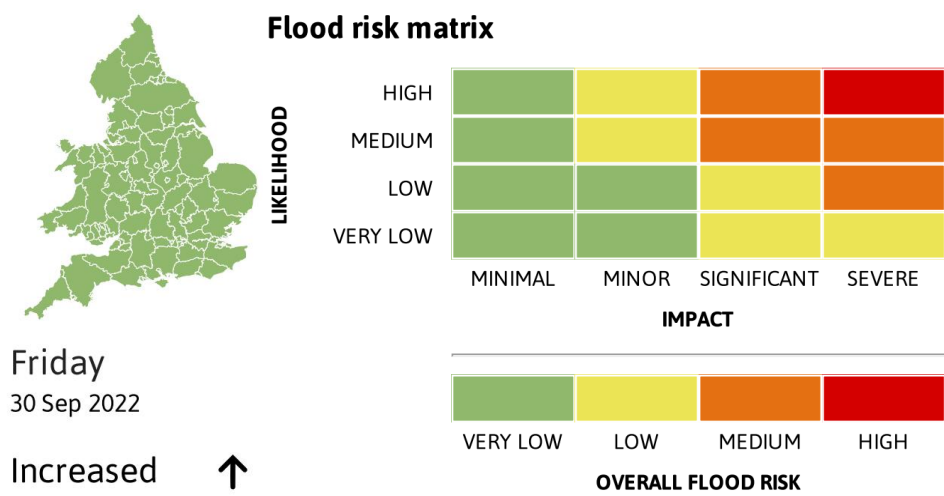
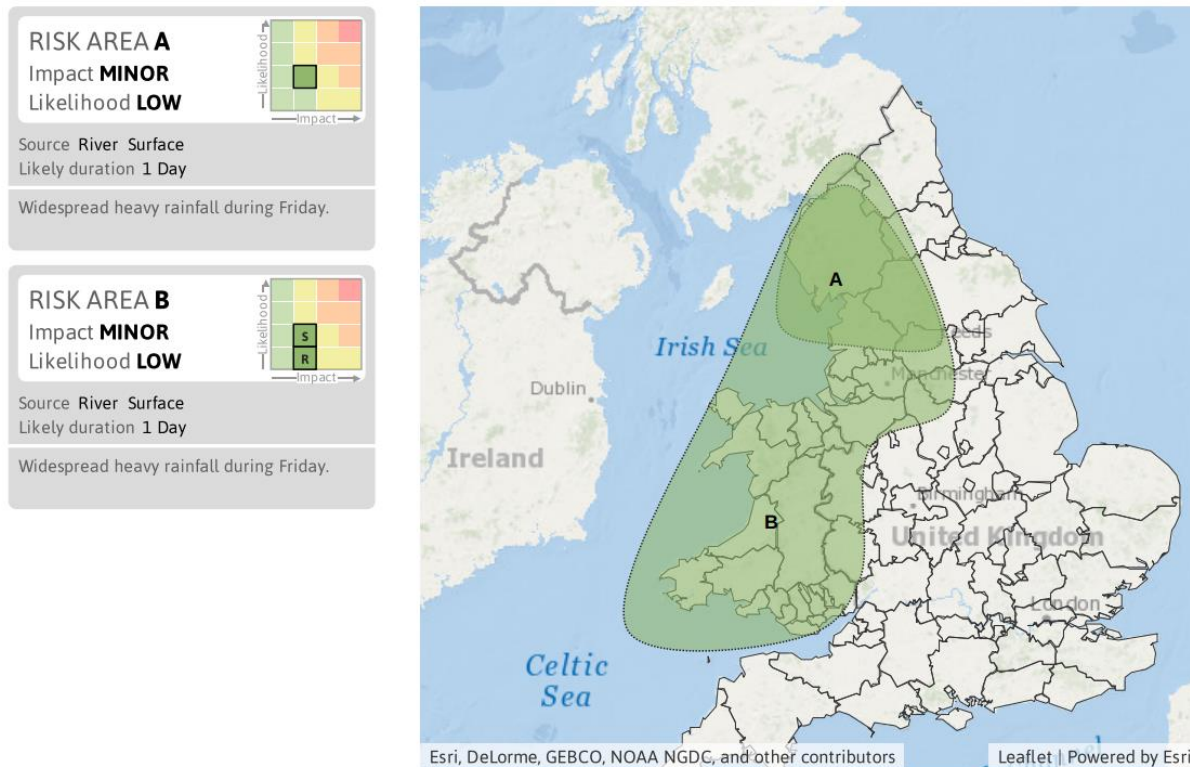
Upper Borrowdale Valley s19 Report **Cumberland Council**

Headline: Minor inland flooding impacts are possible in parts of the North of England, the West Midlands, and parts of Wales on Friday. The overall flood risk is very low.

Rivers: Widespread heavy rain on Friday will bring the potential for isolated minor river flooding impacts to parts of the North of England, West Midlands, and parts of Wales. Refer to the Area of Concern Map.

Surface Water: Isolated minor surface water flooding impacts are possible in parts of Wales, the West Midlands, and parts of the North of England on Friday. Refer to the Area of Concern Map. This is due to widespread heavy rain throughout the day.

Specific Areas of Concern Map 1: Friday 30 September 2022.



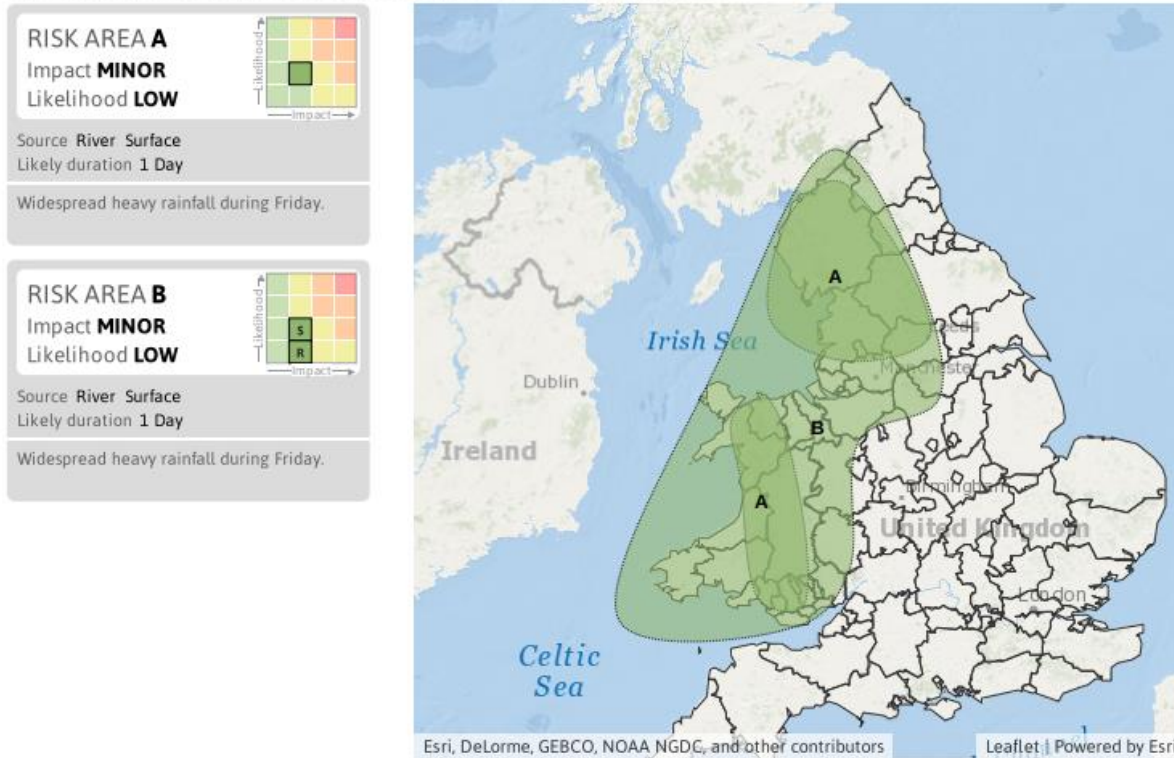
Met Office Flood Guidance Statement 10:30 Friday 30 September

Headline: Minor inland flooding impacts are possible in parts of the North of England, the West Midlands and parts of Wales today (Friday). The overall flood risk is very low.

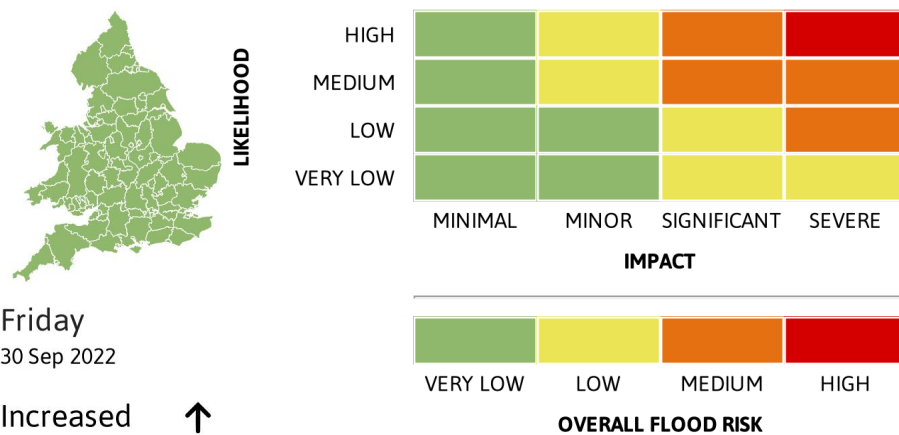
Rivers: Widespread heavy rain today (Friday) will bring the potential for isolated minor river flooding impacts to parts of the North of England, West Midlands, and parts of Wales. Refer to the Area of Concern Map.

Surface Water: Isolated minor surface water flooding impacts are possible in parts of Wales, the West Midlands, and parts of the North of England today (Friday). Refer to the Area of Concern Map. This is due to widespread heavy rain throughout the day.

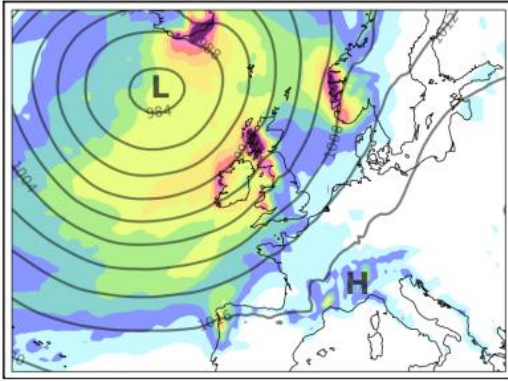
Specific Areas of Concern Map 1: Friday 30 September 2022



Flood risk matrix



Flood Forecasting Centre – Flood Outlook 21/09/2022 to 16/10/2022



Late September / Early October

- Low pressure mainly to the north and west of the UK, but at times low pressure systems may move across the UK
- Periods of rain are most likely to be confined to the north and west, but unsettled spells are possible across England and Wales
- Strong winds are possible mainly for the south and west coasts

Environment Agency Flood Warning Duty Officer Update provided at 15:00 29/09/2022

Medium confidence in the rainfall we are expecting tomorrow. Rain due to start around 9am, with the front passing through the county and should be clearing by about 5pm (then some scattered showers).

Cumbria Lowlands total ~35mm

Cumbria Highlands total ~64mm

Reasonable Worst Case and Best Estimate values are very close.

In terms of flood alerts and warnings, the forecast is currently showing the following:

Flood Alert

- Upper Eden
- Caldew & Petteril
- Ehen, Calder, Irt & Esk
- Duddon, Crake & Mill Beck

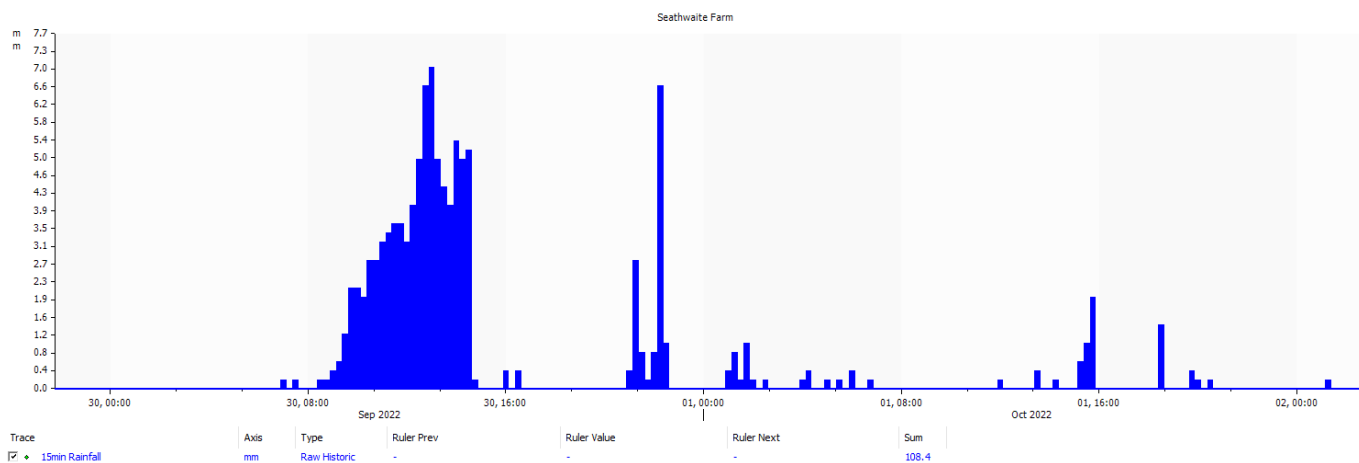
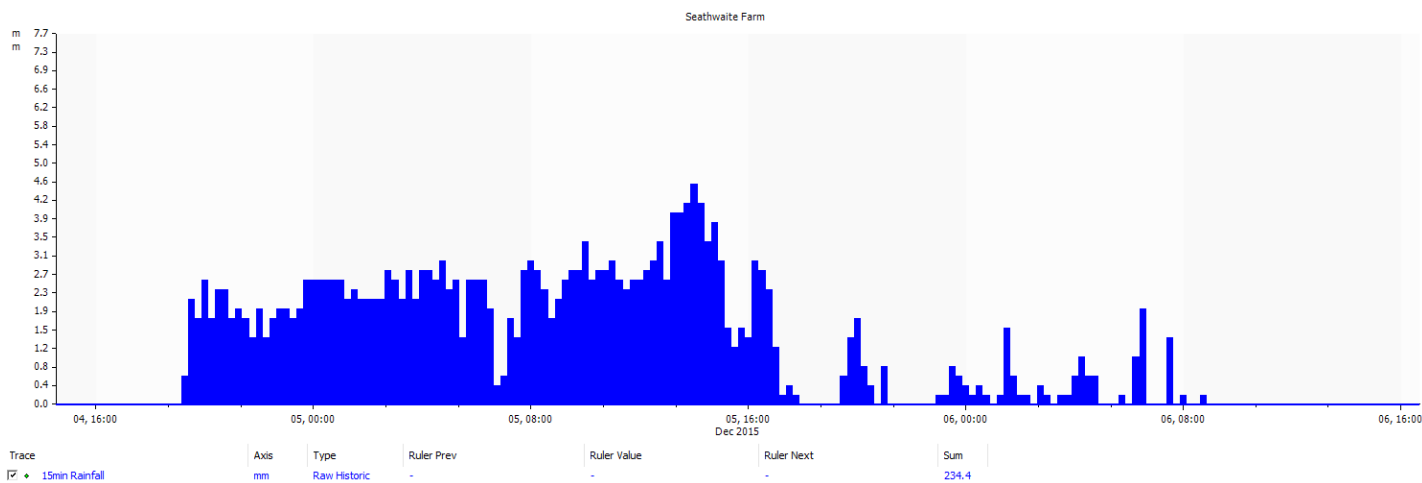
Flood Warning

- Egremont
- Dragley Beck (Ulverston)

All forecasts are showing the thresholds to be met from around 1pm, but then could drop down by 6pm.

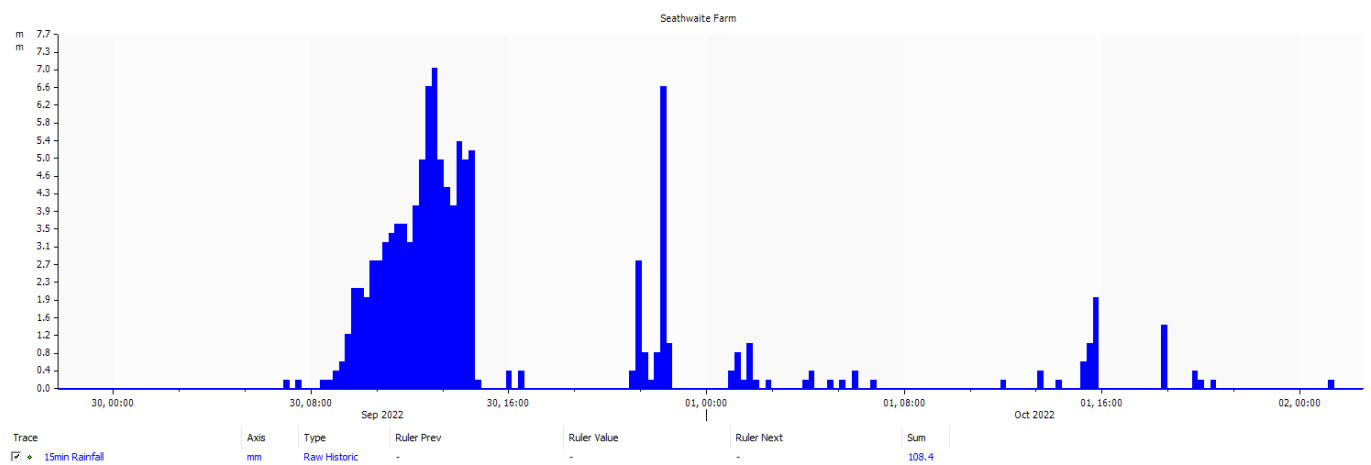
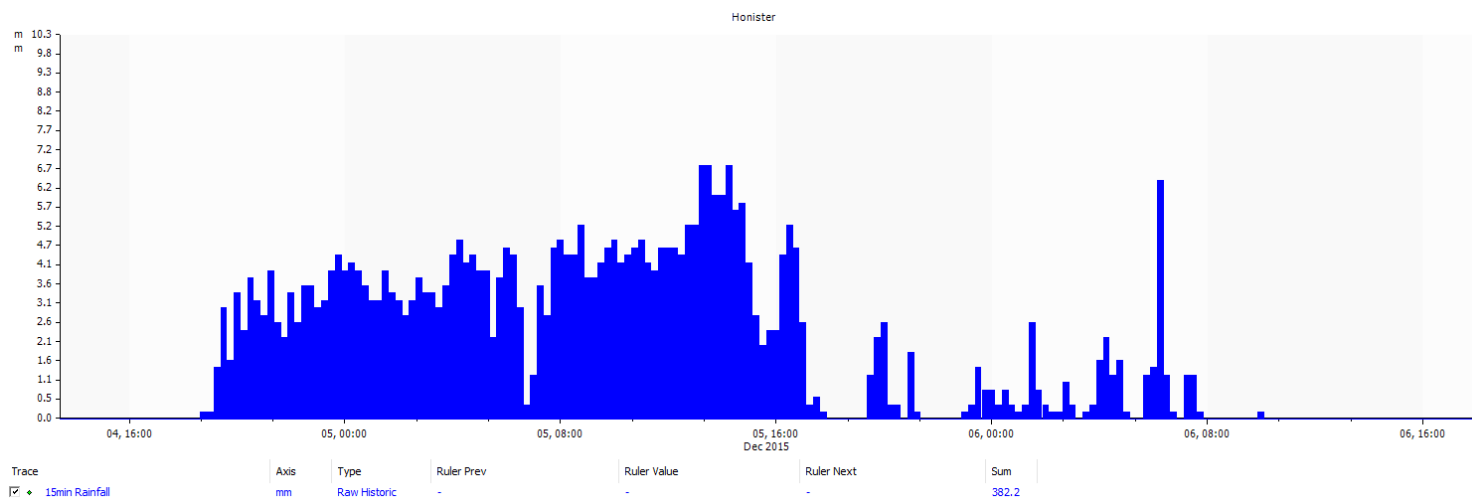
I think we can expect some of the non-forecasted sites to potentially go through too, given that the rain is expected to fall across all catchments.

Storm Desmond Dec 2015 & 30 Sep 2022 Event Borrowdale Rainfall Gauge Trace @ Seathwaite Farm



Note: The peak rainfall intensity on 30.09.22 of 7mm/hr was higher than during Storm Desmond

Storm Desmond Dec 2015 & 30 Sept 2022 Event Borrowdale Rainfall Gauge Trace @ Honister Pass



Note: The peak rainfall intensity on 30.09.22 of 7.3mm/hr was higher than during Storm Desmond

Rainfall Return Period Analysis – Summary for Seathwaite Farm

	Seathwaite Farm 30/09/2022	Seathwaite Farm 04/12/2015 – 05/12/2015	Seathwaite Farm 30/09/2022	Seathwaite Farm 04/12/2015 – 05/12/2015
Time Period (hrs)	Max Period Rainfall (mm)	Max Period Rainfall (mm)	Return Period (1 in n years)	Return Period (1 in n years)
1	23.6	17.0	3.2	1.7
2	42.6	31.2	4.4	1.8
3	58.4	43.0	5.7	1.9
4	71.4	53.2	6.5	1.9
5	80.6	64.8	6.3	2.3
6	83.0	76.0	4.3	2.8
12	86.8	129.8	1.4	8.4
24	101.6	214.0	n/a	23.7

UK Centre for Ecology and Hydrology Flood Estimation Handbook Webservice – FEH22

	Seathwaite Farm 30/09/2022	Seathwaite Farm 04/12/2015 – 05/12/2015	Seathwaite Farm 30/09/2022	Seathwaite Farm 04/12/2015 – 05/12/2015
Time Period (hrs)	Max Period Rainfall (mm)	Max Period Rainfall (mm)	Return Period (1 in n years)	Return Period (1 in n years)
1	23.6	17.0	3.4	1.8
2	42.6	31.2	5.0	2.0
3	58.4	43.0	6.7	2.1
4	71.4	53.2	8.0	2.3
5	80.6	64.8	8.1	2.8
6	83.0	76.0	5.5	3.6
12	86.8	129.8	1.6	12.8
24	101.6	214.0	n/a	70.7

UK Centre for Ecology and Hydrology Flood Estimation Handbook Webservice – FEH13

Rainfall Return Period Analysis – Summary for Honister Pass

	Honister Pass	Honister Pass	Honister Pass	Honister Pass
	30/09/2022	04/12/2015 – 05/12/2015	30/09/2022	04/12/2015 – 05/12/2015
Time Period (hrs)	Max Period Rainfall (mm)	Max Period Rainfall (mm)	Return Period (1 in n years)	Return Period (1 in n years)
1	26.2	25.6	3.8	3.6
2	44.8	49.0	4.1	6.0
3	59.6	67.8	4.3	8.2
4	70.4	85.4	3.9	11.4
5	77.2	103.4	3.1	17.1
6	79.6	120.2	2.3	24.3
12	86.0	209.2	n/a	69.3
24	96.2	341.4	n/a	124.7

UK Centre for Ecology and Hydrology Flood Estimation Handbook Webservice – FEH22

	Honister Pass	Honister Pass	Honister Pass	Honister Pass
	30/09/2022	04/12/2015 – 05/12/2015	30/09/2022	04/12/2015 – 05/12/2015
Time Period (hrs)	Max Period Rainfall (mm)	Max Period Rainfall (mm)	Return Period (1 in n years)	Return Period (1 in n years)
1	26.2	25.6	4.1	3.8
2	44.8	49.0	4.8	7.0
3	59.6	67.8	5.4	10.3
4	70.4	85.4	5.2	15.3
5	77.2	103.4	4.3	24.4
6	79.6	120.2	3.1	36.3
12	86.0	209.2	n/a	161.1
24	96.2	341.4	n/a	852.8

UK Centre for Ecology and Hydrology Flood Estimation Handbook Webservice – FEH13

Appendix 5: National Trust & Environment Agency's Riverlands Project

The Riverlands project is currently undertaking several pieces of work in Borrowdale, and across Cumbria. These pieces of work are summarised below, along with some outputs of studies and projects which have already been completed.

Riverlands:

Riverlands is a partnership programme between The National Trust and the Environment Agency with numerous projects operating nationally. The programme aims to deliver projects and initiatives which result in river catchments which are clean, healthy, and rich in wildlife. This is done through identifying projects which will deliver water quality and biodiversity improvements, restore natural processes, and create systems which are resilient to climate change. This work is done alongside engagement and volunteering opportunities.

Riverlands in the Lake District began in 2017 and has delivered several projects across the Derwent and Ullswater catchments, including:

- Re-meandering of Goldrill Beck, Hartsop
- Assisted natural recovery of Kirkstone Beck, Hartsop and Stonethwaite Beck, Stonethwaite
- Access improvements and wet woodland restoration through The Ings, Keswick
- Access improvements and peat restoration on Armboth Fell
- Large scale pond creation at Kirkhouse Farm, Isel.

What are we currently working on?

River assessment:

In April 2023, the project will commission a full assessment of all rivers, streams and drainage ditches owned by the National Trust in The Lake District. This assessment, which will be carried out by experienced, third-party geomorphologists and hydrologists, will gather information which will allow us to fully understand the following across all our watercourses:

1. The current extent and nature of modifications - Any modification to a river, away from its natural course, has a long-term impact on the functioning of the system in terms of its ability to sort, store and transport gravel and slow the flow of water downstream. The project will identify the full extent and nature of modifications, from straightened channels, to embankments, overly deep/ incised channels to bridges and weirs.
2. The resilience of identified channels – We are seeing increasing evidence of climate change. From more regular flash flood events to prolonged periods of drought. All modifications to a river will impact upon its resilience to climate extremes, through increased or more focused flooding to channels drying up in dryer months. This part of the study will assess how resilient our rivers are and if the modifications present pose risks.
3. An assessment of restoration potential – This part of the assessment will look at the potential for river restoration, or natural flood management where modifications are present. This will be a very high-level assessment and will simply identify if there is potential for restoration, and if so, what that would look like, for example would it be

complex such as full re-meandering, or simple targeted interventions, such as select embankment removal or channel widening.

4. Identify opportunities for pond creation and water storage – Here the study will identify suitable areas for pond creation or water storage with the aim of slowing the flow of water, holding more water in the landscape during dry months and extending standing water habitats.

This study will take place over the course of 2023 and into early 2024. The National Trust will contact all tenants prior to any walk over surveys being conducted and tenants will have the opportunity to meet with the survey team and pass on their knowledge of the river systems.

River level monitoring in Upper Borrowdale

The Riverlands project, with funding from Defra's Green Challenge Recovery Fund, have appointed Imperial College London to build a network of monitoring equipment throughout upper Borrowdale which will provide real time information on river levels through a web-based platform and phone application.

Imperial College London have a huge amount of experience in delivering these monitoring networks throughout the UK and globally, including Nepal, Uganda, and Peru.

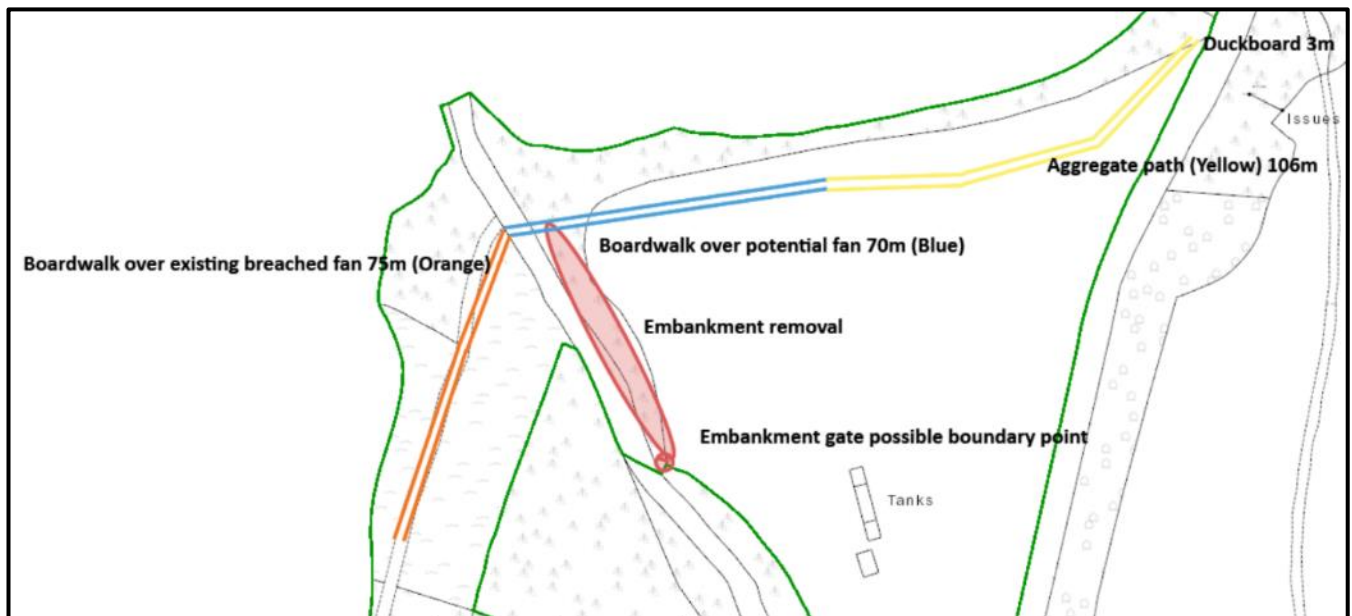
This project will involve the instillation of river level monitoring equipment on Stonethwaite Beck and the River Derwent. This will be combined with new rain gauges across the catchment. The systems will transmit live data to a web-based platform which will display it through a visualisation like those used for Environment Agency gauging stations. There is also potential to set up trigger levels within the software which would send out text or email alerts once the river rises above an agreed level. The project includes a community display monitor which, once a location is agreed, will display live data permanently within a community hub.

The project is intended as a trial, and we would like to collaborate with members of the local community to refine the system, how the data is presented and what river levels trigger alerts. The project team will be reaching out over the coming months for volunteers to work with us on this project, but if you would like to register interest, please email:

Lakes.Riverlands@nationaltrust.org.uk.

Barrow Bay:

This year we will be restoring a section of Barrow Beck and improving access around Barrow Bay. Contractors will start on site in late July, conducting works to remove a section of embankment on the left bank of Barrow Beck and install a raised boardwalk around Barrow Bay.



The removal of the right-hand embankment will allow the restoration of the alluvial fan which the channel currently sits on top of. Naturally, these systems would be very dynamic, with a primary channel moving seasonally across a fanned area of gravel and pebbles, which have deposited at the bottom of a slope over time. The embankments on Barrow Beck mean the channel has become elevated above the surrounding land, impacting on land drainage, requiring bigger and bigger flood banks, and causing a significant accumulation of gravel in the mouth of the channel, where the water's energy drops when it meets the lake. This cuts off the channel from the lake in summer months. Removing the embankment will restore natural processes across this fan, allowing the deposition of sediment and dynamic movement of channels in high flow events.

This work is being done alongside improvements to access. By installing a raised boardwalk around the bay, the restored channel network will be able to move freely underneath it. This not only allows the natural processes of the beck to continue without constraint but enables safe and dry access around this part of the bay.

Black Syke:

We have been assessing the Black Syke channel at Thorneythwaite, identifying opportunities to hold water in the landscape and slow the flow downstream. Black Syke occupies the lowest part of the floodplain throughout the Seathwaite Valley and is the primary flooding route during higher flows. This channel also remains wet when the main River Derwent dries up. The channel has incised significantly, primarily due to a decreased supply in gravels coming from upstream, this makes restoration, without the addition of a lot of material, hard. In order to maximise the benefits of restoring Black Syke, this must be done as part of a wider project in the Seathwaite Valley.

Completed work:

Stonethwaite:

In Summer 2022 works were completed on Stonethwaite Beck to allow the natural recovery of the river channel from historic modifications, in addition to encouraging flood flows to the right side of the valley, reducing the pressure on the more productive agricultural land to the left of the valley.

This work included lowering sections of embankment to various levels to encourage water onto the floodplain at different flows. The lowering furthest upstream was the smallest, to allow the larger flows to access the floodplain, whilst the lowering furthest downstream was to floodplain level, which has encouraged a very regular flow through this area. The work also included the creation of several seepage ponds. These ponds collect water at the break of slope between fell side and valley floor, holding water in the landscape, creating valuable habitat, and providing a sustainable drinking source for stock.

There have been several floods since the works were completed and the river has responded as expected. It was anticipated that the fields on the right bank would flood more rapidly and earlier in a flood event, and this has happened in the events we have seen.



Figure 2.7 1 in 2yr flood extent change, blue = baseline, red = restored (where red is visible indicates flood extent increase, purple indicates no change and blue indicates reduction in flood extent).

Armboth Fell:

Over the course of 2021 and 2022 we have undertaken a significant amount of work on Armboth fell in partnership with United Utilities, Natural England, Cumbria Wildlife Trust, and Fix the Fells. This work has involved the restoration of peat bogs on the high fells through re-profiling eroded peat faces, blocking drainage networks using heather bales and earth bunds and creating pools. This work holds water in the uplands, slowing the flow downstream, capturing carbon and restoring vital habitats.



The works have also involved improvements to access across the Pewits. This is a popular Wainwright route and increased recreational and grazing pressure had caused a large area of bare peat, increasing run-off and degrading habitats.

We are continuing to work on Armbboth Fell through 2023, restoring more degraded peat habitats and improving access through these restoration sites.

Studies completed:

Seathwaite:

Over the past 5 years we have studied the hydrology of the Seathwaite Valley in depth, through field work, drone flying, analysing real flood events, and modelling.

This work has shown the current primary river channel, The River Derwent, to be heavily modified, moved to the left of the valley floor prior to the first OS maps being drawn.



The river would naturally occupy a stable boulder cascade above the hamlet of Seathwaite, flowing into a meandering channel across the valley bottom. The primary natural channel can still be located when analysing the topography of the valley using LiDAR and is shown to flow along the course of the existing Black Syke channel.

The modified channel, through the valley bottom, is confined to the left-hand side of the valley and is significantly embanked. Because of the significant forces on this channel there is a continuous threat of the channel breaking through these embankments, seeking the lowest part of the floodplain. The effects of this straightening and the embankments mean the riverbed has become perched above the valley, impacting drainage, and making the channel itself unsustainable in the long term, especially when climate change projections for rainfall volume and intensity are considered.

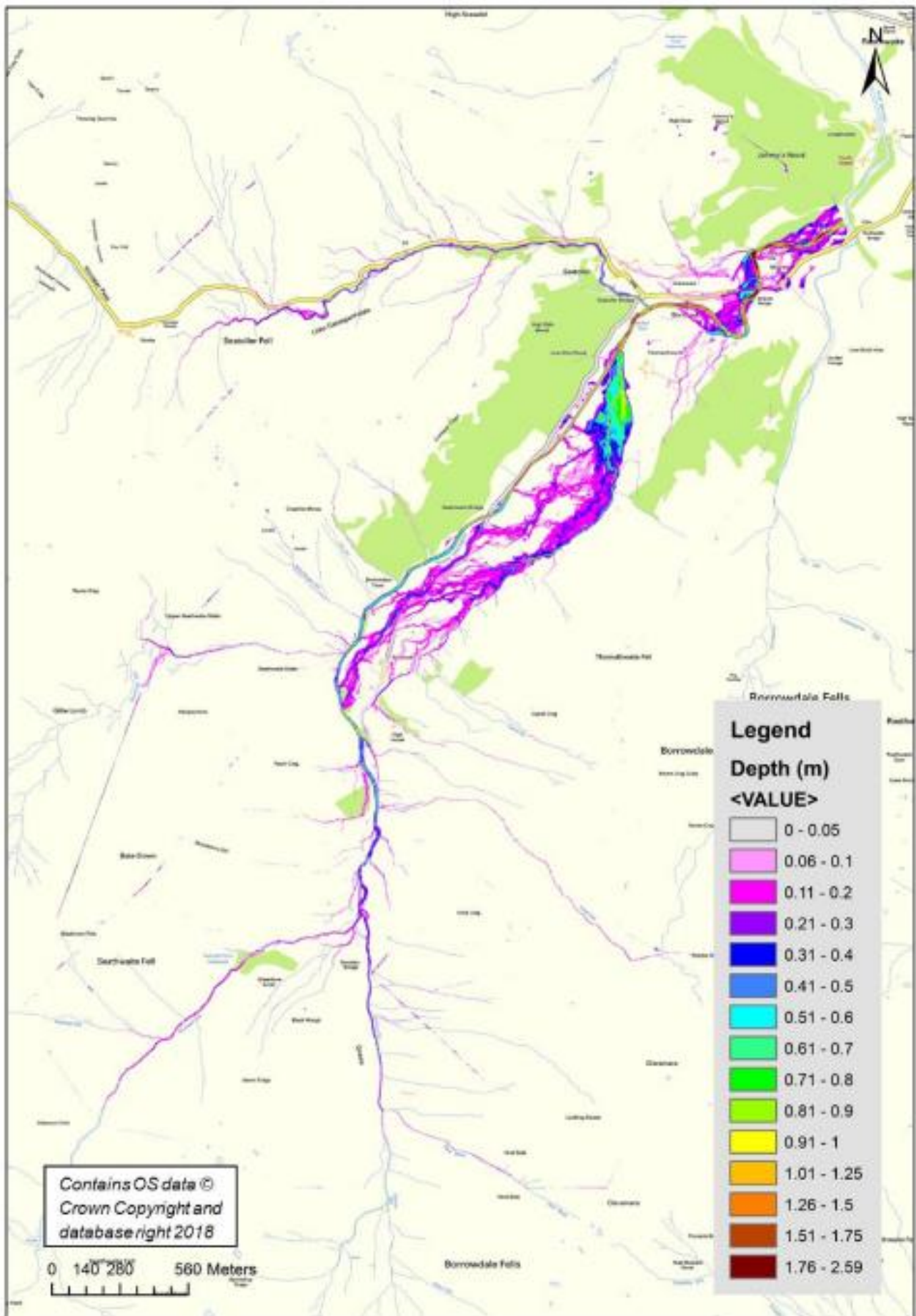
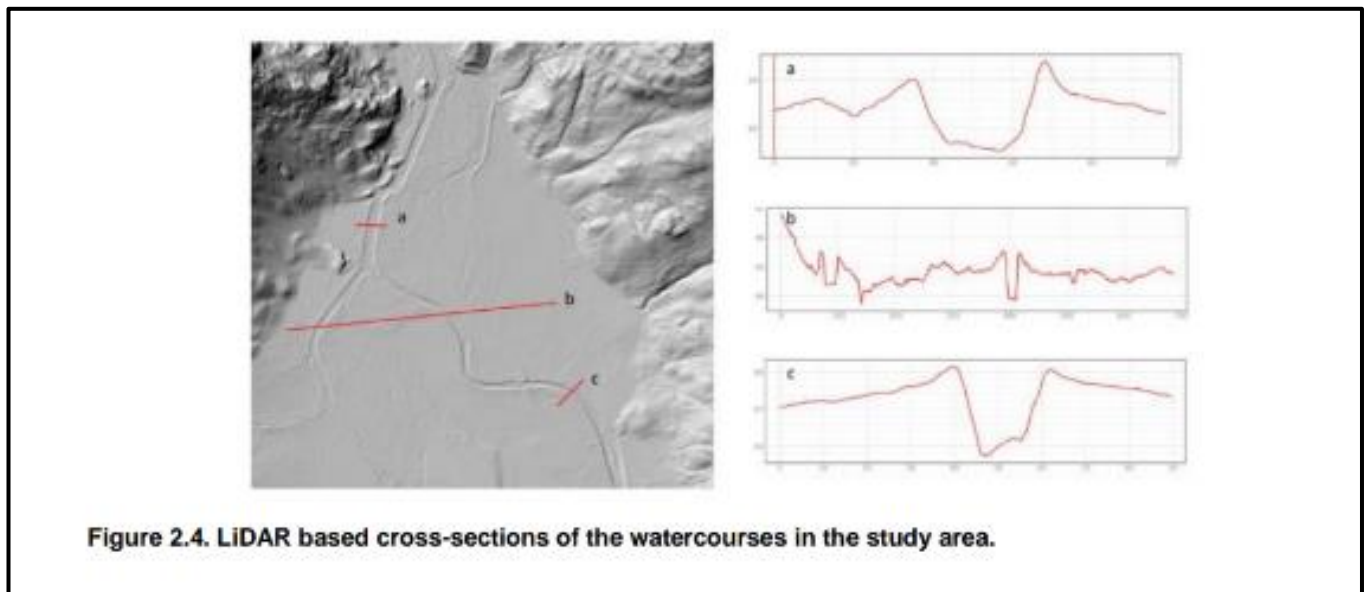


Figure 4.2 Depth output of the TUFLOW direct rainfall model.

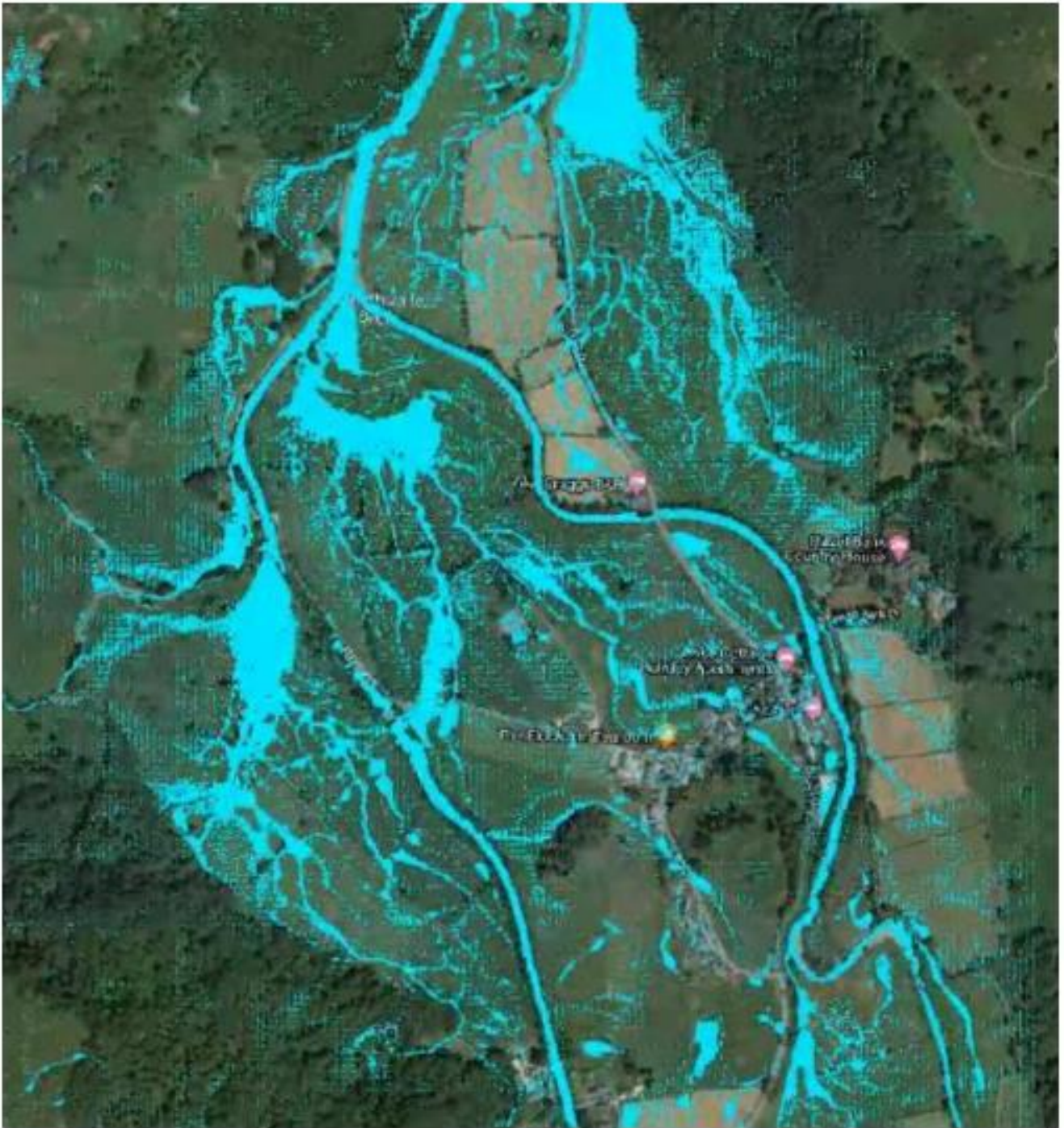
The model data above shows how the current channel of the river Derwent does not occupy the lowest part of the floodplain; therefore, flood flows focus on the opposite side of the valley.

Rosthwaite:

Several studies, like those outlined above have been conducted on the River Derwent and Stonethwaite Beck downstream of Rosthwaite. This has again identified significant modifications to the river channels, ranging from straightening and embankments to the draining of glacial ponds. Downstream of this study reach, the main River Derwent enters a natural bedrock constriction.



The LiDAR shows the river Derwent, through the centre of the valley, to be perched above the valley bottom, putting significant pressure on the right-hand bank, increasing the risk of failure. The embankments shown on the LiDAR, disconnect the river from the floodplain, pushing water and sediment downstream at a faster rate compared to a natural system. Because of the natural bedrock restriction downstream, this puts additional pressure on Grange, where the valley widens again, and flow energy dissipates.



The flooding patterns shown above indicate the current areas where water is held in the landscape in flood and shows us where flood water is held behind embankments following a flood, where natural drainage is impeded.

Over the coming years, we will be collaborating with our tenants and the local community to look at these studies and the outputs of the river assessment in more detail, identifying opportunities for restoration of natural flood management which will reduce the speed at which water and sediment are moving downstream. We are committed to identifying and delivering opportunities which provide benefits to downstream flood risk, river and floodplain habitat and farm businesses.

Appendix 6: Glen Maas (NFU) Report - Review & Recommendations

Background

In 2011 NFU commissioned Glen Maas Consulting to carry out a study with the main aim to provide a management plan for effective and sustainable river management within the Borrowdale Valley. It was designed to be used by river and riparian landowners, tenant farmers and environmental regulators/managers to tackle issues associated with a recent increase in flooding. These issues have led to concerns about the future viability of farming and other activities within the valley floor.

The main concerns explored in the report are:

- An increase in flooding in recent years and the impact this has on farming practices within the valley
- Increased rates of bank erosion and the current and possible continued loss of valuable farming land
- Increased rates of sediment accumulation within the channels, with the general view that this is causing much of the flood related problems
- The increasing occurrence and extent of low flow problems, associated with channel bed sedimentation.

These concerns are primarily those of the farming community, as their livelihoods are directly affected. Regulatory bodies, land managers and land-owners need to ensure any actions taken to address these issues are justified, targeted and managed appropriately. This includes complying with the Habitats Regulations as Stonethwaite Beck and the River Derwent downstream of this confluence are recognised as being of international importance for wildlife and, as such, designated as a Special Area of Conservation.

The report provided the following:

- A catchment overview highlighting the main river controls, existing plans and regulatory considerations
- An overview of the geomorphological processes and features within the Borrowdale Valley
- An ecological appraisal
- The main focus of the report: a river management action plan identifying reactive and proactive options for the Borrowdale Valley. It provides information appropriate for the drafting of Flood Defence Consent (formerly Land Drainage Consent) applications and what sites / actions are considered priority.

Members of the local farming community and landowners along with representatives of land management and regulatory authorities (National Trust, Environment Agency, National Farmers Union, Natural England and the Lake District National Park Authority) acted as the steering group for this work. Within the report they are referred to as the Borrowdale Group.

The conclusion of the report was as follows:

“The river channels of the Borrowdale Valley clearly display the evidence of hundreds of years of modification and intervention: in response to a desire and need to improve the productivity of the adjacent valley floor farmland. Channel straightening, dredging and bank reinforcing has improved land drainage and helped develop a thriving farm-based community within the valley. However, over the last 10 to 15 years, tighter environmental control and changing national flood defence policy have lead to changes in the way landowners and managers are able to maintain and control the river channel. Combined with recent extreme flood events in the northwest of England, river channels in Borrowdale have accumulated sediment and become less effective at conveying flood waters within their banks. The local farming community and land managers are becoming increasingly concerned that without immediate intervention, the farming livelihoods will become unsustainable as flooding has an increasingly detrimental effect on valuable farming land.

A catchment management plan has been prepared which identifies key areas where flood related issues are most acute and presents a suite of reactive management actions to start solving some of the key problems immediately. In addition, it presents a number of proactive management actions that aim to deliver long-term, sustainable solutions that work with natural river processes. Both approaches within this plan have been developed to provide maximum effectiveness in terms of tackling flooding and related impacts, but also focusing on the regulatory requirements to preserve and enhance the natural environment within a SSSI/SAC and to deliver WFD ecological objectives.

Nine hotspots have been identified within the Borrowdale Valley and these have been given a management priority classification. Furthermore, management actions within each hotspot have been assessed and prioritised according to a set of criteria, providing land owners and managers information to establish a management action programme. A very broad indication of likely costs to implement each action is also provided. Additionally, information to aid Flood Defence Consent applications and best practice guidance is presented.

Hotspot management activities include:

- Gravel skimming
- Bank protection maintenance

Borrowdale River Management Plan

- Vegetation management
- Stock fencing modifications
- Bridge re-design.

In contrast to the largely reactive management of hotspots an additional approach that delivers longer-term solutions and tackles the source of the issues, include:

- Sediment source control (gully planting)
- Natural channel recovery
- Assisted channel recovery
- Significant channel restoration.

These activities will require extensive planning and will generally be more expensive. However, initiating these actions within the next year or two and in parallel with the more reactive approaches to river management, the benefits they deliver will negate the need for extensive

intervention in the future. Many activities that provide only a short-term cure and may have limited ecological or additional environmental benefit, as well as possibly being a burden on owners and managers will hopefully, in time, be no longer required.”

Environment Agency Position

The primary funding mechanism available to the Environment Agency to reduce the impact of flooding is through access to HM Treasury allocated Flood Defence Grant in Aid. This funding is primarily aimed to reducing the risk of flooding to property. However, environmental, business and wider considerations do form a component of the prioritisation process.

The protection of farmland does not fall within the remit of this funding mechanism.

Borrowdale is representative of the disparate nature of many rural communities within Cumbria, and as such it remains a high priority area for Environment Agency local teams. The Environment Agency will continue to work with the Borrowdale community and partners, and continue to explore innovative funding opportunities.

Please see recommended actions in Section 9.

Appendix 7: Useful contacts and links

Cumberland Council (Local Flood Risk Management):

LFRMS@cumberland.gov.uk, **www.cumberland.gov.uk**, tel: 01228 221330

Cumberland Council (Highways):

Highways@cumberland.gov.uk

www.cumberland.gov.uk, tel: 0845 609 6609

Out of hours emergencies should be reported via the Police on 101

United Utilities: **www.unitedutilities.com**, tel: 0845 746 2200

Carlisle City Council: tel: 01228 817000

Flood and Water Management Act 2010:

<http://www.legislation.gov.uk/ukpga/2010/29/contents>

Water Resources Act 1991:

<http://www.legislation.gov.uk/all?title=water%20resources%20act>

Land Drainage Act:

<http://www.legislation.gov.uk/all?title=land%20drainage%20act>

Highways Act 1980:

<http://www.legislation.gov.uk/all?title=highways%20act>

EA – ‘Living on the Edge’ a guide to the rights and responsibilities of riverside occupation:

<http://www.environment-agency.gov.uk/homeandleisure/floods/31626.aspx>

EA – ‘Prepare your property for flooding’ how to reduce flood damage including flood protection products and services:

<http://www.environment-agency.gov.uk/homeandleisure/floods/31644.aspx>

Translation services

If you require this document in another format (e.g. CD, audio cassette, Braille or large type) or in another language, please telephone 01228 606060.

আপনি যদি এই তথ্য আপনার নিজের ভাষায় পেতে চান তাহলে অনুগ্রহ করে **01228 606060** নম্বরে টেলিফোন করুন।

如果您希望通过母语了解此信息，
请致电 **01228 606060**

**Jeigu norétumète gauti šią informaciją savo kalba,
skambinkite telefonu 01228 606060**

**W celu uzyskania informacji w Państwa języku proszę
zatelefonować pod numer 01228 606060**

**Se quiser aceder a esta informação na sua língua,
telefone para o 01228 606060**

**Bu bilgiyi kendi dilinizde görmek istiyorsanız lütfen
01228 606060 numaralı telefonu arayınız**