

# Grasmere

## Flood Investigation Report



Stock Lane, 5<sup>th</sup> December 2015

**Flood Event 5-6<sup>th</sup> December 2015**

This flood investigation report has been produced by the Environment Agency as a key Risk Management Authority under Section 19 of the Flood and Water Management Act 2010 in partnership with Cumbria County Council as Lead Local Flood Authority.

Version	Prepared by	Reviewed by	Approved by	Date
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# Executive Summary

As a result of Storm Desmond, there was a period of prolonged, intense, rainfall across Northern England during the 5th and 6th of December 2015. The rainfall fell on already saturated catchments, which led to high river levels and flooding throughout Cumbria.

In response to the flood event, this *Flood Investigation Report* was developed by the Environment Agency as a key Risk Management Authority (RMA), working in partnership with Cumbria County Council as the Lead Local Flood Authority. The report, as required by Section 19 of the Flood and Water Management Act 2010, provides details on the flooding that occurred in Grasmere on the 5th and 6th of December 2015. The report refers to several sources of data including information provided by affected residents, site visits, surveys of the area, data collected by observers, and river and rainfall telemetry during the flood event. This data has been compiled by CH2M, specialist consultants in flood risk management, who have also commented on the mechanisms that led to the flooding and made recommendations for managing flood risk going forward.

Approximately 90 properties were directly affected by the flooding in and around Grasmere, as a result of high water levels in the River Rothay, Easedale Beck, Greenhead Gill and Grasmere lake (south of the village). Many properties, including St Oswald's Church, experienced flooding for the first time. This report indicates the likely causes of flooding and associated flow routes within the village.

A draft version of the Grasmere Flood Investigation Report was published online in July for public consultation. Following the draft publication, a public meeting chaired by Cumbria County Council was held in Grasmere on the 5<sup>th</sup> July, where the Environment Agency formally presented the report to the local community. Other Risk Management Authorities were also present at the meeting to answer any questions raised during a question and answer session following presentation of the report. Through the public meeting and local consultation with the community, including with the Grasmere Flood Action Group, a range of feedback has been provided on the report. The Environment Agency have reviewed this feedback and, where appropriate, updated the Final version of the report to reflect the required amendments.

Please note that references to left and right bank in this report are for the observer looking downstream with the flow of water.

In response to the flooding, a number of community meetings have taken place, and these will continue in order to ensure that all those affected have the opportunity to contribute ideas for reducing the flood risk in their area of the village.

Any additional information that residents and others can provide to the Environment Agency and Cumbria County Council to help develop our understanding of the flooding is welcomed. A lot of information has already been provided, much of which has been used to inform this report. The scale of this report means that not every piece of information can be incorporated into the document. Any additional information should be provided to;

<http://www.cumbria.gov.uk/planning-environment/flooding/floodriskassessment.asp>

# Introduction

Under Section 19 of the Flood and Water Management Act (2010) Cumbria County Council, as Lead Local Flood Authority (LLFA), has a statutory duty to produce Flood Investigation Reports for areas affected by flooding. Section 19 of the Flood and Water Management Act states:

- (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 carries out an investigation under subsection (1) it must —*
- (a) publish the results of its investigation, and*
  - (b) notify any relevant risk management authorities.*

This section of the Act leaves the determination of the extent of flood investigation to the LLFA. It is not practical or realistic for Cumbria County Council to carry out a detailed investigation into every flood incident that occurs in the County, but every incident, together with basic details will be recorded by the LLFA.

Only those with 5 or more properties/businesses involved will have investigations published. An investigation will be carried out, and a report prepared and published by the LLFA when the flooding impacts meet the following criteria:

- where there is ambiguity surrounding the source or responsibility of flood incident,
- internal flooding of one property that has been experienced on more than one occasion,
- internal flooding of five properties has been experienced during one single flood incident and
- there is a risk to life as a result of flooding.

As a flood Risk Management Authority (RMA), the Environment Agency have partnered with Cumbria County Council (CCC) to produce the 53 flood investigation reports across Cumbria.

## Scope of this report

This Flood Investigation Report **is**:

- an investigation on the what, when, why, and how the flooding took place resulting from the 5<sup>th</sup>-6<sup>th</sup> December 2015 flooding event and
- a means of identifying potential recommendations for actions to minimise the risk or impact of future flooding.

This Flood Investigation Report **does not**:

- interpret observations and measurements resulting from this flooding event. Interpretation will be undertaken as part of the subsequent reports,
- provide a complete description of what happens next.

The Flood Investigation Reports outline recommendations and actions that various organisations and authorities can do to minimise flood risk in affected areas. Once agreed, the reports can be used by communities and agencies as the basis for developing future plans to help make areas more resilient to flooding in the future.

For further information on the S19 process, including a timetable of Flood Forum events and associated documentation, please visit the County Council website at:

<http://www.cumbria.gov.uk/floods2015/floodforums.asp>

To provide feedback on the report please email [LFRM@cumbria.gov.uk](mailto:LFRM@cumbria.gov.uk).

## Flooding History

The earliest record of flooding affecting Grasmere is from Parish records, which report flooding in the 1670's. The records also state that following the flooding Stock Bridge was rebuilt with a new arch and larger span. The next recorded flooding was in August 1967, when a summer storm caused flooding in the village. On the 7<sup>th</sup> and 8<sup>th</sup> January 2005, the storm that caused widespread flooding across Cumbria led to flooding from the River Rothay in Grasmere, affecting properties around White Bridge. In October 2008 a small number of properties were flooded in Grasmere, again due to high levels on the River Rothay affecting properties in the White Bridge and Stock Lane areas. Easedale Beck also threatened to affect properties in The Croft area, however measures taken by residents prevented any properties flooding. In November 2009, the then-record rainfall event that caused further widespread flooding across Cumbria led to high river levels on the River Rothay and Easedale Beck which again impacted upon properties in Grasmere. Localised surface water flooding also occurred in the village in 2013.

# Event background

This section describes the location of the flood incident and identifies the properties that were flooded.

## Flooding Incident

Grasmere is located in the South Lakeland District of Cumbria. Grasmere is a small village, with an estimated population of 1440 people with an economy that is largely based on the tourist industry. Figure 1 shows the location of Grasmere and Figure 2 shows the local river network and lakes downstream of the village.

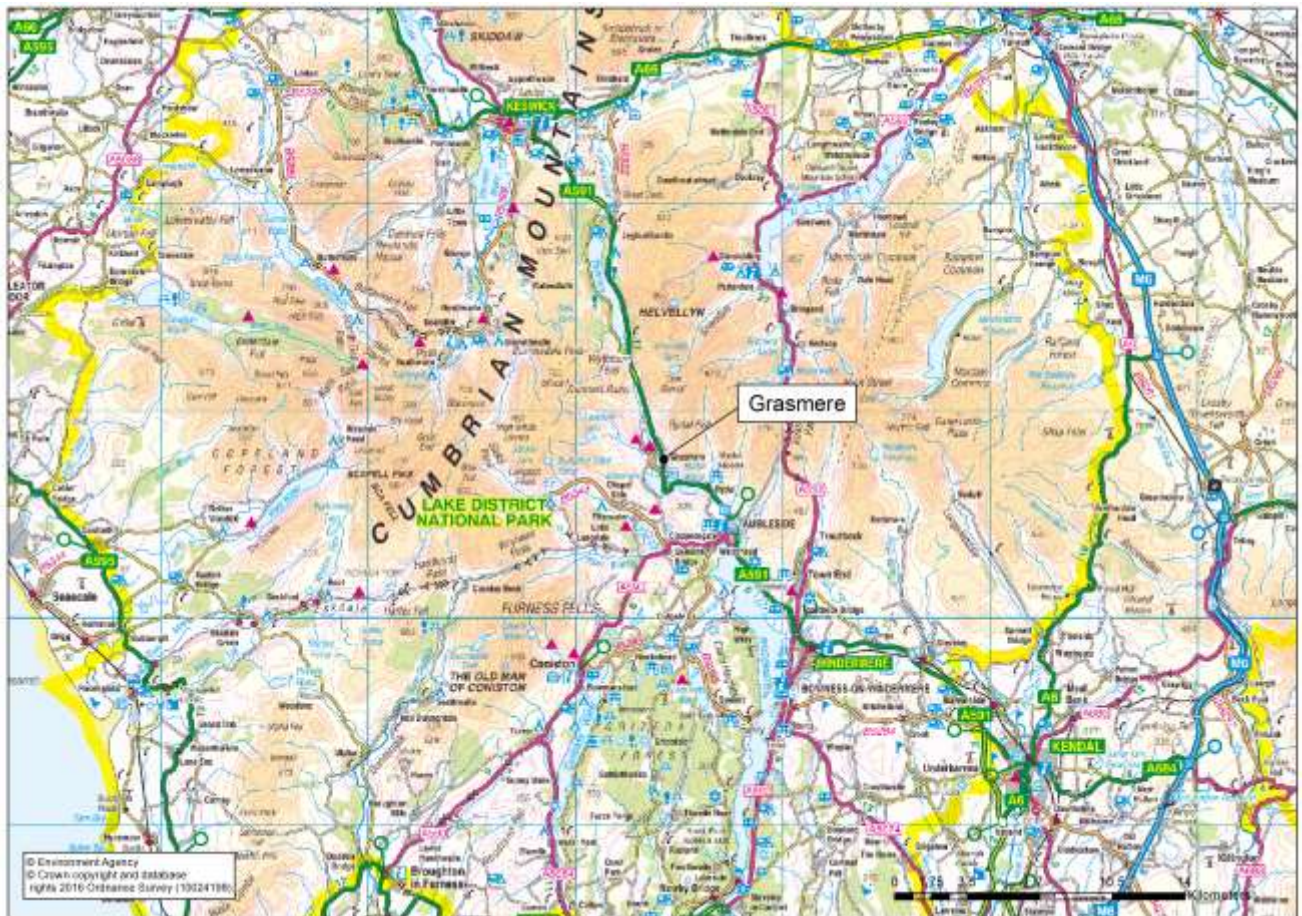


Figure 1 - Location of Grasmere

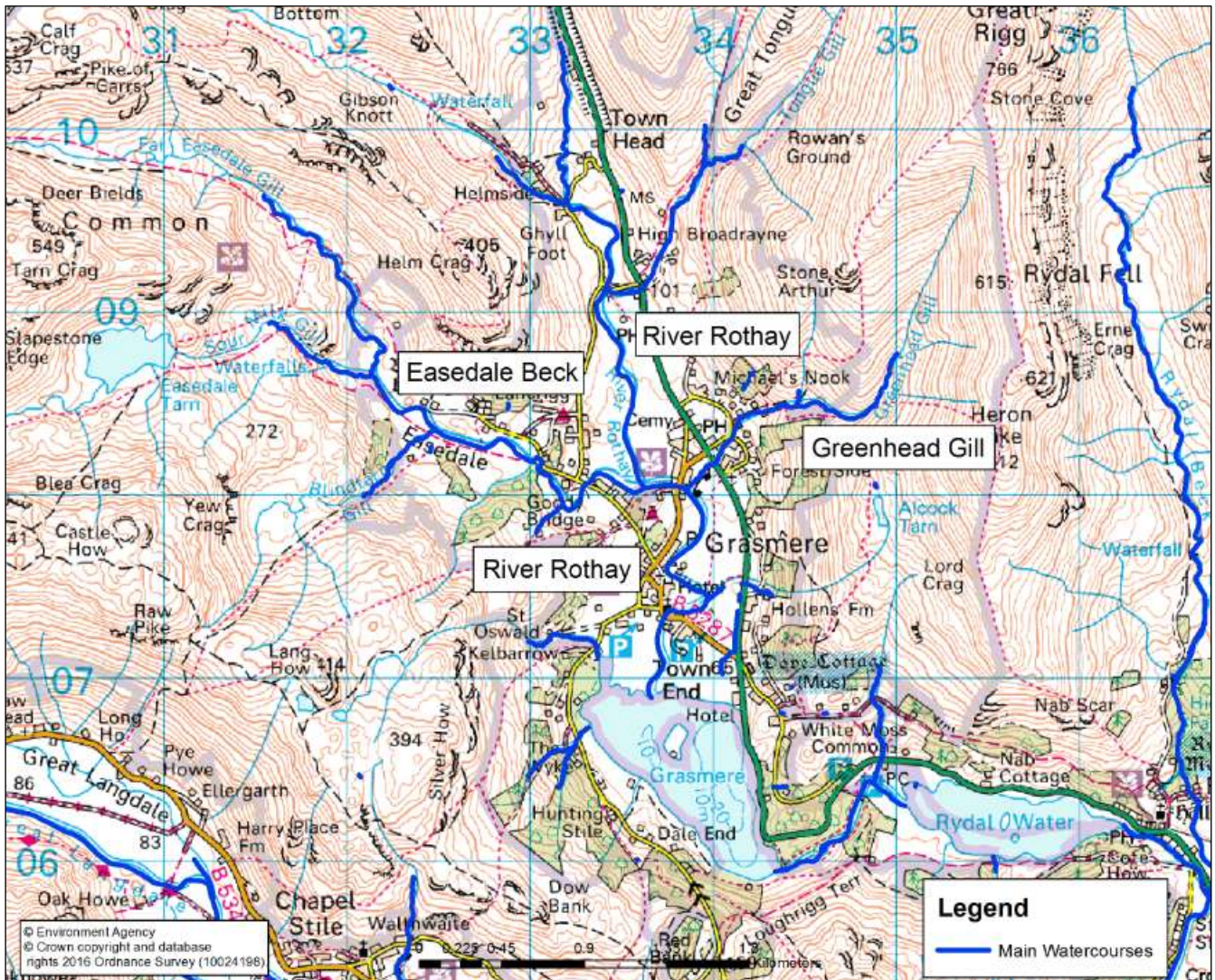


Figure 2 - Grasmere River Network

Due to its position within the floodplains of the River Rothay and Easedale Beck, parts of Grasmere lie within Flood Zone 3 (1% Annual Exceedance Probability or AEP) and are therefore at risk of fluvial flooding (see Figure 3). Parts of the village also lie within Flood Zone 2 (0.1% Annual Exceedance Probability or AEP). The village is also at risk from other sources of flooding, including surface water (see Figure 4).



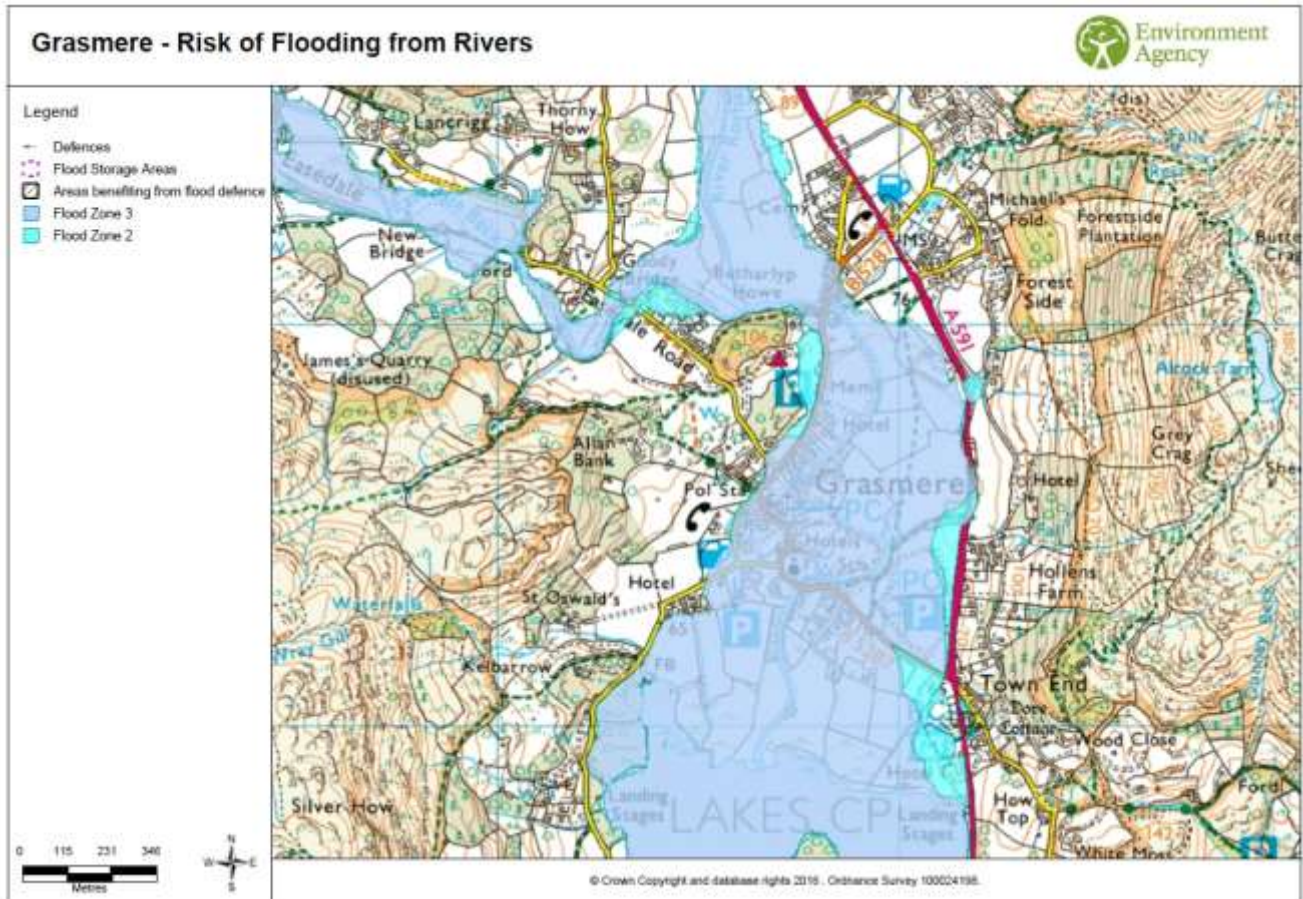
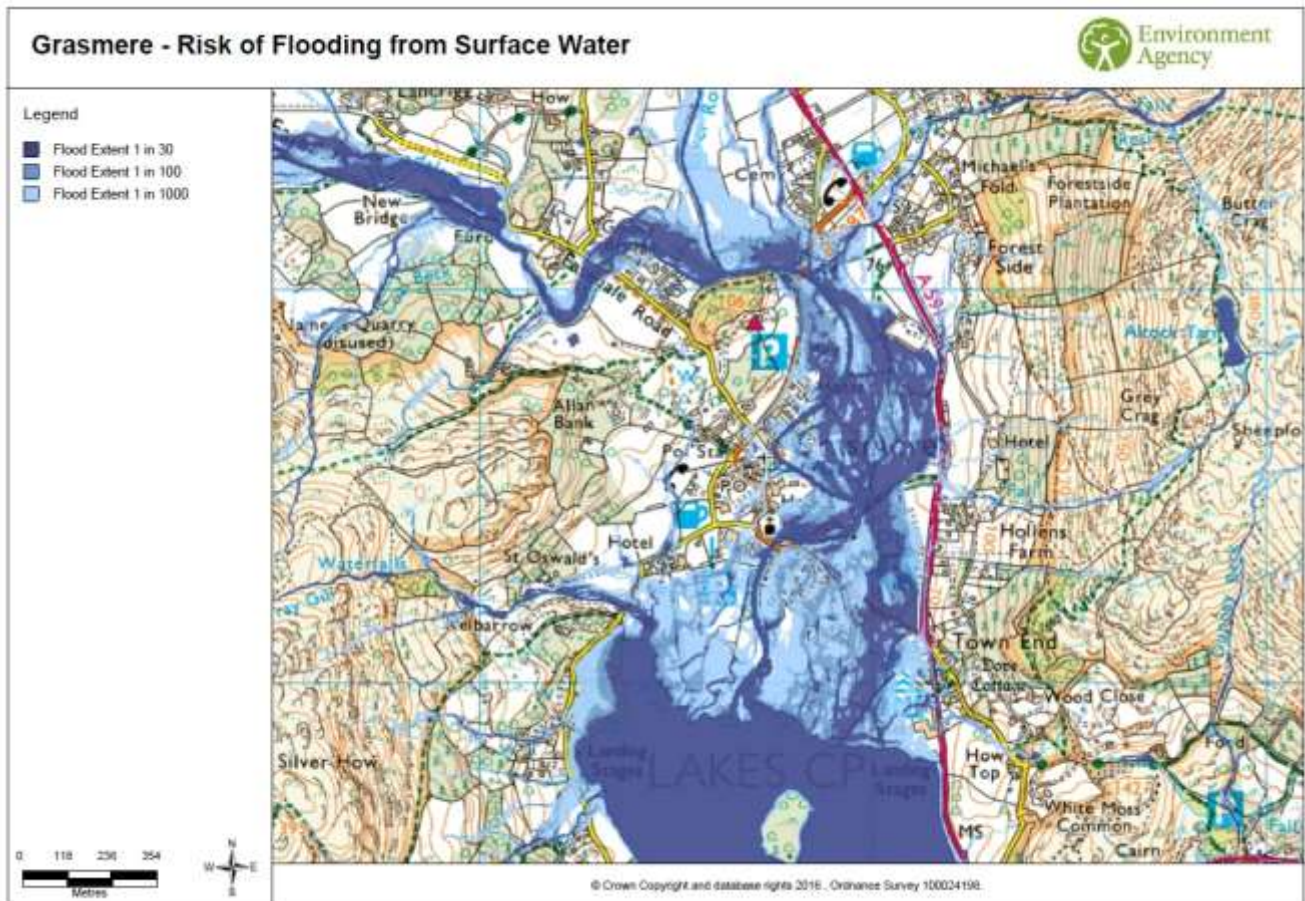


Figure 3 - Indicative risk of flooding to Grasmere from rivers (fluvial)



**Figure 4 - Areas in Grasmere at risk of surface water flooding**

On 5th and 6th December 2015, approximately 90 properties in Grasmere were affected by flooding. This flooding can be attributed to a record-breaking rainfall event from Storm Desmond, falling onto already saturated catchments. The storm led to widespread flooding from overland surface water flow, the River Rothay, Easedale Beck and Greenhead Gill aggravated by landslides that occurred in the north-east area above the village. These landslides led to a significant amount of debris in Greenhead Gill that was then transported down into the River Rothay as shown in Figure 5. The material deposited along the river corridors reduced the flow capacity of the river channels, particularly in the proximity of constrictions such as bridges and culverts.

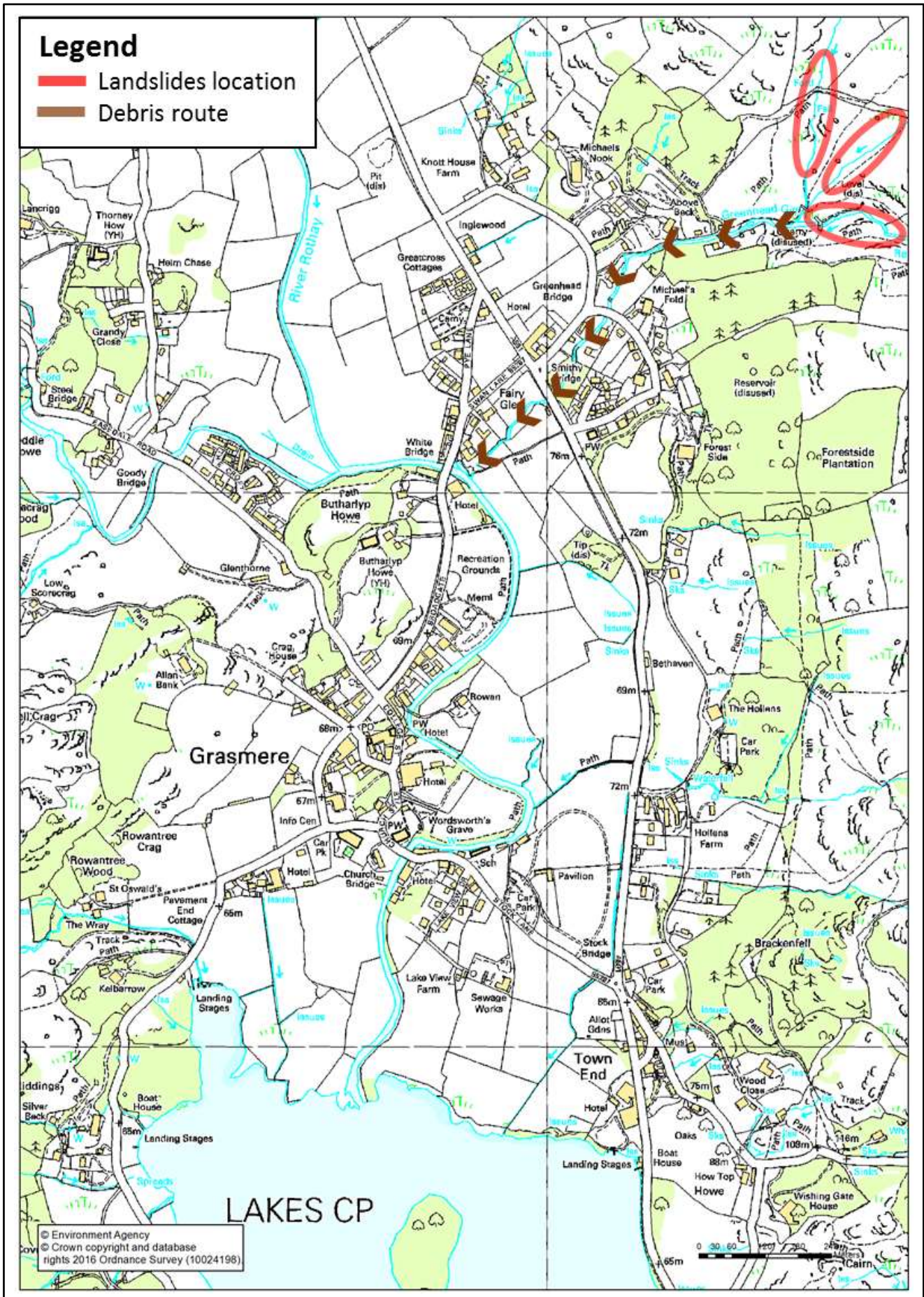


Figure 5 - Landslides in the upstream Greenhead Gill catchment

Figure 6 shows the approximate extent of the flooding.

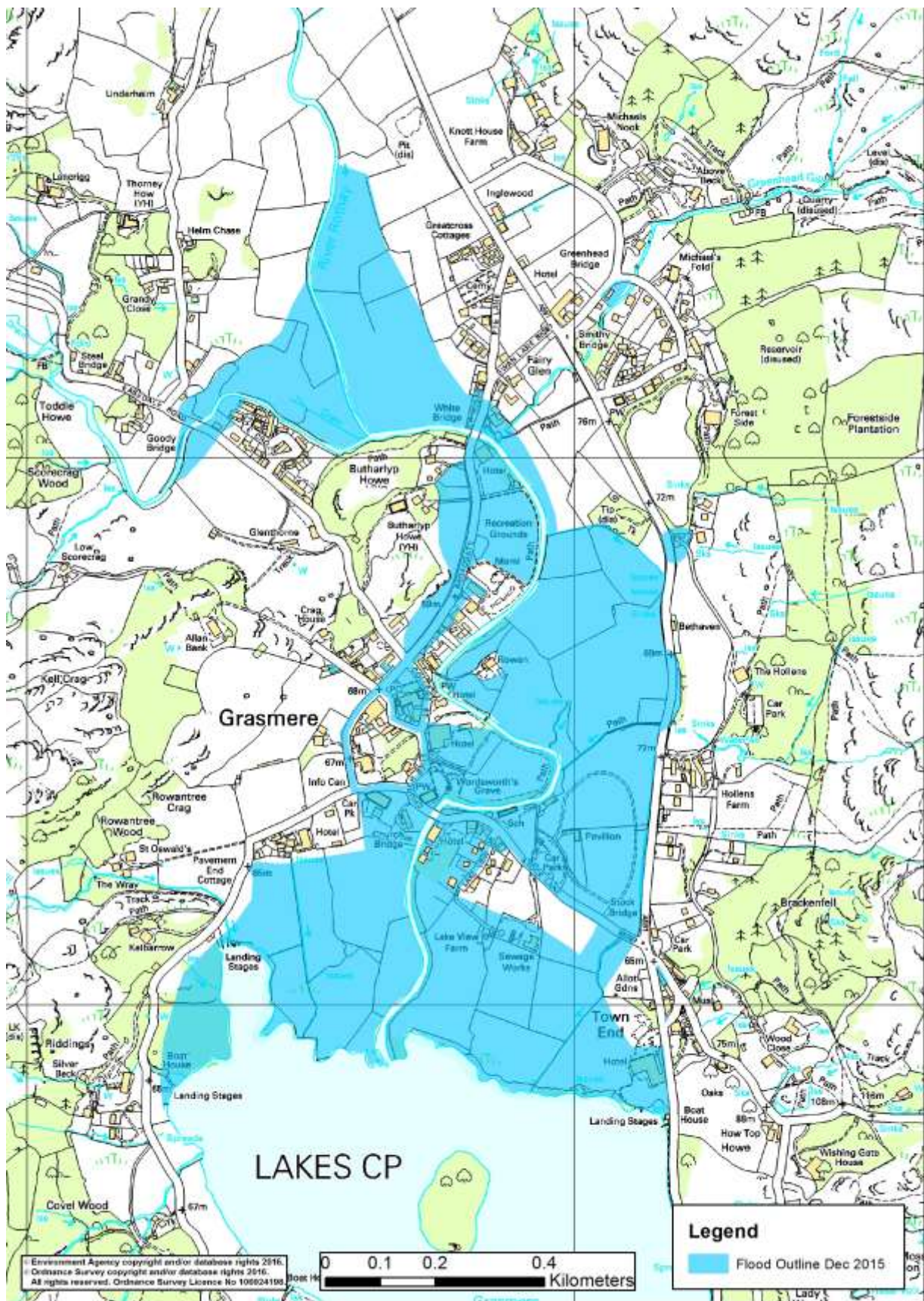


Figure 6 - Extent of Flooding in Grasmere on 5-6<sup>th</sup> December 2015

## Existing Flood Defences

There are currently no formal flood defences in Grasmere. Along the banks of the River Rothay there are some areas of raised ground, made from deposits of excavated channel material that have vegetated over time, however these features are not structurally designed to offer a formal standard of flood protection. Other informal flood defences in the village are made up of privately-owned retaining walls and property boundary wall structures adjacent to watercourses. These structures have not been designed as engineered structures to manage flood risk. Figures 7, 8 and 9 show typical examples of informal flood defences along the River Rothay in Grasmere.



**Figure 7 - Typical Informal Flood Defences on the River Rothay**



Figure 8 – Looking Upstream from Church Bridge at Riverside Retaining Walls on the River Rothay



**Figure 9 – A privately-owned, informal flood defence downstream of White Bridge (photo taken looking upstream). The wall apparently overtopped during the December 2015 flooding. (Note that the arch in White Bridge just visible on the right of the photo is for a mill race and watercourse that flows from Greatcross Cottages).**

# Investigation

This section details the history of flooding in the area, provides details of the rainfall event of 5th and 6th of December 2015 and appraises the likely causes of flooding. This investigation was carried out by the Environment Agency using data collected from surveys of the area and from the communities affected with help from Cumbria County Council and South Lakeland District Council. This report has compiled this data to provide a record of the flooding in Grasmere.

The report has been compiled by CH2M from the data collected. CH2M are a global civil engineering consultancy providing a full range of flood management consultancy services in the UK and overseas. CH2M's specialists have assessed the documented evidence, developed an understanding of how the flood event developed, and made recommendations for future flood management in the area.

## Rainfall Event

December 2015 was the wettest calendar month on record, with much of the northern UK receiving double the average rainfall for December. This also followed a particularly wet November with much of the soil within the Cumbria catchments already saturated. The record rainfall that fell in early December could therefore not be absorbed, leading to higher levels of runoff and exceptionally high river flows across the county.

From the 4th to 7th of December there was a period of prolonged and intense rainfall caused by Storm Desmond. Over this period, new 24 hour and 48 hour rainfall records were set for the UK. Both of these were within Cumbria and broke the previous records, also within Cumbria, set during the November 2009 floods.

Rainfall Period	Storm Desmond			Previous Record		
	Date	Location	Total rainfall (mm)	Date	Location	Total rainfall (mm)
24 hour rainfall	December 2015	Honister Pass	341.4	November 2009	Seathwaite	316.4
48 hour rainfall	December 2015	Thirlmere	405.0	November 2009	Seathwaite	395.6

**Table 1: UK Rainfall Records**

Two rain monitoring gauges in the Grasmere area are Grasmere Tannercroft and Dale Head Hall – the location of which are shown in Figure 10.

The Grasmere Tannercroft rain gauge, which is situated within Grasmere village, recorded a total of 261.1mm of rainfall from 9am on the 4<sup>th</sup> December to 9am on the 6<sup>th</sup> December. This exceeded the previous highest recorded 48 hour total of 240.7mm from the 18<sup>th</sup> and 19<sup>th</sup> November 2009 - a rainfall event which also led to widespread flooding across Cumbria. It is worth noting that the fourth highest recorded 48 hour rainfall total at this gauge was recorded on the 14<sup>th</sup> & 15<sup>th</sup> November 2015, which emphasises that local catchments were saturated prior to the record rainfall from Storm Desmond in early December.



The Dale Head Hall rain gauge, which is situated just to the north of Grasmere on the eastern shore of Thirlmere, recorded a total of 329.8mm of rainfall from 9am on the 4<sup>th</sup> December to 9am on the 6<sup>th</sup> December. A maximum 24 hour total of 261.6mm of rainfall was recorded at this gauge between 22:00 on the 4<sup>th</sup> December and 22:00 on the 5<sup>th</sup> December. This again exceeded the previous highest-recorded 24 and 48-hour totals at the Dale Head Hall rain gauge of 186.8mm and 241.6mm, recorded during the November 2009 storm event.

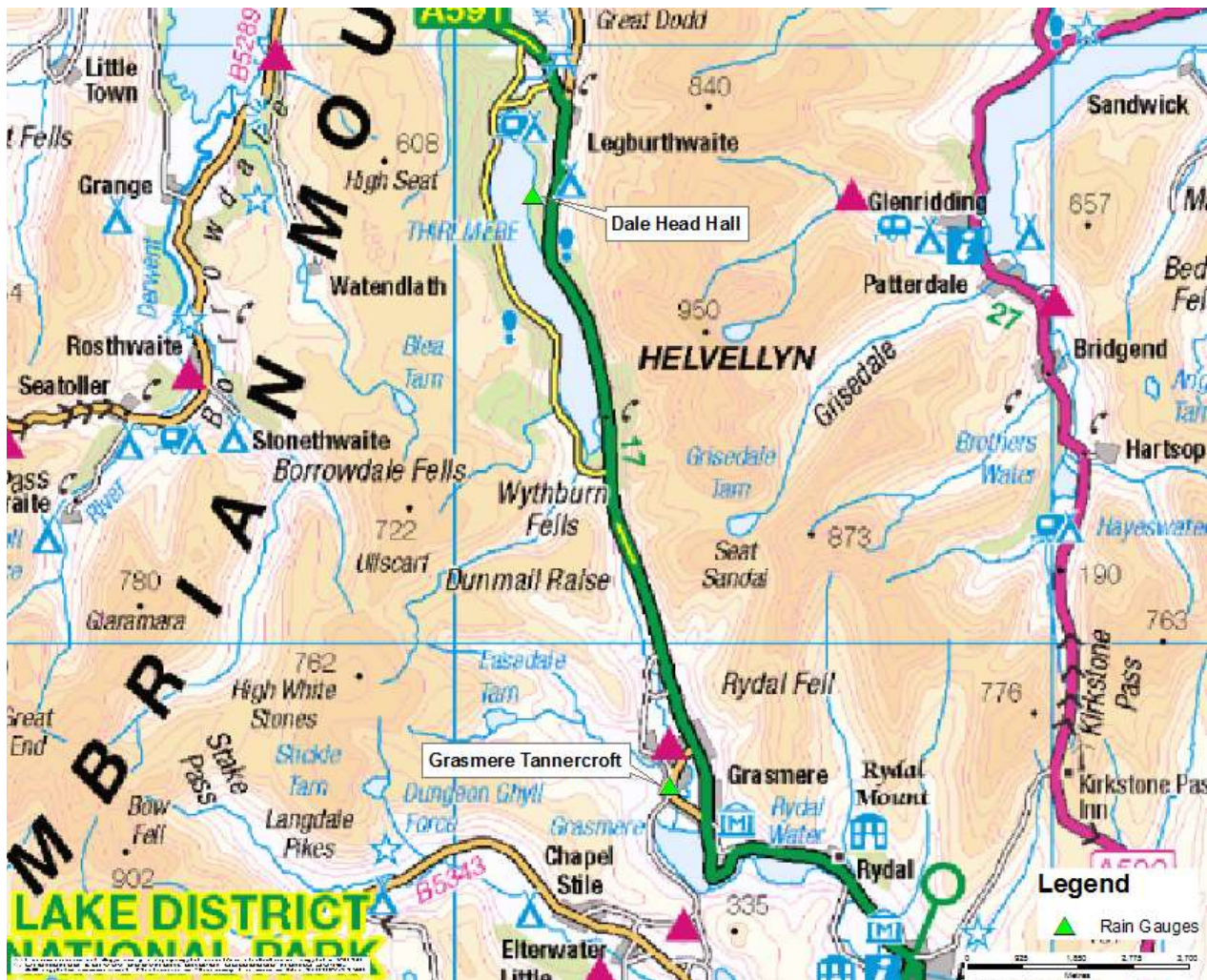


Figure 10 - Location of Rain Gauges

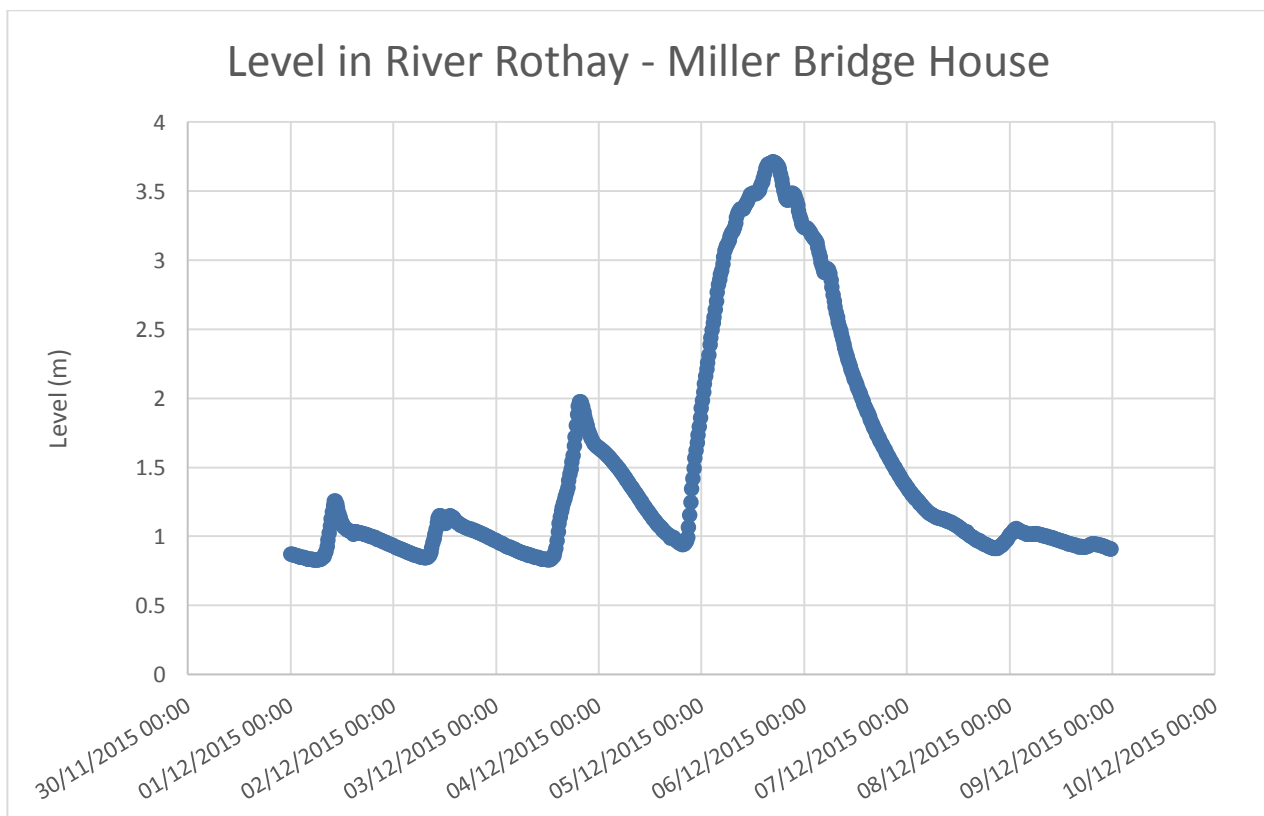
The nearest river monitoring gauge is located on the River Rothay at Miller Bridge House, located approximately 6 km downstream of Grasmere. Between the village and the gauge station are located two small lakes and the confluence of three becks which will impact on the timing of the peak flow compared to that observed at Grasmere village.

A peak level of 3.714m (44.148mAOD) was recorded at Miller Bridge House on the River Rothay during 5<sup>th</sup> December 2015. This exceeded the previous highest recorded level of 3.517m (43.951mAOD), recorded during the November 2009 flood event. Table 2 shows the highest recorded peak flood levels at the Miller Bridge House gauge.

Gauging Station	Highest Recorded Gauging Dates & Levels		
	December 2015	November 2009	January 2005
Miller Bridge House, River Rothay	3.714m	3.517m	3.432m

**Table 2: Miller Bridge House, River Rothay, Record Gauged Levels**

Figure 11 shows the levels recorded by the Miller Bridge House river monitoring gauge. This shows the time and duration of the flood event on the 5<sup>th</sup> and 6<sup>th</sup> of December, and illustrates the magnitude of the flood event.



**Figure 11 - Levels Recorded at Miller Bridge House Gauging Station on the River Rothay from 01/12/2015 to 08/12/2015**

## Map of Flow Routes

There were a number of flood flow routes during the event and for investigation purposes, the flooded areas have been divided into the three sub areas as shown in Figure 12. The main flow routes are shown in Figure 13.

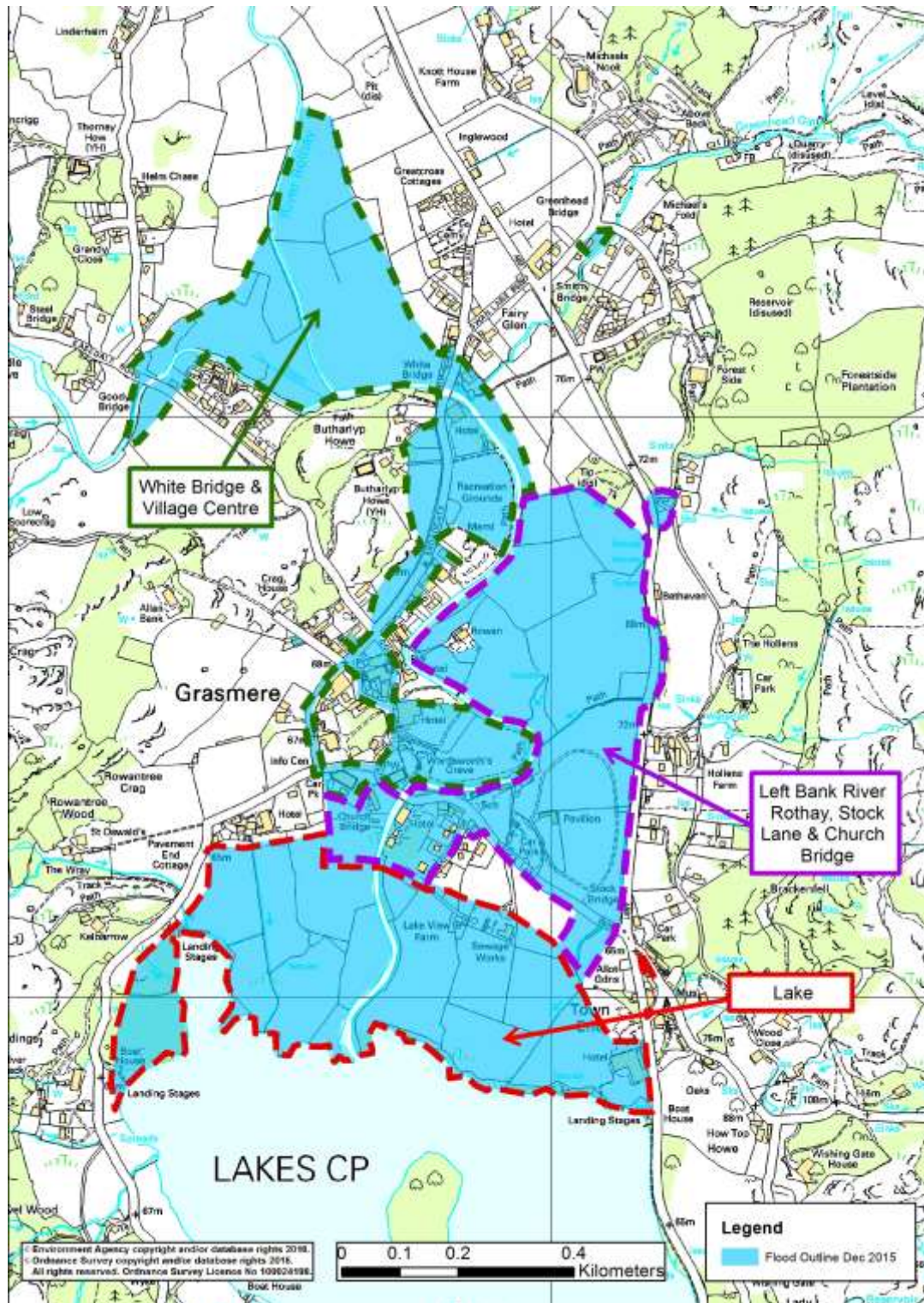


Figure 12 – Sub-Areas Referenced in Report

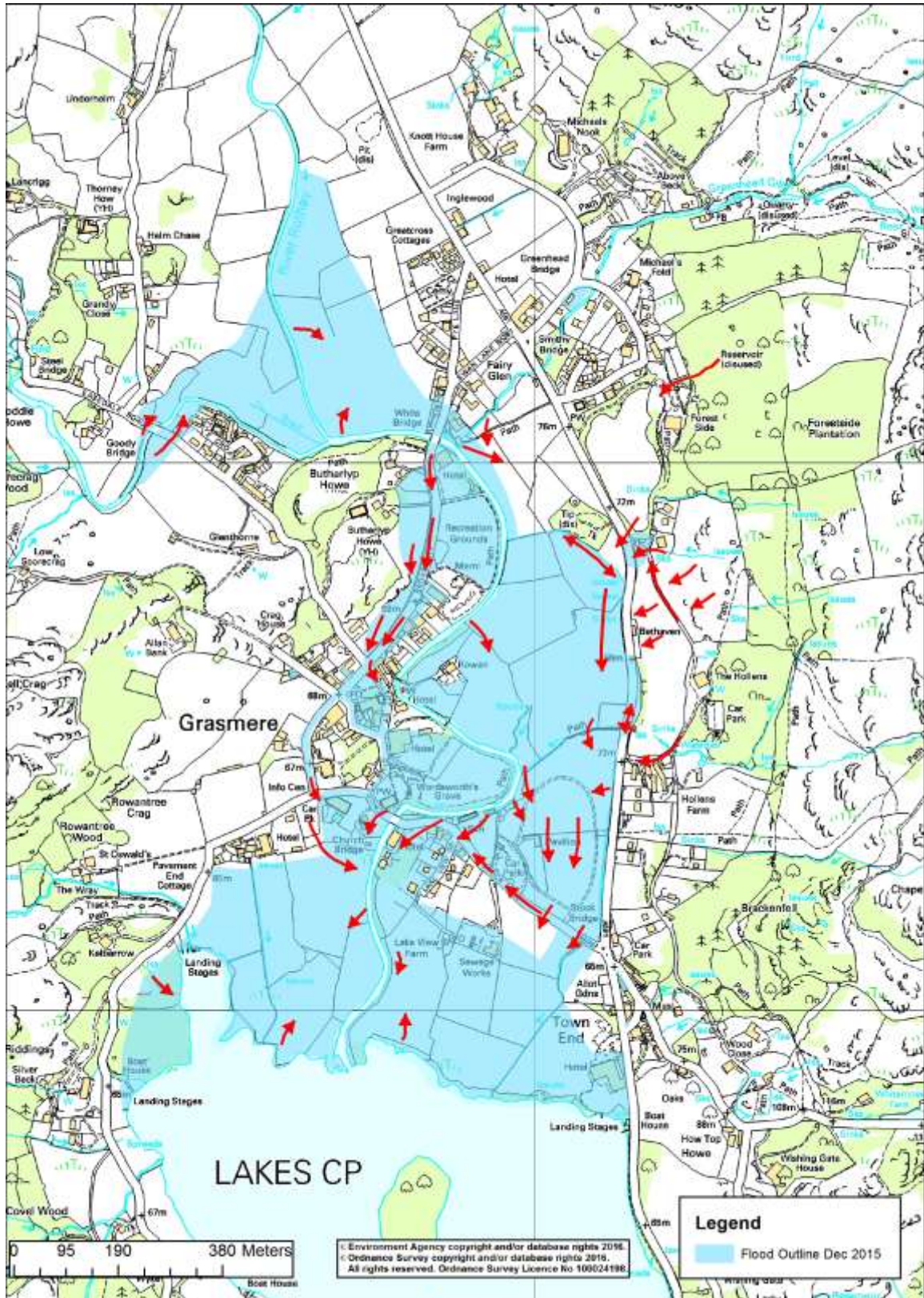


Figure 13 - Observed Flow Routes

Flood flow routes in these areas, the likely causes of flooding and the impacts of the flooding are discussed in the following section. It is important to note that there may also have been other flooding mechanisms that were not observed or recorded during this investigation

## Impacts and Likely Causes of Flooding

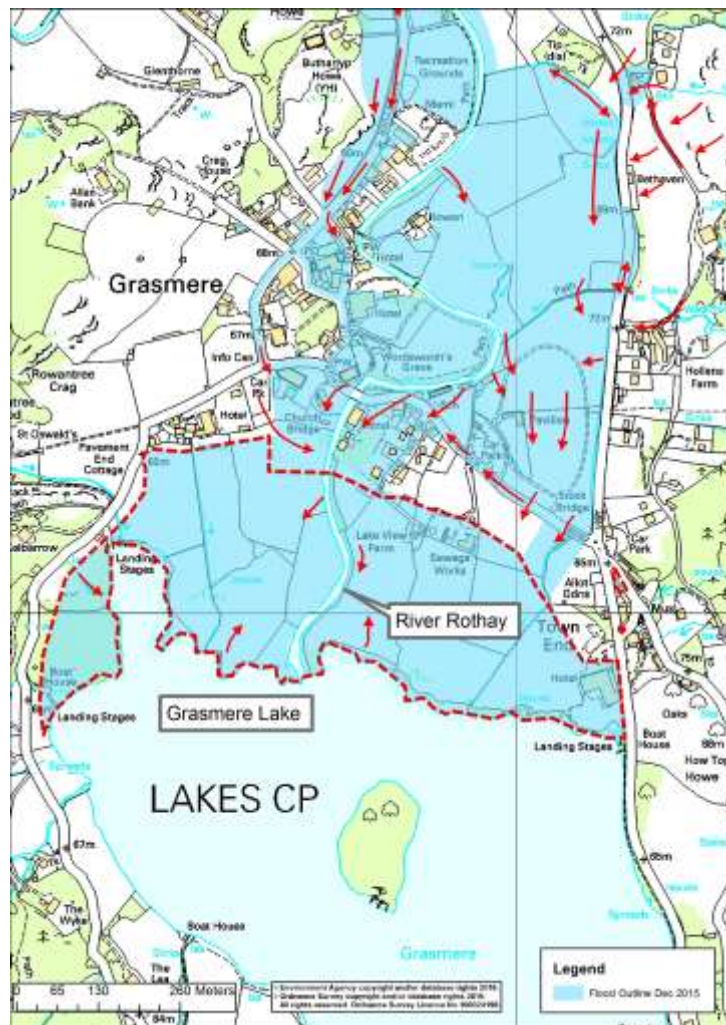
### Timeline

There is a lack of information and evidence available on the timing and sequence of flooding in Grasmere. Table 3 below summarises the key timing information available for the flood event in Grasmere.

4 <sup>th</sup> December	Event
15:22	Flood Alert Issued
5 <sup>th</sup> December	Event
16:45-17:00	River Rothay peaks at Miller Bridge House – 3.714m.

**Table 3: Timeline of key events**

### Lake Area



**Figure 14 - Lake Area Flow Routes**

This area is situated to the south of the village immediately upstream of the confluence of the River Rothay and Grasmere lake.

Information regarding the flooding in this area has been identified from a report submitted to the Environment Agency by the residents of Victoria Cottage which is situated immediately downstream of the Bridge House Hotel.

Figure 15 shows a photo taken from Victoria Cottage at 10:46am on 5<sup>th</sup> December 2015. Taken several hours before the peak of the River Rothay, the photo clearly shows that the River Rothay has exceeded its channel capacity and is spilling onto the floodplain downstream of the village, merging with the rising waters of Grasmere lake. The lake level can clearly be seen in the top left-hand corner of the photo.



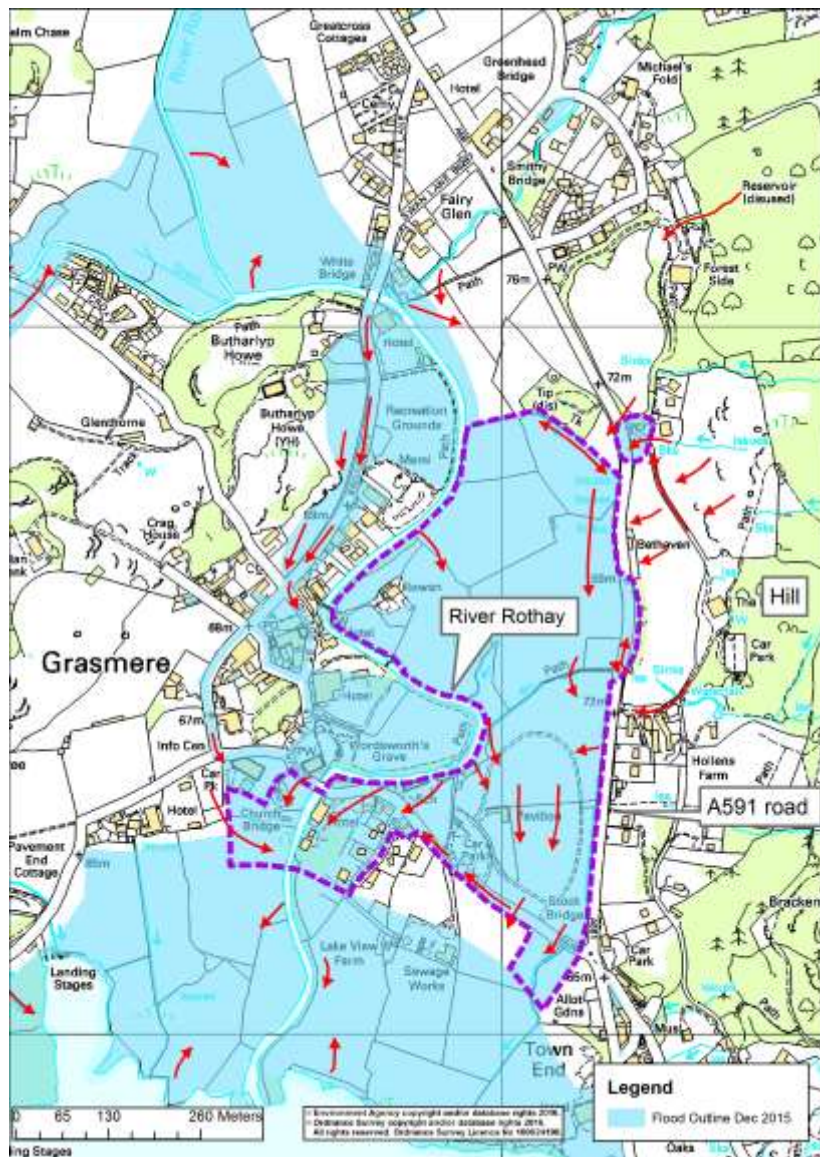
**Figure 15 – Photo taken from Victoria Cottage at 10:46am on 5<sup>th</sup> December 2015.**

The extent of flooding from the lake was determined by a debris line (also known as a ‘wrack’ line) in the fields downstream of Stock Lane and Lake View Drive during post-event data collection. The extent of flooding from the lake was confirmed by local farmer David Thompson, who farms the fields in this area. The wrack line from the lake was clearly downstream of Lake View Drive, confirming that the flooding mechanism upstream of the lake area was from the River Rothay.

A handful of properties were affected by flooding in the Town End area adjacent to the A591. There are minor watercourses that flow through the Town End area that are culverted (piped) under the A591 and discharge into Grasmere lake downstream. It is believed that the culverts reached capacity during the flood event, with the resulting surcharging water and surface water in the area affecting the properties.



## Left Bank River Rothay, Stock Lane & Church Bridge



**Figure 16 - Flood Flow Routes in Left Bank River Rothay, Stock Lane & Church Bridge Sub-Area**

This sub-area contains the floodplain on the left bank of the River Rothay, including the Stock Lane and Church Bridge areas. This sub-area also includes the impacts of flooding from the steep hillsides to the east of the A591. Figure 16 shows this sub-area and approximate flow routes.

The predominant flooding mechanism in this area is from the River Rothay, which exceeded its channel capacity on the left bank throughout this sub-area during the December 2015 flood event. In addition, there was also significant overland flow from surface runoff originating from the steep hillside to the east of the A591, as well as flow from minor watercourses that flow off the hillside.

Figure 17 provides a graphic illustration of the significant floodplain flows on the left bank of the River Rothay. The photo was taken at 13:00 on 5<sup>th</sup> December 2015, with evident damage to field boundary walls due to the velocity of flows. The depth of water can also be seen at the boundary



wall breaches. The photo shows water flowing in a southerly direction on the floodplain, towards the Grasmere Sports Field and the B5287 Stock Lane. This flow route is illustrated further in Figure 19. Once the floodwater reached Stock Lane, it flowed in a westerly direction towards Lake View Drive and the area around Church Bridge due to the local topography - this is illustrated in Figure 20. Some floodwater was conveyed through Stock Bridge, which is situated to the eastern end of Stock Lane near the roundabout on the A591, which then joined floodwater in the 'Lake' sub-area downstream of Stock Lane.



**Figure 17 – Floodplain flows on the left bank of the River Rothay. The river channel is shown by the red line. © Mary & David Bass**



**Figure 18 – Damage to dry stone walls on left bank floodplain of the River Rothay due to flood water.**



**Figure 19 – Overland flow route across the floodplain towards Stock Bridge.**



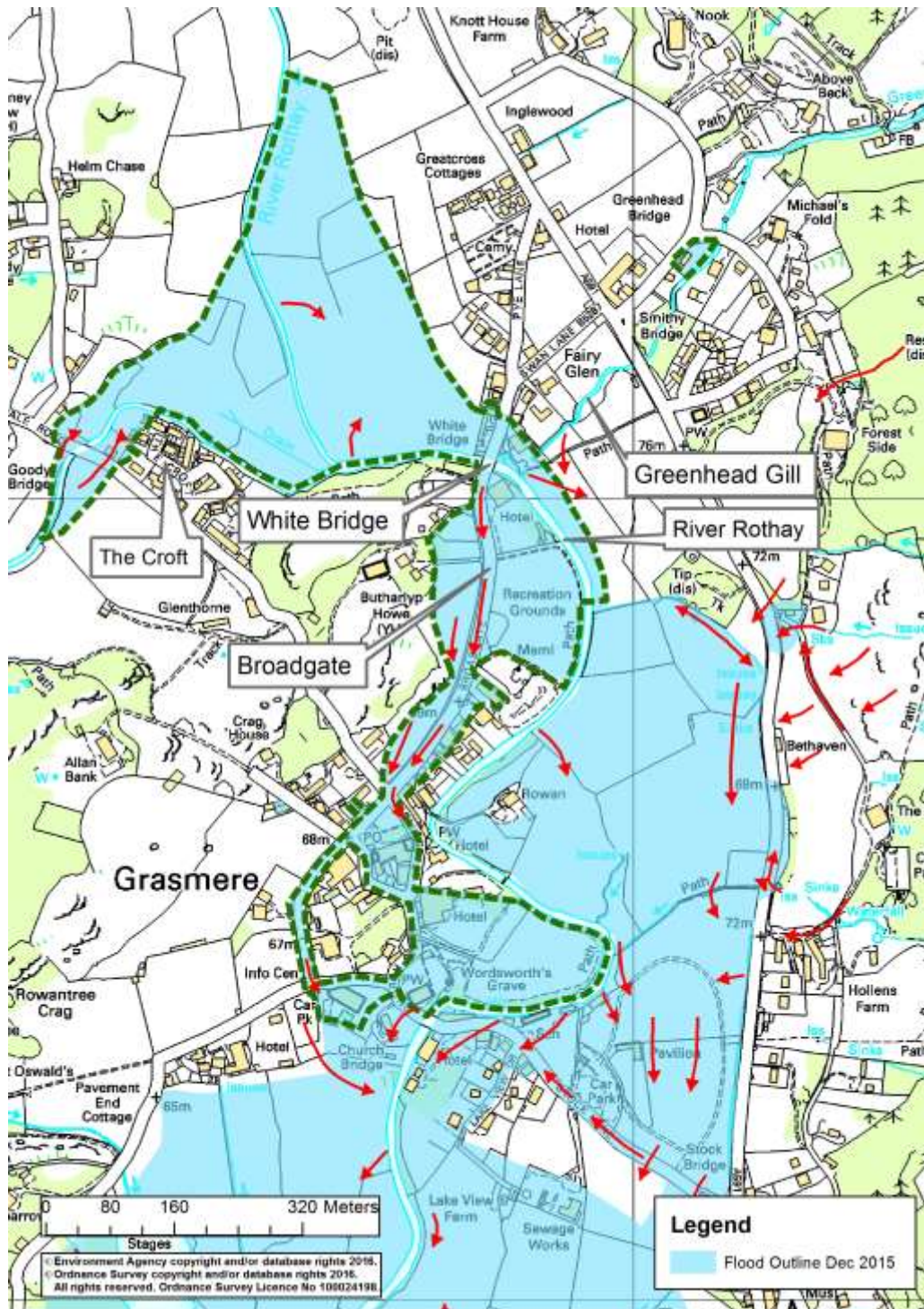
**Figure 20 – Flow down Stock Lane towards Church Bridge.**

The significant overland flow off the hillsides to the east of the A591, combined with flows from minor watercourses and surface water drainage systems, caused flooding on the A591 as water made its way in a westerly direction across the highway. Access tracks leading to properties on the hillside to the east of the A591 provided a conduit for surface water flow down the hillside. The residents of 'Bethaven', which is situated on an elevated plot parallel to the A591, observed significant overland flow down the hillside, with water then cascading onto the A591 below.

Information regarding the flooding mechanisms in the Bridge House Hotel area, downstream of Church Bridge on the left bank of the River Rothay, was provided to the Environment Agency in a report by the residents of Victoria Cottage. The report observes that flood water in the Bridge House Hotel area came from a number of directions. This included lateral overtopping on the left bank of the River Rothay downstream of Church Bridge, flow from across Stock Lane as a result of overtopping further upstream around the School and flow from the rear of properties on Lake View Drive.

The high river levels and velocity of water caused structural damage to several shops in this area as well as a retaining wall adjacent to the school. There was a significant amount of material deposited in the River Rothay as a result of the high flow velocities experienced during the event. Details on the subsequent removal of this material post-event by the Environment Agency is included in the Operational Response section.

## White Bridge & Village Centre



**Figure 21 - Flood Flow Routes in White Bridge & Village Centre Area**

This sub-area contains locations that were affected by flooding from the River Rothay, Greenhead Gill, Easedale Beck and overland surface water flows.

A small number of properties in The Croft estate, which is situated off Easedale Road to the north west of the village centre, were affected by flooding from Easedale Beck. An account of the flooding mechanisms in this area was given by the residents of Becksides, which is situated

immediately downstream of Goody Bridge on the right bank of Easedale Beck. Easedale Beck reportedly 'backed up' from Goody Bridge, flooding the fields situated on the left and right banks upstream of the bridge, before flooding across Easedale Road and towards The Croft estate. Residents took measures to prevent this flow from reaching properties in this area by using wood and sandbags to create a barrier, however this was breached by the force of the water which was estimated to be knee-depth. Flooding in this area resulted in damage to a United Utilities surface water outfall as well as damage to an informal flood defence embankment which provides protection to properties in The Croft.

Properties situated alongside Greenhead Gill, which is an ordinary watercourse that flows from the hillsides to the north east of the village and joins the River Rothay on its left bank downstream of White Bridge, were affected by a combination of erosion, deposition of material from landslides upstream and flooding. Due to the steep gradient of Greenhead Gill and the landslides that occurred in the upper catchment, the resulting high flow velocities experienced on the watercourse transported a significant amount of gravel and larger bed material into the lower reaches of the watercourse, filling the existing shallow river channel. In the immediate aftermath of the flood event, the Environment Agency excavated the deposited material from the lower reach of Greenhead Gill to re-establish the river channel. An example of these excavations in the lower reach of Greenhead Gill can be seen in Figure 22.



**Figure 22 – Excavations in the lower reaches of Greenhead Gill**

Downstream of White Bridge, the River Rothay overtopped its right bank and flooded onto Broadgate, with water then flowing in a southerly direction towards the College Street and Church Stile areas in the centre of the village. Figure 23, taken looking in a northerly (upstream) direction on Broadgate during the flood event, clearly shows this flood mechanism.

Prior to flooding from the River Rothay, property owners in the College Street area observed surface water flow down Butharlyp Howe. Surface water appeared to flow on Butharlyp Howe to the north-west of Broadgate, opposite the Recreation Grounds, in a southerly direction before entering College Street via a gated entrance at the junction of Broadgate and Easedale Road. A depth of one foot was observed flowing onto College Street from this flood mechanism.





**Figure 23 – Flooding on Broadgate, 5<sup>th</sup> December 2015. Photo taken looking north (upstream).**

## Environment Agency Flood Incident Response

The Environment Agency issued a Flood Alert for the Rivers Brathay, Rothay and Winstar catchments on Friday 4<sup>th</sup> December at 15:22. A Flood Alert provides advance notice of possible flooding to low lying land and roads, and also acts as an early notification that river levels are expected to rise and that the Environment Agency are monitoring the situation closely. There are currently no Flood Warning Areas for Grasmere, so during the December flood incident the Environment Agency updated the Flood Alert daily with relevant information.

In the immediate aftermath of the flood event the Environment Agency removed gravel and debris that had accumulated in the lower reach of Greenhead Gill. This was undertaken as emergency works to re-establish the river channel of Greenhead Gill, which had been in-filled by the extensive deposition of gravel and debris.

The Environment Agency also subsequently undertook gravel removal under emergency works on the River Rothay at four key sites of extensive deposition through the village. This gravel removal was undertaken from February to April, with high river levels hampering works through their duration. Figure 24 shows the location of the four gravel removal sites on the River Rothay, as detailed below:

Site 1 – School House/Reading Room area; approximately 200 tonnes removed.

Site 2 – Rear of Beck Allans Hotel; approximately 500 tonnes removed.

Site 3 – Rear of Broadgate Hall & car park; approximately 300 tonnes removed.

Site 4 – Downstream of White Bridge; approximately 300 tonnes removed.

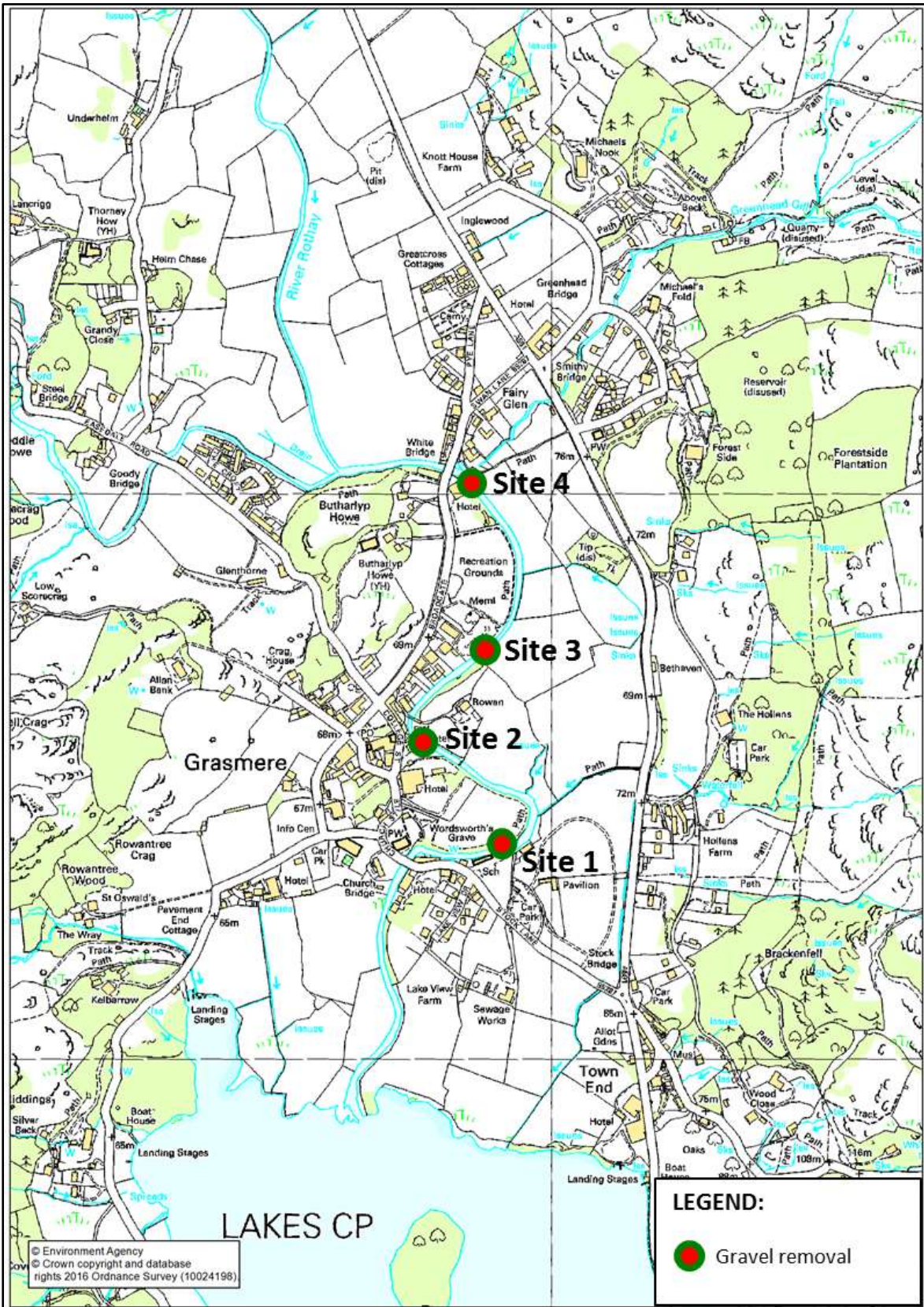


Figure 24 - Locations of Gravel Removal

## Maintenance Activities

The Environment Agency maintains flood risk management structures and sections of river channel where maintenance actively reduces the risk of flooding to people and property. Activities we undertake are summarised below:

- We conduct yearly visual inspections of flood defence embankments and walls and deliver a variety of maintenance tasks which include, as necessary:
  - Grass cutting,
  - Vegetation management,
  - Invasive species control,
  - Vermin control and
  - Expansion joint repairs.
  
- We deliver targeted maintenance on River Channels where the activity is beneficial to the reduction in flood risk. This could include:
  - Weed control,
  - Grass control,
  - Vegetation management,
  - Invasive non-native species control,
  - Gravel removal, when justified through investigation and survey.

# Recommended Actions

The following table details recommended actions for various organisations and members of the public to consider using the Cumbria Floods Partnerships 5 Themes: Resilience, Upstream Management, Strengthening Defences, Maintenance and Water Level Management Boards (WLMB's). Some of these recommendations may have already been carried out and/or are ongoing.

Cumbria Floods Partnership Theme	Action by	Recommended Action	Timescale
Resilience	Cumbria Local Resilience Forum *	Review and update plans to enable homes & business to be better prepared for flooding & reduce the impacts of flooding. For example, review of evacuation procedures / emergency response.	2016
	Environment Agency, Cumbria County Council, United Utilities and Electricity North West.	To review the flood risk and resilience of critical transport, utility and power supply infrastructure, such as the A591. Investigate options to improve the highway drainage and flowpaths across the A591. The extended closure of the A591 to the north of Grasmere due to damage at Thirlmere had a major impact on the local economy in Grasmere.	2016/2017
	Lake District National Park Authority, Cumbria County Council and Environment Agency	Review Local Development Plans and Strategic Flood Risk Assessment to reflect current understanding of flooding	2016/2017
	Environment Agency	Work with the local community flood action group and residents to develop options to provide advance warning of possible flooding.	2016/2017
	Environment Agency & Local Community	Work with the Grasmere Flood Action Group to ensure that they are able to continue into the future. Continue to work with communities to establish network of Flood Action Groups to share learning and best practice.	Ongoing - 2016 Onwards
	Residents and South Lakeland District Council.	Implement flood resilience measures within flooded properties to reduce the impacts of future flooding. South Lakeland District Council is administering the Flood Recovery and Resilience Grants of up to £5000 per property to help people better protect their homes. A further £2000 top up grant can also be applied for from the Cumbria Flood Recovery Fund.	Closing date for grant applications is end of March 2017

Upstream Management	Cumbria Floods Partnership (CFP)	The CFP action plan will consider natural flood management options to reduce flood risk across the catchment. This may also include land use changes and/or flood storage.	Action Plan published Summer 2016
	Cumbria Floods Partnership (CFP), Farmers, Landowners, Community Groups, Trusts.	Explore opportunities for engineered and natural flood management solutions to be used upstream of Grasmere in order to 'slow the flow' and manage peak river levels.	Medium term (over next 5 years)
Maintenance	Environment Agency, United Utilities and Cumbria County Council	Carry out inspections and repairs to assets which may have been damaged during the flood event.	2016 (Environment Agency inspections completed)
	Environment Agency	Review the maintenance programme within the catchment in response to the flooding event of 2015. This will include developing a gravel monitoring strategy to manage gravel accumulation on the River Rothay through Grasmere.	2016/2017
	Environment Agency	Raise awareness and engage with community on gravel management activities.	2016/2017
	Environment Agency	A new Environment Agency system is being developed to make it easier for communities to understand what maintenance work is being carried out in their area. Improvements will show exactly when, where and what maintenance is being planned each year. Make sure that communities understand how they can access information on planned maintenance at: <a href="https://www.gov.uk/government/publications/river-andcoastal-maintenance-programme">https://www.gov.uk/government/publications/river-andcoastal-maintenance-programme</a>	2017
Strengthening Defences	Environment Agency	Investigate a range of possible options to provide an improved standard of flood protection to Grasmere.	2016/2017
	Environment Agency	Review modelling and forecasting data to ensure that models for the Rothay catchment reflect real conditions as accurately as possible and use this information to make any improvements to the flood warnings service. This will be used to inform future investment plans.	2016 (River Rothay catchment model completed)
	Cumbria County Council, United Utilities, and South Lakeland District Council	Review the performance of the existing drainage and sewerage systems during the event to better understand where improvements are required.	2016/2017

	Cumbria County Council & Environment Agency	Assess the impact of all the bridges in Grasmere on conveyance and investigate options to increase conveyancing capacity, taking into account the potential effects on downstream flood risk.	2016/2017
	Environment Agency	Review the influence of the weir structure at the downstream outlet of Grasmere lake to determine if alterations would provide any flood risk benefit.	2017

**Table 4: Recommended actions for consideration**

\*The Cumbria Local Resilience Forum includes emergency services, local authorities, Cumbria County Council, Environment Agency, Maritime Coastguard Agency and health agencies along with voluntary and private agencies. Under the Civil Contingencies Act (2004) every part of the United Kingdom is required to establish a resilience forum.

# Next Steps



# Appendices

## Appendix 1: Acronyms and Glossary

Acronym	Definition
EA	Environment Agency
CCC	Cumbria County Council
SLDC	South Lakeland District Council
LLFA	Lead Local Flood Authority
FLAG	Flood Action Group
LFRMT	Local Flood Risk Management Team
FWMA	Flood and Water Management Act 2010
LDA	Land Drainage Act 1991
WRA	Water Resources Act 1991
UU	United Utilities

Term	Definition
Aquifer	A source of groundwater comprising water-bearing rock, sand or gravel capable of yielding significant quantities of water.
Attenuation	In the context of this report - the storing of water to reduce peak discharge of water.
Catchment Flood Management Plan	A high-level planning strategy through which the EA works with their key decision makers within a river catchment to identify and agree policies to secure the long-term sustainable management of flood risk.
Culvert	A channel or pipe that carries water below the level of the ground.
De Facto Flood Defence	A feature or structure that may provide an informal flood defence benefit but is not otherwise designed or maintained by the Environment Agency
Flood Defence	Infrastructure used to protect an area against floods as floodwalls and embankments; they are designed to a specific standard of protection (design standard).
Floodplain	Area adjacent to river, coast or estuary that is naturally susceptible to flooding.
Flood Resilience	Measures that minimise water ingress and promotes fast drying and easy cleaning, to prevent any permanent damage.
Flood Risk	The level of flood risk is the product of the frequency or likelihood of the flood events and their consequences (such as loss, damage,

Term	Definition
	harm, distress and disruption)
Flood Risk Regulations	Transposition of the EU Floods Directive into UK law. The EU Floods Directive is a piece of European Community (EC) legislation to specifically address flood risk by prescribing a common framework for its measurement and management.
Flood and Water Management Act	Part of the UK Government's response to Sir Michael Pitt's Report on the Summer 2007 floods, the aim of which is to clarify the legislative framework for managing surface water flood risk in England.
Flood Storage	A temporary area that stores excess runoff or river flow often ponds or reservoirs.
Flood Zone	Flood Zones are defined in the NPPF Technical Guidance based on the probability of river and sea flooding, ignoring the presence of existing defences.
Flood Zone 1	Low probability of fluvial flooding. Probability of fluvial flooding is < 0.1%
Flood Zone 2	Medium probability of fluvial flooding. Probability of fluvial flooding is 0.1 – 1%. Probability of tidal flooding is 0.1 – 0.5 %
Flood Zone 3a	High probability of fluvial flooding. Probability of fluvial flooding is 1% (1 in 100 years) or greater. Probability of tidal flooding is 0.5%(1 in 200 years)
Flood Zone 3b	Functional floodplain. High probability of fluvial flooding. Probability of fluvial flooding is >5%
Fluvial	Relating to the actions, processes and behaviour of a water course (river or stream)
Fluvial flooding	Flooding by a river or a watercourse.
Freeboard	Height of flood defence crest level (or building level) above designed water level
Functional Floodplain	Land where water has to flow or be stored in times of flood.
Groundwater	Water that is in the ground, this is usually referring to water in the saturated zone below the water table.
Inundation	Flooding.
Lead Local Flood Authority	As defined by the FWMA, in relation to an area in England, this means the unitary authority or where there is no unitary authority, the county council for the area, in this case Cumbria County Council.
Main River	Watercourse defined on a 'Main River Map' designated by DEFRA. The EA has permissive powers to carry out flood defence works, maintenance and operational activities for Main Rivers only.
Mitigation measure	An element of development design which may be used to manage flood risk or avoid an increase in flood risk elsewhere.

<b>Term</b>	<b>Definition</b>
Overland Flow	Flooding caused when intense rainfall exceeds the capacity of the drainage systems or when, during prolonged periods of wet weather, the soil is so saturated such that it cannot accept any more water.
Residual Flood Risk	The remaining flood risk after risk reduction measures have been taken into account.
Return Period	The average time period between rainfall or flood events with the same intensity and effect.
River Catchment	The areas drained by a river.
Sewer flooding	Flooding caused by a blockage or overflowing in a sewer or urban drainage system.
Sustainability	To preserve /maintain a state or process for future generations
Sustainable drainage system	Methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques.
Sustainable development	Development that meets the needs of the present without compromising the ability of future generations meeting their own needs.
Sustainable Flood Risk Management	Sustainable Flood Risk Management promotes a catchment wide approach to flooding that uses natural processes and systems (such as floodplains and wetlands) to slow down and store water.
Topographic survey	A survey of ground levels.
Tributary	A body of water, flowing into a larger body of water, such as a smaller stream joining a larger stream.
Watercourse	All rivers, streams, drainage ditches (i.e. ditches with outfalls and capacity to convey flow), drains, cuts, culverts and dykes that carry water.
Wrack Marks	An accumulation of debris usually marking the high water line.
1 in 100 year event	Event that on average will occur once every 100 years. Also expressed as an event, which has a 1% probability of occurring in any one year.
1 in 100 year design standard	Flood defence that is designed for an event, which has an annual probability of 1%. In events more severe than this the defence would be expected to fail or to allow flooding.

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

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

Flood Source	Environment Agency	Lead Local Flood Authority	District Council	Water Company	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 the LLFA'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 (RMA's). The EA also collates and reviews assessments, maps, and plans for local flood risk management (normally undertaken by LLFA).

Lead Local Flood Authorities (LLFAs) – Cumbria County Council is the LLFA for Cumbria under the Flood & Water Management Act 2010. 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 RMA 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 RMA's to maximise knowledge of flood risk to all involved. This function is carried out at CCC by the Development Management Team.

District and Borough Councils – These organisations perform a significant amount of work relating to flood risk management including providing advice to communities and gathering information on flooding. These organisations are classed as RMA's.

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. These organisations are classed as RMA's

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. These organisations are classed as RMA's

Flood risk in Cumbria is managed through the Making Space for Water process, which involves the cooperation and regular meeting of the Environment Agency, United Utilities, District/Borough Councils and CCC's Highway and LFRM Teams to develop processes and schemes to minimise flood risk. The MSfWGs meet approximately 4 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. CCC 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 carried out as soon as possible. Any major works requiring capital investment will be considered through the Environment Agency's Medium Term Plan process or a partners own capital investment process.

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

## Appendix 3: Links to Other Information on Flooding

### **Sign up for Flood Warnings**

<https://www.gov.uk/sign-up-for-flood-warnings>

### **Environment Agency – Prepare your property for flooding; a guide for householders and small businesses to prepare for floods**

<https://www.gov.uk/government/publications/prepare-your-property-for-flooding>

### **Environment Agency – What to do before, during and after a flood: Practical advice on what to do to protect you and your property**

<https://www.gov.uk/government/publications/flooding-what-to-do-before-during-and-after-a-flood>

### **Environment Agency – Living on the Edge: A guide of the rights and responsibilities of riverside occupiers**

<https://www.gov.uk/government/publications/riverside-ownership-rights-and-responsibilities>

### **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>

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## Appendix 4: Flood Warnings and Alerts

### Flood Alert Issued

#### **Flood Alert Area - 011WAFBR - Rivers Brathay, Rothay and Winster**

Alert issued on Friday 04/12/2015 at 15:22

**Customers in Flood Alert area registered on FWD: 98**

**Contacts (landline, mobile, email etc) in Flood Alert area registered on FWD: 303**

**Successful contacts: 267**

**Unsuccessful contacts: 36**

#### **Alert Message:**

A Flood Alert has been issued by the Environment Agency for the Rivers Brathay, Rothay and Winster. Flooding is possible for Rivers Brathay, Rothay and Winster.

Low lying land and roads will be affected first. Be prepared to protect yourself, family, pets and property.

Heavy and persistent rainfall along with strong South-Westerly winds are forecast to continue this evening (Friday 04/12/2015) through until Sunday (06/12/2015). With the ground already saturated the river and lake levels are expected to rise further and we may see some significant impacts. Newby Bridge Sluices remain open (opened 9th November). The forecast is likely to result in Flood Warnings being issued on Saturday (05/12/2015). We advise that you keep an eye on the situation by listening to weather forecasts, checking our web pages or calling Floodline. We are continuing to monitor the situation and have workers on site operating defences and clearing blockages where required.

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<sup>1</sup>Contact Successful if at least one attempt to contact a fully-registered recipient registered to the property returned a status of "Acknowledged", "Successfully Received", "Successfully Sent" or "Unacknowledged"