Monmouthshire County Council

Flood and Water Management Act 2010

Section 19 Flood Investigation Report

Watery Lane / Rockfield Road, Monmouth

Storm Dennis
February 2020

Version: FINAL

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Contents

Version Control

Title	Watery Lane / Rockfield Road, Monmouth, Storm Dennis, February 2020
Purpose	Section 19 Flood Investigation Report
Owner	Highways and Flood Risk Management
Approved by	M. Hand (Head of Placemaking, Housing, Highways and Flooding)
Date	11 February 2022
Version Number	V7.0
Status	Final
Review Frequency	Not applicable
Next review date	Not applicable
Consultation	Natural Resources Wales, Monmouthshire County Council

Version	Prepared by	Reviewed by	Approved by	Date
V1.0 Draft	JP	ER		24 June 2021
V2.0 Draft	ER	JS		27 August 2021
V3.0 Draft	ER	JS		5 November 2021
V4.0 Draft	ER	JS		22 November 2021
V5.0 Draft	ER	JS		24 December 2012
V6.0 Draft	ER	JS		31 January 2022
V6.0 Final	ER	JS	MH	11 February 2022

1. Executive Summary

In accordance with Section 19 of the Flood and Water Management Act 2010 (FWMA), Monmouthshire County Council (MCC) has a duty as Lead Local Flood Authority (LLFA) to investigate flooding within its area, insofar as it considers it necessary and appropriate. This report meets the requirements of Section 19 of the Act and provides a factual account of the flood event that occurred on 16 and 18 February 2020 at Watery Lane, Monmouth due to intense rainfall from Storm Dennis on 15 and 16 February 2020.

February 2020 was the wettest February on record in Wales and the UK as well as the fifth wettest month ever recorded. Storm Dennis was the 4th named storm of the season and fell on ground that was already saturated from Storm Ciara 1 week prior, and an unnamed rainfall event on 12 and 13 February 2020. Intense rainfall from Storm Dennis significantly impacted river flows and resulted in substantial flooding across South Wales.

On 16 and 18 February 2020 the Watery Lane Watercourse overtopped the Watery Lane and Rockfield Road roundabout; it caused flooding to the roundabout and properties on these roads near the roundabout, and blocked vehicle access.

The overtopping was due to direct rainfall on the Watery Lane Watercourse catchment. It may also have been because of interactions the watercourse had with the main rivers Monnow and Wye in Monmouth, and contributions from a Welsh Water surface water drain out-falling close to the confluence of the Watery Lane Watercourse with the Monnow, as well as contributions of other local watercourses. The mechanisms that caused flooding in the 1st peak in flood levels on 16 February 2020 are different to those in the 2nd peak on 18 February 2020.

Following the flood event, officers from MCC visited the properties affected to collect information on the event. At the time of preparing this report 7 residential properties are reported to have flooded.

Information has been shared between MCC, and Natural Resources Wales (NRW) as the Risk Management Authorities (RMA). Supporting information on weather patterns and rainfall at the time of the event has been gathered from the Met Office.

2. Introduction

2.1 Purpose of Investigation

On 15 and 16 February 2020, Monmouthshire was impacted by a significant weather event named Storm Dennis which resulted in heavy and prolonged rainfall in the northern parts of the county and upper catchments of many ordinary watercourses and main rivers, including the River Monnow.

As a result, many areas across Monmouthshire flooded particularly in the north.

This report will focus on flooding at Watery Lane, Rockfield Road and the surrounding area, collectively referred to in this report as Watery Lane.

The report has been prepared by MCC in response to the duties of the LLFA in Section 19 of the FWMA, which 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.

2.2 Site Location

Watery Lane is in the Over Monnow suburb of Monmouth at National Grid Reference SO50020 12854. The east end of Watery Lane is connected to Rockfield Road by a roundabout.

On 16 and 18 February 2020, the roundabout and properties close by on Watery Lane and Rockfield Road were flooded. A location plan for the flood investigation area is in Figure 2-3.

The Flood Estimation Handbook catchment for the Watery Lane is shown in Figure 2-1, it has an area of 3.1km² and covers much of the Over Monnow suburb, the upper catchment is predominately rural in nature. There is a watercourse which runs the entirety of Watery Lane; within this report the watercourse will be referred to as the Watery Lane Watercourse.

The Watery Lane Watercourse originates in the Kingswood area, it bifurcates at the western end of Watery Lane, and merges at the junction of Jordan Way and Bigham Close where it is culverted under Watery Lane through 2 culvert inlets. The culvert outfall is to the east of the Watery Lane and Rockfield Road roundabout. The Watery Lane Watercourse is a tributary of the Monnow, and after the outfall at the roundabout, it flows east then southeast along the perimeter of the Wonastow Road Pumping Station and Drybridge Community Pond, before discharging to the Monnow; downstream in Monmouth the Monnow discharges to the Wye. Further downstream in Monmouth the Trothy also discharges to the Wye, at its confluence with the Wye the Trothy's FEH catchment is 145.2km^2. The FEH catchment of the Monnow at the confluence of the Watery Lane Watercourse is 427.6km^2 and is shown in Figure 2-2. At the confluence of the Monnow with the Wye, the Wye has an FEH catchment of 3,434.0km^2.

The known line of the Watery Lane Watercourse can be seen in Figure 2-1. Photos of the culvert inlets on Watery Lane and the roundabout outlet can be seen in section 4.1.

Drybridge Community Pond is connected to Wonastow Brook via the Wonastow Road Pumping Station as part of the Wonastow Road Flood Alleviation Scheme. Wonastow Brook is located to the south of the flood investigation area catchment, the downstream section is culverted under Wonastow Road, the northeastern section of Wonastow Brook is shown in Figure 2-1.

Figure 2-1. FEH catchment of the Watery Lane Watercourse at the Rockfield Road and Watery Lane roundabout.

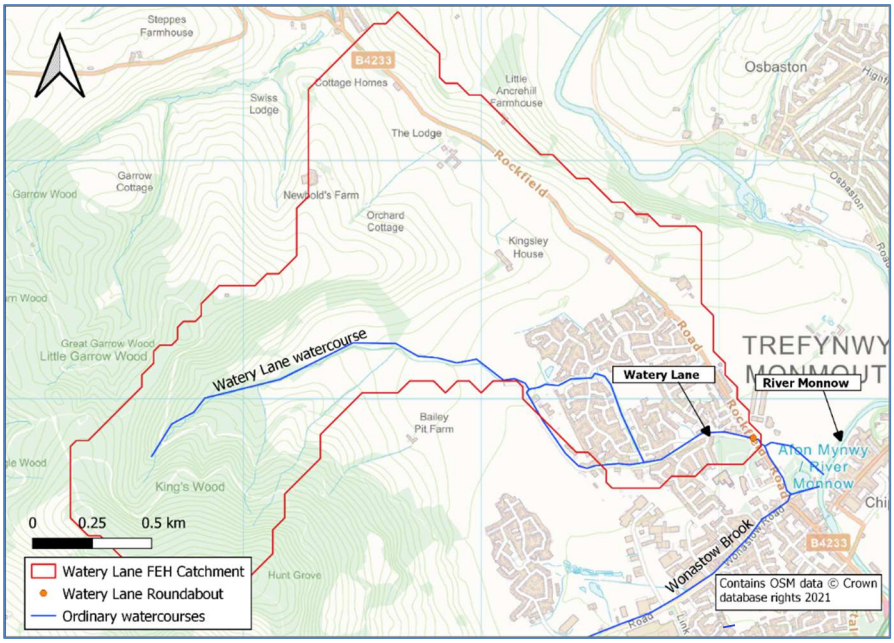


Figure 2-2. FEH catchment of the Monnow at the confluence with the Watery Lane Watercourse.

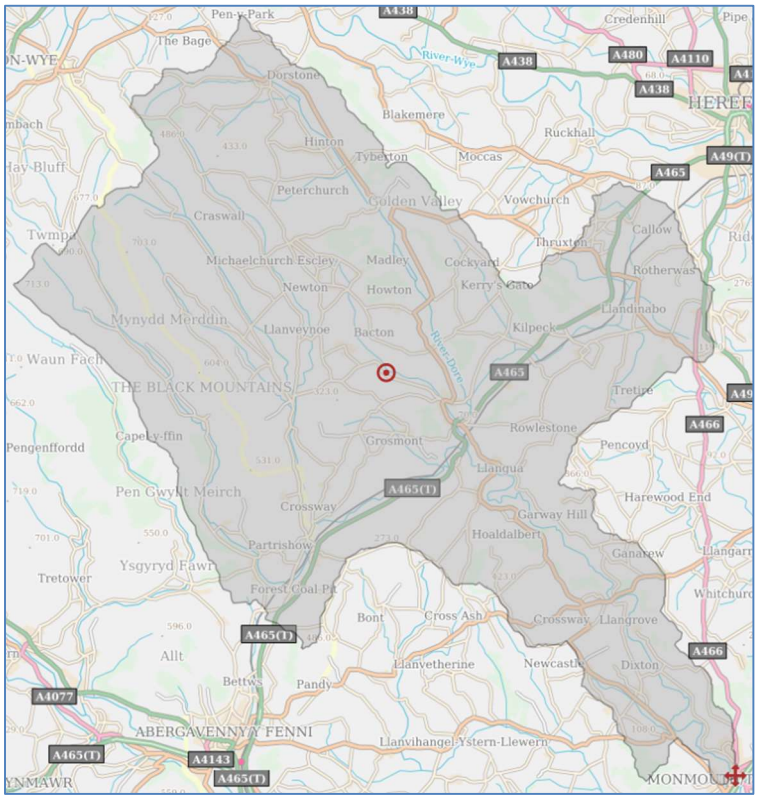
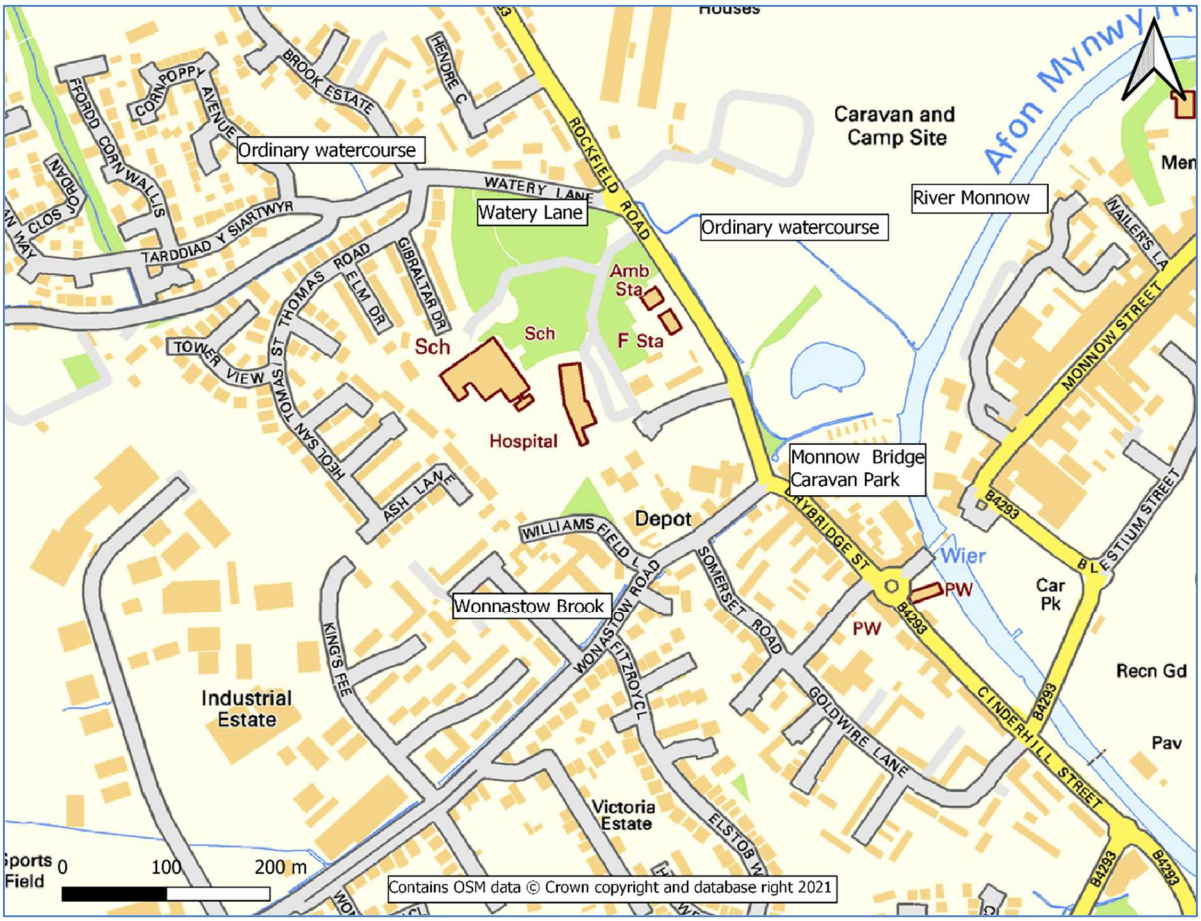


Figure 2-3. Flood investigation area location plan.



The NRW flood map for rivers in Figure 2-4, shows there are areas at high risk of river flooding on the right bank of the River Monnow extending to the Watery Lane Watercourse. There are areas at medium risk of river flooding extending further west along Watery Lane and south along Rockfield Road to Drybridge Community Pond. Much of the land to the north and south of Rockfield Road and Watery Lane is shown to be at low risk of river flooding.

The Natural Resources Wales (NRW) flood map for surface water in Figure 2-4 shows Watery Lane, the roundabout, and northern section of Wonastow Road are at high risk of surface water flooding, as well as an area to the north of Watery Lane and south of Drybridge Community Pond. There are areas of medium surface water flood risk to the north of Watery Lane, on the right bank of the Monnow, along the south of Rockfield Road, and north of Drybridge Street, see Figure 2-5.

Figure 2-4. Extract from Natural Resources Wales, Risk of Flooding from Rivers.

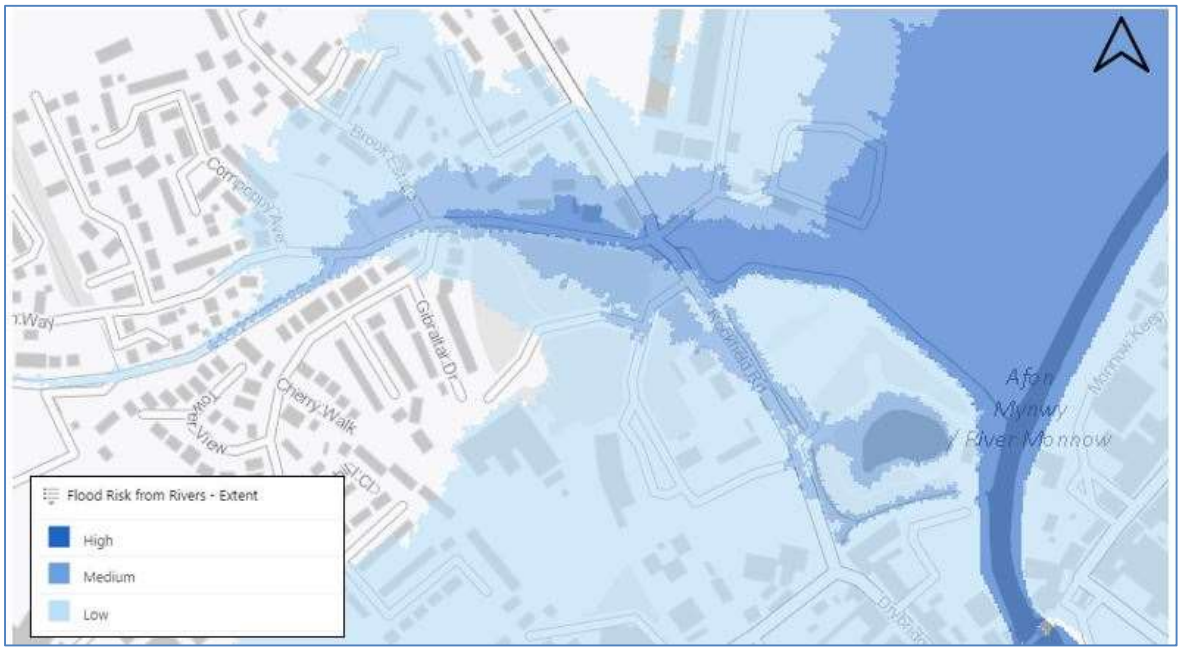
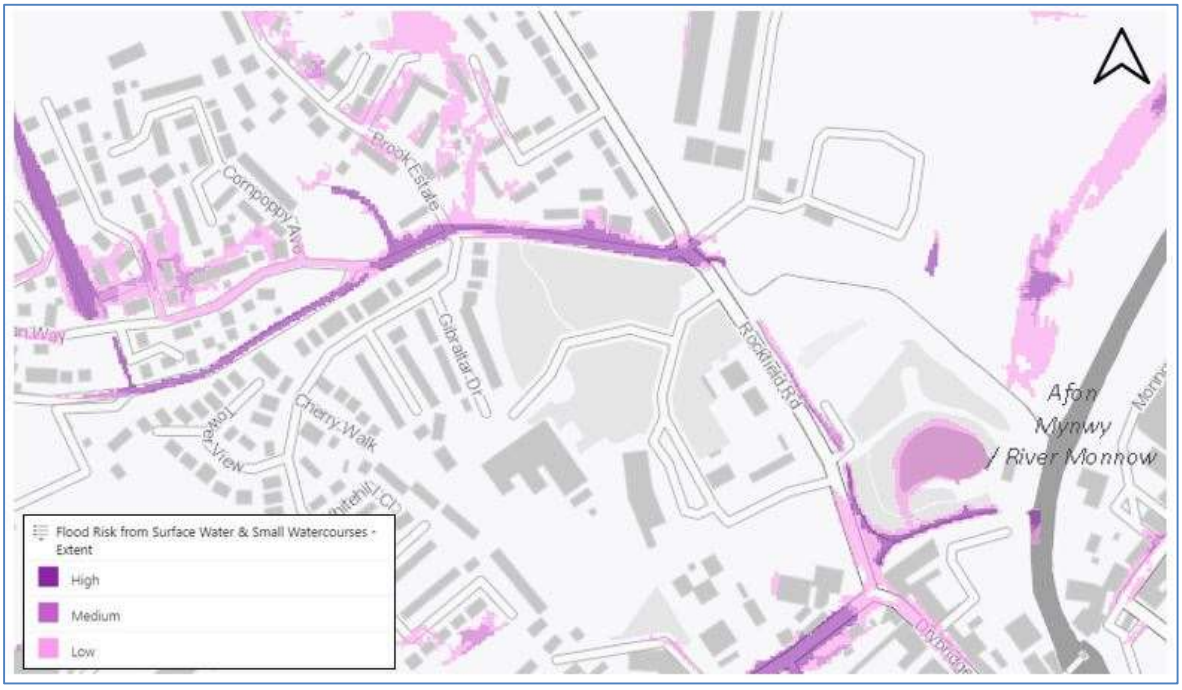


Figure 2-5. Extract from Natural Resources Wales, Risk of Flooding from Surface Water.



2.3 Investigation Evidence and Data

To support the investigation the following list of qualitative and quantitative evidence has been gathered:

- Resident's photos, statements, written correspondence, and recorded verbal correspondence.
- Site inspections and photos.
- Met Office Data – Storm report and weather warnings.
- Natural Resources Wales – hydrometric data, report entitled *February 2020 Floods in Wales: Flood Event Data Summary.*

- Environment Agency – hydrometric data.
- Monmouthshire County Council – hydrometric data, asset database, Flood Risk Management Plan, Preliminary Flood Risk Assessment.
- Media coverage.

2.4 Anecdotal Evidence

Table 2-1 presents anecdotal evidence collected after the flood event by MCC in February 2020, and by telephone interview in May and June 2021, comparing the flood events in October 2019 and February 2020. The table provides a reference to address points of local individuals consulted; a full table with a list of references and addresses can be found in Appendix A, however the appendix will be redacted prior to report publication due to General Data Protection Regulations.

There are anecdotal reports that on Watery Lane and Rockfield Road near the roundabout, 2 properties flooded in October 2019, and 7 properties flooded from Storm Dennis in February 2020.

Table 2-1. Anecdotal evidence.

Address reference	Notes
WL2020/06	February 2020 flood event: • Internal flood depth 0.61m. • Flooding from the front and rear of the property. • Rise in flood depth was not rapid. • Still recovering from October 2019 flood event.
	October 2019 flood event: • Internal flood depths to 0.46m. • Flooding from front and rear of the property. • Rapid onset of flooding.
WL2020/07a	February 2020 flood event: • Internal flood depth 1m. • Rapid onset of flooding. • Flooding in the early hours / morning of 16 February 2020. • Still recovering from October 2019 flood event.
	October 2019 flood event: • Internal flood depth lower than in February 2020. • Onset of flooding slower than in 2019.
WL2020/07b	February 2020 flood event: • Internal flood depth 0.31 to 0.61m. • Still recovering from October 2019 flood event.
	October 2019 flood event: • Internal flooding to property.
WL2020/01	February 2020 flood event: • Internal flooding to property 16 February 2020.
WL2020/02	February 2020 flood event: • Internal flooding to property 16 February 2020.

WL2020/03	February 2020 flood event: • Internal flooding to property 16 February 2020.
WL2020/04	February 2020 flood event: • Internal flooding to property 16 February 2020.
WL2020/05	February 2020 flood event: • Internal flooding to property 16 February 2020. • Water came up through floorboards.

The South Wales Argus website provided media reports that Watery Lane flooded twice in the three days from 16 February to 18 February 2020 as shown in Figure 2-7. It is noted that the report is dated 18 February 2020 and refers to flooding for a second time that morning, it also states that rescue services were drafted in on the Sunday prior to the report date, which was Sunday 16 February 2020. Figure 2-6 shows the roundabout and road signage during the flood event.

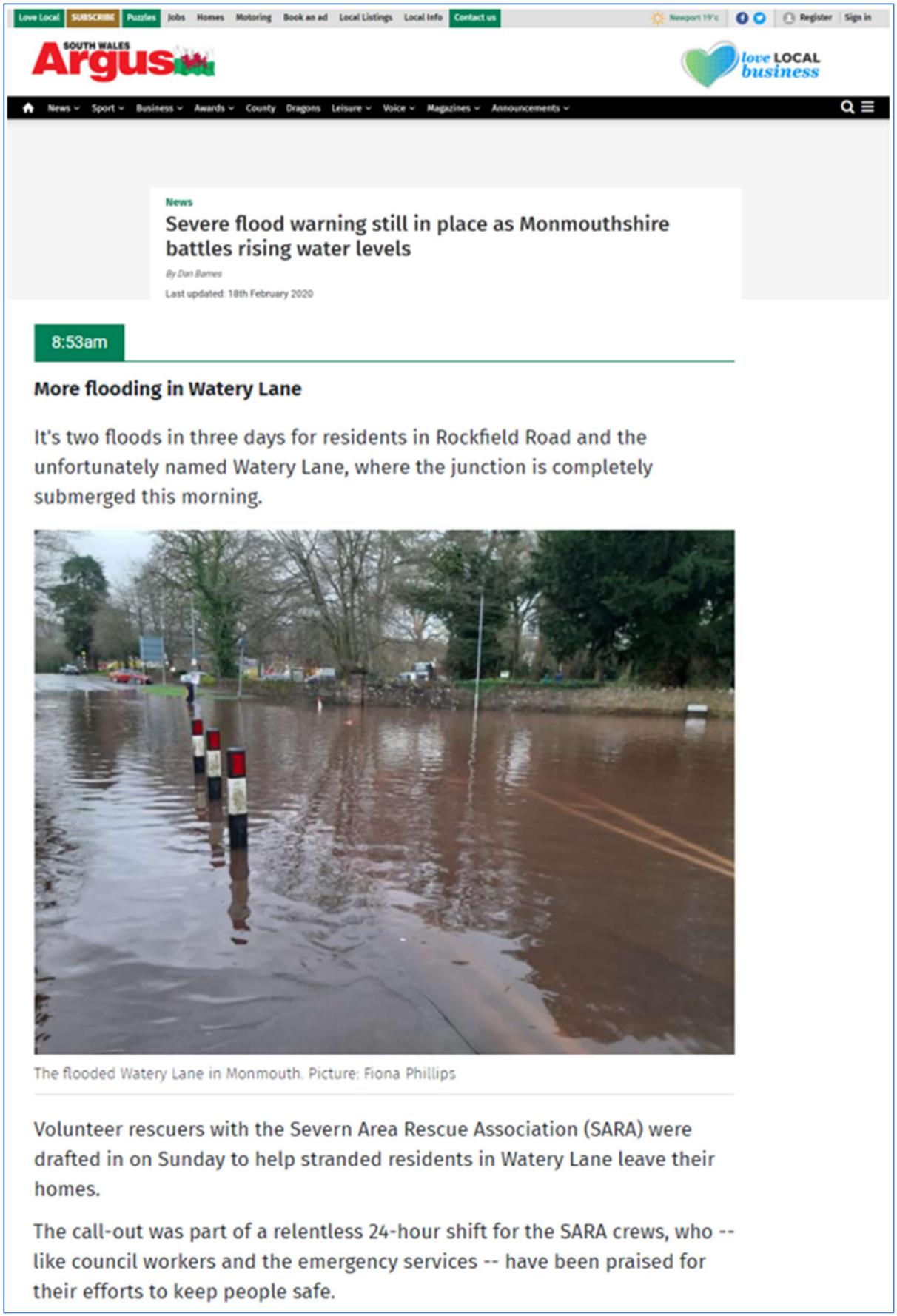
Table 2-2 provides timings of flood event milestones from anecdotal reports, the media report, and MCC.

Table 2-2. Flood event milestones

Milestone	Time and date
Properties flooded 1st time	Morning of 16 February 2020
Properties flooded 2nd time	Morning of 18 February 2020

Figure 2-6. Photo of flooding at Watery Lane and Rockfield Road roundabout, and road signage, Storm Dennis February 2020.

Figure 2-7. Media reports from the South Wales Argus of flooding to properties and the road at Watery Lane and Rockfield Road, Sunday 16 to Tuesday 18 February 2020.



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News

Severe flood warning still in place as Monmouthshire battles rising water levels

By Dan Barnes

Last updated: 18th February 2020

8:53am

More flooding in Watery Lane

It's two floods in three days for residents in Rockfield Road and the unfortunately named Watery Lane, where the junction is completely submerged this morning.

The flooded Watery Lane in Monmouth. Picture: Fiona Phillips

Volunteer rescuers with the Severn Area Rescue Association (SARA) were drafted in on Sunday to help stranded residents in Watery Lane leave their homes.

The call-out was part of a relentless 24-hour shift for the SARA crews, who -- like council workers and the emergency services -- have been praised for their efforts to keep people safe.

3. Flooding

3.1 Previous Flood Incidents

Historical anecdotal reports of flooding at Watery Lane are shown in Table 3-1.

Table 3-1. Recorded historic flood events.

Flood date	No. properties affected
26 October 2019	2
2003	1
1990s	1
1990	1

3.2 Flood Incident

Storm Dennis was the 4th named storm of the 2019/2020 season and brought heavy and persistent rain across South Wales. The Met Office issued a Red Warning for rain across parts of South Wales and there was major and widespread flooding. See section 3.7 for further details on the Met Office severe weather warning.

Storm Dennis delivered heavy rainfall on 15 and 16 February 2020. The rain fell on saturated ground due to Storm Ciara 1 week prior, and an unnamed rainfall event on 12 and 13 February 2020.

MCC has anecdotal reports that the primary source of flooding was the River Monnow backing up the Watery Lane Watercourse.

On 16 February 2020, the Watery Lane Watercourse overtopped at the Watery Lane and Rockfield Road roundabout. As levels rose, water inundated the junction blocking access, and flooding properties on Watery Lane and Rockfield Road from the front and rear, water also came up through the floorboards.

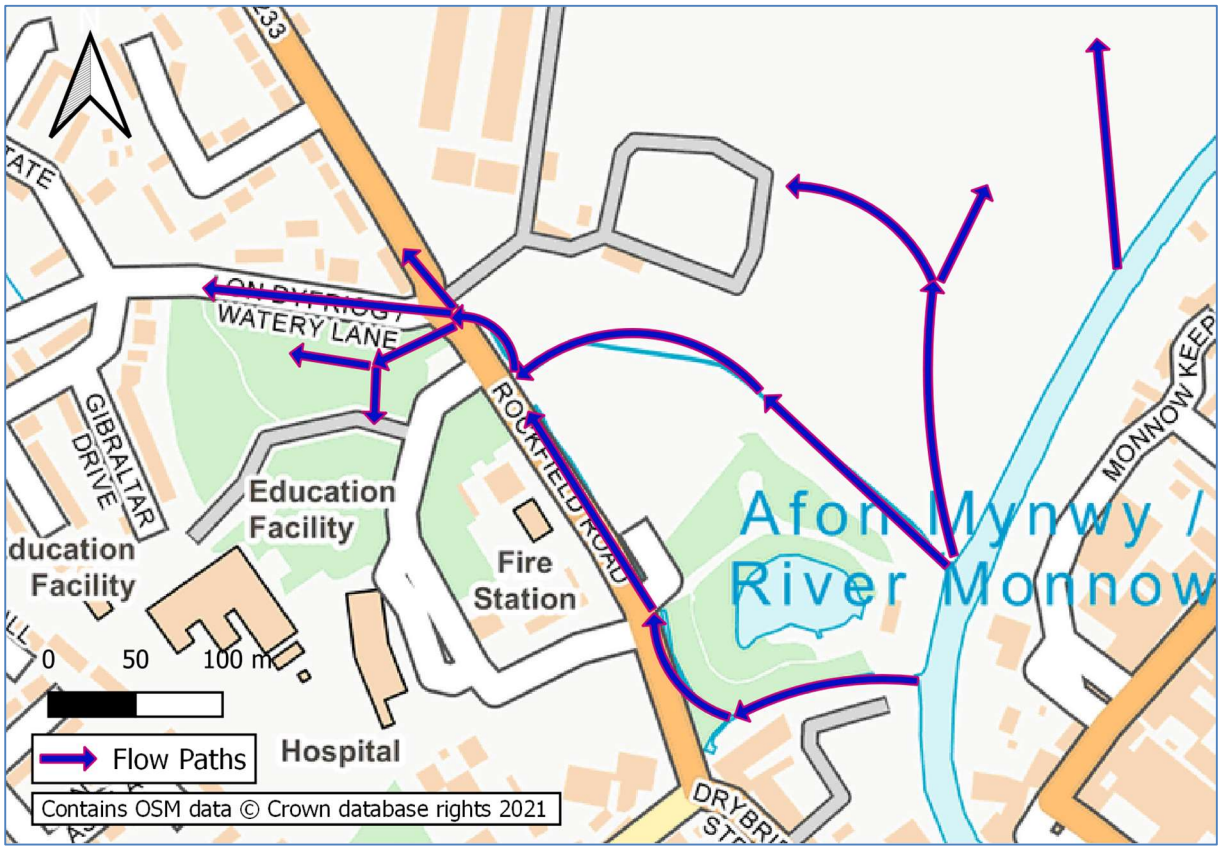
The Watery Lane Watercourse runs eastwards and is culverted under the eastern section of Watery Lane, and the Watery Lane and Rockfield Road roundabout. The watercourse exceeded its capacity at the downstream end of the culvert under the roundabout and spilled out onto the road, there is a picture of this section of the culvert in Figure 4-6. Figure 3-1 shows flood flow paths during the flood event.

Emergency Services attended the incident to redirect traffic and evacuate residents. Anecdotal evidence reports are that internal flooding reached a depth of up to 1m.

At the time of preparing this report 7 properties are reported to have flooded along Watery Lane and Rockfield Road due to Storm Dennis on 16 February 2020. Media coverage shown in section 2.4 reports the Watery Lane and Rockfield Road roundabout flooded for a 2nd time on 18 February 2020.

In addition to flooding at Watery Lane, MCC have recorded that there was also flooding at Monmouth Caravan Park, Monmouth Skate Park, and Drybridge Park.

Figure 3-1. Watery Lane, flood flow paths from anecdotal evidence.



3.3 Gauging Stations

The location of nearby NRW and EA river, rain, and tidal gauges are shown in Figure 3-2.

All gauges are operated by NRW except Vowchurch rain gauge, Ross on Wye river gauge, and Avonmouth Portbury tidal gauge which are operated by the EA. All the listed river and tidal gauges are telemetered. Rain gauges are a mixture of telemetered and logger.

Figure 3-2. Local rain, river, and tidal gauges[1,2].

3.4 Gauge Monitoring

Table 3-2 provides a list of the hydrometric data from NRW and the EA which has been assessed in the investigation. Gauges selected are telemetered as these provide readings at consistent 15-minute time intervals during elevated river flows. Some gauge data has been excluded from the assessment due to known data accuracy issues.

The assessment has been carried out for 2 comparable storms which caused flooding in South Wales, these were the Met Office named events Persistent Wet Weather 25 and 26 October 2019, and Storm Dennis 15 and 16 February 2020. The hydrographs later in this section are for the following 2 periods covering these storms:

[1] Contains Natural Resources Wales information © Natural Resources Wales and database right. All rights reserved.
[2] this uses Environment Agency rainfall data from the real-time data API (Beta).

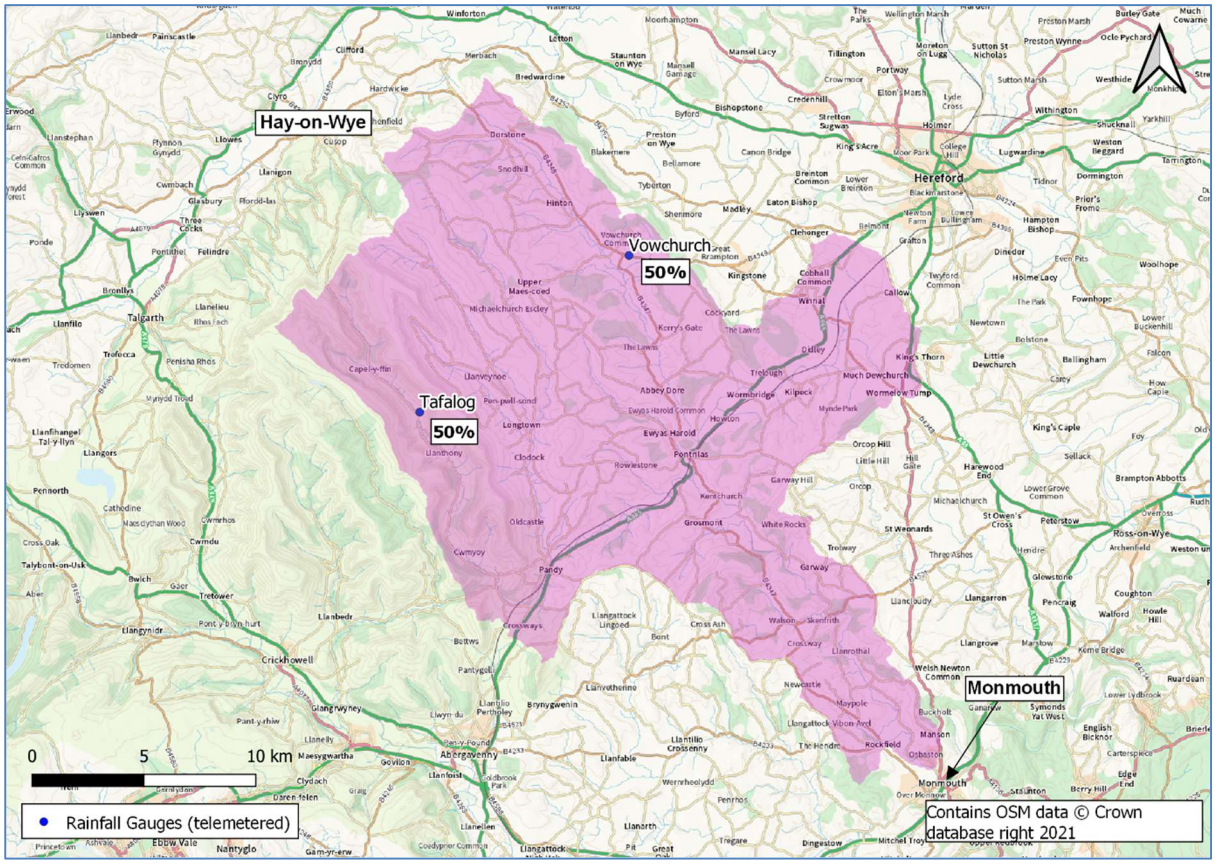
- 15-day period 00:00 on 17 October 2019 to 23:45 on 31 October 2019.
- 15-day period 00:00 on 7 February 2020 to 23:45 on 21 February 2020.

Table 3-2. Hydrometric gauges included in the assessment.

Data	Gauge name	Source
River Monnow	Grosmont	NRW
River Monnow	Skenfrith	NRW
River Monnow	Monnow Gate	NRW
River Wye	Ross on Wye	EA
River Wye	Monmouth	NRW
River Wye	Redbrook	NRW
River Trothy	Michael Troy	NRW
Rainfall	Tafalog	NRW
Rainfall	Vowchurch	EA

Within the Monnow's catchment upstream of Watery Lane there are 2 telemetered rain gauges, Tafalog and Vowchurch. Thiessen Polygon analysis requires a minimum of 3 gauges and so was not carried out. The rain gauges are spread evenly over the catchment and have been assigned equal weighting, see Figure 3-3.

Figure 3-3. Rain gauge weightings.



There are 2 gauges on the Monnow upstream of Watery Lane at Skenfrith and Grosmont. The confluence of the Watery Lane Watercourse with the Monnow is approximately at the location of the Monnow Gate monitoring station.

For the gauges on the Monnow and Wye included in the assessment, Table 3-3 describes their approximate distance upstream and downstream from the Monnow's confluence with the Wye.

Table 3-3. River gauge approximate upstream and downstream distance from the Monnow's confluence with the Wye.

River Gauge	Gauge proximity to the Monnow's confluence with the Wye (km)
Monnow at Grosmont	26.8 upstream
Monnow at Skenfrith	16.1 upstream
Monnow at Monnow Gate	0.8 upstream
Wye at Ross on Wye	33.1 upstream
Wye at Monmouth	1.3 upstream
Wye at Redbrook	2.3 downstream

The following hydrographs in Figure 3-4 to Figure 3-10 present river stage data for the Monnow and Wye, alongside rainfall data for Storm Dennis. The remainder of the hydrographs included in the assessment are in Appendix B. The same rainfall data from Vowchurch has been used for all hydrographs for ease of cross referencing between them. There is a time lag between rainfall on the catchment based on data from Vowchurch, and the response in levels on the Monnow, this is referred to as the time to peak.

Figure 3-4. Storm Dennis - Rainfall and river levels for the Monnow at Grosmont for the 15-day period 7 to 21 February 2020.

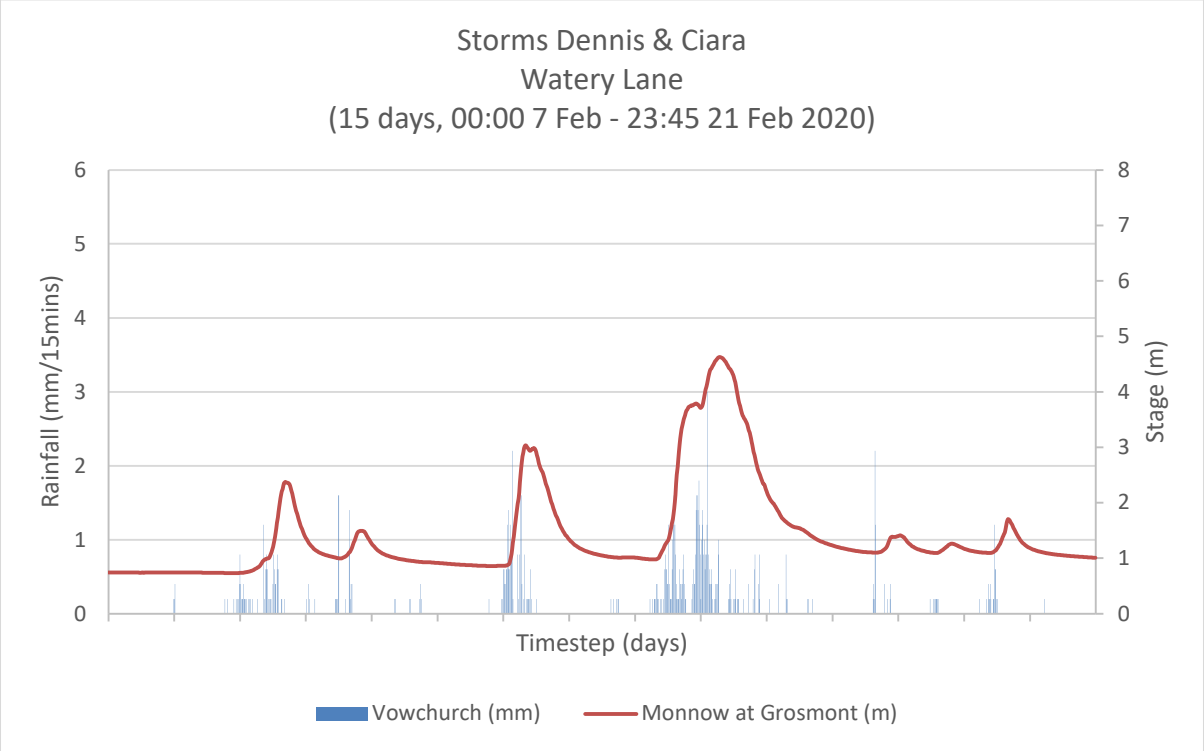


Figure 3-5. Storm Dennis - Rainfall and river levels for the Monnow at Skenfrith for the 15-day period 7 to 21 February 2020.

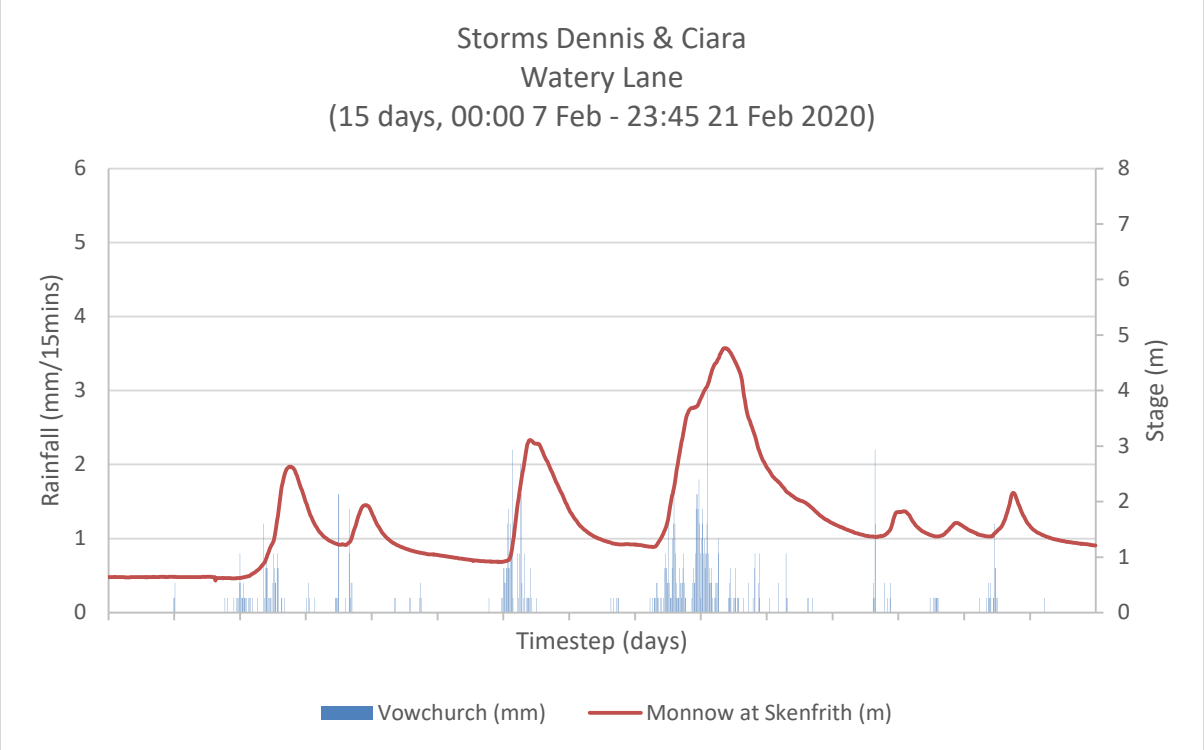


Figure 3-6. Storm Dennis - Rainfall and river levels for the Monnow at Monnow Gate for the 15-day period 7 to 21 February 2020.

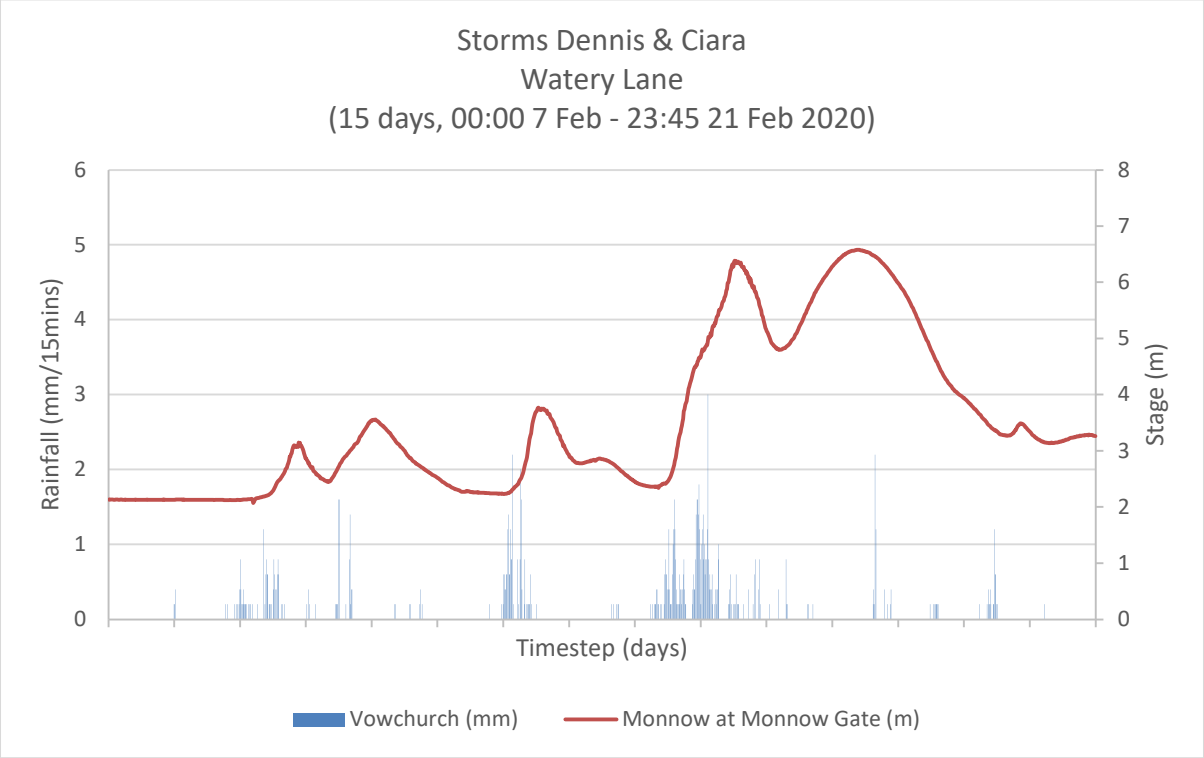


Figure 3-7. Storm Dennis - Rainfall and river levels for the Wye at Ross on Wye for the 15-day period 7 to 21 February 2020.

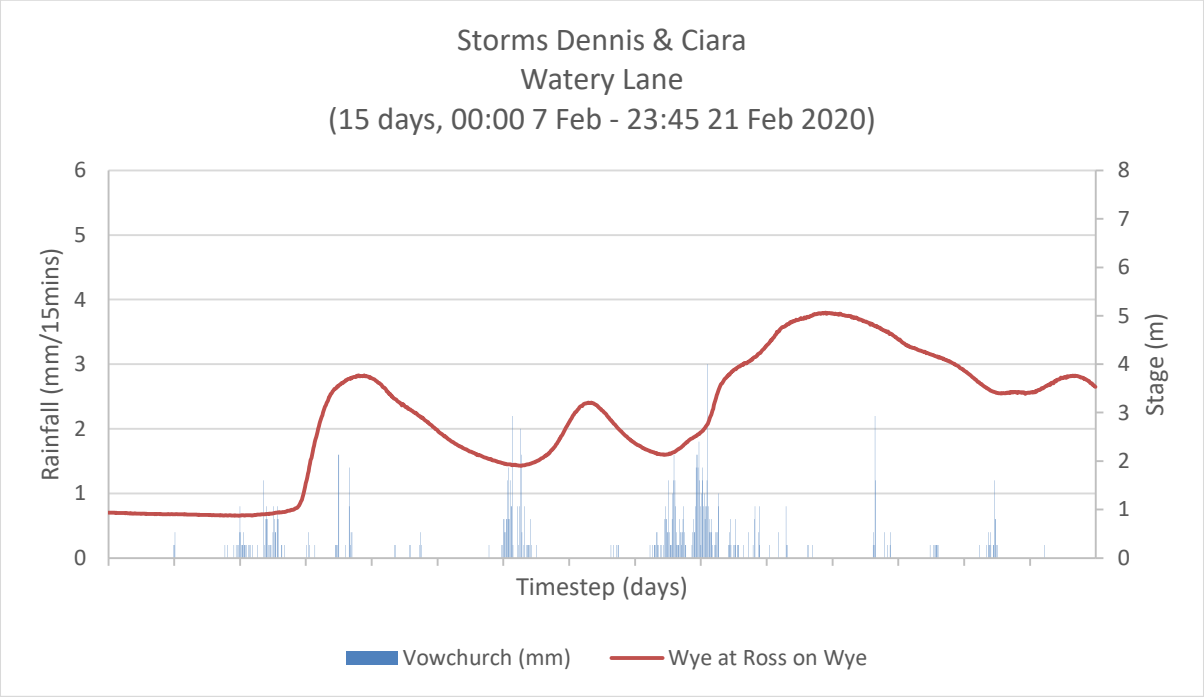


Figure 3-8. Storm Dennis - River levels for the Wye at Monmouth for the 15-day period 7 to 21 February 2020.

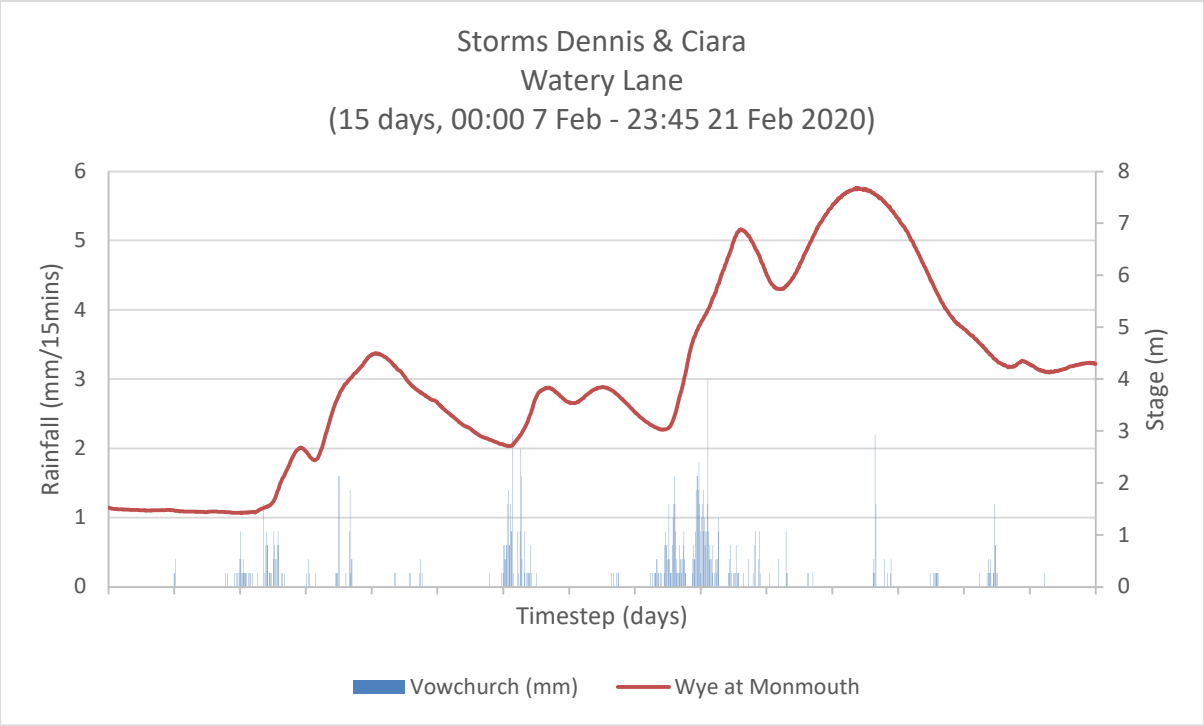


Figure 3-9. Storm Dennis - River levels for the Wye at Redbrook for the 15-day period 7 to 21 February 2020.

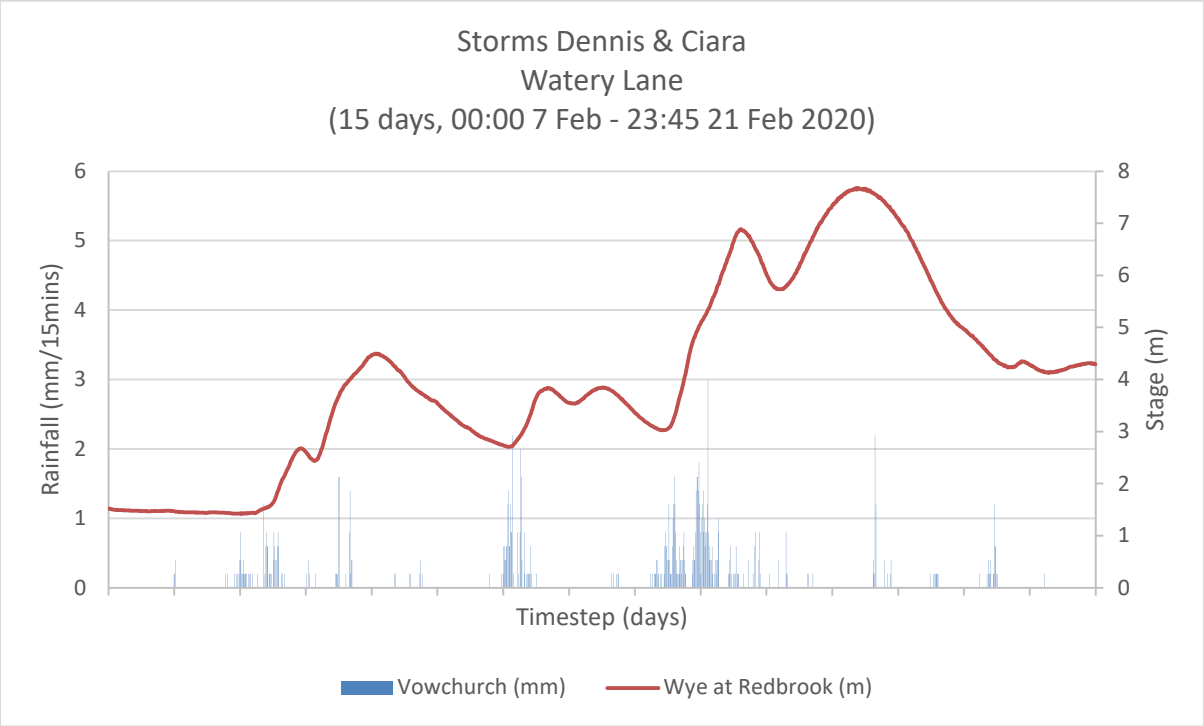
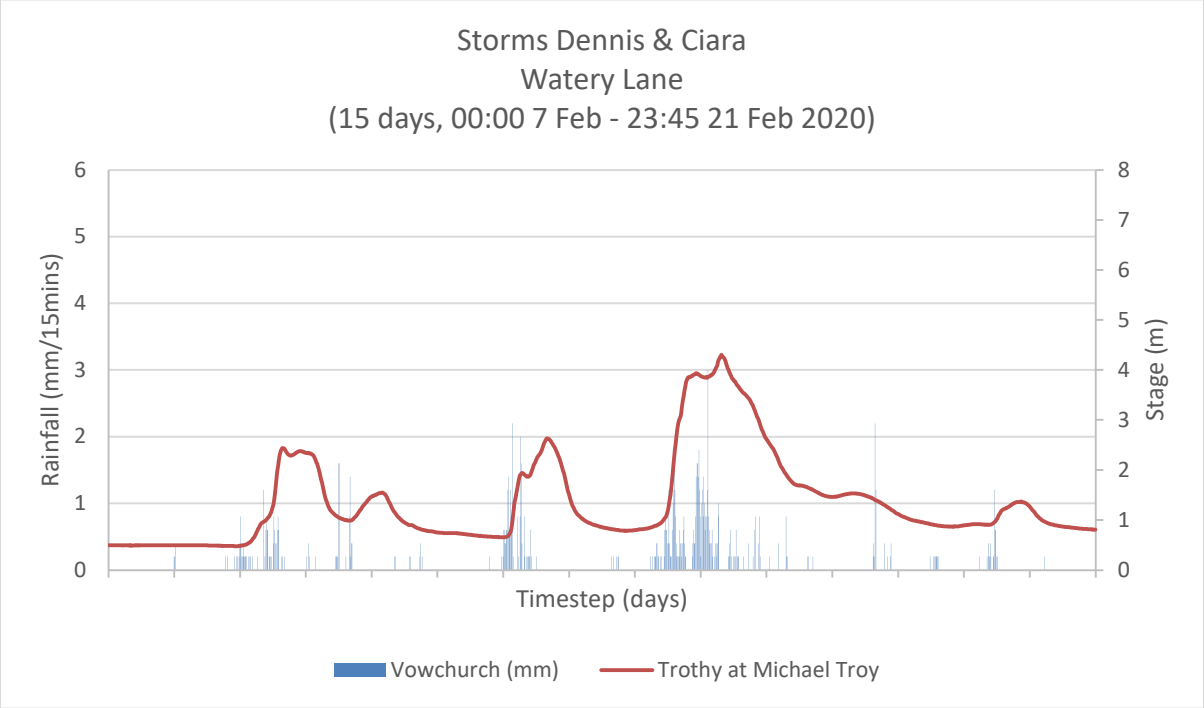


Figure 3-10. Storm Dennis - River levels for the Trothy at Michael Troy for the 15-day period 7 to 21 February 2020.



The peaks in the hydrographs on the Monnow and the Wye are used by flood risk authorities as triggers for flood warnings, and to action emergency flood responses. Lead times are important in emergency flood situations; the earlier the warning, the longer property owners have to evacuate and protect their property, and the longer emergency services have to respond.

Table 3-4 and Table 3-5 present river level peaks in chronological order from the hydrographs included in the assessment:

Table 3-4. Persistent Wet Weather - Hydrograph river peaks for the period 17 to 31 October 2019, in chronological order.

River and gauge	Level (m)	Time (GMT, hrs), Date
Peak on the Monnow at Grosmont	4.622	14:45, 26 Oct, 2019
Peak on the Trothy at Michael Troy	3.988	15:30, 26 Oct, 2019
Peak on the Monnow at Skenfrith	4.841	17:15, 26 Oct, 2019
1st peak on the Monnow at Monnow Gate	6.138	22:00, 26 Oct, 2019
1st peak on the Wye at Redbrook	6.235	00:45, 27 Oct, 2019
1st peak on the Wye at Monmouth	5.345	01:00, 27 Oct, 2019
Peak on the Wye at Ross on Wye	4.895	01:15, 28 Oct, 2019
2nd peak on the Wye at Redbrook	6.277	17:00, 28 Oct, 2019
2nd peak on the Monnow at Monnow Gate	5.237	17:15, 28 Oct, 2019
2nd peak on the Wye at Monmouth	5.920	17:30, 28 Oct, 2019

Table 3-5. Storm Dennis - Hydrograph river peaks for the period 7 February to 21 February 2020, in chronological order.

River and gauge	Level (m)	Time (GMT, hrs), Date
Peak on the Monnow at Grosmont	4.630	07:00, 16 Feb, 2020
Peak on the Trothy at Michael Troy	4.304	07:30, 16 Feb, 2020
Peak on the Monnow at Skenfrith	4.762	09:15, 16 Feb, 2020
1st peak on the Monnow at Monnow Gate	6.385	12:15, 16 Feb, 2020
1st peak on the Wye at Redbrook	6.888	14:30, 16 Feb, 2020
1st peak on the Wye at Monmouth	5.907	14:30, 16 Feb, 2020
Peak on Wye at Ross on Wye	5.065	21:30, 17 Feb, 2020
2nd peak on the Wye at Monmouth	7.146	08:30, 18 Feb, 2020
2nd peak on the Wye at Redbrook	7.681	08:45, 18 Feb, 2020
2nd peak on the Monnow at Monnow Gate	6.579	09:45, 18 Feb, 2020

There are anecdotal reports in section 2.4 that properties and the roundabout at Watery Lane and Rockfield Road flooded on the mornings of 16 and 18 February 2020, these timings are approximately consistent with the peak levels on the Monnow at Monnow Gate in the hydrographs listed in Table 3-5.

The 1st peak in flood levels at the roundabout on 16 February 2020 was from one or more mechanisms. The Watery Lane Watercourse couldn't discharge incoming flows from direct rainfall to its catchment to the Monnow due to high levels on the Monnow. The high levels on the Monnow were due to one or more of the following reasons: the Monnow's response to direct rainfall on its catchment; the Monnow was unable to discharge to the Wye due to high levels on the Wye; the Wye backed up the Monnow from Monmouth. High levels on the Wye in Monmouth were due to coinciding incoming flows from the Monnow and Trothy in Monmouth, causing the Wye to back up from Redbrook. There may also have been some local surface water inflows to the Wye, in particular from hard urban surfaces which were fast

flowing to the river. It's possible the Wye backed up the Monnow, and then the Monnow in turn backed up the Watery Lane Watercourse and overtopped at the roundabout.

The 2nd peak in levels at the roundabout on 18 February 2020 was likely due to high levels on the Wye at Monmouth preventing the Monnow and Watery Lane Watercourse from discharging. It may also have been due to the Wye and/or Monnow backing up. The peak levels on the Wye on 18 February 2020 were the Wye's catchment's response to direct rainfall.

The Monnow has a peakier hydrograph than the Wye and a shorter time to peak. Peakiness can be due to differing catchment characteristics including size, antecedent soil conditions, steepness and topography, land cover, and aspect. It can also be due to differing spatial rainfall intensity. See Figure 3-11 for a diagram indicating the double peak on the Monnow at Monnow Gate, and the catchments that the peaks are generated by.

The 2nd peak was higher than the 1st peak on the Monnow at Monnow Gate; this infers that there may be storm events where only the 2nd peak would result in flooding to the flood investigation area and could be due to the Wye's catchment responding to direct rainfall with the corresponding interactions with the Monnow and Watery Lane Watercourse.

It is noted that river levels at the Monnow Gate, Monmouth and Redbrook gauging stations were significantly higher at the onset of Storm Dennis, than Persistent Wet Weather October 2019, as shown in Table 3-6; this is referred to as an antecedent condition of the storms and is a major contributing factor to flooding during Storm Dennis at this flood investigation area.

Table 3-6. River levels at the onset of Storm Dennis and Persistent Wet Weather October 2019.

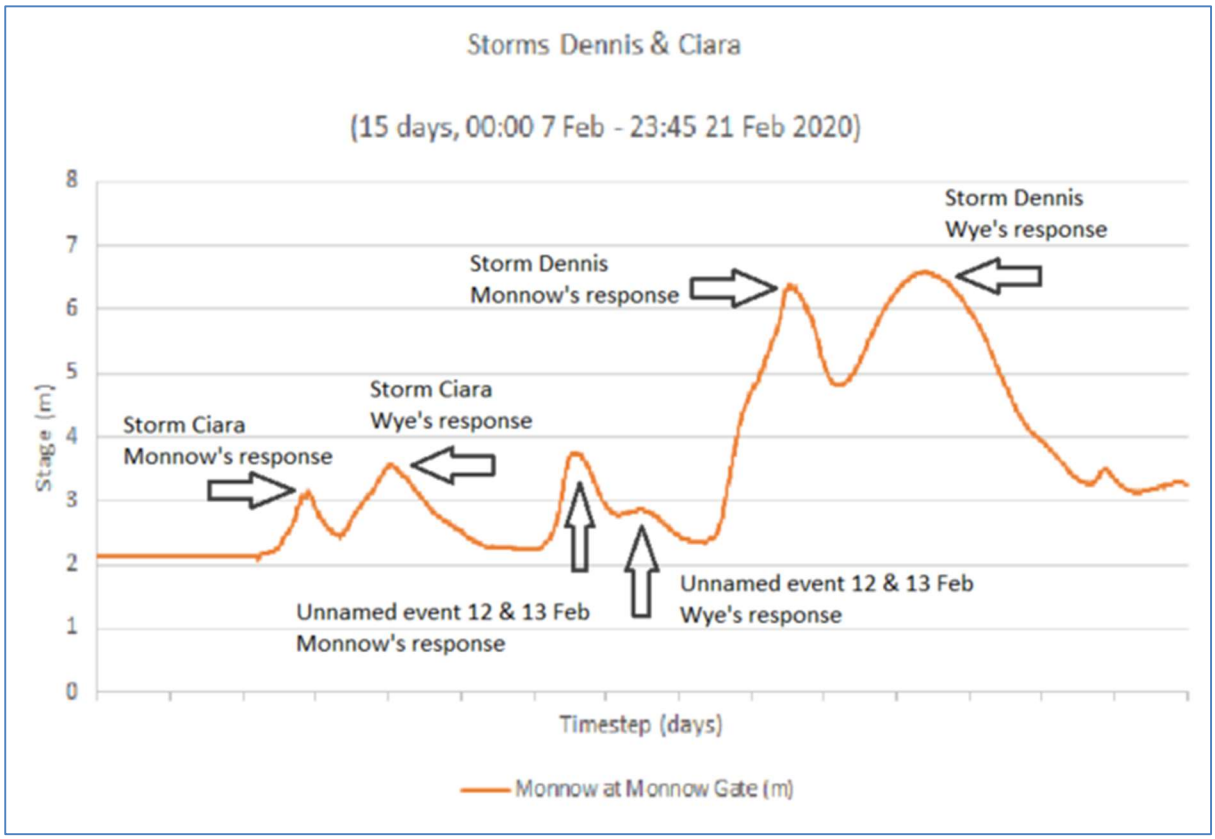
Storm, and time of onset:	Storm Dennis, 07:00hrs (GMT), 15 February 2020	Persistent Wet Weather October 2019, 10:00hrs (GMT), 25 October 2020
Monnow at Monnow Gate	2.363m	2.088m
Wye at Monmouth	2.706m	1.505m
Wye at Redbrook	3.078m	1.455m

Observations on peak levels between the two storms as recorded in the hydrograph figures in Table 3-4 and Table 3-5 are:

- The 1st peak on the Monnow at Monnow Gate was 0.247m higher during Storm Dennis than Persistent Wet Weather October 2019.
- The 2nd peak on the Monnow at Monnow Gate was 1.342m higher during Storm Dennis than Persistent Wet Weather October 2019.
- All 2nd peaks in Storm Dennis were notably higher than in Persistent Wet Weather October 2019.

Peak levels during Storm Dennis for Grosmont, Monmouth and Redbrook were new record highs at these gauges, as recorded in Table 5 of the NRW report entitled *February 2020 Floods in Wales: Flood Event Data Summary.*

Figure 3-11. Storm Dennis - Hydrograph peaks - River levels for the Monnow at Monnow Gate for the 15-day period 7 to 21 February 2020.



Graphs in Figure 3-12 to Figure 3-17 show cumulative rainfall totals for the 4-day period with the storms beginning on day 2, for Tafalog and Vowchurch rain gauges, and for their average rainfall. The cumulative totals are presented in Table 3-7.

Table 3-7. Cumulative rainfall totals.

Rainfall gauge	Persistent Wet Weather (mm)	Storm Dennis (mm)
Tafalog	94.4	93.0
Vowchurch	78.8	62.0
Tafalog Vowchurch average	86.6	77.5

Despite Persistent Wet Weather having a greater cumulative rainfall for the 4-day period, peaks on the Monnow at Monnow Gate were notably higher for the Storm Dennis flood event due to the antecedent conditions on the catchments and the river.

Figure 3-12. Persistent Wet Weather - Rainfall totals Tafalog (mm/15mins), and cumulative rainfall (mm) for the 4-day period 24 to 27 October 2019.

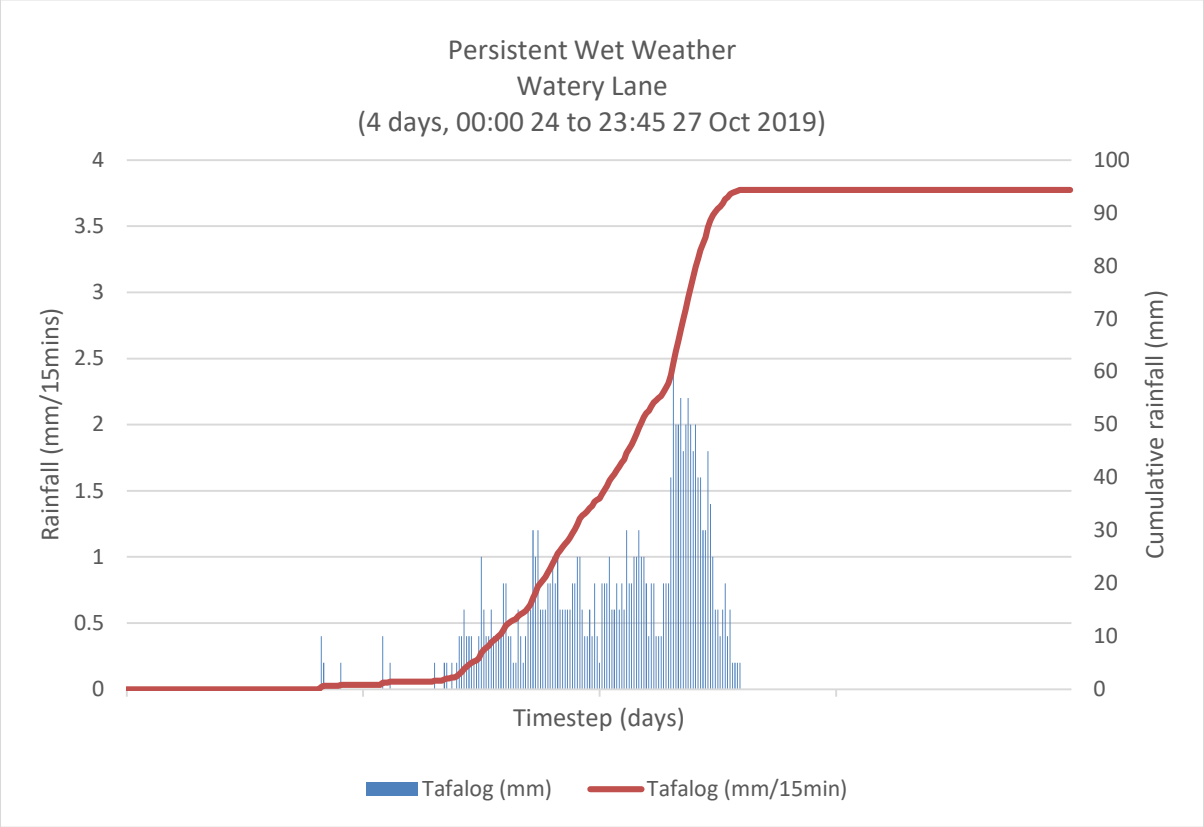


Figure 3-13. Storm Dennis - Rainfall totals Tafalog (mm/15mins), and cumulative rainfall (mm) for the 4-day period 14 to 17 February 2020.

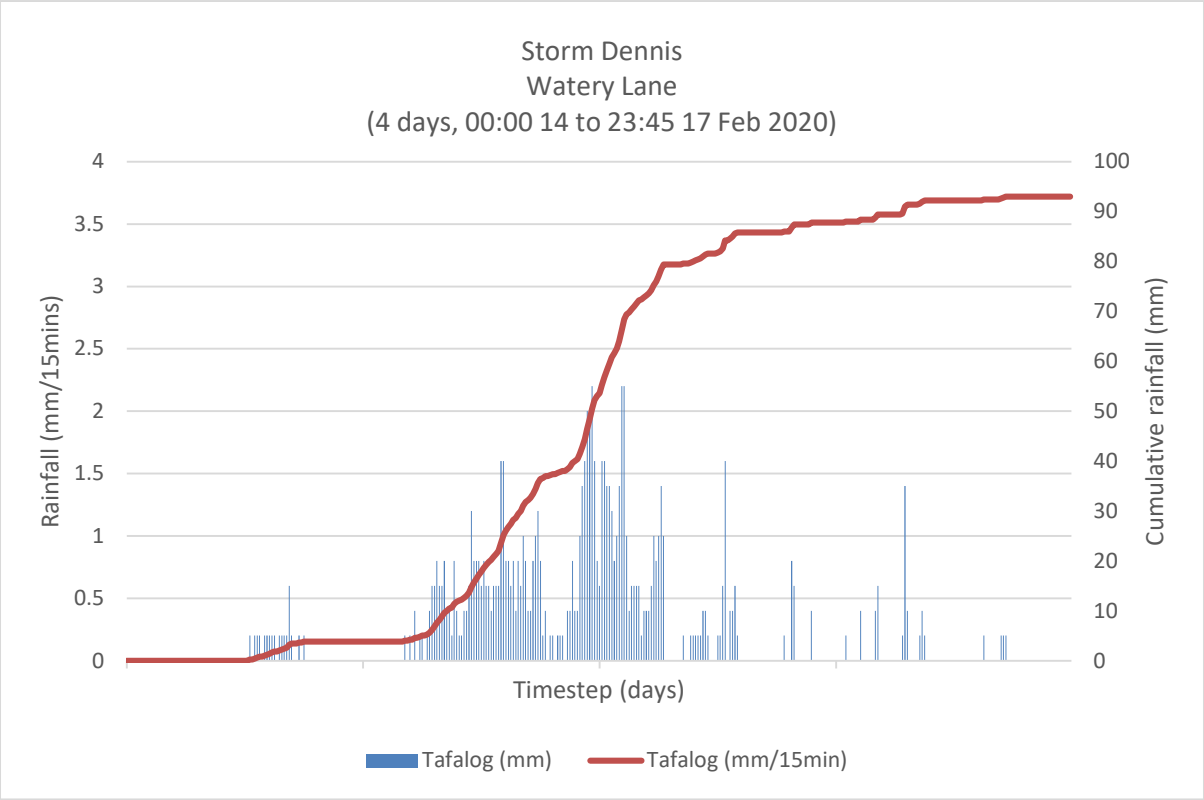


Figure 3-14. Persistent Wet Weather October 2019 - Rainfall totals Vowchurch (mm/15mins), and cumulative rainfall (mm) for the 4-day period 24 to 27 October 2019.

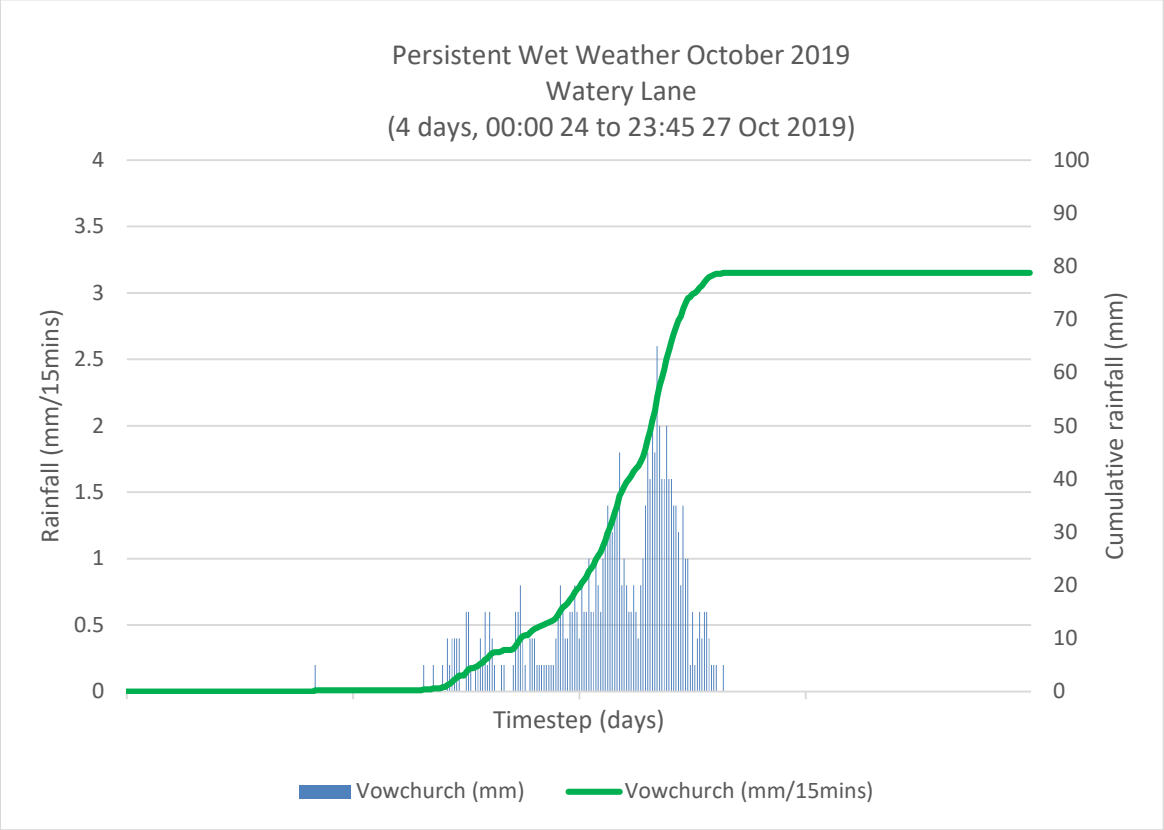


Figure 3-15. Storm Dennis - Rainfall totals Vowchurch (mm/15mins), and cumulative rainfall (mm) for the 4-day period 14 to 17 February 2020.

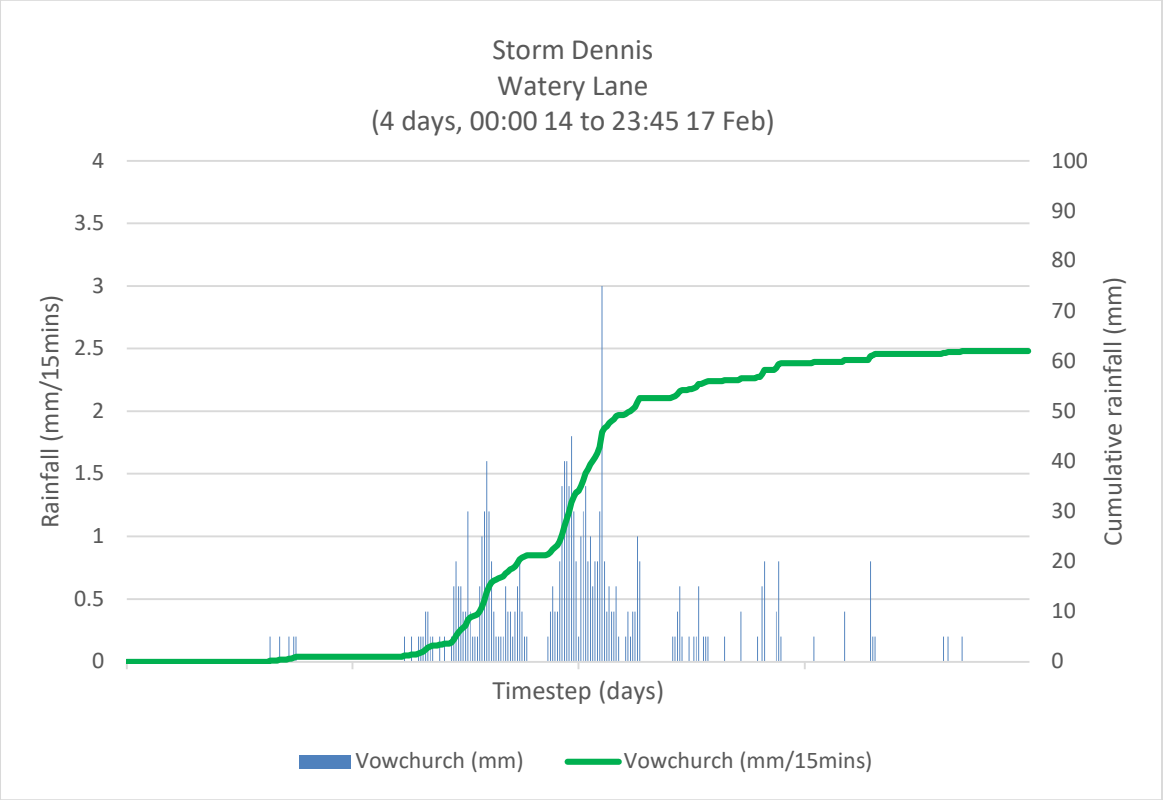


Figure 3-16. Persistent Wet Weather October 2019 - Rainfall totals Tafalog Vowchurch average (mm/15mins), and cumulative rainfall (mm) for the 4-day period 24 to 27 October 2019.

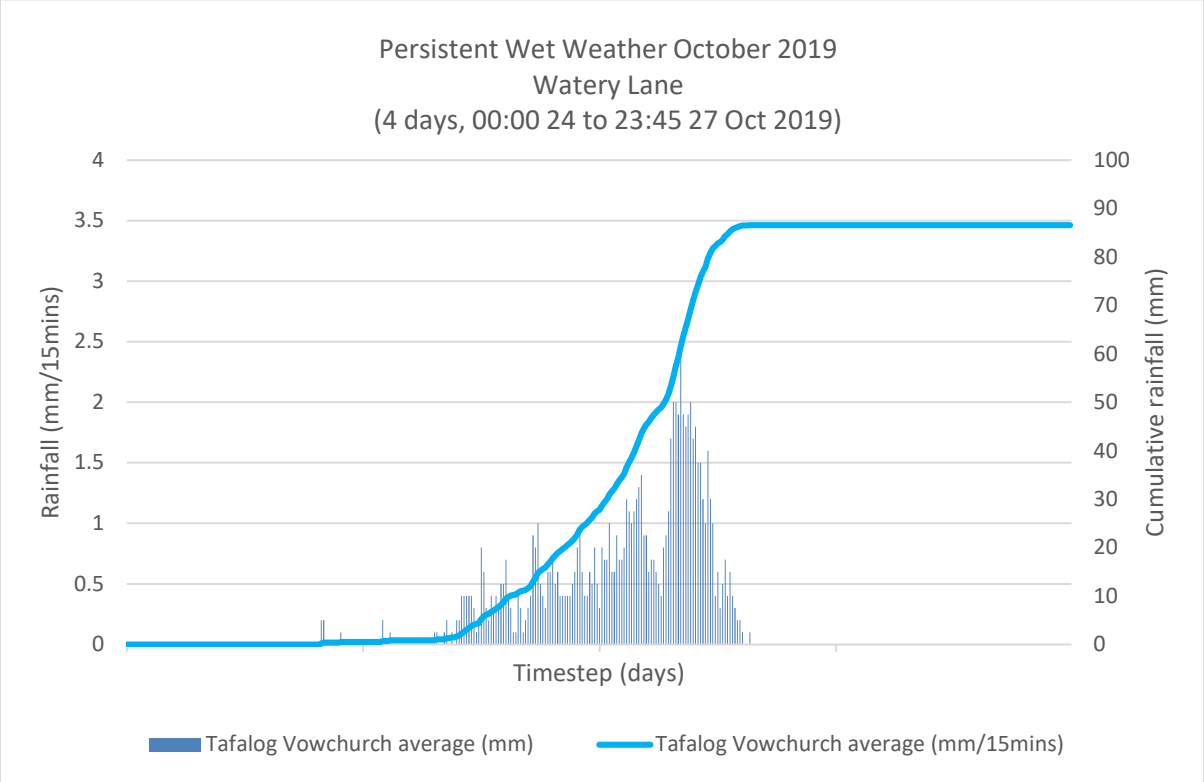
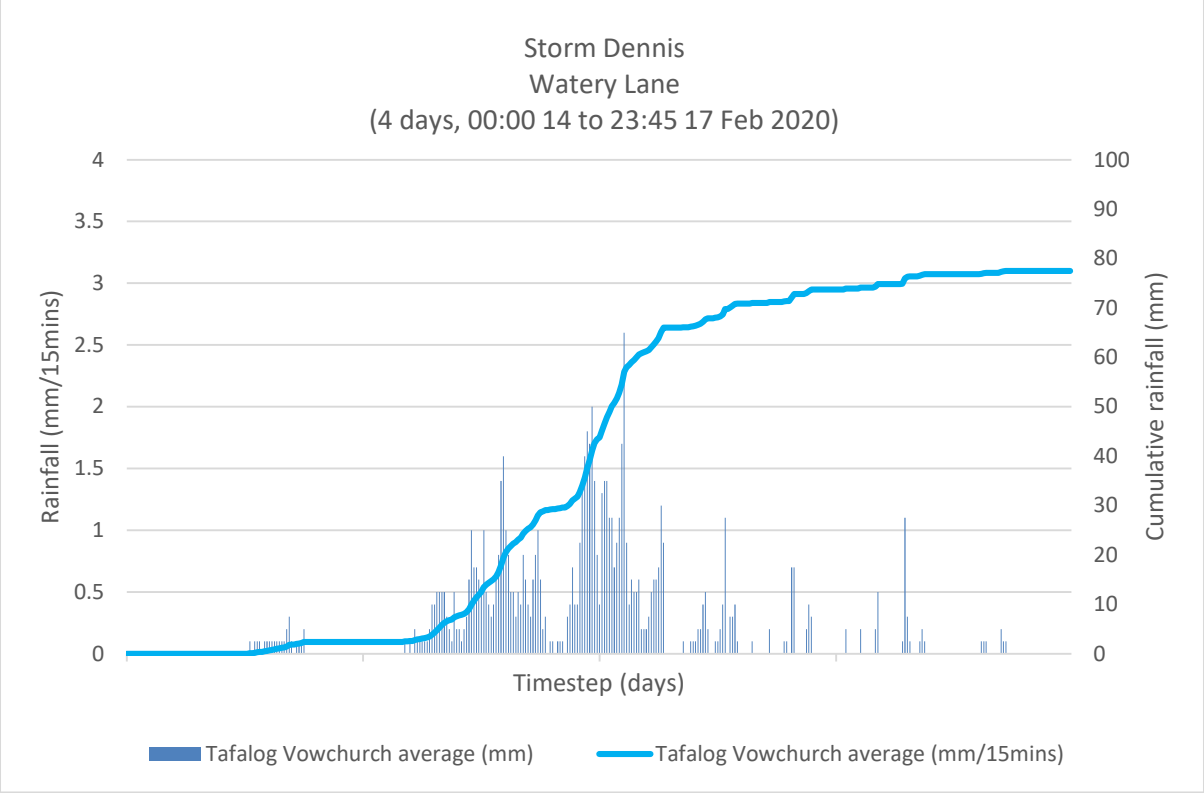


Figure 3-17. Storm Dennis - Rainfall totals Tafalog Vowchurch average (mm/15mins), and cumulative rainfall (mm) for the 4-day period 14 to 17 February 2020.



3.5 Return Period

3.5.1 Rainfall

The Met Office document *Wales: Climate, Updated 10 October 2016* reported that most parts of Wales experience daily totals of 50mm or greater at least once every 2 years.

In the NRW document *February 2020 Floods in Wales: Flood Event Data Summary*, NRW reported that Storm Dennis resulted in substantial and intense rainfall with significant impacts on river flows, river levels and flooding in South Wales. Nant yr Ysfa rain gauge, situated between the Cynon and Rhondda Fach catchments, received 130.4mm of rainfall in 24 hours, equivalent to 72% of an entire month's rainfall in a single day. At the top of the Rhondda Fawr catchment, Tyn Y Waun rain gauge received 132.4mm of rainfall in 24 hours, this equates to 62% of a month's rainfall in a single day.

In Pontypridd, the River Taff reached its highest level since records began in 1968. Peak flow passing through Pontypridd was estimated at 805m3/s, enough to fill an Olympic sized swimming pool in just over three seconds. This river level is 78cm higher than the previous record-level set during the 1979 floods.

The rainfall return period is the average interval a storm of at least a specified magnitude will occur on a catchment. The higher the return period the greater the storm.

The rainfall return period has been calculated for the Monnow's catchment at the confluence of the Watery Lane Watercourse using the Flood Estimation Handbook (FEH), at point 350500, 212700, see Table 3-9. Average rainfall depth and duration was used from Tafalog and Vowchurch rain gauges. The rain gauge depth and duration data used is presented in Table 3-8; the data shows how rainfall varied over the Monnow's catchment during the storms.

Table 3-8. Rainfall depth and duration data.

Rain Gauge	Storm	Period	Duration (hrs)	Rainfall Depth (mm)
Tafalog	Persistent Wet Weather October 2019	09:30hrs 25 Oct to 14:15hrs 26 Oct	28.75	92.2
Tafalog	Storm Dennis	06:30hrs 15 Feb to 06:30hrs 16 Feb	24	74.4
Vowchurch	Persistent Wet Weather October 2019	10:00hrs 25 Oct to 14:30hrs 26 Oct	28.5	77.8
Vowchurch	Storm Dennis	07:00hrs 15 Feb to 06:30hrs 16 Feb	23.5	51.2

Table 3-9. FEH return period in years, Monnow catchment.

Storm	Duration (hrs)	Rainfall Depth (mm)	Return Period in Years
Persistent Wet Weather October 2019	28.63	85	84
Storm Dennis	23.75	62.8	15

The rainfall return period has also been calculated for the catchment of the Watery Lane Watercourse at the Rockfield Road and Watery Lane roundabout using the Flood Estimation Handbook (FEH), point 350150, 212800, see Table 3-10. There are no rain gauges within the catchment; average rainfall depth and duration data from Tafalog and Vowchurch rain gauges has been used as these gauges are in the wider catchment of the Monnow.

Table 3-10. FEH return period in years, Watery Lane Watercourse catchment.

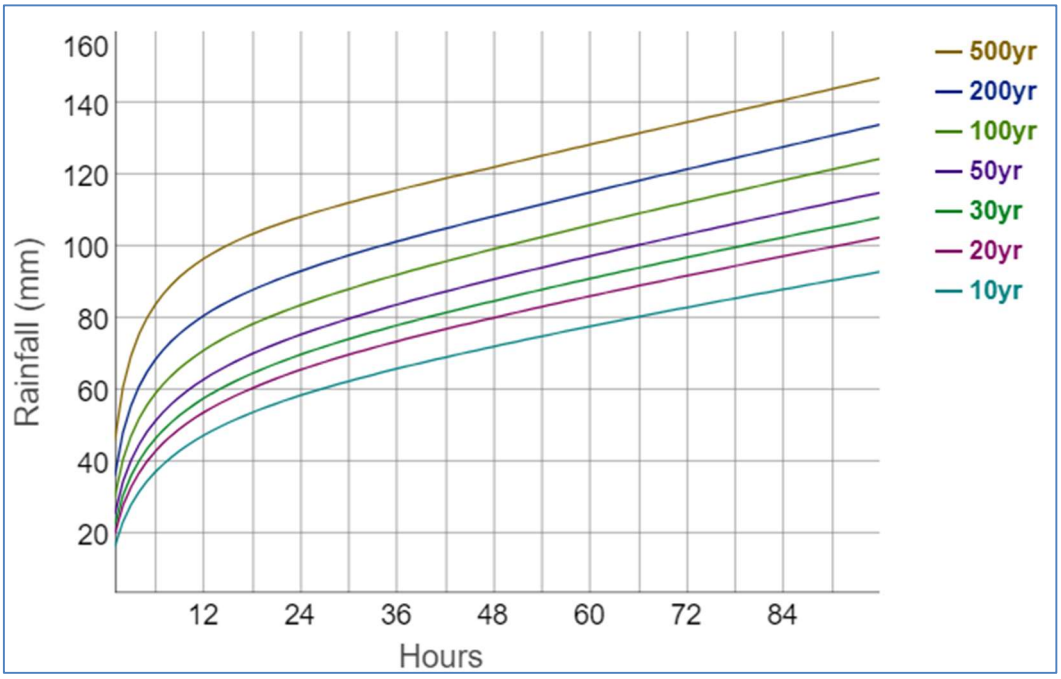
Storm	Duration (hrs)	Rainfall Depth (mm)	Return Period in Years
Persistent Wet Weather October 2019	28.63	85	74
Storm Dennis	23.75	62.8	14

Storm Dennis has a lower return period than Persistent Wet Weather October 2019. The difference in return period between the 2 storms is primarily due to Persistent Wet Weather October 2019 having a higher rainfall depth by 22mm, or 26%. Persistent Wet Weather October 2019 also had a longer average storm duration by 5 hours, or 17%. Additionally, rainfall density can vary significantly over a catchment, and may have been higher in ungauged areas, generating a higher return period for catchments as a whole for Storm Dennis.

The Depth Duration Frequency curves in Figure 3-18 show the relationship between rainfall depth and storm duration for set return periods for the Monnow's catchment at point 350500, 212700. Between 0 and approximately 24-hours, rainfall depths increase at a decreasing rate, and for storms of approximately 24-hour duration and greater, the relationship between storm duration and rainfall depth is linear.

Whilst Storm Dennis has a lower return period, river levels were already high on the Monnow in the location of Watery Lane at the onset of Storm Dennis, and the catchments were already saturated due to Storm Ciara and an unnamed rainfall event on 12 and 13 February 2020, generating very fast runoff to the rivers and high peaks in the hydrographs; these were major contributing factors to the flooding. See section 3.4 for further details on antecedent conditions and factors contributing to flooding.

Figure 3-18. FEH Depth Duration Frequency, Monnow catchment, point 350500, 212700.



3.5.2 River Flow

River flow data for the catchment is required for calculation of the river flow return period. This data is not currently available for the Monnow at Monnow Gate.

3.5.3 Tidal

This section is not applicable to this report, it is retained for consistency with other FWMA Section 19 reports.

There is no tidal influence on the Monnow at Monmouth.

3.6 Storm Dennis 15 and 16 February 2020

South Wales has an oceanic climate and experiences low pressure weather systems moving eastwards from the Atlantic with the polar jet stream. It is also characterised by mountainous terrain and rivers drain radially from the Brecon Beacons to the coast via main rivers.

Orographic uplift rainfall occurs when air is forced from a low elevation to a higher elevation as it moves across rising terrain. The combination of weather systems arriving from the Atlantic and the orographic uplift over the extensive mountainous ranges in South Wales leads to notable storm events.

A Met Office review of the persistent heavy rainfall across Wales and England on 15 and 16 February 2020 (see link in section 10) reported that Storm Dennis brought 100 to 150mm or more rain across high ground of the Brecon Beacons and South Wales valleys. Storm Ciara 1 week earlier brought 100mm of rain across high ground of Snowdonia, and high rainfall in South Wales. For the 9-day period from 8 to 16 February 2020, most of the UK received the February whole month average rainfall, East Wales received 150%, and parts of Herefordshire received 200%, see Figure 3-19 and Figure 3-20.

Figure 3-19. Rain radar images indicating heavy rain and persistent rainfall over south Wales 12:00 UTC 15 February 2020 and 00:00 UTC 16 February 2020.

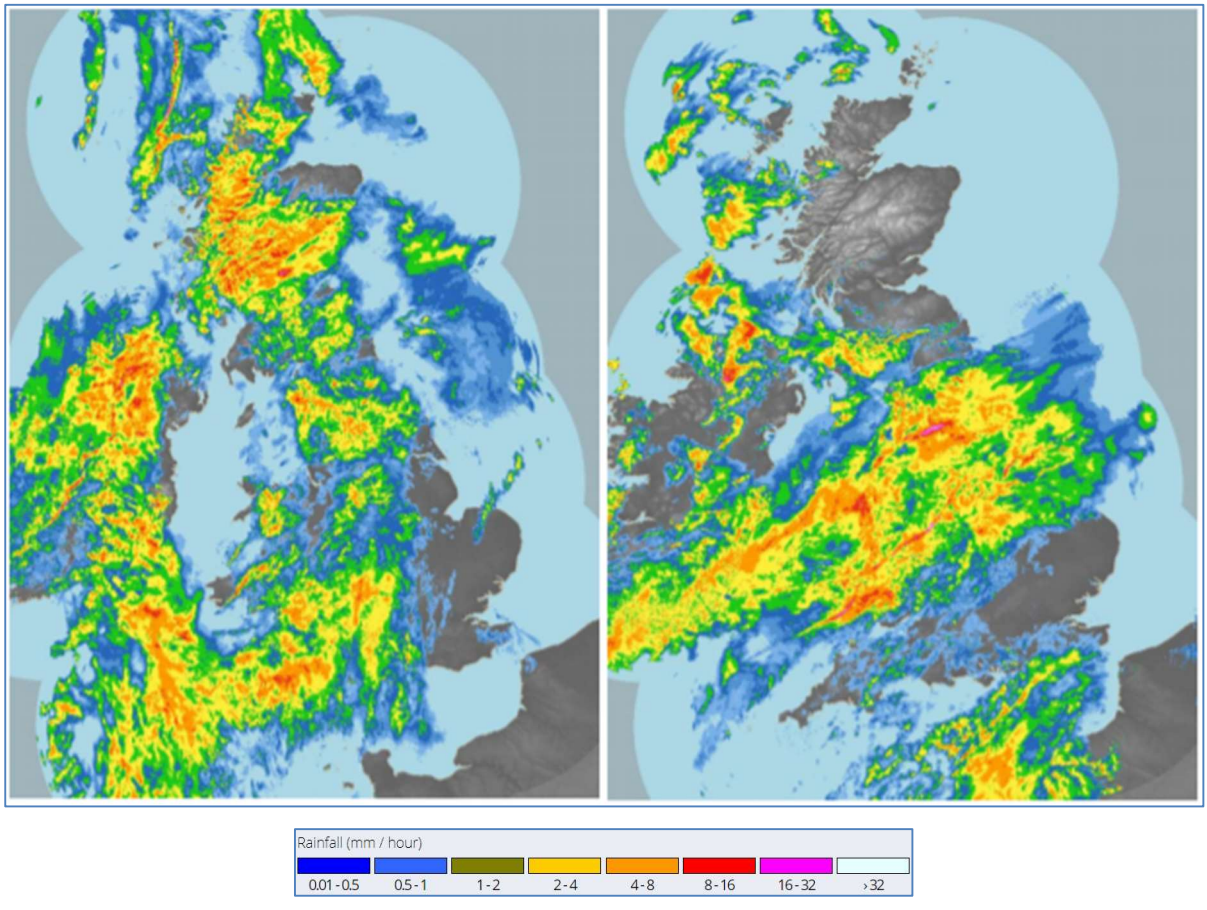
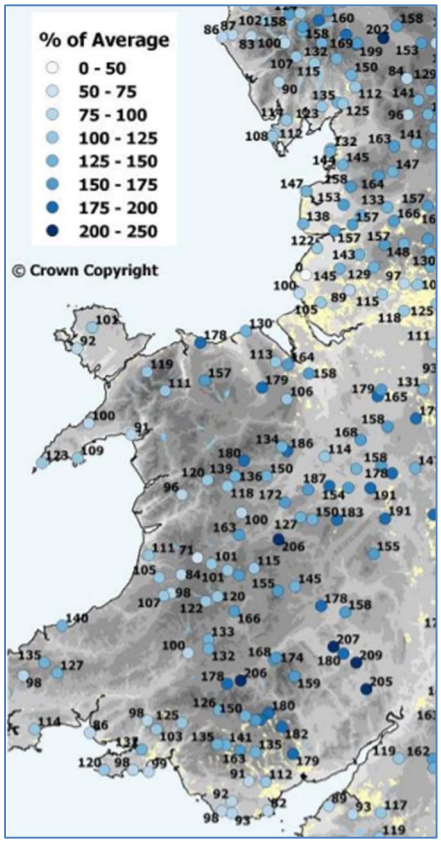
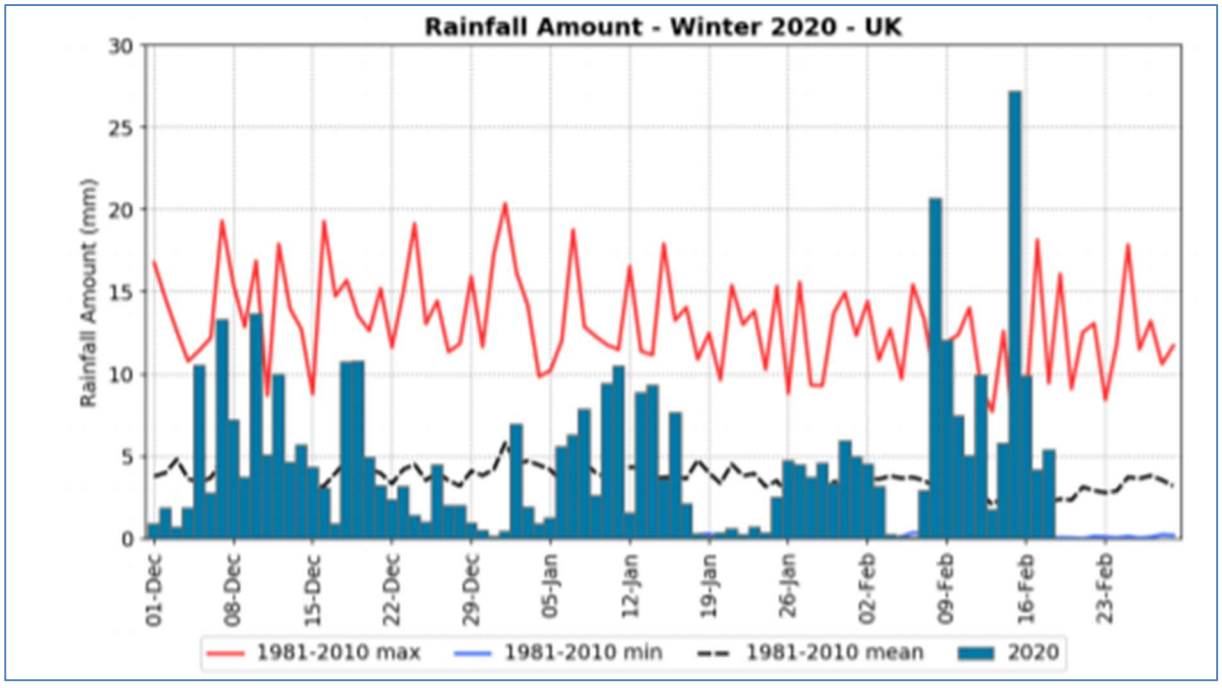


Figure 3-20. Rainfall totals at individual rain gauges for Storms Ciara and Dennis combined as % of 1981-2010 February long term average.



The chart below in Figure 3-21 shows the UK areal-average rainfall totals for each day of winter between 1 December 2019 and 18 February 2020, with the exceptionally wet days of 8 and 15 February associated with storms Ciara and Dennis. The red line shows the maximum rainfall for these days between 1981 and 2010, both storms Ciara and Dennis are above the maximum rainfall for any day within this period between 1981 and 2010.

Figure 3-21. UK areal-average daily rainfall totals for 1 December 2019 to 18 February 2020.



3.7 Met Office Weather and Flood Warning

The NRW report *February 2020 Floods in Wales: Flood Event Data Summary*, reported that February 2020 became the busiest month on record for issuing Flood Warnings in Wales; 243 Flood Alerts, 181 Flood Warnings and 6 Sever Flood Warnings were issued. These warnings reached 55,784 individuals, helping people to prepare and take action to save themselves and protect their property. However, due to the intense nature of events, a small number of flood warnings were issued late, or not at all.

A total of 3,130 properties were flooded during February 2020 in Wales. These included 224 properties flooded during Storm Ciara, 2,765 properties during Storm Dennis, and 141 during Storm Jorge. Of these an estimated 2,527 were households, with an average claims data from the insurance industry valuing around £81 million of flood damage.

Due to Storm Dennis many rivers reached historically high levels, exceeding the 1979 levels which caused extensive flooding and damage across South Wales. However, although significant flooding still occurred, it is estimated that NRW defences across South Wales protected over 19,000 properties.

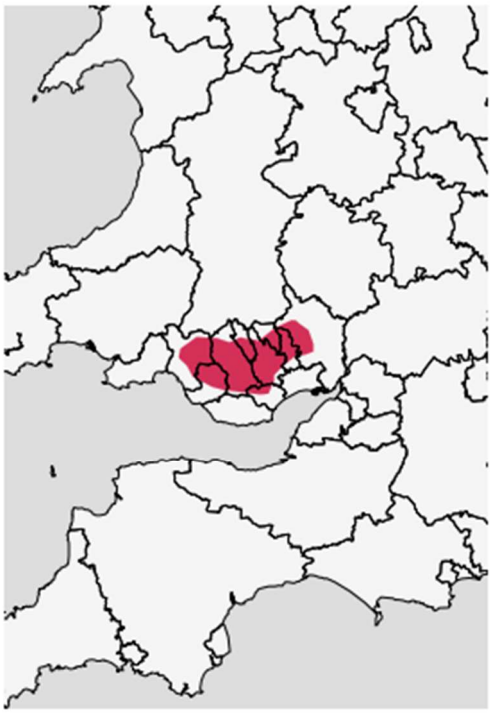
On 11 February 2020 the Met Office issued a Yellow weather warning for disruption to travel in Wales and England due to very strong winds from Storm Dennis on 15 and 16 February 2020. On 13 February 2020 in addition to disruption to travel the Yellow weather warning predicted very heavy rain from Storm Dennis. At 06.10 on 16 February 2020 a Red weather warning was issued for Monmouthshire, in this Storm Dennis was predicted to bring further heavy rain on the morning of 16 February 2020, and there was a warning of danger to life and high impacts as shown in Figure 3-22.

Figure 3-22. Met Office weather warning for South Wales issued 06:10hrs Sunday 16 February 2020.

Met Office — National Severe Weather Warning Service

Red warning
Rain

Between
06:10 Sun 16 Feb 2020 and
11:00 Sun 16 Feb 2020



Storm Dennis is expected to bring further heavy rain for a time on Sunday morning, increasing the likelihood of high impacts.

What to expect

- Danger to life from fast flowing or deep floodwater
- Extensive flooding to homes and businesses is likely
- Collapsed or damaged buildings or bridges
- Road closures and bus and train service delays and cancellations
- Dangerous driving conditions because of spray and flooded roads
- Loss of power and other essential services, such as gas, water, mobile phone service
- Communities could be completely cut off by floodwater, perhaps for several days

Further details

Prolonged, heavy rain will continue until mid-morning, easing slowly into the middle of the day. This rain will bring event totals to between 100 and 140mm over higher ground in south Wales.

High likelihood of high impacts

All regions & authorities affected

Wales

Blaenau Gwent Bridgend Caerphilly Cardiff Merthyr Tydfil Monmouthshire Neath Port Talbot Rhondda Cynon Taf Torfaen

4. Sources of Flooding

4.1 Fluvial Flooding

There are anecdotal reports in section 2.4 that the roundabout at Watery Lane and Rockfield Road, and properties on these roads near the roundabout flooded on the mornings of 16 and then again on 18 February 2020.

The 1st peak in flood levels at the roundabout on 16 February 2020 was from one or more mechanisms. The Watery Lane Watercourse couldn't discharge incoming flows from direct rainfall to its catchment to the Monnow due to high levels on the Monnow. The high levels on the Monnow were due to one or more of the following reasons: the Monnow's response to direct rainfall on its catchment; the Monnow was unable to discharge to the Wye due to high levels on the Wye; the Wye backed up the Monnow from Monmouth. High levels on the Wye in Monmouth were due to coinciding incoming flows from the Monnow and Trothy in Monmouth, causing the Wye to back up from Redbrook. There may also have been some local surface water inflows to the Wye, in particular from hard urban surfaces which were fast flowing to the river. It's possible the Wye backed up the Monnow, and then the Monnow in turn backed up the Watery Lane Watercourse and overtopped at the roundabout.

The 2nd peak in levels at the roundabout on 18 February 2020 was likely due to high levels on the Wye at Monmouth preventing the Monnow and Watery Lane Watercourse from discharging. It may also have been due to the Wye and/or Monnow backing up. The peak levels on the Wye on 18 February 2020 were the Wye's catchment's response to direct rainfall.

See section 3.3 and 3.4 for more details on the hydrographs of the Monnow and the Wye.

The Watery Lane Watercourse runs eastwards and is culverted under the eastern section of Watery Lane, and the Watery Lane and Rockfield Road roundabout. From the roundabout it continues eastwards around the northern perimeter of Drybridge Community Pond and the Wonastow Road Pumping Station before discharging to the Monnow, see Figure 3-1 for a location plan. There is another section of watercourse running to the south of the pond and pumping station and discharging to the Monnow. During the Storm Dennis flood event the Watery Lane Watercourse exceeded its capacity, overtopped at the downstream end of the roundabout culvert and spilled out onto the road, a picture of this section of the culvert is in Figure 4-6.

There are several structures and features on the Watery Lane Watercourse, pictures of many of them can be seen in Figure 4-4 to Figure 4-10, in order from upstream to downstream. The Watery Lane Watercourse originates in the Kingswood area, it bifurcates at the western end of Watery lane and merges again at the junction of Jordan Way and Bigham Close where it is culverted under Watery Lane through 2 culvert inlets 1 and 2 shown in the pictures below. The pictures show that on 18 February 2020 the 2 inlets at Jordan Way were at near full capacity, indicating the watercourse was unable to discharge flows.

At the time of preparing this report 7 properties are reported to have flooded on Watery Lane and Rockfield Road on 16 February 2020. This is an increase from the 2 properties reported to have flooded there in Persistent Wet Weather October 2019. Media coverage shown in section 2.4 and anecdotal evidence collected by MCC indicates that some or all of the same properties and the roundabout flooded for a 2nd time on 18 February 2020 due to Storm Dennis.

MCC have recorded that there was also flooding at Monmouth Caravan Park, Monmouth Skate Park, and Drybridge Park. The Monnow also flowed into its floodplain at Vauxhall Fields, see Figure 4-3.

It is expected that the Wonastow Road Pumping Station was functional during the flood event, as there was minimal flooding to Cinderhill Street, Drybridge Street and Wonastow Road which the pumping station and associated Wonastow Road Flood Alleviation Scheme assets protect. Further details of the scheme are in section 7.

Pictures of the flood event are in Figure 4-1 to Figure 4-5.

Figure 4-1. Severn Area Rescue Association delivering emergency rescue and evacuation services to residents at Watery Lane, Storm Dennis flood event February 2020.

Figure 4-2. Watery Lane and Rockfield Road roundabout inundated by flood water restricting access, Storm Dennis flood event February 2020.

Figure 4-3. Flooding at the slaughterhouse arches, Storm Dennis flood event February 2020.

Figure 4-4. Culvert inlet 1 to the Watery Lane Watercourse, junction of Jordan Way and Watery Lane, left site visit May 2021, right 09:53hrs 18 February 2020.

Figure 4-5. Culvert inlet 2 to Watery Lane Watercourse, junction of Jordan Way and Watery Lane, left site visit May 2021, right 09:15hrs 18 February 2020.

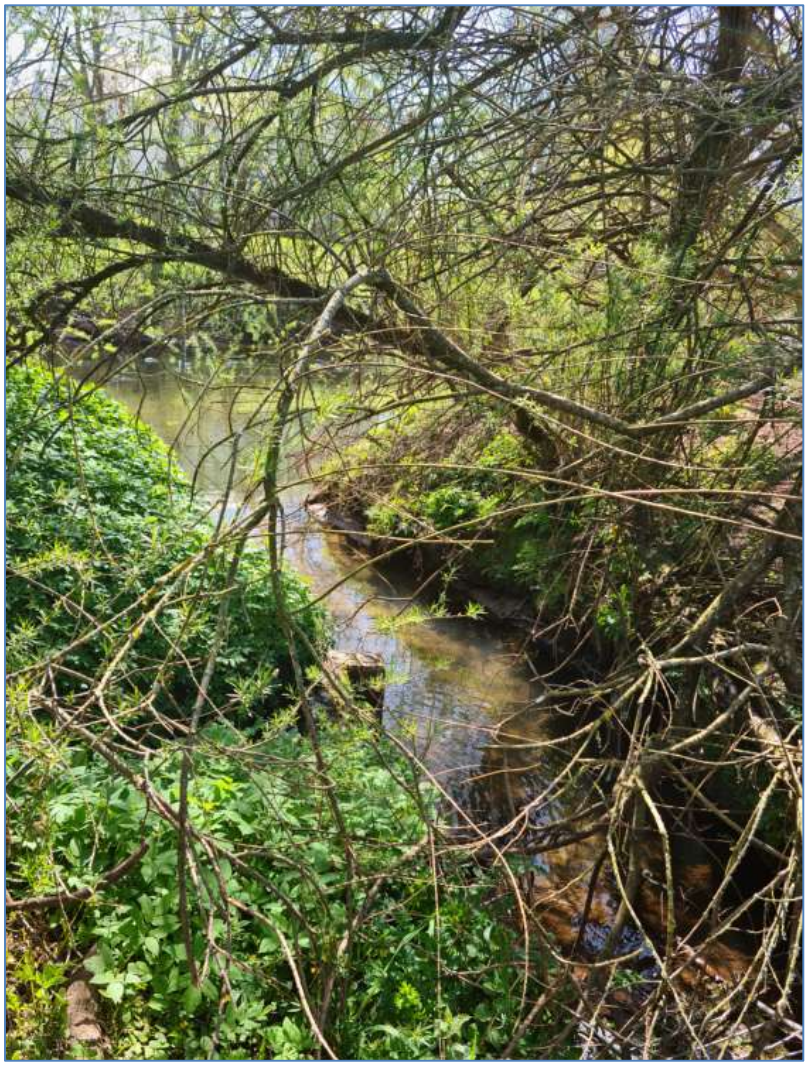
Figure 4-6. Watery Lane Watercourse, Watery Lane and Rockfield Road roundabout culvert outlet, site visit May 2021.

Figure 4-7. Embankment on the right bank of the Watery Lane Watercourse (looking downstream towards the Monnow), northeast of Drybridge Community Pond, site visit May 2021.

Figure 4-8. Blue outfall, Welsh Water surface water outfall and manhole covers southeast corner of Vauxhall Fields, outfall to Watery Lane Watercourse, site visit May 2021.

Figure 4-9. Bridge and weir on the Watery Lane Watercourse, upstream of where it discharges to the Monnow, site visit May 2021.

Figure 4-10. Confluence of the Watery Lane Watercourse with the River Monnow, site visit May 2021.



4.2 Groundwater

There are anecdotal reports in section 2.4 that water rose through the floorboards within some of the flooded properties. This is due to the Watery Lane Watercourse overtopping at the Watery Lane and Rockfield Road roundabout.

4.3 Tidal

This section is not applicable to this report, it is retained for consistency with other FWMA Section 19 reports.

There is no tidal influence on the Wye or Monnow at Monmouth.

4.4 Land Drainage

Vauxhall Fields is storage floodplain for the River Monnow and flooded during the Storm Dennis flood event.

4.5 Surface Water Drainage

The Watery Lane and Rockfield Road roundabout was inundated with water during the Storm Dennis flood event. Drains in the location of the flooding would therefore have been overwhelmed.

It is possible some surface water from hard urban surfaces contributed to the flooding where it was unable to enter the drainage system due to exceeded capacity.

A Welsh Water surface water drainage outfall has been identified close to the confluence of the Watery Lane Watercourse with the Monnow.

5. Rights and Responsibilities of Risk Management Authorities

5.1 Lead Local Flood Authority

Under the FWMA 2010, MCC has been established as the Lead Local Flood Risk Authority (LLFA) for its administrative area.

In its role as LLFA, MCC visited the residents affected by flooding due to Storm Dennis shortly after the event. A consultation with the residents was also carried out by telephone in May 2021.

As defined in the Act, MCC is responsible for 'Managing' what is termed, its 'local flood risk'. This includes the risk of flooding from ordinary watercourses, surface runoff and groundwater.

Local Authorities have always had certain responsibilities in relation to ordinary watercourses, and in practice most Local Authorities take the lead in dealing with surface water flooding incidents prior to the changes contained within the Act.

The Act places statutory duties on Local Authorities in their new role as LLFAs including:

- The preparation of local flood risk management strategies;
- A duty to comply with the national strategy;
- To co-operate with other authorities, including sharing data;
- A duty to investigate all flooding within its area, insofar as the LLFA consider it necessary or appropriate;
- A duty to maintain a register of structures and features likely to affect flood risk;
- A duty to contribute to sustainable development; and
- Consenting powers on ordinary watercourses.

In addition to these, each LLFA has a number of permissive powers. These are powers that allow them to undertake certain activities to manage flood risk, they are discretionary and include:

- Powers to request information;
- Powers to designate certain structures or features that affect flood or coastal erosion risk;
- The expansion of powers to undertake works to include broader risk management actions; and
- The ability to cause flooding or coastal erosion under certain conditions.

LLFA's in Wales have also taken on the role of the Sustainable Drainage Systems (SuDS) Adopting and Approving Body in relation to sustainable drainage systems as of 7 January 2019. In this role they are responsible for both approving the original design of the SuDS and adopting and maintaining the finished system in accordance with Welsh Government's National Standards for Sustainable Drainage.

The function of the LLFA during and after the flooding at the flood investigation area included a range of Response and Recovery functions:

- Officers investigated the flooding and have produced this report in line with Section 19 of the FWMA 2010.
- Officers contacted residents affected by flooding to offer support and advice to assist in the recovery following the event.

- Officers coordinated the response to the flooding with Emergency Services
- Asset information collected during the flood event has been incorporated into the LLFA Asset Register.

5.2 Natural Resources Wales

Under the Flood and Water Management Act 2010 and The Water Resources Act 1991, NRW have discretionary powers to manage the risk of flooding from main rivers and the sea. They are also recognised as a coastal erosion risk management authority under the Coast Protection Act 1949.

Their strategic oversight role is about having a Wales-wide understanding of all sources of flooding, coastal erosion and the risks associated with them, on a consistent basis across Wales to help inform the RMAs and the public.

NRW is the internal drainage board or carries out the functions of the internal drainage board, for the Internal Drainage Districts (IDDs) in Wales. It is granted powers under the Land Drainage Act 1991 to carry out works to manage the risk of flooding from ordinary watercourses and to regulate obstructions to ordinary watercourses within the IDD. Their main role is the management of water levels in ordinary watercourses in areas where there is a special need for drainage, including flooding.

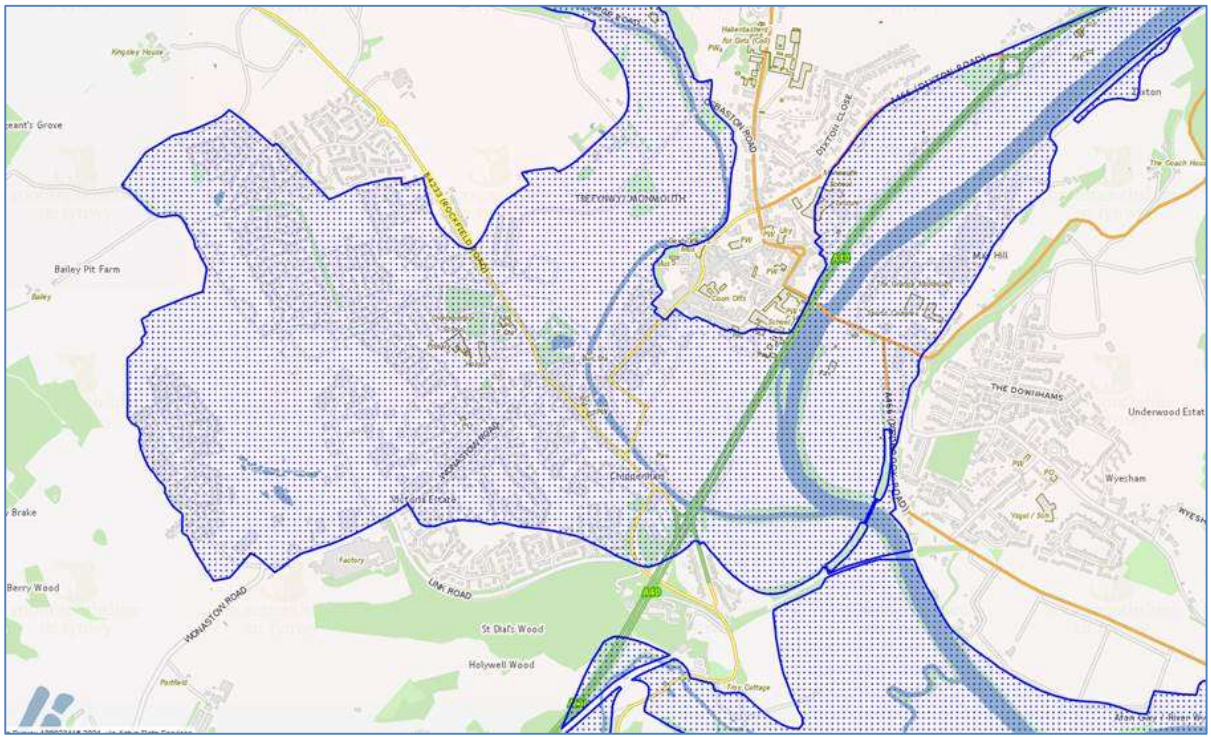
NRW as the Risk Management Authority can use its permissive powers to carry out work in several ways:

- By building new flood defences and other structures such as sluices and pumping stations.
- By maintaining defences and structures once built, keeping them in good condition subsequently, and repairing or improving them if and when required.
- By maintaining main river watercourses, removing obstructions, vegetation and silt or gravel, to keep water flowing and remove significant flooding risks.

Watery Lane is in the Lower Wye IDD as shown in Figure 5-1 and Figure 5-2.

Figure 5-1. IDD boundaries for southern Wales.

Figure 5-2. Lower Wye IDD boundary at Watery Lane.



5.3 Water / Sewerage Company

Sewerage undertakers are responsible for maintaining the public sewerage systems, including adopted sewers carrying surface water run-off.

In flood conditions, the sewer systems can often become overloaded with a mixture of floodwater and sewage leading to overflow and flooding. Where applicable, Sewerage undertakers are responsible for the removal of surface water from impermeable surfaces through their sewerage system. Where there is frequent and severe sewer flooding, sewerage undertakers are required to address this through their capital investment plans which are regulated by Ofwat. To prevent further flooding, water and sewer companies have a responsibility to monitor levels, prevent overloading of the sewer systems, and maintaining and repairing drainage pipes as necessary. This investigation has not identified any assets or infrastructure belonging to a water or sewage company that may have contributed to the flood event.

5.4 Network Rail

Network Rail has an operational responsibility as a riparian owner and is required to undertake regular maintenance of all assets that pose a risk to flooding. This investigation has not identified any assets or infrastructure belonging to Network Rail that may have contributed to the flood event.

5.5 Highways Authority

The Highway Authority is responsible for ensuring the highway is clear of obstructions and has a drainage system that controls direct surface water falling onto the highway.

MCC is the Highways Authority for all highways in Monmouthshire apart from Trunk Roads which are managed by the Welsh Government. Highways Authorities are also Risk

Management Authorities in their own right according to the FWMA 2010 and must adhere to all the responsibilities of Risk Management Authorities.

Under the Highways Act 1980, the Highways Authority has a duty to maintain the highway. This includes ensuring that highway surface water drainage systems are clear and free from blockages.

5.6 Riparian Landowners

A riparian owner possesses rights over and responsibilities for the stretch of a watercourse that forms the boundary of their property. A riparian owner is anyone who owns a property where there is a watercourse within or adjacent to the boundaries of their property. A watercourse includes a river, stream or ditch. Riparian owners, (householders and businesses) are responsible for maintaining their rivers, streams, ditches, pipes culverts and bridges.

Riparian landowners are legally responsible under common law for the maintenance of the land generally up to the centreline of any watercourse adjacent to their property. This includes the maintenance of the bed, banks and any boundary features e.g. vegetated strips such as hedging, with routine clearance of debris and/or blockages.

This does not mean that the owner must remove all debris from the watercourse, but it does require the owner to maintain as far as it does not pose a risk or 'nuisance' to a neighbour. Any works to modify the watercourse by the landowner will first require the necessary consents or permits from the relevant Risk Management Authority, Lead Local Flood Authority (LLFA) or Natural Resources Wales (NRW).

Landowners are responsible for ditches and land drainage assets upon their land. NRW has permissive powers to maintain watercourses which are designated as Main Rivers and MCC has permissive powers to maintain the ordinary watercourses respectively.

This investigation has not identified any defects with watercourses (Main River or Ordinary Watercourse) under riparian ownership which would have contributed to the flooding.

5.7 Residents and Property Owners

Residents and property owners are responsible for the maintenance and operation of drainage assets and connecting pipework falling within their ownership. They are also responsible for the protection of their own properties against flooding. Where safe to do so, they should take measures to protect themselves and their property from flooding. Residents and property owners have the right to defend their property as long as they do not subsequently increase the risk of flooding to other buildings and properties.

6. Permissive Powers of Risk Management Authorities

Natural Resources Wales has permissive powers under the Flood and Water Management Act 2010 and Water Resources Act 1991 to carry out works to manage the risk of flooding from main rivers. These discretionary powers include the ability to undertake works to clear watercourses, as well as developing and implementing flood alleviation schemes when justifiable.

MCC also has similar permissive powers under the Land Drainage Act 1991 on ordinary watercourses.

7. Flood Alleviation Schemes / Drainage Improvements

Previous flood alleviation and drainage improvement schemes in the local area are outlined in Table 7-1.

Table 7-1. Historical local flood alleviation and drainage improvement schemes.

Date	Scheme details
July 2007	The Wonastow Flood Alleviation Scheme was delivered by Monmouthshire County Council in July 2007. The council commissioned Atkins as lead designers and Dean and Dyball for construction of works. The scheme reduces flood risk to properties on Cinderhill Street, Drybridge Street, and Wonastow Road in Monmouth. When levels on the Monnow are too high for Wonastow Brook to discharge to it, the scheme has a pumping station which draws water from Drybridge Community Pond to provide storage capacity within the pond, and pumps it over an embankment into the Monnow. A picture of the pumping station is located adjacent to Drybridge Community Pond is in Figure 7-1. The scheme also delivered some improvements to Wonastow Brook, and Property Flood Resilience (PFR) measures to a small number of houses not protected by the scheme.

Figure 7-1. Wonastow Road Flood Alleviation Scheme pumping station.

8. Conclusion

The NRW report *February Floods in Wales: Flood Event Data Summary*, states that the consensus from climate change scientists is that extreme weather events, such as Storm Dennis and other storms that hit Wales in February 2020, are becoming more frequent. Climate change is increasingly impacting the way we live and work around rivers, catchments and the coast, and the way we manage water. Therefore, we need to understand how to adapt the way we live and work in these locations.

This FWMA Section 19 flood investigation into flooding at Watery Lane, Rockfield Road and the roundabout of these two roads, on 16 and 18 February 2020, has determined that flooding was the result of heavy and persistent rain from Storm Dennis which fell on ground that was already saturated from Storm Ciara and an unnamed rainfall event on 12 and 13 February 2020, and fast runoff from the saturated ground flowed into rivers which were already high due to these recent storms.

At the time of preparing this report 7 properties are reported to have flooded in the area on 16 February 2020; the roundabout also flooded restricting access. The roundabout and at least some of the properties flooded for a 2nd time on the 18 February 2020.

Anecdotal reports are that the main source of flooding was the Watery Lane Watercourse which overtopped at the Watery Lane and Rockfield Road roundabout. The overtopping was due to direct rainfall to the Watery Lane Watercourse's catchment, but it's likely levels on the watercourse were also increased due to the interactions it had with the Monnow and Wye, and their catchments' responses to direct rainfall. There may have been additional contributions from a Welsh Water surface water drain which outfalls to the Watery Lane Watercourse just prior to its confluence with the Monnow. Several features on the Watery Lane Watercourse prior to its confluence with the Monnow may have affected its water levels. The Wonastow Brook discharges to the Monnow close to the confluence of the Watery Lane Watercourse with the Monnow, and may have increased levels on the Monnow, having a knock-on effect to levels of the Watery Lane Watercourse. The River Trothy may have contributed to the Wye backing up to Monmouth and potentially increasing levels on the Monnow and Watery Lane Watercourse.

Two of the properties that flooded from Storm Dennis also flooded less than 4 months prior from Persistent Wet Weather October 2019; the residents of these 2 properties had not fully recovered at the time of the Storm Dennis flood event.

The FEH rainfall return period analysis has calculated that Storm Dennis had a lower return period than Persistent Wet Weather October 2019 for the Watery Lane Watercourse at the Watery Lane and Rockfield Road roundabout, and for the Monnow at the confluence with the Watery Lane Watercourse. The high flood impact of Storm Dennis despite the lower return period is due to antecedent catchment, river and watercourse conditions.

In addition to flooding at Watery Lane, MCC have recorded that there was also flooding at Monmouth Caravan Park, Monmouth Skate Park, and Drybridge Park, and that the Monnow flowed into its floodplain at Vauxhall Fields.

9. Recommendations

In accordance with Section 19 of the FWMA 2010, as LLFA, MCC has investigated this flood event and identified which RMAs have relevant flood risk management functions. As a result of the findings of this investigation and discussions with residents and other authorities, the following recommendations in Table 9-1 have been made.

Table 9-1. Recommendations from the Section 19 Flood Investigation

Reference	Recommendation	Responsible Risk Management Authority(ies)
WL01 (Flood risk)	Undertake an assessment of possible options to reduce the risk of ordinary watercourse flooding and consider the influence of the main River Monnow.	MCC
WL02 (Flood assets and land drainage features)	Record detail, ownership and maintenance responsibility of all flood assets and land drainage features and ensure such features are maintained to the required standards.	MCC/NRW
WL03 (Surface water)	Record detail, ownership and maintenance responsibility of all highway surface water drainage features and ensure such features are maintained to the required standards. Regular maintenance to be undertaken to drains on Watery Lane to mitigate any factors that could exacerbate flood conditions.	MCC
WL04 (Flood warning service)	Raise awareness and understanding of the flood warning service “Floodline” and review take up within Monmouth.	NRW

10. Useful Links and Contacts

- Monmouthshire County Council Flood Pages:
  www.monmouthshire.gov.uk/flood-risk-management
- Natural Resources Wales:
  www.naturalresources.wales/flooding
- Welsh Government:
  www.gov.wales/flooding-coastal-erosion
- Blue Pages:
  www.bluepages.org.uk
- Flood Re (Insurance):
  www.floodre.co.uk
- Met Office, Past Weather Events:
  https://www.metoffice.gov.uk/weather/learn-about/past-uk-weather-events#y2020

11. Table of Acronyms

Table 11-1 below is a list of acronyms used in the report.

Table 11-1. Table of Acronyms.

Full text	Acronym
Environment Agency	EA
Flood and Coastal Erosion Risk Management	FCERM
Flood and Water Management Act 2010	FWMA 2010
Flood Estimation Handbook	FEH
Internal Drainage District	IDD
Lead Local Flood Authority	LLFA
Monmouthshire County Council	MCC
Natural Flood Management	NFM
Natural Resources Wales	NRW
Property Flood Resilience	PFR
Risk Management Authority	RMA

Appendix A – Anecdotal evidence

This appendix has been redacted.

Appendix B - Hydrographs

Figure 0-1. Persistent Wet Weather October 2019 - River and rainfall levels for the Monnow at Grosmont for the 15-day period 17 to 31 October 2019.

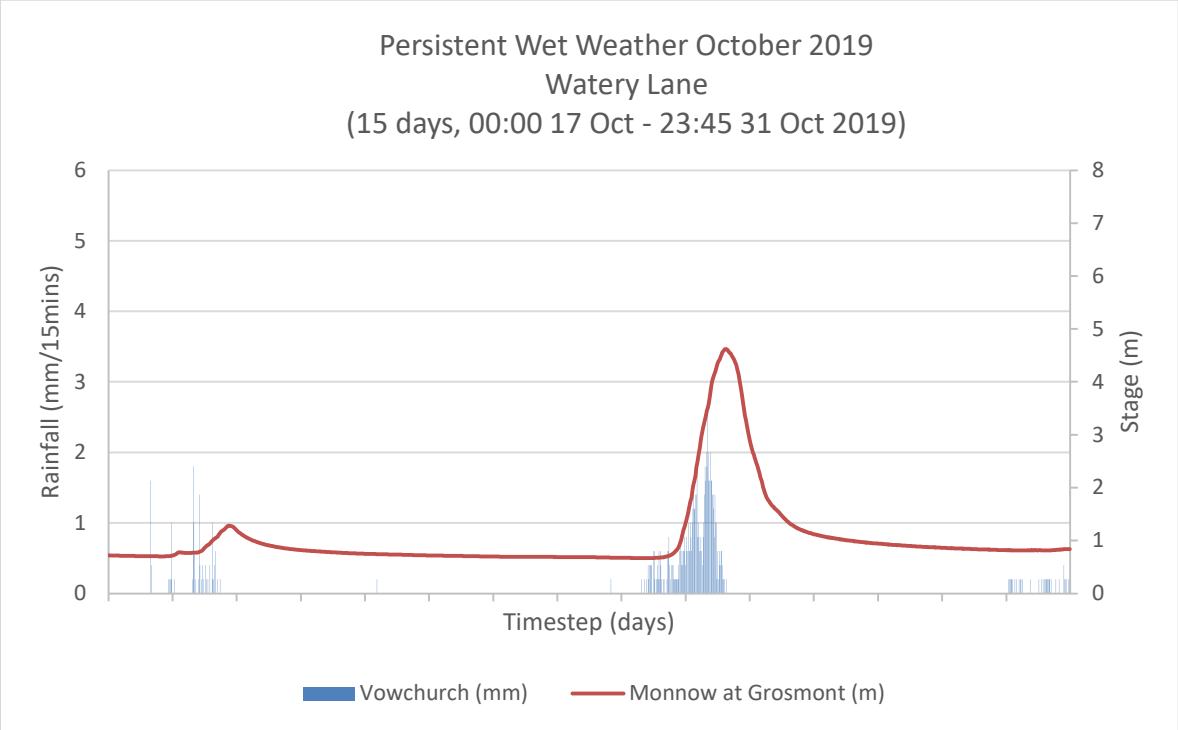


Figure 0-2. Persistent Wet Weather October 2019 - River and rainfall levels for the Monnow at Sklenfrith for the 15-day period 17 to 31 October 2019.

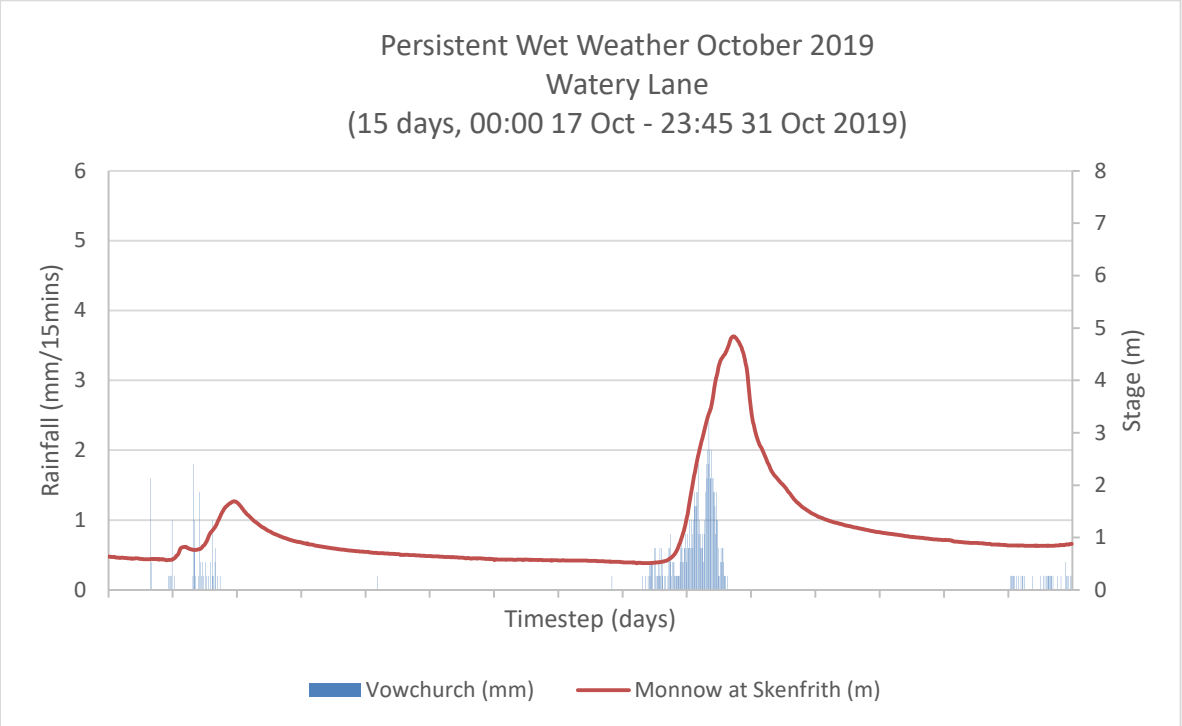


Figure 0-3. Persistent Wet Weather October 2019 - Rainfall and river levels for the Monnow at Monnow Gate for the 15-day period 17 to 31 October 2019.

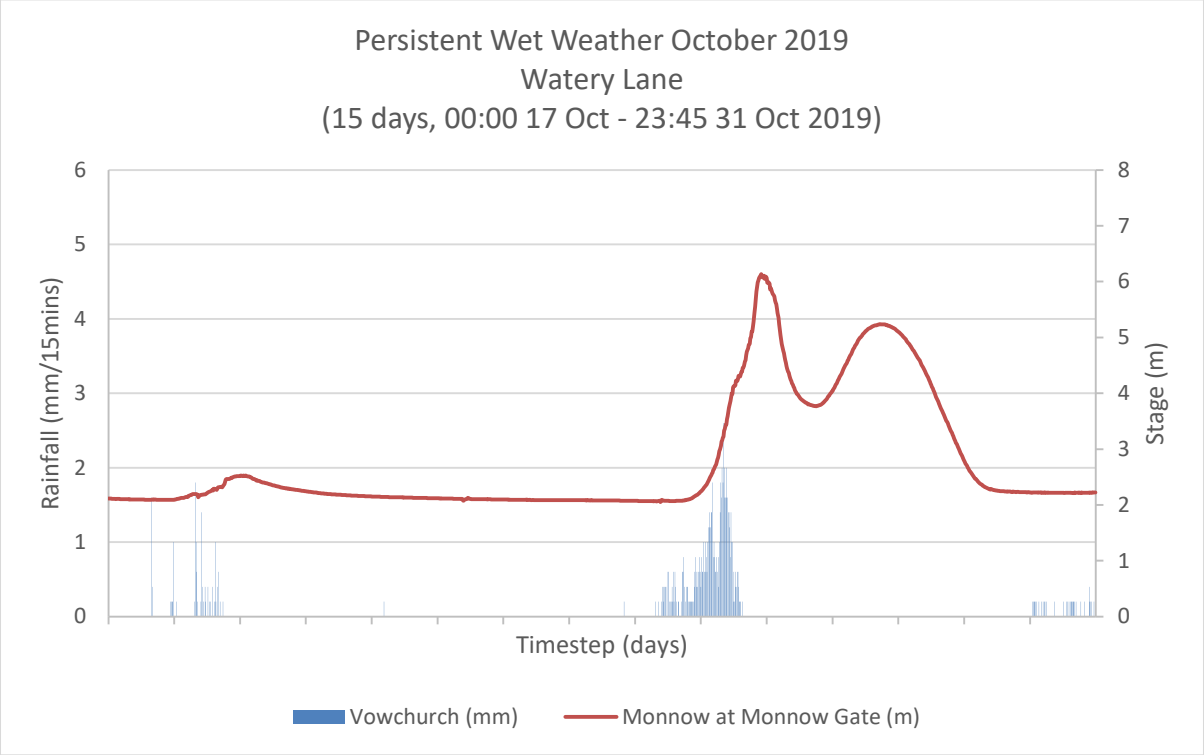


Figure 0-4. Persistent Wet Weather October 2019 - Rainfall and river levels for the Wye at Ross on Wye for the 15-day period 17 to 31 October 2019.

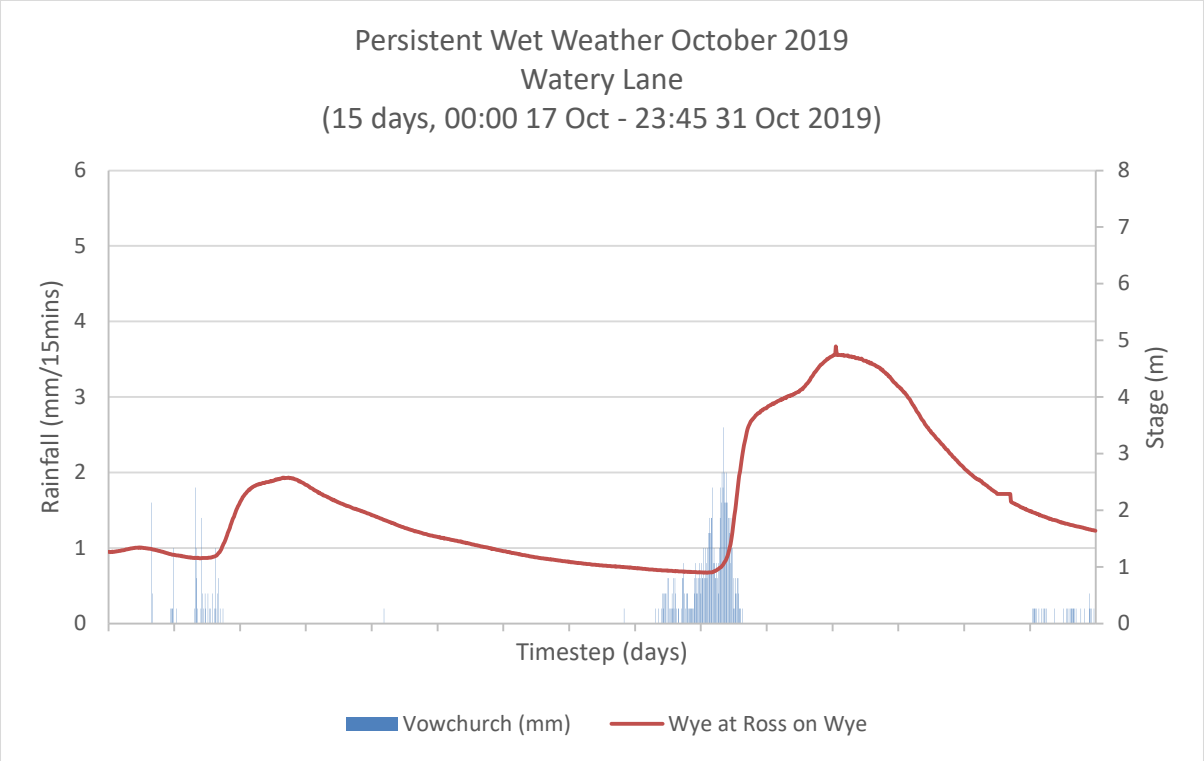


Figure 0-5. Persistent Wet Weather October 2019 - River levels for the Wye at Monmouth for the 15-day period 17 to 31 October 2019.

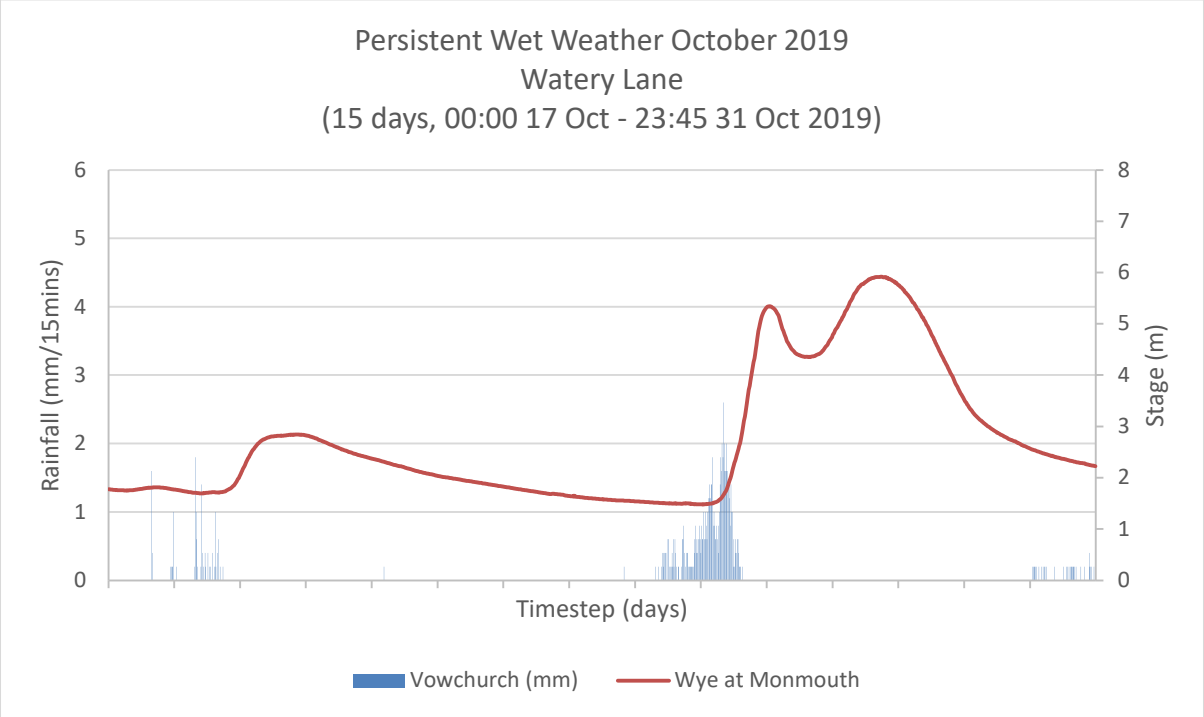


Figure 0-6. Persistent Wet Weather October 2019 - River levels for the Wye at Redbrook for the 15-day period 17 to 31 October 2019.

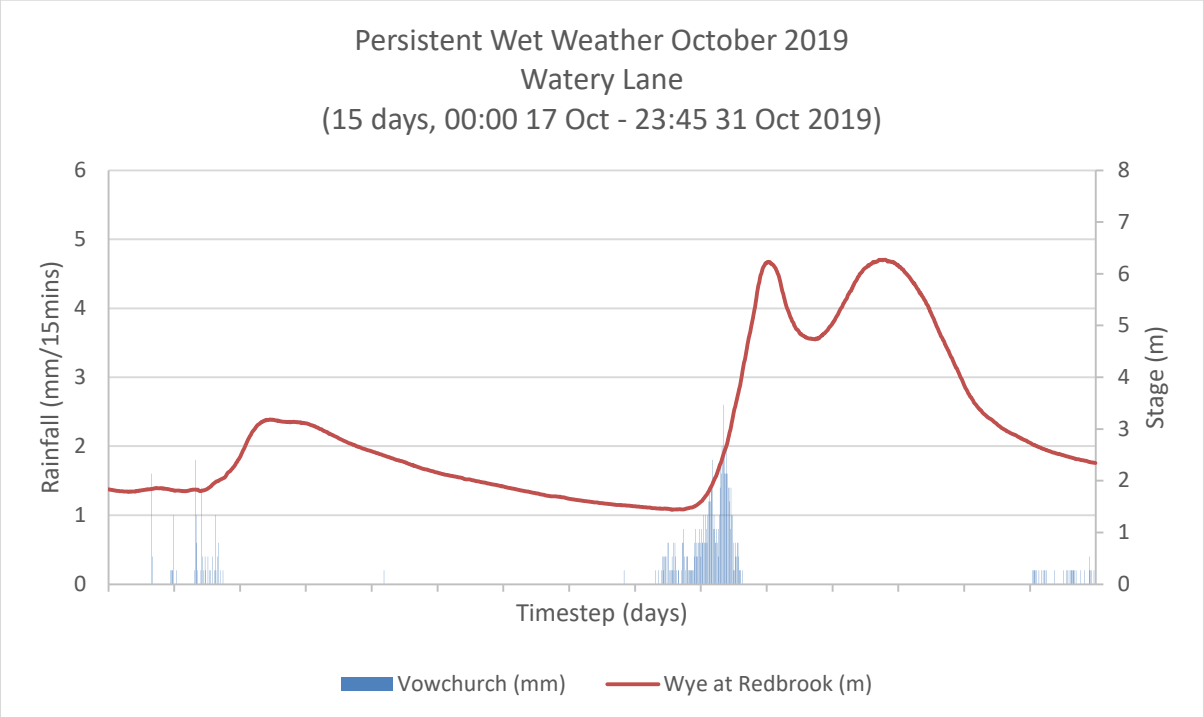


Figure 0-7. Persistent Wet Weather October 2019 - River levels for the Trothy at Michael Troy for the 15-day period 17 to 31 October 2019.