

Flood and Water Management Act 2010

Section 19 Flood Investigation Report

Storm Dennis – Flood Investigation Area RCT25

July 2021

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This report should be read in its entirety.

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EXECUTIVE SUMMARY

This report has been produced through the duties placed upon Rhondda Cynon Taf County Borough Council (RCT) under Section 19 of the Flood and Water Management Act 2010. The Act states, “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”.

This Section 19 investigation provides a factual report of the storm events that occurred between February and August 2020 within the Rhondda Cynon Taf County Borough Council area, focusing investigation on the flooding at Pentre in the Rhondda Fawr valley (Flood Investigation Area RCT 25). This report was undertaken to identify the mechanism for flooding, establish which Risk Management Authorities have relevant flood risk management functions under the Flood and Water Management Act 2010 and ascertain if those Risk Management Authorities had undertaken or were planning to undertake actions related to those functions to reduce/alleviate the risk of flooding.

Pentre was impacted by flooding on five separate occasions during 2020. This report will focus on the largest of the four 2020 flood events which occurred between the 15 and 16th of February 2020. The flooding that affected RCT on 15 and 16th of February 2020, was a result of an extreme rainfall event, designated by the Met Office as ‘Storm Dennis’. The impact of this event at Pentre resulted in internal flooding to 159 residential properties, 10 commercial properties and extensive flooding to the highway. These impacts were identified through inspections made by RCT’s Flood Risk Management Team during the days following the storm event, as well as information collated by residents, RCT’s Public Health team, Natural Resources Wales and Dŵr Cymru Welsh Water.

The evidence gathered within this report indicates the main source of flooding during the initial flood event was a result of significant blockage and damage to the Pentre Road culvert inlet to the north of the village, which resulted in water flowing down Pentre Road onto Elizabeth Street and Queen Street towards the lower streets of Pentre.

The culvert inlet and extensive hillside above Pentre are in the ownership of Welsh Government and managed by NRW. Post event reports identified the culvert inlet to

have been blocked by woody debris washed off the mountain side, which severely reduced the hydraulic capacity of the inlet. Upon a review of the hydraulic performance of the inlet without blockage, it was identified as having a standard of protection of 1 in 1000 year. This confirms that the inlet had sufficient capacity to deal with the storm event, but its capacity was significantly reduced due to blockages which ultimately was the primary cause of flooding at Pentre during Storm Dennis. These blockages at the inlet severely reduced the inlet's capacity to manage the flow of water.

The subsequent impact of this initial blockage resulted in a significant amount of debris washing down into the culvert network, contributing to repeat surface water flooding in the lower reaches of Pentre during the subsequent storm events. Additionally, mud and silt carried overland from the inlet entered the highway drainage infrastructure, leading to a substantial reduction in the hydraulic capacity of the surface water drainage networks in Pentre. A review of NRW's National Surface Water Flood Maps supports this interpretation, displaying flooding in those downstream areas reported by residents and Flood Risk Management officers.

RCTCBC as the Lead Local Flood Authority (LLFA) and Land Drainage Authority (LDA) has been determined as the relevant Risk Management Authority responsible for managing the ordinary watercourse flooding that occurred during Storm Dennis and the surface water flooding that occurred during the following flood events. The LLFA and LDA are working closely with NRW and DCWW to assess the risk of flooding from all sources and to develop a range of flood alleviation options to increase the standard of protection to approximately 400 properties in Pentre.

In response to the flooding events of 2020, the LLFA has;

- Carried out significant upgrades to the Pentre Road inlet to reduce potential blockages;
- Developed and implemented a flood routing scheme at Pleasant Street to manage overland flows;
- Worked with DCWW to construct a high-level overflow to increase the capacity of the highway drainage network in Lewis Street;
- Is developing proposals for significant efficiency upgrades to Volunteer Street pump station; and
- Led on the development of an Outline Business Case for Pentre which seeks to mitigate flood risk in the community.

The event that occurred on 15 and 16th February 2020 was extreme, and it is unlikely flooding from a similar event could be prevented entirely. It is concluded that Risk Management Authorities satisfactorily carried out their flood risk management functions in response to the flood event, however, further functions have been

proposed by all RMAs to better address preparedness and response to surface water flood events.

Further to this, and to address the interconnections between NRW's Forestry operations and flooding, the LLFA has made the following recommendations which align with the recommendations presented by NRW as the land estate manager within their Land Estate Management Review: -

- To review NRW's own Forest Resource Plans and Coupe Management Plans with regard to water management, particularly surface water management and the treatment of brash material in close proximity to an ordinary watercourse;
- To develop a Forest Resource Plan for the Rhondda Fawr valley, in collaboration with the LLFA, to identify and reflect the key challenges facing the community of Pentre;
- To embed NRW's own Water Management Plans into their forestry management operations to ensure the impacts of flood risk downstream are fully realised; and
- To engage with residents in relation to Forest Resource Planning and forest operations to help develop greater confidence in the WGWE and NRW's contribution to managing surface water runoff from their land.

ABBREVIATIONS

DCWW – Welsh Water

FRMP – Flood Risk Management Plan

FWMA – Flood and Water Management Act 2010

LDA – Land Drainage Authority

LFRMS – Local Flood Risk Management Strategy

LLFA – Lead Local Flood Authority

NRW – Natural Resources Wales

RCT - Rhondda Cynon Taff CBC

RMA – Risk Management Authority

SAB – Sustainable Drainage Approval Body

SuDS – Sustainable Drainage Systems

WGWE – Welsh Government Woodland Estate

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1. INTRODUCTION

1.1 PURPOSE OF INVESTIGATION

On the 15 and 16th February 2020 Rhondda Cynon Taf County Borough Council (RCT) was impacted by an extreme weather event which was designated by the Met Office as ‘Storm Dennis’. Due to the extent and impact of the event, the LLFA opted to undertake a formal investigation.

The storm resulted in widespread residential and commercial flooding within the Rhondda Cynon Taf County Borough Council area. This report will focus on Flood Investigation Area RCT 25 which covers the town of Pentre in the Rhondda valley.

The reason behind RCT’s investigation is in response to the duties of the local authority in regards to Section 19; of the Flood and Water Management Act 2010, 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 the response to the flood.”
2. “When an authority carries out an investigation under subsection (1) it must publish the results of its investigation, and notify any relevant risk management authority”¹

The purpose of the investigation is to determine which Risk Management Authorities have relevant flood risk management functions and which functions have been exercised in response to a flood.

Specific details of Storm Dennis, such as rainfall analysis are covered within a separate overview report that covers the wider RCT area. The report is titled ‘Storm Dennis February 2020 – Overview Report’ and will be referred to as ‘FRM – Storm Dennis – Overview Report’.

¹ Flood and Water Management Act 2010 – Section 19 - <https://www.legislation.gov.uk/ukpga/2010/29/section/19>

1.2 SITE LOCATION

The area investigated within this report is located within the electoral ward of Pentre, and community area of Rhondda, which is situated in the western sector of Rhondda Cynon Taf CBC, to the south of Treorchy (Figure 1). Pentre is primarily located within the Rhondda Fawr River catchment which flows northwest to southeast through the centre of Pentre.

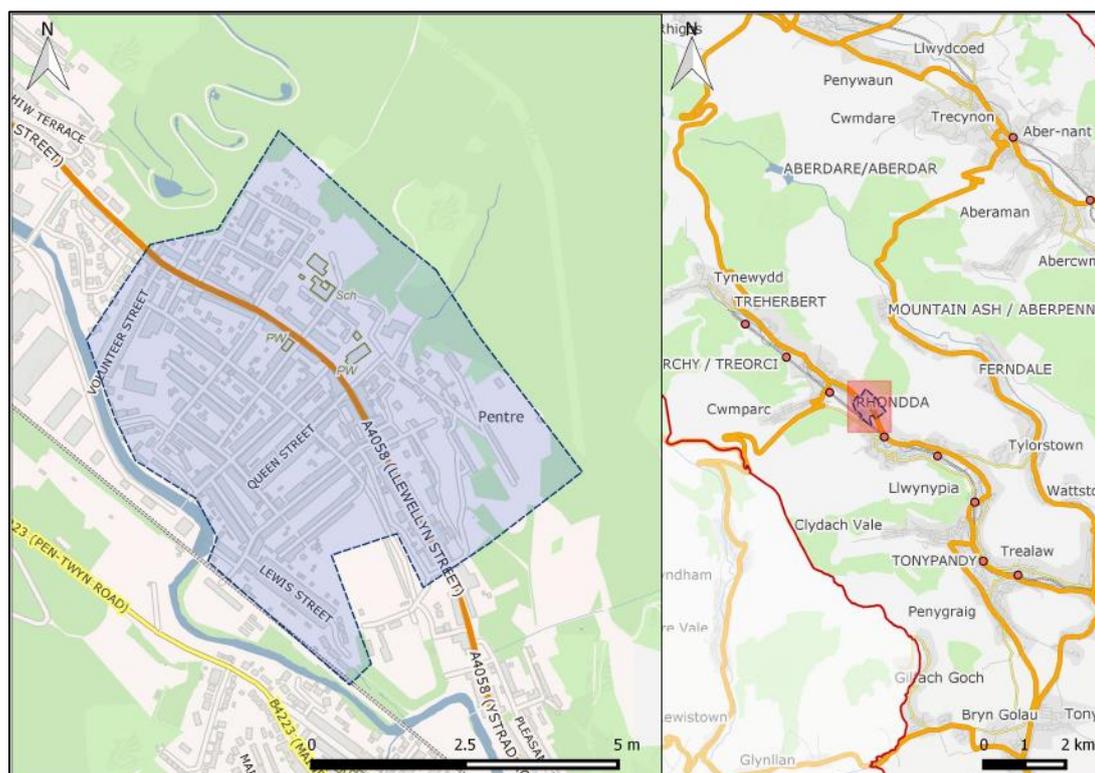


Figure 1: Flood Investigation Area RCT25 Location Plan

The catchment of Pentre is characterised by having steep-sided valleys above the village with a gradual decreasing gradient through the urban area to the valley floor. Pentre village is heavily urbanised, with the surrounding area land use being predominantly forestry with some hill grazing.

The community of Rhondda is identified as having significant flood risk and as such has not only been designated a Flood Risk Area requiring the production of a Flood Risk Management Plan according to the Flood and Water Management Act 2010¹, but Rhondda has also been ranked as the highest risk community in Wales for ordinary watercourse and surface water flooding according to the Communities at Risk Register.

Compared to other community areas in RCT, the extent and degree of flood risk at Pentre is far greater, as is illustrated in NRW's Flood Risk Assessment Wales (FRAW) map presented in Figure 2. The highest risk posed to people and properties within Pentre is broadly associated with the four primary ordinary watercourses which drain the highlands in the east and discharge into the Rhondda Fawr River. These watercourses are heavily culverted beneath Pentre's urbanised area, with flooding primarily being sourced from culvert inlets. Figure 2 outlines the flow path of flood water which generally follows the roads towards the streets on the north bank of the Rhondda Fawr River which are at significant risk of flooding from all sources according to the FRAW.

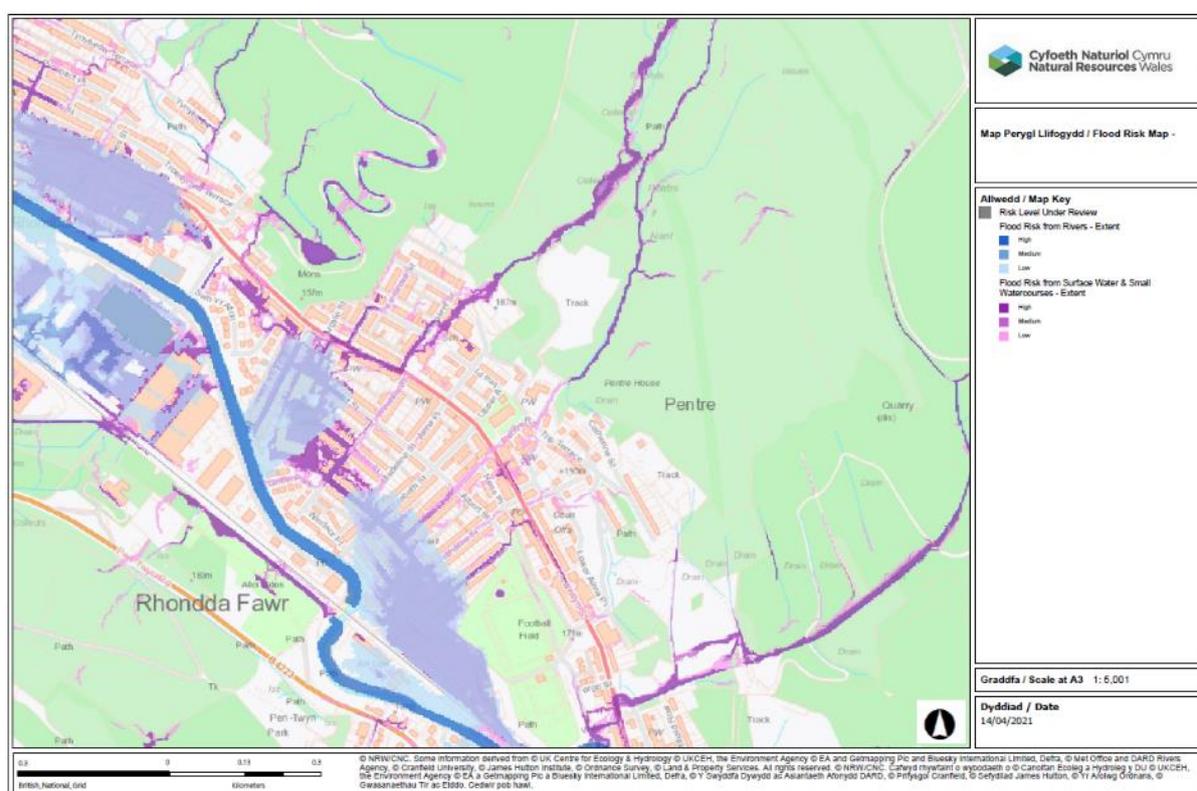


Figure 2: Natural Resources Wales' Flood Risk Assessment Wales (FRAW) Map for rivers and ordinary watercourse and surface water flood risk within investigation area RCT25. Contains Natural Resources Wales information © Natural Resources Wales and database right. All rights reserved.

1.3 DRAINAGE SYSTEM

The surface water drainage system that serves investigation area RCT25 is that of the highway drainage network designed to manage the surface water within the highway and public surface water sewer and combined sewer networks operated by Dŵr Cymru Welsh Water. These drainage networks are largely integrated and complex.

1.4 INVESTIGATION EVIDENCE

To support the investigation, a range of qualitative and quantitative evidence has been gathered from numerous sources, the summary of which is listed in Table 1.

Table 1: Investigative evidence gathered in preparation of the Storm Dennis Section 19 report

Source	Data
Residents	Photos, videos, statements, email correspondence, public engagement survey responses
Responders statements	Local responders' statements
CCTV Surveys	Internal surveys of the local drainage networks
Met Office Data	Weather Warning information (see FRM – Storm Dennis – Overview Report)
Rain Gauges	RCT and NRW operated rain gauge information (see FRM – Storm Dennis – Overview Report)
Natural Resources Wales	River Level and Flood Warning data
RCT Flood Risk Management Plan	Site specific information and data for each electoral ward in RCTCBC
Communities at Risk Register	Flood risk ranking and scores for all flood types based on community data in Wales
Flood Investigation Report (RPS's FIR)	A summary of the source-pathway-receptors, culvert capacity assessment and hydraulic modelling work undertaken by RPS Consulting. The Flood Investigation Report was commissioned by RCTCBC prior to writing the Section 19 report.

Evidence sourced from the 'Flood Investigation Report', commissioned by RCTCBC, will be further referred to as 'RPS's FIR' throughout this report.

1.5 PUBLIC ENGAGEMENT

Following each of the flooding events that affected Pentre, flood risk officers from RCT's Flood Risk Management department were deployed to areas across the borough to investigate reports of internal flooding by residents. Residents were engaged by the Flood Risk Management team to help determine the initial impacts caused by the flooding event and to investigate the potential source(s) and pathway(s) of flood water during the event. Due to the volume of calls received by RCT's Out of

Hour department, visits were prioritised to those areas experiencing significant internal flooding to residential properties.

To support the flood investigations, a public engagement questionnaire was carried out by external consultant RPS Consulting on behalf of RCTCBC post event, in order to gain further local insight and anecdotal evidence to support the flood investigation. The questionnaires were posted to approximately 800 properties across streets affected by one or more of the 2020 flood events. This allowed residents and business owners to provide commentary on each flood event as well as submit photo and video evidence, some of which have been referenced in this report. A site walkover was also carried out by RPS on 26th and 27th August 2020. This data is useful to help us better understand and validate our assessment of the flood event to support the investigation under Section 19 of the FWMA.

2. FLOODING HISTORY

2.1 PREVIOUS FLOOD INCIDENTS

Residents accounts captured by RCT's Flood Risk Management officers post event, as well as responses provided as part of the public engagement exercise, suggest that the residents of Pentre had not experienced flooding anywhere near as significant as the flooding that occurred during Storm Dennis. Several residents stated that they had lived in Pentre for over 40 years and never experienced anything like the Storm Dennis flood event.

Surface water flooding to the highway is relatively common during intense downpours however no significant internal flooding has been reported at Pentre up until the 16th February 2020. Since Storm Dennis, Pentre has experienced flooding on a further four occasions. Each flood event has been described in section 2.2.

2.2 FLOOD INCIDENT(S)

Pentre village has been impacted by flooding on five separate occasions during 2020, at the time of writing. These events resulted in widespread residential and commercial flooding across the village. Each flooding incident has been discussed within this report. The dates of the five events are:

- 15 – 16th February 2020 (Storm Dennis)
- 20 – 21st February 2020
- 28th February 2020 (Storm Jorje)
- 17th June 2020
- 5th August 2020

A summary of the source(s) and pathway(s) for flooding within the Pentre investigation area for each of the five individual flooding events have been outlined in Table 2 and further described in the following section.

Table 2: Source(s), pathway(s) and receptor(s) summary table for each of the five flood events that affected Pentre investigation area

Source	Pathway	Receptor
15 - 16th February 2020 (Storm Dennis)		
Culvert inlet blockage at the top of Pentre Road	Water flowed down Pentre Road onto Elizabeth Street and Queen Street, flowing down various streets towards the lower parts of Pentre.	<p>Internal flooding to a total of 159 residential and 10 commercial properties.</p> <p>Most of the recorded flooded properties from this event were on Lewis Street, Baglan Street and the lower parts of Pleasant Street, Treharne Street, Queen Street and Robert Street.</p> <p>Additional records of flooded properties were identified on Catherine Street, John Street, Llewellyn Street, Rees Place and Windsor Street.</p>

20th February 2020		
Surcharging manhole on culvert network within Pleasant Street Park	Water flowed from the manhole in the park and travelled down Pleasant Street before accumulating at the bottom of the street.	Flood water affected multiple residential properties in the lower part of Pleasant Street. Exact number of recorded internal flooding to properties is unconfirmed.
28th February 2020 (Storm Jorje)		
Intense rainfall resulting in surface water accumulation and surcharging manholes across parts of Pentre	Exact flow paths of the water are unknown but likely to have accumulated in the lower parts of Pentre at the base of the valley.	Exact number of receptors affected is unknown. Streets known to have flooded include Lewis Street, Baglan Street, Pleasant Street, Robert Street, Price Street, John Street, Queen Street, Carne Street and Volunteer Street.
17th June 2020		
Intense rainfall resulting in surface water accumulation and surcharging manholes	Surface water flowing down a lane to the west of Volunteer St then onto Volunteer St, travelling along gullies on both sides of the street. Two manholes within residential properties along Volunteer St surcharged during the event.	Several properties on Volunteer St impacted internally and/or externally, including two properties which flooded from the surcharged manholes.
Intense rainfall resulting in surface water accumulation and surcharging manholes	Surface water pooling outside the Pentre Legion at the junction of Price St and Albert St. Water flowed in an easterly direction towards John Street. Surcharging manholes in the area contributed to flood water accumulation.	Several properties flooded internally on Price Street and Albert Street due to surface water ponding on roads. An additional property on John Street had internal flooding from the rear.
Intense rainfall resulting in surface	Water flowed down Queen Street, Treharne Street and	Several properties at the bottom of Queen Street,

water accumulation and surcharging manholes	Elizabeth Street and accumulated at the bottom of these streets, as well as Baglan Street.	Elizabeth Street, Treharne Street and Baglan Street had internal flooding through the front of their properties. Some properties reporting flooding from both the front and rear.
Intense rainfall resulting in surface water accumulation and surcharging manholes	Significant surface water ponding outside a number of properties on Lewis Street.	Internal flooding to several properties on both sides of Lewis Street.
5th August 2020		
Two surcharging manholes due to a blockage on the combined sewer network	Water filling the gardens of one property at Queen Street and two properties at Treharne Street.	Internal flooding to 3 residential properties.

2.2.1 15 – 16th FEBRUARY 2020 (STORM DENNIS)

The largest of the five events occurred between the 15th and 16th February 2020 as a result of an extreme rainfall event, designated by the Met Office as ‘Storm Dennis’. Storm Dennis was the 4th named storm of the 2019/20 season in the UK, arriving one week after Storm Ciara (8 – 9th February), and the event caused unprecedented flooding across the majority of RCT, including widespread flooding and damage throughout Pentre.

During the early hours of Sunday 16th February, RCT received a large volume of calls from local residents referencing significant flooding emanating from a culvert inlet located at the top of Pentre Road. The inlet location is provided in Figure 3 (red cross). Post event inspections undertaken on the days following the storm event by RCT’s Flood Risk Management Team and Public Health, Protection and Community team identified 159 residential properties and 10 commercial properties as internally flooded.

Further post event surveys carried out through questionnaires and discussions with the local community indicated the main source of flooding during Storm Dennis to be the culvert inlet behind the ‘Pentre House’ care home, resulting in water flowing down

Pentre Road and onto Elizabeth Street and Queen Street (Figure 3), impacting the majority of properties downstream at the base of the valley, particularly properties at Baglan and Lewis Street.

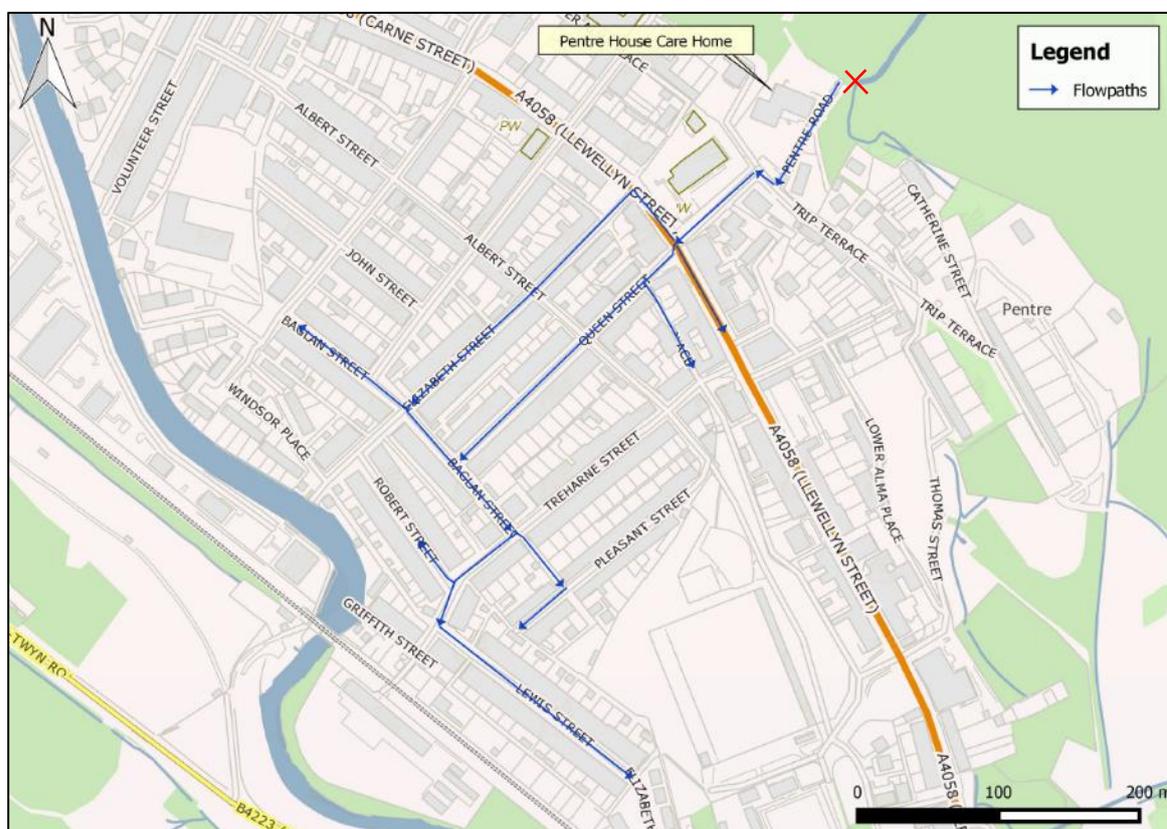


Figure 3: Source and observed flow path of the flood event on the 16th February (Storm Dennis)

The volume and severity of the flood depth within the properties impacted during the event varied by street, with Treharne Street, Lewis Street, Pleasant Street and Baglan Street reported as the worst affected.

Within the worst affected areas, the water level was identified as up to and above the height of windows of parked cars and vans, with an approximate reported flood depth between 1.1m – 1.4m. The significant flood depth experienced in the lower parts of Pentre is apparent within Figures 6 and 7 captured by residents on the 16th February 2020 depicting the flood impacts.

Anecdotal evidence collected during the August 2020 site visit provided evidence of flooding within properties up to 1.3m in depth. Post event photos reveal the severe and long-lasting damage caused by the flooding, with deposits on the streets of Pentre reported to have been transported from the upper catchment and made apparent once the flood water had drained away (Figure 4 and 5). Significant cleansing from a Council

specialist contractor and the respective Council Highways and Streetcare Depot was carried out to clear both the streets and surface water networks following the storm event.



Figure 4: Photo depicts significant deposits post Storm Dennis at Lewis Street captured by FRM officers on 17th February 2020



Figure 5: Photo depicts significant deposits post Storm Dennis at Baglan Street captured by FRM officers on 17th February 2020



Figure 6: Photo showing severe flooding at Lewis Street, Pentre on 16th February 2020 (image provided by resident)



Figure 7: Photo showing severe flooding to the south of Pleasant Street, Pentre on 16th February 2020 (image provided by resident)

2.2.2 19 – 21ST FEBRUARY 2020

In the week following Storm Dennis, the Met Office issued a yellow weather warning for further spells of rainfall to be expected from Wednesday 19th until Thursday 20th February 2020. According to data captured by NRW's nearest rain gauge at Tynewydd, over 50mm of rainfall was recorded during this period². Given the already saturated ground, further flooding was likely during this event according to the Met Office.

Several properties at Pleasant Street reported repeat internal flooding to residential properties on Thursday 20th February, only four days following the initial flood event during Storm Dennis. Post analysis surveys and questionnaire feedback noted the source of flooding to have originated from a manhole situated within Pleasant Street Park, due to blockages of the Pentre Road culvert network within the park (location shown in Figure 8).



Figure 8: Location plan illustrating the location and flow path of flood water from the manhole within Pleasant Street Park

² [River levels, rainfall and sea data \(naturalresources.wales\)](https://naturalresources.wales/)

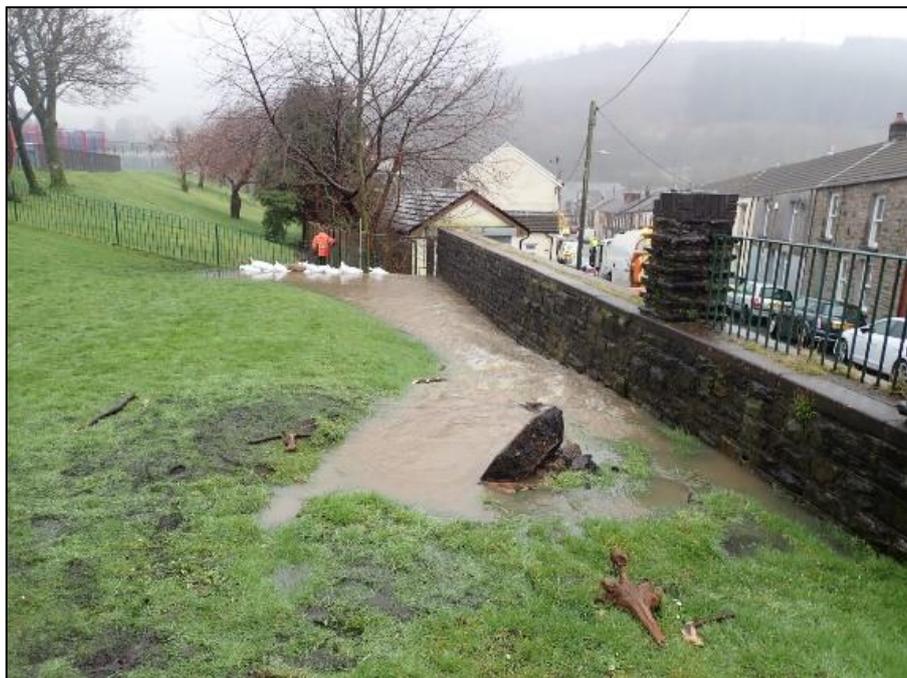


Figure 9: Surcharging manhole within Pleasant Street Park (top) and flow path down Pleasant Street (bottom) taken by RCT's FRM team on 20th February 2020

Figure 9 shows evidence of the manhole overflowing from the park area and flowing down Pleasant Street before accumulating at the bottom of the street, causing internal flooding to an unconfirmed number of residential properties. According to anecdotal

reports from residents, properties at the bottom of Pleasant Street suffered flooding up to half-a-meter in height, with water entering homes from both the front and rear.

2.2.3 28TH FEBRUARY 2020 (STORM JORJE)

Further spells of heavy rain continued to impact Pentre and the rest of Rhondda Cynon Taf when Storm Jorje, the fifth named storm of the 2019/20 season, brought strong winds and heavy rain across Wales and the UK from 28th February to 1st March 2020. Although the weather impacts from Storm Jorje were less severe than from Storm Dennis, localised flooding problems continued in the aftermath of the earlier storms and as a result of further rainfall on already saturated ground³.

A further 128mm of rainfall was recorded during the 48-hour period between the 28 – 29th February at Tynewydd rain gauge². This spell of heavy and prolonged rainfall resulted in further flooding to several properties in Pentre. Post analysis surveys and questionnaire feedback noted the source of the flooding to have potentially originated from the Pentre Road culvert inlet and flowed through the village before accumulating in a number of streets. However, following an inspection of the inlet post event, it was confirmed that the source of flooding did not originate from the Pentre Road inlet. Further material was reported to have become mobilised from the upper catchment area again, which impeded the flow within the ordinary watercourse, but did not cause surcharge at the inlet. An estimated 15 tons of material was cleared from the inlet with a further 20 – 30 tons of material required clearing from the internal structures of the culvert barrel.

Reports from both local residents and Flood Risk Management officers did confirm that gullies and drains in Pentre had become blocked or damaged during the earlier storm events, leading to the backing up and overflow of surface water onto several streets, gardens and roads. Several surcharging manholes were also reported by residents in the area.

The impacts of Storm Jorje were not as easily discernible due the wide-spread flooding caused by the previous two flooding events which left many properties empty. Little evidence was found for the exact source and flow path of this event as much of the flood damages following Storm Dennis were still visible during Jorje which restricted the post event inspections. However, questionnaires returned by members of the public aided in the identification of receptors that experienced flooding on this date. The following streets were identified as experiencing either external and/or internal flooding on the 28th February 2020; Lewis Street, Baglan Street, Pleasant Street,

³ [2020_04_storm_jorge.pdf \(metoffice.gov.uk\)](https://www.metoffice.gov.uk/media/pdf/2020_04_storm_jorge.pdf)

Robert Street, Price Street, John Street, Queen Street, Carne Street and Volunteer Street.

2.2.4 17TH JUNE 2020

The fourth flood event of 2020 occurred on the 17th June, when local residents across Pentre reported flooding due to a high intensity rainfall event that occurred over a short period of time. Several yellow weather warnings for heavy showers and thunderstorms were issued by the Met Office during the 15 and 18th June 2020, however the most intense local downpours occurred in the Rhondda valley area on Wednesday 17th June 2020.

High volumes of surface water runoff across various locations in Pentre were reported by residents on the 17th June, due to overflow from drains and gullies, as well as several surcharging manholes.

Post event inspections were undertaken on 18th June by RCT's Flood Risk Management team, during which a number of receptors were identified as internally flooded across several streets. Questionnaires returned by residents provided further confirmation of internal flooding to several other streets. The following streets were identified as experiencing internal flooding during the flood event on the 17th June; Albert Street, Price Street, Treharne Street, John Street, Queen Street, Volunteer Street, Rees Place and Lewis Street.

Several different sources and pathways have been identified for the June flood event. The main sources of flooding have been considered and summarised below. Figure 10 illustrates the location references.

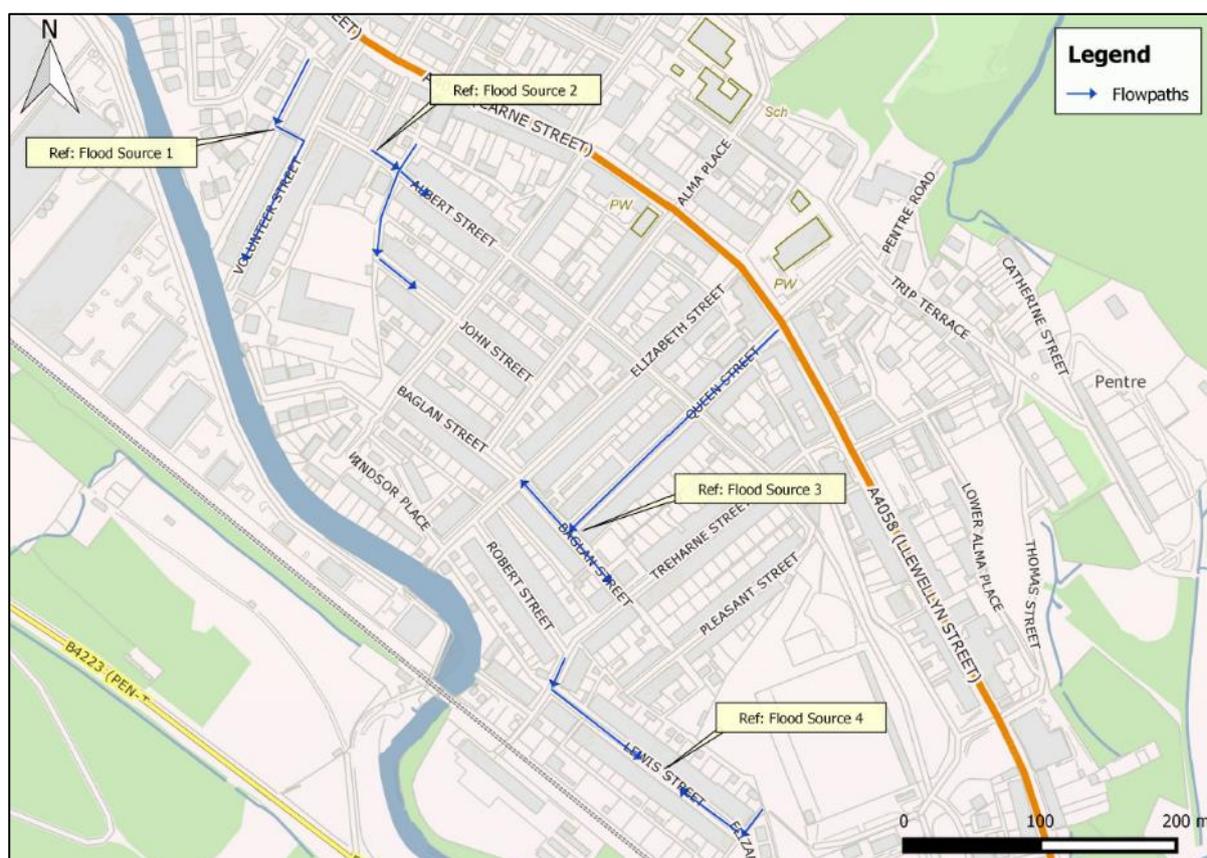


Figure 10: Main sources of flooding on the 17th June 2020 based on anecdotal evidence

Large volumes of water were observed flowing down a lane to the west of Volunteer Street then onto Volunteer Street (Flood Source 1 shown in Figure 10). Surface water travelled along gullies on both sides of Volunteer Street, where a number of properties were impacted internally and/or externally by the flood water. Two manholes were also reported to have surcharged within two residential properties on Volunteer Street, resulting in both properties near the Volunteer Street lane flooding internally.

High volumes of surface water were noted to have accumulated outside the 'Pentre Legion' at the junction of Price Street and Albert Street (Flood Source 2 shown in Figure 10). Several manholes surcharged along Albert Street contributing to the flooding. The water passed along Albert Street in an easterly direction towards John Street, causing internal flooding to one property, with water entering from the rear of the property. Several properties on Price Street and Albert Street were also internally flooded from ponding surface water that was unable to drain away.

Intense rainfall caused surface water runoff to travel down the village's steep roads and accumulate at the bottom of the streets, including Queen Street, Elizabeth Street and Treharne Street (Flood Source 3 shown in Figure 10). The ponding of water led

to several properties at the bottom of these streets and along Baglan Street to flood internally, entering through the front of their properties.

Post event analysis indicated that a number of manholes along Lewis Street had surcharged during the event, resulting in significant surface water ponding outside several properties and causing internal flooding to properties on both sides of the street (Flood Source 4 shown in Figure 10).

2.2.5 5TH AUGUST 2020

Pentre was affected by flooding for a fifth time in 2020 on 5th August when residents reported flooding on Queen Street, Baglan Street and Treharne Street.

Post event analysis carried out by RCT's Flood Risk Management team identified the primary source of flooding during this event to be two surcharging manholes, caused by an assumed blockage in the combined network as shown in Figure 11. DCWW identified the cause of blockage was linked to misuse of the public sewer.

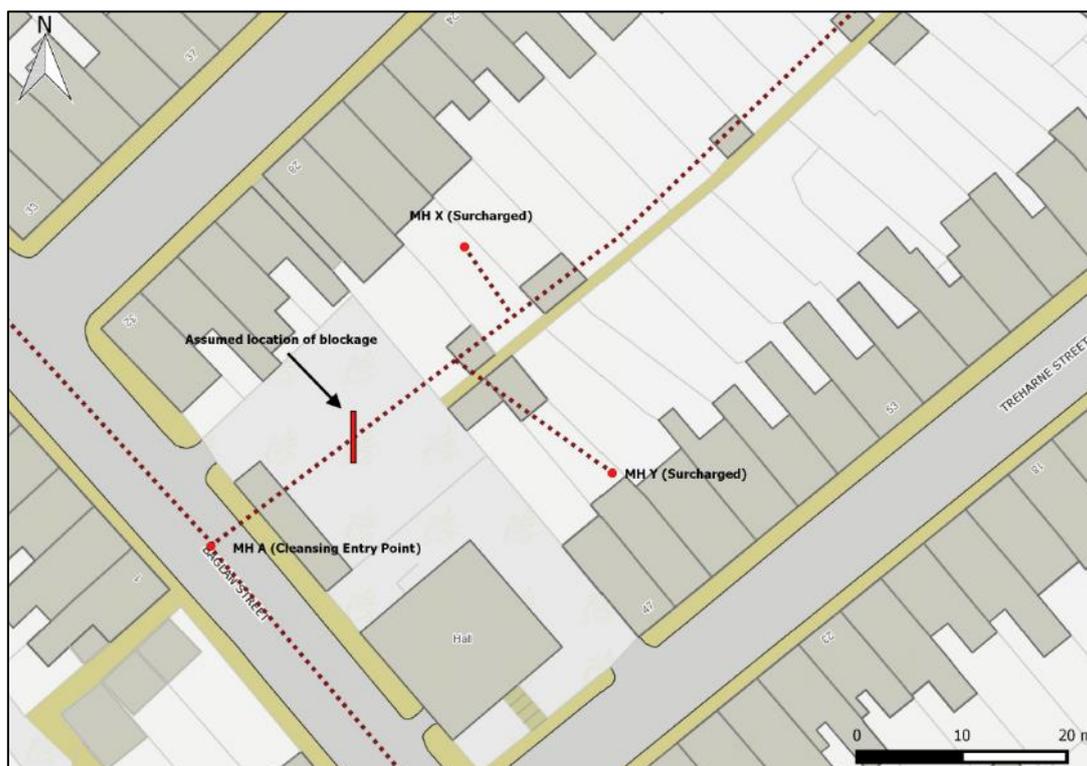


Figure 11: Location of surcharging manholes causing internal flooding to three properties during the 5th August 2020 flooding event

The surcharging manholes proceeded to fill the rear gardens of the affected properties within Queen Street and Treharne Street before entering the properties via the back doors, resulting in three residential properties experiencing internal damage to their property.



Figure 12: Water entering the Queen Street property via the back door (left) and location of surcharging manhole at Treharne Street, causing internal flooding to three properties (right)

2.3 RAINFALL ANALYSIS

See RCT's 'Overview Report' of Storm Dennis, reference 'FRM – Storm Dennis – Overview Report', for a detailed analysis of the rainfall and ordinary watercourse response.

3. POSSIBLE CAUSES

3.1. CULVERT CONDITIONS

Within investigation area RCT25 there are four main culverted Ordinary Watercourse networks that originate to the north of the village, which flow in a south-westerly direction towards the Rhondda Fawr River depicted within Figure 13. Pentre Road and St Stephen's Avenue inlets are identified as the responsibility of Natural Resources Wales on behalf of Welsh Government as the landowner, whilst the Volunteer Street and Fir Grove inlets are identified as the responsibility of two private individual landowners.

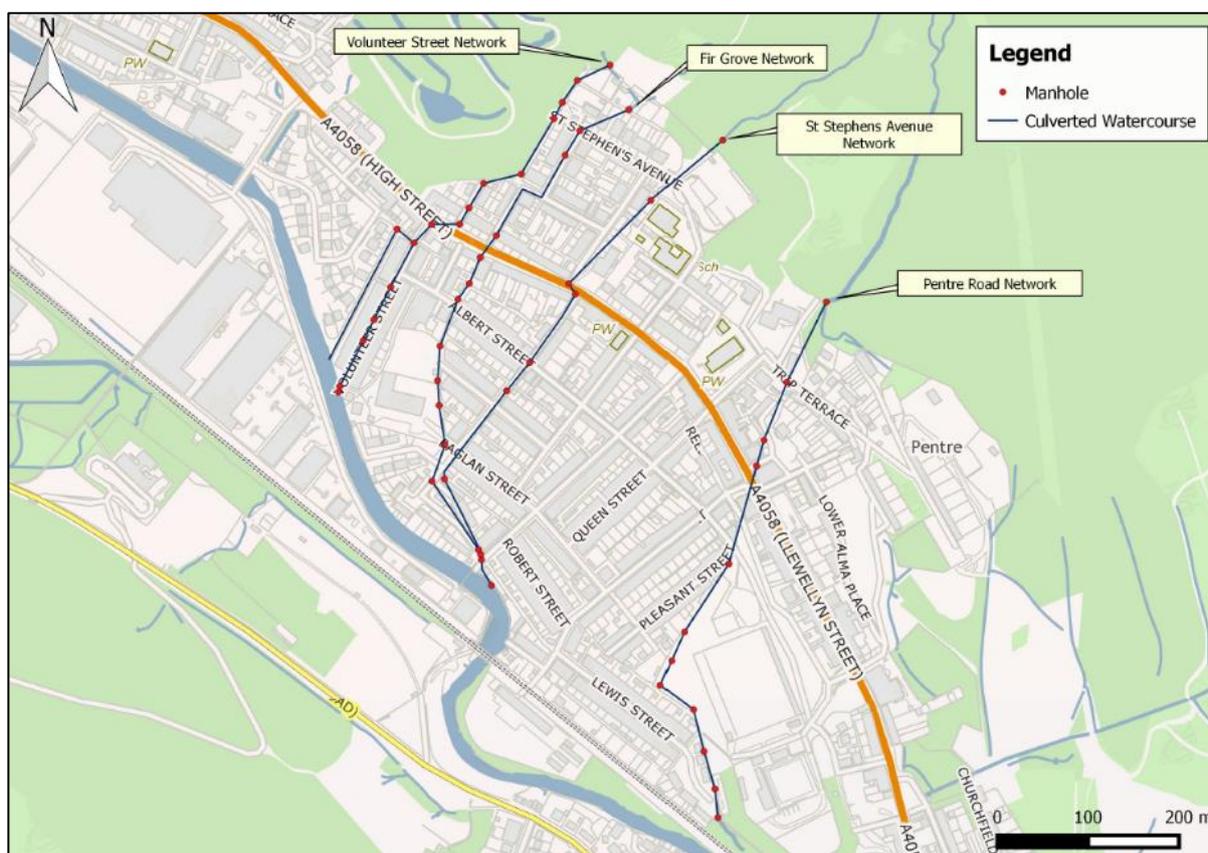


Figure 13: Four culverted watercourse networks in investigation area RCT25

Following the first flood event of 2020 that occurred on 16th February (Storm Dennis), the four culvert inlets were inspected by RCT's Flood Risk Management team. The results of which identified that only Pentre Road inlet was found to have been overcome with debris, reportedly having been washed down from the upper catchment, as shown below in Figures 14 - 17.

Additional photographs of the Pentre Road inlet following Storm Dennis are provided in Appendix A.



Figure 14: Photo of Pentre Road culvert inlet captured by RCT's Highways and Streetcare Depot immediately after the storm event (16/02/2020)



Figure 15: Photo of Pentre Road culvert inlet during works to remove deposited material post Storm Dennis (17/02/2020)



Figure 16: Photo looking across the Pentre Road culvert inlet, showing significant material collected during Storm Dennis (17/02/2020)



Figure 17: Photo of Pentre Road culvert inlet showing significant woody debris deposition (17/02/2020)

The source of the flooding during Storm Dennis was identified by residents and RCT's flood response team, to have originated from the Pentre Road culvert inlet. Photographic and anecdotal evidence indicates that the culvert's inlet capacity was severely reduced during the flood event, due to debris that had been washed down from the upper catchment and accumulated at the culvert inlet, leading to water spilling onto Pentre Road which resulted in widespread flooding downstream.

Pentre Road culvert inlet was inspected by RCT's Highway Authority the day before Storm Dennis and was found to be in good condition with no significant blockages or debris present. The inlet, which falls under the responsibility of NRW, was last inspected by NRW operatives on 27th January 2020, during which NRW contractors cleared the channels and grate and checked/cleared the culvert inlet.

Emergency works commenced post flood event to remove the debris from around the inlet and repair the blocked culvert. An operative from RCT's Highways and Streetcare Depot described the material at the inlet as "trees and logs". A photograph captured by a resident shows evidence of woody debris being transported away from the Pentre Road culvert following initial clearance works (Figure 18). Extensive cleansing of the Pentre Road culvert inlet was carried out during 17th – 21st February.



Figure 18: Photo showing woody debris being transported away from the Pentre Road culvert inlet during emergency clearance works (17/02/2020) (image provided by resident)

The FIR notes that the inlets to the other three culverts were not significantly affected by Storm Dennis, with no sign of blockage or discernable flow paths visible during an inspection post event. This result correlates with the public engagement responses. There is also no other evidence of flooding within the four culvert systems, including Pentre Road culvert, during Storm Dennis.

During the repeat flooding event which occurred on the 20th February 2020 impacting several properties at Pleasant Street, residents identified the source of flooding to have originated from a manhole within Pleasant Street park which had surcharged (Figure 9), resulting in water flowing out of the park towards Pleasant Street. A full-bore blockage within the Pentre Road culvert network was identified as the cause of the surcharging manhole, shown in Figure 19 below.



Figure 19: Photo showing full-bore blockage of the Pentre Road network downstream of Pleasant Street Park manhole

The image provides powerful evidence of how the mobilisation of woody debris from Pentre's upper catchment during Storm Dennis made its way into the culvert network, resulting in damages to the carrier line and a reduction in the culvert's ability to manage the flow of water. This resulted in water backing up the system and causing the manhole to surcharge. Significant resources, including the fire brigade, were rapidly deployed by RCT to remove the blockage and stop the properties from flooding in the days following the event.

In response to the debris identified within the inlet and downstream manhole, RCTCBC on the 28th February undertook extensive surveys to ascertain both the operational condition of the culvert network, and its structural integrity. The CCTV survey identified significant defects and blockages throughout the network, as well as settled deposits and stonewash reducing the networks capacity in several sections. The result was a significant operation to clear the internal culvert barrel of debris utilising specialised contractors that utilised; High Pressure Water Jetting, Vacuumation and Manual 'Hand Balling'; exercises to clear the debris from within the culvert network. This exercise lasted several months.

Following the flood event that occurred during the June thunderstorms, the Pentre Road culvert inlet was surveyed again on the 27th June 2020. The survey identified heavy siltation and debris that had re-accumulated in the line after previous cleansing, particularly towards the lower reaches of Pentre where between 20-60% of the network's cross-sectional areas had been lost due to settled debris and stonewash (illustrated in Figure 20). CCTV surveys of the other three networks in Pentre also confirm siltation in lower sections of the network (albeit less severe than the Pentre Road network) where the culvert gradient becomes less steep, resulting in reductions in the hydraulic capacity of the network. A total length of 3.2 km of culverted Ordinary Watercourse was surveyed, mapped and reviewed.



Figure 20: CCTV survey footage showing stone deposits between nodes SS96959751 and SS96959752 of the Pentre Road culvert network

As a result, a further operation was undertaken by RCTCBC utilising specialist contractors to clear the debris from the four ordinary watercourse culverts. This operation was repeated approximately four times throughout 2020 due to continued debris mobilisation into the lower culvert networks. It is estimated that approximately 600 tons of material was removed from the culvert barrels during this time.

There is no evidence to suggest any of the four culvert inlets surcharged during the June flood event.

3.2. OPEN WATERCOURSE CONDITIONS

On review of the open watercourse sections identified within investigation area RCT25, four distinct networks were identified. The Nant y Pentre watercourse and its tributaries (highlighted red in Figure 21) was reviewed following the mobilisation of debris washed from the hillside which blocked the Pentre Road culvert inlet.

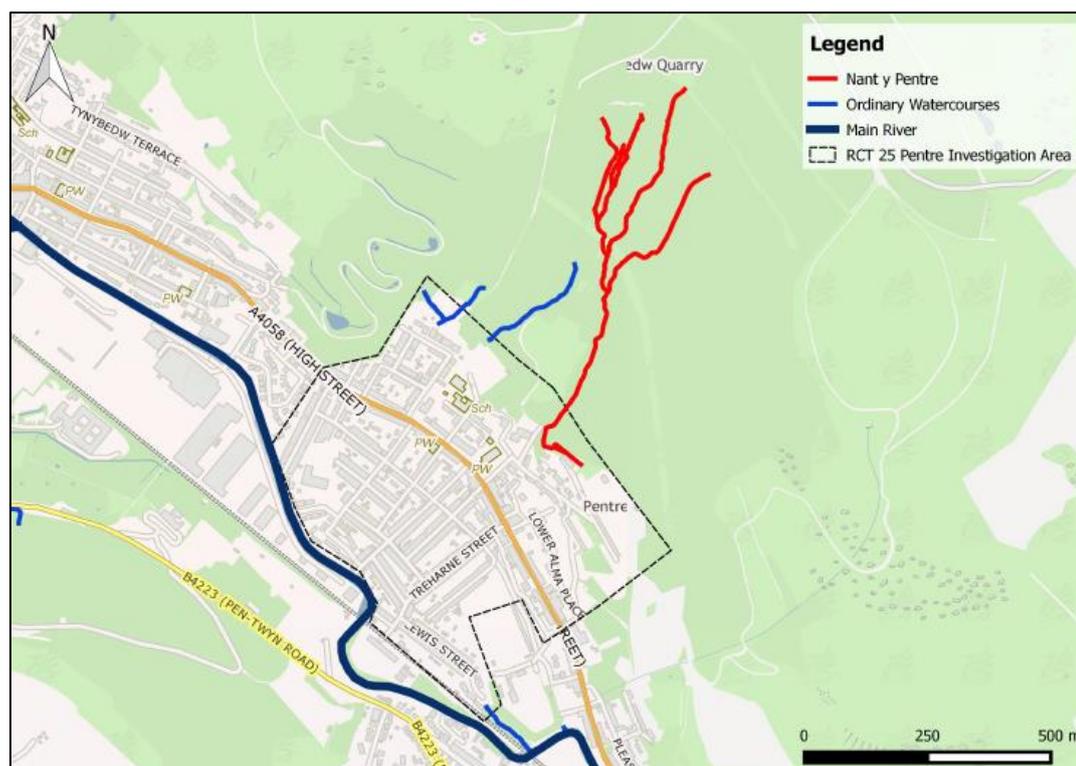


Figure 21: Ordinary watercourses flowing into Pentre investigation area. Nant y Pentre watercourse is highlighted red.

The Nant y Pentre rises steeply from the town situated at the base of the hillslope. Bed incision has created a deeply confined valley with steep, forested sides that rise sharply from the channel. Due to the steepness of the channel and the confined valley, the delivery of overland or sub-surface flow routes to the channel are accelerated, meaning the catchment will respond rapidly to rainfall.

Following the initial flood event during Storm Dennis, RCT Flood Risk Management officers carried out a site walk-over assessment of the catchment above Pentre village to assess the condition of the watercourse for any signs of overtopping, evidence of scour and any land movement of the hillsides.

The walkover found significant amounts of woody debris across the upper catchment; an area where recent tree felling activities were carried out by NRW (Figure 22). This woody debris was similar to the debris found at the Pentre Road culvert inlet.



Figure 22: Photo of the felled area in the upper catchment of Pentre (17/02/2020) showing woody debris within the watercourses

Minor scouring of the embankments of the Nant y Pentre watercourse was evident in sections (Figure 23), however this was expected given the significant flow and volume of water that followed the intense rainfall. Despite this, it is not believed that this scouring significantly contributed to the amount of debris that caused the blockage to the Pentre Road culvert inlet.

Following evidence from the Storm Dennis flooding event, it is clear that morphological processes can be a key contributor to flood risk. As a result, a geomorphological review of the upper catchment of Pentre was carried out in early November 2020 by JBA Consulting, on behalf of RCTCBC, which identified evidence of hillslope failure and notable amounts of slope instability⁴. The soil appears to have a high clay content, which following heavy rainfall events and from saturation of the soil, “failed hillslope material would be delivered to the watercourse and transported downstream”. Active

⁴ Fluvial Geomorphology Assessment: Pentre, JBA Consulting, December 2020

fluvial bank erosion further up the hillslope was also identified, supplying the channel with both coarse and fine material.



Figure 23: Photo of minor scour to the embankments of the Nant y Pentre watercourse in the upper catchment of Pentre (17/02/2020)

The watercourse was found to be in an “unstable condition” based on the amount of erosion observed. JBA conclude that “although the majority of sediment sources observed in the Nant y Pentre catchment were natural (i.e. bank erosion and landslides), it is likely they have been exacerbated by anthropogenic pressures, including land management practices”.

Details of the woodland loss and forestry works in Pentre have been described further in Section 3.5.

3.3. HIGHWAY DRAINAGE CONDITIONS

Following Storm Dennis, Pentre was left with widespread deposits of silt, sand and mud across the village which was reported to have been washed off the mountain and carried by the surcharging water through the village during the event. Figure 24 shows the deposits of mud left behind in Pentre once the flood water had drained away.



Figure 24: Photo shows the deposits of mud left behind in Pentre from the flooding during Storm Dennis (17/02/2020)

Widespread deposits on the streets are assumed to have entered the highway drainage system, leading to blockages and reduction in the hydraulic capacity of the surface water network. Evidence received following the repeat flood events in 2020 strongly suggest that there were issues relating to the function of the drainage system in Pentre, due to blockages and/or damage to the network caused by the initial flood event during Storm Dennis. A number of reports also documented manholes surcharging at various locations across the village during all flood events which suggest that the surface water network was also operating at a reduced capacity.

Figure 25 depicts the surface water drainage systems in Pentre, of which there is approximately 5.5 km of highway drainage infrastructure identified. This infrastructure was surveyed and mapped following extensive jetting and cleansing of the network by the Council Highways and Streetcare Depot. CCTV surveys of the highway drainage conditions in Pentre following the February and June storms confirm significant blockages were present, particularly at the Lewis Street storm water network where

the survey had to be abandoned due to two large obstacles blocking the pipe (between manholes SS96957851 and SS96959750, shown in Figure 26).

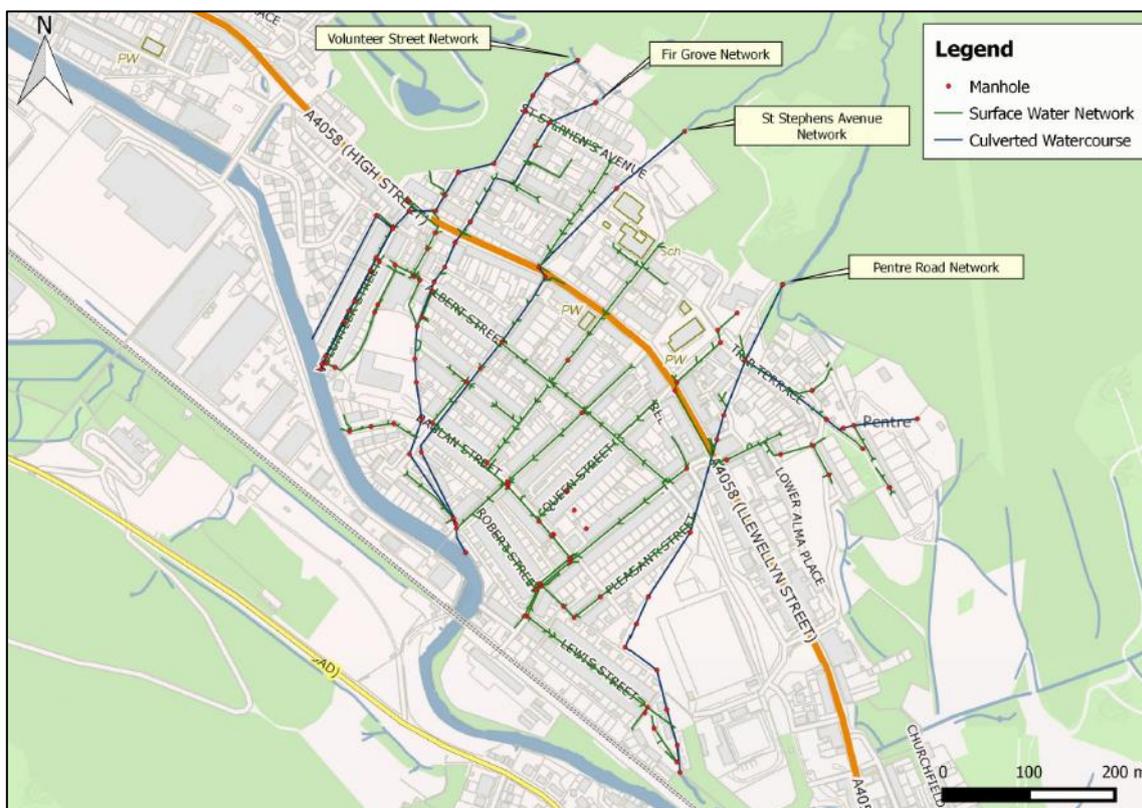


Figure 25: The extent of the surface water drainage and culverted watercourse systems within investigation area RCT25



Figure 26: CCTV footage showing blockage on Lewis Street highway drainage network

The FIR conclude that the blockages identified in the surface water networks may have been significantly impacted by debris carried by overland flows during Storm Dennis, resulting in the drainage network backing up and overflowing onto the highway during heavy rainfall.

The evidence suggests that the poor condition of the highway drainage network following the initial flooding event during Storm Dennis which caused damage and serious capacity and backflow issues throughout the village, is likely to have been a contributing factor which led to repeat internal flooding to several properties and ongoing surface water flooding to the highway during the flood events of 2020 as the damage was being repaired.

3.4. DŴR CYMRU WELSH WATER APPARATUS

During and following the initial flood event (between the 16th and 20th February 2020), DCWW received several reports of surface water flooding within Pentre. Although flooding on both occasions was identified as originating from the Pentre Road culvert network, DCWW informed RCT that during the initial flood event (Storm Dennis), their network was operating fine, albeit with high flows but no restrictions identified.

Upon an investigation into DCWW's network and surface water pumping station located to the bottom of Treharne and Pleasant Street, it was found that both were coping with the high flows and the pumping station was operating with no failures.

During the 17th June 2020 flood event, DCWW received several reports of internal and external flooding across Pentre. The first reported incident occurred at Price Street on the 17th June where upon an investigation by DCWW officers, the source of the flooding appeared to have originated from a surcharged manhole located within the highway. The manhole was identified as part of the highway surface water network and not a DCWW surface water line.

Following the flood event, DCWW investigated the performance of both their Treharne Street SPS and Elizabeth Close pumping stations and confirmed that levels were normal and operating with no concerns raised.

DCWW have concluded that their assets performed well during the 2020 flooding events, however, it should be noted that due to significant debris and blockages identified within the surface water network in Pentre following the initial flood event in February 2020, it is likely that flows travelling towards the pumping stations may have been unable to reach the pumping stations, and instead caused several manholes to surcharge, exacerbating surface water flooding to the highway.

During the August 2020 flood event, it was confirmed that a blockage within DCWW's combined sewer network was the cause of flooding to three residential properties. The blockage was subsequently removed by a Council appointed contractor.

3.5. MAIN RIVER

The designated main river Rhondda Fawr flows northwest to southeast through the centre of Pentre, to the south of investigation area RCT25 (Figure 21).

The hydrograph in Figure 27 illustrates the rapid rise in levels of the Rhondda Fawr River in response to rainfall, captured at NRW's Gelli station near Pentre. The Rhondda Fawr River at Gelli reached a peak level of 1.998 meters at 03:30am (16th February); only 0.3 meters lower than its highest level ever recorded.

The green bar displayed on the hydrograph shows the typical level of the Rhondda Fawr River at Gelli station, ranging between 0 and 0.5 meters. At its peak, the Rhondda Fawr River at Gelli was almost a meter and a half higher than its average level, stressing the extreme and unprecedented levels that RCT's rivers rose to during the storm's peak intensity.

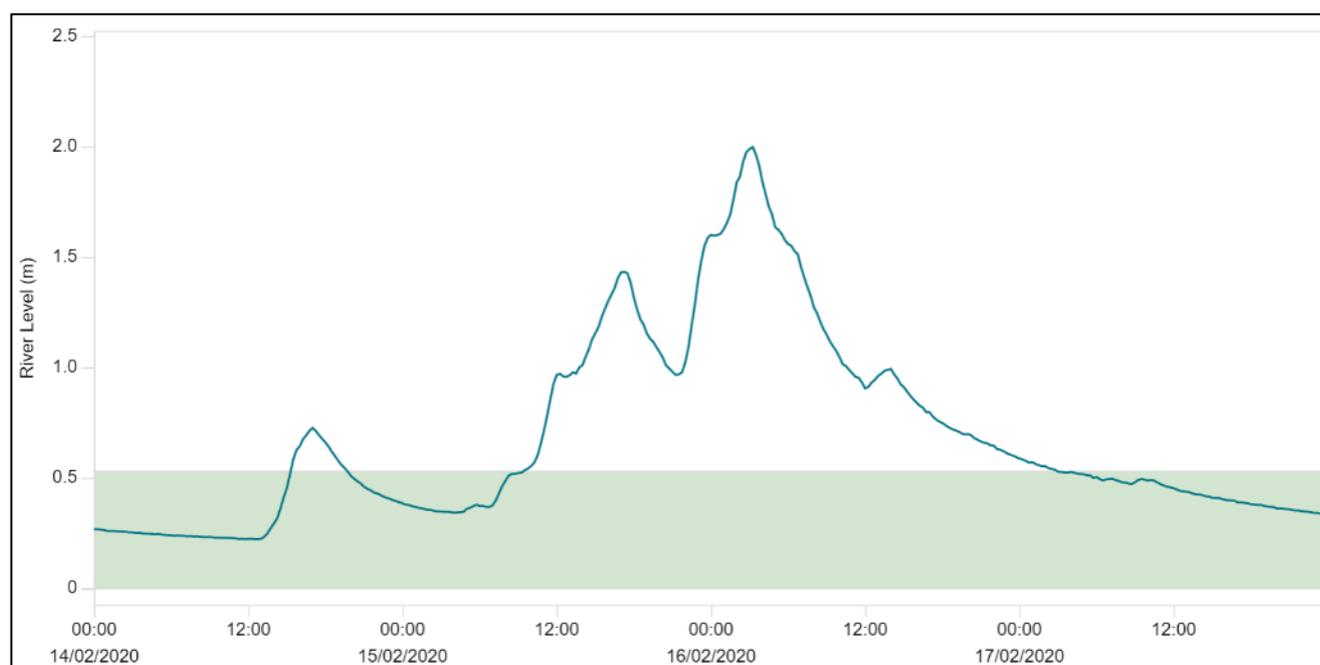


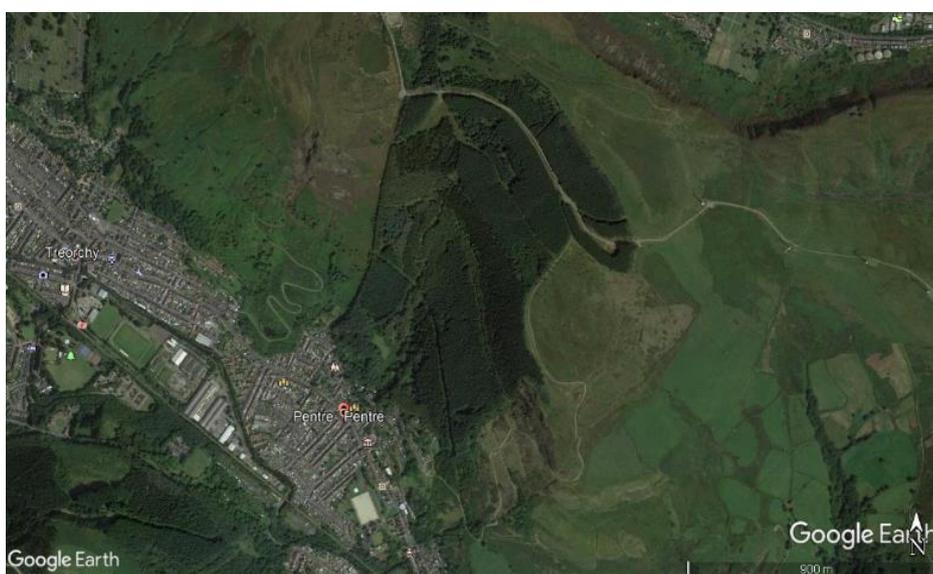
Figure 27: The Rhondda Fawr River levels at Gelli station between the 14th and 17th February 2020 (Natural Resources Wales)

There is no evidence from this investigation that the main river Rhondda Fawr significantly contributed to the recorded flooding of properties in Pentre during the 2020 flood events.

3.6. WOODLAND LOSS AND FORESTRY WORKS

Large areas of woodland to the north of Pentre have been felled during the last 2 years. The area in which tree felling has occurred forms part of the Welsh Government's Woodland Estate (WGWE) which is owned by the Welsh Government and managed by NRW. Figure 28 illustrates the woodland loss observed between 2016 and 2020 in parts of Pentre's upper catchment using historic aerial imagery from Google Earth.

08/2016



05/2020

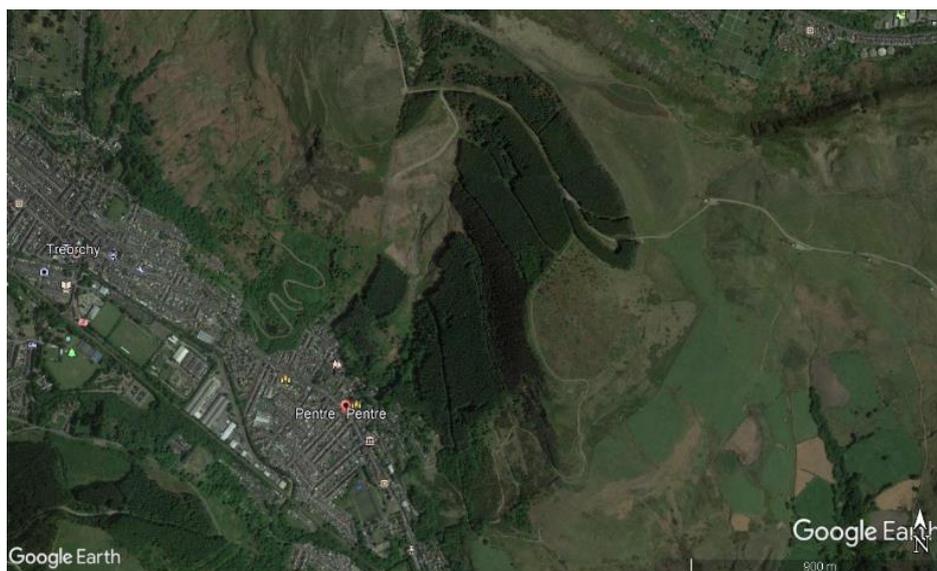


Figure 28: Google Earth imagery of area above Pentre showing change in tree cover between 2016 and 2020

Woodland is currently felled following routine harvesting or removal of Larch infected with 'Phytophthora ramorum' and awaiting 'restocking'. According to NRW's Land Estate Management Review, harvesting was carried out in Pentre mainly over winter 2018/19, although dispatch of timber from the site proceeded until relatively recently⁵.

The treatment of brash – “a term traditionally used to describe the branches and other woody material created by harvesting” - following harvesting is detailed within NRW's Land Estate Management Review. The expectations for brash management, outlined in the Coupe Management Plan and the harvesting contract documents, “specify keeping brash mats, lop top and processed timber at least five meters away from watercourses”, however, NRW do state that “there is scope for some ambiguity on the ground with customers during operations and contract managers often struggle to effectively implement some of these contract conditions”. NRW also note within their review that due to the steep sided nature of Pentre's slopes, “it would have been a significant piece of work to remove all small branches and debris from this area as it would have been a labour-intensive manual operation”.

It is inferred that although NRW followed best practice in relation to their forestry operations, there is ample ambiguity surrounding the treatment of brash in the coupe area to suggest that brash material was part of the material washed down to the culvert inlet. In fact, NRW state that “there is evidence that we (NRW) could have treated the brash better in this case”.

It is concluded within NRW's Review that the act of tree felling alone would not have contributed largely to the flooding which occurred in Pentre due to the apparent lack of scouring in the catchment area, however NRW accept that the brash left within the upper reaches of Pentre is “likely to have been part of the material washed down to the area of the culvert”.

The evidence presented within this report does suggest that although a significant level of silt and stone had been washed down into the watercourse, woody debris (inclusive of brash) was a significant contributing factor in causing the blockage at Pentre Road culvert inlet which resulted in the initial flooding of Pentre village, but also caused further blockages within the drainage network, resulting in repeat flooding to the lower reaches of Pentre. Photographic evidence captured by RCT's Flood Risk Management team on the 17th February 2020 indicates that woody debris within the felled area, and other plantations, above Pentre was washed down to the area of the culvert during the storm event (Figure 29). Additional photographs of the upper catchment are presented in Appendix A.

⁵ [February 2020 Floods in Wales: Natural Resources Wales Land Estate Management Review \(cyfoethnaturiol.cymru\)](https://www.naturalresources.wales.gov.uk/land-estate-management-review)



Figure 29: Photo taken by RCT's Flood Risk Management Team on 17/02/2020 showing evidence of woody debris accumulation in the upper catchment of Pentre

3.7. ACCESS STRUCTURES

No access structures were identified during the asset investigations within the area, as such 'access structures' have not been considered within this report.

3.8. SYSTEM AT CAPACITY

The evidence gathered within this report has identified five individual storm events that has resulted in internal flooding to residential properties within the community of Pentre during 2020. Each flooding event identified within this report outlines a range of different sources of flooding (Table 2) which are summarised as follows:

- Ordinary Watercourse Infrastructure
- Surface Water
 - Foul Drainage
 - Combined Drainage
 - Highway Drainage

Notably the source of flooding that has resulted in the most significant flooding within the community of Pentre is attributed to the Nant Y Pentre Ordinary Watercourse. This section of the report will review the capacity of the ordinary watercourse (Nant Y Pentre) structures identified as sources of flooding.

3.8.1. ORDINARY WATERCOURSE INFRASTRUCTURE

The ordinary watercourse structures as depicted within Figure 30, further referred to as Culvert 1 and MH1, have been assessed to identify the capacity of the network at the point of flooding. The summary of the assessment is depicted within Table 3.



Figure 30: Ordinary watercourse structures identified as flood sources during the 2020 flood events in Pentre

Table 3: Summary of the culvert capacity assessment results to the ordinary watercourse structures identified as flooding during the 2020 flood events in Pentre

Culvert Network	Standard of Protection (SOP) - Free Flowing
Culvert 1	Q1000 (0.1% AEP)
MH 1	Q25 (4% AEP)

Based on the results of Table 3, Culvert 1 has been shown to have a SOP greater than the current design standards for new culverts as defined by CIRIA C786. As such, Culvert 1 is expected to accommodate flows generated during a Q200 event i.e. Storm Dennis.

On review of the condition of the culvert inlet post Storm Dennis (Figures 14 - 17) a sensitivity analysis was undertaken to review the impact of flooding during two scenarios. The scenarios both utilised Q100 event flows, where scenario 1 assumed no blockage and scenario 2 assumes a full-bore blockage (100%) of the culvert inlet.

The results of the sensitivity analysis identified no flooding during scenario 1 outlining the capacity of the culvert inlet with no blockage present can accommodate the catchment flows. Scenario 2 however, identified significant flooding as depicted within Figure 31. On review of the impacts of Storm Dennis there is a close correlation with both the flow paths observed and the properties affected during Storm Dennis. This provides verification that the flooding mechanisms observed in Pentre on the 16th February 2020 were related to a blockage of the Pentre Road inlet caused by debris, the majority of which appears to have been as a result of the felling in the upper reaches of Pentre.

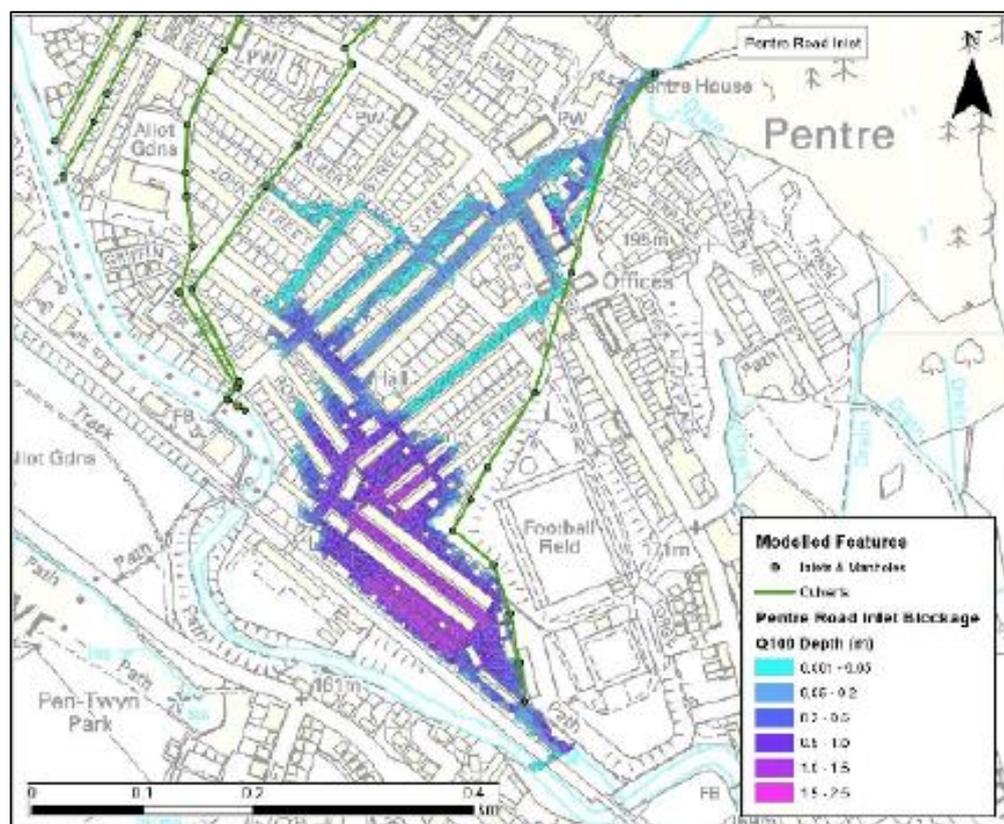


Figure 31: Pentre Road inlet blockage model results, Q100 flood event depths (Scenario 2)

The second node associated to flooding several days following Storm Dennis was MH1 which is a manhole associated to the Nant Y Pentre ordinary watercourse network located within Pleasant Street Park (Figure 30). A review of the capacity of MH1 when free of blockage is identified as providing a SOP of Q25, which is below current design standards. As such the manhole would have been expected to surcharge during Storm Dennis with or without the identified full-bore blockage. It is likely that the initial blockage to the Pentre Road culvert inlet significantly reduced the volume of water entering the network and consequently reduced the likelihood of surcharge at MH1 during the initial flood event.

3.8.2. SURFACE WATER

When examining the three additional flooding events, surface water flooding has been identified as the primary source of flooding which contributed to the widespread impacts within the community of Pentre. Notably, the surface water is typically drained via highway drainage, public surface water sewers and combined drainage infrastructure (roof and yard). When examining the wider drainage infrastructure, the

typical design standards are taken into consideration which stipulate that both highway drainage and combined drainage is to be designed to Q30 SOP.

To assess the likely impacts of surface water flooding within the community of Pentre, the National Flood Maps produced by NRW and published in October 2020, have been used i.e. 'Flood Risk Assessment Wales' (FRAW). The outputs of the FRAW mapping is depicted within Figure 32.

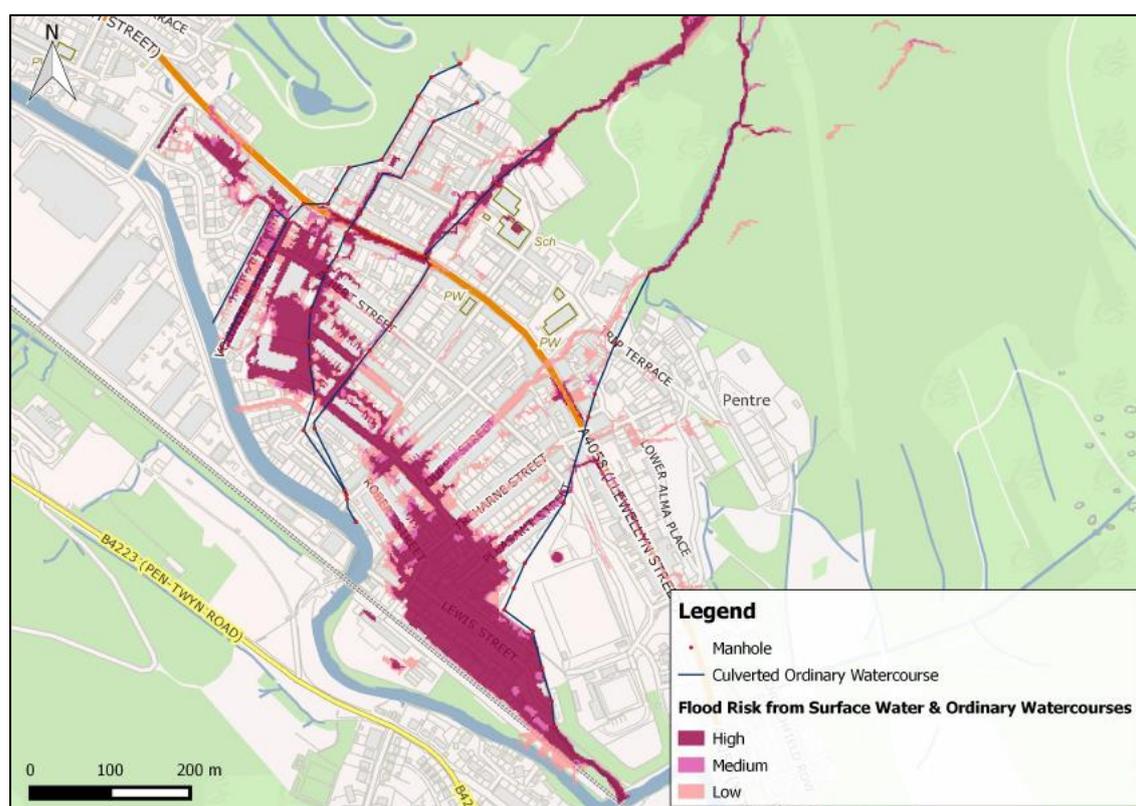


Figure 32: Natural Resources Wales' Flood Risk Assessment Wales (FRAW) map for surface water and ordinary watercourse sources. Contains Natural Resources Wales information © Natural Resources Wales and database right. All rights reserved.

The extent of the high risk (Q30) flooding event, depicted within Figure 32, is comparable to the extent of flooding experienced during Storm Dennis and the June 17th flood event. This comparison provides evidence that surface water flooding has a significant impact on the community of Pentre, particularly towards the lower streets at the base of the catchment.

3.9. SUMMARY OF POSSIBLE CAUSES

The above sections have identified and described the possible causes of flooding within the Pentre investigation area for the five flooding events that occurred in 2020. A summary of the identified sources and possible causes of flooding (issue) have been outlined below in Table 4.

Table 4: Summary of the source(s) and possible cause(s) of flooding in Pentre during the flooding events of 2020

Ref No	Asset (Source)	Issue	Asset Owner	Type of Flooding
1	Culvert inlet at the top of Pentre Road	A large area of the WGWE (forestry land owned by the Welsh Government and maintained by NRW) above Pentre has been felled in recent years which may have contributed to increased sediment and debris runoff from the hillsides exacerbating the blockage of the Pentre Road culvert inlet which resulted in the inlet overflowing and flooding 169 properties downstream. Additionally, the rate and runoff from the felled areas is expected to have increased following the removal of the canopy cover.	Welsh Government (managed by Natural Resources Wales)	Ordinary Watercourse
2	Welsh Government Woodland Estate to the north of Pentre	Recent tree felling and woody debris in the upper catchment of Pentre is considered to have significantly contributed to the blockage of Pentre Road culvert inlet during Storm Dennis and also contributed to repeat flooding events in 2020.	Welsh Government (managed by Natural Resources Wales)	Ordinary Watercourse and Surface Water
3	Manhole situated in Pleasant Street Park (Pentre Road ordinary watercourse network)	Full-bore blockage in the Pentre Road culvert network was identified downstream of the manhole caused by woody debris washing down from the upper catchment, resulting in a reduced capacity of the culvert network. This led to a backflow of water and resulted in surcharging out the park,	Rhondda Cynon Taf CBC Corporate Estates	Ordinary Watercourse

		causing internal flooding to properties at Pleasant Street.		
4	Surface water drainage network at Lewis Street	<p>Several manholes at Lewis Street were reported to have surcharged during Storm Dennis, Storm Jorje and June thunderstorm events.</p> <p>Upon a CCTV analysis of the Lewis Street highway drainage system, several blockages and sections of damaged pipe was evident. This resulted in surface water pooling outside properties on Lewis Street and further internal flooding to properties.</p>	Rhondda Cynon Taf CBC Highway Authority	Surface Water
5	Manhole situated at Albert Street (Fir Grove ordinary watercourse network)	A manhole at Albert Street was reported to have surcharged during the June thunderstorm event, contributing to surface water accumulation on the highway and internal flooding to properties at Price Street, Albert Street and John Street	Rhondda Cynon Taf CBC Highway Authority	Surface Water
6	Manholes to the rear of Volunteer Street	Two manholes were reported to have surcharged at two residential properties on Volunteer Street, resulting in both properties flooding internally on 17 th June 2020.	Dŵr Cymru Welsh Water	Sewer Flooding
7	DCWW combined sewer network to the rear of Queen and Treharne Streets	A blockage was identified within the combined sewer network to the rear of Queen Street and Treharne Street causing two manholes to surcharge and cause internal flooding to three residential properties on 5 th August 2020.	Dŵr Cymru Welsh Water	Sewer Flooding

4. RISK MANAGEMENT AUTHORITY ACTIONS

A Welsh Risk Management Authority is defined in Section 6 of the Flood and Water Management Act 2010 as NRW; a Lead Local Flood Authority, a district council for an area where there is no unitary authority, or a highway authority wholly in Wales; an internal drainage board for an internal drainage district that is wholly or mainly in Wales; a water company that exercises functions in relation to an area in Wales. As the LLFA, RCTCBC has the responsibility to coordinate the management of flood risk and the interaction of Risk Management Authorities across Rhondda Cynon Taf.

An overview of the responsible Risk Management Authority in relation to flood type is provided in Table 5. For further details of the roles and responsibilities of individual Risk Management Authorities in managing flooding, refer to ‘FRM – Storm Dennis – Overview Report’.

Table 5: Risk Management Authority responsible for different flood types

Type of Flooding	Responsible Risk Management Authority
Flooding from Main River, reservoirs and the sea (including coastal erosion).	Natural Resources Wales
Flooding from ordinary watercourses, surface water and groundwater	Lead Local Flood Authority
Flooding from water and sewage systems	Water Companies (Dŵr Cymru Welsh Water)
Flooding from the highway	Highway Authority
Flooding from the highway (motorways and major trunk roads)	Welsh Government Trunk Road Agency

Risk Management Authorities have direct flood risk management functions under the Flood and Water Management Act 2010, as well as the Land Drainage Act 1991 and the Highways Act 1980. Through analysis of the flooding that impacted Pentre, the flood risk management functions exercised or proposed to be exercised by relevant RMAs was recorded in response to the duties placed on the local authority in regard to Section 19 of the Flood and Water Management Act 2010, which states;

“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 the response to the flood.”

Through the investigation process, the source(s) and possible causes of flooding within Pentre during all five flood events have been previously identified and summarised within Table 4. The Risk Management Authorities responsible for managing that flooding have been listed within Table 6 below, along with a series of recommendations presented by the LLFA.

Table 6: Recommendations provided by the LLFA to be considered by the relevant Risk Management Authority identified in response to the source(s) of flooding in Pentre (as per Table 4)

Ref No	Asset (Source)	Asset Owner	Type of Flooding	Risk Management Authority Responsible for Managing Risk	Recommendations	
1	Culvert inlet at the top of Pentre Road	Welsh Government (managed by Natural Resources Wales)	Ordinary Watercourse	Lead Local Flood Authority and Land Drainage Authority	R1A	The LLFA and LDA to identify drainage asset ownership and responsibility.
					R1B	The LLFA and LDA to investigate the standard of protection and the condition of the culvert structure and network as a whole.
					R1C	Jet and cleanse the ordinary watercourse network.
					R1D	Install a new and upgraded culvert inlet structure following the damages caused during Storm Dennis.

					R1E	The LLFA to work collaboratively with other RMAs to develop an OBC to identify suitable management methods to reduce the risk of flooding from all sources in Pentre.
					R1F	The LLFA to install remote telemetry monitoring at Pentre Road culvert inlet.
2	Welsh Government Woodland Estate to the north of Pentre	Welsh Government (managed by Natural Resources Wales)	Ordinary Watercourse and Surface Water	Lead Local Flood Authority and Land Drainage Authority	R2A	NRW to review their Forest Resource Plans and Coupe Management Plans with regard to water management, particularly surface water management and the treatment of brush in close proximity to an ordinary watercourse. Aligned with recommendation FRP1, 2 and 3 within NRW's Land Estate Management Review.
					R2B	NRW to develop a Forest Resource Plan for the Rhondda Fawr valley, in collaboration with the LLFA, to identify and reflect the key challenges facing the community of Pentre. Aligned with recommendation FRP1 within NRW's

						Land Estate Management Review.
					R2C	NRW to ‘develop Water Management Plans at a scale more appropriate for water management’ and embed their Water Management Plans into their forest management operations to ensure the impacts of flood risk downstream are fully realised. Aligned with recommendation FRP2 within NRW’s Land Estate Management Review.
					R2D	NRW to ‘improve engagement of local communities in Forest Resource Planning and forest operations’ to help develop greater confidence in the WGWE and NRW’s contribution to reducing flood risk. Aligned with recommendation FRP4 within NRW’s Land Estate Management Review.
3	Manhole situated in Pleasant Street Park (Pentre Road ordinary	Rhondda Cynon Taf CBC Corporate Estates	Ordinary Watercourse	Lead Local Flood Authority and Land Drainage Authority	R3A	The LLFA and LDA to identify drainage asset ownership and responsibility.
					R3B	The LLFA and LDA to investigate the

	watercourse network)					standard of protection and the condition of the culvert structure and network as a whole.
					R3C	Jet and cleanse the ordinary watercourse culvert network.
					R3D	The LLFA to work collaboratively with other RMAs to identify suitable management methods to reduce the risk of flooding from all sources in Pentre.
4	Surface water drainage network at Lewis Street	Rhondda Cynon Taf CBC Highway Authority	Surface Water	Highway Authority and Lead Local Flood Authority	R4A	The LLFA and Highways Authority to undertake investigations to clarify the connectivity and condition of the surface water drainage network in Pentre.
					R4B	The Highways Authority to jet and cleanse the highway drainage network and action repairs accordingly.
					R4C	The LLFA, Highways Authority and DCWW to evaluate surface water management options to alleviate the flood risk to Lewis Street.
5	Manhole situated at Albert Street	Rhondda Cynon Taf CBC	Surface Water	Highway Authority and Lead Local Flood Authority	R5A	The LLFA and LDA to identify drainage asset ownership and responsibility.

	(Fir Grove ordinary watercourse network)	Highway Authority			R5B	The LLFA and LDA to investigate the standard of protection and the condition of the culvert structure and network as a whole.
					R5C	Jet and cleanse the ordinary watercourse network.
					R5D	The LLFA to work collaboratively with other RMAs to identify suitable management methods to reduce the risk of flooding from all sources in Pentre.
6	Manholes to the rear of Volunteer Street	Dŵr Cymru Welsh Water	Sewer Flooding	Dŵr Cymru Welsh Water	R6A	DCWW to evaluate the standard of service and the condition of the sewer network servicing Volunteer Street.
					R6B	DCWW to work with the LLFA to identify suitable management methods to reduce the risk of flooding.
7	DCWW combined sewer network to the rear of Queen and Treharne Streets	Dŵr Cymru Welsh Water	Sewer Flooding	Dŵr Cymru Welsh Water	R7A	DCWW to evaluate the standard of service and the condition of the combined sewers servicing Queen Street and Treharne Street.
					R7B	DCWW to work with the LLFA to identify suitable management

						methods to reduce the risk of flooding from all sources in Pentre.
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4.1 LEAD LOCAL FLOOD AUTHORITY

In review of Ref 1 – 5 in Table 6, the LLFA has been determined as the responsible Risk Management Authority in relation to the ordinary watercourse and surface water flooding which occurred at Pentre during the February and June flooding events.

The LLFA exercised the following functions in response to the flooding at Pentre;

- Officers investigated the initial flooding and have produced this report in line with Section 19 of the Flood and Water Management Act 2010.
- Officers contacted residents affected by flooding to offer support and advice to assist in the recovery following the five events.
- A public engagement exercise carried out by RPS Consulting, on behalf of RCTCBC as the LLFA, was undertaken in order to gain further local insight and anecdotal evidence to support the flood investigation.
- The LLFA and LDA have exercised their permissive powers under Section 64 of the Land Drainage Act 1991 to investigate the culvert structures and network conditions and its impact on the flooding within the investigation area. **(R1B, R3B, R5B)**
- An estimated 3.2 km of ordinary watercourse and 5.5 km of surface water drainage network length within Pentre has been surveyed following the initial flood event (16th February 2020) to ascertain both the operational condition and structural integrity along sections of the network. **(R1B, R3B, R4A, R5B)**
- An estimated 600 tonnes of material and debris was removed from the culvert and surface water drainage networks within Pentre during jetting and cleansing operations **(R1C, R3C, R4B, R5C)**
- The LLFA and LDA have undertaken clearance works to the culvert inlet structures and network systems which fall under the responsibility of the Authority. **(R1C, R3C, R5C)**
- The LLFA commissioned RPS Consulting to investigate the standard of protection of the existing culvert networks in Pentre to determine their hydraulic capacity following the 2020 flood events. **(R1B, R3B, R5B)**
- Following damages caused to Pentre Road inlet during Storm Dennis, RCTCBC as the LLFA has led on the delivery of new headwall and inlet arrangements for the Welsh Government owned and NRW maintained culvert inlet. Funded by the Welsh Government and part funded by NRW, the existing culvert inlet structure has been upgraded with the emplacement of an upper

debris screen/platform, new headwall and overflow route to provide additional drainage capacity where necessary and reduce the risk of blockage to the culvert. **(R1D)**

- RCTCBC as the LDA have identified the manhole situated at Pleasant Park falls under the ownership and responsibility of the Authority. In response to the flooding event that occurred on 20th February 2020, the LLFA and LDA rapidly deployed significant resources to carry out emergency works to remove the blockage from the network which was completed two weeks after the repeat flood event. **(R3A)**
- In review of Ref 3, 4 and 5, the LLFA and LDA have led on the mapping of the ordinary watercourse and highway drainage infrastructure and networks to identify connectivity and identify where systems can be modified to reduce flood risk, particularly with respect to highway drainage, combined systems and pump stations. **(R3B, R4A, R5B)**
- In review of Ref 4, the LLFA have completed works, in partnership with DCWW, to install an overflow arrangement from the highway drainage system in Lewis Street to the DCWW Storm Overflow network that outfalls to the Rhondda River to the east of Elizabeth Close. These works seek to improve the resilience of the highway drainage system in Lewis Street and to support the alleviation of surface water flood risk within the Lewis Street and Elizabeth Close areas. **(R4C)**
- The LLFA has exercised its powers, under Section 13 of the FWMA, to request information and co-operation from the relevant risk management authorities (NRW and DCWW) in relation to their responsibilities as RMAs and NRW as land estate manager of the Welsh Government Woodland Estate in response to Storm Dennis.
- The LLFA has set up a central Control Room, to compliment the Council's Contact Centre and CCTV centre which is based at the Council's offices, to provide a comprehensive and informed response to the residents of RCT as appropriate during storm events. **(R1F)**
- The LLFA have commissioned JBA Consulting to undertake a formal Strategic Flood Risk Assessment (SFRA) of the Upper Rhondda catchment area to better understand the overall risk from ordinary watercourse and surface water flooding and make recommendations for suitable measures to alleviate the risk. The SFRAs also aim to encourage whole catchment measures, including working with natural processes, to alleviate flood risk in those areas of highest risk. As part of this, JBA were also commissioned to carry out geomorphic

assessments of the upper catchments in Pentre to determine the risk of culvert blockages due to geomorphic instability of the hillside. **(R1E, R3D, R5D)**

- The LLFA have initiated an interim Property Flood Resistance project offering expandable flood gates to those properties deemed at high risk of flooding from local sources.

The LLFA propose to exercise the following functions in response to the flooding at Pentre;

- Following the surveying of culvert networks in Pentre, the LLFA propose to input and update all relevant asset data. **(R1A, R3A, R5A)**
- The LLFA is currently developing an Outline Business Case for Pentre, working in partnership with NRW and DCWW, to better understand the drainage networks as a whole and to provide recommendations for suitable management methods to reduce the risk of flooding from all sources within the community. **(R1E, R3D, R4C, R5D, R6B, R7B)**
- In review of Ref 3, the LLFA propose to develop a flood routing scheme along Pleasant Street. The scheme will involve the instillation of an exceedance flow path and interception drainage (linear drainage) to reconnect overland flows from the park, back into the culverted watercourse, and reduce the risk of surface water flooding to properties along Pleasant Street and Lewis Street. **(R1E, R3D, R4C, R5D, R6B, R7B)**
- The LLFA intend to improve the efficiency of the Volunteer Street pumping station, with construction approved for 2021/22. **(R1E, R3D, R4C, R5D, R6B, R7B)**
- The LLFA and LDA intend to clarify drainage asset owners and management responsibilities to make them aware of their personal risk. To ensure landowners manage the risk in compliance with the relevant legislation, a team of Flood Enforcement Officers including legal support is to be appointed. **(R1A, R3A, R5A)**
- The LLFA propose to install remote telemetry monitoring devices at key culvert structures to enable operators to ensure the drainage systems in Pentre are operating effectively. **(R1F)**

4.2 NATURAL RESOURCES WALES

Natural Resources Wales were not directly identified as a responsible authority in relation to the flooding at Pentre because the flood type was identified as being largely ordinary watercourse and surface water flooding which is the responsibility of the Lead Local Flood Authority to manage. However, the Authority, as the LLFA and LDA, has engaged with NRW in relation to the initial storm event, specifically regarding their role and responsibility as the woodland and forestry land estate manager.

NRW, as both the Risk Management Authority and as a significant land estate manager within RCT, have exercised the following functions in response to the flooding at Pentre;

- Following the flooding events of February 2020, NRW published a review of its incident response to Storm Ciara and Dennis in October 2020⁶. The review contains several recommendations for improvements to their ways of working and services which NRW are in the process of implementing through an internal delivery program.
- As part of NRW's incident response review, and in relation to their role as land estate manager, NRW have published a Land Estate Management Review⁵ following the February 2020 flooding. The report details further recommendations put forward by NRW to improve their current approach to Forest Management. **(R2A, R2C, RCD)**
- NRW deployed their own resources during Storm Dennis to help with the over pumping of water from the Pentre Road culvert at Pleasant Street Park during the second flood event (21/02/2020)
- NRW have commissioned a modelling project on the Rhondda Fawr River to assess the fluvial flood risk.

NRW propose to exercise the following functions in response to the flooding at Pentre;

- As land manager of the WGWE, NRW are developing Flood Risk Guidance for Forest Operations which will explore the mechanisms in which they can provide better advice on the water management of the Welsh Government Woodland Estate. **(R2C)**
- Building upon their role as land manager of the WGWE, NRW are developing a Local Approach to Woodland and Trees which aims to provide NRW with the

⁶ [Natural Resources Wales / Our response to Storm Ciara and Storm Dennis](#)

necessary guidance to ensure that woodland creation can address priority issues including improvements to both air and water quality, rebuilding ecosystem resilience and contribute to reducing flood risk. **(R2C)**

- NRW propose to undertake an initial economic assessment into the viability of potential option for managing flood risk from the Main River Rhondda Fawr following completion of the modelling project mentioned above.
- NRW are proposing to replant the Welsh Government Woodland Estate above Pentre.
- NRW are developing a Forest Resource Plan in the Lower Rhondda woodland area. As part of the development process, NRW wish to engage and collaborate with the Lead Local Flood Authority to identify the key challenges facing the area so that they are reflected in the plan. **(R2B)**

4.3 WATER COMPANY

Following the results into the investigation of flooding at Pentre, DCWW were not identified as a responsible authority in relation to the flooding at Pentre during February 2020, however, DCWW have been identified as the responsible authority in relation to sewer flooding at two residential properties during the June thunderstorms, and a further three properties during the 5th August 2020 flooding event (Ref 6 and 7, Table 6).

DCWW have exercised the following functions in response to the flooding at Pentre;

- DCWW carried out their own investigations in response to incidences of flooding that were reported by residents directly to DCWW. **(R6A, R7A)**
- DCWW contacted residents affected by flooding to offer support and advice to assist in the recovery following the five events.
- DCWW investigated the performance of their network and pumping stations at Treharne Street and Elizabeth Close during the February storm events and again during the June thunderstorms to ensure their assets were operating with no issues.
- Although DCWW have concluded that their assets performed well during the storm events, DCWW have made improvements to their telemetry system. These improvements include dynamic testing of alarms as well as increased the priority on key alarms at both pumping stations in the area.

- DCWW has collaborated with the LLFA and Highway Authority to facilitate an overflow arrangement from the highway drainage system in Lewis Street to the DCWW sewers to improve the resilience of the highway system in Lewis Street (Ref 4, Table 6). **(R4C)**

DCWW propose to exercise the following function's in response to the flooding at Pentre;

- Following the dynamic testing of DCWW's pumping station alarms, DCWW have identified further improvements that could be made to improve the quality of information provided by telemetry from these sites, particularly in the event of a power failure.
- In light of the 2020 flooding events, DCWW propose to increase their knowledge and resource sharing with the LLFA, including a coordinated deployment of pumps to meet specific needs and working together to map integrated infrastructure to identify areas for improvement within the highway drainage, combined network and pumping stations to reduce flood risk. **(R6B, R7B)**

4.4 HIGHWAY AUTHORITY

During the investigation into the flooding at Pentre during Storm Dennis, the Highway was identified as flooding as a result of overland flows originating from the blocked Pentre Road culvert inlet and following the streets towards the lower parts of Pentre. Mud and debris mobilised and deposited by the overland flows caused blockages to the majority of highway drainage infrastructure in the lower reaches of Pentre, exacerbating surface water flooding to the highway and properties.

RCTCBC as the Highway Authority have exercised the following functions in response to the flooding at Pentre;

- The Highway Authority assisted with the emergency response during the event by supplying equipment and sandbags, some to individual properties and using sandbags to redirect flood water away from properties.
- The Highway Authority exercised their functions under Section 100 of the Highways Act 1980, to arrange for all gullies and open drains in the highway to be inspected and cleansed following the influx of flood water to ensure the safety of the highway post event. **(R4A, R4B)**

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- The Highway Authority ahead of the 2020-21 winter period deployed and maintained two standby pump units within the Pleasant street area to act as 'Rapid Response' measures to reduce the impact of future flooding events whilst the Pentre Road inlet works were ongoing. They also supplied a standby excavator at the inlet prior to the works to rapidly remove debris that may build up on the grill.
 - The Highway Authority also carried out repairs to the carriageway, road gullies and gully connections which became damaged by debris during the initial flood event. **(R4B)**
 - RCTCBC as the LLFA and Highway Authority carried out several surveys of the highway surface water drainage infrastructure to identify damages caused by the blockages and also to determine overall connectivity of the drainage network in the aftermath of Storm Dennis, Storm Jorje and the June thunderstorms. **(R4A, R4B)**

RCTCBC as the Highway Authority propose to undertake the following functions in relation to the event at Pentre;

- The Highway Authority intend to increase their resource capacity by establishing a dedicated 'Pluvial Drainage Team' to focus entirely on the refurbishment and maintenance of RCT's existing and enhanced highway drainage infrastructure. **(R4B)**

USEFUL LINKS/CONTACTS

Blue Pages – property Resilience - <http://bluepages.org.uk/>

Flood Re – Flooded Property Insurance Scheme - <https://www.floodre.co.uk/>

Natural Resources Wales – Check Flood Warnings -
<https://naturalresources.wales/flooding/check-flood-warnings/?lang=en>

Natural Resources Wales - Long Term Flood Risk -
<https://naturalresources.wales/evidence-and-data/maps/long-term-flood-risk/?lang=en>

Natural Resources Wales – Response to Storm Ciara and Storm Dennis –
[Natural Resources Wales / Our response to Storm Ciara and Storm Dennis](#)

Rhondda Cynon Taf CBC - Local Flood Risk Management Plan -
<https://www.rctcbc.gov.uk/EN/Resident/ParkingRoadsandTravel/Roadspavementsandpaths/FloodAlleviation/Floodriskregulations2009.aspx>

Rhondda Cynon Taf CBC - Local Flood Risk Management Strategy -
<https://www.rctcbc.gov.uk/EN/Resident/ParkingRoadsandTravel/Roadspavementsandpaths/FloodAlleviation/LocalFloodRiskManagementStrategy.aspx>

Rhondda Cynon Taf CBC – Sustainable Drainage –
<https://www.rctcbc.gov.uk/EN/Resident/ParkingRoadsandTravel/Roadspavementsandpaths/SustainableDrainage/SustainableDrainage.aspx>

Welsh Government - National Strategy for Flood and Coastal Erosion Risk Management -
<https://gov.wales/sites/default/files/publications/2019-03/national-strategy-for-flood-and-coastal-erosion-risk-management-in-wales.pdf>

Welsh Water – How to Contact Us – <https://www.welshwater.com/en/Contact-Us.aspx>

APPENDIX A: PHOTOGRAPHS OF PENTRE ROAD CULVERT INLET AND THE UPPER CATCHMENT



Photo provided by RCT's Highways and Streetcare Depot showing woody debris and damages to the Pentre Road Inlet on 16th February 2020.



Photo provided by RCT's Highways and Streetcare Depot showing woody debris and damages to the Pentre Road Inlet on 16th February 2020.



Photo provided by RCT's Flood Risk Management team showing woody debris in the Nant y Pentre channel and at the culvert inlet on 17th February 2020.



Photo provided by RCT's Flood Risk Management team showing woody debris on the debris screen of the Pentre Road culvert inlet on the 17th February 2020.



Photo provided by RCT's Flood Risk Management team showing woody debris and mud being cleared to the rear Pentre Road Care Home on the 17th February 2020 (situated directly downstream of the Pentre Road culvert inlet).



Photo provided by RCT's Flood Risk Management team of the Pentre Road culvert inlet and channel following emergency clearing works on 18th February 2020.



Photo provided by RCT's Flood Risk Management team on 17th February 2020 of woody debris in the felled area of Pentre's upper catchment.



Photo provided by RCT's Flood Risk Management team on 17th February 2020 of woody debris in the felled area of Pentre's upper catchment looking downstream towards the village.



Photo provided by RCT's Flood Risk Management team on 17th February 2020 of woody debris in the felled area of Pentre's upper catchment looking downstream towards the village.



Photo provided by RCT's Flood Risk Management team on 17th February 2020 of woody debris in the felled area of Pentre's upper catchment looking upstream.



Photo provided by RCT's Flood Risk Management team on 17th February 2020 of woody debris in the felled area of Pentre's upper catchment and adjacent to the watercourse.