

Flood and Water Management Act 2010

Section 19 Flood Investigation Report

Unnamed Storm – 04/10/2021

Rhydyfelin

February 2023

ANDREW STONE

Head of Flood Risk Management and Strategic Projects
Strategic Projects, Sardis House, Sardis Road, Pontypridd, CF37 1DU

ROGER WATERS

Director
Frontline Services, Sardis House, Sardis Road, Pontypridd, CF37 1DU



RHONDDA CYNON TAF

Blank Page

DOCUMENT VERIFICATION

Client	Director Frontline Services
Project	Flood and Water Management Act 2010, Section 19 Flood Investigation Report
Document Title	Unnamed Storm – 04/10/2021 – Rhydyfelin
Document Ref	FRM – S19 – 2021/22 – 01
Project No	N/A

Revision Status	Final			
Publication Status	Publication Approved			
Date of Issue	31/02/2023			
Prepared by	Catrin Evans BSc (Hons)			
Checked by	Owen Griffiths MSc, BSc (Hons)			
Approved by	Andrew Stone BSc (Hons), IEng, MICs, Assoc, MCIWM, AaPS			

This report should be read in its entirety

This report has been prepared in accordance with the requirements of section 19 Flood and Water Management Act 2010. The Council assumes no responsibility or liability from any person in connection with its contents or findings.

Blank Page

CONTENTS

EXECUTIVE SUMMARY	3
ABBREVIATIONS.....	5
TABLES AND FIGURES	6
1. INTRODUCTION.....	9
1.1. Purpose of Investigation.....	9
1.2. Site Location	10
1.3. Drainage System.....	11
1.4. Investigation Evidence	12
1.5. Public Engagement	12
2. STORM EVENT & RAINFALL ANALYSIS.....	13
3. FLOODING HISTORY	16
3.1. Previous Flood Incidents	16
3.2. Flood Incident.....	17
3.2.1. Pathway A.....	21
3.2.2. Pathway B.....	24
3.2.3. Pathway C	29
3.2.4. Pathway D	31
4. POSSIBLE CAUSES	33
4.1. Culvert Conditions.....	33
4.1.1. Culvert Inlet RH03.....	34
4.1.2. Culvert Inlet RH02.....	37
4.1.3. Nant Corrwg Culvert Inlet.....	39
4.2. Ordinary Watercourse Conditions	41
4.2.1. Unnamed Ordinary Watercourse RH03	42
4.2.2. Unnamed Ordinary Watercourse RH02	45
4.2.3. Nant Corrwg Ordinary Watercourse.....	48
4.2.4. Unnamed Ordinary Watercourse RH01	49
4.3. Main River	51
4.4. Highway Drainage Condition.....	52

4.5. DCWW Apparatus.....	53
4.6. Surface Water	54
4.7. Access Structures	56
4.8. System at Capacity	57
4.9. Summary of Possible Causes	58
5. RISK MANAGEMENT AUTHORITY ACTIONS.....	60
5.1. Lead Local Flood Authority	65
5.2. Natural Resources Wales	68
5.3. Water Company	69
5.4. Highway Authority	70
6. USEFUL LINKS/CONTACTS	71

Blank Page

EXECUTIVE SUMMARY

This report has been produced through the duties placed upon Rhondda Cynon Taf County Borough Council 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 an investigative report of the storm event that occurred on the 4th of October 2021 within the Rhondda Cynon Taf County Borough Council area, focusing investigation on the flooding at Rhydyfelin in the Taf valley (Figure 1).

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 manage the risk of flooding.

The flooding that affected RCT on the 4th of October 2021 was a result of an extreme rainfall event. The storm event was not designated by the Met Office as a named storm. The impact of the event at Rhydyfelin resulted in internal flooding to a total of 20 residential properties. 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 Highway and Streetcare Depot and Dŵr Cymru Welsh Water.

It has been established from the evidence gathered within this report that the primary source of flooding at Rhydyfelin on the 4th of October 2021 was a result of significant overland runoff being generated from the steep hillsides above Rhydyfelin draining to lower ground via a series of ordinary watercourses, many of which became overwhelmed with water and debris and eventually overtopped, impacting several properties on its course of flow.

RCT 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 and surface water flooding that occurred at Rhydyfelin on the 4th of October 2021.

In response to the flooding at Rhydyfelin, the LLFA has undertaken 12 actions and have proposed to undertake a further 8. A summary of which include;

- Undertaken clearance works to the culvert inlet structures identified as sources of flooding following the storm event (assisted by the Highway Authority);
- Carried out survey, jetting and cleansing operations to an estimated 134.7 metres of ordinary watercourse drainage network length within the investigation area;
- Led on the development of a central Control Room, to compliment the Council's Contact Centre and CCTV Centre, to provide a comprehensive and informed response to residents during storm events; and
- Initiated an interim Property Flood Resistance project offering expandable flood gates to properties deemed at high risk of ordinary watercourse and surface water flooding.

As the relevant Risk Management Authority for ordinary watercourse flooding, RCT as the LLFA will also look to better understand the catchment, the flood risk and the risk of scour and debris potential above Rhydyfelin through the development of a Strategic Flood Risk Assessment and geomorphological assessments of the upper catchment to provide recommendations for suitable management mechanisms to mitigate the wider risk of ordinary watercourse, surface water and groundwater flooding in the community.

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 RMAs to better address preparedness and response to future flood events.

ABBREVIATIONS

CaRR – Communities at Risk Register

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

Q – Return Period (1 in X chance of an event occurring in any given year)

RCT - Rhondda Cynon Taf CBC

RMA – Risk Management Authority

SAB – Sustainable Drainage Approval Body

SFRA – Strategic Flood Risk Assessment

SOC – Strategic Outline Business Case

SuDs – Sustainable Drainage Systems

TABLES AND FIGURES

Table 1: Investigative evidence gathered in preparation of this Section 19 report	12
Table 1: Rainfall total and peak hourly intensities recorded at three RCT and four NRW monitoring stations during the unnamed storm event on 4 th October 2021	13
Table 2: Summary of the source(s), pathway(s) and receptor(s) affected during the unnamed storm on 4 th October 2021 within Rhydyfelin	17
Table 4: Summary of culvert capacity assessment results which indicate the current standard of protection of the culverted networks in free flowing and blockage conditions within Rhydyfelin	57
Table 5: Summary of source(s) and possible cause(s) of flooding in Rhydyfelin on 4 th October 2021	58
Table 6: Risk Management Authority with relevant functions to manage the risk for different flood types.....	60
Table 7: Recommendations provided by the LLFA to be considered by the relevant Risk Management Authority identified in response to the source(s) of flooding in Rhydyfelin (as per Table 5).....	61
Figure 1: Site Investigation Location Plan.....	10
Figure 2: Natural Resources Wales' Flood Risk Assessment Water (FRAW) map for rivers and ordinary watercourse and surface water flood risk at Rhydyfelin. Contains Natural Resources Wales information © Natural Resources Wales and database right. All rights reserved.....	11
Figure 3: 24-hour cumulative precipitation across South Wales on 4 th October 2021 (Source: MetDesk)	14
Figure 4: Images captured at RCT's monitoring station at culvert inlets RH02 (left) and RH03 (right) in Rhydyfelin. (04/10/21 22:14 (top left), 04/10/21 23:25 (bottom left), 04/10/21 21:53 (top right), 04/10/21 23:55 (bottom right))	15
Figure 5: Rainfall Topographic Watershed above Rhydyfelin investigation area and the four primary flow pathways observed during the storm event on 4 th October 2021	20
Figure 6: Map illustrating the principal sources and flow paths of flooding during the storm event at Rhydyfelin. 'Pathway A', associated to 'Culvert Inlet RH03' is represented by a blue flow path.	21
Figure 7: Image of 'Culvert Inlet RH03' showing material deposited on the channel banks during post event inspections (captured by RCT's Flood Risk Management team on 5 th October 2021).....	22
Figure 8: Location of 'Manhole 1' which was identified as surcharging during the storm event	23
Figure 9: Map illustrating the principal sources and flow paths of flooding during the storm event at Rhydyfelin. 'Pathway B', associated to 'Culvert Inlet RH02' is represented by a red flow path.....	24
Figure 10: Image of 'Culvert Inlet RH02' showing material deposited within the channel during post event inspections (captured by RCT's Flood Risk Management team on 5 th October 2021).....	25
Figure 11: Surcharging flows from 'Culvert Inlet RH02' conveying over the embankment and onto Masfield Way during the storm event (image provided by resident).....	26
Figure 12: Damage to the highway at Wordsworth Gardens (captured by RCT's Flood Risk Management team on 5 th October 2021)	26

Figure 13: Mud and silt deposits within the lane at Wordsworth Gardens (left) and Oak Street (right) during post event cleansing operations (captured by RCT's Flood Risk Management team on 5 th October 2021)	27
Figure 14: Mud and silt deposits (left) and evidence of saturated ground indicative of the flow path of water (right) within the grounds of Heol-y-Celyn School (captured by RCT's Flood Risk Management team on 5 th October 2021)	28
Figure 15: Map illustrating the principal sources and flow paths of flooding during the storm event at Rhydyfelin. 'Pathway C', associated to the 'Nant Corrwg Culvert Inlet' is represented by a purple flow path.	29
Figure 16: Mud, silt and scour material being cleared from the 'Nant Corrwg Culvert Inlet' by RCT's Highway and Streetcare Depot on 5 th October 2021 (captured by RCT's Flood Risk Management team on 5 th October 2021)	30
Figure 17: Map illustrating the principal sources and flow paths of flooding during the storm event at Rhydyfelin. 'Pathway D', associated to the overtopping of an unnamed ordinary watercourse is represented by a green flow path.	31
Figure 18: Silt and stone causing an impediment of flow within the unnamed ordinary watercourse channel (captured by RCT's Flood Risk Management team on 8 th October 2021)	32
Figure 19: Obstruction of flow within the unnamed ordinary watercourse channel (captured by RCT's Flood Risk Management team on 8 th October 2021)	32
Figure 20: Surveyed culverted ordinary watercourse networks within Rhydyfelin	33
Figure 21: CCTV image of 'Culvert Inlet RH03' captured at 15:47 4 th October 2021	34
Figure 22: CCTV image of 'Culvert Inlet RH03' captured at 01:57 5 th October 2021	35
Figure 23: Image of the debris removed from 'Culvert Inlet RH03' during emergency clearance works carried out by RCT's Highway and Streetcare Depot on 5 th October 2021	36
Figure 24: CCTV image of 'Culvert Inlet RH02' captured at 17:11 4 th October 2021	37
Figure 25: CCTV image of 'Culvert Inlet RH02' captured at 02:17 5 th October 2021	38
Figure 26: Image of the debris removed from 'Culvert Inlet RH02' during emergency clearance works carried out by RCT's Highway and Streetcare Depot on 5 th October 2021	38
Figure 27: Image of the 'Nant Corrwg Culvert Inlet' debris screens captured during emergency cleansing operations by RCT's Highway and Streetcare Depot on 5 th October 2021	39
Figure 28: Map of Ordinary Watercourses which feed into and flow through Rhydyfelin investigation area	41
Figure 29: 'Unnamed Ordinary Watercourse RH03' inspection location plan.....	42
Figure 30: Evidence of the overtopping of 'Unnamed Ordinary Watercourse RH03' (left), debris accumulation at the ford (middle) and debris causing an impediment of flow (right) at RH03 Area 1 (images captured by RCT during post event inspections)	43
Figure 31: Obstruction of flow (left) and accumulated debris (right) within RH03 Area 3 of 'Unnamed Ordinary Watercourse RH03' (images captured by RCT during post event inspections).....	44
Figure 32: 'Unnamed Ordinary Watercourse RH02' inspection location plan.....	45

Figure 33: Evidence of significant embankment scour (left), undercutting (middle) and debris deposition (right) within RH02 Area 1 of 'Unnamed Ordinary Watercourse RH02' (images captured by RCT during post event inspections)	46
Figure 34: Obstruction of flow (left), scouring of the channel embankment and tarmac road (middle) and deposits of material indicative of out-of-bank flows (right) within RH02 Area 3 of 'Unnamed Ordinary Watercourse RH02' (images captured by RCT during post event inspections).....	47
Figure 35: Site Inspection and Investigation Plan of 'Unnamed Ordinary Watercourse RH01' produced by RCT's Flood Risk Management team	49
Figure 36: The River Taf levels at Upper Boat station between the 3 rd and 6 th October 2021 (Natural Resources Wales)	51
Figure 37: Surface water accumulation at the fronts of properties at Wordsworth Gardens as a result of 'Culvert Inlet RH02' surcharging during the storm event on 4 th October 2021 (image provided by resident)	54
Figure 38: Natural Resources Wales' FRAW map for surface water and ordinary watercourse sources within Rhydyfelin investigation area. Contains Natural Resources Wales information © Natural Resources Wales and database right. All rights reserved.	55

1. INTRODUCTION

1.1. PURPOSE OF INVESTIGATION

On the 4th of October 2021, RCT was impacted by an extreme weather event. The Met Office did not designate the storm as a named storm however due to the extent and impact of the event, the LLFA opted to undertake a formal investigation as per the threshold recommended by the Welsh Government in the National Strategy for Flood and Coastal Erosion Risk Management¹.

The storm resulted in widespread residential and commercial flooding within the Cynon and Taf valleys. This report will focus on the area of Rhydyfelin in the Lower Taf region.

The reason behind RCT's investigation is in response to the duties of the local authority regarding 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 (a) publish the results of its investigation, and (b) notify any relevant risk management authority"²

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

¹ [National Strategy for Flood and Coastal Erosion Risk Management in Wales \(English\) \(gov.wales\)](https://gov.wales/national-strategy-for-flood-and-coastal-erosion-risk-management-in-wales)

² 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 covers the village and community area of Rhydyfelin, located within the south-eastern region of the county borough, to the south-east of Pontypridd, in the Lower Taf catchment (Figure 1).

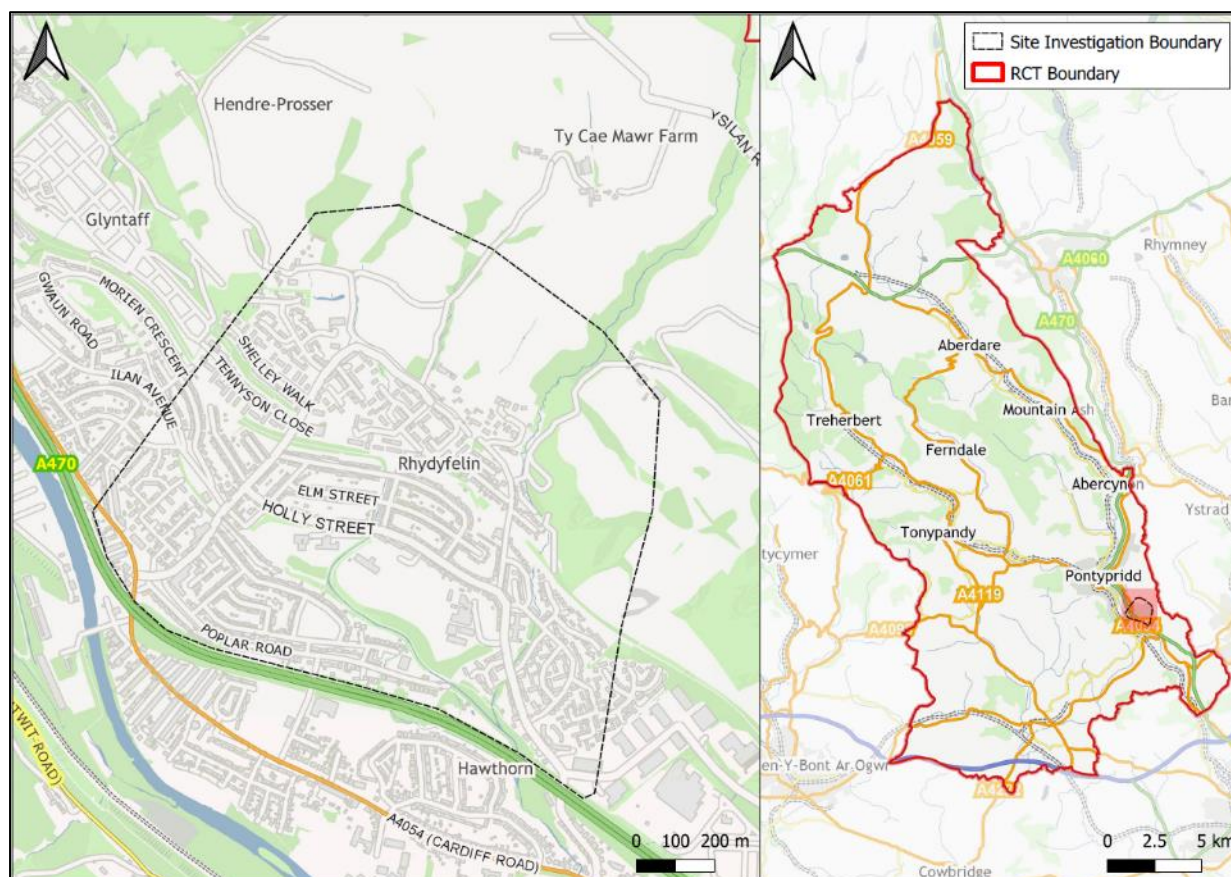


Figure 1: Site Investigation Location Plan

North of the investigation area is mostly rural owing to the steep topography of the highlands in the north which are predominately used for agricultural purposes. Residential development is confined to the base of the valley, of which the investigation area largely encompasses. The main River Taf flows west to east to the south of Rhydyfelin.

There are several ordinary watercourses that drain the eastern highlands above Rhydyfelin and convey through the investigation area, including the Nant Corrgw. These watercourses are partially culverted beneath residential development before discharging into the River Taf.

The community area of Rhydyfelin is ranked 8th in Wales for surface water and ordinary watercourse flood risk according to the CaRR.

Flood risk is generally associated with the network of ordinary watercourses within Rhydyfelin, notably from culvert inlets and bank breaches. A high and medium flood risk is present across the majority of the investigation area, as illustrated in Figure 2 which is an extract from Natural Resources Wales' Flood Risk Assessment Wales (FRAW) mapping.

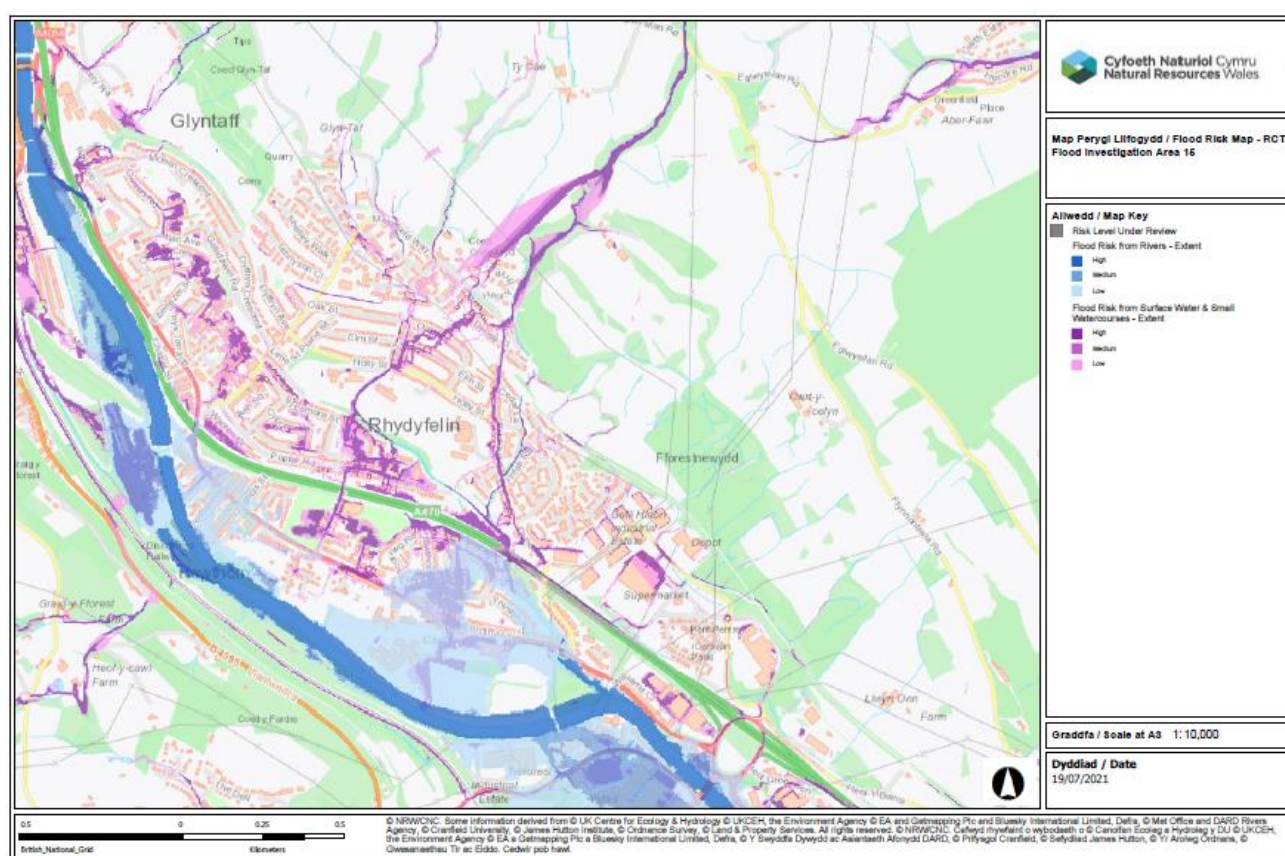


Figure 2: Natural Resources Wales' Flood Risk Assessment Water (FRAW) map for rivers and ordinary watercourse and surface water flood risk at Rhydyfelin. Contains Natural Resources Wales information © Natural Resources Wales and database right. All rights reserved

1.3. DRAINAGE SYSTEM

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

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 this 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
Rain Gauges	RCT and NRW operated rain gauge information
Natural Resources Wales	River Level and Flood Warning data
RCT Flood Risk Management Plan	Site specific information and data for each electoral ward in RCT
Communities at Risk Register	Flood risk ranking and scores for all flood types based on community data in Wales
Flood Investigation Report	A summary of the source-pathway-receptors and upper catchment assessments undertaken by RCT's Flood Risk Management team. The Flood Investigation Report was written by RCT prior to writing the Section 19 report.

1.5. PUBLIC ENGAGEMENT

Following the initial flooding event that occurred on the 4th October 2021, flood risk officers from the RCT Flood Risk Management department were deployed to areas across the borough to investigate reports of internal flooding by residents. Residents were engaged with by the Flood Risk Management team to 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.

2. STORM EVENT & RAINFALL ANALYSIS

At 10:13 on the morning of Monday 4th October 2021, the Met Office issued a yellow weather warning for rain affecting the RCT area between 17:00 on 4th October and 04:00 the following morning. As much as 40-50 mm of rain was forecasted to fall in a few hours across parts of South Wales and southwest England.

On receipt of the yellow weather warning on Monday 4th October, RCT's Flood Risk Management team and Highways and Streetcare depot mobilised resources to inspect all priority culvert inlets across the borough for any evidence of damage and/or obstruction. Maintenance teams were deployed, and drainage infrastructure subsequently cleansed in response to any observed obstructions identified upon inspection. All assets with CCTV coverage were also examined prior to the on-set of the storm.

Rainfall during the storm event was recorded at three weather stations maintained by RCT. An additional four monitoring stations owned and maintained by NRW have also been included below to account for rainfall amounts in the upper Cynon and Rhondda valley catchments. Table 1 details the summary of the rainfall recorded during the storm event on the 4th of October 2021, including the daily total and peak hourly intensities.

Monitoring Station	Total Rainfall (mm) 04/10/21	Peak Intensity (mm/hour)	Date & Time of Peak Intensity
Cwmaman (RCT)	32	11	04/10/2021 - 21:00 - 22:00
Cilfynydd (RCT)	49	16.2	04/10/2021 - 22:15 - 23:15
Coedely (RCT)	58.6	14.8	04/10/2021 - 22:30 - 23:30
Treherbert (NRW)	40.2	12.4	04/10/2021 - 19:45 - 20:45
Maerdy (NRW)	43	14.2	04/10/2021 - 20:15 - 21:15
Hirwaun (NRW)	34.4	9.8	04/10/2021 - 20:00 - 21:00
Llantrisant (NRW)	57.8	19	04/10/2021 - 21:15 - 22:15

Table 2: Rainfall total and peak hourly intensities recorded at three RCT and four NRW monitoring stations during the unnamed storm event on 4th October 2021

The greatest rainfall totals occurred in the southern extent of the borough during the storm event, with particularly high rainfall totals and intensities recorded at Cilfynydd and Coedely. This is supported by Figure 3 which depicts the 24-hour cumulative rainfall across RCT on the 4th of October 2021. Isolated downpours of heavy rainfall are shown to have occurred at Cilfynydd, Pontypridd, Rhydyfelin and Tonyrefail, with approximately 50-60mm of rain falling on these catchments during the storm event.

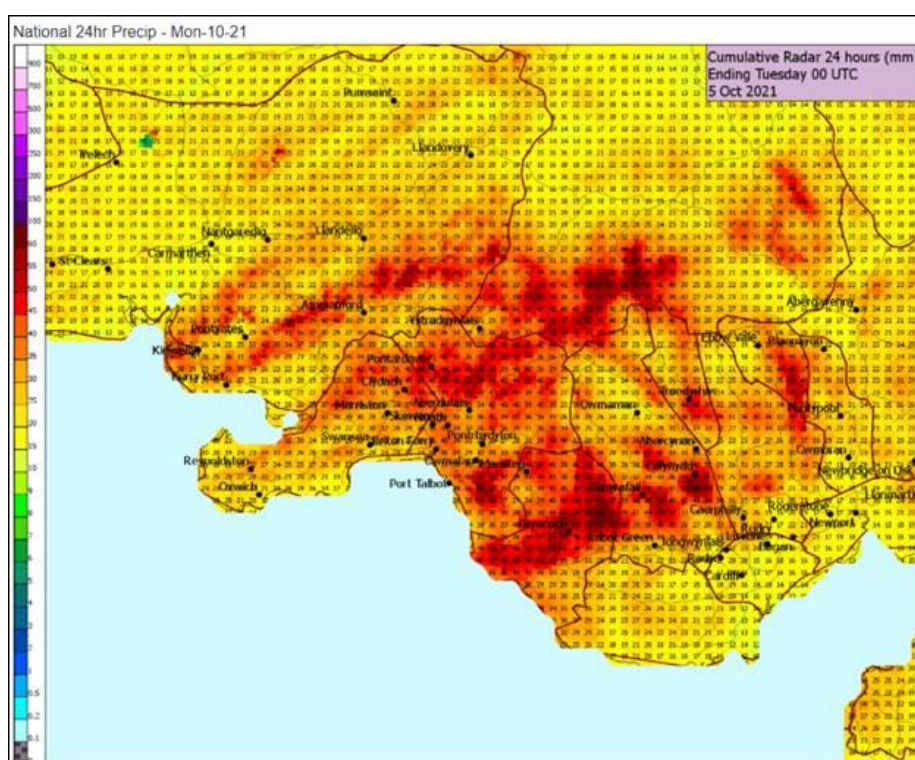


Figure 3: 24-hour cumulative precipitation across South Wales on 4th October 2021 (Source: MetDesk)

The upper catchments of RCT, in both the Cynon and Rhondda valleys, experienced less intense rainfall overall, with NRW's Hirwaun rain gauge recording 34.4 mm on the 4th of October, compared with RCT's Coedely rain gauge which recorded 58.6 mm of rainfall. Given the geographic location of NRW's monitoring stations situated on higher ground, it is notable that the rain gauges situated on lower ground within the urban catchments, where rainfall is expected to be less intense, recorded the greatest totals and intensities during the storm event.

During the storm event, the most intense period of rainfall occurred during the evening of Monday 4th October 2021 between the hours of 21:00 and 23:00 across the borough. This is supported by CCTV footage captured by RCT's monitoring stations at Rhydyfelin which show a significant rise in watercourse levels during this period of

intense rainfall. The location of both CCTV monitoring stations at Rhydyfelin are shown in Figure 6 for reference.

Figure 4 demonstrates the watercourses' rapid response to rainfall within Rhydyfelin, whereby, within a 1-hour period, the unnamed watercourses conveying towards Rhydyfelin rapidly rose in levels, resulting in surcharging flows beyond the culvert inlet structures and onwards to impact properties downstream.



Figure 4: Images captured at RCT's monitoring station at culvert inlets RH02 (left) and RH03 (right) in Rhydyfelin. (04/10/21 22:14 (top left), 04/10/21 23:25 (bottom left), 04/10/21 21:53 (top right), 04/10/21 23:55 (bottom right))

Following the short burst of intense rainfall recorded at several monitoring stations, rainfall across the borough began to recede during the early hours of Tuesday 5th October 2021.

3. FLOODING HISTORY

3.1. PREVIOUS FLOOD INCIDENTS

Previous incidences of flooding to properties within the wider investigation area have occurred over the past twenty years, often in relation to the network of ordinary watercourses and culverted infrastructure which convey a substantial volume of water from the eastern highlands and through the village of Rhydyfelin.

In recent years the frequency and impact of property flooding has increased, with the most notable flood and extreme event being Storm Dennis on 15-16th February 2020, where according to RCT's Flood Risk Management team, several properties within Rhydyfelin were impacted as a result of ordinary watercourse and surface water flooding. Notable areas within Rhydyfelin where flooding has been observed during extreme storm events include Maeshyfryd, Dynea Road and Wordsworth Gardens.

3.2. FLOOD INCIDENT

The flooding that occurred on the 4th of October 2021 at Rhydyfelin was a result of an unnamed storm which caused widespread flooding to several streets within the community area.

The post event inspections undertaken on the days following the storm event by RCT's Flood Risk Management Team and RCT's Public Health, Protection and Community team identified 20 residential properties as internally flooded. An additional 26 residential and 1 non-residential property were also reported as externally flooded within the investigation area during the storm event.

A summary of the source(s) and pathway(s) of flooding within the investigation area during the unnamed storm on 4th October 2021 have been outlined in Table 2 and further described throughout this section.

Table 3: Summary of the source(s), pathway(s) and receptor(s) affected during the unnamed storm on 4th October 2021 within Rhydyfelin

Source(s)	Pathway(s)	Receptor(s)
Intense rainfall running off the hillsides to the northeast of Rhydyfelin draining to lower ground via a series of unnamed ordinary watercourses.	Surcharging flows from the culvert inlet conveyed onto Masefield Way where the topography of the land directed the flow eastwards along the highway.	The flow path along Masefield Way caused external flooding to 6 residential properties and contributed to the internal flooding of one property at Masefield Way.
A culvert inlet to the north of Maesfield Way surcharged during the storm event.	Water flowed towards the fronts of several properties along Masefield Way, in addition to conveying across grassed area and pooling near properties at Shakespeare Rise. Some flow was re-directed back into the downstream unnamed ordinary watercourse at several locations.	The flow path towards Shakespeare Rise caused internal flooding to two ground floor flats and external flooding to a further block of flats.
Intense rainfall running off the hillsides to the northeast of Rhydyfelin draining to	Surcharging flows from the culvert inlet flowed towards Masefield Way where the	The flow path caused internal flooding to one residential property at Masefield Way, 13

<p>lower ground via a series of unnamed ordinary watercourses.</p> <p>A culvert inlet to the north of Wordsworth Gardens surcharged during the storm event.</p>	<p>topography of the land directed the flow towards the junction at Wordsworth Gardens.</p> <p>Water conveyed south towards the properties within the lower reaches of Wordsworth Gardens.</p> <p>Water conveyed through two rows of residential properties at Wordsworth Gardens before reaching Oak Street and passing over the highway towards a lane which runs adjacent to an unnamed ordinary watercourse in addition to flowing down Beachwood Street.</p> <p>Water travelling from Oak Street reached Holly Street before flowing down an access road towards Heol-y-Celyn School.</p> <p>Water passed through the grounds of the school, with some of the flow re-entering the watercourse at various low points, and the exceedance flows conveying downhill towards the rear of properties on Sycamore Street before draining via the highway drainage infrastructure.</p>	<p>properties along Wordsworth Gardens and one property at Sycamore Street.</p> <p>The flow path externally impacted a further 10 residential properties at Wordsworth Gardens, 3 properties at Oak Street, 4 properties at Sycamore Street, as well as Heol-y-Celyn School.</p>
<p>A privately owned combined drainage manhole to the rear of properties at Masefield Way surcharged during the storm event.</p>	<p>Surcharging flows from the manhole travelled east behind properties on Masefield Way, as well as travelling downhill via a small path before re-entering the</p>	<p>Contributed to the internal flooding of one residential property at Masefield Way.</p>

	unnamed watercourse downstream.	
<p>Intense rainfall running off the steep hillsides to the northeast of Rhydyfelin draining to lower ground via the Nant Corrwg ordinary watercourse and its tributaries.</p> <p>A culvert inlet associated to the Nant Corrwg ordinary watercourse surcharged during the storm event. The inlet is located adjacent to Dynea Caravan Site.</p>	<p>Surcharging flows overtopped the western headwall and flowed onto the lane above the caravan site and along Dynea Road towards the junction between Dynea Road and Holly Street, before passing over the kerb and footpath into the gardens of two residential properties at Dynea Road.</p> <p>Water continued to travel downhill along Dynea Road before draining via highway drainage infrastructure.</p>	<p>This flow path caused internal flooding to the ground floor of 2 residential properties on Dynea Road, situated at the junction to Holly Street.</p>
<p>Intense rainfall running off the steep hillsides to the northeast of Rhydyfelin draining to lower ground via an unnamed ordinary watercourse flowing towards a culvert inlet west of Heol-y-Bryn.</p> <p>The watercourse was observed to have overtopped upstream of the culvert.</p>	<p>Out-of-bank flow from the unnamed watercourse travelled overland down the hillside towards the lane adjacent to Masefield Way.</p>	<p>Overland flow caused external flooding to the rear of one residential property.</p> <p>Surface water flows are also considered to have contributed to flooding along Dynea Road.</p>
<p>Intense rainfall, overland flow from the surcharged culverts and the overtopping of watercourses resulted in surface water accumulation along several streets.</p>	<p>Surface water conveyed via the highway network towards the lower reaches within the investigation area.</p>	<p>Contributed to the internal flooding of several properties within the investigation area.</p>

On review of Table 2, the principal source of flooding in this incident originated from intense rainfall generating significant surface water runoff from the steep hillsides to the north and east of Rhydyfelin draining to lower ground. This runoff was routed towards the investigation area via several ordinary watercourse, many of which

became overwhelmed during the storm event and caused flooding associated to overtopping and blocked culvert inlets.

Figure 5 depicts the topographic watershed of the River Taf and Nant yr Aber valleys (bold pink line), with rainfall to the southwest of the watershed draining to the River Taf catchment. On review of the area of land that would expect to drain towards the investigation area, LIDAR based assessment show the valley hillsides above Rhydyfelin's urban settlements to be steeply inclined and absent of any ridge-like features that may divert surface water flows. These steep slopes above the investigation area largely contributed to the rapid surface water and ordinary watercourse flows travelling down the hillside during heavy rainfall.

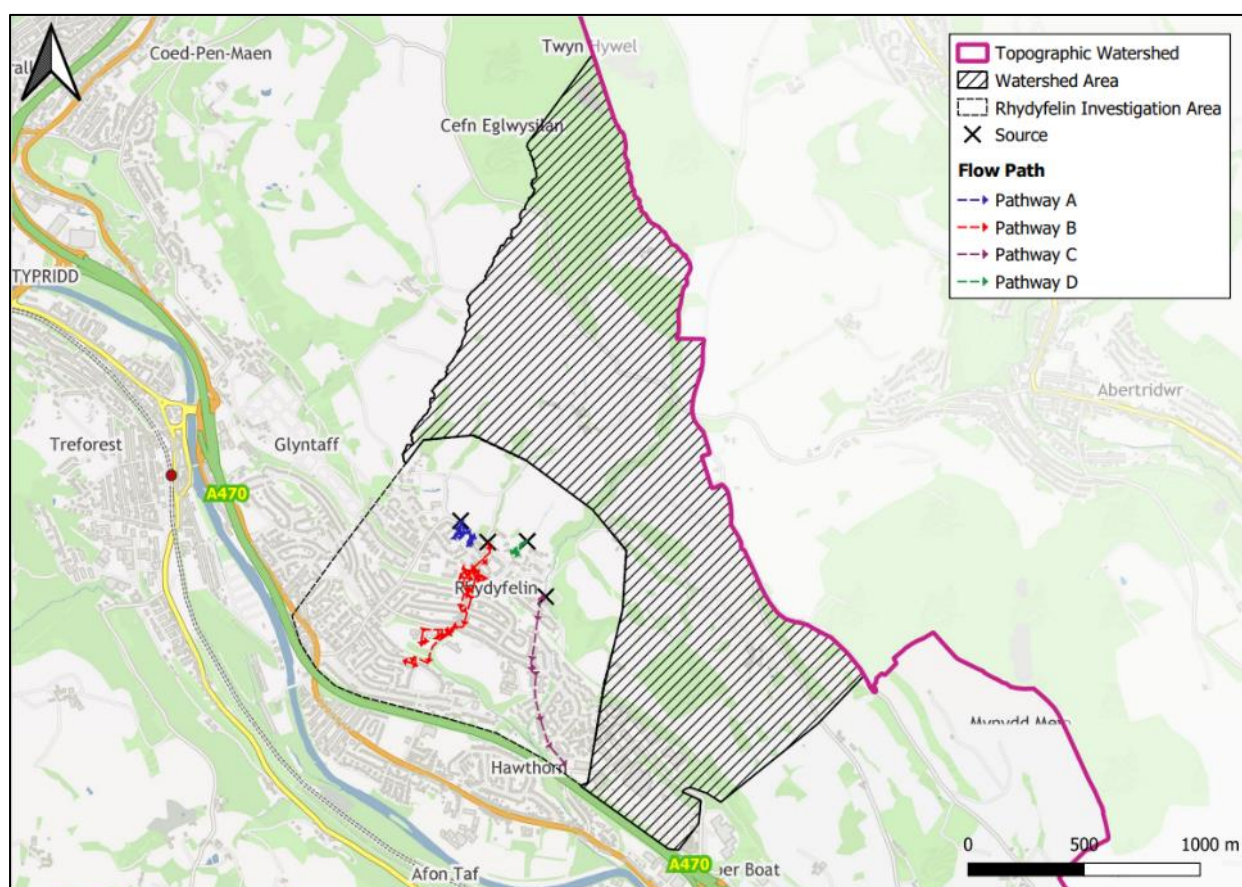


Figure 5: Rainfall Topographic Watershed above Rhydyfelin investigation area and the four primary flow pathways observed during the storm event on 4th October 2021

The principal sources and pathways of flooding, as depicted in Table 2, have been spatially represented in Figure 5. The primary flow paths that occurred within Rhydyfelin on the 4th of October 2021 have been identified as 'Pathway A' (blue flow path), 'Pathway B' (red flow path), 'Pathway C' (purple flow path) and 'Pathway D'

(green flow path). These flow paths have been further described within their individual sections below.

3.2.1. PATHWAY A

Pathway A shows where water enters the northwest of Rhydyfelin via an unnamed ordinary watercourse flowing from the hillside above. The watercourse is culverted beneath Rhydyfelin's residential development at 'Culvert Inlet RH03' which is located above Masefield Way. The inlet location and associated flow paths are illustrated in Figure 6.

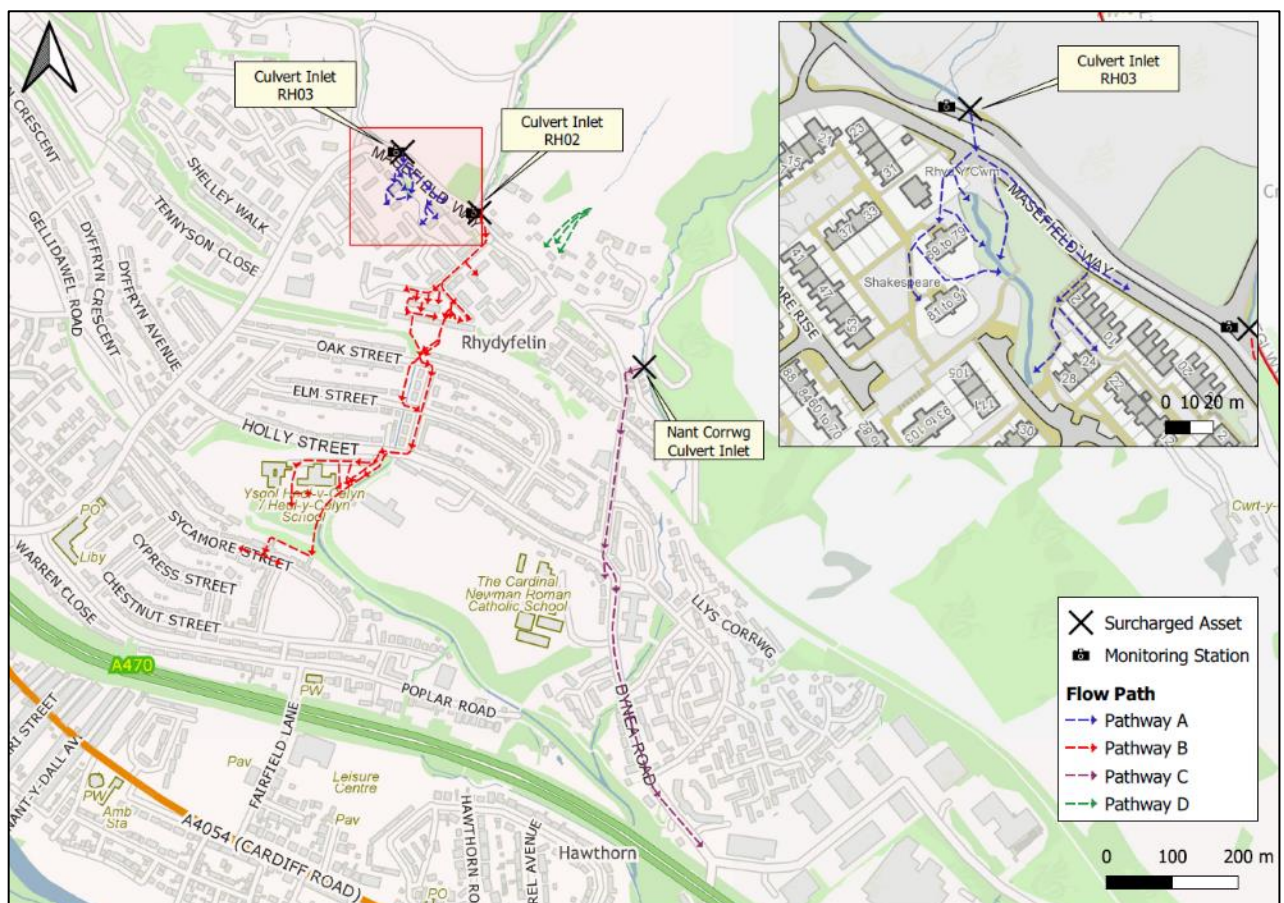


Figure 6: Map illustrating the principal sources and flow paths of flooding during the storm event at Rhydyfelin. 'Pathway A', associated to 'Culvert Inlet RH03' is represented by a blue flow path.

During the night of Monday 4th October 2021, 'Culvert Inlet RH03' was reported by residents and emergency responders as surcharging following intense rainfall. Upon a site inspection undertaken by RCT's Flood Risk Management team on 5th October 2021, 'Culvert Inlet RH03' showed evidence of surcharge, with flattened grass and

mobilised silt and debris indicative of the exceedance flows originating from the overtopping of 'Culvert Inlet RH03' during the storm event.

Post event inspections also noted significant debris, consisting of large stones and silt, deposited along the channel embankments and the area surrounding 'Culvert Inlet RH03' (Figure 7).



Figure 7: Image of 'Culvert Inlet RH03' showing material deposited on the channel banks during post event inspections (captured by RCT's Flood Risk Management team on 5th October 2021)

Water reportedly overtopped the inlet and overflow structure and flowed onto Dynea Lane and onwards to Masefield Way. The topography of the land directed flow towards a residential property situated directly opposite 'Culvert Inlet RH03' and eastwards along Masefield Way. One residential property was confirmed as internally flooded while a further 5 residential properties along Masefield Way were externally impacted by flows conveying along the highway.

Surcharging flows conveyed across the grassed area downstream of 'Culvert Inlet RH03' and pooled outside the perimeter of properties Shakespeare Rise, resulting in internal flooding to two ground floor flats. Some of the flows conveying towards

Shakespeare Rise and along Masefield Way re-entered the unnamed watercourse downstream of 'Culvert Inlet RH03' at various locations.

It was also reported by residents that a privately owned combined sewer manhole to the rear of Masefield Way (labelled Manhole 1, Figure 8) surcharged during the storm event. The manhole was noted as partially blocked with debris by residents and on-site inspectors. Surcharging flows from the manhole flowed east along the lane to the rear of properties at Masefield Way, contributing to the internal flooding of one property from the rear. Flow was also noted as re-entering the unnamed ordinary watercourse at this location.



Figure 8: Location of 'Manhole 1' which was identified as surcharging during the storm event

3.2.2. PATHWAY B

Pathway B shows where water enters the north of Rhydyfelin via an unnamed ordinary watercourse flowing from the hillside above. The watercourse is culverted beneath Rhydyfelin's residential development at 'Culvert Inlet RH02' which is located above Masefield Way, near the junction to Wordsworth Gardens. The inlet location and associated flow paths are illustrated in Figure 9.

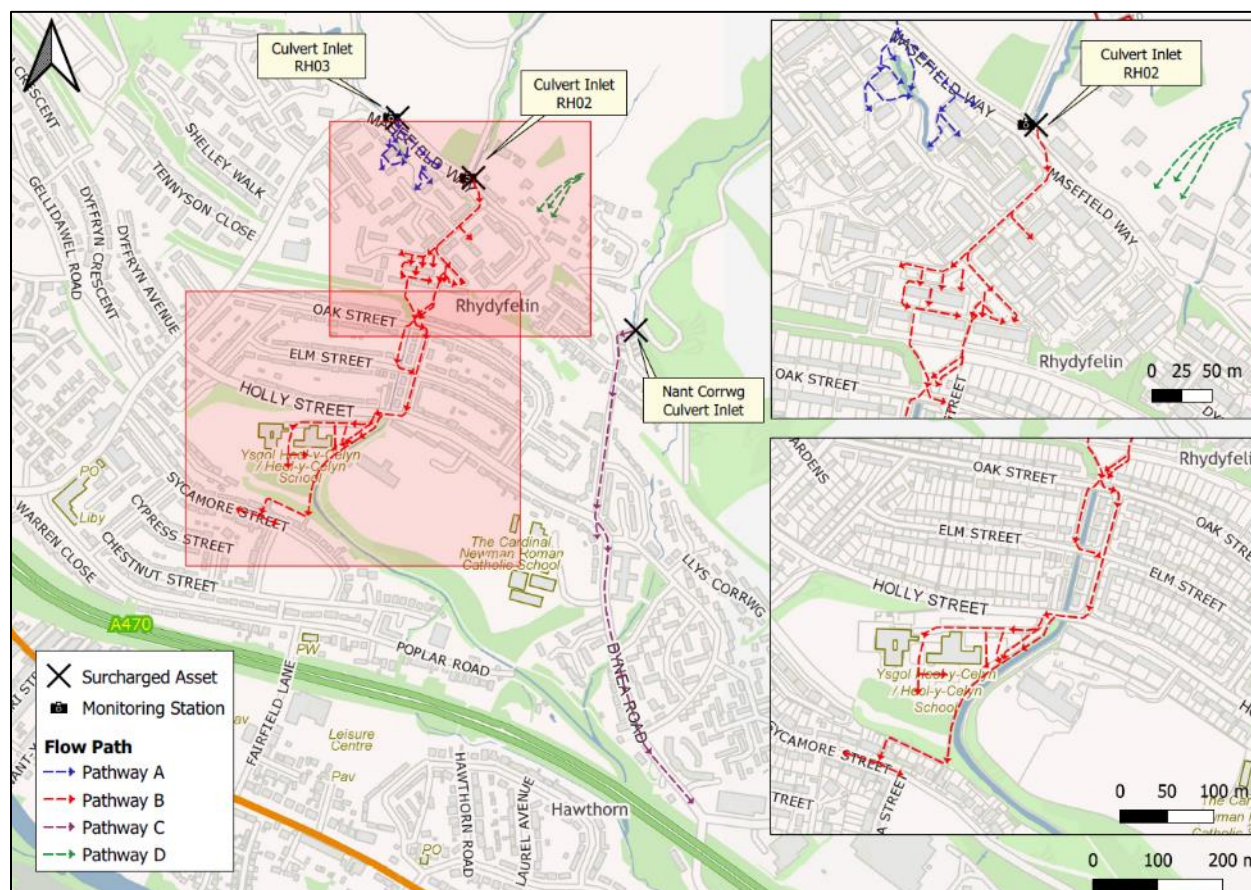


Figure 9: Map illustrating the principal sources and flow paths of flooding during the storm event at Rhydyfelin. 'Pathway B', associated to 'Culvert Inlet RH02' is represented by a red flow path.

Several calls were received from residents at Wordsworth Gardens on the night of the 4th of October 2021 to report water ingress into multiple residential properties. Upon a site inspection undertaken by RCT's Flood Risk Management team on 5th October, a culvert inlet located at Dynea Lane showed evidence of surcharge (labelled 'Culvert Inlet RH02' in Figure 9).

Resident accounts, footage from RCT's monitoring equipment and observations made during post-storm inspections indicate that 'Culvert Inlet RH02' surcharged as a result

of unprecedented high flows and the presence of debris at the culvert inlet debris screen. Figure 10 shows a significant volume of deposited material, consisting of stone and silt, within the channel and area surrounding 'Culvert Inlet RH02'. At the time of inspection, a majority of the material at the inlet structure had already been cleared during emergency cleansing operations by RCT's Highway and Streetcare Depot.



Figure 10: Image of 'Culvert Inlet RH02' showing material deposited within the channel during post event inspections (captured by RCT's Flood Risk Management team on 5th October 2021)

Images captured by residents show exceedance flows from 'Culvert Inlet RH02' conveying over the embankment, onto Maesfield Way, and onwards towards properties within the lower reaches of Wordsworth Gardens (Figure 11). 14 residential properties at Maesfield Way and Wordsworth Gardens were confirmed as internally flooded as a result of the ordinary watercourse flows. A further 10 properties at Wordsworth Gardens were externally impacted.

The powerful ordinary watercourse exceedance flows were also observed to have damaged sections of the highway (Figure 12) and a section of retaining wall opposite the impacted properties at Wordsworth Gardens.



Figure 11: Surcharging flows from 'Culvert Inlet RH02' conveying over the embankment and onto Masefield Way during the storm event (image provided by resident)



Figure 12: Damage to the highway at Wordsworth Gardens (captured by RCT's Flood Risk Management team on 5th October 2021)

Water conveyed through two rows of residential properties at Wordsworth Gardens and onwards towards Oak Street. On its flow path, water entered the rear of 3 residential properties at Oak Street however no internal flooding was confirmed. Water

continued to travel downstream towards Holly Street via Beechwood Street and a small lane which runs adjacent to a section of unnamed ordinary watercourse before pooling at the entrance of Heol-y-Celyn School.

Flow passed through the grounds of Heol-y-Celyn School and onwards towards the rear of Sycamore Street where one residential property was confirmed as internally flooded. The remaining flow was drained via the highway drainage infrastructure along Sycamore Street.

The following images depict the mud and silt deposits along the highway network, indicative of flow 'Pathway B' throughout several streets in Rhydyfelin during the storm event.



Figure 13: Mud and silt deposits within the lane at Wordsworth Gardens (left) and Oak Street (right) during post event cleansing operations (captured by RCT's Flood Risk Management team on 5th October 2021)



Figure 14: Mud and silt deposits (left) and evidence of saturated ground indicative of the flow path of water (right) within the grounds of Heol-y-Celyn School (captured by RCT's Flood Risk Management team on 5th October 2021)

3.2.3. PATHWAY C

Pathway C shows where water enters the northeast of Rhydyfelin via the Nant Corrwg ordinary watercourse flowing from the hillside and farmland/pastures above. The watercourse is initially culverted beneath the highway adjacent to Dynea Caravan Site before continuing to flow downstream through various culverted sections. The inlet location (labelled 'Nant Corrwg Culvert Inlet') and associated flow paths are illustrated in Figure 15.

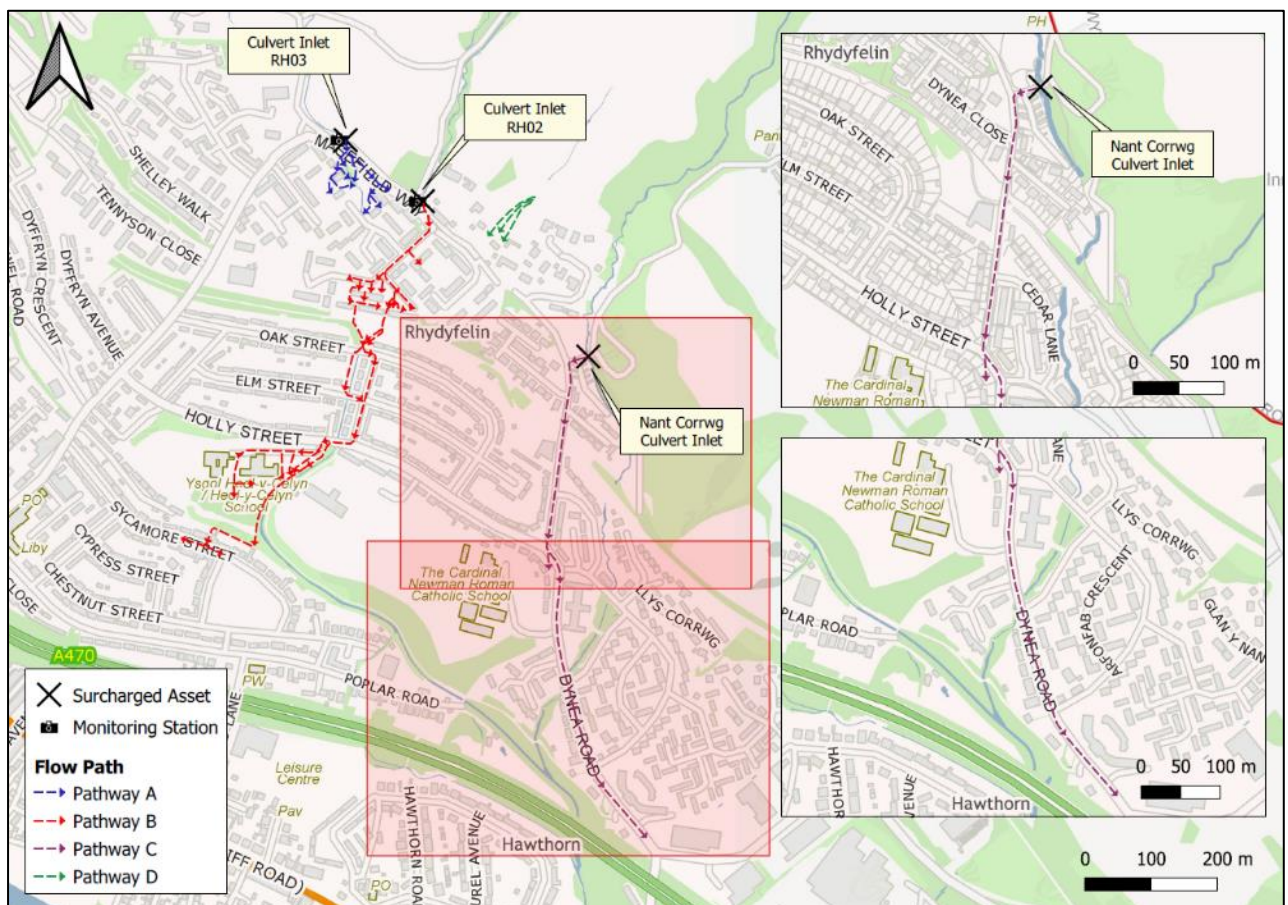


Figure 15: Map illustrating the principal sources and flow paths of flooding during the storm event at Rhydyfelin. 'Pathway C', associated to the 'Nant Corrwg Culvert Inlet' is represented by a purple flow path.

During the evening of the 4th of October 2021, residents at Dynea Road reported flooding to properties sourced by the 'Nant Corrwg Culvert Inlet' above Dynea Caravan Site. The inlet and overflow system showed evidence of overtopping caused by a build-up of debris including natural scour material and wooden debris at the inlet's debris screen. This material was identified in the area surrounding the culvert inlet following cleansing operations on the 5th October 2021 (Figure 16).



Figure 16: Mud, silt and scour material being cleared from the 'Nant Corrwg Culvert Inlet' by RCT's Highway and Streetcare Depot on 5th October 2021 (captured by RCT's Flood Risk Management team on 5th October 2021)

Mud and silt deposits were identified along Dynea Road during post event inspections, indicative of the deposition of material via the surcharging ordinary watercourse flows travelling south during the storm event. At the junction between Holly Street and Dynea Road, 2 residential properties were confirmed as internally flooded as a result of 'Pathway C'. Water continued to flow south along Dynea Road before being drained by the highway drainage infrastructure in the lower reaches.

3.2.4. PATHWAY D

Pathway D shows where water enters the north of Rhydyfelin via an unnamed ordinary watercourse flowing from the hillside above. The watercourse is culverted beneath Rhydyfelin's residential development at 'Culvert Inlet RH01' which is located adjacent to Heol-y-Bryn. The watercourse, inlet location and associated flow paths are illustrated in Figure 17.

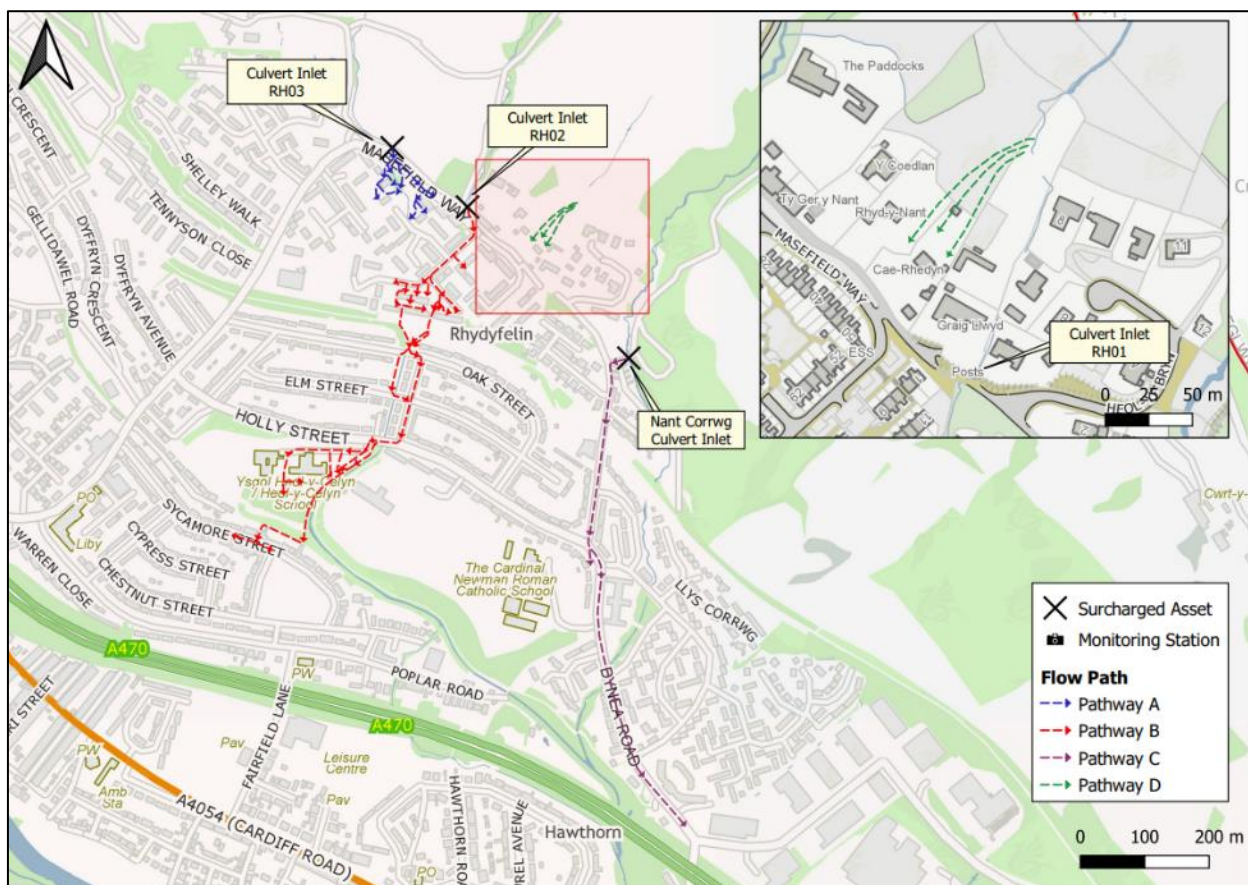


Figure 17: Map illustrating the principal sources and flow paths of flooding during the storm event at Rhydyfelin. 'Pathway D', associated to the overtopping of an unnamed ordinary watercourse is represented by a green flow path.

Residents reported significant overland flow travelling down the hillside to the rear of residential properties along Dynea Lane. It was identified upon a site inspection of the area on 8th October 2021, that the watercourse upstream of 'Culvert Inlet RH01' had significant debris, consisting of stonewash, within the channel (Figure 18). This material was observed to be impeding the flow of water downstream, resulting in out-of-bank flows down the hillside. An obstruction of flow was also identified within the watercourse (Figure 19) which was also observed to be contributing to the overtopping of the watercourse. The obstruction in Figure 19 consists of large concrete slabs.



Figure 18: Silt and stone causing an impediment of flow within the unnamed ordinary watercourse channel (captured by RCT's Flood Risk Management team on 8th October 2021)



Figure 19: Obstruction of flow within the unnamed ordinary watercourse channel (captured by RCT's Flood Risk Management team on 8th October 2021)

The obstruction and impediment of flow caused the unnamed ordinary watercourse to overtop and flow overland towards Dynea Road. Pathway D caused external flooding to one residential property and contributed surface water runoff to Pathway C along Dynea Road.

4. POSSIBLE CAUSES

4.1. CULVERT CONDITIONS

Within the investigation area there are several unnamed watercourses which drain the hillsides above the village of Rhydyfelin and discharge into the River Taf. Many of these watercourses are culverted beneath Rhydyfelin's urban settlements.

Several culvert inlets were inspected by RCT's Flood Risk Management team and Council's Highway and Streetcare Depot before and after the flood event to assess their condition and help determine whether they served as a contributing factor to the flooding at Rhydyfelin on the 4th October 2021. CCTV survey inspections of the culvert networks were also undertaken post event to ascertain both the operational condition of the network, and its structural integrity along sections of the network.

It should be noted that all surveys reported in this section were undertaken post storm event. The networks were previously surveyed and subsequently cleansed following Storm Dennis in February 2020. As such, the following should be considered to be reflective of the asset condition post storm event.

Figure 20 outlines the two culvert networks, associated to 'Culvert Inlets RH02 and RH03', which were surveyed post event.

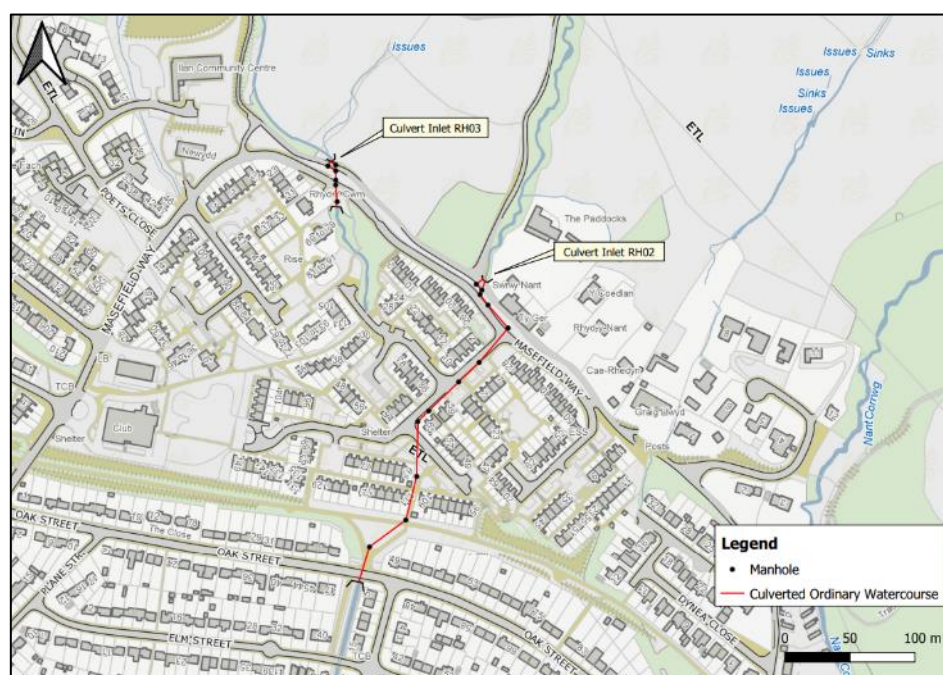


Figure 20: Surveyed culverted ordinary watercourse networks within Rhydyfelin

The culvert inlet structure and networks associated to 'Culvert Inlet RH02 and RH03' were both assessed as being in acceptable condition with no significant defects identified nor significant deposits of silt identified within the networks. Flooding was observed only at the inlet and not elsewhere along the culvert networks during the storm event. It is thereby inferred that the primary cause of surcharge at both culvert inlets was due to blockages caused by debris mobilised from the upper catchments which reduced the hydraulic capacities of both inlets, and associated overflow systems, to manage the flow of water, leading to surcharge.

The condition of the culvert inlets identified as sources of flooding following the deposition of material during the storm event have been further described below.

4.1.1. CULVERT INLET RH03

'Culvert Inlet RH03' was identified as a source of flooding to properties at Masefield Way and Shakespeare Rise during the storm event. The culvert inlet comprises of a 900mm concrete pipe and overflow system and is identified as a Council owned asset.

The condition of 'Culvert Inlet RH03' throughout the duration of the storm event was captured by RCT's CCTV monitoring station. Prior to the storm event, on 4th October 2021, 'Culvert Inlet RH03' was assessed as being in acceptable condition with minor leafy debris identified at the screen. The condition of the culvert inlet captured pre storm event at 15:47 on 4th October is shown in Figure 21.

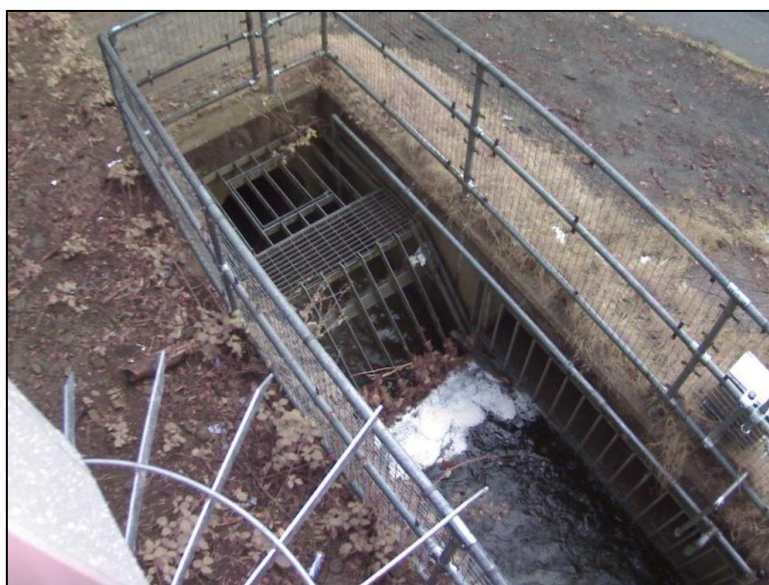


Figure 21: CCTV image of 'Culvert Inlet RH03' captured at 15:47 4th October 2021

Following the surcharge and recession in water levels within the watercourse (shown in Figure 4), a significant volume of debris and material was deposited on the culvert and overflow debris screens. This is depicted within Figure 22 captured at 01:57 5th October 2021.



Figure 22: CCTV image of 'Culvert Inlet RH03' captured at 01:57 5th October 2021

RCT's Highway and Streetcare Depot attended 'Culvert Inlet RH03' on the night of 4th October following reports that the inlet had surcharged. Upon inspection, 'Culvert Inlet RH03' was identified as blocked with debris mobilised from the hillsides and farmland/pastures above Rhydyfelin. Figure 23 depicts the material, which largely consisted of small woody debris and hay bales, that was cleared from 'Culvert Inlet RH03' during the storm event.

Approximately 6 tonnes of material was removed from 'Culvert Inlet RH03' during emergency clearance operations carried out by RCT's Highway and Streetcare Depot.



Figure 23: Image of the debris removed from 'Culvert Inlet RH03' during emergency clearance works carried out by RCT's Highway and Streetcare Depot on 5th October 2021

4.1.2. CULVERT INLET RH02

'Culvert Inlet RH02' was identified as a source of flooding to properties at Masefield Way, Wordsworth Gardens and Sycamore Street during the storm event. The culvert inlet comprises of a 900mm concrete pipe and overflow system and is identified as a Council owned asset.

The condition of 'Culvert Inlet RH02' throughout the duration of the storm event was captured by RCT's CCTV monitoring station. Prior to the storm event, on 4th October 2021, 'Culvert Inlet RH02' was assessed as being in acceptable condition with only some minor woody debris identified at the screen. The condition of the culvert inlet, captured pre storm event at 17:11 on 4th October, is shown in Figure 24.

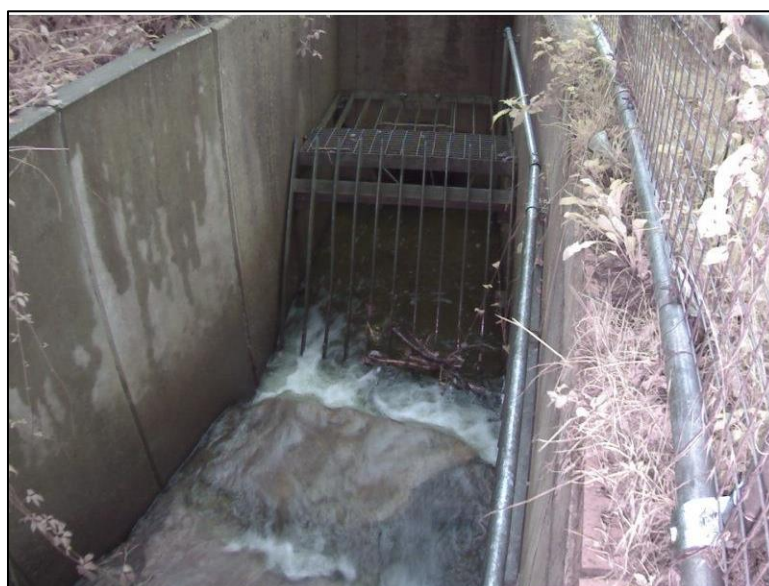


Figure 24: CCTV image of 'Culvert Inlet RH02' captured at 17:11 4th October 2021

Following the surcharge and recession in water levels within the watercourse (shown in Figure 4), a significant volume of debris and material was deposited on the culvert and overflow debris screens. This is depicted within Figure 25 captured at 02:17 5th October 2021.



Figure 25: CCTV image of 'Culvert Inlet RH02' captured at 02:17 5th October 2021

RCT's Highway and Streetcare Depot attended 'Culvert Inlet RH02' on the night of 4th October following reports that the inlet had surcharged. Upon inspection, 'Culvert Inlet RH02' was identified as blocked with debris mobilised from the hillsides and farmland/pastures above Rhydyfelin. Figure 26 depicts the material, which largely consisted of stones, silt and woody debris, that was cleared from 'Culvert Inlet RH02' during the storm event.

Approximately 7 tonnes of material was removed from 'Culvert Inlet RH02' during emergency clearance operations carried out by RCT's Highway and Streetcare Depot.



Figure 26: Image of the debris removed from 'Culvert Inlet RH02' during emergency clearance works carried out by RCT's Highway and Streetcare Depot on 5th October 2021

4.1.3. NANT CORRWG CULVERT INLET

The 'Nant Corrwg Culvert Inlet' structure was identified as a source of flooding to properties at Dynea Road during the storm event. The culvert inlet comprises of a large concrete pipe, overflow system and two debris screens. The inlet is identified as a Council owned asset.

The debris screens upstream of the 'Nant Corrwg Culvert Inlet' was identified by first responders as being significantly blocked with scour material and woody debris mobilised by the fast-flowing water within the Nant Corrwg watercourse during the storm event. The blockage at the debris screens was observed as restricting the flow of water entering the culvert inlet and overflow system, resulting in the overtopping of flows over the western headwall (behind the debris screen depicted in Figure 27) and onwards towards Dynea Road.

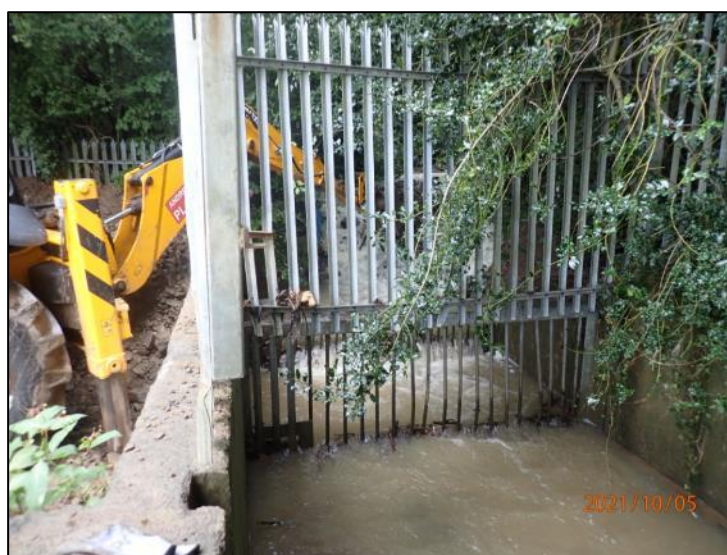


Figure 27: Image of the 'Nant Corrwg Culvert Inlet' debris screens captured during emergency cleansing operations by RCT's Highway and Streetcare Depot on 5th October 2021

All three culvert inlets identified as sources of flooding during the storm event on 4th October 2021 are identified as Council owned assets and fall under the responsibility of RCT as the Highway Authority. In response to the identified debris, all three culvert inlets were cleared by RCT's Highway and Streetcare Depot in the days following the storm event.

Prior to the storm event, the condition of the culvert inlet structures identified as sources of flooding were assessed as being in acceptable condition with no blockages or obstacles present and are therefore not considered to have impacted the

surcharging. The blockages to the inlet and overflow structures which occurred during the storm event has been determined as the primary cause of surcharging and associated flow pathways (Pathway A, B and C, Figure 6) within Rhydyfelin.

4.2. ORDINARY WATERCOURSE CONDITIONS

Several sections of natural ditches and open watercourses which drain the steep hillsides above Rhydyfelin are identified to flow through the investigation area and discharge into the River Taf to the south of the investigation area (Figure 28). The most notable watercourse includes the Nant Corrwg ordinary watercourse.

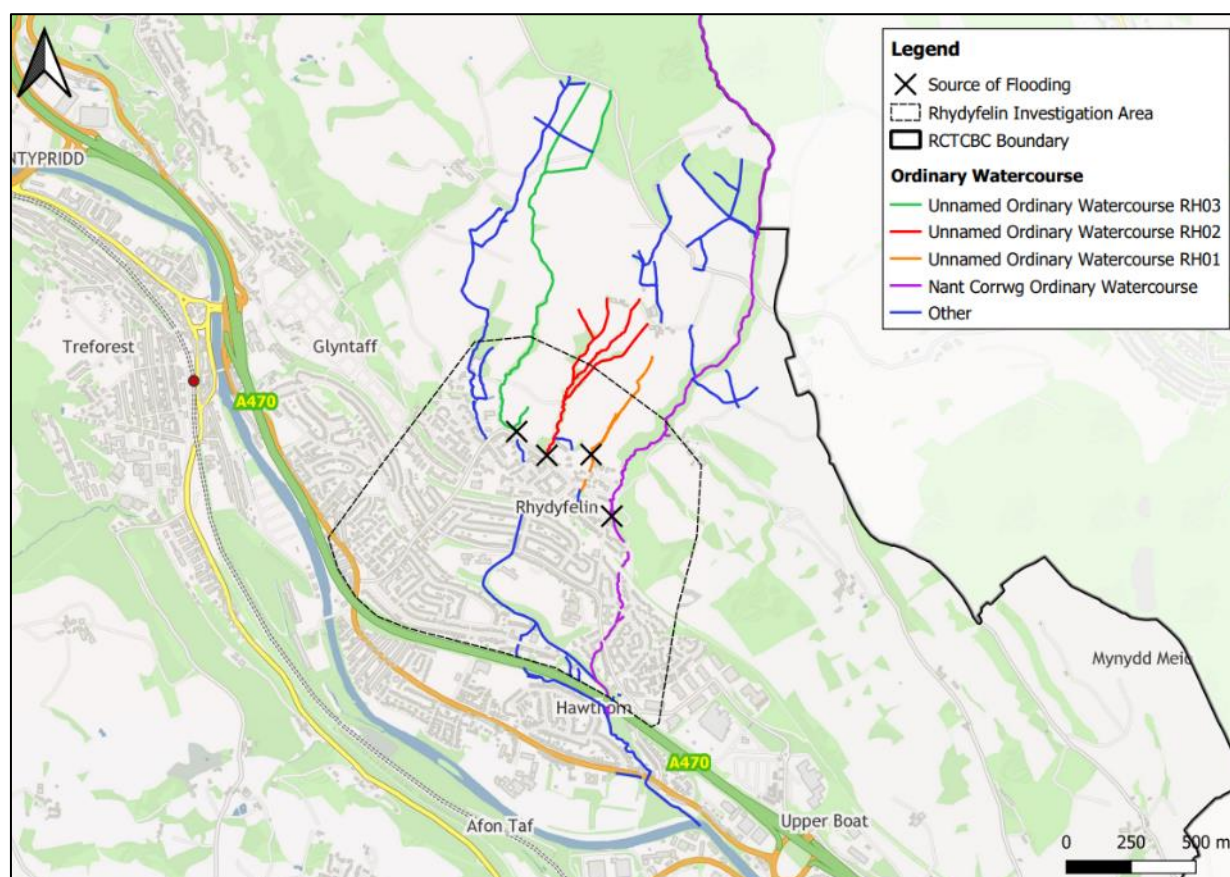


Figure 28: Map of Ordinary Watercourses which feed into and flow through Rhydyfelin investigation area

Following the storm event, RCT Flood Risk Management officers carried out a site walk-over assessment, where possible, of the ordinary watercourses upstream of the culverted infrastructure identified as sources of flooding (highlighted in Figure 28) to assess the condition of the watercourses for any signs of overtopping, evidence of scour and any land movement of the hillsides.

4.2.1. UNNAMED ORDINARY WATERCOURSE RH03

Following the surcharging of 'Culvert Inlet RH03' caused by debris blockage during the storm event, the unnamed ordinary watercourse upstream of the inlet (labelled 'Unnamed Ordinary Watercourse RH03', Figure 28) was inspected by Flood Risk Management officers for signs of debris mobilisation.

The catchment which feeds into 'Culvert Inlet RH03' is large and predominantly farmland. 'Unnamed Ordinary Watercourse RH03' was inspected at three areas, depicted in Figure 29 the results of which are described below.

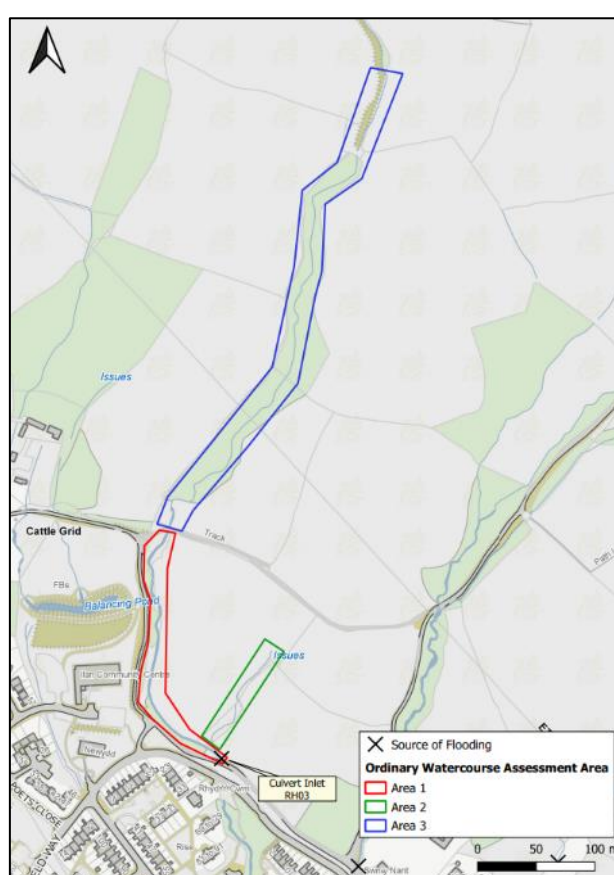


Figure 29: 'Unnamed Ordinary Watercourse RH03' inspection location plan

'RH03 Area 1' is a manmade channel comprising of blockstone construction. 'RH03 Area 1' did not display any evidence of significant scour within the channel itself however there was evidence of overtopping at several locations (Figure 30).

At the location of the ford which is located approximately 200 metres upstream of 'Culvert Inlet RH03', a significant volume of material was identified (Figure 30), indicative of the entrainment of material downstream during the storm event. A debris screen is located at the ford however, the majority was identified as hidden by the significant volume of debris.

Debris was also identified downstream of the ford at the fence line (shown in Figure 30). The debris consisted of vegetation and debris, causing an impediment to the flow. During the storm event this area was observed to be overtopping onto the highway and onwards towards Masefield Way.



Figure 30: Evidence of the overtopping of 'Unnamed Ordinary Watercourse RH03' (left), debris accumulation at the ford (middle) and debris causing an impediment of flow (right) at RH03 Area 1 (images captured by RCT during post event inspections)

'RH03 Area 3' extends from the ford to an outfall located approximately 450 metres upstream. The channel is primarily natural with steep embankments comprising of bare ground, highly susceptible to erosion. Natural watercourse deposits such as cobbles, gravels and dead vegetation was also observed within the channel. Debris was also observed to be obstructing and impeding the flow of water at locations, resulting in out-of-bank flows (Figure 31). The identified material is considered to have been mobilised during the storm event and transported downstream towards 'RH03 Area 1'.

No significant scouring was identified within 'RH03 Area 3' however, given the meandering nature of the watercourse, the exposed steep embankments, the high

velocities flowing downstream during the storm event, in addition to the identified areas of deposition, it is likely that scouring occurred.



Figure 31: Obstruction of flow (left) and accumulated debris (right) within RH03 Area 3 of 'Unnamed Ordinary Watercourse RH03' (images captured by RCT during post event inspections)

'RH03 Area 2' covers a small section of ordinary watercourse which collects runoff from a small catchment area and conveyed toward 'Culvert Inlet RH03'. Upon observation, there was limited material within the channel. 'RH03 Area 2' is not considered to have contributed to the blockage at 'Culvert Inlet RH03'.

On review of the condition of 'Unnamed Ordinary Watercourse RH03', stone and vegetation debris was evident throughout the channel and is assumed to have been mobilised during the storm event. Visual indicators also suggest that high water levels within the watercourse mobilised loose debris on the embankment, contributing to the blockage observed at 'Culvert Inlet RH03'. Minor scouring was evident in 'RH03 Area 3' however this was not remarkable. The material mobilised during the storm event is considered to have been present within the channel and embankment prior to the storm event.

4.2.2. UNNAMED ORDINARY WATERCOURSE RH02

The catchment which feeds into 'Culvert Inlet RH02' is significant in size with several smaller ordinary watercourses converging. The catchment is also noted as predominantly farmland.

'Unnamed Ordinary Watercourse RH02' was inspected at three areas, depicted in Figure 32, the results of which are described below.

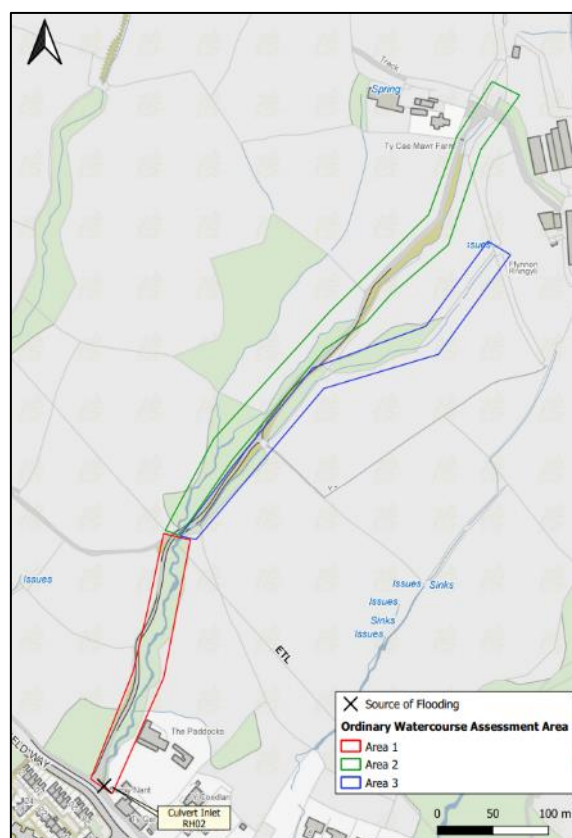


Figure 32: 'Unnamed Ordinary Watercourse RH02' inspection location plan

'RH02 Area 1' extends from the convergence of the ordinary watercourses within 'RH02 Area 2 and 3' and onwards towards 'Culvert Inlet RH02'. The channel was identified as predominantly natural with dense vegetation and scour material identified within the channel and the surrounding the embankments. This debris alongside the channel suggests that the watercourse overtopped its normal depth during the storm event.

Several areas of minor scour and undercutting of the watercourse was evident upon inspection of 'RH02 Area 1', with one section of significant embankment scour identified (Figure 33, left) and considered to have occurred during the storm event. The soil of the embankments were also observed to comprise of alluvium deposits inclusive of stones and cobbles which is susceptible to scour.



Figure 33: Evidence of significant embankment scour (left), undercutting (middle) and debris deposition (right) within RH02 Area 1 of 'Unnamed Ordinary Watercourse RH02' (images captured by RCT during post event inspections)

The evidence indicates that significant natural scour material was mobilised within 'RH02 Area 1' and transported downstream towards 'Culvert Inlet RH02' during the storm event. The meandering nature of the watercourse at 'RH02 Area 1' also suggests that the watercourse is subject to natural scouring during high flows.

'RH02 Area 2' extends upstream of 'RH02 Area 1' towards the farmland within the upper catchment. The channel is primarily natural and is culverted beneath the road at five locations. Several culvert structures were identified as surcharging during the inspection and observed to be overtopping onto the adjacent road. This surcharging was identified as a result of debris consisting of natural scour material and vegetation obstructing and impeding the flow of water.

Based on the available evidence it is considered that, in addition to 'RH02 Area 1', 'RH02 Area 2' was also identified to have suffered minor scouring and subsequently contributed to the delivery of additional scour material towards 'Culvert Inlet RH02'.

'RH02 Area 3' covers the section of natural channel upstream of 'RH02 Area 1', to the east of 'RH02 Area 2'. The channel is primarily natural and is culverted in two areas.

Minor scouring of the channel embankments was observed, particularly towards the lower section of 'RH02 Area 3'. Figure 34 (middle) depicts the observed embankment scour which appears to have resulted in the overtopping of the watercourse and conveyance along the tarmac road causing minor erosion.

Evidence of further overtopping was also observed as a result of obstructions identified along the watercourse length in 'RH02 Area 3'. Figure 34 depicts debris accumulation alongside the fence line causing an obstruction of flow and resulting in deposition of material on the banks of the channel.



Figure 34: Obstruction of flow (left), scouring of the channel embankment and tarmac road (middle) and deposits of material indicative of out-of-bank flows (right) within RH02 Area 3 of 'Unnamed Ordinary Watercourse RH02' (images captured by RCT during post event inspections)

On review of the condition of 'Unnamed Ordinary Watercourse RH02', stones, silt and vegetation debris was evident throughout the channel and is assumed to have been mobilised by the storm event. Visual indicators also suggest high water levels within the watercourse mobilised loose debris on the embankment, contributing to the blockage observed at 'Culvert Inlet RH02'. Minor to moderate scouring was evident in several areas, particularly in 'RH02 Area 1', and along the bends of the meandering channel. Some of this scouring was identified to have occurred during the storm event, contributing additional scour material downstream.

4.2.3. NANT CORRWG ORDINARY WATERCOURSE

The Nant Corrwg ordinary watercourse is a large watercourse which is fed by the headwaters along the topographic watershed of the Taf valley. The Nant Corrwg flows along the eastern boundary of the investigation area.

A general assessment of the Nant Corrwg ordinary watercourse could not be undertaken post storm event due to the steep and restrictive nature of the watercourse upstream of the 'Nant Corrwg Culvert Inlet'. Based on a desktop assessment of the watercourse, the channel is very steep and consists of several meanders which during high flows is considered to have contributed significant natural scour material downstream.

This material was identified to have obstructed the debris screen, restricting the flow of water entering the 'Nant Corrwg Culvert Inlet', and has been attributed as the primary cause of surcharge.

4.2.4. UNNAMED ORDINARY WATERCOURSE RH01

Following reports of the overtopping of 'Unnamed Ordinary Watercourse RH01' during the storm event, the watercourse was inspected by Flood Risk Management officers post event. On review of the watercourse an obstruction of flow (Blockage A, Figure 35) and an impediment to the flow (Blockage B, Figure 35) was identified upstream of a short culverted section during the site inspection. The location of both obstructions is illustrated in Figure 35.

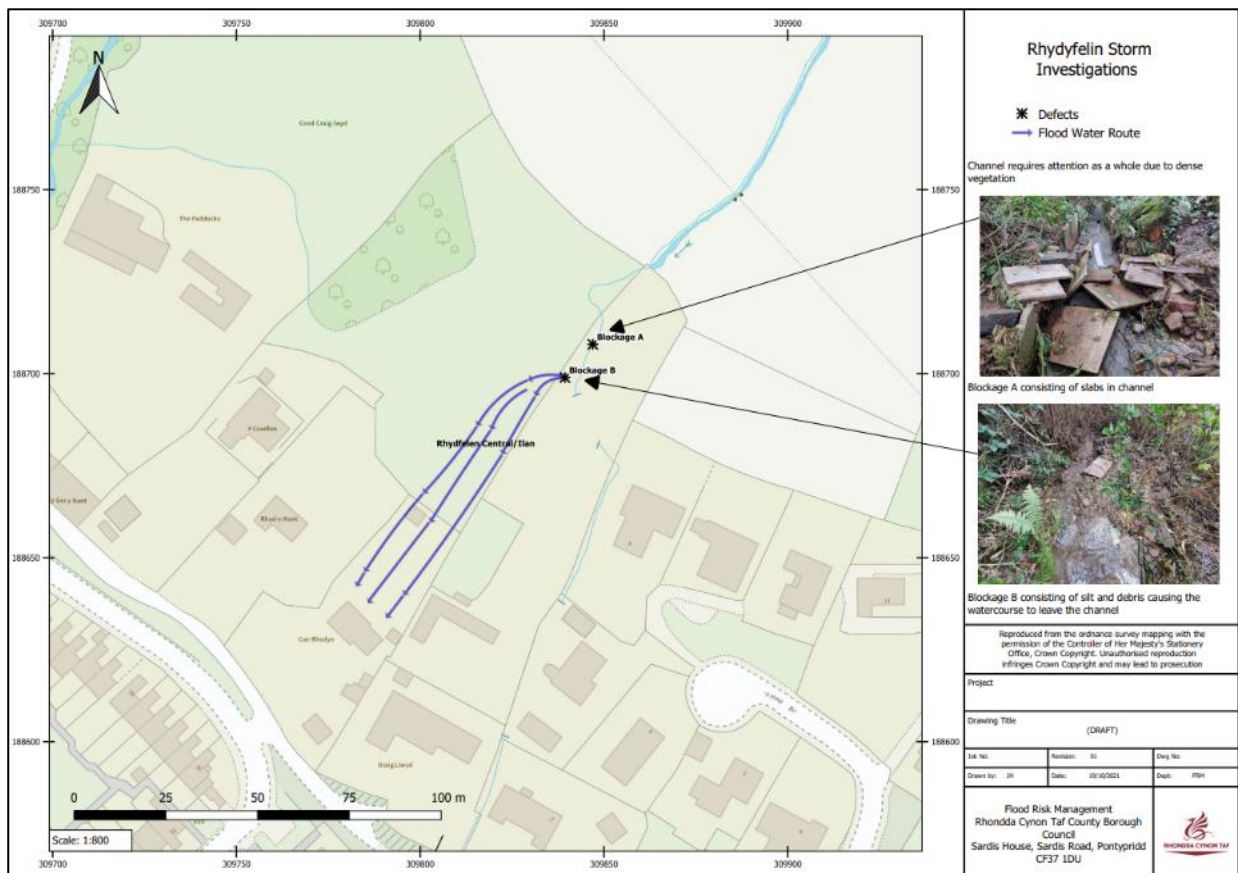


Figure 35: Site Inspection and Investigation Plan of 'Unnamed Ordinary Watercourse RH01' produced by RCT's Flood Risk Management team

Blockage B consisted of stone and silt, indicative of natural erosive processes within the channel. Blockage A comprised of concrete slabs which is considered to have been the primary cause of the overtopping of 'Unnamed Ordinary Watercourse RH01' and the resultant overland flows running down the hillside towards Dynea Road.

In response to the identified obstruction (Blockage A), an enforcement warning letter was issued to the riparian landowner under Section 25 of the Land Drainage Act 1991 that resulted in the owner removing the obstruction within the channel.

The significant deposition of debris within the ordinary watercourse channels and culvert inlet structures identified as sources of flooding during the storm event are indicative of the entrainment of materials within the watercourses during the storm event and stresses the impact of morphological processes as a key contributor to flood risk.

4.3. MAIN RIVER

The designated main River Taf flows south of the Rhydyfelin investigation area (Figure 1).

The hydrograph in Figure 36 illustrates a moderate rise in levels of the River Taf in response to rainfall, captured at NRW's Upper Boat station, located approximately 0.5 km downstream of the investigation area. The River Taf at Upper Boat reached a recorded peak of 2.978 metres at 00:15 on 5th October 2021.

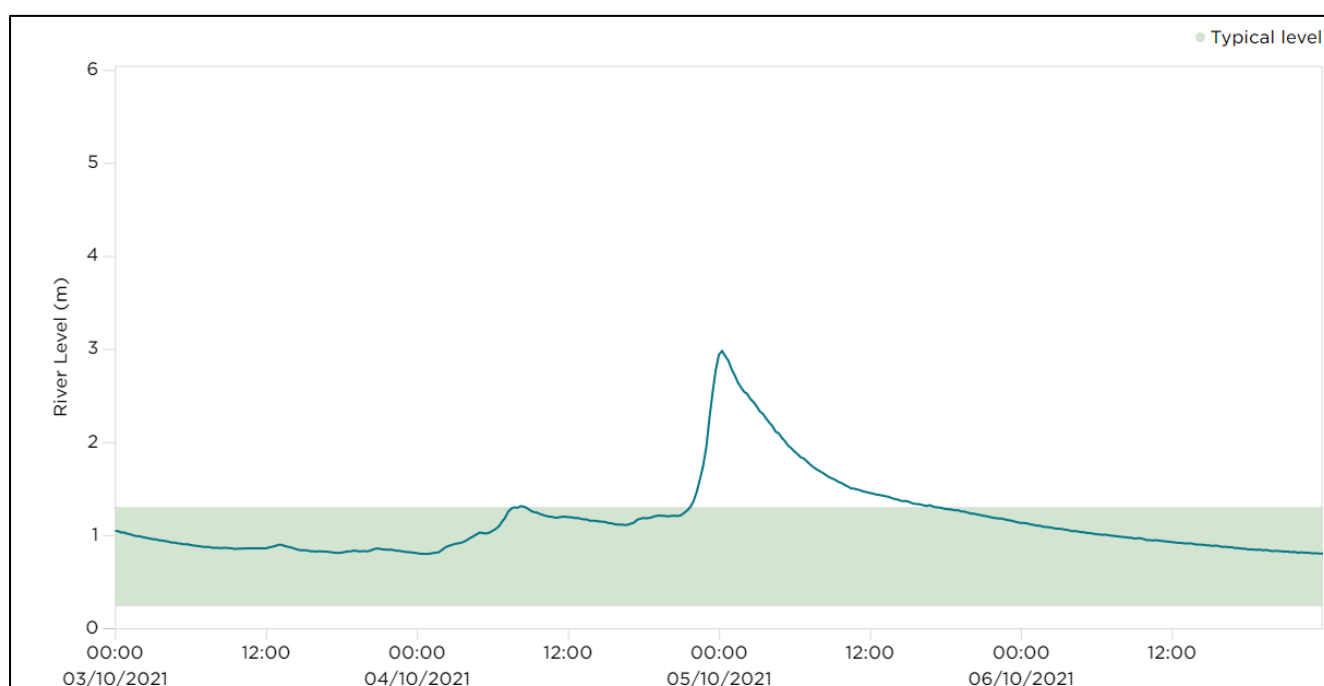


Figure 36: The River Taf levels at Upper Boat station between the 3rd and 6th October 2021 (Natural Resources Wales)

The green bar displayed on the hydrograph shows the typical level of the River Taf at Upper Boat station, ranging between 0.1 and 0.5 metres. At its peak, the River Taf was approximately a metre higher than its average level. Within 12 hours of reaching its peak, levels within the River Taf fell rapidly to its typical level. The hydrograph illustrates the rapid response of RCT's catchments and river levels to rainfall.

There is no evidence from this investigation to suggest that the main River Taf significantly contributed to the recorded flooding of properties within the Rhydyfelin investigation area during the storm event on 4th October 2021.

4.4. HIGHWAY DRAINAGE CONDITION

Surface water runoff along the highway was reported by residents at various locations within the investigation area during the storm event, however, there is no evidence to suggest that the condition of the highway drainage within Rhydyfelin significantly contributed to the flooding of properties. The majority of the highway drainage infrastructure was overwhelmed by intense rainfall and subsequent surface water flows, in addition to ordinary watercourse flooding associated to culvert infrastructure surcharging, which led to the accumulation of standing water entering properties within the lower reaches of the investigation area.

Overland flows from areas of hillside and runoff originating from surcharged culvert infrastructure resulted in deposition of mud, silt and debris across several streets which is assumed to have entered the highway drainage network via gullies. Several figures in Section 3 depict evidence of deposited debris along various streets including Masefield Way, Dynea Road, Wordsworth Gardens and Oak Street (Figure 13). In these instances, it is likely that highway drainage assets will have had a limited capacity to intercept flows within the investigation area.

The large quantities of sediment and debris washed onto the streets is also indicative of the high sediment loading from the ordinary watercourses described in Section 4.2.

Highway drainage is not designed to manage overland flows from private areas, parks or open space. In this instance, the capacity of the highway drainage was exceeded by substantial ordinary watercourse and surface water flows entering the drainage network across Rhydyfelin.

4.5. DCWW APPARATUS

There is no evidence from this investigation that DCWW apparatus contributed to the flooding that occurred on the 4th of October 2021 within the investigation area.

4.6. SURFACE WATER

Surface water flooding as a result of ordinary watercourse flooding associated to blocked and overwhelmed culvert infrastructure, in addition to overland flows originating from areas of hillside, has been determined as a contributing source of flooding to several residential and non-residential properties within the lower reaches of Rhydyfelin, particularly along Wordsworth Gardens, where water naturally accumulates. Figure 37 depicts the accumulation of surface water outside properties at Wordsworth Gardens as a result of the surcharge at 'Culvert Inlet RH02'.



Figure 37: Surface water accumulation at the fronts of properties at Wordsworth Gardens as a result of 'Culvert Inlet RH02' surcharging during the storm event on 4th October 2021 (image provided by resident)

Figure 38 depicts the surface water and ordinary watercourse flood extents based on NRW's FRAW mapping exercise. A high to low risk of surface water and ordinary watercourse flooding is noted along several streets which were impacted by flooding across Rhydyfelin and is mostly consistent with the pathways of flooding observed along the highway network on the 4th of October 2021.

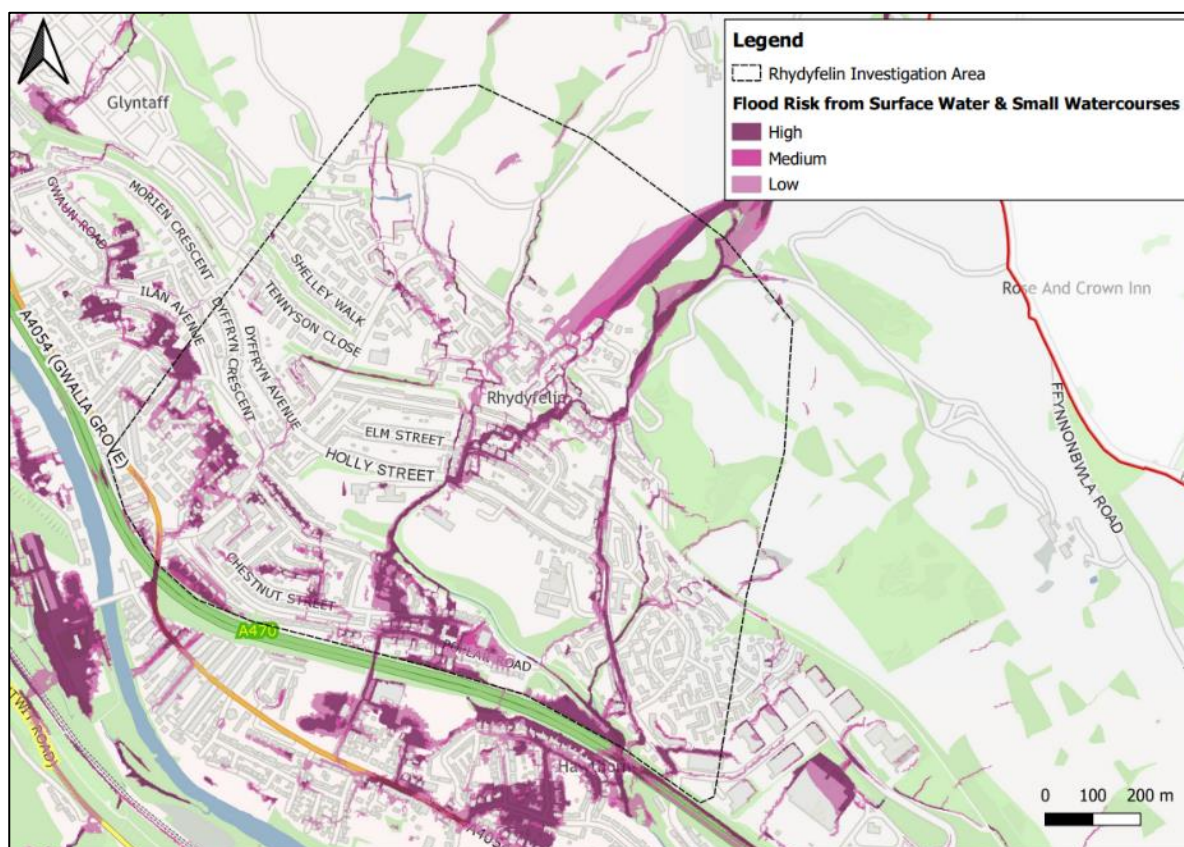


Figure 38: Natural Resources Wales' FRAW map for surface water and ordinary watercourse sources within Rhydyfelin investigation area. Contains Natural Resources Wales information © Natural Resources Wales and database right. All rights reserved.

4.7. 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.

4.8. SYSTEM AT CAPACITY

The capacity of the culverted ordinary watercourse structures identified as sources of flooding at Rhydyfelin on the 4th of October 2021 have been described below.

The culvert networks within the investigation area (Figure 20) were surveyed post event to ascertain the internal condition of the networks, the results of which fed into a review of the hydraulic performance of the network to ascertain its current standard of protection using Causeway Flow modelling. The results of the culvert inlet capacity assessments are summarised in the Table below (refer to Figure 6 for culvert labels).

Table 4: Summary of culvert capacity assessment results which indicate the current standard of protection of the culverted networks in free flowing and blockage conditions within Rhydyfelin

Culvert Network	Standard of Protection (SOP) – Free Flowing	Standard of Protection (SOP) – Blockage Conditions
Culvert Inlet RH03	Q100 (1% AEP)	>Q100 (>1% AEP)
Culvert Inlet RH02	Q100 (1% AEP)	>Q100 (>1% AEP)
Nant Corrwg Culvert Inlet	Q100 (1% AEP)	>Q100 (>1% AEP)

The results from the culvert capacity assessments and hydraulic modelling undertaken by RCT, infer that all three culvert inlets provide adequate standards of protection in free-flowing conditions up to 1 in 100 annual probability flood event (Q100) plus 30% climate change allowance. This is in accordance with current design standards, as defined by CIRIA C786.

A sensitivity analysis was undertaken to review the impact of flooding during ‘medium’ (67%) blockage conditions³ to assess the impact of debris blockages. In blockage conditions, the capacity of all three culvert inlets is reduced to below Q100. On review of the condition of all three culvert inlets post storm event, it was also concluded that the total blockage percentage on the structures was greater than 67%, further reducing the capacity of the culvert inlets to manage the flow of water, which would account for the surcharging at all three locations.

³ Natural Resources Wales Guidance Note (Ref No GN43)

4.9. SUMMARY OF POSSIBLE CAUSES

The above sections have identified and described the possible causes of flooding within Rhydyfelin during the storm event on the 4th of October 2021. A summary of the identified source(s) and possible cause(s) of flooding (issue) has been outlined below in Table 5.

Table 5: Summary of source(s) and possible cause(s) of flooding in Rhydyfelin on 4th October 2021

Ref No	Asset (Source)	Issue	Asset Owner	Type of Flooding
1	Culvert Inlet RH03	The culvert inlet surcharged during the storm event after becoming blocked with debris mobilised from the ordinary watercourse upstream, causing water to overtop at the inlet and flow south towards Masefield Way and Wordsworth Gardens.	RCT Highway Authority	Ordinary Watercourse
2	Culvert Inlet RH02	The culvert inlet surcharged during the storm event after becoming blocked with debris mobilised from the ordinary watercourse upstream, causing water to overtop at the inlet and flow towards Masefield Way and Wordsworth Gardens and onwards to impact several streets within the lower reaches of Rhydyfelin.	RCT Highway Authority	Ordinary Watercourse
3	Nant Corrwg Culvert Inlet	The culvert inlet surcharged during the storm event after becoming blocked with debris mobilised from the ordinary watercourse upstream, causing water to overtop at the inlet and flow south along Dynea Road, resulting in internal flooding to 2 residential properties.	RCT Highway Authority	Ordinary Watercourse
4	Unnamed Ordinary	Blockages identified within the unnamed ordinary watercourse acting as an obstruction and impediment	Private Landowner	Ordinary Watercourse

	Watercourse RH01	to the flow, resulting in out-of-bank flows travelling overland down the hillside towards several properties and causing external flooding.		
5	Surface water drainage network across Rhydyfelin	Intense rainfall across RCT, combined with the overtopping of several ordinary watercourses within Rhydyfelin, severely overwhelmed highway drainage infrastructure, resulting in the accumulation of surface water on many streets throughout the investigation area.	RCT Highway Authority	Surface Water

5. 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 LLFA, 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, RCT 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 relevant 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 Welsh Government's National Strategy for Flood and Coastal Erosion Risk Management, Section 4 'Roles and Responsibilities'¹, and RCT's 'FRM – Storm Dennis - Overview Report'**Error! Bookmark not defined..**

Table 6: Risk Management Authority with relevant functions to manage the risk for different flood types

Type of Flooding	Relevant 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 Water Resources Act 1991, Land Drainage Act 1991 and the Highways Act 1980. Through analysis of the flooding that impacted RCT03, the flood risk management functions exercised, or proposed to be exercised, by relevant RMAs was recorded pursuant 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 cause(s) of flooding in Rhydyfelin as a result of the storm event on 4th October 2021 has been previously identified and summarised within Table 5. The Risk Management Authorities responsible for managing that flooding have been listed within Table 7 below, along with a series of recommendations presented by the LLFA.

Table 7: Recommendations provided by the LLFA to be considered by the relevant Risk Management Authority identified in response to the source(s) of flooding in Rhydyfelin (as per Table 5)

Ref No	Asset (Source)	Asset Owner	Type of Flooding	Relevant Risk Management Authority	Recommendations	
1	Culvert Inlet RH03	RCT Highway Authority	Ordinary Watercourse	Lead Local Flood Authority and Land Drainage Authority	R1A	The LLFA and LDA to identify 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	The LLFA and LDA to review the risk of scour potential within the ordinary

						watercourse channel.
					R1E	The LLFA to upgrade the existing remote telemetry monitoring at Culvert Inlet RH03 to improve the monitoring of blockages.
2	Culvert Inlet RH02	RCT Highway Authority	Ordinary Watercourse	Lead Local Flood Authority and Land Drainage Authority	R2A	The LLFA and LDA to identify asset ownership and responsibility.
					R2B	The LLFA and LDA to investigate the standard of protection and the condition of the culvert structure and network as a whole.
					R2C	Jet and cleanse the ordinary watercourse network.
					R2D	The LLFA and LDA to review the risk of scour potential within the ordinary watercourse channel.

					R2E	The LLFA to upgrade the existing remote telemetry monitoring at Culvert Inlet RH02 to improve the monitoring of blockages.
3	Nant Corrwg Culvert Inlet	RCT Highway Authority	Ordinary Watercourse	Lead Local Flood Authority and Land Drainage Authority	R3A	The LLFA and LDA to identify asset ownership and responsibility.
					R3B	The LLFA and LDA to investigate the standard of protection and the condition of the culvert structure and network as a whole.
					R3C	Jet and cleanse the ordinary watercourse network.
					R3D	The LLFA and LDA to review the risk of scour potential within the ordinary watercourse channel.
4	Unnamed Ordinary Watercourse	Private Landowner	Ordinary Watercourse	Lead Local Flood Authority and Land Drainage Authority	R4A	The LLFA and LDA to identify drainage asset ownership and responsibility.

					R4B	The LLFA and LDA to investigate the condition of the ordinary watercourse.
					R4C	The LLFA and LDA to engage with the riparian landowner to regulate the ordinary watercourse infrastructure to ensure the infrastructure is free flowing and unobstructed.
5	Surface water drainage network	RCT Highway Authority	Surface Water	Lead Local Flood Authority and Highway Authority	R5A	The Highway Authority to jet and cleanse the highway drainage network and action repairs accordingly.
					R5B	The LLFA and Highway Authority to evaluate surface water management options to alleviate pluvial flooding at locations across the investigation area.

5.1. LEAD LOCAL FLOOD AUTHORITY

In review of Ref 1 – 4 in Table 7, the LLFA has been determined as a relevant Risk Management Authority in relation to the ordinary watercourse and surface water flooding which occurred within the Rhydyfelin investigation area on 4th October 2021.

The LLFA exercised the following functions in response to the flooding at Rhydyfelin:

- 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 event.
- 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 condition and its impact on the flooding within the investigation area. **(R1B, R2B, R3B)**
- An estimated 314.7 metres of culverted ordinary watercourse network length within Rhydyfelin has been surveyed following the event to ascertain both the operational condition of the network, and its structural integrity along section of the network. **(R1B, R2B)**
- An estimated 66 tonnes of material and debris was removed from the culvert inlet structures and networks within Rhydyfelin during jetting and cleansing operations. **(R1C, R2C, R3C)**
- The LLFA and LDA, assisted by the Highway Authority, have undertaken clearance works to the culvert network systems which fall under the responsibility of the Authority. **(R1C, R2C, R3C)**
- The LLFA have investigated the standard of protection of the existing culvert networks in Rhydyfelin to determine their hydraulic capacity following the identification of several structural and operational defects within sections of the network. **(R1B, R2B, R3B)**
- 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.
- 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 and LDA have initiated engagement with riparian landowners to ensure the ordinary watercourse infrastructure is free flowing and unobstructed.
- The LLFA undertook an initial walkover assessment of the Rhydyfelin upper catchment to assess and review the risk of scour potential within 'Unnamed Ordinary Watercourse RH01, RH02 and RH03'. **(R1D, R2D, R4B)**
- The LLFA have installed remote telemetry monitoring devices at key culvert structures to enable operators to ensure the drainage systems in Rhydyfelin are operating effectively. **(R1E, R2E)**

The LLFA propose to exercise the following functions in response to the flooding at Rhydyfelin:

- Following the surveying of culvert network in Rhydyfelin, the LLFA propose to input and update all relevant asset data. **(R1A, R2A, R3A, R4A)**
- The LLFA and LDA intend to communicate with 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.
- The LLFA and LDA will work with landowners and property owners to manage their personal flood risk through local measures, such as property resilience and resistance measures.
- The LLFA and LDA will continue to engage with riparian landowners and regulate the ordinary watercourse infrastructure to ensure the infrastructure is free flowing and unobstructed. **(R4C)**
- The LLFA and LDA propose to upgrade their existing telemetry monitoring devices at key culvert structures to improve their resilience against potential debris deposition and associated damages. **(R1E, R2E)**
- In response to the mobilisation of debris upstream of 'Culvert Inlet RH03', the LLFA have applied for Welsh Government funding to undertake a flood alleviation and upper catchment scour scheme. The schemes will involve the installation of an upper catchment debris basin for the deposition of material, and a control structure upstream of 'Culvert Inlet RH03' which is intended to divert a proportion of ordinary watercourse flow west, towards a pre-existing attenuation basin. These works are aimed at providing resilience to the culvert inlet structure and associated downstream culvert network through the interception of debris and the enhancement of the inlet structures' standard of protection. **(R1D)**

- The LLFA and LDA propose to undertake Geomorphological assessments of the upper catchment in Rhydyfelin to determine the risk of culvert blockages as a result of scour and debris potential. In addition to this, the LLFA and LDA will engage with Riparian landowners to identify suitable management methods to reduce the risk of scour within the ordinary watercourses. **(R1D, R2D, R3D, R4C)**
- As part of RCT's comprehensive review of the County Borough's most at risk communities, the LLFA are proposing to undertake a formal SFRA of the Lower Taf catchment area to better understand the overall risk from ordinary watercourse and surface water flooding in order to target investment to areas of highest 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.

5.2. NATURAL RESOURCES WALES

Natural Resources Wales were not identified as a relevant authority in relation to the flooding at Rhydyfelin on the 4th of October 2021. Furthermore, the authority does not propose to undertake any functions in relation to the event.

5.3. WATER COMPANY

DCWW were not identified as a relevant authority in relation to the flooding at Rhydyfelin on 4th October 2021. Furthermore, the authority does not propose to undertake any functions in relation to the event.

5.4. HIGHWAY AUTHORITY

During the investigation into the flooding at Rhydyfelin on 4th October 2021, the Highway was identified as flooding as a result of ordinary watercourse and surface water flooding associated to blocked and overwhelmed culverted watercourse infrastructure.

Ref 5 of Table 7 identified the Highway Authority as a relevant Risk Management Authority in relation to the surface water flooding that occurred along the highway in the lower reaches of Rhydyfelin.

RCT as the Highway Authority have exercised the following functions in response to the flooding at Rhydyfelin:

- The Highway Authority assisted with the emergency response during the event by supplying equipment and sandbags to residential and commercial properties and by 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. **(R5A)**
- The Highway Authority has undertaken emergency clearance and repair works to the culverted infrastructure identified as sources of flooding. **(R1C, R2C, R3C)**
- The Highway Authority, in collaboration with the LLFA, have completed a flood routing scheme along the lower reaches of Rhydyfelin to improve the capacity of the surface water drainage network and to manage exceedance flows from 'Culvert Inlet RH02 and RH03' by installing overflow structures and interception controls within the highway. **(R5B)**
- The Highway Authority have increased 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.

RCT as the Highway Authority propose to undertake the following functions in relation to the event at Rhydyfelin:

- The Highway Authority to work with the LLFA to evaluate surface water management options to alleviate pluvial flooding at location across the investigation area. **(R6B)**

6. 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>

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>