

Flood and Water Management Act 2010

Section 19 Flood Investigation Report

Storm Dennis –

Flood Investigation Area RCT21
(Blaenllechau & Ferndale)

October 2022

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	Storm Dennis – Flood Investigation Area RCT 21 (Blaenllechau & Ferndale)
Document Ref	FRM – S19 – 021
Project No	N/A

Revision Status	Final			
Publication Status	Publication Approved			
Date of Issue	06/10/2022			
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.....	6
TABLES AND FIGURES	7
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 FLOODING HISTORY	14
2.1. Previous Flood Incidents	14
2.2. Flood Incident.....	15
2.3. Rainfall Analysis.....	19
3. POSSIBLE CAUSES	20
3.1. Culvert Conditions.....	20
3.2. Ordinary Watercourse Conditions	22
3.3. Main River	26
3.4. Highway Drainage Conditions	27
3.5. Groundwater	29
3.6. Surface Water	31
3.6.1. Area 1	32
3.6.2. Area 2	33
3.7. Woodland Loss and Forestry Works	35
3.8. Access Structures	37
3.9. System at Capacity	38
3.10. Summary of Possible Causes.....	40
4. RISK MANAGEMENT AUTHORITY ACTIONS.....	42
4.1. Lead Local Flood Authority	47
4.2. Natural Resources Wales	50

4.3. Water Company	52
4.4. Highway Authority	53
USEFUL LINKS/CONTACTS	54

Blank Page

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 event that occurred on 15 and 16th of February 2020 within the Rhondda Cynon Taf County Borough Council area, focusing investigation on the flooding at Blaenllechau village, adjacent to the town of Ferndale, in the Rhondda Fach valley (Flood Investigation Area RCT 21, Figure 1).

This report was undertaken to identify the mechanism of 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’ have undertaken or were planning to undertake actions related to those functions to manage the risk of flooding.

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 the event at investigation area RCT21 resulted in internal flooding to 25 properties, including one commercial property and 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, RCT’s Highway and Streetcare Depot, Natural Resources Wales and Dŵr Cymru Welsh Water.

The evidence gathered within this report demonstrates that the cause of the internal flooding at investigation area RCT21 on the 15 and 16th February 2020 was a result of significant overland runoff and groundwater flow being generated from the steep hillside above Blaenllechau and conveying towards the rear of the impacted properties before continuing to flow towards lower ground, resulting in extensive surface water flooding to the highway and additional properties.

On review of the observed flow paths recorded during the event and upon a hydrodynamic assessment of the catchment undertaken by Redstart, it was concluded that complex flow routing from the hillside is causing water to find its own route down the catchment rather than discharging into the existing drainage system. The area of hillside to the west of investigation area RCT21 is owned by the Welsh Government and managed by NRW. The area of hillside to the east of investigation area RCT21 falls under private land ownership.

Storm Dennis was estimated to be a Q200 (0.5% AEP) flood event, according to NRW, which would have exceeded normal design criteria for culverts, however, no flooding was observed from the ordinary watercourse and culvert networks flowing through the investigation area during the storm. Although flooding was not observed anywhere in the culvert system, the results from Redstart's hydraulic modelling suggest that there is a wider risk of ordinary watercourse flooding to investigation area RCT21 based on the conditions and capacity of the culverted network. The modelled outputs support the conclusion that surface water was unable to reach the drainage system during the storm event.

RCT as the Lead Local Flood Authority (LLFA) and Land Drainage Authority (LDA) has been determined as the relevant Risk Management Authority (RMA) responsible for managing the surface water and groundwater flooding that originated from the hillside above the investigation area during Storm Dennis.

In response to the flooding at RCT21, the LLFA has undertaken 13 actions and have proposed to undertake a further 6. A summary of which include;

- Carried out survey, jetting and cleansing operations to an estimated 1,284 meters of culvert 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;
- Expanded their asset inspection and maintenance schedule to include several culvert structures within the investigation area in its response to extreme weather event planning; and
- Exercised its powers, under Section 13 of the Flood and Water Management Act 2010, to engage with NRW in relation to their responsibilities as land manager of the WGWE.

As the relevant RMA for ordinary watercourse, surface water and groundwater flooding, RCT as the LLFA will also look to better understand the upper catchment above investigation area RCT21 through the development of a Strategic Outline Business

Case (SOC) to provide recommendations for suitable management mechanisms to mitigate the wider risk of ordinary watercourse, surface water and groundwater flooding 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 RMAs 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 Taff CBC

RCT21– Flood Investigation Area RCT 21

RMA – Risk Management Authority

SAB – Sustainable Drainage Approval Body

SFRA – Strategic Flood Risk Assessment

SOC – Strategic Outline Business Case

SuDs – Sustainable Drainage Systems

WGWE – Welsh Government Woodland Estate

TABLES AND FIGURES

Table 1: Investigative evidence gathered in preparation of the Storm Dennis Section 19 report	12
Table 2: Summary of the source(s), pathway(s) and receptor(s) affected during Storm Dennis within investigation area RCT21.....	15
Table 3: Summary of culvert capacity assessment results which indicate the current standard of protection of the culverted networks and whether flooding was observed based on anecdotal evidence	38
Table 4: Summary of source(s) and possible cause(s) of flooding in investigation area RCT21 during Storm Dennis	40
Table 5: Risk Management Authority with relevant functions to manage the risk for different flood types.....	42
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 RCT21 (as per Table 4)	43
Figure 1: Flood Investigation Area RCT21 Location Plan.....	10
Figure 2: Natural Resources Wales' Flood Risk Assessment Wales (FRAW) map for rivers and ordinary watercourse and surface water flood risk at investigation area RCT21. Contains Natural Resources Wales information © Natural Resources Wales and database right. All rights reserved. ..	11
Figure 3: Pathway of flooding conveying from the side of a property at Aberdare Road and flowing down the steep road during Storm Dennis (image provided by resident).....	17
Figure 4: Post Event: Steps and path to the rear of Taff Street that the water flowed down during the event (left) and surface water pooling on the lane to the rear of Taff Street (right)	18
Figure 5: Surveyed culverted ordinary watercourse networks within flood investigation area RCT21	20
Figure 6: Map of defined and undefined ordinary watercourses which flow through Investigation Area RCT21	22
Figure 7: Image of the undefined ordinary watercourse / land drainage channel on the topside track above Aberdare Road following excavation works carried out by NRW in August 2020	23
Figure 8: Evidence of woody material piled on the eastern side of the forestry access road, acting as an embankment (captured by RCT officers post NRW clearance works)	24
Figure 9: Drainage ditch identified below the forestry access road upon RCT's site visit	24
Figure 10: The Rhondda Fach River levels at Maerdy station between the 14 th and 17 th February 2020 (Natural Resources Wales).....	26
Figure 11: Condition of the highway drainage channel adjacent to Aberdare Road (captured by RCT's Flood Risk Management team on 18 th February 2020)	27
Figure 12: Photograph showing visual condition of the 'Retaining Wall 2' adjacent to a property at Aberdare Road.....	30
Figure 13: Welsh Government Woodland Estate boundary within the upper catchment above investigation area RCT21. Sub-catchment areas 1 and 2 have been highlighted.....	31

Figure 14: Detailed flow route of the catchment. Flow path 1 (A-B-C) and flow path 2 (A-D-E). Produced by Redstart's FIR.	33
Figure 15: LIDAR assessment of 'Area 2' indicating small channel / rill features present across the hillside	34
Figure 16: Digitised woodland loss between 2001 and 2018 based on Google earth data	35
Figure 17: Map illustrating the modelled outputs indicating which node is predicted to flood based on the estimated return periods in Table 3	39

1 INTRODUCTION

1.1. PURPOSE OF INVESTIGATION

On the 15th and 16th of February 2020, RCT was impacted by an extreme weather event which was designated by the Met Office as ‘Storm Dennis’. Due to the extent of the event’s impact, 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 21 which covers the village of Blaenllechau, adjacent to the town of Ferndale, in the Rhondda Fach valley.

The reason behind RCT’s investigation is in response to the duties of the local authority in regard 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 (a) publish the results of its investigation, and (b) notify any relevant risk management authority”¹

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 the flood event in question.

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’².

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

² [Flood Investigation Reports | Rhondda Cynon Taf County Borough Council \(rctcbc.gov.uk\)](https://www.rctcbc.gov.uk/flood-investigation-reports)

1.2. SITE LOCATION

The area investigated within this report covers the village of Blaenllechau which neighbours the town of Ferndale, located within the central region of Rhondda Cynon Taf CBC in the Rhondda Fach valley, just north of Tylorstown (Figure 1).

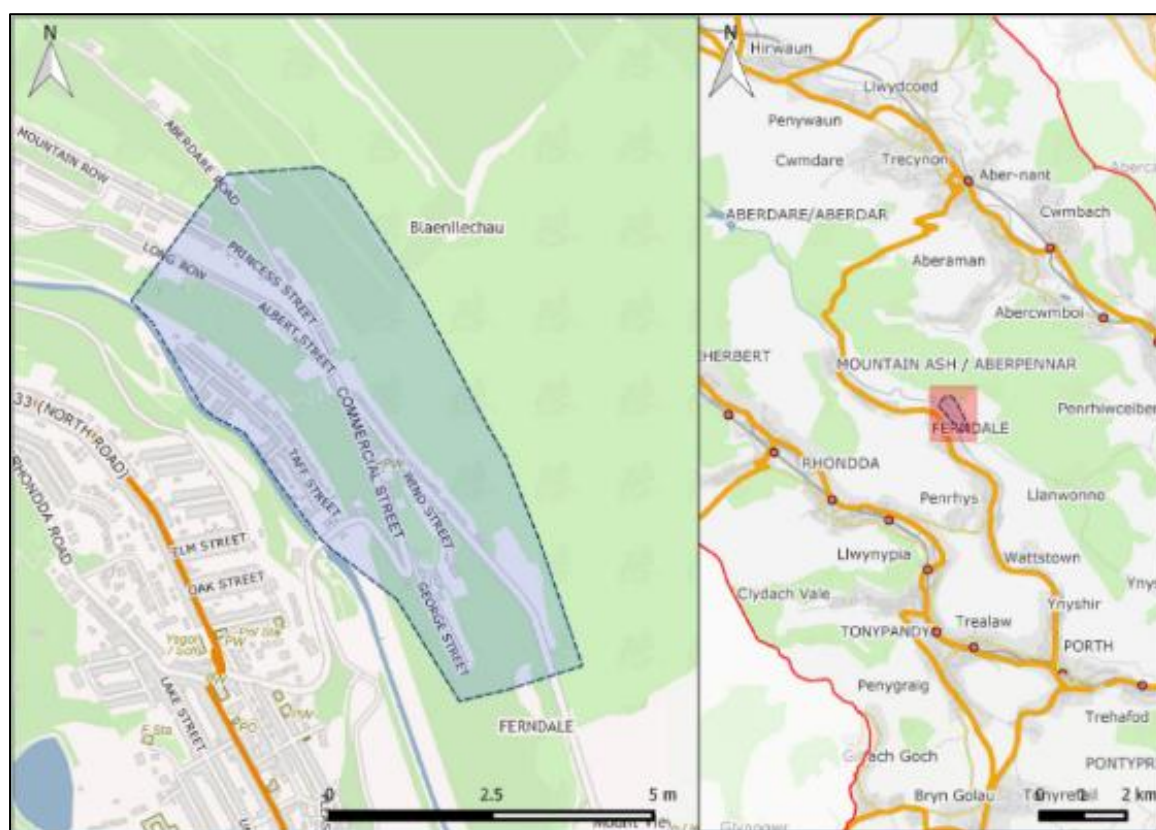


Figure 1: Flood Investigation Area RCT21 Location Plan

Blaenllechau sits at the bottom of the Rhondda Fach valley with steep hillsides and woodland either side. The area under investigation is bounded to the southwest by the Rhondda Fach River, and to the north and east by steep mountain sides and a network of unnamed ordinary watercourses which form part of the Rhondda Fach River catchment. The investigation area itself is primarily residential dwellings confined to the base of the valley.

Several properties impacted during the storm event along Aberdare Road and Blaenllechau Road cling to the mountainside with the remaining impacted properties situated nearer to the base of the Rhondda Fach River valley along Taff Street, Commercial Street and Wind Street.

Blaenllechau is situated within the Electoral Ward and Community of 'Ferndale' which is ranked 18th highest risk of surface water flooding according to RCT's Flood Risk Management Plan and ranked 56th in Wales for surface water and ordinary watercourse flood risk according to the Communities at Risk Register (CaRR).

Based on NRW's Flood Risk Assessment Wales (FRAW) map presented in Figure 2, the investigation area is identified as an area of relatively low to medium flood risk sourced from the potential surcharge of culvert inlets but primarily flood risk is associated with breached banks of the Rhondda Fach River to the south of Blaenllechau.



Figure 2: Natural Resources Wales' Flood Risk Assessment Wales (FRAW) map for rivers and ordinary watercourse and surface water flood risk at investigation area RCT21. Contains Natural Resources Wales information © Natural Resources Wales and database right. All rights reserved.

1.3. DRAINAGE SYSTEM

The surface water drainage systems that serve RCT21 are 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 within 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 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 RCT
Communities at Risk Register	Flood risk ranking and scores for all flood types based on community data in Wales
Flood Investigation Report (Redstart's FIR)	A summary of the source-pathway-receptors, culvert capacity assessment and hydraulic modelling work undertaken by Redstart. The Flood Investigation Report was commissioned by RCT prior to writing the Section 19 report.

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

1.5. PUBLIC ENGAGEMENT

Following the initial flooding event that occurred on the 15 and 16th of February during Storm Dennis, 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

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

To support the flood investigations, a public engagement exercise was undertaken between the 4th and 25th of January 2021 by Redstart, on behalf of RCT. The aim of this exercise was to engage with local residents who were affected by the flood event to capture details on how they were impacted, the source and movement of flood water within the area, how receptors were impacted as well as drawing on local knowledge to query how local conditions could have exacerbated the event. This data is useful to help the LLFA 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 at Aberdare Road and Blaenllechau Road had never experienced flooding prior to the Storm Dennis flood event. One resident at Aberdare Road reported that they had lived in the property for over 42 years and never experienced flooding before Storm Dennis.

Residents within the investigation area also reported that they were not aware of their properties being at risk of flooding prior to Storm Dennis.

2.2. FLOOD INCIDENT

The flooding that occurred on the 15th and 16th February 2020 was a result of an extreme rainfall event, designated by the Met Office as ‘Storm Dennis’, which affected the majority of RCT and caused widespread flooding to communities.

Specific details of Storm Dennis, such as rainfall and river level analysis are covered within a separate overview report that covers the wider RCT area, referenced ‘FRM – Storm Dennis – Overview Report’².

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 24 residential properties and 1 commercial property as internally flooded within the investigation area.

A summary of the source(s) and pathway(s) of flooding within RCT21 during Storm Dennis have been outlined in the Table 2 and further described throughout this section.

Table 2: Summary of the source(s), pathway(s) and receptor(s) affected during Storm Dennis within investigation area RCT21

Source	Pathway	Receptor
Intense rainfall running off the steep hillsides to the north and east above Blaenllechau draining to lower ground.	<p>The primary flow path for this incident was the conveyance of overland runoff and groundwater flow from the steep hillside towards the rear of properties along Aberdare Road and Blaenllechau Road.</p> <p>Groundwater was observed as discharging from the junction of a recently constructed retaining wall and an old stone retaining wall located adjacent to a property at Aberdare Road.</p> <p>The secondary flow path for this incident was the routing of runoff from the steep hillsides above Blaenllechau</p>	<p>Internal flooding to a total of 25 properties within the investigation area.</p> <p>Most of the recorded flooded properties from this event were on Aberdare Road and Blaenllechau Road.</p> <p>Additional records of flooded properties were identified on Wind Street, Commercial Street and Taff Street.</p>

	conveying downhill via the highway network at Aberdare Road and Blaenllachu Road towards Commercial Street and Wind Street. This water then continued downhill towards Taff Street.	
--	---	--

The source of the recorded flooding at RCT21 in this incident originated from extreme rainfall generating significant groundwater flow and overland runoff from the steep hillsides above Blaenllechau draining to lower ground.

During the storm event on the 16th of February 2020, flood water was initially reported to have entered through the rear of several properties on Aberdare Road and Blaenllechau Road, as well as ingress through property walls, causing internal flooding to the ground floor of 20 residential properties.

Upon a site inspection undertaken by RCT's Flood Risk Management officers on the 18th of February 2020, it was confirmed that the source of water originated from the steep hillsides to the rear of Aberdare Road and Blaenllechau Road.

Anecdotal accounts provided by residents of Aberdare Road note that the flood water was observed to originate from a junction of a recently constructed retaining wall and an old stone retaining wall adjacent to a property at Aberdare Road. This flow path resulted in internal flooding to three residential properties at Aberdare Road.

Figure 3 depicts the flow of water discharging from beneath the side garden gate of a property at Aberdare Road and onwards towards the lower reaches of RCT21. Video evidence provided by residents identify water as penetrating through the old stone retaining wall which would suggest that the source of flooding was originating from underground as groundwater.

Residents of Aberdare Road stressed that they had not experienced flooding to their properties prior to Storm Dennis in February 2020 however, since then, the residents of Aberdare Road have experienced repeat flooding issues on three occasions as a result of groundwater emulating through the old stone retaining wall during periods of heavy and prolonged rainfall.



Figure 3: Pathway of flooding conveying from the side of a property at Aberdare Road and flowing down the steep road during Storm Dennis (image provided by resident)

17 residential properties were recorded as internally impacted along Blaenllechau Road. Overland flow along the hillside is considered to have been the primary source and pathway of flooding above Blaenllechau Road, however there is limited information to outline the exact pathway of flooding. Groundwater is also considered to have impacted properties however, the area of hillside to the rear of Blaenllechau Road is steeper, thereby limiting the opportunity for rainfall to infiltrate into the ground and instead exacerbating the surface water runoff travelling down the hillside.

Residents accounts at Aberdare Road and Blaenllechau Road also report some secondary flooding from the front of properties due to the substantial surface water flows travelling down the hillsides and intercepted by the steep roads.

An assessment of the catchment above RCT21, undertaken by Redstart, show that there is potential for areas to the west of the identified catchment to contribute flow to the investigation area by means of a forestry access road off Aberdare Road and the upper end of Aberdare Road acting to potentially intercept overland flow and direct it along the road towards the investigation area.

Anecdotal evidence suggests that this flow path was observed during the event by local witness. Water was observed to have flowed down Aberdare Road to the south-east towards the main roundabout area and then continued downhill towards

Commercial Street and onwards to Station Road. This flow path also impacted the Taff Street area whereby flood water continued to travel downhill towards lower ground. Figure 4 depicts the steps and path that the water followed, causing surface water to accumulate at the rear lane behind Taff Street properties which resulted in internal flooding to at least one residential property.



Figure 4: Post Event: Steps and path to the rear of Taff Street that the water flowed down during the event (left) and surface water pooling on the lane to the rear of Taff Street (right)

Secondary flow paths were observed from the steeper sections of the valley side above Blaenllechau Road, whereby overland flow was intercepted by Blaenllechau Road and contributed to the flow paths towards Wind Street and Commercial Street. Water was observed to have entered properties on Commercial Street from the rear, originating from surface water flows along Blaenllechau Road which travelled towards Wind Street, affecting one residential property, and then onwards to the rear gardens of the three properties affected at Commercial Street.

2.3. RAINFALL ANALYSIS

See RCT's 'Overview Report' of Storm Dennis, reference 'FRM – Storm Dennis – Overview Report'², for a detailed analysis of the rainfall and ordinary watercourse response.

3. POSSIBLE CAUSES

3.1. CULVERT CONDITIONS

Within investigation area RCT21 there are several unnamed watercourses which drain the hillsides above the village of Blaenllechau and discharge into the Rhondda Fach River. Many of these watercourses are culverted beneath Ferndale and Blaenllechau's residential areas.

Four culverted ordinary watercourse networks were identified within the investigation area. Figure 5 depicts the location of these four networks. Aberdare Road West and East inlets are identified as the responsibility of Natural Resources Wales on behalf of Welsh Government as the landowner of the Welsh Government Woodland Estate (WGWE), whilst the Blaenllechau Road East and West inlets are identified as the responsibility of two private individual landowners.



Figure 5: Surveyed culverted ordinary watercourse networks within flood investigation area RCT21

All four culvert networks were inspected and surveyed by a Council appointed contractor following Storm Dennis, to ascertain both the operational condition of the network, and its structural integrity along sections of the network. The culvert inspections highlighted several sections of the culvert drainage systems in RCT21 that are in poor condition, however it is not possible to say whether its poor condition was as a result of the storm event. In response, a cleansing operation of the four culvert networks was carried out post flood event to remove the settled deposits identified within the networks, particularly within the downstream sections. Approximately 46 tonnes of material was removed during these operations.

Stone masonry culverts are among the earliest culvert structures, built in the late nineteenth and early twentieth centuries. A large proportion of Blaenllechau's culverted networks are made of stone masonry, making most over 100 years old. The typical construction of Blaenllechau's drainage network indicates that the infrastructure is aged and may no longer adequately accommodate the movement of floodwaters and debris necessary during current storm events.

The FIR notes that the culvert inlets however were not significantly affected by Storm Dennis, with no evidence of significant blockage or damages to the structures identified during post event inspections. This result correlates with the anecdotal evidence supplied by RCT's Flood Risk Management inspectors, as well as residents accounts and photo evidence showing very clearly that the dominant flood mechanism during Storm Dennis was groundwater and overland flow entering properties from the hillside above Blaenllechau.

Based on the location of the flooded properties and the flow paths, the culvert conditions of the four identified networks are not considered to have significantly contributed to the recorded flooding of properties in investigation area RCT21 during Storm Dennis.

3.2. ORDINARY WATERCOURSE CONDITIONS

Several unnamed ordinary watercourses which drain the steep catchment above Blaenllechau are identified to flow through the investigation area, as illustrated in Figure 6. A number of these watercourses are undefined due to the steepness of the catchment being drained.

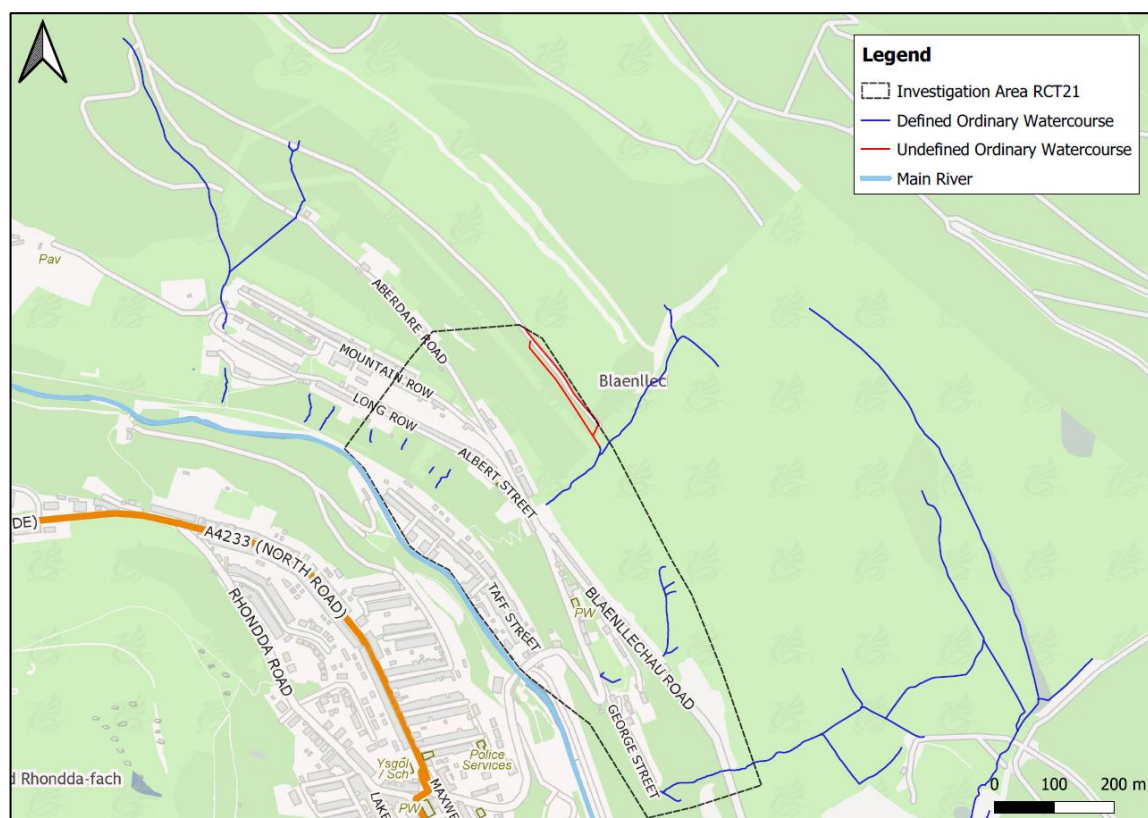


Figure 6: Map of defined and undefined ordinary watercourses which flow through Investigation Area RCT21

On review of the available information there is a limited amount of dedicated and defined ordinary watercourse channels identified within the investigation area. This is considered to result in a large proportion of the catchment above RCT21 draining overland during heavy rainfall and following natural and manmade contours as opposed to draining via defined ordinary watercourse channels.

A site walk-over assessment of the upper catchment above RCT21 was undertaken by RCT's Flood Risk Management team post event to inspect the drainage arrangements of the hillside. A forestry access road was identified above Aberdare Road which indirectly acts as a secondary rill feature and is considered to have intercepted some of the overland flows coming down the hillside during the storm

event. The forestry access road forms part of the Welsh Government Woodland Estate (WGWE) which is owned by the Welsh Government and managed by NRW.

The assessment identified undefined ordinary watercourse channels / land drainage channels across parts of the forestry track (highlighted red in Figure 6) which are considered to manage the overland flows from the hillside and covey into the defined ordinary watercourse which is culverted beneath Commercial Street (highlighted blue in Figure 6).

Upon engagement with NRW as land estate manager of the WGWE, it was confirmed that remedial works were undertaken to improve the capacity of the undefined ordinary watercourse / land drainage channel on the topside of the forestry track following Storm Dennis, in August 2020. Figure 7 illustrates the condition of the drainage channel post excavations works.



Figure 7: Image of the undefined ordinary watercourse / land drainage channel on the topside track above Aberdare Road following excavation works carried out by NRW in August 2020

RCT's Flood Risk Management team undertook a site visit following the remedial works and identified evidence of woody material, inclusive of brash, on the eastern side of the track acting as artificial bunds (Figure 8). Evidence of similar woody material was also identified across the hillside above the forestry track. On review of the condition of the undefined land drainage channels it appears that debris had been cleared from the topside track and moved to the side of the track by NRW during post event clearance works



Figure 8: Evidence of woody material piled on the eastern side of the forestry access road, acting as an embankment (captured by RCT officers post NRW clearance works)

An undefined ordinary watercourse / land drainage channel was also identified below the forestry track (depicted in Figure 8). This ditch typically acts as a cut off feature to channel the overland flows into the adjacent ordinary watercourse, however, it was noted that the channel was heavily vegetated during RCT's site visit (Figure 9).



Figure 9: Drainage ditch identified below the forestry access road upon RCT's site visit

NRW confirmed further clearance works were undertaken in February 2022 to remove the vegetation from the undefined ordinary watercourse channel. It is considered that during the storm event the undefined channel was operating at a reduced capacity to intercept the overland flows coming from the hillside.

On review of the above it is considered that during the storm event the undefined ordinary watercourse channels and land drainage ditch along the track became hydraulically overwhelmed during the storm event as a result of intense rainfall.

Based on the post event clearance works undertaken by NRW, it is also considered that the undefined drainage channels were operating at a reduced capacity at the time of Storm Dennis, further contributing to the surface water and groundwater flows along the hillside.

3.3. MAIN RIVER

The designated main river Rhondda Fach flows through the town of Ferndale (Figure 6), to the south of the investigation area.

The hydrograph in Figure 10 illustrates the rapid rise in levels of the Rhondda Fach River in response to rainfall, captured at NRW's Maerdy station. The Rhondda Fach River at Maerdy reached its second highest peak ever recorded at 02:30am (16th February), reaching 1.371 meters.

The green bar displayed on the hydrograph shows the typical level of the Rhondda Fach River at Maerdy station, ranging between 0.05 and 0.35 meters. At its peak, the Rhondda Fach River was over a meter higher than its average level, stressing the extreme and unprecedented levels that RCT's rivers rose to during the storm's peak intensity.

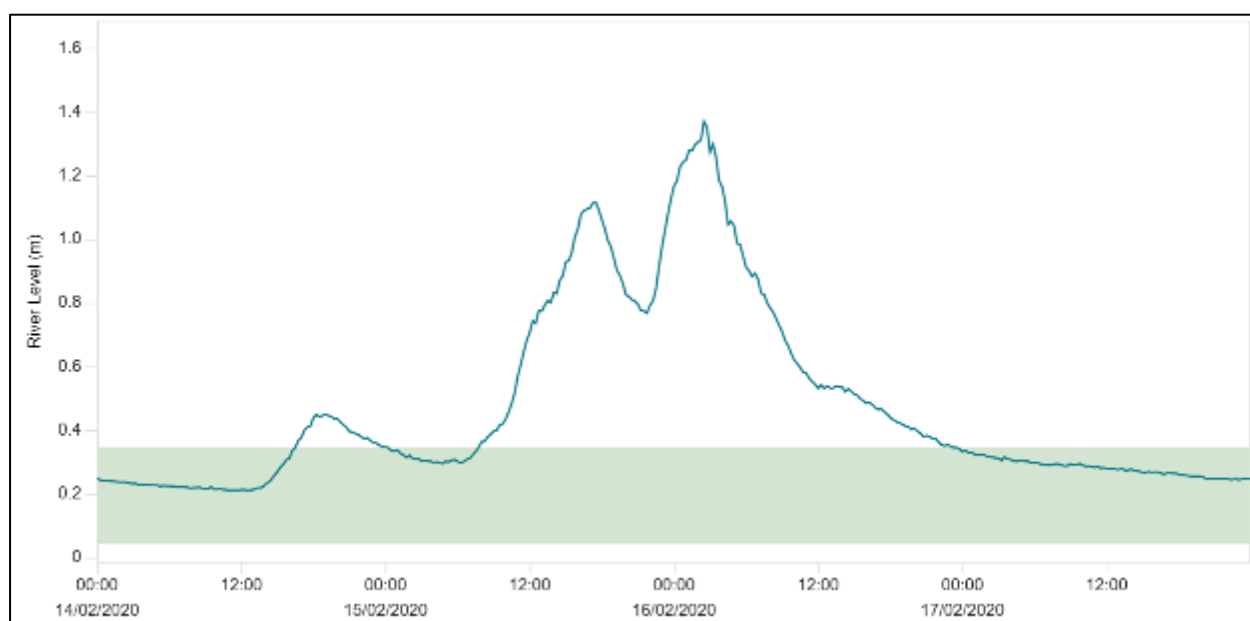


Figure 10: The Rhondda Fach River levels at Maerdy station between the 14th and 17th February 2020 (Natural Resources Wales)

There is no evidence from this investigation to suggest that the Rhondda Fach River contributed to the recorded flooding of properties in investigation area RCT21 during Storm Dennis.

3.4. HIGHWAY DRAINAGE CONDITIONS

Surface water runoff along the highway was reported by residents across the investigation area during Storm Dennis. Notably, much of the observed surface water originated as overland flows from areas of hillside and groundwater flows discharging onto Aberdare Road and Blaenllechau Road.

These flows, in addition to intense rainfall falling onto the catchment, are considered to have hydraulically overwhelmed the highway drainage system on its course of flow, particularly within the lower reaches of the investigation area. Natural detritus, mud and silt, washed down from the hillsides is also considered to have entered the highway drainage network via gullies. In these instances, it is likely that highway drainage assets will have had a limited capacity to intercept the surface water flows within RCT21.

Upon a site inspection of Aberdare Road post storm event, it was reported that the drainage channel which runs adjacent to the highway and discharges into Aberdare Road West culvert network (Figure 5), was operating with little to no flow during the storm event. The highway drainage channel is depicted in Figure 11.



Figure 11: Condition of the highway drainage channel adjacent to Aberdare Road (captured by RCT's Flood Risk Management team on 18th February 2020)

The condition of the highway drainage channel depicted in Figure 11 was observed as heavily vegetated which is considered to have reduced its ability to manage the

surface water flows conveying along the highway from the hillside above Blaenllechau. Despite the poor condition of the highway drainage infrastructure along Aberdare Road limiting the interception of surface water flows during Storm Dennis, it is not considered to have significantly contributed to the primary flooding of properties on Blaenllechau Road and Aberdare Road due to their relative position and lack of opportunity for exceedance flows to reach the rears of these properties.

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 a combination of overland and groundwater flows from the hillsides entering the drainage network across RCT21. Given the severity of the storm, the maintenance condition of the highway surface water drainage system is not considered to have significantly impacted on the flooding experienced within RCT21.

In response to residents reports of blocked highway drainage infrastructure, the Council Highways and Streetcare Depot undertook extensive cleansing of the highway drainage networks post event.

3.5. GROUNDWATER

Groundwater flooding has been identified as the primary source of flooding to properties at Aberdare Road and a contributing source to those properties at Blaenllechau Road during Storm Dennis. The exact flow path of groundwater is unknown however, it is considered to have originated from the steep hillside above Blaenllechau and conveyed via Throughflow within the subsurface.

Throughflow, is the lateral flow of water within the soil layer which normally takes place when the ground is completely saturated with water following heavy and persistent rainfall. This process causes water to return to the surface before entering a watercourse, drainage system or returning as groundwater flow. Given the prolonged period of rainfall during February 2020, it is considered likely that the groundwater table was high during Storm Dennis, indicating Throughflow conveyance of groundwater likely contributed to the flooding of properties at Aberdare Road and Blaenllechau Road.

A review of available geological information indicates that RCT21 is underlain by superficial deposits consisting of Glacial Till and River Deposits, overlying the Lower and Upper Rhondda Member, consisting of mudstone, sandstone and siltstone³. Superficial deposits associated with fluvial deposition, such as river gravels and alluvial clays and sands, are found at the base of the main river valleys. According to the Environment Agency, flooding from groundwater is most common in these areas with sand and gravel in the river valleys⁴, again indicating that the investigation area is susceptible to groundwater flooding.

Groundwater was observed by residents of Aberdare Road as discharging from the junction of a recently constructed retaining wall (referred to as 'Retaining Wall 1') and an old stone retaining wall (referred to as 'Retaining Wall 2') located adjacent to a property at Aberdare Road. 'Retaining Wall 1' is identified as a privately owned structure. 'Retaining Wall 2' is identified to fall under the ownership of NRW as land estate manager of the WGWE.

'Retaining Wall 2' primarily retains the hillside material above to prevent it from encroaching over the property boundary. Following Storm Dennis, NRW undertook an inspection of 'Retaining Wall 2' which identified potential structural weaknesses. The mortar in the joints of the wall were identified to have deteriorated over time, as evidenced in Figure 12 which shows vegetation growing in the joints. This has led to

³ [Geology of Britain viewer - British Geological Survey \(bgs.ac.uk\)](https://www.bgs.ac.uk/)

⁴ Flooding from Groundwater, Environment [Agency, September 2011 \(publishing.service.gov.uk\)](https://www.publishing.service.gov.uk/)

multiple holes and large openings within the wall which is considered to have facilitated overland runoff and groundwater to water to pass through the structure.



Figure 12: Photograph showing visual condition of the 'Retaining Wall 2' adjacent to a property at Aberdare Road

'Retaining Wall 1' adjacent and to the rear of the impacted properties at Aberdare Road was also inspected post event by NRW. The inspection did not identify adequate drainage behind the wall and the absence of an outlet for the drainage of groundwater is considered to have exacerbated the discharge of water through the old retaining wall.

The degraded structural integrity of 'Retaining Wall 2' is considered to have contributed to the discharge of groundwater through the structure, which impacted 3 residential properties at Aberdare Road, in addition to contributing to the surface water flows conveying towards the lower streets of RCT21. The prolonged rainfall experienced during February 2020, however, is considered the primary cause of groundwater flooding during Storm Dennis. The prolonged rainfall caused the hillside to become saturated and led to the rising of the water table from the rocks and soils underground towards the surface.

3.6. SURFACE WATER

Surface water flooding generated by intense rainfall running overland down the steep hillslopes above Blaenllechau has been identified as a contributing source and pathway of flooding within investigation area RCT21. This runoff was routed by the topographic catchment of the hillsides to the north and east of the investigation area which channelled rainfall towards the rear of the impacted houses on Aberdare Road and Blaenllechau Road.

The area of land that drains towards investigation area RCT21 can be divided into two sub-catchment areas as shown in Figure 13. Both areas of hillside are separated by an unnamed ordinary watercourse which is culverted beneath Commercial Street.

The majority of 'Area 1' forms part of the Welsh Government Woodland Estate (WGWE) which is owned by the Welsh Government and managed by NRW. This area of hillside drains towards the rear of Aberdare Road, to the northwest of RCT21, where 3 properties were impacted by flooding. 'Area 2', to the northeast of RCT21, drains towards Blaenllechau Road and is owned and maintained by a private landowner. 17 residential properties were impacted during Storm Dennis at Blaenllechau Road.

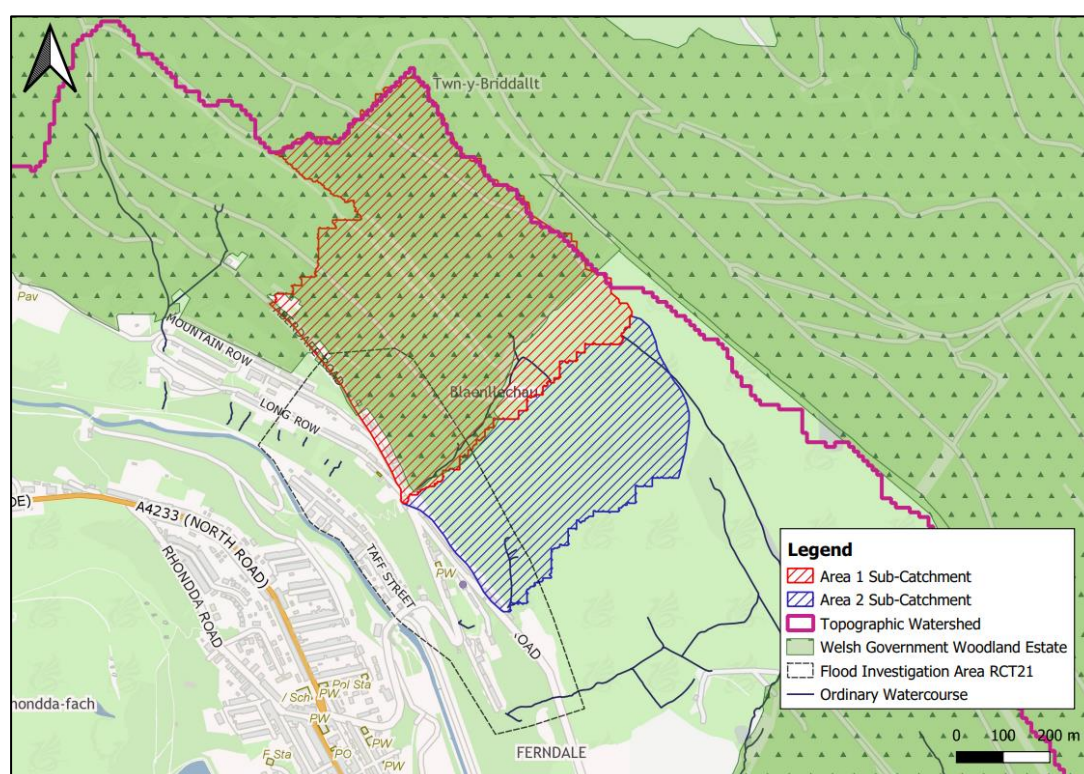


Figure 13: Welsh Government Woodland Estate boundary within the upper catchment above investigation area RCT21. Sub-catchment areas 1 and 2 have been highlighted.

3.6.1. AREA 1

'Area 1' is approximately 34.4 hectares in catchment area and has an estimated average gradient of 1:2.9 based on rudimentary LIDAR assessments.

On review of the area of land that would expect to drain towards Aberdare Road, there is potential for complex flow routing. LIDAR based hydrodynamic assessments produced by Redstart's FIR identify two significant pathways which are outlined below and illustrated within Figure 14:

- Flow path 1 follows the dominant valley gradient where runoff from the source area (A) flows directly downhill, over the ridge (B) and down towards Aberdare Road (C)
- Flow path 2 follows the secondary gradient with runoff from the source area (A) flowing down the valley, above the ridge, and intercepted by a rill feature (D). The flow is directed via the watercourse toward the junction of Albert Street and Commercial Street (E) and towards the Rhondda Fach channel.

The analysis shows that both flow routes are valid for this part of the catchment and the route taken is dependent on the rate of flow. Lower flows were shown to be intercepted by the ridge and follow flow path 2 (A-D-E), with larger exceedance flows routing over the ridge following flow path 1 (A-B-C).

Based on the intensity of rainfall during Storm Dennis, and in review of the observed flow paths described by residents, it is inferred that flow path 1 was the primary pathway at 'Area 1', i.e., surface water runoff travelling overland down the hillside rather than atypically via the ordinary watercourses. The increase in overland runoff is also considered to have saturated the hillside, contributing to the observed groundwater flooding.

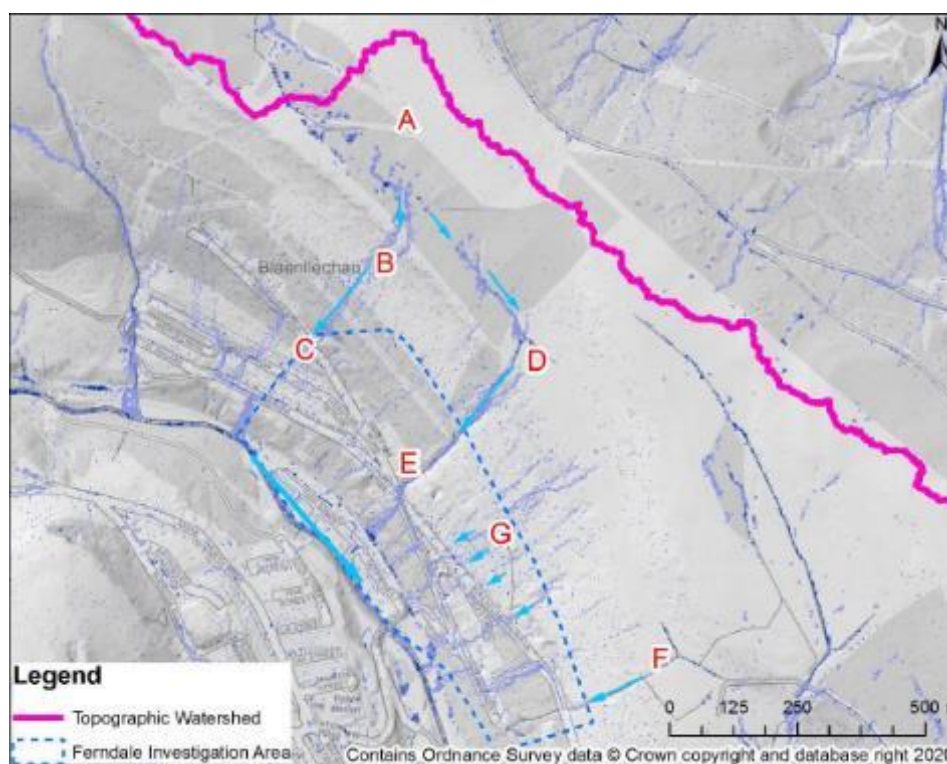


Figure 14: Detailed flow route of the catchment. Flow path 1 (A-B-C) and flow path 2 (A-D-E).
Produced by Redstart's FIR.

3.6.2. AREA 2

Overland flow from the steeper sections of the valley side (area G on Figure 14) is also identified as a pathway of flooding during the storm event, resulting in surface water flows towards Blaenllechau Road. These flows are sourced by the area of hillside to the east of the investigation area, labelled 'Area 2' in Figure 13, which falls under private ownership.

'Area 2' is approximately 17.6 hectares in catchment area and has an average gradient of 1:3 based on rudimentary LIDAR assessments.

'Area 2' was heavily overgrown at the time of inspection, restricting the LLFA's assessment of the catchment, however, based on visual and LIDAR assessments, it was apparent that this area of hillside is marginally steeper than the hillside above Aberdare Road.

According to available OS data there appears to be no formal drainage arrangements or rill features to intercept and/or direct the flow of surface water towards the ordinary watercourses that drain the hillside of 'Area 2'. Further interrogation of LIDAR data and satellite imagery however, identified multiple channels / rill features that appear to convey towards the rear of properties at Blaenllechau Road. Figure 15 depicts these small channels / rill features across 'Area 2' using LIDAR data.

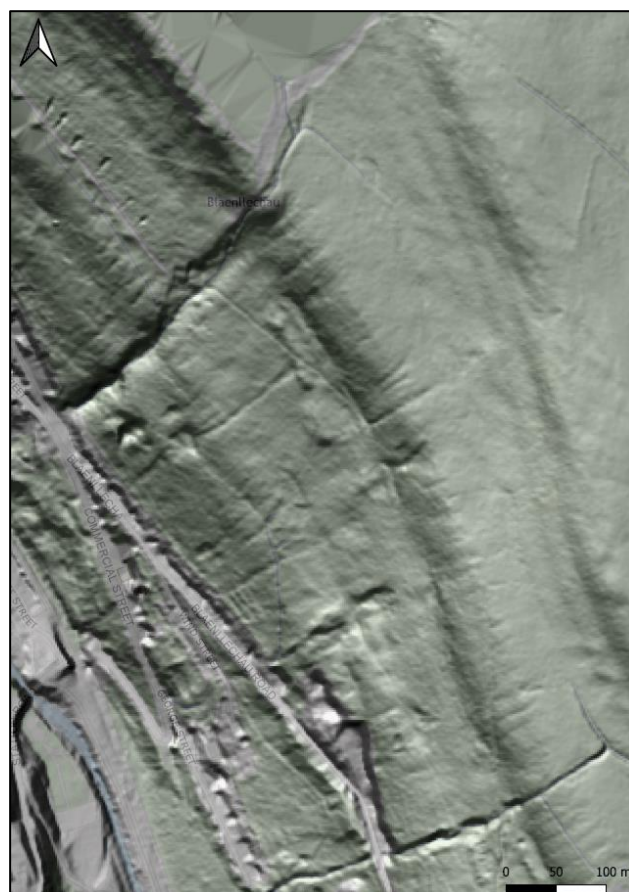


Figure 15: LIDAR assessment of 'Area 2' indicating small channel / rill features present across the hillside

It is considered that the undefined ordinary watercourse channels identified along 'Area 2' contributed to the conveyance of surface water flows towards the rear of properties at Blaenllechau Road, however, despite this, it is concluded that surface water is largely uncontrolled above Blaenllechau Road which allowed intense rainfall during Storm Dennis to flow overland, in addition to saturating the area of hillside, leading to surface water and groundwater flooding to several properties along Blaenllechau Road.

3.7. WOODLAND LOSS AND FORESTRY WORKS

The area of land to the northwest of the investigation area forms part of the Welsh Government Woodland Estate (WGWE) which is owned by the Welsh Government and managed by NRW. Areas of woodland within NRW's Forestry estate to the north and east of Ferndale have been felled since 2001 based on evidence presented by Redstart's FIR. The woodland loss has been digitised based upon the observed woodland loss in Google Earth and tree cover loss with greater than 10% canopy based upon data analysed from global forest watch⁵. The combination of datasets is depicted within Figure 16 and confirms that areas of woodland above the investigation area has been felled during the last five years.

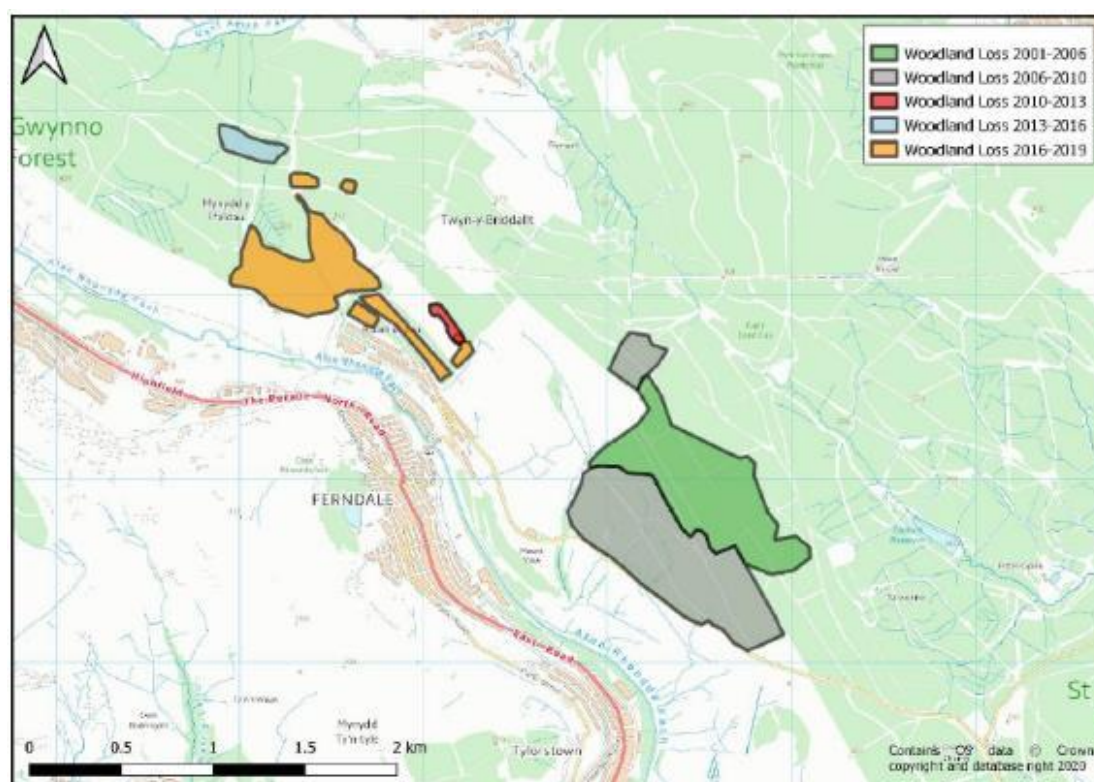


Figure 16: Digitised woodland loss between 2001 and 2018 based on Google earth data

Forests and woodlands can have an impact on flooding in multiple ways; trees reduce sediment runoff and forests and woodlands typically produce less runoff than other land uses such as farms and grasslands; the removal of canopy cover increases the rate and volume of runoff of surface water due to the reduction in rainfall interception; and furthermore, felling activity can involve large mechanical plant to fell and transport the material causing disturbances and alterations to local landscape. The choice of

⁵ <https://blog.globalforestwatch.org/>

forest management can thereby have an impact on the water use of a stand of trees and clear-felling is “the most dramatic intervention” in terms of its impact on the reduction of water use from trees, as stated within NRW’s Land Estate Management Review⁶.

During post event investigations, residents had expressed their concerns about the impact of recent land use changes in the upper catchments of Blaenllechau, specifically in relation to the land to the rear of Aberdare Road where clear-felling has recently taken place. Anecdotal accounts captured by residents post storm event report possible landscape changes as a result of the felling activity impacting on surface water flow paths. Harvesting operations can in fact affect existing surface water drainage on forestry land, as noted by NRW within their review; “harvesting does have the potential to create new pathways for water, channeling it into inappropriate areas”.

NRW state that “woodlands are usually benign or helpful when reducing flood risk” but when considering extreme flood events such as Storm Dennis, there is some uncertainty surrounding the limited available evidence to conclude the impact of woodland and forests on extreme flood flows at a wider landscape level. They do, however, state that “there is evidence that changes to how we (NRW) design, manage and run land management operations on the WGWE could have a positive impact on a more local scale in some high risk areas”, especially “where the WGWE is a high % of the total catchment of smaller rivers, streams; and areas prone to flooding upstream from main rivers”. Whilst the total % cover by the WGWE is 21% in RCT, the WGWE represents approximately 37% of the total catchment area of Ferndale Electoral Ward.

It is difficult to determine the exact impact of woodland felling on overland and groundwater flow routes, however, woodland loss within the investigation area has been observed over the last decade and this, paired with the evidence presented within NRW’s Land Estate Management Review and anecdotal evidence provided by residents, suggest that forestry loss and felling operations have influenced the groundwater and surface water flow paths from the hillside which are considered to have contributed to the flooding of several properties within the investigation area during Storm Dennis.

⁶ [February 2020 Floods in Wales: Natural Resources Wales Land Estate Management Review \(cyfoethnaturiol.cymru\)](https://www.cyfoethnaturiol.cymru/)

3.8. 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.

3.9. SYSTEM AT CAPACITY

Notably the source of flooding that resulted in the most significant flooding within investigation area RCT21 is attributed to groundwater flow and surface water runoff originating from the hillsides. Despite this, the LLFA undertook surveys of the culvert networks identified within the investigation area, the results of which fed into a review of the hydraulic capacity of the network and culvert structures to ascertain its current standard of protection.

The results of the culvert capacity assessments are summarised in Table 3, along with a determination of whether flooding was observed during Storm Dennis based on evidence provided by residents and RCT's Flood Risk Management team.

Table 3: Summary of culvert capacity assessment results which indicate the current standard of protection of the culverted networks and whether flooding was observed based on anecdotal evidence

Culvert Network	Standard of Protection	Flooded Node	Observed Flooding
Aberdare Road West	Q5 (20% AEP)	SS99978700 (inlet)	No
Aberdare Road East	Q5 (20% AEP)	ST0097650 (inlet)	No
Blaenllechau Road West	Q100 (1% AEP)	ST00970454 (manhole)	No
Blaenllechau Road East	Q75 (1.33% AEP)	ST0097251 (manhole)	No

Current design standards for culverted ordinary watercourses in Wales stipulate that new culverts must provide a standard of protection from flooding up to and including the Q100 (1% AEP) event plus climate change allowance, as defined by CIRIA C786. The modelled outputs suggest that three out of the four culvert networks do not provide adequate capacity to manage the expected flows.

The network is predicted to flood at the nodes highlighted in Figure 17 based on the calculated standards of protection outlined in Table 3. There is however no evidence to verify that flooding did in fact occur anywhere in the modelled culvert systems during Storm Dennis. It is therefore inferred that surface water from the hillside is not draining into the culvert networks as suggested by the hydraulic modelling and is instead finding its own route down the hillside, affecting several properties on its flow path during Storm Dennis.



Figure 17: Map illustrating the modelled outputs indicating which node is predicted to flood based on the estimated return periods in Table 3

3.10. SUMMARY OF POSSIBLE CAUSES

The above sections have identified and described the possible causes of flooding within investigation area RCT21 during Storm Dennis, which occurred on the 15 and 16th February 2020. A summary of the identified source(s) and possible cause(s) of flooding (issue) has been outlined below in Table 4.

Table 4: Summary of source(s) and possible cause(s) of flooding in investigation area RCT21 during Storm Dennis

Ref No	Asset (Source)	Issue	Asset Owner	Type of Flooding
1	Welsh Government Woodland Estate to the northwest of the investigation area (Area 1)	<p>Intense and prolonged rainfall during February 2020 is considered to have saturated the hillside, contributing to the observed groundwater and surface water flooding downstream.</p> <p>In addition to this, areas of the WGWE (forestry land owned by the Welsh Government and maintained by NRW) above Blaenllechau has been felled in recent years which may have contributed to increased rate and runoff of surface water following the removal of the canopy cover as well as potential alterations to the surface water and groundwater drainage arrangements from the WGWE following forestry operations.</p>	Welsh Government (managed by Natural Resources Wales)	Groundwater & Surface Water
2	Privately owned land to the northeast of the investigation area (Area 2)	Part of the hillside that contributed significant overland flows towards properties at Blaenllechau Road is privately owned. The area of hillside is very steep with no formal drainage arrangements present, indicating the surface water flows are not well controlled and	Private Landowner	Groundwater & Surface Water

		<p>the opportunity for infiltration of surface water is limited due to the steep gradient of the hillside.</p> <p>The prolonged rainfall during February 2020 is also considered to have saturated the hillside, contributing to the observed groundwater and surface water flooding downstream.</p>		
--	--	--	--	--

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 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'⁷, and RCT's 'FRM – Storm Dennis - Overview Report'**Error! Bookmark not defined.**

Table 5: 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, the Water Resources Act 1991 and the Highways Act 1980. Through analysis of the flooding that impacted investigation area RCT21, the flood risk management functions exercised or proposed to be exercised by relevant RMAs were

⁷ [National Strategy for Flood and Coastal Erosion Risk Management in Wales \(English\) \(gov.wales\)](#)

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 RCT21 during Storm Dennis have previously been identified and summarised within Table 4. The Risk Management Authorities responsible for managing that flooding have been listed in Table 6 below, along with a series of recommendations put forward 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 RCT21 (as per Table 4)

Ref No	Asset (Source)	Asset Owner	Type of Flooding	Relevant Risk Management Authority	Recommendations	
1	Welsh Government Woodland Estate to the northeast of the investigation area (Area 1)	Welsh Government (managed by Natural Resources Wales)	Groundwater & Surface Water	Lead Local Flood Authority and Land Drainage Authority	R1A	NRW to review their Forest Resource Plans and Coupe Management Plans with regard to water management, particularly surface water management. Aligned with recommendation FRP1, 2 and 3 within NRW’s Land Estate Management Review.
					R1B	NRW to review their Llanwynoo Forest Resource Plan which encompasses

						<p>the forestry above investigation area RCT21, in collaboration with the LLFA, to identify and reflect the key challenges facing the community of Blaenllechau. Aligned with recommendation FRP1 within NRW's Land Estate Management Review.</p>
					R1C	<p>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 FRP1 within NRW's Land Estate Management Review.</p>
					R1D	<p>NRW to 'improve engagement of local communities in Forest Resources Planning and forest operations' to help develop greater confidence in the WGWE and NRW's contribution to reducing flood risk.</p>

						Aligned with recommendation FRP4 within NRW's Land Estate Management Review.
						R1E The LLFA to develop a Strategic Outline Business Case (SOC), engaging with NRW as land estate manager of the WGWE, to identify suitable management methods to reduce the risk of flooding from local sources (ordinary watercourse, surface water, groundwater).
						R2A The LLFA and LDA to identify asset ownership and responsibility.
2	Privately owned land to the northeast of the investigation area (Area 2)	Private Landowner	Groundwater & Surface Water	Lead Local Flood Authority and Land Drainage Authority		R2B The LLFA and LDA to exercise their permissive powers under Section 64 of the Land Drainage Act to inspect and investigate the area of hillside which falls under private ownership to investigate the sources and possible causes of groundwater flooding and to assess the surface water drainage arrangements and its impact on flooding.

					R2C	The LLFA to develop a Strategic Outline Business Case (SOC) to identify suitable management methods to reduce the risk of flooding from local sources (ordinary watercourse, surface water, groundwater).
--	--	--	--	--	-----	---

4.1. LEAD LOCAL FLOOD AUTHORITY

In review of Ref 1 and 2 in Table 6, the LLFA has been determined as the relevant Risk Management Authority in relation to the surface water and groundwater flooding which occurred at investigation area RCT21 during Storm Dennis.

The LLFA exercised the following functions in response to the flooding at investigation area RCT21;

- 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.
- A public engagement exercise carried out by Redstart, 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.
- The LLFA and LDA have exercised their permissive powers under Section 64 of the Land Drainage Act 1991 to investigate the area of privately owned hillside identified as a source of flooding during Storm Dennis **(R2B)**.
- An estimated 1,284 meters of ordinary watercourse culvert network length within investigation area RCT21 has been surveyed following the storm event to ascertain both the operational condition and structural integrity along sections of the network.
- An estimated 46 tonnes of material and debris was removed from the culverted watercourse network within investigation area RCT21 during jetting and cleansing operations.
- The LLFA, assisted by the Highway Authority, have undertaken clearance works to the culvert inlet structures which fall under the responsibility of the Authority.
- The LLFA have expanded their asset inspection and maintenance schedule to include culvert inlets within the investigation area in its response to extreme weather event planning.
- The LLFA commissioned Redstart to investigate the standard of protection of the existing culvert networks in RCT21 to determine their hydraulic capacity

following the identification of several structural and operational defects within sections of the network.

- The LLFA has exercised its powers, under Section 13 of the FWMA, to request information and co-operation from NRW in relation to their responsibilities as a RMA and as land 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.
- 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 investigation area RCT21;

- Following the surveying of culvert networks in RCT21, the LLFA propose to input and update all relevant asset data.
- 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.
- 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 modelled outputs suggest that the flow of water down the hillsides above Blaenllechau are not well controlled. The outputs also imply that three out of the four culverted networks within the investigation area do not provide adequate standards of protection. The LLFA will develop a SOC to better understand the risk of flooding within Blaenllechau. The SOC will use a whole catchment approach to provide recommendations for suitable management mechanisms to reduce the wider risk of flooding to people and properties from local sources (Ordinary Watercourse, Surface Water and Groundwater). **(R1E, R2C)**
- The LLFA and LDA will engage with NRW as land estate manager of the WGWE to work collaboratively to develop the SOC for the Blaenllechau area. **(R1E)**

- As part of RCT's comprehensive review of the County Borough's most at risk communities, the LLFA are proposing to undertake a formal Strategic Flood Risk Assessment (SFRA) of the Rhondda Fach 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. **(R1E, R2C)**

4.2. NATURAL RESOURCES WALES

Natural Resources Wales were not directly identified as a responsible authority in relation to the flooding at investigation area RCT21 on the 15th and 16th February 2020 because the flood type was identified as being surface water and groundwater which is the responsibility of the Lead Local Flood Authority. However, the Authority, as the LLFA and LDA, has engaged with NRW in relation to the event, specifically regarding their role and responsibility as the woodland and forestry 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 investigation area RCT21;

- Following the flooding events of February 2020, NRW published a review of its incident response to Storm Ciara and Dennis in October 2020⁸. 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 Review **Error! Bookmark not defined.** following the February 2020 flooding. The report details further recommendations put forward by NRW to improve their current approach to Forest Management. **(R1A, R1B, R1C, R1D)**
- NRW, as the woodland and forestry estate manager of the Welsh Government Woodland Estate, have undertaken clearance of the existing trackside drainage ditch above Aberdare Road in August 2020.
- NRW commissioned a consultant to investigate the stability of the rear retaining wall adjacent to properties affected at Aberdare Road.
- NRW undertook a topographic survey of the rear retaining wall at Aberdare Road and the upstream drainage channel along the forestry track
- In July 2021, NRW officers attended a site meeting with residents of Aberdare Road to discuss the recent flooding.
- In February 2022, NRW undertook vegetation removal and cleansing of 170 metres of existing drainage channel above Aberdare Road.
- NRW installed a flood door to one of the impacted properties at Aberdare Road in May 2022.

⁸ [Natural Resources Wales / Our response to Storm Ciara and Storm Dennis](#)

NRW, as a significant land estate manager within RCT, propose to exercise the following functions in response to the flooding at investigation area RCT21;

- As land managers of the WGWE, NRW are developing Flood Risk Guidance for Forest Operations which will explore the mechanisms in which they can provide better advise on the water management of the Welsh Government Woodland Estate. **(R1C, R1D)**
- Building upon their role as land managers of the WGWE, NRW are developing a Local Approach to Woodland and Trees which aims to provide NRW with the 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. **(R1C)**
- Further works adjacent to properties affected at Aberdare Road have been proposed by NRW which will involve the removal and rebuilding of retaining wall inclusive of drainage.
- Further drainage works have been proposed to improve the surface water drainage arrangements on the Welsh Government Woodland Estate to the north and east of the investigation area. These works are estimated to begin at the end of 2021, with construction planned for Autumn 2022. The works include design works to remove the old stone retaining wall adjacent to the property at Aberdare Road. **(R1A)**

4.3. WATER COMPANY

DCWW were not identified as a relevant authority in relation to the flooding at RCT21 on the 15th and 16th February 2020. Furthermore, the authority does not propose to undertake any functions in relation to the event.

4.4. HIGHWAY AUTHORITY

During the investigation into the flooding at investigation area RCT21 during Storm Dennis, the Highway was identified as flooding as a result of the overland flows down the hillsides above Blaenllechau Road and Aberdare Road. The influx of flood waters through the properties from the rear and onto the Highway resulted in flooding to the highway, however, the highway drainage apparatus eventually managed the additional overland flows once the rainfall had subsided.

RCT as the Highway Authority have exercised the following functions in response to the flooding at investigation area RCT21;

- 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.
- The Highway Authority also carried out maintenance works to clear vegetation and debris from the area surrounding their highway drainage infrastructure.
- 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 drainage infrastructure.

RCT as the Highway Authority propose to undertake the following function in relation to the event at investigation area RCT21;

- The Highway Authority to work with the LLFA to evaluate surface water management options to alleviate pluvial flooding at locations across the investigation area.

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>