



Flood and Water Management Act 2010

Section 19 Flood Investigation Report FI0084/A

Location: Mold, Flintshire
Incident Date: October 2023

Document Control Sheet

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Executive Summary

Following widespread flooding throughout Flintshire County in October 2023, Section 19 (Flood and Water Management Act 2010) Flood Investigation Reports have been prepared. Mold experienced flooding at numerous locations. Two separate Section 19 Reports have been produced for Mold. This report covers flooding across the centre of Mold which shared the same flooding source.

Locations considered by this report include:-

- Fir Grove, Park Avenue,
- Gwernaffield Road,
- Maes y March, Ash Grove,
- Clayton Road, Nant Garmon,
- Y Coetir, New Street,
- Ruthin Road,
- Cae Bracty,
- Brook Street,
- Wrexham Street,
- Gas Lane,
- Conway Street,
- Cunliffe Street; and
- Lon yr Orsaf

A separate Section 19 Report has been prepared to consider other areas of Mold with differing flood sources including:-

- Meadowside,
- Queens Park,
- Holland Cottages; and
- Alyn Meadows.

This report has been prepared for the purpose of meeting the requirements of Section 19 of the Flood and Water Management Act 2010. Under Section 19 of the Flood and Water Management Act 2010, the Lead Local Flood Authority (Flintshire County Council) on becoming aware of a flood in its area must, to the extent it considers necessary or appropriate, investigate, prepare and publish a Flood Investigation Report.

As a Lead Local Flood Authority (LLFA), it is the responsibility of Flintshire County Council (FCC) to manage the local flood risk from surface water, groundwater and ordinary watercourses such as streams and ditches (including lakes and ponds).

Section 19 of the Flood and Water Management Act 2010 states:

“On becoming aware of a flood in its area, a lead local flood authority must, to the extent it considers 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 intending to exercise, those functions in response to the flood”*

The flood risk management authorities in Flintshire are:

- Flintshire County Council
- Flintshire's Environment Department
- Natural Resources Wales
- Dŵr Cymru / Welsh Water

The relevant Flood Risk Management Authority for this event is Flintshire County Council as flooding was mainly attributed to an 'ordinary watercourse'. Internal flooding to a single residential property warrants that the incident should be investigated, and a report prepared in accordance with the Council's Local Flood Risk Management Strategy (LFRMS):¹

In October 2023, Storm Babet brought periods of heavy rainfall across large areas of the United Kingdom. The Met Office reported that the 18th to the 21st of October saw "the third-wettest independent 3-day period for England and Wales in a series from 1891".

Representatives of Waterco Ltd, on behalf of FCC, have carried out community engagement and communicated with relevant stakeholders to gain an understanding of the nature of the October 2023 flood event. This Report provides details of the flooding incident.

Across the areas of Mold considered by this S19 Flood Investigation Report, there were 48 reports of internal flooding. The majority of the internal flooding incidents can be attributed to the exceedance of hydraulically linked watercourses. Other reports of internal flooding have been attributed to exceedance of drainage systems, including highway gullies.

Table 1 sets out the recommended actions required to reduce the flooding, and the stakeholder required to undertake each action.

¹ <https://www.flintshire.gov.uk/en/PDFFiles/Flooding-and-Drainage/Flintshire-Local-Flood-Risk-Management-Strategy.pdf>.

Table 1 - Recommendations to Address Flooding

Ref	Stakeholder	Action
01	Riparian Owner	Inspect the existing culvert inlet at Highfield Villas on a frequent basis and remove debris as required.
02	FCC Highways Authority	Post event undertake a CCTV condition survey of the Brook Street culvert confluence to ensure the culvert is free of blockage and any significant siltation. Take remedial action as required.
03	FCC Highways Authority	Continue maintenance of highway drainage assets in high-risk areas. For example, at Brook Street and Ruthin Road.
04	FCC LLFA	Communicate with local communities to raise awareness of property level flood resilience measures that can be implemented to help mitigate flood risk.
05	FCC LLFA	Investigate implementing natural flood management upstream of the areas impacted by flooding from ordinary watercourses / surface water, namely Fir Grove and Highfield Villas culvert inlets.
06	FCC LLFA	Review condition of the ordinary watercourses and inform the riparian landowners if any issues are identified. FCC to use permissive duties and powers under the LDA and FWMA to allow flow via culvert entrances, watercourses and culverts are maintained to convey flows as intended.
07	NRW	Ensure Main Rivers are inspected on a risk-based frequency and where appropriate and justifiable, a maintenance regime is documented and completed by an appropriate Risk Management Authority and/or Riparian Owner.
08	DCWW	Review customer complaints and investigate the associated sections of public sewer system to remove any blockage / significant debris following the October 2023 event.
09	Property Owners / Residents	Sign up to the free signing up to the NRW Flood Warning System and consider the implementation of property level flood resilience measures. These could include; the installation of non-return valves to prevent ingress of floodwater on private drainage systems and installing flood barriers or flood doors.

1.0 Introduction

- 1.1 Since the introduction of the Flood and Water Management Act 2010 (FWMA) Flintshire County Council (FCC) is the designated Lead Local Flood Authority (LLFA).
- 1.2 Under Section 19 of the FWMA, Flintshire County Council as the LLFA, on becoming aware of a flood in its area must, to the extent that it considers necessary or appropriate, investigate and prepare a report.
- 1.3 Where a LLFA carries out an investigation then the report must be published, and any relevant risk management authorities notified.
- 1.4 Waterco have been commissioned by FCC to carry out a Flood Investigation Report in relation to flooding in the Fir Grove, Park Avenue, Gwernaffield Road, Maes y March, Ash Grove, Clayton Road, Nant Garmon, Y Coetir, New Street, Ruthin Road, Cae Bracty, Brook Street, Wrexham Street, Gas Lane, Conway Street, Cunliffe Street, and Lon yr Orsaf areas of Mold during Storm Babet which occurred in October 2023. Storm Babet caused both internal and external flooding to residential properties in Mold. The flooding to all areas considered in this Section 19 Report is hydraulically linked. A separate Section 19 report is available for the Meadowside, Queens Park, Holland Cottages and Alyn Meadows areas of Mold. These areas are not hydraulically linked to the flooding experienced in the centre of Mold.
- 1.5 The purpose of this Section 19 (S19) Flood Investigation Report is to identify the cause of internal flooding to properties in the Fir Grove, Park Avenue, Gwernaffield Road, Maes y March, Ash Grove, Clayton Road, Nant Garmon, Y Coetir, New Street and Ruthin Road, Cae Bracty, Brook Street, Wrexham Street, Gas Lane, Conway Street, Cunliffe Street, and Lon yr Orsaf areas during the October 2023 flood event. This report will provide an overview of flooding mechanisms, identify relevant Risk Management Authorities and stakeholders, and provide a list of recommendations.
- 1.6 The opinions expressed in this report and the comments and recommendations given are based on an assessment of available information.
- 1.7 The information, views and conclusions drawn are based, in part, on information supplied to Waterco by other parties. Waterco has proceeded in good faith on the assumption that this information is accurate. Waterco accepts no liability for any inaccurate conclusions, assumptions or actions taken resulting from any inaccurate information supplied to Waterco from others.

2.0 Summary of Storm Babet and Impact

National Context

- 2.1 Storm Babet brought heavy and persistent rainfall across much of the UK and 'was the third-wettest independent 3-day period for England and Wales in a series from 1891' according to the Met Office². As shown in Figure 1, many parts of the UK received over 50mm of rain, with 75-100mm of rain recorded across areas of North Wales. Several areas across the UK received over 100% of the average rainfall amount for October.

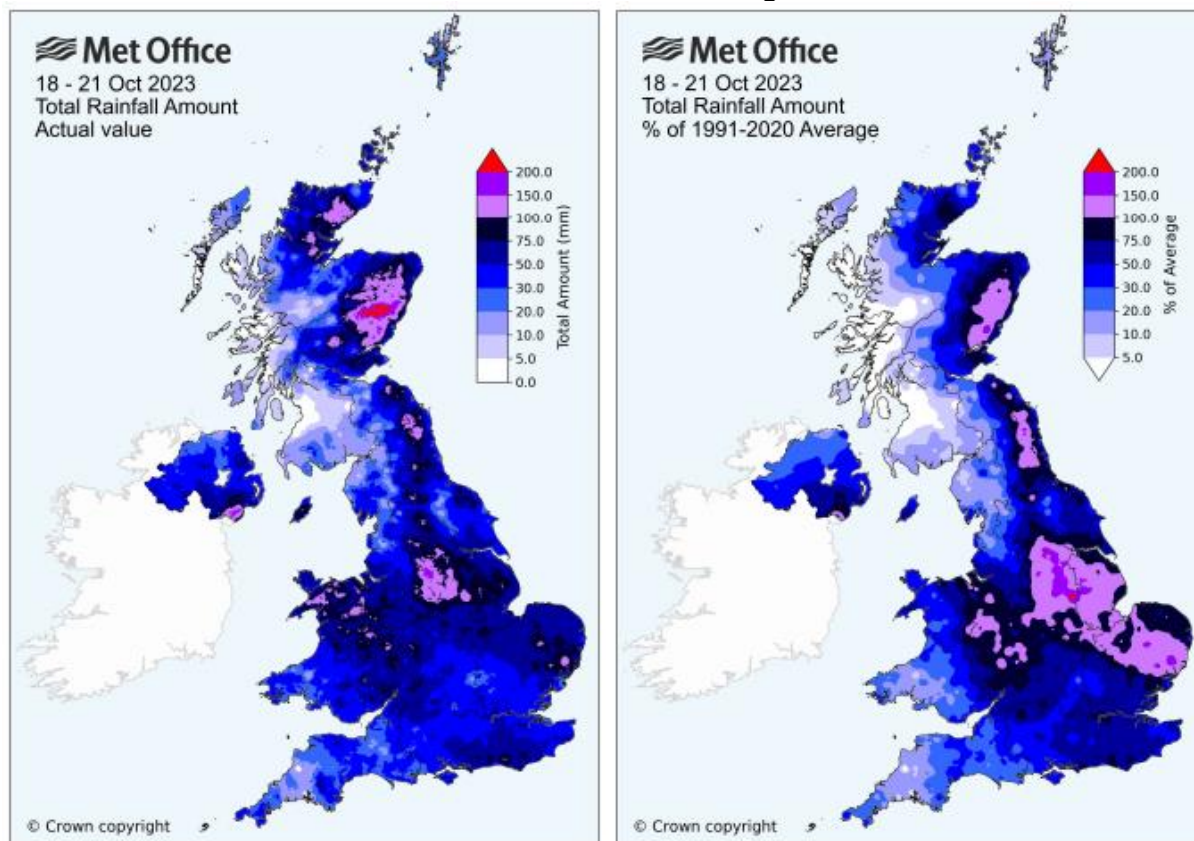


Figure 1 - Met Office Accumulated Daily Rainfall 18th-21st of October 2023

- 2.2 Storm Babet was part of a wider period of heavy rainfall across the country. NRW state that the 9-month period ending in March 2024 was the second wettest of any 9-month period recorded in North Wales, and the wettest 9-month period ending in the month of March. Storms over this period (such as Storm Babet) were characterised more by their prolonged rainfall rather than their intensity. Between September 2023 and March 2024 NRW issued 194 Flood Warnings and 3 Severe Flood Warnings.

Regional Context

- 2.3 Unlike most storms, Storm Babet did not pass over rapidly. This allowed multiple fronts to add more rainfall over a prolonged period of time. The evapotranspiration rate in October was low and rainfalls were frequent throughout the month, with high levels of antecedent rainfall on October 13th / 14th (27mm in Mold) leading to soils being close to saturation.
- 2.4 Rainfall records have been obtained from NRW's Mold rain gauge³.

² Storm Babet Report https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/weather/learn-about/uk-past-events/interesting/2023/2023_08_storm_babet.pdf

³ <https://rivers-and-seas.naturalresources.wales/Station/1011?parameterType=2>

- 2.5 Figure 2 shows the rainfall in the days leading up to the flooding on the 20th of October. Flintshire experienced rainfall two days prior to the 20th of October, with 15.2mm of rainfall on the 18th and 11.8mm on the 19th. On the 20th of October, Mold rain gauge recorded 61.8mm of rainfall.

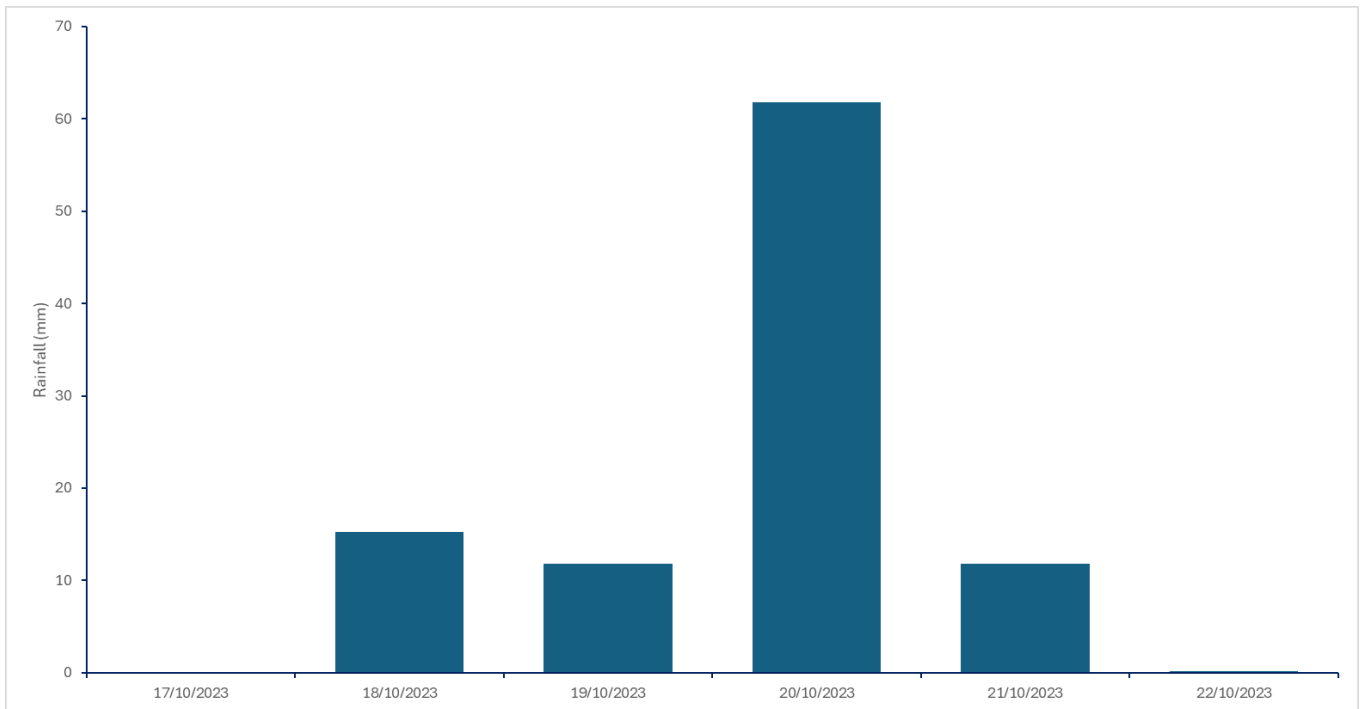


Figure 2 - NRW Mold Rain Gauge - Daily Rainfall From 18th-21st October

- 2.6 Figure 3 shows that there was a period of intense rainfall on Wednesday the 18th of October which began at 19:00pm and peaked between 21:00-22:00 with 5mm of rainfall per hour. There was some additional rainfall on Thursday the 19th of October peaking at approximately 1mm per hour. During 20th October, rainfall was prolonged with peak rainfall intensities at approximately 4.2mm per hour.

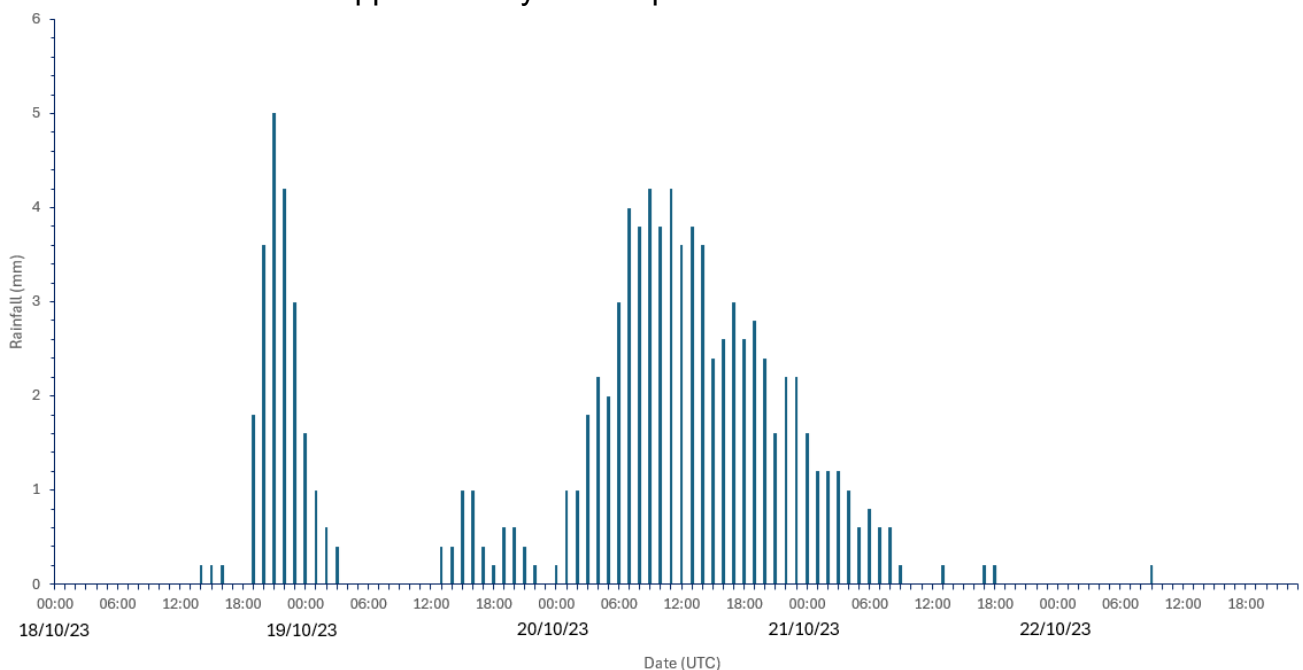


Figure 3 - Hourly rainfall between the 18th and 22nd of October

- 2.7 Flood Estimation Handbook (FEH) analysis estimates that a total of 61.8mm of rainfall over 24 hours (on the 20th of October), as recorded at the NRW Mold rain gauge, equates to an approximate return period of 1 in 20 years.
- 2.8 The 73.6mm of rainfall over a 48-hour period between the 19th and 20th of October (recorded at the NRW Mold rain gauge) equates to a return period of approximately 1 in 23 years. The 88.8mm of rainfall over a 72-hour period between the 18th and 20th of October equates to an approximate return period of 1 in 39 years.
- 2.9 Due to high amounts of rainfall throughout October, it is likely that there would have been a lack of soil water storage, which may have led to higher and quicker runoff resulting in flooding.

Local Context

- 2.10 Community Engagement was undertaken by Waterco in Mold on the 29th of August 2024 and the 2nd of September 2024. The purpose of the community engagement exercise was to gather information on the number of properties affected and the flooding mechanisms / source(s). In addition to speaking with householders, a questionnaire was posted to seek additional feedback. Table 2 shows a summary of the number of responses received.

Table 2 - Summary of Community Engagement Undertaken in Mold

Location	Verbal responses received (properties)	Number of postal / email responses
Fir Grove, Park Avenue and Gwernaffield Road	14	7
Maes y March, Ash Grove, Clayton Road, Nant Garmon and Y Coetir	14	11
New Street and Ruthin Road	6	5
Cae Bracty	0	0
Brook Street and Wrexham Street	9	5
Gas Lane	2	0
Conway Street and Cunliffe Street	7	3
Y Gilfach, Glynteg and Highfield Villas	4	1
Lon yr Orsaf	6	6

- 2.11 In addition to the community engagement exercise, relevant stakeholders were consulted regarding any information on flooding in Mold:
- **Natural Resources Wales** – provided information on calls received during Storm Babet; a record of properties known to have flooded; and correspondence with North Wales Fire and Rescue Service.
 - **FCC Highways Authority** – provided a call log showing where members of public had reporting flooding.

- **Dŵr Cymru Welsh Water** – held a post-Storm Babet meeting with FCC and Waterco to share details of asset performance and flooding records during Storm Babet.

2.12 Table 3 provides a summary of the locations and reported effects of flooding following the community engagement exercise and stakeholder engagement.

2.13 A photographic record showing the flooding during and following Storm Babet for the Fir Grove, Park Avenue, Gwernaffield Road, Maes y March, Ash Grove, Clayton Road, Nant Garmon, Y Coetir, New Street and Ruthin Road, Cae Bracty, Brook Street, Wrexham Street, Gas Lane, Conway Street, Cunliffe Street, and Lon yr Orsaf areas of Mold is included in Appendix A.

Table 3 - Summary of Flooding in Mold During Storm Babet

Location	Internal Flooding	Impact
Fir Grove, Park Avenue and Gwernaffield Road	6	Internal flooding to 6 properties, external driveway / garden flooding confirmed to at least 12 others.
Maes y March, Ash Grove, Clayton Road, Nant Garmon and Y Coetir	10	Internal flooding to 10 properties, external driveway / garden flooding confirmed to at least 8 others.
New Street and Ruthin Road	4	Internal flooding to 4 properties, external driveway / garden flooding confirmed to at least 7 others.
Cae Bracty	13	Internal flooding to 13 properties.
Brook Street and Wrexham Street	6	Internal flooding to 6 properties, external driveway / garden flooding confirmed to at least 4 others.
Conway Street and Cunliffe Street	4	Internal flooding to 4 properties, external driveway / garden flooding confirmed to at least 5 others.
Lon yr Orsaf	5	Internal flooding to 5 properties, external driveway / garden flooding confirmed to at least 2 others.
Total Internal Flooding Reports	48	Number of internal flooding incidents based on community engagement exercises and stakeholder engagement. Flooding to additional properties may have occurred but not reported to FCC.

3.0 Study Area Overview

Location

- 3.1 Flooding in Mold was generally recorded in locations in close proximity to ordinary watercourses which flow through the urban area of Mold and form tributaries of the River Alyn. Figure 4 shows the approximate locations of property flooding in Mold, reported by FCC, stakeholders, and residents. Figure 4 is also reproduced as Appendix B.

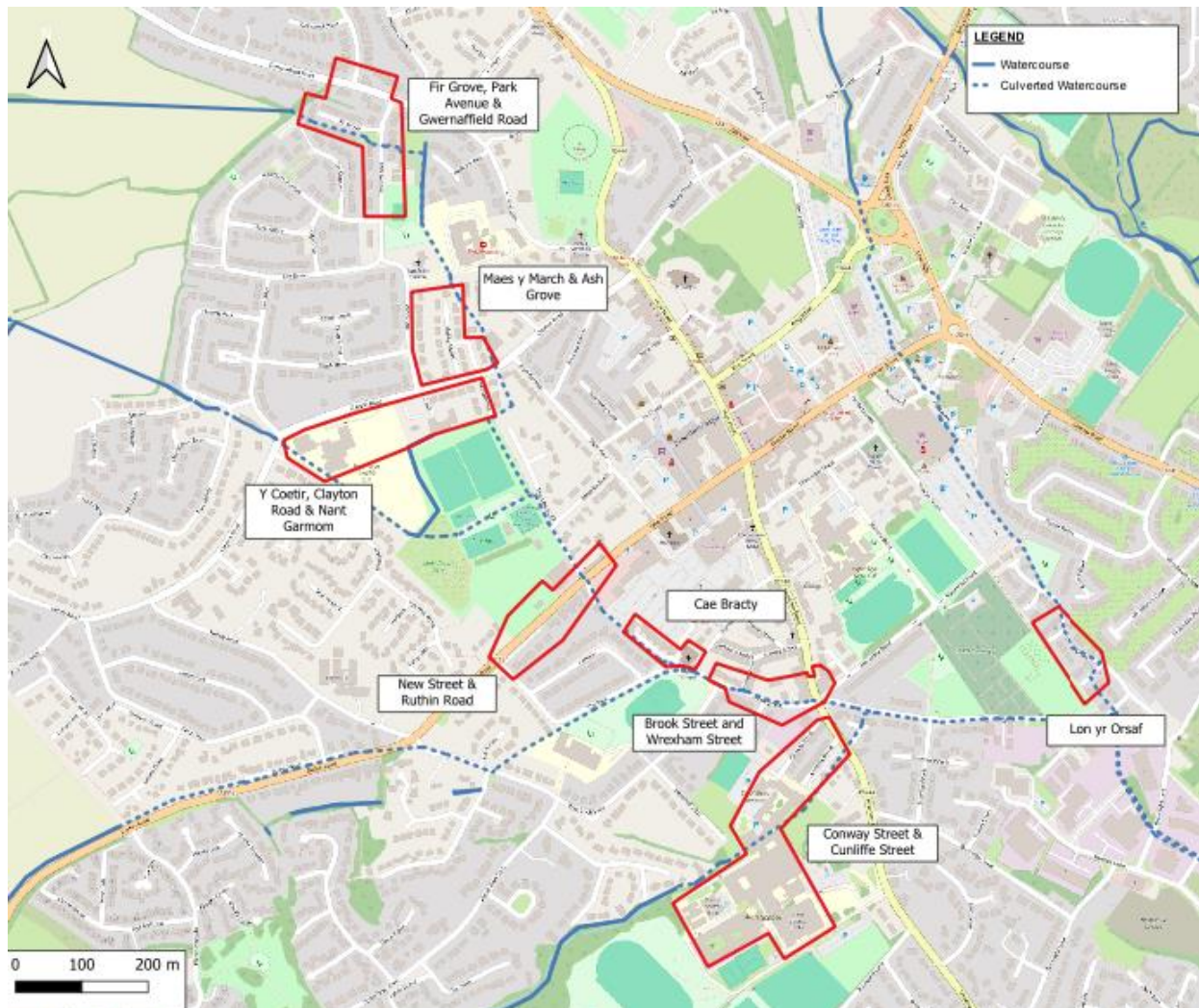


Figure 4 - Plan of Reported Flooding Areas

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Geology

- 3.2 The British Geological Survey (BGS)⁴ online mapping (1:50,000 scale) indicates that Mold is predominantly underlain by superficial Glaciofluvial deposits, generally comprising Sand and Gravel, and Alluvium, generally comprising of Clay, Silt, Sand and Gravel. The underlying bedrock geology is identified as being interbedded Sandstone, Mudstone, Siltstone and Conglomerate. BGS Records for the area can be found in Appendix G.

Hydrological Setting

Fir Grove, Park Avenue and Gwernaffield Road Area

- 3.3 As shown in Figure 5, there is an unnamed culverted watercourse flowing east beneath Fir Grove and Park Avenue. The culvert discharges to a watercourse on the eastern edge of the playing fields east of Park Avenue. The unnamed watercourse flows south and becomes culverted at the southern end of the playing fields. The locations of the culverted watercourses have been obtained from DCWW sewer records and are approximate only.

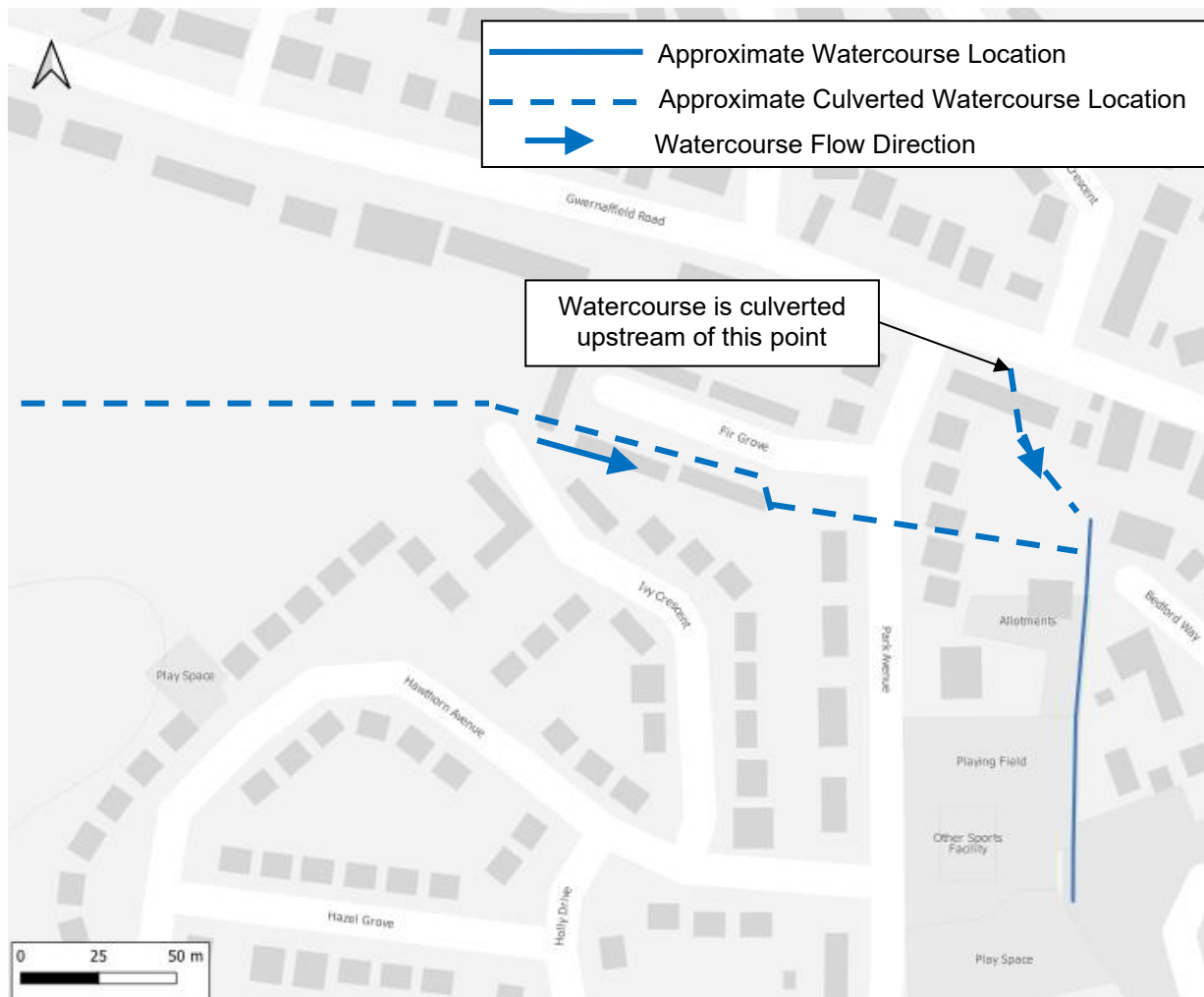


Figure 5 – Fir Grove, Park Avenue and Gwernaffield Road Area Watercourse Map

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⁴ British Geological Survey - <https://mapapps2.bgs.ac.uk/geoindex/home.html>

- 3.4 The catchment area of the unnamed watercourse at Fir Grove, shown in Figure 5 above, covers approximately 0.49km². Figure 6 shows the approximate catchment area generated using Scalgo software. The catchment area shown is approximate only and features such as highway drainage and private drainage systems which may intercept flow and redirect water are not represented.



Figure 6 – Fir Grove, Park Avenue and Gwernaffield Road Area Contributing Watercourse Catchment
(source: SCALGO)

Maes y March, Ash Grove, Clayton Road, Nant Garmon and Y Coetir Area

- 3.5 As shown in Figure 7, the unnamed watercourse detailed in Figure 5 is culverted at the southern extent of the playing fields and continues south. The culvert is located east of Maes y March and flows south beneath Clayton Road. 2no. culverted watercourses join immediately south of Nant y Garmon, before continuing south.

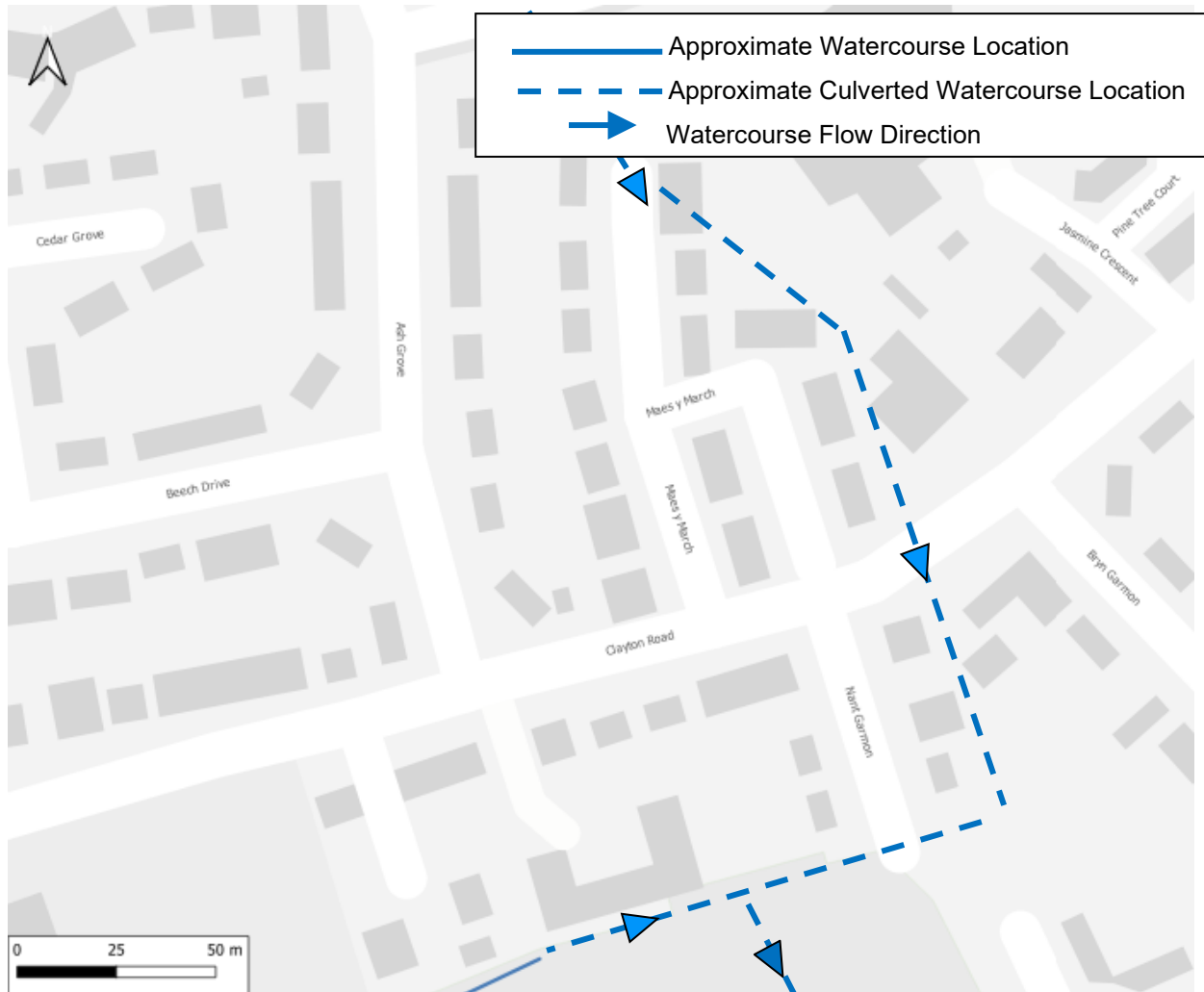


Figure 7 – Maes y March, Ash Grove, Clayton Road, Nant Garmon and Y Coetir Area Watercourse Map

Contains OS Data © Crown Copyright (2024)

- 3.6 The catchment area of the unnamed watercourse near Clayton Road covers approximately 4.3km². Figure 8 shows the approximate catchment area generated using Scalgo software.



Figure 8 – Maes y March, Ash Grove, Clayton Road, Nant Garmon and Y Coetir Area Contributing Watercourse Catchment
(source: SCALGO)

New Street and Ruthin Road

- 3.7 As shown in Figure 9, the culverted watercourse which flows south beyond Clayton Road continues beneath Maes Bodlondfa (to the east of the play and recreation ground). The culverted watercourse crosses beneath New Street (A5119) at NGR: 323545, 363715. A separate unnamed watercourse is located approximately 100m south of Ruthin Road and flows east.



Figure 9 – New Street and Ruthin Road Area Watercourse Map

Contains OS Data © Crown Copyright (2024)

3.8. The catchment area of the unnamed watercourse near New Street covers approximately 6.7km². Figure 10 shows the approximate catchment area generated using Scalgo software.

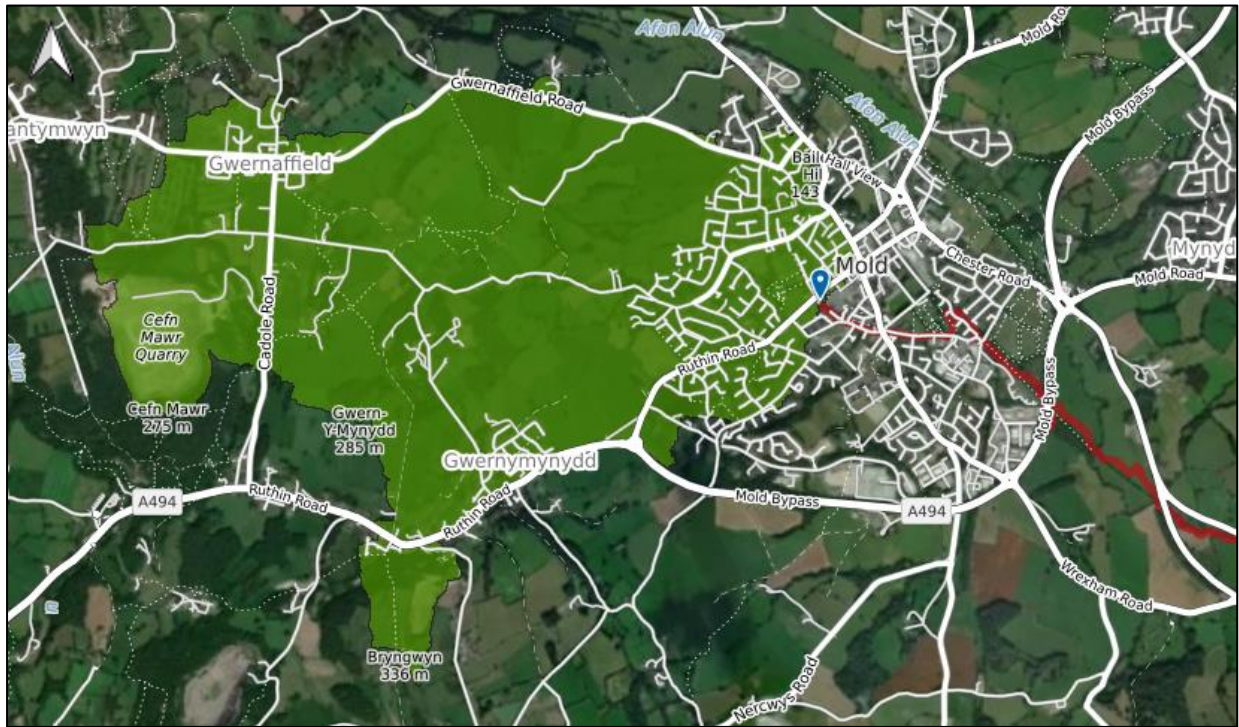


Figure 10 – New Street and Ruthin Road Area Contributing Watercourse Catchment
(source: SCALGO)

Cae Bracty Area

- 3.8 As shown in Figure 11, the unnamed watercourse culverted beneath New Street continues south-east, crossing beneath Cae Bracty continuing beneath Stryd Y Nant. The unnamed watercourse south of The Park (road) joins the aforementioned watercourse south-east of Cae Bracty.

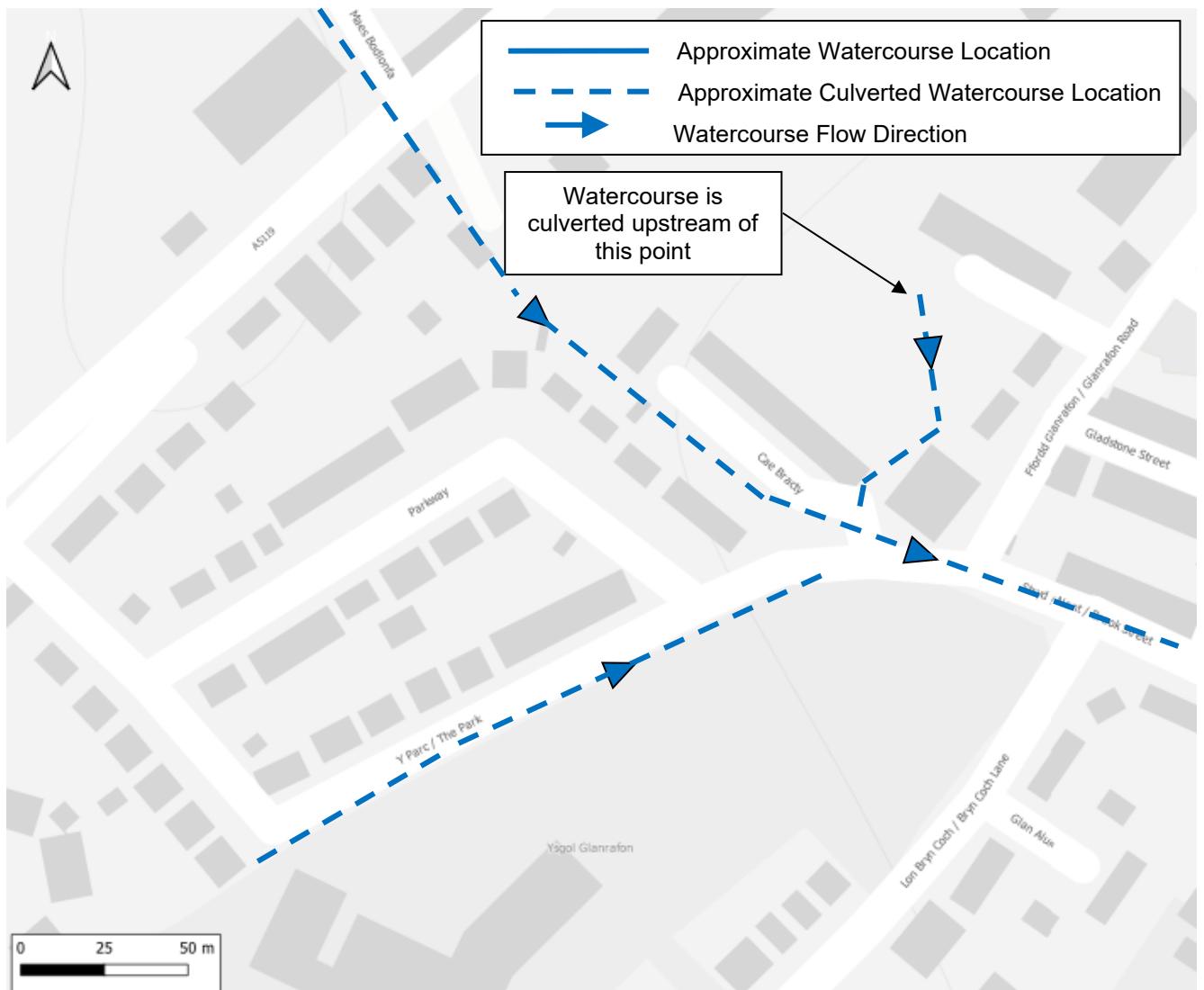


Figure 11 – Cae Bracty Area Watercourse Map

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- 3.9 The catchment area of the watercourse downstream of Cae Bracty covers approximately 6.73km². Figure 12 shows the approximate catchment area generated using Scalgo software.



Figure 12 – Cae Bracty Area Contributing Watercourse Catchment
(source: SCALGO)

Brook Street and Wrexham Street Area

- 3.10 As shown in Figure 13, the unnamed culverted watercourse continues south-east from Cae Bracty and flows beneath Stryd y Nant / Brook Street, continuing beneath Wrexham Street (B5444).

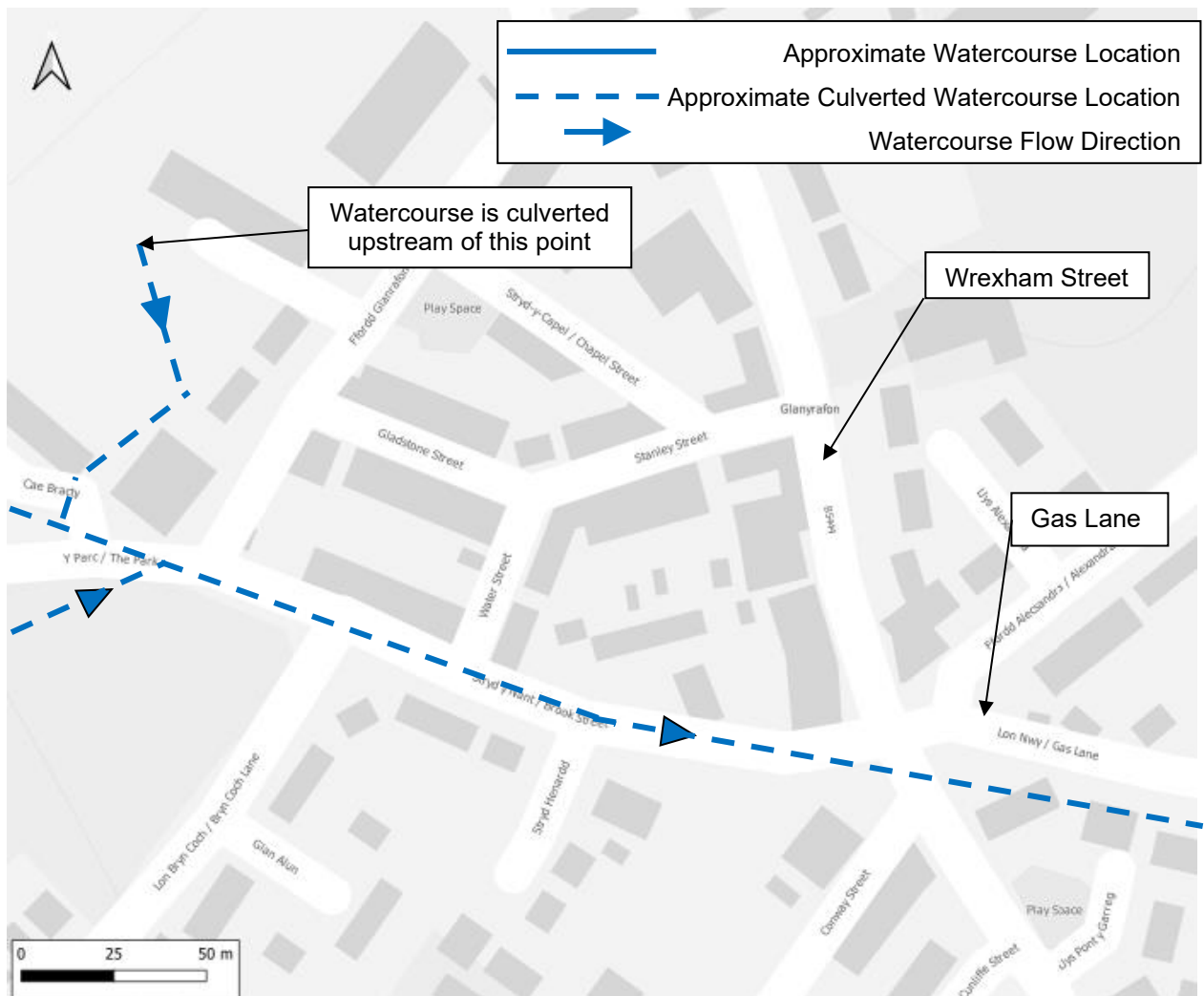


Figure 13 – Brook Street and Wrexham Street Area Watercourse Map
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- 3.11 The catchment area of the unnamed watercourse at Wrexham Street covers approximately 6.88km². Figure 14 shows the approximate catchment area generated using Scalgo software.



Figure 14 – Brook Street and Wrexham Street Area Contributing Watercourse Catchment
(source: SCALGO)

Conway Street and Cunliffe Street Area

- 3.12 As shown in Figure 15, a culverted watercourse flows north-east through the grounds of Ysgol Maes Garmon / Alun School. The culverted watercourse crossing the school grounds joins the aforementioned unnamed watercourse beneath Gas Lane.

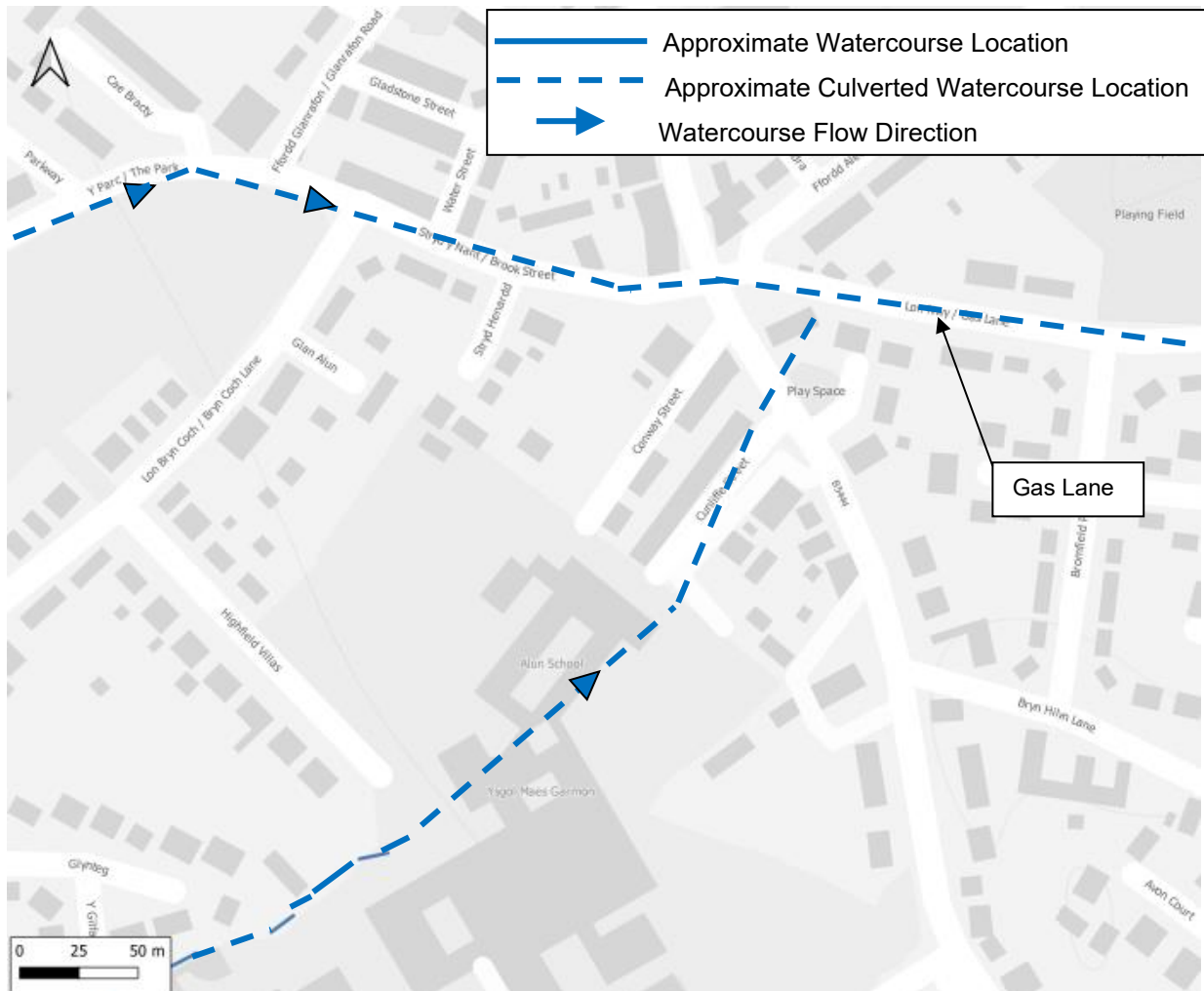


Figure 15 – Conway Street and Cunliffe Street Area Watercourse Map

Contains OS Data © Crown Copyright (2024)

- 3.13 The catchment area of the culverted watercourse which crosses the school grounds covers approximately 1.6km². Figure 16 shows the approximate catchment area generated using Scalgo software.

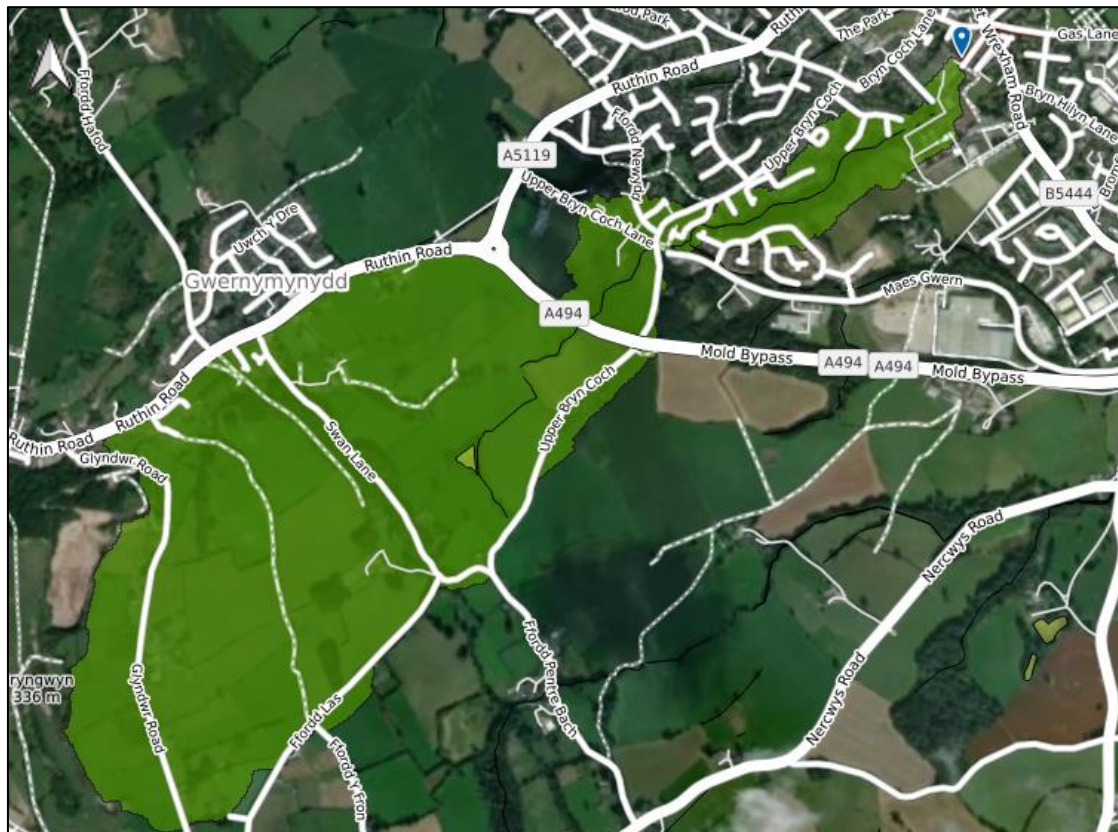


Figure 16 – Conway Street and Cunliffe Street Area Contributing Watercourse Catchment
(source: SCALGO)

Lon yr Orsaf Area

- 3.14 As shown in Figure 17, an unnamed culverted watercourse flows south beneath Lon yr Orsaf and joins the aforementioned culverted watercourse (which is culverted in Gas Lane) near the junction of Gas Lane and Llys Derwen.

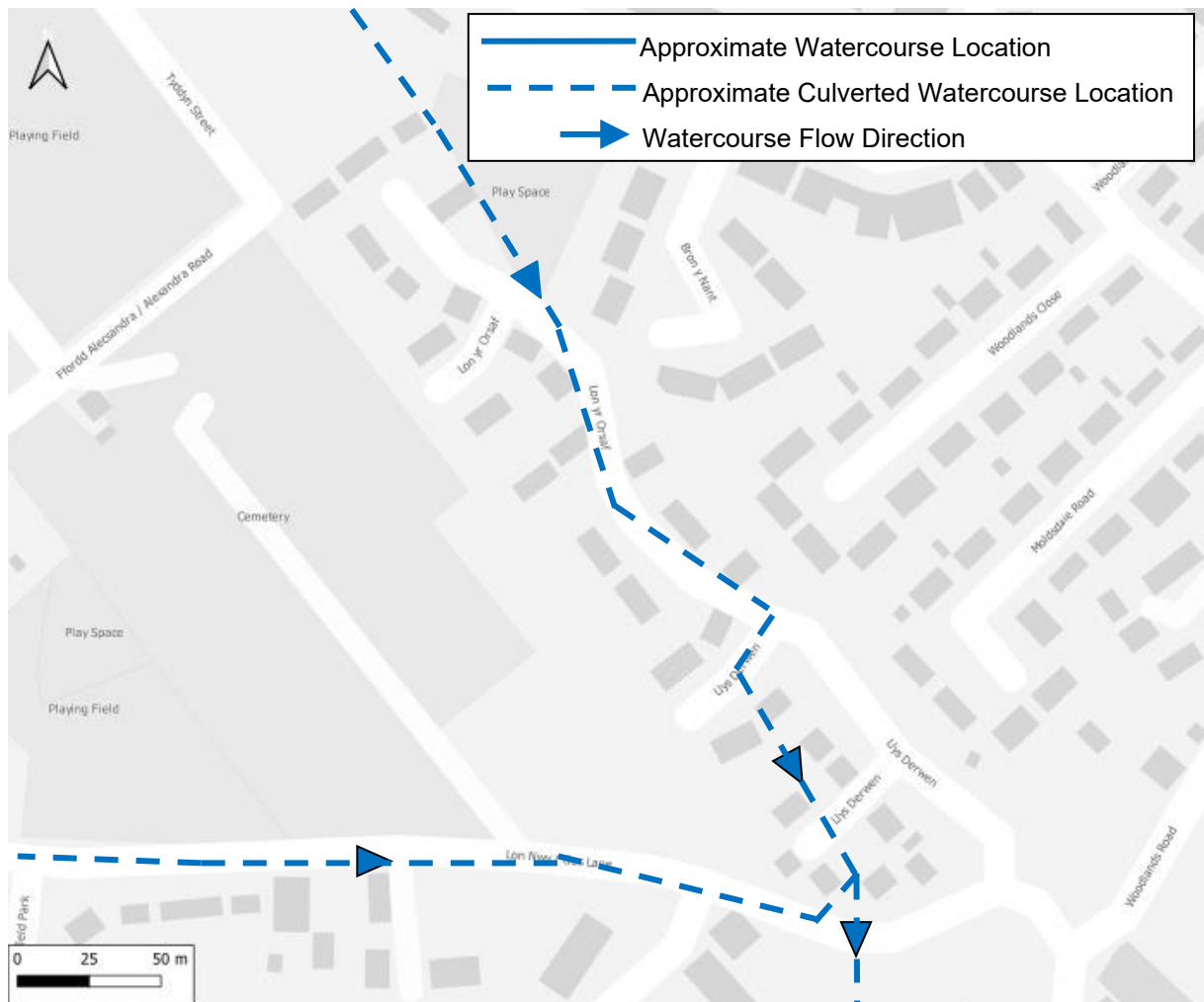


Figure 17 – Lon yr Orsaf Area Watercourse Map
Contains OS Data © Crown Copyright (2024)

- 3.15 The catchment area downstream of where the culverted watercourses merge at the junction of Gas Lane and Llys Derwen covers approximately 9.19km². Figure 16 shows the approximate catchment area generated using Scalgo software.



Figure 18 – Lon yr Orsaf Area Contributing Watercourse Catchment
(source: SCALGO)

Drainage Assets

- 3.17 Public sewer records have been obtained from Dŵr Cymru Welsh Water (DCWW). The sewer records show that the majority of Mold is served by a combined sewer drainage system, including the areas of Fir Grove, Park Avenue, Gwernaffield Road, Clayton Road, Nant Garmon, Y Coetir, New Street, Ruthin Road, Brook Street, Wrexham Road, Conway Street, Cunliffe Street. Various roads are served by separate surface water and foul sewers, including the areas of Maes y March, Ash Grove, Cae Bracty and Lon yr Orsaf. The various surface water sewers are shown to connect to unnamed culverted watercourses across Mold, including Maes y March and Ash Grove at NGR: 323161, 364787, Cae Bracty at NGR: 323678, 363597 and Lon yr Orsaf at NGR: 324236, 363704, NGR: 324268, 363638 and NGR: 324312, 363568. DCWW records are included in Appendix D.

NRW Flood Maps

- 3.18 The NRW 'Flood Map for Planning – Rivers and Sea' map identifies the flood risk associated with main river and sea. The NRW map shows land within Flood Zones 2 and 3. Flood Zone 2 is defined as an area with between a 0.1% and 1% chance of flooding from rivers and / or sea in any given year, including the effects of climate change. Flood Zone 3 is defined as an area with a greater than 1% chance of flooding in any given year, including the effects of climate change.
- 3.19 The flood risk shown on the NRW 'Flood Map for Planning –Surface Water and Small Watercourses' map identifies the flood risk associated with small watercourses throughout Mold and is based on a combination of rainfall and LiDAR data. The mapping identifies areas where surface water may flow or pool during heavy rainfall. LiDAR Mapping for context of elevations surrounding Mold can be found in Appendix C. Again, many areas throughout Mold lie within Flood Zone 2 and 3 from small watercourses and/or surface water.
- 3.20 Further NRW Flood Maps are available in Appendix E.
- 3.21 The NRW Flood Map for Planning – Rivers, Sea, Surface Water and Small Watercourses map shown in Figure 19 identifies the flood risk associated with rivers and small watercourses across Mold.

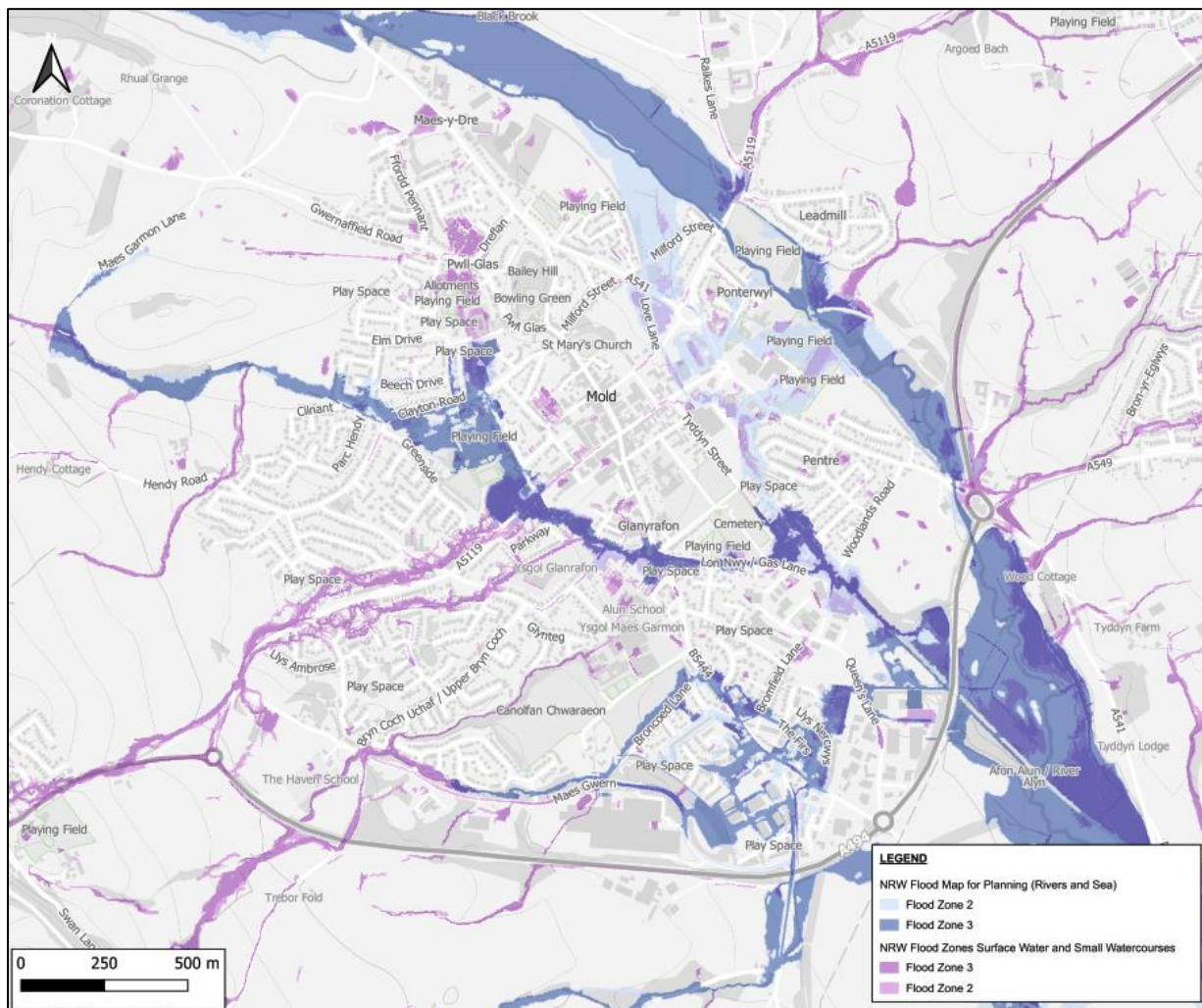


Figure 19 - NRW Flood Map for Planning - Rivers, Sea, Surface Water and Small Watercourses Map

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Fir Grove, Park Avenue and Gwernaffield Road

- 3.22 Figure 20 shows the flood extent for rivers, sea, surface water and small watercourse in Fir Grove and Park Avenue. Land west of Fir Grove and a topographical low point along Park Avenue are shown within surface water flood zones 2 and 3.



Figure 20 - NRW Flood Risk from Rivers, Sea, Surface Water and Small Watercourses Map at Fir Grove, Park Avenue and Gwernaffield Road

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Maes y March, Ash Grove, Clayton Road, Nant Garmon and Y Coetir

- 3.23 Figure 21 shows the flood extent around Maes y March, Ash Grove, Clayton Road, Nant y Garmon and Y Coetir. Several properties and roads are within the flood extent associated with the culverted watercourse.

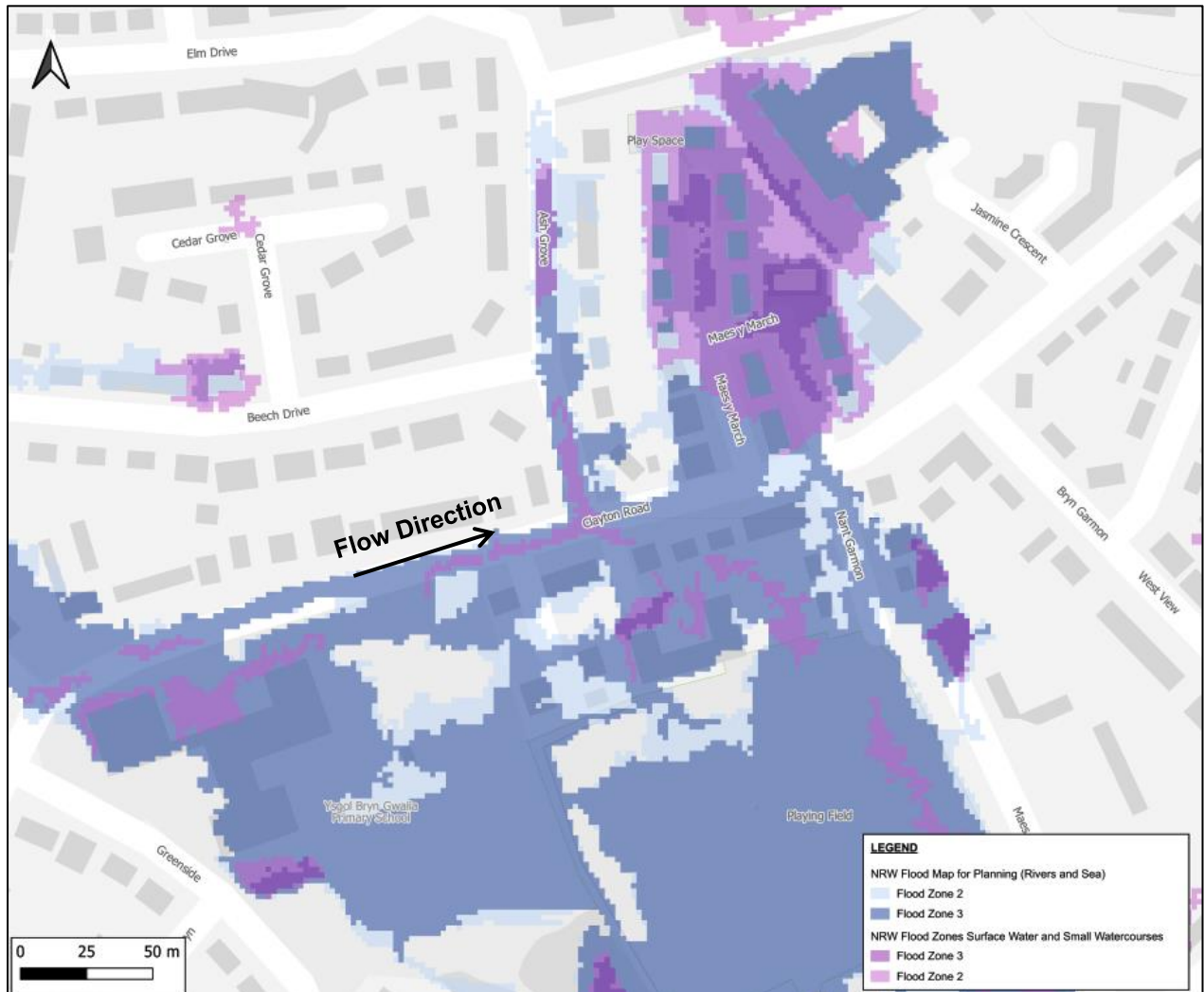


Figure 21 - NRW Flood Map for Planning - Rivers, Sea, Surface Water and Small Watercourses Map at Maes y March, Ash Grove, Clayton Road, Nant Garmon and Y Coetir

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New Street and Ruthin Road

- 3.24 As shown in Figure 22, NRW mapping shows a large area of surface water pooling north of New Street and Ruthin Road. Flood flow routes north-west of Ruthin Road are associated with the culverted watercourse. The flow route orientates south-east towards Cae Bracty.

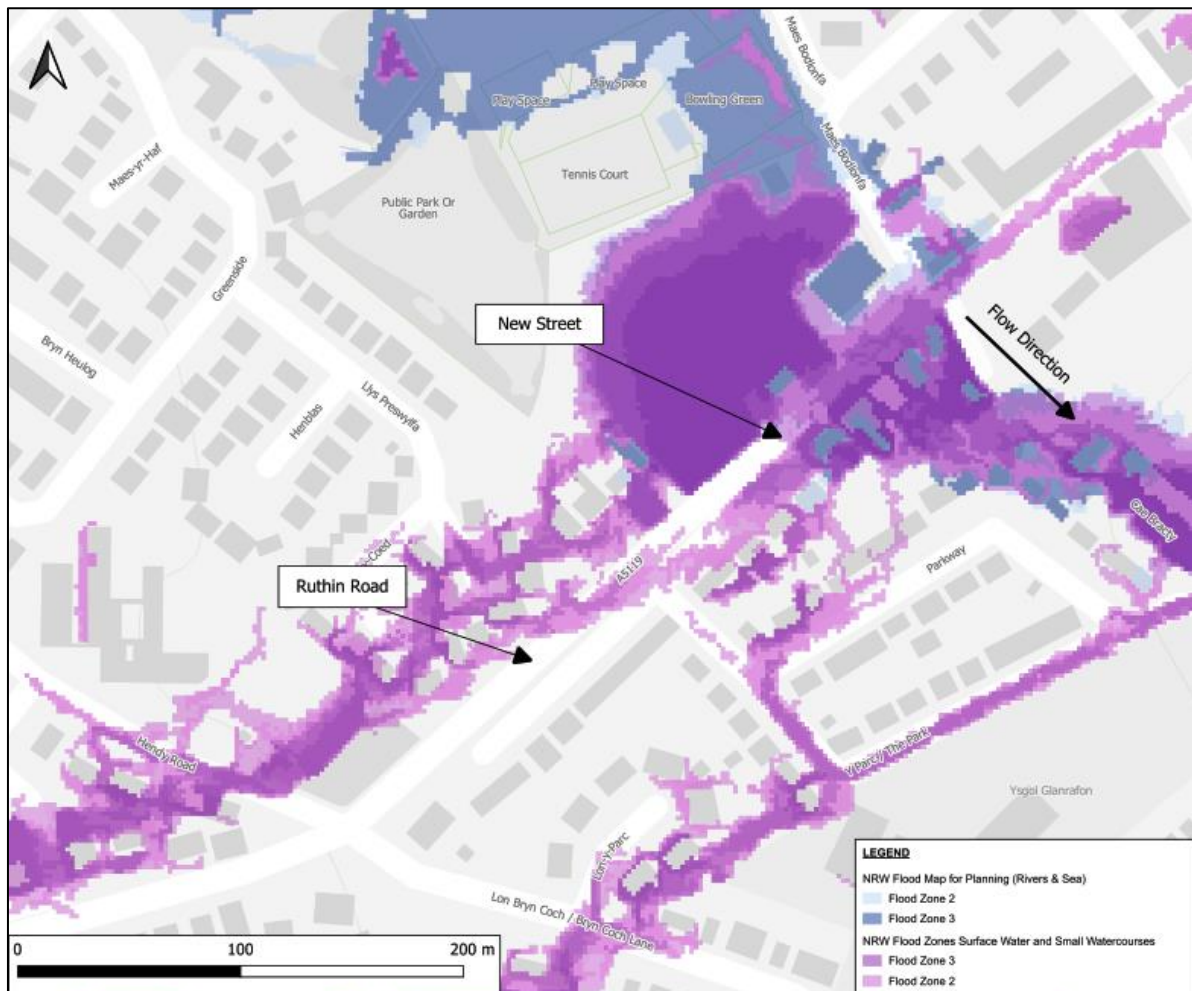


Figure 22 - NRW Flood Map for Planning - Rivers, Sea, Surface Water and Small Watercourses Map at New Street and Ruthin Road

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Cae Bracty

- 3.25 As shown in Figure 23, a surface water flow route associated with the culverted watercourse crosses through Cae Bracty. Cae Bracty is situated at an isolated topographical low point and flood water is shown to pool (as represented by the Flood Zone 3 extent).



Figure 23 - NRW Flood Map for Planning - Rivers, Sea, Surface Water and Small Watercourses Map at Cae Bracty

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Brook Street and Wrexham Street

- 3.26 As shown in Figure 24, Brook Street and Wrexham Street are shown within the Flood Zone 2 and 3 extents associated with the culverted watercourse. Flood flows orientate south-east within Brook Street with properties adjacent to Brook Street shown within the flood extent.

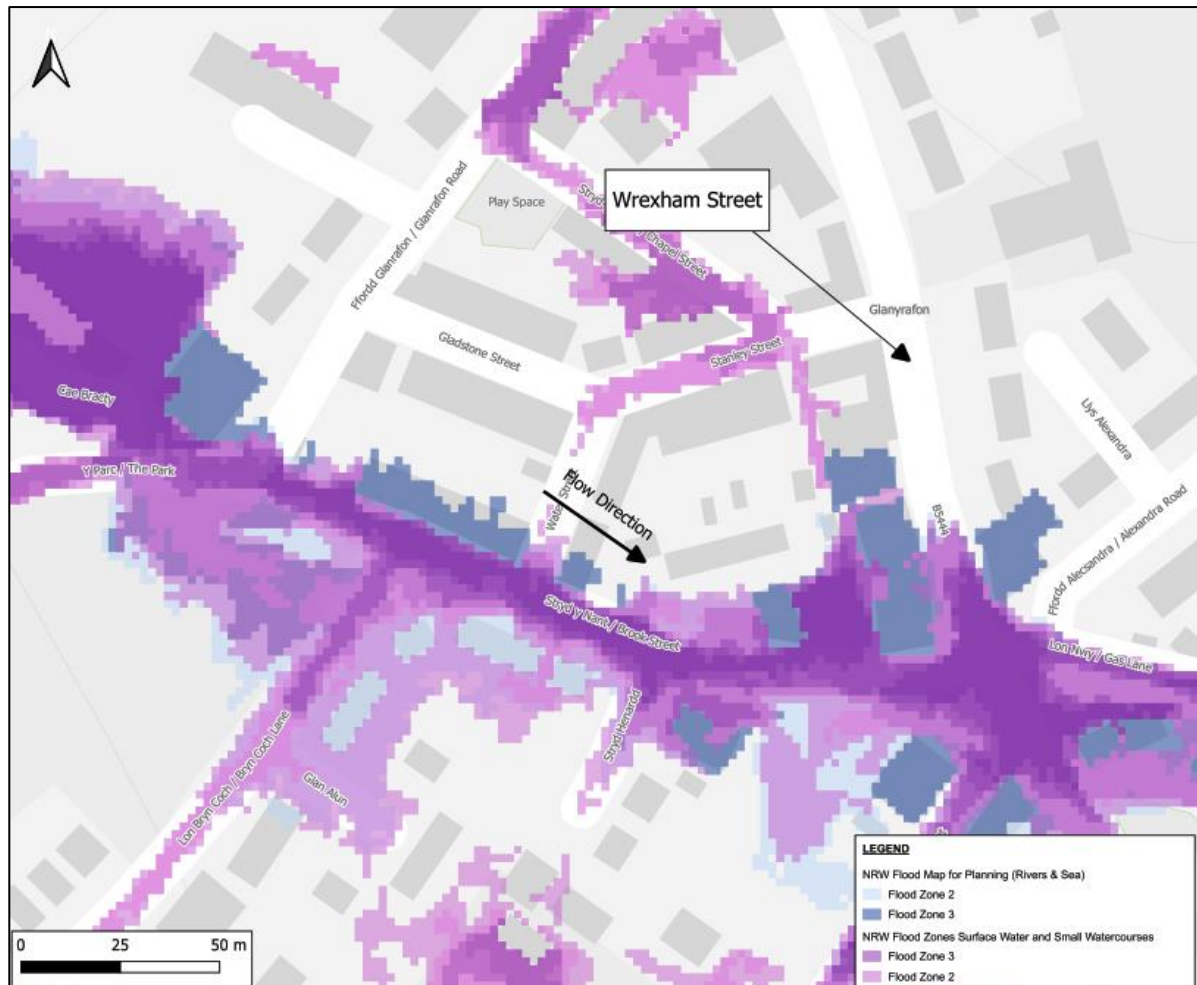


Figure 24 - NRW Flood Map for Planning - Rivers, Sea, Surface Water and Small Watercourses Map at Brook Street and Wrexham Street

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Conway Street and Cunliffe Street

- 3.27 As shown in Figure 25, NRW Mapping shows flooding from rivers, small watercourses and surface water along Conwy Street, and surface water flooding to the rear (northwest) of properties along Cunliffe Street. Flooding appears to flow south down Conway Street from the direction of the junction for Brook Street, Wrexham Street and Gas Lane.



Figure 25 - NRW Flood Map for Planning - Rivers, Sea, Surface Water and Small Watercourses Map at Conway Street and Cunliffe Street

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Lon yr Orsaf

- 3.28 NRW Mapping shown in Figure 26 shows a large area of flooding across and surrounding Lon yr Orsaf, with the sources being from rivers, small watercourses and surface water. Flooding appears to occur along the route of the culverted watercourse which runs directly through Lon yr Orsaf, as well as surface water and small watercourse flooding which pools in the land to the east and west of the area.

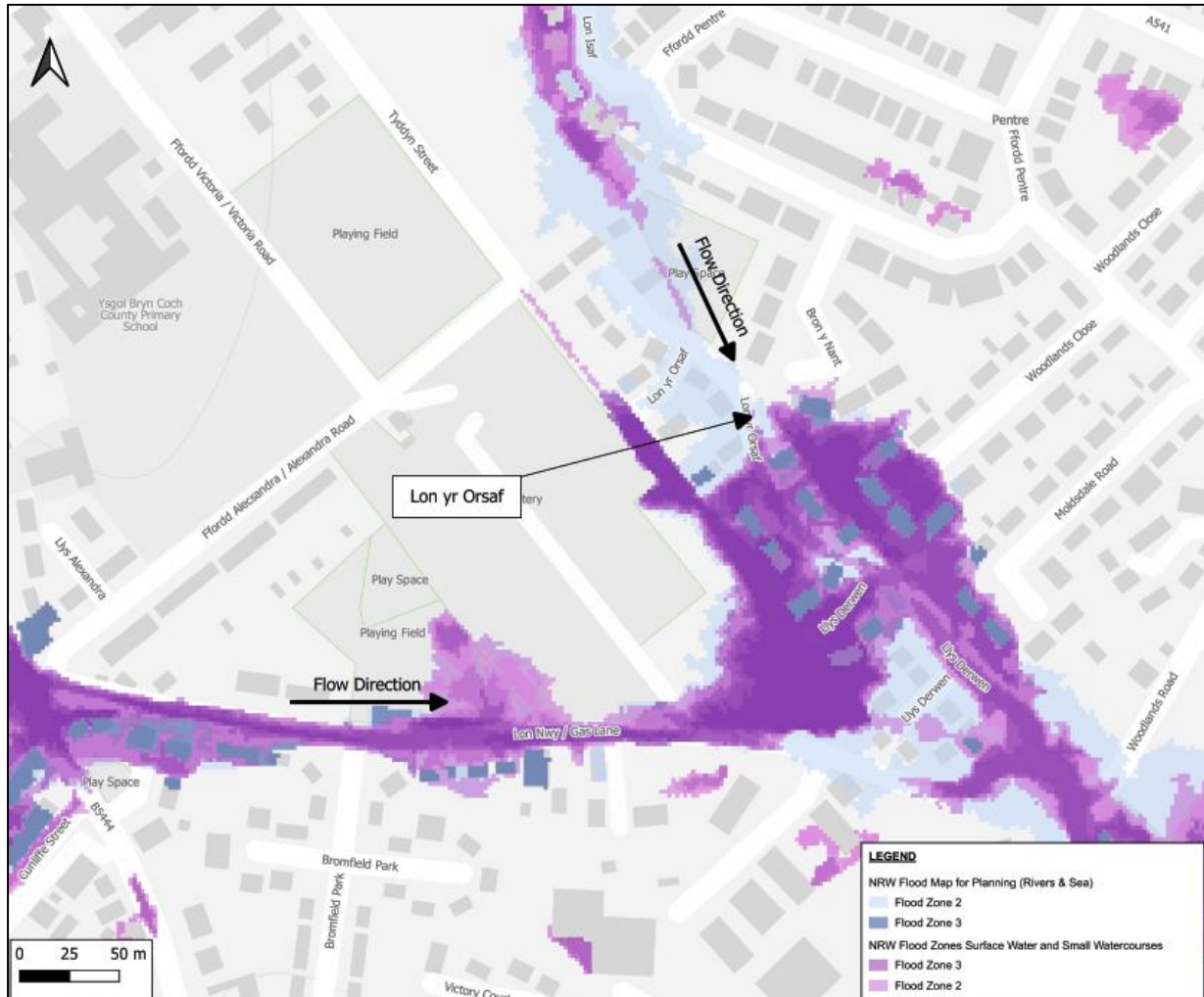


Figure 26 - NRW Flood Map for Planning – Rivers, Sea, Surface Water and Small Watercourses Map at Lon yr Orsaf

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4.0 Flood Locations, Descriptions and Mechanisms

Fir Grove, Park Avenue and Gwernaffield Road

- 4.1 Based on the findings of the community engagement exercise and stakeholder engagement, the flooding to Fir Grove, Park Avenue and Gwernaffield Road is attributed to flooding from an exceedance of the culverted watercourse at Fir Grove. Several of the properties along Fir Grove are situated below the road level, leading to flood flows from the road entering properties.
- 4.2 Bow waves caused by traffic resulted in flooding on roads being pushed towards properties. The emergency services closed Park Avenue to prevent traffic movements.
- 4.3 Flooding caused electricity to turn off, and water to back up through internal drains. Damage caused to properties meant that some residents had to find alternative accommodation for up to 6 months whilst restoration took place.
- 4.4 Figure 27 provides a summary of the reported flooding.

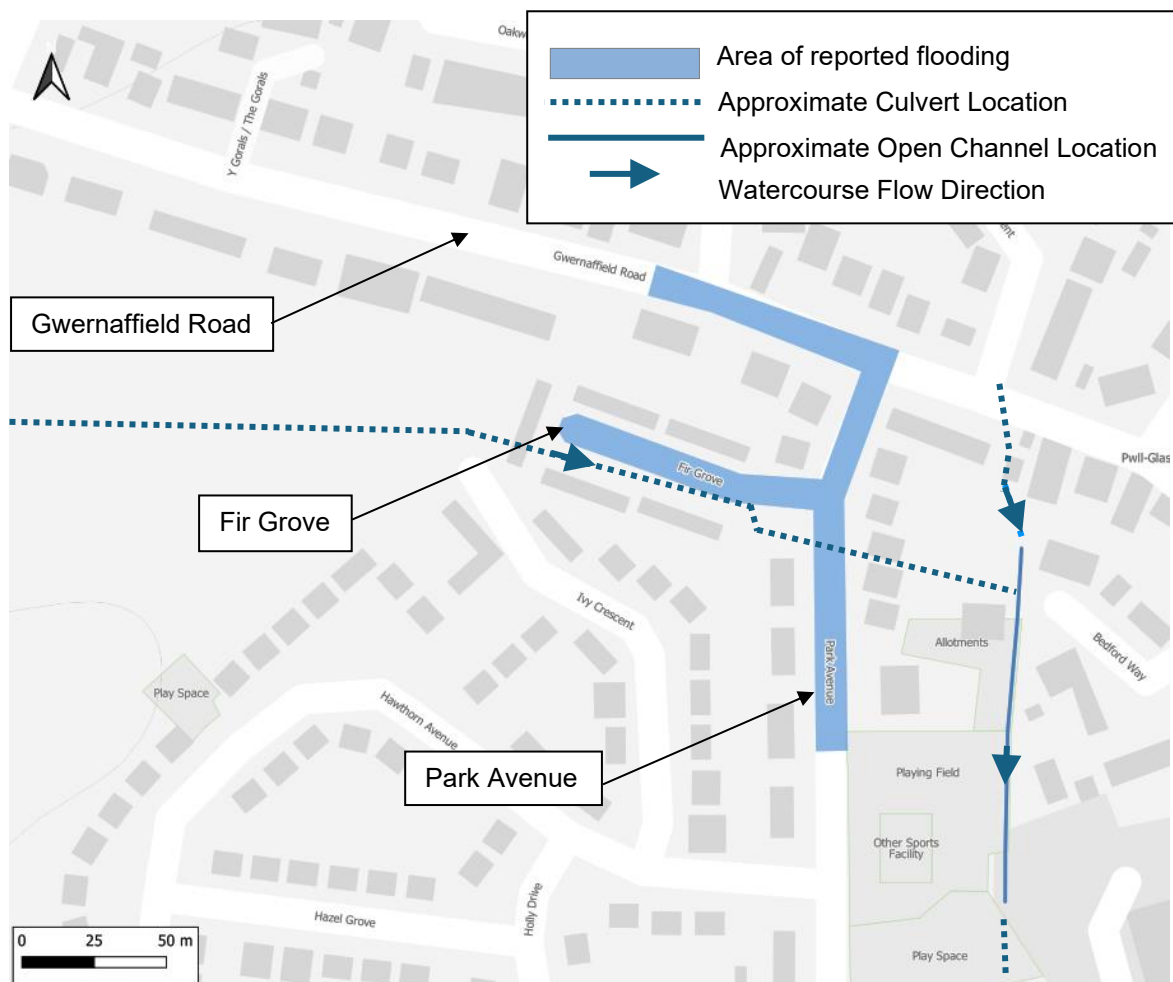


Figure 27 - Fir Grove, Park Avenue and Gwernaffield Road

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Maes y March, Ash Grove, Clayton Road, Nant Garmon and Y Coetir

- 4.5 Based on the findings of the community engagement exercise and stakeholder engagement, the flooding at Maes y March, Ash Grove, Clayton Road, Nant Garmon and Y Coetir resulted from an exceedance of a culverted watercourse to the west of Clayton Road.
- 4.6 Residents reported that flood flows appeared to be associated with a blocked culvert in the Clayton Road area. It was reported that flooding flowed east along Clayton Road.
- 4.7 There were reports of internal flooding in some properties, and cars driving through the flood flows caused bow waves which worsened flooding to properties. Flooding entered properties through doors as well as through air bricks.
- 4.8 Properties at Y Coetir reportedly had internal flooding. Residents were evacuated by emergency services. It was reported that flood flows pooled in the car park of Y Coetir at a level high enough to cause cars to float. Emergency services reportedly demolished a concrete panel to allow flows to disperse into land to the south of the properties.
- 4.9 Flooding to Ash Grove was limited to the southern end of the road, with most properties remaining unaffected. It is understood that the properties affected had lower door thresholds than the unaffected properties.
- 4.10 Figure 28 provides a summary of the reported flooding.

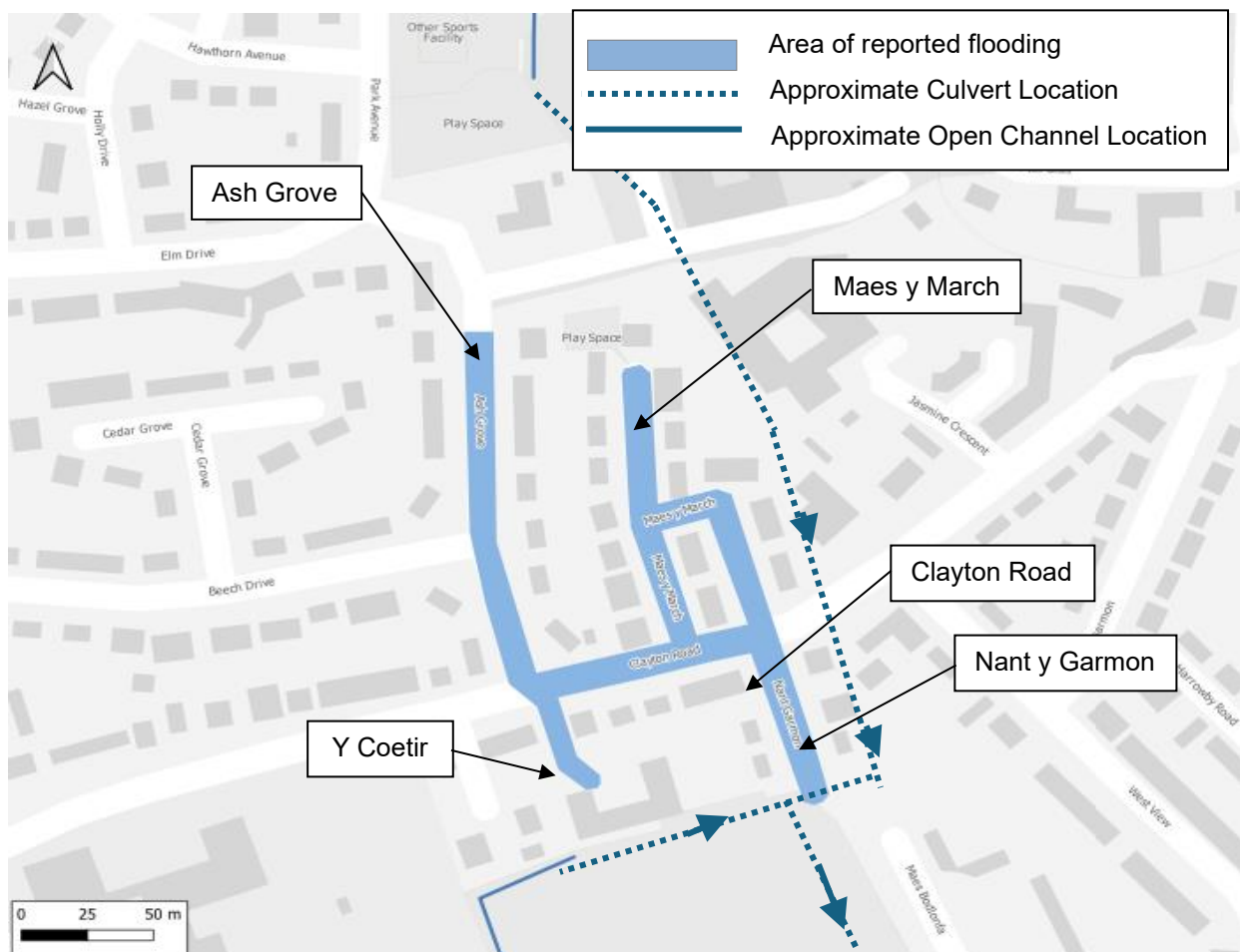


Figure 28 - Maes y March and Ash Grove, Clayton Road, Nant Garmon and Y Coetir

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New Street and Ruthin Road

- 4.11 Based on the findings of the community engagement exercise and stakeholder engagement, the reported source of flooding was from ordinary watercourses along Ruthin Road, the Red Rec Park and from surface water (possibly associated with an exceedance of the capacity of the culverted watercourse) on New Street.
- 4.12 The flooding was reported to be worsened by bow waves caused by passing traffic.
- 4.13 There were reports of sewerage in flood flows, likely a result of flood water entering and exceeding sewer systems, as well as gravel that washes from the road.
- 4.14 Figure 29 provides a summary of the reported flooding.

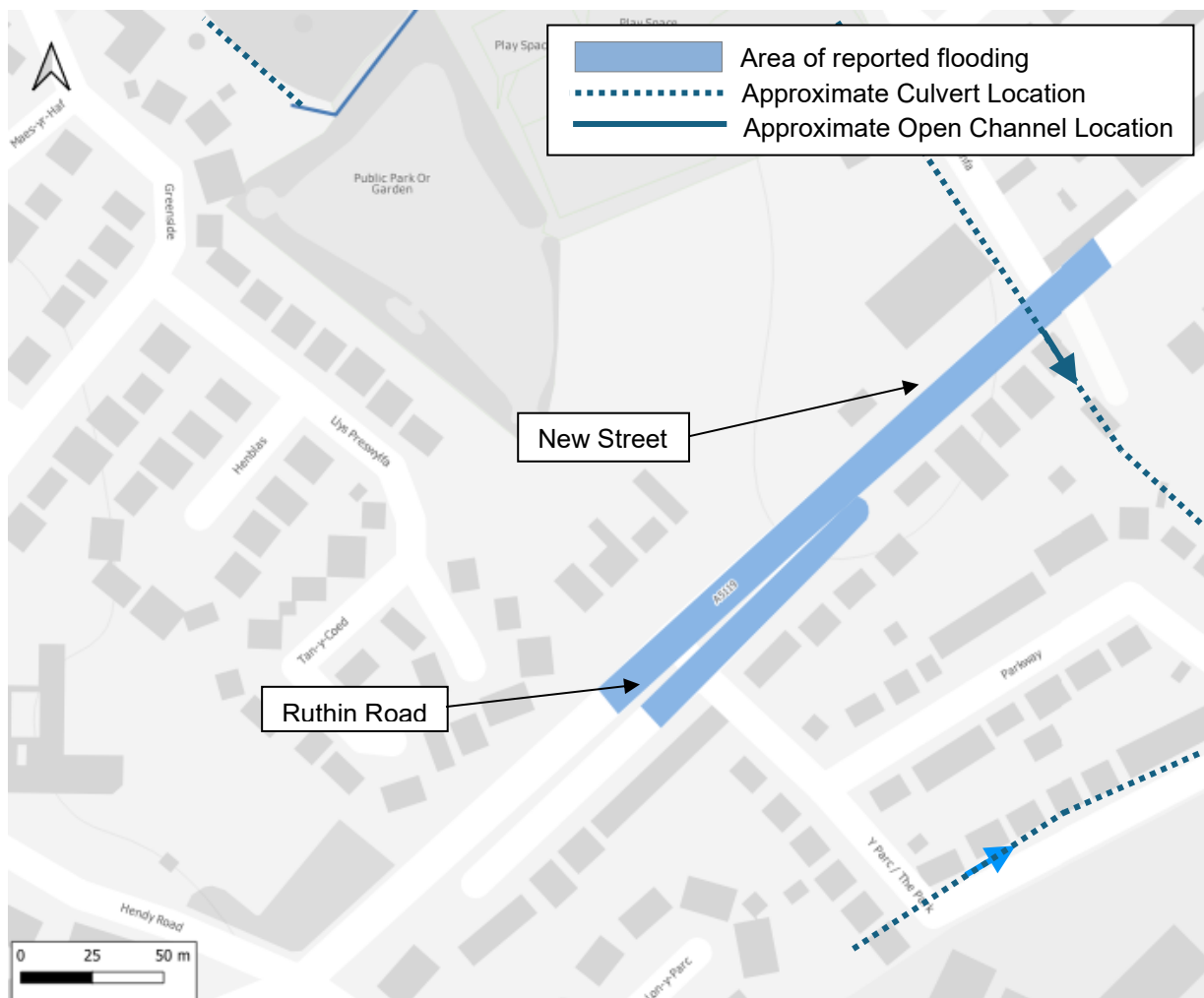


Figure 29 - New Street and Ruthin Road

Contains OS Data © Crown Copyright (2024)

Cae Bracty

- 4.15 Based on the findings of the community engagement exercise and stakeholder engagement, the reported source of flooding was from an exceedance of the culverted watercourse which flows directly through Cae Bracty. Surcharging of surface water from a chamber on the culverted watercourse was reported on Brook Street where 3no. culverted watercourses combine, as well as surface water which is unable to drain into the culvert. Surface water flooding is also reported to flow into Cae Bracty from the car park to the north-east of Cae Bracty.
- 4.16 There were reports that all ground floor properties were flooded, however residents were relocated following a previous flooding event in 2021. Figure 30 provides a summary of the reported flooding.

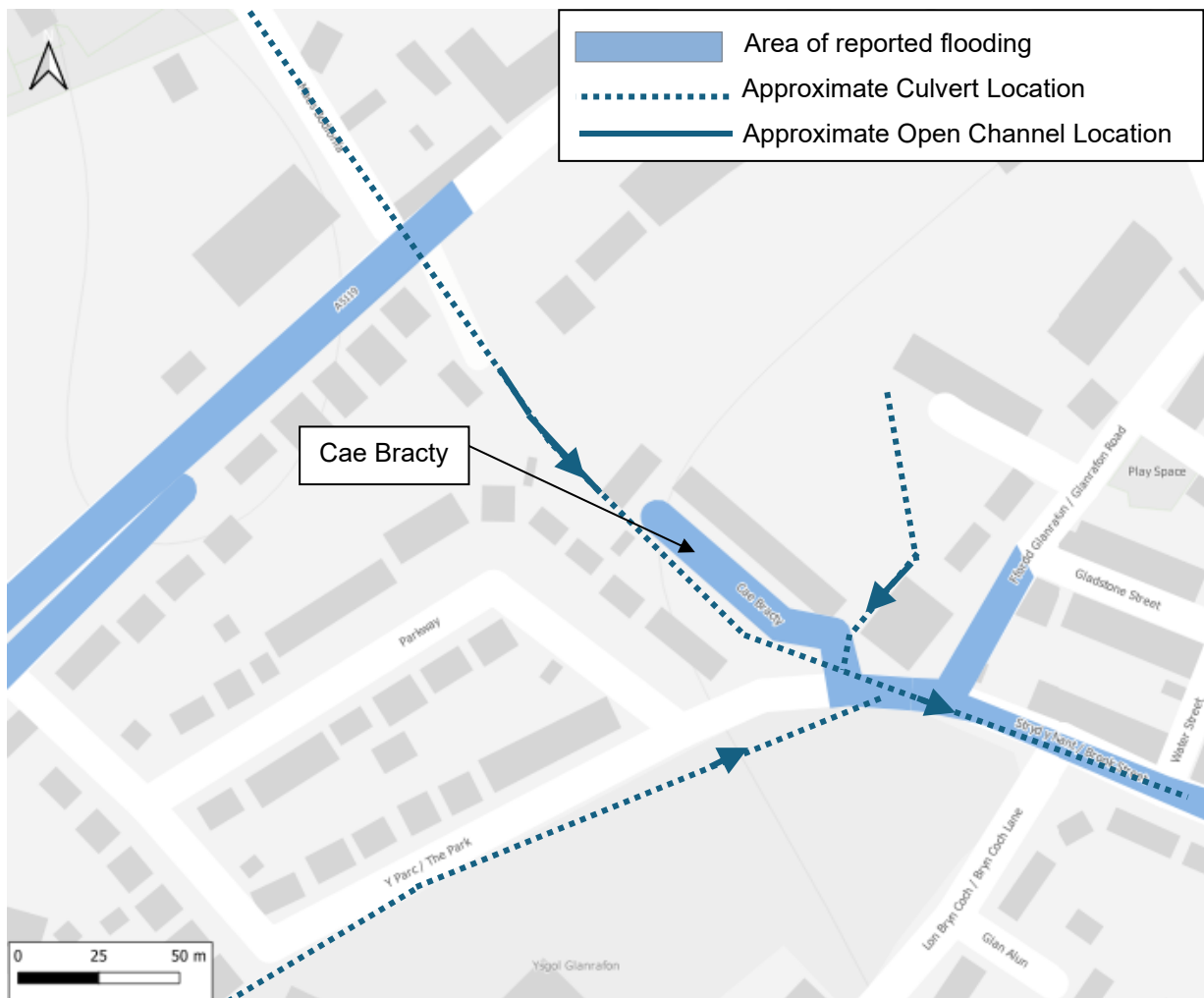


Figure 30 - Cae Bracty
Contains OS Data © Crown Copyright (2024)

Brook Street and Wrexham Street

- 4.17 Based on the findings of the community engagement exercise and stakeholder engagement, the reported source of flooding was from an exceedance of the culverted watercourse which flows beneath Brook Street. The flooding is a continuation of the flooding upstream at the entrance to Cae Bracty, at the confluence of the 3 watercourses.
- 4.18 Residents reported flooding of around 200mm on Brook Street, with high flow velocities. The flooding was reported to worsen with traffic, causing bow waves which pushed water towards properties. There were reports of highway drains becoming blocked at the time of the flood.
- 4.19 There were reports of water flowing out of the culvert manhole cover at the junction of Brook Street and Glanrafon Road.
- 4.20 Properties on Wrexham Street were reportedly affected by flood flows which entered basements to a depth of around 1200mm.
- 4.21 Figure 31 provides a summary of the reported flooding.

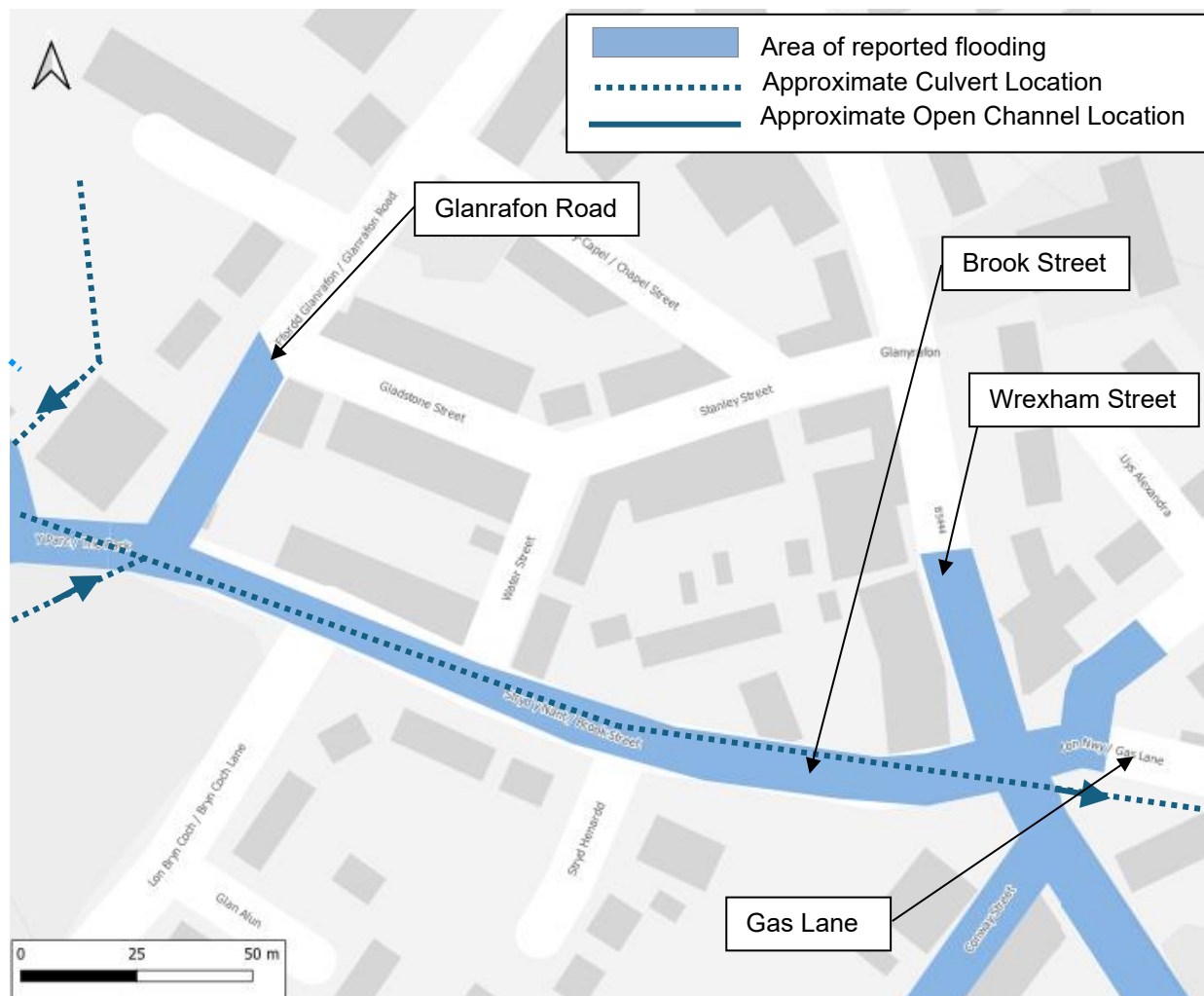


Figure 31 - Brook Street and Wrexham Street

Contains OS Data © Crown Copyright (2024)

Conway Street and Cunliffe Street

- 4.22 Based on the findings of the community engagement exercise and stakeholder engagement, the reported source of flooding was from an exceedance of the culverted watercourse beneath Cunliffe Street (linked with the flooding on Brook Street and Wrexham Road). It is anticipated that flows overtop a culvert to the southwest of Cunliffe Street within the grounds of Ysgol Maes Garmon and Alyn School.
- 4.23 There were reports that basements were flooded on both Conway Street and Cunliffe Street.
- 4.24 Figure 32 provides a summary of the reported flooding.

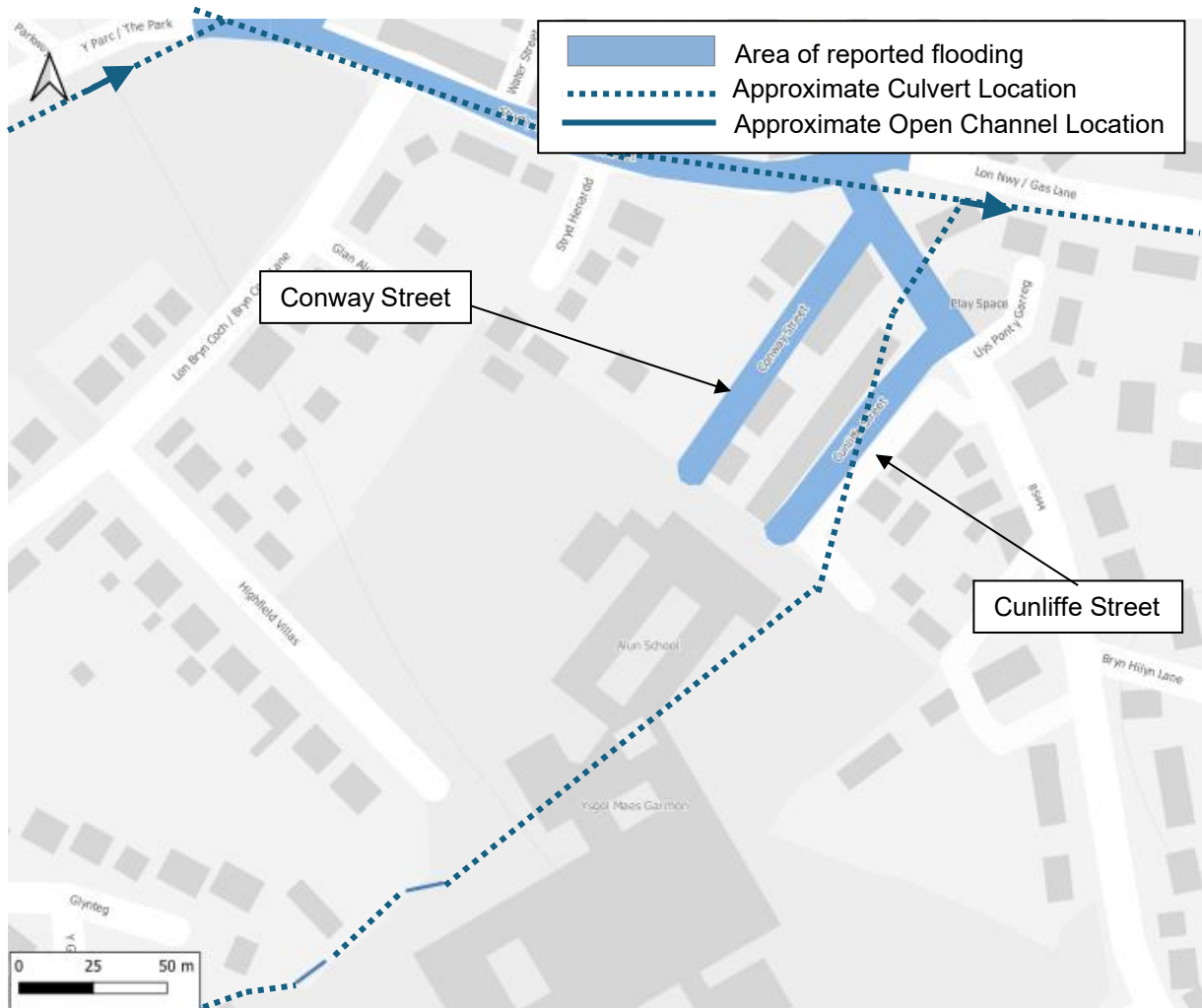


Figure 32 - Conway Street and Cunliffe Street
Contains OS Data © Crown Copyright (2024)

Lon yr Orsaf

4.25 Based on the findings of the community engagement exercise and stakeholder engagement, the reported source of flooding was from an exceedance of the culverted watercourse which flows east beneath Gas Lane. Flood flows are reported to pool in an area of public open space north of Gas Lane and west of Lon yr Orsaf. Flooding in the area of open space reached a sufficient level to flood Lon yr Orsaf.

4.26 Figure 33 provides a summary of the reported flooding.

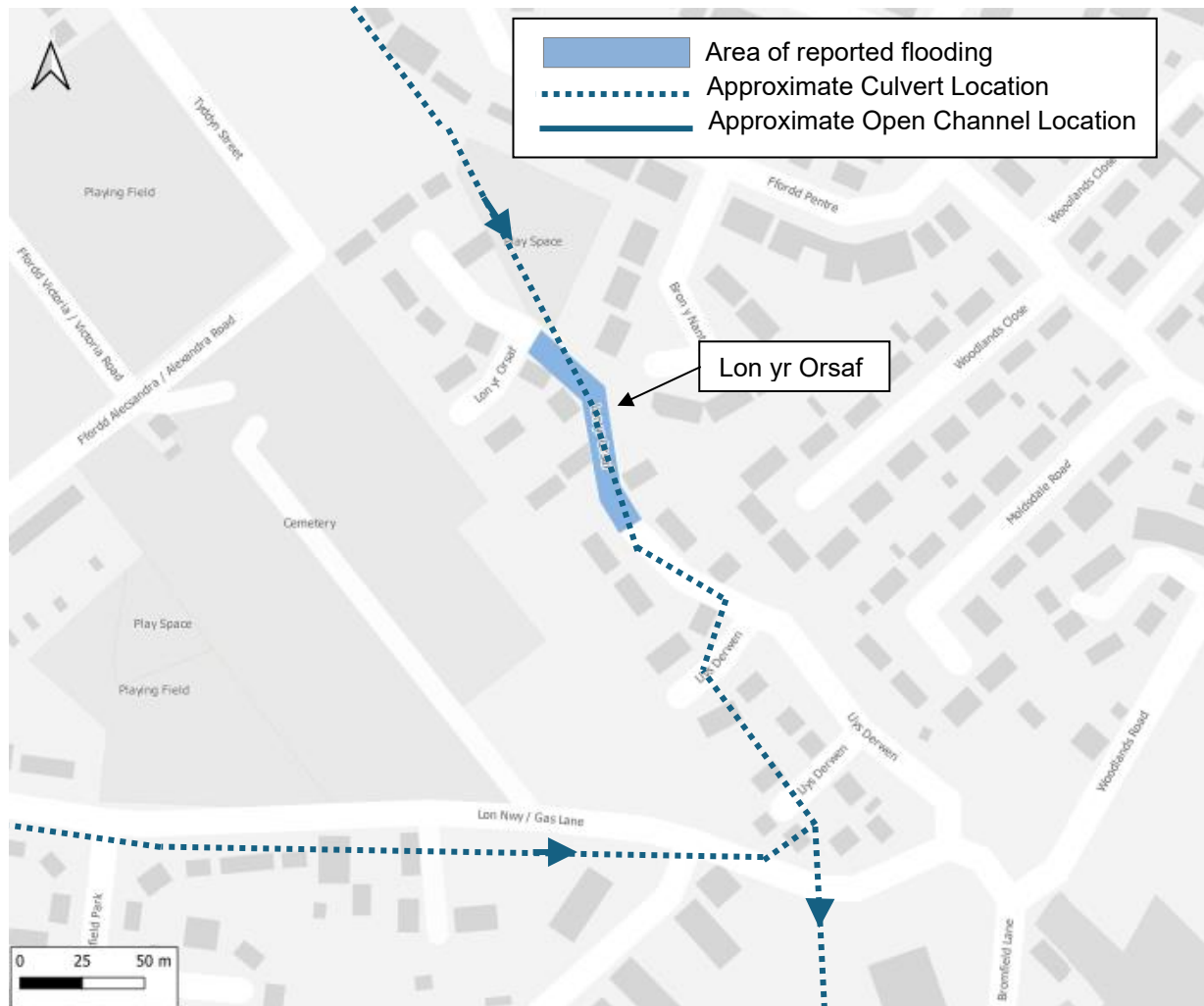


Figure 33 - Lon yr Orsaf
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Other Areas

Gas Lane

- 4.27 It was reported that flood flows travelled east along Gas Lane towards Lon yr Orsaf. However, community engagement established that properties along Gas Lane were not subject to flooding.

Stryd Henardd

- 4.28 Desk studies, including an examination of LiDAR data and a review of NRW Flood Mapping, identified that Stryd Henardd may have been subject to flooding during Storm Babet. Community Engagement confirmed that this was not the case, so it is understood that this area was unaffected by flooding during Storm Babet. LiDAR Mapping can be found in Appendix C.

Y Gilfach, Glynteg and Highfield Villas

- 4.29 Desk studies identified that these areas may have been subject to flooding during Storm Babet. Community engagement confirmed that this was not the case, so it is understood that these areas were unaffected during Storm Babet.

5 Relevant Parties Communication Register

- 5.1 The table below provides the details of communications that have taken place with relevant parties up to the time of writing this report. Relevant parties are considered to be all authorities and stakeholders directly involved and responsible for flood risk management, property owners affected by the flood event, and all parties who may be able to provide information salient to the flood investigation.

Table 4 - Relevant Parties Communications Register

Contact	Communications
Local Residents	Community engagement undertaken on 29/09/2024 and 01/10/2024. Questionnaires and photographs returned to Waterco.
Flintshire County Council (FCC)	Shared details of call logs and confirmed flooding locations.
Dŵr Cymru Welsh Water DCWW	Meeting on the 19/02/2024 to share information of flood locations and sources.
Natural Resources Wales (NRW)	Email consultation from NRW with information on flood locations and sources. NRW also shared data from North Wales Fire and Rescue (on callouts / flood locations).
North Wales Fire and Rescue	

6.0 Conclusions

- 6.1 Waterco Ltd were appointed by FCC to prepare a Flood Investigation Report for Mold following flooding from Storm Babet on the 20th of October 2023.
- 6.2 Internal flooding was confirmed along Fir Grove, Park Avenue, Gwernaffield Road, Maes y March, Ash Grove, Clayton Road, Nant Garmon, Y Coetir, New Street, Ruthin Road, Cae Bracty, Brook Street, Wrexham Road, Gas Lane, Conway Street, Cunliffe Street, and Lon yr Orsaf, with the source of flooding being primarily from a series of interlinked small watercourses which are predominantly culverted beneath Mold. Surface water was found to worsen flooding in certain areas caused by small watercourses.
- 6.3 Rainfall experienced during Storm Babet was prolonged and steady, and high levels of rainfall throughout October meant soils were already saturated which led to faster runoff rates.
- 6.4 Surcharge of numerous culverts across Mold are thought to have been attributed to the vast amount of water flowing through them during Storm Babet.
- 6.5 Residents reported water exceeding drainage systems and causing internal flooding through backflow at Fir Grove. This is likely a result of flood water entering the public foul or combined sewer system.
- 6.6 A total of 48 internal flooding incidents were reported in Mold during Storm Babet

7.0 Recommendations

7.1 Table 5 sets out the recommended actions required following the flooding of October 2023 and the stakeholder required to undertake each action.

Table 5 - Recommendations

Ref	Stakeholder	Action
01	Riparian Owner	Inspect the existing culvert inlet at Highfield Villas on a frequent basis and remove debris as required.
02	FCC Highways Authority	Post event undertake a CCTV condition survey of the Brook Street culvert confluence to ensure the culvert is free of blockage and any significant siltation. Take remedial action as required.
03	FCC Highways Authority	Continue maintenance of highway drainage assets in high-risk areas. For example, at Brook Street and Ruthin Road.
04	FCC LLFA	Communicate with local communities to raise awareness of property level flood resilience measures that can be implemented to help mitigate flood risk.
05	FCC LLFA	Investigate implementing natural flood management upstream of the areas impacted by flooding from ordinary watercourses / surface water, namely Fir Grove and Highfield Villas culvert inlets.
06	FCC LLFA	Review condition of the ordinary watercourses and inform the riparian landowners if any issues are identified. FCC to use permissive duties and powers under the LDA and FWMA to allow flow via culvert entrances, watercourses and culverts are maintained to convey flows as intended.
07	NRW	Ensure Main Rivers are inspected on a risk-based frequency and where appropriate and justifiable, a maintenance regime is documented and completed by an appropriate Risk Management Authority and/or Riparian Owner.
08	DCWW	Review customer complaints and investigate the associated sections of public sewer system to remove any blockage / significant debris following the October 2023 event.
09	Property Owners / Residents	Sign up to the free signing up to the NRW Flood Warning System and consider the implementation of property level flood resilience measures. These could include; the installation of non-return valves to prevent ingress of floodwater on private drainage systems and installing flood barriers or flood doors.

APPENDIX A

Photo Log

Photo No.1	
Date: 29 th August 2024	
Description: View looking east along Fir Grove. Flood flows were reported to flow east onto Park Avenue	
Source: Waterco Site Visit	

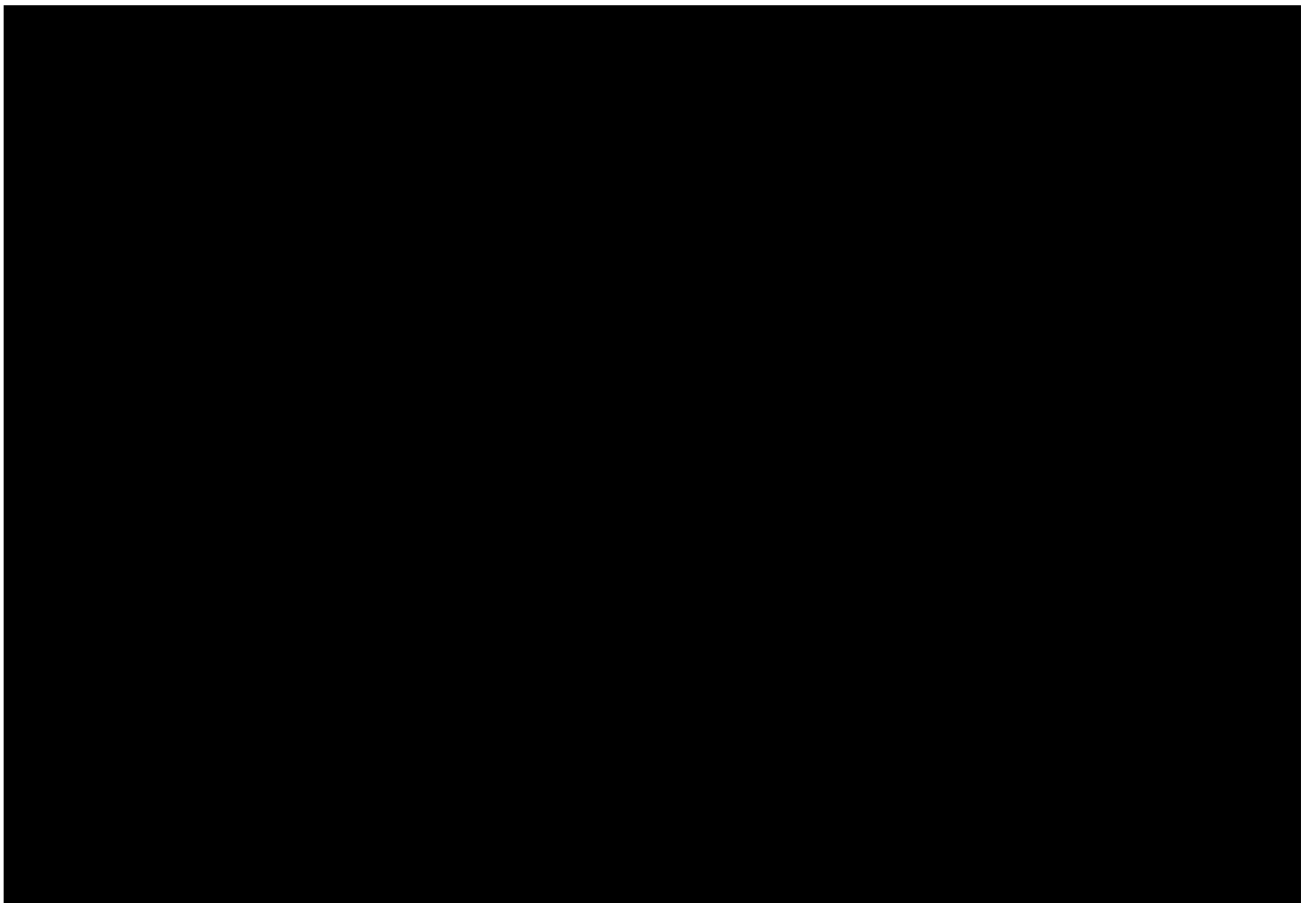


Photo No.3

Date: 29th August 2024Description: Inside a
highway gully along
Brook Street

Source: Waterco Site Visit



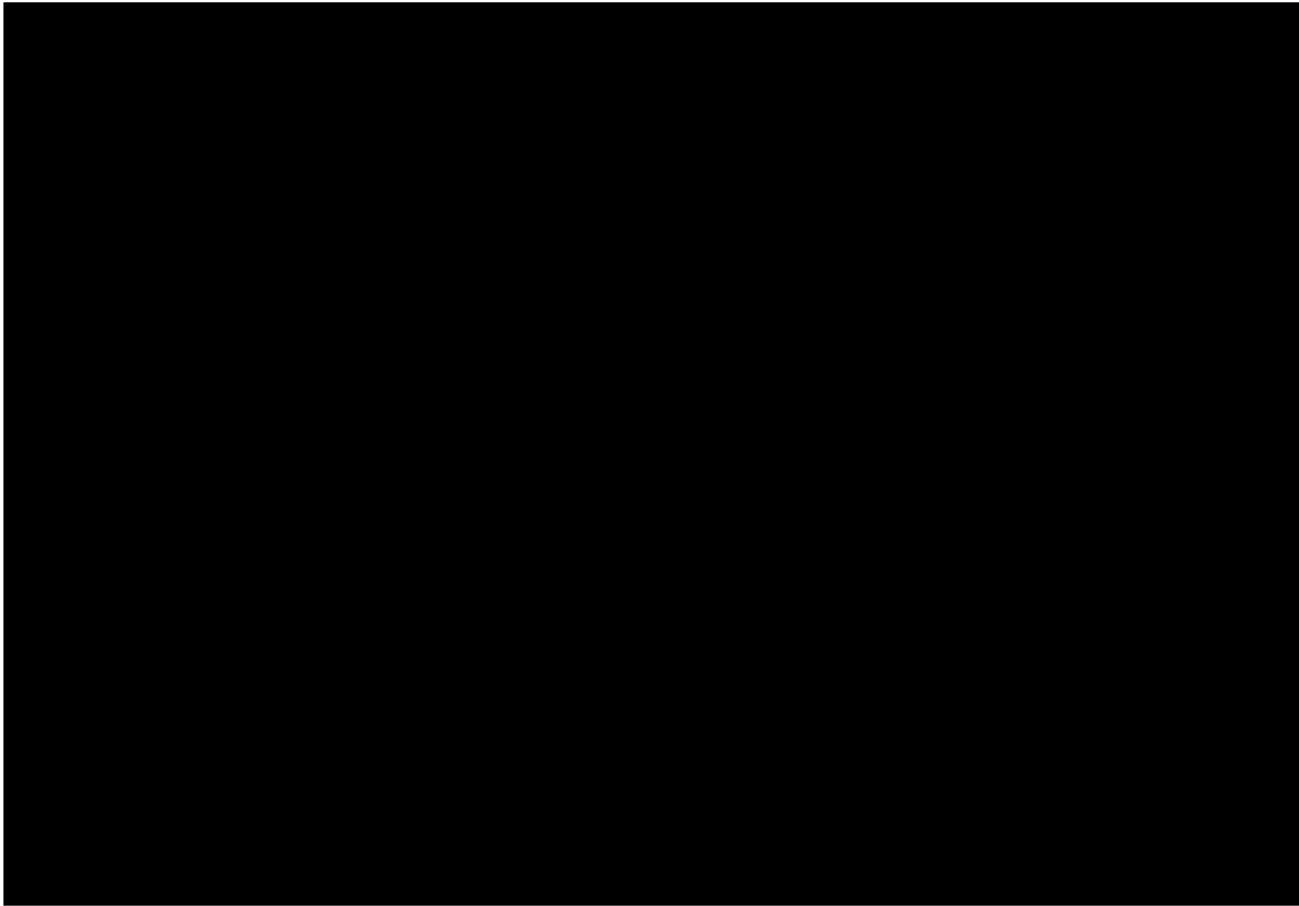


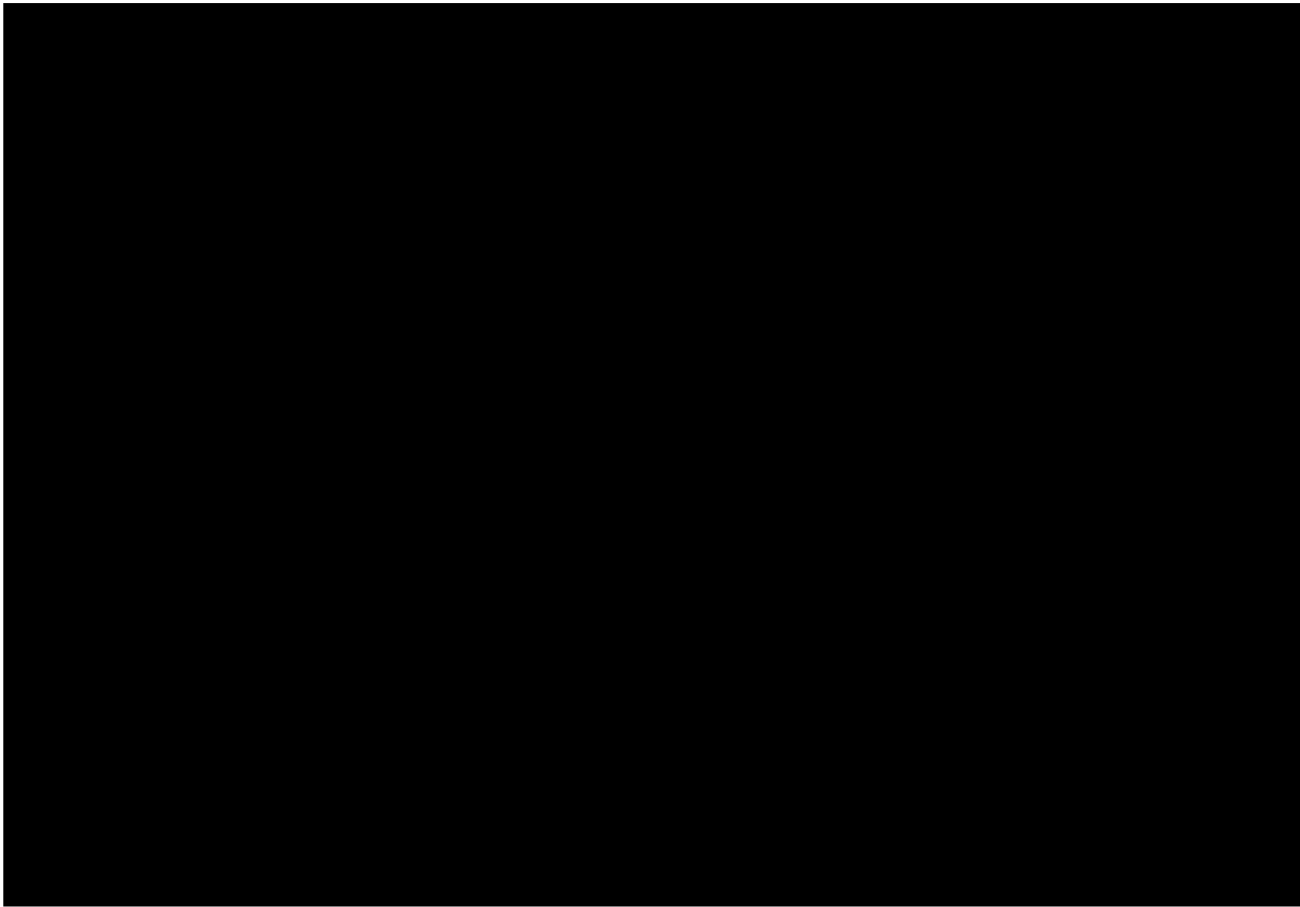
Photo No. 6	
Date: 29 th August 2024	
Description: Car Park north of Cae Bracty where flood flows are reported to pool before flowing into Cae Bracty	
Source: Waterco Site Visit	

Photo No. 7

Date: 29th August 2024

Description: Sand bags at
Cae Bracty

Source: Waterco Site Visit



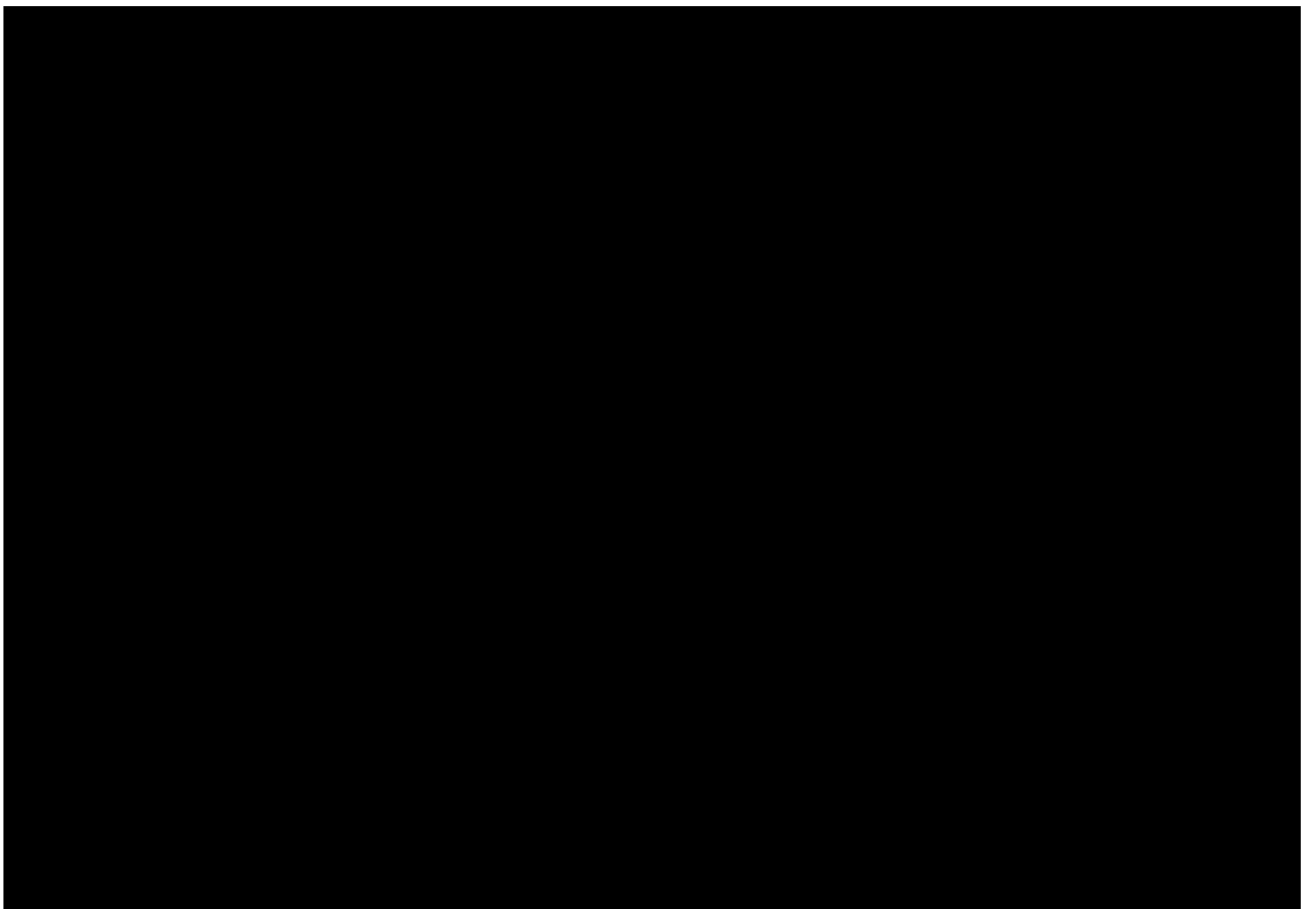


Photo No. 11

Date: 2nd September 2024

Description: Fence that was reported to have been replaced on Maes y March following reported destruction by flood flows during Storm Babet

Source: Waterco Site Visit



Photo No. 13 Date: 2nd September 2024 Description: View of culvert inlet for unnamed watercourse nr. Glynteg, which flows towards Cunliffe Street. Source: Waterco Site Visit	 A photograph showing the interior of a brick-lined culvert. The view is looking down a narrow passage where water is flowing. The walls are made of red bricks, and there are some wooden beams or pipes across the top. The water is dark and turbulent as it flows towards the bottom of the frame.
Photo No. 14 Date: 2nd September 2024 Description: View of culvert inlet for unnamed watercourse nr. Glynteg, which flows towards Cunliffe Street. Source: Waterco Site Visit	 A photograph showing the exterior of a culvert inlet. The inlet is a large, dark, circular opening surrounded by dense green foliage and bushes. The culvert is constructed from concrete blocks, and the surrounding area is overgrown with plants and ferns.

Photo No. 15	
Date: 2 nd September 2024	
Description: View of culvert inlet on Maes Garmon and Alun School Grounds, nr. Highfield Villas Source: Waterco Site Visit	
Photo No. 16	
Date: 2 nd September 2024	
Description: View of culvert inlet on Maes Garmon and Alun School Grounds, nr. Highfield Villas Source: Waterco Site Visit	

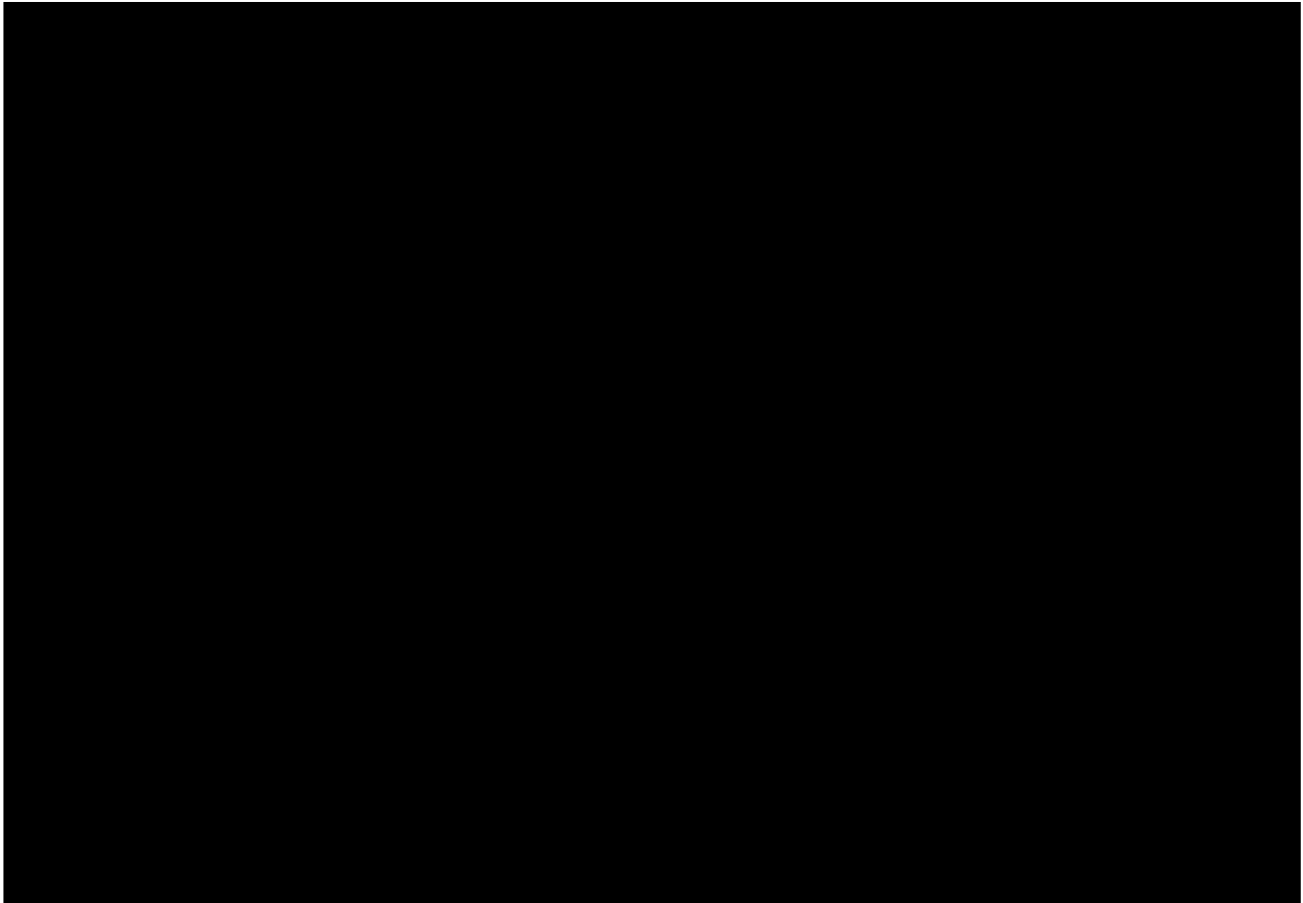


Photo No. 18	
Date: 21 October 2023 (approx.)	
Description: Damage to road on junction of Cae Bracty and Brook Street following flooding during Storm Babet Source: Community Engagement	

Photo No. 19

Date: 22nd October 2023
(approx.)

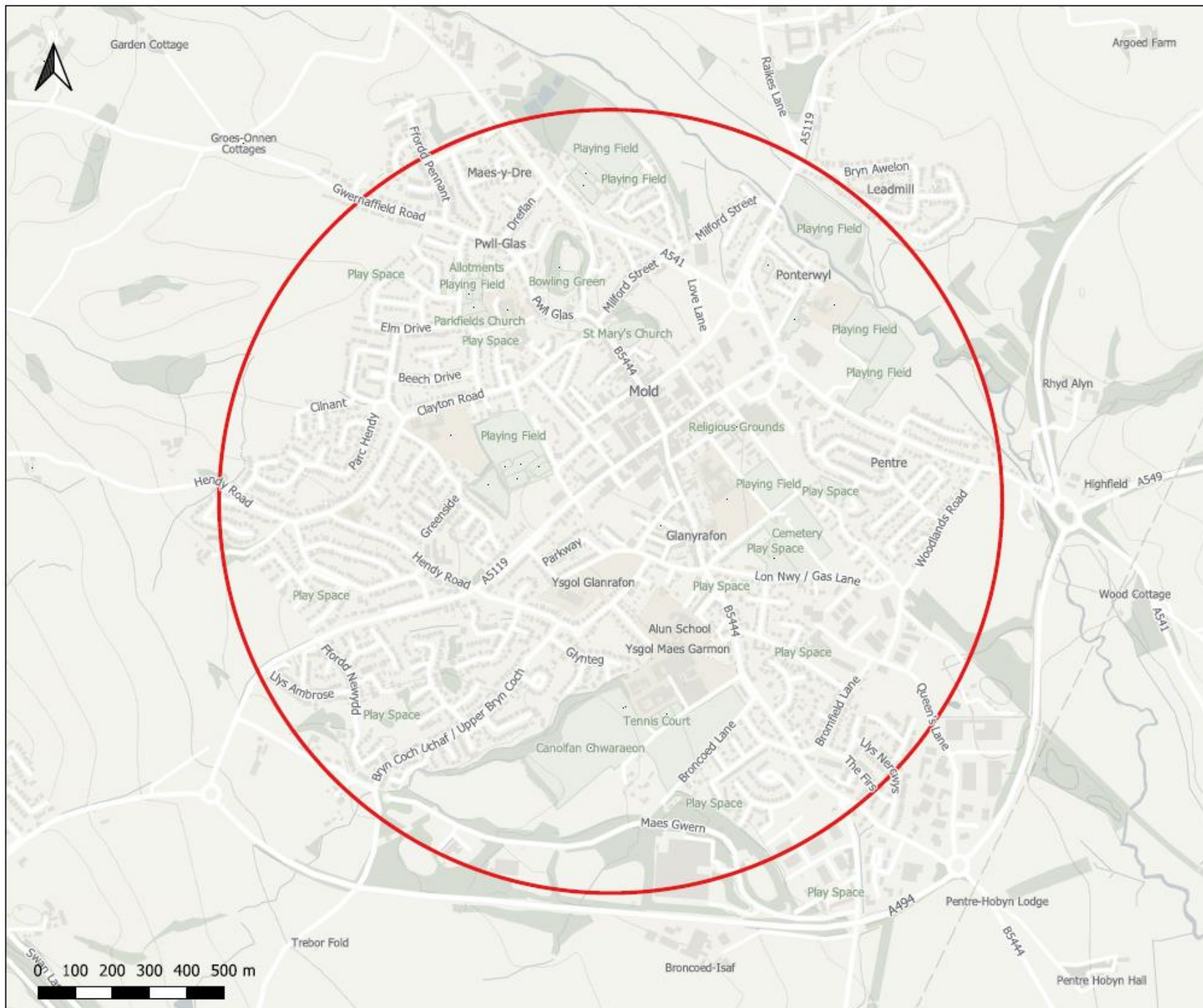
Description: Damage to
road on junction of Cae
Bracty and Brook Street
following flooding during
Storm Babet

Source: Community
Engagement



APPENDIX B

Location Plan and Ariel Image

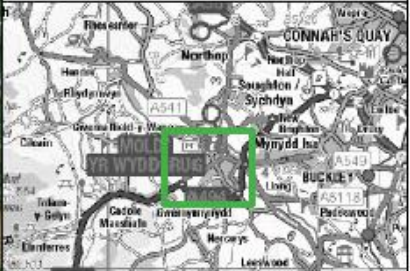


Notes: 1) All dimensions are in metres and all levels in metres above Ordnance Datum unless stated otherwise LEGEND  Site Boundary			
			
CLIENT:			
Flintshire County Council			
 www.waterco.co.uk			
SCHEME:			
15972-Mold S19 Flood Investigation Report			
PLOT TITLE:			
Location Plan			
PLOT STATUS:			DATE:
FINAL			19-09-2024
DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
EJ	AW	MW	1:10000
PLOT NAME:			REVISION:
15972_Location_Plan			-



Notes:
1) All dimensions are in metres and all levels in metres above Ordnance Datum unless stated otherwise

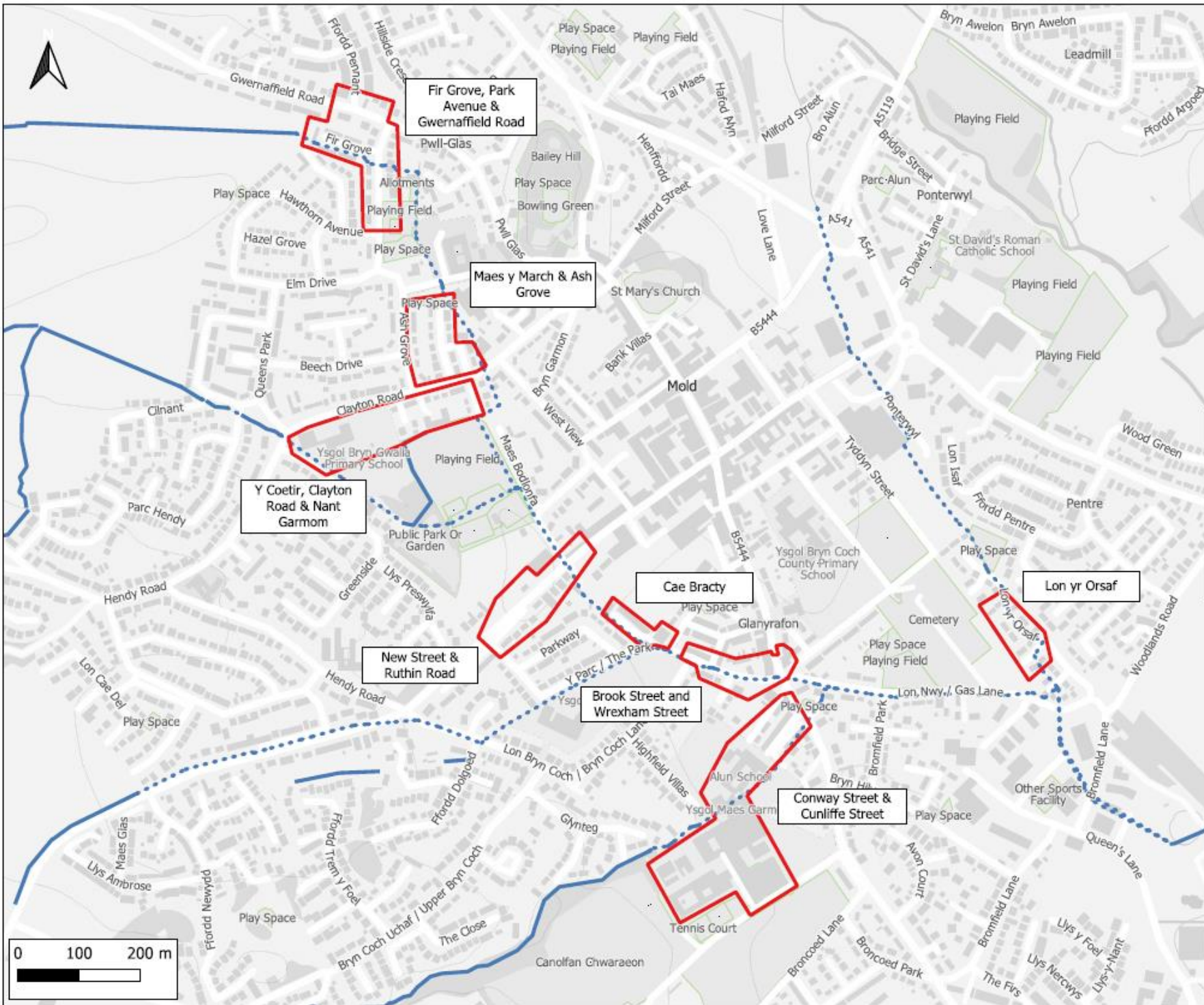
LEGEND
 Site Boundary



CLIENT: Flintshire County Council			
 www.waterco.co.uk			
SCHEME: 15972-Mold S19 Flood Investigation Report			
PLOT TITLE: Aerial Plan			
PLOT STATUS: FINAL		DATE: 19-09-2024	
DRAWN: EJ	CHECKED: AW	APPROVED: MW	PLOT SCALE AT A3: 1:10000
PLOT NAME: 15972_Aerial_Plan			REVISION: -

APPENDIX C

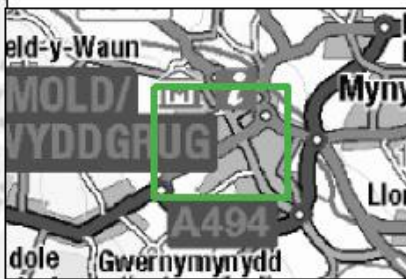
Reported Flooded Areas



Notes:
1) All dimensions are in metres and all levels in metres above Ordnance Datum unless stated otherwise

LEGEND

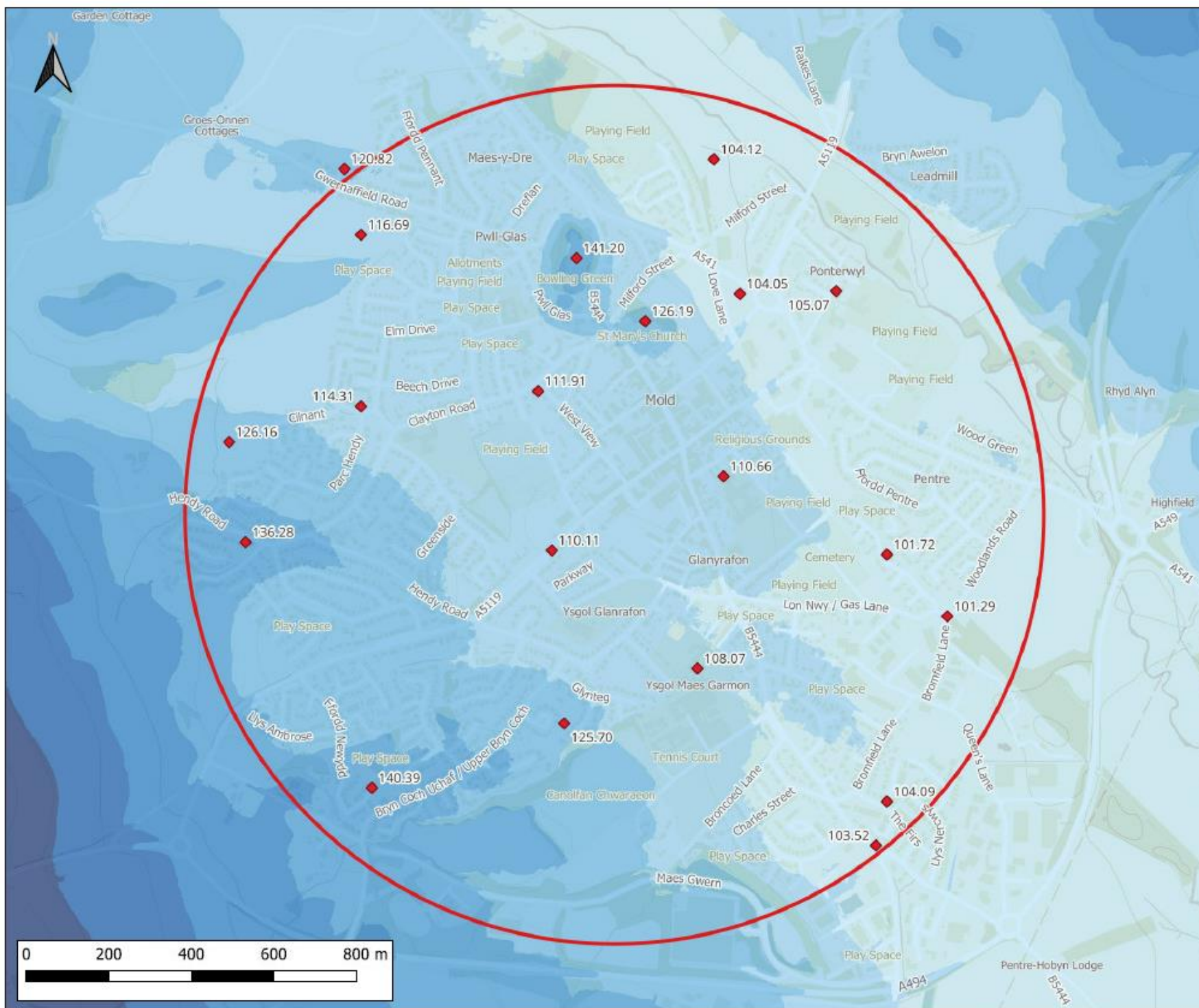
- Mold Reported Flooding Areas
- Culverted Watercourse
- Watercourse



CLIENT: Flintshire County Council			
 www.waterco.co.uk			
SCHEME: 15972-Mold Hydraulically Linked S19 Flood Investigation Report			
PLOT TITLE: Location Plan			
PLOT STATUS: FINAL		DATE: 10-07-2025	
DRAWN: BT	CHECKED: LW	APPROVED: MW	PLOT SCALE AT A3: 1:6100
PLOT NAME: 15972_Mold_Location_Plan			REVISION: -

APPENDIX D

LiDAR Plan



Notes:
1) All dimensions are in metres and all levels in metres above Ordnance Datum unless stated otherwise

LEGEND

- Site Boundary
- Ground Elevations (mAOD)

wales_lidar_dtm_1m_32bit_cog

Band 1 (Gray)

- <= 72.00
- 72.00 - 84.00
- 84.00 - 96.00
- 96.00 - 108.00
- 108.00 - 120.00
- 120.00 - 132.00
- 132.00 - 144.00
- 144.00 - 156.00
- 156.00 - 168.00
- > 168.00



CLIENT:

Flintshire County Council



www.waterco.co.uk

SCHEME:

15972-Mold S19 Flood
Investigation Report

PLOT TITLE:

LIDAR Plan
1m Resolution
Data from Environment Agency

PLOT STATUS:

FINAL

DATE:

19-09-2024

DRAWN:

EJ

CHECKED:

AW

APPROVED:

MW

PLOT SCALE AT A3:

1:9000

PLOT NAME:

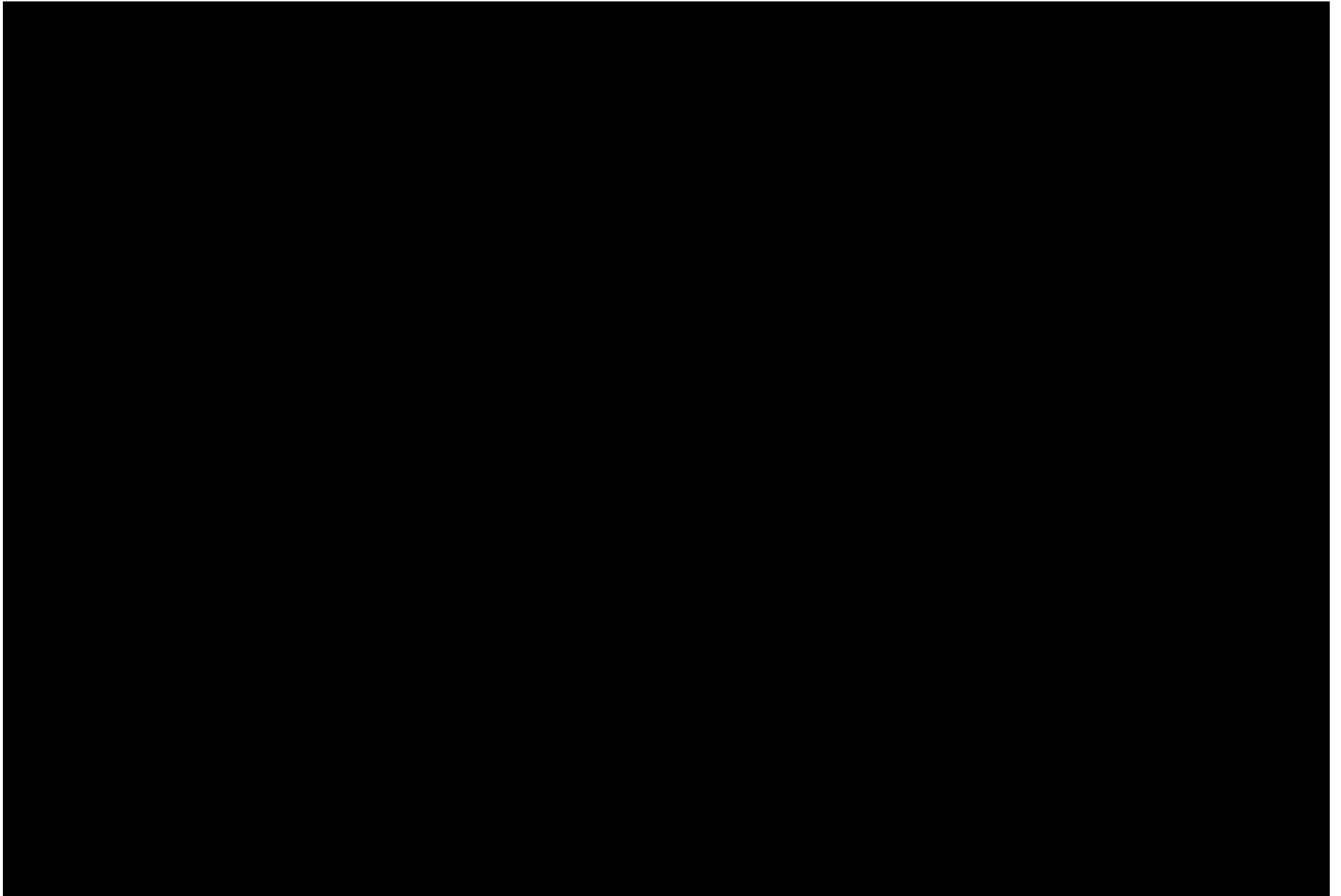
15972_LIDAR_Plan

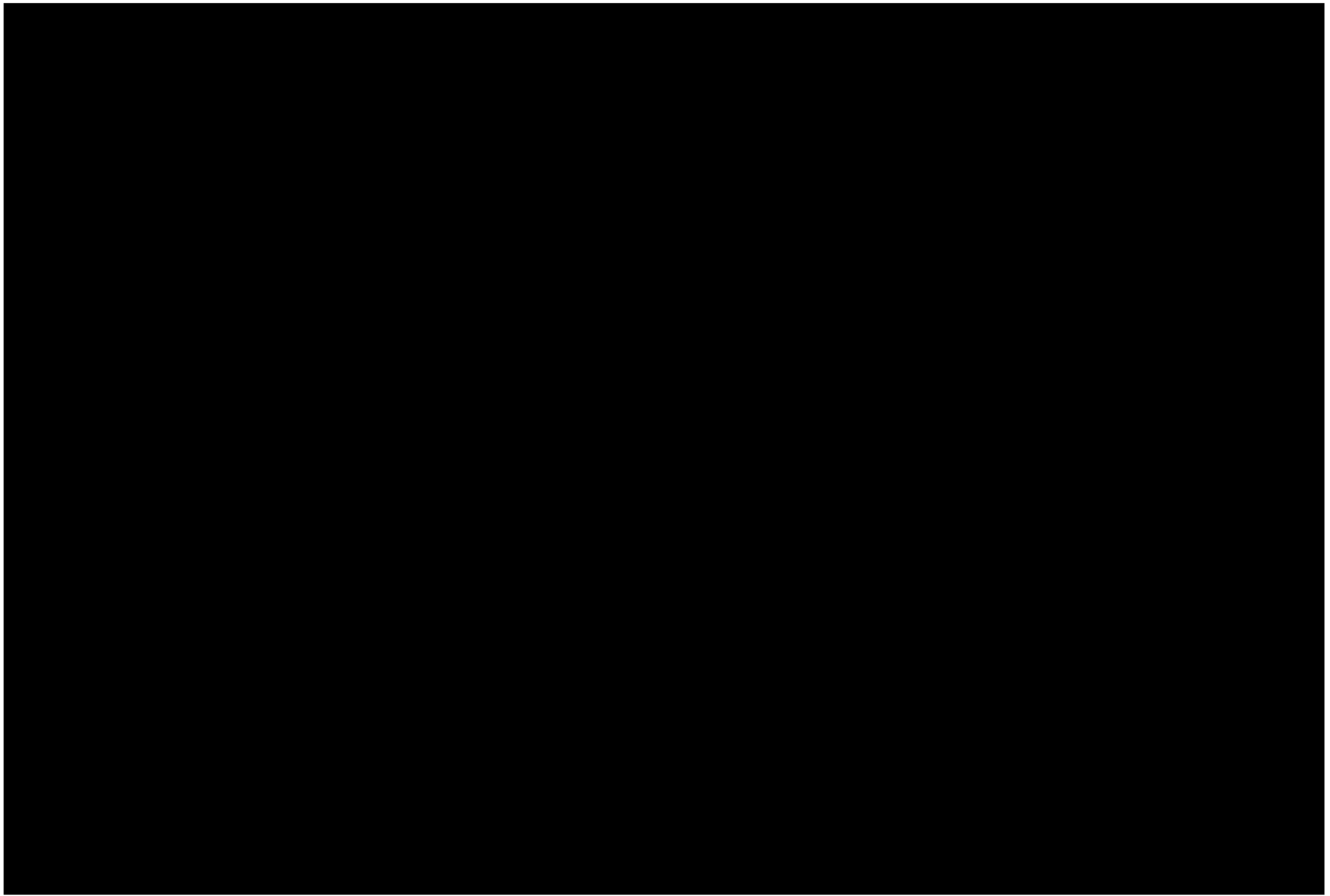
REVISION:

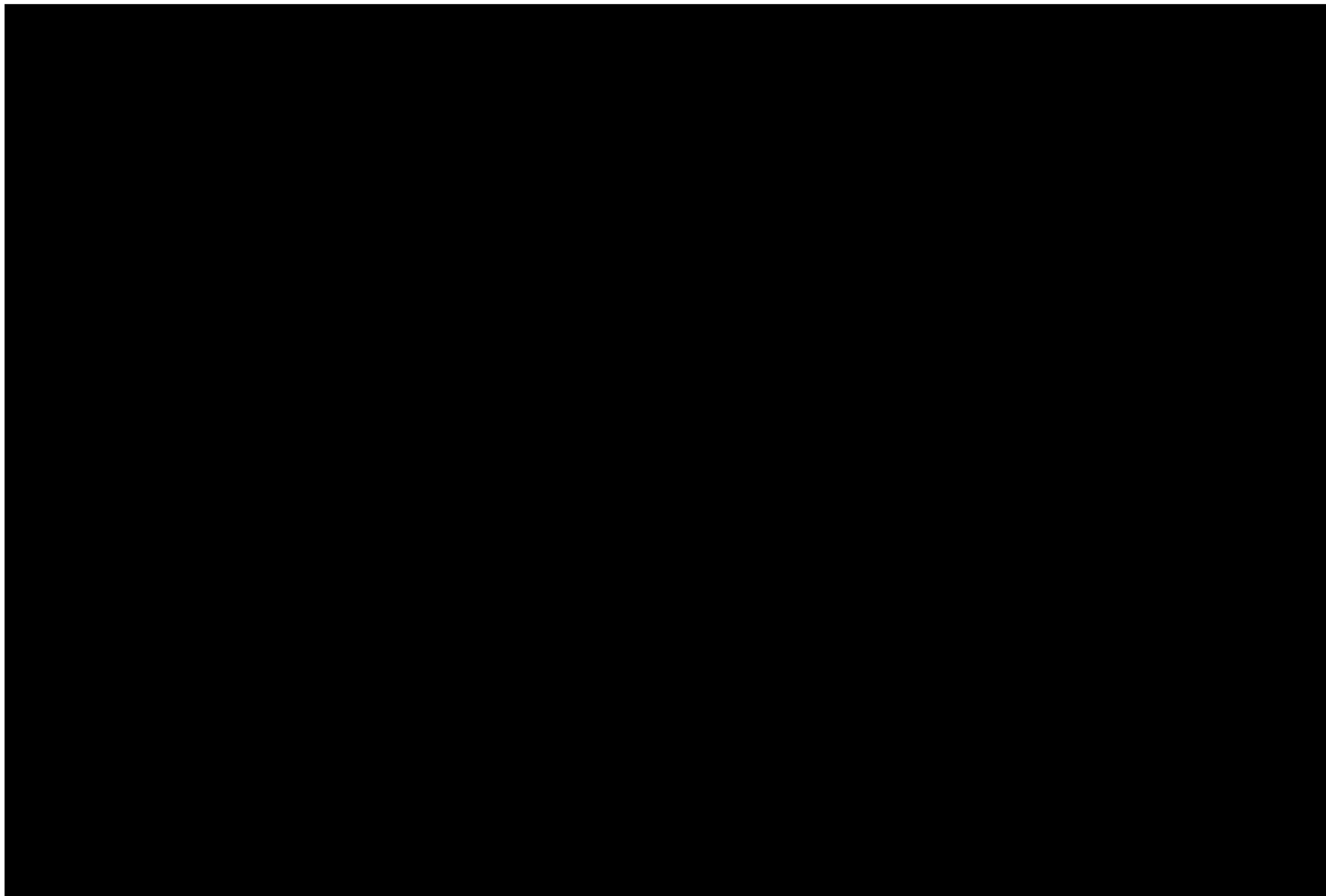
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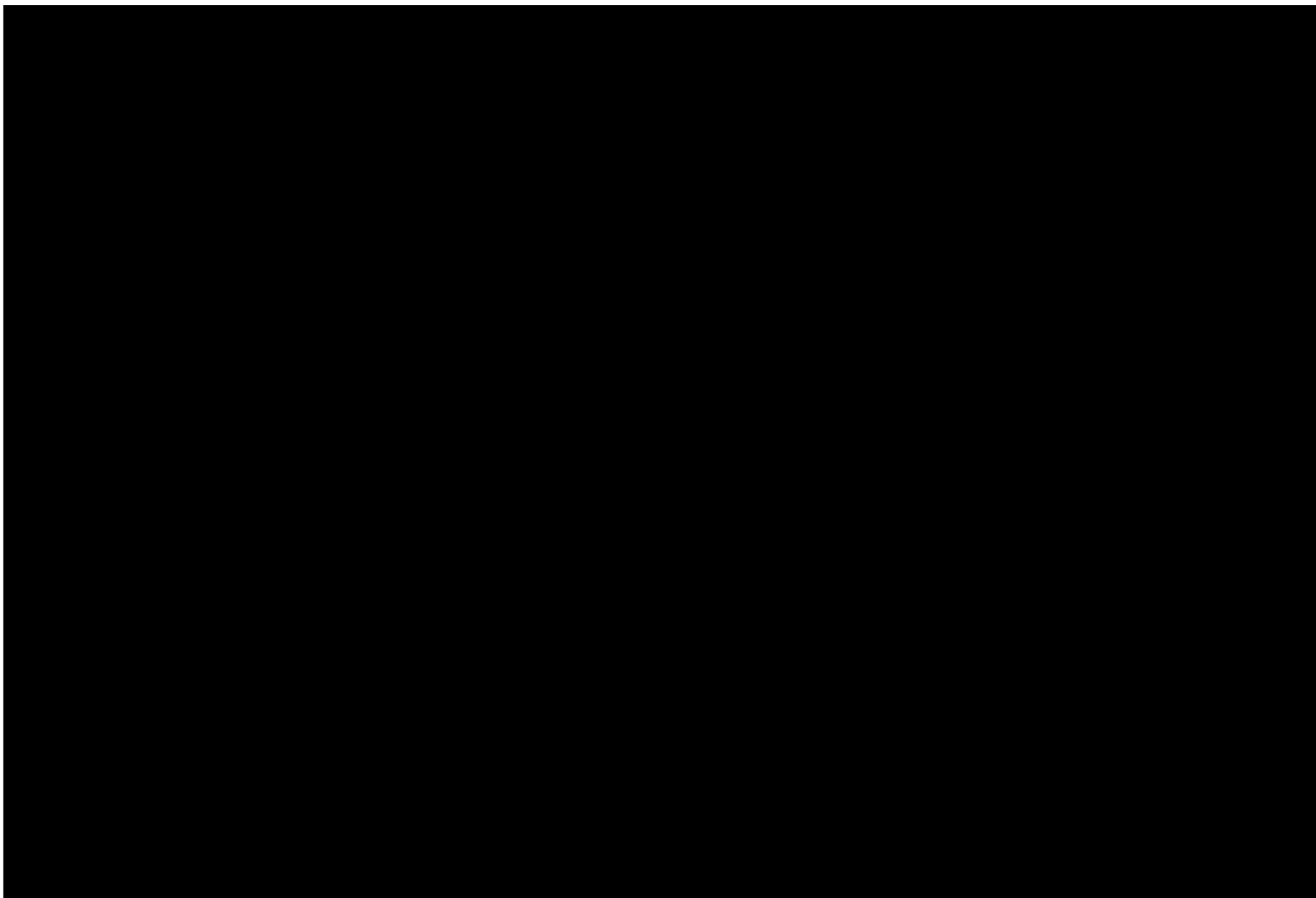
APPENDIX E

DCWW Sewer Plans



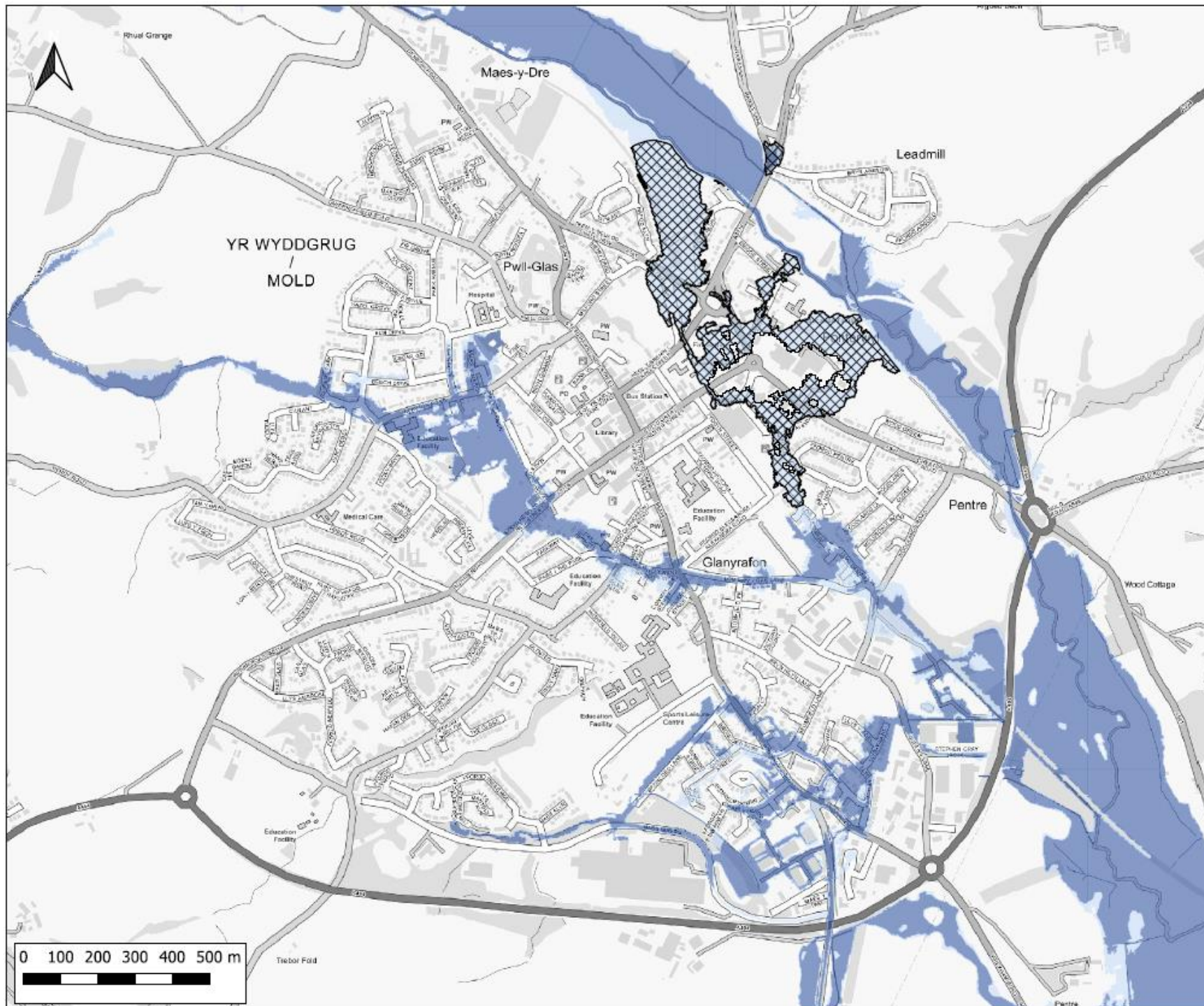






APPENDIX F

NRW Flood Maps



Notes:
 1) All dimensions are in metres and all levels in metres above Ordnance Datum unless stated otherwise
 2) Flood Zone 3 displays the extent of flooding from rivers with a 1% AEP or greater of flooding in a given year including and allowance for climate change and the sea with a 0.5% AEP or greater of flooding in a given year including and allowance for climate change
 3) Flood Zone 2 displays the extent of flooding from rivers with a less than 1% AEP but greater than or equal to 0.1% AEP of flooding in a given year including and allowance for climate change and the sea with a less than 0.5% AEP but greater than or equal to 0.1% AEP of flooding in a given year including an allowance for climate change

LEGEND

TAN15 Defended Zones

Flood Map for Planning

Flood Zone 1

Flood Zone 2

Flood Zone 3



www.waterco.co.uk

SCHEME:

Mold Hydraulically Linked Areas S19
Flood Investigation Report

PLOT TITLE:

NRW Flood Map for Planning (Rivers and Sea)
Data published May 2025

PLOT STATUS:

FINAL

DATE:

02-07-2025

DRAWN:

TH

CHECKED:

LS

APPROVED:

MW

PLOT SCALE AT A3:

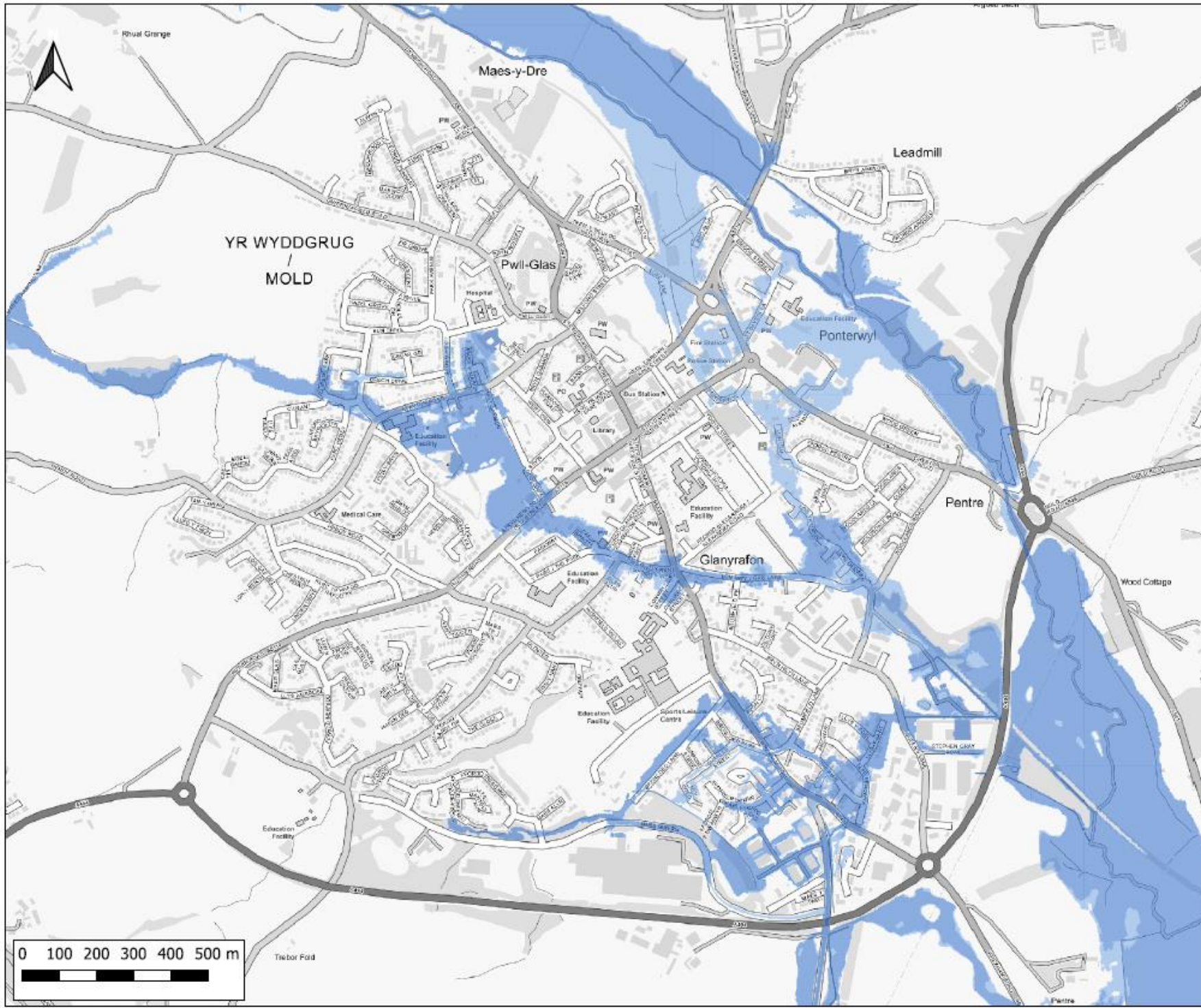
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PLOT NAME:

15972_NRW_FMIP

REVISION:

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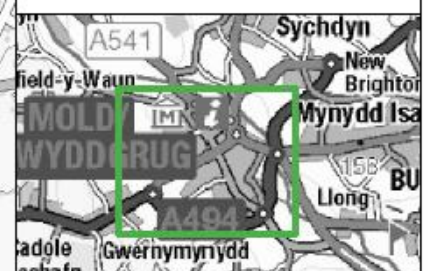


Notes:
1) All dimensions are in metres and all levels in metres above Ordnance Datum unless stated otherwise

LEGEND

Flood Zones - Rivers

- Flood Zone 1
- Flood Zone 2
- Flood Zone 3



CLIENT:

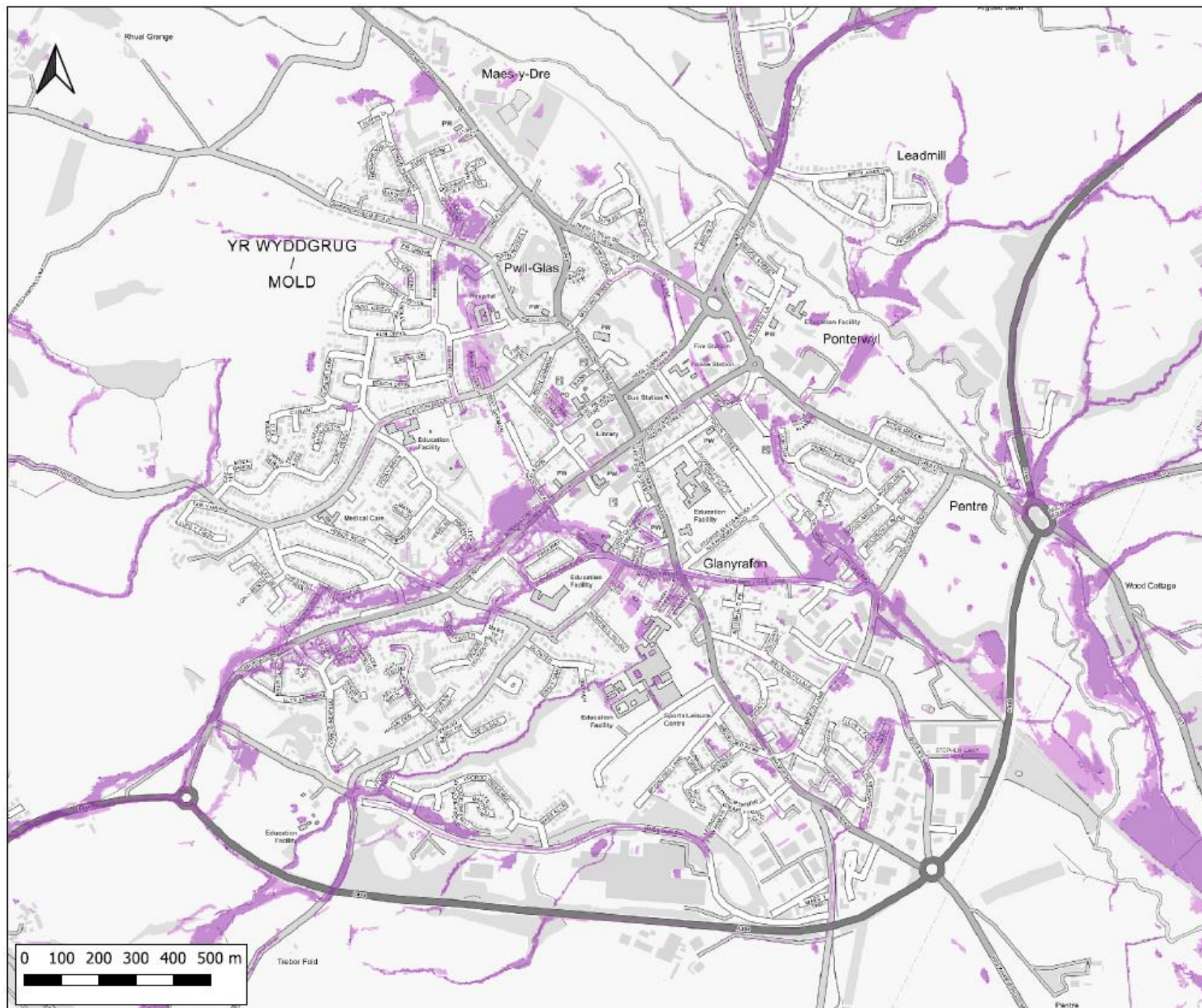
Sir y Fflint
Flintshire
COUNTY COUNCIL

waterco
www.waterco.co.uk

SCHEME:
Mold Hydraulically Linked Areas S19
Flood Investigation Report

PLOT TITLE:
NRW Flood Zones - Rivers
Data published May 2025

PLOT STATUS: FINAL			DATE: 02-07-2025
DRAWN: IH	CHECKED: LS	APPROVED: MW	PLOT SCALE AT A3: 1:10000
PLOT NAME: 15972_NRW_Flood_Zones_Rivers			REVISION: -



Notes:
1) All dimensions are in metres and all levels in metres above Ordnance Datum unless stated otherwise

LEGEND

Flood Zones - Surface Water & Small Watercourses

- Flood Zone 1
- Flood Zone 2
- Flood Zone 3

CLIENT: **Sir y Fflint Flintshire** COUNTY COUNCIL

waterco
www.waterco.co.uk

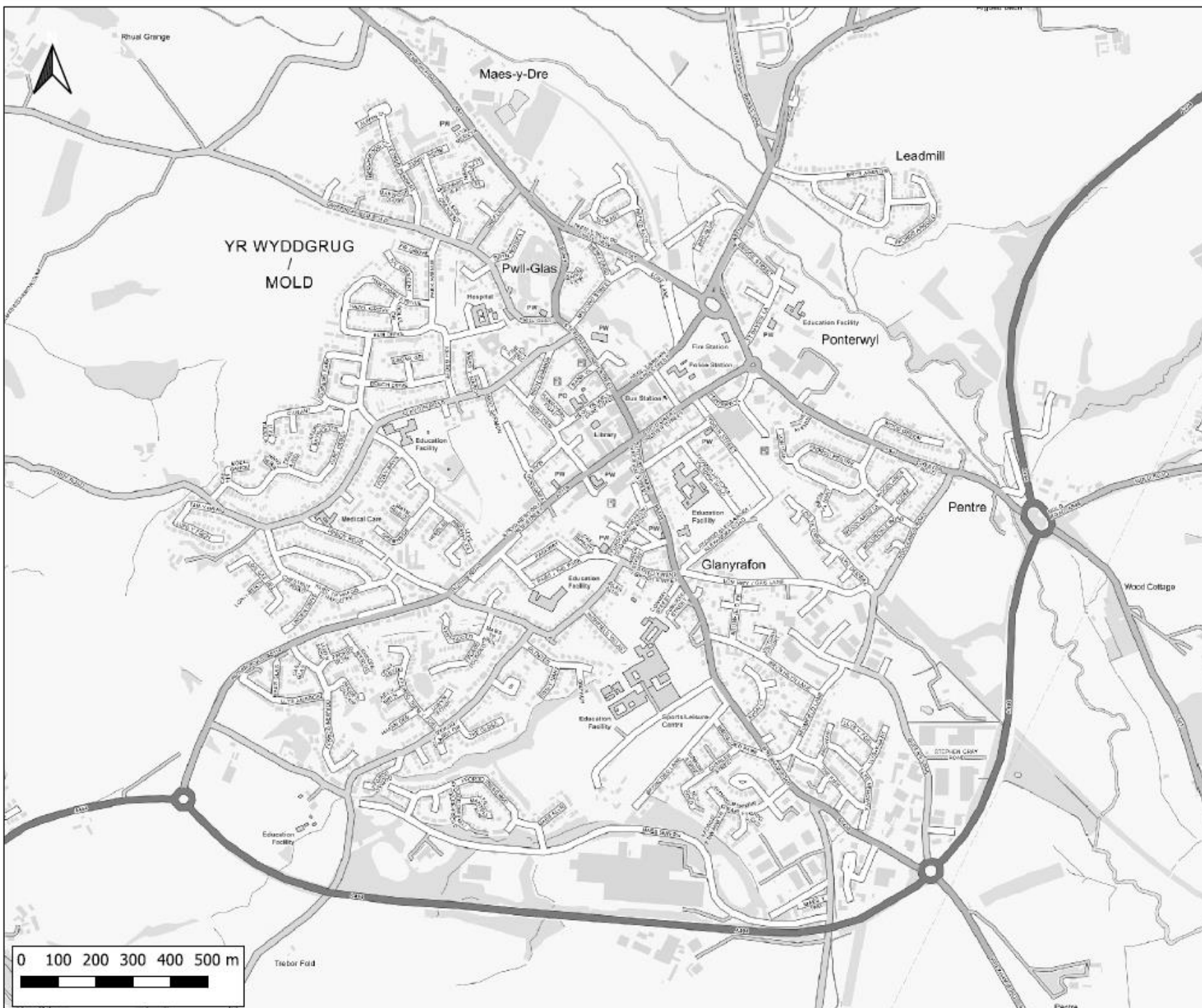
SCHEME:
Mold Hydraulically Linked Areas S19 Flood Investigation Report

PLOT TITLE:
NRW Flood Zones - Surface Water & Small Watercourses
Data published May 2025

PLOT STATUS: **FINAL** DATE: **02-07-2025**

DRAWN: TH	CHECKED: LS	APPROVED: MW	PLOT SCALE AT A3: 1:10000
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PLOT NAME: **15972_NRW_Flood_Zones_Surface_Water** REVISION: **-**



Notes:
1) All dimensions are in metres and all levels in metres above Ordnance Datum unless stated otherwise

LEGEND

Flood Zones - Sea

Flood Zone 1

Flood Zone 2

Flood Zone 3



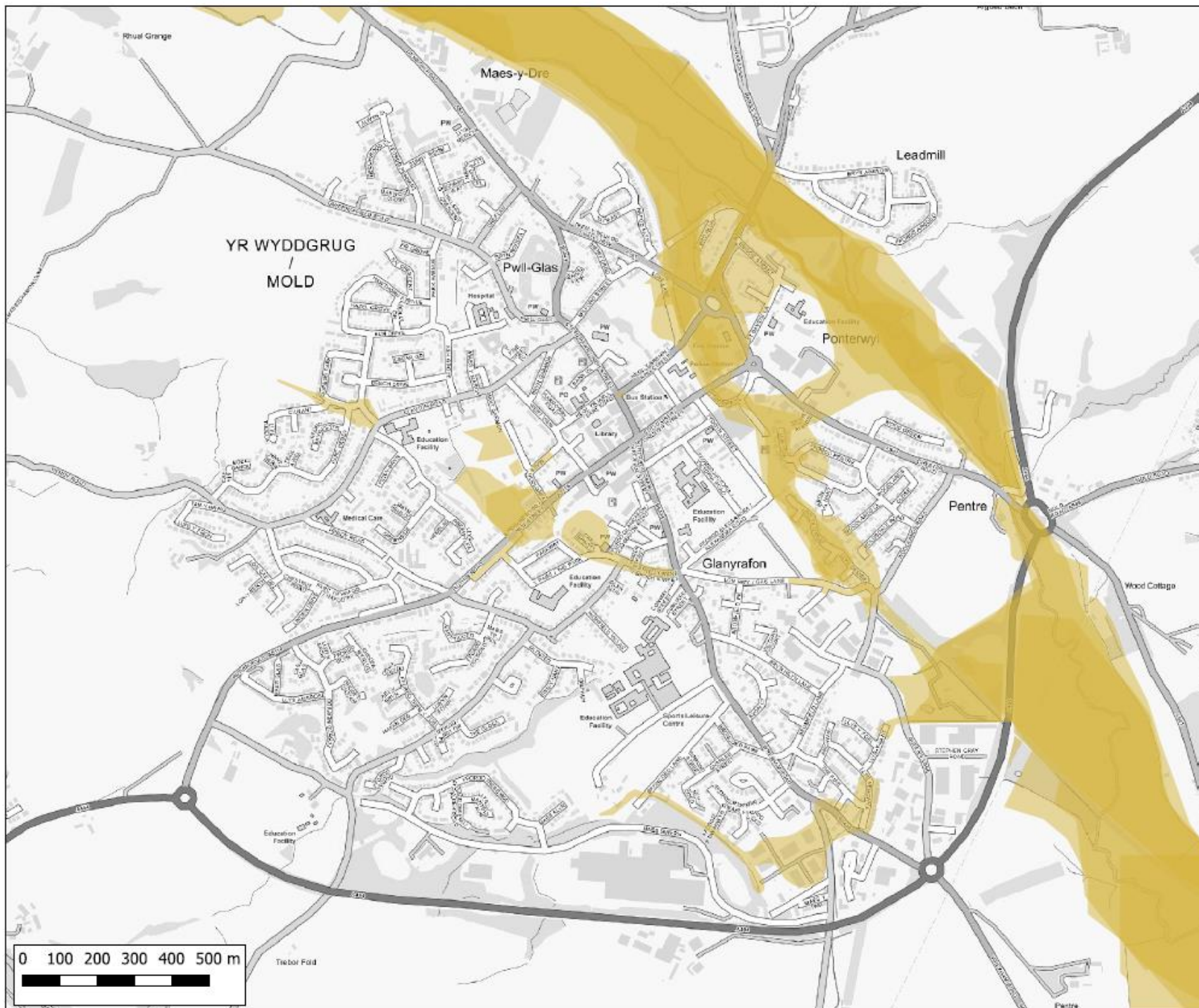
SCHEME:
**Mold Hydraulically Linked Areas S19
Flood Investigation Report**

PLOT TITLE:
**NRW Flood Risk from the Sea
Data published May 2025**

PLOT STATUS: **FINAL** DATE: **02-07-2025**

DRAWN: **IH** CHECKED: **LS** APPROVED: **MW** PLOT SCALE AT A3: **1:10000**

PLOT NAME: **15972_NRW_Flood_Zones_Sea** REVISION: **-**



Notes:
1) All dimensions are in metres and all levels in metres above Ordnance Datum unless stated otherwise

LEGEND

■ NRW Recorded Flood Extents

CLIENT:

Sir y Fflint
Flintshire
COUNTY COUNCIL

waterco
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SCHEME:
Mold Hydraulically Linked Areas S19
Flood Investigation Report

PLOT TITLE:
NRW Recorded Flood Extents
Data published May 2025

PLOT STATUS: FINAL			DATE: 02-07-2025
DRAWN: IH	CHECKED: LS	APPROVED: MW	PLOT SCALE AT A3: 1:10000
PLOT NAME: 15972_NRW_Recorded_Flood_Extents			REVISION: -

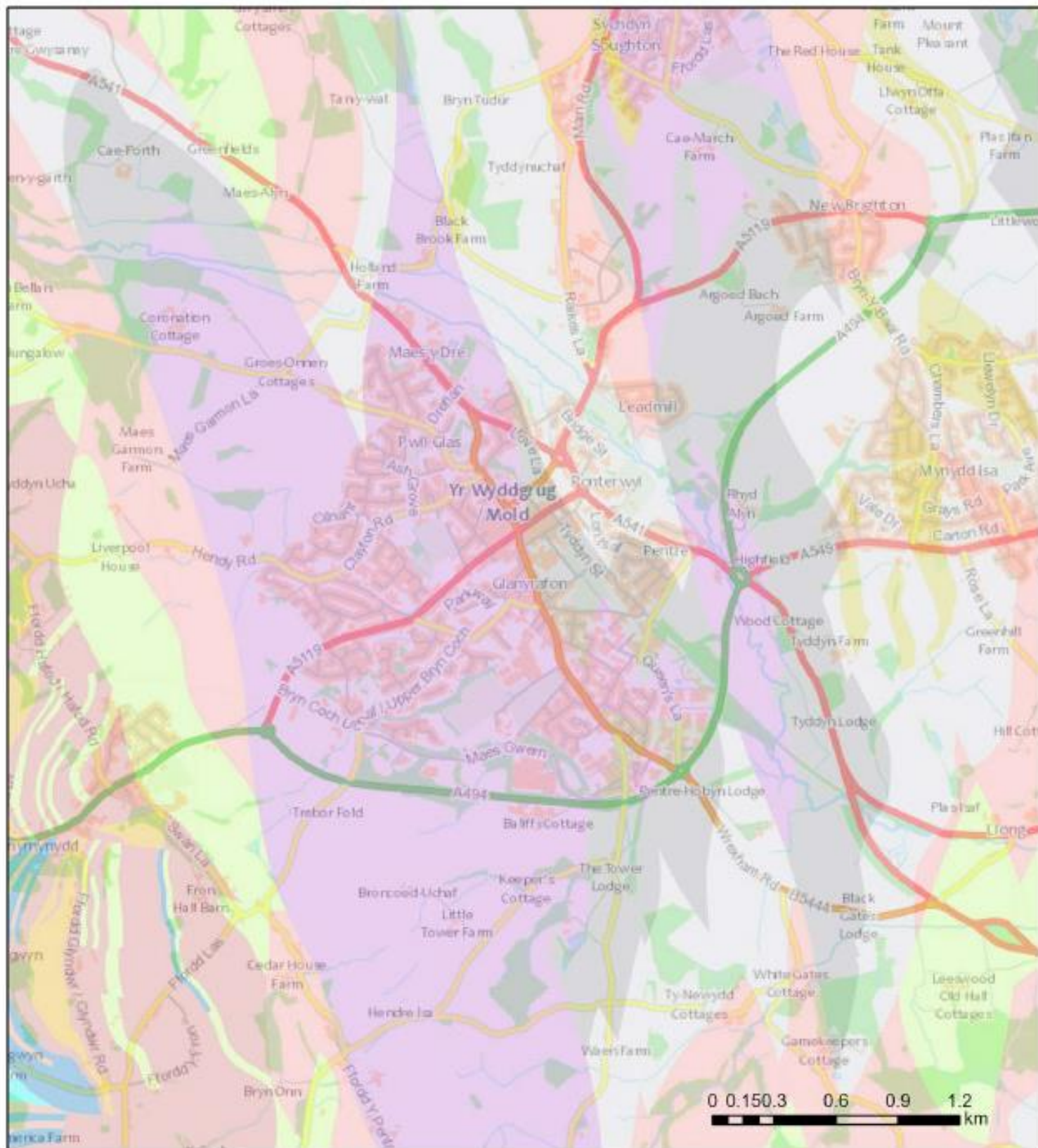
APPENDIX G

BGS Records

GeoIndex Report



British
Geological
Survey



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Geolindex Onshore Data Sources: NERC, Natural England, English Heritage and Ordnance Survey

Map Key

Bedrock geology 1:50,000 scale

	<u>LEETE LIMESTONE FORMATION - LIMESTONE</u>
	<u>CEFN MAWR LIMESTONE FORMATION - LIMESTONE AND [SUBEQUAL/SUBORDINATE] ARGILLACEOUS ROCKS, INTERBEDDED</u>
	<u>PENNINE LOWER COAL MEASURES FORMATION - MUDSTONE, SILTSTONE AND SANDSTONE</u>
	<u>ETRURIA FORMATION - MUDSTONE, SANDSTONE AND CONGLOMERATE</u>
	<u>LOGGERHEADS LIMESTONE FORMATION - LIMESTONE</u>
	<u>MAIN SHALE BED (LLANGOLLEN AREA) - MUDSTONE</u>
	<u>LLANARMON LIMESTONE FORMATION - LIMESTONE</u>
	<u>NEOGENE ROCKS (UNDIFFERENTIATED) - CLAY, SILT AND SAND</u>
	<u>FOEL FORMATION - LIMESTONE AND [SUBEQUAL/SUBORDINATE] ARGILLACEOUS ROCKS, INTERBEDDED</u>
	<u>ELWY FORMATION - MUDSTONE, SILTSTONE AND SANDSTONE</u>
	<u>ELWY FORMATION - SLUMPED MUDSTONE, SLUMPED SILTSTONE AND SLUMPED SANDSTONE</u>
	<u>CEFN-Y-FEDW SANDSTONE FORMATION - LIMESTONE</u>
	<u>MINERA FORMATION - LIMESTONE AND [SUBEQUAL/SUBORDINATE] SANDSTONE, INTERBEDDED</u>
	<u>GWESPYR SANDSTONE - SANDSTONE AND [SUBEQUAL/SUBORDINATE] ARGILLACEOUS ROCKS, INTERBEDDED</u>
	<u>PENNINE MIDDLE COAL MEASURES FORMATION - MUDSTONE, SILTSTONE AND SANDSTONE</u>
	<u>MINERA FORMATION - SANDSTONE</u>
	<u>CEFN-Y-FEDW SANDSTONE FORMATION - SANDSTONE AND [SUBEQUAL/SUBORDINATE] ARGILLACEOUS ROCKS, INTERBEDDED</u>
	<u>BOWLAND SHALE FORMATION - MUDSTONE</u>
	<u>LLWYN-Y-FRAN SANDSTONE MEMBER - SANDSTONE</u>
	<u>ELWY FORMATION - SANDSTONE</u>
	<u>PENNINE LOWER COAL MEASURES FORMATION - SANDSTONE</u>
	<u>PENNINE MIDDLE COAL MEASURES FORMATION - SANDSTONE</u>
	<u>CEFN-Y-FEDW SANDSTONE FORMATION - CHERT</u>
	<u>ETRURIA FORMATION - SANDSTONE</u>
	<u>HOLLIN ROCK - SANDSTONE</u>

GeolIndex Report



British Geological Survey



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GeolIndex Onshore Data Sources: NERC, Natural England, English Heritage and Ordnance Survey

Map Key

Superficial deposits 1:50,000 scale

	<u>GLACIOFLUVIAL DEPOSITS, DEVENSIAN - SAND AND GRAVEL</u>
	<u>GLACIOFLUVIAL ICE CONTACT DEPOSITS, DEVENSIAN - SAND AND GRAVEL</u>
	<u>GLACIOFLUVIAL SHEET DEPOSITS, DEVENSIAN - SAND AND GRAVEL</u>
	<u>TILL, DEVENSIAN - DIAMICTON</u>
	<u>ALLUVIUM - CLAY, SILT, SAND AND GRAVEL</u>
	<u>HEAD - CLAY, SILT, SAND AND GRAVEL</u>
	<u>RIVER TERRACE DEPOSITS (UNDIFFERENTIATED) - SAND AND GRAVEL</u>
	<u>ALLUVIAL FAN DEPOSITS - SAND AND GRAVEL</u>
	<u>LACUSTRINE DEPOSITS - CLAY AND SILT</u>
	<u>PEAT - PEAT</u>
	<u>SUPERFICIAL DEPOSITS - SEDIMENT</u>