Contents

4. Don and Rother Catchment

4.1 Don and Rother Catchment Event Hydrology

This section describes the hydrological conditions that were experienced across the Don and Rother sub-catchment during Storm Babet, including rainfall and river patterns and their rarity. The Hydrology Technical Appendix provides more details on the event hydrology within Derbyshire leading up to and during Storm Babet.

4.1.1 Catchment Characteristics

The Don and Rother sub-catchment is located in the north-east of Derbyshire, south of Sheffield, encompassing Chesterfield and southwards to Clay Cross. The River Rother headwaters are near Clay Cross, to the south of the sub-catchment. The river passes northwards through North Wingfield and Wingerworth before flowing through the centre of Chesterfield. The river then flows north of Staveley and up to Killamarsh. This is the total extent of the River Rother within Derbyshire, although it continues further north to its confluence with the River Don in Rotherham. The main tributaries include the River Doe Lea on the right bank (right bank of the river when looking downstream), and River Hipper, River Drone and River Whitting on the left bank (left bank of the river when looking downstream).

Figure 4-1 indicates the sub-catchment extent in respect of the Derbyshire area, in addition to showing the location of rainfall, river flow and level gauges within or near the sub-catchment.

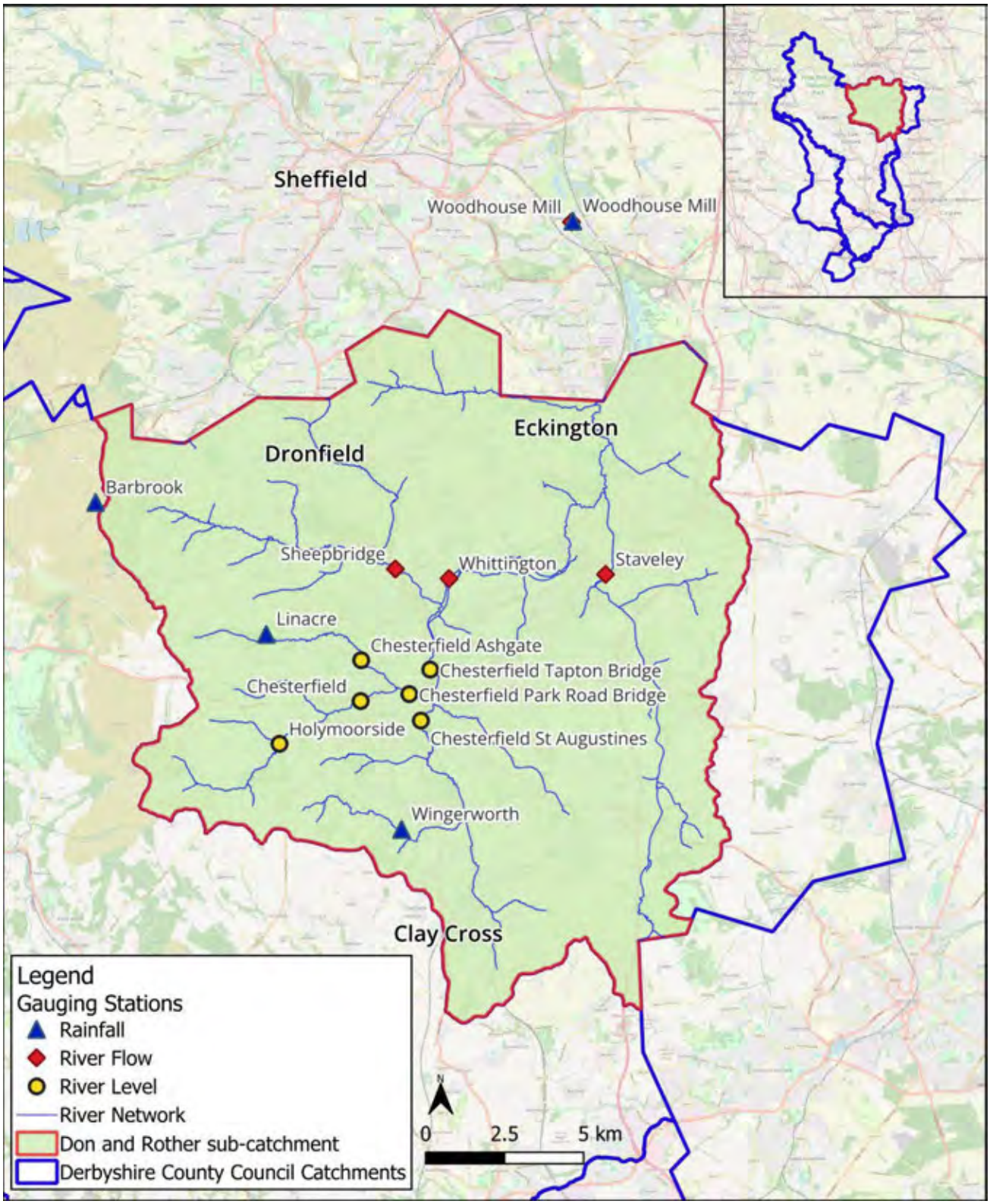

Figure 4-1: Extent of the Don and Rother sub-catchment and rainfall, river flow and river level gauges.

4.1.2 Hydrological Summary

4.1.2.1 A Reminder on Probability

The chance of something happening is often expressed as a probability. If something has a small probability of occurring it is a rare event, meaning that the chance of it happening within a certain timeframe is small. Within the context of this report, a rare event is also a more extreme event, for example a more extreme weather event. Conversely, if something has a higher probability of occurring then the chance of it happening in a certain timeframe is higher. Again, within the context of this report, a more frequent event is also a less extreme event, for example a less extreme weather event.

More specifically, this section of the report refers to the probability of high rainfall and river flow events using

the term “annual exceedance probability” (AEP). This indicates the severity or rarity of an event at a particular location. AEP refers to the chance that a specific hydrological condition, for example 100mm of rain falling during a storm, is exceeded in a one year period. In this context to exceed means a rarer, or extreme, weather event.

An example of a severe and rare event would be a 1% AEP event. This is an extreme weather condition that has only a one in a hundred chance of being exceeded in any given year. An example of a less extreme, but still intense, event would be a 25% AEP event. This has a one in four chance of being exceeded in any given year. As indicated by these examples, the smaller the percentage AEP stated, the more rare or extreme an event is.

4.1.2.2 Rainfall

During Storm Babet, heavy rainfall lasted from the 19th to 21st of October 2023 across the Don and Rother sub catchment, with rainfall peaking early on the 20th from 4:00am to 4:15am. The rarity of rainfall was similar across the catchment, with recorded rainfall equating to 1.1% AEP to 3.4% AEP events at all stations. Towns experiencing this extreme rainfall include Dronfield, Eckington, Staveley, Clay Cross and Chesterfield.

4.1.2.3 Rivers

Quicker and earlier river responses to heavy rainfall were recorded on tributaries of the River Rother, including the River Hipper near Chesterfield and Holymoorside, and the River Whitting near Whittington. Longer and slower responses to heavy rainfall were recorded on the River Rother nearer to Sheffield. The shortest lag time between peak rainfall and peak flow was recorded near Staveley (8 hours) while the longest was recorded at Woodhouse Mill, just north of the sub-catchment, nearer Sheffield.

All gauging stations produced the highest or second highest ranked flows or levels on record in response to Storm Babet.

4.1.2.4 Communities

The rainfall conditions severity at each local community within the Don and Rother sub-catchment is listed below. Event rarity was estimated from the nearest rainfall gauging station to each community:

- 1.1% AEP: Chesterfield South, Central Chesterfield
- 2% AEP: Station Road (Whittington Moor), Holymoorside, Brampton, Chatsworth Road (West), Tapton Terrace (and surrounding area), Meadow Close
- 3.4% AEP: Poolsbrook, Eckington, Renishaw

For access to the nearest gauging station to each community, please see the Government’s Check for Flooding Service at https://check-for-flooding.service.gov.uk/river-and-sea-levels.

4.2 Community Impacts – Poolsbrook

4.2.1 Location Characteristics

Seven properties in Poolsbrook, a village close to Staveley, at the eastern edge of Chesterfield borough, suffered internal flooding as a result of Storm Babet. Figure 4-2 below shows the area where the main group of residential properties flooded, to the west of the River Doe Lea. The River Doe Lea flows in a north-westerly direction to the east of the community and is separated from the village by the A6192 (Erin Road). Pools Brook is an ordinary watercourse to the west of the village, which flows in a north-easterly direction before joining with the River Doe Lea approximately 500m to the north of the village. A ditch referred to herein as ‘Ditch 1’ passes through the village from west to east and parallel to Moorhen Drive. It passes beneath Staveley Road and connects the River Doe Lea with Pools Brook. Another ditch is located in the woodland to the south of the village, and herein is called ‘Ditch 2’. South of Ditch 2, an ordinary watercourse is located along the southern boundary of the woodland and flows westwards into Pools Brook Lake.

Figure 4-2: Overview map of Poolsbrook village.

Poolsbrook consists mainly of residential buildings, most of which are semi-detached, with some non-residential buildings such as businesses and a primary school. The houses are a mixture of Victorian-era and newer homes. Erin Court is a new housing development located to the south-east of the village, off Staveley Road and Court Road. Houses at Erin Court are recent builds; therefore they are not currently shown on mapping systems but are de-marked by a black dashed line on Figure 4-2. Construction of properties at Erin Court began in 2021 but is not fully complete. Once complete the development will consist of 175 homes.

The only known vulnerable building type within the community is the primary school, although this was not reported to have flooded during Storm Babet.

The community is not located on a floodplain, with most of the village on slightly higher ground than the River Doe Lea.

The local superficial geology is sedimentary, i.e., mudstone, siltstone and sandstone.

The Environment Agency's Historic Flood Map indicates that much of the area, where Erin Court is now located, was flooded in June 2007 by the River Doe Lea, prior to the development being built.

The Flood Map for Planning (https://flood-map-for-planning.service.gov.uk/) shows that the flooded homes within this community are in Flood Zone 1. Areas in Flood Zone 1 have less than 0.1% AEP of river flooding. Figure 4-3 below shows the flood zones and flood risk management assets in the vicinity of Poolsbrook.

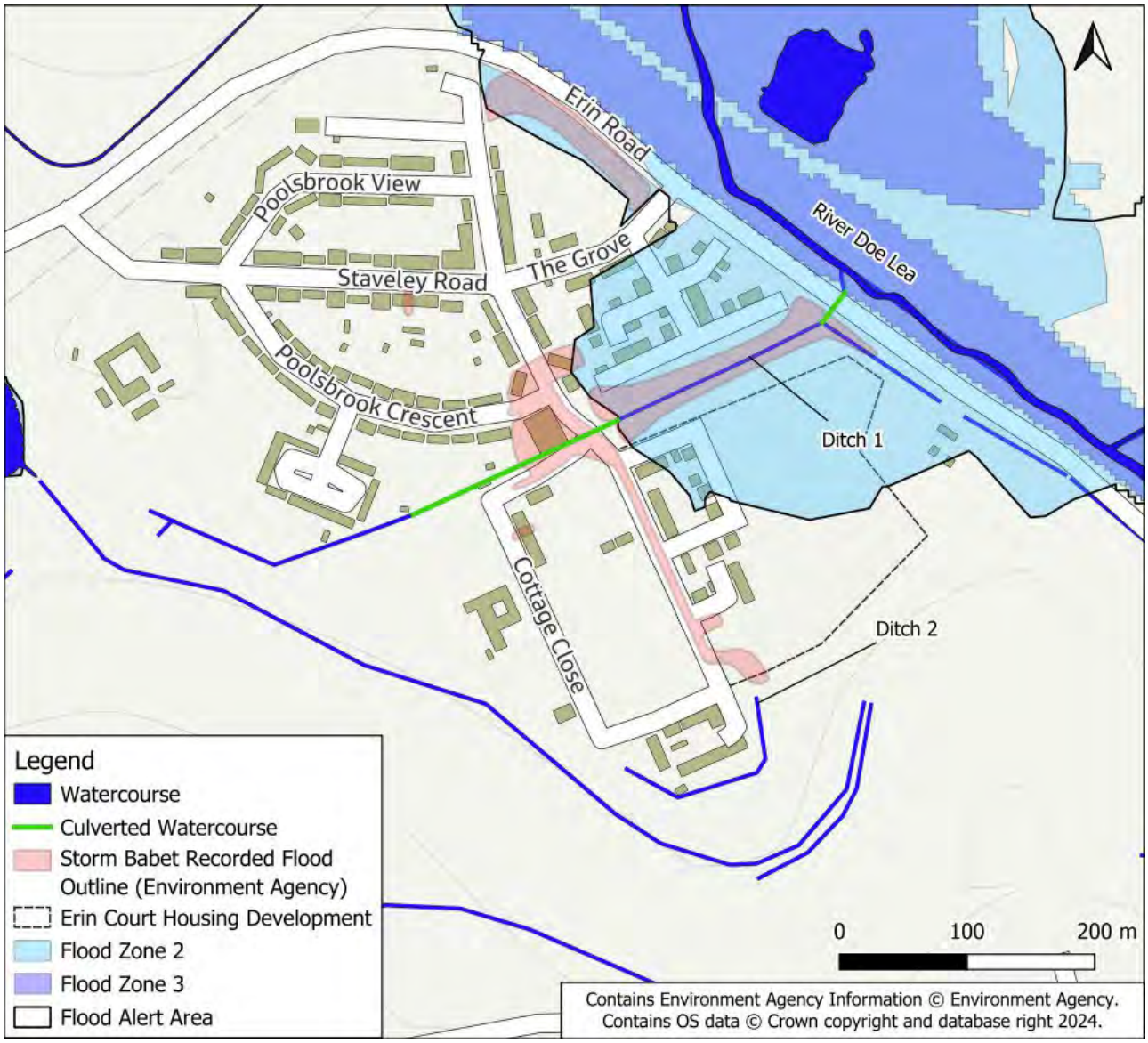

Figure 4-3: Flood map for Planning Flood Zones and Flood Risk Management Assets in the vicinity of Poolsbrook.

Additionally, some homes in the community located near to Ditch 1 have a high risk of surface water flooding, based on the Long Term Flood Risk Map (https://check-long-term-flood-risk.service.gov.uk/postcode). High risk is defined as greater than 3.3% AEP of flooding. Figure 4-4 shows the surface water flood risk for the community based on the national mapping referred to above.

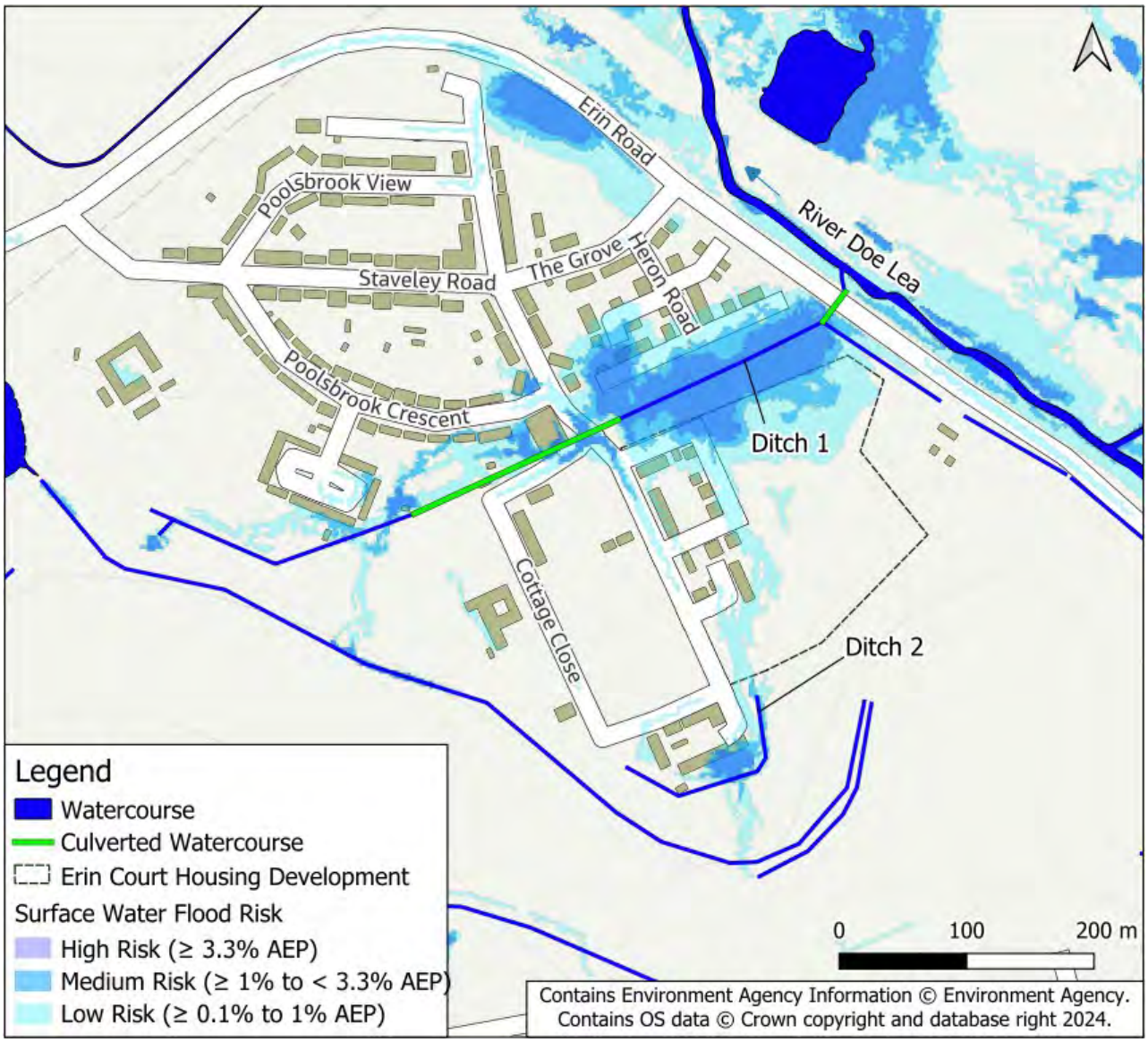

Figure 4-4: Map showing the chance in any given year of flooding from surface water at Poolsbrook (Source: Long Term Flood Risk Map).

The community is not located within or nearby to any nationally designated environmental sites.

4.2.2 Current Flood Risk Management Arrangements

None of the properties flooded within this community were located in a flood alert or flood warning area.

The Environment Agency's Asset Information and Maintenance Programme (https://environment.data.gov.uk/asset-management/) shows that the only river flood defences in Poolsbrook are those along the River Doe Lea, which is lined by a combination of embankments and natural high ground.

Ditch 1 is a surface water flood storage area owned by a riparian landowner. There is a flap valve at its confluence with the Doe Lea to prevent river water ingress.

A combined sewer pumping station which regulates the local network is operated by Yorkshire Water and located to the north of the village.

4.2.3 Storm Babet Incident Details

A flood alert was issued to the reach of the 'River Doe Lea Catchment' Flood Alert Area on the 19th of October 2023 at 8:54pm. The flood alert area covered some of Poolsbrook to the east, although none of the properties which flooded internally were located within it. No flood warnings were issued to or in the vicinity of Poolsbrook.

Six residential properties and one non-residential property suffered internal flooding across two streets. Five of these properties are located on Staveley Road next to the Staveley Road and Poolsbrook Crescent junction. The other two are newer build homes located further south on the Erin Court development.

4.2.4 Flood Mechanisms, Extent and Impacts

The flood extent at Poolsbrook covered the low spot at the Staveley Road and Poolsbrook Crescent junction and its surrounding area. Parts of Erin Court, near to the end of Staveley Road, and Staveley Road between the Staveley Road and Erin Court junction were also impacted. Land surrounding Ditch 1 also flooded.

Mechanisms which caused homes to internally flood at Poolsbrook are complex and are currently unconfirmed. Investigations are ongoing into whether a combination of the following exacerbated the impact of the exceptional weather:

- headwater blockage at Ditch 2;
- a redirection of flows from the blocked ditch south of Ditch 2 flowing into Ditch 2; and
- over flowing of Yorkshire Water sewers at the east end of Ditch 1 and at Staveley Road.

Floodwater flowed from the woodland to the south of Erin Court into the housing development where two homes were flooded internally. This floodwater then flowed downslope along Staveley Road to the low spot, internally flooding the six other properties. It is understood that the floodwater that flowed out of the woodland originated from Ditch 2. Chesterfield Borough Council, as the riparian owner of Ditch 2, have since been investigating the cause of flooding. Investigations are ongoing to understand to what extent a potential blockage could have exacerbated the impact of exceptional weather.

The sewer network discharged at the rear of No. 58 Staveley Road, at the junction of Staveley Road and Poolsbrook Crescent and from the trunk sewer adjacent to the eastern end of Ditch 1 by the A6192. The Yorkshire Water pumping station is shown on Figure 4-2. Yorkshire Water is undertaking an investigation into the potential pumping station failure.

Figure 4-5 below shows ground level, Storm Babet flooding extent and Storm Babet flow routes at Poolsbrook.

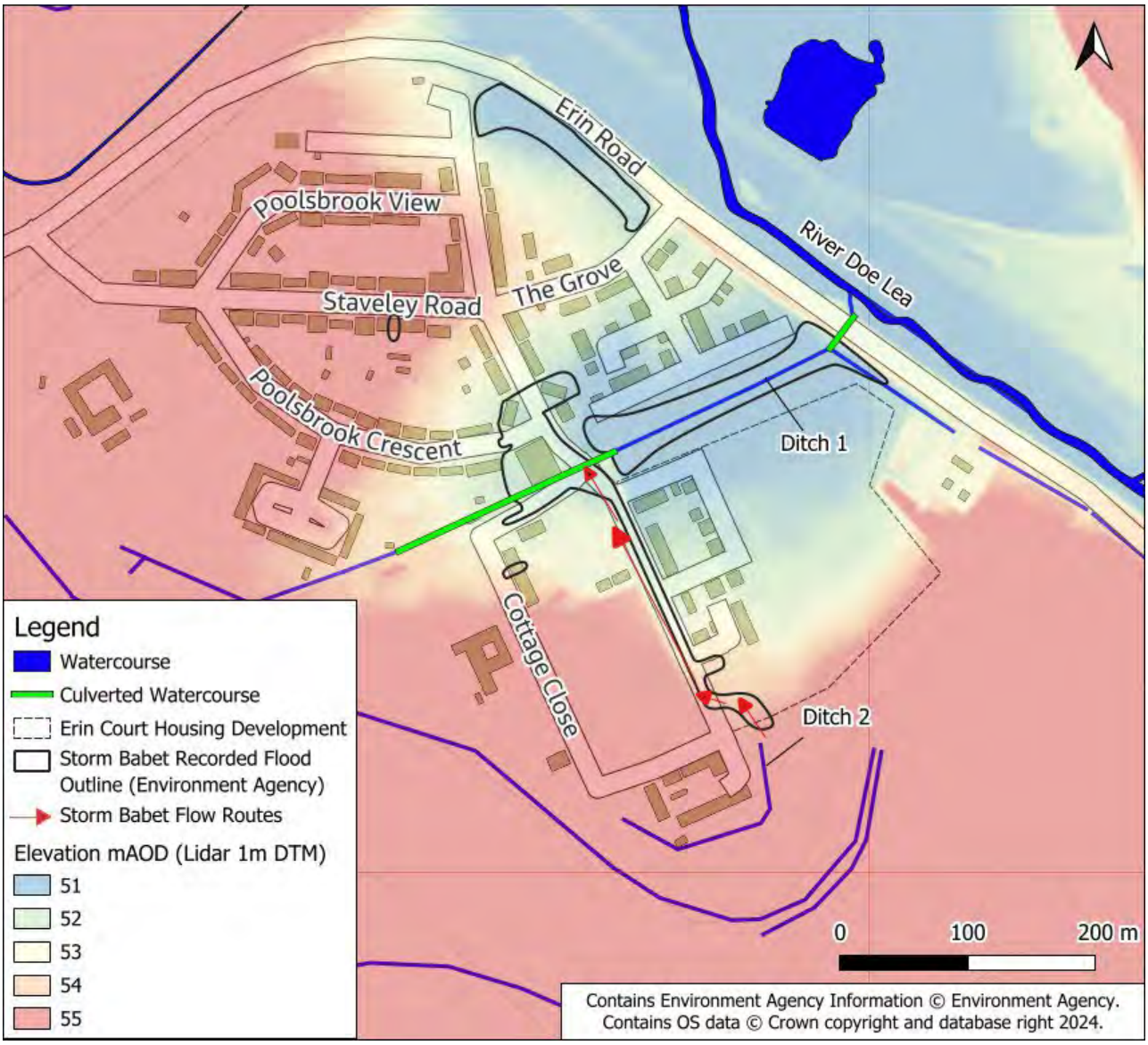

Figure 4-5: Ground level, flooding extent and flow routes at Poolsbrook.

4.2.5 Actions by Public Bodies

This section outlines the actions undertaken by public bodies immediately and in the aftermath of the flood event which are specific to this community. Please refer to section 8.1 of this report for a summary of actions that were implemented at all communities.

Public bodies that have been involved in the flood-event response at this community include:

- Derbyshire County Council
- Environment Agency
- Chesterfield Borough Council
- Yorkshire Water
- Emergency services

Derbyshire County Council - Actions undertaken by Derbyshire County Council as the LLFA include the following:

- Requesting that maintenance is undertaken by the riparian landowner of Ditch 1 which passes through Erin Court, to better accommodate floodwater storage.
- Requesting that maintenance is undertaken by the riparian landowner of Ditch 2 (Chesterfield Borough Council) which passes to the south of Poolsbrook, to better enhance flow and mitigate against blockages which may result in overland flow.
- Investigating the drainage arrangements of the land to the south of the southern ordinary watercourse (south of Erin Court) to determine if drainage arrangements at this site contributed to the outflowing of floodwater into Erin Court.

- Investigating the causes of floodwater flowing from Ditch 2 and the ordinary watercourse to the south of Poolsbrook in conjunction with Chesterfield Borough Council. This investigation has identified that a headwall was partially blocked, which is likely to have contributed to the flooding. However, there are other causes that may have also contributed or exacerbated flooding. For example, overland flow originating from the ordinary watercourse to the south, which is the responsibility of its respective riparian owner and is being actioned by Derbyshire County Council. Investigations are ongoing.

Chesterfield Borough Council - Actions undertaken by Chesterfield Borough Council include the following:

- Investigating the causes of floodwater flowing from Ditch 2 and the ordinary watercourse to the south of Poolsbrook in conjunction with Derbyshire County Council.
- Investigating, alongside Yorkshire Water, reports that there are blockages within the drainage network at the Erin Court housing development which is still under construction.
- Assisting residents with applications to the Property Flood Resilience (PFR) Scheme, which allows the owners of flood-hit homes and businesses to apply for up to £5,000, including VAT, to help pay for measures to help protect their property from flooding in the future.
- Chesterfield Borough Council received a request for sandbags from one property on Staveley Road, Poolsbrook at 9:26am on the 20th of October 2023.

The Environment Agency issued a Flood Alert to the 'River Doe Lea Catchment' on the 19th of October at 8:54pm. The flood alert area covered some of Poolsbrook to the east, although none of the properties which flooded internally were located within it.

Chesterfield Borough Council will continue to undertake proactive maintenance to ensure the continued functionality of the flap valve located where Ditch 1 and the River Doe Lea join.

Yorkshire Water is investigating the Poolsbrook drainage issues which is believed to be associated with a pumping station defect.

A multi-agency drop in event was held in Chesterfield on the 27th of November 2023 which was open to members of the public and included the Environment Agency, Derbyshire County Council, Chesterfield Borough Council and Yorkshire Water. There has been further site visits and local engagement after the flood event.

4.3 Community Impacts - Station Road, Whittington Moor

4.3.1 Location Characteristics

Ten residential properties at Station Road, Whittington Moor, approximately 2.5km north of Chesterfield, suffered internal flooding as a result of Storm Babet. Figure 4-6 below shows the area where the main group of residential properties flooded. The River Whitting flows in a south-easterly direction through the community and is a tributary of the River Rother.

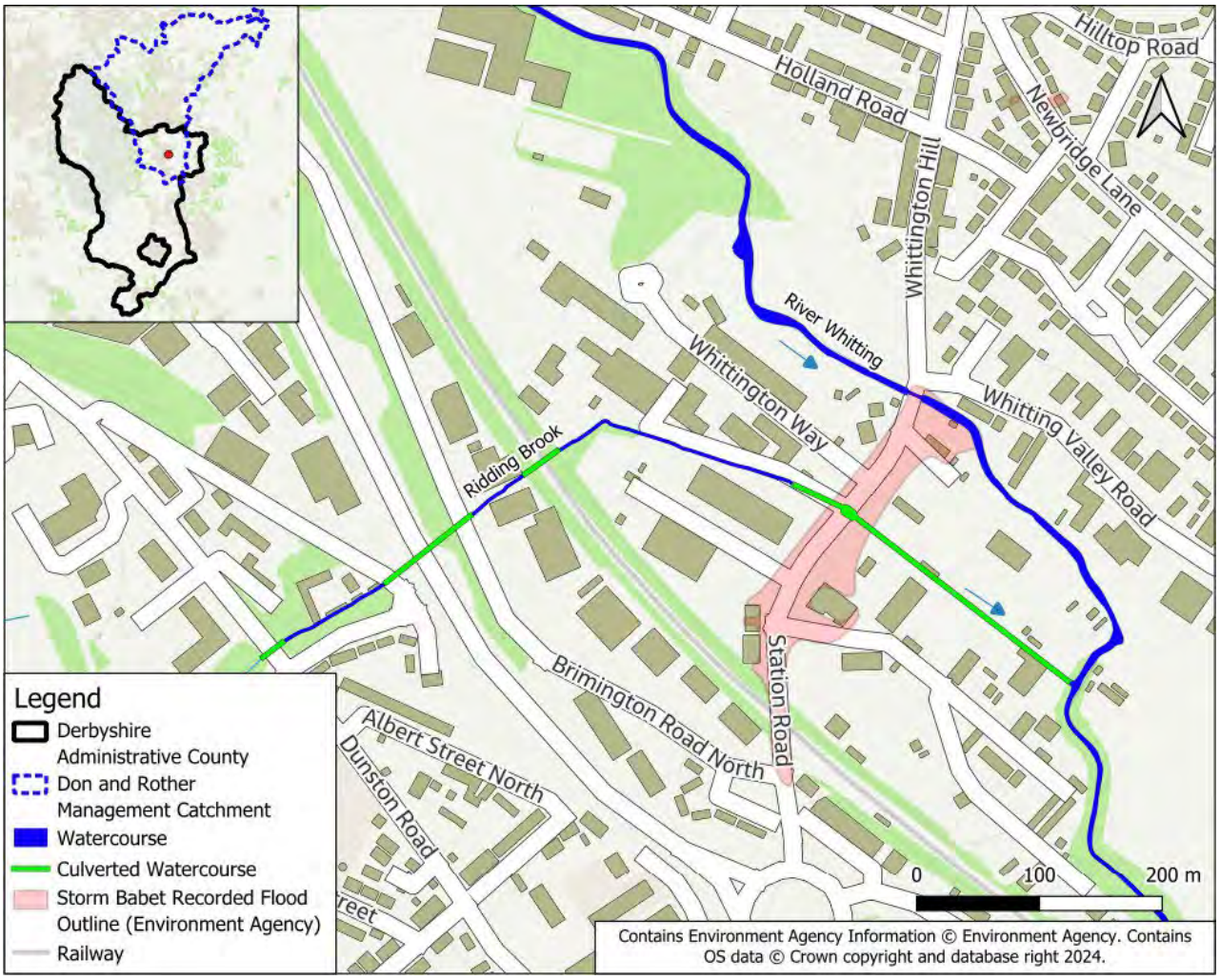

Figure 4-6: Overview map of the Station Road community.

The affected community is a retail district, consisting of numerous businesses with large building footprints, as well as some residential properties. There are no known vulnerable group within the community.

The community is located on the floodplain of the River Whitting. Topographic data shows that the properties flooded sit at a similar elevation to the top of the bank of the River Whitting, and lower than the surrounding area.

The local superficial geology consists of alluvium, including gravel, sand, silt and clay. The bedrock geology is sedimentary and includes mudstone and siltstone.

The Environment Agency Historic Flood Map indicates that some of the community suffered river flooding during the June 2007 flood event, but that flooding was significantly less extensive than the Storm Babet flooding.

The Flood Map for Planning (https://flood-map-for-planning.service.gov.uk/) shows that all of the flooded properties within this community are in Flood Zone 3, as shown in Figure 4-7. Flood Zone 3 means the properties have a greater than 1% AEP of flooding from rivers.

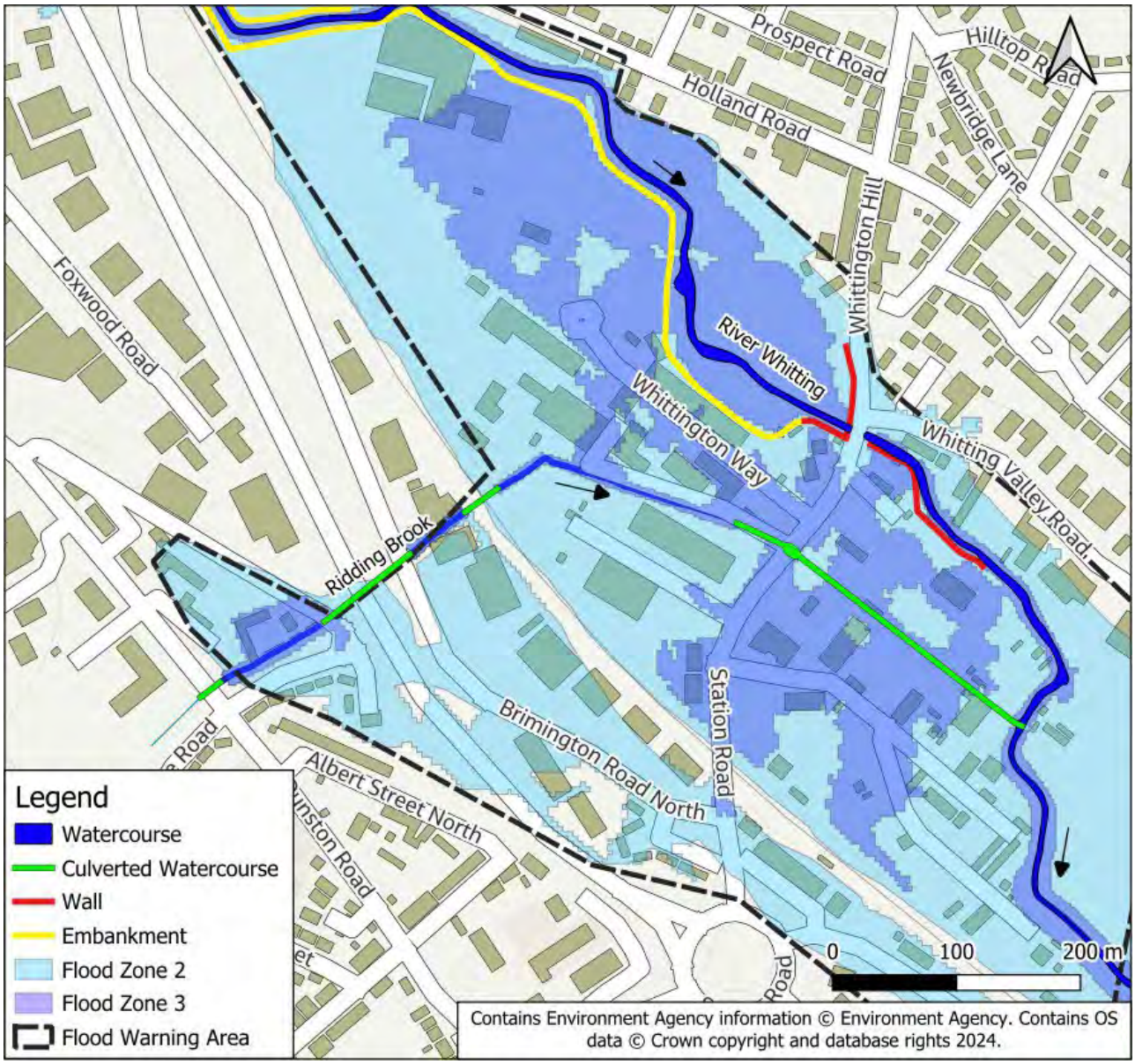

Figure 4-7: Local flood risk management assets in the vicinity of Station Road.

Additionally, all properties have a high risk of surface water flooding based on the Long Term Flood Risk Map (https://check-long-term-flood-risk.service.gov.uk/postcode). High risk in the surface water mapping is defined as greater than 3.3% AEP of flooding. Figure 4-8 shows the risk of surface water flood risk based on this.

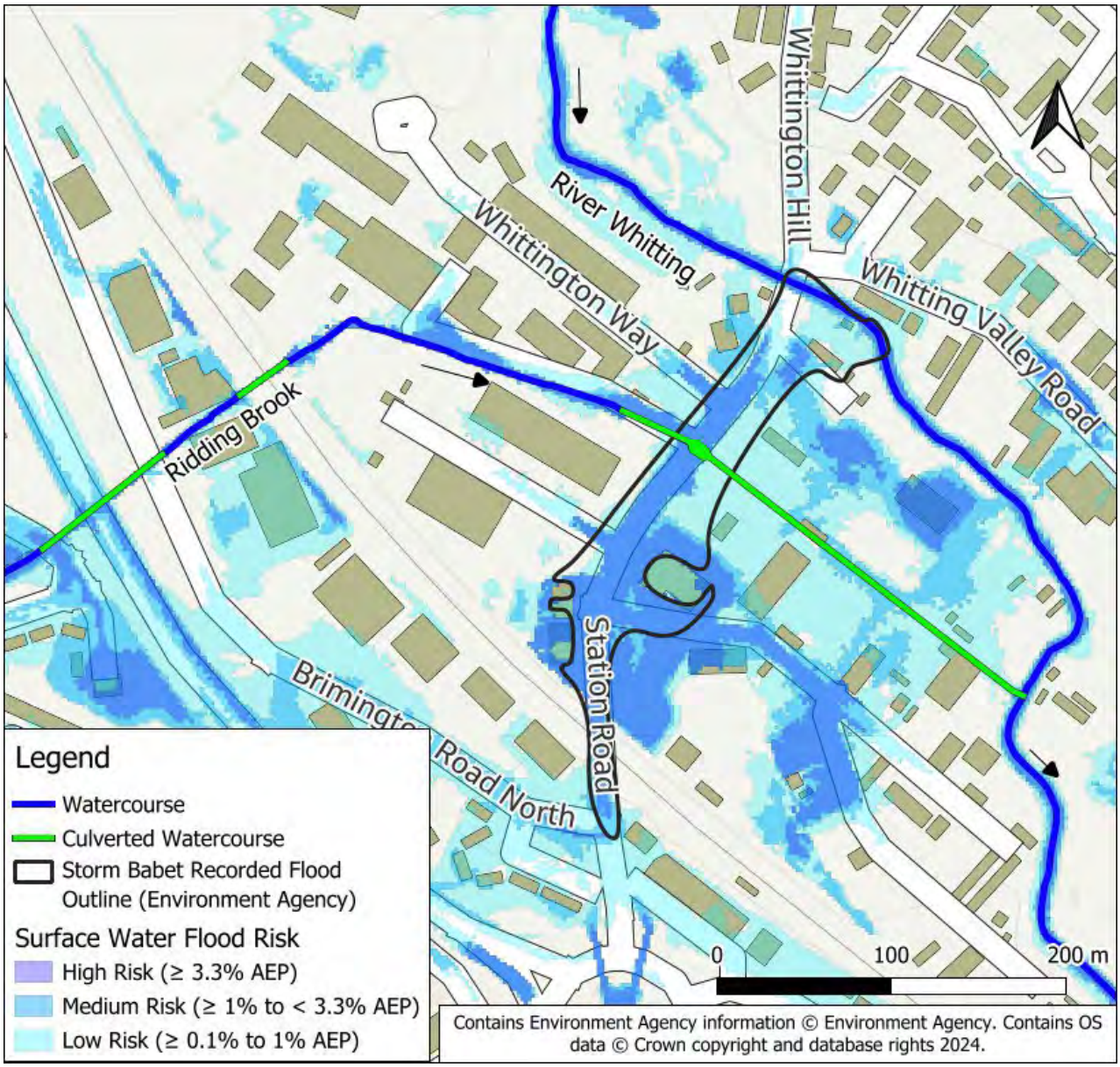

Figure 4-8: Map showing the chance in any given year of flooding from surface water in the vicinity of Station Road (Source: Long Term Flood Risk Map).

The community is not located within or nearby to any nationally designated environmental sites.

4.3.2 Current Flood Risk Management Arrangements

All properties flooded within this community were located within the 'Upper Rother Catchment' Flood Alert Area and the 'River Whitting at Old Whittington and Sheepbridge (including Barlow Brook)' Flood Warning Area. On anticipation of a potential flood event, residents who are signed up to alerts and warnings are informed when flooding is likely to occur.

The Environment Agency's Asset Information and Maintenance Programme (https://environment.data.gov.uk/asset-management/) shows that the right bank of the River Whitting upstream of the community is bordered by approximately 850m of embankment.

4.3.3 Storm Babet Incident Details

A flood alert was issued to the 'Upper River Rother Catchment' on the 19th of October 2023 at 8:54pm. A Flood Warning was issued twice to the 'River Whitting at Old Whittington and Sheepbridge (including Barlow Brook)', at 11:40am and 11:58amm respectively, on the 20th of October. All internally flooded properties fell within these Flood Alert and Flood Warning areas.
Of the ten properties suffering from internal flooding, nine were located on Station Road (eight homes and one business property) between the bridge crossing the River Whitting, and the railway bridge. An additional

business flooded on Whitting Valley Road on the banks of the River Whitting near to the Station Road junction.

4.3.4 Flood Mechanisms, Extent and Impacts

The primary source of flooding affecting all properties within this community was from the River Whitting.

Figure 4-9 shows the flow routes at this community, based on discussions with Chesterfield Borough Council. Hydrology data shows that on the 20th of October, the peak level recorded at the Sheepbridge River Whitting gauge, located approximately 0.9km from the community reached 2.56m; the highest level ever recorded. The gauge indicates that water levels in the River Whitting began to rise on the 20th of October at about midnight, reaching its peak at 2:00pm on the 20th of October.

Figure 4-9: Ground level flow routes at Station Road, Whittington Moor.

The River Whitting initially overtopped a low spot on its east bank, directly south of the bridge over which Station Road crosses the river, flooding one business on Whitting Valley Road. Floodwater then inundated Station Road bridge, and flowed westwards, downslope, along Station Road for approximately 300m. Floodwater accumulated at a low spot on Station Road, directly east of the railway bridge, which Station Road passes beneath.

The reported depths of floodwater reached approximately 30cm at the low spot on Station Road, as shown in Figure 4-10. The reported depths of internal flooding reached approximately 50cm, as indicated by a watermark left on one property.

Figure 4-10: Flood water at Station Road low spot on the afternoon of the 20th of October. Photo taken looking south-westwards.

4.3.5 Actions by Public Bodies

This section outlines the actions undertaken by public bodies immediately and in the aftermath of the flood event which are specific to this community. Please refer to section 8.1 of this report for a summary of actions that were implemented at all communities.

Public bodies that have been involved in the flood-event response at this community include:

- Derbyshire County Council
- Environment Agency
- Chesterfield Borough Council
- Yorkshire Water
- Emergency services

Chesterfield Borough Council report that one property along Station Road made a sandbag request on the 20th of October at 3pm, with the resident reporting that flooding was imminent. It is unknown whether this request was actioned in time or whether it mitigated internal flooding. Both during and after the event Chesterfield Borough Council have made extensive attempts to undertake investigations and record the event. Chesterfield Borough Council were also involved in assisting residents with applications to the PFR Scheme.

A multi-agency drop in event was held in Chesterfield on the 27th of November 2023 which was open to members of the public and included the Environment Agency, Derbyshire County Council, Chesterfield Borough Council and Yorkshire Water. There has been further site visits and local engagement after the flood event.

4.4 Community Impacts – Holymoorside

4.4.1 Location Characteristics

Seven properties in Holymoorside suffered internal flooding as a result of Storm Babet. Holymoorside is a village in north east Derbyshire, approximately 3km west of Chesterfield. Figure 4-11 below shows the area where the main group of residential properties flooded. Holymoorside is located in the Rother and Doe Lea sub-catchment. The River Hipper, which is an ordinary watercourse at Holymoorside, flows through the community in a north easterly direction and is a tributary of the River Rother, which it joins approximately 7km downstream in Chesterfield. An unnamed ordinary watercourse passes through the village from the north-west and joins the River Hipper about 15m south of New Road. Land rises to the west and south of Holymoorside and typically consists of land used for agriculture.

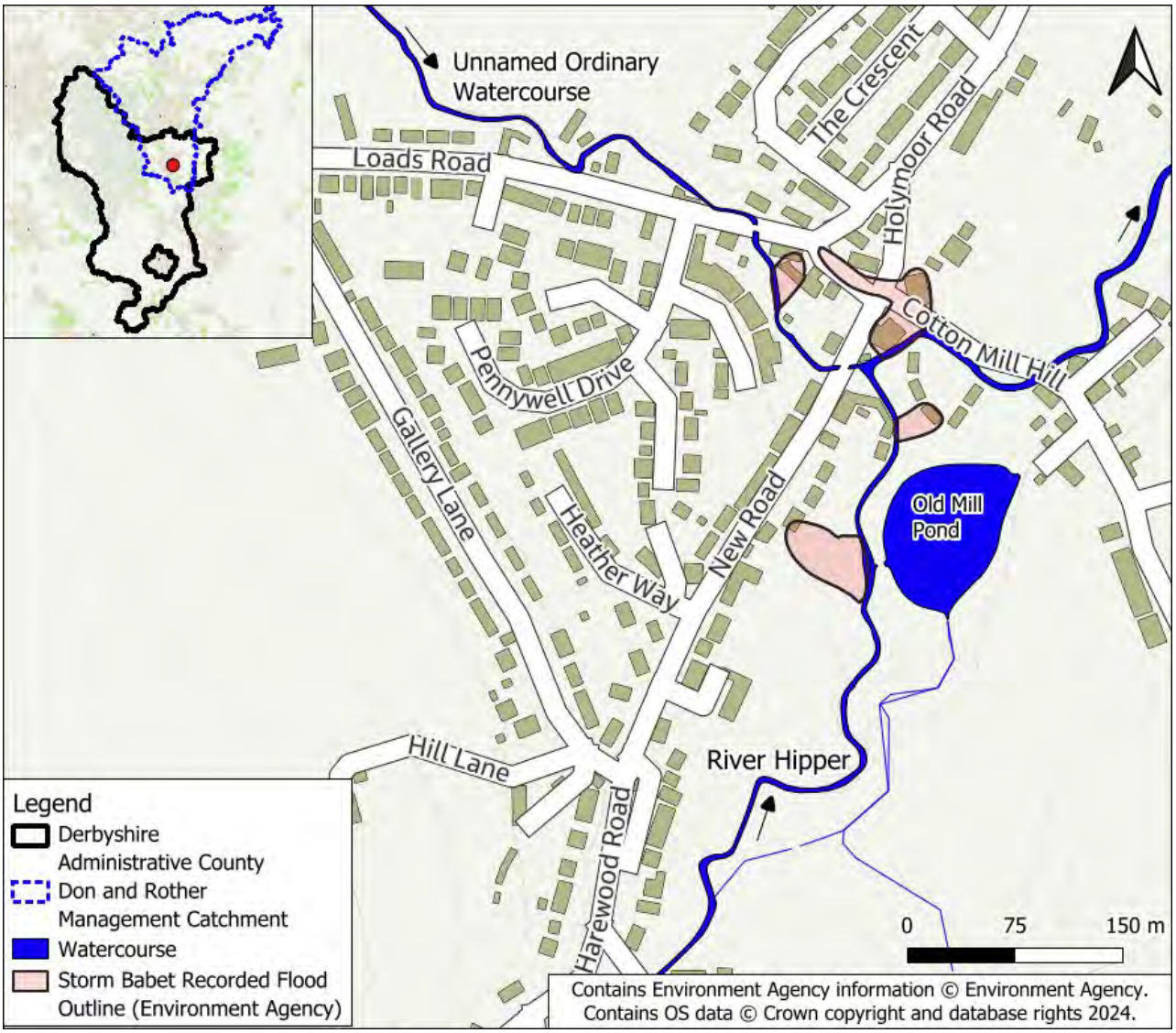

Figure 4-11: Overview map of Holymoorside.

The community affected by flooding is entirely residential, with mostly detached homes that suffered internal flooding during Storm Babet. The only known vulnerable building type within the community is the primary school, although the building itself did not suffer flooding during Storm Babet.

Local bedrock geology consists of sedimentary deposits, including mudstone, siltstone and sandstone.

The community is located on the floodplain of the River Hipper. The Environment Agency's Historic Flood Map indicates that the properties that flooded as a result of Storm Babet have not flooded previously. The Flood Map for Planning (https://flood-map-for-planning.service.gov.uk/) shows that five of the seven flooded homes within this community are in Flood Zone 3, as shown in Figure 4-12. Flood Zone 3 means the properties have a greater than 1% AEP of flooding from rivers. The other two homes are in Flood Zone 1. Flood Zone 1 means the properties have a less than 0.1% AEP of flooding from rivers.

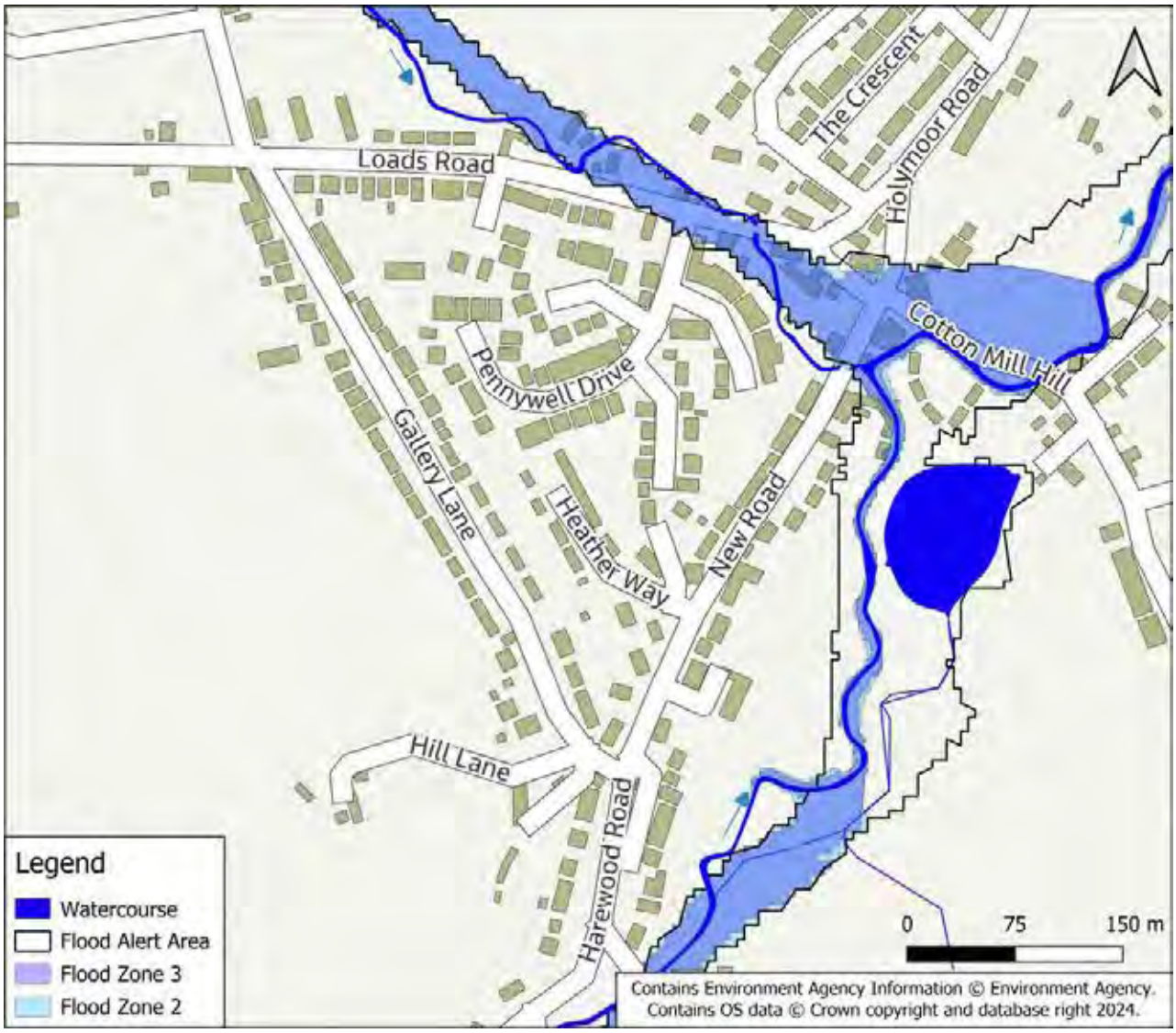

Figure 4-12: Extent of Flood Zones 2 and 3 at Holymoorside.

Additionally, all internally flooded homes have a medium risk of surface water flooding, based on the Long Term Flood Risk Map (https://check-long-term-flood-risk.service.gov.uk/postcode). Medium risk is defined as between 1% and 3.3% AEP of flooding. Some of the internally flooded homes have a high risk of surface water flooding, which is defined as more than 3.3% AEP of flooding. Figure 4-13 shows the surface water flood risk for the community based on the national mapping referred to above

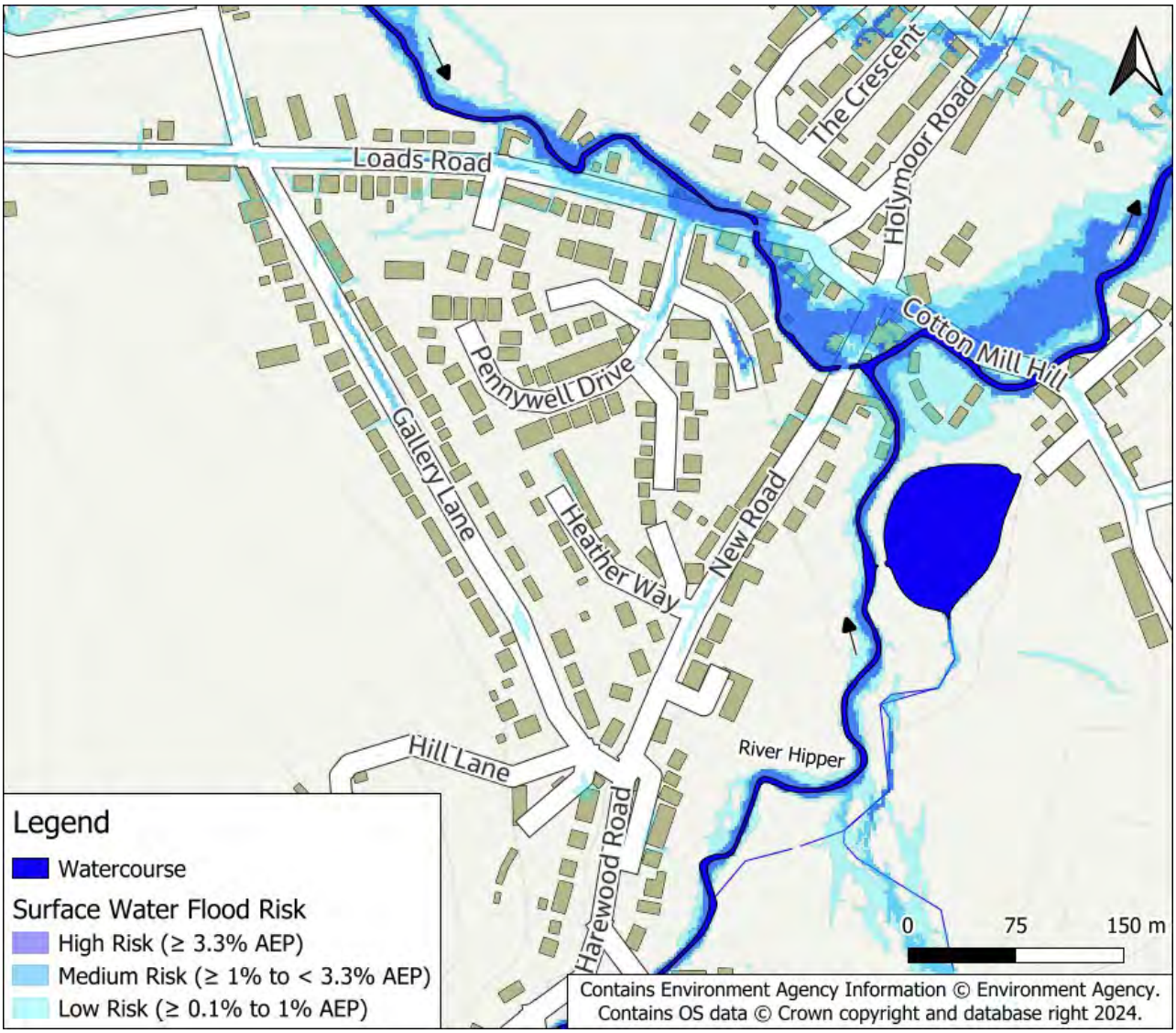

Figure 4-13: Map showing the chance in any given year of flooding from surface water at Holymoorside (Source: Long Term Flood Risk Map).

The community is not located within or nearby to nationally designated environmental sites.

4.4.2 Current Flood Risk Management Arrangements

Six of the seven homes which were flooded internally at Holymoorside were located within the 'Upper Rother catchment' Flood Alert, as shown in Figure 4-12. On anticipation of a potential flood event, residents who are signed up to receive alerts are warned of the possibility of flooding. The community is not covered by an Environment Agency Flood Warning Area.

The Environment Agency's Asset Information and Maintenance Programme (https://environment.data.gov.uk/asset-management/) shows that there are no flood defences that manage flood risk to Holymoorside.

4.4.3 Storm Babet Incident Details

A Flood Alert was issued to the 'Upper River Rother Catchment' on the 19th of October 2023 at 8:54pm. The Flood Alert covered six of the seven homes which were flooded internally.

The seven residential properties which flooded internally were located on The Alders, New Road and Loads Road. One business also suffered internal flooding.

4.4.4 Flood Mechanisms, Extent and Impacts

The primary source of flooding affecting all of the homes within this community was from the River Hipper, however surface water is likely to have contributed to the flooding of some homes.

Figure 4-14 shows the assumed flow routes and elevations which will have contributed to the flood extent. Hydrology data shows that on the 20th of October, the peak level recorded at the Holymoorside gauge downstream of Loads Road bridge on the River Hipper, reached 1.58m; the highest level ever recorded. The gauge indicates that water levels in the River Hipper began to rise on the 20th of October at about midnight, reaching its peak twelve hours later at 12:00pm.

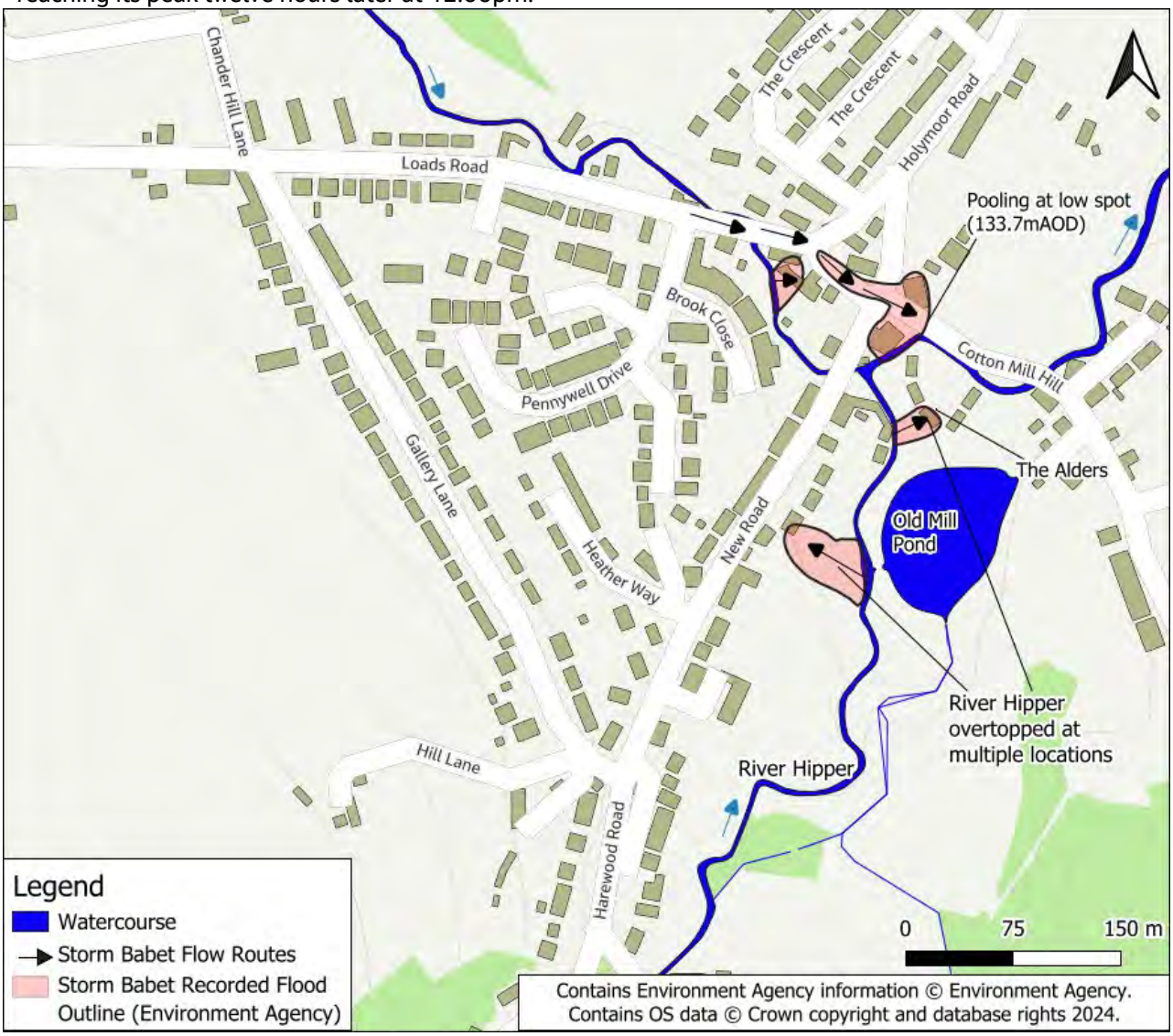

Figure 4-14: Flood extent and flow routes at Holymoorside.

Video evidence shows that the highway was flooded on the 20th of at 9:53am, although it is unclear when flooding commenced. Floodwater is reported to have entered the properties on New Road at approximately 12:00pm and to have receded by approximately 1:00pm.

Flood water is understood to have flowed eastwards along Loads Road and pooled at the Loads Road and New Road junction low spot. Much of this water is understood to have come from the ordinary watercourse, which overtopped its bank immediately upstream of Loads Road bridge, as the bridge arches exceeded their capacity. In addition to the insufficient capacity beneath the bridge arch, there are anecdotal local reports of small debris impeding flows at Loads Road bridge. Loads Road slopes eastwards through Holymoorside to the low spot near to the bridge over the River Hipper. The source of some of the flow along Loads Road is understood to have been runoff from agricultural land located upslope to the west of the village. However, it is unclear to what extent this runoff contributed to the floodwater volume compared to river overtopping. This floodwater is believed to be the only cause of internal flooding of the properties on Loads Road.
The River Hipper is also understood to have overtopped its banks at multiple locations along the section near to Old Mill Pond and the middle of the village. Old Mill Pond was also reported to have overtopped local to a weir. The two internally flooded homes on the New Road and Loads Road junction were flooded from two sources; overtopping of the River Hipper which entered properties from the rear and Loads Road runoff entering properties from the front. The runoff accumulated at the Loads Road low spot located adjacent to The Alders, as shown in Figure 4-14. The Alders are on the inside of a bend in the Hipper and were flooded by water on multiple sides from the Hipper overtopping.

A common secondary impact of the flooding at Holymoorside was the significant soil and silt deposits on Loads Road. Anecdotal evidence received by Derbyshire County Council indicates that agricultural land upstream of the unnamed watercourse had recently had a layer of topsoil added to it which was washed downstream during the event.

4.4.5 Actions by Public Bodies

This section outlines the actions undertaken by public bodies immediately and in the aftermath of the flood event which are specific to this community. Please refer to section 8.1 of this report for a summary of actions that were implemented at all communities.

Public bodies that have been involved in the flood-event response at this community include:

- Derbyshire County Council
- Environment Agency
- North East Derbyshire District Council
- Yorkshire Water
- Emergency services

The Environment Agency issued a Flood Alert to the Upper River Rother Catchment on the 19th of October at 8:54pm.

Derbyshire County Council distributed information to the affected residents regarding the PFR Scheme.

Derbyshire County Council highways team cleared the soil and silt deposited on Loads Road approximately four days after the flood event.

North East Derbyshire District Council helped remove debris from the road using a sweeper and communicated with the landowner whose land is thought to be a source of runoff on Loads Road.

4.5 Community Impacts – Chatsworth Road West

4.5.1 Location Characteristics

Eighteen properties near Chatsworth Road and Walton Road, approximately 1km west of the centre of Chesterfield, suffered internal flooding as a result of Storm Babet. Figure 4-15 below shows the area where the main group of properties flooded. The River Hipper is a main river which flows through the community and is a tributary of the River Rother. All internally flooded properties are within 75m of the River Hipper, with eight on its north bank and ten on its south bank. Walton Dam is a lake located to the south of the River Hipper which receives flow from the River Hipper at an upstream inlet.

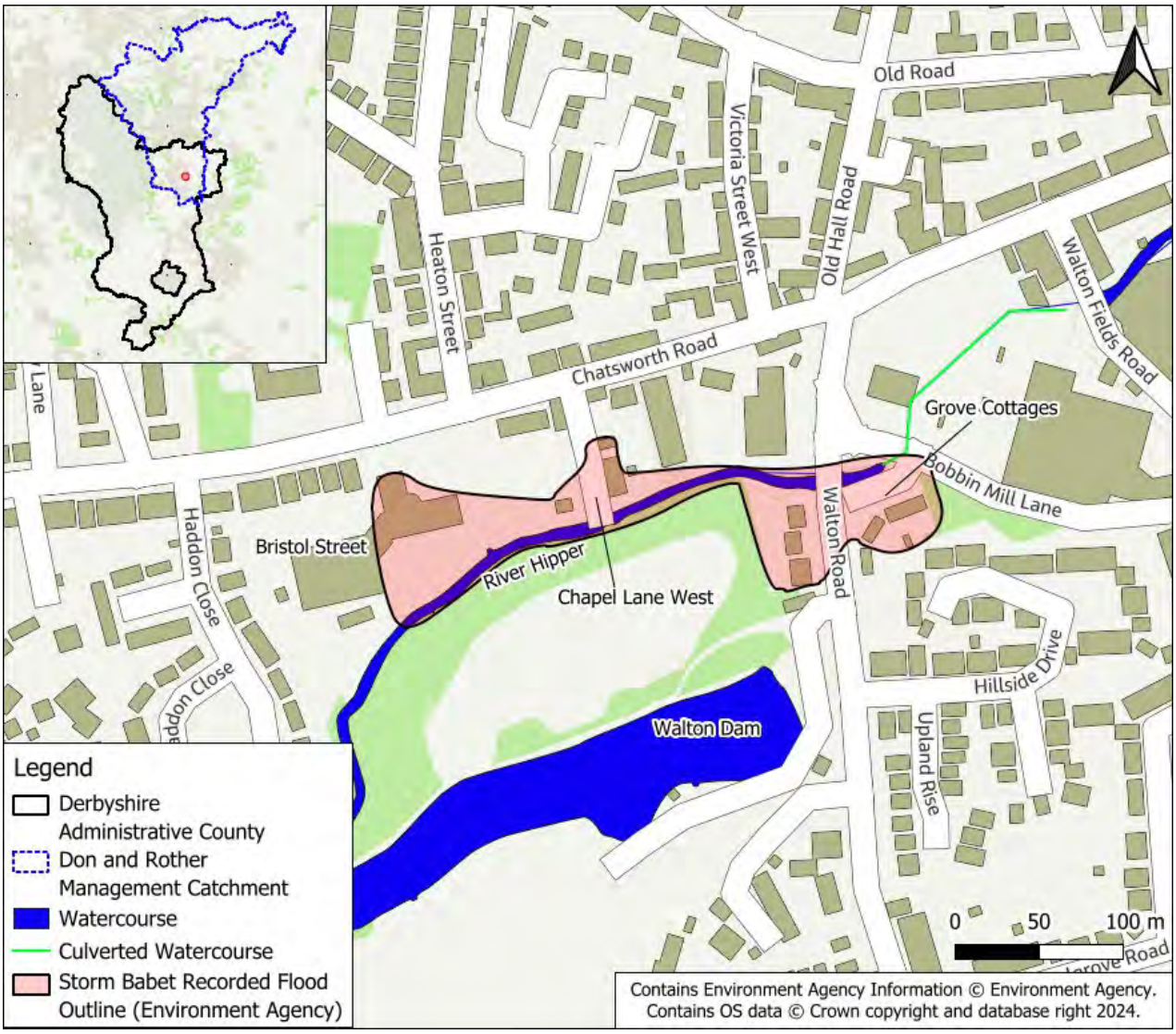

Figure 4-15: Overview of Chatsworth Road West Community

The Chatsworth Road West community consists of a mix of residential properties and businesses. Homes in the area consist of terraced, semi-detached and detached properties, while businesses are predominantly large retail outlets. Seventeen of the eighteen internally flooded properties are residential, all of which are semi-detached. One property is commercial. There are no known vulnerable groups within this community.

The local bedrock geology is sedimentary, including mudstone, siltstone and sandstone.

The community is located on the floodplain of the River Hipper, which flows west to east through the community. Topographic data shows that the properties flooded sit at a similar elevation to the top bank level of the River Hipper.

The Environment Agency Historic Flood Map indicates that the properties that flooded as a result of Storm Babet have not flooded previously.

The Flood Map for Planning (https://flood-map-for-planning.service.gov.uk/) shows that eleven of the eighteen internally flooded properties within this community are in Flood Zone 2, as shown in Figure 4-16. Areas in Flood Zone 2 have between a 1% and 0.1% AEP of river flooding. The remaining internally flooded properties are in Flood Zone 1. Flood Zone 1 means the properties have a less than 0.1% AEP of flooding from rivers.

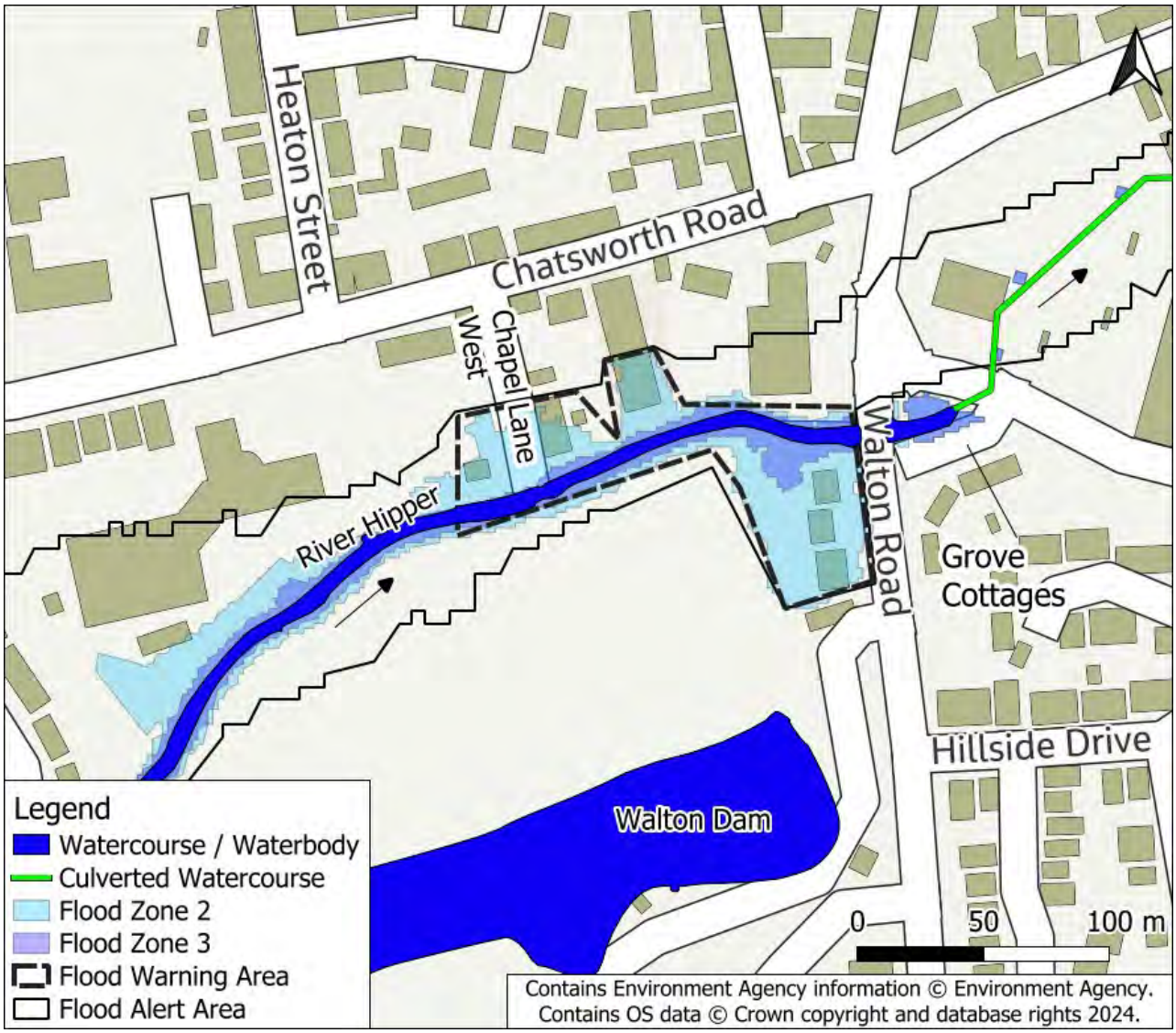

Figure 4-16: Flood zones and flood risk management arrangements in place at the Chatsworth Road West community.

Additionally, some homes on Bobbin Mill Lane have a high risk of surface water flooding, based on the Long Term Flood Risk Map (https://check-long-term-flood-risk.service.gov.uk/postcode). High risk is defined as greater than 3.3% AEP of flooding. Figure 4-17 shows surface water flood risk at the Chatsworth Road West community.

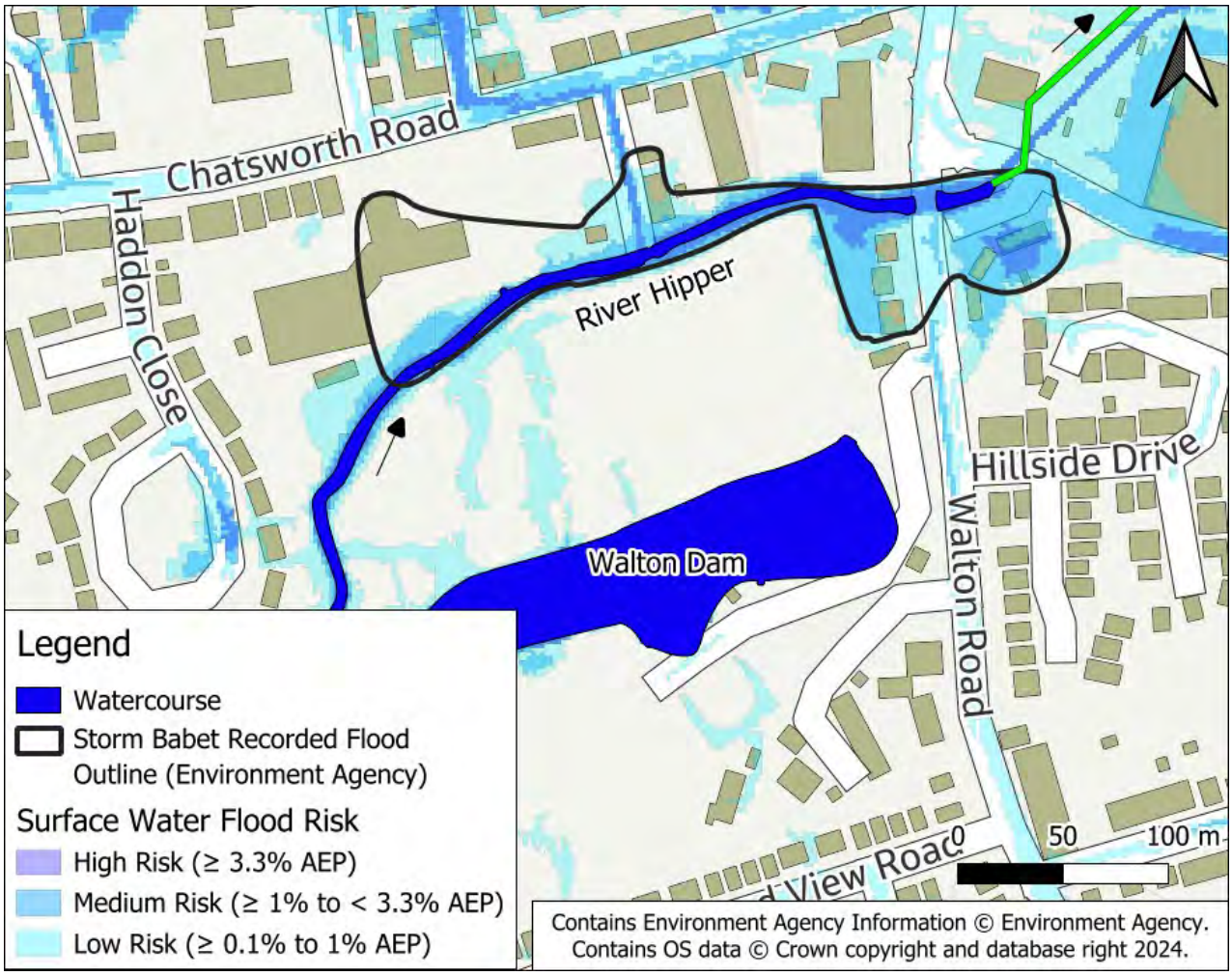

Figure 4-17: Map showing the chance in any given year of flooding from surface water at the Chatsworth Road West community (Source: Long Term Flood Risk Map).

The community is not located within or nearby to any nationally designated environmental sites.

4.5.2 Current Flood Risk Management Arrangements

Ten of the eighteen flooded properties within this community were located within the 'Upper River Rother Catchment' Flood Alert Area and the 'River Hipper at Brampton' Flood Warning Area. On anticipation of a potential flood event, residents who are signed up to alerts and warnings are informed when flooding is likely to occur.

The Environment Agency's Asset Information and Maintenance Programme (https://environment.data.gov.uk/asset-management/) shows that there are no formal flood risk management assets reducing flood risk to the surrounding community. A culvert extends between Bobbin Mill Lane and Walton Fields Road inlet, as shown in Figure 4-15.

4.5.3 Storm Babet Incident Details

A Flood Alert was issued to the 'Upper River Rother Catchment', on the 19th of October 2023 at 8:54pm. A Flood Warning was then issued for the 'River Hipper at Brampton' on the 20th of October at 11:15am. The eighteen properties which flooded internally were located on Chatsworth Road, Walton Road, Chapel Lane West and Grove Cottages.

4.5.4 Flood Mechanisms, Extent and Impacts

The primary source of flooding affecting all of the homes within this community was from the River Hipper, however surface water is likely to have contributed to the flooding of some homes.
Figure 4-18 shows the assumed flow routes and elevations which will have contributed to the flood extent.
Hydrology data shows that on the 20th of October, the peak level recorded at the Chesterfield Hipper gauge,

located approximately 20m upstream of Walton Road bridge, reached 3.59m; the highest level on record. The gauge indicates that water levels in the River Hipper began to rise on the 20th of October at about 3:00am, reaching its peak at 1:00pm.

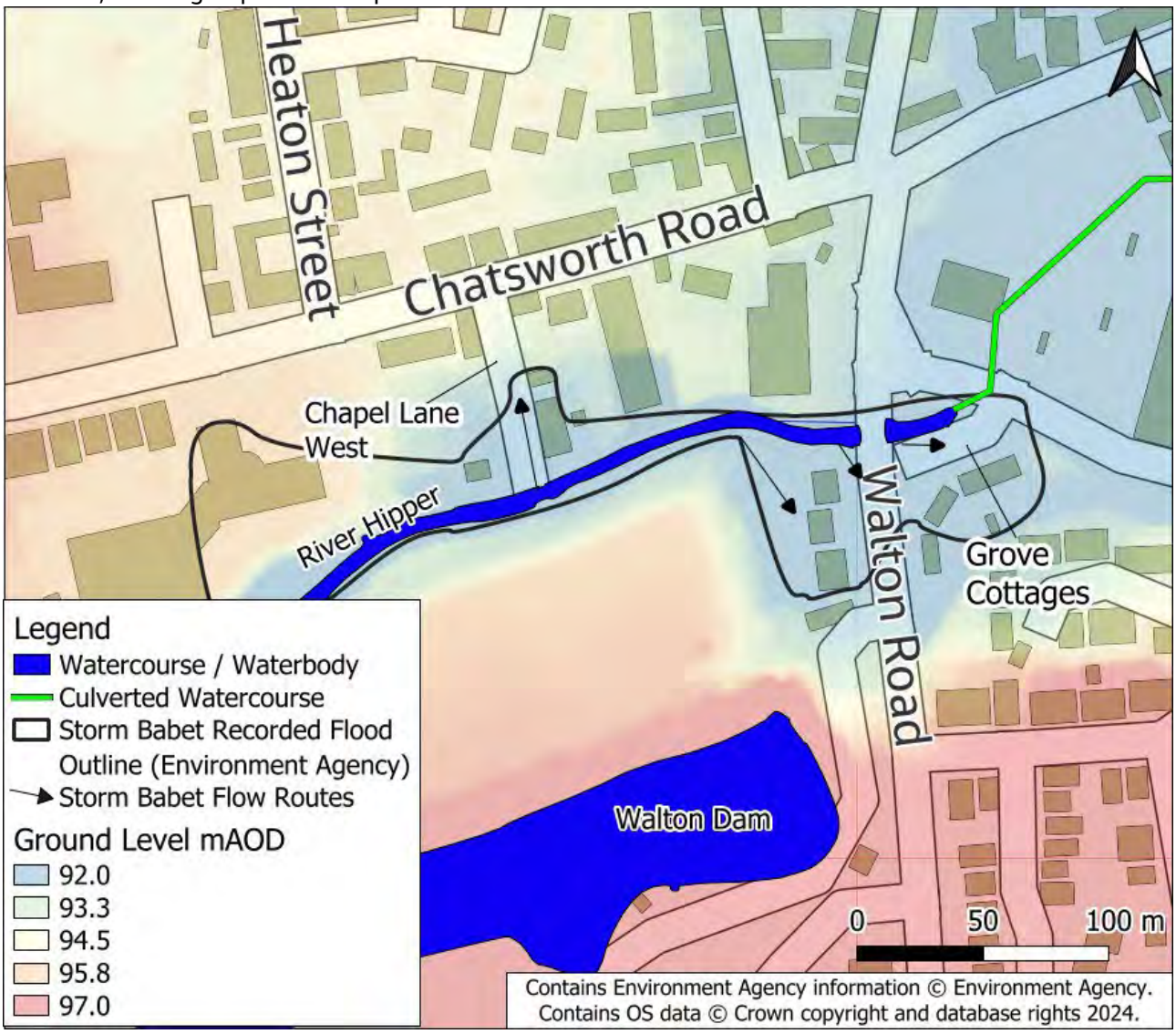

Figure 4-18: Ground level and likely floodwater flow routes during Storm Babet at the Chatsworth Road West community.

The River Hipper exceeded the channel at several locations at this community. At Chapel Lane West, on the north bank of the River Hipper, the river breached its banks and flowed northward up the street to an elevation of approximately 92.7mAOD. Although river water was the dominant flood source at Chapel Lane West, surface water runoff from Chatsworth Road is also understood to have contributed to the flooding. It is unclear whether this was rainfall runoff or related to the surface water network surcharging from road gullies. Residents have reported that floodwater reached waist height at the south end of Chapel Street West, adjacent to the River Hipper.

Floodwater from the River Hipper is understood to have entered five homes on Walton Road through their rear gardens before flooding them internally. Although the flow route that led to the flooding of properties on Grove Cottages is unconfirmed, it is likely to have come from either drainage holes in the riverside wall or from surface water from the highway.

Surface water was a contributing flood source at the Walton Road and Grove Cottage area; the area has experienced surface water flooding incidents in the past, with surface water from the highway flowing northwards down Walton Road.

4.5.5 Actions by Public Bodies

This section outlines the actions undertaken by public bodies immediately and in the aftermath of the flood event which are specific to this community. Please refer to section 8.1 of this report for a summary of actions that were implemented at all communities.

Public bodies that have been involved in the flood-event response at this community include:

- Derbyshire County Council
- Environment Agency
- Chesterfield Borough Council
- Yorkshire Water
- Emergency services

The Environment Agency issued to the Upper River Rother Catchment, on the 19th of October 2023 at 8:54pm. A Flood Warning was then issued for the River Hipper at Brampton on the 20th of October at 11:15am.

The Derbyshire County Council Flood Team undertook a meeting to investigate the mechanisms and extent of flooding on Chapel Lane West on the 14th of February 2024, which involved a site inspection and discussions with affected residents and businesses.

Derbyshire County Council and Chesterfield Borough Council distributed information to the affected residents regarding the PFR Scheme.

A multi-agency drop in event was held in Chesterfield on the 27th of November 2023 which was open to members of the public and included the Environment Agency, Derbyshire County Council, Chesterfield Borough Council and Yorkshire Water. There has been further site visits and local engagement after the flood event.

4.6 Community Impacts – Brampton

4.6.1 Location Characteristics

192 properties, including 137 homes and 55 businesses, in Brampton, Chesterfield, suffered internal flooding as a result of Storm Babet. Figure 4-19 below shows the area where the properties flooded. The River Hipper and Holme Brook flow through the community. The River Hipper, a main river, flows eastwards. Holme Brook is an ordinary watercourse that joins the Hipper at the downstream end of the community, directly to the east of Boythorpe Road. The River Hipper then flows eastwards before joining the River Rother.

The River Hipper and Holme Brook are heavily modified at Brampton as both watercourses have been straightened and pass through multiple culverts and beneath numerous bridges. Figure 4-19 below shows the culvert locations. The Hipper is culverted through the community at the following points:

- beneath the Lidl entrance for approximately 80m;
- between Chatsworth Business Park for approximately 40m;
- parallel to Dock Walk for approximately 100m; and
- beneath Boythorpe Road for approximately 60m.

Holme Brook is culverted beneath Chatsworth Road and Wheatbridge Road for approximately 80m.

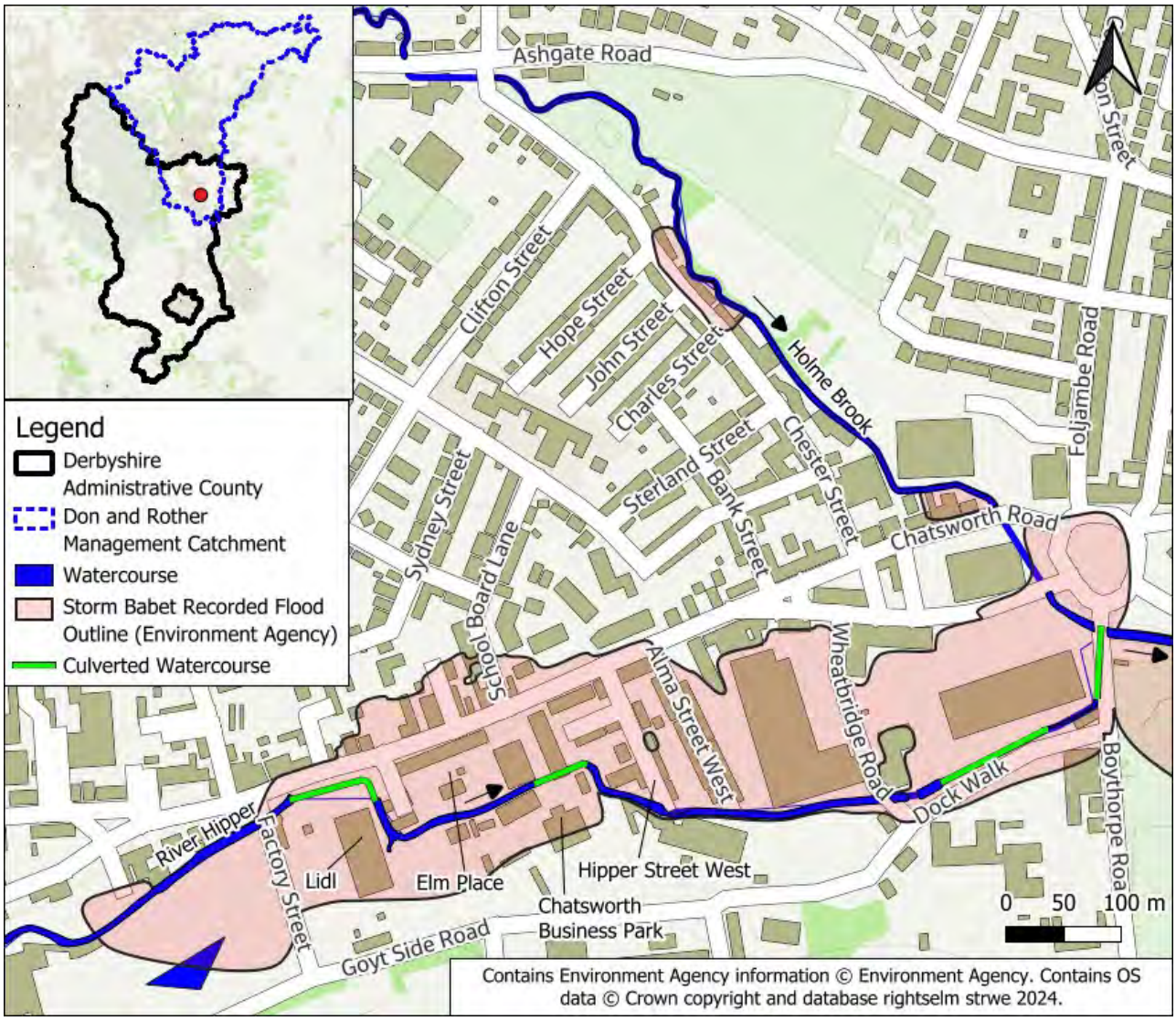

Figure 4-19: Overview map of Brampton community.

No known vulnerable building types were reported to have flooded internally at this community.

The local bedrock geology is sedimentary, including mudstone, siltstone and sandstone.

The community is in the floodplain of the River Hipper and Holme Brook. Topographic data shows that the properties flooded sit at a similar elevation to the top bank level, with some low spots in the floodplain.

The Environment Agency's Historic Flood Maps shows that 142 properties, which is 73% of the properties that were internally flooded during Storm Babet, had flooded previously.

The Flood Map for Planning (https://flood-map-for-planning.service.gov.uk/) shows that the majority of flooded properties within this community are in Flood Zone 2. Areas in Flood Zone 2 have between a 1% and 0.1% AEP of river flooding. There are however properties in Flood Zone 3, which means that they have a greater than 1% AEP of flooding from rivers, as shown in Figure 4-20. Table 4-1 shows the distribution of properties in each Flood Zone.

Table 4-1: Distribution of internally flooded properties at Brampton within Flood Map for Planning Flood Zones. Numbers are the property count and then the percentage of the total internally flooded properties.

Flood Zone	Homes	Businesses	All properties
Flood zone 1 only	3 (3%)	5 (9%)	8 (5%)
Flood zone 2	121 (88%)	43 (78%)	164 (85%)
Flood zone 3	13 (9%)	7 (13%)	20 (10%)
Total	**137**	**55**	**192**

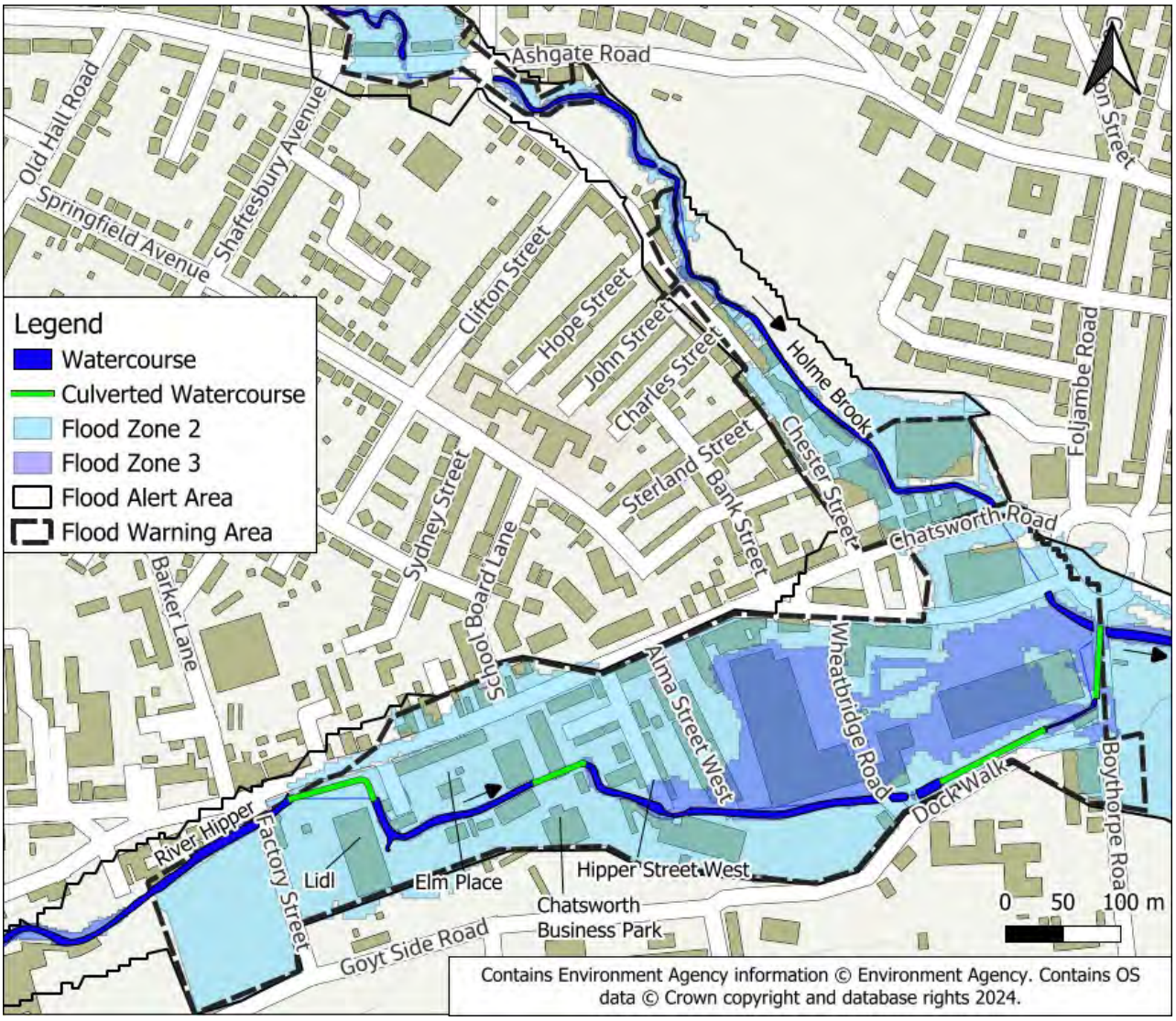

Figure 4-20: Flood Zones and flood risk arrangements in place at the Brampton community.

Based on the Long Term Flood Risk Map (https://check-long-term-flood-risk.service.gov.uk/postcode) the majority of properties have a low risk of surface water flooding. Low risk is defined as between a 1% and 0.1% AEP of flooding. There are however some areas around Factory Street and Chatsworth Road that have a high risk of surface water flooding. High risk is defined as greater than 3.3% AEP of flooding. Figure 4-21 shows the risk of flooding from surface water at Brampton.

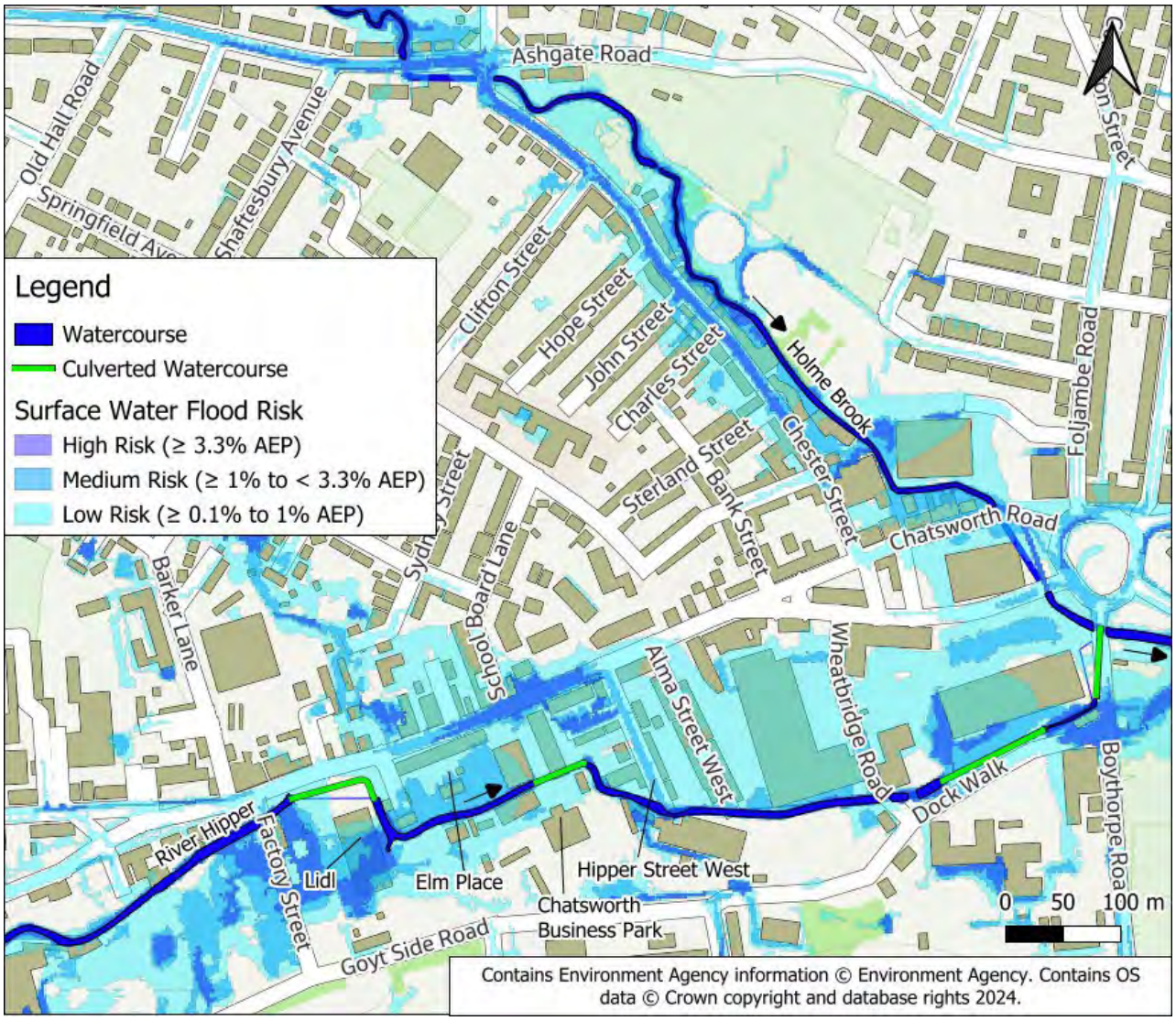

Figure 4-21: Map showing the chance in any given year of flooding from surface water at and in the vicinity of Brampton (Source: Long Term Flood Risk Map).

There are a couple of listed buildings within this community, including the grade II Cannon Mill and Mill Wheel on Dock Walk which are located on the banks of the Hipper. The community is not located within or nearby to any nationally designated environmental sites.

4.6.2 Current Flood Risk Management Arrangements

Most properties that flooded internally within the community were located in the 'Upper River Rother Catchment' Flood Alert Area. The 'River Hipper at Brampton' and 'Holme Brook' Flood Warning Areas cover the majority of internally flooded properties in Brampton. On anticipation of a potential flood event, residents who are signed up to alerts and warnings are informed when flooding is likely to occur.

The Environment Agency's Asset Information and Maintenance Programme (https://environment.data.gov.uk/asset-management/) shows that aside from the areas where it is culverted, the entire length of the Hipper is bounded by natural high ground on both banks. A PFR scheme has previously been delivered to properties on Hipper Street West and Alma Street West by Derbyshire County Council. Some properties within the community also have PFR measures in place which were installed by Chesterfield Borough Council.

There are no other formal flood defences in this community.

4.6.3 Storm Babet Incident Details

A Flood Alert was issued to the 'Upper River Rother Catchment' on the 19th of October 2023 at 8:54pm. This covered all properties that flooded internally at Brampton apart from those on Hardwick's Yard and the property on Welfare Avenue. A Flood Warning was then issued for the 'River Hipper at Brampton' on the 20th

of October at 11:15am, with a separate flood warning being issued at 12:45pm for 'Home Brook', which covered most internally flooded properties. The coverage of these warning areas is shown in Figure 4-20.

Table 4-2 shows the count of internally flooded properties for the affected streets at Brampton.

Table 4-2: Internally flooded properties within the Brampton community.

Street	Homes	Non-residential	All properties
Chatsworth Road Business Park	0	7	7
School Board Lane	3	0	3
Brook Vale	10	0	10
Alma Street West	53	0	53
Chatsworth Road	34	34	78
Chester Street	6	2	8
Wheatbridge Road	0	9	9
Boythorpe Road	0	2	2
Hipper Street West	26	0	26
Hardwicks Yard	4	0	4
Welfare Avenue	1	0	1
Factory Street	0	1	1
Total	**137**	**55**	**192**

4.6.4 Flood Mechanisms, Extent and Impacts

Internal property flooding can be attributed primarily to river sources. For the majority of properties, floodwater originated from the River Hipper. Holme Brook was responsible for the flooding of properties on Chester Street and seven properties located at the east-end of Chatsworth Road, near to West Bars roundabout. Surface water is also likely to have contributed to the flooding of some homes. Flooding was extensive, with some locations experiencing flood depths in excess of 1m, with high velocity.

Figure 4-22 shows the flow routes which will have contributed to the flood extent. Hydrology data has been taken for two separate river level gauges in proximity of Brampton; the Chesterfield Hipper gauge, and the Chesterfield Ashgate gauge. The Chesterfield Hipper gauge shows that on the 20th of October, the peak level recorded reached 3.59m; the highest level ever recorded. The gauge indicated that water in the River Hipper began to rise on the 20th of October at about 3:00am, reaching its peak at 1:00pm.

The Chesterfield Ashgate gauge is located on Holme Brook by Purbeck Avenue bridge, approximately 1.5km upstream of where Holme Brook joins the Hipper and shows that on the 20th of October, the peak level recorded reached 1.6m; the second highest level ever recorded. The gauge indicated that water in Holme Brook began to rise on the 20th of October at about 2:00am, reaching its peak at 1:00pm.

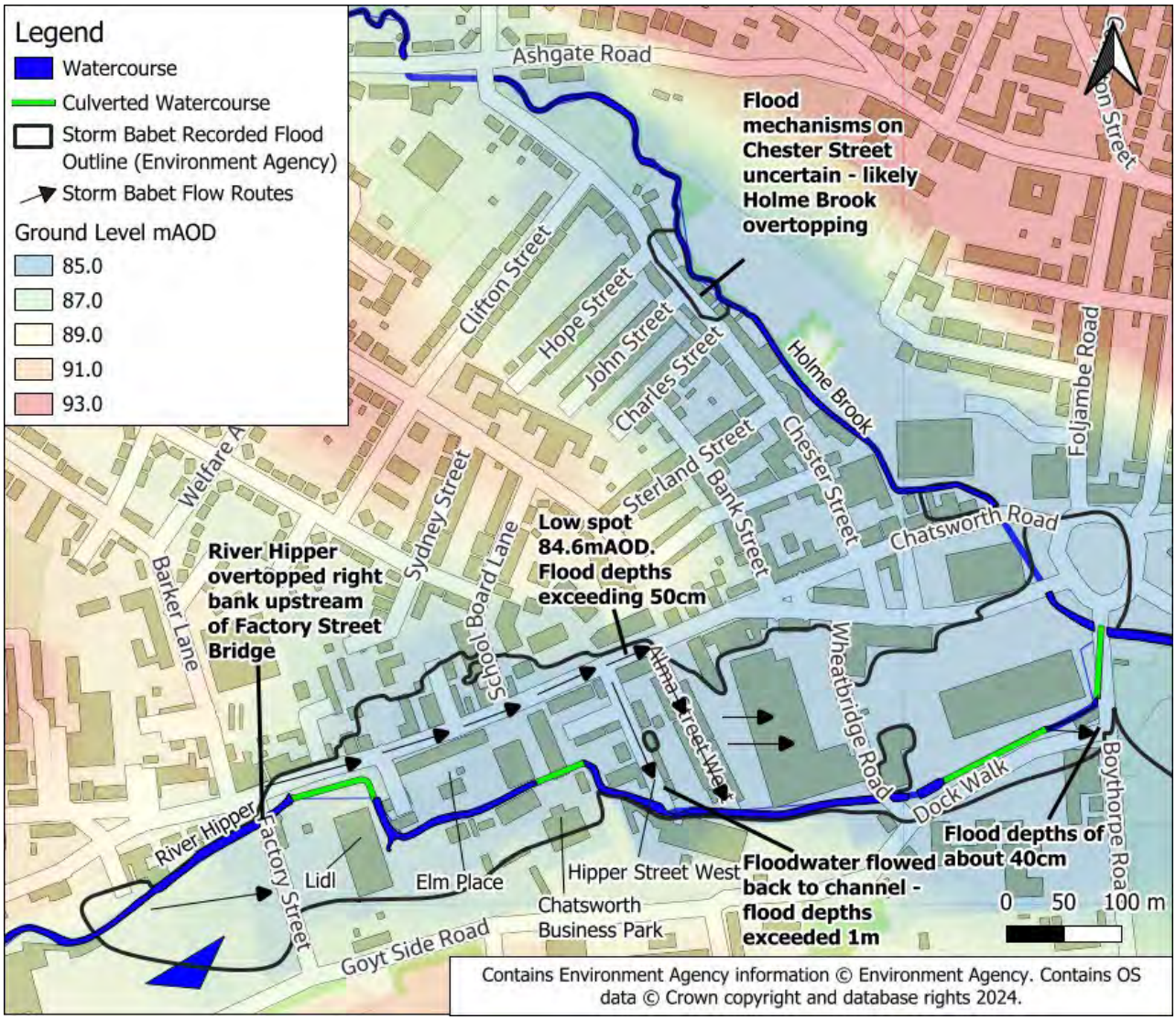

Figure 4-22: Ground level and Storm Babet flow routes at the Brampton community.

Note that the following analysis is based on media and reports received during and after the event, some estimations have been made with regards to flood extents, depths and flow routes.

The River Hipper overtopped near the derelict brownfield site upstream of Factory Street, inundating this site before flooding Factory Street and the Lidl car park. Properties on Chatsworth Road, upstream of the Factory Street bridge, are not reported to have internally flooded. Factory Street bridge was surcharged, as is evidenced by Figure 4-23, taken after water levels had receded somewhat. The figure shows debris caught in the bridge rails on either side of the road. A public house was internally flooded on Factory Street, shown in Figure 4-23 to be submerged south of the River Hipper. Media evidence indicates that the flood depth at the entrance to Lidl, which is a low spot-on Factory Street, likely exceeded 0.5m.

Figure 4-23: Flooding of low spot on Factory Street. Photograph taken from immediately north of Factory Street bridge.

Approximately 30m downstream of the Factory Street bridge, the River Hipper surcharged the culvert which passes beneath the entrance to Lidl from Chatsworth Road. River floodwater is then understood to have joined Chatsworth Road and flowed eastwards, downstream from Factory Street, with further overtopping occurring downstream of the Lidl culvert by Elm Place. Floodwater flowing along Chatsworth Road pooled at a low spot located at the School Board Lane and Chatsworth Business Park junction. This spot has an elevation of 84.6mAOD, which is 2.2m lower than the elevation on the Factory Street bridge, being at 86.8mAOD, where some of the floodwater originated from. Media evidence from during the event suggests that floodwater depths reached at least 0.5m here, although depths might have been more depending on when water levels peaked.

Floodwater continued to flow eastwards along Chatsworth Road past the low spot, flooding properties opposite Bradbury Hall. Pizza Hut was the furthest property eastwards that flooded on the north side of Chatsworth Road, indicating that flood depths became less severe further east of School Board Lane.

Hipper Street West and Alma Street West slope southwards from Chatsworth Road to the River Hipper. Therefore, floodwater on Chatsworth Road travelled downslope along these streets before rejoining the River Hipper. This resulted in most homes on Hipper Street West and all homes on Alma Street West suffering internal flooding. Media evidence shows that floodwater reached the windowsill of a property at the Hipper Street junction with Chatsworth Road, demonstrating that floodwater depths exceeded 0.5m at this location. Footage taken from social media during the event taken at the south end of Hipper Street West, next to the River Hipper, shows a car about 0.4m from being entirely submerged. This indicates that floodwater likely exceeded 1m here. The speed at which debris is being carried by flood water in this footage demonstrates the high velocities along Hipper Street West.

The severity of flooding along Hipper Street West and Alma Street West indicates that the conditions posed a danger to all and a risk to life. It is possible that other locations within this community also experienced a flood hazard to this extent, however there is no clear evidence to confirm this.

Eastwards of Alma Street West, numerous retail warehouses suffered internal flooding. It is not understood whether this flooding was as a result of floodwater entering from Chatsworth Road to the north-west, from the Hipper overtopping its banks to the south, or a combination of both. It is also unclear whether the two properties which internally flooded on Wheatbridge Road were flooded from the front or rear.

The River Hipper is understood to have overtopped just upstream of the culvert beneath Boythorpe Road. Floodwater collected at the low spot on Boythorpe Road, where the ground level is 81.0mAOD, by the Dock Walk junction, resulting in one business being internally flooded. Media evidence indicates flood depth exceeded 0.4m here. The electricity substation located on the banks of the River Hipper along Dock Walk is not thought to have flooded.

Details of the internal flooding of eight homes and businesses on Chester Street and seven homes located at the west-end of Chatsworth Road, near to West Bars Roundabout, are less certain due to insufficient evidence. All properties on Chester Road are within 40m of Holme Brook, therefore their proximity to the watercourse and the water levels recorded at the Holme Brook gauge makes it very likely that these properties suffered internal flooding as a result of Holme Brook overtopping its banks. There is no evidence that surface water runoff contributed to the flooding of properties on Chester Street, however the road slopes southwards from Ashgate Road, therefore this should not be discounted as a possible contributor.

River channel exceedance within this community caused numerous instances of infrastructure damage. For example, the overtopping of Holme Brook and River Hipper caused a riparian owned brick wall to collapse adjacent to West Bars roundabout and just upstream of the culvert immediately west of Boythorpe Road, respectively. The damage sustained to a red brick wall during Storm Babet is shown in Figure 4-24 below. The area is taped off and cones have been placed around the section that has collapsed.

Figure 4-24: Collapsed walls as a result of the overtopping of Holme Brook (left) and the Hipper (right).

It is highly likely that the drainage network would have been surcharged during the flooding event which would have contributed to the flooding.

River level exceedance was the primary cause of flooding, caused by exceptional rainfall within the catchment, bridges and culverts throttling river flow, and debris causing blockages and reducing channel capacity.

4.6.5 Actions by Public Bodies

This section outlines the actions undertaken by public bodies immediately and in the aftermath of the flood event which are specific to this community. Please refer to section 8.1 of this report for a summary of actions

that were implemented at all communities.

Public bodies that have been involved in the flood-event response at this community include:

- Derbyshire County Council
- Environment Agency
- Chesterfield Borough Council
- Yorkshire Water
- Emergency services

Chesterfield Borough Council reported that properties on the following streets requested sandbags on the 20th of October 2023 between 9:28am and 8:31pm:

- School Board Lane
- Hardwick Yard
- Hipper Street West
- Alma Street West
- Chester Street
- Welfare Avenue

Numerous affected properties within this community did not make sandbags requests because they already had PFR measures installed or because the flooding was too severe to have been mitigated by sandbags. Attempts were made by Chesterfield Borough Council to deliver on all requests, although some properties were already inaccessible due to floodwater.

Chesterfield Borough Council were involved in several post-event actions at this community, including:

- assisting with the removal of debris; and
- assisting residents with applications to the PFR Scheme.

The community was attended by the Fire and Rescue Service during the event.

The Environment Agency issued a Flood Alert to the Upper River Rother Catchment on the 19th of October 2023 at 8:54pm. A Flood Warning was then issued for the River Hipper at Brampton on the 20th of October at 11:15am, with a separate flood warning being issued at 12:45pm for Home Brook

The Environment Agency was involved in post-event channel clearance to ensure flows are not compromised.

The Environment Agency conducted a river inspection on the 13th of November 2023. Issues were identified at eleven lengths of retaining or boundary walls. This included missing coping stones, wall cracks, vegetation-related issues and missing brickwork. Defect reports were completed for six of these, and the other five were noted for further monitoring. A defect report was submitted for one of the culverts due to tree growth within the channel which had the potential to undermine the culverts retaining wall. No issues were found with the other three culverts inspected. A crack in the wall adjacent to the inspected security screen was noted for further monitoring and a defect report was submitted for an abutment which is in poor condition, adjacent to the inspected outfall.

Multi-agency drop-in events were held provide support and guidance to those affected.

Table 4-3: Environment Agency actions that are specific to Brampton Community.

Date	Action undertaken by Environment Agency
20/10/2023 at 11:42	Flood Incident Duty Officer (FIDO) receives reports of the River Hipper flooding; the team had already been sent to patrol.
23/10/2023 at 09:00	Asset Performance Team conduct a visit to various locations within Chesterfield, including Brampton.
23/10/2023 at 11:51	FIDO logs that a patrol of the River Hipper at Brampton showed lots of debris and land drainage blockages. Noted that it requires a channel clearance, but this needs planning and preparation.
24/10/2023 at 10:00	A South Yorkshire Partnership and Strategic Overview (PSO) staff member met Derbyshire County Council and Chesterfield Borough Council staff on site at Queen's Park on the Hipper and conducted a walkover upstream to Morrisons.
24/10/2023 at 14:49	FIDO receives report regarding a collapsed wall on the Hipper in Chesterfield.

24/10/2023 at 15:00	FIDO receives NIRS report regarding some damage to flood defences at Boythorpe. It is noted that the Environment Agency's Asset Information and Maintenance Programme does not indicate the presence of any flood defences.

4.7 Community Impacts – Chesterfield South

4.7.1 Location Characteristics

A total of103 properties in Chesterfield South suffered internal flooding as a result of Storm Babet. Figure 4-25 below shows the area where the main group of properties flooded, either side of the River Rother. The River Rother is a main river which flows south to north through the community. The Chesterfield South community which suffered internal property flooding is located approximately 500m upstream of the River Rother confluence with Spital Brook.

Figure 4-25: Overview of South Chesterfield community.

Chesterfield South consists mainly of residential buildings, with some isolated businesses. Homes to the west of the River Rother are predominantly Victorian terraces, while homes to east are detached, newer builds. Critical infrastructure within the area includes the A61 trunk road (Derby Road) and the Midlands Main Line Railway, a major line running between London and Sheffield. There are no known vulnerable groups within the community.

The local superficial geology is alluvium, including gravel, sand, silt and clay.

The community is located on the floodplain of the River Rother which flows northwards. The local topography is flat and relatively low-lying compared to its surroundings. Most of the flooded homes are west of the River Rother which sit at a at a similar elevation to that of the Rother floodplain, with the land slopping gradually to the river.

The Environment Agency Historic Flood Map indicate that most properties that flooded as a result of Storm Babet were also flooded previously. The Flood Map for Planning (https://flood-map-for-planning.service.gov.uk/) shows that all of the flooded properties within this community are in Flood Zone 2. Areas in Flood Zone 2 have between a 1% and 0.1% AEP of river flooding. However, the majority are also

located within Flood Zone 3, which means the properties have a greater than 1% AEP of flooding from rivers, as shown in Figure 4-26.

Figure 4-26: Local Flood Risk Management Arrangements and Flood Zones at Chesterfield South community.

Additionally, based on Long Term Flood Risk Map (https://check-long-term-flood-risk.service.gov.uk/postcode) there is extensive potential surface water flood risk, ranging from high to low risk. High risk is defined as greater than 3.3% AEP of flooding. Low risk is defined as between a 1% and 0.1% AEP of flooding. Properties located on Hawthorne Street and Sherwood Street are noted to be at high risk. Figure 4-27 below chance in any given year of flooding from surface water at the Chesterfield South community.

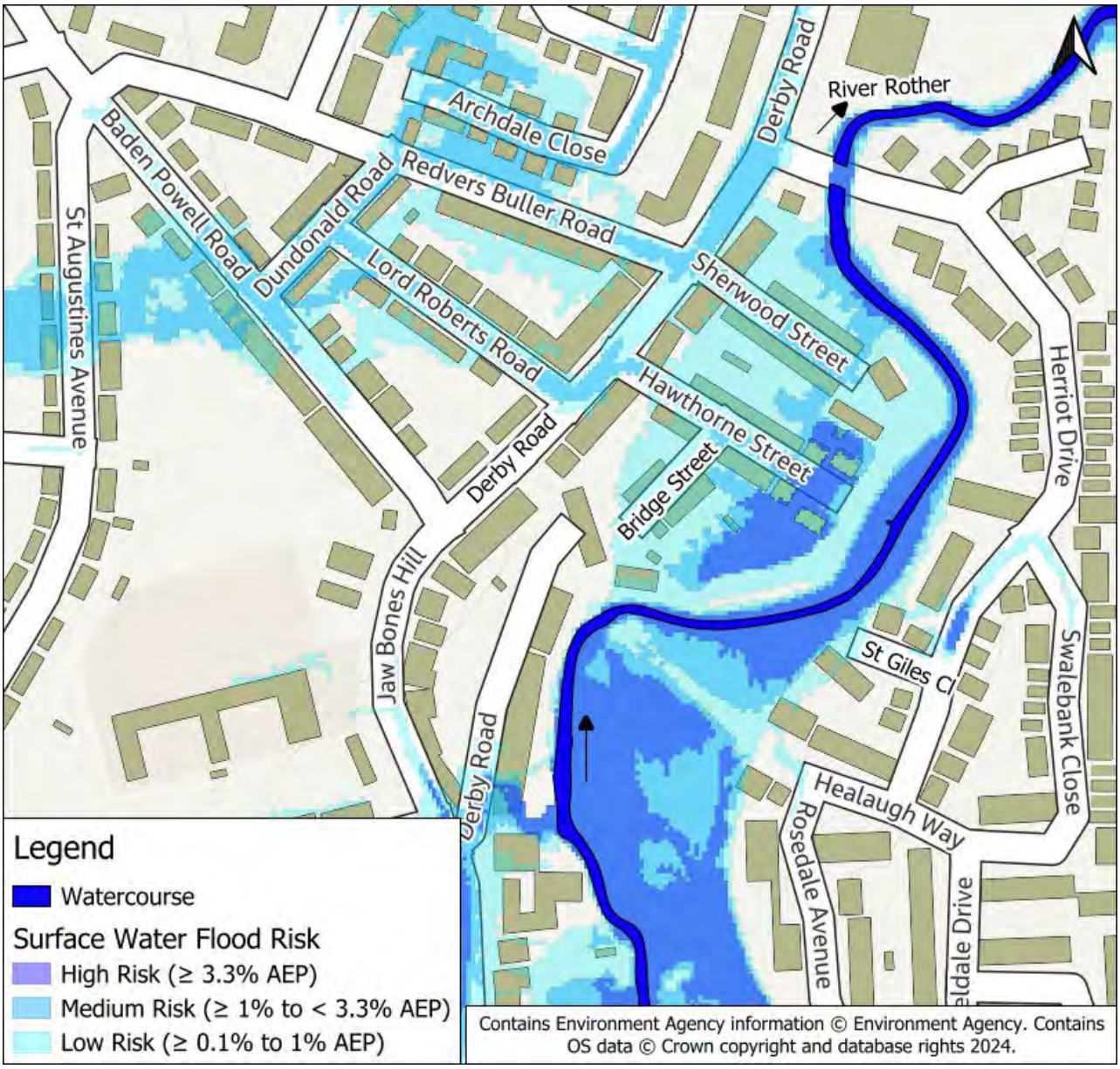

Figure 4-27: Map showing the chance in any given year of flooding from surface water at the Chesterfield South community (Source: Long Term Flood Risk Map).

The community is not located within or nearby to any nationally designated environmental sites.

4.7.2 Current Flood Risk Management Arrangements

All properties flooded within this community are located within the 'Upper River Rother Catchment' Flood Alert Area and the 'River Rother at Central Chesterfield' Flood Warning Area. On anticipation of a potential flood event, residents who are signed up to alerts and warnings are informed when flooding is likely to occur.

The Environment Agency's Asset Information and Maintenance Programme (https://environment.data.gov.uk/asset-management/) demonstrates that embankments and flood walls are present along the River Rother, as shown in Figure 4-26. On the West bank, there are two flood walls with a total length of 170m and Hawthorne Street embankment which is also170m in length. The flood walls and embankments on the west bank of the river were originally built in the 1980s. There are no engineered defences on the east bank of the River Rother. The Avenue Flood Balancing Reservoir is located approximately 1.7km upstream of the community. The reservoir was delivered as part of a flood risk management scheme in September 2018. It was operating as intend throughout the event, storing about 100m^3 of water. The Environment Agency monitor and maintain these flood defence assets as needed.

In 2019, Chesterfield Borough Council delivered a PFR project at St Augustines Road, which is located south of the affected community and was implemented primarily to protect properties against surface water flooding. No residential properties located on St Augustines Road flooded internally during Storm Babet.

There is a pumping station located at the end of Hawthorne Street which is operated by Yorkshire Water.

4.7.3 Storm Babet Incident Details

A Flood Alert was issued to the 'Upper River Rother Catchment' on the 19th of October 2023 at 8:54pm, and a Flood Warning was issued to the River Rother at Central Chesterfield on the 20th of October at 11:48am. Internal flooding of residential properties is understood to have taken place on the afternoon and evening of the 20th of October.

The 103 homes which flooded internally include all properties on Hawthorne Street, Bridge Street, Sherwood Street and Riverview, and some of the properties located on Derby Road and at Octavia Court, near to the Hawthorne Street and Sherwood Street junctions. On the east side of the River Rother, some homes on St Giles Close and Healaugh Way also flooded.

In addition, three businesses flooded internally including a commercial depot located at the end of Sherwood Street, and two located within the same property on Derby Road.

An electricity substation was also flooded, causing power outages.

4.7.4 Flood Mechanisms, Extent and Impacts

The primary source of flooding affecting all properties within this community was from the River Rother.

The River Rother overtopped flood defence structures at several locations, with floodwater then inundating low lying areas of the community. No defences collapsed, and post-flood asset surveys undertaken by the Environment Agency did not identify any deterioration in the condition of defences at this community.

Hydrology data has been taken from the Chesterfield St Augustines river level gauge. This river level gauge is located at the Rothervale Road bridge across the River Rother. The Chesterfield St Augustines gauge shows that on the 20th of October, the peak level recorded was 3.1m; the highest level ever recorded at this river level gauge. The gauge indicated that the water in the River Rother began to rise on the 20th of October at 3:15am, reaching its peak at 6:30pm.

There are several flow routes that are understood to have contributed to river flooding during the event. Discussions between residents and the Environment Agency suggest that properties along Riverview were the first to be flooded, as a result of floodwater overtopping the bank by Derby Road bridge; this floodwater then flowed through the gardens of Bridge Steet, before flooding Hawthorne Street. Topographic data indicates that floodwater reached 76.0mAOD. Photographs taken on Hawthorne Street (Figure 4-28) indicate that flood depths exceeded 0.8m.

Figure 4-28: Water mark on the rear door of a property on Hawthorne Street.

Residents on Hawthorne Street reported that floodwater also overtopped the embankment at the south-east end of the street. Sherwood Street residents reported floodwater to have initially originated from a manhole, and that floodwater then entered the rear gardens of Sherwood Street homes from the Rother by infiltrating through the wall rather than by overtopping it (i.e., penetrated through the flood wall to the north-east of Sherwood Street). Note, however, that post-event asset surveys conducted by the Environment Agency did not detect any infiltration. The initial route of floodwater entering homes on Sherwood Street was reported to be through property air bricks and subsequently through the floor.

Properties at St Giles Close and Healaugh Way were inundated by river floodwater.

The Yorkshire Water pumping station was flooded by the River Rother and failed, which may have resulted in surface water flooding and flooding from the sewer network. However, there is no clear evidence that this contributed to the flooding experienced.

4.7.5 Actions by Public Bodies

This section outlines the actions undertaken by public bodies immediately and in the aftermath of the flood event which are specific to this community. Please refer to section 8.1 of this report for a summary of actions that were implemented at all communities.

Public bodies that have been involved in the flood-event response at this community include:

- Derbyshire County Council
- Environment Agency
- Chesterfield Borough Council
- Yorkshire Water
- Emergency services

Chesterfield Borough Council reported that properties on Derby Road, Healaugh Way, Hawthorne Street, St Giles Street and Bridge Street requested sandbags on the 20th of October between 2:30pm and 7:30pm. Attempts were made by Chesterfield Borough Council to deliver on all requests, although some residents said they did not receive sandbags.

Chesterfield Borough Council were also involved in several post-event actions, including:

- assisting with the removal of debris over a 4-week period; and
- assisting residents with applications to the PFR Scheme.

The Environment Agency, Derbyshire County Council and Yorkshire Water have undertaken numerous site visits and post flood local engagement events to provide support and guidance to those affected. Multi-agency drop-in events were held to provide support and guidance to those affected.

In response to the flooding, Hawthorne Street was attended by the Fire and Rescue Service.

The Environment Agency issued a Flood Alert to the Upper River Rother Catchment on the 19th of October 2023 at 8:54pm and a Flood Warning was to the River Rother at Central Chesterfield on the 20th of October at 11:48am.

The Environment Agency issued Flood Alerts and Flood Warnings to this community as part of their Flood Warning Service. Refer to section 4.7.3 for further details.

Table 4-4 provides details of other actions by the Environment Agency.

Table 4-4: Environment Agency actions that are specific to Chesterfield South community.

Date	Action undertaken by Environment Agency
20th October 2023 at 9:23am	The Environment Agency Flood Incident Duty Officer (FIDO) received an alarm for 'Avenue Flood Storage Reservoir Operations including patrol and trash screen clearance'; this was placed on hold to follow on from another alarm.
20th October at 5:26pm	FIDO receives information that the Supervising Engineer for Avenue Flood Storage Reservoir is inspecting the dam on Saturday morning and will report back to FIDO.

21st October at 9:00am	Supervising Engineer for Avenue Flood Storage Reservoir attends site, conducts report and takes photos.
	Community Information Officers deployed to Chesterfield.
	FIDO receives reports from local Member of Parliament of flooding behind the embankment at Hawthorne/Sherwood Street, Chesterfield, which requires pumping on Sunday morning.
23rd October at 10:44am	FIDO discussion with FODO that UPR Operations Patrol were in Chesterfield yesterday (21st of October) and that the feedback was assets in Chesterfield appeared to be undamaged. Avenue Flood Storage Reservoir was patrolled with no issues, but screens were heavily blinded.

4.8 Community Impacts – Renishaw

4.8.1 Location Characteristics

Thirty-nine properties in the village of Renishaw, located about 2km to the south-east of Eckington, suffered internal flooding as a result of Storm Babet. Figure 4-29 shows the area where the main group of residential properties flooded. Renishaw is located within the North East Derbyshire District, bordering Bolsover District to its east. Smithy Brook, an ordinary watercourse, flows through the north of the village from east to west. The Smithy Brook catchment upstream of Renishaw is small, with its source 2km upstream near the M1. The watercourse takes drainage from the M1. Smithy Brook joins the River Rother approximately 0.4km downstream of the village boundary. Chesterfield Canal borders the village to the west and Emmett Carr Brook, an ordinary watercourse, borders the village to the east, representing the boundary between North East Derbyshire District and Bolsover District. Emmett Carr Brook flows parallel to Emmett Carr Lane before being culverted beneath Main Road and joining Smithy Brook.

Figure 4-29: Overview map of Renishaw community.

Renishaw consists mainly of residential properties, the majority of which are detached. There are isolated businesses and public buildings located across the village, and a cluster of non-residential buildings located in the north-east area of the village. These properties are located primarily along Smithy Brook Road. A primary school is the only known vulnerable building type in the community, although this was not reported to have flooded during Storm Babet.

The local bedrock geology is sedimentary, including mudstone, siltstone and sandstone. The community is not located within or near any nationally designated environmental sites.

The Environment Agency's Historic Flood Map and Recorded Flood Outlines Map show no evidence of previous flooding to this community. However, Derbyshire County Council have records of flood events occurring in 2007 and 2019.

The Flood Map for Planning (https://flood-map-for-planning.service.gov.uk/) shows that the majority of flooded properties within this community are in Flood Zone 3. Areas in Flood Zone 3 have a greater than 1% AEP of flooding from rivers. The extents of Flood Zone 2 and Flood Zone 3 at Renishaw are shown in Figure 4-30.

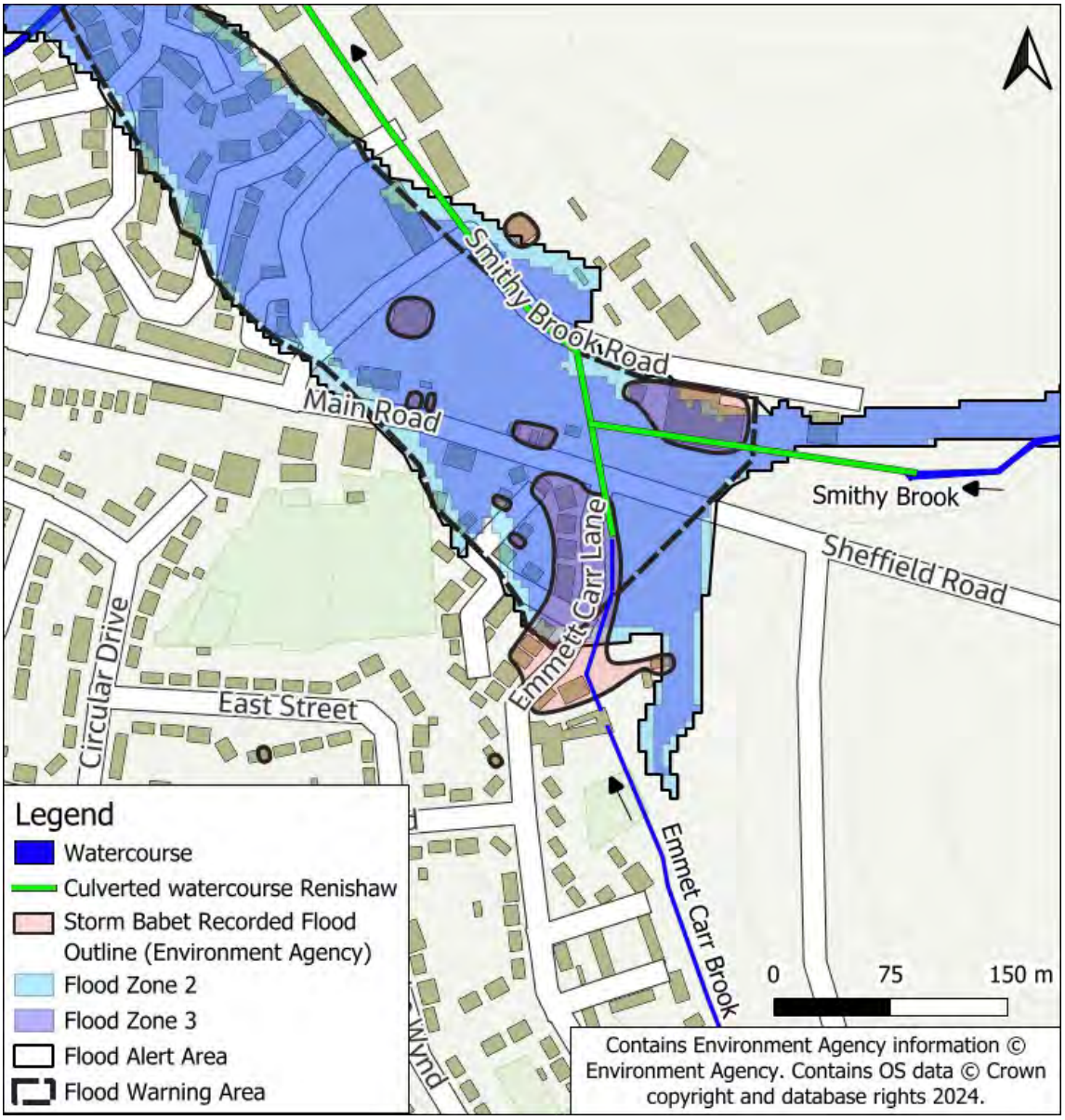

Figure 4-30: Flood Map for Planning Flood Zones 2 and 3 extents and Flood Alert and Flood Warning areas at Renishaw.

Table 4-5 shows the distribution of properties in each Flood Zone.

Table 4-5: Distribution of internally flooded properties at Renishaw within Flood Map for Planning Flood Zones. Numbers are the property count and then the percentage of the total internally flooded properties.

Flood Zone	Homes	Businesses	All properties
Flood zone 1 only	9 (28%)	0	9 (25%)
Flood zone 2	2 (6%)	1 (25%)	3 (8%)
Flood zone 3	21 (66%)	3 (75%)	24 (67%)
Total	**32**	**4**	**36**

Additionally, based on the Long Term Flood Risk Map (https://check-long-term-flood-risk.service.gov.uk/postcode) the majority of the properties at risk from the watercourses also have a high risk of surface water flooding, as shown in Figure 4-31. High risk is defined as greater than 3.3% AEP of flooding.

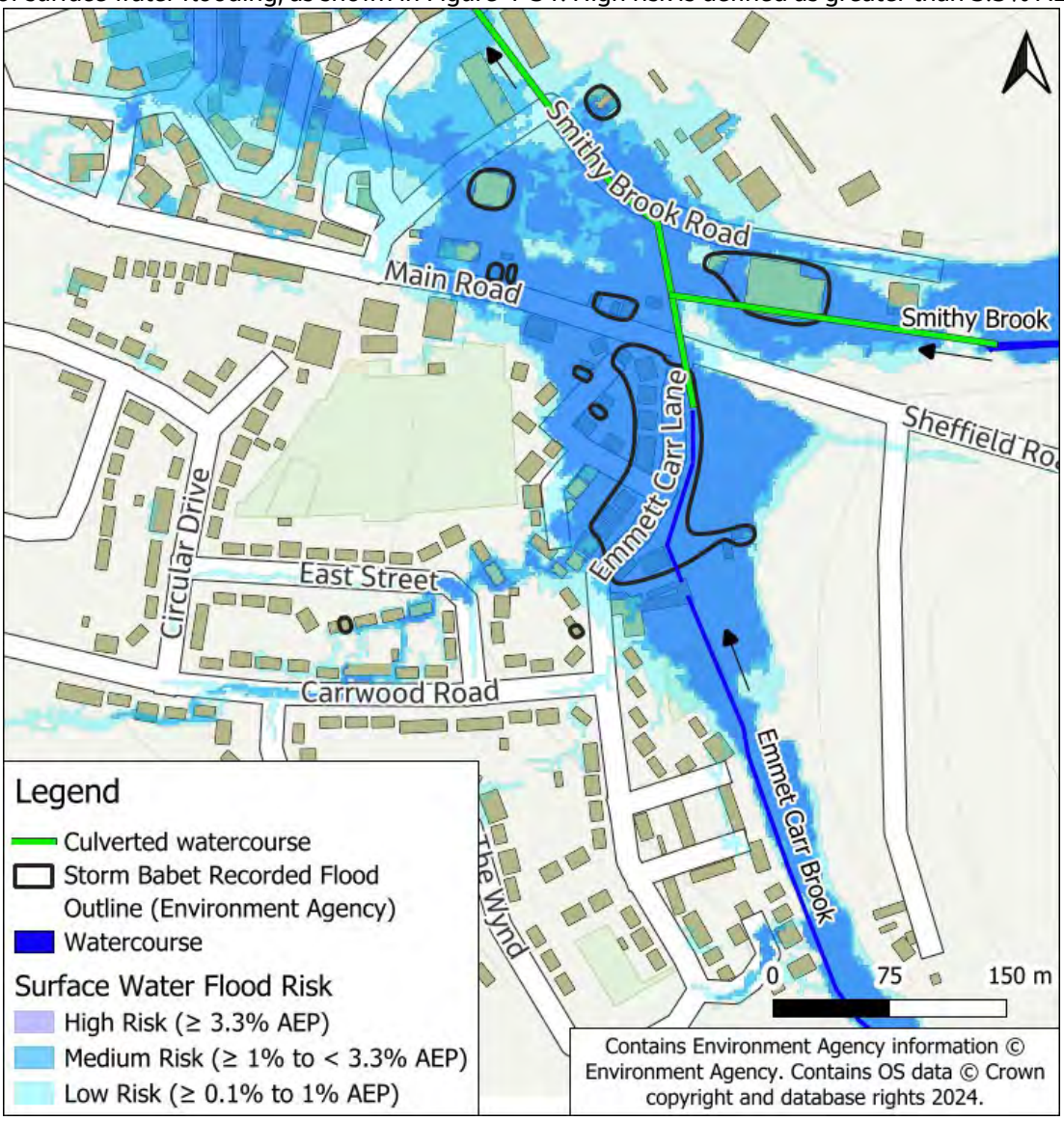

Figure 4-31: Map showing the chance in any given year of flooding from surface water at Renishaw (Source: Long Term Flood Risk Map).

4.8.2 Current Flood Risk Management Arrangements

Renishaw is located in the 'Lower River Rother Catchment' Flood Alert Area and the 'River Rother and Smithy Brook at Renishaw' Flood Warning Area. On anticipation of a potential flood event, residents who are signed up to alerts and warnings are informed when flooding is likely to occur.

In 2022 Derbyshire County Council installed PFR measures to properties at risk of flooding in Renishaw. This was in response to the flooding of November 2019. In total twelve properties received PFR measures, seven on Emmett Carr Lane, five on Main Road. This was funded by Derbyshire County Council and the Yorkshire Regional Flood and Coastal Committee Local Levy.

There are no formal flood defences in this community.

4.8.3 Storm Babet Incident Details

A Flood Alert was issued for the 'Lower River Rother Catchment' Flood Alert Area at 9:52am on the 20th of October 2023, and 'River Rother and Smithy Brook at Renishaw' Flood Warning was issued at 11:43am on the 20th of October.

Table 4-6 shows the property count on streets affected by internal property flooding. Other than four businesses located on Smithy Brook Road, all internally flooded properties were residential.

Table 4-6: Internally flooded properties within the Renishaw community.

Street	Homes	Businesses
Abbey Place	6	0
East Street	1	0
Emmettt Carr Lane	18	0
Emmett Carr Drive	2	0
Main Road (A6135)	7	0
Marsh Quarry	1	0
Smithy Brook Road	0	4
Total	35	4

4.8.4 Flood Mechanisms, Extent and Impacts

Figure 4-32 shows the flood extent, mechanisms and flow routes that occurred at Renishaw. It is clear that in addition to the exceptional rainfall, the flooding was also caused by culvert blockages at the inlet of both Smithy Brook and Emmettt Carr Brook culvert inlets. Flood depths of up to 1.5m outside and 1m inside properties were reported.

Flow routes traversed westwards along Smithy Brook Road after having overtopped at the Smithy Brook culvert inlet. Overflowing is also considered to have occurred upstream of the Emmet Carr Brook culvert inlet. Both instances are noted as being exacerbated by culvert blockages. Smithy Brook flood water is shown to join Sheffield Road and the Emmet Carr Brook floodwater. Internal flood depths are thought to have reached depths of 0.2m to 0.8m on Sheffield Road, and upto 1.2m in a property on Emmet Carr Lane.

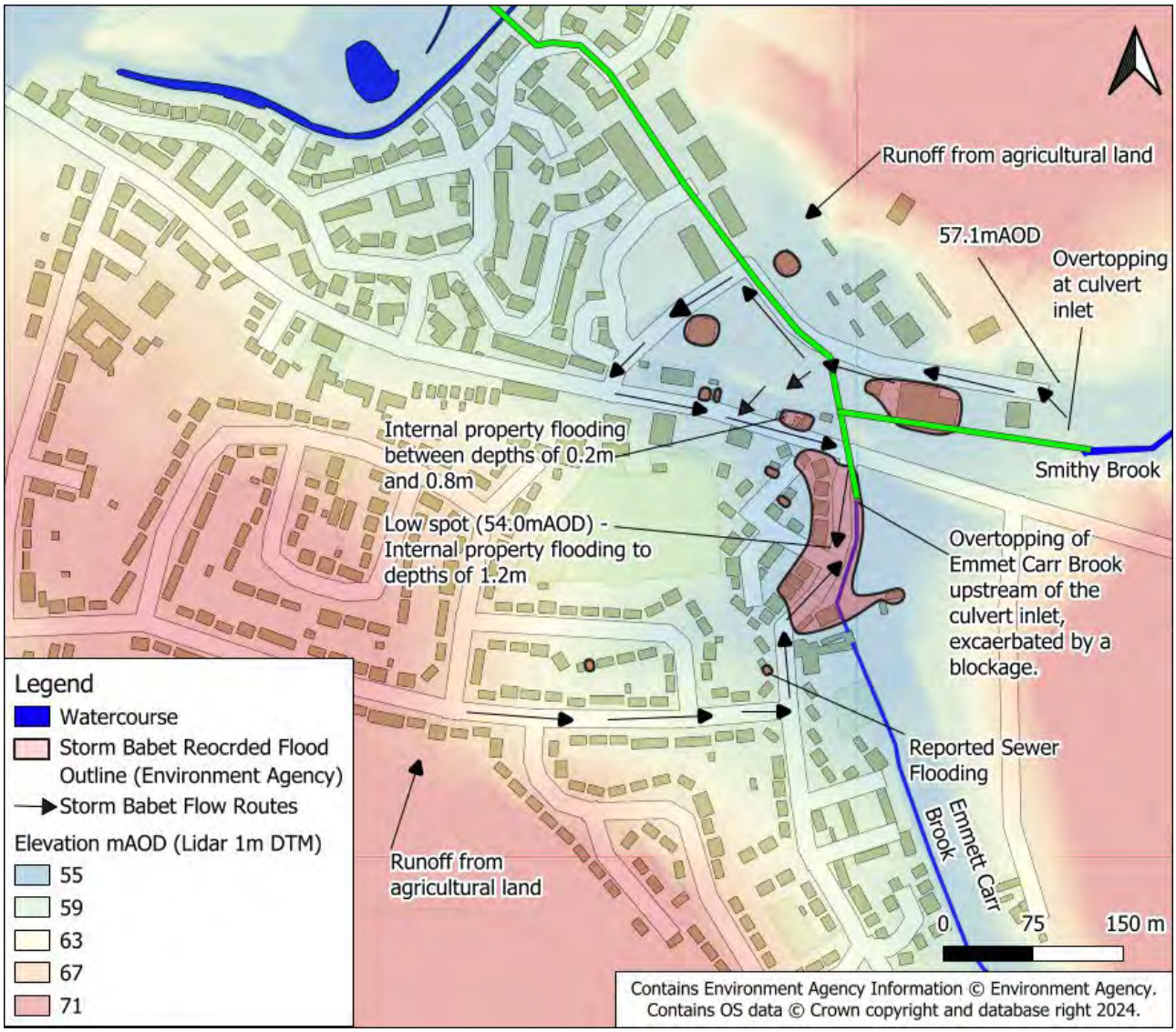

Figure 4-32: Ground level and Storm Babet flow routes at Renishaw.

Internal flooding at Renishaw occurred primarily as a result of overtopping of Smithy Brook at its culvert inlet. There are no river gauges upstream of Renishaw therefore it is unclear when water levels in Smithy Brook peaked. Reports from North East Derbyshire District Council indicate that flood severity was greatest on the 20th of October between 12:00pm and 2:00pm.

Figure 4-33 shows the blocked culvert inlet of Smithy Brook after Storm Babet. Note that since this photograph was taken following Storm Babet, it is unclear to what extent the culvert was blocked leading up to the event. It is the responsibility of the riparian owner to clear this culvert. Pooling then occurred on derelict land to the east of Smithy Brook Road following the overtopping. It then flowed westwards downslope along Smithy Brook Road, flooding four businesses. This floodwater is reported to have flowed onto the Main Road near to the Main Road and Smithy Brook Road junction, before continuing to flow downslope. Floodwater then flowed eastwards along the Main Road A6135, flooding six homes. It then flowed southwards along Emmettt Carr Lane to the low spot approximately 50m south of the Main Road and Emmett Carr Lane junction, flooding eighteen homes on this street.

Figure 4-33: Debris blockage at Smithy Brook culvert inlet (upstream of Smithy Brook Road).

Emmett Carr Brook was also a source of flood risk according to Derbyshire County Council. The Emmett Carr Brook trash screen at the culvert inlet east of Emmettt Carr Lane was blocked. During the event, residents quickly cleared the debris from this trash screen which initially helped. However, the flow quickly overwhelmed the culvert and contributed to extensive flooding.

Runoff from the agricultural land to the south of Renishaw is understood to have flowed onto Carwood Road. Flood water then flowed eastwards and downslope on Emmettt Carr Lane to the aforementioned low spot. There is no clear evidence to confirm to what extent this surface water runoff contributed to the internal flooding of properties in this community. Similar agricultural land runoff was reported to the north east of the village.

Multiple properties also reported sewer flooding on Emmett Carr Lane and East Street, although there is no clear evidence to confirm this.

The PFR measures installed in 2022 failed to prevent these properties flooding during Storm Babet. This was due to flood depths exceeding the height of the PFR measures.

4.8.5 Actions by Public Bodies

This section outlines the actions undertaken by public bodies immediately and in the aftermath of the flood event which are specific to this community. Please refer to section 8.1 of this report for a summary of actions that were implemented at all communities.

Public bodies that have been involved in the flood-event response at this community include:

- Derbyshire County Council
- Environment Agency
- North East Derbyshire District Council
- Yorkshire Water
- Emergency services

Actions undertaken by Derbyshire County Council include the following:

- Requesting that maintenance is undertaken by the riparian landowner of the land upstream of Smithy Brook culvert to clear the trash screen. Figure 4-34 shows the cleared trash screen (right) compared to the debris present prior to its clearance (left).
- Investigating which properties in the affected community have had PFR installed and how effective they were during the flood event.

- Assisting residents with applications to the new PFR Scheme.
- Investigatory work with regards to understanding the flood mechanisms and properties affected, and also how this could be mitigated in the future.

Figure 4-34: Smithy Brook culvert prior (left) and post (right) trash screen clearance.

Actions undertaken by North East Derbyshire District Council include the following:

- On the 9th of November 2023, they undertook a site visit to investigate the Renishaw flooding which has helped to inform this section of the report.
- In conjunction with National Highways, they investigated the impact of drainage from the M1 on the volume of water that flowed through Renishaw along Smithy Brook. There was no evidence to suggest that the drainage from the M1 exacerbated the flooding.
- Clearance of the Smithy Brook debris screen.

The Environment Agency issued a Flood Alert to the 'Lower River Rother Catchment Flood' Alert Area at 9:52am on the 20th of October 2023 and a Flood Warning to the 'River Rother and Smithy Brook at Renishaw' at 11:43am on the 20th of October.

Derbyshire County Council have undertaken numerous site visits and local engagement sessions following the flood event.

4.9 Community Impacts – Tapton Terrace and Surrounding Area

4.9.1 Location Characteristics

Twenty-six residential properties in Tapton Terrace and seventeen non-residential properties on Crow Lane and Brimington Road, located approximately 750m from Chesterfield town centre, suffered internal flooding as a result of Storm Babet. Also, tragically, one resident lost their life. Figure 4-35 below shows the area where the main group of properties flooded, around the River Rother. The River Rother is a main river that flows through the centre of the community.

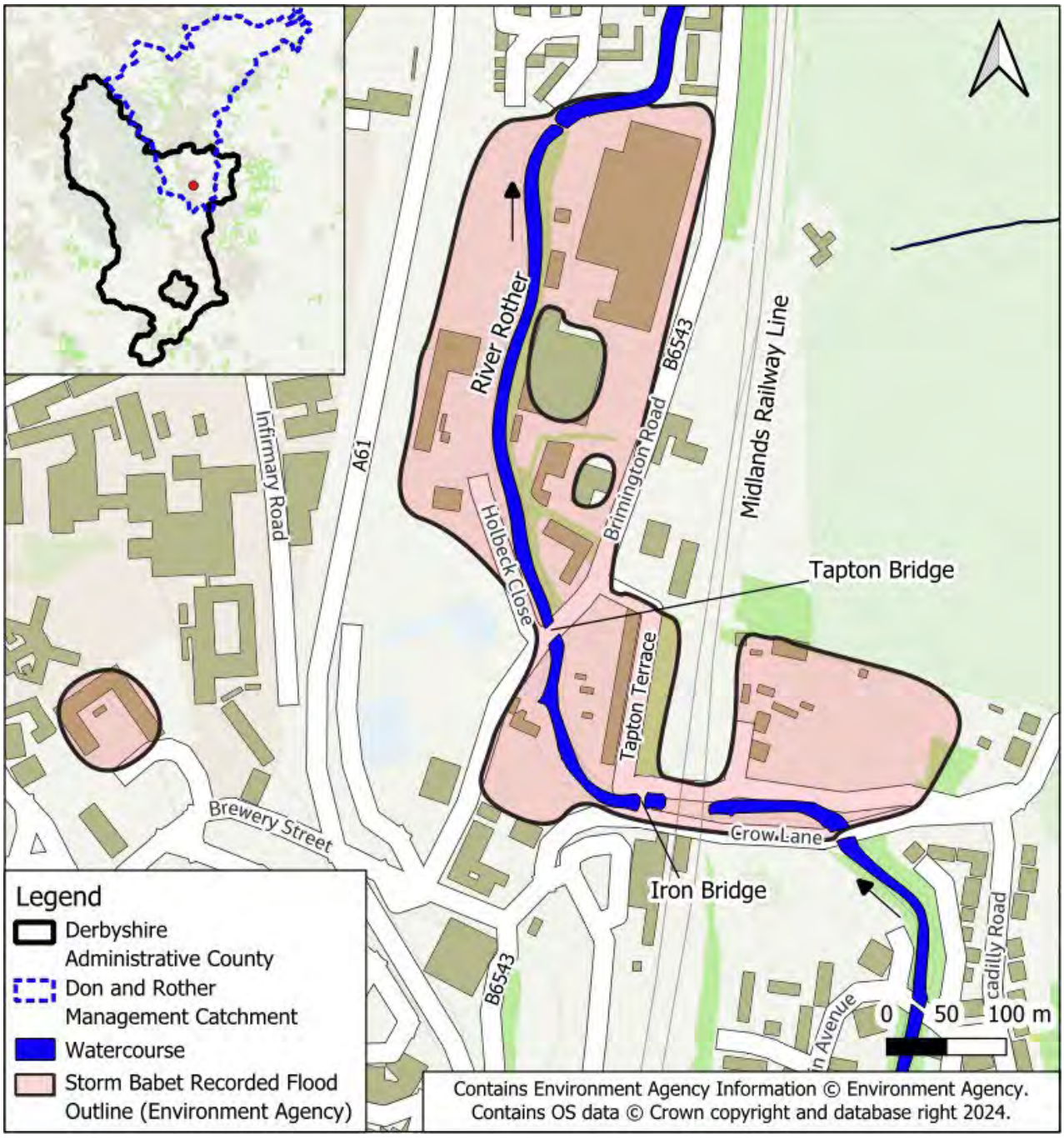

Figure 4-35: Overview map of Tapton Terrace and the area surrounding it.

The community consists of a mix of terraced homes and non-residential buildings, such as industrial units and car dealerships. The front of the homes on Tapton Terrace face the River Rother. Critical infrastructure in the area includes the Midlands Railway Line, with Chesterfield Railway Station on higher ground on the opposite bank of the Rother to Tapton Terrace. There are no known vulnerable building types within the community.

The community is located on the floodplain of the River Rother. Topographic data shows that the flooded properties sit at a similar elevation to that of the top of the bank of the River Rother. The properties within the flooded community are situated at approximately 70.5mAOD, with the surrounding land rising away from the river to approximately 75mAOD.

The local bedrock geology is sedimentary, including mudstone, siltstone and sandstone.

The Environment Agency's Historic Flood Map shows that all homes that were internally flooded during Storm Babet had flooded previously. Of the seventeen non-residential properties that flooded during Storm Babet, twelve flooded previously in 2007, with some also flooding in 2019.

The Flood Map for Planning (https://flood-map-for-planning.service.gov.uk/) shows that all twenty-six homes, and twelve of the non-residential properties that flooded within this community are in Flood Zone 3,

as shown in Figure 4-36. Flood Zone 3 means the properties have a greater than 1% AEP of flooding from the river. One of the non-residential properties is located in Flood Zone 2, which means it has between a 1% and 0.1% AEP of flooding. Four non-residential properties are located in Flood Zone 1, which means they have less than a 0.1% AEP of flooding from the river.

Additionally, some homes in the community have a medium risk of surface water flooding, based on the Long Term Flood Risk Map (https://check-long-term-flood-risk.service.gov.uk/postcode). Medium risk is defined as between 1% and 3.3% AEP of flooding. Figure 4-37 shows the surface water flood risk for the community based on the national mapping referred to above.

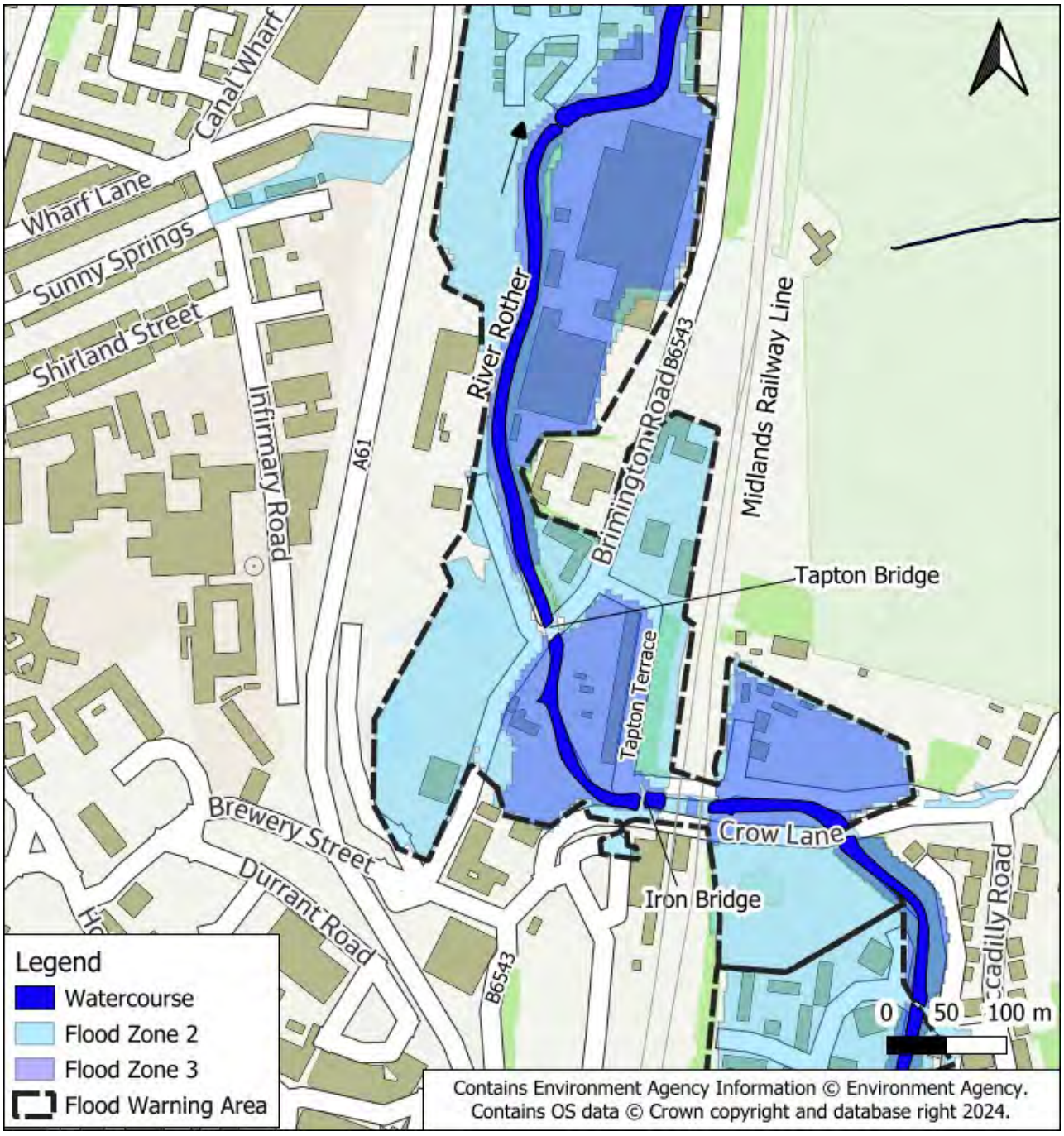

Figure 4-36: Flood Map for Planning Flood Zones and areas of natural high ground in the vicinity of Tapton Terrace.

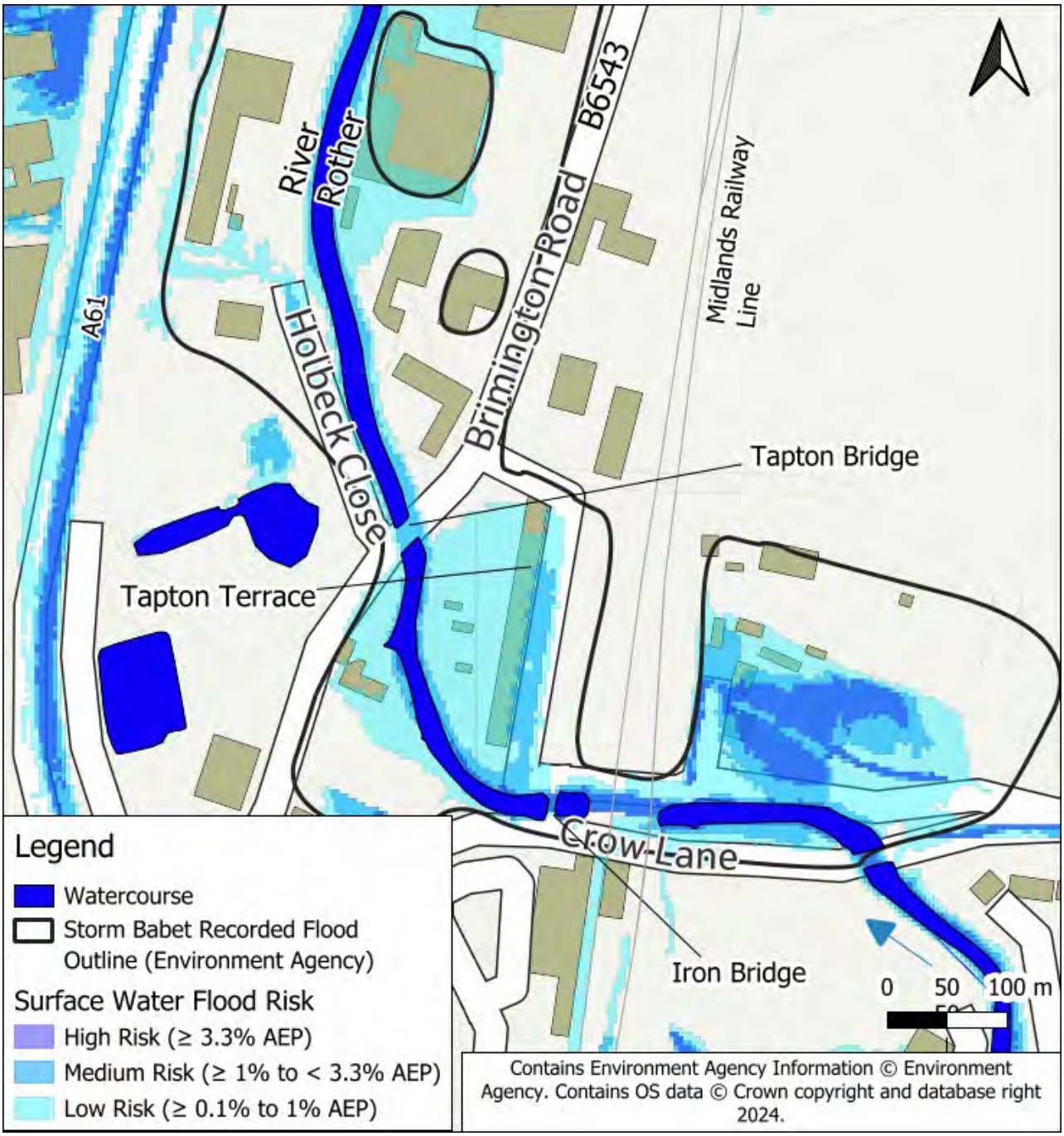

Figure 4-37: Map showing the chance in any given year of flooding from surface water at Tapton Terrace and the surrounding area (Source: Long Term Flood Risk Map). The community is not located within or nearby any nationally designated environmental sites.

4.9.2 Current Flood Risk Management Arrangements

All properties flooded within this community are located within the 'Upper River Rother Catchment' Flood Alert Area, with all homes and thirteen non-residential properties located in the 'River Rother at Tapton' Flood Warning Area. On anticipation of a potential flood event, residents who are signed up to alerts and warnings are informed when flooding is likely to occur.

The Environment Agency's Asset Information and Maintenance Programme (https://environment.data.gov.uk/asset-management/) shows that there are no formal flood defences indicated at this location.

The River Rother is bounded by natural high ground on both banks near Tapton Terrace, extending to Tapton Bridge, which is the Brimington Road bridge at the northern end of Tapton Terrace and southern end of Holbeck Close. Downstream of the Iron Bridge, there is an approximately 40m long wall on the east bank of the River Rother, which informally acts as a raised flood defence, but is not designed as such. The wall is the

responsibility of the riparian owner.

Properties along Tapton Terrace have PFR measures in place, however these were exceeded by floodwater, which reached depths of 1.5m in some homes. PFR measures will typically be effective up to flood depths of 0.6m.

4.9.3 Storm Babet Incident Details

In total, forty-three residential and non-residential properties suffered internal flooding in the local community. Twenty-six homes flooded on Tapton Terrace where, tragically, one resident lost their life. Additionally, seventeen non-residential properties located on nearby industrial areas around Brimington Road and Holbeck Close also flooded.

A Flood Alert was issued to the Upper River Rother Catchment on the 19th of October 2023 at 8:54pm, which covers all residential and non-residential properties. A Flood Warning was issued to the River Rother at Tapton area on the 20th of October at 8:29am, which covers all residential properties and the majority of non-residential properties.

4.9.4 Flood Mechanisms, Extent and Impacts

The primary source of flooding affecting all properties within this community was from the River Rother.

Figure 4-38 shows the flow routes and elevations which will have contributed to the flood extent. Hydrology data shows that on the 20th of October 2023, the peak level recorded at the at the Chesterfield Tapton Bridge river gauge, which is located directly downstream of Tapton Terrace, reached 3.42m; the highest level ever recorded at the gauge. The gauge indicates that water levels began to rise on the 19th of October at 8:00pm, reaching its peak the following day at 3:00pm.

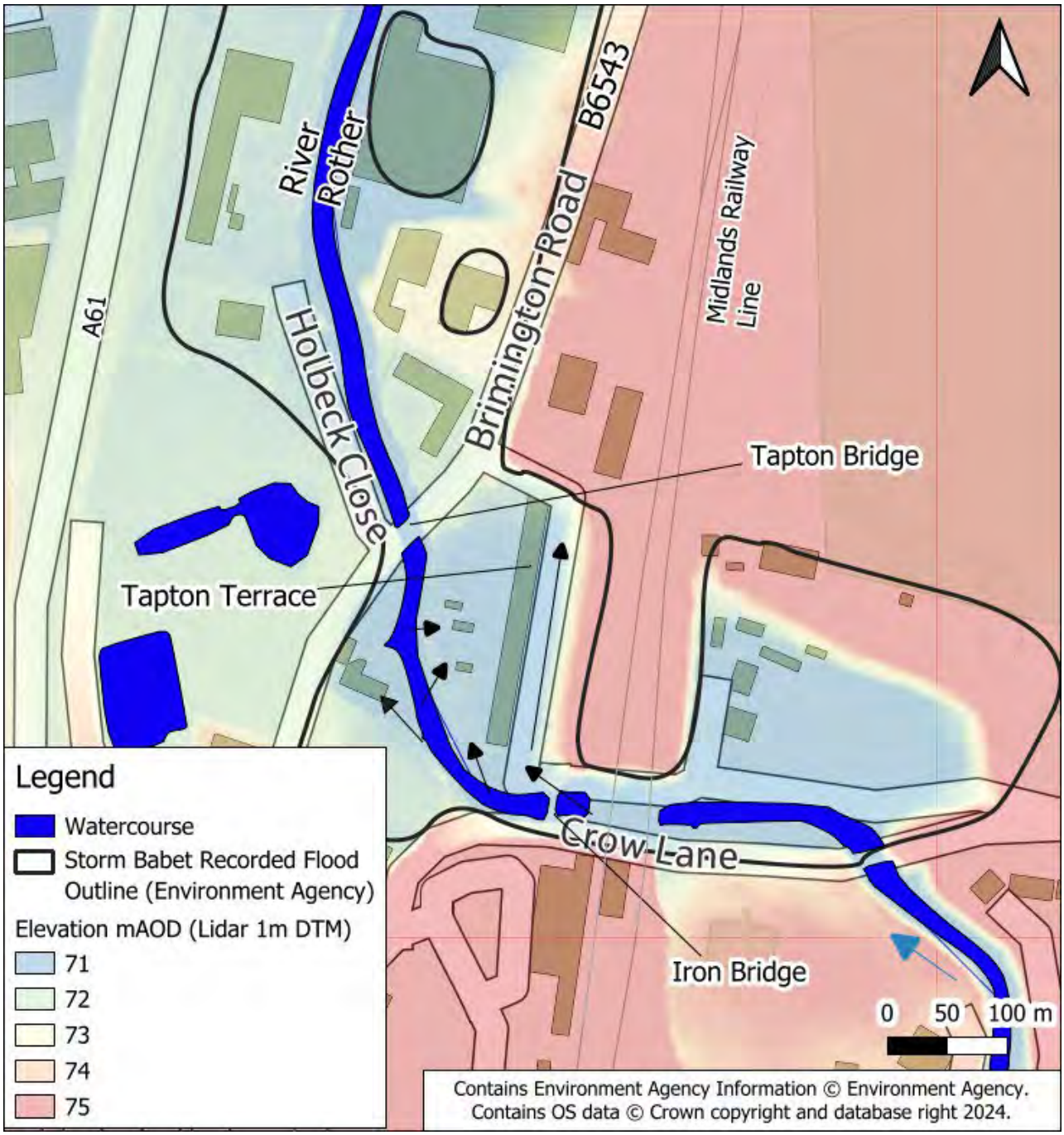

Figure 4-38: Ground level and Storm Babet flow routes at Tapton Terrace.

Investigations are ongoing to determine the impact of Tapton Bridge on restricting flow in the River Rother. Initial flooding near Tapton Terrace occurred at the low spot of the west bank of the river, impacting a non-residential property. River levels then exceeded the low spot on the east bank of the river, impacting the rear of all twenty-six homes, before flooding from the front, down to Tapton Bridge. Flooding reached depths of 1.5m in some properties, which would exceed the design standards of external PFR measures. Flooding of such depths represents a hazard to members of the public.

Non-residential properties on Tapton Industrial Estate were then flooded.

4.9.5 Actions by Public Bodies

This section outlines the actions undertaken by public bodies immediately and in the aftermath of the flood event which are specific to this community. Please refer to section 8.1 of this report for a summary of actions that were implemented at all communities.

Public bodies that have been involved in the flood-event response at this community include:

- Derbyshire County Council

- Environment Agency
- Chesterfield Borough Council
- Yorkshire Water
- Emergency services

The Environment Agency issued a Flood Alert to the 'Upper River Rother Catchment' on the 19th of October at 8:54pm. A Flood Warning was issued to the 'River Rother at Tapton' area on the 20th of October at 8:29am. After the river levels had receded, the Environment Agency deployed Community Information Officers to Chesterfield at 9:00am on the 21st of October. They also sent operatives with two 75mm pumps to Tapton Terrace, only requiring one to empty a manhole chamber. This started at 8:08pm on the 22nd of October and continued until 3:00am on the 23rd of October.

Emergency services attended Tapton Terrace during the event to support the emergency response. This included attending to the resident who lost their life. A Coroners Court inquest was opened in February 2024 regarding this death.

Chesterfield Borough Council reported that three properties in Tapton Terrace requested sandbags during Storm Babet. The council also conducted visits after the event to look at the impact of Tapton Bridge on flooding.

Derbyshire County Council have undertaken numerous site visits and local engagement after the flood event.

4.10 Community Impacts – Central Chesterfield

4.10.1 Location Characteristics

Forty-nine homes and thirty businesses in central Chesterfield suffered internal flooding as a result of Storm Babet. Figure 4-39 below shows the areas that were flooded, and includes Camlough Walk, Spital Lane, Hasland Road, Alma Retail Park, Ravenside Retail Park, Clayton Street and Hollis Lane. Three watercourses pass through this community: the River Rother, a main river; the River Hipper, a main river, and Spital Brook, an ordinary watercourse.

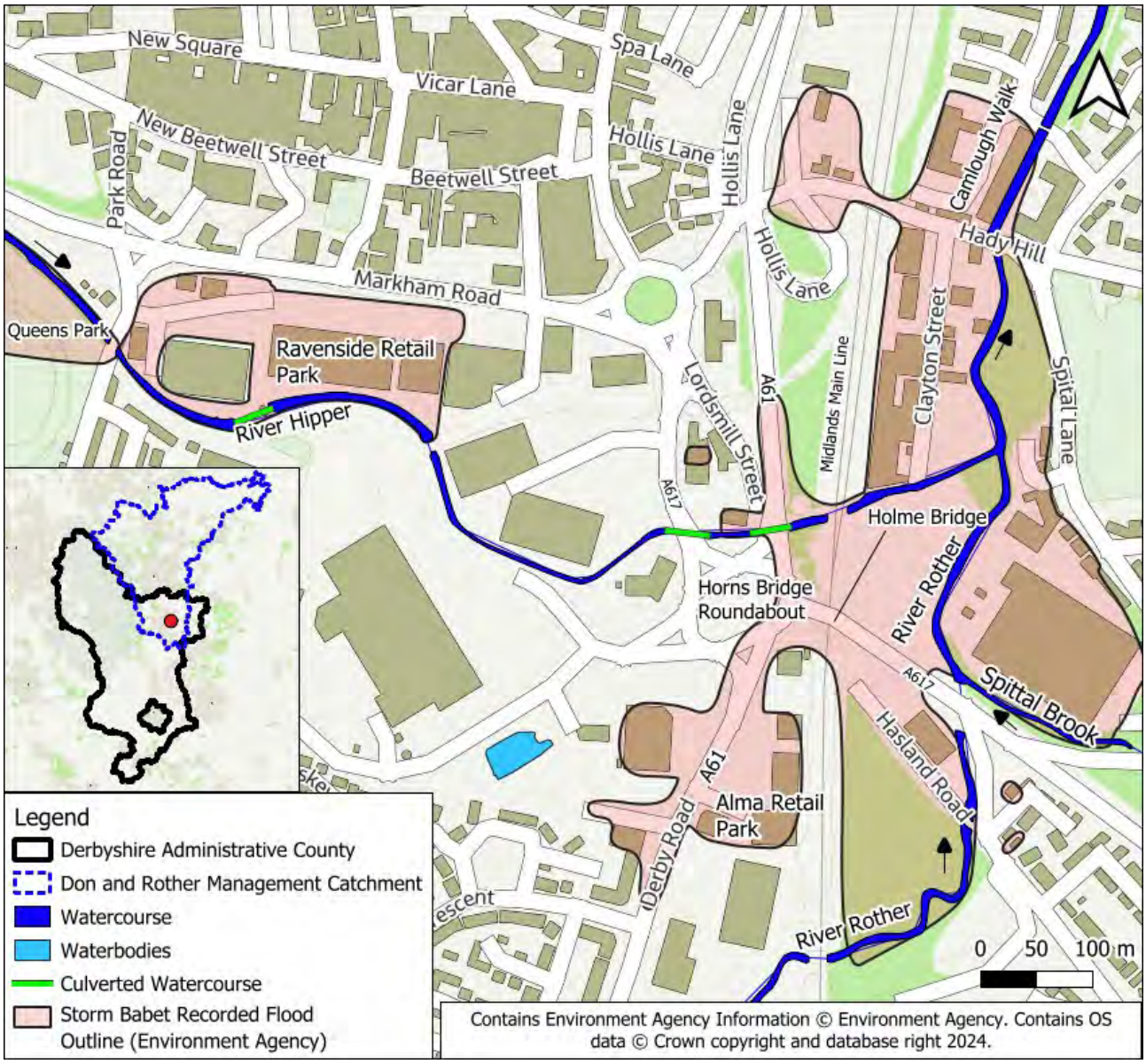

Figure 4-39: Central Chesterfield overview map.

The River Rother flows north-east past Alma Retail Park, before passing beneath the West Midlands Railway Line. It then flows north, passing beneath Hasland Road, where three homes and a business were internally flooded, before it passes beneath the A617 and is joined by Spital Brook from the east.

Approximately 200m downstream of where the Spital Brook joins the River Rother, the River Hipper joins the River Rother from the west. Three homes and four businesses were internally flooded at Spital Lane, at the confluence of the River Rother and River Hipper. Clayton Street is located downstream and to the west of the River Rother and River Hipper confluence, where ten businesses were flooded internally. A further 200m downstream, the River Rother passes beneath Hollis Lane and Hady Hill where a total of four homes and five businesses were internally flooded. Directly downstream of the Hollis Lane Bridge, the River Rother then passes Camlough Walk, which is located on its west bank, where thirty-nine homes were internally flooded.

The River Hipper enters this community from the west at Queen's Park, where a business was internally flooded. It then passes south of Ravenside Retail Park where nine business units were internally flooded, beneath the A617 and south of Lordsmill Street where two businesses were internally flooded. Continuing eastwards, the River Hipper passes beneath the A61 and the Midlands Main Line before reaching its aforementioned confluence with the River Rother.

The local bedrock geology is sedimentary, including mudstone, siltstone and sandstone.
The Environment Agency Historic Flood Map indicates that about half of the flooded properties have previously flooded in November 2000 and June 2007, from either river or surface water sources. The properties with no records of historic flooding include those on Camlough Walk and some of Spital Lane and Hasland Road.

The Flood Map for Planning (https://flood-map-for-planning.service.gov.uk/) shows that several of the flooded homes within this community are in Flood Zone 3. Flood Zone 3 means the properties are within the floodplain and have a greater than 1% AEP of flooding from rivers. Flood zones and flood risk management assets at Central Chesterfield are shown in Figure 4-40.

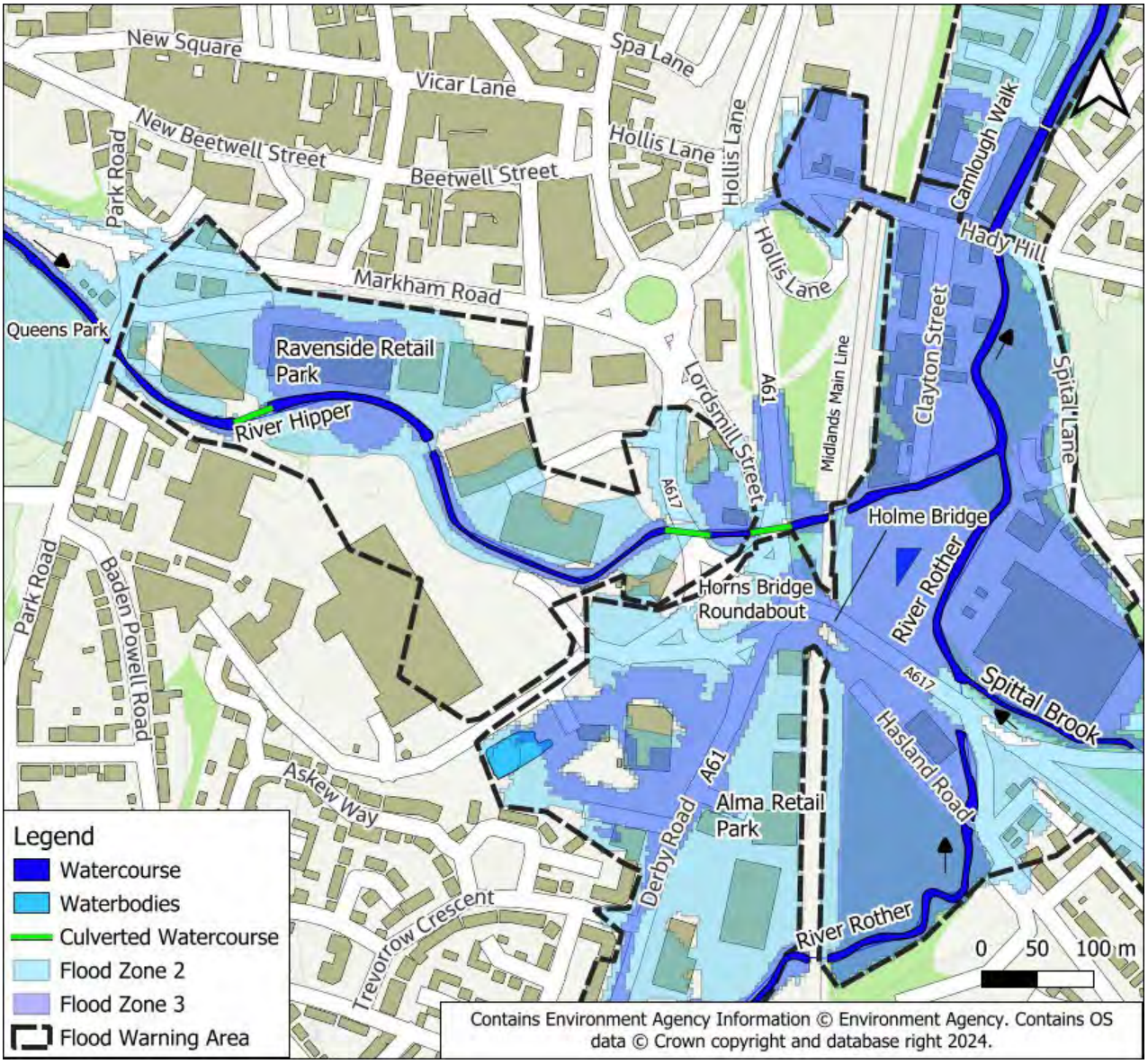

Figure 4-40: Flood zones and flood risk management assets at Central Chesterfield.

Additionally, some properties near Queens Park, Ravenside Retail Park, and isolated stretches of the A61 and A617 have a high risk of surface water flooding, based on the Long Term Flood Risk Map (https://check-long-term-flood-risk.service.gov.uk/postcode). High risk is defined as greater than 3.3% AEP of flooding. A large proportion of Central Chesterfield has a low risk of surface water flooding. Low risk is defined as between a 1% and 0.1% AEP of flooding. Figure 4-41 shows the risk of surface water flooding at Central Chesterfield.

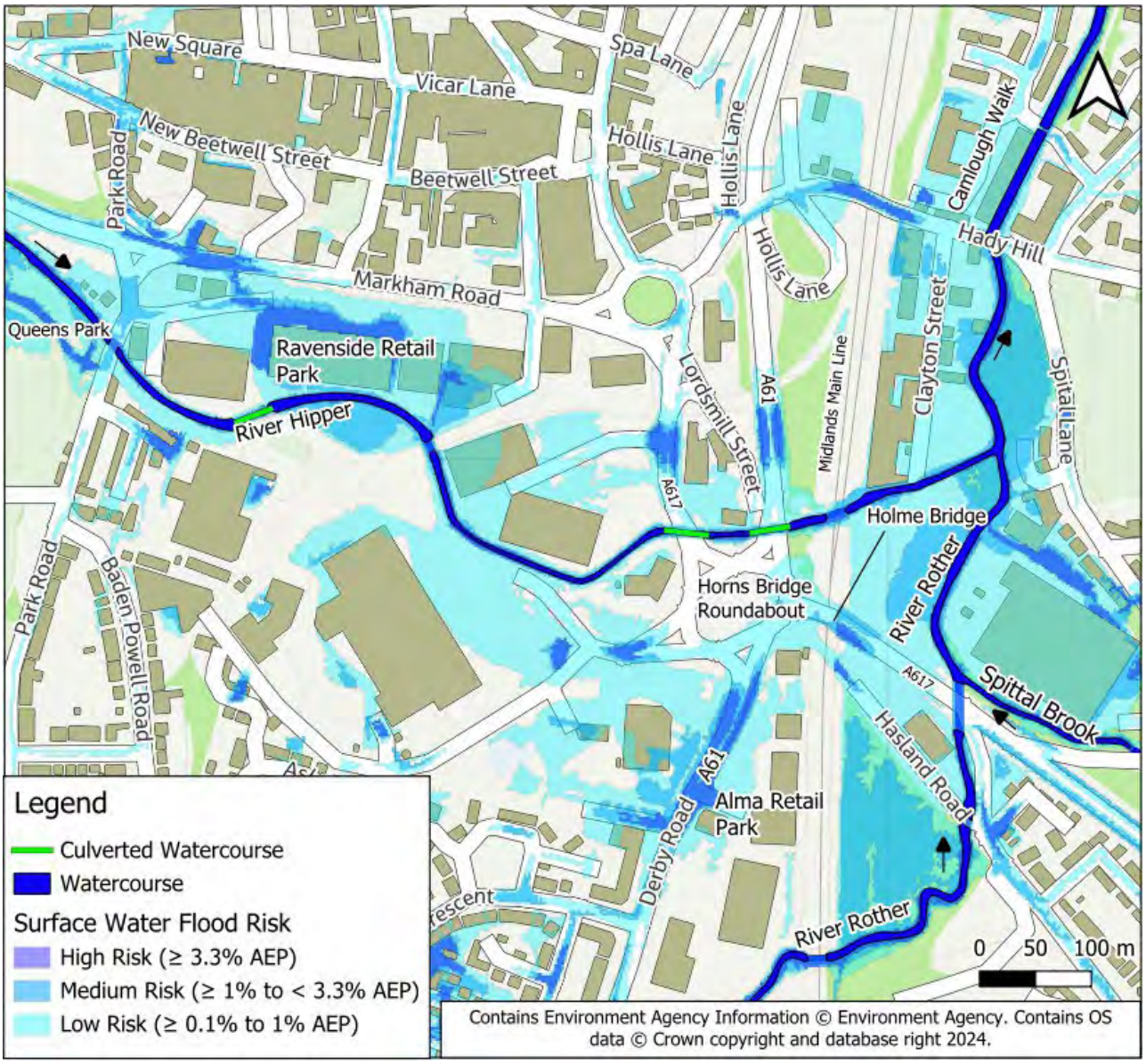

Figure 4-41: Map showing the chance in any given year of flooding from surface water at the Central Chesterfield community (Source: Long Term Flood Risk Map).

The community is not located within or nearby to any nationally designated environmental sites.

4.10.2 Current Flood Risk Management Arrangements

All of the properties which suffered internal flooding in this community are within the 'Upper River Rother Catchment' Flood Alert Area. Central Chesterfield is covered by three Flood Warning Areas. 'The River Hipper at Central Chesterfield' Flood Warning Area covers the affected properties adjacent to the River Hipper, with the exception of Queens Park which is not in a Flood Warning Area. The 'River Rother at Central Chesterfield' Flood Warning Area covers affected areas including Horns Bridge, Alma Retail Park, Clayton Street, Spital Lane, Hasland Road, and Hollis Lane. Camlough Walk is within the 'River Rother at Hady Hill' Flood Warning Area. On anticipation of a potential flood event, residents who are signed up to alerts and warnings are informed when flooding is likely to occur.

The Environment Agency's Asset Information and Maintenance Programme (https://environment.data.gov.uk/asset-management/) shows that there are no formal flood defences bordering the River Rother and the River Hipper in the Central Chesterfield community. Much of the land bordering the rivers is natural high ground, engineered high ground and/or privately owned walls along the watercourse that may provide some informal flood risk reduction. The responsibility of maintenance of these walls is that of the riparian landowner.

4.10.3 Storm Babet Incident Details

A Flood Alert was issued to the 'Upper River Rother Catchment', which covers all flooded areas of this

community, on the 19th of October 2023 at 8:54pm. Three Flood Warnings were issued to areas within this community. The first was issued to the 'River Hipper at Central Chesterfield' area on the 20th of October at 10:58am, including to all of the internally flooded properties along the River Hipper, with the exception of a business on Park Road. The second was issued to the 'River Rother at Central Chesterfield' area on the 20th of October at 11:48am, including the affected properties adjacent to the River Rother and Spital Brook, with the exception of Camlough Walk. A third was issued to the 'River Rother at Hady Hill' on the 20th of October 2023 at 12:26pm, including Camlough Walk.

Forty-nine homes were internally flooded in the Central Chesterfield community. The majority of these homes are located on Camlough Walk with a few further properties located on Hasland Road, Hollis Lane and Spital Lane. Thirty businesses also internally flooded across the community.

4.10.4 Flood Mechanisms, Extent and Impacts

Flooding at this community was mainly caused by the River Rother, the River Hipper and Spital Brook exceeding their channel capacity. There is evidence to suggest that sewer systems were also overwhelmed in some areas of this community, which is likely to have contributed to flooding. Surface water runoff also likely exacerbated flooding in some areas, although the extent of floodwater contribution from sewer and surface water sources is unclear.

Figure 4-42 shows the assumed flow routes which contributed to the flood extent.

There are two river level gauges at this community. Hydrology data from the Hady Hill gauge, which is located on the River Rother at Hady Hill bridge, shows that on the 20th of October 2023, the peak reached 4.20m; the highest level ever recorded. The gauge indicates that water levels in the River Rother began to rise on the 20th of October at about 2:00am, reaching its peak at 5:30pm.

Hydrology data from the Chesterfield Park Road Bridge gauge, located on the River Hipper, at the upstream end of Ravenside Retail Park, shows that on the 20th of October, the peak reached 2.93m; the highest level ever recorded. The gauge indicates that water levels in the River Hipper began to rise on the 20th of October at about 2:00am, reaching its peak at 2:30pm.

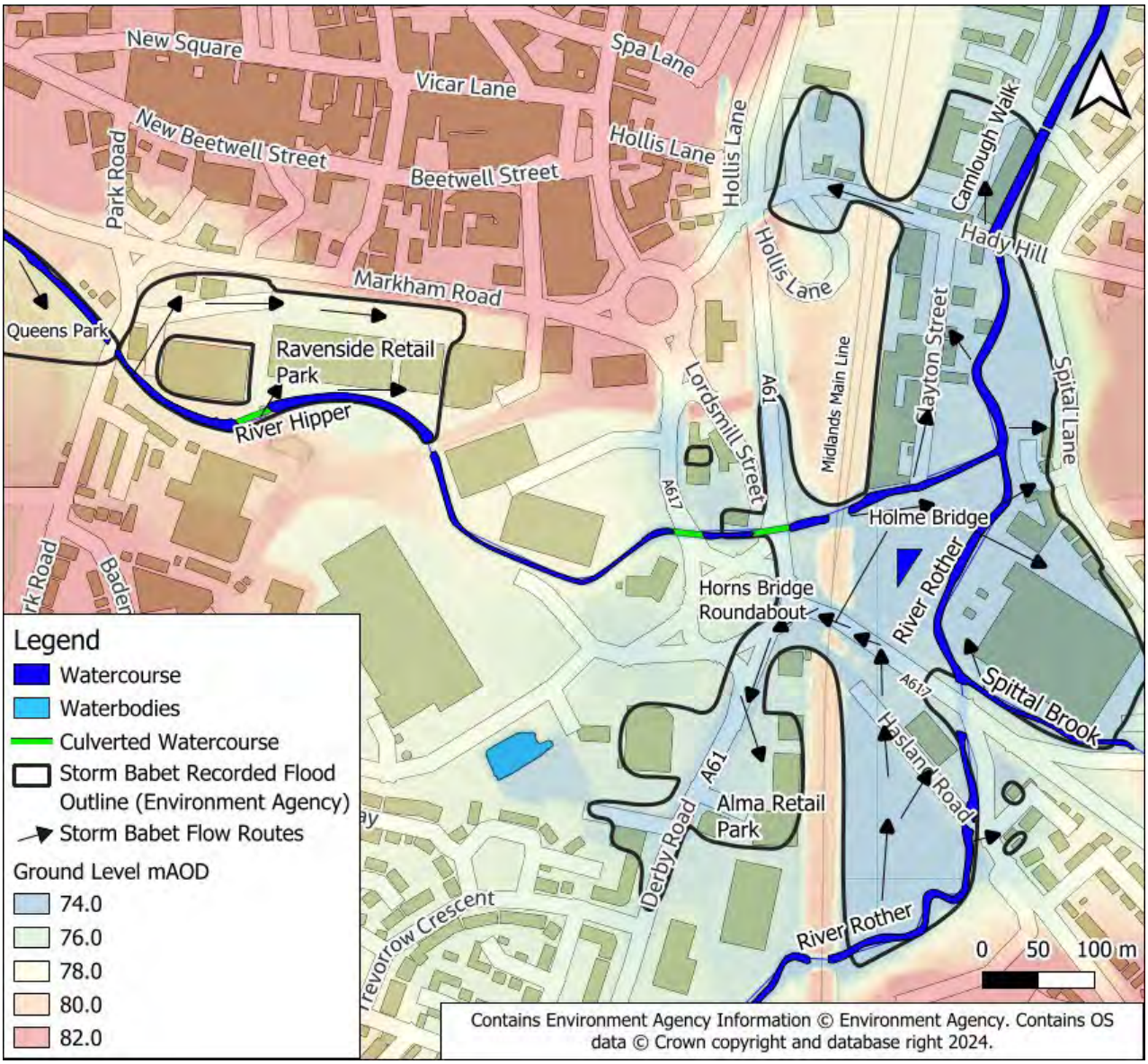

Figure 4-42: Ground level and Storm Babet flow routes at Central Chesterfield.

The River Hipper overflowed its banks at Queens Park and Ravenside Retail Park, flooding ten businesses. Watermarks on the building, shown in the left image of Figure 4-43, indicate that floodwater at the Queens Park business reached approx. 0.7m deep. The right image of Figure 4-43 shows the extent of flooding at Ravenside Retail Park. Watermarks on one of the internally flooded businesses at Ravenside Retail Park indicate that flood depths reached approx. 0.8m. Some buildings within the Ravenside Retail Park avoided internal flooding due to being at a higher elevation than other buildings in the retail park.

Figure 4-43: Left - Flooding at a business within Queens Park. Right - Flooding on the northern side of Ravenside Retail Park.

Downstream of Ravenside Retail Park, the River Hipper overflowed its north bank downstream of the A617 and upstream of the A61 (also referred to as Rother Way), flooding two commercial properties on Lordsmill

Street.

Hasland Road crosses the River Rother about 100m upstream of its confluence with Spital Brook. One commercial property to the west of the River Rother and four residential properties to the east of the River Rother suffered internal flooding here. This flooding occurred as a result of the River Rother overflowing its banks, however it is not clear whether this was affected by the flow capacity at Hasland Road or the A617 bridge.

Three homes and four non-residential properties flooded on Spital Lane as a result of Spital Brook overflowing. Spital Brook borders these properties before joining the River Rother, which continues to flow parallel to these properties. Spital Brook at this location is about 6m-7m wide, with several bridges crossing it. It is understood that the River Rother overflowed its banks at multiple locations in this area, both upstream of the A617 bridge at Hasland Road and downstream at its confluence with Spital Brook.

Flooding at this community had a substantial impact on infrastructure in the vicinity of Horns Bridge. Numerous roads were impassable due to excessive flood depths, including all arms of Horns Bridge roundabout. Watermarks on railings and signposts at the roundabout indicate water depths reached about 0.5m. The A617, to the south-east of Horns Bridge roundabout, was flooded to depths exceeding 0.5m at its low spot. The cause of flooding here is understood to have been a combination of river, sewer, and surface water sources. Floodwater overflowing the River Rother near to the A617 is understood to have flowed from both north and south directions towards the low spot on the A617. Additionally, a sewer passes beneath the rail embankment at this location, which has a history of being overwhelmed. During Storm Babet, floodwater surcharged from the manhole on the A617, contributing to the flooding there. In addition, surface water is likely to have contributed to flooding at this location due to the local topography. Flooding at the low spot is shown in Figure 4-44.

Figure 4-44: Flooding on the A617 at the low spot beneath the railway underpass at Horns Bridge. Photograph taken from Horns Bridge Roundabout.

Flooding at Alma Retail Park was caused by a combination of river, sewer and surface water flooding. Floodwater from the A617, to the east of Horns Bridge roundabout, flowed onto the roundabout and south along the A61 (Derby Road), flooding four businesses on Alma Retail Park. The A61 was flooded from Horns Bridge Roundabout to about 200m south, at the Byron Street junction. The electricity substation located on

the A61 opposite Byron Street was flooded, leaving around 200 homes without power. The railway did not flood due to its elevation.

Ten non-residential properties flooded at Clayton Street as a result of river flooding. Clayton Street is located on the north bank of the River Hipper and west bank of the River Rother immediately downstream of the confluence. Reports indicate that Clayton Street was initially flooded by the River Hipper, which overtopped near to where Clayton Street Bridge crosses the River Hipper, with floodwater flowing north down the street. It is reported that the River Rother subsequently overflowed its left bank, internally flooding properties on the east side of Clayton Street from the rear. Reports of debris on vehicle windscreens parked on Clayton Street suggest flood depths exceeded approximately 1m.

The River Rother overflowed its west bank at Hady Hill. Hady Hill slopes westwards from the Hady Hill bridge to a low spot beneath the East Midlands Main Line, which crosses Hady Hill about 100m west of the River Rother. The Foundry and Markham Quay are apartment blocks located on Camlough Walk, just north of Hady Hill and west of the River Rother. Markham Quay is located on the west bank of the River Rother, while The Foundry is about 50m further west but at a similar elevation. The ground floor of both these buildings suffered internal flooding, as did three businesses on Hady Hill between the River Rother and the railway underpass. Although the dominant flood source was from the River Rother overflowing, reports of sewage at The Foundry and Markham Quay indicate that the sewer system was likely to have been overwhelmed.

Figure 4-45: Photograph of watermarks reaching over 0.5m on The Foundry building, Camlough Walk taken in the aftermath of flooding.

Four homes and two businesses suffered internal flooding on Hollis Lane on the western side of the railway underpass. Figure 4-46 shows floodwater from the River Rother that accumulated at the low spot beneath the railway underpass. This image was taken from Hollis Lane facing eastwards along Hady Hill. Video footage taken during the event shows individuals evacuating the area to the east of this railway underpass by wading on foot through floodwater. Footage indicates that flood depths exceeded 1m at this location.

Figure 4-46: Flooding on Hollis Lane, facing eastwards towards Hady Hill.

4.10.5 Actions by Public Bodies

This section outlines the actions undertaken by public bodies immediately and in the aftermath of the flood event which are specific to this community. Please refer to section 8.1 of this report for a summary of actions that were implemented at all communities.

Public bodies that have been involved in the flood-event response at this community include:

- Derbyshire County Council
- Environment Agency
- Chesterfield Borough Council
- Yorkshire Water
- Emergency services

The Environment Agency issued a Flood Alert to the Upper River Rother Catchment, which covers all flooded areas of this community, on the 19th of October 2023 at 8:54pm. The Environment Agency then issued three separate Flood Warnings to areas within this community. The first was issued to the River Hipper at Central Chesterfield on the 20th of October at 10:58am, including to all of the internally flooded properties along the River Hipper, with the exception of a business on Park Road. The second was issued to the 'River Rother at Central Chesterfield' area on the 20th of October at 11:48am, including the affected properties adjacent to the River Rother and Spital Brook, with the exception of Camlough Walk. A third was issued to the 'River Rother at Hady Hill' on the 20th of October 2023 at 12:26pm, including Camlough Walk.

Derbyshire County Council were involved in these post-event actions, including:

- Assisting residents with applications to the PFR Scheme.
- Extensive post flood investigations throughout Chesterfield, site visits and meetings with the Environment Agency.

Chesterfield Borough Council were involved in several post-event actions at this community, including:

- Assisting with the removal of debris.
- Liaising with Ravenside Retail Park owners to discuss the potential of improved servicing of their flap valves.
- Hosting drop-in-sessions for those who required assistance and guidance in the aftermath of the event.

The Environment Agency were involved in several post-event actions at this community, including:

- They conducted a site visit to the area on the 23rd of October 2023.
- They conducted inspections along the River Hipper on the 13th of November 2023.
- At Ravenside Retail Park, they recorded collapsed banks, a missing flap valve from an outfall and sections of walls in poor condition. They sent letters to the riparian owners of these assets notifying them to make the necessary repairs and to maintain the assets.

Yorkshire Water is considering potential options that could increase the capacity of their network at Horns Bridge, which has a history of surcharging and may have contributed to the flooding at Horns Bridge during Storm Babet.

A multi-agency drop in event was held in Chesterfield on the 27th of November 2023 which was open to members of the public and included the Environment Agency, Derbyshire County Council, Chesterfield Borough Council and Yorkshire Water. All parties have undertaken numerous site visits and local engagement after the flood event.

4.11 Community Impacts – Meadow Close

4.11.1 Location Characteristics

Fifteen properties in Meadow Close, a cul-de-sac in New Whittington, approximately 4.5km north of Chesterfield, suffered internal flooding as a result of Storm Babet. Figure 4-47 below shows the area where the properties flooded. The River Rother flows eastwards approximately 150m south of the community, with the Midlands Railway Line and Chesterfield Canal parallel to the River Rother to the south. An ordinary watercourse passes southwards as an open channel through Brearley Park to the west of the community, before becoming culverted and flowing beneath Caxton Close and Meadow Close. The watercourse then flows through the field south of Meadow Close, beneath Station Lane, before joining the River Rother. Upstream of Meadow Close, some of the ordinary watercourse flow is diverted westwards during periods of higher flows and feeds into the wetland area to the west and then on to the River Rother.

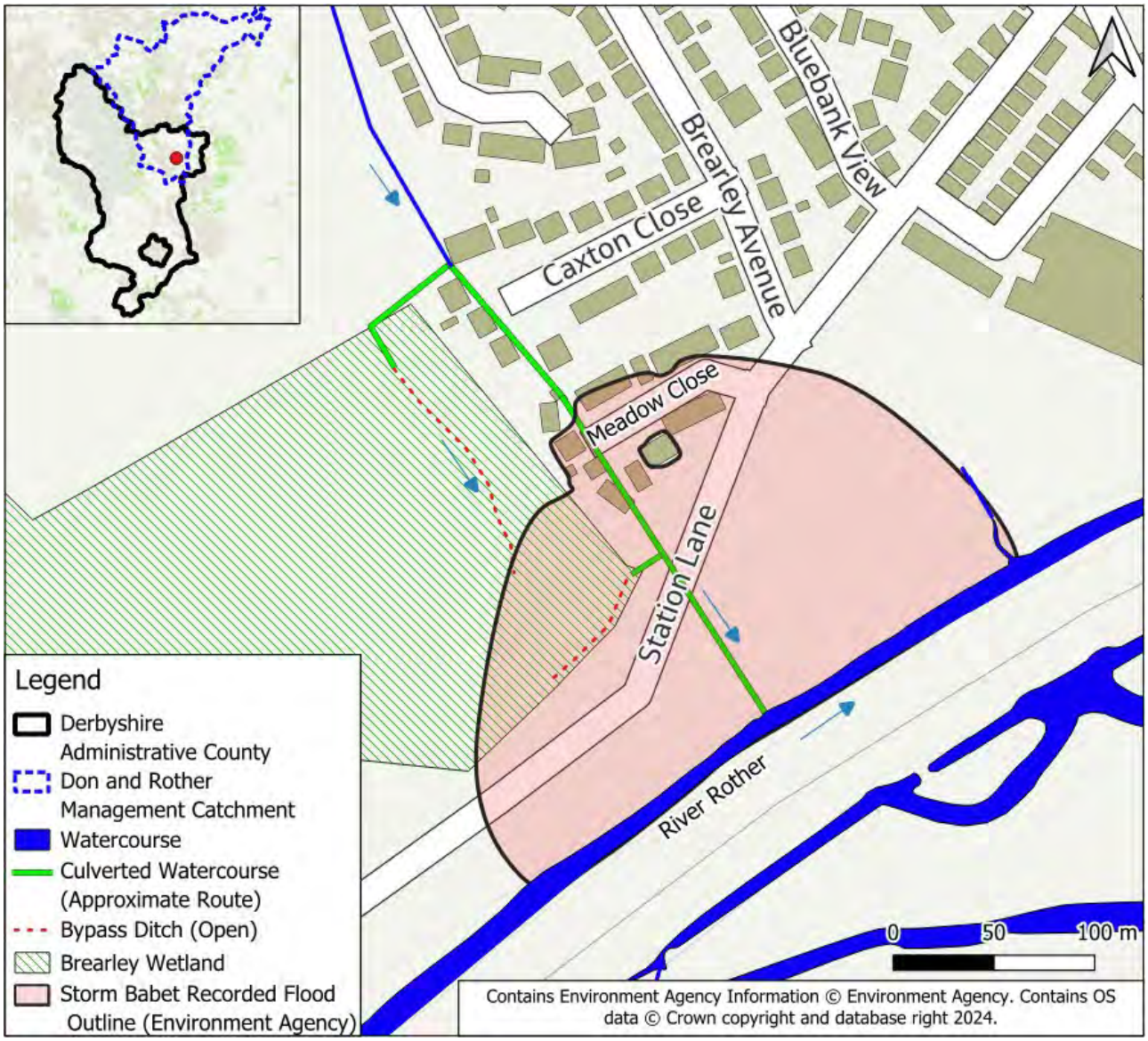

Figure 4-47: Overview map of Meadow Close community.

The community is located on the floodplain of the River Rother. Topographic data shows that the properties that flooded sit at a similar elevation to the top of the bank of the River Rother. The local bedrock geology is sedimentary, including mudstone, siltstone and sandstone.

The Environment Agency's Historic Flood Map indicates that there are records of six of the fifteen internally flooded properties on Meadow Close having flooded previously from the River Rother. There are no records of flooding from the ordinary watercourse, although Chesterfield Borough Council report that it has previously contributed towards flooding issues.

The Flood Map for Planning (https://flood-map-for- planning.service.gov.uk/) shows that all of the flooded homes within this community are in Flood Zone 2, as shown in Figure 4-48. Areas in Flood Zone 2 have between a 1% and 0.1% AEP of river flooding.

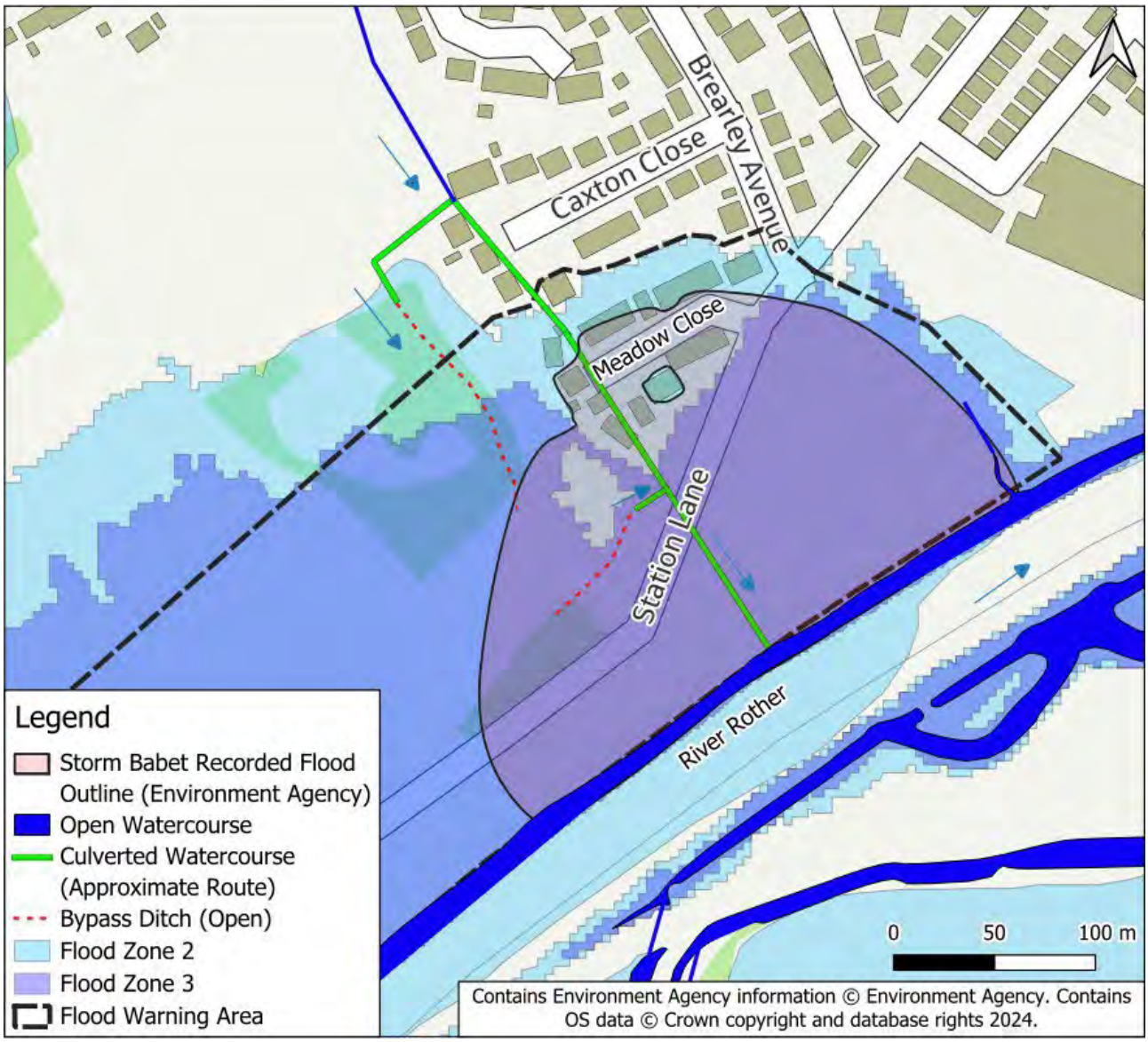

Figure 4-48: Flood Zones and flood risk management arrangements in the vicinity of Meadow Close.

Additionally, some homes on Meadow Close have a low risk of surface water flooding, based on the Long Term Flood Risk Map (https://check-long-term-flood-risk.service.gov.uk/postcode). Low risk is defined between a 1% and 0.1% AEP of flooding. Figure 4-49 shows the surface water flood risk for the community based on the national mapping referred to above.

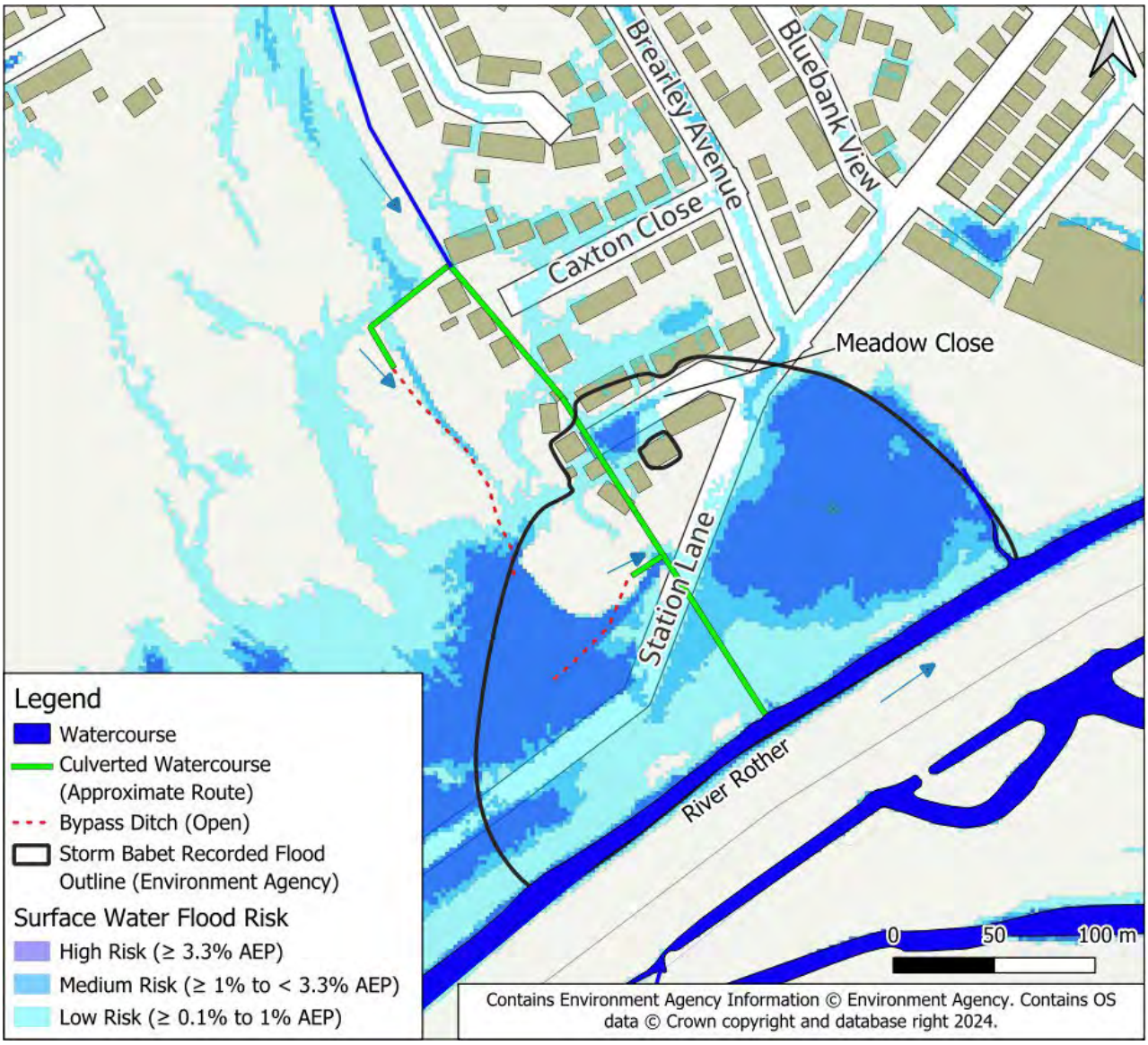

Figure 4-49: Map showing the chance in any given year of flooding from surface water at Meadow Close and its surrounding area (Source: Long Term Flood Risk Map).

The community is not located within or nearby to any nationally designated environmental sites. Brealey Wetlands, to the west of the community, is a local nature reserve.

4.11.2 Current Flood Risk Management Arrangements

All properties within this community were located within the 'Upper Rother Catchment' Flood Alert area and the 'River Rother at New Whittington' Flood Warning Area. On anticipation of a potential flood event, residents who are signed up to alerts and warnings are informed when flooding is likely to occur.

The Environment Agency's Asset Information and Maintenance Programme (https://environment.data.gov.uk/asset-management/) shows that there are no flood walls, embankments or pumping stations at this location. However, there is a water storage area in undeveloped parts of the floodplain.

4.11.3 Storm Babet Incident Details

A Flood Alert was issued to the 'Upper Rother Catchment' on the 19th of October 2023 at 8:54pm, followed by a Flood Warning to the 'River Rother at New Whittington' area, which was issued on the 20th of October at 3:30pm.

All fifteen internally flooded properties within this community were homes located on Meadow Close and would have been covered by the Flood Alert and Flood Warning issued.

4.11.4 Flood Mechanisms, Extent and Impacts

Hydrology data shows that on the 20th of October 2023, the peak level recorded at the Whittington river gauge, located on the River Rother about 700m upstream of Meadow Close, reached 4.09m; the second highest level ever recorded. The gauge indicates that water levels in the River Rother began to rise on the 19th of October at about 11:00pm, reaching its peak at 8:00pm the following day.

The initial flooding was from a double gully in the highway at the end of the driveway of 10 Meadow Close. This was then supplemented by flooding from the River Rother. The latter is likely to have been more dominant in causing the final flood extent, but this is not certain. Culvert exceedance is a known issue in this community; however, it has not previously resulted in flooding to this extent, which supports the hypothesis that the dominant flood source was the River Rother. Figure 4-50 shows the flow routes that contributed to the flood extent.

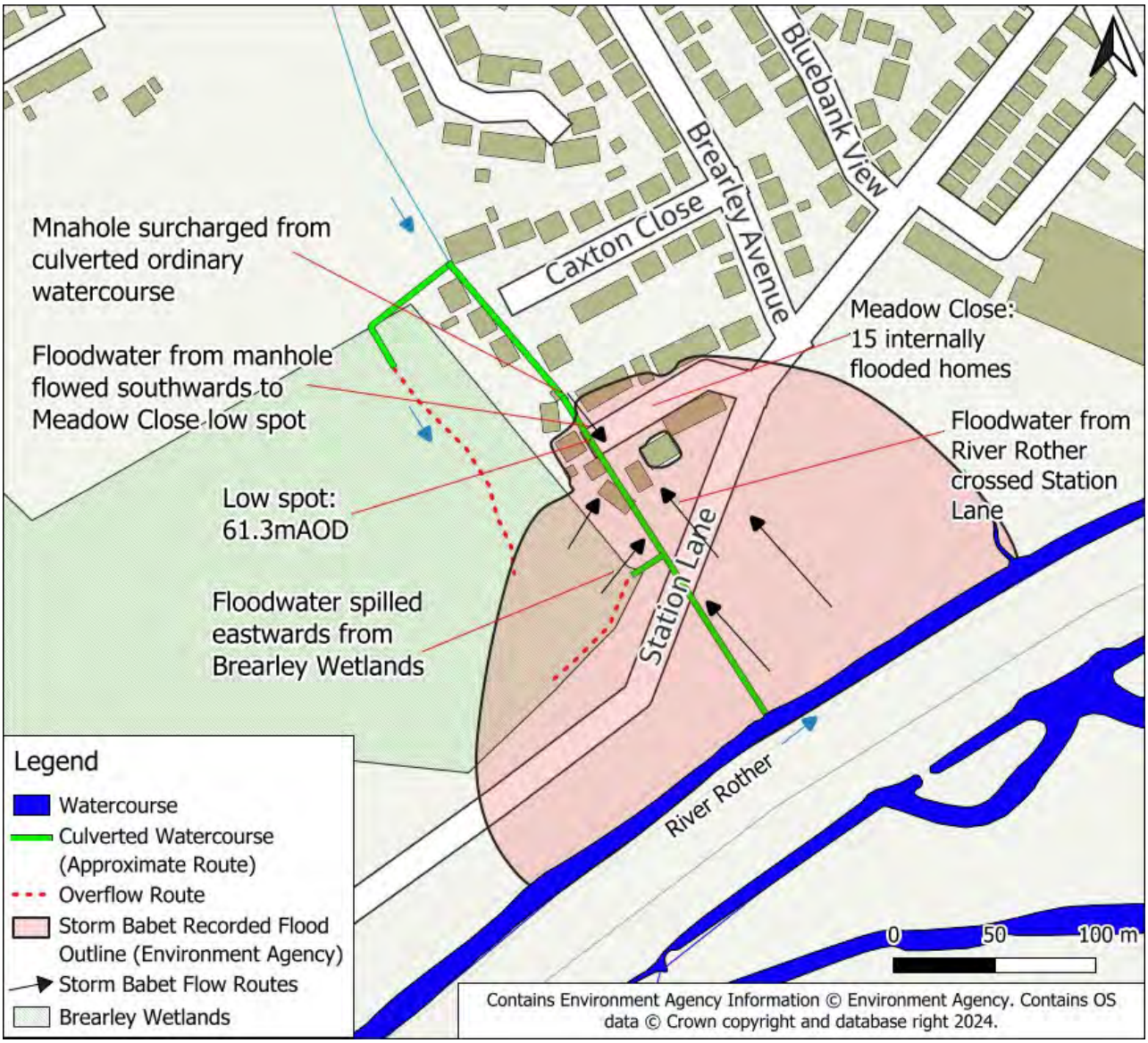

Figure 4-50: Flow pathways and annotated flood mechanisms of Storm Babet flooding in the vicinity of Meadow Close. Source: Derbyshire County Council Flood Team.

4.11.5 Actions by Public Bodies

This section outlines the actions undertaken by public bodies immediately and in the aftermath of the flood event which are specific to this community. Please refer to section 8.1 of this report for a summary of actions that were implemented at all communities.

Public bodies that have been involved in the flood-event response at this community include:

- Derbyshire County Council
- Environment Agency

- Chesterfield Borough Council
- Emergency services

The Environment Agency issued a Flood Alert to the Upper Rother Catchment on the 19th of October at 8:54pm, followed by a Flood Warning on the 20th of October at 3:30pm.

Chesterfield Borough Council received sandbag requests from two residents at this location on the 20th of October 2023 at 4:40pm. Sandbags were deployed to residents; however, they were ineffective at mitigating internal flooding.

Derbyshire County Council and Chesterfield Borough Council have undertaken numerous site visits following the flood event.

4.12 Community Impacts – Eckington

4.12.1 Location Characteristics

Eight properties, including five residential properties and three commercial properties, in Eckington, north-east Derbyshire suffered internal flooding as a result of Storm Babet. Figure 4-51 below shows the area where the properties flooded, to the north of a river called The Moss. The Moss flows from west to east through the community and is a tributary to the River Rother. Both The Moss and River Rother are classified as main rivers at this location. The Moss is also recognised as an ordinary watercourse west of the A6135 (Sheffield Road).

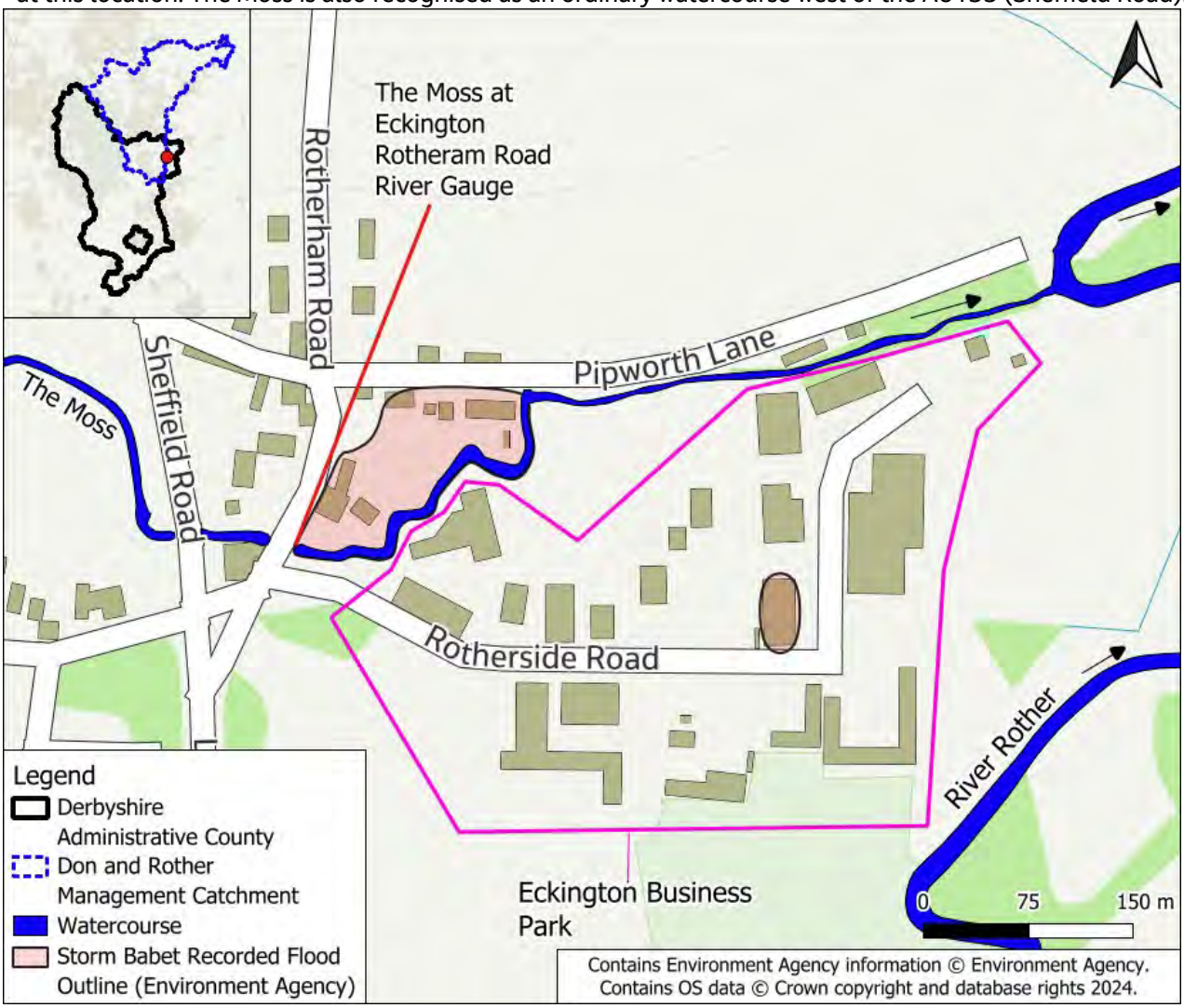

Figure 4-51: Overview Map of Eckington.

The community is mainly residential. Properties to the south west of the community are primarily 1960s or 1970s semi-detached and detached houses. Properties to the north west are mainly detached. The Eckington Business Park is characterised by warehousing and industrial commercial buildings.

Critical infrastructure located within the area includes the A6135 Sheffield Road and The Midland Mainline

railway running between London and Sheffield is located 650m east Eckington. There are no vulnerable properties within the flood extent.

The community is located on the floodplain of the River Rother which flows northwards. The local topography is flat and relatively low-lying compared to its surroundings to the north-west, south-west and east. Most of the flooded homes are west of the River Rother, and south of The Moss. The local superficial geology is alluvium, including gravel, sand, silt and clay.

The Environment Agency Historic Flood Map indicates that the properties that flooded because of Storm Babet were also flooded previously.

The Flood Map for Planning (https://flood-map-for-planning.service.gov.uk/) shows that all of the flooded homes within this community are in Flood Zone 2 and some are in Flood Zone 3, see Figure 4-52. Areas in Flood Zone 2 have between a 1% and 0.1% AEP of river flooding. Flood Zone 3 means the properties have a greater than 1% AEP of flooding from rivers.

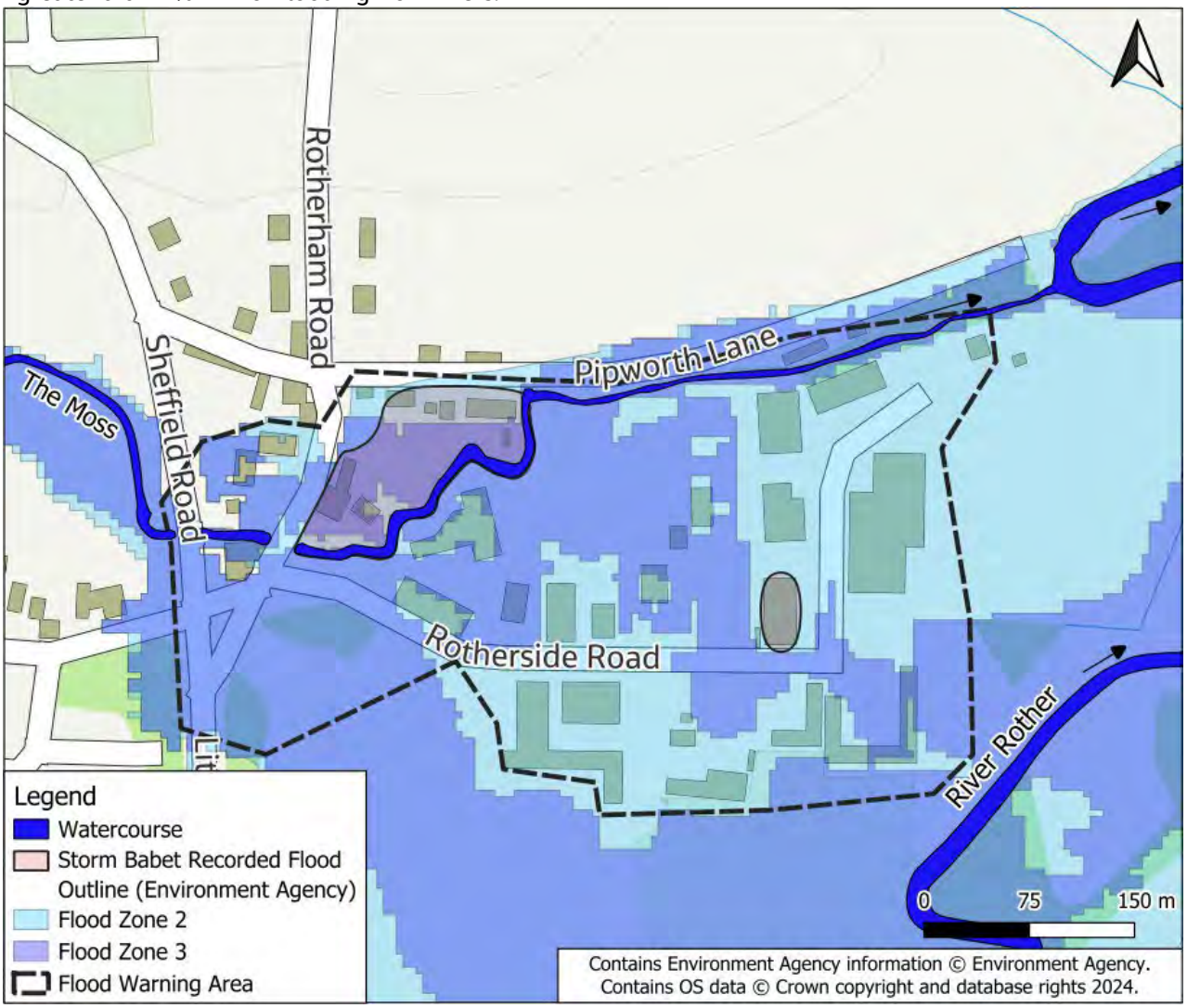

Figure 4-52: Current flood risk management strategies within Eckington.

Based on the Long Term Flood Risk Map (https://check-long-term-flood-risk.service.gov.uk/postcode) there is only a low risk of surface water flooding. Low risk is defined as between 0.1% and 1% AEP of flooding. Figure 4-53 shows the surface water flood risk for the community based on the national mapping referred to above.

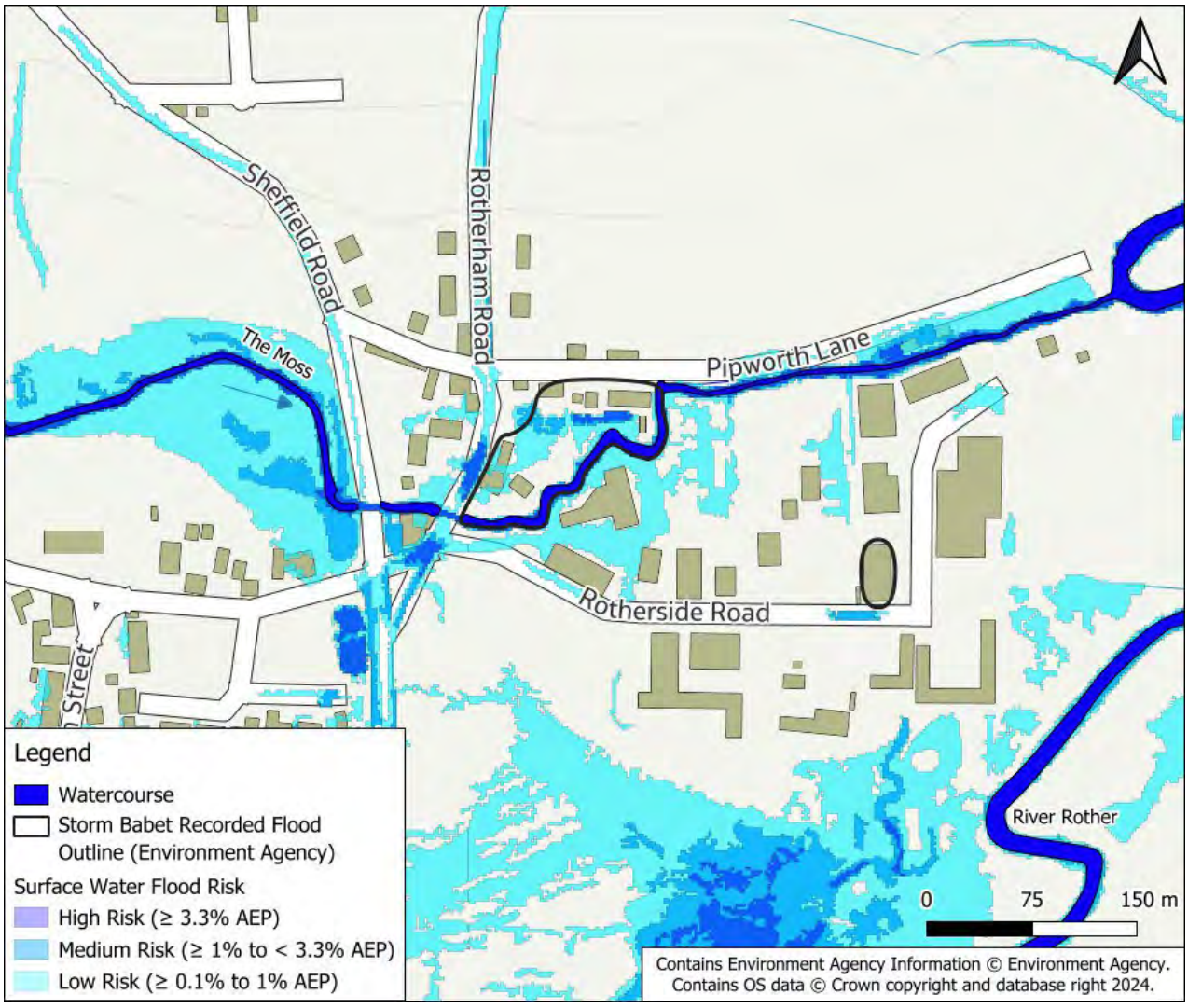

Figure 4-53: Map showing the chance in any given year of flooding from surface water at Eckington (Source: Long Term Flood Risk Map).

Eckington is not located within or nearby to any nationally designated environmental sites.

4.12.2 Current Flood Risk Management Arrangements

All properties flooded within this community were located within the 'Lower River Rother Catchment' Flood Alert Area, and the 'Moss and River Rother at Eckington' Flood Warning Area. On anticipation of a potential flood event, residents who are signed up to alerts and warnings are informed when flooding is likely to occur.

The Environment Agency's Asset Information and Maintenance Programme (https://environment.data.gov.uk/asset-management/) shows that there are currently no formal flood defences in the area. However, the above asset information does identify a water storage area associated with the undeveloped parts of the River Rother floodplain. Refer to Figure 4-54.

Information provided by Derbyshire County Council suggests that PFR measures have been installed on one property previously affected by flooding.

4.12.3 Storm Babet Incident Details

A Flood Alert was issued to the 'Lower River Rother Catchment' on the 20th of October 2023 at 9:52am, and a Flood Warning was issued to the 'Moss and River Rother at Eckington' Flood Warning Area at 1:45pm.

The five homes that flooded internally are all located on Rotherham Road and Pipworth Lane, north of The Moss tributary and east of the River Rother. An additional commercial property also flooded in this location. The remaining commercial properties that were internally flooded were located on the Eckington Business Park, south of The Moss and east of the River Rother.

4.12.4 Flood Mechanisms, Extent and Impacts

The primary source of flooding likely affecting all properties within this community was from The Moss tributary. It is unclear whether the River Rother contributed to flooding, most obviously because of possible high levels preventing The Moss from discharging flood flows.

Figure 4-54 shows the flow routes and elevations which will have contributed to the flood extent.

Hydrology data shows that on the 20th of October, the peak level recorded at the Eckington Rotherham Road river gauge located on The Moss tributary at Rotherham Road bridge, reached 2.46m; the highest level ever recorded. The gauge indicates that water levels in The Moss began to rise on the 20th of October 2023 at about 4:00am, reaching its peak at 2:45pm.

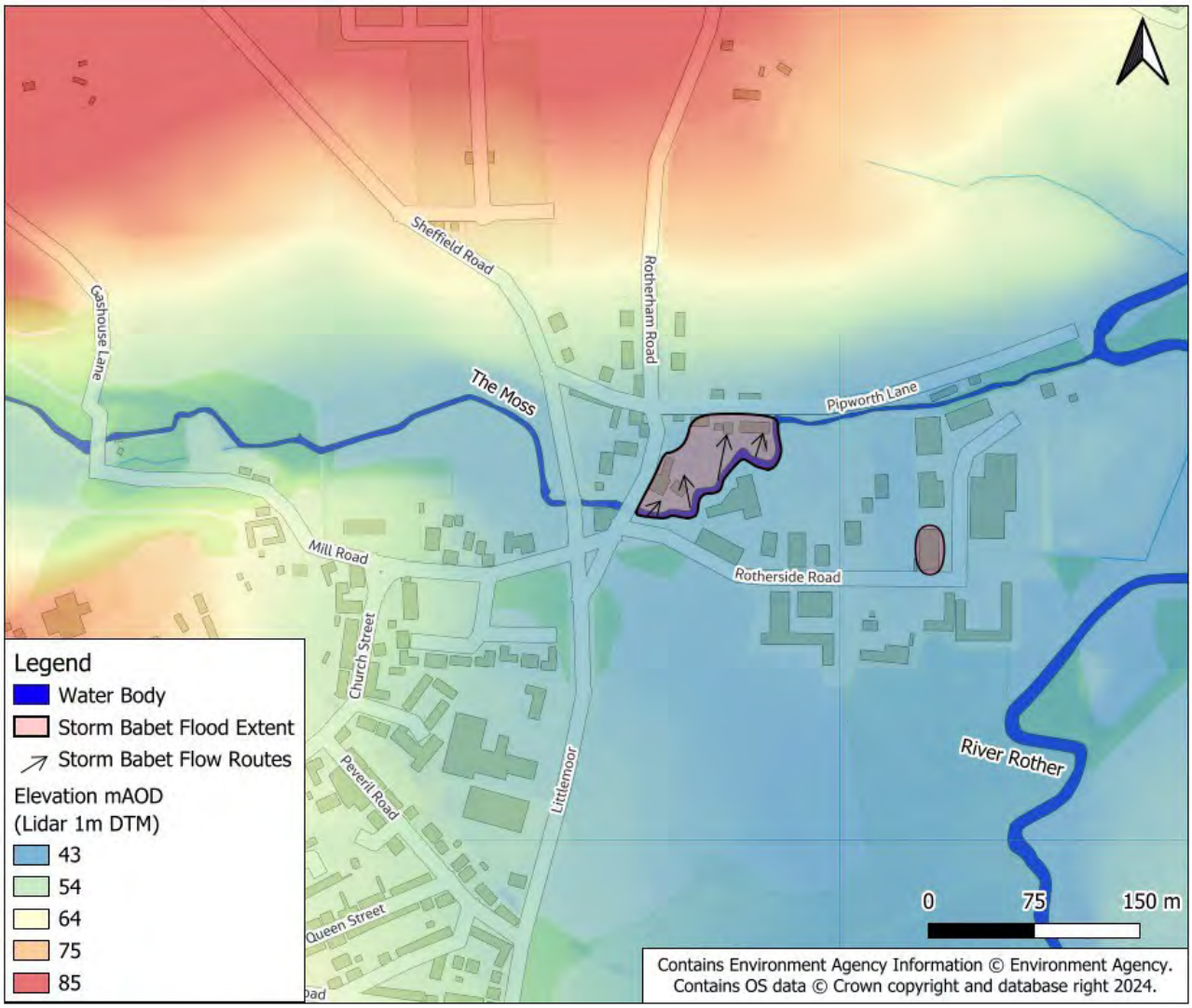

Figure 4-54: Ground level and Storm Babet flow routes at Eckington.

Following the flooding, residents reported through the National Incidents Reporting System (NIRS). NIRS allows the public to report environmental incidents such as flooding to the Environment Agency. In this case residents reported that trees around Pipworth Lane had fallen and were blocking The Moss. While these incidents were recorded in the days following Storm Babet, concerns were raised about the potential for the blockages to inflict further damage and flooding to the community. Within one of the reports, a resident notes that flood water was around 0.6m deep as a result of Storm Babet on the 20th of October.

Notable infrastructure that was flooded included the North East Derbyshire District Council depot, as pictured in Figure 4-55 and Figure 4-56, and the southern end of Sheffield Road.

Figure 4-55: Eckington Depot affected by flooding because of Storm Babet.

Figure 4-56: Interior of Eckington Depot affected by flooding because of Storm Babet.

4.12.5 Actions by Public Bodies

This section outlines the actions undertaken by public bodies immediately and in the aftermath of the flood event which are specific to this community. Please refer to section 8.1 of this report for a summary of actions that were implemented at all communities.

Public bodies that have been involved in the flood-event response at this community include:

- Derbyshire County Council
- Environment Agency
- North East Derbyshire District Council
- Yorkshire Water
- Emergency services

The Environment Agency issued a Flood Alert to the Lower River Rother Catchment on the 20th of October 2023 at 9:52am, and a Flood Warning to the Moss and River Rother at Eckington at on the 20th of October 2023 at 1:45pm.

Derbyshire County Council have undertaken numerous site visits after the flood event.
Alongside supporting cleanup efforts in Eckington, North East Derbyshire District Council worked to return the depot to its operating standard, ensuring the provision of statutory functions. The district council also

produced a new evacuation procedure in response to the event.