Section 19

Flood and Water Management Act 2010

Ref S19-729

Number of properties covered in this document – 129

Date and version number – 05/12/2024

Version 2.0 **REDACTED**

GeoSmart Information Ltd

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Property information

This S19 report was commissioned to investigate internal flooding in Horncastle following Storm Babet in October 2023 (Table 1).

According to records held by LCC, 138 properties were reported to have experienced internal flooding in Horncastle during Storm Babet. Further investigation, which includes conversations with residents and responses to an LCC questionnaire, indicates that 129 properties experienced internal flooding. (Note: for the purposes of the S19 process, internal flooding is defined as flooding which occurred inside the main building, and does not include any flooding within domestic garages, outbuildings, driveways and gardens.)

A further 23 properties have been reported as having experienced flooding, although the extent of flooding (i.e., whether internal flooding occurred) has not been determined (Table 2). The majority of these properties are located within the vicinity of other properties known to have flooded. As a result, they are likely to have flooded via the same mechanisms and have been discussed alongside such properties.

An additional 27 properties have been confirmed as having experienced exclusively external flooding. As no internal flooding occurred at these properties, they have not been investigated further. However, it should be noted that flooding occurred within garages and other outbuildings at many of the properties (Table 3).

Two road closures also occurred in Horncastle during Storm Babet, which are discussed further within the report (Table 4).

Given the distance between the affected properties and the variation in flood causation mechanisms, the properties are discussed within twelve separate clusters. The clusters are set out in the 'Cluster Information' section of this report and are also presented within Figure 1 (overleaf).

(*Figure 1 – Clusters of properties within Horncastle. Further information about these clusters is provided within the 'Cluster Information' section.*)

Location	Reported extent	Confirmed extent	Property Easting	Property Northing	Date visited	Cluster
[redacted] Winceby Gardens, Horncastle, [redacted]	Internal	Internal	[redacted]	[redacted]	01-May-24	1
[redacted] Winceby Gardens, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	01-May-24	1
[redacted] Winceby Gardens, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	01-May-24	1
[redacted] Winceby Gardens, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	01-May-24	1
[redacted] Winceby Gardens, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	01-May-24	1
[redacted] Clarke Court, Horncastle, [redacted]	Internal	Internal	[redacted]	[redacted]	01-May-24	2
[redacted] Lodington Court, Horncastle, [redacted]	Internal	Internal	[redacted]	[redacted]	01-May-24	2
[redacted] Lodington Court, Horncastle, [redacted]	Internal	Internal	[redacted]	[redacted]	01-May-24	2
[redacted] Saxon Way, Horncastle, [redacted]	N/A	Internal	[redacted]	[redacted]	N/A	2
[redacted] Banovallum Gardens, Horncastle, [redacted]	Internal	Internal	[redacted]	[redacted]	01-May-24	2
[redacted] Maltby Way, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	01-May-24	2
[redacted] Saxon Way, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	01-May-24	2
[redacted], Spilsby Road, Horncastle, [redacted]	Internal (TBC)	N/A	[redacted]	[redacted]	01-May-24	2
[redacted] Saxon Way, Horncastle, [redacted]	Internal	Unknown	[redacted]	[redacted]	01-May-24	2

Location	Reported extent	Confirmed extent	Property Easting	Property Northing	Date visited	Cluster
[redacted] Lodington Court, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	01-May-24	2
[redacted] Maltby Way, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	01-May-24	2
[redacted] Lodington Court, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	01-May-24	2
[redacted] Lodington Court, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	01-May-24	2
[redacted] Lodington Court, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	01-May-24	2
[redacted] Maltby Way, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	01-May-24	2
[redacted] Maltby Way, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	01-May-24	2
[redacted] Maltby Way, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	01-May-24	2
[redacted] Maltby Way, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	01-May-24	2
[redacted] Banovallum Gardens, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	01-May-24	2
[redacted] Banovallum Gardens, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	01-May-24	2
[redacted], [redacted] Maltby Way, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	01-May-24	2
[redacted] Maltby Way, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	01-May-24	2
[redacted] Lodington Court, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	01-May-24	2
[redacted] Saxon way, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	01-May-24	2

Location	Reported extent	Confirmed extent	Property Easting	Property Northing	Date visited	Cluster
[redacted] Saxon Way, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	01-May-24	2
[redacted] Saxon Way, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	01-May-24	2
[redacted] Clarke Court, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	01-May-24	2
[redacted] Lodington Court, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	01-May-24	2
[redacted] Cupit Road, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	01-May-24	2
[redacted] Cupit Road, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	01-May-24	2
[redacted] Stanhope Road, Horncastle, [redacted]	Internal	Internal	[redacted]	[redacted]	01-May-24	3
[redacted] Stanhope Road, Horncastle, [redacted]	Internal	Internal	[redacted]	[redacted]	01-May-24	3
[redacted] Stanhope Road, Horncastle, [redacted]	Internal	Internal	[redacted]	[redacted]	01-May-24	3
[redacted], [redacted] Stanhope Road, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	01-May-24	3
[redacted], Bowl Alley Lane, Horncastle, [redacted]	N/A	Internal	[redacted]	[redacted]	N/A	3
[redacted], Stanhope Beck, Horncastle, [redacted]	Internal	Internal	[redacted]	[redacted]	02-May-24	3
[redacted], Stanhope Road, Horncastle, [redacted]	Internal	Internal	[redacted]	[redacted]	02-May-24	3
[redacted], Stanhope Road, Horncastle, [redacted]	Internal	Internal	[redacted]	[redacted]	02-May-24	3
[redacted] Stanhope Road, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	01-May-24	3

Location	Reported extent	Confirmed extent	Property Easting	Property Northing	Date visited	Cluster
[redacted], Linden Road, Horncastle, [redacted]	Internal (TBC)	Internal	[redacted]	[redacted]	01-May-24	3
[redacted], Banks Road, Horncastle, [redacted]	N/A	Internal	[redacted]	[redacted]	N/A	3
[redacted] Banks Road, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	01-May-24	3
[redacted] Banks Road, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	01-May-24	3
[redacted] Banks Road, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	01-May-24	3
[redacted] Banks Road, Horncastle, [redacted]	Internal	Internal	[redacted]	[redacted]	01-May-24	3
[redacted] Banks Road, Horncastle	Internal	Internal	[redacted]	[redacted]	01-May-24	3
[redacted], Linden Road, Horncastle, [redacted]	Internal (TBC)	N/A	[redacted]	[redacted]	01-May-24	3
[redacted] Banks Road, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	01-May-24	3
[redacted] Banks Road, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	01-May-24	3
[redacted] Banks Road, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	01-May-24	3
[redacted], Linden Road, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	01-May-24	3
[redacted] Betts Yard, Francis Lane, Horncastle, [redacted]	Internal	Internal	[redacted]	[redacted]	01-May-24	4
[redacted] Francis Lane, Horncastle, [redacted]	Internal	Internal	[redacted]	[redacted]	01-May-24	4
[redacted] Betts Yard, Francis Lane, Horncastle, [redacted]	Internal	Internal	[redacted]	[redacted]	01-May-24	4

Location	Reported extent	Confirmed extent	Property Easting	Property Northing	Date visited	Cluster
[redacted] Plough Yard, Water Lane, Horncastle, [redacted]	Internal	Internal	[redacted]	[redacted]	30-Apr-24	4
[redacted] East Street, Horncastle, [redacted]	N/A	Internal	[redacted]	[redacted]	N/A	4
[redacted] East Street, Horncastle, [redacted]	Internal	Internal	[redacted]	[redacted]	30-Apr-24	4
[redacted] East Street, Horncastle, [redacted]	Internal	Internal	[redacted]	[redacted]	30-Apr-24	4
[redacted] Plough Yard, Water Lane, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	30-Apr-24	4
[redacted], Water Lane, East Street, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	30-Apr-24	4
[redacted], [redacted] - [redacted] East Street, Horncastle, [redacted]	Internal	Internal	[redacted]	[redacted]	02-May-24	4
[redacted], [redacted] East Street, Horncastle, [redacted]	Internal	Internal	[redacted]	[redacted]	30-Apr-24	4
[redacted] East Street, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	30-Apr-24	4
[redacted] East Street, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	30-Apr-24	4
[redacted] East Street, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	30-Apr-24	4
[redacted] East Street, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	30-Apr-24	4
[redacted] East Street Horncastle [redacted]	Internal	N/A	[redacted]	[redacted]	30-Apr-24	4

Location	Reported extent	Confirmed extent	Property Easting	Property Northing	Date visited	Cluster
[redacted], [redacted] East Street, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	30-Apr-24	4
[redacted] East Street, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	30-Apr-24	4
[redacted] East Street, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	30-Apr-24	4
[redacted], Water Lane, Horncastle, [redacted]	Internal	Internal	[redacted]	[redacted]	30-Apr-24	4
[redacted], East Street, Horncastle, [redacted]	N/A	Internal	[redacted]	[redacted]	01-May-24	4
[redacted] Plough Yard, Water Lane, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	30-Apr-24	4
[redacted], [redacted] Wharf Road, Horncastle, [redacted]	Internal	Internal	[redacted]	[redacted]	30-Apr-24	5
[redacted], Wharf Road, Horncastle, [redacted]	N/A	Internal	[redacted]	[redacted]	N/A	5
[redacted], Church Lane, Horncastle, [redacted]	N/A	Internal	[redacted]	[redacted]	N/A	5
[redacted] West Street, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	30-Apr-24	6
[redacted] & [redacted], Coronation Walk, Horncastle, [redacted]	Internal	Internal	[redacted]	[redacted]	30-Apr-24	6
[redacted], Coronation Walk, Horncastle, [redacted]	Internal	Internal	[redacted]	[redacted]	30-Apr-24	6
[redacted] Lincoln Road, Horncastle, [redacted]	Internal	Internal	[redacted]	[redacted]	30-Apr-24	7

Location	Reported extent	Confirmed extent	Property Easting	Property Northing	Date visited	Cluster
[redacted] Lincoln Road, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	30-Apr-24	7
[redacted], Manor House Street, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	30-Apr-24	8
[redacted], Manor House Street, Horncastle, [redacted]	Internal	Internal	[redacted]	[redacted]	30-Apr-24	8
[redacted] / [redacted], [redacted] Bridge Street, Horncastle, [redacted]	Internal	Internal	[redacted]	[redacted]	30-Apr-24	8
[redacted] Bridge Street, Horncastle	Internal	N/A	[redacted]	[redacted]	30-Apr-24	8
[redacted] Grundys Court, Horncastle, [redacted]	Internal (TBC)	N/A	[redacted]	[redacted]	30-Apr-24	8
[redacted] West Street Horncastle [redacted]	Internal	N/A	[redacted]	[redacted]	30-Apr-24	8
[redacted] Bridge Street, Horncastle	Internal	N/A	[redacted]	[redacted]	30-Apr-24	8
[redacted], [redacted] Bridge Street, Horncastle, [redacted]	TBC	Internal	[redacted]	[redacted]	30-Apr-24	8
[redacted], [redacted] West Street, Horncastle, [redacted]	N/A	Internal	[redacted]	[redacted]	N/A	8
[redacted] Prospect Street, Horncastle, [redacted]	Internal	Internal	[redacted]	[redacted]	30-Apr-24	9
[redacted] Prospect Street, Horncastle, [redacted]	N/A	Internal	[redacted]	[redacted]	N/A	9
[redacted] Prospect Street, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	30-Apr-24	9

Location	Reported extent	Confirmed extent	Property Easting	Property Northing	Date visited	Cluster
[redacted] Prospect Street, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	30-Apr-24	9
[redacted] Prospect Street, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	30-Apr-24	9
[redacted] Prospect Street, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	30-Apr-24	9
[redacted] Prospect Street, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	30-Apr-24	9
[redacted] Prospect Street, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	30-Apr-24	9
[redacted] Prospect Street, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	30-Apr-24	9
[redacted] Prospect Street, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	30-Apr-24	9
[redacted] Prospect Street, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	30-Apr-24	9
[redacted] Prospect Street, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	30-Apr-24	9
[redacted] Prospect Street, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	30-Apr-24	9
[redacted] Prospect Street, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	30-Apr-24	9
[redacted] Prospect Street, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	30-Apr-24	9
[redacted] Prospect Street, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	30-Apr-24	9
[redacted] Prospect Street, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	30-Apr-24	9
[redacted] Prospect Street, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	30-Apr-24	9

Location	Reported extent	Confirmed extent	Property Easting	Property Northing	Date visited	Cluster
[redacted] Prospect Street, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	30-Apr-24	9
[redacted] Prospect Street, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	30-Apr-24	9
[redacted] St Lawrence Street, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	30-Apr-24	10
[redacted] St Lawrence Street, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	30-Apr-24	10
[redacted], [redacted] Watermill Road, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	30-Apr-24	10
[redacted], Watermill Road, Horncastle, [redacted]	Internal (TBC)	Internal	[redacted]	[redacted]	30-Apr-24	10
[redacted] St Lawrence Street, Horncastle, [redacted]	Internal	Internal	[redacted]	[redacted]	30-Apr-24	10
[redacted] St Lawrence Street, Horncastle, [redacted]	Internal	Internal	[redacted]	[redacted]	30-Apr-24	10
[redacted] Watermill Road, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	30-Apr-24	10
[redacted] Accommodation Road, Horncastle, [redacted]	Internal	Internal	[redacted]	[redacted]	30-Apr-24	11
[redacted] Accommodation Road, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	30-Apr-24	11
[redacted] Accommodation Road, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	30-Apr-24	11
[redacted] Accommodation Road, Horncastle, [redacted]	Internal	N/A	[redacted]	[redacted]	30-Apr-24	11
[redacted], Hemingby Lane, Horncastle, [redacted]	Internal	Internal	[redacted]	[redacted]	01-May-24	12

Location	Reported extent	Confirmed extent	Property Easting	Property Northing	Date visited	Cluster
[redacted], Hemingby Lane, Horncastle, [redacted]	Internal	Internal	526154	370081	01-May-24	12

(*Table 1 – Properties confirmed to have experienced internal flooding, as discussed within this S19 report*)

Location	Reported extent	Confirmed extent	Property Easting	Property Northing	Date visited	Cluster
[redacted] Maltby Way, Horncastle, [redacted]	TBC	N/A	[redacted]	[redacted]	N/A	2
[redacted] Banovallum Gardens, Horncastle, [redacted]	TBC	N/A	[redacted]	[redacted]	N/A	2
[redacted] Banovallum Gardens, Horncastle, [redacted]	TBC	N/A	[redacted]	[redacted]	N/A	2
[redacted] Banovallum Gardens, Horncastle, [redacted]	TBC	N/A	[redacted]	[redacted]	N/A	2
[redacted] Maltby Way, Horncastle, [redacted]	TBC	N/A	[redacted]	[redacted]	N/A	2
[redacted] Banovallum Gardens, Horncastle, [redacted]	TBC	N/A	[redacted]	[redacted]	N/A	2
[redacted] Maltby Way, Horncastle, [redacted]	TBC	Internal***	[redacted]	[redacted]	01-May-24	2
[redacted] Maltby Way, Horncastle, [redacted]	TBC	N/A	[redacted]	[redacted]	N/A	2
[redacted] Wesley Way, Horncastle	TBC	N/A	[redacted]	[redacted]	N/A	2
[redacted] Clarke Court, Horncastle, [redacted]	TBC	N/A	[redacted]	[redacted]	N/A	2
[redacted] Wesley Way, Horncastle	TBC	N/A	[redacted]	[redacted]	N/A	2

Location	Reported extent	Confirmed extent	Property Easting	Property Northing	Date visited	Cluster
[redacted] East Street, Horncastle, [redacted]	TBC	N/A	[redacted]	[redacted]	N/A	4
[redacted] Lincoln Road, Horncastle, [redacted]	TBC	N/A	[redacted]	[redacted]	N/A	7
[redacted] West Street, Horncastle, [redacted]	TBC	N/A	[redacted]	[redacted]	N/A	8
[redacted] West Street, Horncastle, [redacted]	TBC	N/A	[redacted]	[redacted]	N/A	8
[redacted] West Street, Horncastle, [redacted]	TBC	N/A	[redacted]	[redacted]	N/A	8
[redacted] West Street, Horncastle, [redacted]	TBC	N/A	[redacted]	[redacted]	N/A	8
[redacted] West Street, Horncastle, [redacted]	TBC	N/A	[redacted]	[redacted]	N/A	8
[redacted] West Street, Horncastle, [redacted]	TBC	N/A	[redacted]	[redacted]	N/A	8
[redacted] Prospect Street, Horncastle, [redacted]	TBC	N/A	[redacted]	[redacted]	N/A	9
[redacted], [redacted] Prospect Street, Horncastle, [redacted]	TBC	N/A	[redacted]	[redacted]	N/A	9
[redacted] Prospect Street, Horncastle, [redacted]	TBC	N/A	[redacted]	[redacted]	N/A	9
[redacted] Prospect Street, Horncastle, [redacted]	TBC	N/A	[redacted]	[redacted]	N/A	9

(*Table 2 – Properties where the nature of flooding has not been determined. These properties are considered within their closest cluster due to them likely sharing the same flood mechanism, as discussed within this S19 report; * Flooding was reported in garages and outbuildings but not in the main dwelling; ** Flooding was reported beneath the floorboards within the main building; *** The property was reported as being internally flooded by neighbours, but this has not been confirmed directly with the property resident*)

Location	Reported extent	Confirmed extent	Property Easting	Property Northing	Date visited
[redacted], Prospect Street, Horncastle, LN9 5BA	External (TBC)	N/A	[redacted]	[redacted]	N/A
Wesley Way, Horncastle	highway	N/A	[redacted]	[redacted]	N/A
Winceby Gardens, Horncastle, [redacted]	External (TBC)	N/A	[redacted]	[redacted]	N/A
[redacted] Prospect Street, Horncastle, [redacted]	External	N/A	[redacted]	[redacted]	N/A
[redacted] Wesley Way, Horncastle, [redacted]	External	N/A	[redacted]	[redacted]	N/A
[redacted] Mark Avenue, Horncastle, [redacted]	External	N/A	[redacted]	[redacted]	N/A
[redacted] Winceby Gardens, Horncastle, [redacted]	External	N/A	[redacted]	[redacted]	N/A
[redacted] Maltby Way, Horncastle, [redacted]	External	N/A	[redacted]	[redacted]	N/A
[redacted] high Street, Horncastle, [redacted]	External	N/A	[redacted]	[redacted]	N/A
[redacted] Accommodation Road, Horncastle, [redacted]	External	N/A	[redacted]	[redacted]	N/A
[redacted] Mark Avenue, Horncastle, [redacted]	External	N/A	[redacted]	[redacted]	N/A
[redacted] Lodington Court, Horncastle, [redacted]	Internal	External	[redacted]	[redacted]	01-May-24
[redacted] and/or [redacted] Adrian Shinn Way, Horncastle, [redacted]	Internal	External	[redacted]	[redacted]	30-Apr-24
[redacted] Grundys Court, Horncastle, [redacted]	Internal (TBC)	External	[redacted]	[redacted]	30-Apr-24
[redacted] Watermill Road, Horncastle, [redacted]	Internal	External	[redacted]	[redacted]	30-Apr-24

Location	Reported extent	Confirmed extent	Property Easting	Property Northing	Date visited
[redacted]	N/A	External	[redacted]	[redacted]	N/A
[redacted] Stickleback Cottage, Linden Road, Horncastle, [redacted]	Internal (TBC)	External	[redacted]	[redacted]	01-May-24
[redacted], [redacted] Bridge Street, Horncastle, [redacted]	Internal	External	[redacted]	[redacted]	30-Apr-24
[redacted] Stonewell Row, Horncastle, [redacted]	N/A	External*	[redacted]	[redacted]	N/A
[redacted] Stonewell Row, Horncastle, [redacted]	Internal	External*	[redacted]	[redacted]	01-May-24
[redacted] Banovallum Gardens, Horncastle, [redacted]	Internal	External*	[redacted]	[redacted]	01-May-24
[redacted] Corn Close, Horncastle, [redacted]	Internal	External*	[redacted]	[redacted]	30-Apr-24
[redacted] Winceby Gardens, Horncastle, [redacted]	Internal	External*	[redacted]	[redacted]	01-May-24
[redacted] Banovallum Gardens, Horncastle, [redacted]	Internal	External*	[redacted]	[redacted]	01-May-24
[redacted] John Brown Close, Horncastle, [redacted]	Internal	External**	[redacted]	[redacted]	30-Apr-24
[redacted] Mark Avenue, Horncastle, [redacted]	External	N/A	[redacted]	[redacted]	N/A
[redacted] Maltby Way, Horncastle, [redacted]	Internal	External	[redacted]	[redacted]	01-May-24

(*Table 3 – Properties confirmed to have experienced external flooding, which are not discussed further within this S19 report. Note that incidents of highway flooding, which did not result in a road closure, have also been included within this table; * Flooding was reported in garages and outbuildings*

*but not in the main dwelling; ** Flooding was reported beneath the floorboards within the main building; *** The property was reported as being internally flooded by neighbours, but this has not been confirmed directly with the property resident*)

Location	**Reported extent**	**Confirmed extent**	**Easting**	**Northing**	**Date visited**
Low Toynton Road	Road Closure	N/A	[redacted]	[redacted]	01-May-24
A158 Spilsby Road, Horncastle	Road Closure	N/A	[redacted]	[redacted]	01-May-24

(*Table 4 – Road closures in Horncastle*)

Cluster Information

Given the distance between the affected properties and the variability in flood mechanisms, the known internally flooded properties have been split into twelve clusters. The clusters have been determined by the road on which the properties are located, and similarity in flood mechanisms. The twelve clusters are:

Cluster	Number of internally flooded properties	Road names
1	5	Winceby Gardens
2	31	Maltby Way, Banovallum Gardens, Lodington Court, Clarke Court, Saxon Way & Cupit Road
3	21	Stanhope Road, Bowl Alley Lane, Linden Road & Banks Road
4	22	East Street, Water Lane, Plough Yard, Betts Yard & Francis Lane
5	4	Wharf Road, Church Lane & Manor House Street
6	3	Coronation Walk
7	2	Lincoln Road
8	8	Bridge Street, West Street (excluding [redacted]) & Grundy's Court
9	20	Prospect Street
10	7	Watermill Road & St Lawrence Street
11	4	Accommodation Road

12	2	Hemingby Lane

(Table 5 – Clusters of properties within Horncastle. The cluster to which individual properties belong can be found in Tables 1 and 2. Note that only properties which are confirmed as having experienced internal flooding are included within this table.)

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For further information regarding this report, please contact FloodRisk@lincolnshire.gov.uk

Version History

Revision	Purpose description	Originated	Checked	Reviewed	Authorised	Date
1.0	Overview Draft LCC Comment	AE	JB	JR	-	05/07/24
1.1	Full Draft LCC Comment	AE	JB & JR	BS & PE	-	23/08/24
1.2	Amendments Following LCC Comments	AE	JR	JR	-	08/10/24
1.3	Further Amendments Following LCC Comments	AE	JR	JR	-	11/10/24
1.4	LCC Amendments	TH	SG	RD	TH/RD	30/10/24
2.0	Updated Following Receipt of Additional Information	RD	AB	AB, MH, & RD	MH	05/12/24

Authorities with Flood Risk Management Functions

The following Risk Management Authorities (RMA) have flood risk management functions within Lincolnshire:

- **Lead Local Flood Authority (LLFA): Lincolnshire County Council** - Responsible for coordinating the mitigation of risk of flooding from surface water, groundwater and ordinary watercourses (non-main rivers). The LLFA is also responsible for developing, maintaining and applying a strategy for local flood risk management in its area and for maintaining a register of flood risk assets. The LLFA also has a statutory duty to investigate significant flood events to the extent it considers necessary.
- **Environment Agency** - Tasked with the protection and conservation of the water environment in England, the natural beauty of rivers and wetlands and the wildlife that lives there. Its responsibilities include: water quality and resources; fisheries; conservation and ecology; and operational responsibility for managing the risk of flooding from main rivers (usually large streams and rivers), reservoirs, estuaries and the sea. Flood risk management work can include: constructing and maintaining 'assets' (such as flood banks or pumping stations) and works to main rivers to manage water levels and make sure flood water can flow freely; operating flood risk management assets during a flood; dredging the river; and issuing flood warnings. The Environment Agency can also do work to prevent environmental damage to watercourses, or to restore conditions where damage has already been done.
- **Internal Drainage Boards** (IDBs) - Independent public bodies, established in areas of special drainage need, known as drainage districts. The IDB is responsible for the supervision of land drainage, water level management and flood risk management works and regulation of ordinary watercourses within its Drainage District. IDBs play an important role in the areas they cover (approximately 10% of England at present), working in partnership with other authorities to actively manage and reduce the risk of flooding.
- **highways Authority: Lincolnshire County Council** - Responsible for maintaining the highway drainage system to an acceptable standard and ensuring that road projects do not increase flood risk.
- **Water and Sewage Company: Anglian Water** - Responsible for the provision of wastewater collection and treatment systems, including for managing the risks of flooding from surface water and foul or combined public sewer systems providing drainage from buildings and yards.
- **District Councils** - Including Borough and City Councils, have powers to carry out works to manage flood risk from ordinary watercourses (outside the internal drainage district of Internal Drainage Boards) and the sea. They are also planning authorities, responsible for developing a local plan, which must have regard to national planning policy and work with Lead Local Flood Authorities and others to ensure decisions on development in their area effectively manage the risks from flooding. Additionally, those District Councils that are next to the sea are also designated coast protection authorities. This role includes leading on coastal erosion risk management activities,

leading and supporting coastal groups, and leading the production of shoreline management plans.

In addition to the above, the other parties that may have responsibilities include:

- **Riparian Landowners** - Riparian landowners who own land or property crossed by or next to a river, stream or ditch (including where this runs through a pipe or culvert) have rights and responsibilities over the management of the land including: a responsibility to let water flow through the land without any obstruction, pollution or diversion which affects the rights of others; keeping banks clear of anything that could cause an obstruction and increase flood risk; maintaining the bed and banks of the watercourse; and keeping structures clear of debris.
- **Residents, Businesses and Property Owners** - Should find out about any flood risk in their area, sign up for the Environment Agency's free flood warnings and make a written plan of how they will respond to a flood situation. Business owners should also make a flood plan for their business. There are measures that can be taken to reduce the amount of damage caused by flooding and properties at risk should be insured. Local residents can find out if their property is at risk, prepare for flooding, get help during a flood and get help after a flood.

Executive Summary

The purpose of this Section 19 (S19) Flood Investigation Report is to identify the cause of flooding which affected properties internally. The report will provide an overview of the problem, identify the flooding mechanisms, identify relevant Risk Management Authorities (RMAs) and stakeholders, and provide a list of recommendations.

This report focuses on flooding in Horncastle, which occurred as a result of a storm event, designated as 'Storm Babet' by the MET office, from 18 to 25 October 2023. Storm Babet was a south-to-north tracking storm, which was prolonged due to a blocking area of high pressure across Scandinavia. As a result, prolonged heavy rainfall was recorded across the catchments upstream of Horncastle, resulting in extreme flows on the River Bain, River Waring and Thunker Drain.

As a result of Storm Babet, 129 properties have been confirmed to have experienced internal flooding in Horncastle, which have been investigated within this report. A further 23 properties have been reported as having experienced flooding, although the extent of flooding has not been determined. An additional 27 properties have been confirmed to have experienced external flooding, but, as no internal flooding occurred, they have not been investigated further. Two road closures were also reported.

The evidence gathered within this report, including conversations held with the residents between 30 April and 02 May 2024, indicates that the properties flooded via a variety of different mechanisms, including fluvial flooding from the River Bain, River Waring and Thunker Drain, and surface water and groundwater flooding due to intense rainfall. Given the number of properties which flooded, these have been considered within twelve separate clusters, as detailed below. A range of issues and recommendations have been identified which would apply to multiple clusters; these have also been presented within the summary:

Cluster 1 – Winceby Gardens

Flooding Mechanism

Five properties on Winceby Gardens are likely to have flooded primarily from overland surface water flows from the neighbouring fields. There also remains potential for the capacity of the dyke on the eastern side of the neighbouring field to have been exceeded, resulting in out of bank flows which travelled towards Winceby Gardens.

Relevant RMA

Given that the flooding at Winceby Gardens results primarily from flooding from surface water, potentially with flooding from a nearby drainage ditch, the relevant RMA is considered to be LCC, in its capacity as the LLFA.

Recommendations

It is understood that a dyke has been constructed to the east of Winceby Gardens, which would act as an intervening feature for overland flows. It is also understood that this dyke is currently temporary in nature, and therefore it is subsequently recommended that LCC

considers advising the relevant landowners to assess whether a more permanent mechanism to address overland flows is needed.

Cluster 2 – Maltby Way, Banovallum Gardens, Lodington Court, Clarke Court, Cupit Road & Saxon Way

Flooding Mechanism

31 properties in the south-east of Horncastle are reported to have internally flooded. The source of flooding is likely to be extreme flows on the Thunker Drain alongside overland flows from the adjacent Poppy Fields site. Flooding could have been exacerbated by a restriction of flows beneath the bridges at Maltby Way and Banovallum and the backing up of surface water further up the catchment.

Relevant RMA

Given that the flooding within this cluster results primarily from flooding from the Thunker Drain, which is an Ordinary Watercourse upstream of Maltby Way and a Main River downstream of Maltby Way, and overland surface water flows, the relevant RMAs and persons responsible are the EA and riparian landowners. Given that there may have been a contribution from surface water, LCC, in its capacity as the LLFA, is also a relevant RMA.

Recommendations

A modelling study of the Thunker Drain should be undertaken to confirm the likely flood extents and depths, both during Storm Babet and hypothetical future storm events. Following this, consideration should be given to carrying out an appraisal for potential flood alleviation schemes, such as enlarging the channel or constructing a bypass channel or storage area upstream. The installation of a river gauge on the Thunker Drain should also be considered.

Cluster 3 – Stanhope Road, Bowl Alley Lane, Linden Road & Banks Street

Flooding Mechanism

20 known internally flooded properties in the central east of Horncastle are likely to have experienced flooding due to extreme flows on the River Waring, which overtopped and flooded the adjacent properties. There may have been a limited foul water component. The EA (2024) have investigated the operational failures at the Horncastle Flood Storage Reservoir (FSR) and Swimming Baths Sluice and consider that both are unlikely to have had a significant impact on flooding at these properties.

Relevant RMA

Given that the flooding within this cluster results primarily from flooding from the River Waring, the relevant RMA is considered to be the Environment Agency.

Recommendations

See the general recommendations within this section.

Cluster 4 – East Street, Water Lane, Plough Yard, Betts Yard & Francis Lane

Flooding Mechanism

23 known internally flooded properties in the central east of Horncastle are likely to have experienced flooding due to flows from both the River Waring and Thunker Drain.

The Thunker Drain overtopped upstream of the confluence with the River Waring, which caused out of bank flows to travel down East Street and through Francis Lane and Water Lane to reach the River Waring. Flooding of the properties on East Street was exacerbated by bow waves from vehicles on the street (prior to its closure).

The River Waring also overtopped adjacent to the properties, causing flooding to the rear.

The EA (2024) have investigated the operational failures at the Horncastle FSR and Swimming Baths Sluice and consider that both are unlikely to have had a significant impact on flooding at these properties.

Relevant RMA

Given that the flooding within this cluster results primarily from flooding from the Thunker Drain and River Waring, both of which are Main Rivers throughout the study area, the relevant RMA is considered to be the Environment Agency.

Recommendations

The existing procedures for road closures during flood events, both within Horncastle and the wider area, should be reviewed to ensure they are efficient and effective.

Cluster 5 – Wharf Road, Church Lane & Manor House Street

Flooding Mechanism

Four known internally flooded properties in the centre of Horncastle are likely to have experienced flooding due to fluvial flows.

For the properties on Wharf Road and Church Lane, flows originated from the River Waring, which overtopped adjacent to the buildings. Internal flood depths may have been exacerbated by the threshold levels of each building, which are set at the same level as the highway.

Flows at [redacted] originated from the River Bain, which overtopped adjacent to the property and caused widespread flooding in low-lying land between the Bain and Waring. The River Waring is considered unlikely to appreciably have contributed to flooding at this property.

The EA (2024) have investigated the operational failures at the Horncastle FSR and Swimming Baths Sluice and consider that both are unlikely to have had a significant impact on flooding at these properties.

Relevant RMA

Given that the flooding within this cluster results primarily from flooding from the River Bain and River Waring, the relevant RMA is considered to be the Environment Agency.

Recommendations

See the general recommendations within this section.

Cluster 6 – Coronation Walk

Flooding Mechanism

Three known internally flooded properties in the centre of Horncastle are likely to have experienced flooding due to fluvial and surface water flows.

For the properties on Coronation Walk, flows primarily originated from the River Waring, which overtopped adjacent to the properties. Flood depths may have been exacerbated by the partial closure of the Swimming Baths Sluice during Storm Babet, which is poorly resolved within the EA's reporting; however, no detailed information regarding the exact extent and depths at the properties has been sourced as part of this investigation, so this investigation cannot be used to conclusively determine the impact of this operational failure on these properties.

Flooding on West Street is considered most likely to be surface water in nature during Storm Babet, but fluvial flows from the River Bain cannot be discounted.

Relevant RMA

Given that the flooding within this cluster results primarily from flooding from the River Waring and surface water, the relevant RMAs are considered to be the Environment Agency and LCC, in its capacity as the LLFA.

Recommendations

Consideration should be given to improving the banks of the River Waring adjacent to the properties (e.g. by raising or reinforcing them), as well as carrying out dredging works.

Cluster 7 – Lincoln Road

Flooding Mechanism

Two known internally flooded properties in the north-west of Horncastle are likely to have experienced flooding due to surface water. In the case of one of the properties, flooding occurred due to an overland flow from John Brown Close, which flowed down the alleyway connecting the two roads and into the property. No further details regarding the flooding at the other property have been provided to refine the source of flooding at this property.

Relevant RMA

Given that the flooding within this cluster results primarily from flooding from surface water, the relevant RMA is considered to be LCC, in its capacity as the LLFA.

Recommendations

Consideration should be given to implementing additional drainage (e.g. gullies or a linear drain) in the easternmost section of John Brown Close.

Cluster 8 – Bridge Street, West Street & Grundy's Court

Flooding Mechanism

Eight known internally flooded properties in the centre of Horncastle are likely to have experienced flooding from the River Bain. The watercourse likely overtopped where Bridge Street crosses it; water would have flowed towards areas of low topography (in this case, a depression close to the junction between Bridge Street and West Street, as well as to the south, towards [redacted]). It is not known whether any flows were sourced from Prospect Street.

Relevant RMA

Given that the flooding within this cluster results primarily from the River Bain, the relevant RMA is considered to be the Environment Agency.

Recommendations

See the general recommendations within this section.

Cluster 9 – Prospect Street

Flooding Mechanism

20 known internally flooded properties on Prospect Street are likely to have experienced flooding from two separate sources.

The northern set of properties are likely to have flooded from surface water. They are located at a low point relative to the surrounding land and have thresholds set at highway level, which would allow any surface water ponding in the highway to enter the properties.

The southern set of properties are likely to have flooded from the River Bain, with flood water filling up the land to the east before encroaching and collecting in the highway. These properties also have thresholds set at highway level, so they would be impacted even at shallow depths.

Relevant RMA

Given that the flooding within this cluster results primarily from the River Bain and surface water, the relevant RMAs are considered to be the Environment Agency and LCC, in its capacity as LLFA.

Recommendations

Consideration should be given to raising the kerbs adjacent to the properties in the north of the street.

Cluster 10 – Watermill Road & St Lawrence Street

Flooding Mechanism

Seven known internally flooded properties in the centre of Horncastle are likely to have experienced flooding from the River Bain, which experienced extreme flows during Storm Babet and overtopped throughout the area. The nearby unnamed watercourse (part of the Horncastle Ings System) may have acted as a conduit for flood waters.

Relevant RMA

Given that the flooding within this cluster results primarily from the River Bain and flows may also relate to the Horncastle Ings System, which is IDB-maintained, the relevant RMAs are considered to be the Environment Agency and Witham Third District IDB.

Recommendations

See the general recommendations within this section.

Cluster 11 – Accommodation Road

Flooding Mechanism

Four known internally flooded properties along Accommodation Road are likely to have experienced flooding from surface water, due to the extreme rainfall experienced during Storm Babet, which would have collected in the easternmost portion of the highway (reflecting a low point relative to the adjacent roads). Flooding may have been exacerbated by the capacity of the surface water drains being exceeded, in part due to fluvial flows likely blocking their outfalls and/or deficiencies in the network (if any).

Relevant RMA

Given that the flooding within this cluster results primarily from surface water, the relevant RMAs are considered to be LCC, in its capacity as the LLFA and highways Authority, and Anglian Water.

Recommendations

Consideration should be given to raising the kerbs or adding highway gullies adjacent to the properties along Accommodation Road, as well as implementing interceptor drains at the entrances to each property. The drainage arrangement along Chestnut Close and Mark Avenue should also be reviewed, followed by the rectification of any issues identified.

Cluster 12 – Hemingby Lane

Flooding Mechanism

Two known internally flooded properties along Hemingby Lane are likely to have experienced flooding predominately from surface water sources. Anecdotal evidence suggests that the River Bain may have overtopped at this location, providing a source of fluvial flows; surface water flows were also reported from the land to the east. The primary source of flooding cannot be definitively confirmed, with groundwater also remaining a viable mechanism for flooding at the properties.

Relevant RMA

Given that the flooding within this cluster results primarily from surface water, exacerbated potentially by overtopping of the River Bain, the relevant RMAs are considered to be the Environment Agency and LCC, in its capacity as the LLFA.

Recommendations

Further analysis of the recorded and modelled flood outlines should be undertaken to confirm the extent of flooding associated with the River Bain at Hemingby Lane. Consideration should be given to implementing intervening drainage (e.g. highway gullies, ditches or interceptor drains) adjacent to the properties.

Recommendations for all clusters

- Works to automate the Swimming Baths Sluice should continue. The progress of such works and the associated timescales should be confirmed with the EA.
- The processes for operating flood structures in the Horncastle catchment should be reviewed by the EA. (It is understood that this has occurred in response to the operational failures at Horncastle during Storm Babet.) In particular, the plan for manually operating the assets in the event they do not work automatically should be reviewed.
- The potential to implement a flood alleviation scheme along the River Waring and Thunker Drain should be considered. Consideration should also be given to evaluating potential additional flood alleviation schemes along the River Bain.
- The absence of a link between water levels on the River Bain and River Waring should be verified as part of further investigation into the system.
- Further improvements should be made to the surface water and fluvial flood model for Horncastle, based on the recorded flooding and the findings of the EA's study into Storm Babet.
- Flood resistance and resilience measures should be implemented at all the affected properties as part of reparative works.
- The flood response plan should be reviewed in light of Storm Babet to ensure it is effective for future storms.

Road closures

Low Toynton Road

The road closure at Low Toynton Road is considered most likely to have occurred due to flooding from the River Waring on the highway. This likely occurred due to the channel of the watercourse being particularly shallow and banks particularly low in this area, as well as the bridge crossing the Waring having a low soffit (which may have restricted flows). Whilst the depth of flooding on the road is not known, given the significant extent and depth of flooding resulting from the River Waring downstream in Horncastle, it would be reasonable to assume this was significant and impassible for vehicles.

A158 (Spilsby Road)

The road closure along the A158 likely corresponds to flooding from the Thunker Drain along East Street (which also resulted in internal flooding of the adjacent properties). The Thunker Drain overtopped upstream of its confluence with the River Waring, resulting in flows down East Street. Given the significant flood depths and speeds reported on the highway, the flood waters would have been impassable to vehicles.

Abbreviations / Acronyms

- LCC – Lincolnshire County Council
- IDB – Internal Drainage Board
- LLFA – Lead Local Flood Authority
- EA – Environment Agency
- RMA – Risk Management Authority
- AEP – Annual Exceedance Probability
- SFRA – Strategic Flood Risk Assessment
- BGS – British Geological Society
- SoP – Standard of Protection
- CC – Climate Change
- SuDS – Sustainable Drainage System
- FSR – Flood Storage Reservoir

1. Introduction

1.1 The purpose of this S19

The purpose of this S19 investigation report is to:

- Investigate reports of internal flooding to understand and determine the cause of flooding following a recent flood event named as Storm Babet, which occurred between 19 and 25 October 2023. Note that reports of external flooding (including properties which have been reported to have internal flooding, but subsequent investigation indicates that flooding was external) are outside the scope of this S19 report;
- Determine which Risk Management Authorities (RMAs) have relevant flood risk management functions;
- Suggest recommendations that may alleviate potential future flooding events or if the affected properties or location should be considered as suitable for a capital project.

1.2 Sources of evidence

The information used to inform the conclusions of this S19 report are, where available:

- Site visits, including conversations with residents at properties reported to have internally flooded, and observations of nearby watercourses and drainage assets;
- The results of a survey which LCC made available to residents affected by flooding following Storm Babet;
- Review of the EA's Flood Map for Planning and Flood Risk from Surface Water, and GeoSmart's FloodSmart Analytics mapping;
- Publicly available mapping, such as the EA's LiDAR elevation data and BGS geological data;
- River level gauge data covering the storm event;
- Mapping of LCC's known drainage assets;
- Mapping of Anglian Water's surface and foul sewer network (where available); and
- Any additional site-specific data provided by LCC.

Following receipt and assessment of this information, the likely flood mechanism was determined. Where respondents have not provided information regarding the timing and source of flooding, this has been inferred from Site walkovers as well as the available flood mapping and publicly available records.

Given the source of flooding, issues have been identified within the Site area which contributed to the flooding, and recommendations have been made to resolve these issues.

In the case of some Sites, flood mitigation measures have already been implemented following the flood events. Where this has occurred, an indication of whether this has or will provide satisfactory resolution of the issues has been included.

Note that much of the data was provided from personal accounts. As such, the completion and accuracy of this information is variable, and in some cases, there have been contradictions between nearby residents' accounts.

1.3 Previous S19 investigations

The following previous S19 reports apply to Horncastle:

- S19-001 to S19-006, following surface water flooding at properties along East Street, Stanhope Road, West Street, the Bull Ring, South Street, Langton Hill, Mark Avenue, Prospect Street, Accommodation Road and Bowl Alley Lane, as well as Queen Elizabeth's School, in June 2012;
- S19-096 & S19-120, following surface water / highway flooding at properties on Langton Hill and Stanhope Road in June to September 2014;
- S19-211 & S19-220, following surface water / sewer flooding on Churchill Avenue and West Street in July 2018;
- S19-227, S19-247 & S19-250, following surface water / sewer flooding on Station Road and Stanhope Road in June 2019;
- S19-369, following a surcharging culvert causing flooding on Lincoln Road in June 2019;
- S19-439, following groundwater flooding at two properties on the Bull Ring in December 2020.

2. Background Information

2.1 Location

The properties are located in the town of Horncastle within the East Lindsey District Council area of Lincolnshire (Figure 2.1). They are situated within the internal drainage district of Witham Third District IDB.

Numerous watercourses flow through Horncastle. These include:

- River Bain, which flows in a southerly direction through the centre. It then flows through the former channel of the Horncastle Canal, towards the south-west;
- River Waring, which flows in a westerly direction before discharging into the River Bain in the south-west corner of the town;
- Old River Bain, which reflects the former path of the River Bain, and is present in the south-west corner of the town;
- Thunker Drain, which is present in the east of the town, prior to discharging into the River Waring.

The River Bain and River Waring are designated as Main Rivers as they pass through Horncastle. The Thunker Drain is designated as an Ordinary Watercourse until the passage with Maltby Way, at which point it also becomes designated a Main River.

Horncastle is generally located within the base of a valley structure, following the channel of the River Bain (Figure 2.2). Ground levels generally slope inwards towards the centre of the town and broadly fall in a southerly direction, with elevations ranging from 28 to 36m AOD for the affected properties.

Given the distance between the affected properties in Horncastle and the variability in the flood causation mechanisms, the properties have been grouped into twelve clusters. The specific information with regards to each cluster are discussed further within Sections 4 to 15.

(*Figure 2.1 – Location of the affected properties and watercourses within Horncastle*)

(*Figure 2.2 – LiDAR elevation data for Horncastle*)

2.2 Flood risk overview

As expected for such a large area, the flood risk across Horncastle is variable and is sourced from multiple watercourses, including the River Bain, River Waring and Thunker Drain. An overview of the flood risk has been provided below, with additional site-specific information included within the discussion for each cluster.

2.2.1 National flood mapping

According to the EA's Flood Map for Planning Purposes (Figure 2.3), a significant proportion of central Horncastle is located within Flood Zones 2 and 3, indicating a medium to high probability of fluvial flooding. It is important to note that this map is "based on present day flood risk, [i.e.,] they do not show how it may change in future because of climate change", and it "ignores the effect any flood defences shown could have".

The extent of Flood Zone 3 generally covers the floodplain of the River Bain, extending into properties along Prospect Street and Bridge Street. Areas of Flood Zone 3 associated with the River Waring are present along East Street and Banks Road.

Flood Zone 2 covers a wider area within Horncastle, with coverage extending across Jubilee Way and across a large number of properties. Areas adjacent to the Thunker Drain downstream of Banovallum Gardens are also mapped within Flood Zone 2, with the flood zones otherwise restricted to the channel of the watercourse.

According to the EA's Risk of Flooding from Rivers and the Sea (RoFRS) map, the fluvial flood risk is primarily very low to low across Horncastle. Areas at high risk are generally restricted to the channel of each watercourse, and an area at medium risk extends across Stanhope Road and Beck. Low risk areas are present across a significant proportion of Horncastle, including West Street, Prospect Street, East Street and Banks Road.

There is significant variation in the risk of surface water flooding at the Site as indicated by the Risk of Flooding from Surface Water maps, with the risk ranging from very low to high (Figure 2.4). Of particular note, areas along Wharf Road, East Street and Banks Road are at high pluvial flood risk. Areas in the floodplain of the River Bain are at low risk of surface water flooding which extends into the surrounding properties. Areas surrounding the Thunker Drain are mapped at low to medium risk of surface water flooding.

The RoFRS and Surface Water Flood Risk mapping uses the following classifications:

- high risk – an area has an annual chance of flooding greater than 3.3%;
- medium risk – an area has an annual chance of flooding of between 1% and 3.3%;
- low risk – an area has an annual chance of flooding of between 0.1% and 1%; and
- very low risk – an area has an annual chance of flooding less than 0.1%.

It should be noted that the above analysis carries the following disclaimer (EA, 2024):

> "*All information, particularly the likelihood of surface water flooding, is a general indicator of an area's flood risk. As such, it is not suitable for identifying whether an individual property will flood. This service uses computer models to assess an area's long-term flood risk from rivers, the sea, surface water and some groundwater. It does not include flood risk from sources such as blocked drains and burst pipes.*"

(*Figure 2.3 – Fluvial and tidal flood risk at the affected properties in Horncastle*)

(*Figure 2.4 – Surface water flood risk at the affected properties in Horncastle*)

2.2.2 FloodSmart Analytics mapping

GeoSmart's FloodSmart Analytics mapping provides further information regarding the flood risks associated with the properties within Horncastle.

FloodSmart Analytics uses publicly and commercially available flood risk data indicating potential sources of flood risk to a site from fluvial (rivers), tidal (coastal), pluvial (surface run-off) and groundwater sources, including historical flood information and modelled flood extent.

As expected for such a large area, the mapping indicates that Horncastle is at variable risk of flooding from rivers, surface water and groundwater. In most cases, the areas at highest risk are concentrated around the channel of the River Bain and River Waring, which also represent the areas with the lowest ground levels. low risk areas are also present adjacent to the Thunker Drain.

The FloodSmart Analytics mapping confirms that Horncastle is at very low risk (less than 0.1% AEP) of flooding from the sea.

The risk of flooding at the specific clusters within Horncastle are discussed further within Sections 4 to 15.

2.3 Previous flood incidents

Relevant incidents of flooding that have been reported to and recorded by LCC in Horncastle between 01 January 2019 and 19 October 2023 include:

- The resident at [redacted] West Street followed up regarding incidents of sewer / highway flooding at their property;
- Report of a burst pipe on St Lawrence Street;
- Request for sandbags on the Becks;
- Request for sandbags at Bridge Street;
- Report of sewer / highway flooding on East Street;
- Several reports of a surcharging manhole on Mark Avenue;
- Report of a surcharging manhole on John Brown Close;
- Report of flooding at [redacted] (off Langton Hill);
- Report of flooding at Mark Avenue.

The EA's Historic Flood Map indicates that several flood events have occurred in Horncastle (Figure 2.5), including:

- Widespread flooding in the west of Horncastle in 1920, associated with the Rivers Bain and Waring;
- Flooding across the River Waring in the south of Horncastle in October 1960;
- Flooding to the east of the River Bain in April 1981, attributed to the channel capacity being exceeded, and along the River Waring and lower section of the River Bain, attributed to operational failure / breach of defences;
- Flooding in central Horncastle from the River Bain in June 2007, associated with the River Bain;
- Flooding along the River Waring and River Bain in June 2019.

The East Lindsey Strategic Flood Risk Assessment includes one reference to flooding in Horncastle in 2007 (East Lindsey District Council, 2017).

(*Figure 2.5 – Historic flood extents within Horncastle, as indicated by the EA*)

2.4 EA flood assets in Horncastle

Several EA flood assets are present within and in the vicinity of Horncastle, which are presented separately below.

Information regarding the alleviation structures has been obtained from the EA's reporting following Storm Babet, including Horncastle Investigation Initial Findings (EA, 2023), Horncastle Reservoir Review Summary (2024), Chief Engineers Report, Horncastle Reservoir (EA, 2024) and Horncastle Asset Operation Failure Impact Assessment (EA, 2024), as well as from online sources.

The operation of each flood structure during Storm Babet is discussed separately within Section 3.4.

2.4.1 Horncastle Flood Storage Reservoir

Horncastle benefits from the presence of the Horncastle Flood Storage Reservoir (FSR), completed in 2017 and designed to reduce the flood risk to 169 properties in and upstream of Horncastle (EA, 2017). The FSR was designed to reduce flood risk to properties along the River Bain to a 1% AEP, and is located at Hemingby, c. 6 km upstream of Horncastle.

The FSR comprises a control structure with storage area behind. The control structure limits the onward flow of water to Horncastle from the Upper Bain catchment by temporarily storing water in the reservoir and controlling the outflow. The equipment releases water from the FSR based on a pre-set relationship between the upstream water level and the outflow.

Previous modelling indicated that the 1% AEP event in Horncastle was equivalent to 14 m^3/s, and during this event the flows from the catchments between the FSR and town would be equivalent to 7 m^3/s. As such, the control structure was designed to limit the outflow from the FSR to 7.1 m^3/s.

A separate sluice gate is in place to drain the agricultural land when the flood alleviation scheme is not in use. The sluice gate is designed to close automatically during periods of high river flows, such that the flows exiting the FSR are limited entirely by the control structure.

The FSR is not designed to reduce flooding along the River Waring or Thunker Drain. According to the EA's reporting, the FSR has limited impact on the flood extents and depths on these watercourses.

2.4.2 Swimming Baths Sluice

The Swimming Baths Sluice is an additional EA-operated structure in Horncastle (Photograph 6.1 in Appendix 20). It is located at the confluence of the River Waring and Old River Bain.

Under typical conditions, the sluice is left partially closed to permit flows down the Old River Bain. During extreme river levels on the River Waring, the sluice is fully opened to increase the downstream flow.

The Swimming Baths sluice is a manual structure which requires staff from the EA to operate it. It is understood that work on the automation of the sluice is ongoing (but was not present during Storm Babet).

According to the EA's reporting, previous modelling has indicated that the operation of the sluice has the greatest impact to the River Waring immediately upstream of the gate. This modelling demonstrated that there is limited impact upstream of Jubilee Way, with no impact on the River Bain.

2.4.3 Other flood structures

A variety of other EA-managed flood assets are present within Horncastle, including engineered high ground and walls. These are discussed further within each respective cluster.

3. Overview of Flood Event

3.1 Conditions prior to the event

Prior to Storm Babet, rainfall conditions were normal to high across the wider Lincolnshire area. August was recorded as being fairly dry, followed by a wet September (Met Office, 2023).

During September 2023, the Lincolnshire and Northamptonshire area received average rainfall of 77 mm, which was equivalent to 157% of the long-term average for September in the region. During the month there was a significant decrease in soil moisture deficits. Additionally, whilst groundwater followed a typical fall in line with the seasonal trend, groundwater levels were generally classed as normal to high within the Lincolnshire area (EA, 2023).

Significant rainfall was recorded between 11 and 13 October 2023 in Horncastle, with 45.4mm of rainfall recorded at the Hemingby Bridge Gauge between these dates.

Following on from this, Storm Babet, a south-to-north tracking Atlantic storm, arrived in the UK on 18 October 2023. This was associated with heavy rainfall and high winds across Lincolnshire and Eastern England.

3.2 Rainfall analysis

The closest available rainfall gauge is the Hemingby Bridge Gauge (ref: E43545), c. 4.7 km north of the centre of Horncastle. Rainfall data from this gauge for 18 to 20 October 2023 has been analysed as part of this investigation (Figure 3.1).

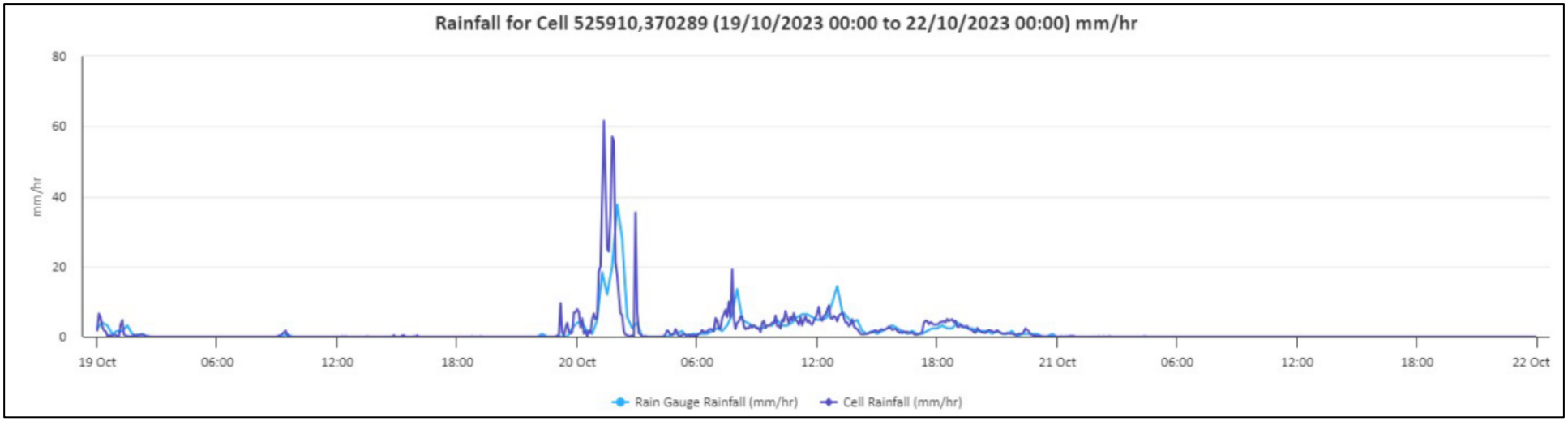
The rainfall data from Hemingby Gauge was captured by the Met Office's Radar technology and made available from the Meniscus Analytics Platform. Annual chance events were calculated using the FEH2013 DDF model (c).

This rainfall data indicates that rainfall initially began in the late evening of 19 October 2023 in Horncastle, reaching a peak intensity of c. 62 mm/hr at around 02:00 on 20 October 2023. The intensity of the rainfall dropped around 03:00, but rainfall continued until 00:00 on 21 October 2023, with intensities reaching 10 to 20 mm/hr during this period. A total of 91mm of rainfall was recorded.

This rainfall data indicates that Storm Babet was equivalent to a 1 in 45 annual chance (2.2% AEP) rainfall event in Horncastle.

Further analysis of the rainfall experienced within the catchments upstream of Horncastle is provided within the Horncastle Asset Operation Failure Impact Assessment (EA, 2024). This assessment estimated that the catchments had average rainfall totals estimated to be in the order of 1 in 25 annual chance to 1 in 50 annual chance (2 to 4% AEP).

Note that rainfall intensities and depths vary across an area, and therefore the rainfall data included should be used as an indicative guide only.



(Figure 3.1 – Rainfall intensities for Cell 525910, 370289, in the centre of Horncastle, between 19 and 22 October 2023.)

3.3 River levels and flows

Two EA-operated monitoring stations are present on watercourses within Horncastle. The first – the River Bain at Victoria Mill (ref: E1901) – is located at grid reference 525890, 369850, c. 80m east of Prospect Street in the north of Horncastle. The second – the River Bain at Banks Road (ref: E1839) – is located at grid reference 526250, 369610, on the northern side of East Street, in the east of the town.

The river levels and flows experienced during Storm Babet are shown in Figures 3.2 and 3.3, and are discussed further below:

River Bain at Victoria Mill

According to the monitoring station on the River Bain, river levels fell from 0.32m on 16 October 2023 to 0.28m on 18 October 2023. Following a short burst of rainfall on the night of 18 / 19 October 2023, river levels rose to 0.38 m, then fell to 0.37m at 00:00 on 19 October 2023. River levels began to rise steeply at 01:00 on 20 October 2023, reaching a peak level of 1.21m at 18:00. Following which river levels began to decline over the following days.

Flows on the River Bain rose from 1.3 m^3/s at midnight on 20 October 2023 and reached a peak flow of 17.4 m^3/s at 16:30 on the same day. Flows remained at a similar level until around 19:00 then began to decline over the following days.

River Waring at Banks Road

According to the monitoring station on the River Waring, river levels fell from 0.24m on 16 October 2023 to 0.19m on 18 October 2023. Following a short burst of rainfall in the night of 18 / 19 October 2023, river levels rose to a peak level of 0.47m at 04:00. River levels then gradually fell to 0.32m at 22:00 on 19 October 2023. River levels began to rise steeply at midnight on 20 October 2023, reaching a peak level of 2.52m at 14:30. River levels almost immediately began to fall steeply, falling beneath 1m at 03:00 on 21 October 2023. A short rise in river levels was recorded at around 14:00 (rising from 0.66 to 0.71 m), before river levels continued to fall gradually.

Flows on the River Waring rose from 0.58 m^3/s at midnight on 20 October 2023, to 17.8 m^3/s at 13:45. The maximum flow value at the gauge was exceeded between 14:00 and 15:00 and therefore the peak flow reached cannot be confirmed. From 15:30, the flows on the River Waring rapidly fell. A short increase in river flows was recorded at around 14:00 on 21 October 2023 (rising from 2.65 to 2.92 m^3/s), with flows subsequently falling gradually.

Annual chance probability for flows

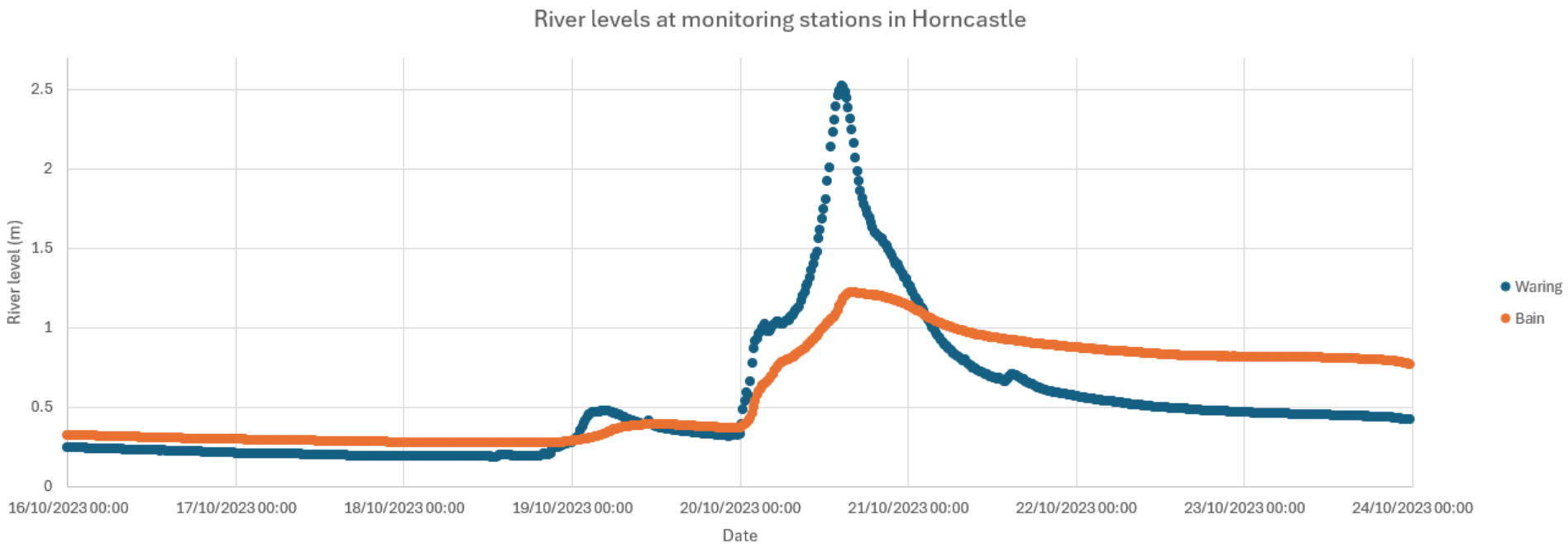
Following the flood event, the EA undertook a modelling study for the River Bain catchment, which took into account the operational failures at the Horncastle FSR and Swimming Baths Sluice (see Section 3.4). As part of this study, the flows along the watercourses were estimated.

The rainfall intensity during Storm Babet was estimated to be 1 in 45 annual chance (2.2% AEP), with the EA's assessment placing rainfall totals in the catchments upstream of Horncastle between 1 in 25 and 1 in 50 annual chance (2 to 4% AEP). However, the EA's Horncastle Asset Operation Failure Impact Assessment (2024) has indicated that river flow annual chance probabilities may be more extreme due to the impacts of wet antecedent conditions (i.e., the catchment was very wet due to previous rainfall, so all the rainfall during Storm Babet ran off and entered watercourses within the catchment).

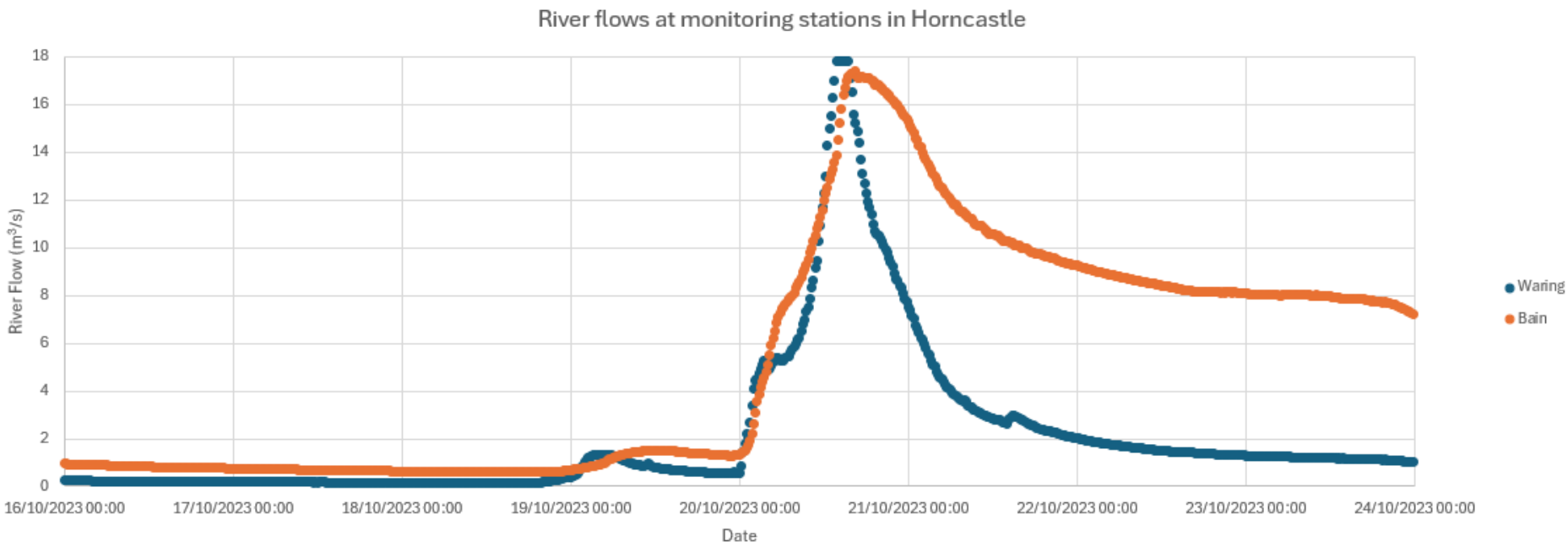
The extreme flows along the River Bain were estimated to be in excess of the 1 in 1000 annual chance flow due to extreme flows from the Hemingby Beck and West Ashby Beck, downstream of the Horncastle FSR. The EA's assessment indicated that the FSR did not overflow, and therefore it is assumed that the 1 in 100 design event was not exceeded in the upstream catchment.

Similarly, the flows along the River Waring were estimated as being in excess of the 1 in 1000 annual chance flow (0.1% AEP) as it passed through Horncastle.

It should be noted that there remains some uncertainty in the flows experienced as modelled by the EA, particularly along the River Waring and Thunker Drain. The mismatch between the recorded rainfall intensity and modelled flows presents a significant uncertainty within this assessment. The accuracy and uncertainties associated with the EA's modelling will be discussed further within an independent review (GeoSmart, 2024).



(Figure 3.2 – River levels on the River Bain and River Waring, as measured at the Victoria Mill and Banks Road Monitoring Stations, respectively.)



(Figure 3.3 – Flows on the River Bain and River Waring, as measured at the Victoria Mill and Banks Road Monitoring Stations, respectively.)

3.4 Operation of EA flood structures

During Storm Babet, there were known issues with the operation of the Horncastle FSR and Swimming Baths Sluice. These issues are discussed further below.

Information regarding their intended operation has been obtained from the EA's reporting following Storm Babet, including Horncastle Investigation Initial Findings (EA, 2023), Horncastle Reservoir Review Summary (EA, 2024), Chief Engineers Report, Horncastle Reservoir (EA, 2024) and Horncastle Asset Operation Failure Impact Assessment (EA, 2024).

3.4.1 Horncastle Flood Storage Reservoir

During periods of extreme flows on the River Bain, the sluice gate at the Horncastle Flood Storage Reservoir (FSR) is designed to close automatically once a river level of 42.3m AOD was reached.

During Storm Babet, the threshold level for the sluice gate to be closed was reached at 03:23 on 20 October 2023. However, the sluice gate did not automatically close. It was later manually closed at 14:15.

It should be noted that the threshold level was chosen such that there was a period of time before flows exceeded 7.1 m^3/s (the threshold above which flooding was modelled to occur). This time was reached at 11:45, indicating there was a period of 2.5 hours where flows were able to exceed the target rate.

According to the EA's reporting, a range of factors contributed to the late closure of the sluice gate, which includes a non-standard gate operation and scheme design, a poor alert system, and no complete investigation of the sluice gate's poor performance during previous storm events.

Following Storm Babet, the EA have completed an investigation into the contribution of the late closure of the sluice gate at the FSR. This concluded that the operational failure did not cause an increase in flooding in Horncastle due to flows from the Hemingby Beck and West Ashby Beck Catchments exceeding their maximum design flow of 7 m^3/s. As such, they concluded that the flows through Horncastle had a 0.1% AEP, which exceeds the design of the FSR even if it were operated successfully.

It should be noted that the EA reporting is currently undergoing an independent review to confirm its validity, the results of which have not yet been published.

3.4.2 Swimming Baths Sluice

Under typical conditions, the Swimming Baths Sluice is left partially closed, with an opening of 50mm to permit flows along the Old River Bain (Photograph 6.1 in Appendix 20). During periods of extreme flows on the River Waring, the sluice is designed to be manually opened in stages, to a maximum opening of 1390 mm.

During Storm Babet, the gate was initially raised to provide an opening of 200mm at 04:00 on 20 October 2023. This should have been later raised in stages up to its maximum opening; however, EA operatives were unable to get back to the sluice to open it further.

The EA included the impact of the Swimming Baths Sluice not being fully opened during their investigation into the operational failure at the FSR. This included modelling, with separate scenarios considering the sluice in a partially opened (i.e. what happened in Storm Babet) and fully opened (i.e. normal operation).

These scenarios produced a similar flood extent for the majority of Horncastle, suggesting that the partial closure of the Swimming Baths Sluice had minimal impact on the flooding experienced. Flood depths were reduced by up to 50mm along the River Waring in the fully open scenario, but the report concluded this would be insufficient to prevent flooding at individual properties.

Of particular interest is the impact of the Swimming Baths Sluice on the area immediately surrounding it (i.e., the affected properties on Coronation Walk, considered within Cluster 6). There was minimal difference between the actual observed operation and normal operation scenarios, with the exception of the land to the north of the confluence between the Rivers Waring and Bain (which flooded in the former scenario but not in the latter).

Additionally, the extent of flooding at the [redacted] was greater during the former (observed operation) scenario, suggesting the poor operation of the Swimming Baths Sluice may have had some effect on this property during Storm Babet.

However, it is noted that no scenarios resulted in flooding adjacent to [redacted] and [redacted] West Street (as observed in Storm Babet). Therefore, the model runs do not confirm or disprove the impact of the partial closure of the Swimming Baths Sluice on these properties.

3.5 Knowledge of flooding

As part of the S19 investigation, consultants from GeoSmart Information Ltd visited the affected properties between 30 April and 02 May 2024.

During this Site visit, conversations were held with residents at the properties. Where no residents were available to speak with, a letter containing a link to a LCC survey questionnaire was left. Information obtained from responses to this questionnaire, conversations with residents, follow-up meetings with residents and councillors and video evidence have been used to develop a knowledge of the nature of flooding throughout Horncastle.

Further information regarding the flooding during Storm Babet has been obtained from the EA's reporting and online articles, photos and videos (see also Figure 3.4).

Information collected for each cluster of properties has been provided separately within Sections 4 to 15.

(Figure 3.4 – reported flood outline, as included within the Horncastle Asset Operation Failure Impact Assessment (EA, 2024). Note that the affected properties included within this figure does not match the properties discussed in this S19 report as the list of affected properties has been further refined since the completion of the EA's reporting.)

4. Cluster 1 – Winceby Gardens

4.1 Location

Cluster 1 covers five properties along Winceby Gardens, a road within the Winceby Fields development in the far east of Horncastle (Figure 4.1).

Five properties have been confirmed as having internally flooded ([redacted], [redacted], [redacted], [redacted] and [redacted] Winceby Gardens). A further two properties reported external flooding, with highway flooding also reported during Storm Babet.

The properties are located c. 15 to 20m north of the Thunker Drain.

Ground levels in the area surrounding the properties fall in a south-westerly direction, following the flow direction of the Thunker Drain (Figure 4.2). The fields to the east are noted to slope relatively steeply towards the properties. Ground levels on Winceby Garden vary between 36.0 and 36.5m AOD.

(*Figure 4.1 – Location of the affected properties along Winceby Gardens*)

(*Figure 4.2 – LiDAR elevation data for the area surrounding Winceby Gardens*)

4.2 Flood risk

4.2.1 The EA's flood mapping

According to the EA's Flood Map for Planning Purposes (Figure 4.3), the affected properties on Winceby Gardens are located within Flood Zone 1, indicating a low probability of flooding from rivers and the sea.

According to the EA's Risk of Flooding from Rivers and the Sea map, Winceby Gardens has a very low risk of fluvial and tidal flooding.

Winceby Gardens is at a variable risk of surface water flooding, ranging from very low to low (Figure 4.4). One of the five internally flooded properties is situated entirely on land with a very low pluvial flood risk; one property is located adjacent to an area at low pluvial flood risk but otherwise has a very low risk. The remaining three have a low risk of surface water flooding.

(*Figure 4.3 – Fluvial flood zones in the area surrounding Winceby Gardens*)

(*Figure 4.4 – Risk of surface water flooding in the area surrounding Winceby Gardens*)

4.2.2 FloodSmart Analytics mapping

GeoSmart's FloodSmart Analytics mapping (Figure 4.5) indicates that all properties on Winceby Gardens are at very low risk of fluvial flooding.

A low risk of surface water flooding is associated with four out of the five internally flooded properties; only property at very low risk of pluvial flood risk is [redacted] Winceby Gardens.

A low to medium risk of groundwater flooding is associated with the southern side of [redacted] and [redacted] Winceby Gardens. The remaining properties are entirely at very low risk of groundwater flooding.

Figure 4.5 – Flood risk at Winceby Gardens according to FloodSmart Analytics mapping

(Figure 4.5a – Fluvial flood risk)

(Figure 4.5b – Tidal flood risk)

(Figure 4.5c – Surface water flood risk)

(Figure 4.5d – Groundwater flood risk)

4.3 Drainage arrangement

LCC drainage asset records at time of publication have been provided. However, these records do not include any drainage assets on the southern section of Winceby Gardens, indicating that the drainage infrastructure in this area has not been adopted by LCC.

During the walkover, highway gullies were observed on the eastern and western sides of the close, confirming the presence of highway drains (Photographs 1.1 and 1.2 in Appendix 20).

The drainage layout submitted as part of the planning application for the development (ref: S/086/00810/20) indicates that a SuDS scheme is present at the Site, with runoff from Winceby Gardens draining to two attenuation basins to the west of the properties. The SuDS scheme was designed to provide storage for runoff from the development up to the 1 in 100 annual chance + 40% CC rainfall event.

4.4 Knowledge of flooding

Consultants from GeoSmart Information Ltd visited Winceby Gardens on 01 May 2024. Within conversations and responses to the LCC questionnaire (ref: SRS000180), flood waters first entered the properties via the doors in the morning of 20 October 2023. Flood waters remained within the buildings for 6-12 hours, reaching a maximum reported depth of 130mm internally and 300 to 450mm externally.

Flushing toilets were impacted at one property and at least two garages on the road flooded.

The residents reported that the Thunker Drain did not overtop its banks adjacent to Winceby Gardens (although they confirmed that this had occurred downstream of the properties); this is confirmed by photographs taken at around 12:00, during the flooding (Photograph 1.5 in Appendix 20). They indicated that overland flows came from the fields to the east of the properties – video evidence confirms that this field was also flooded, and that flood waters extended throughout the highway.

4.5 Flooding mechanism & Causation

From the available evidence, it is likely that flood waters at Winceby Gardens were likely pluvial in nature. Winceby Gardens is located at a lower elevation compared to the adjacent fields, and therefore would reflect the natural flow direction for runoff from these fields.

A significant volume of runoff was generated in Storm Babet, with the event estimated as having a 2.2% AEP (1 in 45 annual chance). Therefore, it is possible that typical highway drainage systems were overwhelmed and would not have helped to drain surface water from Winceby Gardens.

Based on available evidence it is considered that overland flows from the neighbouring upstream land are likely to have been the primary cause of surface water accumulation at Winceby Gardens.

Several dykes are present on the eastern side of the field (c. 90m east of the properties), which drain to the Thunker Drain. It is possible that the capacity of these dykes was exceeded upstream of the Thunker Drain, which produced out of bank flows. These flows would follow the natural topography of the area and travel in a south-westerly direction, potentially via Winceby Gardens.

4.6 Cluster-specific issues identified

Issues that have been identified specific to Winceby Gardens are provided below. The issues identified within Section 17 are also applicable to these properties.

4.6.1 Absence of intervening drainage to the east of Winceby Gardens

The most significant factor contributing to flooding at Winceby Gardens was the absence of sufficient intervening drainage between the properties and the land to the east. The properties are situated on the northern side of a valley feature; therefore, any runoff from the land would flow downgradient, towards the buildings.

Without an intervening drainage feature during Storm Babet, flood waters would flow towards the buildings and accumulate in the highway, contributing to internal flooding.

4.6.2 Insufficient capacity in drainage ditch

A drainage ditch is present c. 90m east of the properties at a higher elevation. Given the significant level of rainfall recorded in Horncastle on 20 October 2023, it is possible that the runoff from the surrounding land was significant enough (2.2% AEP rainfall event) that the capacity of the drainage ditch was likely exceeded.

The capacity of the ditch is not known, and information is not available to confirm whether it overtopped. As such, it cannot be confirmed that the channel had sufficient capacity.

Should this have been the case, flood waters from the dyke would preferentially flow in a south-westerly direction, towards the properties, as it cuts across the land to rejoin the Thunker Drain downstream of Winceby Gardens.

4.7 Risk Management Authorities

In relation to this flood event, the following RMA has relevant flood risk management functions:

- Lead Local Flood Authority (Lincolnshire County Council)

A record as to whether Lincolnshire County Council, as the relevant RMA, has exercised or is proposing to exercise its functions in response to the flood shall be monitored through the existing Joint Lincolnshire Flood Risk and Water Management Partnership.

The property owners also have a responsibility with regards to the resilience and resistance measures implemented at each property.

4.8 Cluster-specific recommendations

Cluster-specific recommendations to reduce the flood risk in future events are provided below. The recommendations in Section 18 are also applicable to these properties.

4.8.1 Implementation of intervening drainage

From correspondence provided by LCC, it is understood that the riparian landowner has constructed a dyke to the east of Winceby Gardens. This would form an intervening feature which would allow overland flows to be intercepted and diverted back into the channel prior to them reaching the developed area of Horncastle.

It is understood that this dyke is currently temporary in nature, and therefore it is subsequently recommended that LCC considers advising the relevant landowners to assess whether a more permanent mechanism to address overland flows is needed.

5. Cluster 2 – Maltby Way, Banovallum Gardens, Lodington Court, Clarke Court, Cupit Road & Saxon Way

5.1 Location

Cluster 2 covers 31 known internally flooded properties in the east of Horncastle. These include:

- 9 residential properties on Maltby Way ([redacted]);
- 3 residential properties on Banovallum Gardens ([redacted]);
- 8 residential properties on Lodington Court ([redacted]);
- 2 residential properties on Clarke Court ([redacted]);
- 6 residential properties on Saxon Way ([redacted]);
- 2 residential properties on Cupit Road ([redacted]); and
- [redacted] on Spilsby Road.

A further 11 properties reported as having experienced flooding, but with an unconfirmed flood extent, have also been included within this cluster (Figure 5.1).

The properties are located c. 10 to 30m from the left and right banks of the Thunker Drain.

Several bridges cross the Thunker Drain in the study area. These include:

- Maltby Way, towards the west of the cluster;
- Banovallum Gardens, in the centre of the cluster (Photographs 2.1 and 2.8 in Appendix 20);
- A footbridge connecting Saxon Way and Lodington Court, in the east of the cluster (Photographs 2.2 and 2.5);
- A bridge over a private driveway c. 40m south-east of [redacted]; and
- Spilsby Road (becoming East Street) crosses the River Waring c. 70m north-west of [redacted].

During the Site visit on 02 May 2024, the channel of the Thunker Drain was observed to be in reasonable condition throughout the study area (Photographs 2.1 and 2.3). However, grass detritus was observed on the banks adjacent to the bridge on Banovallum Gardens, which a resident mentioned had been present since Storm Babet (Photograph 2.1). One of the culverts beneath Maltby Way was also blocked by plant debris (Photograph 2.11).

Ground levels in the area surrounding the properties fall in a northerly direction (in the case of the southern reaches of Maltby Way, Lodington Court, Clarke Court, Banovallum Gardens and Cupit Road), or southerly direction (in the case of Saxon Way and the northern reaches of Maltby Way) (Figure 5.2). Ground levels generally follow the flow direction of the Thunker Drains, also falling in a westerly direction. Ground levels at the properties vary between 32 and 34m AOD.

The ground levels at [redacted] also fall towards the Thunker Drain, in a north-easterly direction, with an elevation of c. 30.5m AOD.

(*Figure 5.1 – Location of the affected properties in Cluster 2*)

(*Figure 5.2 – LiDAR elevation data for the area surrounding Cluster 2*)

5.2 Flood risk

5.2.1 The EA's flood mapping

According to the EA's Flood Map for Planning Purposes (Figure 5.3), the affected properties are located across Flood Zones 1 to 3, indicating a low to high probability of flooding from rivers and the sea. In particular:

- One property [redacted] Maltby Way) is located across Flood Zones 2 to 3 (c. 3% of the properties);
- Four properties ([redacted] Maltby Way, and [redacted] Cupit Road) include areas within Flood Zone 2 (c. 13% of the properties);
- The remaining 26 properties are located in Flood Zone 1 (c. 84% of the properties).
- [redacted] is located within Flood Zone 1.

It is noted that several properties without reported flooding, which are close to the known internally flooded properties, are located in Flood Zones 2 and 3, suggesting there is not an obvious linkage between flood zone mapping and the flood incident.

According to the EA's Risk of Flooding from Rivers and the Sea map, all the considered properties have a very low risk of fluvial and tidal flooding.

The properties within the cluster are at a variable risk of surface water flooding, ranging from very low to medium (Figure 5.4). In particular:

- Two properties ([redacted] Maltby Way and [redacted] Clarke Court) are situated in land where there is a low to medium surface water flood risk (c. 5% of the total properties in the cluster);
- 23 known internally flooded properties are situated on land with a low surface water flood risk, alongside 6 with unconfirmed flooding (c. 70% of the properties);
- Seven properties are situated on land with a very low to low surface water flood risk, alongside two with unconfirmed flooding (c. 20% of the properties) and [redacted];
- Two properties with unconfirmed flooding are situated on land with a very low surface water flood risk (c. 5% of the properties).

(*Figure 5.3 – Fluvial flood zones in the area surrounding Cluster 2*)

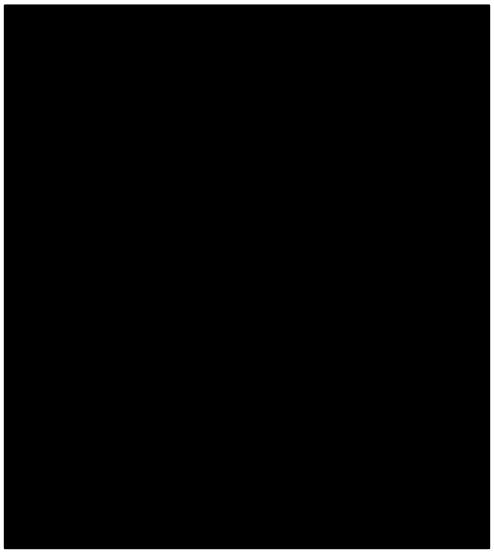
(*Figure 5.4 – Risk of surface water flooding in the area surrounding Cluster 2)*

5.2.2 FloodSmart Analytics mapping

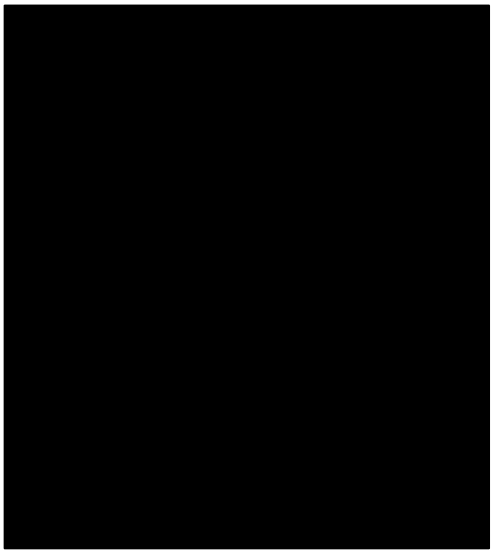
GeoSmart's FloodSmart Analytics mapping (Figure 5.5) indicates that all properties in Cluster 2 are at very low risk of tidal flooding.

A low to high risk of groundwater and surface water flooding and low to medium risk of fluvial flooding is associated with the Thunker Drain, which extends into the adjacent properties.

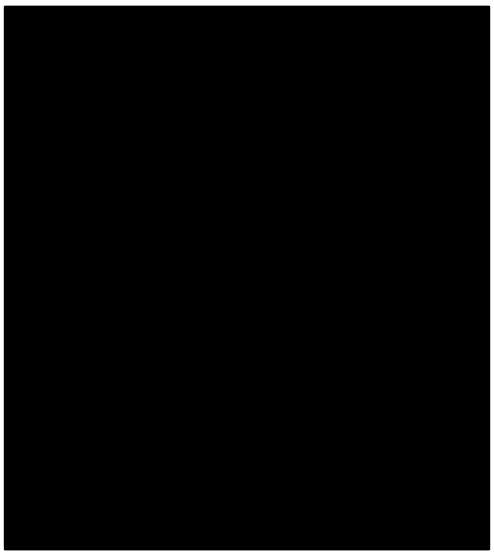
Figure 5.5 – Flood risk at Winceby Gardens according to FloodSmart Analytics mapping



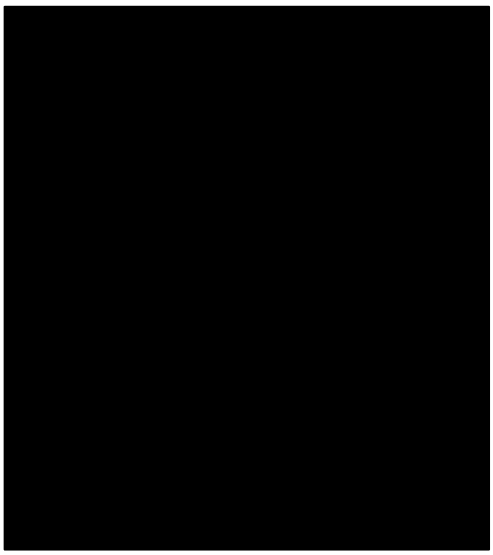
(Figure 5.5a – Fluvial flood risk)



(Figure 5.5b – Tidal flood risk)



(Figure 5.5c – Surface water flood risk)



(Figure 5.5d – Groundwater flood risk)

5.3 Drainage arrangement

LCC drainage asset records at time of publication have been provided and are shown within Figure 5.6. This indicates that the properties are serviced by the public sewer network, which drains to a pumping station at the corner between Banovallum Gardens and Maltby Way. An additional pumping station is present adjacent to Maltby Way.

There is significant highway drainage within the clusters, with gullies servicing the area. According to records held by LCC, these are cleansed on a biennial cycle. The majority of gullies were last cleansed in August 2023. Several gullies are noted to have a jammed lid, but these are not located within close proximity of the properties.

A headwall was observed adjacent to the pumping station on Maltby Way. This is understood to be a SuDS feature, with the land used for storage in the event that the capacity of the drainage system is exceeded.

According to records held by the EA, natural high ground (considered to be informal flood defences) is present along the northern and southern banks of the Thunker Drain. This is recorded as providing a 1 in 200 annual chance SoP adjacent to all the affected properties (with the exception of [redacted] Clarke Court, which are not protected by any defences); minimum crest levels vary between 31.54 and 33.47m AOD.

It should be noted that there is no detailed modelling of the Thunker Drain, with the existing model along the River Bain and River Waring unable to reproduce the flood extents experienced along this watercourse during Storm Babet (EA, 2024). Therefore, the standard of protection afforded by the banks should not be considered reliable.

(*Figure 5.6 – LCC drainage assets and known sewer networks in the area surrounding the properties in Cluster 2 at the time of publication)*

5.4 Knowledge of flooding

Consultants from GeoSmart Information Ltd visited the affected properties on 01 May 2024. Within conversations and responses to the LCC questionnaire (refs: SRS000181, SRS000004 & SRS000027) from 9 properties, the following information has been collated:

- Flood waters generally entered the properties between 13:00 and 13:30 on 20 October 2023. One resident reported that an increase in flood levels occurred around 11:00;
- Flood waters generally remained in the properties for less than 1 hour, to 1-2 hours. Several residents noted that flood waters began to fall around 14:30;
- The method of entry varied on a property level, with residents reporting that water entered their properties via walls, doors, floors and air bricks;
- Internal depths varied, with the maximum depth reported being 75 mm. Depths outside properties were reported to be much higher, ranging from 0.20 to 0.45 m, which appears to be a function of distance from the Thunker Drain;
- Utilities were not impacted at most properties. However, one resident reported that the electrics and gas supply was impacted, and that toilets could not be flushed at their property;
- Most properties experienced flooding within a garage or outbuilding, even if the dwelling did not flood internally;
- The access to each property during Storm Babet varied. Around 50% of the residents reported that they were unable to leave their property during the flood event, with the remaining residents reporting that they could only leave their property if they waded through flood waters.

Flood waters were generally attributed to the Thunker Drain and were reported as travelling rapidly in a westerly direction (i.e. following the natural flow direction of the watercourse).

It should be noted that the resident at one property ([redacted] Clarke Court) reported flood waters entered the building on two separate occasions (in the night, and early afternoon on 20th October 2023); no other property was flooded twice, although multiple residents at other properties mentioned that this had occurred upstream during conversations.

Video and photo evidence provided by residents (included within Appendix 20) suggests that the Thunker Drain breached its banks at some (but not all) locations. Overtopping can be observed adjacent to Maltby Way and Banovallum Gardens and in sections along Saxon Way and Lodington Court.

No detailed information has been provided by [redacted] however, this is anticipated to share the same source of flooding as the other properties.

5.5 Flooding mechanism & Causation

From the available evidence, the majority of flows in Cluster 2 appear to have originated from a combination of overtopping of the Thunker Drain and overland flows from the adjacent Poppy Fields site. During Storm Babet, a significant volume of runoff was likely generated in the catchment of the Thunker Drain, with the rainfall event estimated at 2.2% AEP (1 in 45 annual chance). This would have entered the watercourse; where the capacity of the channel was exceeded in its lower reaches, this would have produced out of bank flows which impacted the adjacent properties.

With respect to the [redacted] site overland flows were noted by residents to materialise following a breach made to the on-site attenuation pond (Appendix 20.3.2 - Photograph 2.20) which subsequently resulted in flows following the natural topography and causing flooding on Wesley Way, Loddington Court, and Clarke Court.

There are no river gauges on the Thunker Drain. However, the Banks Road gauge on the River Waring recorded a peak level at 14:30, at which time the river level almost immediately began to steeply fall (Section 3.3). The time of flooding provided by residents within Cluster 2 is consistent with the rise and fall of river levels on the River Waring.

The EA records informal defences with a 1 in 200 annual chance SoP along the banks of the Thunker Drain. However, no detailed modelling studies have been completed for the Thunker Drain (and that existing models for the Bain and Waring poorly resolve the observed flooding during Storm Babet). Additionally, these defences only comprise natural high ground and therefore are only representative of the capacity of the channel. In any case, the EA's modelling reported that flows along the Bain and Waring reached in excess of 1 in 1000 annual chance; assuming similar flows were experienced on the Thunker Drain, the capacity of the channel would have been exceeded.

It is possible that bridges over the Thunker Drain have acted as a constraining factor on flows. The footbridge between Saxon Way and Lodington Court is considered unlikely to have had any impact on flows; however, the soffit of the bridges at Maltby Way and Banovallum Gardens are notably low, with the available area through which water can flow comparatively limited (Photographs 2.1, 2.8, 2.10 and 2.11 in Appendix 20). This could cause a reduction in flows, locally increasing the flood level upstream and increasing the flood depths experienced for the upstream properties.

Likewise, the bridges may have acted as diversion features. Once the river level reached the soffit of the bridge, flows could potentially have been directed either side of the bridge, preferentially impacting the properties adjacent and immediately downstream of the bridge.

The channel appeared to be in good condition at the time of the Site visit on 01 May 2024, although it is acknowledged that this does not necessarily mean the channel was clear during Storm Babet due to the time passed between the storm and walkover. Plant debris, such as grass and sticks, were observed to be built up against the bridge at Maltby Way (Photograph 2.11).

Grass debris was also observed along the banks at Banovallum Gardens, which anecdotally is understood to have been there since Storm Babet. Residents reported that during the event,

grass debris collected at the top of the fence on the bridge and formed a blockage for flows. This could have reduced the capacity of the watercourse and restricted flows.

There is also potential for surface water flows to have impacted the easternmost properties in the cluster (i.e. those on Clarke Court and Saxon Way). These flows would have been unable to enter the channel of the Thunker Drain where this was at capacity (as observed throughout the study area) and could have caused flooding adjacent to the channel. A surface water source would be consistent with the first flood incident at [redacted] Clarke Court, but otherwise its relative contribution appears limited.

5.6 Cluster-specific issues identified

The issues identified, specific to Cluster 2 are provided below. The issues identified within Section 17 are also applicable to these properties.

5.6.1 Blockages formed by bridges

It is considered possible that the bridges along the Thunker Drain (at Maltby Way and Banovallum Gardens) acted as a constraint for the river flow during Storm Babet. These bridges may have restricted the river flow once the river level had reached the soffit of each feature.

Both bridges were observed to have a small aperture. Therefore, it is possible that a blockage would be formed, either due to the restriction of flows through the aperture or by the build up of plant material and debris during Storm Babet, increasing the potential for the banks to be overtopped.

The bridges may have also acted as a diversion feature for flows. Once the soffit of the base was reached, flows could potentially have been directed either side of the bridge (i.e. in north-westerly and south-westerly directions), preferentially impacting the properties adjacent and immediately downstream of the bridge.

However, in the absence of detailed modelling, it cannot be confirmed whether these bridges constrained flows during Storm Babet, or whether they remain a potential problem for future storm events.

5.7 Risk Management Authorities

In relation to this flood event, the following RMA has relevant flood risk management functions:

- Environment Agency
- Lead Local Flood Authority and highways Authority (LCC)

A record as to whether LCC and the Environment Agency, as the relevant RMAs, have exercised or is proposing to exercise its functions in response to the flood shall be monitored through the existing Joint Lincolnshire Flood Risk and Water Management Partnership.

The Thunker Drain is understood to be the responsibility of riparian landowners as it passes through the cluster area. Downstream of Maltby Way, the Thunker Drain is a designated Main River and therefore the EA has permissive powers.

The property owners also have a responsibility with regards to the resilience and resistance measures implemented at each property.

5.8 Cluster-specific recommendations

Cluster-specific recommendations to reduce the flood risk in future events are provided below. The recommendations in Section 18 are also applicable to these properties.

5.8.1 Modelling study into the Thunker Drain

Fluvial flooding occurred along the Thunker Drain during Storm Babet throughout Cluster 2 as well as on East Street, the extent of which did not fully agree with the available fluvial and surface water flood mapping.

It is recommended that a modelling study is conducted for the Thunker Drain as it flows through Horncastle, prior to its discharge into the River Waring on East Street. This would allow the risks to each property to be confirmed, which would support future investigation into possible alleviation, both on a catchment-wide and property-specific level.

In particular, the study should confirm whether the bridges at Maltby Way and Banovallum Gardens have a sufficient aperture.

This recommendation sits most appropriately with LCC in its capacity as LLFA to co-ordinate on with support from other RMAs as appropriate.

5.8.2 Flood alleviation scheme for the Thunker Drain

It is recommended that discussions take place between all relevant RMAs, to appropriately consider undertaking a flood alleviation scheme for the Thunker Drain. This could be devised following the completion of a modelling study for the watercourse, with potential solutions including the enlargement of the existing channel, the construction of a bypass channel, or the construction of a storage area upstream.

5.8.3 Installation of river gauge on Thunker Drain

At present, no monitoring stations are located along the Thunker Drain.

It is recommended that as consideration should also be given to explore the possible installation of monitoring gauges along the Thunker Drain. The monitoring level data collected from any gauge could be used to support investigation into future flood events, aid in the production of a modelling study for this watercourse, and feed into discussions for future flood alleviation schemes, as well as allowing the typical flows on this watercourse to be verified. It would also enhance the flood warning scheme for properties in the east of Horncastle, allowing residents to plan more effectively for future flood events.

6. Cluster 3 – Stanhope Road, Bowl Alley Lane, Linden Road & Banks Street

6.1 Location

Cluster 3 covers 21 known internally flooded properties in the central east of Horncastle (Figure 6.1). This includes:

- 8 properties on Stanhope Road, of which 7 are residential ([redacted]) and 1 is commercial ([redacted]);
- 1 property on Bowl Alley Lane ([redacted]);
- 8 properties on Banks Street ([redacted]); and
- 3 properties on Linden Road ([redacted]).

The properties are located c. 10 to 70m north of the right bank of the River Waring. The confluence of the Waring and Thunker Drain occurs adjacent to Stanhope Beck.

Within the study area, two bridges cross the River Waring. The first one occurs at Stanhope Road; a weir is present on the eastern side of the bridge. A footbridge is also present, connecting Francis Lane with Banks Road.

An unmarked culverted drainage ditch is present between [redacted] and [redacted] Stanhope Road; the connection as well as information such as diameter and condition of which, is unknown.

It should be noted that the location of [redacted] has not been confirmed. According to OS mapping, [redacted] is located c. 190m north of the River Waring, and c. 150m north of the nearest affected property. However, information within the LCC questionnaire filled in by the resident suggests that the property is in close proximity to the watercourse. The position indicated within OS mapping has been used within the mapping in this report but is otherwise unconfirmed.

Ground levels in the area surrounding the properties fall in a southerly direction, towards the River Waring (Figure 6.2). Ground levels at the properties vary between 19.1 and 29.6m AOD, with the exception of [redacted], which is located at an elevation of c. 33.5m AOD.

(*Figure 6.1 – Location of the affected properties in Cluster 3*)

(*Figure 6.2 – LiDAR elevation data for the area surrounding Cluster 3)*

6.2 Flood risk

6.2.1 The EA's flood mapping

According to the EA's Flood Map for Planning Purposes (Figure 6.3), the affected properties are located across Flood Zones 1 to 3, indicating a low to high probability of flooding from rivers and the sea. In particular:

- Four properties are located entirely within Flood Zone 3 (25% of the affected properties);
- Eleven properties are located entirely within Flood Zone 2 (55% of the affected properties);
- Four properties are located on the boundary between Flood Zones 2 and 3 (20% of the affected properties);
- One property ([redacted]) is located within Flood Zone 1 (5% of the affected properties).

According to the EA's Risk of Flooding from Rivers and the Sea map, four of the properties ([redacted] Stanhope Road) have a medium risk of fluvial flooding. Two properties are located on land with a low to medium risk, whilst thirteen of the properties have a low risk of fluvial flooding. One property ([redacted]) has a very low risk.

The properties within the cluster are at a variable risk of surface water flooding, ranging from very low to high (Figure 6.4). In particular:

- Five properties have a high risk of surface water flooding (25% of the affected properties);
- Seven properties have a medium to high risk of surface water flooding (35% of the affected properties);
- Two properties have a medium surface water flood risk (10% of the affected properties);
- Two properties have a low to medium surface water flood risk (10% of the affected properties);
- Three properties have a low surface water flood risk (15% of the affected properties);
- One property ([redacted]) has a very low surface water flood risk (5% of the affected properties).

(*Figure 6.3 – Fluvial flood zones in the area surrounding Cluster 3*)

(*Figure 6.4 – Risk of surface water flooding in the area surrounding Cluster 3)*

6.2.2 FloodSmart Analytics mapping

GeoSmart's FloodSmart Analytics mapping (Figure 6.5) indicates that all properties in Cluster 3 are at very low risk of tidal flooding.

[redacted] are mapped as having a high risk of fluvial flooding, whilst the remaining properties on Stanhope Road and Linden Road, and [redacted] Banks Street, have a medium risk. The properties on Banks Street ([redacted]) have a low risk of fluvial flooding, with [redacted] having a very low risk of fluvial flooding.

The majority of the properties in the study area have a high risk of surface water flooding. The exception to this is [redacted] and [redacted] Stanhope Road, which have a medium risk; Stanhope Beck and [redacted] Stanhope Road, which have a low risk; and [redacted], which has a very low risk.

The majority of the affected properties in the cluster have a high risk of groundwater flooding. The only exception to this is [redacted], which has a very low groundwater flood risk.

Figure 6.5 – Flood risk in Cluster 3 according to FloodSmart Analytics mapping

(Figure 6.5a – Fluvial flood risk)

(Figure 6.5b – Tidal flood risk)

(Figure 6.5c – Surface water flood risk)

(Figure 6.5d – Groundwater flood risk)

6.3 Drainage arrangement

LCC drainage asset records at time of publication have been provided and are shown within Figure 6.6. This indicates that highway drainage is present along Banks Road and Stanhope Road.

According to records held by LCC, gullies are present along the southern side Banks Road. These are generally recorded as being without defect and inspected on an annual cycle. The majority of the gullies were last cleansed in August 2023, with an 'amber' silt level. The gully adjacent to [redacted] Banks Road has been recorded as having a jammed lid.

LCC records confirm the presence of Anglian Water surface water sewers on Stanhope Road and Linden Road, which drain into the River Waring. Foul sewers are recorded adjacent to the north of the River Waring, on Banks Road, and within The Becks and Banks Street.

During the Site visit on 30 April 2024, the gullies generally appeared to contain some silt and debris; given the time passed, this would not be indicative of the conditions during Storm Babet, although one resident noted that this was typical of the condition of the gullies. The gullies appeared to be particularly blocked on Linden Road.

According to data from the EA, informal flood defences (such as walls and natural high ground) are present along the northern banks of the River Waring throughout the cluster. This provides a variable standard of protection for the surrounding land:

- A wall is present along the northern bank of the River Waring, adjacent to Banks Road. This is recorded as having a minimum crest level of 28.56m AOD, providing a 1 in 10-annual chance standard of protection;
- Engineered high ground is present immediately to the east of the bridge on Stanhope Road. This has a minimum crest level of 29.58m AOD, providing a 1 in 75 annual chance SoP;
- Natural high ground is present adjacent to Stanhope Beck and [redacted]. This has a minimum crest level of 29.29m AOD, providing a 1 in 10 annual chance SoP;
- The natural high ground adjacent to [redacted] has a minimum crest level of 29.25m AOD, providing a 1 in 1 annual chance SoP.

(*Figure 6.6 – LCC drainage assets and known sewer networks in the area surrounding the properties in Cluster 3 at the time of publication)*

6.4 Knowledge of flooding

Consultants from GeoSmart Information Ltd visited Stanhope Road and Banks Street on 01 and 02 May 2024. Within conversations and responses to the LCC questionnaire (refs: SRS000005, SRS000028, SRS000170, SRS000171, SRS000173, SRS000174, SRS000176, SRS000178 & SRS000188) from residents / business owners at 11 of the 20 known internally flooded properties (as well as several nearby properties where outbuildings were impacted), the following information has been collated:

- Flood waters entered the properties between 12:00 and 15:30 on 20 October 2023. In general, [redacted] and [redacted] are reported to have flooded around 12:30, followed by most other properties flooding between 13:00 and 14:00. Several properties also reported flooding later (between 15:00 and 15:30).
- The reported depth of flood waters within the buildings was variable, reflecting the ground levels and threshold levels of each property. Reported internal depths vary from 20 to 510 mm.
- Externally, flood depths reached up to 1.14m on the highway. The reported flood depths varied from 0.4 to 1.0 m, depending on the specifics of the property.
- Flood waters remained within the properties for a variable amount of time. The shortest reported amount of time was 1 hour (in the case of [redacted] Banks Street) and the longest reported time was 12-24 hours (in the case of [redacted]). Most properties reported that flood waters remained in the building between 1 and 6 hours.
- Several residents mentioned that flood depths peaked around 14:00 to 15:00 before rapidly falling by around 0.6 to 1.0m in one hour; this is consistent with the fall in river levels recorded at the Banks Road gauge (see Section 3.3).
- Utilities were impacted at 63% of the properties, with the water supply impacted at 2 properties, power impacted at 4 properties, and toilets impacted at 4 properties.
- The majority of the properties had a garage or outbuilding which also experienced flooding.
- Three residents reported that they were unable to leave their properties during Storm Babet. Residents at five other properties reported that they could leave their property but only by wading through flood waters.
- Internal flooding was reported to have occurred at several properties on Stanhope Road in 2007 and 2019.
- Residents at two properties noted that the water contained sewage, with one reporting at a foul sewer manhole had been dislodged during the storm.

All residents attributed the flooding to the River Waring, with rapid waters flowing in a westerly direction. Flows were so forceful that a perimeter wall was reportedly broken outside [redacted] / [redacted] Stonewell Row (Photograph 3.13 in Appendix 20). The residents at Stanhope Beck and [redacted] reported that fluvial flows came from upstream along the watercourse, with no initial overtopping occurring adjacent to their properties.

Several residents at properties on Stanhope Road reported that flooding was exacerbated by bow waves from vehicles; this is also consistent with accounts from residents on East Street.

6.5 Flooding mechanism & Causation

From the available evidence, flood waters have been confirmed as originating from the River Waring. This is known to have first overtopped in the morning / midday of 20 October 2023, providing a source of flooding at the easternmost properties in the cluster ([redacted], [redacted] and Stanhope Beck).

Rising river levels later caused widespread flooding throughout the cluster, as the River Waring overtopped and flooded the surrounding properties. The timing of flooding reported by residents is consistent with the rise and fall in river levels at the Banks Road gauge (see Section 3.3).

There is no evidence that the flooding had an appreciable surface water component, with flood waters not observed until midday (i.e. after the rainfall peak).

Multiple residents mentioned that the timing of the sluice gate at the FSR being opened coincided with the fall in river level along the River Waring. However, according to the EA's reporting, river levels on the River Bain have minimal impact on those on the River Waring. It remains plausible that a 'backing up' effect could occur on the River Waring when water levels on the Bain are high; however, for the most part this seems unlikely to be a significant factor in the flooding that occurred at the cluster, c. 650m upstream of their confluence (subject to the necessary verification).

It is also noted that the Swimming Baths Sluice was not fully opened during Storm Babet. The EA's investigation of this operational failure suggests that this did not increase the extent of flooding further upstream than Jubilee Way. During the modelling (which compared the normal operation of the sluice to the observed partially closed sluice), the report noted that flood depths were reduced between 10 and 50mm along the River Waring up to Stanhope Road when the Swimming Baths Sluice was operated as intended. This reduction in flood depth would not be sufficient to prevent flooding in the majority of the affected properties (only one of which reported flooding on a similar order).

Therefore, based on the available information, the EA's operational failures are considered unlikely to have had an impact on the properties in this cluster, subject to further analysis and verification.

It is noted that several residents reported that the flood waters contained sewage. At one property, this is understood to have originated from a manhole with a cover dislodged during the storm event; it is not known whether surcharging occurred at any other location.

6.6 Cluster-specific issues identified

No cluster-specific issues have been identified for the affected properties on Stanhope Road and Banks Road. However, the issues identified in Section 17 would be applicable to the properties; the issues identified in Section 7 (for Cluster 4) would also be applicable.

6.7 Risk Management Authorities

In relation to this flood event, the following RMA has relevant flood risk management functions:

- Environment Agency

A record as to whether the Environment Agency, as the relevant RMA, has exercised or is proposing to exercise its functions in response to the flood shall be monitored through the existing Joint Lincolnshire Flood Risk and Water Management Partnership.

The property owners also have a responsibility with regards to the resilience and resistance measures implemented at each property.

6.8 Cluster-specific recommendations

No cluster-specific recommendations have been identified for the affected properties on Stanhope Road and Banks Road. However, the recommendations in Section 18 would be applicable to the properties; the recommendations made in Section 7 (for Cluster 4) would also be applicable.

7. Cluster 4 – East Street, Water Lane, Plough Yard, Betts Yard & Francis Lane

7.1 Location

Cluster 4 covers 22 known internally flooded properties in the central east of Horncastle (Figure 7.1). This includes:

- 3 properties on Francis Lane ([redacted]);
- 5 properties on Water Lane ([redacted]);
- 14 properties on East Street, of which 10 are residential ([redacted]) and 4 are commercial ([redacted])

These properties have been grouped as they are anticipated to share the same flood mechanism. They are all located within 25m of the southern bank of the River Waring.

The stretch of the River Waring closest to the properties occupies an artificial channel with engineered walls. The Thunker Drain is noted to join the River Waring c. 50m east of the closest property.

Ground levels in the area surrounding the properties generally falls towards and along the River Waring (i.e. in a northerly-westerly direction) (Figure 7.2). Typical elevations are between 28.7 and 29.1m AOD for properties adjacent to the River Waring, and 29.2 and 29.9m AOD for properties adjacent to East Street.

(*Figure 7.1 – Location of the affected properties in Cluster 4*)

(*Figure 7.2 – LiDAR elevation data for the area surrounding Cluster 4*)

7.2 Flood risk

7.2.1 The EA's flood mapping

According to the EA's Flood Map for Planning Purposes (Figure 7.3), the affected properties are all located across within either Flood Zone 2 or Flood Zone 3 (indicating a medium to high probability of flooding from rivers and the sea).

In particular, two properties are located on the boundary between Flood Zones 2 and 3 ([redacted], Water Lane; and [redacted] Betts Yard) (c. 9% of the affected properties).

The remaining properties are located entirely within Flood Zone 2 (c. 91% of the affected properties).

According to the EA's Risk of Flooding from Rivers and the Sea map, all the considered properties have a low risk of fluvial and tidal flooding. Several properties (e.g. [redacted], Water Lane) are noted to infringe onto an area at high risk, but this is likely to be confined to the Waring channel.

The properties within the cluster are at a variable risk of surface water flooding, ranging from low to high (Figure 7.4). In particular:

- Seven properties ([redacted], Water Lane; [redacted] Betts Yard; [redacted] Plough Yard; and [redacted] East Street) are located on land with a high surface water flood risk (c. 35% of the affected properties);
- Three properties ([redacted], [redacted] East Street and [redacted] Plough Yard) have a medium to high surface water flood risk (c. 15% of the affected properties);
- One property ([redacted]) has a medium surface water flood risk (c. 5% of the affected properties);
- Two properties ([redacted] East Street and [redacted] Francis Lane) have a low to high surface water flood risk (c. 10% of the affected properties);
- One property ([redacted] East Street) has a low to medium surface water flood risk (c. 5% of the affected properties);
- Seven properties ([redacted] East Street; and [redacted]) have a low surface water flood risk (c. 35% of the affected properties).

(*Figure 7.3 – Fluvial flood zones in the area surrounding Cluster 4*)

(*Figure 7.4 – Risk of surface water flooding in the area surrounding Cluster 4)*

7.2.2 FloodSmart Analytics mapping

GeoSmart's FloodSmart Analytics mapping (Figure 7.5) indicates that all properties in the cluster are at very low risk of tidal flooding.

All the properties have a medium risk of fluvial flooding; the exception to this are the properties on East Street, which have a low risk of fluvial flooding.

All the properties have a high risk of groundwater flooding.

All the properties have a high risk of surface water flooding, except for [redacted] East Street and [redacted], which have a medium risk.

All the affected properties have a high risk of groundwater flooding.

Figure 7.5 – Flood risk in Cluster 4 according to FloodSmart Analytics mapping

(Figure 7.5a – Fluvial flood risk)

(Figure 7.5b – Tidal flood risk)

(Figure 7.5c – Surface water flood risk)

(Figure 7.5d – Groundwater flood risk)

7.3 Drainage arrangement

According to data from the EA, engineered high ground (classed as informal flood defences) is present continuously along the River Waring as it passes to the north of East Street. This has a minimum crest level of 28.68m AOD, providing a 1 in 10 annual chance standard of protection.

LCC drainage asset records at time of publication have been provided and are shown within Figure 7.6. The records do not include any highway drainage within East Street; however, gullies were observed along the highway during the Site visit on 30 April 2024. These gullies generally appeared to be in reasonable condition.

Highway gullies are recorded on the corner between East Street and Stanhope Road, which are cleansed on an annual cycle. During the last inspection in August 2023, an 'amber' silt level was recorded.

Anglian Water have surface water assets and a foul sewer servicing the affected properties. The foul sewer is recorded along East Street and Water Lane, connecting to a sewer adjacent to the south of the River Waring.

(*Figure 7.6 – LCC known drainage assets and known sewer networks in the area surrounding the properties in Cluster 2 at the time of publication)*

7.4 Knowledge of flooding

Consultants from GeoSmart Information Ltd visited the affected properties on 30 April 2024. Within conversations and responses to the LCC questionnaire (e.g. ref: SRS000179 and SRS000182) from 10 properties across the study area, the following has been collated:

- Flood waters were present on Water Lane by 12:00 on 20 October 2023, and late morning at the junction between Stanhope Road and East Street. However, most of the residents / business owners reported that flooding occurred in their buildings between 13:00 and 15:00, with 13:30 the most common response.
- Internal depths varied, likely due to the variation in finished floor levels and position relative to the River Waring. Internal depths between 0.03m and 0.45m were reported on East Street, with internal depths up to 1.20m on Water Lane and between 0.60 and 0.90m on Francis Lane.
- All the reported external depths were between 0.67 and 1.20m.
- Flood waters remained in the properties for a variable amount of time, with some residents reporting water remained for 2-4 hours, and others reporting up to 2 days.
- Utilities were impacted at c. 75% of the properties. Power was impacted at all reported properties, with water supply and toilets being impacted at some properties.
- Several properties also experienced flooding in outbuildings.
- Multiple residents noted that there was a drop in water level of around 1m by 15:30, which is consistent with the fall in water levels recorded at the Banks Road gauge (see Section 3.3).

According to residents, flood waters originated from the Thunker Drain or upstream along the River Waring, flowing in a westerly direction along East Street. Flood waters then flowed along the passages between East Street and the River Waring (e.g. Water Lane and Francis Yard). Flows were reported to be fast moving.

Flood waters were exacerbated by bow waves from vehicles passing down East Street. (Note that the road was later closed due to being impassable.)

Flooding was noted to have previously occurred on East Street in 2007.

Multiple residents noted that a flood alert had been received for the area at 03:00 on 20 October 2023; however, others did not receive an alert. The reliability of the EA warning system was raised as a concern.

7.5 Flooding mechanism & Causation

From the available evidence, flood waters have been confirmed as having a fluvial source. This occurred as two components:

- Out of bank flows upstream of the cluster, which flowed down East Street. These likely originated from both the River Waring and Thunker Drain;
- Overtopping of the River Waring immediately adjacent to the properties.

The timing of the reported flooding is consistent with a fluvial source and correlates with the peak river level recorded at the Banks Road gauge (which peaked at 14:30).

There is no evidence that the flooding had an appreciable surface water component, with flood waters not observed until late morning (i.e. after the rainfall peak).

Multiple residents mentioned that the timing of the sluice gate at the FSR being opened coincided with the fall in river level along the River Waring. However, according to the EA's reporting, river levels on the River Bain have minimal impact on those on the River Waring. It remains plausible that a 'backing up' effect could occur on the River Waring when water levels on the Bain are high; however, for the most part this seems unlikely to be a significant factor in the flooding that occurred at the cluster, c. 650m upstream of their confluence (subject to the necessary verification).

It is also noted that the Swimming Baths Sluice was not fully opened during Storm Babet. The EA's reporting suggests that this did not increase the extent of flooding further upstream than Jubilee Way. During the modelling (which compared the normal operation of the sluice to the observed partially closed sluice), the report noted that flood depths were reduced between 10 and 50mm along the River Waring up to Stanhope Road when the Swimming Baths Sluice was operated as intended. This reduction in flood depth would not be sufficient to prevent flooding in the majority of the affected properties (only one of which reported flooding on a similar order).

Therefore, based on the available information, the EA's operational failures are considered unlikely to have had an impact on the properties in this cluster, subject to further analysis and verification.

7.6 Cluster-specific issues identified

Issues which have been identified which are specific to the affected properties on East Street, Water Lane and Francis Lane are provided below. The issues identified within Section 17 are also applicable to these properties.

7.6.1 Late closure of East Street

Multiple residents and business owners noted that vehicles remained passing through East Street whilst there was a significant depth of water on the road. This resulted in bow waves entering their properties via the doors and exacerbating the flooding each building experienced.

It is acknowledged that in most cases, there would have been a significant flood depth regardless of whether the road was open or closed. However, the late closure of East Street remains a contributing factor for flooding in the area.

7.7 Risk Management Authorities

In relation to this flood event, the following RMA has relevant flood risk management functions:

- Environment Agency

A record as to whether the Environment Agency, as the relevant RMA, has exercised or is proposing to exercise its functions in response to the flood shall be monitored through the existing Joint Lincolnshire Flood Risk and Water Management Partnership.

The property owners also have a responsibility with regards to the resilience and resistance measures implemented at each property.

7.8 Cluster-specific recommendations

The following cluster-specific recommendation has been identified for the affected properties in this cluster. The recommendations provided in Section 18 would also be applicable to the properties.

7.8.1 Consider efficiency of road closures within future flood planning

The residents in this cluster reported that bow waves from vehicles passing through East Street exacerbated the flooding experienced at each property.

Therefore, it is recommended that the existing procedure for the closure of roads in Horncastle during a storm event is reviewed, to ensure that it is efficient and effective. This could be done as part of a wider review of the Horncastle flood response plan (see Section 18).

8. Cluster 5 – Wharf Road, Church Lane & Manor House Street

8.1 Location

Cluster 5 covers four known internally flooded properties in the centre of Horncastle (Figure 8.1). Two of these properties are on Wharf Road ([redacted] and [redacted]); one on Church Lane ([redacted]); and one on Manor House Street ([redacted]).

The properties on Wharf Road and Church Lane are located c. 5 to 10m north of the River Waring. Meanwhile, [redacted] on Manor House Street is located c. 60m north of the River Waring and c. 70m south-east of the River Bain.

Ground levels along Wharf Road and Church Lane fall in a southerly direction, towards the River Waring (Figure 8.2). The three properties are situated on land with an elevation between c. 28.3 and 29.7m AOD; [redacted] is notably raised higher than the other two properties. Wharf Road forms a low point adjacent to [redacted] and [redacted], with ground levels falling in a westerly direction (from the Bull Ring) and southerly direction (from Church Lane).

[redacted] is located in an area of generally low lying land, reflecting the floodplain at the confluence between the River Bain and River Waring. Ground levels broadly fall to the west in the area surrounding this property, with the property itself having an elevation between 28.3 and 28.5m AOD.

The buildings occupied by [redacted] and [redacted] have threshold levels which are set at the adjacent highway level along Wharf Road. The main building at [redacted] appears to be raised above ground levels (visually estimated at c. 0.5m), although an outbuilding in the south-east corner of the plot can be observed as being set at highway level; note that the extent of flooding within the buildings at [redacted] has not been confirmed.

(*Figure 8.1 – Location of the affected properties in Cluster 5*)

(*Figure 8.2 – LiDAR elevation data for the area surrounding Cluster 5*)

8.2 Flood risk

8.2.1 The EA's flood mapping

According to the EA's Flood Map for Planning Purposes (Figure 8.3), [redacted] is located in Flood Zone 3 and is therefore classified as having a high probability of flooding from rivers. This flood zone appears to be associated with the River Bain as opposed to the Waring.

The remaining three properties on Wharf Road and Church Lane are located within Flood Zone 2, with an associated medium probability of flooding from the River Waring.

According to the EA's Risk of Flooding from Rivers and the Sea map, [redacted] are all located at low risk of fluvial flooding. The remaining property ([redacted]) is mapped in an area with a very low risk of fluvial flooding.

The properties within the cluster are at a variable risk of surface water flooding, ranging from very low to high (Figure 8.4). In particular:

- [redacted] is situated on land where there is a low risk of surface water flooding;
- [redacted] is situated on land with a very low to high risk of surface water flooding;
- [redacted] is situated on land where there is a medium to high surface water flood risk;
- [redacted] is situated on land with a low to high surface water flood risk.

(*Figure 8.3 – Fluvial flood zones in the area surrounding Cluster 5*)

(*Figure 8.4 – Risk of surface water flooding in the area surrounding Cluster 5)*

8.2.2 FloodSmart Analytics mapping

GeoSmart's FloodSmart Analytics mapping (Figure 8.5) indicates that [redacted] is at a medium risk of fluvial flooding. The remaining three properties are at very low risk of fluvial flooding.

Both properties on Wharf Road are at high risk of surface water flooding, whilst [redacted] is at low to high surface water flood risk. [redacted] is at low risk of pluvial flooding.

A high risk of groundwater flooding is associated with the properties on Wharf Road and Church Lane, whilst a low groundwater flood risk is associated with [redacted].

Figure 8.5 – Flood risk at the properties according to FloodSmart Analytics mapping

(Figure 8.5a – Fluvial flood risk)

(Figure 8.5b – Tidal flood risk)

(Figure 8.5c – Surface water flood risk)

(Figure 8.5d – Groundwater flood risk)

8.3 Drainage arrangement

LCC drainage asset records at time of publication have been provided and are shown within Figure 8.6. This indicates that highway gullies are located within Church Lane and Wharf Road.

According to records held by LCC, the gullies on this road are cleansed on an annual cycle. The gullies were last cleansed in August 2023, with an 'amber' silt level.

[redacted] is located on a private road and is therefore not serviced by highway drainage, with the nearest gully being c. 60m east of the building.

According to data from the EA, informal flood defences (comprising natural high ground and engineered high ground) are present along the River Bain and River Waring adjacent to the properties. This provides a variable standard of protection for the surrounding land:

- Engineered high ground is present adjacent to Wharf Road, which is recorded as having a minimum crest level of 28.37m AOD and providing a 1 in 50 annual chance standard of protection;
- Natural high ground is present on the southern bank of the River Bain as it flows at its closest point to [redacted]. This is recorded as having a minimum crest level of 28.23m AOD, providing a 1 in 100 annual chance SoP.

(*Figure 8.6 – LCC drainage assets and known sewer networks in the area surrounding the properties in Cluster 5 at the time of publication)*

8.4 Knowledge of flooding

Consultants from GeoSmart Information Ltd visited the properties on 30 April 2024. Within a response to the LCC questionnaire (ref: SRS000177), the manager at [redacted] has indicated that flood waters first entered the property at 17:00 on 20 October 2023 and

remained within the building for 1-2 days. Flood waters reached a maximum depth of 300mm inside the building and 600mm outside.

The manager at [redacted] attributed the source of flooding to rivers and sewers. They indicated that toilets could not be flushed during the event and that outbuildings on the Site were also flooded. Workers could leave the property, but only by wading through flood waters.

Within conversations during the Site visit, the manager at [redacted] indicated that flood waters entered the property at 13:00 on 20 October 2023, peaking around 16:30; the water had vacated the building by the next morning. Flood waters reached a maximum depth of 250mm at the front of the building and 500mm outside.

The manager also attributed the source of flooding to the River Waring. Egress from the building was possible but only via the rear doors. They indicated that flood waters were fast flowing and followed the flow direction of the river. Power was impacted within the building.

8.5 Flooding mechanism & Causation

From the available evidence, the flooding at all four affected properties can be confirmed as having a fluvial source.

In the case of [redacted] and [redacted], flood waters originated from the nearby River Waring. The timing of flooding is consistent with the rise and fall of the River Waring as recorded by the Banks Road gauge (see Section 3.3).

The buildings occupied by [redacted] have threshold levels set slightly above the adjacent highway level. The stretch of Wharf Road adjacent to these properties forms a low point. Therefore, once the River Waring overtopped its banks, fluvial flows would preferentially occupy this area of the highway and could enter the properties once the thresholds were breached (which would occur at relatively low depths).

The outbuilding at [redacted] is set close to the river and does not have raised threshold levels, so it is likely to have flooded around the same time as [redacted] and [redacted]. However, the main building has raised thresholds; if this building flooded, it likely would have occurred at a later time than the other buildings.

In the case of [redacted], flood waters likely originated primarily from the River Bain. The recorded flood outline reported in the Horncastle Asset Operation Failure Impact Assessment (EA, 2024) (Figure 3.4) does not indicate any connectivity between fluvial flows from the Waring and the area of flooding at [redacted], with areas of high ground (including the raised highway of Lincoln Road) separating the two areas. It therefore seems unlikely that the River Waring significantly contributed to flooding at this property.

Overtopping appears most likely to have occurred adjacent to the property. Once this occurred, the low-lying floodplain would have been inundated by waters from the River Bain. The timing of flooding (with water first entering the building at 17:00) is consistent with data recorded at the Victoria Mill gauge, where river levels rose rapidly until around 18:00, before declining over the following days.

[redacted] is located in an area which may have been impacted by delays in the use of the Horncastle FSR. However, in this case the building flooded after the sluice gate at the FSR was closed, suggesting that the delays were unlikely to have contributed to flooding. Likewise, there remains little evidence to suggest a significant connection between flood extents on the River Waring and flows on the River Bain.

In the case of the properties on Wharf Road and Church Lane, EA reporting suggests that flood depths on the River Waring would have been minimally increased by the partial closure of the Swimming Baths Sluice, which would have been insufficient to prevent internal flooding at the affected properties in this cluster.

8.6 Cluster-specific issues identified

No cluster-specific issues have been identified for the affected properties on Wharf Road and Church Lane. However, the issues identified in Section 17 would be applicable to the properties.

8.7 Risk Management Authorities

In relation to this flood event, the following RMA has relevant flood risk management functions:

- Environment Agency

A record as to whether the Environment Agency, as the relevant RMA, has exercised or is proposing to exercise its functions in response to the flood shall be monitored through the existing Joint Lincolnshire Flood Risk and Water Management Partnership.

The property owners also have a responsibility with regards to the resilience and resistance measures implemented at each property.

8.8 Cluster-specific recommendations

No cluster-specific recommendations have been identified for the affected properties on Wharf Road and Church Lane. However, the recommendations in Section 18 would be applicable to the properties.

9. Cluster 6 – Coronation Walk

9.1 Location

Cluster 6 covers three properties in the south-west of Horncastle (Figure 9.1). The first two of these – the [redacted], and [redacted] – are located on Coronation Walk.

The final property in the cluster is [redacted] West Street. All other properties on West Street have been considered separately within Cluster 8; however, [redacted] West Street is geographically closer to the properties on Coronation Walk and is considered likely to share a more similar flood mechanism. As such, it has considered within Cluster 6 instead.

The affected properties in this cluster are located at the confluence between the River Waring and River Bain. The River Bain then flows down the former path of the Horncastle Canal, with a weir located at this junction.

The former channel of the River Bain (the Old River Bain) is located off the River Waring. A sluice gate is present at the confluence between the River Waring and Old River Bain, known as the Swimming Baths Sluice (Photograph 6.1 in Appendix 20); its operation under normal conditions and during Storm Babet is discussed further within Sections 2.4.2 and 3.4.2, respectively. The Swimming Baths Sluice is typically left open by 50mm to control the flows down the Old River Bain.

The area surrounding the properties generally comprises flat and low-lying land, reflecting its position in the floodplain of the River Bain (Figure 9.2).

[redacted] is located between the River Bain and Old River Bain, with the River Waring to the north. It occupies a raised position compared to the channels of these watercourses, with an elevation of c. 28.5m AOD (compared to c. 26.0 to 27.0m AOD in each adjacent channel, subject to fluvial conditions and rainfall recharge impacting the derived levels).

[redacted] is located to the east of the Old River Bain, with the River Waring along its northern boundary. It is situated on land with an elevation of c. 27.8m AOD.

[redacted] West Street is located c. 20m west of the River Bain, on an alleyway connecting to West Street. The area surrounding this property generally falls to the east, with the property being situated on land with an elevation of c. 29.6m AOD (compared to c. 27.0m AOD in the adjacent channel).

(*Figure 9.1 – Location of the affected properties along Coronation Walk and the nearby watercourses*)

(*Figure 9.2 – LiDAR elevation data for the area surrounding the properties on Coronation Walk*)

9.2 Flood risk

9.2.1 The EA's flood mapping

According to the EA's Flood Map for Planning Purposes (Figure 9.3), [redacted] and [redacted] West Street are located in Flood Zone 2 and therefore are classified as having a medium probability of fluvial flooding. [redacted] is mapped within Flood Zones 2 to 3, with an associated medium to high probability of fluvial flooding.

Land to the north of the confluence between the River Waring and River Bain is located within Flood Zone 3, as are the channels of each watercourse.

According to the EA's Risk of Flooding from Rivers and the Sea map, the properties are at variable risk of fluvial flooding. [redacted] West Street is at very low fluvial flood risk (less than 0.1% AEP). Meanwhile, [redacted] is located in an area with very low to low (0.1 to 1% AEP) risk of fluvial flooding, and the [redacted] is located in an area with a low fluvial flood risk.

The properties are also at variable risk of flooding from surface water (Figure 9.4):

- [redacted] is situated on land with a very low risk of surface water flooding;
- [redacted] is situated on land with a low risk of surface water flooding (to the south, east and west). The land to the north is at very low pluvial flood risk;
- The stretch of West Street adjacent to [redacted] is at high risk (greater than 3.3% AEP) of surface water flooding, with a low risk extending onto the property itself.

(*Figure 9.3 – Fluvial flood zones in the area surrounding the affected properties on Coronation Walk)*

(*Figure 9.4 – Risk of surface water flooding in the area surrounding the affected properties on Coronation Walk)*

9.2.2 FloodSmart Analytics mapping

GeoSmart's FloodSmart Analytics mapping (Figure 9.5) indicates that all properties in the cluster have a very low risk of tidal flooding, as with the rest of Horncastle:

- [redacted] has a low risk of fluvial flooding and very low risk of surface water flooding. The north-western corner of the building has a high groundwater flood risk, with a very low groundwater flood risk covering the remainder;
- [redacted] has a low risk of fluvial flooding. The area surrounding the building is at low risk of surface water flooding, which infringes into the east of the building. Otherwise, the building is at very low risk of surface water flooding. The north-western and south-eastern corners of the building have a high groundwater flood risk, with a very low groundwater flood risk covering the remainder;
- [redacted] West Street has a low risk of fluvial flooding, high risk of surface water flooding and very low risk of groundwater flooding.

Figure 9.5 – Flood risk in the area surrounding the properties, according to FloodSmart Analytics mapping

(Figure 9.5a – Fluvial flood risk)

(Figure 9.5b – Tidal flood risk)

(Figure 9.5c – Surface water flood risk)

(Figure 9.5d – Groundwater flood risk)

9.3 Drainage arrangement

LCC drainage asset records at time of publication have been provided and are shown within Figure 9.6. This indicates that an Anglian Water surface water sewer is present which likely services [redacted] West Street, prior to discharging to the River Bain; however, otherwise the properties are not connected to the public sewer network.

LCC records confirm that highway drainage is not present on Coronation Walk or adjacent to [redacted] West Street. However, gullies were observed in the vicinity of the properties during the Site visit on 30 April 2024, with gullies and linear drains observed within the east of the car park.

According to data from the EA, natural high ground (classed as informal flood defences) is present continuously along all the considered watercourses at Coronation Walk. This provides a variable standard of protection for the surrounding land:

- The natural high ground on the southern bank of the River Waring is recorded as having a minimum crest level of 28.55m AOD, providing a 1 in 100 annual chance SoP;
- The natural high ground on the eastern and western banks of the Old River Bain has a minimum crest level of c. 18.58 and c. 18.92m AOD respectively (likely to be much higher in the study area), providing a 1 in 1 annual chance SoP;
- The natural high ground on the eastern bank of the River Bain (former Horncastle Canal section) is recorded as having a minimum crest level of 28.29m AOD, providing a 1 in 100 annual chance SoP;
- The natural high ground on the western bank of the River Bain (former Horncastle Canal section) is recorded as having a minimum crest level of 28.48m AOD, providing a 1 in 200 annual chance SoP;
- A stretch of natural high ground on the western bank of the River Bain, at its confluence with the River Waring, is noted to have a minimum crest level of 29.13m AOD, providing a 1 in 1000 annual chance SoP;

- Engineered high ground is present on the western bank of the River Bain adjacent to [redacted] West Street, with a minimum crest level of 29.13m AOD and a 1 in 200 annual chance SoP.

(*Figure 9.6 – LCC drainage assets and known sewer networks in the area surrounding the affected properties at the time of publication)*

9.4 Knowledge of flooding

Consultants from GeoSmart Information Ltd visited the affected properties on 30 April 2024 and undertook conversations with the [redacted] at the [redacted] and [redacted] of [redacted].

From these conversations, it is understood that flood waters first entered the [redacted] of [redacted] at 11:00 on 20 October 2023. This resulted in the [redacted] being closed for 2 to 3 days due to the essential plant being shut down. Flood waters reached a maximum depth of c. 150 to 200mm in the [redacted] and c. 300mm in the front car park.

Flood waters were confirmed as having originated from the nearby watercourses. They indicated that the flood level went down once the sluice gate at the Horncastle FSR was closed.

The [redacted] is noted to be located on the eastern side of the main building, at a lower elevation than this building. A ramp leads down to the entrance to the [redacted], which has thresholds c. 90mm above ground level.

The members of the [redacted] confirmed that flooding occurred via the same mechanism, with flood waters affecting this building prior to reaching [redacted]. Note that the extent of flooding could not be confirmed.

The resident was not in when [redacted] West Street was visited, and no information was returned via the LCC questionnaire; therefore, limited information is available regarding the flooding at this property.

The flood outline for the area surrounding Coronation Road is shown within Figure 4 of the Horncastle Asset Operation Failure Impact Assessment (EA, 2024). This figure indicates that flooding occurred throughout the [redacted] and to the east of [redacted] West Street and [redacted].

9.5 Flooding mechanism & Causation

From the available evidence, it is likely that flood waters at [redacted] and the [redacted] were fluvial in nature. The source of flooding at [redacted] West Street remains ambiguous but is likely to have a fluvial or pluvial source.

[redacted] and [redacted]

Flood waters generally were to the east of the building and travelled in an easterly / south-easterly direction. The river level along the River Waring also increased significantly more than the River Bain in the hours prior to 11:00 on 20 October 2023; between 09:00 and 11:00, the river level at the Banks Road gauge rose from 1.20 to 1.48m, compared to an increase from 0.86 to 0.95m at Victoria Mill gauge over the equivalent timescale.

Both these points are indicative of flood waters being sourced from the River Waring, with the River Bain being a comparatively limited source of flood waters for both buildings.

It is understood that the Swimming Baths Sluice was partially closed during Storm Babet, as discussed further within Section 3.4.2. Given the close proximity of this sluice to the properties, it seems likely that its poor operation contributed to the flooding experienced.

The EA's modelling included within the Horncastle Asset Operation Failure Impact Assessment (EA, 2024) appears to show a reduction in flood extent at the [redacted] between the observed scenario in Storm Babet (partial closure of the sluice) and the normal operation scenario (the sluice being fully open as intended). This would confirm that the sluice gate's partial closure may have contributed to flooding at this property.

However, no detailed information regarding the exact extent and depths at the properties has been sourced as part of this investigation. Therefore, it is not possible to confirm whether this reduction in flood extent and depths would be sufficient to avoid internal flooding of the [redacted].

It is noted that none of the modelled scenarios resulted in flooding adjacent to [redacted] and [redacted] West Street (as observed in Storm Babet). Therefore, the model runs do not confirm or disprove the impact of the partial closure of the Swimming Baths Sluice on these properties.

[redacted] West Street

Given the absence of detailed information regarding the flooding which occurred at [redacted] West Street, it is not possible to confirm the source of flooding.

The first option is that flood waters were sourced from the River Bain; this possibility would be consistent with the observed flood extent. In this situation, it is possible that flows from the Bain exited the channel and collected at the low point to the south-east of the property.

The second option is that flood waters were pluvial in nature, with an overland flow occurring along the alleyway at West Street. This would also be consistent with the observed flood extent and the topography of the area, as well as the high mapped surface water flood risk adjacent to the property (Figure 9.4). In this situation, high river levels on the Bain could have prevented these surface water flows from discharging into the watercourse.

It should be noted that the natural high ground on the western bank of the River Bain, at the point of flooding, is recorded as having a 1 in 1000 annual chance SoP. The EA's modelling suggested flows on the watercourse could have had a 1 in 1000 annual chance annual chance probability, so it is possible that this was exceeded; albeit it seems more likely that either the flood waters had a pluvial source, or the SoP of the banks would provide have been overcalculated.

On balance, surface water is considered the more likely flood source of the two options.

9.6 Cluster-specific issues identified

No cluster-specific issues have been identified for the affected properties on Coronation Walk. However, the issues identified in Section 17 would be applicable to the properties.

9.7 Risk Management Authorities

In relation to this flood event, the following RMAs have relevant flood risk management functions:

- Environment Agency
- Lead Local Flood Authority (Lincolnshire County Council)

A record as to whether the Environment Agency and Lincolnshire County Council, as the relevant RMAs, have exercised or are proposing to exercise their functions in response to the flood shall be monitored through the existing Joint Lincolnshire Flood Risk and Water Management Partnership.

9.8 Cluster-specific recommendations

9.8.1 Improvements to riverbank defences

Consideration should be given to locally improving the banks of the River Waring adjacent to [redacted] and the [redacted], which could potentially include raising and/or reinforcing the defences. This would provide both properties with some additional protection.

Consideration may also be given to undertaking dredging works in the channel of the watercourse to remove any build-up of silt and plant material.

The powers for considering the raising of the riverbank would lie with the EA.

10. Cluster 7 – Lincoln Road

10.1 Location

Cluster 7 covers three properties on Lincoln Road, in the north-west of Horncastle (Figure 10.1). This includes two properties which are confirmed to have experienced internal flooding [redacted], as well as one property at which the severity of flooding has not been confirmed [redacted].

The properties are c. 370m from one another, and the same exact flood mechanism is unlikely to apply to both. However, given their relative isolation from the other affected properties, they have been considered in conjunction with one another.

There are no surface water features within close proximity of either property.

Ground levels in the area surrounding the properties fall in a south-easterly direction, towards the centre of Horncastle and the associated watercourses. Lincoln Road and the properties to the west of it appear to have particularly low ground levels compared to the surrounding land.

Ground levels at [redacted] generally fall in an easterly direction (Figure 10.2). The property appears to occupy a local depression relative to the surrounding land, with an elevation of c. 43.3 to 43.4m AOD. However, although this is noted to not be a significant feature, with the highway having an elevation of c. 43.4 to 43.6m AOD immediately adjacent to the property.

Ground levels at [redacted] form a local depression relative to the land to the south and west. The land to the west falls quite steeply towards the property, with the easternmost section of John Brown Close having particularly low ground levels. The property is situated on land with an elevation of c. 36.3m AOD.

(*Figure 10.1 – Location of the affected properties along Lincoln Road*)

(*Figure 10.2 – LiDAR elevation data for the area surrounding the properties on Lincoln Road*)

10.2 Flood risk

10.2.1 National flood mapping

According to the EA's Flood Map for Planning Purposes, both affected properties are located in Flood Zone 1 and are therefore classified as having a low probability of flooding from rivers, acknowledging the caveat outlined in Section 2.2.1.

According to the EA's RoFRS map, both properties occupy land that has a very low risk of fluvial and tidal flooding (less than 0.1% AEP).

[redacted] is situated on land where there is a very low (less than 0.1% AEP) to medium (1 to 3.3% AEP) risk of surface water flooding (Figure 10.3). The rear (south-west corner) of the property has a medium risk of surface water flooding, whilst the adjacent highway has a low surface water flood risk, which extends into the south-eastern corner of the building.

[redacted] is also situated on land with a very low to medium risk of surface water flooding. An area to the west of the property is mapped at medium surface water flood risk, perhaps representing an isolated area of ponding; the remainder of the surrounding area has a very low surface water flood risk.

(*Figure 10.3 – Risk of surface water flooding in the area surrounding the affected properties on Lincoln Road)*

10.2.2 FloodSmart Analytics mapping

GeoSmart's FloodSmart Analytics mapping (Figure 10.4) indicates that [redacted] are both at very low risk of fluvial, tidal and groundwater flooding.

[redacted] is mapped as having a low to medium risk of surface water flooding. The south-west corner of the property has a medium surface water flood risk, whilst the area surrounding the property, including the adjacent highway, has a low surface water flood risk.

[redacted] is mapped as having a very low to medium risk of surface water flooding, with a medium risk mapped in the north of the building and the remainder of the property being mapped at very low risk.

Figure 10.4 – Flood risk at [redacted] according to FloodSmart Analytics mapping

[redacted]

10.3 Drainage arrangement

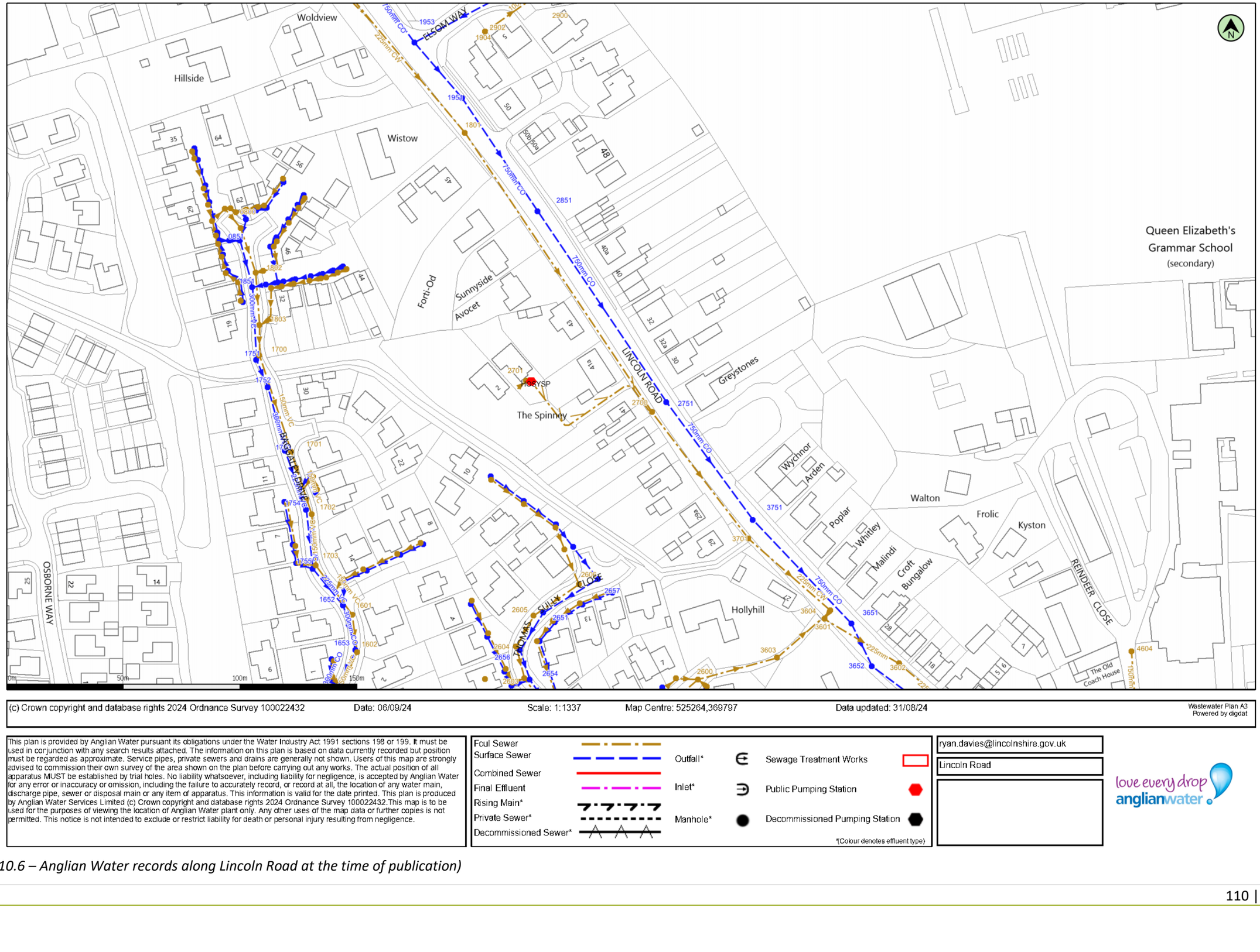
LCC and Anglian Water records at time of publication have been provided and are shown within Figures 10.5, 10.6 and 10.7. These indicate that the properties are all served by surface water and foul sewers.

highway drainage is present along Lincoln Road, with numerous gullies being present within close proximity to the properties. These gullies are generally recorded as being without defect.

According to LCC records, the gullies along Lincoln Road are cleansed on an annual cycle and were last cleaned in August and September 2023. Most gullies had an 'amber' silt level prior to the last cleanse. Note that both gullies adjacent to [redacted] and to the south-east of [redacted] were recorded as having a 'red' silt levels prior to the last cleanse.

highway gullies are also present on John Brown Close (to the west of [redacted]). According to LCC records, these are cleansed on a biennial cycle, with the last cleansing works occurring in August 2023. The silt level in the gullies on the northern side of the road was recorded as 'green' (prior to the last cleanse). It is noted that the two gullies on the southern side of the road had a jammed lid and therefore could not be cleansed during the last inspection; the lids on these gullies are understood to have since been freed off.

(*Figure 10.5 – LCC records along Lincoln Road at the time of publication)*



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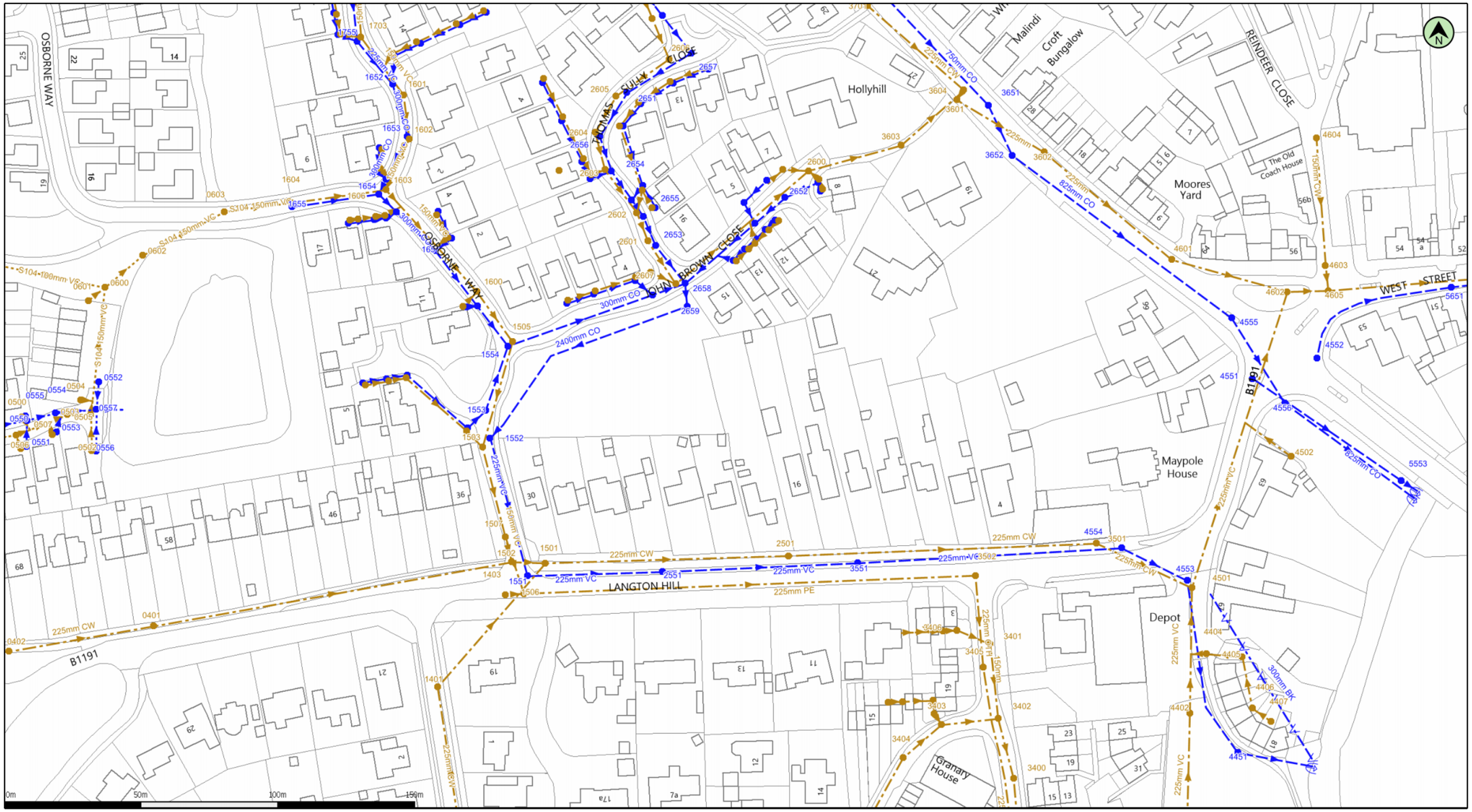
Foul Sewer
Surface Sewer
Combined Sewer
Final Effluent
Rising Main*
Private Sewer*
Decommissioned Sewer*
Outfall*
Inlet*
Manhole*
Sewage Treatment Works
Public Pumping Station
Decommissioned Pumping Station
*(Colour denotes effluent type)

ryan.davies@lincolnshire.gov.uk
Lincoln Road

love every drop anglianwater

(*Figure 10.6 – Anglian Water records along Lincoln Road at the time of publication)*



Date: 06/09/24 | Scale: 1:1337 | Map Centre: 525266,369569 | Data updated: 31/08/24

Wastewater Plan A3
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Foul Sewer
Surface Sewer
Combined Sewer
Final Effluent
Rising Main*
Private Sewer*
Decommissioned Sewer*
Outfall*
Inlet*
Manhole*
Sewage Treatment Works
Public Pumping Station
Decommissioned Pumping Station
*(Colour denotes effluent type)

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John Brown Close

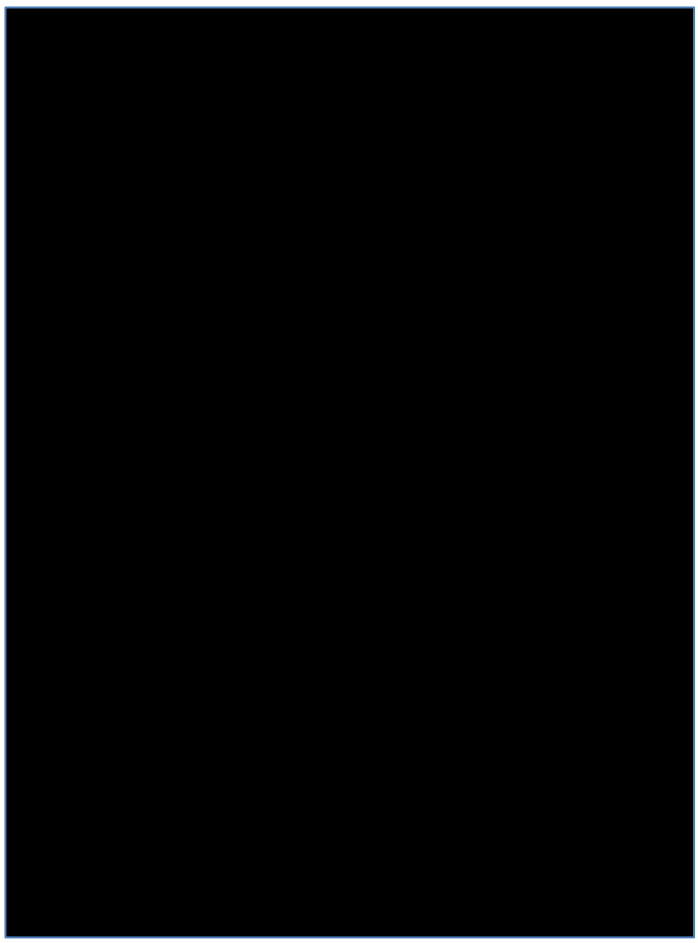
love every drop anglianwater

(*Figure 10.7 – Anglian Water records along John Brown Close at the time of publication)*

10.4 Knowledge of flooding

Consultants from GeoSmart Information Ltd visited the affected properties on Lincoln Road on 30 April 2024.

From conversations with the resident at [redacted], it is understood that flood waters first entered the property via the front and rear doors at 09:00 on 20 October 2023 (Figure 10.8). Flood waters remained in the building for less than 1 day, although it took 3 to 4 days to dry out. Utilities were not impacted.



(*Figure 10.8 – evidence of external flooding at* [redacted]*, Source: taken by LCC contractor during the provision of sandbags*)

The rear garden also flooded, reaching a maximum depth of 300mm externally. There was no flooding on Lincoln Road; the resident reported that the highway drainage worked well, with the system recently having been jetwashed.

The resident at [redacted] attributed the source of flooding from surface water, which was travelling in an easterly direction from John Brown Close (to the west). They also indicated that the situation was exacerbated by bow waves from passing cars along Lincoln Road (albeit significant standing water on the road was not reported).

Note: conversations from the resident at [redacted] John Brown Close confirm that they did not experience internal flooding. However, flood waters were reported beneath the floor boards. The residents confirmed that flood waters reached a maximum depth of 200mm on the highway, prior to travelling in an easterly direction towards Lincoln Road.

Standing water was also reported on John Brown Close during Storm Henk in January 2024, during which a manhole was reported as surcharging. A report of this was not made during Storm Babet.

No response was received from the residents at [redacted] and therefore no details are available regarding the flooding that occurred at this property.

10.5 Flooding mechanism & Causation

From the available evidence, surface water is the only viable source of flooding at both properties.

The topography of the area is such that surface water flooding falling to the west of [redacted] is likely to flow in an easterly direction, channelled down the alleyway connecting John Brown Close and Lincoln Road and into the property. Flood waters are then able to accumulate in the areas adjacent to the front door and garden, given the particularly low topography at this point when compared to the surrounding area.

A surcharging manhole was reported along John Brown Close during Storm Henk. However, this was not reported during Storm Babet by the property residents; as such, this is considered unlikely to have contributed appreciably to internal flooding in October 2023.

In the case of [redacted], it is possible that surface water collected in the rear garden and entered the property via the rear walls / doors. However, in the absence of detailed information, the root cause of flooding (beyond extreme rainfall intensity) cannot be confirmed.

10.6 Issues identified

10.6.1 Limited highway drainage on John Brown Close

According to records held by LCC and observations from the Site visit, highway gullies are present on John Brown Close. However, there is a general absence of highway drains on the easternmost section of the highway. The alleyway also lacks any formal drainage features.

Given the absence of highway gullies or intervening features in the easternmost section of John Brown Close, any surface water which collects in this area would not be drained away. Therefore, ponding could occur, with the subsequent development of an overland flow down the alleyway once the kerb was exceeded.

10.7 Risk Management Authorities

In relation to this flood event, the following RMAs have relevant flood risk management functions:

- Lead Local Flood Authority (Lincolnshire County Council)

A record as to whether Lincolnshire County Council, as the relevant RMA, has exercised or is proposing to exercise its functions in response to the flood shall be monitored through the existing Joint Lincolnshire Flood Risk and Water Management Partnership.

The property owners also have a responsibility with regards to the resilience and resistance measures implemented at each property.

10.8 Recommendations

10.8.1 Intervening highway drainage on John Brown Close

Given that surface water from [redacted] resulted from an overland flow developing on John Brown Close, it is recommended that consideration is to be given to installing additional highway drainage on the easternmost section of this road by LCC.

Alternatively, intervening drainage (e.g. a linear drain) could be constructed at the junction between John Brown Close and the alleyway connecting it to Lincoln Road. This would reduce the potential for an overland flow route to develop on the alleyway and improve the drainage along the highway.

The powers for considering the above betterments would lie with LCC, in its capacity as the highways Authority.

11. Cluster 8 – Bridge Street, West Street & Grundy's Court

11.1 Location

Cluster 8 covers 8 known internally flooded properties in the centre of Horncastle (Figure 11.1). This includes:

- 1 property on Manor House Street ([redacted]);
- 4 commercial properties on Bridge Street ([redacted]);
- 2 commercial properties on West Street ([redacted]); and
- 1 property on Grundy's Court [redacted].

The properties are located adjacent to the northern bank of the River Bain, with the furthest property being c. 40m north. The only exception to this is [redacted], which is located c. 30m south of the River Bain; this property is accessible off Manor House Street but is otherwise geographically close to the other affected properties in this cluster.

Ground levels in the area surrounding the properties fall in a southerly direction, towards the River Bain. However, the junction between Prospect Street, West Street and Bridge Street forms a low point, which locally extends in a westerly direction.

Ground levels are generally between 28.6 and 28.7m AOD at the properties on Bridge Street, 28.6 to 28.9m AOD for the properties on West Street, and 29.0 to 29.1m AOD for the property on Grundy's Court (Figure 11.2). [redacted] is set at c. 28.6 to 29.3m AOD.

The properties on West Street and Bridge Street generally have threshold levels set at or only slightly above highway level. The kerbs along the street are generally only slightly raised above highway level. The highway falls in a southerly direction, with the properties on the south side of the road set lower than those on the northern side.

[redacted] is noted to have raised threshold levels surrounding the surrounding ground levels, with the front door appearing to be raised by c. 1 m.

(*Figure 11.1 – Location of the affected properties on Bridge Street and West Street*)

(*Figure 11.2 – LiDAR elevation data for the area surrounding West Street and Bridge Street*)

11.2 Flood risk

11.2.1 National flood mapping

According to the EA's Flood Map for Planning Purposes (Figure 11.3), the affected properties are all located in Flood Zone 3 and are classified as having a high probability of flooding from rivers, acknowledging the caveats outlined in Section 2.2.1. The only exception to this is [redacted], which is located on the boundary between Flood Zones 2 and 3, with an associated medium to high probability of flooding.

According to the EA's RoFRS map, all the considered properties occupy land that has a low risk of fluvial and tidal flooding.

The properties within the cluster are located on land with a variable risk of surface water flooding, ranging from very low to high (Figure 11.4).

The stretch of Bridge Street adjacent to the properties is at medium risk of surface water flooding, whilst the stretch of West Street adjacent to the properties is at high risk.

The land to the rear of [redacted] is mapped at low risk of surface water flooding, whilst the land surrounding [redacted] is mapped as having a low to medium surface water flood risk. The other properties occupy land that has a very low risk other than what is afforded to them by the adjacent highways and Bain.

(*Figure 11.3 – Fluvial flood zones in the area surrounding the affected properties on Bridge Street and West Street*)

(*Figure 11.4 – Risk of surface water flooding in the area surrounding the affected properties on Bridge Street and West Street*)

11.2.2 FloodSmart Analytics mapping

GeoSmart's FloodSmart Analytics mapping (Figure 11.5) indicates that all the affected properties on Bridge Street and West Street are at medium risk of fluvial flooding.

There is a variable risk of surface water flooding in the area surrounding the properties. An area at high risk of surface water flooding is present along Bridge Street, which infringes across [redacted]. West Street has a mapped low to medium surface water risk which infringes onto the adjacent properties, whilst [redacted] has a very low to low surface water flood risk.

[redacted] are mapped as having a high risk of groundwater flooding, whilst [redacted] have a low groundwater flood risk. The remaining properties in the cluster have a very low mapped risk of groundwater flooding.

Figure 11.5 – Flood risk at Bridge Street and West Street according to FloodSmart Analytics mapping

11.3 Drainage arrangement

LCC and Anglian Water drainage records at time of publication have been provided and are shown within Figure 11.6 and 11.7. This indicates that there is significant highway drainage along Bridge Street and West Street, adjacent to the properties.

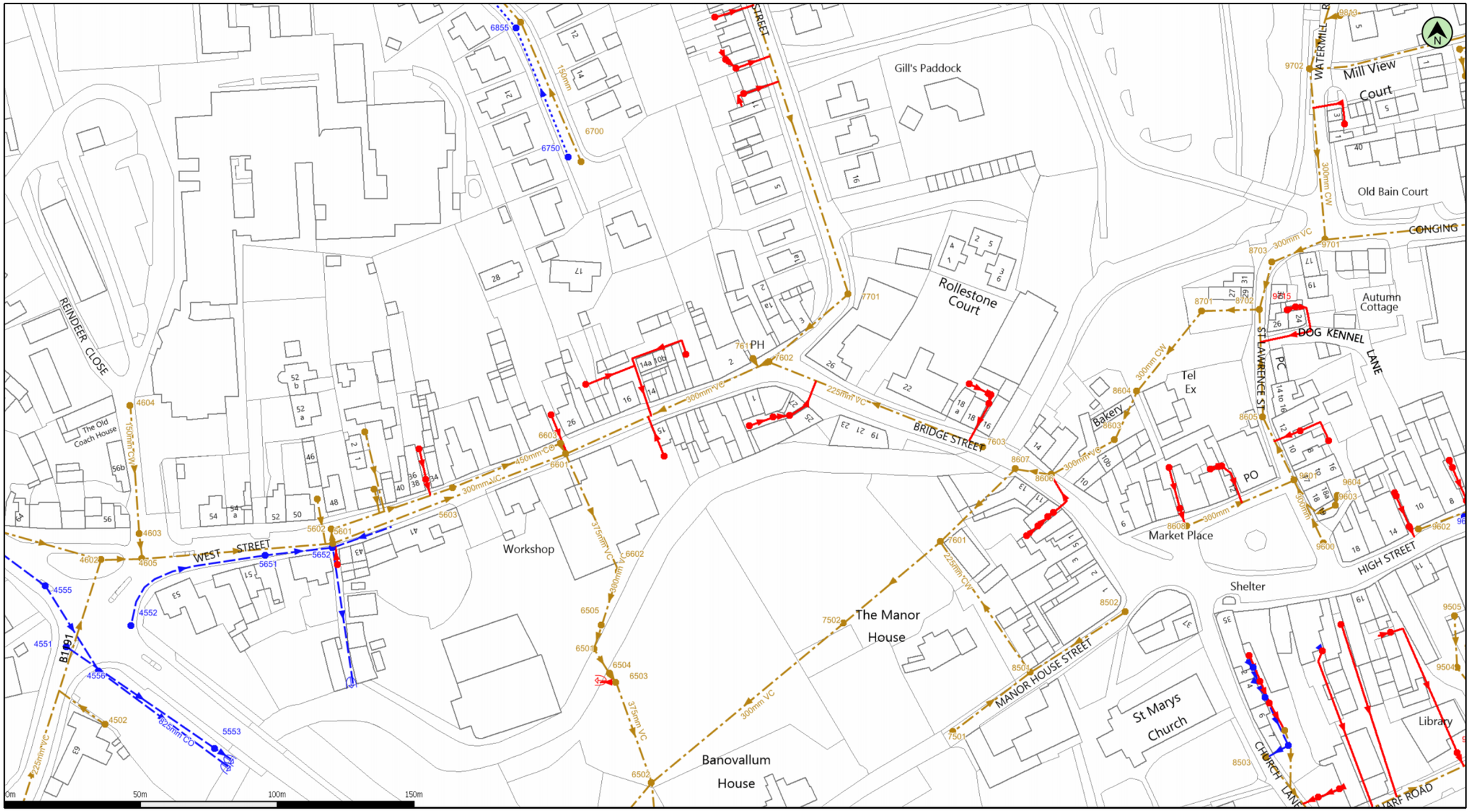
According to records held by LCC, the majority of the gullies are without defect and are inspected on a biennial cycle. They were last cleansed in August and September 2023, with a 'amber' silt level recorded prior to the last cleanse. One gully is noted to be with defect at the junction between Prospect Street and the adjacent highways. This defect is understood to be an undefined blockage. The gully was also recorded as having an 'amber' silt level prior to the last cleanse.

According to data from the EA, flood defences are present continuously along the River Bain as it passes adjacent to the cluster. This provides a variable standard of protection for the surrounding land:

- Natural high ground is present along the northern bank of the River Bain (directly to the south of [redacted]) with a minimum crest level of 28.84m AOD, providing a 1 in 100 annual chance SoP;
- Engineered high ground is present on the southern bank of the River Bain c. 20m north of [redacted]. This has a minimum crest level of 29.35m AOD, which provides a 1 in 100 annual chance SoP;
- An embankment is present on the southern bank of the River Bain c. 40m north-west of [redacted]. This has a minimum crest level of 29.35m AOD, which provides a 1 in 100 annual chance SoP.

During the Site visit on 30 April 2024, the highway gullies appeared to be in reasonable condition.

(*Figure 11.6 – LCC drainage records for the area surrounding the properties in Cluster 8 at the time of publication)*



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Foul Sewer
Surface Sewer
Combined Sewer
Final Effluent
Rising Main*
Private Sewer*
Decommissioned Sewer*
Outfall*
Inlet*
Manhole*
Sewage Treatment Works
Public Pumping Station
Decommissioned Pumping Station
*(Colour denotes effluent type)

ryan.davies@lincolnshire.gov.uk
S19-729
Cluster 8 - Anglian Water Sewer Records

love every drop anglianwater

(*Figure 11.7 – Anglian Water sewer assets in the area surrounding the properties in Cluster 8 at the time of publication*)

11.4 Knowledge of flooding

Consultants from GeoSmart Information Ltd visited the affected properties on Bridge Street and West Street on 30 April 2024. Within conversations and responses to the LCC questionnaire (ref: [redacted]), the following information has been collated:

- Flood waters first entered the properties between 15:00 and 16:00 on 20 October 2023;
- Flood depths at the properties were variable. At [redacted], internal flooding reached a depth of c. 460 mm, whilst at [redacted] it reached c. 410 mm;
- Flood waters continued to rise until at least 20:00 but had receded by the following morning, indicating flood waters were present within the buildings for 12-18 hours;
- Images of the flooding (e.g. Photograph 8.1 in Appendix 20) indicate the highway was flooded. It is understood from conversations with business owners and residents that flood depths in the highway reached at least 600 mm;
- It was possible to exit the properties, but only by wading through flood waters;
- Utilities were not impacted for at least one property.

Flood waters were generally attributed to the River Bain. Accounts vary in terms of whether flows were received from Prospect Street, with one business owner indicating there were strong flows from this highway, and another suggesting no flows came from this street.

11.5 Flooding mechanism & Causation

From the available evidence, it is likely that flood waters on Bridge Street and West Street originated from the River Bain, which overtopped its banks downstream of Bridge Street. Flood waters travelled in a northerly direction towards the properties on Bridge Street and West Street, and also travelled in a southerly direction towards [redacted].

A depression is noted to be present c. 10m east of the junction between Bridge Street and West Street, within which fluvial flows are able to collect. This likely built up and extended westerly towards West Street, which is located at a lower elevation compared to the highway to the east of the Bain.

[redacted] are located adjacent to the northern bank of the River Bain. It is unclear from the available evidence if flood waters directly entered the properties via the rear walls, or if flood waters primarily entered from the highway via the front door and walls. Either would be plausible methods of entry that are consistent with the mechanism of flooding.

It is not known whether any additional flows were sourced from Prospect Street. To the south of Prospect Street (as discussed in Cluster 9 – see Section 12), the highway is relatively level and there is no obvious flow route connecting the two roads. However, given the volume of water involved in flooding during Storm Babet, it seems reasonable to assume that some flood waters were sourced from Prospect Street, albeit with the primary source of flood waters being the Bain to the south of most of the properties.

There remains potential for surface water to have contributed to flooding, given the relatively low ground levels in the vicinity of the properties and the extreme rainfall intensity

experienced during Storm Babet. However, this source is considered to have been insignificant compared to flooding from the River Bain.

The properties in this cluster are located in an area which may be impacted by delays in the use of the Horncastle FSR. However, in this case the properties flooded after the sluice gate at the FSR was closed, suggesting that the delays were unlikely to have contributed to flooding.

11.6 Cluster-specific issues identified

No site-specific issues have been identified for the affected properties on West Street and Bridge Street. However, the issues provided in Section 17 would be applicable to the properties.

11.7 Risk Management Authorities

In relation to this flood event, the following RMA has relevant flood risk management functions:

- Environment Agency

A record as to whether the Environment Agency, as the relevant RMA, has exercised or is proposing to exercise its functions in response to the flood shall be monitored through the existing Joint Lincolnshire Flood Risk and Water Management Partnership.

The property owners also have a responsibility with regards to the resilience and resistance measures implemented at each property.

11.8 Cluster-specific recommendations

No cluster-specific recommendations have been identified for the affected properties on Bridge Street and West Street. However, the recommendations provided in Section 18 would be applicable to the properties.

12. Cluster 9 – Prospect Street

12.1 Location

Cluster 9 covers 20 known internally flooded properties on Prospect Street in central Horncastle (Figure 12.1). The properties have been grouped due to their location on the same street; however, they can be sub-grouped into two clusters, which are located 100m apart:

- Northern Prospect Street [redacted]
- Southern Prospect Street [redacted]

Four properties at which the extent of flooding has not been confirmed are also present within the southern cluster. It is noted that all known internally flooded properties in the southern cluster are located on the [redacted] side of the road.

All the properties are located c. 100m from an unnamed watercourse which forms part of the Horncastle Ings System; this is understood to be a former mill leat which was constructed to provide water for a former mill in the area. This watercourse forms the western side of a basin (sometimes known as "Watermill Basin"), with the River Bain forming its eastern side.

A drain connecting to this unnamed watercourse is noted to be c. 70m east of the properties in the northern Prospect Street cluster.

The River Bain is located c. 80m south of the southernmost property in the southern Prospect Street cluster.

Ground levels along Prospect Street generally fall in a southerly direction, following the flow direction of the River Bain (Figure 12.2). The wider area also falls in an easterly direction, reflecting low-lying land, used as amenity space, between the highway and watercourse.

The properties in the northern cluster have ground levels between 29.1 and 29.7m AOD, whilst the properties in the southern cluster have ground levels between 28.7 and 29.0m AOD. It is noted that the properties in the southern cluster generally have lower ground levels than the surrounding land to the west, north and south (and generally lower than the properties on the eastern side of the highway). The properties which internally flooded in the northern cluster are also broadly in an area of low lying land relative to the surrounding area.

The majority of the properties which flooded along Prospect Street have thresholds set adjacent to the highway, which are generally only raised slightly above highway level (maximum of 150mm above the highway). In the northern cluster in particular, the dwellings have threshold levels set at ground level; kerbs along this stretch of the highway are also minimally raised.

(*Figure 12.1 – Location of the affected properties along Prospect Street)*

(*Figure 12.2 – LiDAR elevation data for the area surrounding Prospect Street)*

12.2 Flood risk

12.2.1 National flood mapping

According to the EA's Flood Map for Planning Purposes, all the properties in the southern cluster are located within Flood Zone 3 and are therefore classified as having a high probability of flooding from rivers (Figure 12.3), acknowledging the caveats raised in section 2.2.1.

One of the seven properties in the northern cluster is also located within Flood Zone 3. Three properties are located on the boundary between Food Zones 2 and 3, whilst the remaining three properties are located entirely within Flood Zone 2, with an associated medium probability of flooding from rivers.

According to the EA's RoFRS mapping, all the affected properties in both clusters occupy land that has a low risk of fluvial flooding (0.1 to 1% AEP).

The properties on Prospect Street are located on land with a variable risk of surface water flooding (Figure 12.4). A high risk of surface water flooding is mapped throughout the highway, which partially infringes onto the adjacent properties. Otherwise, within the southern cluster, four properties are situated on land with a low risk of surface water flooding [redacted] and one is situated on land with a low to medium surface water flood risk [redacted], with the remainder situated on land having a very low risk.

Meanwhile, within the northern cluster, one property is situated on land with a high risk of surface water flooding [redacted], two properties are situated on land with a low surface water flood risk [redacted], and one is situated on land with a medium surface water flood risk [redacted]. The remaining properties are situated on land with a very low surface water flood risk (aside from the high risk derived from the highway).

(*Figure 12.3 – Flood zone mapping in the area surrounding the affected properties)*

(*Figure 12.4 – Risk of surface water flooding in the area surrounding the affected properties)*

12.2.2 FloodSmart Analytics mapping

GeoSmart's FloodSmart Analytics mapping (Figure 12.5) indicates that all the properties are at very low risk of tidal flooding.

Three properties in the northern cluster have a medium to high risk of fluvial flooding, with the remaining four having a medium fluvial flood risk. All thirteen properties in the southern cluster have a medium fluvial flood risk.

Two properties in the northern cluster have a high risk of pluvial flooding. Two have a low to high risk, two have a very low to high risk and one has a very low to low risk.

One property in the southern cluster has a low to high pluvial flood risk, and four have a low risk of pluvial flooding. The remaining properties are mapped adjacent to an area at high risk of pluvial flooding, which infringes into the buildings due to the resolution of the mapping; otherwise they are mapped as having a very low risk.

One property in the northern cluster has a high risk of groundwater flooding, with the remaining properties in this cluster having a very low risk.

Six properties in the southern cluster are mapped as having a high risk of groundwater flooding, with a further three properties mapped as having a very low to medium risk of groundwater flooding. The remaining properties in this cluster have a very low groundwater flood risk.

Figure 12.5 – Flood risk at Prospect Street according to FloodSmart Analytics mapping

12.3 Drainage arrangement

LCC and Anglian Water asset records at time of publication have been provided and are shown within Figures 12.6 and 12.7. Figure 12.6 indicates the presence of significant highway drainage along Prospect Street, with gullies spaced throughout the highway. All these gullies were recorded either as being without defect or having a vehicle parked over (i.e. unable to be inspected).

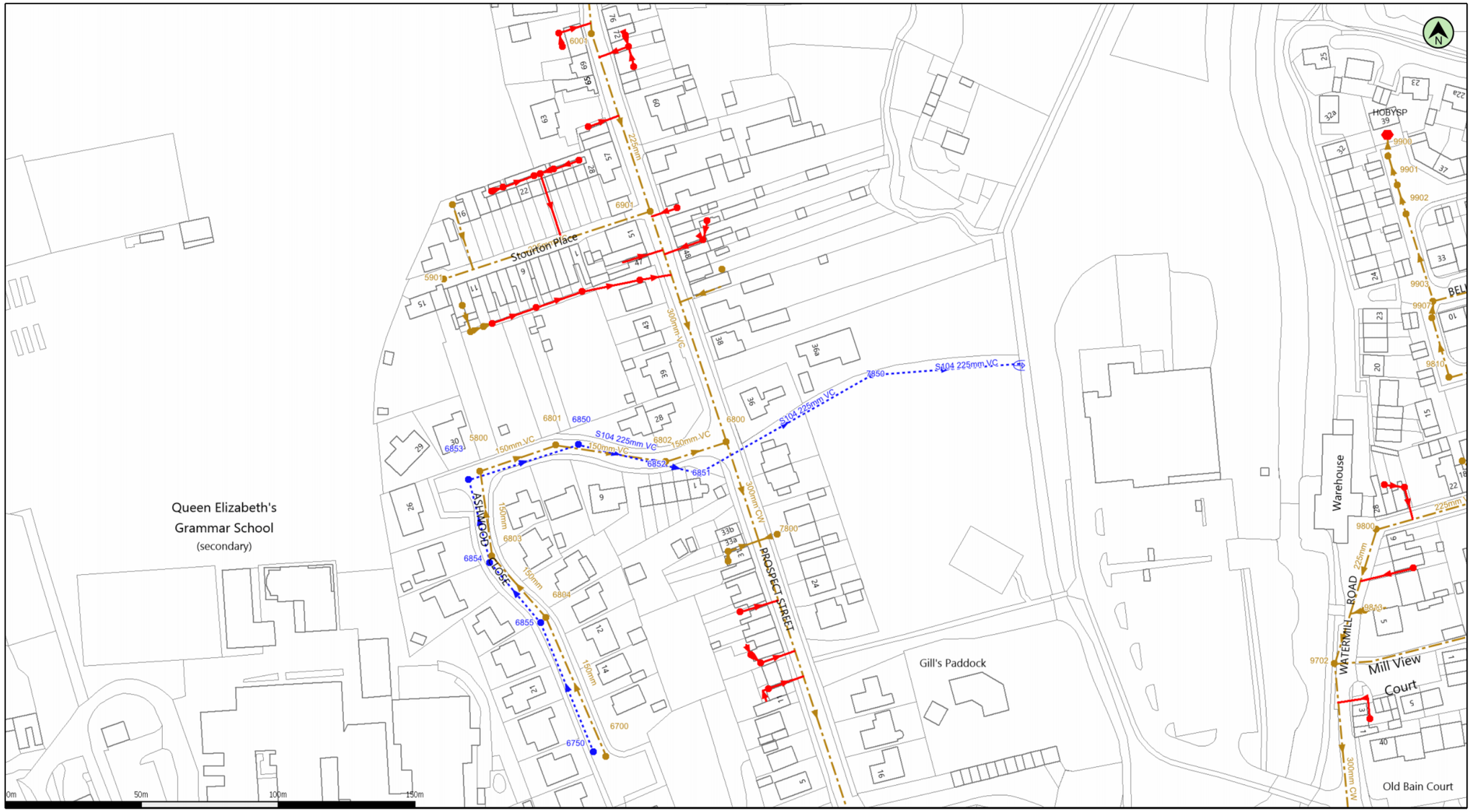
According to LCC records, the gullies are inspected on an annual cycle, with the most recent cleansing works occurring in August 2023. The majority of gullies were classified as having an 'amber' silt level prior to the last cleanse.

During the Site visit on 30 April 2024, the gullies were generally observed to be in reasonable condition.

According to data from the EA, no flood defences are located on the unnamed watercourse to the east of the properties. However, engineered / natural high ground is present along the northern / western banks of the River Bain:

- On the northern bank of the River Bain as it passes downstream of Bridge Street, natural high ground is present, which has a minimum crest level of 28.84m AOD and provides a 1 in 100 annual chance standard of protection;
- Upstream of Bridge Street, the western bank of the River Bain comprises engineered high ground, which also has a minimum crest level of 28.84m AOD and provides a 1 in 100 annual chance standard of protection.

(*Figure 12.6 – LCC drainage records along Prospect Street)*



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Foul Sewer
Surface Sewer
Combined Sewer
Final Effluent
Rising Main*
Private Sewer*
Decommissioned Sewer*
Outfall*
Inlet*
Manhole*
Sewage Treatment Works
Public Pumping Station
Decommissioned Pumping Station
*(Colour denotes effluent type)

ryan.davies@lincolnshire.gov.uk
Prospect Street

love every drop anglianwater

(*Figure 12.7 – Anglian Water public sewer records along Prospect Street*

12.4 Knowledge of flooding

Consultants from GeoSmart Information Ltd visited the affected properties on 30 April 2024. Conversations were held with the resident at [redacted], and further information was provided within the LCC questionnaire from the residents at two properties ([redacted] and [redacted]; questionnaire ref: [redacted]).

From the conversations and questionnaires, it is understood that flood waters in the north of Prospect Street entered the properties between 02:00 and 16:30 on 20 October 2023, remaining in the properties for 6-12 hours. Flood waters entered [redacted] via the doors, reaching a maximum depth of 10mm in the building.

Meanwhile, at [redacted], flood waters entered through the walls, reaching a maximum depth of 100mm internally. Initially flood waters were sourced from the adjacent garden. Later, water entered through the party wall between them and the neighbouring dwelling (assumed but not confirmed [redacted]) as the neighbouring property flooded.

The resident at [redacted] indicated that flood waters exceeded the kerb on the highway and entered the property, causing dampness in the carpets.

The residents confirmed they were able to leave their properties, albeit by wading through flood waters. Utilities were generally not impacted, although power was affected at [redacted]. A previous flood event also occurred in 2012 which caused internal flooding at the properties.

No residents were available to speak to at any of the affected properties in the southern cluster, and there were no responses to the LCC questionnaire. Therefore, detailed information for these properties is not available.

A video provided to LCC by the resident at [redacted] indicates that flood waters were clean (i.e. they did not contain significant silt).

More broadly, according to Figure 4 of the Horncastle Asset Operation Failure Impact Assessment (EA, 2024), the properties in the southern cluster are included within the mapped flood outline extending from the River Bain to the east. This same figure indicates that there is no continuity between flooding from the River Bain and the properties in the northern cluster, which is consistent with information from the residents.

The Horncastle Asset Operation Failure Impact Assessment (EA, 2024) included modelling, with separate scenarios considering the sluice gate at the Horncastle FSR when opened late (i.e. what happened in Storm Babet) and closed at the correct time (i.e. normal operation). According to the EA's comparison of these scenarios, there would be a reduction in flood depths in the area between Prospect Street and the River Bain by 12mm during a normal operation scenario. The report concluded that, "*given the depth of flooding such a small difference would not change the impact at individual properties and is within model tolerances.*"

12.5 Flooding mechanism & Causation

From the available evidence, flood waters were likely to have been sourced separately within the northern and southern clusters. These are considered separately below:

Northern cluster ([redacted])

Flood waters in the northern cluster are likely to have had a primarily surface water source during Storm Babet. There is no evidence to suggest that any flood waters were sourced from the River Bain or any other watercourse, with resident accounts indicating this was sourced from surface water or sewers.

The properties are generally set in an area with lower ground levels than the surrounding land. They have thresholds which are set at highway level and are set immediately adjacent to it. Kerbs are minimally raised relative to the main highway.

It is likely that surface water would collect within the highway. Once this had exceeded the kerbline, flows would preferentially travel towards the dwellings, entering through doors (and walls where these are not watertight).

Given that garden areas are also generally lower than the surrounding area, surface water could also collect in these areas, providing a source of flood water to the properties from the rear.

At this stage there is insufficient information to confirm whether there were any deficiencies in the highway drainage network or public sewer network which could contribute to flooding. It is not known whether this could have been exacerbated by blockages or defects in the system. However, the rainfall event has an estimated 2.2% AEP (Section 3.2), there is reasonable potential for the capacity of the drainage network to have been exceeded, and backing up of surface water could have occurred regardless of whether any problems were present, especially when considering the likely flooding mechanism of the southern cluster and the outfall of the drainage system into the River Bain / unnamed watercourse to the east of the properties.

Southern cluster ([redacted])

Flood waters in the southern cluster are likely to have had a primarily fluvial source. Whilst there is potential for surface water to have contributed to the flooding experienced (e.g. by backing up along the road), particularly in the north of the cluster, it seems more likely that this was insignificant compared to flows from the River Bain.

The land to the east of Prospect Street is low-lying and forms a natural part of the floodplain for the River Bain. It is likely that this area flooded once the banks of the River Bain were overtopped. Following this, out of bank flows from the River Bain could travel in a south-westerly direction towards Prospect Street, causing fluvial flows to travel down the highway.

The known internally flooded properties in the southern cluster are generally located in the lowest lying land on the road. The majority are noted to be set on the road, with threshold levels set a maximum of 150mm above the highway. Therefore, any fluvial flows on the road

would preferentially enter the properties once the kerb line was exceeded. The properties on Prospect Street are located in an area which may be impacted by delays in the use of the Horncastle FSR. According to the EA's reporting, the delay in the closure of the sluice gate at the FSR did not result in an increase in peak flows in Horncastle and therefore would not be the direct cause of flooding at the affected properties.

It is noted that an independent review of the EA's reporting is being undertaken to confirm the plausibility of the EA's conclusions. However, at this stage it appears that the extreme flows on the River Bain were the primary cause of flooding, as opposed to the operational failure at the Horncastle FSR.

12.6 Cluster-specific issues identified

12.6.1 Insufficient capacity within the surface water drainage system

The surface water drainage network along Prospect Street may have had insufficient capacity for the level of rainfall experienced, which could have contributed to surface water flooding in the northern cluster.

The rainfall experienced during Storm Babet was extreme and has been estimated at a 2.2% AEP event. This may have overwhelmed the drainage network, not just on Prospect Street, but across much of Horncastle.

Notwithstanding this, it is likely that the functioning of the drainage network was also reduced or compromised by fluvial waters in the south of Prospect Street, which could have had a backing up effect by preventing runoff from being discharged to the River Bain.

It is possible that deficiencies (such as broken pipes or the collection of debris) reduced the capacity of the drainage network during Storm Babet. However, given the rainfall intensity experienced as well as fluvial flooding in the vicinity, it seems unlikely that problems in the network would have significantly contributed to flooding. Even if the system was optimal during Storm Babet, surface water flooding would likely still have occurred.

12.6.2 low kerb height and threshold levels

The kerbs along Prospect Street, adjacent to the affected properties, appear not to be significantly raised, and threshold levels at the affected properties generally appeared to be set at or only slightly higher than the adjacent pavement level. This meant that the kerbs and thresholds were easily exceeded by flood waters, contributing to flows entering the buildings.

It should be noted that the flood depths in the south of Prospect Street originating from the River Bain are unknown; therefore, it cannot be confirmed whether the absence of a significantly raised kerb height contributed to flooding in this cluster.

However, flood depths appear to be lower in the northern cluster and therefore a higher kerb and/or higher threshold levels may have reduced the extent of internal flooding experienced in each property.

12.7 Risk Management Authorities

In relation to this flood event, the following RMAs have relevant flood risk management functions:

- Environment Agency
- highways Authority & Lead Local Flood Authority (Lincolnshire County Council)

A record as to whether the Environment Agency and LCC, as the relevant RMAs, have exercised or are proposing to exercise their functions in response to the flood shall be monitored through the existing Joint Lincolnshire Flood Risk and Water Management Partnership.

12.8 Recommendations

Cluster-specific recommendations to reduce the flood risk in future events are provided below. The recommendations in Section 18 are also applicable to these properties.

12.8.1 Raised kerbs in the north of Prospect Street

Consideration should be given to the raising of kerbs adjacent to the properties in the north of Prospect Street, having regard to existing LCC technical standards. This would reduce the potential for flood waters to exceed the kerb line and enter the properties in future events.

The powers for considering the raising of any kerbs would lie to LCC in its capacity as the highways Authority.

13. Cluster 10 – Watermill Road & St Lawrence Street

13.1 Location

Cluster 10 covers [redacted] in central Horncastle (Figure 13.1). This includes two residential properties on Watermill Road ([redacted] and [redacted]), four residential properties on St Lawrence Street, and [redacted], off Watermill Road.

The residential properties are all located within 20m of the River Bain.

[redacted] is located in a basin (sometimes known as "Watermill Basin") between two watercourses. The River Bain is located c. 20m to the east of the building. Meanwhile, an unnamed drain is located c. 20m west, which forms part of the Horncastle Ings System; this is understood to be a former mill leat which was constructed to provide water for a former mill in the area. The watercourses approximately meet 250m north and 130m south of [redacted].

Ground levels in the area surrounding the residential properties fall in a westerly direction, towards the River Bain (Figure 13.2). The properties on Watermill Road have an elevation of c. 28.6m AOD, whilst the properties on St Lawrence Street have an elevation of c. 28.6 to 29.0m AOD.

[redacted] is located on low-lying land between the two watercourses. The main building is located on land with an elevation between 28.5 and 29.0m AOD.

(*Figure 13.1 – Location of the affected properties along Watermill Road and St Lawrence Street*)

(*Figure 13.2 – LiDAR elevation data for the area surrounding the affected properties)*

13.2 Flood risk

13.2.1 National flood mapping

According to the EA's Flood Map for Planning Purposes, all the affected properties are located within Flood Zone 3 and are therefore classified as a high probability of flooding from rivers (Figure 13.3) acknowledging the caveats raised in section 2.2.1.

According to the EA's RoFRS map, all the affected properties occupy land that has a low risk of fluvial flooding (0.1 to 1% AEP).

All the affected properties are located on land where there is a very low to low risk of surface water flooding (Figure 13.4). An area at medium risk of surface water flooding is noted to lie within St Lawrence Street, adjacent to the properties on this highway.

(*Figure 13.3 – Flood zone mapping in the area surrounding the affected properties)*

(*Figure 13.4 – Risk of surface water flooding in the area surrounding the affected properties)*

13.2.2 FloodSmart Analytics mapping

GeoSmart's FloodSmart Analytics mapping (Figure 13.5) indicates that [redacted] is mapped at medium to high risk of fluvial flooding, with the remaining properties having a medium fluvial flood risk.

One property on St Lawrence Street has a low to medium risk of surface water flooding. The remaining properties on Watermill Road and St Lawrence Street have a low risk of surface water flooding, whilst [redacted] has a very low to low risk.

The properties on Watermill Road have a high risk of groundwater flooding, whilst [redacted] has a medium to high risk of groundwater flooding. The properties on St Lawrence Street have a low to medium groundwater flood risk.

Figure 13.5 – Flood risk at Watermill Road and St Lawrence Street according to FloodSmart Analytics mapping

13.3 Drainage arrangement

LCC drainage records at time of publication have been provided and are shown within Figure 10.6. this indicates that highway drainage is present along Watermill Road and St Lawrence Street, with numerous gullies present within close proximity to the properties.

[redacted] is not serviced by highway drains and utilises its own private system. Linear drains are observable in the car park and running along the western side of the building.

According to LCC records, the gullies adjacent to the properties on St Lawrence Street are without defect, although it is noted that one gully between St Lawrence Street and Watermill Road is recorded as having concrete blocking the outlet. The gullies are inspected on a biennial cycle and were last cleansed in November 2023, with an 'amber' silt level recorded prior to the last cleanse.

The gullies adjacent to the affected properties on Watermill Road are also recorded as not having defects. They are inspected on a biennial cycle and were last cleansed in August 2023, with an 'amber' silt level recorded prior to the last cleanse.

According to data from the EA, natural high ground (classed as informal flood defences) is present along the River Bain. This provides a variable standard of protection for the surrounding land:

- On the eastern bank adjacent to the residential properties on Watermill Road, the natural high ground has a minimum crest level of 28.53m AOD, providing a 1 in 100 annual chance standard of protection;
- On the eastern bank adjacent to the affected properties on St Lawrence Street, the natural high ground has a minimum crest level of 28.78m AOD, providing a 1 in 100 annual chance standard of protection;
- On the western bank (immediately adjacent to the [redacted] building), the natural high ground has a minimum crest level of 29.59m AOD, providing a 1 in 100 annual chance standard of protection.

There are no flood defences along the unnamed watercourse to the west of [redacted].

(*Figure 13.6 – LCC drainage records along Watermill Road and St Lawrence St at the time of publication)*

13.4 Knowledge of flooding

Consultants from GeoSmart Information Ltd visited the affected properties on 30 April 2024. Conversations were held with the manager at [redacted] and resident at [redacted]. The residents were not in at the affected properties on St Lawrence Street, or at [redacted]; therefore, the details of flooding at these properties cannot be confirmed. However, it has been confirmed via the Defra PFR grant that [redacted] experienced internal flooding. For other properties, the flood mechanism is likely to be similar to what was experienced by other properties in the cluster.

From conversations with the manager at [redacted], flood waters entirely surrounded the shop building and entered storage areas on 20 October 2023, although the shop floor was not directly affected. Flood waters remained in the car park for 3 days, reaching a maximum depth of c. 200 mm. Utilities were not impacted, although there was a loss of stock, and the store was unable to open during the event.

The manager at [redacted] confirmed that the site has flooded twice before (c. 2012 and c. 2019).

During Storm Babet, flood waters flowed from both sides of the basin (i.e. both from the unnamed watercourse to the west of [redacted], as well as from the River Bain to the east).

The resident at [redacted] confirmed that flood waters did not enter the property, although flood waters were present in the highway. From the Site visit, this may be attributed to the raised threshold levels of the property (Photograph 10.1 in Appendix 20).

From the Site visit, the properties on St Lawrence Street appear to have thresholds set at or close to the ground level along the highway, with dropped kerbs. Photo evidence online[1] confirms flood waters occurred throughout the highway, originating from the River Bain, and that sandbags were used for the thresholds at least one property.

13.5 Flooding mechanism & Causation

From the available evidence, flood waters were likely to have been sourced primarily from the River Bain. Whilst surface water may have contributed to some flooding in the area, this source is likely to be insignificant to the flows from the River Bain.

Flooding occurred along the River Bain due to the rainfall which was experienced in the catchments upstream of Horncastle (estimated at a 2.2% AEP rainfall event according to the Hemingby Gauge; see Section 3.3). This resulted in extreme flows along the River Bain.

According to the EA's flow data at Victoria Mill gauge, flows along the River Bain reached a peak of 17.4 m^3/s at 16:30 on 20 October 2023, which is equivalent to 0.1% AEP flows. Whilst it should be acknowledged that there is some uncertainty regarding this data, this suggests an extreme flow event which would be the direct cause of out of bank flows on the River Bain as it passed through Horncastle.

[1] https://www.lincsonline.co.uk/horncastle/two-and-half-hour-delay-in-closing-a-sluice-gate-did-not-ca-9354802/

The unnamed watercourse is likely also to have some continuity with the Bain which would cause its water levels to rise, potentially providing an additional source for flood waters.

In the case of the properties on St Lawrence Street, they appear to have threshold levels which are set at or close to ground level, with no raised kerbs. The properties are also located down-gradient of the watercourse, in the direction that runoff would preferentially take. Therefore, out of bank flows from the River Bain would potentially move in this direction towards the properties.

The affected properties on Watermill Road and St Lawrence Street are in an area which may be impacted by delays in the use of the Horncastle FSR. According to the EA's reporting, the delay in the closure of the sluice gate at the FSR did not result in an increase in peak flows in Horncastle and therefore would not be the direct cause of flooding at the affected properties.

It is noted that an independent review of the EA's reporting is being undertaken to confirm the plausibility of the EA's conclusions. However, at this stage it appears that the extreme flows on the River Bain were the primary cause of flooding, as opposed to the operational failure at the Horncastle FSR.

13.6 Cluster-specific issues identified

13.6.1 low kerb height and threshold levels

The kerbs along St Lawrence Street, adjacent to the affected properties, appear not to be significantly raised, and threshold levels at the affected properties generally appeared to be set at or only slightly higher than the adjacent pavement level. This meant that the kerbs and thresholds were easily exceeded by flood waters, contributing to flows entering the buildings.

13.7 Risk Management Authorities

In relation to this flood event, the following RMAs have relevant flood risk management functions:

- Environment Agency: responsible for the River Bain
- Witham Third District IDB: responsible for the Horncastle Ings System

A record as to whether the Environment Agency and Witham Third District IDB, as the relevant RMAs, have exercised or are proposing to exercise their functions in response to the flood shall be monitored through the existing Joint Lincolnshire Flood Risk and Water Management Partnership.

13.8 Cluster-specific recommendations

No cluster-specific recommendations have been identified for the affected properties on Watermill Road and St Lawrence Street. However, the recommendations provided in Section 18 would be applicable to the properties.

14. Cluster 11 – Accommodation Road

14.1 Location

Cluster 11 covers four known internally flooded properties along Accommodation Road ([redacted]), in the north of Horncastle (Figure 14.1).

The properties are located c. 300m north-west of the River Bain. The nearest watercourse is a dyke c. 80m south-east.

Open farmland is c. 150m north of the properties.

Ground levels in the area surrounding the properties fall in an easterly direction, towards the River Bain (Figure 14.2). The properties are not associated with any obvious depressions, although driveways visually appear to fall towards the buildings. They are located on land with an elevation between 30 and 31m AOD.

(*Figure 14.1 – Location of the affected properties on Accommodation Road*)

(*Figure 14.2 – LiDAR elevation data for the area surrounding the affected properties on Accommodation Road*)

14.2 Flood risk

14.2.1 National flood mapping

According to the EA's Flood Map for Planning Purposes, the affected properties are all located within Flood Zone 1 and are therefore classified as having a low probability of flooding from rivers, acknowledging the caveats raised in section 2.2.1.

According to the EA's RoFRS map, the affected properties all occupy land that is deemed to be at very low risk of fluvial and tidal flooding.

The properties are all situated on land with a variable risk of surface water flooding ranging from low to high (Figure 14.3). Generally, the land to the front of each property has a very low to low risk of pluvial flooding, whilst the land at the rear has a low to high risk of pluvial flooding. The highway to the front of the properties is noted to have a medium to high risk of pluvial flooding.

(*Figure 14.3 – Risk of surface water flooding in Accommodation Road)*

4.2.2 FloodSmart Analytics mapping

GeoSmart's FloodSmart Analytics mapping (Figure 14.4) indicates that all the affected properties on Accommodation Road are at very low risk of fluvial and groundwater flooding.

The rear of the properties is generally at low to medium risk of surface water flooding, whilst the front of the properties is at very low to medium pluvial flood risk.

Figure 14.4 – Flood risk at Accommodation Road according to FloodSmart Analytics mapping

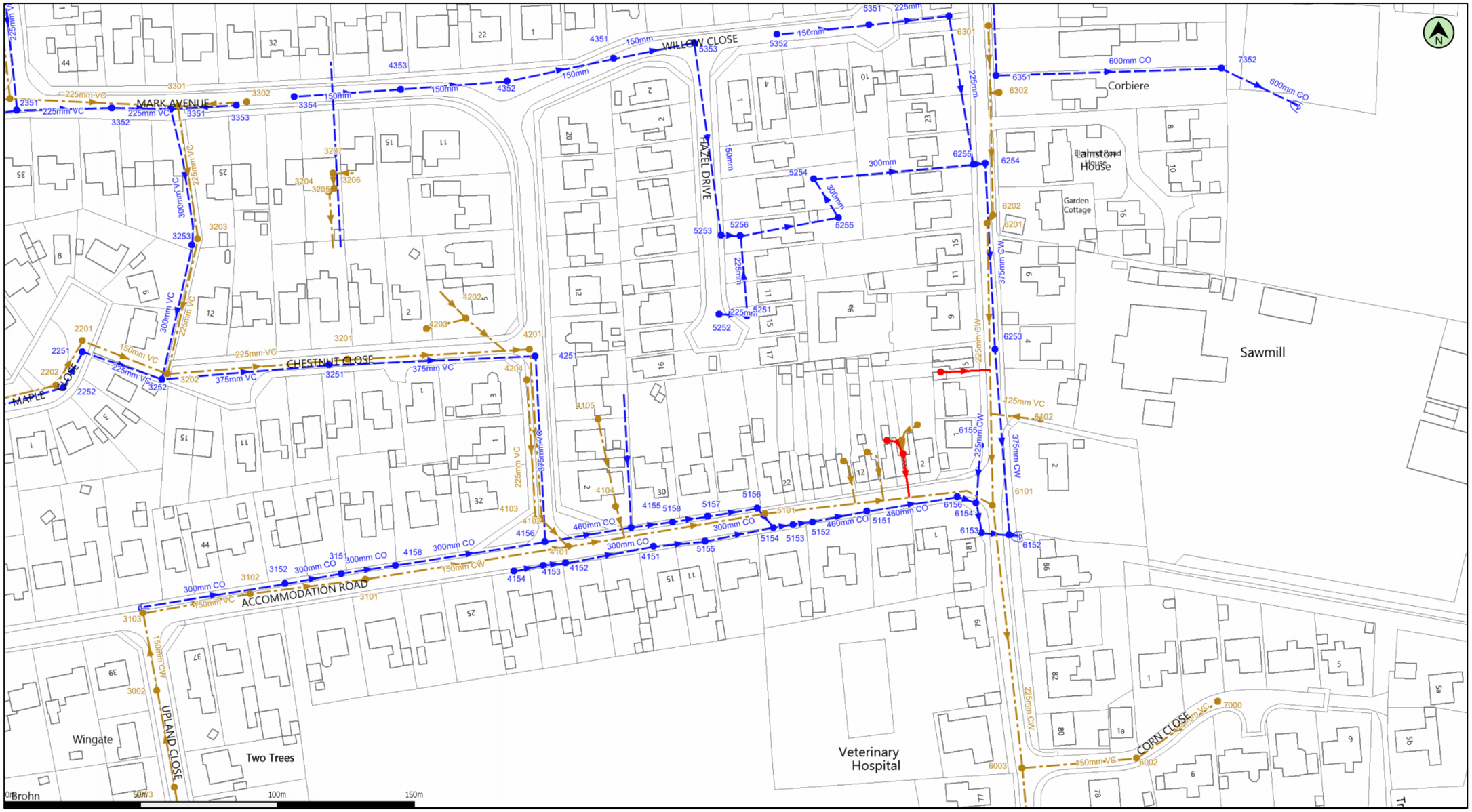
14.3 Drainage arrangement

LCC and Anglian Water asset records at time of publication have been provided, and are shown within Figure 14.5 and 14.6. These indicate that the properties are served by surface water drains and foul sewers.

highway gullies are present within the highway. According to records held by LCC, these are cleansed on an annual cycle. The majority of gullies were last cleansed in August 2023, with an 'amber' silt level (prior to the last cleanse); none are recorded as having defects.

Of particular note, two gullies are present on the northern side of the road (i.e. on the same side of the properties). A dropped kerb is present throughout this stretch of the road.

(*Figure 14.5 – LCC drainage asset records)*



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Foul Sewer
Surface Sewer
Combined Sewer
Final Effluent
Rising Main*
Private Sewer*
Decommissioned Sewer*
Outfall*
Inlet*
Manhole*
Sewage Treatment Works
Public Pumping Station
Decommissioned Pumping Station
*(Colour denotes effluent type)

ryan.davies@lincolnshire.gov.uk

Accommodation Road

love every drop anglianwater

(*Figure 14.6 – Anglian Water public sewer records)*

14.4 Knowledge of flooding

Consultants from GeoSmart Information Ltd visited the affected properties on Accommodation Road on 30 April 2024. During this visit, conversations were held with one resident at [redacted]. Residents were not in at any of the other properties, and no responses were received to the LCC questionnaire.

From this conversation, the resident attributed flood waters to an overflowing drainage ditch within the fields to the west of the property. They indicated that surface water flowed down the highway in an easterly direction; note that from the available mapping, the drainage ditch to which the resident is referring cannot be identified.

Additional information can be obtained by a report of external flooding to LCC, which was received on 20 October 2023. This report indicated that water was flowing from Chestnut Avenue, through [redacted], towards [redacted]. Additional reports to LCC indicate that external flooding have previously occurred along Mark Avenue during periods of rainfall, with overflowing drains reported in September 2022 and November 2023.

14.5 Flooding mechanism & Causation

From the available evidence, it is likely that flood waters at Accommodation Road comprised of surface water. There is no evidence to suggest that any waters had an alternative source (e.g. from rivers or groundwater).

A significant volume of runoff was generated in Storm Babet, with the event estimated as having a 2.2% AEP (1 in 45 annual chance). Therefore, surface water likely collected in the highway as well as on rear gardens (such as the garden at [redacted] Accommodation Road). An overland flow is reported to have developed on Chestnut Close, which flowed in a south-easterly direction, via Mark Avenue, onto Accommodation Road. Accommodation Road slopes in an easterly direction, with the junction with Prospect Street reflecting a low point, which may cause the collection of surface water in this area of the highway especially.

It is also possible that typical highway drainage systems were overwhelmed and would not have helped to drain surface water from Accommodation Road, Chestnut Close and Mark Avenue; overflowing drains were reported on Mark Avenue in September 2022 and November 2023, which may suggest that this occurred during Storm Babet. It is noted that the design standard of the highway drains is unknown, so this cannot be confirmed.

Additionally, surface water drains along Accommodation Road (and within the surrounding area) appear to drain to the dyke c. 80m east, which in turn drains to the unnamed watercourse and River Bain, further east. As these watercourses flooded during Storm Babet, the outfalls of these drains may have been blocked by flood waters, preventing discharge of runoff as would occur under typical rainfall events.

14.6 Cluster-specific issues identified

Issues which have been identified which are specific to Accommodation Road are provided below. The issues identified within Section 17 are also applicable to these properties.

14.6.1 Insufficient capacity within the surface water drainage system

The surface water drainage network along Accommodation Road, Chestnut Close and Mark Avenue may have had insufficient capacity for the level of rainfall experienced, which could have contributed to surface water flooding at the properties.

The rainfall experienced during Storm Babet was extreme and has been estimated at a 2.2% AEP event. This may have overwhelmed the drainage network throughout and upstream of Accommodation Road.

Given that surface water drains along Accommodation Road appear to discharge into the River Bain system via a connecting dyke, flood waters may have caused the outfalls to be blocked, preventing the discharge of runoff as would occur under normal conditions.

It is possible, although unconfirmed, that deficiencies (such as broken pipes or the collection of debris) reduced the capacity of the drainage network during Storm Babet. However, given the rainfall intensity experienced as well as fluvial flooding in the vicinity, it seems unlikely that problems in the network would have significantly contributed to flooding. Even if the system was optimal during Storm Babet, surface water flooding would likely still have occurred.

14.6.2 low kerb height and property threshold

The kerbs along Accommodation Road, adjacent to the affected properties, are set at highway level and are not raised. This meant that the kerbs were easily exceeded by flood waters, contributing to flows entering the buildings. The threshold levels of each affected property are set at ground level which would permit flows to easily enter via the doors.

14.7 Risk Management Authorities

In relation to this flood event, the following RMA has relevant flood risk management functions:

- Anglian Water
- Lead Local Flood Authority & highways Authority (Lincolnshire County Council)

A record as to whether Lincolnshire County Council and Anglian Water, as the relevant RMAs, have exercised or are proposing to exercise their functions in response to the flood shall be monitored through the existing Joint Lincolnshire Flood Risk and Water Management Partnership.

The property owners also have a responsibility with regards to the resilience and resistance measures implemented at each property.

14.8 Cluster-specific recommendations

Cluster-specific recommendations to reduce the flood risk in future events are provided below. The recommendations in Section 18 are also applicable to these properties.

14.8.1 Raised kerbs along Accommodation Road

Consideration should be given to the raising of kerbs adjacent to the affected properties on Accommodation Road. This would reduce the potential for flood waters to exceed the kerb line and enter the properties in future events.

The powers for considering the raising of any kerbs would lie to LCC in its capacity as the highways Authority.

14.8.2 Implementation of intervening drainage

Consideration could be given to the implementation of intervening drainage at the affected properties on Accommodation Road. This could potentially include interceptor drains adjacent to the thresholds of each property (depending on the water entry method). Alternatively, additional gullies could be implemented in the highway, adjacent to the properties.

The responsibility for considering implementation of interceptor drains would lie with the residents of each property, with support from LCC where required. The powers for considering implementation of additional highway gullies would lie with LCC in its capacity as the highways Authority.

14.8.3 Review of the drainage arrangement on Chestnut Close and Mark Avenue

Given that surface water flows at the properties on Accommodation Road were partially sourced from the north-west, it is recommended that the drainage arrangement on Chestnut Close and Mark Avenue is reviewed to confirm the capacity and effectiveness of the surface water drains in this area. This would allow any deficiencies in the system to be identified and rectified, potentially reducing the risk of flooding occurring on the highway during similar storm events.

The responsibility for reviewing the drainage arrangement along these highways would lie to Anglian Water and LCC, in its capacity as the highways Authority.

15. Cluster 12 – Hemingby Lane

15.1 Location

Cluster 12 covers two properties on Hemingby Lane, in the north of Horncastle: [redacted] (Figure 15.1). Both properties are located c. 110m from the River Bain as it first enters Horncastle.

A drainage ditch is noted to run adjacent to the south of [redacted], connecting to the Bain.

Ground levels in the area surrounding the properties fall in a westerly direction, towards the Bain (Figure 15.2). Both properties appear to be located on land with a lower elevation than the surrounding area, with the land surrounding [redacted] having ground levels between 29.5 and 30.0m AOD, and the [redacted] having ground levels around 29.5m AOD.

A particularly low depression is noted adjacent to the Bain, to the west of the properties.

However, the banks of the Bain form an intervening raised feature and are recorded as an informal flood defence by the EA, with a minimum crest level of c. 29.55m AOD.

(*Figure 15.1 – Location of the affected properties along Hemingby Lane*)

(*Figure 15.2 – LiDAR elevation data for the area surrounding the properties on Hemingby Lane*)

15.2 Flood risk

15.2.1 The EA's flood mapping

According to the EA's Flood Map for Planning Purposes (Figure 15.3), both affected properties are located entirely within Flood Zone 2 and therefore are classified as having a medium probability of fluvial flooding acknowledging the caveats raised in section 2.2.1.

According to the EA's RoFRS map, both properties occupy land that is deemed to have a low risk of fluvial flooding (0.1 to 1% AEP).

[redacted] is situated on land with a very low to low risk of surface water flooding, whilst the [redacted] is situated on land with a low surface water flood risk (Figure 15.4).

(*Figure 15.3 – Fluvial flood zones in the area surrounding the affected properties on Hemingby Lane*)

(*Figure 15.4 – Surface water flood risk in the area surrounding the affected properties on Hemingby Lane*)

15.2.2 FloodSmart Analytics mapping

GeoSmart's FloodSmart Analytics mapping (Figure 15.5) indicates that the properties have a medium risk of fluvial flooding.

The [redacted] has a low risk of surface water flooding and high risk of groundwater flooding, whilst [redacted] has a very low to low risk of surface water flooding and very low to high risk of groundwater flooding.

Figure 15.5 – Flood risk on Hemingby Lane according to FloodSmart Analytics mapping

15.3 Drainage arrangement

The banks of the River Bain, c. 110m west of the properties, are recorded as an informal flood defence by the EA. The EA records a standard of protection of 1 in 100 annual chance, with a maximum crest level of 29.55m AOD.

LCC drainage records at time of publication have been provided and are shown within Figure 15.6. This indicates that [redacted] may have a connection to the surface water drainage network, but otherwise both properties do not have connections to the public sewer network, with [redacted] utilising a septic tank.

highway drainage is not present immediately adjacent to the properties along Hemingby Lane. Gullies are present c. 100m south of the properties along the highway, but this would not have any impact on the drainage at the properties. This was confirmed by observations during the Site visit on 01 May 2024.

During the Site visit, ponding of surface water was observed on Hemingby Lane, opposite the properties (Photograph 12.5 in Appendix 20).

(*Figure 15.6 – LCC drainage assets and known sewer networks in the area surrounding the affected properties on Hemingby Lane at the time of publication)*

15.4 Knowledge of flooding

Consultants from GeoSmart Information Ltd visited Hemingby Lane on 01 May 2024 and undertook conversations with the resident at [redacted].

From these conversations, it is understood that flood waters first entered [redacted] at 19:00 on 20 October 2023 and remained in the property for 1 day, with depths between 220 to 250mm in the front of the house and 280mm in the conservatory. Flood waters entered the property via the floorboards and did not breach any thresholds.

The driveway and garden were also flooded, with maximum respective depths of 300mm and 1000 mm. The garage did not flood due to the use of sandbags.

Within conversations with the worker at [redacted], it is understood that flood waters first entered the building at 17:00 on 20 October 2023, via the front door, floor and air bricks. Flood waters remained in the property for 4-5 days, reaching a maximum depth of 300 mm, and entering the ground floor and cellar.

Toilets could not be flushed at both properties. Both properties were also impacted by flooding in 2007.

Flood waters at both properties were attributed from two sources: the Bain to the north-west, and land from the north-east. The resident mentioned that the drainage along the highway is inadequate and did not mitigate the flooding.

15.5 Flooding mechanism & Causation

From the available evidence, it seems most likely that flood waters were sourced from surface water.

Flooding at the properties began around 17:00 on 20 October 2023. The peak flow on the River Bain was reached at 16:30 on the same day at the Victoria Mill gauge. This suggests either that flood levels must be comparatively higher in order to cause overtopping at the River Bain near the properties, or that fluvial flood waters were not the primary source of flooding at the properties. Based on hydraulic model simulations conducted by the EA, overtopping of the River Bain at this location is not predicted to have occurred.

Alternatively, fluvial flood waters from the River Bain may have travelled via the drainage ditch to the south of [redacted], which required a higher flood level to be reached prior to overflowing occurring. It is noted that this ditch was not mentioned during any discussion with residents / workers, which suggests it was not a significant source of flooding.

Therefore, surface water remains the most likely source of flooding. Given the properties are situated on land with ground levels which are lower than the surroundings, this could result in the collection of overland flows. It is possible that flooding could be exacerbated by high levels on the River Bain.

There also remains potential for flood waters to have been exacerbated by groundwater, which may be suggested by the amount of time they remained in the building (4-5 days in the case of [redacted]). However, it is also possible that overtopped flood waters were unable to be discharged into the River Bain once river levels decreased, due to the presence of natural high ground.

It should be noted that the flood outline at Hemingby Lane is not presented within the Horncastle Asset Operation Failure Impact Assessment (EA, 2024), and therefore this report does not readily allow the contribution from fluvial flood waters to be assessed.

However, given that flooding did not occur at the property until 17:00 and the sluice gate at the FSR was closed at 14:15, it is likely that the late closure of the sluice gate did not have a significant impact on flooding at these properties (i.e. internal flooding would have been experienced even in a normal operation scenario).

15.6 Cluster-specific issues identified

15.6.1 Absence of highway drainage along Hemingby Lane

There are no highway drains along Hemingby Lane adjacent to the properties. Likewise, there are no intervening drainage features within the land to the north-east which could prevent the collection of surface water on the road (or indeed within the properties).

The absence of drainage along this stretch of the road is a potential issue which contributed to flooding at the affected properties during Storm Babet.

Both [redacted] are located downgradient of the highway, therefore any runoff from the road would be channelled into the driveway. Once flood waters collected adjacent to the buildings, flood waters would have been able to enter the buildings via the walls and floorboards.

15.7 Risk Management Authorities

In relation to this flood event, the following RMAs have relevant flood risk management functions:

- Environment Agency
- Lead Local Flood Authority (Lincolnshire County Council)

A record as to whether Lincolnshire County Council and the Environment Agency, as the relevant RMAs, have exercised or are proposing to exercise their functions in response to the flood shall be monitored through the existing Joint Lincolnshire Flood Risk and Water Management Partnership.

The property owners also have a responsibility with regards to the resilience and resistance measures implemented at each property.

15.8 Cluster-specific recommendations

Cluster-specific recommendations to reduce the flood risk in future events are provided below. The recommendations in Section 18 are also applicable to these properties.

15.8.1 Analysis of flood outlines from the EA's modelling for Hemingby Lane

The affected properties on Hemingby Lane are not shown on the published flood outlines (both for what occurred in Storm Babet and what was modelled as part of the EA's study into the event).

It is recommended that consideration be given to further analysing the EA's model to determine the extent of flooding at these properties. This would allow the contribution of

fluvial sources at the properties during Storm Babet to be determined, and therefore would allow potential mitigation measures to be reviewed more effectively.

The powers for providing flood extents for Hemingby Lane would lie with the Environment Agency.

15.8.2 Implementation of additional intervening drainage along Hemingby Lane

Consideration should be given to implementing additional highway and / or land drainage along Hemingby Lane, adjacent to the affected properties. This could take the form of gullies along the highway, or as an intervening drainage feature within the land to the north-east.

Alternatively, interceptor drains could be implemented at the entrance to the driveway / car park for both properties. These should extend across the width of the driveway, to intercept any flows which might enter from the driveway. It is noted that there are no public sewers / highway drains to which these could ready connect.

This solution would only be suitable if surface water drainage is considered a significant source of flooding, following further analysis of the flood extent during Storm Babet.

The powers for considering the implementation of any highway gullies or land drains would fall to Lincolnshire County Council and the respective landowner, whilst the use of any interceptor drains would be the responsibility of the property owner.

16. Road Closures

16.1 low Toynton Road

During Storm Babet, a road closure occurred along low Toynton Road, in the north-east of Horncastle (Figure 16.1). The exact location, extent and timing of the road closure is not known, with no photo or video evidence available, given the absence of nearby properties.

The River Waring crosses low Toynton Road c. 260m north-east of the nearest property. It is considered most likely that flood waters on low Toynton Road originated from this watercourse.

During the Site visit on 01 May 2024, the River Waring was observed to have a shallow channel in this area. low Toynton Road crosses the watercourse using a bridge which was observed to have a relatively low soffit (Photograph 13.4 in Appendix 20). It is therefore possible that the capacity of the channel was exceeded due to extreme flows down the river, with the bridge potentially contributing to a restriction of flows.

Whilst the depth of flooding on the road is not known, given the significant extent and depth of flooding resulting from the River Waring downstream in Horncastle, it would be reasonable to assume this was significant and impassible for vehicles, resulting in the road closure.

(*Figure 16.1 – Location of low Toynton Road*)

16.2 A158 (Spilsby Road)

During Storm Babet, a road closure occurred along the A158 (Spilsby Road), in central Horncastle. The exact location, extent and timing of the road closure is not known. It is noted that the A158 is known as East Street as it passes through the east of Horncastle and Jubilee Way as it passes over the floodplain between the River Bain and River Waring. The road closure was reported on East Street, which is consistent with photo evidence online and accounts from the residents.

Widespread fluvial flooding occurred on East Street during Storm Babet, which caused internal flooding at fourteen properties on this road. Within conversations with residents and information provided within the LCC questionnaire, external depths along the highway were reported to be between 0.67 and 1.20 m.

The source of flooding on East Street has been attributed to the Thunker Drain, which overtopped upstream of its confluence with the River Waring. Whilst some properties on East Street may have been impacted by flows from the River Waring, this generally occurred to the rear of the properties rather than on the highway. As such, it is unlikely that the River Waring was a significant source of flood water on the highway.

Given the significant flood depths reported on East Street, this would have been impassable to vehicles. Residents reported that the flows were rapid and this would have presented a danger to life if vehicles tried to cross them during peak flooding.

It should be noted that residents on East Street and Stanhope Road widely reported that vehicles (such as lorries) passed through East Street during Storm Babet, which caused bow waves and exacerbated flooding at the known internally flooded properties. It can therefore be assumed that East Street was closed following a build up of flood depths along the road.

The source of flooding along East Street, including the potential contribution of bow waves from vehicles, is discussed further within Section 7 (Cluster 4 – East Street, Water Lane, Plough Yard, Betts Yard & Francis Lane).

17. General Issues Identified

17.1 Extreme rainfall intensity

During Storm Babet, Horncastle was impacted by extreme rainfall with a 2.2% AEP. This caused a significant volume of rainfall to be generated within the already saturated catchments immediately upstream of Horncastle, which entered watercourses such as the River Bain, River Waring and Thunker Drain, causing their channel capacity to be exceeded. This generated out of bank flows which affected significant areas of the town.

Additionally, direct rainfall within Horncastle caused surface water flooding for some properties.

17.2 Insufficient capacity within the surface water drainage system

The highway and sewer network throughout Horncastle may have had insufficient capacity for the intensity of rainfall experienced, which could have contributed to surface water flooding throughout Horncastle.

Runoff from these systems in many areas is discharged to the watercourses in Horncastle. However, during Storm Babet, where these watercourses had exceeded their capacity, their effectiveness was likely further reduced due to the outfalls being submerged, preventing discharge.

It is possible, although unconfirmed, that deficiencies (such as broken pipes or the collection of debris) reduced the capacity of the drainage network during Storm Babet. However, given the rainfall intensity experienced as well as widespread fluvial flooding, it seems unlikely that problems in the network would have significantly contributed to flooding. Even if the system was optimal throughout Horncastle during Storm Babet, surface water flooding would likely still have occurred.

17.3 Operational failures at the Horncastle FSR and Swimming Baths Sluice

During Storm Babet, there were several operational failures at EA-operated flood structures in and upstream of Horncastle:

- The sluice gate at the Horncastle FSR failed to automatically shut. Instead, it was manually shut over 12 hours after the time it failed to close, equivalent to 2.5 hours after the critical closure time;
- The Swimming Baths Sluice remained partially closed throughout the storm event.

The operation of these structures during Storm Babet is detailed further in Section 3.4.

The EA's review of the operation of these structures concluded that neither had a significant impact on the flood extents and depths observed during Storm Babet. The reporting associated with this review is currently being independently reviewed.

Assuming that the EA's assessment is correct, and the operation of these structures did not significantly contribute to flooding in Horncastle during Storm Babet, the following issues remain:

- The EA's reporting did not publish any modelled scenarios which cover all the affected properties in Horncastle (i.e. their conclusions cannot be confirmed for the properties on Hemingby Lane);
- Whilst the partial closure of the Swimming Baths Sluice did not impact the majority of the affected properties in Horncastle, there remains multiple which were impacted ([redacted] and the [redacted]). The impact on these properties should not be ignored even if there were no wider issues;

18. General Recommendations

18.1 Automation of Swimming Baths Sluice

The Swimming Baths Sluice is a manually operated sluice, which is opened in stages during a storm event to allow flows to enter the Old River Bain.

During Storm Babet, EA operatives partially opened the sluice; however, they were unable to return to continue opening the sluice due to the storm conditions. This is considered likely to be the case during similar or worse future storm events.

It is understood that the EA have proposed to automate the Swimming Baths Sluice, such that the sluice opens in stages automatically as the river level rises. The progress of such works and the associated timescales should be confirmed with the EA to ensure that it is completed in an efficient manner.

The powers for automating the Swimming Baths Sluice lies with EA.

18.2 Review of EA processes for operating flood structures in the Horncastle catchment

Given that both EA flood assets in Horncastle were not operated successfully during Storm Babet, it is recommended that the processes involving the operation of such structures are reviewed.

It is understood that a review of the processes relating to the operation of the Horncastle FSR has been undertaken, with the proposed improvements as detailed within the Horncastle Chief Engineers Report implemented as of November 2023. The sluice gate has since closed automatically as intended on all required occasions.

The plan for manually operating the assets in the event they do not work automatically should be reviewed. This should include consideration of the possibility that EA operatives are unable to reach the assets (e.g. due to flood waters in the road). It is possible that training and emergency authorisation could be given to members of Horncastle Town Council so that select residents are able to manually operate the sluice gates, in the event that these do not operate as intended.

The powers for reviewing the processes for operating flood structures in Horncastle would lie with the EA.

18.3 Evaluation of flood alleviation schemes for the River Waring, River Bain and Thunker Drain

Consideration should be given to re-evaluating possible flood alleviation schemes for the River Waring. A variety of possible options may be considered, which could include the construction

of a flood storage reservoir upstream along this watercourse (similar to the existing Horncastle FSR), or locally constructing defences along the River Waring as it passes through Horncastle.

Similarly, consideration should be given to further evaluation of possible alleviation schemes for the River Bain, to account for the flows received from catchments downstream of the Horncastle FSR.

The potential for a flood alleviation scheme for the Thunker Drain may also be considered. However, this should only be undertaken following a detailed modelling study for this watercourse, as the existing mapping for the drain appear to poorly represent the flood risks relative to what was observed during Storm Babet.

The powers for evaluating possible flood alleviation schemes would lie with the EA, with support from the Joint Lincolnshire Flood Risk and Water Management Partnership due to the large number of RMAs involved. This includes the EA, who have powers for the River Waring, and LCC and Witham Third District IDB, where the Thunker Drain or other Ordinary Watercourses are involved.

18.4 Verification of the absence of a link between the River Bain and River Waring

Based on the EA's assessment of the flood structures in Horncastle following Storm Babet, there is limited connection between high river flows on the River Bain and River Waring. However, there appears to be strong public perception that there is a linkage between these watercourses.

Consideration should be given to verifying this is correct, as it would potentially help inform future works for both watercourses, and would also improve public confidence in the EA's asset review following Storm Babet.

The powers for confirming this would be with the EA.

18.5 Property Flood resistance and resilience measures

Property Flood resistance and resilience measures should be considered for all properties impacted by flooding in Horncastle (if not already implemented).

The resistance and resilience measures for each property should be chosen on a site-specific basis and take into account the method of flood water ingress and extent of flooding.

Possible resistance measures which could be considered include:

- Use of a demountable flood barrier against the doors of the property during periods of known heavy rainfall and high river levels;
- Implementation of airbrick covers against any airbricks at or close to ground level;
- Chemical waterproofing methods where flood waters entered via the walls;
- Implementation of solid flooring where flood waters entered via the floorboards; and/or
- Incorporation of an interceptor drain adjacent to the thresholds of each property.

Resilience measures which may also be considered include:

- Replacing ground floor carpets with hard flooring;
- Installing uPVC skirting boards;
- Raising furniture and appliance on plinths;
- Using internal lime plaster/render;
- Where plasterboards are used, fitting these horizontally instead of vertically, or using moisture resistance plasterboard at lower levels;
- Installing non-return valves on air bricks and utility pipework; and
- Avoiding storing valuable items within the property at ground level.

The responsibility for the implementation of flood resistance and resilience measures would fall to the residents and owners of each property, with support from the LLFA, where appropriate.

18.6 Improvements to national surface water and fluvial flood models

It is recommended that further improvements are made to the surface water and fluvial flood models for Horncastle, based on the recorded flooding and the findings of the EA's study into Storm Babet. This should include further consideration of the recommendations made within the independent review of the EA's reporting following Storm Babet, including:

- Provision of a risk analysis and uncertainty assessment of the modelling results;
- Verification of the modelled discharge from the Horncastle FSR;
- Further review of alternative model options;
- Completion of a sensitivity analysis for the findings of the impact assessment;
- Verification of the river levels and flows at the Victoria Mill monitoring station;
- Confirmation that flooding at the Victoria Mill modelling station does not begin when flows are lower than previously anticipated;
- Publication of annual chance analyses for rainfall and river flow throughout the catchments.

The responsibility for amending the surface water model would fall to LCC, with co-operation from the EA with respect to updating the national flood mapping, whilst the responsibility for updating the fluvial flood model would fall to the EA.

18.7 Review of multi-agency flood response plan

It is recommended that the flood response plan for Horncastle is reviewed following the flooding which occurred during Storm Babet. In particular, the effectiveness of the plan should be confirmed, with the plan modified to accommodate any feedback from the storm event.

The powers for reviewing the flood emergency plan would lie with the Lincolnshire Local Resilience Forum, with support from Horncastle Town Council where appropriate.

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20. Appendices

20.1 Definitions

Coastal / tidal flooding – Flooding which occurs due to extreme coastal conditions. May occur due to high tide levels, surges and wave action.

Culvert – Where a watercourse flows through a pipe, often underground.

External flooding – Flooding that occurs outdoors. Includes flooding in highways, open land, gardens and driveways.

Flap valve – Hinged valve placed on a pipe outlet into a river. Stays open during normal flow but closes when it is submerged, to prevent flow from backing up the pipe.

Foul sewer – Sewer which carries wastewater (e.g. from toilets, sinks, showers and kitchen appliances) to a sewage works for treatment.

Groundwater flooding – Flooding which occurs when sub-surface water emerges from the ground at the surface or into Made Ground and structures. Occurs due to persistent rainfall that recharges aquifers until they are full; or may be as a result of high river levels, or tides, driving water through near-surface deposits.

Gully – Drainage pit covered by an open metal grate, located at the edge of a road.Drains rainwater from the road into either the surface water sewer or into nearby watercourses.

HYRAD – Real-time radar display system for weather.

Internal Drainage Boards – A public authority that managed water levels within an Internal Drainage District.

Internal flooding – flooding which occurs inside a building.

Lead Local Flood Authority – County councils and unitary authorities which lead in managing local sources of flood risk (i.e. flooding from surface water, groundwater and ordinary watercourses)

LiDAR – A remote sensing technique that allows ground elevation to be determined over a regional area.

Main river – A watercourse shown as such on the main river map for England and includes any structure or appliance for controlling or regulating the flow of water into, in or out of the channel which—

a) is a structure or appliance situated in the channel or in any part of the banks of the channel; and

b) is not a structure or appliance vested in or controlled by an internal drainage board.

Ordinary Watercourse – A watercourse that does not form part of a main river.

Public sewer – Sewers owned and maintained by a Sewerage Company (e.g. Thames Water). Are usually located in roads or public open spaces by may run through private gardens.

Riparian owner – The owner of land that is next to a watercourse or has a watercourse running through or beneath it.

River (fluvial) flooding – Flooding that occurs during times of heavy rainfall or snow melt when watercourses' capacity can be exceeded, over topping the banks and flood defences.

Soil moisture deficit – The difference between the amount of water actually present in the soil and the amount of water which the soil can hold.

Surface water (pluvial) flooding – Flooding which occurs when intense rainfall exceeds the infiltration capacity of the ground and overwhelms the drainage systems.

Surface water sewer – Sewer which carries rainwater directly to a watercourse.

Telemetry – Instruments used to monitor the level of water in a watercourse.

Weir – A small dam structure built across a watercourse to raise the water level or to divert flow.

20.2 Walkover photographs

A selection of photographs taken during the walkover between 30 April 2024 and 02 May 2024 have been provided below. Where a cluster is not listed, no photographs are available for this area.

20.2.1 Cluster 1 – Winceby Gardens

(Photograph 1.1 – [redacted]; facing north-west)

(Photograph 1.2 – Junction at the southern end of Winceby Garden, with [redacted])

(Photograph 1.3 – Thunker Drain, to the south of Winceby Gardens; facing south-west)

(Photograph 1.4 – Thunker Drain, to the south of Winceby Gardens; facing east)

20.2.2 Cluster 2 – Maltby Way, Banovallum Gardens, Lodington Court, Clarke Court, Cupit Road & Saxon Way

(Photograph 2.1 – The Thunker Drain, showing the bridge on Banovallum Gardens; facing south-west)

(Photograph 2.2 – The Thunker Drain, showing the footbridge connecting Saxon Way and Lodington Court. Lodington Court is shown beyond the watercourse; facing south-west)

(Photograph 2.3 – Thunker Drain, as viewed from the bridge on Maltby Way in the westernmost area of the cluster. A pumping station can be seen on the right of the photograph; facing east)

(Photograph 2.4 – The southern reaches of Saxon Way; facing east)

(Photograph 2.5 – The footbridge connecting Saxon Way and Lodington Court; facing west)

(Photograph 2.6 – The Thunker Drain, with Lodington Court beyond; facing south)

(Photograph 2.7 – The north-western section of Maltby Way; facing north)

(Photograph 2.8 – Banovallum Gardens, showing the bridge over the Thunker Drain; facing north)

(Photograph 2.9 – Entrance to north-western corner of Maltby Way; facing north-west)

(Photograph 2.10 – Bridge at Banovallum Gardens over the Thunker Drain; facing north)

(Photograph 2.11 – Bridge at Maltby Way over the Thunker Drain; facing west)

(Photograph 2.12 – Entrance to [redacted]; facing south-east)

(Photograph 2.13 – Blocked gully on the entrance road to [redacted])

20.2.3 Cluster 3 – Stanhope Road, Bowl Alley Lane, Linden Road & Banks Street

(Photograph 3.1 – Junction between Stanhope Road and East Street; facing south)

(Photograph 3.2 – River Waring, as viewed from the rear garden at [redacted]; facing west)

(Photograph 3.3 – River Waring, as viewed from the rear garden at [redacted]; facing west)

(Photograph 3.4 – Residential garages at [redacted]. Flood waters came up to the property; facing west)

(Photograph 3.5 – River Waring as viewed from the rear garden at [redacted]; facing east)

(Photograph 3.6 – Flood wall comprised of sandbags and concrete by the River Waring within the rear garden at [redacted]; facing south-west)

(Photograph 3.7 – Bund adjacent to the River Waring in the garden at [redacted]; facing east)

(Photograph 3.8 – Banks Street, with the River Waring on the left hand side; facing west)

(Photograph 3.9 – River Waring as it flows past Banks Road; facing east)

(Photograph 3.10 – Footbridge over the River Waring, connecting Banks Street and Francis Lane; facing west)

(Photograph 3.11 – Linden Road; facing north)

20.2.4 Cluster 4 – East Street, Water Lane, Plough Yard, Betts Yard & Francis Lane

(Photograph 4.1 – Banks Street, with the River Waring on the left hand side; facing west)

20.2.5 Cluster 6 – Coronation Walk

(Photograph 6.1 – Swimming Baths Sluice over the Old River Bain, with Horncastle Swimming Pool & Lifestyle Fitness Suite to the rear; facing south-west)

(Photograph 6.2 – River Bain downstream of its confluence with the River Waring (i.e., in the former channel of the Horncastle Canal); facing south)

[redacted]

(Photograph 6.3 – Entrance to [redacted]; facing south)

(Photograph 6.4 – Confluence between the River Bain, on the left, and River Waring, on the right; facing north-east)

20.2.6 Cluster 7 – Lincoln Road

(Photograph 7.1 – The front driveway at [redacted]; facing south)

(Photograph 7.2 – The alleyway connecting John Brown Close to Lincoln Road, to the south of [redacted]; facing east)

(Photograph 7.3 – Gully at the front door of [redacted])

20.2.7 Cluster 10 – Watermill Road & St Lawrence Street

(Photograph 10.1 – Watermill Road; facing north-east)

(Photograph 10.2 – River Bain, adjacent to Watermill Road; facing north)

(Photograph 10.3 – River Bain, adjacent to Watermill Road; facing south)

20.2.8 Cluster 12 – Hemingby Lane

(Photograph 12.1 – View of Hemingby Lane to the south of the affected properties; facing north)

(Photograph 12.2 – Damages at [redacted])

(Photograph 12.3 – Hemingby Lane, as viewed from the entrance to the [redacted] ; facing south)

(Photograph 12.4 – Entrance to [redacted]; facing south-east)

(Photograph 12.5 – Ponding on Hemingby Lane, [redacted]; facing south)

20.2.9 Road closure – low Toynton Road

(Photograph 13.1 – low Toynton Road at the point of marked road closure; facing south-west)

(Photograph 13.2 – River Waring as it crosses low Toynton Road; facing south)

(Photograph 13.3 – Drainage ditch adjacent to low Toynton Road; facing north-east)

(Photograph 13.4 – Bridge over River Waring on low Toynton Road)

20.3 Resident photographs

A selection of photographs of the flooding during Storm Babet taken by residents have been provided below. Where a cluster has not been mentioned, no photographs of the flooding were provided by the residents in this area. Note that videos were also provided by several residents, which have not been reproduced within this report.

20.3.1 Cluster 1 – Winceby Gardens

(Photograph 1.5 – Flooding to the south of [redacted] at around 12:30; facing south)

(Photograph 1.6 – Internal flooding at [redacted])

20.3.2 Cluster 2 – Maltby Way, Banovallum Gardens, Lodington Court, Clarke Court, Cupit Road & Saxon Way

(Photograph 2.14 – Flood waters on Banovallum Gardens, as provided by the resident [redacted]; facing north)

(Photograph 2.15 – Flood waters over the footbridge connecting Lodington Court and Saxon Way, as provided by the resident at [redacted]; facing north-east)

(Photograph 2.16 – Flood waters as observed from [redacted]; facing north)

(Photograph 2.17 – Flood waters downstream of Lodington Court, as provided by the resident at [redacted]. The channel of the Thunker Drain is present on the right hand side of the photograph; facing west)

(Photograph 2.18 – Flood waters in the rear garden at [redacted])

(Photograph 2.19 – Flood waters to the front of [redacted], with the channel of the Thunker Drain shown and Lodington Court beyond; facing south)

(Photograph 2.20 – Breech on Poppy Fields on-site attenuation pond)

20.3.3 Cluster 3 – Stanhope Road, Bowl Alley Lane, Linden Road & Banks Street

(Photograph 3.12 – Water inside [redacted] following Storm Babet.)

(Photograph 3.13– Broken wall caused by fluvial flows during Storm Babet, as provided by the manager at the [redacted] on Banks Street)

20.3.4 Cluster 8 – Bridge Street, West Street & Grundy's Court

[redacted]

(Photograph 8.1 – Flood waters at [redacted], as provided by the business owner)

20.4 EA reporting