

West Brook, Emsworth fluvial flood risk modelling report

Final report

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Contract

This report describes work commissioned by Matt Twinberrow of Bellamy Roberts, on behalf of Telstar Limited, by an email dated 9 June 2021. Telstar Limited's representative for the contract was Matt Twinberrow. Ben Gibson, Gwyn Jones and Lucy Archer-Lock of JBA Consulting carried out this work.

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Purpose

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Abbreviations

1D	One-dimensional
2D	Two-dimensional
AEP	Annual Exceedance Probability
FEH	Flood Estimation Handbook
Flood Modeller	Proprietary modelling software developed by Jacobs (all instances of Flood Modeller in this report refer specifically to Flood Modeller 1D)
JBA	Jeremy Benn Associates Limited
LIDAR	Light Detection And Ranging
mAOD	metres Above Ordnance Datum
ReFH	Revitalised Flood Hydrograph method
TUFLOW	Two-dimensional Unsteady FLOW (Proprietary 2D modelling software developed by WBM BMT)

1 Introduction

1.1 Overview

JBA Consulting was commissioned by Bellamy Roberts on behalf of Telstar Limited to prepare fluvial (river) flood modelling and mapping for the West Brook watercourse, Emsworth. This watercourse flows along the eastern boundary of the proposed development site, which is located to the west of Coldharbour Farm Road. The information prepared from this modelling will be used by Telstar Limited as part of development planning at the site.

The existing mapping available from the Environment Agency is based on generalised 2D flood modelling, and so does not include the detail of channel hydraulic or other influential features in the catchment such as a flood storage area and structures.

Specific objectives of the project were to:

- Prepare flood flow hydrology inputs for the West Brook catchment to be used within the flood risk model;
- Develop a baseline flood risk model reflecting the current site condition;
- Simulate the model for the 5% Annual Exceedance Probability (AEP), 1% AEP and 0.1% AEP present day events, and the 1% AEP event with an increase to flood flows of 25% (reflecting the Environment Agency's guidance for considering the influence of climate change on flood flows in Flood Risk Assessments¹);
- Prepare flood risk mapping for the modelling to communicate the level of flood risk at the site;
- Prepare a report documenting the hydrology and flood risk modelling.

The current Environment Agency Flood Map for Planning, which is based on the generalised flood modelling approach, displays significant flood extents from the West Brook watercourse, extending onto the south-eastern corner of the site.

¹ Flood risk assessments: climate change allowances, Environment Agency, November 2021. Available: <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>

2 Site description

2.1 Proposed development site

The development site is located west of Coldharbour Farm Road, which lies just north of the A27. The site comprises open space grassland which generally slopes from west to east. A ditch is displayed on mapping to flow through the centre of the site. Although this could not be observed on site due to access issues and very long vegetation, it is expected to be a minor channel, based on the absence of formal connectivity back to the West Brook watercourse. The red line boundary for the development site is displayed in Figure 2-1.

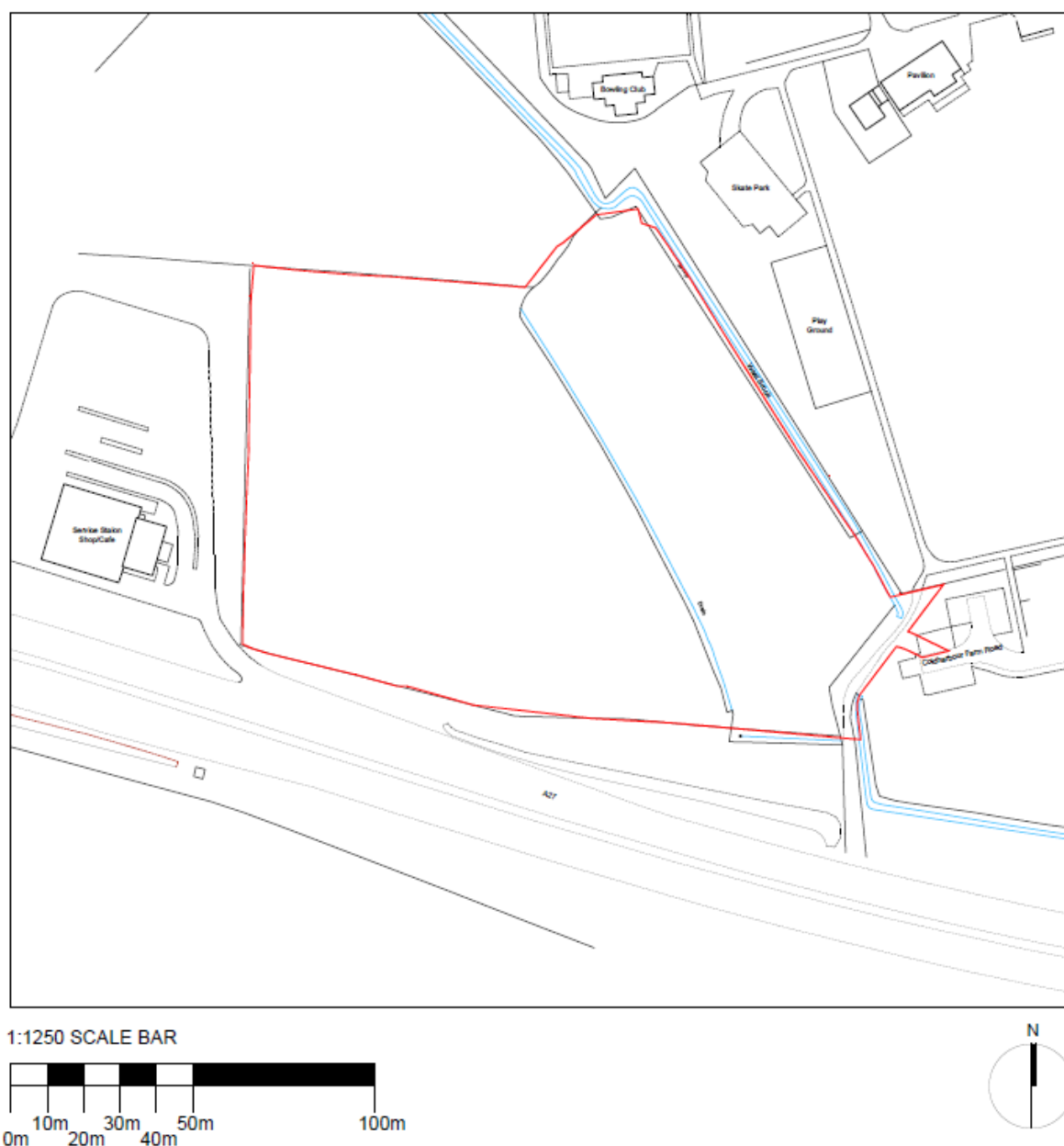


Figure 2-1: Site location plan

2.2 West Brook watercourse and catchment

The West Brook watercourse, catchment and topography are displayed in Figure 2-2.

The catchment is primarily composed of London Clay formation – clay, silt and sand. In the upper part of the catchment soils are slowly permeable and seasonally wet, while in the lower part of the catchment the soils are loamy soils with naturally high groundwater. The catchment topography is relatively steep in the upper catchment, and fairly flat in the lower catchment.

The West Brook (Environment Agency main river) flows in a south easterly direction adjacent to the site. The watercourse rises north west of Emsworth and flows south through Emsworth to its outfall at Emsworth Mill Pond, which discharges into Chichester Harbour. There are a number of drains, notably in the west of the catchment, which mapping indicates joins the West Brook. However, the flow paths and connectivity of these drains is unclear.

The channel banks along West Brook adjacent to the development site (Figure 2-3) and downstream within woodland north of the A27 (Figure 2-4) appear overgrown, although the channel itself is relatively clear from vegetation.

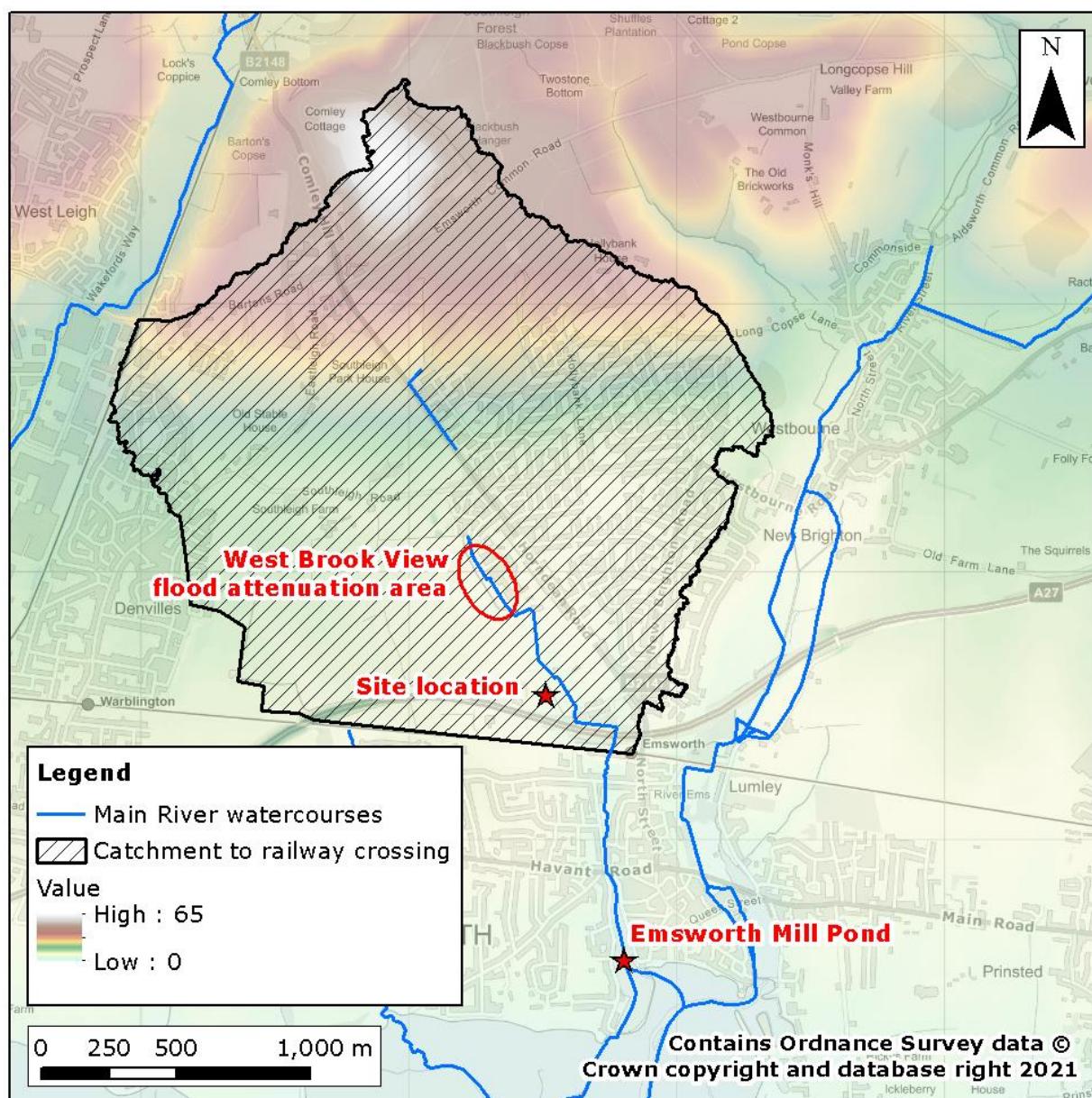


Figure 2-2: West Brook watercourse and catchment



Figure 2-3: West Brook watercourse, north of Coldharbour Farm Road and adjacent to the proposed development site (02/07/2021)



Figure 2-4: West Brook watercourse, north of the A27 (02/07/2021)

2.3 Upstream flood attenuation feature

A new development has recently been built at West Brook View, upstream of the proposed development site. As part of this, a flood attenuation feature has been constructed, which appears as though it would attenuate flow from the West Brook. The location of this in the catchment is presented in Figure 2-2. The flood attenuation feature comprises a circa 330m long wide basin with embanked sides in places, and a 0.6m diameter outlet culvert (invert level of 7.50mAOD) which has a penstock gate installed on the upstream face to allow the culvert outlet area to be adjusted. Figure 2-5 presents a view of the attenuation area and Figure 2-6 presents an image of the downstream control structure.

At the time of visiting the site (on 02/07/2021) the gate was partially lowered reducing the outflow area of the culvert. The opening area on site appeared consistent with the design drawings which indicate that the normal opening position would be 0.25m above the culvert invert (7.75mAOD). At a level 2.1m (9.60mAOD) above the culvert invert level a weir is present which would act as a spillway should levels rise sufficiently high. The minimum level of the embankments surrounding flood attenuation area are reported to be 0.2m above the weir (9.80mAOD).

Drawings for the development scheme and flood attenuation feature are available as part of planning application reference 14/00547 and 17/00358 on Havant Borough Council's planning portal website. The drawings most relevant to the geometry of the feature included drawing "APP_14_00547-CONDITION_14_-_LONG_SECTION-1032556.pdf" displaying a location plan and long-section of the flood attenuation, and drawing "APP_17_00358-FLOOD_STORAGE_AREA_CONTROL_STRUCTURE-1032788.pdf" displaying the downstream control structure. Key images of the control structure drawing are presented in Appendix A.



Figure 2-5: View of the flood attenuation area, look downstream (02/07/2021)



Figure 2-6: Flood attenuation area control structure (02/07/2021)

3 Data and methodology

3.1 Available data

Data available to inform the flood risk modelling is presented within Table 3-1.

Table 3-1: Data available to inform the flood modelling assessment

Data type	Details
Ground elevations	LIDAR data - Source: Environment Agency - Details: National LIDAR Programme 1m DTM data (2020)
	Limited topographic survey at Coldharbour Farm Road and the footpath south towards the underpass at the A27 - Source: Lewis Brown Limited - Details: Collected August 2021 (ref: C21201) The topographic survey data is presented in Appendix B The location of point elevations is presented in Figure 3-1.
Channel survey for West Brook	Channel and structure survey data - Source: Lewis Brown Limited - Details: Collected August 2021 (ref: C21201) - Open channel sections, plus structure sections at A) the culvert under the footpath beside Coldharbour Farm Road, B) the culvert under the A27 and C) the culvert under the railway line The location of survey sections is presented in Figure 3-1.

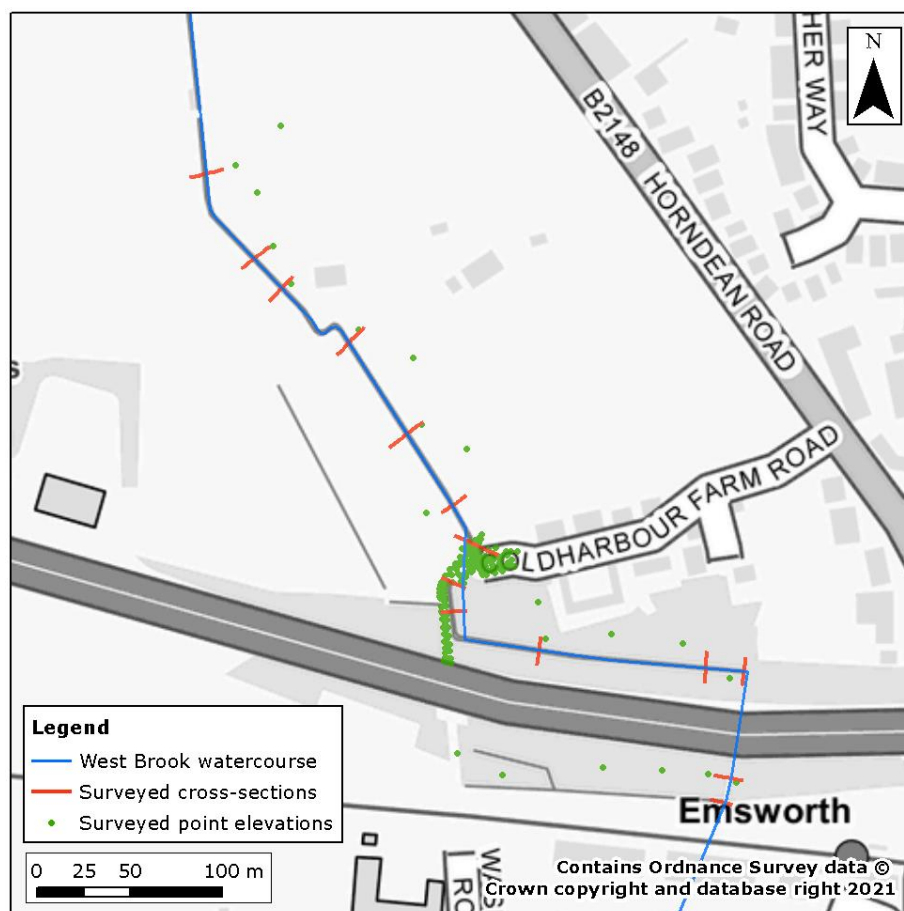


Figure 3-1: Location of survey sections and point elevation data (Lewis Brown Limited, August 2021, ref: C21021)

3.2 Site walkover and survey

A site walkover was undertaken by JBA Consulting on 02/07/2021, with Lewis Brown Limited, to inform the specification of survey (delivery ref C21021) required to inform the modelling.

3.3 Hydrology (flood flows)

Refer to the hydrology report (calculation record) provided in Appendix C for full details of the hydrology assessment.

West Brook drains a total area of 1.6km² to the downstream of the West Brook View flood attenuation area, and circa 2.3km² to the downstream extent of the site. A region of catchment, without the presence of watercourses being present, also slopes towards West Brook upstream of the railway line, meaning the total area of catchment upstream of the railway line is 3.9km².

There are a network of drains within the catchment to the west of West Brook. The connectivity of these drains is uncertain, and these may have a significant impact on the catchment area. A conservative approach to deriving the catchment boundaries was adopted, where it assumes all of these drainage channels would direct flood water towards West Brook watercourse.

Hydrological inflows for the hydraulic model were prepared for the following events:

- 5% Annual Exceedance Probability (AEP)
- 1% AEP
- 0.1% AEP
- 1% AEP, with flows increased by 25% to account for the predicted effects of climate change.

3.3.1 Flood estimation and model inflow locations

Three flood flow inputs were derived, as described below:

- 1 Inflow WEST01, representing the West Brook catchment to the downstream of the flood attenuation area
- 2 Inflow TRIB01, representing the urbanised eastern part of the catchment. This catchment does not appear to have watercourses, but the topography slopes towards West Brook where it flows under the A27
- 3 Inflow WEST02_IA, representing the intervening area of catchment between WEST01 and TRIB01.

3.3.2 Choice of method

Flood estimates were prepared using both the Flood Estimation Handbook (FEH) Statistical and Revitalised Flood Hydrograph (ReFH) 2 methods. Flood flows from the FEH Statistical method were larger than those for the ReFH2 method and were taken forward. For inflows WEST01 and TRIB01, hydrographs from the ReFH2 method were scaled to fit the statistical peaks, which for WEST02_IA, ReFH2 hydrographs were applied to the model.

3.3.3 Storm duration testing

Testing of storm durations using the ReFH2 method was completed for the 1% AEP +25% flows event, for both the flood attenuation area penstock open and partially closed scenarios. Storm durations of 7.5-hours, 11.5-hours and 15.5-hours were tested. In both scenarios, the 7.5-hour event was found to produce greatest flood flows, levels and extents at the site, and so was taken forward.

3.3.4 Inflows from TRIB01 catchment

The TRIB01 catchment is heavily urbanised and a watercourse draining to West Brook is not present, so any flood water resulting from rainfall would runoff overland. In light of the

absence of a channel system, consideration was given to removing the TRIB01 inputs from the model. This was considered to be an extreme approach (although potentially justifiable).

However, a compromised approach was taken forward whereby flows originating from the TRIB01 catchment are still applied to the model, but it was assumed that the surface water sewer system in the urbanised area captures a proportion of the runoff, meaning there are losses in terms of the flow rate that enters the watercourse.

The capacity of the sewer system was assumed to accept rainfall associated with the 3.3% AEP event (an event magnitude often considered for sewer capacity), and so the 3.3% AEP peak inflow rate for TRIB01 (1.302m³/s) was subtracted from the flood inflow rates applied to the model.

3.3.5 Final peak flood flow estimates

Final peak flow inputs to the flood mapping model for the three boundary inflows are presented in Table 3-2. Note that these inflows represent the peak flows applied to the model and may not be representative of the lumped catchment estimates presented within the hydrology report.

Table 3-2: Final flood flow estimates applied to the model

Inflow	Peak flow (m ³ /s) for the following AEP events			
	5% AEP	1% AEP	1% (+25%)	0.1%
WEST01	1.2	1.9	2.2	3.3
TRIB01* (*after subtraction of 3.3% AEP flow)	0	0.5	0.9	1.9
WEST02_IA	0.4	0.6	0.7	0.9

3.4 Hydraulic (flood risk) modelling

A linked 1D-2D Flood Modeller (1D) and TUFLOW (2D) model was developed and has been built in accordance with standard methods adopted for flood risk modelling and mapping. Some key aspects of the model schematisation are presented in Table 3-3. The schematisation of the flood risk mapping model is presented in Figure 3-2.

Table 3-3: Key aspects of the model schematisation

Aspect of model	Details
DTM data	LIDAR: National LIDAR Programme 2020 data, 1m resolution
Resolution of the model grid	2m
Orientation of the model grid	The 2d_loc line, and so the grid orientation, is positioned so that it follows the direction of the channel and floodplain south from Coldharbour Farm Road, and including potential overland flow across Coldharbour Farm Road and the proposed development site. This approach, in addition to the 2m model grid means that flow routes and elevations are well defined in the model.
Length of model watercourse	1.3km
Changes to default run parameters	Flood Modeller run parameters alpha and minitr were adjusted to values of 1 and 4, from their defaults of 0.7 and 3, respectively. This is a positive adjustment to reduce the mass error of the model simulation, which is particularly important given the presence of the flood attenuation area at the upstream of the model.

Aspect of model	Details
1D channel roughness (Manning's n)	Bed: 0.040-0.045 Banks: 0.060-0.080 These values were informed by observations while on site, and used Cowan's (1956)² method and Chow (1959)³ sources as guidance. Note that the hydraulic roughness values for both the channel and floodplain at the flood attenuation area are set to $n=0.040$. While it might typically be expected that the floodplain roughness is higher than the channel, the amount of vegetation is similar across the flood attenuation area and the significant flood depths expected during times that water is stored means the use of the same values is appropriate.
2D floodplain roughness (Manning's n)	Four land cover categories, each with different hydraulic roughness values: #1, 0.050 representing grass #2, 0.080 representing woodland #3, 0.030 representing paths and roads #4, 0.300 representing buildings There is little formal guidance for the selection of hydraulic roughness for 2D domains, so the values selected are consistent with those used for other flood risk mapping projects.
Flood attenuation area	Flood Modeller 1D River Sections describing the channel: - Numerous cross-section profiles were extracted from the LIDAR data which includes elevations of the flood attenuation area - Levels of the channel invert were inspected from drawing "APP_14_00547-CONDITION_14_- LONG_SECTION-1032556.pdf" and the LIDAR section data modified at the channel to provide a 1.5m wide base with the relevant invert applied This approach was selected as LIDAR captures the geometry of the floodplain the flood storage area well, and the flow direction is known - upstream to downstream - with water levels rising and attenuation occurring. Detailed predictions of flooding are not required on the floodplain here, and it was not necessary to increase the complexity of the model (and potentially introduce instability) by representing this as a 1D-2D linked area. Flood Modeller 1D structures representing flow routes allowing water out of the FSA, connected to the 2D domain downstream with SX links: - Outlet culvert (when open): Circular orifice unit - Outlet culvert (when partially closed): Rectangular orifice unit with invert and soffit levels, and bore area adjusted to reflect the partial opening - Overtopping weir: SPILL unit - Adjacent embankments: 2 no. SPILL units

² Cowan, W. L. (1956). Estimating hydraulic roughness coefficients: Agricultural Engineering, v. 37, no. 7, p. 473-475.

³ Chow, V.T. (1959) Open-Channel Hydraulics. McGraw-Hill, New York

Aspect of model	Details
West Brook downstream of attenuation area	From the FSA outlet to the upstream extent of survey (circa 300m length of channel): • 2D Z-Shape used to modify the model DEM to route water over the model grid surface, and back into the 1D channel downstream via HX links across to top of the river reach. • A 2m width is applied to channel, which is consistent with the width of the channel bed in the 1D channel sections downstream. The 2m width is an approximate width based on surveyed channel sections downstream, and is appropriate in light of the 2m model grid size. • Bed levels of the channel are informed by the invert level at the outlet of the FSA and the invert level of the 1D channel downstream (section WB01_0523). • The 'MIN' command is applied in TUFLOW so that if any model cells within elevations initially informed by LIDAR data have elevations lower than produced by the Z-Shape, these are retained. • This approach is appropriate given that the reach of channel is upstream of the proposed development site, and flood water is directed back into the 1D channel downstream. The purpose of the 2D model area is to route water from the FSA to the 1D-2D linked area of the model, but not to provide definition predictions of flood extents/depths. The approach is conservative, with the upstream flow remaining in bank, and so increasing the flow rate at the proposed development site, compared with a circumstance where the influence of structure or wetting of the floodplain results in attenuation of flows. Surveyed reach to model downstream boundary: • 1D River Sections connected to the 2D floodplain domain via HX links. • Culvert units are applied at the three culverts present within the reach. Culvert inlet and outlet units are applied where applicable. Note that testing was completed on the outlet loss unit applied to model culvert "WB01_0274" (downstream of the footpath at Coldharbour Farm Road) which was producing a spurious headloss and spike in water level predictions. The approach found to be most representative, and stable was to remove culvert outlet loss unit. This approach is representative given that the culvert discharges to a channel where little or no expansions losses are expected.
Bypassing at structures	At the flood attenuation area, SPILL units are used to represent the flow routes of water exceeding the control structure of embankment levels and flowing downstream. At structures within the 1D-2D model area, SPILL units are not applied for the following reasons: Structure WB01_0274cu: Coldharbour Farm Road culvert. Bypassing flow is permitted in the 2D domain. Applying a SPILL unit which would assume water flows directly from the upstream channel to the downstream channel would be a simplistic assumption, and would potentially mean that potential

Aspect of model	Details
	for flood water to flow over the footpath adjacent to Coldharbour Farm Road would be underestimated. Structures WB01_0071cu and WB01_0000cu: Culverts located at the A27 and railway line, respectively. Peak flood levels do not exceed the level of these features and so SPILL units are not needed. Flow could pass over them in the 2D domain if predicted.
A27 and railway underpasses	TUFLOW 2D Z-Shape features apply a flow route through these features, with elevations extracted from topographic survey and LIDAR data where required.
Downstream boundary and channel sections downstream of the railway line	Two River Sections, with interpolate units, are applied to the model downstream of the railway line culvert (model culvert "WB01_0000") to extend the model and provide an appropriate downstream boundary condition. The width of these sections is informed by Ordnance Survey mapping, site observations and satellite imagery, while the invert levels are extracted from LIDAR data. Although the coast is located circa 750m south of the downstream boundary, a tidal influence is not evident in telemetry data at the West Brook gauge located 200m south of the downstream boundary, which is likely to be due to presence of the mill pond at the outlet to the coast. The downstream boundary applied is a normal depth boundary with the slope (0.003m/m or 1 in 333 slope) informed by the channel gradient downstream of the railway line.

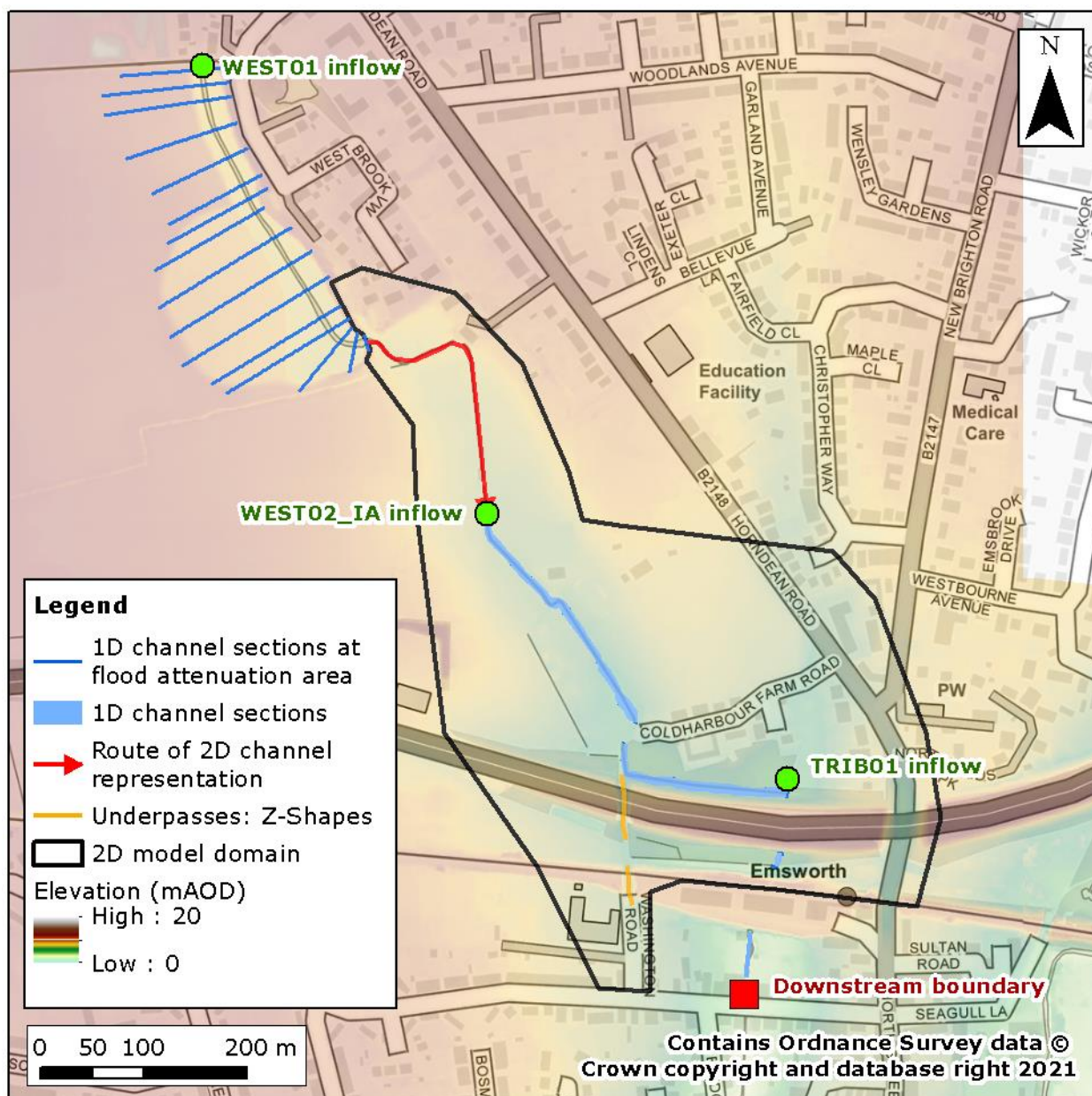


Figure 3-2: Schematisation of the flood risk mapping model

3.4.1 Flood attenuation area outlet position

The drawings available for the outlet of the flood attenuation area indicate that the normal position for the penstock gate is positioned partially obscuring the culvert, with the bottom of the gate 0.25m above the invert level of the culvert. No operating procedures for the attenuation area could be identified and so it is considered unlikely that during a flood event the penstock would be manually operated to modify the storage of flood water. However, it is possible that the penstock could be in a different position than 'normal' at the onset of a flood event, which would influence the rate of storage, and therefore attenuation upstream. This would in turn also influence the likelihood and timing of exceedance of the maximum storage level before flow passes across the weir and potentially embankments. In light of this possibility, the flood modelling prepared as part of this assessment simulated two scenarios for the penstock: 1) as per the design drawings (penstock set 0.25m above the culvert invert) and 2) penstock fully open. From these scenarios, the worst-case flood predictions are then presented.

3.5 Sensitivity testing

Sensitivity testing was completed for using the 1% AEP +25% flows design event, given that this event is likely to be most influential for decision-making at the proposed development site. The results described are for the scenario in which the flood attenuation area penstock gate is open, as this produces worst-case flood levels at the site. Two sensitivity test scenarios were completed, as presented below.

3.5.1 Hydraulic roughness (1D and 2D)

Hydraulic roughness for both the channel and the floodplain was increased by 20%. The change in flood extents between the baseline and sensitivity test are displayed in Figure 3-3. Conclusions drawn from comparison of these results with those of the baseline model are as follows:

- Peak water levels at the upstream and downstream of the culvert under the footpath beside Coldharbour Farm Road (model node WB01_0274) increase by 0.05m.
- The extent of flooding increases, with the shallow (<0.15m) depth flooding from the western bank of West Brook which extends onto the site in the baseline, flowing onto and across the footpath south of Coldharbour Farm Road. Flood depths on the footpath remain below 0.25m.
- The hydraulic roughness values selected to inform the baseline model are considered representative, but the sensitivity of predictions to hydraulic roughness should be kept in mind. The 1% AEP +25% flows event appears to represent an event where the watercourse is 'at capacity' and so any increase in flood water levels results in a more notable increase in flood extent.

3.5.2 Downstream boundary slope

The slope value assigned to the downstream boundary was adjusted from 0.003m/m (1 in 333 slope) to 0.002m/m (1 in 500 slope). The change in flood extents between the baseline and sensitivity test are displayed in Figure 3-4. Conclusions drawn from comparison of these results with those of the baseline model are as follows:

- Peak water levels at the upstream and downstream of the culvert under the footpath beside Coldharbour Farm Road (model node WB01_0274) increase by 0.04m and 0.05m, respectively.
- The extent of flooding increases, with the shallow (<0.15m) depth flooding from the western bank of West Brook which extends onto the site in the baseline, flowing onto and across the footpath south of Coldharbour Farm Road. Flood depths on the footpath remain below 0.25m.
- The downstream boundary value selected to inform the baseline model is considered representative, but the sensitivity of predictions to adjustment of this boundary should be kept in mind, as any reduction in efficiency of the system downstream (e.g. through blockage) may influence water levels at the site. The 1% AEP +25% flows event appears to represent an event where the watercourse is 'at capacity' and so any increase in flood water levels results in a more notable increase in flood extent.

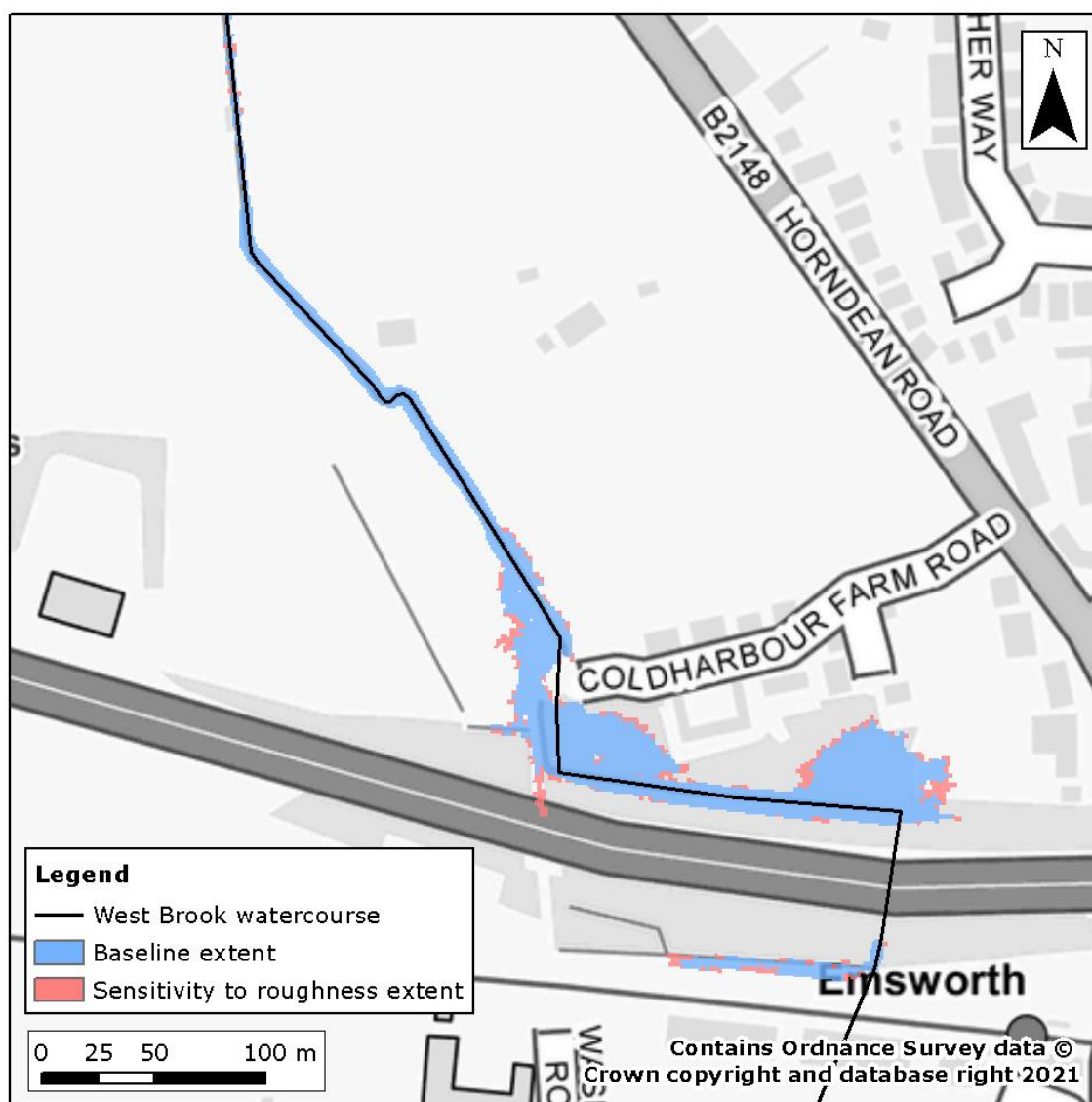


Figure 3-3: Flood extents – sensitivity to hydraulic roughness test (FSA Open / 1% AEP plus 25% flows)

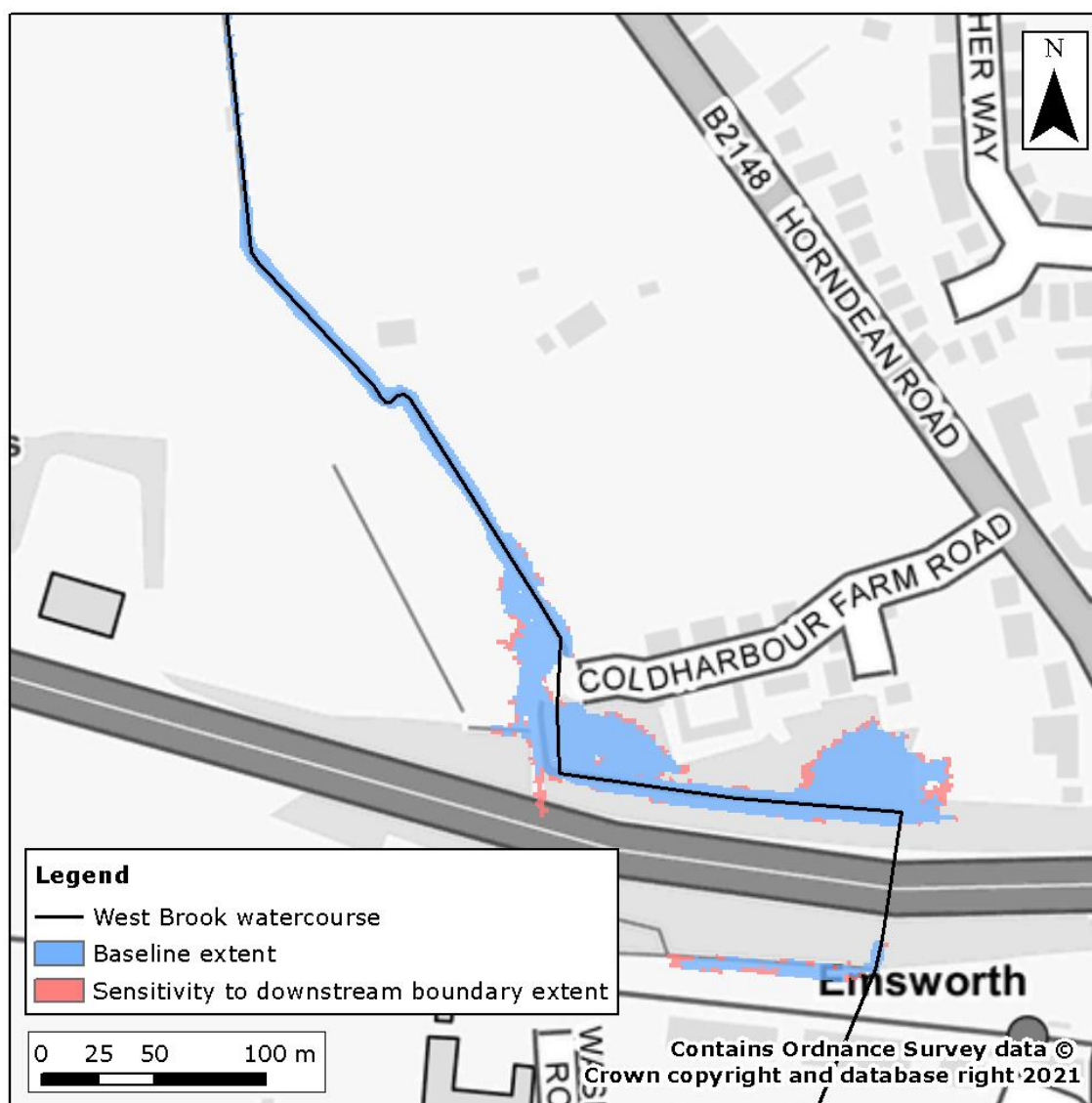


Figure 3-4: Flood extents – sensitivity to downstream boundary test (FSA Open / 1% AEP plus 25% flows)

3.5.3 Blockage of the culvert at Coldharbour Farm Road

A blockage of 50% was applied at the upstream of the culvert at Coldharbour Farm Road, by specifying a blockage proportion of 0.5 within the culvert inlet loss unit. The change in flood extents between the baseline and sensitivity test are displayed in Figure 3-5. Conclusions drawn from comparison of these results with those of the baseline model are as follows:

- Peak water levels at the upstream and downstream of the culvert under the footpath beside Coldharbour Farm Road (model node WB01_0274) increase by 0.12m and 0.01m, respectively.
- The extent of flooding increases, with the shallow (<0.15m) depth flooding from the western bank of West Brook which extends onto the site in the baseline, flowing onto and across the footpath south of Coldharbour Farm Road. Flood depths on the footpath remain below 0.25m.
- Representing the culvert as free from blockage in the baseline model is appropriate, but the sensitivity of predictions to blockage (which is a residual risk) should be kept in mind.

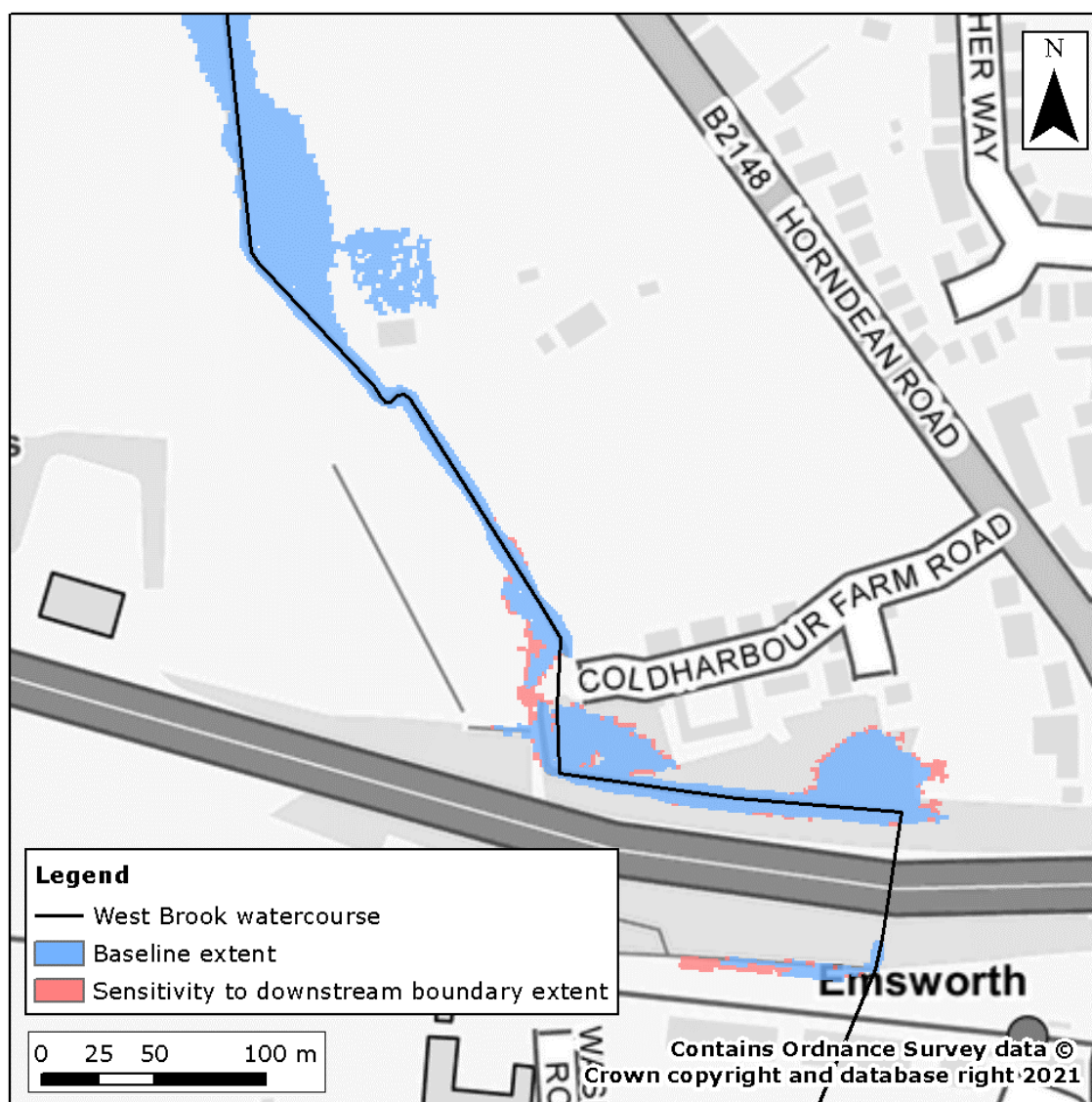


Figure 3-5: Flood extents – sensitivity to 50% blockage of the inlet to the culvert at Coldharbour Farm Road (FSA Open / 1% AEP plus 25% flows)

3.6 Modelling uncertainty

While the flood predictions presented within this report show information that appears definitive, in practice there are uncertainties inherent within all modelling which could mean that model predictions of extents, depth, water levels and so on, differ from what would occur in reality. Uncertainty may be introduced through aspects of the modelling including; the data used to inform the geometry of the model (e.g. ground levels), choices made regarding model parameterisation (e.g. hydraulic roughness), as well as the hydrology (flood flow) inputs.

While uncertainty is present within the modelling, the data, parameterisation and schematisation of the model is considered to be appropriate, and the model can be used to assess impacts of any proposed development with confidence.

Management of the uncertainty (and sensitivity) with the flood modelling predictions could be addressed by taking a precautionary approach to site design/levels, and/or including measures within the site design to help manage flooding, should flood levels exceed those modelled (including events that exceed the design standard).

4 Results

4.1 Change in flood risk: updated baseline

Flood depth mapping for the 1% AEP, 1% AEP +25% flows and 0.1% AEP events is presented in Appendix D. Flood water level mapping for the 1% AEP, 1% AEP +25% flows and 0.1% AEP events is presented in Appendix E.

Predicted flooding from the latest detailed modelling is notably reduced compared with the existing flood mapping published by the Environment Agency in their Flood Map for Planning.

The following observations are made regarding flooding in the updated modelling:

- Apart from for the 0.1% AEP event, flood levels within the watercourse are slightly greater in the scenario where the flood attenuation area culvert is fully open, compared with partially closed. The outputs of the scenario which provides greatest water levels in watercourse at the site have therefore been considered as they provided a conservative (more worst-case) scenario of flooding.
- Water levels within West Brook, adjacent to, and beyond the site remain in-bank for the 5% and 1% AEP events i.e. water does not flow onto the floodplain.
- For the 1% AEP +25% flow event, flood water flows out of bank of the western side of West Brook, into the site immediately upstream of the culvert at Coldharbour Farm Road. Flood depths are relatively shallow (less than 0.15m) and encroach onto the footpath. Flood water flows out of bank through parts of the woodland north of the A27.
- Blockage of the culvert at Coldharbour Farm Road would increase flood levels at the eastern side of proposed development site and on the footpath adjacent to the site. This forms a residual risk.
- For the 0.1% AEP event, channel exceedance is widespread and flooding of the south-eastern side of the proposed development site is predicted, including parts of Coldharbour Farm Road and the footpath west of this. Flood depths along Coldharbour Farm Road and the footpath exceed 0.5m.

5 Conclusions

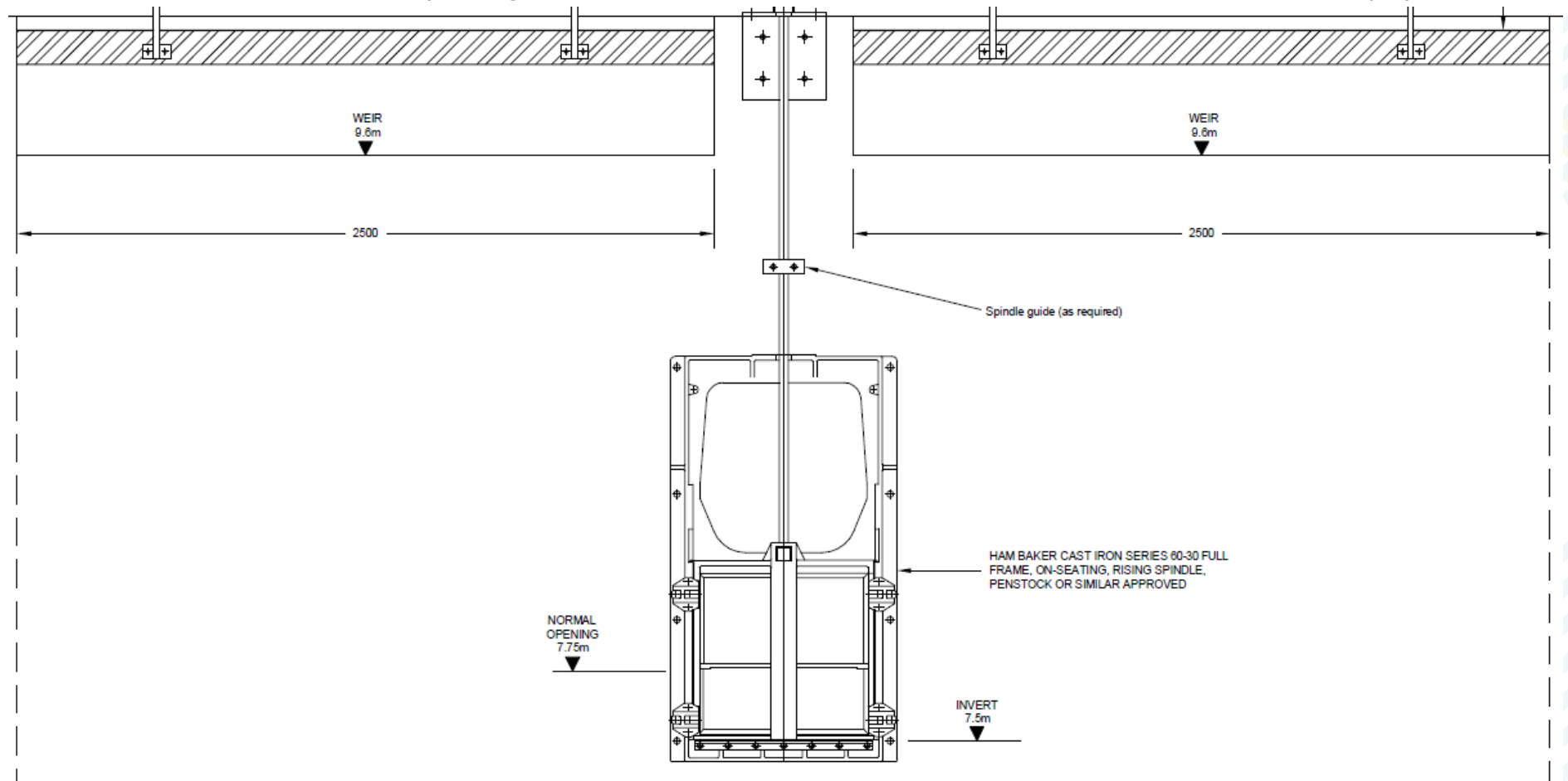
The updated hydraulic modelling, supported by new flood flow hydrology, new survey data and modelling and mapping using latest methods, has shown an improvement in the understanding of flood risk along West Brook and within the area of the proposed development site located west of Coldharbour Farm Road. For the baseline (as now) scenario, the site is not predicted to flood during the 5% or 1% AEP event. A small area at the southeast of the site is predicted to flood in the 1% AEP +25% flows event, representing the potential effects of climate change. The depth of flooding is shallow (less than 0.15m), but is predicted to extend onto the footpath west of Coldharbour Farm Road, or the road itself. During the 0.1% AEP event, flooding is widespread, and the south and southeast corner of the site are predicted to flood.

Sensitivity testing was conducted for hydraulic roughness (influencing channel and floodplain conveyance) and model conditions at the downstream extent of the model. This was completed for the 1% AEP +25% flows event, and predicted flooding at the site was not found to be sensitive to the scenarios tested.

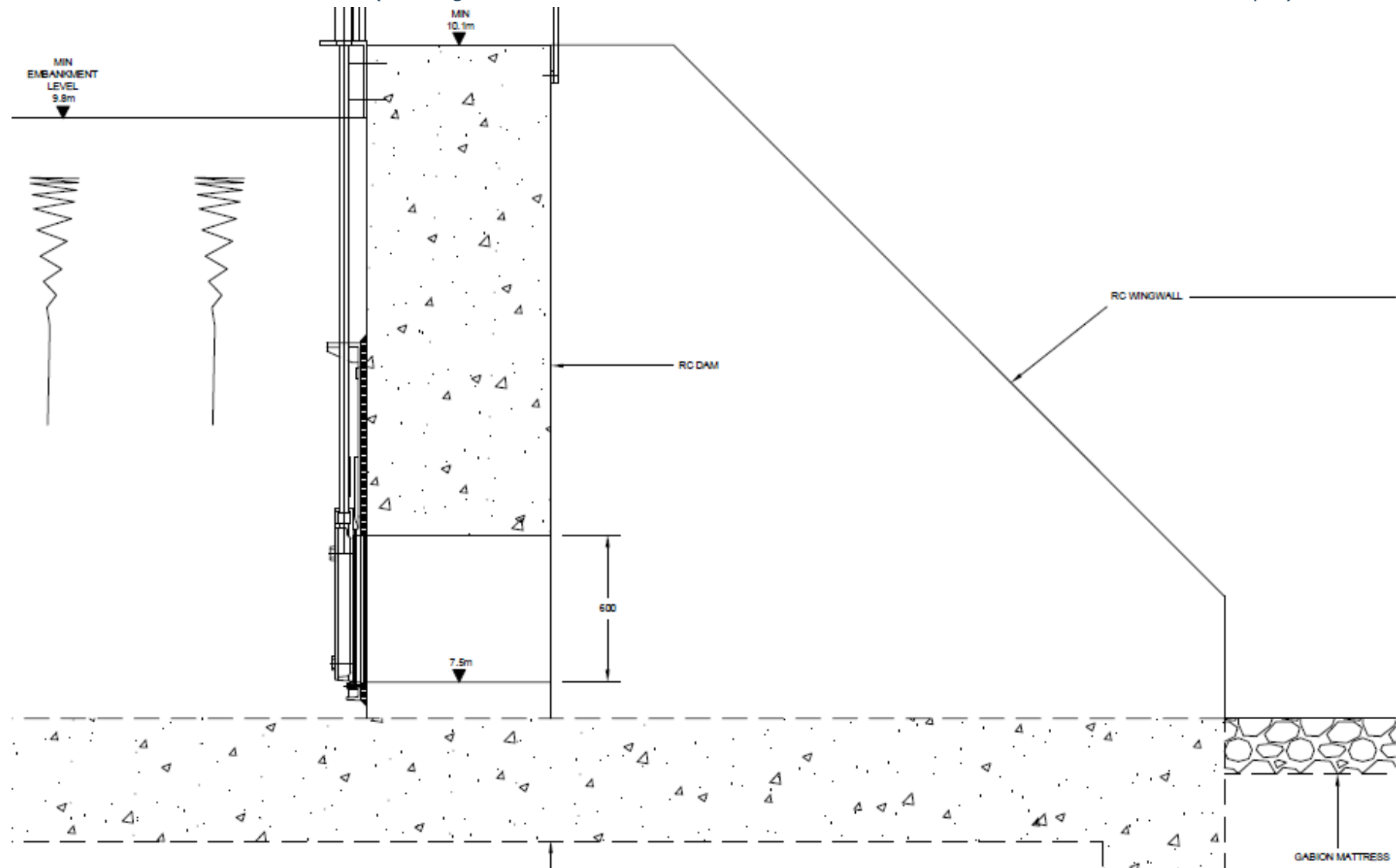
Appendices

A West Brook View flood attenuation area drawings

A.1 Flood control structure elevation (drawing APP_17_00358-FLOOD_STORAGE_AREA_CONTROL_STRUCTURE-1032788.pdf)



A.2 Flood control structure section (drawing APP_17_00358-FLOOD_STORAGE_AREA_CONTROL_STRUCTURE-1032788.pdf)

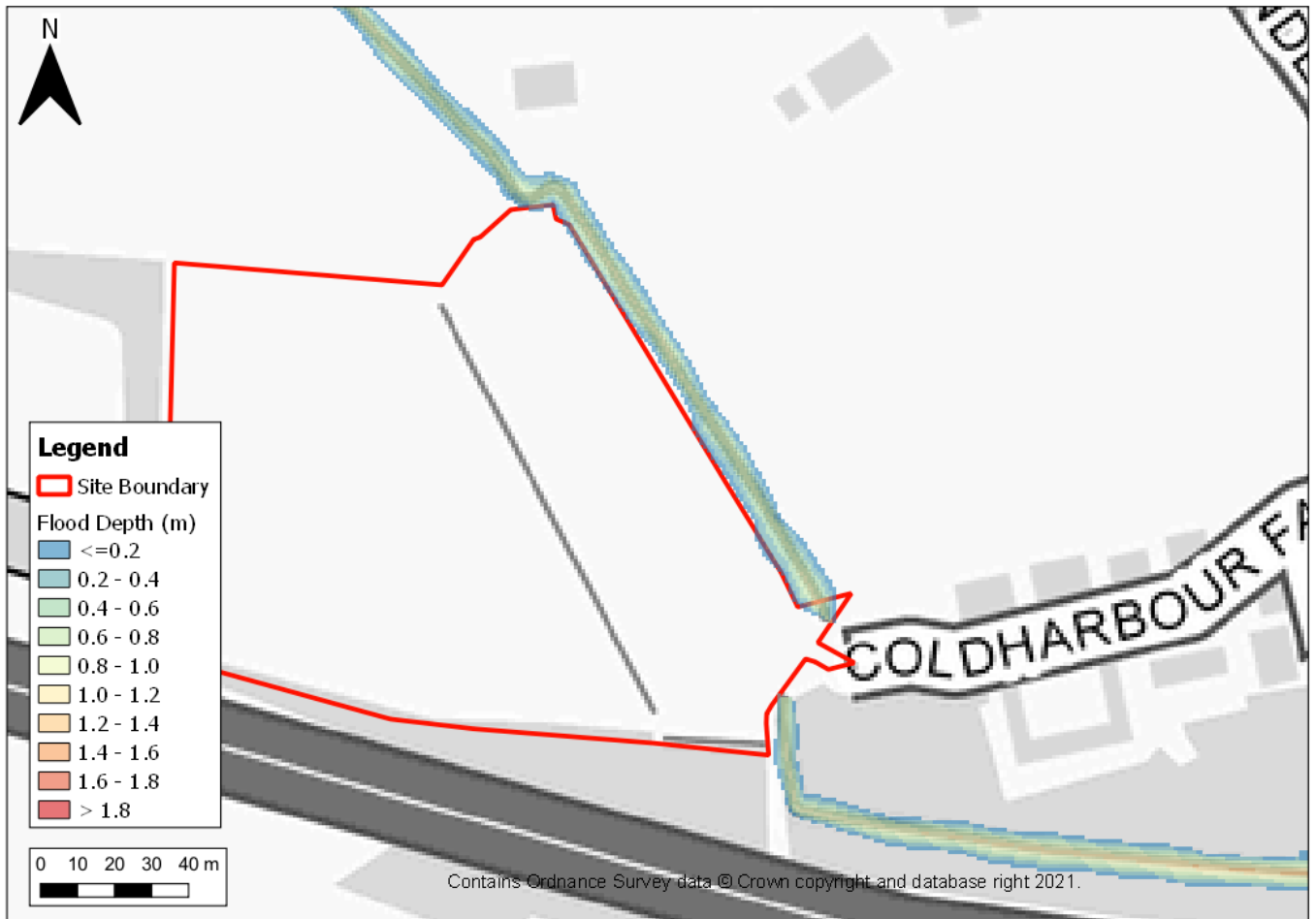


B Topographic survey at Coldharbour Farm Road and footpath south towards A27 underpass (Lewis Brown Limited)

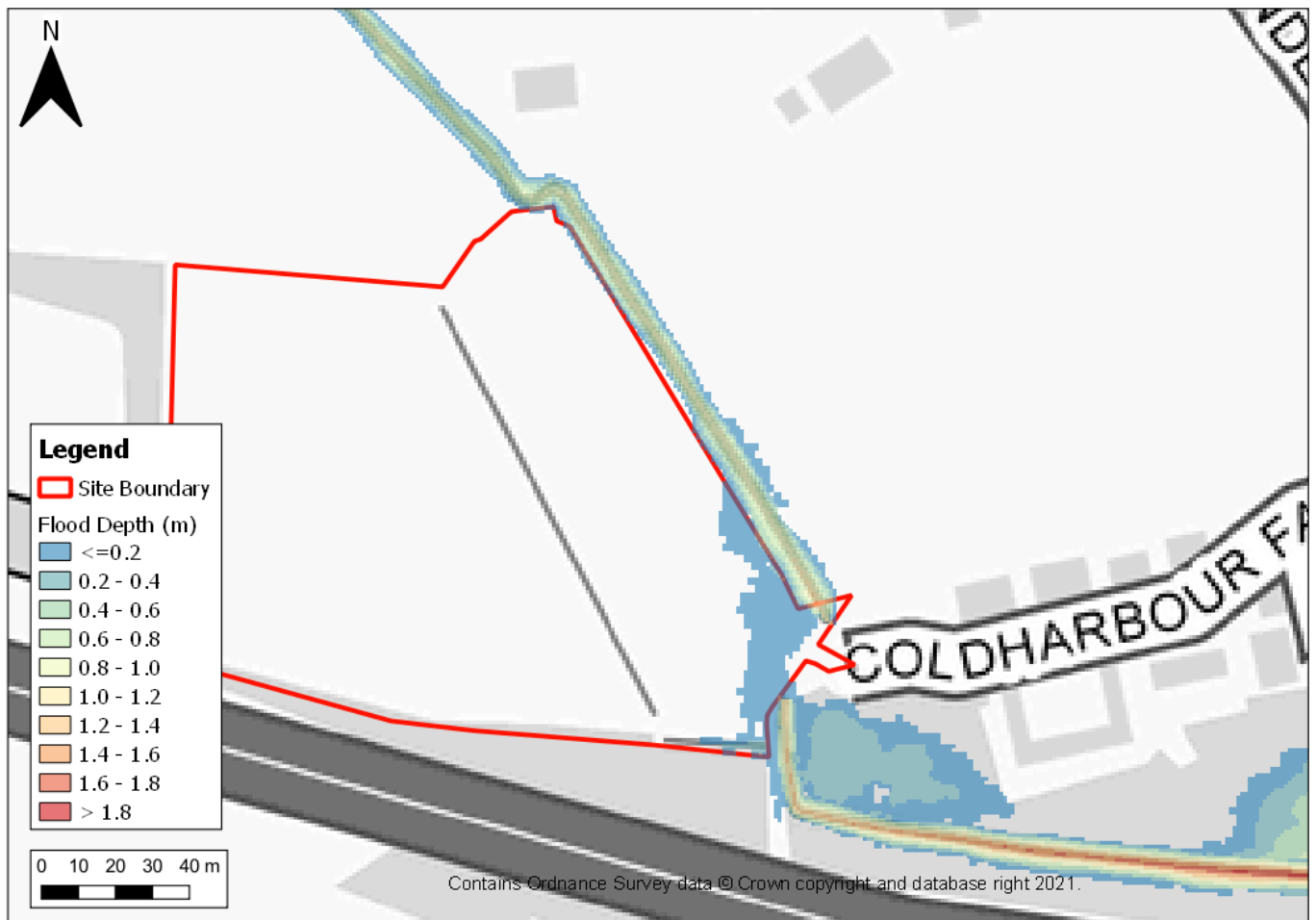
C Hydrology report (FEH Calculation Record)

D Flood mapping: flood depths

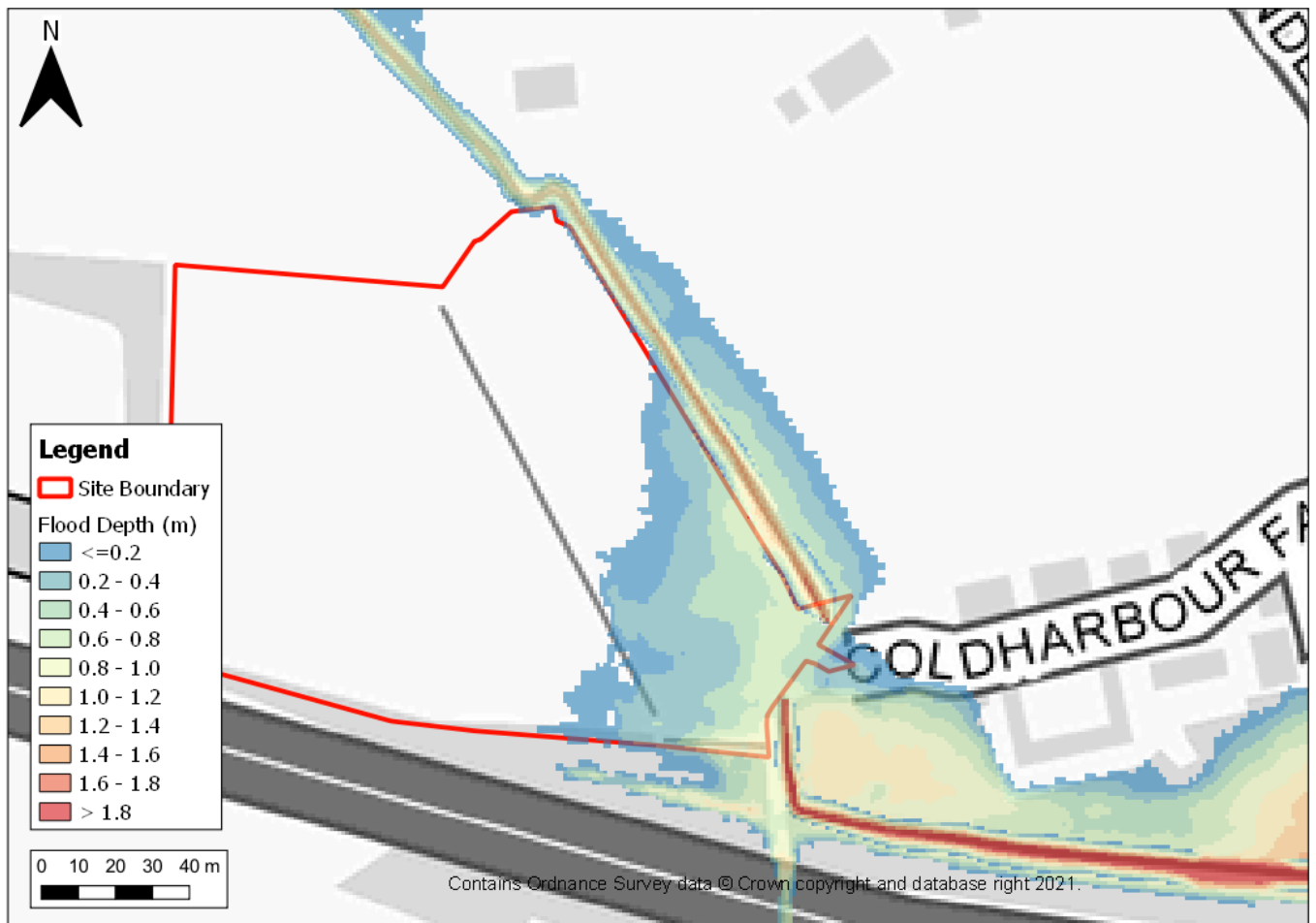
D.1 1% AEP (present day)



D.2 1% AEP +25% flows (climate change)

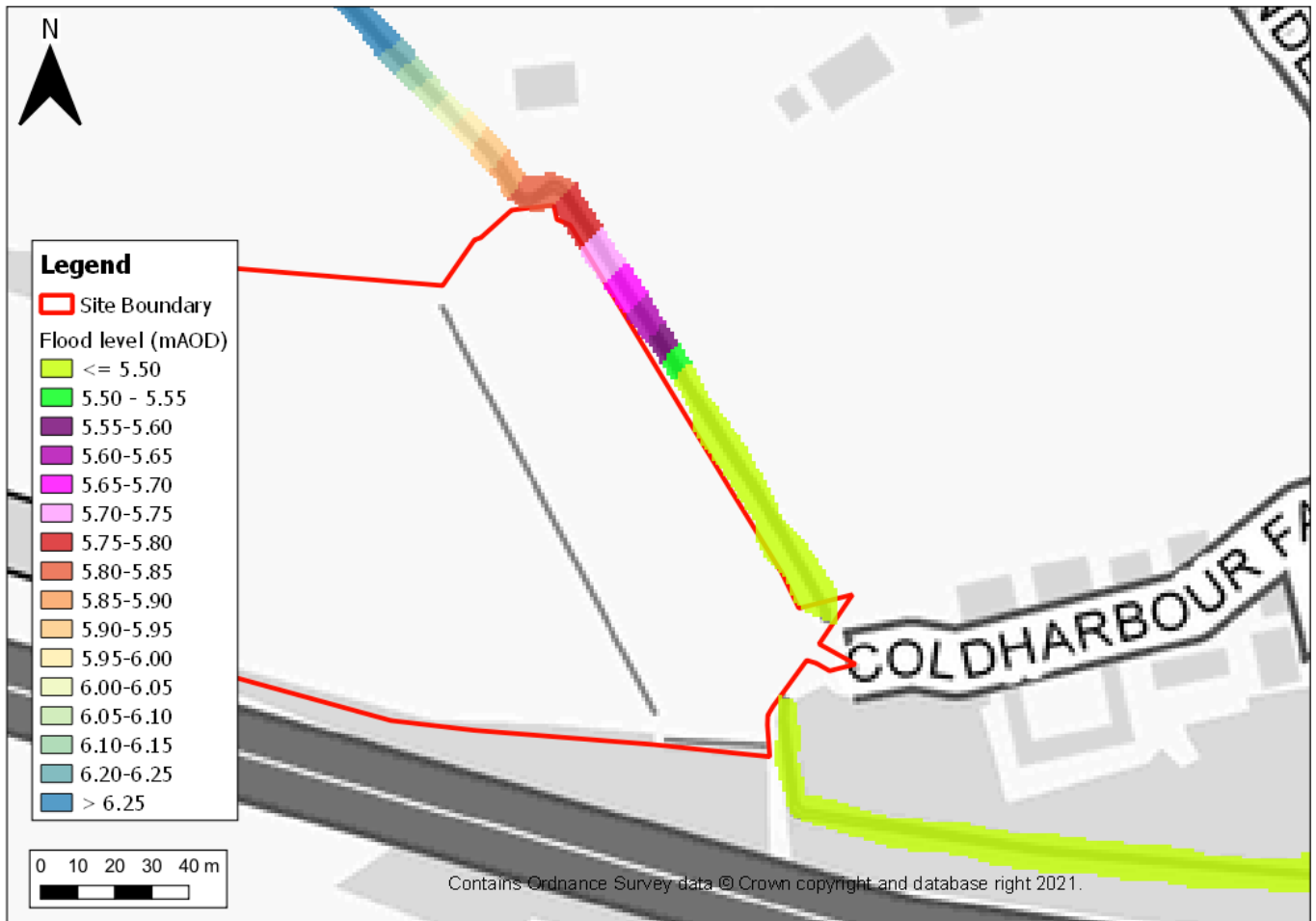


D.3 0.1% AEP (present day)

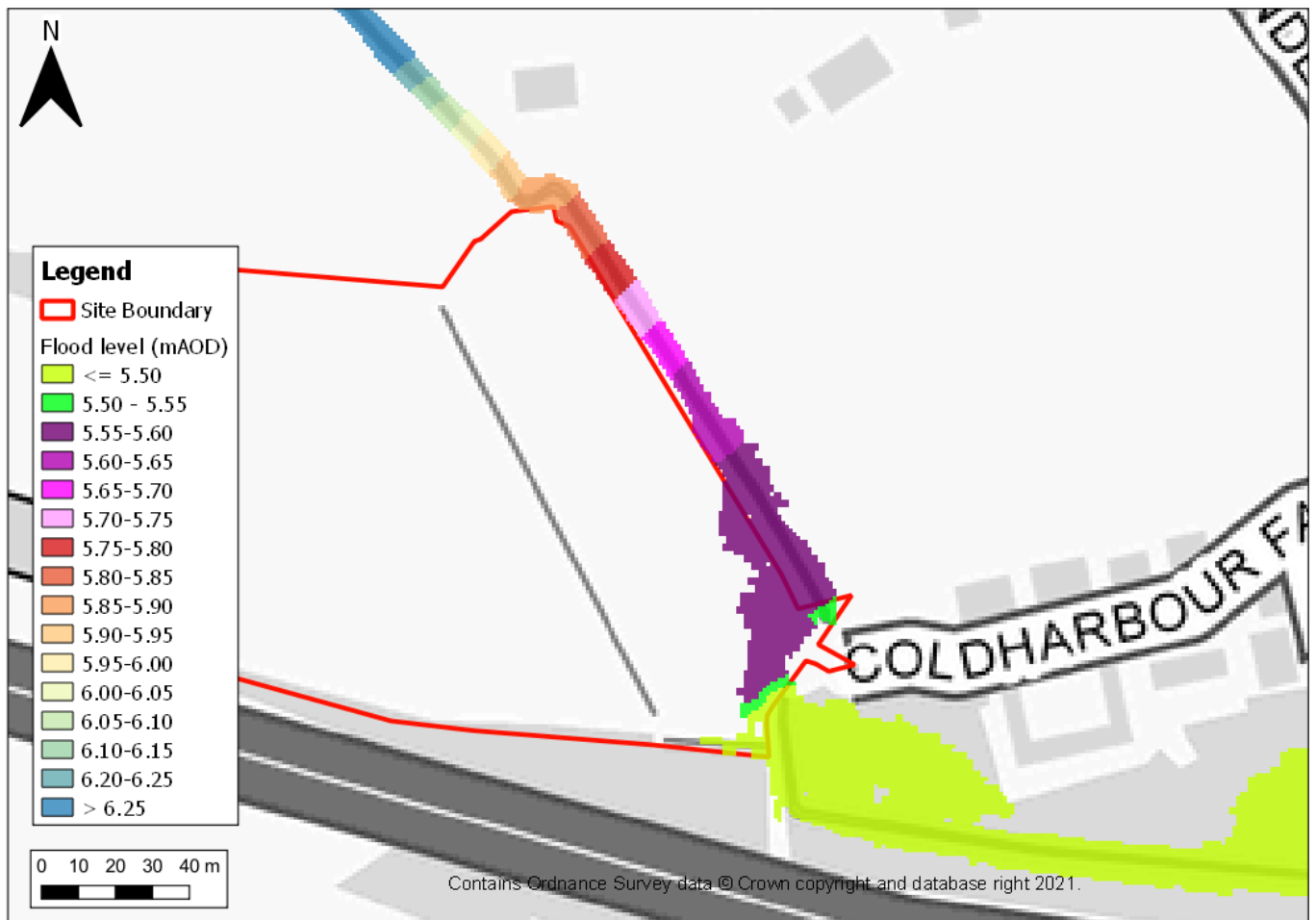


E Flood mapping: flood water levels

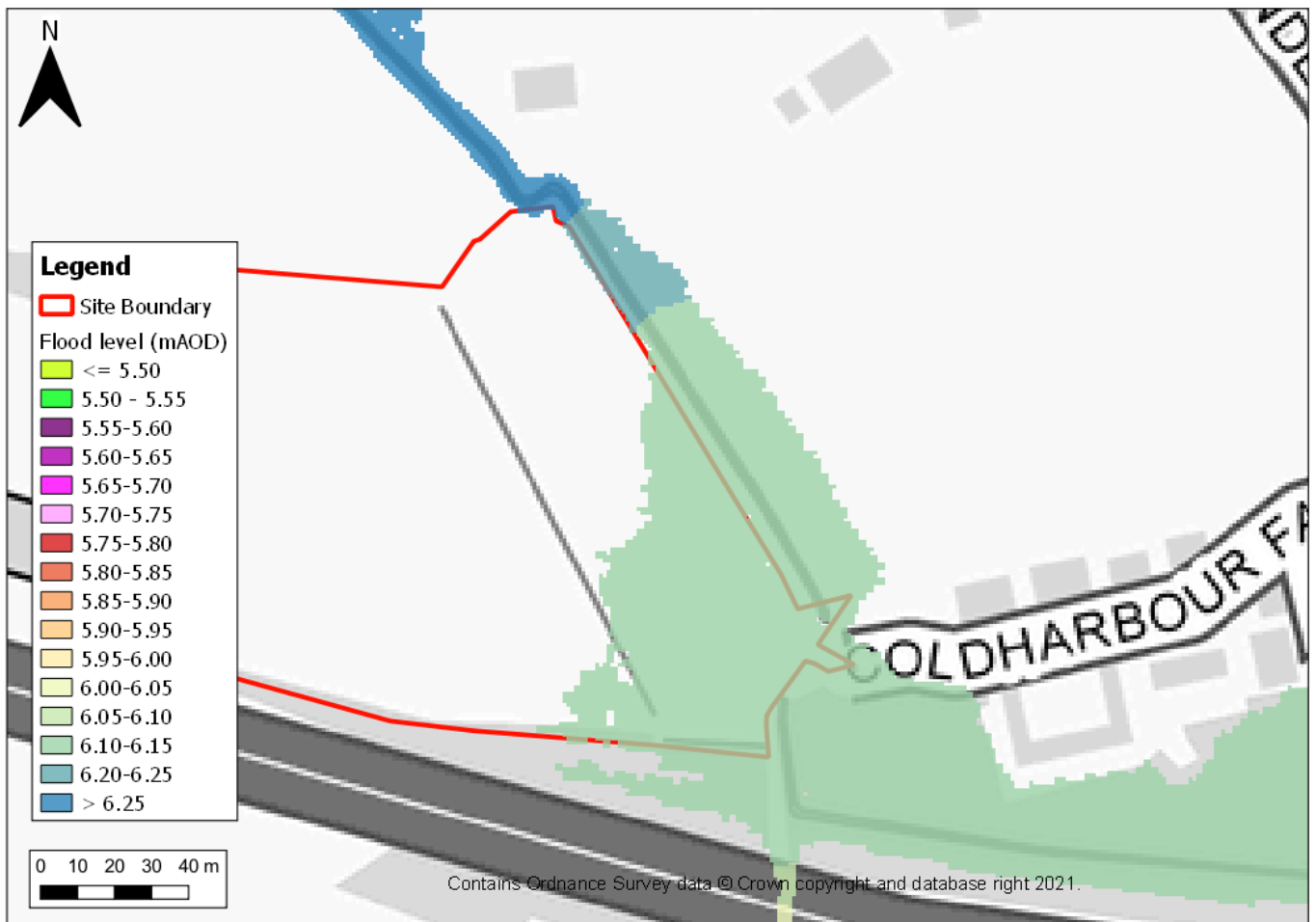
E.1 1% AEP (present day)



E.2 1% AEP +25% flows (climate change)



E.3 0.1% AEP (present day)



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