

Flood Risk Assessment

Bedford Road Hitchin

Document Ref: 30203467-ARC-YYY-XX-TR-DH-00003

Revision: P01

December 2025

Revision Control

Revision	Date	Author	Checker	Reviewer	Approver	Changes
P01	05/12/2025	NM	ML	CG	RG	

This report dated 05 December 2025 has been prepared for Arte Construction Ltd. (the “Client”) in accordance with the terms and conditions of appointment between the Client and **Arcadis UK** (“Arcadis”) for the purposes specified in the Appointment. For avoidance of doubt, no other person(s) may use or rely upon this report or its contents, and Arcadis accepts no responsibility for any such use or reliance thereon by any other third party.

Contents

Tables.....	1
Figures	1
1 Introduction	1
2 Background	3
3 Planning Policy Context.....	6
4 Potential Sources of Flooding.....	10
5 Surface Water Modelling.....	17
6 Conclusions	25

Tables

Table 1: Flood risk vulnerability and flood zone ‘incompatibility’	7
Table 2: Flood Zones	8
Table 3: Sources of Flooding	10

Figures

Figure 1: Site location	3
Figure 2: Site topography	4
Figure 3: Environment Agency Flood Zones	9
Figure 4: Environment Agency Risk of Flooding from Rivers and Sea - current day	11
Figure 5: Environment Agency Risk of Flooding from Rivers and Sea - future risk due to climate change	12
Figure 6: Risk of Flooding from Surface Water - Current day	13
Figure 7: Risk of Flooding from Surface Water - Future risk due to climate change.....	14
Figure 8 Baseline Flood Depths (m) - all events (flood depths less than 2.5cm not shown for clarity).	18
Figure 9 Summary of proposed flood management measures	19
Figure 10 Proposed Flood Depths (m) - all events (depths less than 2.5cm are not shown for clarity)	22
Figure 11 Depth Difference Grids between baseline and design - all events.....	23
Figure 12 Flood Hazard Maps - all events (areas where flood depths are less than 2.5cm are not shown for clarity)	24

Appendices

Appendix A

Surface Water Modelling Report

Appendix B

Development Areas Plan

Appendix C

Consultation with Anglian Water

1 Introduction

1.1 Overview

Arcadis (UK) Limited (“Arcadis”) was instructed by Arte Construction Ltd (“the client”) to prepare a Flood Risk Assessment (FRA) to support a planning application for the proposed residential development on land to the east of Bedford Road, Hitchin (hereafter referred to as the site).

The site is approximately 1.7 hectares (ha) in area and is located within Flood Zone 1 on the Environment Agency (EA) Flood Map for Planning (FMfP)¹. Since the site exceeds 1 ha, an FRA is required to accompany an application for planning permission at the site, in line with the requirements of the National Planning Policy Framework (NPPF)² and its accompanying Planning Practice Guidance (PPG)³.

1.2 Scope of works

Our proposed scope of work for producing this FRA is as follows:

- Desk study to collect and review published flood risk data (from all sources) and reports.
- Qualitative assessment of all relevant sources of flood risk.
- Quantitative assessment of surface water flood risk, based on bespoke surface water modelling; the modelling report is included as Appendix A.
- Assess the potential off-site flood impacts as a consequence of the development.
- Produce an FRA report in accordance with the NPPF and its PPG.

The design of flood management measures and preparation of a Drainage Strategy have been undertaken by Levee Consulting. This FRA considers the effectiveness of the proposed flood management measures to ensure the safety of the proposed development from off-site sources of surface water flooding. Consideration of surface water generated on the site is not included in this assessment. This is addressed by the site drainage strategy.

1.3 Terminology

Flood risk is a product of both the likelihood and consequences of flooding. Throughout this document, flood events are defined according to their likelihood of occurrence. Floods are described according to an ‘annual chance’, meaning the chance of a particular flood occurring in any one year. This is directly linked to the probability of a flood. For example, a flood with an annual chance of 1 in 100 (a 1 in 100 chance of occurring in any one year), has an annual probability of 1%. This may also be referred to as an Annual Exceedance Probability (AEP).

¹ Flood map for planning - GOV.UK last accessed December 2025

² National Planning Policy Framework - Guidance - GOV.UK last accessed December 2025

³ Flood risk and coastal change - GOV.UK last accessed December 2025

1.4 Limitations

This report has been compiled from a number of sources which Arcadis believes to be trustworthy. However, Arcadis is unable to guarantee the accuracy of information provided by others. The report is based on information available at the time of writing. Additional information may become available in the future which may have a bearing on the conclusions of this report and for which Arcadis cannot be held responsible.

2 Background

2.1 Site Location

The site is located approximately 1.6km north of Hitchin town centre, at National Grid Reference (NGR) TL 17910 30870. The site occupies an area of approximately 1.7 hectares (ha) and can be accessed via Bedford Road (A600) to the west of the site. The site is bound by trees/hedgerow to the east, the Priory School car park to the south, Bedford Road to the west, and an access road towards a residential property to the north of the site.

The site is located within the Hiz (downstream of Hitchin) water body catchment (Water Body ID: GB105033037700). The River Oughton, an ordinary watercourse, is a tributary of the River Hiz and is located 28m north of the site. It flows in a north-easterly direction past the site before draining into the River Hiz approximately 800m downstream. These features are displayed in Figure 1.



Figure 1: Site location

Contain map data @Google Satellite 2025. Contains OS Open Rivers information © Ordnance Survey (OS) and/or database right.

2.2 Proposed Development

The proposed development consists of 50 housing units, of which 25 are private dwellings and 25 are affordable housing units. The housing units include parking spaces and the development also includes visitor parking spaces. The layout assessed in the FRA and surface water flood modelling is included in Appendix B

The flood mitigation measures proposed at the site include a swale located along the southern and western boundaries, a small bund located in the northern part of the site, and a french drain located along the eastern boundary. The proposed measures are discussed in Section 5.3.

2.3 Topography

The Environment Agency (EA) 1m resolution Digital Terrain Model (DTM) derived from data collected by the National lidar Programme⁴ is shown in Figure 2. The ground levels across the site slope from 57.6m Above Ordnance Datum (AOD) at the southern boundary to 54.7m AOD at the northern boundary. There is a depression located across the centre of the site in which the average ground levels range from 56.1m AOD in the centre of the site to 55.1m AOD in the north of the site.

The surrounding topography gradually slopes in a northerly direction towards the River Oughton, along which the approximate ground levels range from 53.2m AOD to 54.5m AOD as it passes the site.



Figure 2: Site topography

Contains map data @Google Satellite 2025. Contains Department for Environment, Food, and Rural Affairs (DEFRA) Lidar data downloaded October 2025.

⁴National Lidar Programme, accessed October 2025

2.4 Historical Flooding

The EA Historic Flood Map⁵ and the EA Recorded Flood Outlines⁶ datasets do not show any land within the site or its surroundings that have been previously subject to flooding.

While the North Hertfordshire Council Strategic Flood Risk Assessment (SFRA)⁷ does not specifically list the site itself, it lists a historic fluvial flood event affecting Laurel Way, located on the River Oughton approximately 560m downstream of the site. The reason for the event was recorded as a bank full River Oughton, however no event date was provided.

⁵EA Historic Flood Map, accessed October 2025

⁶EA Recorded Flood Outlines Dataset, accessed October 2025

⁷ North Hertfordshire Council Strategic Flood Risk Assessment (2008), North Hertfordshire Council, accessed October 2025

3 Planning Policy Context

3.1 NPPF and Flood Risk

The NPPF² and its accompanying PPG³ sets out the government's planning policies for England and how these are expected to be applied. The principal aim of the NPPF is to achieve sustainable development. This includes ensuring that flood risk is considered at all stages of the planning process, avoiding inappropriate development in areas at risk of flooding and directing development away from those areas where risks are highest. Where development is necessary in areas of flooding, the NPPF aims to ensure that it is safe, without increasing flood risk elsewhere. Suitable mitigation and adaption measures are also advised in the planning process to address the likely future impacts of climate change.

Early adoption of, and adherence to, the principles set out in the NPPF and PPG, with respect to flood risk, should ensure that detailed designs and plans for developments take due account of flood risk and the need for appropriate mitigation, where required.

3.2 Local Planning Policy

3.2.1 North Hertfordshire Local Plan 2011 – 2031⁸

The site is located within the administrative boundary of North Hertfordshire. Their Reducing Flood Risk Policy (Policy NE7) includes the following:

'Planning permission for development proposals will be granted provided that (as applicable):

a) Development is located outside of medium and high-risk flood areas (flood zone 2 and 3) and other areas affected by other sources of flooding where possible;

b) Where (a) is not possible, application of the sequential and exception tests is demonstrated where development is proposed in areas of flood risk using the Strategic Flood Risk Assessment (SFRA) and Environment Agency flood maps; '

c) An FRA has been prepared in accordance with national guidance that considers the lifetime of the development, climate change impacts and safe access and egress;

d) It will be located, designed and laid out to ensure the risk of flooding is reduced whilst not increasing flood risk elsewhere;

e) The impact of any residual flood risk will be minimised through flood resistant, resilient design and construction;

f) Any flood protection and mitigation measures necessary will not cause harm to nature conservation, heritage assets, and/ or landscape and recreation and, where possible, will have a positive impact in these respects; and

g) Overland flow routes and functional floodplain areas are protected from all development other than that which is "water compatible" and this must be designed and constructed to remain operational and safe for users during flood events, resulting in no net loss of flood plain storage and not impeding water flows or increasing flood risk elsewhere.'

⁸ North Hertfordshire Local Plan 2011 – 2031, North Herts Council, accessed October 2025

3.3 The Sequential and Exception Test

The NPPF specifies that the suitability of all new development in relation to flood risk should be assessed by applying the Sequential Test to demonstrate that there are no reasonably available sites in areas with a lower probability of flooding that would be appropriate to the type of development proposed. The PPG provides further guidance on the compatibility of each land use classification in relation to each of the Flood Zones as summarised in Table 1.

Table 1: Flood risk vulnerability and flood zone 'incompatibility'

Flood Zone	Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
1	✓	✓	✓	✓	✓
2	✓	Exception Test required	✓	✓	✓
3a	Exception Test required	✗	Exception Test required	✓	✓
3b	Exception Test required	✗	✗	✗	✓

Key: ✓ Exception Test is not required ✗ Development should not be permitted

(Source: PPG, Flood Risk and Coastal Change, Table 2)

It is stated in the PPG that some developments may contain different elements of vulnerability, and the highest vulnerability category should be used to categorise unless the development is considered in its component parts.

If it is not possible for development to be located in zones with a lower risk of flooding, the Exception Test may have to be applied. For the test to be passed, it should be demonstrated that:

- The development would provide wider sustainability benefits to the community that outweigh the flood risk; and
- The development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

3.4 Flood Zone Classification

The PPG identifies four Flood Zone classifications, detailed in Table 2.

Table 2: Flood Zones

Flood Zone	Annual Probability of Flooding (%)
1 Low Probability	Fluvial and Tidal <0.1% (1 in 1,000)
2 Medium Probability	Fluvial 0.1 – 1.0 % (1 in 1,000 to 1 in 100) Tidal 0.1 – 0.5 % (1 in 1,000 to 1 in 200)
3a High Probability	Fluvial >1.0 % (greater than 1 in 100) Tidal >0.5 % (greater than 1 in 200)
3b The Functional Floodplain	Land where water has to flow or be stored in times of flood, identified by local authorities in Strategic Flood Risk Assessments. Fluvial and Tidal >3.3 % (greater than 1 in 30) is recommended as a starting point for consideration, but it should not be defined solely by rigid probability parameters.

(Source: PPG, Flood Risk and Coastal Change, Table 1)

The proposed development site is located in Flood Zone 1 (low risk), as shown in Figure 3. Flood zone 1 is defined as land having an annual probability of flooding of less than 0.1% (1 in 1000).



Figure 3: Environment Agency Flood Zones

Contain map data @Google Satellite 2025. Contains Environment Agency information © Environment Agency and/or database right

3.5 Application of the Sequential and Exception Test

In applying the Sequential Test, the PPG³ states: *'Where a site-specific flood risk assessment demonstrates clearly that the proposed layout, design, and mitigation measures would ensure that occupiers and users would remain safe from current and future surface water flood risk for the lifetime of the development (therefore addressing the risks identified e.g. by Environment Agency flood risk mapping), without increasing flood risk elsewhere, then the sequential test need not be applied.'*

Throughout the remaining sections of this FRA, it is demonstrated that the proposed development will be safe for its lifetime and will not increase flood risk elsewhere. Therefore, in line with the PPG, the Sequential Test need not be applied.

Since the site is located in Flood Zone 1, the proposed development is considered to be appropriate in accordance with Table 1 and the Exception Test is not required. The remainder of this FRA therefore provides an assessment of flood risk to the site from all potential sources in line with the requirements of the NPPF and PPG.

4 Potential Sources of Flooding

4.1 Overview

In line with best practice, this section considers flood risk from the range of possible sources listed in Table 3 and identifies where further appraisal and/or mitigation measures may be required.

Table 3: Sources of Flooding

Source of Flooding	Description
Flooding from rivers (fluvial)	Floodwater originating from a nearby watercourse when the amount of water exceeds the channel capacity of that watercourse.
Flooding from the sea (tidal)	Flooding originating from the sea or a connected waterbody when seawater overflows onto land through extreme tidal conditions, storm surge or breach.
Flooding from surface water (pluvial)	Flooding caused by intense rainfall exceeding the available infiltration and/or drainage capacity of the ground.
Flooding from groundwater	Flooding caused when groundwater levels rise above ground level following prolonged rainfall.
Flooding from sewers	Flooding originating from surface water, foul or combined drainage systems, typically caused by limited capacity or blockages.
Flooding from reservoirs, canals, and other artificial sources	Failure of infrastructure that retains or transmits water or controls its flow.

4.2 Flooding from Rivers and the Sea

Due to its distance from the coast (approximately 105km) and its ground elevations being above 50mAOD, the site is not considered to be at risk of tidal flooding.

The River Oughton is located 28m north of the site and flows in a north-easterly direction past the site before draining into the River Hiz approximately 800m downstream of the site. OS mapping indicates that land drainage and groundwater springs are the principal source of flow for the River Oughton⁴.

The EA Risk of Flooding from Rivers and Sea Map (RoFRS)⁹ is informed by the EA National Flood Risk Assessment 2 (NaFRA2) study. The RoFRS mapping products are probabilistic, meaning that they show the overall risk, rather than the risk associated with a specific event or scenario. This risk is displayed as one of four likelihood bandings:

- There is a chance of flooding of greater than 3.3% (1 in 30) in any year ('High' risk)
- There is a chance of flooding between 1% (1 in 100) and 3.3% (1 in 30) in any year ('Medium' risk)
- There is a chance of flooding between 0.1% (1 in 1000) and 1% (1 in 100) in any year ('Low' risk)
- There is a chance of flooding of less than 0.1% (1 in 1000) in any year ('Very Low' risk)

⁹ EA Risk of Flooding from Rivers and Sea, accessed October 2025

The current RoFRS is shown in Figure 4. This shows that the site is at 'very low' risk of fluvial flooding in the present day.



Figure 4: Environment Agency Risk of Flooding from Rivers and Sea - current day

Contain map data @Google Satellite 2025. Contains Environment Agency information © Environment Agency and/or database right.

A second NaFRA2 dataset, the RoFRS with climate change allowances based on the latest UK Climate Projections (UKCP18) from the Met Office and Representative Concentration Pathway (RCP) 8.5, the highest 95th percentile emissions scenario, includes anticipated changes to peak river flows and therefore flood extents in future.

The RoFRS inclusive of climate change is shown in Figure 5. This shows that the site remains at a 'very low' risk of fluvial flooding in future.



Figure 5: Environment Agency Risk of Flooding from Rivers and Sea - future risk due to climate change

Contain map data @Google Satellite 2025. Contains Environment Agency information © Environment Agency and/or database right.

The site is considered to be at 'very low' risk of tidal or fluvial flooding.

4.3 Flooding from Surface Water

The EA Risk of Flooding from Surface Water Map¹⁰ (Figure 6) is informed by 'direct rainfall' modelling undertaken at a high (2m) spatial resolution. It illustrates those areas at elevated risk of surface water flooding, in low spots down-gradient of sloping ground or in the topographic valleys associated with current or former watercourses.

The EA Risk of Flooding from Surface Water Map categorises the risk of flooding resulting from severe rainfall events based on the following:

- 'High' risk - A greater than or equal to 1 in 30 (3.3%) annual probability rainfall event.
- 'Medium' risk - Less than 1 in 30 (3.3%) but greater than or equal to 1 in 100 (1%) annual probability rainfall event.
- 'Low' risk - Less than 1 in 1,000 (0.1%) annual probability rainfall event.
- 'Very Low' risk - Land with less than a 1 in 1,000 (0.1%) annual probability of surface water flooding.

Prior to the completion of NaFRA 2, the site was considered at 'medium' to 'high' risk of surface water flooding, which resulted in the Lead Local Flood Authority (LLFA) requesting that bespoke surface water

¹⁰ Risk of Flooding from Surface Water Environment Agency. Accessed October 2025.

modelling be undertaken. Since the publication of NaFRA 2, the site is classified as being at 'low' to 'medium' risk of flooding from surface water. A notable surface water flow path across the centre of the site remains; the flow path is mostly classified as being at 'low' risk with an area at 'medium' risk ponding within the northern section of the site.

The NaFRA2 depth data shows that there is a very low chance of flood depths exceeding 0.2m, with only a low chance of this depth being exceeded along the northern boundary. Therefore the flood depths associated with this surface water flow path are predicted to be very shallow.

Climate change is predicted to increase rainfall intensity in future, potentially increasing the flood risk from surface water. Figure 7 shows the future risk of surface water flooding due to climate change (for the 2040 to 2060 epoch), highlighting an increase in the extent of the flow path along with an increase in risk in some areas.

The SFRA states that overland flow, along with other sources of flooding, were not deemed significant enough to affect district-wide land-use planning in North Hertfordshire.



Figure 6: Risk of Flooding from Surface Water - Current day

Contains Google Satellite Imagery 2025. Contains Environment Agency information © Environment Agency and/or database right.



Figure 7: Risk of Flooding from Surface Water - Future risk due to climate change

Contains Google Satellite Imagery 2025. Contains Environment Agency information © Environment Agency and/or database right.

Therefore, the site is considered at a low to ‘medium’ risk of surface water flooding, in both the present and future scenarios. Given the LLFA’s previous request for bespoke surface water modelling, this is considered in more detail in Section 5.

4.4 Flooding from Groundwater

Groundwater flooding occurs when groundwater rises to the ground surface. There are generally two forms of groundwater flooding. ‘Clearwater flooding’ is associated with the water table rising to the surface in areas of permeable bedrock geology such as chalk and ‘river-groundwater interaction’ flooding occurs where river levels interact with permeable superficial deposits within river valleys, potentially flooding areas far from the river without necessarily overtopping raised riverbanks.

According to the British Geological Survey (BGS) ¹¹, approximately a third of the site is underlain by superficial deposits of Alluvium (Clay, Silt, Sand and Gravel) and Glaciofluvial Deposits (Sand and Gravel) in the northern section. The rest of the site is underlain by Lowestoft Formation (Diamicton). These superficial deposits are classified as a Secondary undifferentiated aquifer. Secondary undifferentiated aquifers are defined as aquifers ‘where it is not possible to apply either a Secondary A or B definition because of the

¹¹ **BGS Viewer** British Geological Survey. Accessed October 2025.

variable characteristics of the rock type. These only have a minor value'.¹² The site is underlain by bedrock of Gault Formation (Mudstone), classified as an unproductive aquifer. Unproductive strata are '*unable to provide usable water supplies and are unlikely to have surface water and wetland ecosystems dependent on them*'¹².

Given that the site is underlain by a bedrock geology that is classified as unproductive and that it is located approximately 28m south of the River Oughton, it is considered that there is a low risk of clearwater flooding. However, the overlying superficial deposits may support an aquifer, though it is not possible to confirm due to the variable permeability of the rock type.

The BGS viewer indicates that the bedrock geology upstream of the site is a West Melbury Marly Chalk Formation. Chalk can be a source of groundwater and due to the local topography, should groundwater emerge on the surface, floodwater could move towards the site; a bespoke hydrogeological assessment would provide more clarity on this risk.

In addition, the site is located approximately 1.3m higher than the watercourse levels and is at 'very low' risk of fluvial flooding. Therefore, it is considered that there is a low risk of flooding from 'river-groundwater interaction'.

Therefore, the overall risk of flooding from groundwater is considered to be 'medium'.

4.5 Flooding from Sewers

Flooding from sewers can result from lack of sewer capacity, blockages within the sewer network or failure of infrastructure such as pumps. Any area that benefits from sewerage infrastructure has a potential risk of flooding, but the likelihood and consequences are increased by topographic constraints such as low spots or flow paths that could influence the behaviour of floodwater originating from sewers.

Consultation with Anglian Water identified that there have been instances of flooding within the vicinity of the proposed development (Appendix C). However, specific locations cannot be provided as the information is confidential.

In the absence of specific sewer flooding locations, the EA Risk of Flooding from Surface Water Map can aid understanding of how a failure in the sewer network could potentially impact the site. Once sewer flooding reaches the surface it is likely to follow the same flow paths as surface water. The same mitigation measures for managing off-site surface water flood risk will therefore be suitable for the management of off-site sewer flood risk.

A Drainage Strategy has been prepared by Levee Consulting to manage the surface water and foul flows generated by the proposed development; therefore, these risks are not considered further in this FRA.

Given the known occurrence of sewer flooding nearby, the site is at 'medium' risk of sewer flooding. However, the mitigation measures for managing off-site surface water runoff are considered sufficient to manage the risk from sewer flooding should it occur.

¹² [Protect groundwater and prevent groundwater pollution - GOV.UK](#) Environment Agency. Accessed October 2025.

4.6 Flooding from Reservoirs, Canals and other Artificial Sources

The EA Risk of Flooding from Reservoirs Map¹³ shows the potential flood extent if large, embanked reservoirs were to fail and release the water they hold. This is under a 'dry day' condition where water levels in watercourse channels are low and therefore able to provide significant storage capacity, and under 'wet day' conditions where they cannot.

The mapping shows that the site is not at risk of reservoir flooding; the closest area of flooding under 'wet day' conditions is located approximately 4.5km north-east of the site boundary and flooding from this source drains north, away from the site.

There are no canals in the vicinity of the site, and no other artificial sources have been identified.

The site is not at risk of flooding from reservoirs, canals or other artificial sources.

¹³ [EA Risk of Flooding from Reservoirs](#), accessed October 2025.

5 Surface Water Modelling

5.1 Introduction

A surface water flood model was acquired from the previous project consultants. The Surface Water Modelling Report (30203467-ARC-YYY-XX-TR-DH-00002), included as Appendix A, documents the work undertaken on the surface water flood model to support the proposals and address the concerns of the LLFA. The model has been used to assess the existing (baseline) and the post-development risk from surface water originating from outside of the site. This section of the FRA presents an assessment of safety to users/occupiers of the development and consideration of potential impacts on flood risk elsewhere.

5.2 Baseline Flood Depths

The model was run for the 3.3% AEP (1 in 30 annual chance), 3.3% AEP + 35% climate change (CC), 1% AEP (1 in 100 annual chance), 1% AEP + 25%CC, 1% AEP + 40%CC, and 0.1% AEP (1 in 1000 annual chance). Modelled flood depths for the full range of simulated events are presented in Figure 8.

The model predicts a surface water flow route through the centre of the site for all events modelled. The onset of flooding occurs primarily due to water flowing down Bedford Road and the associated service road immediately to the east. Flows passing down the two roads join to the west of the entrance to Priory School (refer to Figure 1 for location), which flows in a northerly direction through the lower areas of the site.

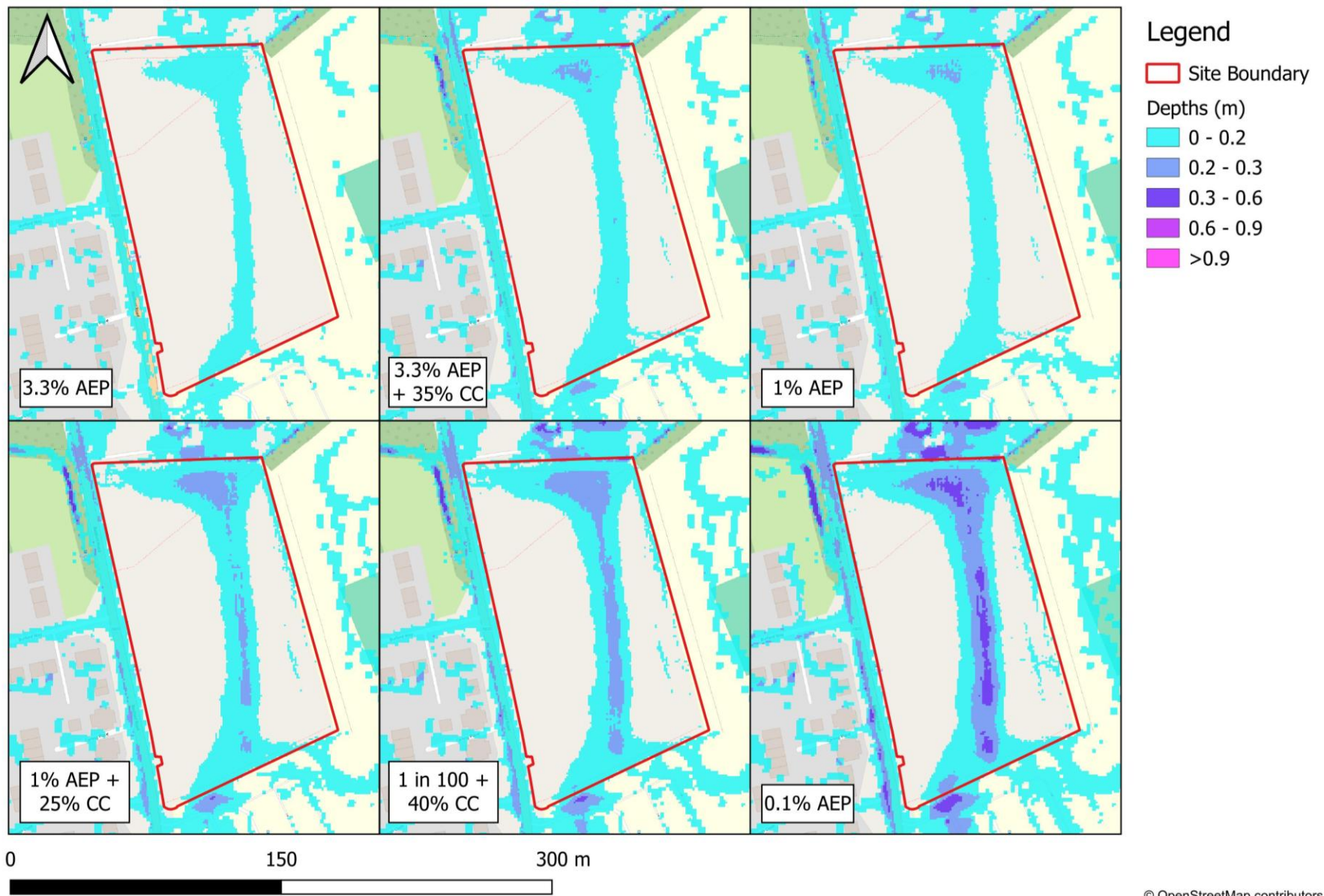


Figure 8 Baseline Flood Depths (m) - all events (flood depths less than 2.5cm not shown for clarity)

5.3 Proposed Flood Management Measures

Levee Consulting have proposed to intercept the surface water flow path originating from outside the site predominantly with the use of a swale located along the southern boundary. Smaller flows originating away from this main flow route will be intercepted with a channel drain which then discharges to the swale. The swale conveys surface flows along the western boundary with the use of two culverts to pass flows beneath the proposed access roads.

Flows are discharged to the open area in the northern part of the site where water is allowed to leave the site along the northern boundary as it would do at present. A small bund is proposed along part of the northern boundary in order to mimic the existing pattern of offsite flow as closely as possible.

Flows that are not intercepted by the swale or channel drain are captured by a french drain which routes along the eastern boundary to also collect off-site flows from this direction.

A summary of the proposed measures can be seen in Figure 9. Further detail on the model representation is included in Appendix A.



Figure 9 Summary of proposed flood management measures

© OpenStreetMap contributors

5.4 Post Development Modelling

The post-development model was run for the same suite of events as the baseline model. The modelled flood depths for the full range of events are presented in Figure 10.

The model results demonstrate that up to the 1% (1 in 100) AEP event the proposed measures intercept almost all of the off-site runoff and convey it around the proposed development. There are very small amounts of shallow flooding shown along the access road and in the rear gardens of the properties along the eastern boundary. In the 1% AEP + 25%CC and 1% AEP + 40%CC events, the capacity of the swale is exceeded immediately south of the main access into the site; however, this is not shown to result in the flooding of any proposed dwellings. The modelling therefore demonstrates that, in the design event (1% AEP +40%CC), the dwellings and majority of the built development are shown to be free of significant depths of flooding.

In the extreme 0.1% AEP event, more extensive flooding of the development is predicted including potential flooding to the proposed dwellings. This residual risk should be managed through the use of appropriate access, egress and evacuation measures along with flood resilience measures at the property level where appropriate.

5.5 Impact on Flood Risk Elsewhere

Figure 11 shows the change in flood depth between the baseline and post-development models for all events. In all events, there is an increase in flood depths within the undeveloped northern area of the site. For all events up to and including the 1% AEP +40%CC, the change in flood depth outside of the site boundary is within the acceptable tolerance of $\pm 10\text{mm}$ ¹⁴ (note this also covers areas where there is zero change), therefore showing no significant change in flood depths or increase in flood risk to third parties. Where there are changes in flood depths of more than 10mm, these are overall slightly beneficial.

There are increases of in flood depths of between 10mm at 50mm outside the site in the 0.1% AEP event, but these occur in areas which are already at risk at flooding and do not affect any sensitive receptors. Conversely, there are areas which are predicted to experience a reduction in flood risk as a result of the proposals.

Overall, it is concluded that the proposed development with the flood management measures in place would not result in any observable detriment to third parties.

5.6 Safe Access and Egress

The flood hazard rating, in accordance with DEFRA guidance FD2321¹⁵, for all events have been presented in Figure 12. In all events up to and including the 1% AEP +40%CC event, the dwellings, access roads and walkways are in areas of 'very low hazard'. In the 0.1% AEP event, there are some very small, localised, areas on the access road that are considered to lie within an area classified as 'danger for some' or 'danger for most'. However, based on the depth and velocity timeseries on the site, these higher hazard conditions are likely to last for a very short time. As such, it is concluded that suitably safe access and egress within the development is available.

¹⁴ LA113 - Road drainage and the water environment of the Design Manual for Road and Bridges recommends that a negligible change in flood level (or depths) should be $\pm 10\text{mm}$. This is the test for significance in this report.

¹⁵ FD2321_PR_Mar2006.doc Flood Risks to People; Defra/Environment Agency; March 2006

Overall, it is concluded that users/occupiers of the development would be able to safely access and/or egress the site during extreme rainfall events.

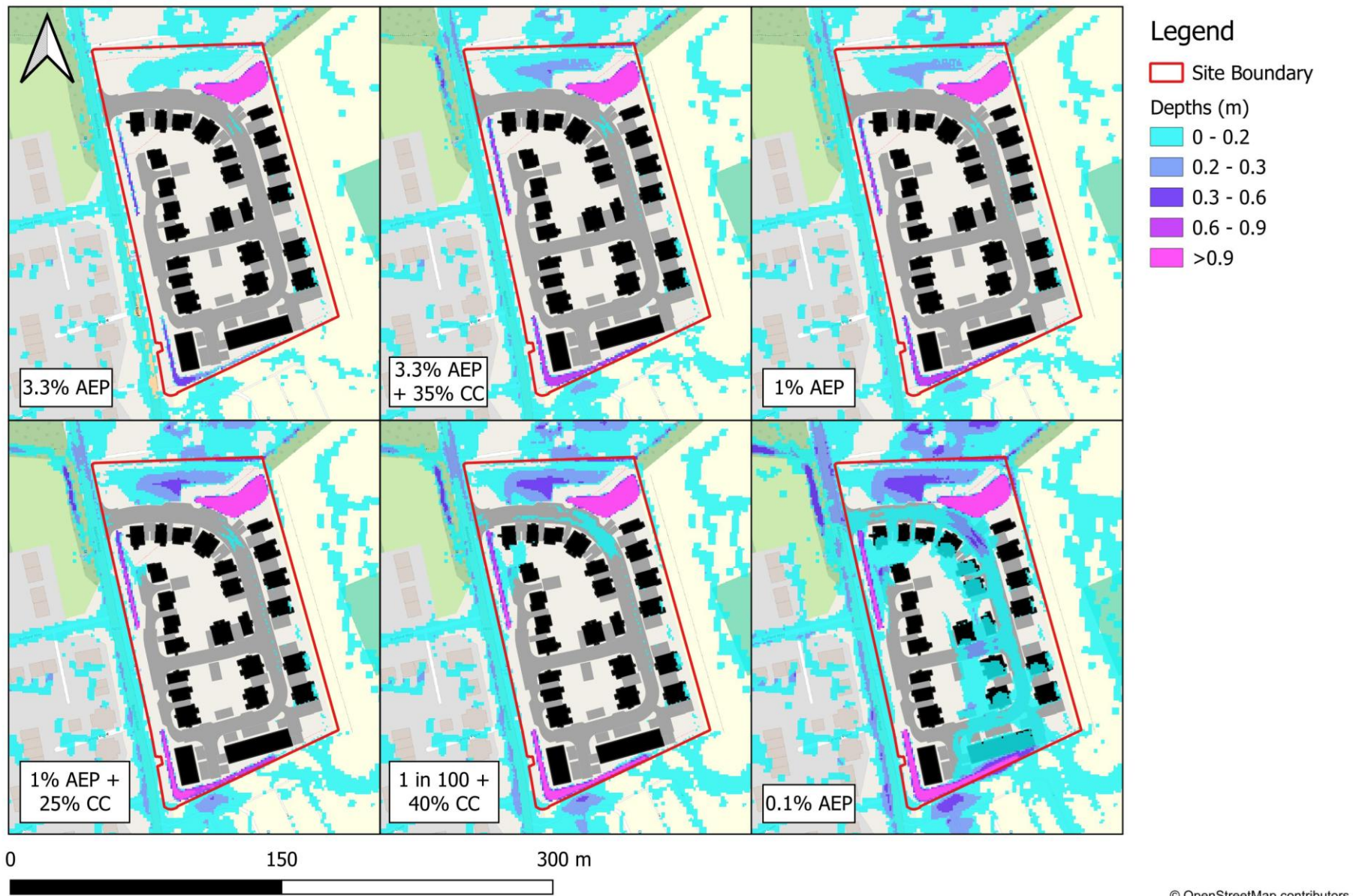


Figure 10 Proposed Flood Depths (m) - all events (depths less than 2.5cm are not shown for clarity)

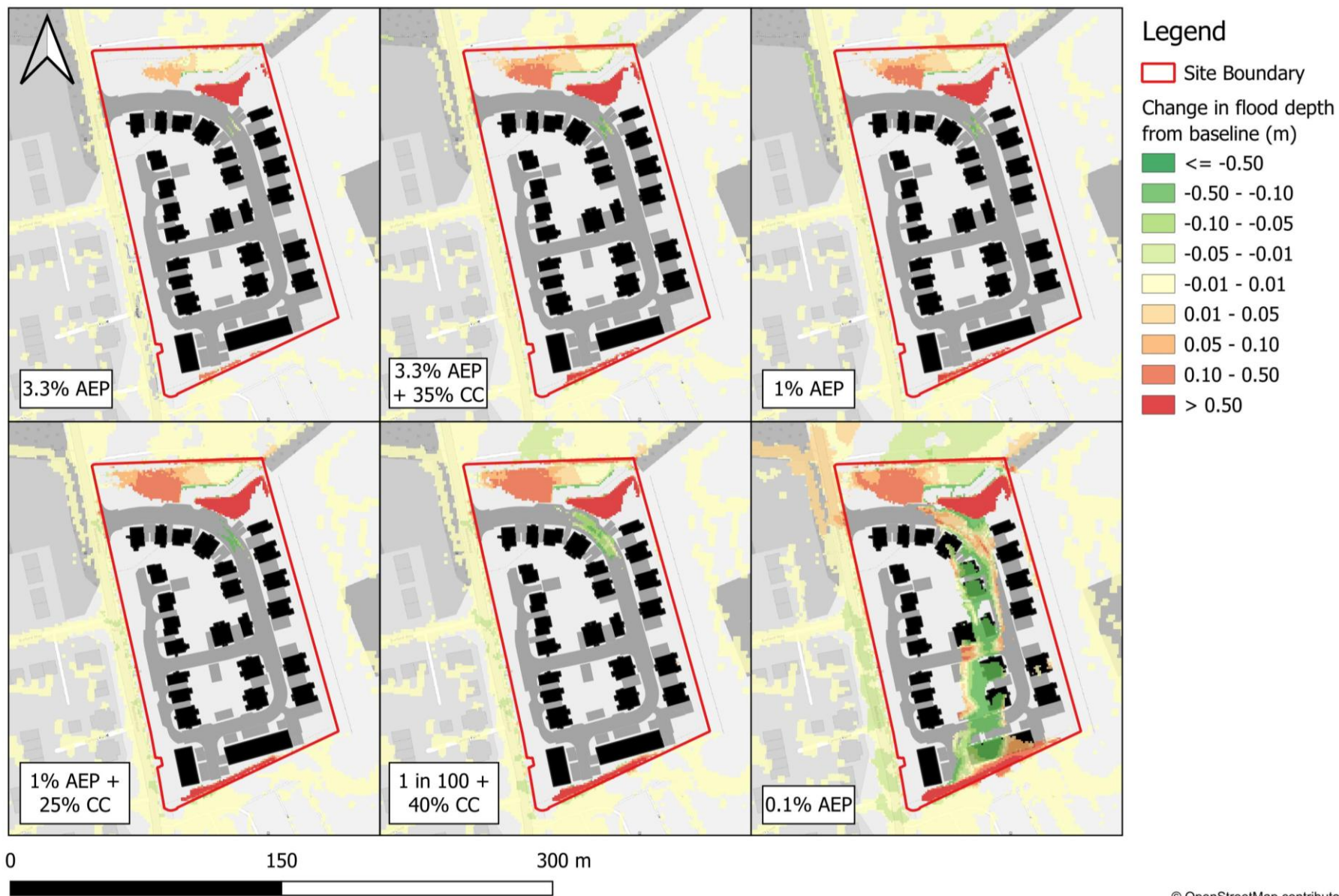


Figure 11 Depth Difference Grids between baseline and design - all events

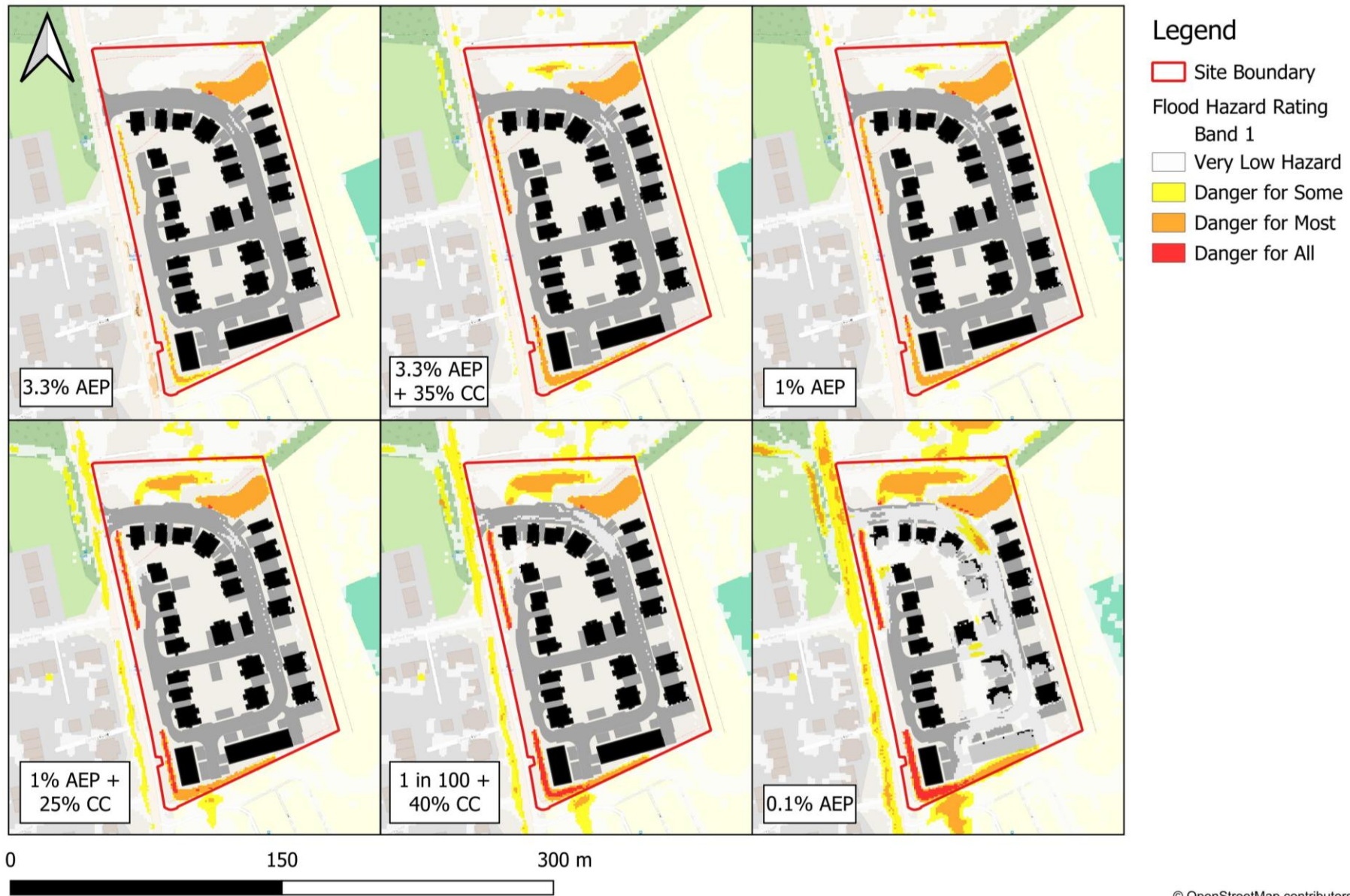


Figure 12 Flood Hazard Maps - all events (areas where flood depths are less than 2.5cm are not shown for clarity)

6 Conclusions

This FRA has assessed the proposed development at Land east of Bedford Road, Hitchin, which will provide 50 new homes and associated infrastructure. The FRA has resulted in the following conclusions:

- The site is located in Flood Zone 1 which is indicative of a 'low' risk of flooding from rivers and the sea.
- Based on the EA Risk of Flooding from Rivers and Sea mapping, the site is shown to be at 'very low' risk flooding from rivers and the sea under current day conditions and over the development lifetime.
- The site is considered to be at a 'medium' risk of surface water flooding; detailed flood modelling has been undertaken to assess and inform the proposed development, including developing a robust mitigation strategy for surface water flows originating from off site.
- The surface water flood modelling has demonstrated that the development would remain safe and would not increase flood risk elsewhere in design flood events up to and including the 1% AEP +40%CC.
- Records of sewer flooding have been noted within the vicinity of the development; however, these are not considered to pose a risk more onerous than the risk from surface water that has been quantitatively assessed.
- The site is considered to be at medium risk of groundwater flooding; a bespoke hydrogeological assessment would provide more clarity on this risk.
- No other sources of flood risk considered within this FRA pose a material risk to the proposed development.

Appendix A

Surface Water Modelling Report

Surface Water Modelling Report

Bedford Road Hitchin

Document No: 30203467-ARC-YYY-XX-TR-DH-00002

Revision: P1

DECEMBER 2025

Version Control

Version	Date Issued	Author	Checker	Reviewer	Approver	Changes
01	05/12/25	NM/ML	ML	CG	IA	

This report dated 05 December 2025 has been prepared for **Arte Construction Ltd** (the "Client") in accordance with the terms and conditions of appointment dated 22 November 2023(the "Appointment") between the Client and **Arcadis UK** ("Arcadis") for the purposes specified in the Appointment. For avoidance of doubt, no other person(s) may use or rely upon this report or its contents, and Arcadis accepts no responsibility for any such use or reliance thereon by any other third party.

Contents

1	Introduction	4
2	Baseline Modelling	5
3	Baseline Results	13
4	Design Updates.....	17
5	Summary and Conclusions	24

Tables

Table 2-1 Manning's n roughness values applied to the floodplain	9
Table 2-2 Modelled design flood scenarios	10
Table 4-1 Proposed culvert details	19
Table 4-2 Manning's n roughness values applied to the design model	21

Figures

Figure 2-1 Model schematic	5
Figure 2-2 Two additional flow path features	7
Figure 2-3 Baseline model DEM Z check file	8
Figure 2-4 Comparison of the 2d_RF polygons	11
Figure 3-1 Modelled baseline flood extents (cells where flood depths are less than 0.025m are not shown)	13
Figure 3-2 3.3% AEP flood depths (flood depths below 0.025m are not shown)	14
Figure 3-3 1% AEP + 40% CC flood depths (flood depths below 0.025m are not shown)	15
Figure 3-4 Modelled flow hydrographs for the Baseline 1% AEP +40%CC event.....	16
Figure 4-1 Proposed development surface representation.....	18
Figure 4-2 Information on Max-E channel. Source: Marshalls	19
Figure 4-3 Model representation of channel drain	20
Figure 4-4 Post-development modelled flood extents	22
Figure 4-5 Modelled flood depths for the post-development 1% AEP +40% CC event (note depths less than 0.025m are not shown)	23

1 Introduction

1.1 Project Appointment

Arcadis Consulting (UK) Ltd (Arcadis) has been commissioned by Arte Construction Ltd (the Client) to undertake surface water flood modelling to support the development of land to the east of Bedford Road, Hitchin (hereafter referred to as the site), National Grid Reference (NGR) TL 17910 30870.

In November 2022, a full planning application was submitted for 53 no. residential dwellings on Land at Bedford Road, Hitchin. The planning application was submitted accompanied by a Flood Risk Assessment (FRA) and Drainage Strategy prepared by Delta Simons (dated November 2022)¹. Hertfordshire County Council, who are the Lead Local Flood Authority (LLFA), objected to the application, citing a requirement for surface water modelling to demonstrate that a surface water flow path originating off site and flowing across the proposed development could be managed in a way that ensured there was no increase in flood risk elsewhere and that the development, including its access and egress, remained safe.

Surface water modelling work was undertaken at the time to address the LLFA's concerns and Arcadis were subsequently engaged to provide further support. This report documents the surface water flood modelling work undertaken to support the planning application and Flood Risk Assessment.

1.2 Project Scope

The scope of this modelling study is to:

- Review the existing surface water model (supplied by the Client and henceforth referred to as the 'incoming model') to identify where improvements to the baseline (existing scenario) model are required.
- Update the incoming model so it is suitable to inform the study.
- Undertake post-development modelling to allow an assessment of flood risks to the scheme and potential impacts off-site.

It should be noted that Arcadis have not been engaged as a designer. The proposed design of the flood risk management measures has been prepared by Levee Consulting Limited. The purpose of this study is to represent the proposed design within the flood model and use the outputs to assess the impacts on flood risk.

The assessment of flood risk to the site and the impact of the proposed works to third parties is detailed in the FRA, whilst this report focuses on the technical details of the modelling.

¹ 88096-545795 / 21-1295.01 Flood Risk Assessment and Drainage Strategy | Land at Bedford Road, Hitchin, SG5 2UR; Delta Simons, November 2022

2 Baseline Modelling

2.1 Incoming Model Review

The incoming TUFLOW 2D direct rainfall model supplied by the client was reviewed and a number of updates and amendments were made by Arcadis prior to use in this study. There was no report supplied with the incoming model and therefore any information which could not be readily traced was replaced with information of known provenance. The sections below describe the schematisation and set up of the baseline model developed for use in this study. The site location and model domain are shown in Figure 2-1. Additional figures showing the location and context of the site are included in the Flood Risk Assessment report¹.



Figure 2-1 Model schematic

2.2 Topography

A 4m grid was applied across the model, with a 2d_qnl file used to apply a nested QuadTree approach at the site. The QuadTree approach enables the site to be modelled with a 1m cell size and the surrounding roads with a 2m cell size. The orientation of the model grid is in line with the surface water flow path shown to run from south to north through the site.

The lidar data used in the incoming model was cross checked with the lidar currently available on the DEFRA Data Services Platform² (dated 2022) and found to be consistent. A topographic survey of the site only (carried out in November 2020) was provided by the client and used to undertake a comparison of ground levels between the survey and lidar data. Overall, the differences between the two datasets were within the published vertical accuracy tolerance of +/- 0.15m for the lidar data. Therefore, the lidar was considered to give a good representation of the site levels and was taken forward for the modelling.

The River Oughton (to the north of the site) was included as 2D channel, defined using lidar data along with z-shapes and z-points to add additional detail. Since the capacity of the River Oughton is not the main focus of this study, this was deemed appropriate.

During a site visit undertaken by Arcadis in November 2023, a small ditch running along the western site boundary was noted. This ditch was heavily vegetated and the depth and nature of the ditch could not be verified. A review of the model input data showed that this had not been represented either as a topographic feature or within the lidar DTM. Therefore, the ditch was enforced as a 'THIN' line using z-lines and points, with levels taken from the topographic survey. This is referred to as 'Onsite Ditch' and is shown in Figure 2-2.

A footpath between Bedford Road and the unnamed road, which is referred to as 'Bedford Road Crossing' was also included in the updated baseline (Figure 2-2). The Bedford Road Crossing was represented by z-lines and points and applied as a 'THICK' line with ground levels taken from the lidar data.

All buildings were represented by z-shapes with a 0.3m increase in elevation applied. This approach is consistent with the industry best practice of applying 'stubby buildings' in surface water models. In addition, the roughness was updated (section 2.4). The roads were represented by z-shapes with a 0.125m reduction in lidar ground levels applied to account for the channelling effect of kerbs on surface water flows.

² <https://environment.data.gov.uk/survey>

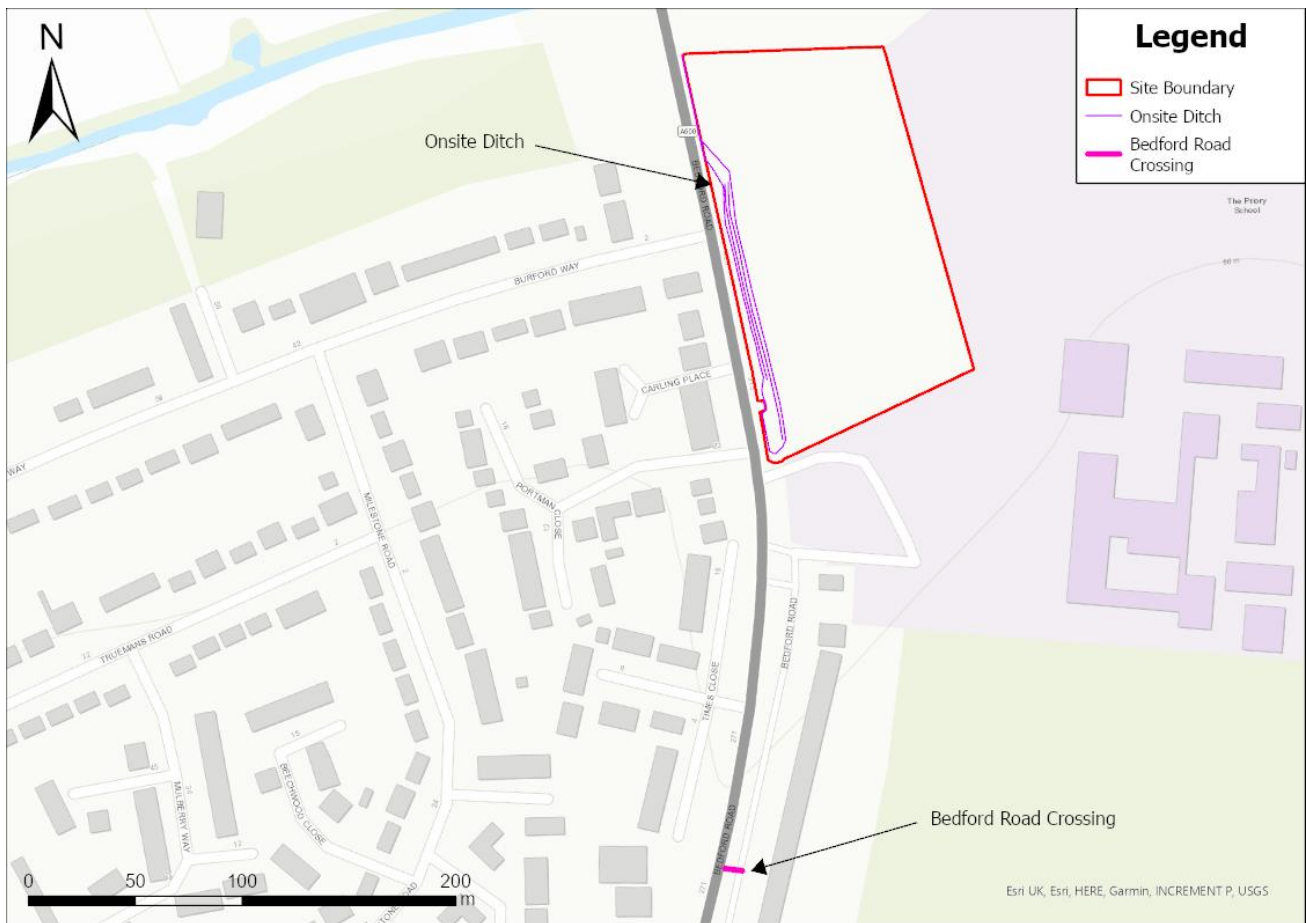


Figure 2-2 Two additional flow path features

Figure 2-3 shows the baseline DEM_Z file which is based on the lidar data and topographic modifications described above.

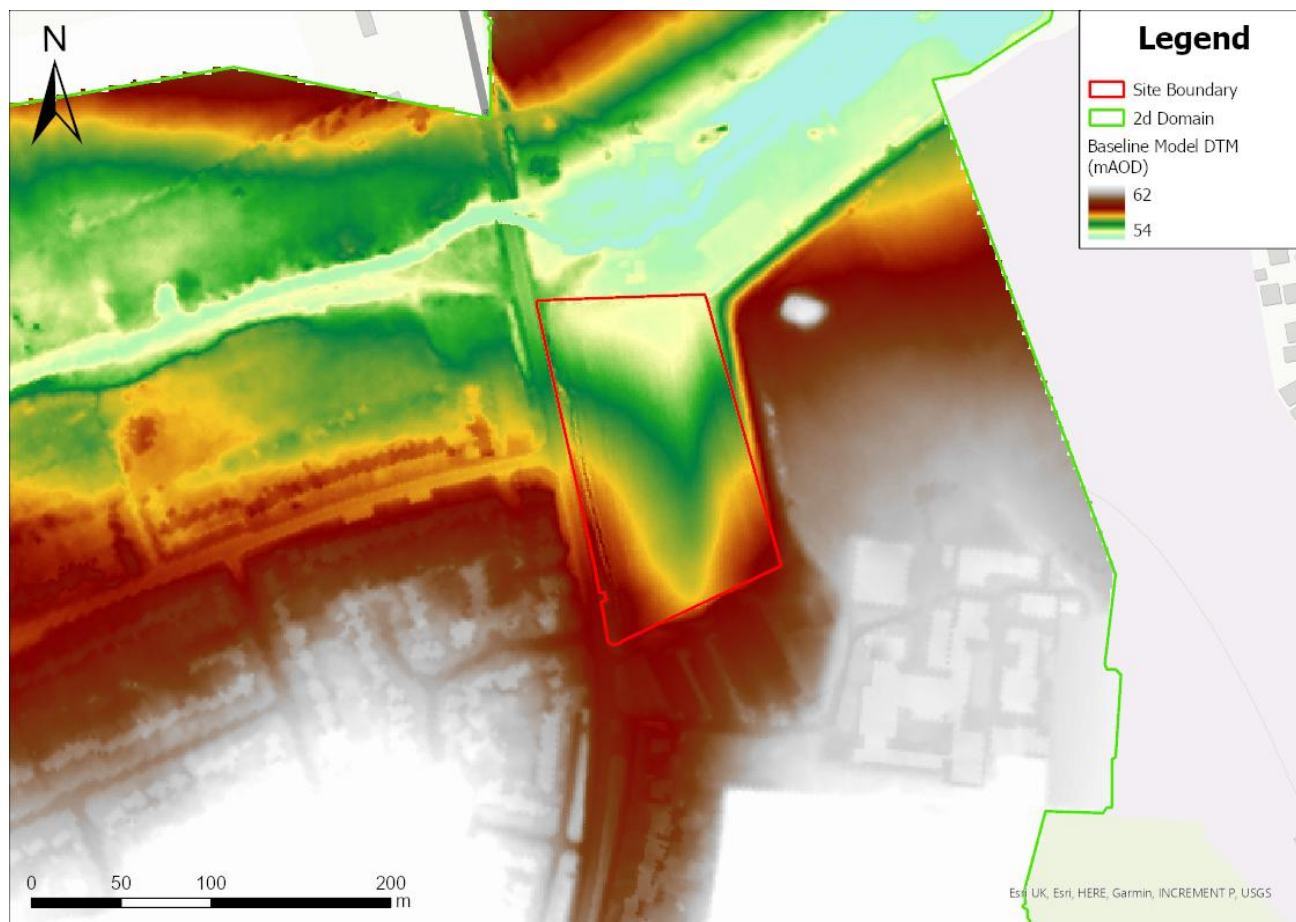


Figure 2-3 Baseline model DEM Z check file

2.3 Drainage

The incoming model had no explicit representation of the drainage system, nor was there any broader representation of drainage capacity through the application of a continuing loss parameter. This exclusion of any allowance for existing drainage systems would result in an overestimation of surface flows through the site.

Although it was not considered necessary to include an explicit representation of the drainage network in the updated baseline model, as the aim of the study is to manage surface water flows in more extreme events, a continuing loss of 12mm/hour was applied to all urban areas in the model.

2.4 Roughness

Aerial imagery and Ordnance Survey (OS) MasterMap data have been used to determine the spatial distribution of 2D roughness in the model. The roughness values are based on industry accepted Manning's n roughness coefficients with the values applied checked against the aerial imagery. Table 2-1 shows the roughness value applied to each land use type.

Table 2-1 Manning's *n* roughness values applied to the floodplain

ID	Type of use	Manning's <i>n</i>
10021	Buildings	0.300
10053	Residential Curtilage	0.050
10056	General Surface (natural)	0.040
10089	Inland Water	0.030
10111	Natural Environment (non-coniferous trees)	0.080
10123	Footpaths and Tracks	0.030
10172	Roads	0.025
10183	Roadside (pavements / public areas)	0.025

2.5 Infiltration Losses

The model was updated to use the Green-Ampt method for the representation of infiltration into the soil. Soilsclapes³ data confirms that the model is covered by:

- Slightly acid loamy and clayey soils with impeded drainage; and
- Loamy and clayey floodplain soils with naturally high groundwater.

Table 7.12 of the TUFLOW manual⁴ provides recommended infiltration parameters for the Green-Ampt method based on United States Department of Agriculture (USDA) soil types. The two Soilsclapes classifications are analogous to a clay loam and clay, respectively.

2.6 Boundary Conditions

The model domain and boundary are presented in Figure 2-1. Rainfall is the only hydrological input and the rainfall hyetographs supplied with the incoming model for a storm duration of 1 hour were used. The rainfall totals were compared to estimates from the Flood Estimation Handbook's 2022 Depth-Duration-Frequency model and there was broad agreement. The model uses a direct rainfall approach, whereby the rain hyetograph is applied directly to each model cell.

The downstream boundary has been applied in the northeast corner of the model domain, at the River Oughton. The downstream boundary is a stage-flow (HQ) boundary with a slope (*b* value) of 0.01 used to automatically calculate the stage-flow curve within TUFLOW.

2.7 Model Events

The model has been run for six different Annual Exceedance Probability (AEP) events, as set out in Table 2-2. The upper end peak rainfall intensity climate change allowance was applied to the 3.3% AEP event (a 35% uplift) and the 1% AEP event (a 40% uplift). In addition, the central allowance (a 25% uplift) was assessed for the 1% AEP. In all cases, the 2070's epoch was considered, to be consistent with the expected design life of the development.

³ Soilsclapes [Soilsclapes England & Wales \(UK Soil Observatory, Cranfield\) - Overview](#)

⁴ [TUFLOW Classic/HPC User Manual 2025.2](#)

Table 2-2 Modelled design flood scenarios

Scenario	Description
3.3% AEP	3.3% AEP rainfall event
3.3% AEP +35%CC	3.3% AEP plus 35% uplift in rainfall to account for climate change in line with the upper end allowance for the 2070s
1% AEP	1% AEP rainfall event
1% AEP +25%CC	1% AEP plus 25% uplift in rainfall to account for climate change in line with the central allowance for the 2070s.
1% AEP +40%CC	1% AEP plus 40% uplift in rainfall to account for climate change in line with the upper end allowance for the 2070s.
0.1% AEP	0.1% AEP rainfall event

2.8 Model Run Parameters

The model was run using the latest version of TUFLOW (2025.0.2 HPC) using an initial 0.5 second timestep. TUFLOW HPC uses adaptive timestepping meaning that the timestep is adjusted throughout the simulation to maintain mathematical stability.

2.9 Model Proving

The baseline model simulations displayed no significant reductions in timestep and the overall efficiency of the model indicated that the model was performing well. Supporting checks on the results, the dt and the modelled flood levels further confirmed this to be the case.

2.10 Sensitivity Analysis

Sensitivity tests have been conducted on key model parameters to quantify any uncertainty in the model results. The following sensitivity tests have been undertaken:

- Extending the extent of the rainfall polygon:
 - The 2d_rf polygon supplied with the incoming model was extended to the east of the site in order to cover some potential additional contributing areas of the catchment (Figure 2-4). This resulted in no impact on flows through the site meaning that the modelling could be progressed using the supplied 2d_rf polygons.

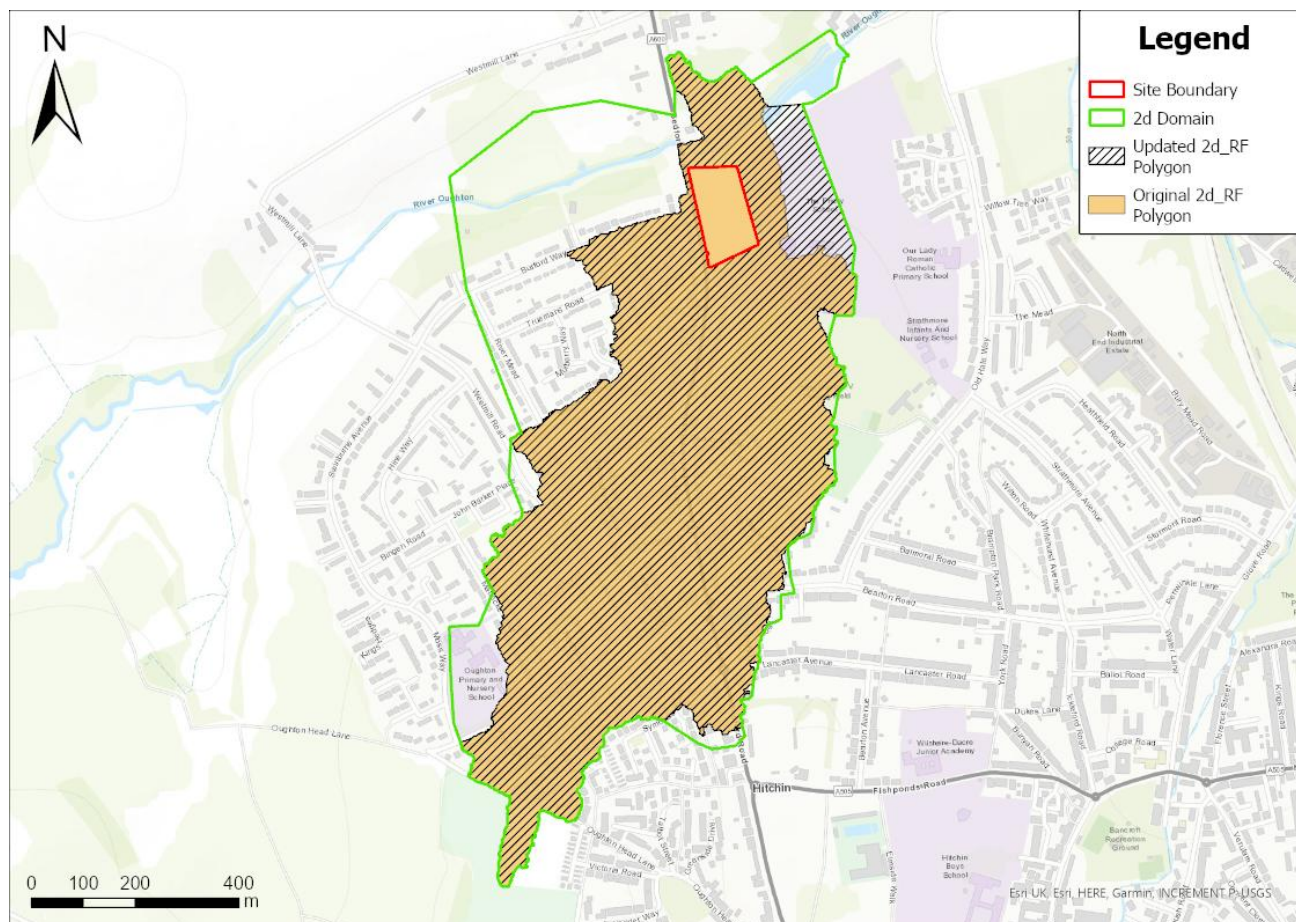


Figure 2-4 Comparison of the 2d_{RF} polygons

- Increasing and decreasing the slope of the downstream boundary:
 - The downstream boundary slope was increased and decreased by 20%. The test resulted in no impacts on the water levels at the site and minimal impact at the downstream boundary itself. This demonstrated that the model is not sensitive to the downstream boundary condition.
- Altering the global drainage rate:
 - The global drainage rate was increased from 12mm/hr to 20mm/hr for all surfaces in the 3.3%, 1% and 0.1% AEP simulations. This resulted in a reduction in the peak flow through the site of less than 5%. No readily available evidence could be found to suggest that there is an enhanced level of drainage within this area of Hitchin and, given the relatively small change in flow, the original drainage rate of 12mm/hr was retained.
- Application of depth varying roughness:
 - Depth varying roughness values for the sensitivity test were set up as follows:
 - n1 (the Manning's n value which is applied below depth y1) values that were double the n2 (Manning's n value which is applied for depths above y2) values
 - y1 (the depth below which Manning's n value n1 is applied) values were set to 0m
 - y2 (depth above which Manning's n value n2 is applied) values set to 0.05m.
 - This meant that the Manning's n value reduced as the flood depths increased. Between y1 and y2, the Manning's n value is interpolated based on a spline curve.

- This test was run for the 3.3% and 1% AEP simulations and resulted in the peak flows across the site reducing by 15%. These depth varying roughness values were subsequently retained as they resulted in flows on the site which were more consistent with the ReFH2 catchment estimate. The modelled flows remain higher, indicating that the approach taken is conservative.

3 Baseline Results

3.1 Flood Mechanisms and Extents

The model predicts a surface water flow path across the site for all events modelled. Figure 3-1 shows the flood extents for the full range of simulated events. For all simulations, the map cutoff depth was set to 0.025m meaning that TUFLOW only outputs results for cells where flood depths are more than 0.025m. This provides clarity in mapped extents as without this, the whole model domain is shown as wet. It should be noted that the NaFRA2 surface water dataset removes depths less than 7.5cm⁵ meaning that the bespoke mapping produced for this assessment may give a more conservative view. The modelling demonstrates that surface water primarily originates from Bedford Road before flowing through the carpark associated with The Priory School. A smaller flow path is shown to originate from the school buildings flowing towards the south-eastern corner of the site. Surface water then flows across the southern boundary of the site and follows the lower ground, through the centre of the site, towards the north-eastern corner. Surface water is shown to pond in the northern area of the site before flowing over the northern boundary and eventually entering the River Oughton.

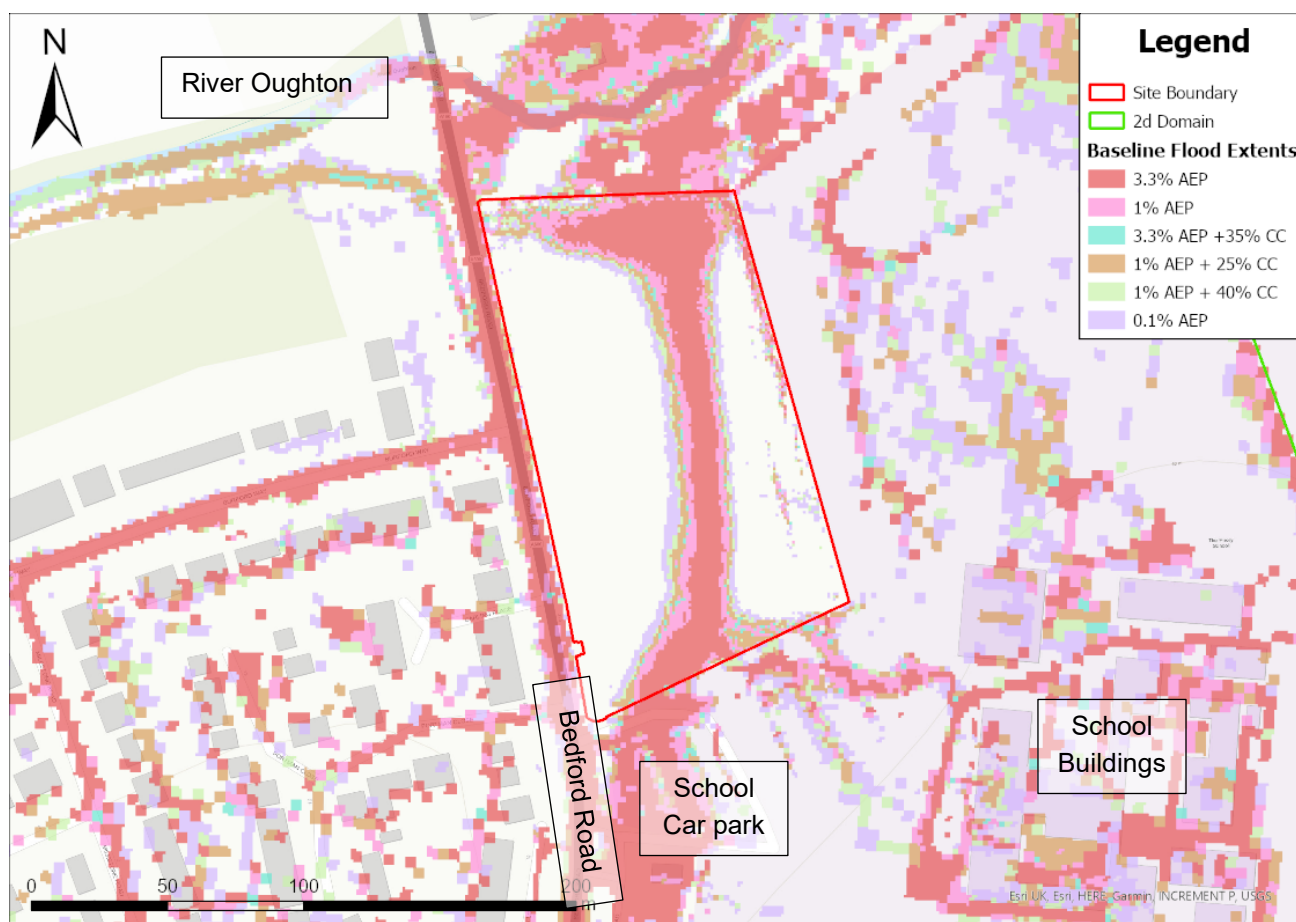


Figure 3-1 Modelled baseline flood extents (cells where flood depths are less than 0.025m are not shown)

⁵ Risk of flooding from surface water – understanding and using the map - GOV.UK (accessed December 2025)

3.2 Flood Depths

The modelled flood depths for the 3.3% AEP and 1% AEP + 40% climate change events are presented in Figure 3-2 and Figure 3-3, respectively. These represent a more frequent flood event and the site design event (further details and plots for all modelled events are presented in the FRA). The modelled flood depths in the 3.3% AEP event are less than 0.20m across the site, with depths typically less than 0.10m, but up to 0.15m in the northern part of the site.

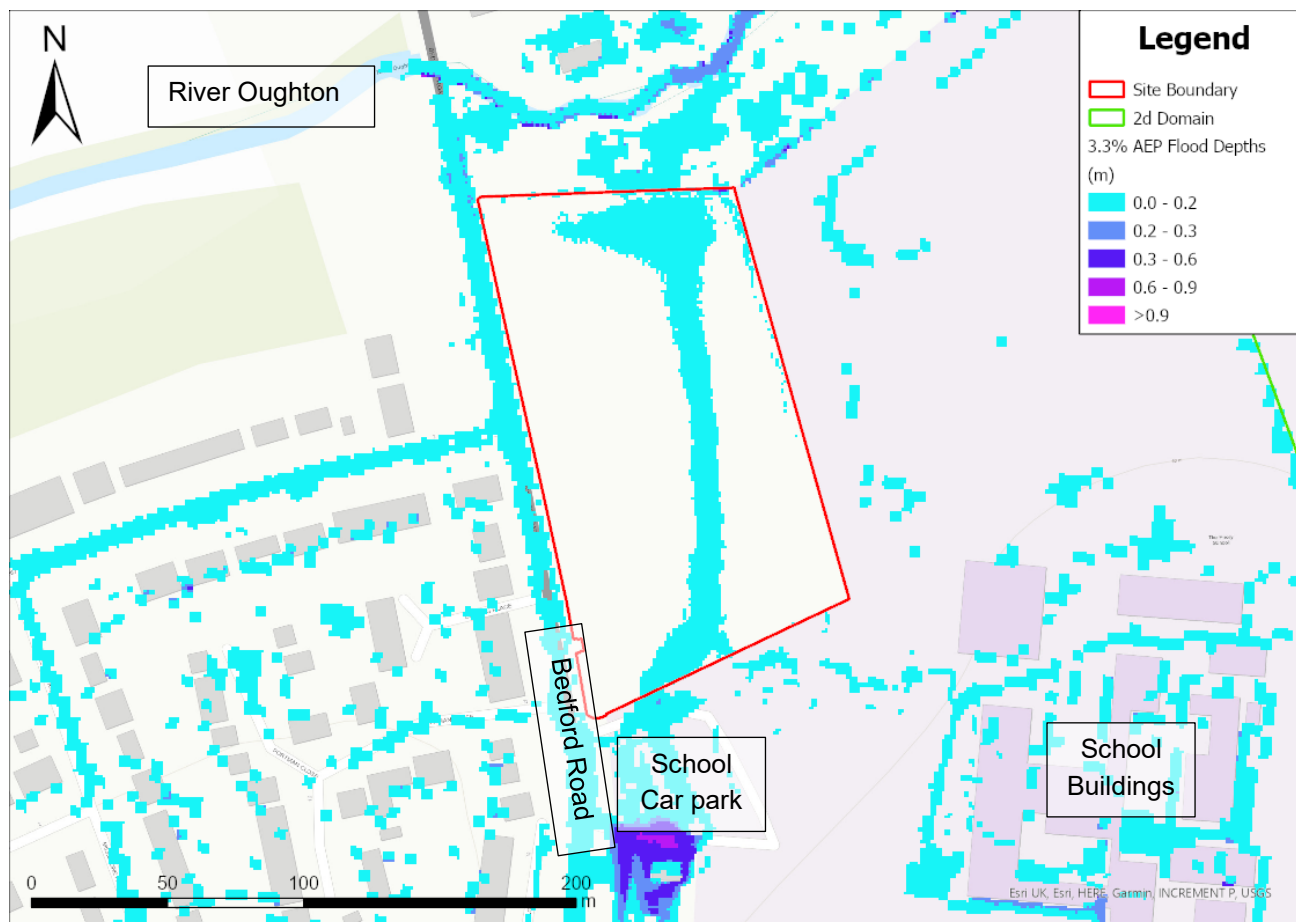


Figure 3-2 3.3% AEP flood depths (flood depths below 0.025m are not shown)

In the modelled baseline 1% AEP +40% climate change event, the depths exceed 0.20m within the centre of the flow path running through the centre of the site but are no greater than 0.30m. The maximum depth in the ponded area in the north is 0.28m.

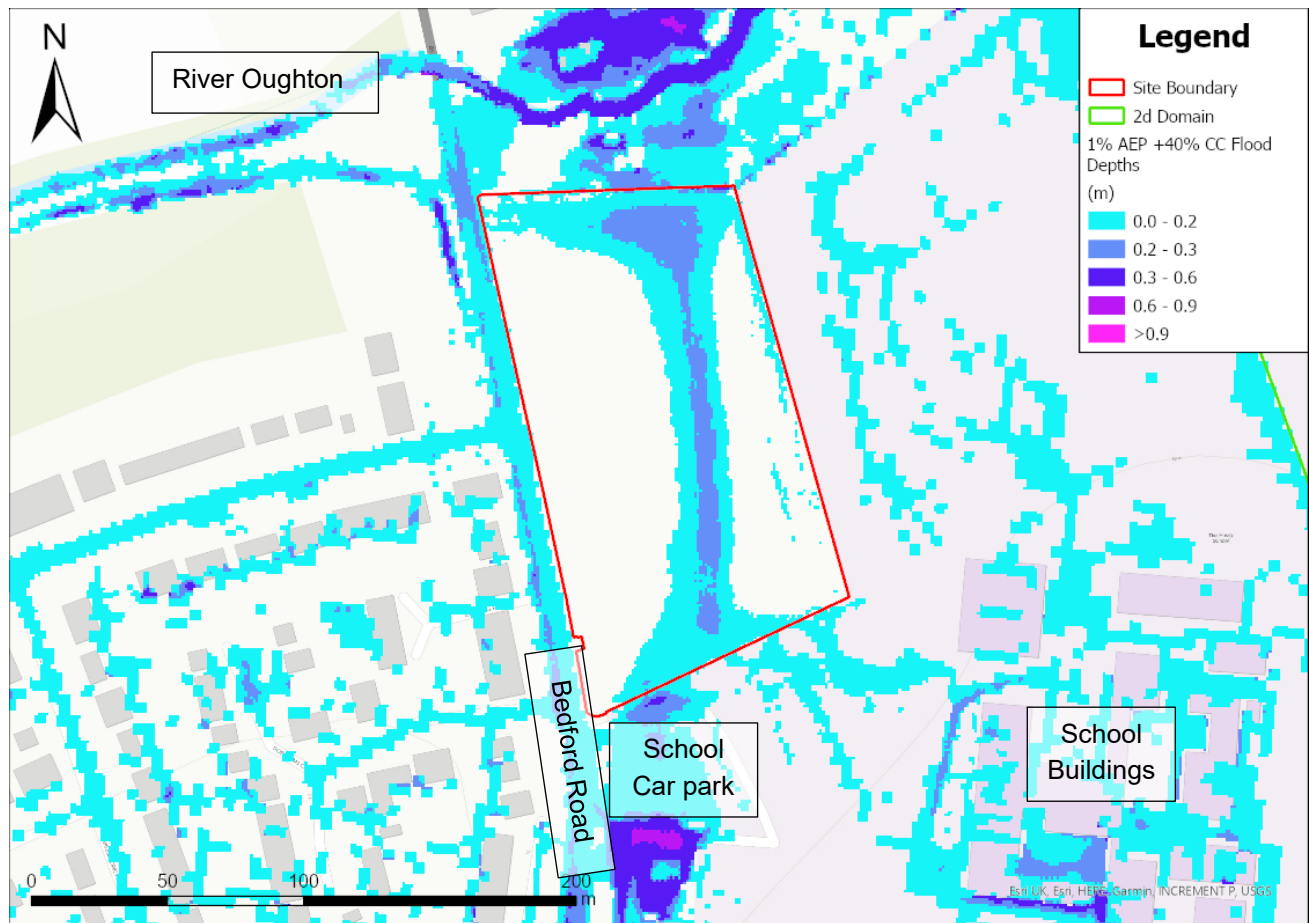


Figure 3-3 1% AEP + 40% CC flood depths (flood depths below 0.025m are not shown)

3.3 Modelled Flows

The modelled baseline flows at the southern (upstream) and northern (downstream) boundaries of the site are presented in Figure 3-4. This demonstrates that there is 5% increase in peak flow as water passes through the site which is due to surface water flows entering the site via the eastern boundary.

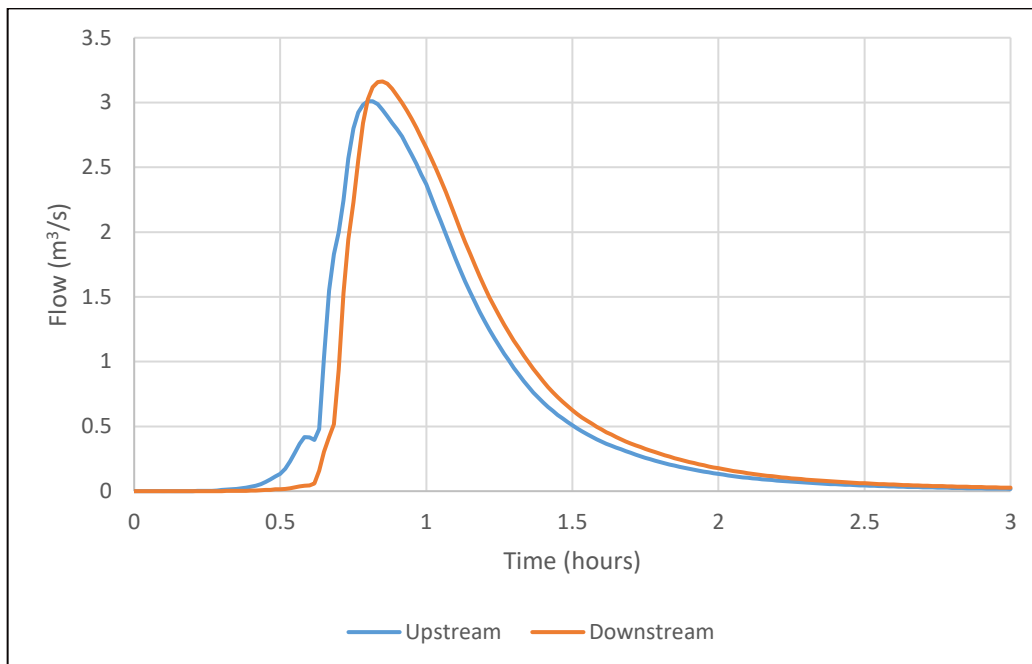


Figure 3-4 Modelled flow hydrographs for the Baseline 1% AEP +40%CC event.

4 Design Updates

The proposed design and flood risk management measures have been provided by Levee Consulting. The implications of the proposed measures and design on flood risk across the site and surrounding area are discussed within the Flood Risk Assessment⁶, whilst this report focusses on providing technical details on the representation of the proposed development within the model and discussion of the results.

4.1 Development Representation

4.1.1 Proposed Levels

The proposed levels for the development, including floor levels, roads, parking, gardens and landscaping have been provided by Levee Consulting in the form of a 3D surface⁷. The proposed surface file was converted to a gridded raster in GeoTIFF format with a grid size of 0.25m. The proposed surface is presented in Figure 4-1 and was read directly into TUFLOW. To avoid double counting potential storage within the proposed attenuation basin, an initial water level of 56mAOD was applied to this. A small area of null values were found in the 3D surface, located towards the south west of the site. This area was filled using the TUFLOW interpolation tool.

⁶ 30203467-ARC-YYY-XX-TR-DH-00003 - Bedford Road_FRA; Arcadis, December 2025

⁷ Final Surface RevE.dwg; Levee Consulting, November 2025

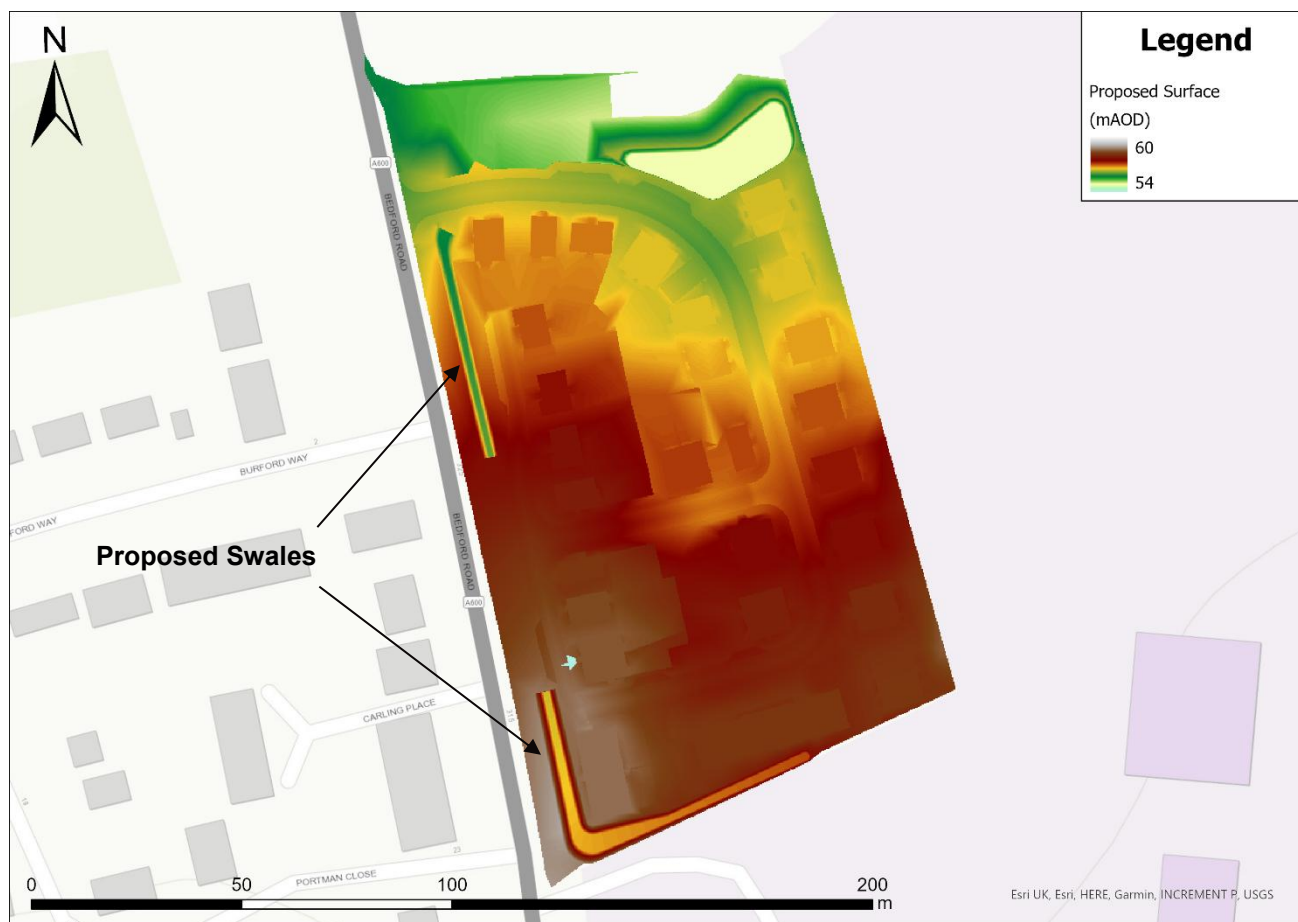


Figure 4-1 Proposed development surface representation

A swale is proposed to intercept and convey surface water runoff originating from off site around the development. The representation of this swale was investigated; the swale generally has a bed width of at least 1m, which corresponds well with the model grid size of 1m within the site. However, the use of layered flow constriction shapes was tested, to determine if this resulted in a better representation than simply relying on the GeoTIFF file. It was concluded that there a negligible difference in the model results and adopting the approach of relying directly on the proposed GeoTIFF file was preferred, as this enabled the rapid testing of multiple design iterations.

4.1.2 Proposed Culverts

Two culverts are proposed to carry flow between the sections of the swale (refer to the FRA⁶ for a location plan), these have been represented by 1d_nwk lines, and the key parameters are provided in Table 4-1.

Table 4-1 Proposed culvert details

Structure Parameters	1d_nwk_BFR_DES_Culvert_L	
ID	NewCulvert1	NewCulvert2
Inlet NGR	517862, 230905	517885, 230796
Outlet NGR	517871, 230921	517872, 230851
Type	Rectangular (R)	Rectangular (R)
Number of barrels	2	2
Length (m)	18.0	57.3
Internal Height (m)	0.5	0.8
Internal Width (m)	1.5	1.5
Roughness (n)	0.012 (new concrete)	0.012 (new concrete)
Upstream Invert Level (mAOD)	55.66	56.42
Downstream Invert Level (mAOD)	55.30	56.07

4.1.3 Channel Drain

The proposed Max-E 630 channel drain in the south-east corner of the site has been represented using a 1d_nwk line to approximate the equivalent pipe diameter of 0.475m (refer to Figure 4-2). To connect the 1d_nwk line to the surface, a series of 1d_pits have been digitised that link to a continuous line of 2D cells along the length of the channel drain (refer to Figure 4-3). The invert levels of the pipe have been set so that they are around 0.63m below the proposed ground levels.



Figure 4-2 Information on Max-E channel. Source: [Marshalls](#)

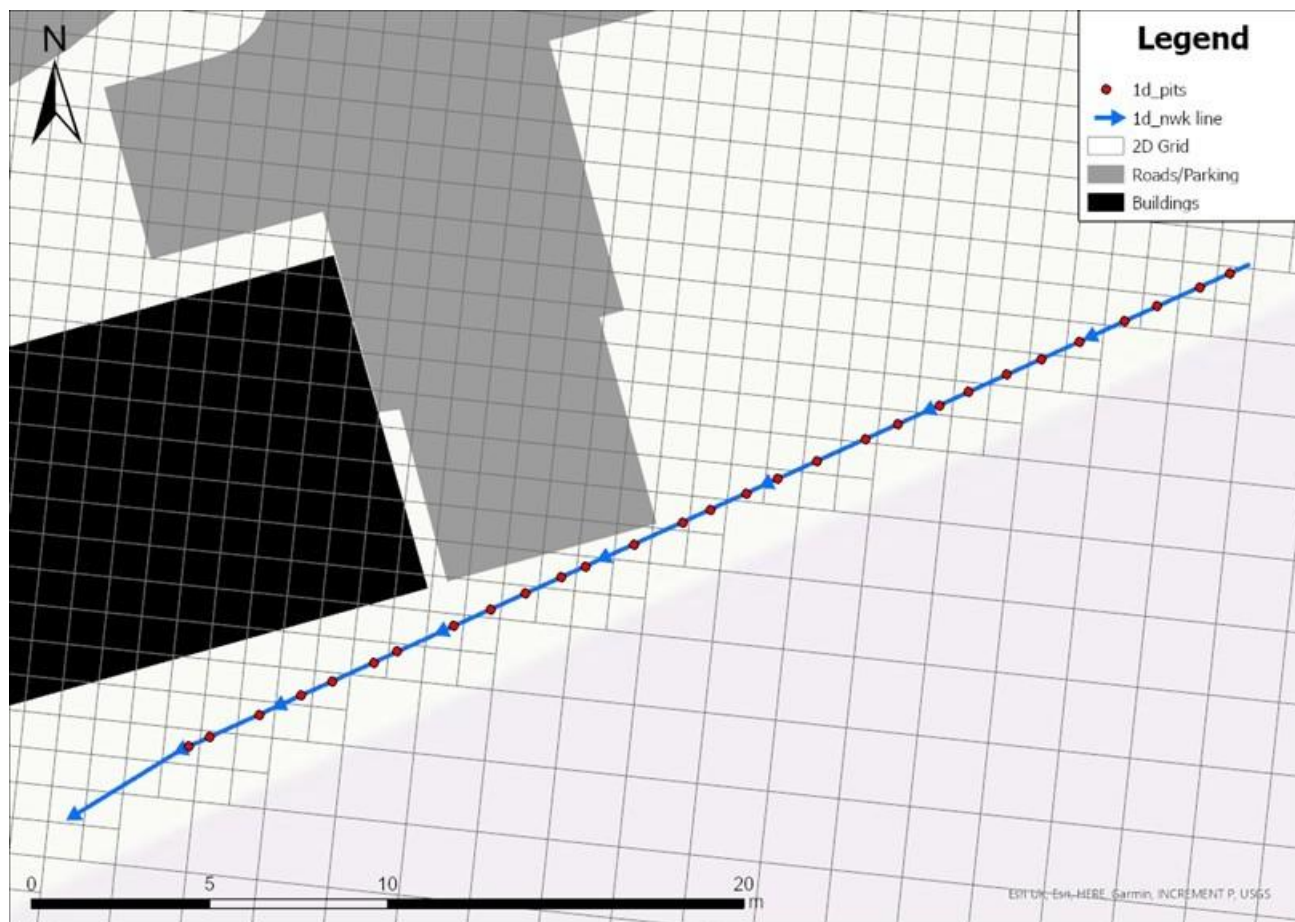


Figure 4-3 Model representation of channel drain

The depth-discharge relationship for the 1d_pits has been derived using the calculation spreadsheet available on the TUFLOW website⁸. The following assumptions have been made in estimating the depth-discharge relationship:

- A cast iron cover will be used on the channel drain and is conservatively estimated to have a grate void ratio of 10%.
- The flow towards the pit will be subcritical due to the vegetated surface on the approach to the channel drain. It should be noted that the depths expected at these locations are generally less than 0.05m and, therefore, the depth-discharge relationship has low sensitivity to the selection of subcritical or supercritical equations.

At the downstream end of the channel drain there is a short 0.45m diameter pipe that will connect the channel drain to the swale. This has been represented in the 1d_nwk line but has no 1d_pits connected to it.

⁸ https://downloads.tuflow.com/Other/Inlet_Spreadsheets/Inlet%20Curve%20Capture%20tool%20v4.xlsx

4.1.4 French Drain

A french drain is proposed to capture any exceedance flows in the climate change scenario, as well as to pick up the small amounts of flow entering the site from the eastern boundary. The model representation is similar to the channel drain with the following differences:

- The pipe diameter is 0.45m
- The depth to invert is 0.75m
- The void ratio for the depth-discharge relationship is taken as 30%⁹
- The conveyance capacity of the aggregate trench surrounding the pipe is not accounted for
- The aggregate will be exposed at the surface to enhance interception of runoff.

4.1.5 2D Roughness

The proposed buildings, roads, and car parking are represented in the model as 2d_mat files with a specific roughness value allocated to each. The roughness values applied are shown in Table 4-2 below.

Table 4-2 Manning's n roughness values applied to the design model

ID	Type of use	Manning's n
10021	Buildings	0.300
10172	Roads	0.025
10172	Car Parks and Stores	0.025

⁹ The SuDS Manual CIRIA C753 2015, page 659

4.2 Design Results

The modelled flood extents for the post-development model are presented in Figure 4-4 and demonstrate that for the events up to and including the present-day 1% AEP event, surface water runoff from off-site is almost entirely intercepted and conveyed through the site. In both the 1% AEP events including climate change, there is some flooding that is not contained by the flood management measures. However, as is evident in Figure 4-5, the flood depths are shallow and do not result in flooding to any of the proposed dwellings. Larger flood depths to the north of the site are located within the undeveloped areas. Discussion on the implications of all events for the site, including the extreme 0.1% AEP is included in the FRA⁶.

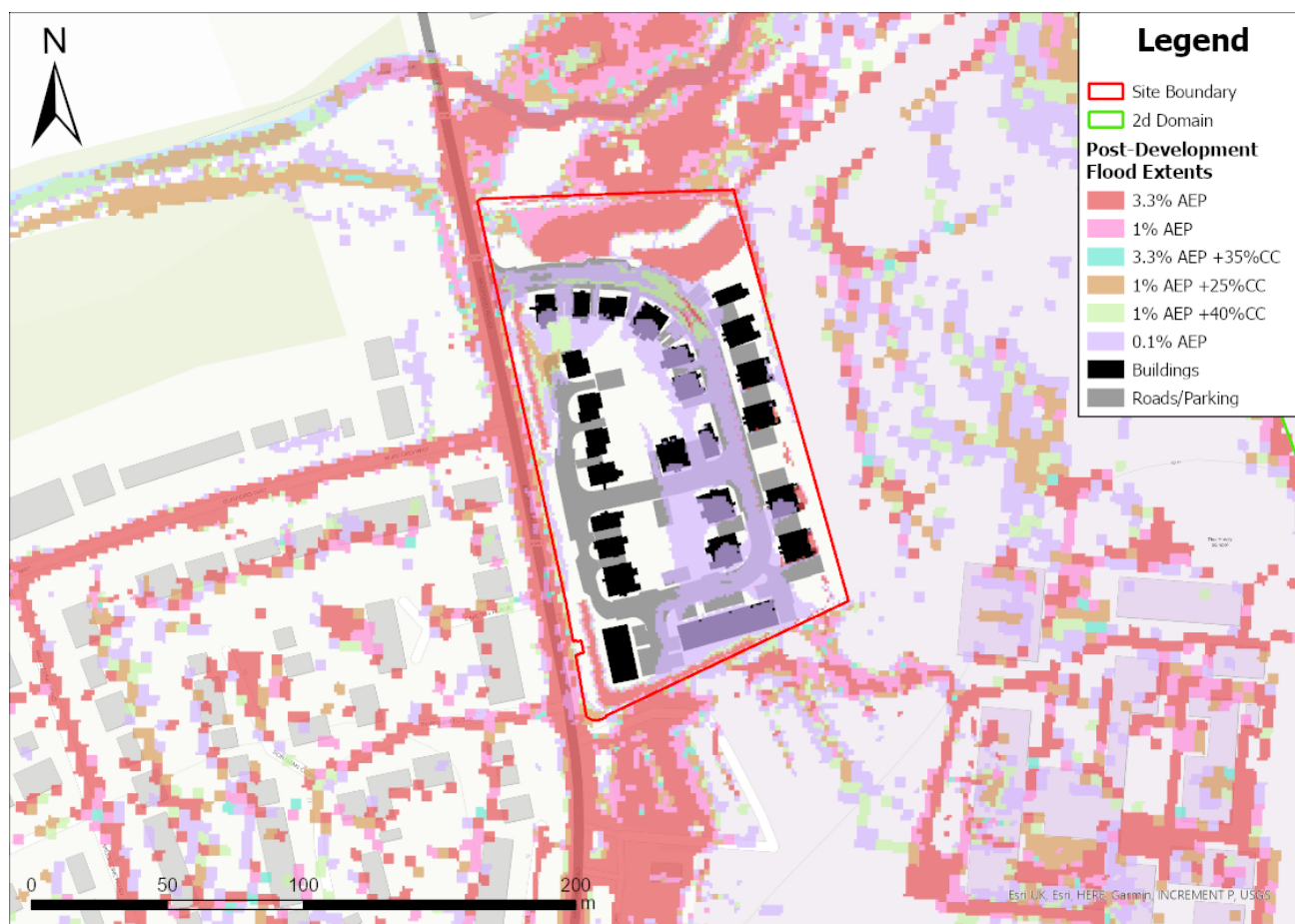


Figure 4-4 Post-development modelled flood extents



Figure 4-5 Modelled flood depths for the post-development 1% AEP +40% CC event (note depths less than 0.025m are not shown)

The post-development model results are discussed further within the FRA, where the safety of the development and impacts to third parties are considered.

5 Summary and Conclusions

This report has been prepared to document the surface water modelling undertaken to support the proposal for a residential development on land east of Bedford Road, Hitchin. A 2D TUFLOW model was provided by the client; Arcadis reviewed and updated this model to provide both a baseline and post-development representation of the site and contributing catchment.

This study is limited to the review of off-site surface water flooding and does not consider the management of rain falling directly on the site which is addressed by the drainage strategy, which is to be supplied separately by the client.

The incoming model was revised to improve the representation of the topography, drainage within the catchment, roughness values and infiltration parameters. This has produced a surface water model that is considered suitable for informing the safe design of the proposed development.

The surface water flood model was then amended to include a representation of the proposed development, including changes to ground levels, roughness values and proposed structures and features for the management of off-site surface water flow paths.

The results are discussed in this report for the purpose of model proving, whilst the FRA considers the model results in relation to assessing risks to and from the proposed development.

Arcadis UK

80 Fenchurch Street
London EC3M 4BY
United Kingdom

T: +44 (0) 20 7812 2000

[arcadis.com](https://www.arcadis.com)

Appendix B

Development Areas Plan

Regulation and compliance

Vehicle access for fire appliances

Designated fire access routes

Details of fire access routes are shown on the site plan. The routes are designed to provide access to the site from the public highway. The routes are shown in red on the site plan. The routes are designed to provide access to the site from the public highway. The routes are shown in red on the site plan.

Designated fire access routes

Details of fire access routes are shown on the site plan. The routes are designed to provide access to the site from the public highway. The routes are shown in red on the site plan. The routes are designed to provide access to the site from the public highway. The routes are shown in red on the site plan.

Regulation and compliance

Vehicle access for fire appliances

Designated fire access routes

Details of fire access routes are shown on the site plan. The routes are designed to provide access to the site from the public highway. The routes are shown in red on the site plan. The routes are designed to provide access to the site from the public highway. The routes are shown in red on the site plan.

Designated fire access routes

Details of fire access routes are shown on the site plan. The routes are designed to provide access to the site from the public highway. The routes are shown in red on the site plan. The routes are designed to provide access to the site from the public highway. The routes are shown in red on the site plan.

Building Access to be reviewed at full application design stage

Accommodation Schedule

Private Dwellings					
No	Ref	Beds	Storey	ft²	Total ft²
4	2B3P800	2	2	800	3200
5	3B5P 1001a	3	2	1001	5005
7	3B 5P 1001b	3	2	1001	7007
1	3B 5P 1050a	3	2	1050	1050
4	4B 6P 1280	4	2	1280	5120
2	4B 6P 1300a	4	2	1300	2600
2	4B 6P 1350a	4	2	1350	2700
25					26682

Affordable Housing					
No	Ref	Beds	Storey	ft²	Total ft²
3	Ap1	1	2	540	1620
8	Ap2	2	2	753	6024
6	2B4P 880a	2	2	880	5280
3	HA 2B 4P WC	2	2	1131	3393
5	3B5P 1030a	3	2	1030	5150
25					21467
Total					Total ft²
--					

Development Areas plan



Development Areas

	ft² Per Ha	ft² Per Acre
Coverage GROSS	27388.510	11083.781
Coverage NET	35665.926	14433.545

Site Area			Density		
	ha	Acres		Dph	Dpa
Gross	1.758	4.344	Gross	28.44	11.51
Net	1.326	3.236	Net	27.04	10.80

Legend

- 2.5m x 5.0m Parking space
- 3.3m x 5.5m Parking space
- Disabling parking
- 26 Private plot number
- 26 Affordable plot number
- Vp Visitor Parking Space
- Allocated parking space
- 1.8m high brick wall
- Public Realm
- Paving Aquasett Vengage
- No Build Easement
- Site Boundary (Unchecked)
- Net Boundary

Footprint Legend

- 3B 5P 1001a
- 3B 5P 1001b
- 3B 5P 1001c
- 3B 5P 1050a
- 4B 6P 1280
- 4B 6P 1300a
- 4B 6P 1350a
- Affordable
- HA 2B 4P 880a
- HA 3B 5P 1030a
- HA 2B 4P 1131WC
- 1B 2P 540a
- 1B 2P 753a



Project:-
Bradford Road Hitchin

Description:-
Option 5 Working layout

Date:- August 2025
Drawing number:- AC001-OP5-WL-01
Drawing Scale:- 1 / 500 @ A1
Revision:- 00

Appendix C

Consultation with Anglian Water

RE: Bedford Road Sewer Query



Fri 24/10/2025 11:41

 This sender is from outside your organization.

Arcadis Warning: Exercise caution with email messages from external sources such as this message. Always verify the sender and avoid clicking on links or scanning QR codes unless certain of their authenticity.

Good Morning,

Anglian Water are able to confirm that there have been instances of flooding within the vicinity of the proposed development. Locations of flooding incidents are protected under GDPR and therefore AW are not able to share this information freely.

It is also possible that other flooding may have occurred that we do not have records of, other organisations such as the Local Authority, Internal Drainage Board or the Environment Agency may have records.

We recommend you submit a pre planning application form to enable Anglian Water to advise you of any suitable connection points for the proposed development and identify any mitigation that would be required. Further details including the application form can be found on our website.

Kind regards



For details on how to submit a pre-planning enquiry to the Pre-Development Team, please visit the ["how to apply"](#) section on our website.
Growth Planning Team contact number: 

Arcadis UK

80 Fenchurch Street
London EC3M 4BY
United Kingdom

T: +44 (0) 20 7812 2000

[arcadis.com](https://www.arcadis.com)