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All design and construction is to be in accordance with the Construction Design and Management (CDM) Regulations 2015, and HSE guidance.

Scale bar (m) 1:500

0 10 20

N

Rev: Date: Note: By:

FOR PLANNING

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Contract:

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Drawing Title:

Existing Site Plan

Scale:	Drawn/check:
1:500 @ A2	paw rda
Job No:	Date:
18955	December 2020
Drawing No:	Revision:
PL02	-

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All design and construction is to be in accordance with the Construction Design and Management (CDM) Regulations 2015, and HSE guidance.

Scale bar (m) 1:500

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Rev:	Date:	Note:	By:
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Drawing Title:
Proposed Site Plan

Scale:	Drawn/check:
1:500 @ A2	paw rda
Job No: 18955	Date: January 2021
Drawing No: PL03	Revision: -

Appendix B – Hydraulic Modelling

JBA Consulting Hydraulic Modelling Study at Joseph Farm, Little Chesterford dated February 2020

Hydraulic Modelling Study at Joseph Farm, Little Chesterford

Final Report

February 2020

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Revision History

Revision Ref/Date	Amendments	Issued to
P01 / Jan 2020	Draft	Jack Dudmish, Caroline Richardson
C01 / Feb 2020	Final	Jack Dudmish, Caroline Richardson

Contract

JBA Consulting was contacted on 05/07/2019 by Jack Dudmish from Stomor, on behalf of Caroline Richardson. Charlotte Turner of JBA Consulting carried out this work.

Prepared by .... Charlotte Turner

Technician

Reviewed by .... Olivier Saillofest BEng MSc CEng MCIWEM C.WEM

Technical Director

Purpose

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Executive summary

JBA Consulting was contacted on 05/07/2019 by Jack Dudmish from Stomor, on behalf of Caroline Richardson, to undertake a hydraulic modelling study in relation to a proposed residential dwelling at Joseph Farm.

The site is located within the vicinity of an unnamed watercourse which is a tributary of the River Cam. To represent the watercourse, a 1D – 2D detailed hydraulic model was built using version 4.3.6458.29637 of FLOOD MODELLER and version 2018-03-AE-ISP-W64 of TUFLOW. LiDAR data was used to provide ground levels throughout the floodplain.

The baseline model results indicate that:

- The site is located outside of the 20-year, 100-year, 100-year plus 35% climate change, 100-year plus 65% climate change and 1,000-year fluvial flood extent.
- No flooding occurs within the site boundary, this is due to the steep terrain surrounding the proposed development.
- Flood depths along the BB184 will not exceed 0.2m during the 100-year plus 35% climate change fluvial flood event. This will not affect the site entrance.
- The B184 has a 'Low' hazard to people rating to the west of the development site during the 100-year plus 35% climate change event.
- Safe access and egress to/from the proposed site is available at all time during the 100-year plus 35% climate change event.

A blockage analysis was carried out at the closest structure to the proposed site at Joseph Farm. Due to the nature of the surrounding environment (i.e. branches hanging over the channel), a 90% blockage was put on the culvert running underneath the B184. The results from this analysis show that flood water would bypass the culvert headwall without causing flooding on site.

The sensitivity of the model results for changes in roughness, flow values and downstream boundary conditions were also tested. Results indicate that the model is sensitive to change in the channel whereas the site is deemed insensitive.

As a way forward, it is recommended that the results from this modelling study are taken into consideration in the Flood Risk Assessment when confirming safe access and egress routes and recommending minimum Finished Floor Levels for the proposal.

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Abbreviations

1D One Dimensional

2D Two Dimensional

CC Climate Change

DTM Digital Terrain Model

FEH Flood Estimation Handbook

FFL Finished Floor Levels

Ha Hectares

HQ Head-Flow

LIDAR Light Detection and Ranging

m AOD Metres Above Ordnance Datum

TUFLOW 2D Hydraulic Modelling Software

1 Introduction

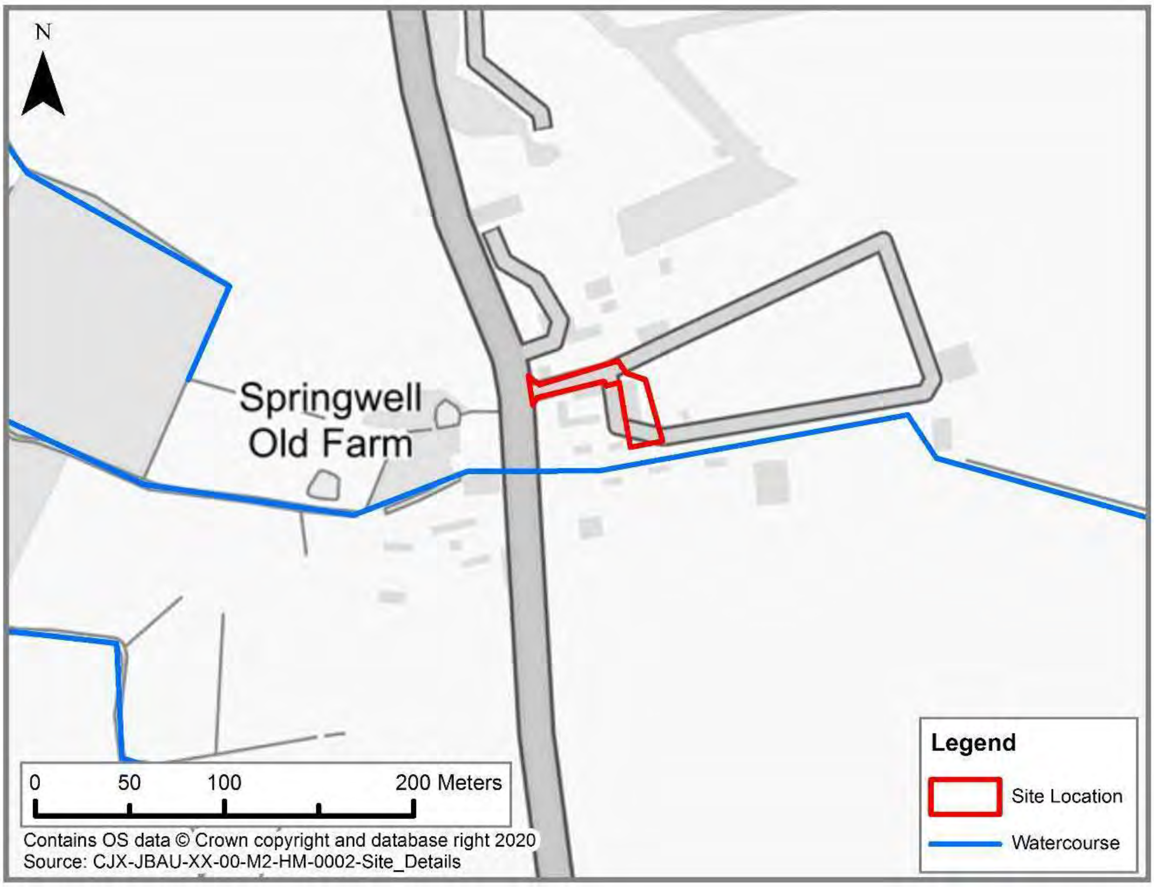
1.1 Terms of Reference

JBA Consulting was contacted on 05/07/2019 by Jack Dudmish from Stomor, on behalf of Caroline Richardson, to undertake a hydraulic modelling study of an unnamed watercourse in relation to a proposed residential dwelling at Joseph Farm.

1.2 Site Details

Table 1-2: Site Details

Site address	Joseph Farm, Saffron Walden
Site area	0.09ha (approximate)
Existing Land-use	Brownfield
OS NGR	TL 51225 41823
Country	England
County	Essex



The site is currently occupied by a stable block and a domestic storage barn.

The site is bounded by Waldon Road (B184) to the west and is surrounded by greenfield land. An unnamed watercourse is located to the south of the proposed development and flows in a Westerly direction.

1.3 The proposal

The proposal is for the change-of-use of the site (from a stable block and a domestic storage barn into a residential dwelling). The unnamed watercourse located next to the site is not represented in the Environment Agency's (EA) Flood Map for Planning[1]. As a result, a detailed hydraulic modelling study is required to support the flood risk assessment accompanying the planning application.

1.4 General Approach

A hydrological assessment was carried out to derive fluvial flow estimates and a 1D-2D FLOOD MODELLER (version 4.3.6458.29637) -TUFLOW (2018-03-AE-ISP-W64) hydraulic model was produced to allow the accurate representation of the flood depths, velocity and hazard within the site boundary.

The hydraulic model's sensitivity to flow, downstream boundary and roughness values were tested to improve confidence in the models results within the development site boundary.

1 https://flood-map-for-planning.service.gov.uk/

2 Approach

2.1 Data Availability

Grantham Coates Surveys (GCS) were commissioned to collect topographic survey data across the channel in December 2019. The survey consisted of 9 cross-sections taken at regular intervals along the unnamed watercourse and at key hydraulic structures. At the site, four key hydraulic structures were identified, including a bridge and three culverts. Detailed information on these hydraulic structures is provided in Appendix D.

LiDAR data was obtained from the Open Data website to represent ground levels within the floodplain. The LiDAR had a grid resolution of 1m and was last flown in 2018.

2.2 Input Data Quality Assessment

The topographic survey (3D Ground Model) was not provided in a standard CAD format and thus was not used within the modelling study. This does not affect model results though as flooding does not occur within the site boundary during any of the modelled flood scenarios.

A quality assessment was carried out to check the difference between the topographic survey and LiDAR data within the site boundary. Ten spot levels were compared on site and differences up to 8.53m were found.

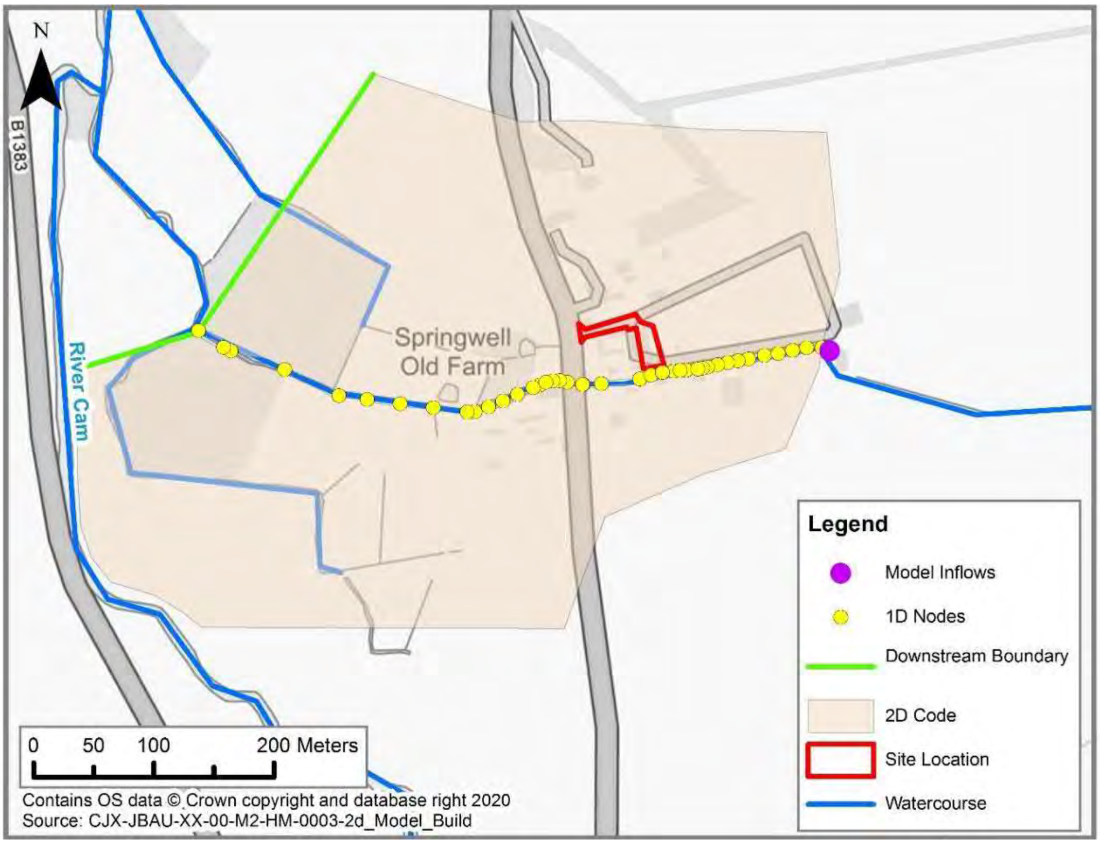
2.3 Model Extent

The hydraulic model represents the unnamed watercourse, as illustrated in Figure 2-3.

The modelled reach represents the unnamed watercourse from approximately 149m upstream of the site boundary to 400m downstream.

The channel was represented in the 1D domain using FLOOD MODELLER, constructed from the channel topographic survey data collected in December 2019. The cross sections were trimmed to the top of bank and linked to the 2D TUFLOW domain representing the floodplain. The TUFLOW 2D domain (modelled using the latest version) has an area of 1.85 km^2 with a 2m grid resolution.

Figure 2-3: Model Extent



2.4 Modelling Approach

The model was built using version 4.3.6458.29637 of FLOOD MODELLER and version 2018-03-AE-ISP-W64 of TUFLOW to calculate the flood extents expected to be seen at Joseph Farm. LiDAR data were used to represent the ground levels within the floodplain and within the site boundary. The bank levels were interpolated from a mix of surveyed bank levels collected by GCS in December 2019 and LiDAR data (1m) last flown in 2018 (to represent low spots along the banks). Manning's 'n' values were used to represent the roughness of the channel and the floodplain. The values for channel roughness were based on photographs gathered by Grantham Coates Surveys during the site visits. Manning's 'n' values in the floodplain were set to represent the different land uses within the modelling extent. Land uses were defined using OS mapping and satellite imagery. Table 2-4 gives the range of Manning's 'n' values used in the 1D and 2D domains.

Table 2-4**: Manning's 'n'** range within the hydraulic model

Features	Manning's n value assigned
Watercourses (1D domain)	0.058 – 0.077
Ponds or Lakes	0.035
Roads or Tracks	0.015
Railway	0.045
Buildings	0.300
Woodland	0.080
Greenspace	0.050
General Surface	0.060

2.5 Climate Change

In line with the Environment Agency's guidance on climate change allowances, the impact of climate change was modelled by factorising the model inflows by 1.35 (100-year plus 35% climate change exceedance) and 1.65 (100-year plus 65% climate change exceedance). This related to the 'higher central' and 'upper end' allowances, respectively for the Anglian river basin.

2.6 Model Runs

The following flood scenarios were simulated using the unnamed watercourse's hydraulic model:

- [Base-line Scenario] – 20-year (5% AEP) flood event – existing condition scenario.
- [Base-line Scenario] – 100-year (1% AEP) flood event – existing condition scenario.
- [Base-line Scenario] – 100-year (1% AEP) plus Climate Change (35%) – existing condition scenario.
- [Base-line Scenario] – 100-year (1% AEP) plus Climate Change (65%) – existing condition scenario.
- [Base-line Scenario] – 1,000-year (0.1% AEP) flood event – existing condition scenario.
- [Base-line blockage Scenario 1] 100-year (1% AEP) plus 35% Climate Change – existing condition scenario with a 90% blockage at the 1st culvert closest to the site;
- [Sensitivity analysis] 100-year (1% AEP) flood event with +20% increase in peak flows;
- [Sensitivity analysis] 100-year (1% AEP) flood event with +20% increase in roughness value;
- [Sensitivity analysis] 100-year (1% AEP) flood event with +250mm increase in peak water level at the downstream model boundary.

3 Baseline Results

3.1 Flood Extents

Figure 3-1 shows the baseline flood extents at the site.

Figure 3-1: Baseline Flood Extents

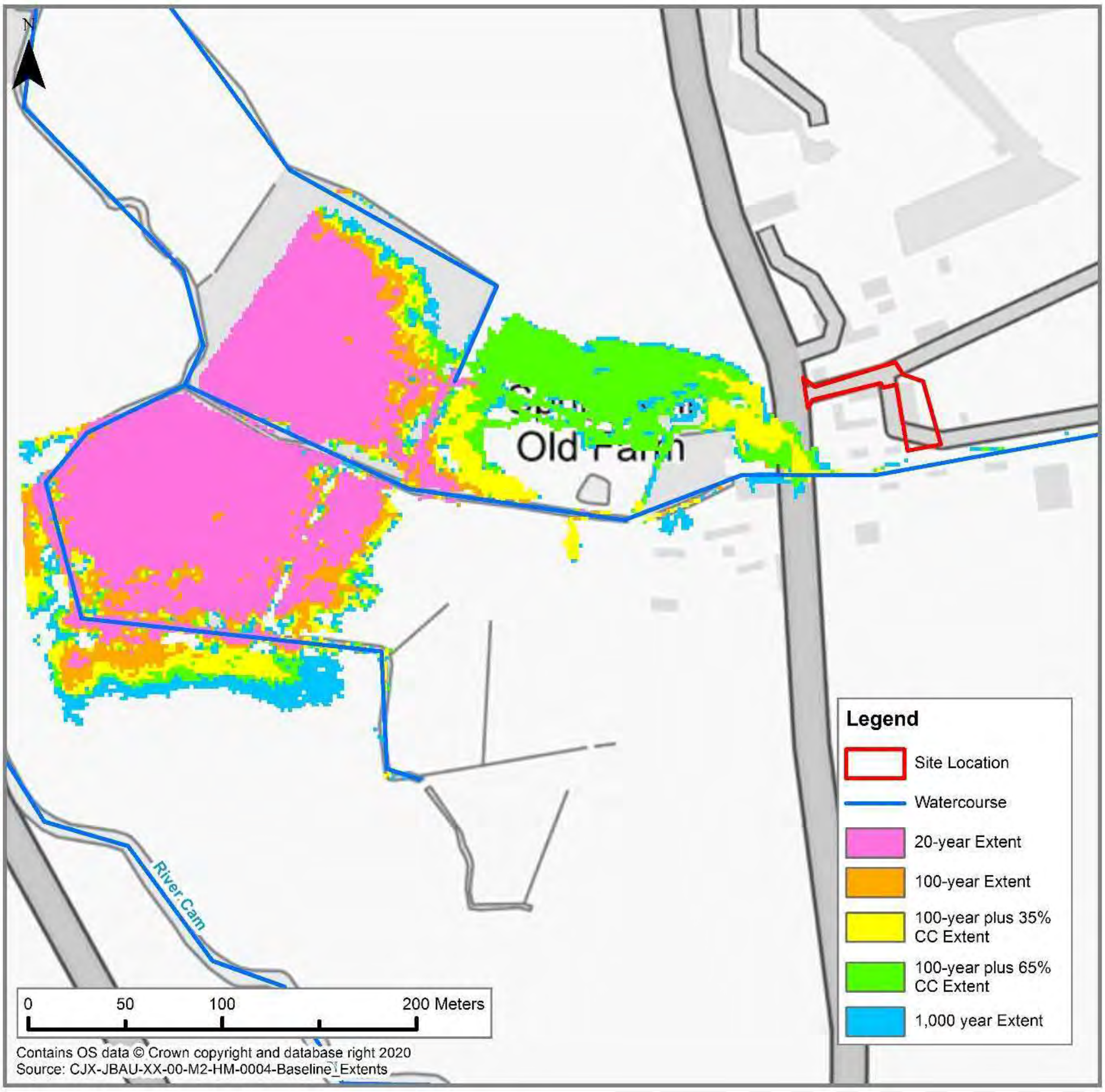


Figure 3-1 shows that:

- The site is located outside of the 20-year, 100-year, 100-year plus 35% climate change, 100-year plus 65% climate change and 1,000-year fluvial flood extents.

3.2 Flood Depths

The baseline 100-year plus 35% climate change flood depths in relation to the site are represented in Figure 3-2.

Figure 3-2: Baseline 100-year plus 35% Climate Change flood depths

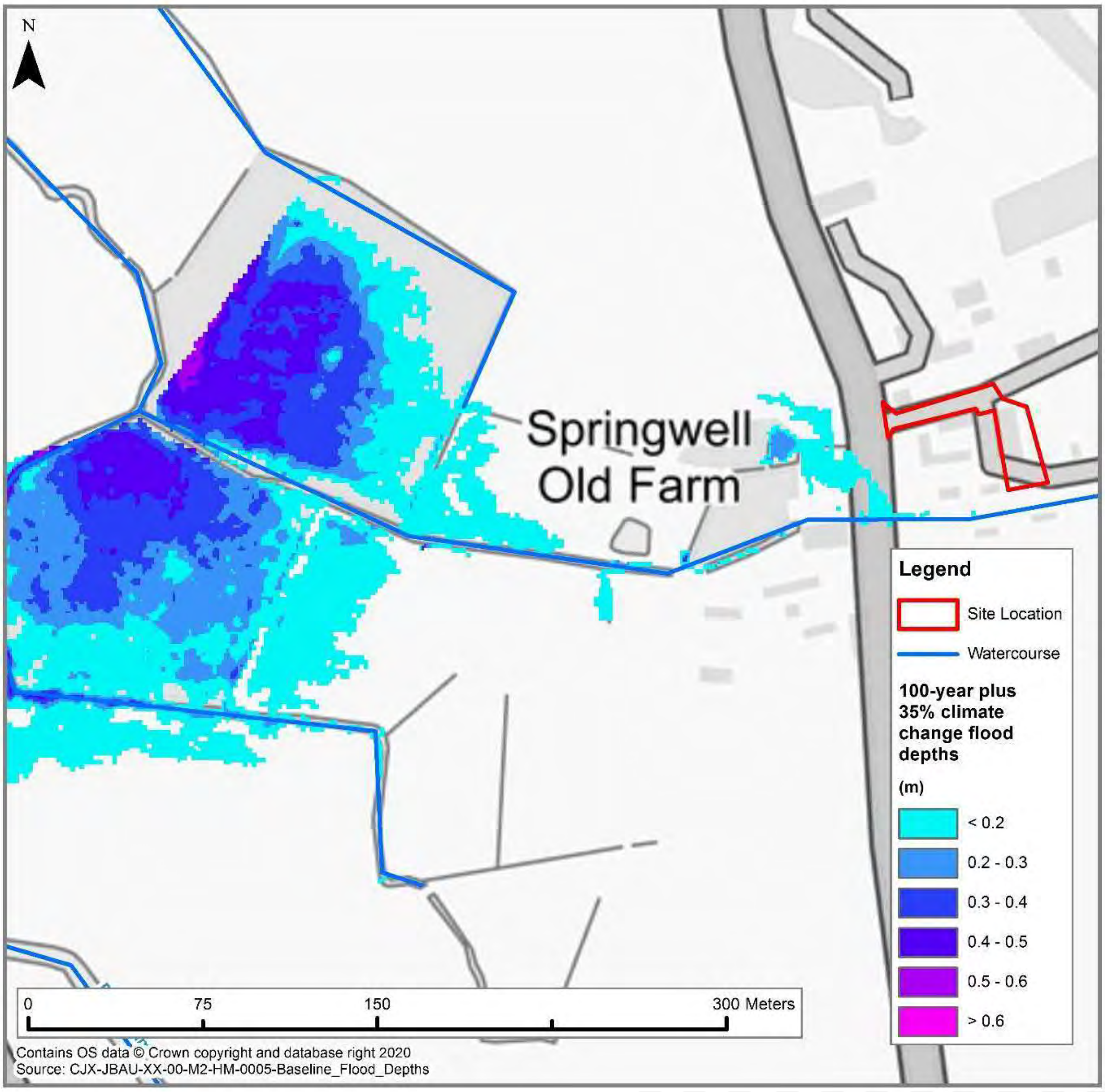


Figure 3-2 shows:

- No flooding occurs within the site boundary, this is due to the steep terrain surrounding the proposed development.
- Flood depths along the B184 will not exceed 0.2m during the 100-year plus 35% climate change fluvial flood event. This will not affect the site entrance.

3.3 Modelled Flood Levels

The baseline 100-year plus 35% climate change flood levels in relation to the site are represented in Figure 3-3, respectively.