Hydraulic Modelling Report

Loddon: Western Watercourses

Abley Letchford

SHF.1229.003.HY.R.001.B

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Executive Summary

This report presents the updated modelling methodology for a 1D2D ESTRY TUFLOW Hydraulic Modelling exercise for Oldhouse Farm Main Watercourse and associated tributary watercourse network. The model build is based on 1m DTM LIDAR Data, and a detailed channel/structures survey. The purpose of the modelling exercise is to establish baseline fluvial (river) flood risk.

The model was run for a range of return periods to establish the baseline fluvial flood outlines and associated parameters (depth, velocity and hazard). Sensitivity analysis was carried out to understand the seasonal effects of vegetation, impact of downstream boundary levels and model inflows, 2D grid resolution and existing sewer capacity impact upon model results within the study area. An up-to-date climate change allowance of 14%, 23% and 46% representing the Loddon and tributaries Management Catchment (Central, Higher and Upper Estimate) has also been applied to the 1 in 100-year event, following Environment Agency guidance.

A hydrological assessment, inclusive of a desk-based assessment of catchment descriptors, was undertaken, which considered recognised methodologies such as FEH Statistical and ReFH2, to provide hydrological inputs, in the form of hydrographs for use in the hydraulic model. The hydrological assessment determined that peak flows and hydrographs from the ReFH2 method were most appropriate for the contributing catchment.

The baseline flood outlines show out of bank flows (as per online surface water mapping, with flow pathways along watercourse being indicative of fluvial flooding), albeit with refinement through the use of a channel/structures survey and more detailed ground model.

Sensitivity analysis shows that the upper and middle reach of the modelled watercourses are not sensitive to downstream boundary changes, inflows change, accounting for sewer drainage catchments, Manning's roughness and 2D grid resolution. However, the lower reach is sensitive to changes in downstream boundary condition (as expected), which is representative of the River Loddon floodplain.

An existing flood alleviation channel has previously been excavated within the central reach of the model to improve the developable area associated with a new development (film studio and museum) by reducing the flood outline. A 'future baseline' model was run to incorporate a survey of the completed channel, which demonstrates an improvement to localised flooding, which now only occurs during a 1 in 1000-year event.

1.0 Introduction

1.1 Background

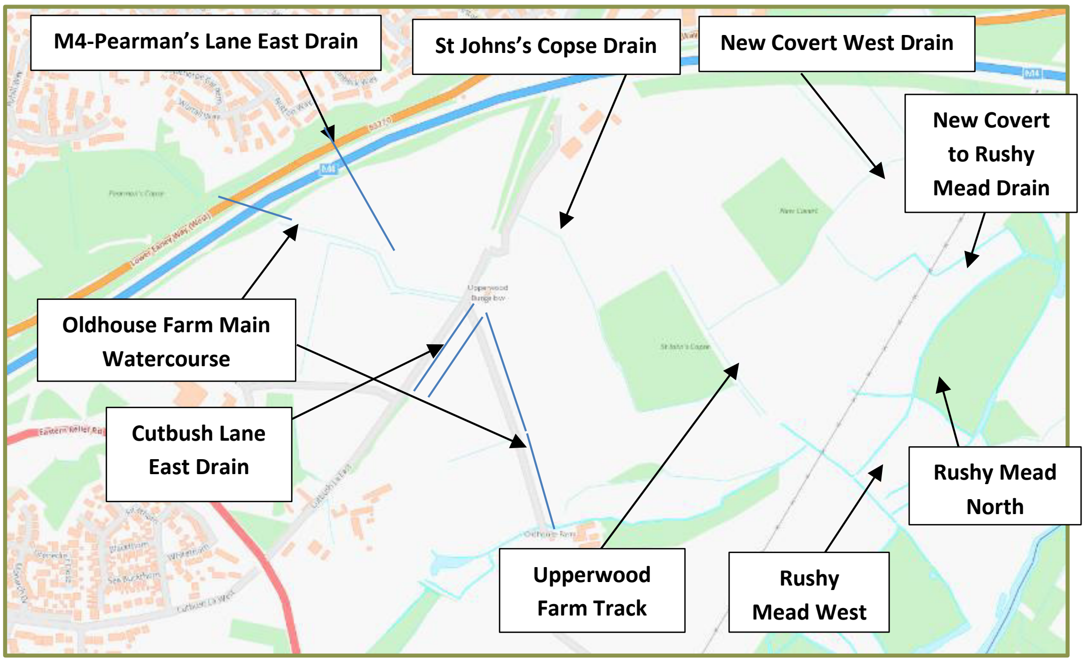
1.1.1 Enzygo Ltd were commissioned by Abley Letchford Partnership Ltd to undertake an updated hydraulic modelling exercise to inform fluvial (river) flood risk, associated with the Oldhouse Farm Main watercourse and the associated tributary network. The study area is centred at (NGR) 474073, 169250.

1.1.2 Enzygo previously prepared a modelling report (Document Reference. SHF.1229.003.HY.R.001.A, dated October 2021), supported by a Hydrologcial Assessment (Document Reference. SHF.1229.002.HY.R.004.A, dated April 2023). The updated modelling exercise/hydrologvial assessment utilsies latest modelling software and data sets, but aslo follows latest modelling guidance documents.

1.1.3 A desktop study identified a number of tributary watercourses (ordinary watercourses) located within the model domain. These watercourses are described below and in Figure 1.1:

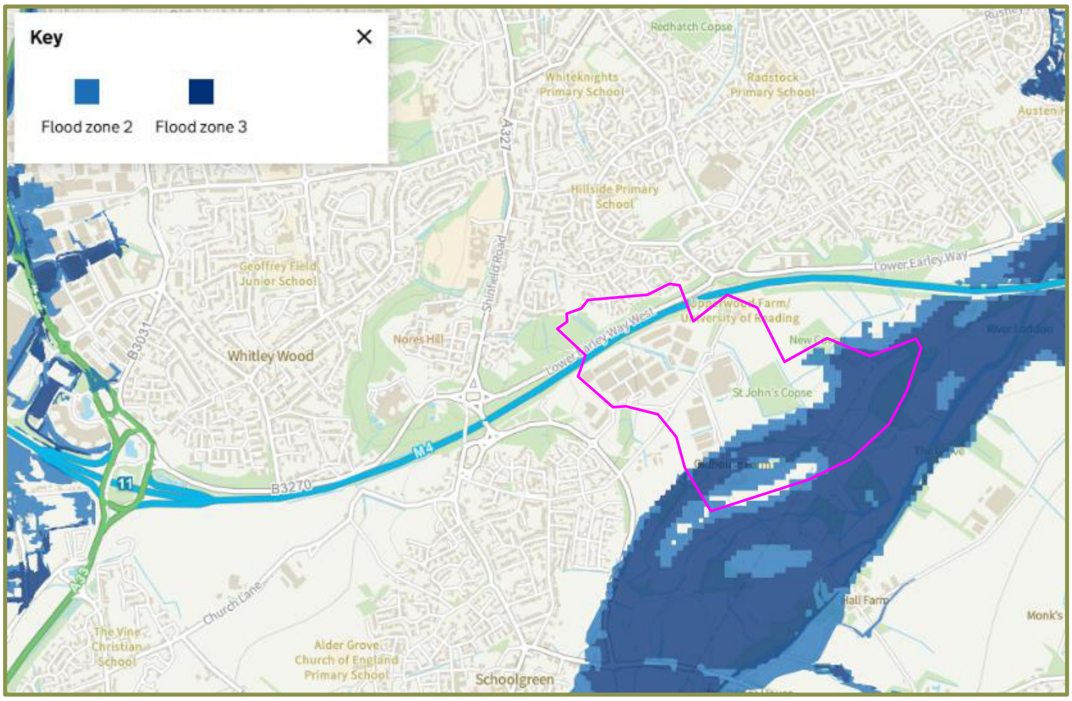
- Oldhouse Farm Main Watercourse - The main watercourse that flows through the model. Nearly all other watercourse within this model connect to the Oldhouse Farm Main Watercourse.
- M4-Pearman's Lane East Drain - Shown to transfer flows from the north of the M4 to the south, before discharging into Oldhouse Farm Main Watercourse.
- Cutbush Lane East Drain - Located in the western extent of the model domain, this watercourse flows to the northeast before discharging into Oldhouse Farm Main Watercourse.
- St John's Copse Drain - A watercourse located to the north of St John's Copse, that flows south and adjacent to the western side of St John's Copse before eventually discharging to Oldhouse Farm Main Watercourse.
- Upperwood Farm Track (watercourse) - A short section of watercourse, which flows south and is located on the eastern boundary of the St John's Copse, before discharging to St John's Copse Drain.
- New Covert West Drain - A short section of watercourse located to the north east of Upperwood Farm Track, which flows south west before discharging to the aforementioned watercourse.
- New Covert to Rushy Mead Drain - Watercourse connecting New Covert West Drain to Rushy Mead North (watercourse). The watercourse begins at New Covert and is orientated north west to east, with the direction of flow being east.
- Rushy Mead West (watercourse) - Located in the lower extent of the model domain and flows discharge into St John's Copse Drain.
- Rushy Mead North (watercourse) - This watercourse is located in the lower extent of the model. Flows from New Covert to Rushy Mead Drain enter this watercourse. Flows exit the model from the lower extent of Rushy Mead North.

Figure 1.1: Modelled Watercourses



1.1.4 Environment Agency Flood Map for Planning (Figure 1.2) shows that the model domain is in Flood Zone 1 (low risk). However, the Flood Zone 1 designation is likely to be due to no modelling of the ordinary watercourse network having previously being undertaken. Flood Zones 2 and 3 are associated with the downstream River Loddon (a 'main river'), which is located approximately 500m to the south-east of the study area and is the primary watercourse defining fluvial flood risk in the Loddon valley.

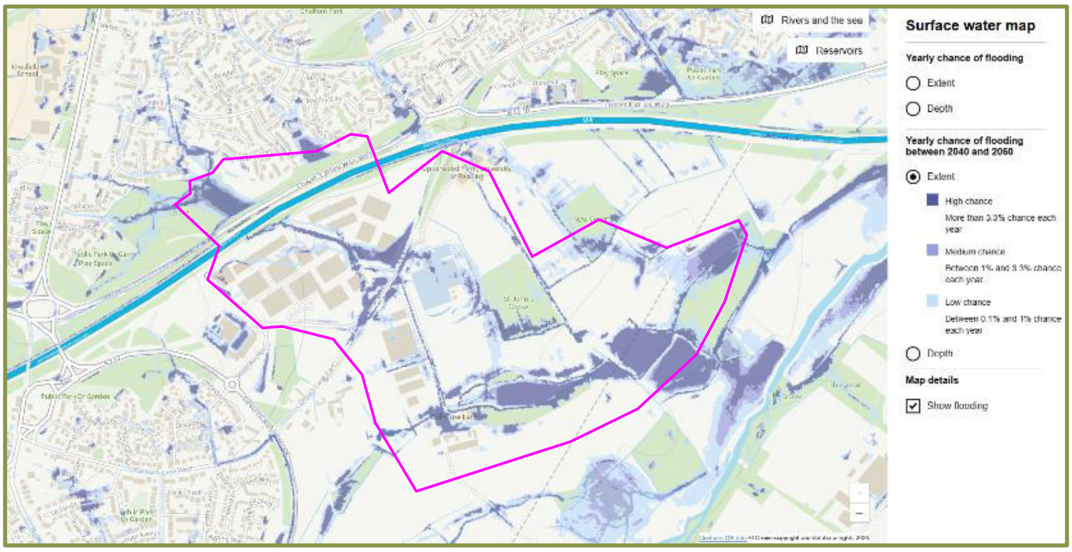
Figure 1.2: Environment Agency Flood Map for Planning Map



Pink Line: *Model Domain.*

1.1.5 Environment Agency surface water flood mapping (Figure 1.3) shows high, medium and low risk surface water flow pathways within the model domain, which are indicative of fluvial flooding, albeit are considered conservative without the channel profiles and structures being represented by the coarse ground model.

Figure 1.3: Environment Agency Surface Water Floodmap



Pink Line: *Model Domain.*

1.2 Purpose

1.2.1 The purpose of this Hydraulic Modelling report (SHF.1229.003.HY.R.001.B, June 2025) is to confirm/refine the flood fluvial flood outlines associated with the model domain. This report will:

- Present the methodologies to build/run the baseline hydraulic model.
- Model run for a 'future baseline' - an existing flood alleviation channel, which has previously been excavated within the central reach of the model to improve the developable area associated with a new development (film studio and museum) by reducing the flood outline. A 'future baseline' model was run to incorporate a survey of the completed channel.
- Report the results in tabular and mapping format.

1.3 Scope

1.3.1 The scope of works includes the following:

- Undertake a hydrological assessment to produce peak flows, which will be used as input boundaries within the new model (Appendix 1).
- Build a 1D2D linked model using detailed channel survey/LIDAR data and new hydrological peak flows to provide baseline flood outlines in order to refine existing mapped flood outlines, which will support future new development.

2.0 Baseline Model Methodology

2.1 Introduction

2.1.1 Hydraulic modelling is used to convert the hydrological modelling outputs (peak flows) into flow and water levels within a watercourse and its associated floodplain areas.

2.1.2 A 1D2D linked hydraulic model of watercourse network was constructed by Enzygo Ltd during May 2021 and updated in April 2025, utilising ESTRY-TUFLOW modelling software (version 2025.0.2-iSP-w64).

2.1.3 The model files and a modelling log, which includes a model file schedule (list of all files used in the modelling), are included in Appendix 3.

2.1.4 It should be noted that there are two 'baseline' model runs; these are:

- Baseline - Modelled baseline outputs updated (model hydrology and structure representation) using Enzygo Ltd 'Shinfield Studios' Model and Report SHF.1229.003.HY.R.001.A - October 2021.
- Future Baseline - Modelled future baseline outputs updated (model hydrology and structure representation) using Enzygo Ltd 'Shinfield Studios' Phase 2 Model and Technical Note SHF.1229.003.HY.R.003.C - January 2023.

2.2 Model Extent

2.2.1 A detailed channel survey of the watercourses, inclusive of cross sections and in-channel structures, was undertaken in 2021 for the below extents.

- Oldhouse Farm Main Watercourse - 1.4km survey reach length.
  - From north (upstream) of the M4 (NGR) 473766, 169352 to 200m downstream of St Johns's Copse (NGR) 474822, 168914.
- M4-Pearman's Lane East Drain - 0.2km survey reach length.
  - From north (upstream) of the M4 (NGR) 474002, 169504 to 150m downstream of the M4 (NGR) 474061, 169258.
- Cutbush Lane East Drain - 0.7km survey reach length.
  - Adjacent to the western side of Cutbush Lane East (road) (NGR) 474108, 169039 (NGR) 474209, 169171.
- St. John's Copse Drain - 0.8km survey reach length.
  - From 180m south of the M4 (NGR) 474310, 169329 to 350m north-east of Oldhouse Farm (NGR) 474740, 168971.
- Upperwood Farm Track - 0.5km survey reach length.
  - From 375m southeast (downstream) of the University of Reading Upperwood Farm (NGR) 474647, 169125 to 350m north-east of Oldhouse Farm (NGR) 474947, 168815.
- New Covert West Drain - 0.3km survey reach length.
  - From 450m south of the M4 (NGR) 474645, 169124 to 250m south of the M4 (NGR) 474870, 169338.

- New Covert to Rushy Mead Drain - 0.5km survey reach length.
    - From 300m south of the M4 (NGR) 474858, 169288 to 350m south of the M4 (NGR) 475210, 169258.
- Rushy Mead West - 0.2km survey reach length.
    - From 2750m south east (downstream) of the St John's Copse (NGR) 474909, 168866 to 430m east (downstream) of St John's Copse (NGR) 475020, 168999.
- Rushy Mead North - 0.4km survey reach length.
    - From 430m east (downstream) of St John's Copse (NGR) 475008, 168993 to 350m south of the M4 (NGR) 475232, 169250.

2.2.2 A copy of the detailed watercourse channel survey is included in Appendix 2.

2.2.3 The overall model extent is from (NGR) 473600, 169450 to (NGR) 474945, 168813 and 475232, 169250 encompassing a total Oldhouse Farm Main Watercourse reach length of approximately 1.4km, 0.8km of St Johns Copse and the remainder of the watercourses in the model vary between 0.2km and 0.5km, all of the model reach is covered by the detailed channel survey.

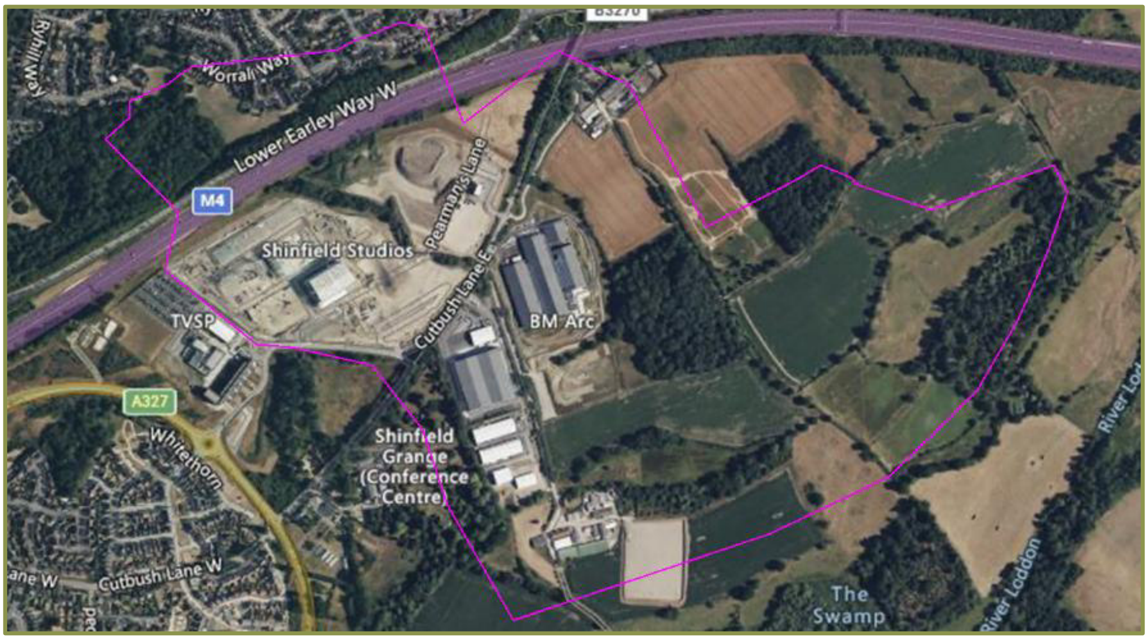
2.2.4 A survey was undertaken in April 2021, the majority of the survey provided defined channels and structures in the upper extent of the model. The lower extent of the model contains watercourses that are less defined and some structures that require repair. The survey identified seasonal vegetation throughout, with denser vegetation in the lower model reaches. In the main reaches of the model, water was observed, although some minor connecting ditches were dry at the time the survey was undertaken and did not show signs of recent conveyance.

2.2.5 Scrutiny of aerial photography in Google Earth Pro software for the period of 2003 to 2020 confirms that the associated channels of the watercourses have not spatially changed, indicating a stable channel network for the 'Baseline' model run. For the 'Future Baseline' it is noted that some change has occurred to the channel network to the south of the M4 (as per 2022 mapping).

2.2.6 The topographical survey includes 24 in-channel structures and described the type, size (diameter, width, height, length), invert and soffit level. These details are outlined in Section 2 of this report. Photographs of the watercourses and associated structures were provided with the detailed channel survey with key photographs included in Table 2.1.

2.2.7 The model domain is included in Figure 2.1.

Figure 2.1: Model Extent



***Pink Line:** Model Domain.*

2.3 Cross-Sections

2.3.1 The model includes a single reach of Oldhouse Farm Main Watercourse which has a length of 170m (Figure 2.2). Cross-sections were taken from the detailed channel survey (Appendix 2) at an average interval of approximately 80m. Cross sections were taken on both the upstream and downstream faces of in-channel structures. A total of 70 sections were surveyed and included within the model (Figure 2.2).

2.3.2 Of the 70 surveyed cross sections, 40 are representative of the upstream and downstream faces of structures.

Figure 2.2: Location of Modelled Cross-Sections

***Blue:** Open channel. **Yellow:** Culverts. **Black:** Connectors. **Pink:** Cross sections.*

2.3.3 All cross-sections have been trimmed (between right and left bank top) to include only in-channel data representative of the in-channel 1D domain.

2.3.4 Modelled left and right bank levels and locations were based on the cross-section survey data.

2.3.5 All cross-sections have been modelled looking downstream (left bank to right bank).

2.3.6 All cross-sections have been modelled through layer '1d_xs_SHI_001' which links to associated cross-section csv files. The .csv files also contain varying 1D Manning's 'n' roughness values linking to .tmf file 'SHI_001.tmf' through an 'M' flag attribute.

2.4 Structures

2.4.1 The survey picked up 24 in-channel structures along the extent of the surveyed watercourses.

2.4.2 Identified structures comprise bridges, irregular culverts and circular culverts in various states of repair/maintenance, the details of which are summarised in Table 2.1 and locations in Drawing 001.

Table 2.1: In-channel Structure Photos and Descriptions (continues over page)

Structure 1 (SHI_009 – Ø1000mm Concrete Culvert)

Looking upstream to the downstream face of Structure 1

- Modelled as a 'C' (Circular culvert with overtopping modelled in the 2D domain)
- Losses: default as per the TUFLOW manual
- Opening Dimensions: 1.04m
- u/s invert: 49.65mAOD (informed from bounding cross sections)
- d/s invert: 48.27mAOD (informed from bounding cross sections)
- Length: 102m
- Manning's: 0.012 (representative of concrete, cement - finished).

Structure 2 (SHI_007 – Ø1000mm Concrete Culvert)

Looking upstream to the downstream face of Structure 2

- Modelled as a 'C' (Circular culvert with overtopping modelled in the 2D domain)
- Losses: default as per the TUFLOW manual
- Opening Dimensions: 1.02m
- u/s invert: 49.80mAOD (informed from bounding cross sections)
- d/s invert: 48.37mAOD (informed from bounding cross sections)
- Length: 114m
- Manning's: 0.012 (representative of concrete, cement - finished).

Structure 3 (SHI_011_a – Ø320mm Concrete Culvert)

Looking downstream to the upstream face of Structure 3

- Modelled as a 'CW' (Circular culvert with 1D overtopping weir)

- Losses: default as per the TUFLOW manual
- Opening Dimensions: 0.32m
- u/s invert: 48.07mAOD (informed from bounding cross sections)
- d/s invert: 48.07mAOD (informed from bounding cross sections)
- Length: 5.00m
- Manning's: 0.013 (representative of concrete).

Structure 4 (SHI_003 – Ø380mm Concrete Culvert)

Looking upstream to the downstream face of Structure 4

- Modelled as a 'C' (Circular culvert with overtopping modelled in the 2D domain)
- Losses: default as per the TUFLOW manual
- Opening Dimensions: 0.38m
- u/s invert: 44.34mAOD (informed from bounding cross sections)
- d/s invert: 43.87mAOD (informed from bounding cross sections)
- Length: 20m
- Manning's: 0.013 (representative of concrete)

Structure 5 (SHI_038 – Ø300mm Concrete Culvert)

Looking upstream to the downstream face of Structure 5

- Modelled as a 'C' (Circular culvert with overtopping modelled in the 2D domain)
- Losses: default as per the TUFLOW manual
- Opening Dimensions: 0.30m
- u/s invert: 43.73mAOD (informed from bounding cross sections)
- d/s invert: 43.46mAOD (informed from bounding cross sections)
- Length: 11.00m
- Manning's: 0.012 (representative of concrete, cement - finished)

Structure 6 (SHI_004_a – Ø600mm Polyethylene PE Culvert)

Looking downstream to the upstream face of Structure 6

- Modelled as a 'CW' (Circular culvert with 1D overtopping weir)

- Losses: default as per the TUFLOW manual
- Opening Dimensions: 0.60m
- u/s invert: 43.72mAOD (informed from bounding cross sections)
- d/s invert: 43.71mAOD (informed from bounding cross sections)
- Length: 10.00m
- Manning's: 0.018 (Polyethylene PE - Corrugated with corrugated inner walls).

Structure 7 (SHI_041 – Ø450mm Concrete Culvert)

Looking downstream to the upstream extent of Structure 7

- Modelled as a 'C' (Circular culvert with overtopping modelled in the 2D domain)
- Losses: default as per the TUFLOW manual
- Opening Dimensions: 0.45m
- u/s invert: 39.37mAOD (informed from bounding cross sections)
- d/s invert: 39.30mAOD (informed from bounding cross sections)
- Length: 16.00m
- Manning's: 0.012 (representative of concrete, cement - finished).

Structure 8 (SHI_023_R – Ø590mm Concrete Culvert)

- Modelled as a 'C' (Circular culvert with overtopping modelled in the 2D domain)
- Losses: default as per the TUFLOW manual
- Opening Dimensions: 0.59m
- u/s invert: 38.59mAOD (informed from bounding cross sections)
- d/s invert: 38.70mAOD (informed from bounding cross sections)
- Length: 12.40m
- Manning's: 0.012 (representative of concrete, cement - finished)

Structure 9 (SHI_022 – Ø225mm Concrete Culvert)
• Modelled as a 'C' (Circular culvert with overtopping modelled in the 2D domain) • Losses: default as per the TUFLOW manual • Opening Dimensions: 0.225m • u/s invert: 39.39mAOD (informed from bounding cross sections) • d/s invert: 39.16mAOD (informed from bounding cross sections) • Length: 19.00m • Manning's: 0.012 (representative of concrete, cement - finished).
Structure 010 (SHI_024 – Ø910mm Concrete Culvert)
 *Looking downstream to the upstream face of Structure 10* • Modelled as a 'C' (Circular culvert with overtopping modelled in the 2D domain) • Losses: default as per the TUFLOW manual • Opening Dimensions: 0.91m • u/s invert: 38.33mAOD (informed from bounding cross sections) • d/s invert: 38.33mAOD (informed from bounding cross sections) • Length: 4.30m • Manning's: 0.013 (representative of concrete).

Structure 11 – (SHI_061 – Ø900mm Concrete Culvert)

Looking downstream to the upstream face of Structure 11

- Modelled as a ‘C’ (Circular culvert with overtopping modelled in the 2D domain)
- Losses: default as per the TUFLOW manual
- Opening Dimensions: 0.90m
- u/s invert: 38.26mAOD (informed from bounding cross sections)
- d/s invert: 38.26mAOD (informed from bounding cross sections)
- Length: 4.00m
- Manning’s: 0.013 (representative of concrete).

Structure 12 – (SHI_016 – Ø450mm Concrete Culvert)

Looking downstream to the upstream face of Structure 12

- Modelled as a ‘C’ (Circular culvert with overtopping modelled in the 2D domain)

- Losses: default as per the TUFLOW manual
- Opening Dimensions: 0.45m
- u/s invert: 44.80mAOD (informed from bounding cross sections)
- d/s invert: 43.25mAOD (informed from bounding cross sections)
- Length: 33.00m
- Manning's: 0.012 (representative of concrete, cement - finished).

Structure 13 – (SHI_029 – Wooden Bridge with Steel Based Construction)

Looking downstream to the upstream face of Structure 13

- Modelled as a 'BW' (Bridge with 1D overtopping weir)
- Inlet/exit losses: SHI_029_LC (informs loss co-efficient)
- Opening Dimensions: bg layer – SHI_029_XZ (informed from SH12_0450)
- u/s invert: 41.31mAOD
- d/s invert: 41.31mAOD
- Length: 3.54m
- Manning's: 0.012 (representative of steel base construction)

Structure 14 – (SHI_027 – Irregular Brick Culvert)

Looking downstream to the upstream face of Structure 14

- Modelled as an ‘I’ (Irregular culvert with 2D overtopping weir)
- Losses: default as per the TUFLOW manual
- Opening Dimensions: CS layer – SHI_027_HW (informed from SHI_027)
- u/s invert: 39.60mAOD (informed from bounding cross sections)
- d/s invert: 39.60mAOD (informed from bounding cross sections)
- Length: 3.80m
- Manning’s: 0.018 (representative of brick and cement).

Structure 15 – (SHI_028 – Ø600mm Concrete Culvert)

Looking downstream to the upstream face of Structure 15

- Modelled as a ‘C’ (Circular culvert with overtopping modelled in the 2D domain)

- Losses: default as per the TUFLOW manual
- Opening Dimensions: 0.60m
- u/s invert: 38.81mAOD (informed from bounding cross sections)
- d/s invert: 38.81mAOD (informed from bounding cross sections)
- Length: 7.60m
- Manning's: 0.013 (representative of concrete).

Structure 16 – (SHI_025 – Ø600mm Concrete Culvert)

Looking downstream to the upstream face of Structure 16

- Modelled as a 'CW' (Circular culvert with 1D overtopping weir)
- Losses: default as per the TUFLOW manual
- Opening Dimensions: 0.60m
- u/s invert: 38.52mAOD (informed from bounding cross sections)
- d/s invert: 38.52mAOD (informed from bounding cross sections)
- Length: 4.70m
- Manning's: 0.013 (representative of concrete).

Structure 17 – (SHI_033 – Ø720mm Concrete Culvert)

- Modelled as a 'CW' (Circular culvert with 1D overtopping weir)
- Losses: default as per the TUFLOW manual
- Opening Dimensions: 0.48m
- u/s invert: 40.19mAOD (informed from bounding cross sections)
- d/s invert: 40.19mAOD (informed from bounding cross sections)
- Length: 7.20m
- Manning's: 0.013 (representative of concrete).

Structure 18 – (SHI_034 – Wooden Bridge with Steel Based Construction)

Looking downstream to the upstream face of Structure 18

- Modelled as a 'B' (Bridge with 2D overtopping weir)
- Inlet/exit losses: SHI_034_LC (informs loss co-efficient)
- Opening Dimensions: bg layer – SHI_034_XZ (informed from SH08_0235)
- u/s invert: 40.70mAOD
- d/s invert: 40.70mAOD
- Length: 2.72m
- Manning's: 0.012 (representative of steel base construction)

Structure 19 – (SHI_026 – Ø228mm Concrete Culvert)

Looking downstream to the upstream face of Structure 19

- Modelled as a 'C' (Circular culvert with overtopping modelled in the 2D domain)

- Losses: default as per the TUFLOW manual
- Opening Dimensions: 0.228m
- u/s invert: 39.6mAOD (informed from bounding cross sections)
- d/s invert: 39.6mAOD (informed from bounding cross sections)
- Length: 44.00m
- Manning's: 0.013 (representative of concrete, cement - finished).

Structure 20 – (SHI_063_a – Ø228mm Concrete Culvert)

Looking downstream to the upstream face of Structure 20

- Modelled as a 'C' (Circular culvert with overtopping modelled in the 2D domain)
- Losses: default as per the TUFLOW manual
- Opening Dimensions: 0.88m
- u/s invert: 38.19mAOD (informed from bounding cross sections)
- d/s invert: 38.19mAOD (informed from bounding cross sections)
- Length: 4.57m
- Manning's: 0.013 (representative of concrete, cement - finished).

Structure 21 – (SHI_032 – Ø450mm Brick Culvert)

Looking downstream to the upstream face of Structure 21

- Modelled as a 'C' (Circular culvert with overtopping modelled in the 2D domain)
- Losses: default as per the TUFLOW manual
- Opening Dimensions: 0.45m
- u/s invert: 39.90mAOD (informed from bounding cross sections)
- d/s invert: 39.90mAOD (informed from bounding cross sections)
- Length: 3.56m
- Manning's: 0.015 (representative of brick).

Structure 22 – (SHI_031 – Wooden Bridge with Steel Based Construction)

Looking downstream to the upstream face of Structure 22

- Modelled as a 'B' (Bridge with 2D overtopping weir)

- Inlet/exit losses: SHI_031_LC (informs loss co-efficient)
- Opening Dimensions: bg layer – SHI_031_XZ (informed from SH04_0488)
- u/s invert: 39.81mAOD
- d/s invert: 39.81mAOD
- Length: 4.00m
- Manning's: 0.012 (representative of steel base construction)

Structure 23 – (SHI_021 – Ø900mm Concrete Culvert)

Looking downstream to the upstream face of Structure 23

- Modelled as a 'C' (Circular culvert with overtopping modelled in the 2D domain)
- Losses: default as per the TUFLOW manual
- Opening Dimensions: 0.90m
- u/s invert: 39.23mAOD (informed from bounding cross sections)
- d/s invert: 39.92mAOD (informed from bounding cross sections)
- Length: 16.37m
- Manning's: 0.013 (representative of concrete).

Structure 24 – (SHI_001_a – Ø900mm Concrete Culvert)

Looking downstream to the upstream face of Structure 24

- Modelled as an 'C' (Circular culvert with overtopping modelled in the 2D domain)
- Losses: default as per the TUFLOW manual
- Opening Dimensions: 0.90m
- u/s invert: 55.27mAOD (informed from bounding cross sections)
- d/s invert: 49.29mAOD (informed from bounding cross sections)
- Length: 106.00m
- Manning's: 0.012 (representative of concrete, cement - finished).

2.5 Inflow Boundaries

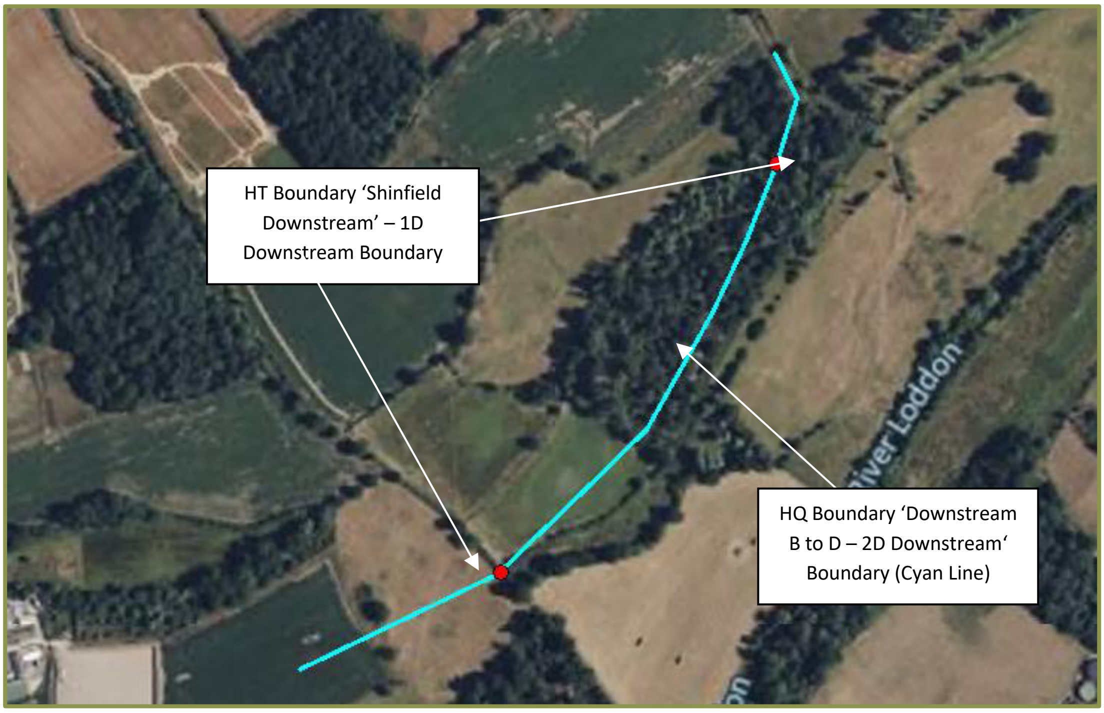
2.5.1 A hydrological assessment was undertaken to derive peak flow inputs and hydrographs for multiple flow calculation locations on the network of watercourses (Figures 2.3 and 2.4).

2.5.2 Hydrological peak flows have been input into the model at three locations at the upstream extent of the 1D model domain using layer '1d_bc_SHI_BNDY_001' (Catchment 1, Catchment 2 and Catchment 4). Flows have been input as 'QT' boundaries (Flow Time). Peak flows have also been put into the model at two locations along the watercourse network in the upstream extent of the model in the 2D model domain using layer '2d_bc_SHI_BNDY_001' (Catchment 3). Flows have been input as 'QT' boundaries (Flow Time).

Figure 2.3: Peak Flow Calculation and Input Locations (Inflows)

Red hatched denote catchment boundaries.

Figure 2.4: Peak Flow Calculation and Input Locations (Downstream Boundary)



2.5.3 A climate change allowance of 14%, 23% and 46% has been added to the 1 in 100-year flow estimate representing the 'Central', 'Higher' and 'Upper' estimates for the Total Potential Change for the 2080s (2070 to 2115) for the Loddon and tributaries Management Catchment.

2.5.4 A summary of the peak flows for all return periods are included in Table 2.2. The model has been run for the central, higher central and upper end allowance, as this will be used to guide any type of future development. This is to ensure that any proposed development is located outside the mapped extent of flooding and to ensure it is safe for its lifetime.

Table 2.2: Peak Flows Used in the Modelling Study

Return Period	Catchment 1 Peak Flows (m^3/s)	Catchment 2 Peak Flows (m^3/s)	Catchment 3 Peak Flows (m^3/s)	Catchment 4 Peak Flows (m^3/s)
30-Year	0.93	0.58	0.30	0.11
100-Year	1.21	0.76	0.39	0.14
1000-Year	1.97	1.24	0.64	0.24
*100-Year +14%CC	1.38	0.86	0.45	0.17
*100-Year +23%CC	1.49	0.93	0.49	0.18
*100-Year +46%CC	1.77	1.11	0.58	0.21

*Climate change Peak flow allowance for Loddon and tributaries Management Catchment: Central, Higher and Upper (2070 - 2115).

2.6 Downstream Boundary

2.6.1 The downstream 1D boundary has been input via layer '1d_bc_SHI_BNDY_001', as a 'HT' (Level Time) boundary.

2.6.2 The downstream boundaries at the two 1D boundary input locations have been run with a 1D downstream water level of 39.09mAOD and 39.62mAOD ('HT' boundary), which is representative of the River Loddon at the model downstream extent. The modelled elevations are representative of bank full level, as taken from the detailed survey. The modelling of equal return period in the ordinary watercourse network and River Loddon was considered unrealistic due to catchment size. It is highly unlikely that both the ordinary watercourse network, and River Loddon would experience extreme return period events simultaneously. As the focus of this study are flood extents associated with the ordinary watercourse network, the River Loddon downstream boundary represents a significant, but not extreme, flood level compared to ordinary watercourse peak flows presented in Table 2.4.

2.6.3 An additional 2D boundary has been applied through layer '2d_bc_SHI_BNDY_003' to allow overland flow to freely exit the 2D model domain without glass walling. 2D boundaries have been applied at the following locations:

- **Location**: (NGR) 474735, 168709 to 474944, 168812: **Name**: Downstream B **Type**: HQ **'b' Attribute/slope factor**: 0.005
- **Location**: (NGR) 474950, 168819 to 475231, 169246: **Name**: Downstream C **Type**: HQ **'b' Attribute/slope factor**: 0.005
- **Location**: (NGR) 475233,169255 to 475299, 169366: **Name**: Downstream D **Type**: HQ **'b' Attribute/slope factor**: 0.005