


Left: *Looking upstream from OLDH_1721 (Manning's of 0.040 left bank, 0.070 right bank and channel 0.035)*

Right: *Looking downstream from OLDH_1427 (Manning's of 0.070 banks and 0.060 channel)*

M4-Pearman's Lane East Drain Manning's Roughness


Left: *Looking upstream from SH14_0146 (Manning's of 0.040 left bank, 0.100 right bank and 0.050 channel)*

Right: *Looking upstream from SH14_0030 (Manning's 0.040 banks and 0.100 channel)*

Cutbush Lane East Manning's Roughness


Left: *Looking downstream from SH15_0166 (Manning's of 0.020 banks and channel)*

Right: *Looking upstream from SH15_0095 (Manning's 0.020 banks and channel)*

St. John's Copse Drain Manning's Roughness
 
Left: *Looking downstream from SH12_0781 (Manning's of 0.060 banks and 0.060 channel)*
Right: *Looking upstream from SH12_0567 (Manning's 0.070 banks and 0.070 channel)*
 
Left: *Looking upstream from SH12_0273 (Manning's of 0.040 banks and 0.050 channel)*
Right: *Looking upstream from SH12_0170 (Manning's 0.060 banks and 0.050 channel)*
Upperwood Farm Track Manning's Roughness

Looking upstream from SH11_0081 (Manning's of 0.070 left bank, 0.040 right bank and 0.050 channel)

New Covert West Drain Manning's Roughness

Left: *Looking downstream from SH08_0235 (Manning's of 0.050 banks and 0.045 channel)*

Right: *Looking upstream from SH08_0129 (Manning's 0.070 banks and 0.050 channel)*

New Cover to Rushy Mead Drain Manning's Roughness

Left: *Looking upstream from SH04_0376 (Manning's of 0.040 banks and channel)*

Right: *Looking upstream from SH04_0200 (Manning's 0.040 banks and 0.050 channel)*

Rushy Mead West Manning's Roughness

Looking upstream from SH01_0141 (Manning's of 0.040 banks and channel)

Rushy Mead North Manning's Roughness
 
Left: *Looking upstream from SH02_0417 (Manning's of 0.060 banks and 0.040 channel)*
Right: *Looking downstream from SH02_0228 (Manning's 0.060 banks and channel)*

2.7.4 The majority of the watercourse network comprises vegetated banks, with varying density, and natural bed. The watercourse channel (bed) generally comprises a natural bed with a roughness of between 0.035 and 0.060 which is representative of a '*natural stream which is clean, winding, some pools'* to *'Natural stream - sluggish reaches, weedy, deep pools'*.

2.7.5 The manning's 'n' roughness coefficient value for the left and right banks in the 1D domain ranged between 0.04 (Vegetated bank, materials based on grass and light brush) and 0.07 (Thickly vegetated banks consisting of trees and heavy scrub).

2.7.6 Scrutiny of the model extent using OS mapping, aerial photographs and walkover photographs showed that significant areas were grassed. As such, a base value of 0.045 representing 'General Surface Natural' was utilised within the model. Further layers representing roughness for various land uses have been added, namely:

- 2d_MAT_SHI_Roads_Tracks_Hardstanding_001 (Manning's value of 0.025)
- 2d_MAT_SHI_Gardens_001 (Manning's value of 0.05)
- 2d_MAT_SHI_ Trees_and_Shrubs_001 (Manning's value of 0.10)
- 2d_MAT_SHI_General_Surface_Manmade_001 (Manning's value of 0.04)

2.8 Flow Constrictions

2.8.1 Buildings have been represented in layer '2d_fcsh_SHI_Buildings_001' as flow constrictions, with a 90% constriction value. Use of a 90% constriction is considered a default value, representative of typical buildings. Building representation as 'flow constrictions' is considered to better replicate overland flow paths in and around built-up areas when compared to using increased Manning's 'n' roughness values[1].

2.9 Topographic Changes

2.9.1 Layer '2d_ztin_SHI_Site_001' has been used to define the topography of the Site, with this being represented in the 2D domain. This layer applies levels from the topographical survey to reinstate levels that may have been 'filtered' from the DTM LiDAR.

[1] Flooding in Urban Areas – 2D Modelling Approaches for Buildings and Fences, W J Syme

2.9.2 Layer '2d_zsh_SHI_Deck_001' has been used to define road level and structure decks where structures have been represented in the 2D domain. This layer applies levels from the topographical and channel survey to reinstate structure decks that have been 'filtered' from the DTM LiDAR.

2.9.3 Layer '2d_zsh_Stability_Site_001' has been used to provide a 'patch' in the DTM LiDAR to improve the stability of the model. This layer applies a stated ground level to an area in the upper extent of the model, near the flow inputs in order to improve the stability of the model.

2.9.4 Layer '2d_za_BM building_001' has been used to define the finished floor levels of an existing building located inside the model domain. A 'fixed' finished floor level has been applied to the building which will be read into the model to define the floor level.

2.9.5 Layer '2d_bc_hx_SHI_001' has been used to define the bank top of each cross section in the model in the 2D domain. This layer applies a stated ground level to the bank top of each cross section to ensure the levels on the cross sections and the DTM LiDAR correspond accordingly.

2.10 Model layers

1D Model Layers

- 1d_xs_SHI_001; defines cross-section locations (Baseline)
- 1d_cs_SHI_001; defines irregular culvert openings (Baseline)
- 1d_bg_SHI_001: defines bridge structure openings and associated loss coefficients (Baseline)
- 1d_nwke_SHI_001; defines in-channel network (Baseline)
- 1d_nwke_SHI_003_N-20; defines in-channel Manning's roughness decrease of 20%
- 1d_nwke_SHI_003_N+20; defines in-channel Manning's roughness increase of 20%
- 1d_bc_SHI_BNDY_001; defines fluvial inflows and HT downstream boundary (Baseline)
- 1d_bc_SHI_BNDY_004a; defines fluvial inflows and +0.50m HT downstream boundary
- 1d_bc_SHI_BNDY_004b; defines fluvial inflows and -0.50m HT downstream boundary
- 1d_WLL_SHI_001; defines in-channel water level lines (Baseline)

2D Model Layers

- 2d_bc_hx_SHI_001; defines 1D2D linking cells (Baseline)
- 2d_code_SHI_001; defines model extent (Baseline)
- 2d_bc_SHI_BNDY_001; defines 2D flow inputs and floodplain boundaries to prevent glass walling (Baseline)
- 2d_code_1d_SHI_001; defines 1d channel domain (Baseline)
- 2d_po_SHI_001; defines a line used as an aid to inform flows across the 2D domain in the model (Baseline)

2D Topographical Layers

- 2d_zsh_SHI_Deck_001; defines road levels and structure decks (Baseline)
- 2d_zsh_001_Stability_001; defines topographical levels used to stabilise the model (Baseline)

- 2d_za_BM building_001; defines the finished floor levels of the existing warehouse storage building in the model domain
- 2d_ztin_SHI_Site_001; defines the site-specific topography in an area of the model
- 2d_fcsh_SHI_Buildings_001; defines buildings through flow constriction layer. A 90% constriction has been applied
- 2d_MAT_SHI_Roads_Tracks_Hardstanding 001; defines 2D roughness for roads, tracks and car parks
- 2d_MAT_SHI_Trees_and_Shrubs_001; defines 2D roughness for wooded areas
- 2d_MAT_SHI_Gardens_001; defines 2D roughness for gardens
- 2d_MAT_SHI_General_Surface_Manmade_001; defines 2D roughness for general manmade surfaces

2.11.1 It should be noted that changes to Mannings 'n' values the 2d materials layers to account for a 20% increase and decrease has been done through the amendment of values in 'SHI_003_plus20.tmf' and 'SHI_003_minus20.tmf'.

2.11.2 Additionally, to account for changes in the downstream boundary and model inflows (to account for sewer capacity) new BC Databases have been created. These are 'bc_dbase_plus20', 'bc_dbase_minus20' and 'bc_dbase_Sewer'.

2.11 Model Runs

2.11.3 The 1D2D linked ESTRY-TUFLOW hydraulic model was run for a range of return periods, using peak flows as detailed within this report.

2.11.4 A 1D timestep of 0.25 seconds, a 2D timestep of 0.5 second and 2D grid size of 1m were chosen. These parameters are in-line with industry standard guidance for grid sizes and timesteps where the 2D timestep should be ½ to ¼ of the grid size and the 1D timestep should be ½ to ¼ of the 2D timestep. A simulation time of 10-hours was also selected to allow the flood peak to pass through the model and ensure the maximum extent of flooding was captured.

2.11.5 The model was run for the following return periods; 30-year, 100-year and 1000-year.

2.11.6 The model also was run with a 14%, 23% and 46% allowance for climate change for the 1 in 100-year event, representative of the Central, Higher and Upper estimates for the Loddon and tributaries Management Catchment (2070 - 2115).

2.11.7 Sensitivity analysis was carried out using the 1 in 100-year event, which includes +/-20% Manning's 'n' (to allow for seasonal changes in vegetation), increases and decreases to the downstream boundary by +/- 0.5m and the grid size resolution was increased to 2m.

2.11.8 An additional suite of model runs was undertaken to establish the sensitivity of when the sewer network is accounted for in the hydrological derivation process.

2.11.9 Table 2.4 and the modelling log (Appendix 2) provide a summary of all model runs undertaken.

Table 2.4: Run Identifiers and Description (Baseline)

Model Run ID	Scenario Description
~e~_001	Existing free-flowing structures (Baseline)
~e~_002	Grid Size Test (2m Grid)
~e~_003a	20% Manning's Increase
~e~_003b	20% Manning's Decrease
~e~_004a	+0.5m Downstream Boundary Increase
~e~_004b	-0.5m Downstream Boundary Decrease
~e~_005a	+20% Inflows
~e~_005b	-20% Inflows
~e~_006	Model inflows accounting for sewer capacity

3.0 Analysis of Results

3.1 Summary of Model Outputs

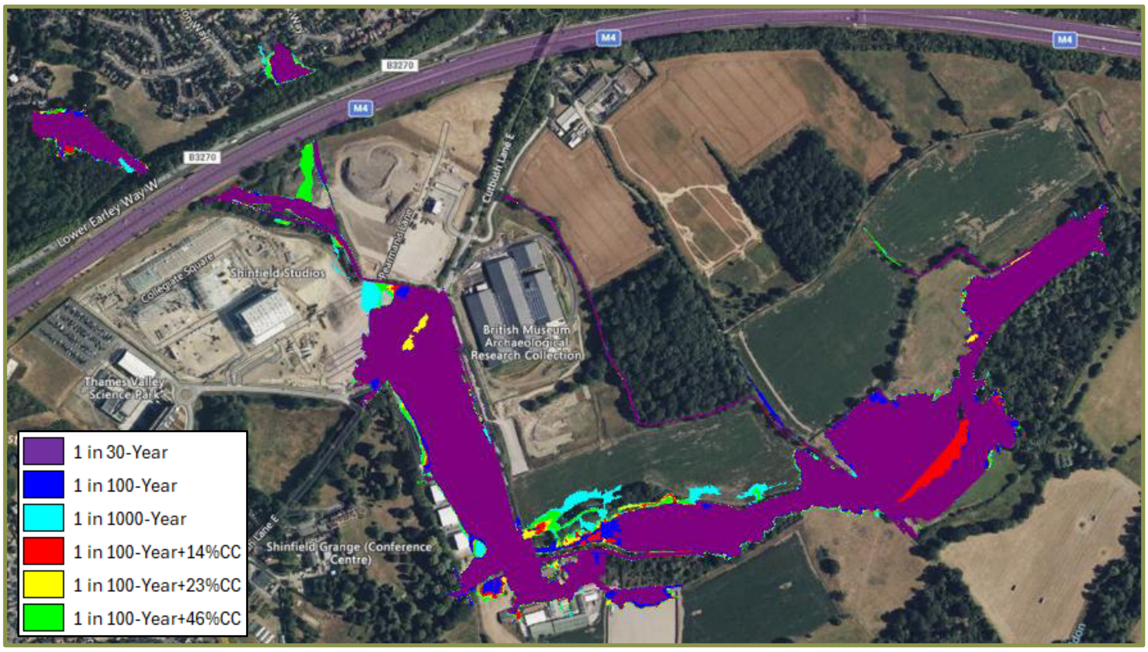
Baseline Scenario (001)

3.1.1 Figure 3.1 shows the maximum flood extents for the whole model domain and site respectively. The baseline flood extents are also provided as Drawing 002.

3.1.2 The model results show significant out of bank flooding occurs during all modelled return periods, in particular to the south of Cutbush Lane East Drain. Out of bank flooding primarily occurs as a southerly flow pathway; to the west of Oldhouse Farm Main Watercourse (hereafter 'Pathway 2). Floodwater is also shown to the north of Cutbush Lane East Drain, due to ponding to the north of the elevated Cutbush Lane and conveyance exceedance of for Structures 4 and 5. Once ponding elevations exceed Cutbush Lane elevations, Pathway 2 conveys south towards Old House Farm before re-entering Oldhouse Farm Main Watercourse and its associated floodplain.

3.1.3 Floodwater is shown to spill from the Old House Farm Main Watercourse immediately to the south of the M4, where significant flows conveyed by Structures 1 and 2 are constrained by the much smaller Structure 3. Floodwater spills over the left-hand bank of the Oldhouse Farm Main Watercourse and conveys overland towards the south east where it re-enters the channel in the vicinity of the confluence with the M4-Pearmans Lane East Drain.

Figure 3.1: Baseline Flood Outlines



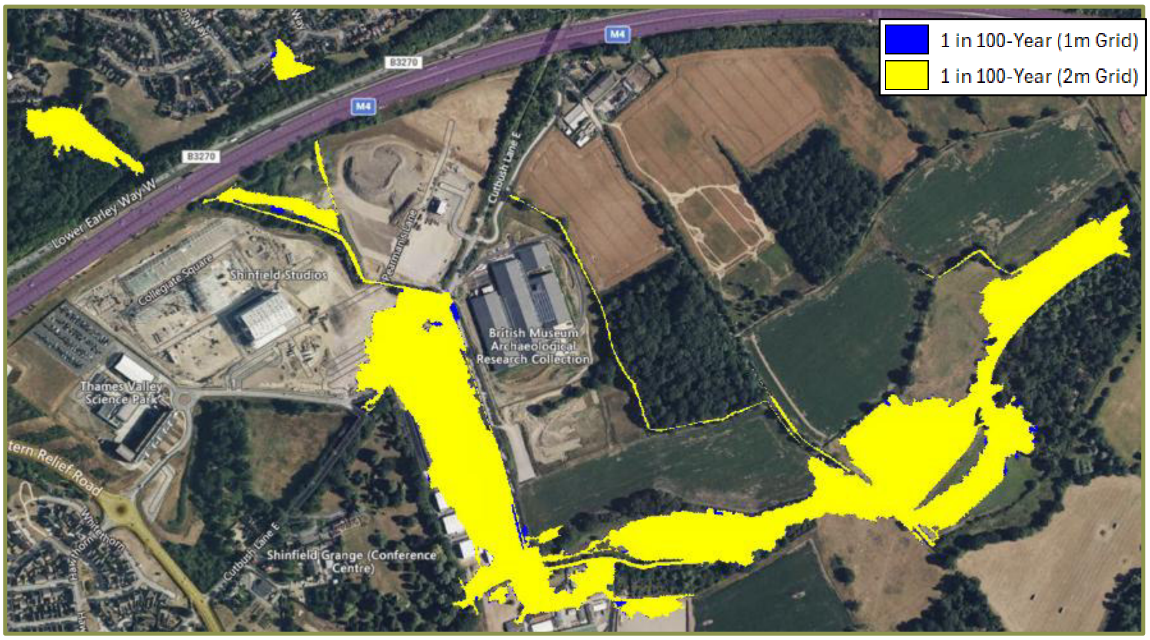
Grid Resolution (002)

3.1.9 Figure 3.2 and Appendix 4, provide a summary of the maximum flood levels and extents when the model is run on a larger 2m grid size to determine if the baseline model result is sensitive to 2D grid resolution. A 2m grid provides a coarser ground surface which could alter the representation of overland flow pathways.

3.1.10 When the grid size is increased to a 2m grid, very little difference is seen when compared to the baseline (Run 001) extents. A small reduction in flood extent is seen to the west of the British Museum Research Collection building. However, changes are negligible and more importantly do not create or remove overland flow pathways.

3.1.11 Based on a comparison of the flood outlines for a 2m and 1m grid, the model is considered insensitive to gid resolution.

Figure 3.2: Flood Outlines – 2m Grid

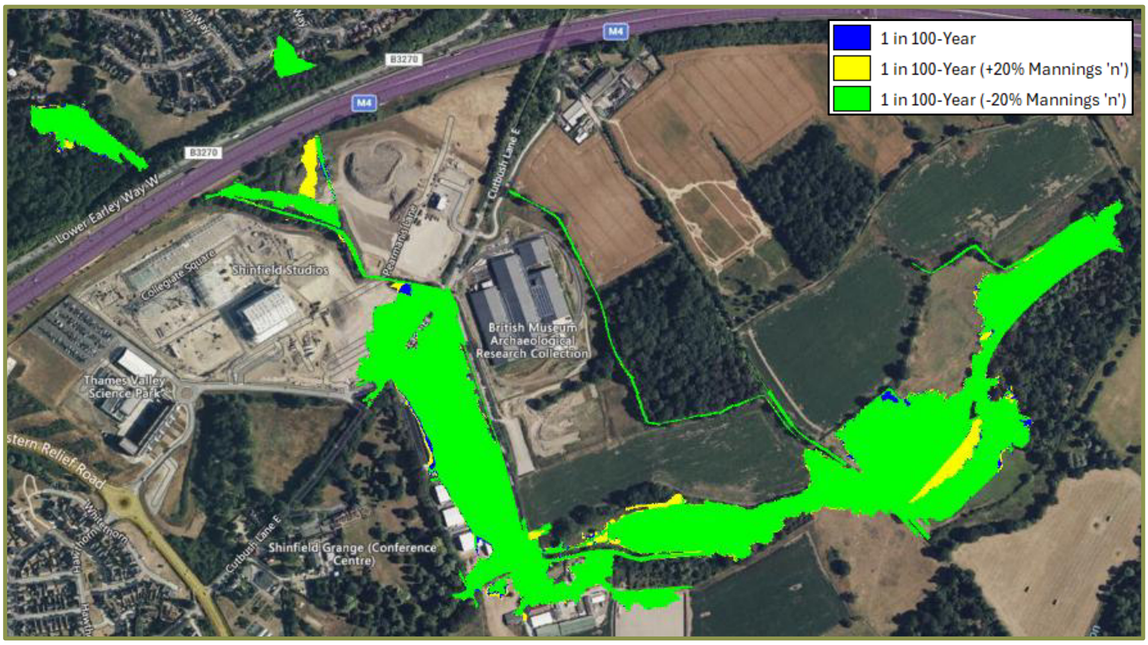


Manning's 'n' Sensitivity (003a and 003b)

3.1.16 When Manning's 'n' roughness values are increased by 20%, in-channel water levels within the model exhibit an average increase of 0.03m, with a maximum increase of 0.21m at node SHI_063.1 (Figure 3.3 and Appendix 4). In-channel water level increase results in increased flow pathway extents, with an additional flow pathway produced to the south of the M4. As such, the model behaves as expected with minor increases to in-channel flood level and pathway extent, however, model results are largely insensitive to Manning's roughness increase.

3.1.17 When Manning's 'n' roughness values are decreased by 20%, in-channel water levels within the model exhibit an average increase of 0.01m, with a maximum decrease of 0.10m at node SHI_061.2 (Figure 3.3 and Appendix 4). In-channel water level decrease results in reduced flow pathway extents. The reductions do not result in new or removal of flow pathways. As such, the model behaves as expected with minor decreases to in-channel flood level and pathway extent, however, model results are largely insensitive to Manning's roughness increase.

Figure 3.3: Modelled Flood Extents +/-20% Manning's 'n'



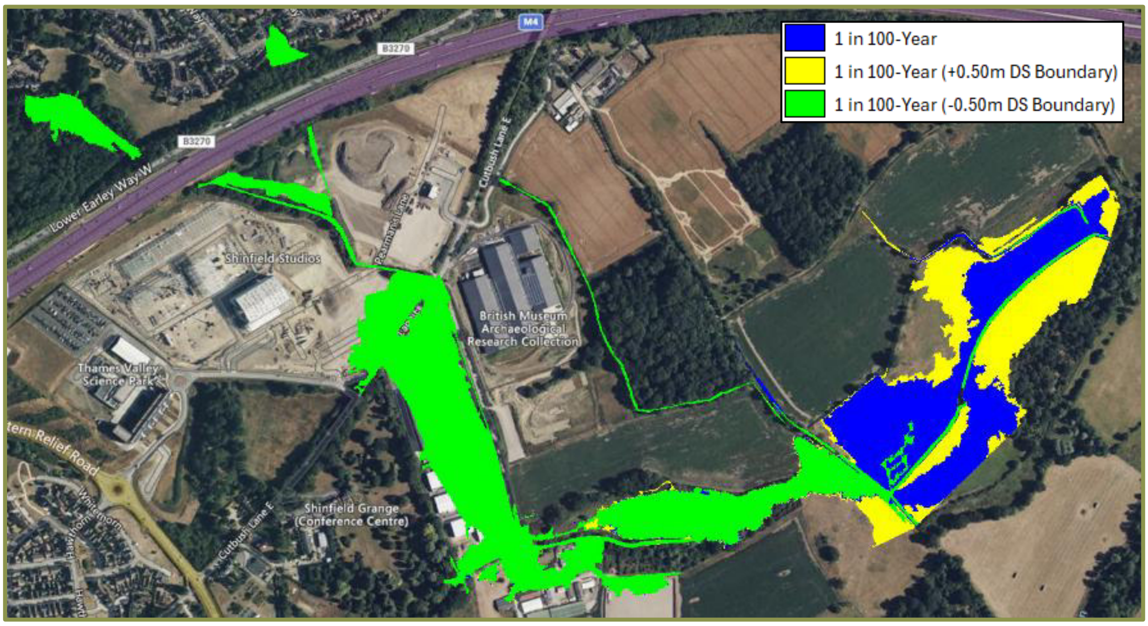
Downstream Boundary Sensitivity (004a and 004b)

3.1.12 This section provides a summary of the 1 in 100-year event modelled water levels within the modelled extent when the downstream modelled water level is increased and decreased by +/-0.5m to represent changes in the River Loddon water level (Figure 3.4).

3.1.13 When the downstream water level is increased by +0.5m to 39.59mAOD and 40.42mAOD, there are minimal changes in the upstream extent of the model (Figure 3.4 and Appendix 4). The lower model extent is shown to be sensitive to changes to the downstream boundary with an increase in flood extent to the south-west of St Johns Copse. This is as expected as the lower model extent represents the River Loddon Floodplain. The model shows negligible sensitivity to downstream boundary increase in the upper and middle model extent and in the vicinity of the site.

3.1.14 When the downstream water level is decreased by -0.5m to 38.59mAOD and 39.12mAOD, as per an increase in downstream water levels, there are minimal changes to the flood outline in the upper and middle extent of the model. There is a significant change in the flood extent in the lower extent of the model, associated with the River Loddon floodplain, with flows being mostly confined to the watercourses of Rushy Mead North and Rushy Mead West. The model shows negligible sensitivity to downstream boundary decrease in the upper and middle model extent and in the vicinity of the site.

Figure 3.4: Downstream Boundary Sensitivity



3.1.15 The above assessment has demonstrated that flood extents are sensitive to change in the downstream boundary level as expected. The downstream extent of the model, representative of the River Loddon floodplain, is where change in flood extent occurs.

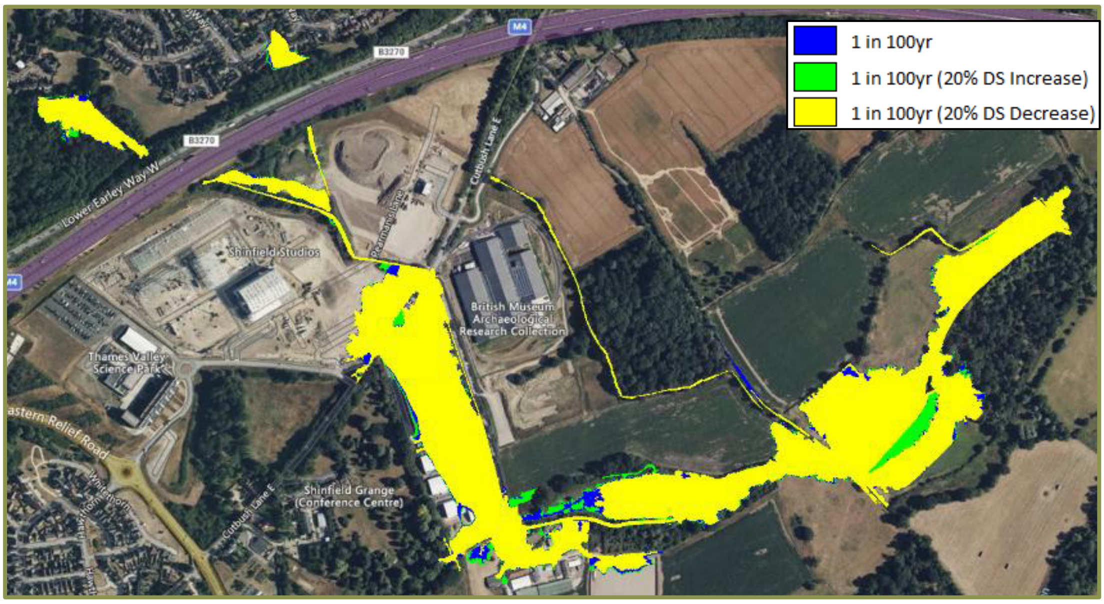
Inflow Sensitivity (005a and 005b)

3.1.16 This section provides a summary of the 1 in 100-year event modelled water levels within the modelled extent when the model inflows are increased and decreased by +/-20% (Figure 3.5).

3.1.17 When the inflow is increased by +20%, there are minimal changes within the model domain. In the southern extent of the model domain there are no new flow pathways though one is increased in extent when compared to the baseline scenario (Figure 3.5 and Appendix 4).

3.1.18 When the inflow is decreased by +20%, there are minimal changes within the model domain. In the southern extent of the model domain there are no new flow pathways through there is the removal of one from the north of the watercourse network when compared to the baseline scenario (Figure 3.5 and Appendix 4).

Figure 3.5: Downstream Boundary Sensitivity



3.1.19 The above assessment has demonstrated that flood extents within the Site are not sensitive to inflow changes.

Model Inflows Accounting for Sewer Capacity (006)

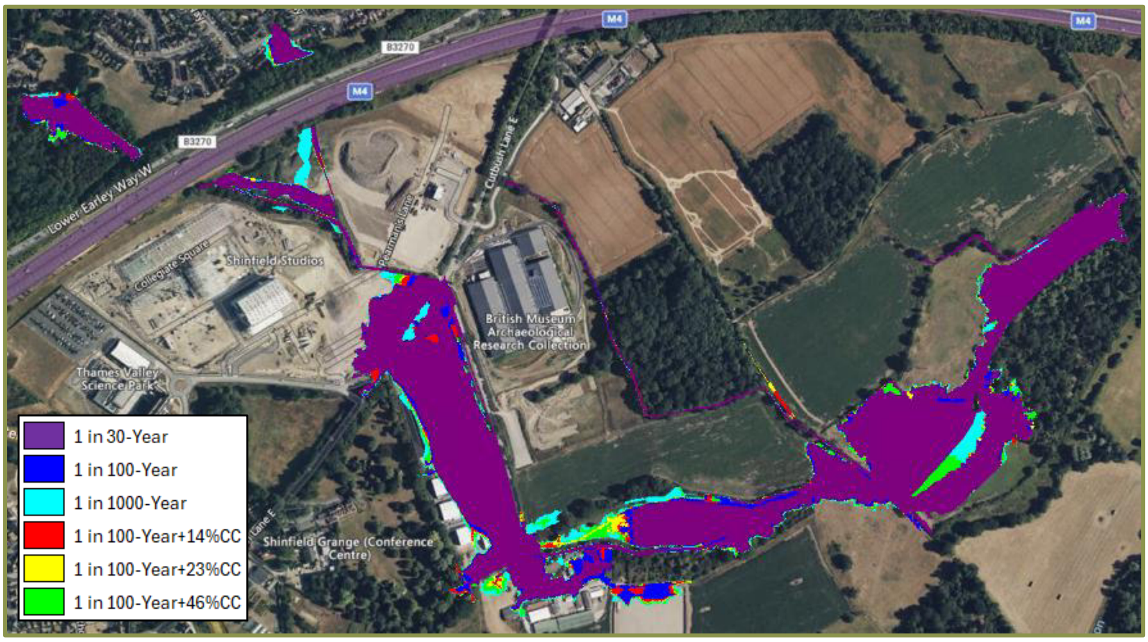
3.1.20 This section provides a summary of the model outputs for when the existing Thames Water sewer network in the northern extent of the catchment has been accounted for and removed from the ReFH2 flow calculations for the model.

3.1.21 The area served by the Thames Water sewer network (asset plans shown in Appendix 5) has an 'Exporting drained area' of $0.48km^2$ and a 'Sewer capacity' of $0.55m^3/s$. The sewer capacity is based on the main trunk main for the sewer being Ø750mm, having a minimum gradient of 1:500 (which is the minimum gradient that groundworkers can physically achieve with that size pipe) and a minimum flow rate of 1m/s (minimum flow rate as detailed for a surface water sewer in the most recent issue of Design and Construction Guidance[2]).

3.1.22 Figure 3.6 and Appendix 4 shows that there is a small reduction in flood extents when compared to the baseline model run, which is to be expected when flows are removed from the inflow locations. The main areas of change of some areas previously associated with the 100-year+23%CC and 100-year+46%CC allowances now flood during the 1000-year return period instead. There is also a partial removal of a small flow pathway located within the southern extent of the model domain.

[2] https://www.water.org.uk/sites/default/files/wp/2021/07/SSG-App-C-Des-Con-Guide.pdf

Figure 3.6: Model Inflows Accounting for Sewer Capacity Sensitivity



Sensitivity Analysis Summary

3.1.19 The model extents display limited sensitivity to grid resolution, inflow changes and manning's roughness changes. Changes are as expected and result in minor changes to flood extents with no significant changes to flow pathways i.e., the creation of new or removal of baseline pathways.

3.1.20 The lower extent of the model shows sensitivity to downstream boundary changes. This is as expected as the lower model extent lies within the River Loddon Floodplain.

3.1.21 The choosing of hydraulic parameters can often be subjective and parameters such as Manning's roughness can undergo seasonal change through vegetation growth. The sensitivity analysis increases confidence in the modelled results through identifying those changes in subjective parameters are limited.

Message Layers

3.1.4 No negative depth warnings are present during the entirety of all model runs. The model is considered to be healthy and stable.

3.1.5 An assessment of the warning and check messages is included below:

- Check 1152: this refers to the use of the CS layers to culvert openings. All messages have been checked and are as expected.
- Check 1284: this relates to a 1D H boundary connecting to a 2D HX link. All messages have been checked and it has been determined that the model will not be impacted.
- Check 2099: this relates to the repetition of a boundary which has been applied to a 2D cell. All messages have been checked and it has been determined that the model will not be impacted.
- Check and Warning 2118: this relates to elevation of a 1D node being lowered, due to the usage of 'Z' flag. All messages have been checked and are as expected.

- Warning 1100: this message relates to the crest/invert of a structure being below the bed of the upstream and downstream bed of the channel. The messages have been checked against the 'nwke' layer and detailed survey and are as intended.
- Warning 1253: this relates to an unused 1D-ta line with associated attributes. Warning location was checked and determined to be in a location that does not convey and does not impact on model results.
- Warning 1317: this relates to a WLL line that does not cross or snap to a 1D channel. WLL lines help to visually represent water in the 1D domain. The warning has been checked and has been determined to not affect the overall model performance.
- Warning 2073: this message relates to an 'ignored object'. However, the message is located outside of the model domain and despite attempts, the source of the warning could not be identified. It is not considered that Warning 2073 will impact upon model results.

3.2 Mass Balance Error

3.2.1 The TUFLOW User Manual states that a healthy model should display less than a ±1% error or 2 or 3% depending on the objectives of the modelling. During model reviews, the Environment Agency adopts a ±1% threshold for acceptability.

3.2.2 On all runs, cumulative and 1D mass error is above +/-1% between time 0 and 1 min. This is associated with initial model wetting and will not impact upon results. 2D error peaks at the start of the model runs during all runs, but this again is associated with initial model wetting at the downstream boundary. Mass balance error is within the acceptable threshold for all model runs (Table 3.1).

Table 3.1: Mass Balance Error

Model Run	Maximum Cumulative Error (%)	Maximum 1D Error (%)	Maximum 2D Error (%)
30-Year	Between +1.0% and -1.0% from 1 hour 5 minutes	Between +1.0% and -1.0% from 1 hour 5 minutes	Between +1.0% and -1.0% from 1 hour 5 minutes
100-Year	Between +1.0% and -1.0% from 1 hour 6 minutes	Between +1.0% and -1.0% from 1 hour 6 minutes	Between +1.0% and -1.0% from 1 hour 6 minutes
1000-Year	Between +1.0% and -1.0% from 1 hour 6 minutes	Between +1.0% and -1.0% from 1 hour 6 minutes	Between +1.0% and -1.0% from 1 hour 6 minutes
100-Year+14%CC	Between +1.0% and -1.0% from 1 hour 7 minutes	Between +1.0% and -1.0% from 1 hour 7 minutes	Between +1.0% and -1.0% from 1 hour 7 minutes
100-Year+23%CC	Between +1.0% and -1.0% from 1 hour 8 minutes	Between +1.0% and -1.0% from 1 hour 8 minutes	Between +1.0% and -1.0% from 1 hour 8 minutes
100-Year+46%CC	Between +1.0% and -1.0% from 1 hour 7 minutes	Between +1.0% and -1.0% from 1 hour 7 minutes	Between +1.0% and -1.0% from 1 hour 7 minutes

3.2.3 The TSMB1D2D results file, which represents error within linking cells, can be used to spatially locate cumulative mass error in situations where areas of instability are not evident.

TSMB1D2D files were checked for all model runs. No error was shown within the files for all model runs.

3.2.4 The model is stable, with no fluctuation in 'Qi', 'Qo' or 'Dvol', which represents the variation between inflow and outflow volumes.

3.2.5 It is considered that the constructed model is healthy and representative.

4.0 Baseline Flood Mapping

4.1 Methodology

4.1.1 Flood mapping was undertaken within MapInfo software. As the model is a 1D2D linked model, results are produced for the out-of-bank floodplain based upon the underlying 2m grid derived from 1m DTM LiDAR data. Results were produced in 'xmdf' format and imported into MapInfo, where the results were mapped and contoured.

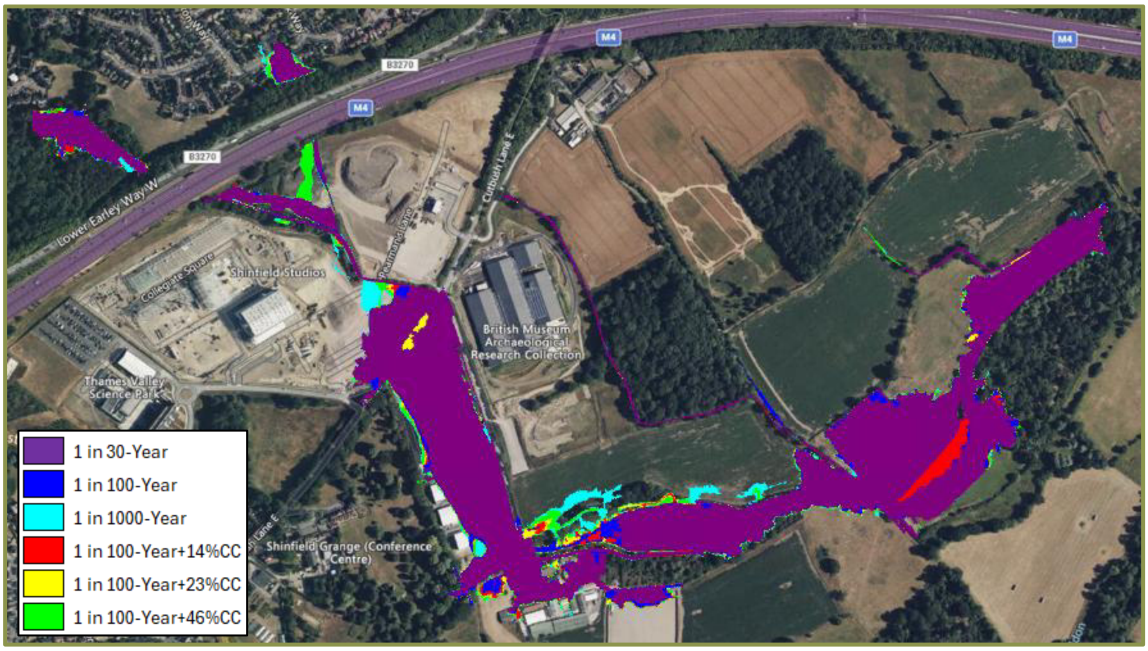
4.1.2 The purpose of this modelling exercise is to refine and confirm surface water flood outlines, representative of fluvial flooding from the identified watercourses to confidently determine fluvial flood extents in the development Site. Contouring of the results allows the production of Flood Zones; 3a (100-year), 3b (functional floodplain based upon the 30-year results) and 2 (1000-year).

4.1.3 Flood Zone 3 outlines were also produced to represent flood risk to the catchment. The contoured and mapped results are presented in Figure 4.1 and Drawing 002.

4.1.4 Model flood extents were cleaned by using the following criteria:

- Dry islands and polygons smaller than 200m^2 were removed from the outlines;
- Polygons disconnected from the watercourse or surrounding the flood outline where there is no flow path were removed.

Figure 4.1: Baseline Flood Outlines



4.2 Reality Check

4.2.1 Figures 4.2 and 4.3 present the Environment Agency Surface Water Flood Map and Enzygo modelled flood outlines for the 100-year ('medium' risk) and 1000-year events ('low' risk). It should be noted that there are no flood outlines shown on the Environment Agency Flood Map for Planning mapping and as such, the produced Enzygo Ltd flood outlines have been assessed against surface water mapping for the catchment, as this is representative of fluvial flooding.

Figure 4.2: Environment Agency Surface Water Mapping ('Medium Risk' – 100-year event)

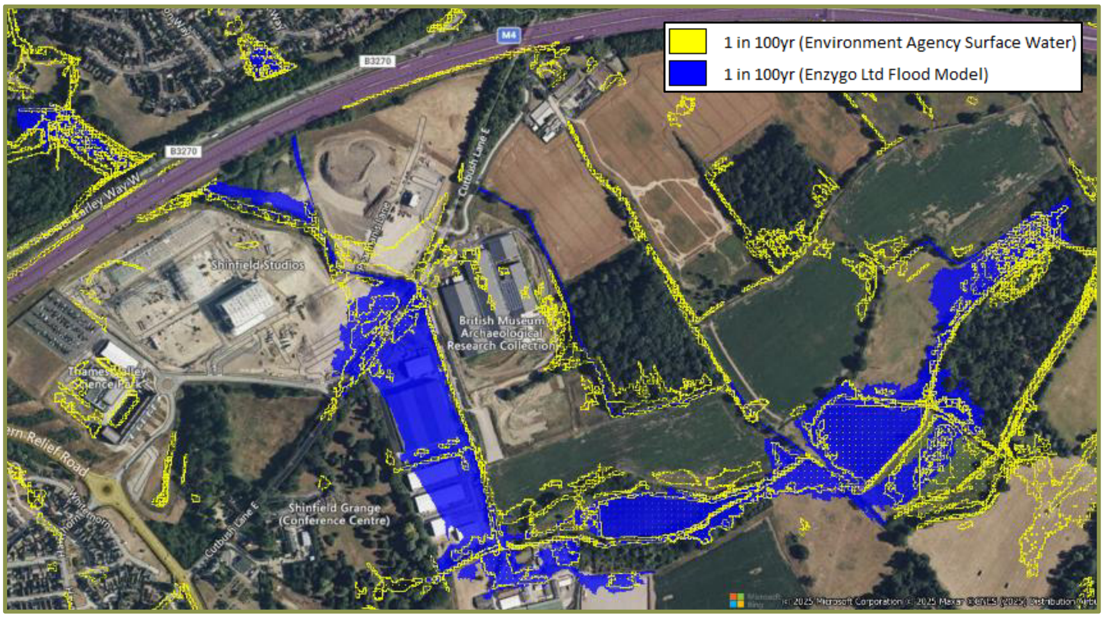
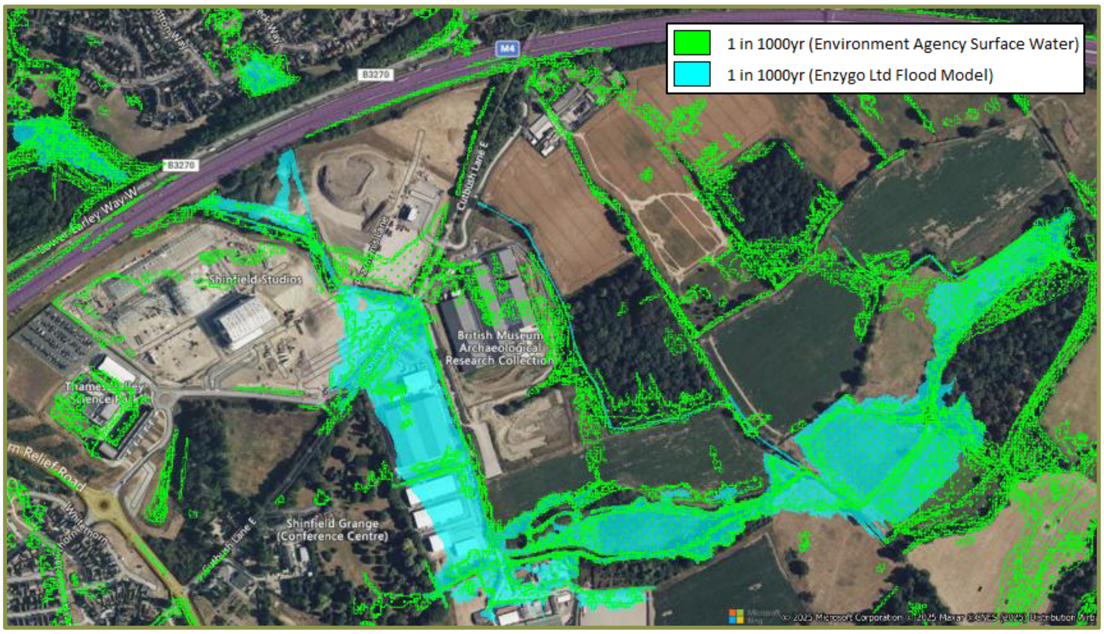


Figure 4.3: Environment Agency Mapping ('Low' Risk – 1000-year event)



Environment Agency Surface Water Flood Mapping

4.2.2 Figures 4.2 and 4.3 show significant differences between the Environment Agency surface water mapping and modelled flood extents. The key differences are as follows:

- Reduction in ponding within to the north of Cutbush Lane East, but and increase to the south (to the west of the British Museum Archaeological Research Collection building.

- Increase in the flow pathway from the M4 along the route of the M4 Pearman's Lane Est drain and Oldhouse Farm Main Watercourse. This is despite representation of the Channels using detailed survey.

4.2.3 A comparison of Environment Agency surface water mapping and Enzygo modelled outlines does not show an overall increase or decrease but represents a change to the outlines based on model schematisation and included information/details. Based on the changes in schematisation and included detail, the changes to the flood outlines are as expected and are considered representative. As such, the Enzygo modelled outlines should be carried forward as representative of the fluvial flooding from the Oldhouse Farm Main Watercourse and associated watercourse network.

5.0 Future Baseline Outlines

5.1 Future Baseline Detail

5.1.1 This section provides details of the 'Future Baseline' model ruse for the Site. Which details the proposed scheme for the Shinfield Studios development. The modelled future baseline outputs updated (model hydrology and structure representation) are as per Enzygo Ltd 'Shinfield Studios' Phase 1 and 2 model and Technical Note SHF.1229.003.HY.R.003.C - January 2023.

5.1.2 Table 5.1 and the modelling log (Appendix 2) provide a summary of the additions to the Run 007 to form the Future Baseline scenario (Table 5.1). This section considers model results for a comparison of Run 001 (Baseline) and Run 007 (Future Baseline) only.

Table 5.1: Run Identifiers and Description (Future Baseline)

Model Run ID	Scenario Description
~e~_007	A new watercourse was added to redirect offsite surface water flows to Pearman's Lane watercourse. A new box culvert was added to the north west of the offsite watercourse (dimensions 2.7m x 1.0m). Addition of the proposed building finished floor levels, a change the alignment of added watercourse in the south west of the model, remove culvert upstream of the Site and removal of the 2D flow input above the new box culvert. The inclusion of a new offsite watercourse to the north of St John's Copse. New offsite watercourse dimensions ~6m top width, ~1m bottom width and from 1.6m to 0.90m depth (varying along the length of the proposed watercourse – dependent upon constraints). Watercourse design as per the received from Abley Letchford Partnership Ltd. Levels raised on the right bank of the proposed offsite watercourse, adjacent to St John's Copse, to keep flows in channel (41.50mAOD). Finished floor levels and road levels as per received drawing 66202168-MLM-ZZ-XX-DR-C-1015 Rev C03.

5.1.3 Figure 5.1 details the routing of the proposed new watercourse. Flows are directed to a new proposed box culvert that conveys north-east alongside Cutbush Lane east. The culvert then turns towards the east where it passes under Cutbush Lane and enters a new open offsite watercourse (hereafter 'proposed watercourse'). The proposed watercourse crosses the St Johns Copse Drain before routing north-east and south-east around the northern and eastern boundaries of St Johns Copse. The proposed watercourse then connects into the Upperwood Farm Track watercourse, downstream of structure 19. The principal objective for the proposed watercourse is to divert displaced floodwater from the Old House Farm Main Watercourse and ensure that flood extents are not exacerbated downstream, with particular focus on St Johns Copse.

5.1.4 In addition to the proposed watercourse, the proposals also include the diversion of the M4-Pearmans Lane East Drain, so it connects to the Oldhouse Farm Main Watercourse approximately 20m upstream from its current connection location.

5.1.5 The ground levels of the Phase 1 and Phase 2 development to the north and south of Cutbush Lane, respectively, were added to the model. Details of the Phase 2 development to the south of Cutbush Lane were obtained from a received client drawing 'Shinfield Studio Creative Hub (Drawing Number: 66202168-MLM-ZZ-XX-DR-C-1015 Rev C03 [Appendix 1])'. New model layers have been created to represent the finished floor levels of the buildings and the road levels as shown in Figures 5.2 and 5.3.

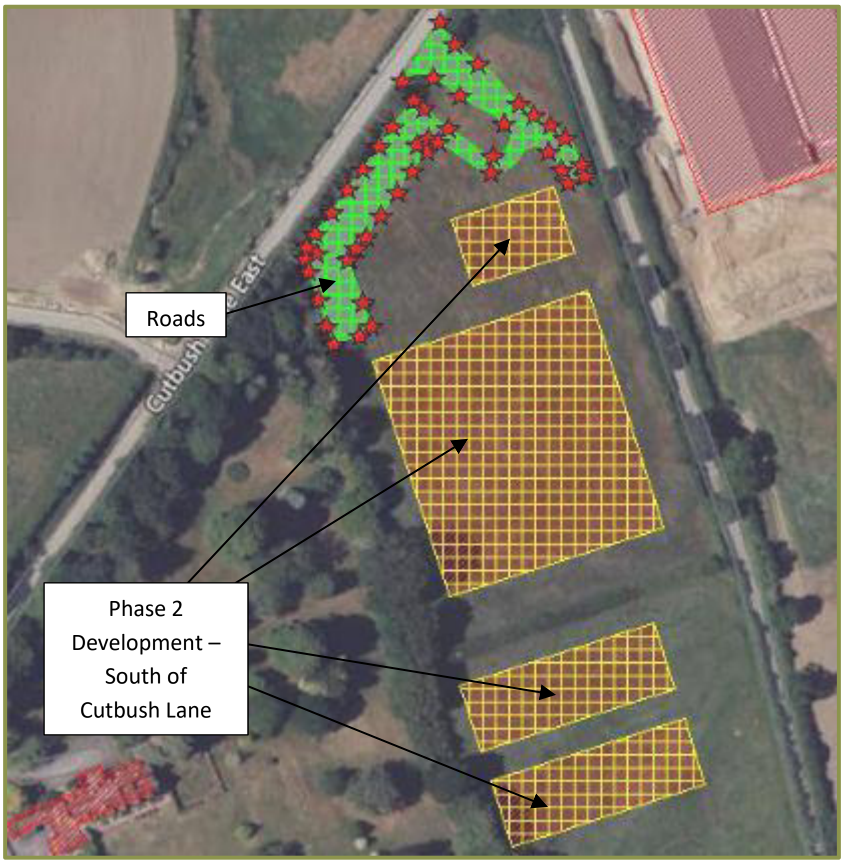
5.1.6 The model amendments included in Run 007 are detailed in Table 5.1 and Appendix 2.

Figure 5.1: Proposed Watercourse Location

Blue: *Open channel.* ***Yellow:*** *Structures.* ***Black:*** *Connectors.* ***Green Box:*** *Location of the proposed Watercourse.*

Figure 5.2: Phase 1 Model Layers

Figure 5.3: Phase 2 Model Layers

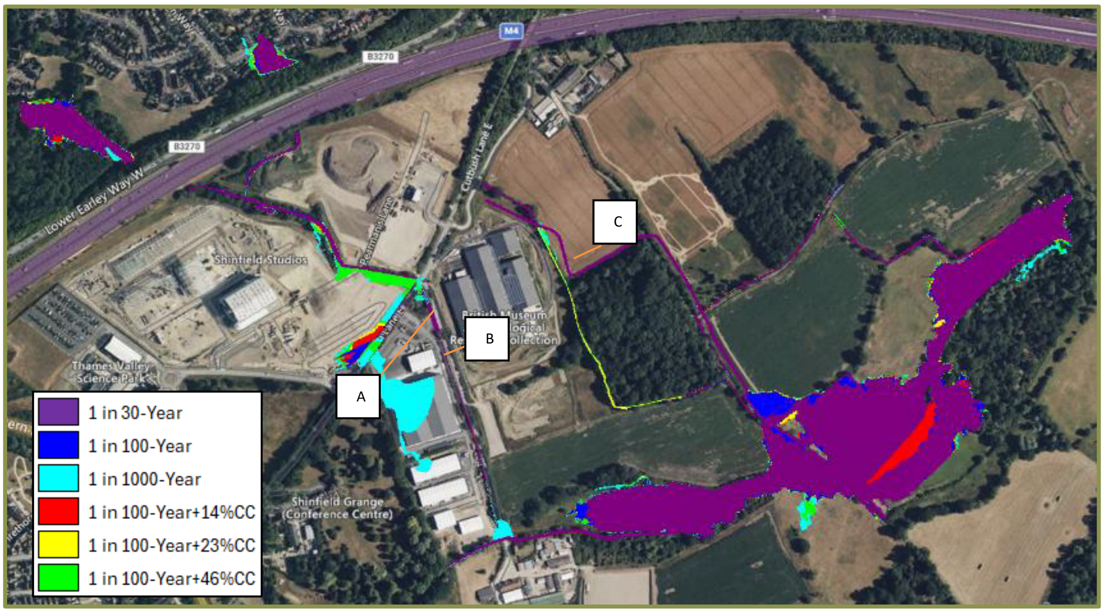


5.2 Run 007 Future Baseline Outlines

5.2.1 Figure 5.4 depicts flood extents for Run 007, the final proposed development iteration, which is a new independent watercourse around the northern and eastern perimeter of St Johns Copse. The proposed watercourse has a top width of 6m, base width of 1m and a depth varying between 0.9m and 1.6m depending upon ground profiles. The proposed watercourse has been proven to be sufficiently sized to convey excess flows in an appropriate manner to the outfall point located to the south of St Johns Copse without introducing additional flood risk.

5.2.2 A flow pathway within the western extent of the model domain is reduced and only occurs during the worst case 1 in 1000-year event. Full 1D tabulated results are provided as Appendix 2 and flood depths and extents are provided in Drawing 003.

Figure 5.4: Modelled Flood Extents (Future Baseline [Run 007] – Modelled flood Extent)



5.2.3 Figures 5.3 and 5.4 show the difference between Run 001 (Baseline) and Run 007 (Future Baseline). The results show a significant reduction in flood extents in the western extent of the model domain for both the 100-year and 1000-year events.

Figure 5.3: Modelled Flood Extents (Future Baseline [Run 007] and Baseline [Run 001] - 1 in 1000-year Event

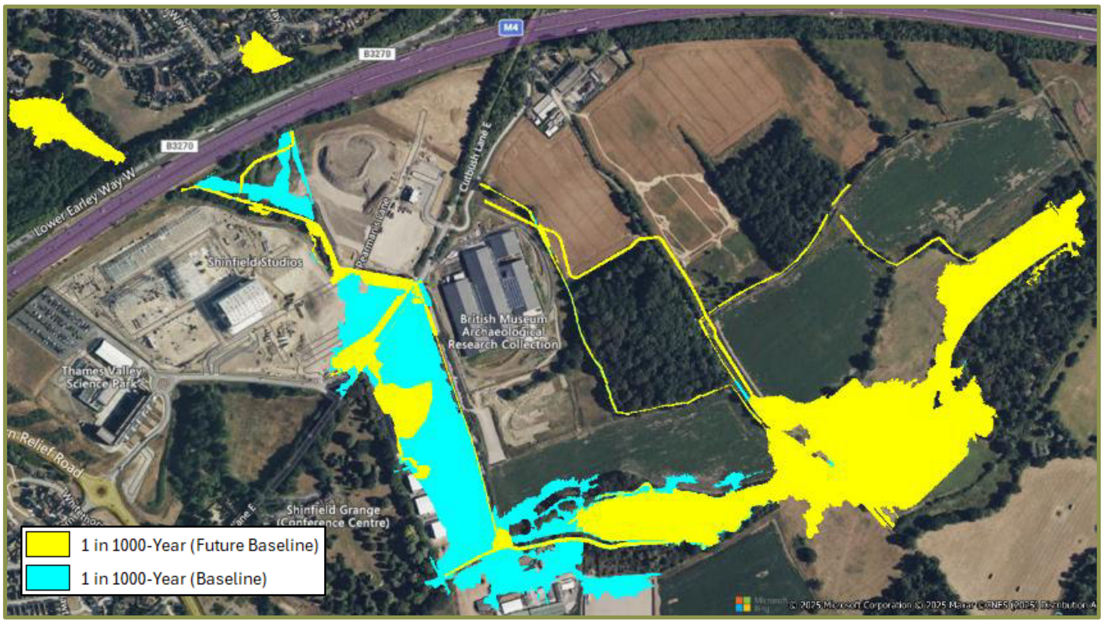
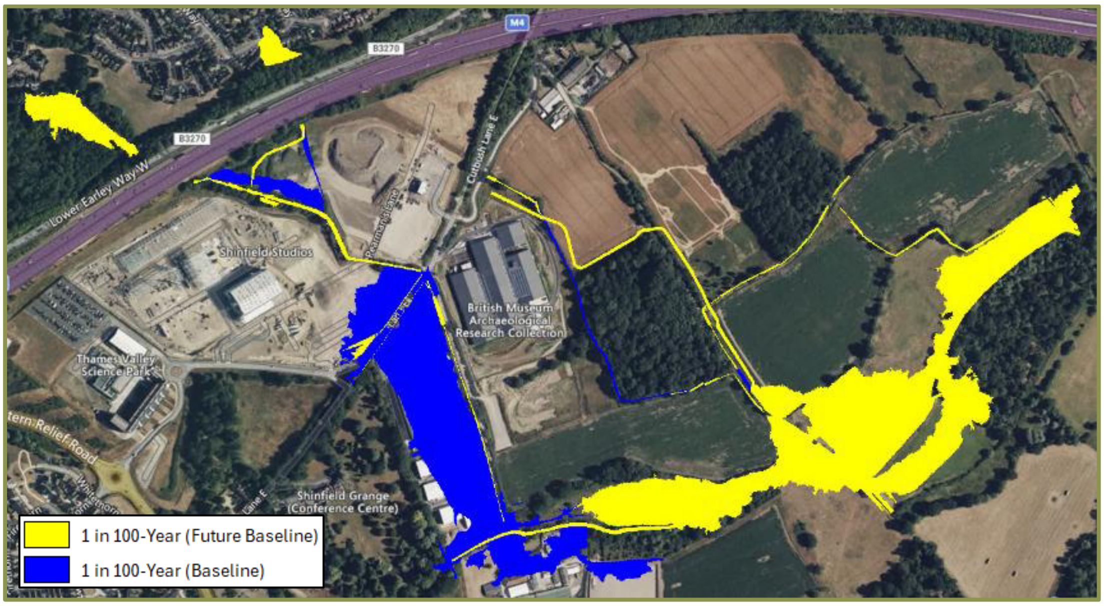


Figure 5.4: Modelled Flood Extents (Future Baseline [Run 007] and Baseline [Run 001] - 1 in 100-year Event



5.2.4 Run 007 modelled flows are presented in Table 5.2 for the 1 in 100-year and 1 in 1000-year events and provide a comparison against 001 baseline results. The modelled flows are provided for assessment points A to C, as shown in Figure 5.2.

Table 5.2: Run 007 Key Model Results

Assessment Point	Baseline (001) flow m^3/s – 1 in 100-year	Future Baseline (007) flow m^3/s - 1 in 100-year	Baseline (001) flow m^3/s - 1 in 1000-year	Future Baseline (007) flow m^3/s 1 in 1000-year
A	1.79	0.00	2.99	0.09
B	0.55	0.17	0.82	0.48
C	0.00	2.28	0.00	3.32

5.2.5 Results presented in Table 5.2 and Figures 5.3 and 5.4 demonstrate how the proposed watercourse and associated culverts divert floodwater away from Old House Farm Main Watercourse and reduce flood risk within the western extent of the model domain without increasing flood extents elsewhere.

6.0 Summary and Conclusions

6.1 Introduction

6.1.1 This report presents an updated Hydraulic Modelling Exercise for a 1D2D ESTRY-TUFLOW model for an ordinary watercourse network based on 1m DTM LIDAR Data, detailed channel and structure survey and topographical survey in order to refine surface water flood mapping (indicative of fluvial flooding) and provide baseline for flood extents to inform future development.

6.1.2 The model was run for a range of return periods to establish the baseline fluvial flood extents and parameters. Sensitivity analysis was carried out to understand the seasonal effects of vegetation, impact of downstream boundary levels and 2D grid resolution upon model results within the Site. 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.

6.1.3 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.

6.2 Baseline Flood Risk

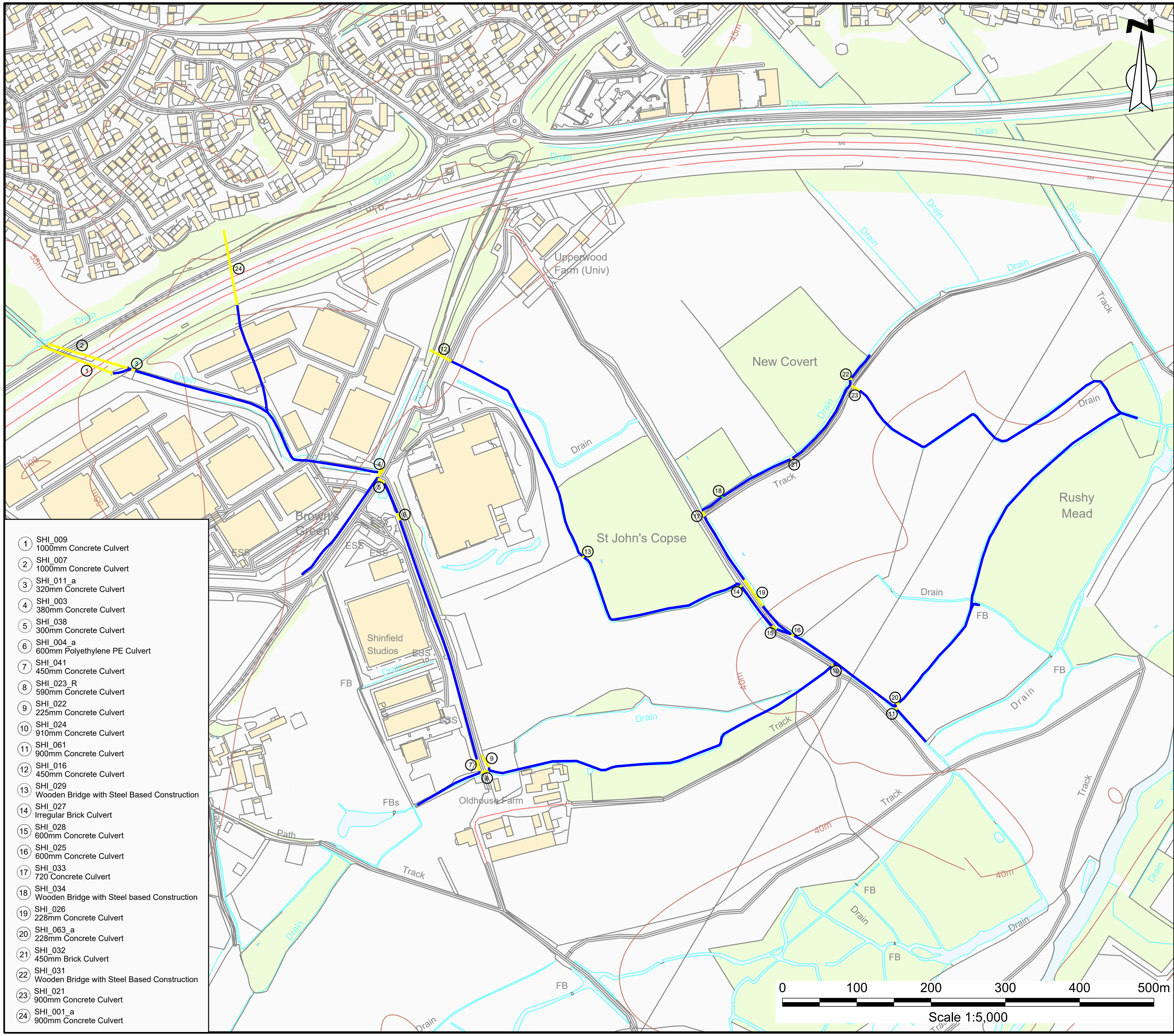
6.2.1 The baseline flood outlines show out of bank flows (as per online surface water mapping, with flow pathways along watercourse being indicative of fluvial flooding), albeit with refinement through the use of a channel/structures survey and more detailed ground model.

6.2.2 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.

6.3 Future Baseline Outlines

6.3.1 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.

DRAWINGS



1. SHI_009 – 1000mm Concrete Culvert
2. SHI_007 – 1000mm Concrete Culvert
3. SHI_011_a – 320mm Concrete Culvert
4. SHI_003 – 380mm Concrete Culvert
5. SHI_038 – 300mm Concrete Culvert
6. SHI_004_a – 600mm Polyethylene PE Culvert
7. SHI_041 – 450mm Concrete Culvert
8. SHI_023_R – 590mm Concrete Culvert
9. SHI_022 – 225mm Concrete Culvert
10. SHI_024 – 910mm Concrete Culvert
11. SHI_061 – 900mm Concrete Culvert
12. SHI_016 – 450mm Concrete Culvert
13. SHI_029 – Wooden Bridge with Steel Based Construction
14. SHI_027 – Irregular Brick Culvert
15. SHI_028 – 600mm Concrete Culvert
16. SHI_025 – 600mm Concrete Culvert
17. SHI_033 – 720 Concrete Culvert
18. SHI_034 – Wooden Bridge with Steel based Construction
19. SHI_026 – 228mm Concrete Culvert
20. SHI_063_a – 228mm Concrete Culvert
21. SHI_032 – 450mm Brick Culvert
22. SHI_031 – Wooden Bridge with Steel Based Construction
23. SHI_021 – 900mm Concrete Culvert
24. SHI_001_a – 900mm Concrete Culvert

KEY:

- (1) Structure Number
- Structure Type - Culvert
- Structure Type - Bridge
- Open Channel

Rev	Date	Description	DRA	CHK	APP
P01	22/04/25	Issued for comment / approval	HDR	DA	DA

Project
Loddon: Western Watercourses

Client
Abley Letchford

Drawing Title
Structure Locations

Scale	Date	Status
1:5000@A3	22/04/2025	Preliminary

DWG No. SHF1229003-ENZ-XX-XX-DR-Y-0001
Revision P01

Bristol 01454 269 237
Cardiff 02920 023 700
Manchester 0161 413 6444
Cambridge 01799 542 473
Sheffield 0114 321 5151
Belfast 07377673948

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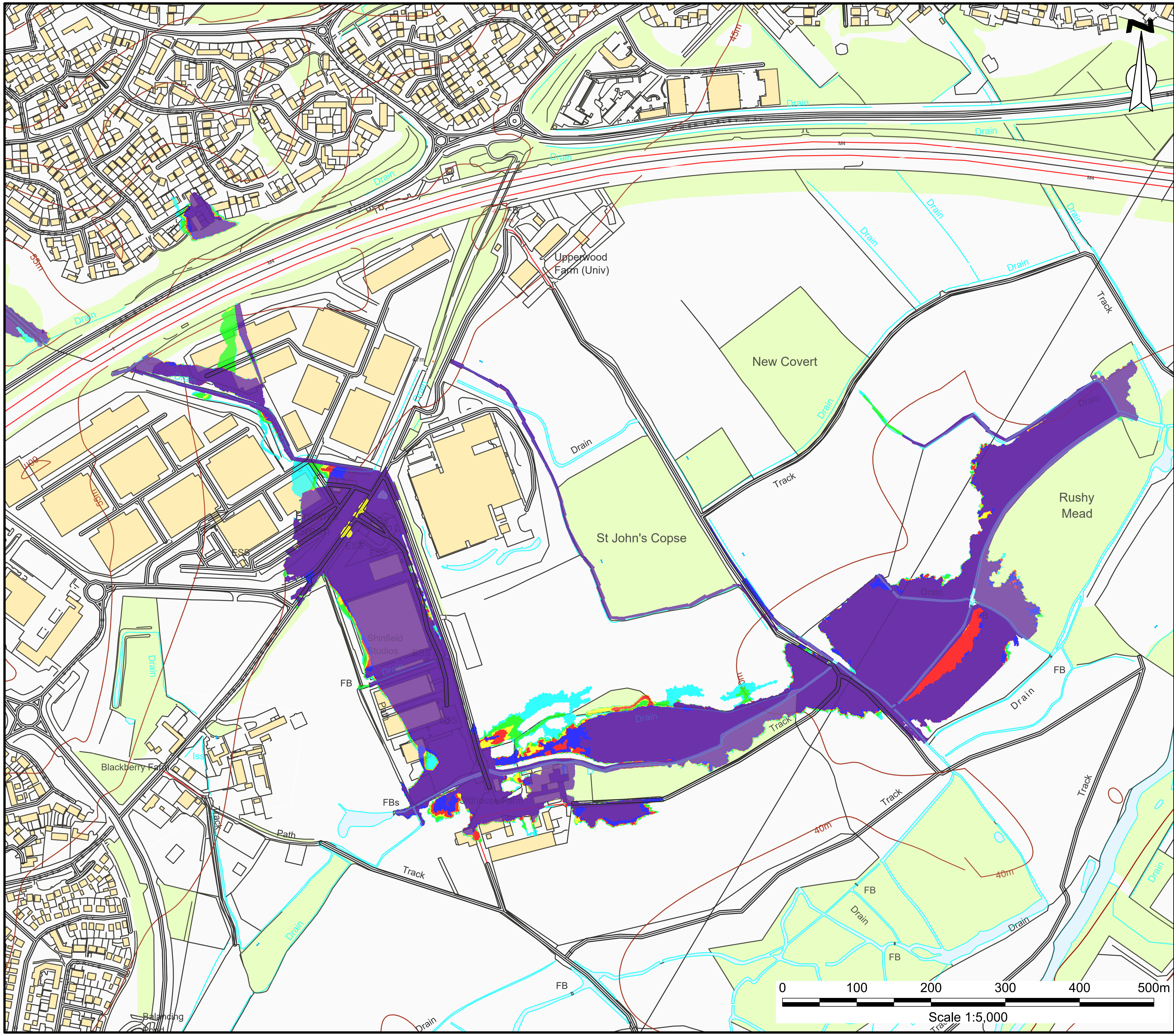

KEY:

- 30-Year
- 100-Year
- 1000-Year
- 100-Year+14%CC
- 100-Year+23%CC
- 100-Year+46%CC

Rev	Date	Description	DRA	CHK	APP
P01	22/04/25	Issued for comment / approval	HDR	DA	DA

Project
Loddon: Western Watercourses

Client
Abley Letchford

Drawing Title
Baseline Flood Outlines

Scale	Date	Status
1:5000@A3	22/04/2025	Preliminary

DWG No. SHF1229003-ENZ-XX-XX-DR-Y-0002 **Revision** P01

Bristol 01454 269 237
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Manchester 0161 413 6444
Cambridge 01799 542 473
Sheffield 0114 321 5151
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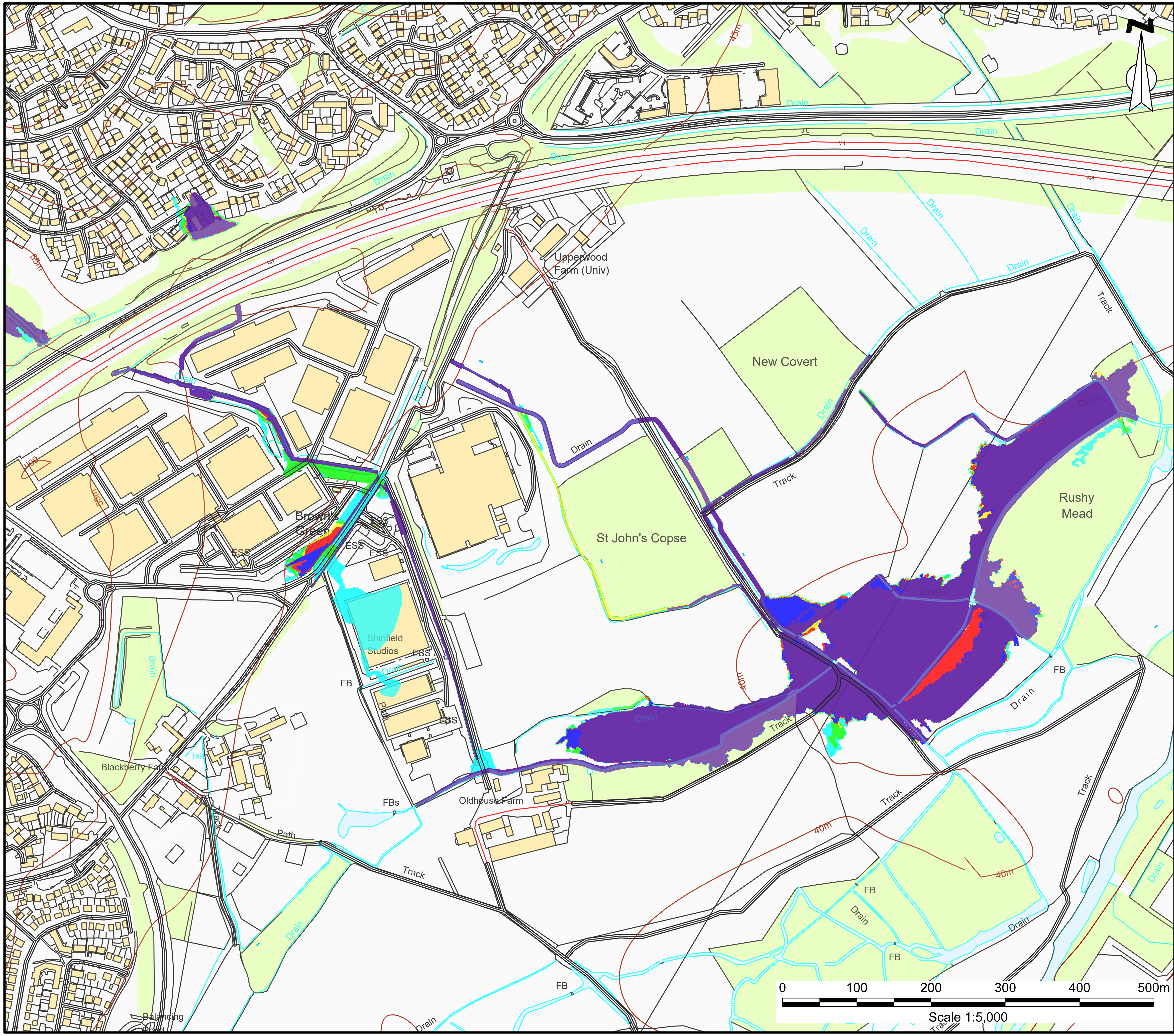

KEY:

- 30-Year
- 100-Year
- 1000-Year
- 100-Year+14%CC
- 100-Year+23%CC
- 100-Year+46%CC

Rev	Date	Description	DRA	CHK	APP
P01	30/04/25	Issued for comment / approval	HDR	DA	DA

Project
Loddon: Western Watercourses

Client
Abley Letchford

Drawing Title
Future Baseline Outlines

Scale	Date	Status
1:5000@A3	30/04/2025	Preliminary

DWG No. SHF1229003-ENZ-XX-XX-DR-Y-0003
Revision P01

Bristol
0145 269 237
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APPENDICES