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Land at Southwick Court, Trowbridge

Wain Homes

Hydraulic Modelling Note
May 2026





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1 Introduction

- 1.1 This report has been prepared by Rappor on behalf of Wain Homes to provide technical input through detailed hydraulic modelling to support the Reserved Matters application for the erection of up to 180 dwellings, site servicing; laying out of open space and associated planting; creation of new roads, accesses and paths; installation of services; and drainage infrastructure for which Outline approval (Ref 20/00379/OUT) was granted via Appeal (Appeal Ref APP/Y3940/W/23/3321957).
- 1.2 The appeal was supported by a Flood Risk Assessment and a series of Flood Risk Assessment Addendum documents (undertaken by TeignConsult Consulting Engineers) and these included a summary of the flood risk to the site along with details of site-specific hydraulic modelling that had been undertaken for the Lambrok Stream.
- 1.3 The modelling undertaken utilised the Environment Agency's (EA) HEC-RAS 1D river channel model and undertook some key updates with respect to hydrology and to ensure it followed the relevant guidance at the point of submission (May 2022). As part of this review work, the model was also converted from HEC-RAS and run in Flood Modeller Pro. The model remained as being a river channel model (1d) only.
- 1.4 On completion of the relevant updates, the modelling was progressed to include the proposed development and specifically the proposed raised road access to the proposed development site which crosses the Lambrok Stream and its associated floodplain. This crossing was again modelled in Flood Modeller and as a 1d only channel.
- 1.5 The previous modelling recommended that 3no. crossings would be required in the form of 1no. 20m span culvert over the watercourse and then 2 further no. 10m span culverts on the floodplain (one on each bank) to ensure the proposals had no detrimental impact on flood risk to third party land whilst also ensuring the road access remained dry and therefore safe – i.e. policy compliant.
- 1.6 Through the Outline application, and as can be seen on the planning portal, significant consultation was undertaken with the EA through this process and ultimately the EA provided approval to the modelling and proposed roads crossing. It should be noted that flood risk was not a contested point at the appeal but was referenced within the appeal decision (para 45) with the Inspector stating:

no apparent reason why the design of the stream crossing would be constrained: there are no limitations of the land availability, it would be a direct straight bridging point, the watercourse is fairly narrow, and the flood risk implications are understood.



- 1.7 The conclusion of the EA, and that of the Inspector, therefore, confirms that the modelling approach (i.e. 1D only) was acceptable and no comments were outstanding on the hydrology nor the hydraulic elements.
- 1.8 Further to the above, Wain Homes are undertaking detailed design of the proposed road and as part of this the crossing dimensions have been reviewed. To support this, a further detailed modelling exercise has been undertaken to confirm acceptability. Owing to the significant 2d flow process at this location, the approved model (noting it was agreed in 2023) has been upgraded to a 1d/2d model.
- 1.9 This note provides a summary of the updated baseline modelling (i.e. inclusion of the 2d elements) and then discussion around the revised approach for the culverts through the road along with model outputs for both baseline and proposed scenarios.



2 Site Information

- 2.1 The site is located to the immediate south of Trowbirdge and to the northeast of Southwick. The approximate co-ordinates for the centre of the site are E:384573, N: 155986. The site is currently undeveloped pastureland and considered as undeveloped.
- 2.2 Access to the site is currently gained via Firs Hill which forms the western site boundary. To the north of the site are residential units that formed the southern limit of Trowbridge.

Existing Drainage & Hydrology

- 2.3 The Lambrok Stream is located within the site and flows in a generally northern direction through the approximate centre of the site. At the northern boundary of the site, and where the site meets the existing residential development to the north, the watercourse turns and flows in a westerly direction and ultimately under Firs Hill Road.
- 2.4 Within the site and immediately upstream the watercourse is largely an open and natural channel. That said, and as included within the approved modelling, there are several farm access type crossings of the watercourse. One such crossing is located on the southern site boundary. All these culverts have been included within the approved modelling.



3 Hydraulic Modelling

- 3.1 The modelling study that was undertaken to support the Outline Application was reviewed and ultimately approved by the EA in late 2022. This then supported the Appeal which was decided in March 2024. On this recentness of the appeal decision, and EA approval, no changes to the input hydrology have been undertaken. This also ensures as little deviation from the approved position as possible to ensure the previously agreements remain unchanged.
- 3.2 As with the baseline modelling, the event modelled is the 1 in 100 years plus 39% climate change event. This matches the design event used within the approved modelling but also meets the requirements of Planning Practise Guidance (para 002) with respect to the design event. This event remains the most appropriate for use.

Model Type and Extents

- 3.3 As outlined above, the available modelling exercise undertaken has previously been accepted and approved. This was a 1D model and remains as being considered the most appropriate methodology to represent the existing watercourse. However, it is considered that the limitation of this modelling is that it doesn't accurately assess overland flow interactions occurring within the floodplain and this could have a significant impact on the proposed road access and associated culvert crossings.
- 3.4 To ensure consistency with the provided baseline modelling, Flood Modeller Pro was used to represent the watercourse channels, but this was then extended to use TUFLOW to represent overland flow routing across the floodplain – this element being new. The model was run using double precision software versions in line with standard guidance for hydraulic modelling. The software versions used for these assessments were:
- Flood Modeller Pro version 6.0
 - TUFLOW 2023-03-AC
- 3.5 The model extents are shown in Figure 4.1 below and these are the same as those within the original model, no alteration to cross sections or length of the model have been made and therefore considered to meet the previously agreed approach and remain acceptable.

Model Files

- 3.6 Whilst the changes to the provided modelling were kept to a minimum, the construction of the model did result in run files to ensure the post development scenario was represented. The final files for the baseline scenario are as follows:
- DAT file: A-X100CC_RPR.dat
 - IEF: A-X100CC_RPR.ief
 - TCF: TRO_001_100CC,
 - TBC: TRO_001.tbc
 - TGC: TRO_001.tgc



3.7 Shapefiles: all referenced within the TCF, TRD, TBC, and TGC.

3.8 A model has also been constructed for the post development scenario. This looks at including the proposed river crossings to ensure these still provide suitable conveyance to ensure no detrimental impact on third party land and ensuring the road remains free from flooding within the modelled design life.

3.9 As outlined above, the proposals within the original modelling were for inclusion of a 10m span culvert on the floodplain on the left bank, a 20m span culvert over the channel and a 10m culvert on the left bank floodplain. This modelling, and for reasons explained below, has focussed on no crossings on the left bank floodplain, a 5.4m wide culvert over the watercourse and 2no. 3.9m wide culverts on the right bank floodplain. The final files for the baseline scenario are as follows:

- DAT file: A-X100CC_RPR_v2.1.dat
- IEF: A-X100CC_RPR_v2.1.ief
- TCF: TRO_001_100CC,
- TBC: TRO_001.tbc
- TGC: TRO_001.tgc

3.10 Shapefiles: all referenced within the TCF, TRD, TBC, and TGC.

Baseline Model Results

- 3.11 The model results for the baseline scenario are presented in Figure 4.3 for the 1 in 100 year plus 39% climate change event is shown below.

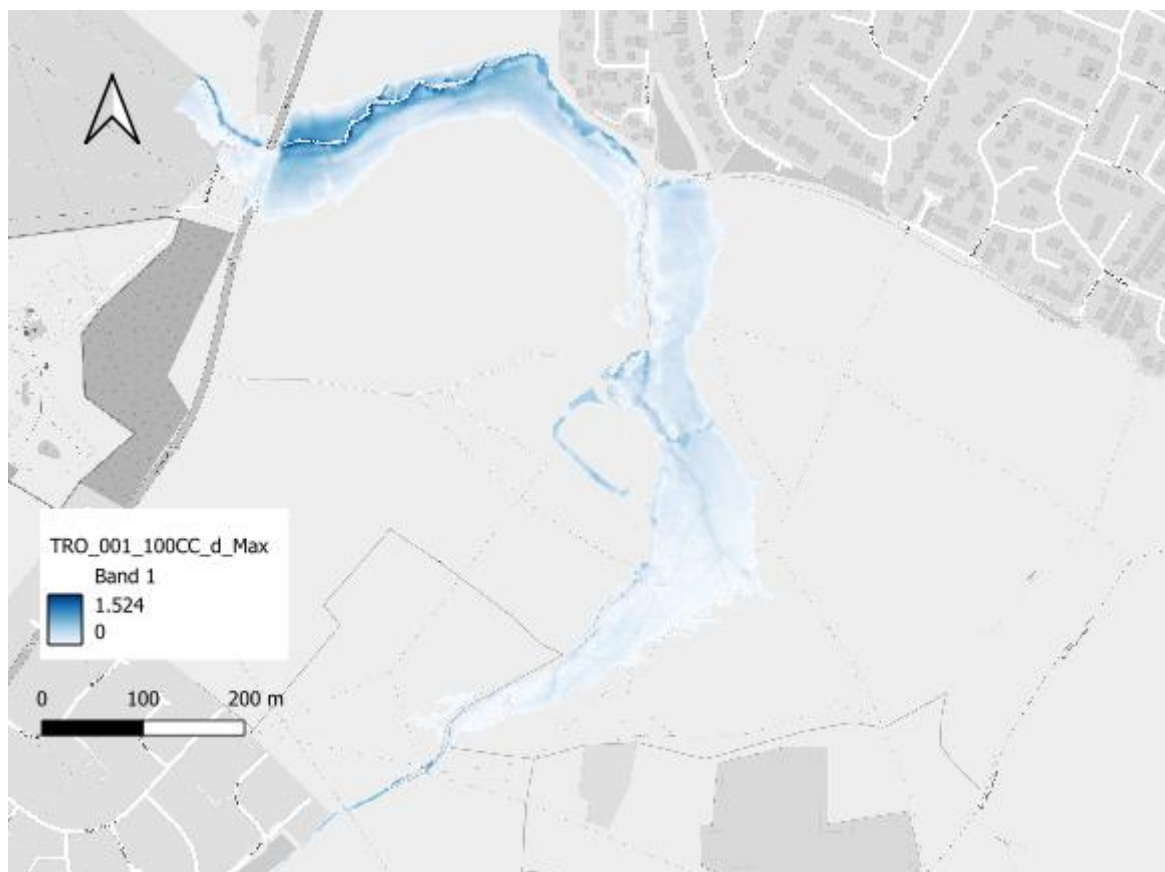


Figure 3.1. 100yr plus 39% Climate Change Model Outputs.

- 3.12 The above provided similar flood patterns to those shown on the current Flood Map for Planning and those within the works that supported the Outline Application. Whilst the general pattern is the same, it should be noted that the inclusion of the 2d elements has resulted in a reduction on flood extents throughout much of the reach, and specifically within the application boundary. This is not uncommon when moving from 1D only models to linked 1D/2D models as the 1D results are often extrapolated from the in-channel node point with little consideration to floodplain flow process. The inclusion of these elements results in a more accurate representation of floodplain and therefore flood extents.
- 3.13 It should also be noted that the linked model, and the outputs shown in Figure 3.1, also provide a depth grid within the floodplain and therefore allow a more detailed understand of flood depths and confirm that the river channel capacity would be exceeded with floodplain depths shown as being 'shallow' and less than 300mm deep.
- 3.14 The flood extents, whilst shallow, are however shown to extend around 80m along the river corridor with around 60m of this being on the right bank of the watercourse. On review of the site topographical survey and the LiDAR, this matches the fact that the right bank is lower than the left bank and provides an accurate representation.



Model Results – Post Development Scenario

- 3.15 The results of the baseline modelling have confirmed that the majority of out of bank flooding is both shallow and contained within an approximate maximum width of 60m on the right bank and around 15-20m on the left bank.
- 3.16 On this basis, it is considered that the previous bridge design could be refined owing to the outputs from the baseline modelling. As such, several model iterations have been run to assess potential changes in the configuration of the crossings. These initially involve reconfiguring the previous proposed (i.e. 20m wide over the channel and then 2no. 10m on the floodplain) to better understand the impacts. Each iteration was initially modelling in 1D.
- 3.17 The key change was to remove a floodplain culvert from the left bank and instead model the impact of two on the right bank where levels are lower (than the left bank) and where out of bank flooding occurs first.
- 3.18 The outputs from the revised culvert arrangement showed limited impact on flood levels upstream of the site with depths remaining consistent and less than 300mm deep. As such, the culverts were reduced in size to determine what would remain acceptable in terms of flooding risk (i.e. providing suitable conveyance to ensure no third-party risk and site remains safe).
- 3.19 Through various testing of culvert dimensions, the post development scenario has demonstrated that the use of 5.4m wide crossing over the watercourse channel and 2no. 3.9m culverts on the right bank would provide sufficient conveyance to meet the requirements and align with the conclusions of the modelling that supported the outline application.
- 3.20 An indicative extract from the modelling with the revised bridge included is shown in Figure 3.2 below.

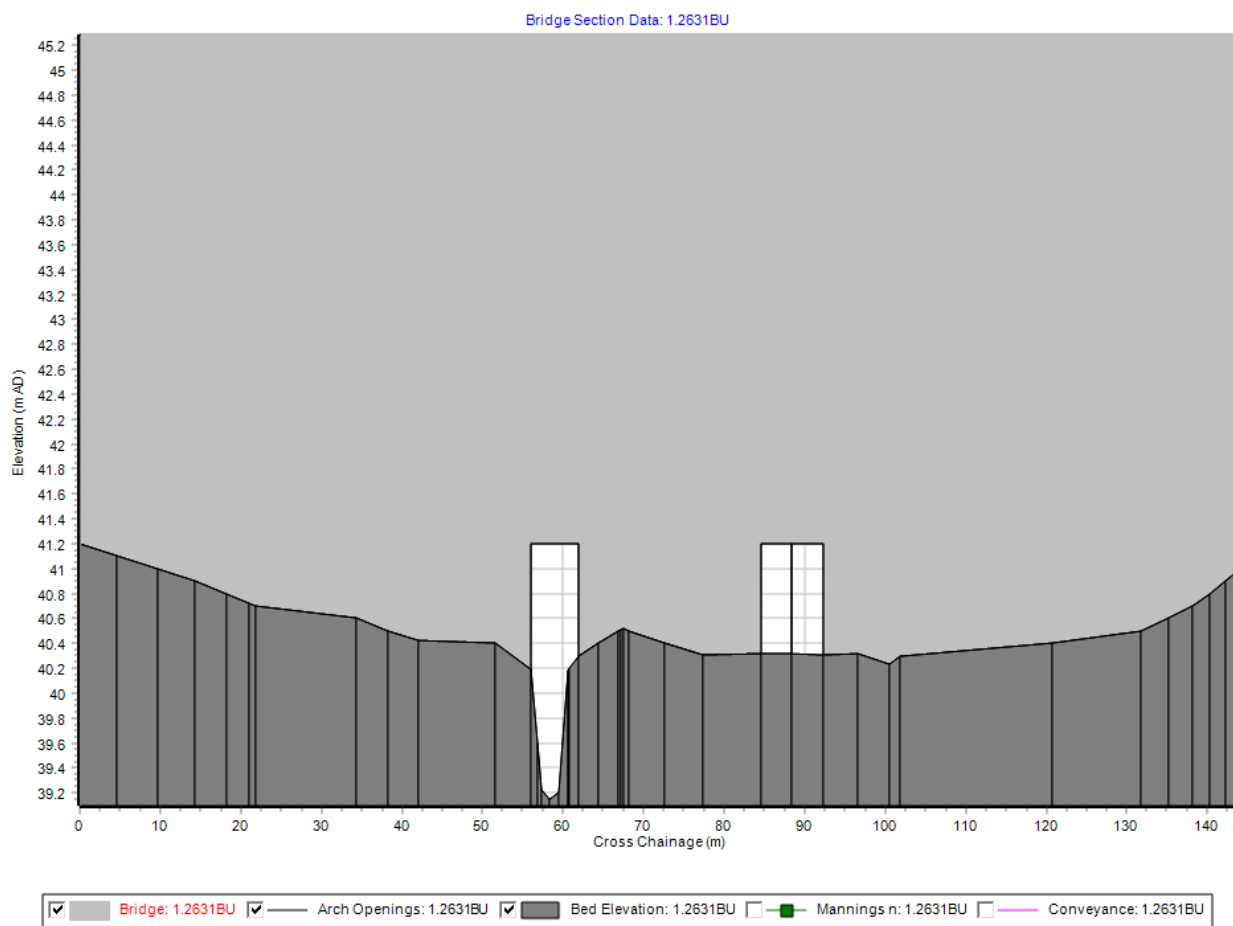


Figure 3.2. Revised Bridge Configuration.

- 3.21 The results of the modelling with the above bridge crossing have confirmed that suitable capacity has been provided along with a 600mm freeboard from the top water level to the internal soffit of the culvert structure, see Figure 3.3 below.

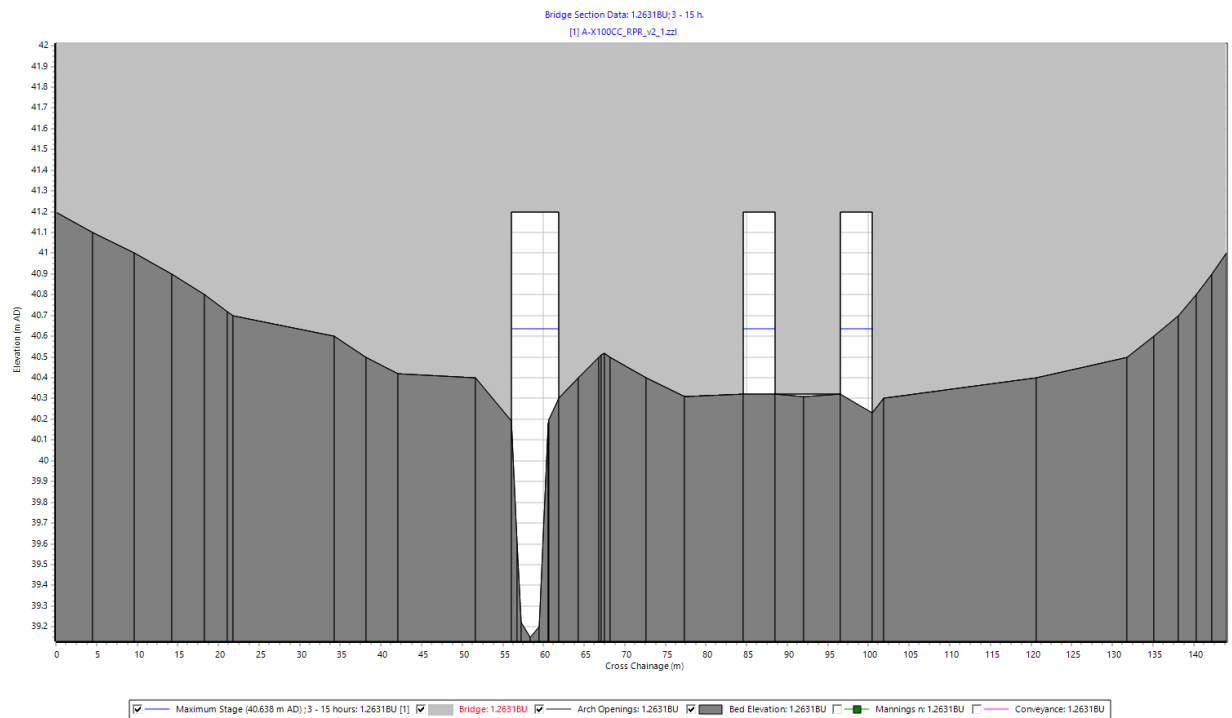


Figure 3.3. Revised Bridge Configuration – with 100yr + 39% CC Flood Level

- 3.22 The maximum water level for the revised bridge is 40.753m AOD with the internal soffit of the culvert structure being set at 41.353m AOD. This accords with the requirements of Condition 11 (freeboard of 600mm), within the Appeal Decision (ref: APP/Y3940/W/23/3321957).
- 3.23 With respect to the floodplain flooding, Figure 3.4 shows the flood extents with the culverts in place.

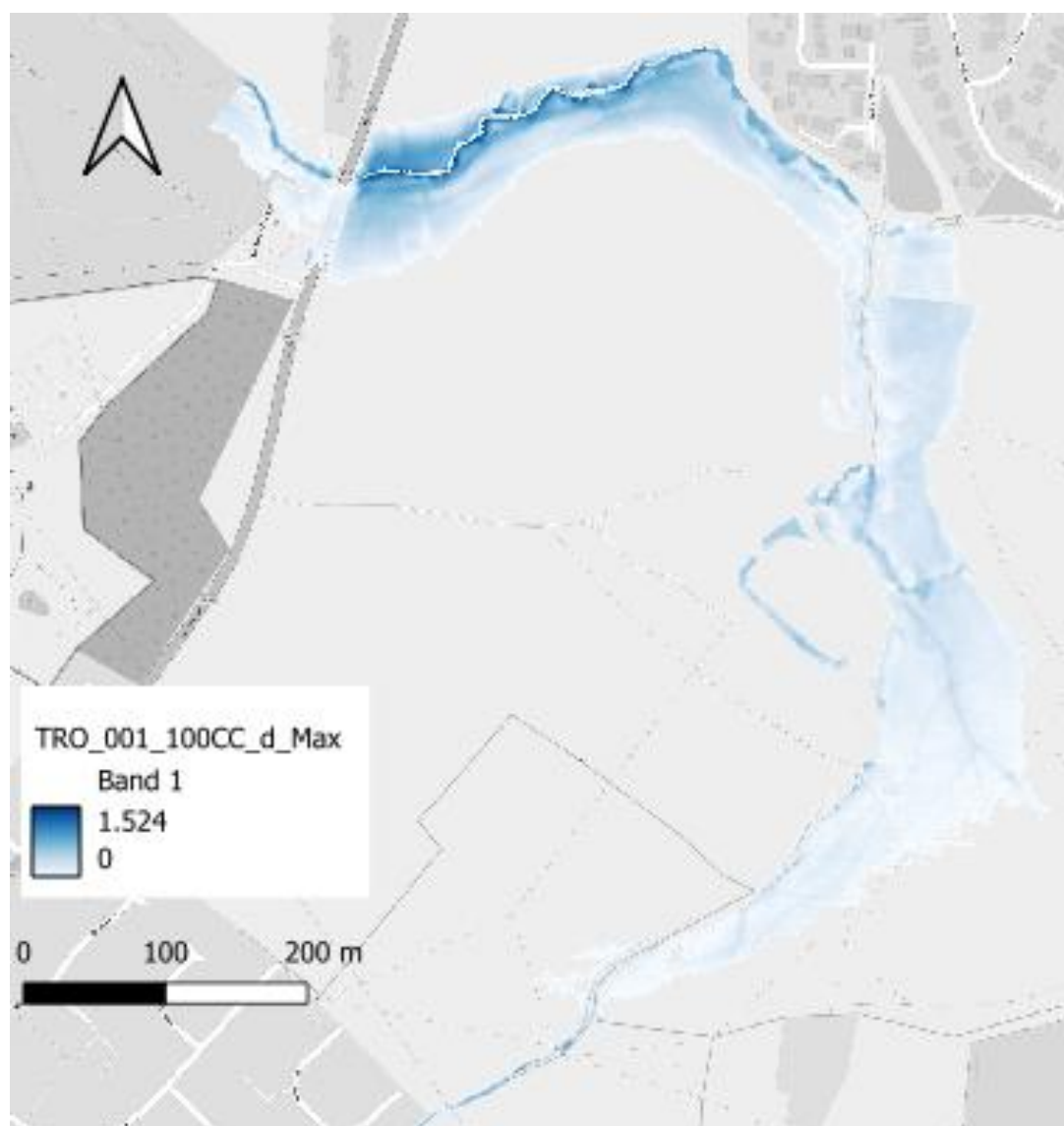


Figure 3.4. Revised Bridge Configuration – with 100yr + 39% CC Flood Level Outputs

- 3.24 The outputs confirm that the road itself remains dry and therefore provides suitable safe (and even dry) access and egress to the site and therefore this maintains the acceptable approach to access and egress.
- 3.25 The flood depths immediately upstream of the revised bridge crossings are shown to reach a maximum of around 0.39m. Whilst this represents an increased flood depth from the baseline by up to 0.1m, it should be noted that this is all contained within the application boundary and confirms the inspector's position in the appeal decision (para 45) around *no limitation of the land availability* and therefore the increases remain on land within applicant control and would therefore not constitute a third party increase. To confirm this, Figure 3.5 shows a depth comparison between the pre and post development scenarios.

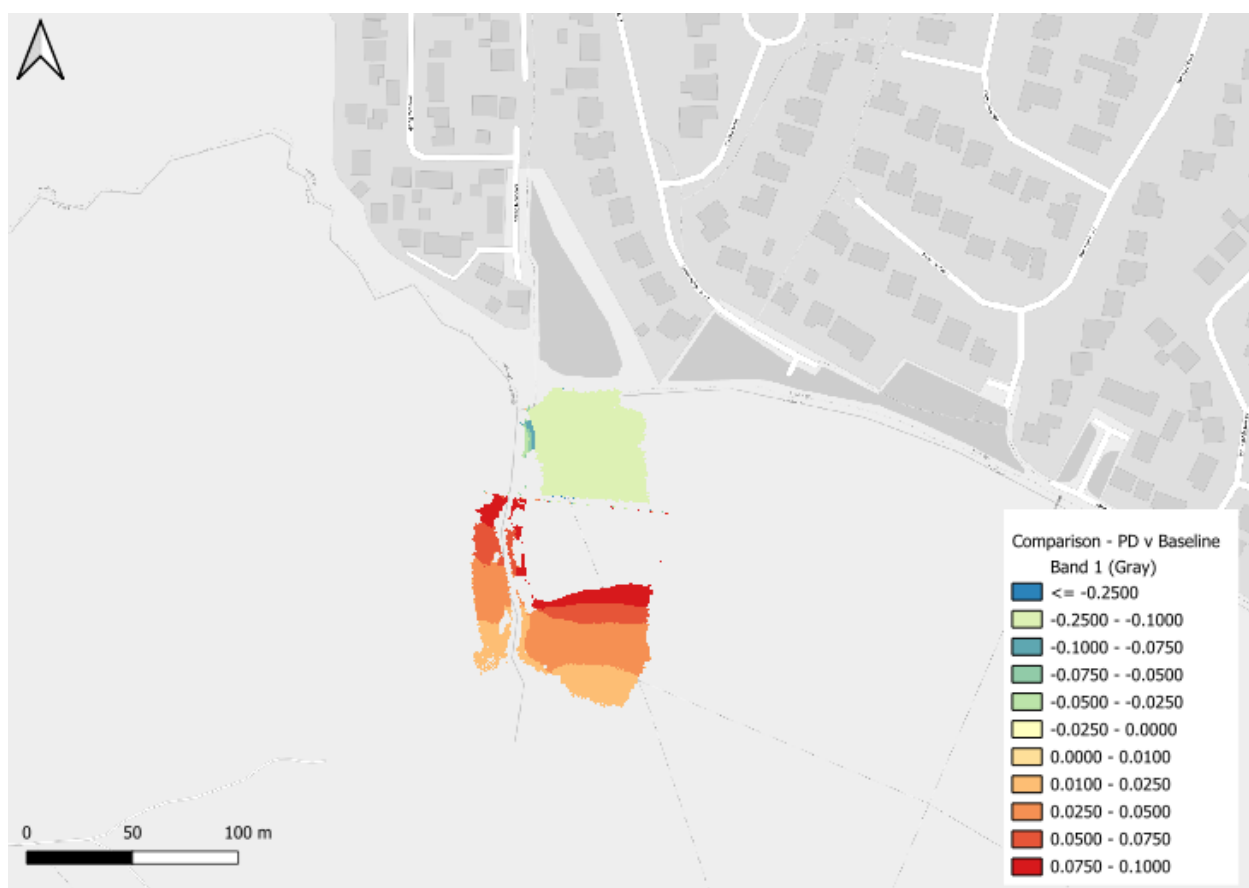


Figure 3.5. Depth Comparison – Pre v Post Development – 100yr + 39% CC event.

- 3.26 The above confirms that through the optimisation of the culvert dimensions, the only impact on flood risk is localised to immediately upstream of the crossing and extending a maximum of 55m upstream and remains within the application boundary.
- 3.27 The upstream increases are considered as being limited both because of the crossing dimensions but also due to the existing hydraulic control to the immediate south (and upstream) of the site boundary. This crossing is the Southwick Court crossing prevents upstream flooding.
- 3.28 The above mapping has confirmed that whilst the previous modelling provided a suitable option it was, if anything, over designed and this assessment has demonstrated that through a review of various iterations, reduced culvert dimensions can be utilised whilst not deviating from the position that was previously agreed with the EA – i.e. no increase in flood risk on third party land.
- 3.29 On this basis, the reduced culverts are considered as maintaining a policy compliant approach to the crossing.



4 Summary

- 4.1 This report has been prepared by Rappor on behalf of Wain Homes to provide technical input through detailed hydraulic modelling to support the Reserved Matters application for the erection of up to 180 dwellings, site servicing; laying out of open space and associated planting; creation of new roads, accesses and paths; installation of services; and drainage infrastructure for which Outline approval (Ref 20/00379/OUT) was granted via Appeal (Appeal Ref APP/Y3940/W/23/3321957).
- 4.2 This study has progressed the previously agreed modelling to include the floodplain elements through construction of a TUFLOW 2d floodplain element that has been linked to the 1d elements.
- 4.3 This approach has provided, if anything, a slightly reduced flood extent through accurate representation of the floodplain and the predicted flow processes whilst also confirming details flood depths throughout the floodplain.
- 4.4 On review of the updated baseline outputs, the floodplain depths were shown as being considered shallow and less than 300mm deep. As such, a series of post development iterations were assessed around the crossing and associated culverts.
- 4.5 Owing to the flow mechanisms and ground levels, it was felt more beneficial for the floodplain culverts to be based on the right bank and this approach was adopted. Additionally, and through testing with various iterations, the flood depths weren't overly sensitive to the width of the culverts and therefore the previously proposed culverts were reduced to a 5.4m crossing over the watercourse and then 2no. 3.9m culverts in the right bank floodplain.
- 4.6 The above has been modelled for the design event and confirms that whilst these would increase flood depths immediately upstream of the site, these are all contained within the site area and therefore do not constitute a third party increase and would be acceptable. It should also be noted that the maximum increase in flood depth would be immediately upstream of the crossing and 100mm. These depth increases reduced upstream of the bridge and after around 60m there is no detrimental impact.
- 4.7 Whilst the revised culvert arrangement provides suitable conveyance routes through the site and contains any increased within the application boundary, it should be noted that the dimensions proposed maintain the 600mm freeboard that was used within the modelling to support the Outline Application. With the revised culverts in place the 1 in 100 years plus 39% climate change flood level is 40.753m AOD and the soffit of each crossing is set to 41.353m AOD.
- 4.8 The updated modelling that has been undertaken has confirmed that the upstream flood levels are insensitive to the dimensions of the structure. This is due to the floodplain at the point of the culverts being shown as wide but relatively shallow. As such, and through the inclusion of the crossings, there is limited impact through contraction of flows through the restriction given the dimensions being proposed.
- 4.9 The above has demonstrated that through an optimised design the principles (and conclusions) that were agreed at Outline remain and the revised approach remains a policy compliant approach.



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