Wokingham Borough Council

SOUTH WOKINGHAM DISTRIBUTOR ROAD - CENTRAL AND WESTERN SECTION

Post Development Hydraulic Modelling Addendum – Version 2

66439-HMA-01 (V2)
OCTOBER 2020

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Wokingham Borough Council

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Post Development Hydraulic Modelling Addendum

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CONTENTS

EXECUTIVE SUMMARY

1 INTRODUCTION 1

1.1 APPOINTMENT AND BRIEF 1
1.2 AIM AND OBJECTIVES 1
1.3 EMM BROOK MODEL DEVELOPMENT 1
1.4 STUDY AREA 2
1.5 REPORT REFERENCES 4
1.6 SUCCESS MEASUREMENT CRITERIA 4

2 POST DEVELOPMENT MODEL 5

2.1 DATA SOURCES 5
2.2 POST DEVELOPMENT PROPOSALS 5
2.3 HYDROLOGICAL APPROACH 10
2.4 MODEL SCENARIOS & EVENTS 11
2.5 MODEL PARAMETERS 11
2.6 HYDRAULIC MODEL SCHEMATISATION CHANGES 13
2.7 PROPOSED CULVERTS 15

3 MODEL INTEGRITY 17

3.1 VALIDATION 17

4 RESULTS 19

4.2 SENSITIVITY TESTING 22

5 ASSUMPTIONS AND LIMITATIONS 26

5.1 ASSUMPTIONS 26

5.2 LIMITATIONS 26

6 CONCLUSIONS 27

TABLES

Table 2-1 – Comparison between Thames Water Balancing Pond and SANG Basin 8

Table 2-2 – Modelled proposals 9

Table 2-3 – Events Simulated 11

Table 2-4 – Key Model Parameters 12

Table 2-5 – Model Parameter Change 13

Table 2-6 - Culvert and Bridge Structure Details 15

Table 3-1 – Model Health Summary 18

Table 4-1 – Difference in Flood Levels between the Baseline and Post Development model (1% AEP plus 70% climate change) 19

Table 4-2 - Sensitivity Rating 22

Table 4-3 - Sensitivity Matrix (Blockage Scenarios 1 and 2) 24

Table 4-4 – Sensitivity Matrix (Blockage Scenario 3) 25

FIGURES

Figure 1-1 - Location Plan 3

Figure 1-2 - Proposed Highway and Existing Watercourses 3

Figure 2-1 - Proposed Upper Emm Brook Tributary and Thames Water Sewer Diversions 5

Figure 2-2 - Proposed Luckley Brook Diversion 6

Figure 2-3 - Location of PROW Diversion 7

Figure 2-4 - Extract of Consortium Landscape plan showing flood compensation area 8

Figure 3-1 - Courant Number Acceptable Limits 17

APPENDICES

Appendix A - Location Plan

Appendix B - PROW Design Drawings

Appendix C - Hydraulic Model Schematic

Appendix D - Consortium Drawings

Appendix E - Hydraulic Model Extents

Appendix F - Hydraulic Model Results

EXECUTIVE SUMMARY

WSP was commissioned by Wokingham Borough Council to undertake numerical hydraulic modelling to support the Flood Risk Assessment prepared for Central and Western section of the proposed SWDR. The purpose was to determine the effect of the SWDR on flood risk within the vicinity of the proposed development and develop a flood compensation scheme to mitigate the effect.

A planning application for the proposed SWDR was submitted in November 2019 (Planning Ref. 192928), where a hydraulic modelling report was prepared to support a Flood Risk Assessment (FRA) for the scheme, however subsequent design changes have required an update to be made to the hydraulic modelling previously carried out.

The Post Development model has been developed from the Updated Baseline Emm Brook model for which a separate Technical Note has been prepared and previously submitted to the Environment Agency (Document No. 32441-HMTN-01).

The Post Development model has been run for the 20%, 5%, 1%, 1% (plus 25%, 35% and 70% climate change), and 0.1% Annual Exceedance Probability (AEP) events.

The designs that are required to facilitate the SWDR consist of:

- re-alignment of the Emm Brook and its tributaries providing a two-stage channel where possible;
- diversion of the Luckley Brook providing a two-stage channel; and,
- diversion of the existing PROW (WOKI FP24 and WOKW FP9) with a new footbridge being provided across the Emm Brook.

The measures required to mitigate the SWDR's effect on flood risk consist of an online flood compensation area, comprising of two basins, within a SANG area to the south of the SWDR. This area will attenuate fluvial flows and provide sufficient compensation for the loss of floodplain storage as a result of the Proposed Highway.

A comparison of the Baseline and Post Development (with mitigation) model results indicate that flood levels and extents are increased within the SANG area as designed. There is also a slight increase in flood extent and levels immediately upstream of the proposed PROW footbridge and road bridge over the Emm Brook (Main River). However, there is no exacerbation of flood risk to existing properties in the vicinity of these locations.

Overall, the mitigation measures will provide a net benefit in terms of reducing fluvial flood risk extents and flood levels downstream of the study area.

The results of the Post Development hydraulic modelling exercise should be used to inform the design of future development within the SDL to ensure that it is safe and free from flood risk over its design lifetime.

1 INTRODUCTION

1.1 APPOINTMENT AND BRIEF

1.1.1. Wokingham Borough Council commissioned WSP to undertake numerical hydraulic modelling to support a Flood Risk Assessment (FRA) prepared for the Central and Western section of the proposed South Wokingham Distributor Road.

1.1.2. The Central and Western section is the third of four phases of the South Wokingham Distributor Road (SWDR) and runs along an east – west route from Waterloo Road in the east (where it ties into Phase 2 – the Eastern Gateway) to a new Tesco Roundabout in the west (from which Phase 4 – the Western Gateway works will take place). Refer to Appendix A for a location plan.

1.1.3. A planning application for the proposed SWDR was submitted in November 2019 (Planning Ref. 192928), and a hydraulic model and report was prepared to support the FRA (Report No. 32441-HMA-01), however subsequent design changes have required an update to be made to the hydraulic model.

1.1.4. The Environment Agency undertook a review of, and commented on, the hydraulic model submitted for planning in November 2019 and this latest update also addresses these comments, where still relevant.

1.1.5. Alongside the planning application for the SWDR two separate planning applications (Planning Application Nos. 190914 and 191068) have been submitted by a Consortium of developers for a mixed-use development which will be accessed from the proposed SWDR. There has been close collaboration between WSP, Wokingham Borough Council and the Consortium to ensure that the mitigation measures proposed for the road are appropriate against the backdrop of the overall SWDR / Consortium developments.

1.2 AIM AND OBJECTIVES

1.2.1. The aim of the hydraulic model is to determine the potential effect of the Proposed Highway on flood risk attributable to fluvial flows on the Emm Brook and its tributaries and determine the necessary mitigation measures required to avoid exacerbation of flood risk to upstream and downstream areas.

1.2.2. To achieve this aim, the following objectives have been achieved:

- Amend the Updated Baseline Emm Brook Model to a Post Development model, to allow for the changes in ground profile resulting from the Proposed Highway;
- Incorporate subsidiary designs such as a realigned PROW & footbridge and diverted Emm Brook & tributaries and Luckley Brook; and,
- Establish and model appropriate mitigation measures to manage changes in flood risk to people and property upstream and downstream of the site.

1.3 EMM BROOK MODEL DEVELOPMENT

1.3.1. The 2016 Upper Emm Brook model was originally based on a 2009 Emm Brook model obtained from the Environment Agency. It updated the upper reaches of the Emm Brook, upstream of Finchampstead Road, which included improvements to the representation of the channel using LiDAR data.

1.3.2. On completion of the 2016 Upper Emm Brook model, and following discussions with the Environment Agency, it was agreed to develop a comprehensive updated flood model for the Emm Brook to include mitigation works on the upstream South Wokingham Strategic Development Land (SDL) which could have a beneficial effect downstream at Toutley Road. Consequently, the 2009 Emm Brook and the 2016 Upper Emm Brook models were fully reviewed and a number of enhancements were made to produce the 2017 Baseline Emm Brook Model using the latest hydrological and 1d-2d modelling techniques.

1.3.3. The 2017 Baseline Emm Brook Model represented the baseline situation for the North Wokingham Distributor Schemes (Ashridge Farm and North Wokingham Distributor Road) and the Eastern Gateway scheme.

1.3.4. For the SWDR project, the 2017 Emm Brook baseline model has been further updated following completion of Phase 1 of the SDL, Montague Park residential development. The development has included mitigation for a surface water overland flow route currently represented in the 2017 baseline model. The baseline model has also been updated to provide a more detailed representation of the existing highway and parapet levels at the bridge on Finchampstead Road, which crosses the Emm Brook (Main River) north of Tesco.

1.3.5. A Technical Note has been prepared and submitted to the Environment Agency which details the changes to the baseline model (refer to Document No. 32441-HMTN-01). All other elements of the 2017 Baseline Emm Brook Model remain the same.

1.3.6. For full details of the Updated Emm Brook Baseline Model please refer to the following documents:

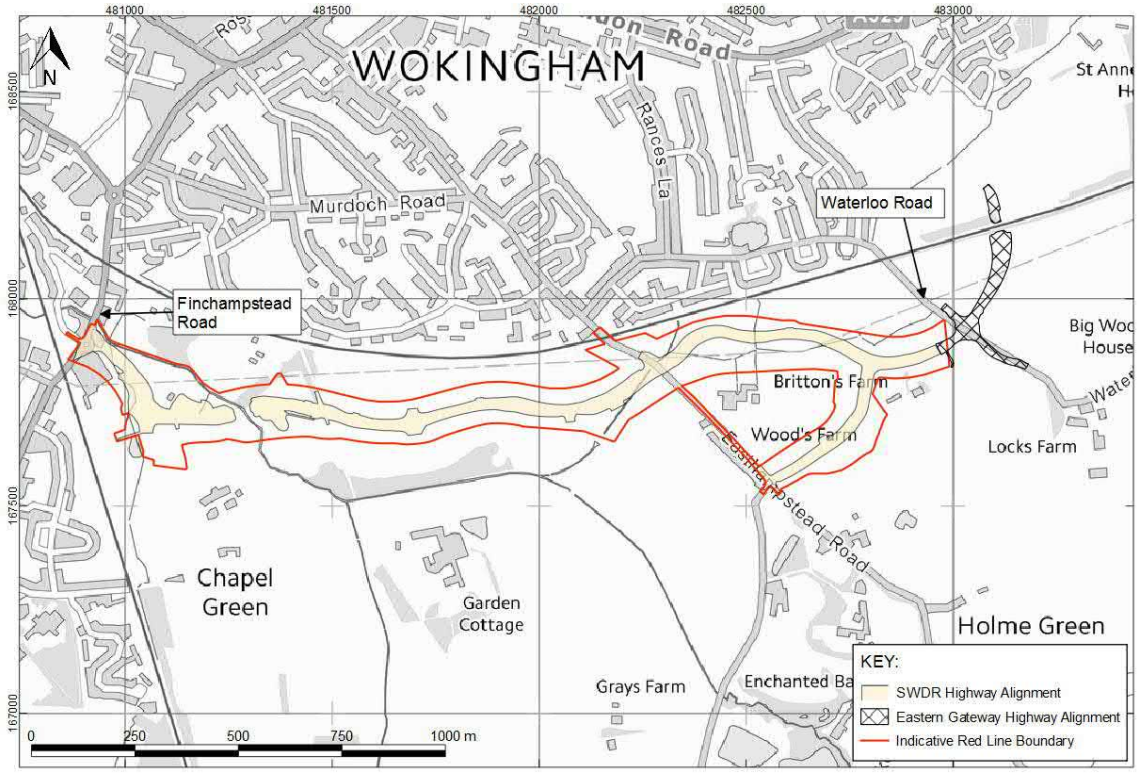
- Updated Baseline Hydraulic Modelling Technical Note (Document No. 32441-HMTN-01); and
- North Wokingham Distributor Road, Toutley Road – Flood Modelling Report (Report No. 22800-HMR-01).

1.3.7. The Updated Baseline Emm Brook model has been used to develop the latest Post Development model and assess flood risk to and from the Central and Western section of the SWDR.

1.4 STUDY AREA

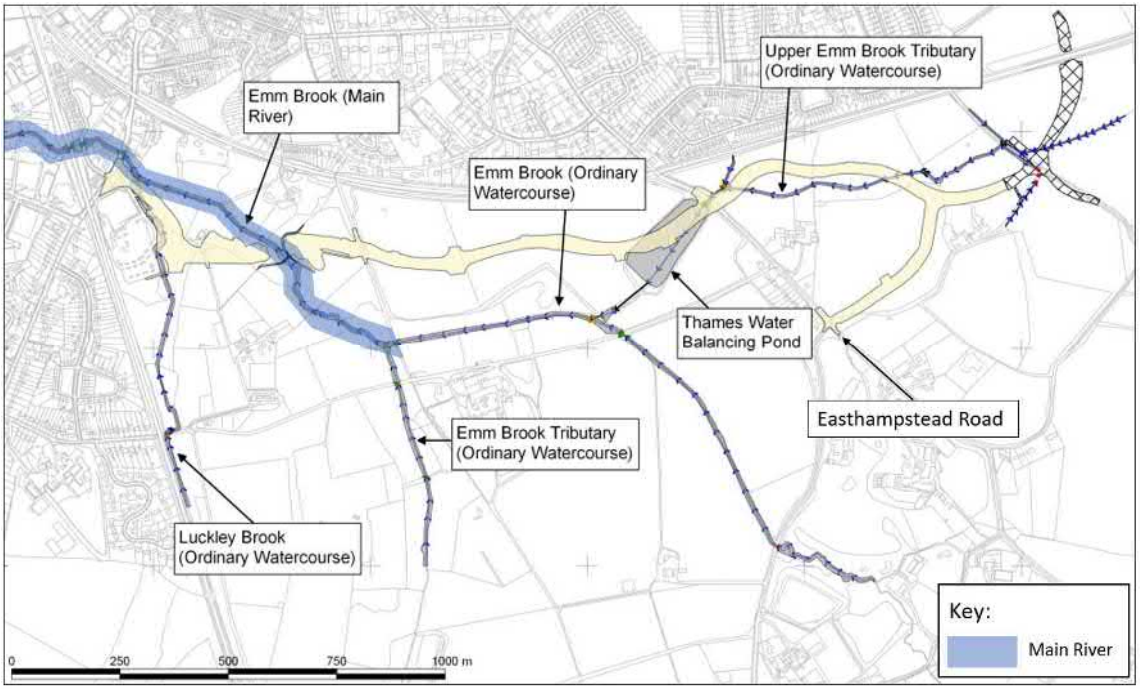
1.4.1. The area of study extends from Waterloo Road in the east, where it ties in with the Eastern Gateway, to the Tesco superstore in the west, where a new link will be provided to Finchampstead Road. The proposed road will also form a junction with Easthampstead Road along its route. Refer to Figure 1-1 below and Drawing No. 66439-LOC-001 in Appendix A.

Figure 1-1 - Location Plan



1.4.2. The proposed alignment crosses the Emm Brook and its tributaries at various locations. Refer to Figure 1-2 below which shows the proposed highway alignment and existing watercourses.

Figure 1-2 - Proposed Highway and Existing Watercourses



1.5 REPORT REFERENCES

1.5.1. The main references that are used throughout this report are:

- "Proposed Highway" – The proposed Central and Western Section of the SWDR.
- "Updated Baseline Emm Brook Model" – The baseline model used for this project, developed from the original 2017 Baseline Emm Brook model. (N.B. The Updated Baseline Emm Brook Model has been submitted to the Environment Agency for review and approval alongside this Post Development Model and Report)
- "Post Development Emm Brook Model" – The Updated Baseline Emm Brook Model with modifications to represent the Proposed Highway and other elements of the scheme including measures necessary to mitigate the proposed highway impacts.

1.6 SUCCESS MEASUREMENT CRITERIA

1.6.1. To be considered successful, the Post Development Emm Brook model must demonstrate that the flood risk profile to people and property within the area of interest is no higher than identified from the Updated Baseline Emm Brook Model.

2 POST DEVELOPMENT MODEL

2.1 DATA SOURCES

2.1.1. Topographical data sources (land and watercourses) and hydrology from the Updated Baseline Emm Brook Model remain the same for the Post Development Emm Brook Model.

2.1.2. Additional data for the Proposed Highway and PROW diversion has been taken from the 3D Highways Model prepared by TGP (refer to Drawing No. 66439-LOC-002 in Appendix A). Changes to the channel profile have been made within the model itself. In addition, a flood compensation area has been created within AutoCAD and converted for use within the model. These and other changes included within the Post Development model are discussed below.

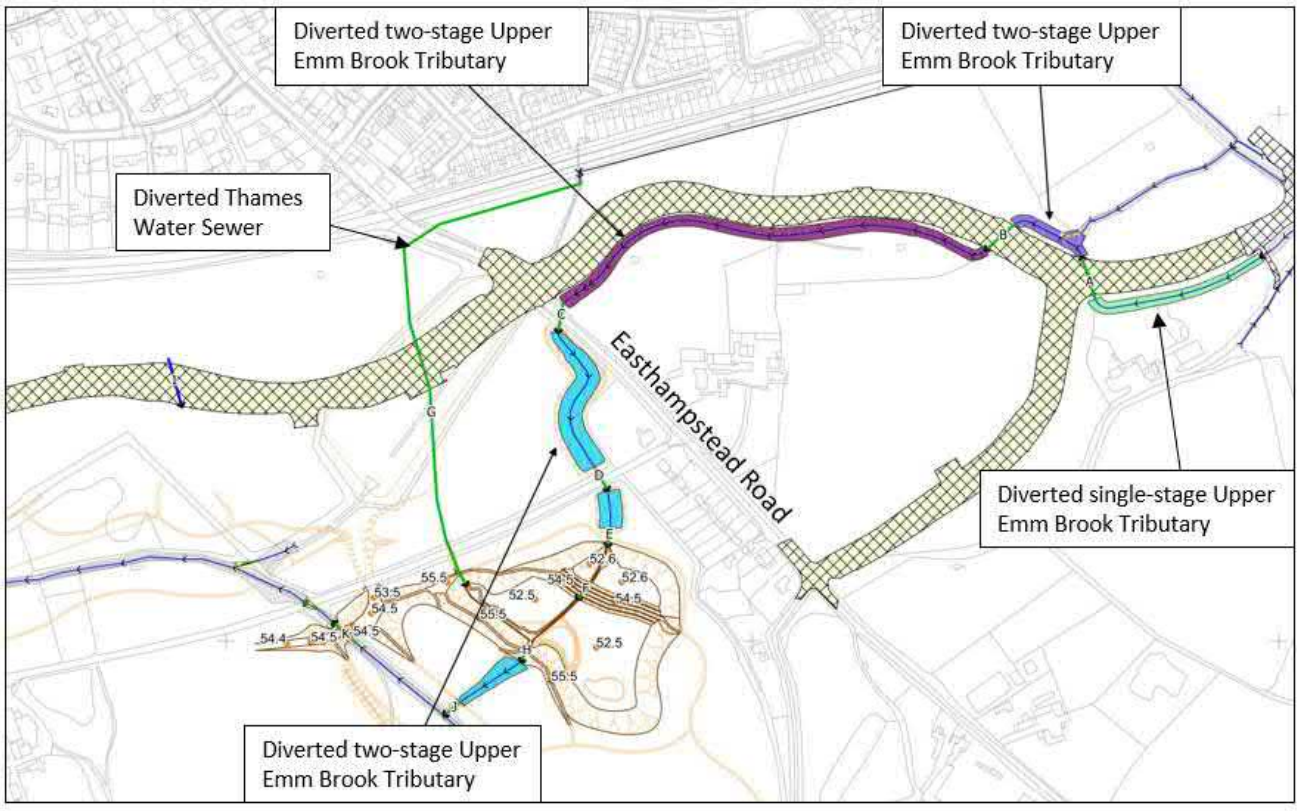
2.2 POST DEVELOPMENT PROPOSALS

UPPER EMM BROOK TRIBUTARY DIVERSION

2.2.1. As shown in Figure 1-2, the eastern part of the proposed alignment, in-between the tie-in with the Eastern Gateway roundabout on Waterloo Road and the Easthampstead Road, crosses the existing Upper Emm Brook tributary at various locations.

2.2.2. In order to satisfy technical and environmental requirements it is proposed to re-align and upgrade the existing Upper Emm Brook tributary east of Easthampstead Road by constructing a two-stage channel, where possible, along the route shown on Figure 2-1 below and Drawing No. 66439-HMS-001 in Appendix C.

Figure 2-1 - Proposed Upper Emm Brook Tributary and Thames Water Sewer Diversions

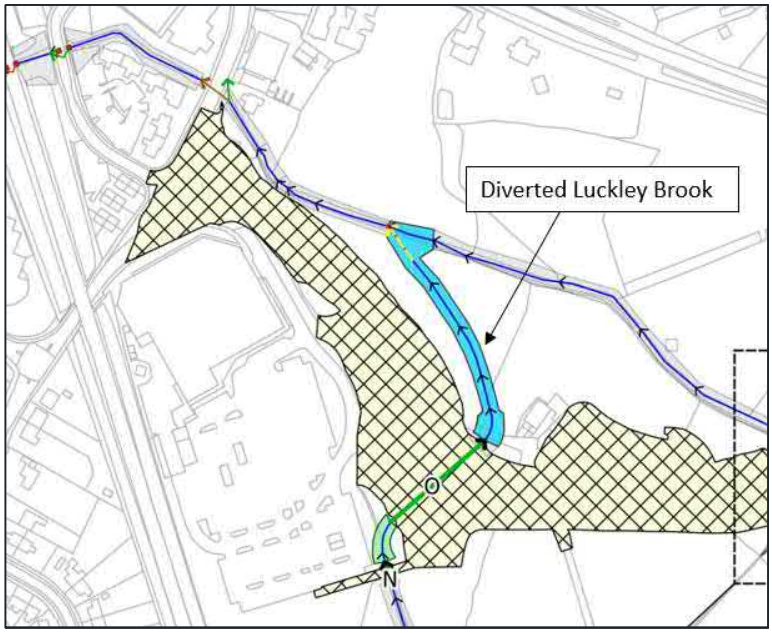


2.2.3. The Upper Emm Brook tributary will be also diverted immediately to the west of Easthampstead Road so that it flows along a new southerly route, mainly following land boundaries to optimise developable land, towards a flood compensation area described in Section 2.2.9 below.

LUCKLEY BROOK DIVERSION

2.2.4. The Luckley Brook is proposed to be diverted adjacent to Tesco to ensure that the channel can be accessed for maintenance purposes. The diversion will route the channel east beneath the Proposed Highway into a new two-stage channel alignment that will run parallel to the SWDR. Refer to Figure 2-2 below and Drawing No. 66439-HMS-001 in Appendix C.

Figure 2-2 - Proposed Luckley Brook Diversion



SEWER DIVERSIONS

2.2.5. Two Thames Water surface water sewers, originating from north of the Waterloo – Reading railway, currently discharge into an open ditch to the south of the railway before being combined with fluvial flows in the Upper Emm Brook tributary immediately upstream of Easthampstead Road.

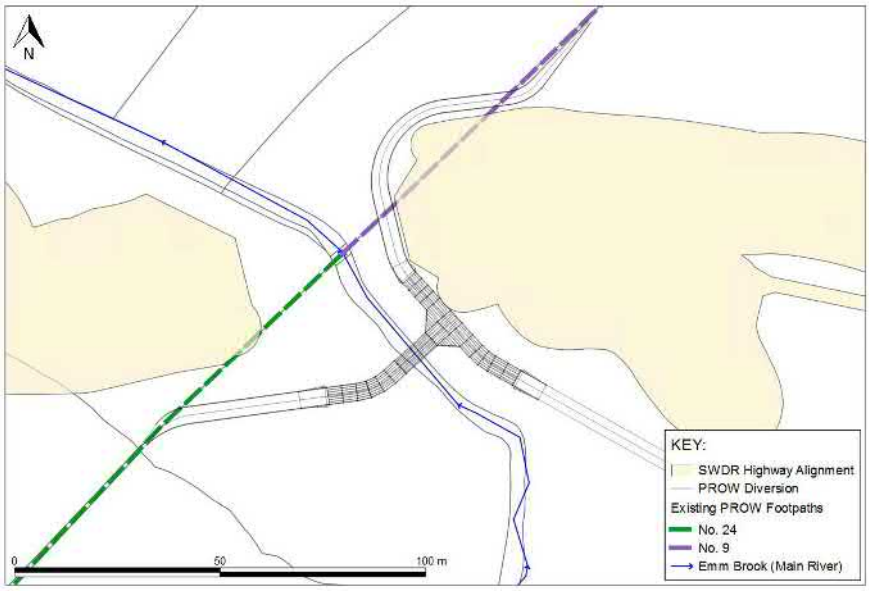
2.2.6. As part of the Post Development Model, it is proposed to separate these surface water flows from fluvial flows and culvert them west and south via a new culvert, mainly following proposed access routes that will be constructed as part of the Consortium development, towards the flood compensation area. Refer to Figure 2-1 above.

PROW DIVERSION

2.2.7. The realigned PROW referred to in Section 1.2 above (linked WOKI FP24 and WOKW FP9) is required to be diverted to the south, with a new footbridge being provided across the Emm Brook, to facilitate the SWDR bridge crossing (refer to Figure 2-3 - Location of PROW DiversionFigure 2-3 **Error! Reference source not found.**below). The PROW is also proposed to be upgraded to accommodate both cyclists and pedestrians.

2.2.8. The footbridge is proposed to be a timber boardwalk with screw piles, and a clear span section where the footbridge crosses the channel. Refer to Appendix B for design drawings of the footbridge.

Figure 2-3 - Location of PROW Diversion

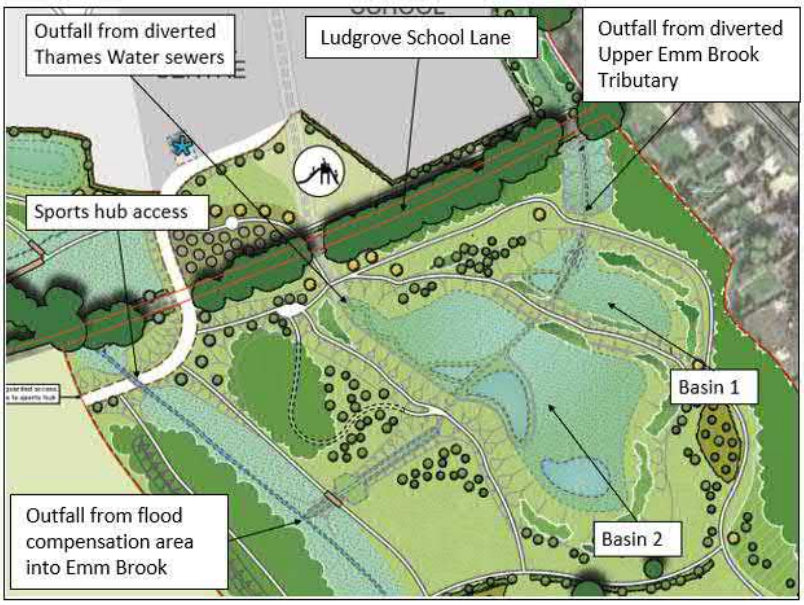


FLOOD COMPENSATION AREA

2.2.9. Part of the highway alignment passes through the Thames Water Balancing Pond located to the west of Easthampstead Road (refer to Figure 1-2). The proposal requires partial infilling of the pond to facilitate the SWDR. Infilling of the remainder of the basin is required to satisfy Consortium development requirements.

2.2.10. In order to mitigate the loss of flood storage caused by infilling of the basin and the encroachment of part of the SWDR route on Flood Zones 2 & 3, it is proposed to construct an online flood compensation area within a SANG to be constructed south of the SWDR route. Refer to Figure 2-4 **Error! Reference source not found.**for an extract of the Consortium landscape plan showing the flood compensation area (full landscape plan and design drawing of the SANG provided in Appendix D).

Figure 2-4 - Extract of Consortium Landscape plan showing flood compensation area



2.2.11. The flood compensation area will be made up of two basins. The first basin will receive flows via a 1.5m x 1.2m rectangular culvert from the diverted Upper Emm Brook Tributary. These flows will discharge into a low flow channel which has an approximate depth of between 100-300mm. The outlet from the first basin is via a 300mm diameter culvert and a spill provided via an embankment which separates the two basins. The second basin receives flows from the first basin and the outlet of the Thames Water culvert (refer to Drawing No. 66439-HMS-001 for details of the proposed culverts).

2.2.12. As shown in Table 2-1**Error! Reference source not found.** the basins provided within the SANG area provide additional area and volume compared to the existing Thames Water Balancing Pond.

Table 2-1 – Comparison between Thames Water Balancing Pond and SANG Basin

	Maximum Depth (m)	Area (m^2)	Volume (m^3)
Thames Water Balancing Pond	2.3	20,325	30,000-35,000
SANG Basin (1)	2.2	5,900	8,940
SANG Basin (2)	3.4	20,500	39,860

2.2.13. An area of ground raising, by approximately 1.7m, is required along the lowest (western) edge of the compensation area (i.e. in-between the second basin and the Emm Brook) to provide sufficient freeboard above design water levels in the basin. Refer to Appendix D for a drawing showing the SANG levels)

2.2.14. A 450mm diameter culvert is proposed at the outlet of the second basin and will act as a flow control. The culvert will discharge into a new channel which will discharge via a 525mm diameter culvert into the existing Emm Brook.

2.2.15. As part of the mitigation measures, flows on the Emm Brook will also be restricted downstream of the outfall from the basin and upstream of an existing culvert below Ludgrove School lane, by a 2100mm diameter circular culvert beneath a proposed sports hub access road.

2.2.16. The sports hub access road level has been set at 54.5m AOD which provides approximately 400mm freeboard above the peak flood level for the 1% AEP plus 70% climate change event.

SUMMARY OF PROPOSALS

2.2.17. For a detailed summary of the proposals, including the mitigation measures, please refer to Table 2-2**Error! Reference source not found.** and Drawing No. 66439-HMS-001 in Appendix C.

Table 2-2 – Modelled proposals

Measure	Description
Proposed Highway	The road has been designed to ensure that it is raised above the peak flood level for the 1% AEP + 70% climate change event.
Realignment / Diversion of the Upper Emm Brook Tributary and Thames Water sewers	The Upper Emm Brook Tributary (Ordinary Watercourse) is proposed to be realigned between the tie in with Eastern Gateway and the SANG area. Twin 1.2m diameter culverts (modelled with 0.19m soft bed depth) are proposed to take flows from two Thames Water sewers (both 1.2m diameter which ultimately originate from north of the railway). The proposed culverts will flow west and south to discharge into the second basin within the SANG area.
Realignment / Diversion of the Luckley Brook	The Luckley Brook (Ordinary Watercourse) is proposed to be diverted adjacent to Tesco. The diversion will route the channel east, beneath the Proposed Highway via a 2.1m x 2.1m rectangular culvert (modelled as a 2.1 x 1.8m to allow for sufficient soft bed). The diverted channel will have a two-stage profile and the diversion will ensure that the channel can be accessed for maintenance purposes.
PROW Diversion	The existing PROW footpath is required to be diverted. Therefore, the existing footbridge, which was modelled as a 1D element in the Baseline

Measure	Description
	model, has been removed from the Post Development model. The new footbridge has been included in the model as a 2D layered flow constriction file representing a percentage blockage based on the number and size of the piers (0.1m diameter) on the upstream face of the footbridge. The 2D layered flow constriction file allows varying obverts along the structure to represent the ramp to the clear span section. As the soffit level of the clear span bridge section has been set a minimum of 0.3m above the 1% AEP +70% climate change level (refer to Drawing No. 66439-HMS-001 in Appendix C) and there are no piers within the channel extent, the clear span section has been modelled as a normal channel.
Flood Compensation Areas	Within the SANG an online flood compensation area is proposed, made up of two basins. The first basin takes flows from the diverted Upper Emm Brook Tributary only and the second basin takes flows from the first basin and the diverted Thames Water sewers. The first basin has a 300mm culvert outlet as well as a weir overspill set to 54.5m AOD (which will also act as a SANG footpath when dry and will be closed when flooded). The second basin also has a culvert outlet. Localised ground raising of approximately 1.7m is proposed at the south western extent of the second basin (set at 55.5m AOD) to ensure that there is a consistent top of bank to maximise the storage potential. A 450mm diameter culvert is proposed beneath this embankment as a flow restriction.
Proposed Sports Hub Access Road Alignment and Culvert Flow Control on the Emm Brook (Ordinary Watercourse)	The proposed sports hub access road, which ties in with the SANG earthworks, will serve to restrict flows downstream of the basin outlets and the wider SANG area. A 2.1m culvert (modelled with 0.3m soft bed) is proposed beneath the sports hub access road to restrict flows on the Emm Brook. The level of the sports hub access road is set at 54.5m AOD which is 0.4m above the peak flood level for the 1% AEP plus 70% climate change event.

2.3 HYDROLOGICAL APPROACH

2.3.1. The hydrological approach used in the Updated Baseline Emm Brook Model has been replicated for the Post Development Model (refer to Report No. 22800-HMR-01).

2.4 MODEL SCENARIOS & EVENTS

2.4.1. The hydraulic model has utilised TUFLOW's Scenarios and Events feature meaning that only one TUFLOW control file (.tcf), ESTRY control file (.ecf), geometry control file (.tgc), boundary control file (.tbc), and materials control file (.tmf) have been used. Events were defined within a TUFLOW event file (.tef). This approach is best practice as it simplifies the management of model runs and reduces the risk of user error.

2.4.2. In order to achieve the aim of the hydraulic modelling, a number of design flood events have been simulated (refer to Table 2-3 below). This includes sensitivity testing of key culverts.

Table 2-3 – Events Simulated

Scenario	Definition	AEP	Model Scenario ~s1~	Model Scenario ~s2~	Model Event ~e2~
Post Development Model	Updated Baseline Emm Brook Model with the Proposed Highway, PROW diversion, new footbridge and all mitigation measures included.	20% 5% 1% 1% + 25% 1% + 35% 1% + 70% 0.1%	302_8	5m	Q0005 Q0020 Q0100 Q0100CC25 Q0100CC35 Q0100CC70 Q1000
Sensitivity Analysis – blockage on key culverts	Post Development Model with 50% blockage on Culvert C	1%	BLOCK_2	5m	Q0100
	Post Development Model with 50% blockage on Culvert D	1%	BLOCK_3	5m	Q0100
	Post Development Model with 50% blockage on Culvert O	1%	BLOCK_3	5m	Q0100

2.5 MODEL PARAMETERS

2.5.1. Table 2-4 below identifies the key model parameters.

Table 2-4 – Key Model Parameters

Variable	Value	Changes for Post Development Model
Software	1D / 2D ESTRY/TUFLOW version 2016-03-AD-iSP-w64 (64-bit Single Precision).	No change
Duration of modelled event	40 hour model run time	Reduced model run time to 35 hours. The peak of the event sufficiently passes the study area and therefore the run time was reduced.
1D & 2D time step	1D = 1 seconds. 2D = 2 seconds.	No change
1D Cross Section Extent and Intervals	Approximately 16 km of open watercourse is included. Approximately 13.5km of the Emm Brook from upstream of Finchampstead Road down to confluence with the River Loddon. Approximately 2.5km of Ashridge Stream from Warren House Road to the confluence with Emm Brook. Sections range from 50m to 70m apart on the Ashridge Stream and from 50 to 100m on the Emm Brook.	An approximate 790m section of the Upper Emm Brook Tributary (Ordinary Watercourse) has been diverted to facilitate the SWDR. The diversion of the tributary has increased the overall length of the channel in this section. A section of the Luckley Brook (Ordinary Watercourse) has also been diverted to ensure that there is sufficient maintenance access. Where a channel has been diverted and where sufficient space is available a two-stage channel profile has been provided. Drawing No. 66439-HMS-001 shows the changes to the tributaries.
2D Domain, coverage and cell size	The 2D is set with a regular grid with a 5m cell size. The active area of the 2D Domain is 10.81 km2.	No change
1D/2D Links	Head-Exchange (HX) lines were used along the banks of the watercourse to allow flow between the 1D and 2D domains. A ‘z line’ was added along either side of the watercourses modelled in 1D with levels taken from the surveyed cross-section at each vertex to ensure that the grid cells picked up these bankline elevations.	These were updated to reflect the proposed re-alignment / diversions on the Upper Emm Brook Tributary and Luckley Brook.

Variable	Value	Changes for Post Development Model
Inflow Conditions	Point Inflows inserted at strategic locations along the Emm Brook and Ashridge stream and Bean stream.	For the 1% AEP plus 70% Climate Change event three point inflows have been inserted to represent surface water flows from three highway drainage catchments which will freely discharge into the diverted Upper Emm Brook Tributary and be attenuated downstream within SANG area. Two inflows have been inserted upstream of Culvert C (refer to Drawing No. 66439-HMS-001 in Appendix C) and one inflow downstream which match the discharge locations.
Outflow Conditions	2D: Head vs Flow boundary based on a general catchment slope. 1D: Head vs Flow curve based on channel dimensions and slope.	No change
Scenarios Modelled	Baseline, Sensitivity: n +/-20% and blockage	Post Development (including mitigation) and blockage on key structures
Events Modelled	20% AEP, 5% AEP, 1% AEP, 1% AEP+25%CC, 1% AEP+35%CC, 1% AEP+70%CC and 0.1% AEP.	No change

2.6 HYDRAULIC MODEL SCHEMATISATION CHANGES

2.6.1. The Updated Baseline Emm Brook model schematisation has been amended to represent the Post Development scenario. Drawing No. 66439-HME-101-A shows an overview of the post development model schematisation and Drawing Nos. 66439-HME-101-1-A to 101-9-A shows the schematisation in more detail (refer to Appendix E).

2.6.2. The topography (ground model) has been amended to represent the Proposed Highway as well as the diverted PROW, the SANG area and the sports hub access road alignment, as shown on Figure 66439-HMS-001 in Appendix C. Table 2-5 below details all files that were changed; all other geometry parameters remain the same. The model schematisation outside of the study area has not been changed.

Table 2-5 – Model Parameter Change

Description	Baseline Model Files	Post Development Model Files
1d Cross Section: Set reference in cross section database to the post	1d_xs_WBC_Base_Upd_01.shp	1d_xs_302_8_L.shp

Description	Baseline Model Files	Post Development Model Files
development watercourse network.	All other watercourse networks are deemed to be the same as the 2017 Baseline model.	
1d Watercourse Network: Set reference in 1d river network section to post development watercourse network.	1d_nwke_WBC_Base_Upd_01.shp	1d_nwke_302_6_L.shp
1d Tab File: Mid cross sections to define bridges, weirs and irregular culvert sections.	1d_CS_Base_Upd_L1.shp	1d_CS_302_8_L1.shp
Adjusted water level lines to reflect post development watercourse network where diversions are proposed.	1d_WLL_WBC_Base_Upd_01.shp	1d_WLL_302_8_L1.shp
HXI boundary and 1d-2d interface changed to reflect post development watercourse network where diversions are proposed.	2d_hxi_WBC_Base_Upd_L1.shp	2d_hxi_302_8_L1.shp
Adjusted inactive code boundary to reflect post development watercourse network where diversions are proposed.	2d_code_NULL_Base_Upd_01.shp	2d_code_NULL_302_8_R1.shp
Adjusted banks using 2d 'z-line' file to reflect post development watercourse network where diversions are proposed.	2d_zln_banks_WBC_Base_Upd_L1.shp	2d_zln_banks_302_8_L1.shp
Adjusted banks using 2d 'z-point' file to reflect post development watercourse network and ensure that the correct top of bank level was being used for the connection between 1d to 2d.	2d_zln_banks_WBC_Base_Upd_P1.shp	2d_zln_banks_302_8_P1.shp
Adjusted location of 1d inflow point (A5) to match diverted Upper Emm Brook Tributary.	1d_bc_EMM_EG_01_P.shp	1d_bc_EMM_EG_301_2_01_P.shp
Inclusion of three additional 1d inflow points to represent surface water drainage flows (1% AEP plus 70% Climate Change event only).	Not used.	1d_bc_TGP_Flows_01_P.shp

Description	Baseline Model Files	Post Development Model Files
1d-2d SX Points to link diverted Upper Emm Brook Tributary and Thames Water Culvert into 2d SANG area.	Not used.	2d_bc_sx_301_2_P1.shp
2d Layered Flow Constriction 'z-shape' to reflect PROW boardwalk alignment.	Not used.	2d_lfcsh_301_9_R1.shp
2d Layered Flow Constriction z-point' to reflect varying soffit levels along the PROW boardwalk.	Not used.	2d_lfcsh_301_9_P1.shp
Inclusion of 2d 'z-shape' to reflect the three ramps to the PROW boardwalk.	Not used.	2d_zsh_301_3_R1.shp | 2d_zsh_301_3_P1.shp
Inclusion of ground model (.asc) to represent the Proposed Highway.	Not used.	Highway_DEM_3D.asc
Inclusion of ground model (.asc) to represent the SANG area and the sports hub access road.	Not used.	SANG_Basins_302_4.asc
Inclusion of 2d gully 'z-line' and 'Z-points' to represent low flow channel within SANG basins.	Not used.	2d_zsh_302_4_L1.shp | 2d_zsh_302_4_P1.shp

2.7 PROPOSED CULVERTS

2.7.1. The majority of the proposed culvert crossings have also been modelled to take account of a soft bed depth. For the circular culverts a height-width table has been produced to model the reduction in flow area and classified in the 1d network as 'Irregular'. For the rectangular culverts the height has been altered. Refer to Table 2-6 which shows the soft bed depth applied for each culvert and Drawing No. 66439-HMS-001 (Appendix C) which shows the culvert locations.

Table 2-6 - Culvert and Bridge Structure Details

Structure Reference	Type	No.	Width (m)	Height (m)	Diameter (m)	Soft Bed Depth (m)
A	Culvert	4	-	-	0.60	0.15
B	Culvert	3	-	-	0.90	0.20
C	Culvert	1	3.6	1	-	0.25
D	Culvert	1	1.5	1.2	-	0.15

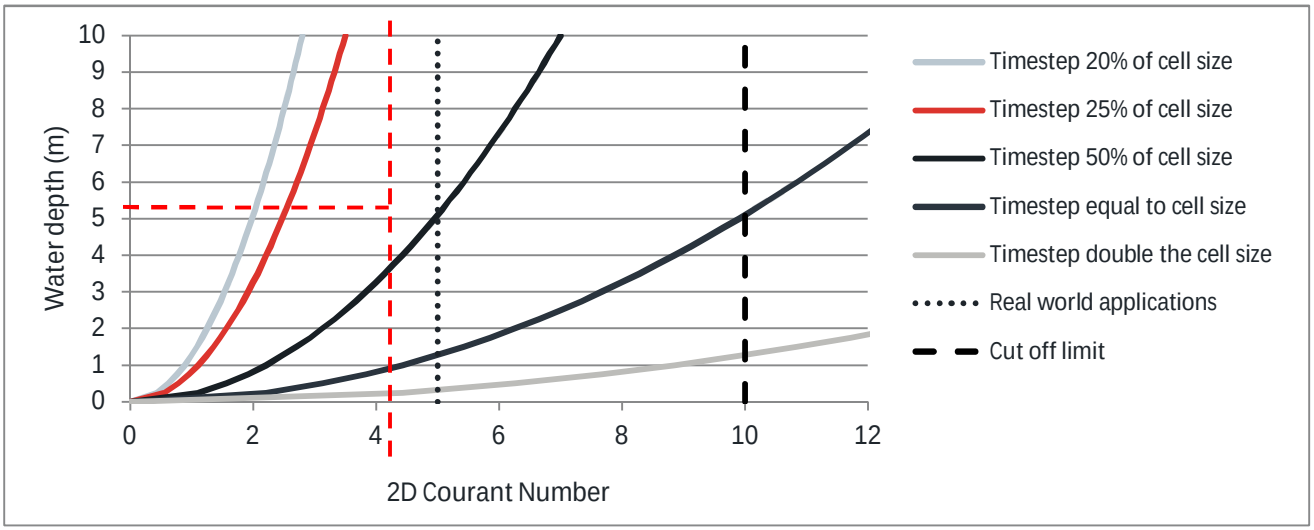
Structure Reference	Type	No.	Width (m)	Height (m)	Diameter (m)	Soft Bed Depth (m)
E	Culvert	1	1.5	1.2	-	0.15
F	Culvert	1	-	-	0.30	-
G	Culvert	2	-	-	1.20	0.19
H	Culvert	1	-	-	0.45	-
J	Culvert	1	-	-	0.53	0.11
K	Culvert	1	-	-	2.1	0.3
L	PROW Bridge	1	10.2	-	-	-
M	Road Bridge	1	40	-	-	-
N	Culvert	1	1.8	1.8	-	0.3
O	Culvert	1	2.1	2.1	-	0.3

3 MODEL INTEGRITY

3.1 VALIDATION

3.1.1. The Courant number is a function of the water depth and cell size. The equations used within TUFLOW do not perform well when the water depth increases towards or is greater than the 2D cell size. The maximum water depth recorded in the 2D domain was approximately 5.2m which gives a maximum Courant number of approximately 4.07 which is well within the acceptable limits indicated in Figure 3-1.

Figure 3-1 - Courant Number Acceptable Limits



3.1.2. The mass balance error at the end of each model run was within the limits suggested by the Environment Agency of within +/-1%. Mass error is a function of the flows into the model and the flows out. For very small depths and flows, there is insufficient water to trigger the 2D cell to switch on as “wet” and therefore this small depth is lost. The Mass Balance error is a percentage of the water lost compared to the overall volume of water throughout the model simulation.

3.1.3. A number of negative depth warnings were recorded during all of the model runs. After interrogation of the model and results, it was found that these negative depths were recorded at the initial wetting stage of the channel around complex section of weirs and culverts.

3.1.4. Almost all of these negative depths were resolved as the channel had increased flows and occurred well before the peak flood depths were recorded. The peak flood depths and times were checked and it was found that the early negative depths were not having an impact on the final model results.

3.1.5. None of the negative depths resulted in errors causing the model to stop due to instability.

3.1.6. All other checks and warnings prior to the simulation were as a result of geometry alterations and channel/structure sections and were reviewed prior to producing results. None of these affect the results of the hydraulic modelling.

3.1.7. All models ran to completion. A summary of the model health is shown in Table 3-1. This confirms that the model is deemed stable and acceptable for use in comparison with the baseline model.

Table 3-1 – Model Health Summary

Run No.	Scenario	AEP (%)	Mass Error (%)		Negative Depths	
			Final	Peak	1D	2D
1	Post Development	20%	-0.43	-0.52	10	0
2		5%	-0.41	-0.60	12	1
3		1%	-0.39	-0.67	13	1
4		1% + 25% CC	-0.27	-0.63	5	13
5		1% + 35% CC	-0.30	-0.73	1	2
6		1% + 70% CC	-0.32	-0.90	19	2
7		0.1%	-0.35	-0.91	7	1
8	Blockage on Key Structures	1%	-0.39	-0.66	10	4
9		1%	-0.39	-0.66	9	2
10		1%	-0.39	-0.65	8	2

4 RESULTS

4.1.1. Mapping of the maximum flood area and depth are presented in Appendix F for all scenarios and events simulated.

4.1.2. Drawing No. 66439-HMR-206-A in Appendix F presents a flood map showing the changes in floodplain extent between the Updated Baseline Emm Brook Model and the Post Development Emm Brook Model, for the 1% AEP plus 70% climate change. Refer to Drawing Nos. 66439-HMR-201 to 207 in Appendix F for all of the Post Development model results compared against the Baseline model results.

4.1.3. Table 4-1 provides a detailed overview of the change in peak flood level along the Emm Brook and its tributaries as a result of the Proposed Highway and mitigation measures for the 1% AEP plus 70% climate change event. No comparison has been made where the tributaries have been realigned to the west of the Eastern Gateway.

4.1.4. Common reference points have been used to cross reference results. Refer to Table 4-1 below and Drawing No. 66439-HMR-206 in Appendix F for the 1% AEP + 70% Climate Change model results.

Table 4-1 – Difference in Flood Levels between the Baseline and Post Development model (1% AEP plus 70% climate change)

Point	Easting	Northing	1% AEP + 70% CC Baseline Water Level (m AOD)	1% AEP + 70% CC Post Development Water Level (m AOD)	Difference in Flood Levels (m)
1	482459	167013	54.89	54.88	-0.001
2	482484	167057	54.86	54.86	-0.002
3	482391	167091	54.43	54.45	0.018
4	482435	167109	54.61	54.61	-0.001
5	482354	167169	54.18	54.24	0.064
6	482387	167186	54.11	54.14	0.034
7	482246	167372	53.46	54.10	0.643
8	482283	167387	53.36	54.10	0.739
9	482202	167448	53.36	54.10	0.745
10	482220	167465	53.36	54.10	0.744
11	482244	167490	53.36	54.10	0.744
12	482174	167476	53.35	54.10	0.748
13	482196	167494	53.36	54.10	0.746

Point	Easting	Northing	1% AEP + 70% CC Baseline Water Level (m AOD)	1% AEP + 70% CC Post Development Water Level (m AOD)	Difference in Flood Levels (m)
14	482219	167512	53.36	54.10	0.745
15	482120	167485	53.35	54.10	0.751
16	481932	167567	52.13	52.09	-0.043
17	481927	167620	52.07	52.05	-0.012
18	481727	167520	51.83	51.80	-0.035
19	481589	167498	51.83	51.79	-0.034
20	481650	167009	52.42	52.42	0.000
21	481618	167106	52.33	52.33	0.000
22	481655	167105	52.33	52.33	0.000
23	481547	167333	52.31	52.31	0.000
24	481600	167342	52.31	52.31	0.000
25	481460	167511	50.91	50.89	-0.014
26	481388	167542	50.70	50.74	0.036
27	481430	167597	50.68	50.72	0.040
28	481283	167689	50.52	50.66	0.134
29	481348	167701	50.54	50.67	0.129
30	481105	167800	50.39	50.34	-0.045
31	481065	167227	53.40	53.40	0.000
32	481036	167336	52.56	52.56	0.000
33	480998	167459	51.58	51.58	0.000
34	481027	167467	51.44	51.44	0.000
35	481047	167569	50.73	50.74	0.014
36	481054	167673	50.39	50.00*	-0.386
37	481107	167897	50.39	50.33	-0.051
38	481014	167927	50.38	50.33	-0.053

Point	Easting	Northing	1% AEP + 70% CC Baseline Water Level (m AOD)	1% AEP + 70% CC Post Development Water Level (m AOD)	Difference in Flood Levels (m)
39	481006	167991	50.38	50.33	-0.052
40	480904	167903	50.36	50.27	-0.096
41	480938	167985	50.38	50.33	-0.053
42	480874	167954	50.31	50.22	-0.087
43	480734	167958	49.87	49.80	-0.070
44	480744	168003	49.87	49.80	-0.071
45	480340	168112	49.13	48.83*	-0.301

* Level taken from Environment Agency LiDAR data.

4.1.5. The results show that flood extents and levels are increased within the SANG area and upstream of the sports hub access road as expected (refer to points 3 to 15 in Table 4-1). The increased extents and levels are contained within SANG area and do not extend upstream of Heathlands Road, which is at the southern boundary of the SANG (refer to points 1 and 2 in Table 4-1).

4.1.6. The future development as part of the Consortium masterplan is not proposed within the SANG area (refer to Drawing No. 66439-HMR-208 in Appendix F which shows the Consortium masterplan and the 1% AEP plus 70% climate change flood extents) and flood risk to existing properties is not increased. This increase is therefore acceptable within the SANG area.

4.1.7. The model indicates that flood levels and extents are decreased immediately downstream of the proposed sports hub access road by up to approximately 43mm (refer to point 16 in Table 4-1).

4.1.8. Flood extents and levels are increased by approximately 135mm immediately upstream of the proposed road bridge and PROW footbridge over the Emm Brook (Main River) as expected (refer to points 28 and 29 in Table 4-1).

4.1.9. Flood levels and extents are decreased by approximately 386mm on the floodplain adjacent to the Luckley Brook (Ordinary Watercourse) south east of Tesco, and by approximately 50mm to the north of the Emm Brook (Main River) east of Tesco and Finchampstead Road. Levels are decreased immediately downstream of the scheme area by approximately 70mm.

4.1.10. It is considered that the risk attributable to the nominal increase in flood levels within open areas along the proposed SWDR route is outweighed by the benefit of reducing flood levels and extents downstream of the Proposed Development.

4.1.11. The Post Development option is therefore considered to provide sufficient compensation to mitigate the effect of the scheme on flood risk.

4.1.12. It should be noted that while the modelled option shows that a viable compensation solution exists within the SANG, opportunities will be taken at the detailed design stage to refine the design and achieve the optimum balance between effect and mitigation.

4.2 SENSITIVITY TESTING

4.2.1. A 50% blockage scenario was applied to three key proposed culvert structures within the study area.

4.2.2. The results of the blockage testing are presented in Drawing Nos. 66439-HMR-301 to 303 in Appendix F for the 1% AEP event.

4.2.3. A sensitivity rating for the results has been determined using the absolute change in flood level, and the relative change in flood level (refer to Table 4-2).

Table 4-2 - Sensitivity Rating

	Proportional Change in Flood Depth			
Absolute Change in Flood Depth	0 to 2%	2 to 5%	5 to 10%	Greater than 10%
0 to 25 mm	Nominal	Negligible	Moderate	Severe
25 to 50 mm	Negligible	Negligible	Moderate	Severe
50 to 150 mm	Moderate	Moderate	Severe	Severe
Greater than 150 mm	Severe	Severe	Severe	Severe

BLOCKAGE ON CULVERT C (SCENARIO 1)

4.2.4. A 50% blockage has been applied to Culvert C, which is a 3.6m x 0.75m rectangular culvert proposed beneath the existing Easthampstead Road.

4.2.5. The results of the blockage scenario compared to the unblocked post development model for the 1% AEP event indicate an increase in flood depth upstream of the culvert of approximately 70mm (refer to Points 2 and 3 on Drawing No. 66439-HMR-301 in Appendix D).

4.2.6. The difference in flood depths, absolute and relative, have been provided in Table 4-3. Based on the sensitivity rating in Table 4-2 the model mostly has nominal sensitivity to a 50% blockage on Culvert C. Two inspection points, upstream of the blockage, are classified with moderate and severe sensitivity. However, this has not resulted in an increase in flood extents or flows within the floodplain upstream of Culvert C, indicating that the upstream channel has sufficient capacity to cater for the increase in flood depth.

4.2.7. The results also do not show a significant impact on flood levels downstream of the blockage.

BLOCKAGE ON CULVERT D (SCENARIO 2)

4.2.8. A 50% blockage has been applied to Culvert D, which is a 1.5m x 1.05m rectangular culvert proposed beneath the existing Ludgrove School access lane.

4.2.9. The results of the blockage scenario compared to the post development model for the 1% AEP event indicate an increase in flood depth upstream of the culvert of approximately 170mm (refer to Points 2 to 5 on Drawing No. 66439-HMR-302 in Appendix D).

4.2.10. The difference in flood depths, absolute and relative, have been provided in Table 4-3. Based on the sensitivity rating in Table 4-2 the model mostly has nominal sensitivity to a 50% blockage on Culvert D. Four inspection points, upstream of the blockage, are classified with severe sensitivity. However, this has not resulted in an increase in flood extents or flows within the floodplain upstream of Culvert D, indicating that the upstream channel has sufficient capacity to cater for the increase in flood levels.

4.2.11. The results also do not show a significant impact on flood levels downstream of the blockage.

BLOCKAGE ON CULVERT O (SCENARIO 3)

4.2.12. A 50% blockage has been applied to Culvert O, which is a 2.1m x 1.8m rectangular culvert proposed beneath the SWDR highway alignment.

4.2.13. The results of the blockage scenario compared to the post development model for the 1% AEP event indicates an increase in flood depth upstream of the culvert of approximately 43mm (refer to Point 9 on Drawing No. 66439-HMR-303 in Appendix D).

4.2.14. The difference in flood depths, absolute and relative, have been provided in Table 4-4 for Scenario 3. Based on the sensitivity rating in Table 4-2 the model mostly has nominal sensitivity to a 50% blockage on Culvert O. One inspection point upstream of the blockage, is classified with moderate sensitivity. However, this has not resulted in an increase in flood extents or flows within the floodplain upstream of Culvert O, indicating that the upstream channel has sufficient capacity to cater for the increase in flood levels.

4.2.15. The results also do not show a significant impact on flood levels downstream of the blockage.

Table 4-3 - Sensitivity Matrix (Blockage Scenarios 1 and 2)

Scenario	Inspection Point, Peak Flood Depth (m)										
	1	2	3	4	5	6	7	8	9	10	11
Post Development Model: 1% AEP	0.292	0.457	0.993	1.404	1.652	1.919	1.919	1.997	1.997	0.390	0.909
Blockage Scenario 1: 1% AEP	0.292	0.517	1.051	1.400	1.647	1.919	1.919	1.997	1.997	0.390	0.909
Absolute Depth Change (m)	0.000	0.060	0.058	-0.004	-0.004	0.000	0.000	0.000	0.000	0.000	0.000
Relative Depth Change (%)	0%	13%	6%	0%	0%	0%	0%	0%	0%	0%	0%
Blockage Scenario 2: 1% AEP	0.292	0.605	1.134	1.550	1.808	1.915	1.915	2.000	2.000	0.390	0.909
Absolute Depth Change (m)	0.000	0.148	0.141	0.146	0.156	-0.004	-0.004	0.003	0.003	0.000	0.000
Relative Depth Change (%)	0%	32%	14%	10%	9%	0%	0%	0%	0%	0%	0%

Table 4-4 – Sensitivity Matrix (Blockage Scenario 3)

Scenario	Inspection Point, Peak Flood Depth (m)											
	1	2	3	4	5	6	7	8	9	10	11	12
Post Development Model: 1% AEP	0.181	0.072	0.076	0.027	0.364	0.064	0.401	0.721	0.792	1.216	1.450	0.433
Blockage Scenario 3: 1% AEP	0.181	0.072	0.077	0.027	0.364	0.064	0.401	0.721	0.835	1.227	1.450	0.433
Absolute Depth Change (m)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.043	0.011	-0.001	0.000
Relative Depth Change (%)	0%	0%	0%	0%	0%	0%	0%	0%	5%	1%	0%	0%

5 ASSUMPTIONS AND LIMITATIONS

5.1 ASSUMPTIONS

5.1.1. The following assumptions have been made during the development of the hydraulic model.

- The ground model has been derived from Environment Agency LiDAR data, obtained from the Environment Agency's open survey portal. The data has been assumed to be fit for purpose. The ground model matches the model used in the Baseline modelling report however adjustments have been made to represent the Proposed Highway, ditch and sewer realignments, the PROW, the SANG and the sports hub access road alignment.
- 2D surface roughness values have been assumed based on Ordnance Survey Mastermap data, as per the Baseline modelling report.
- The percentage blockage applied to the 2D layered flow constriction file to represent the elevated PROW was calculated by taking the length of the upstream face of the structure and the total diameter of the obstructing piers (each pier 0.1m diameter).
- All structures in the model were assumed to be free and clear of debris in the proposed model runs (in line with the Baseline model), however sensitivity runs were also undertaken to assess blockages of three key culverts in the model.
- A soft bed depth has been taken into account for modelling proposed culverts.

5.2 LIMITATIONS

5.2.1. The limitations of the model are the same as those highlighted in the baseline modelling report.

5.2.2. The modelling is based on the design proposals presented in Drawing No. 66439-HMS-001 in Appendix C. Should there be significant changes to the design during the detailed design process then re-testing of the proposals would be required.

6 CONCLUSIONS

6.1.1. WSP has been commissioned by Wokingham Borough Council to undertake numerical hydraulic modelling to support the Flood Risk Assessment prepared for Central and Western section of the proposed SWDR. The aim of the hydraulic modelling is to determine the impacts on flood risk resulting from the construction of the road and mitigate against any increase in risk.

6.1.2. A planning application for the proposed SWDR was submitted in November 2019 (Planning Ref. 192928), however subsequent design changes have resulted in an update to the hydraulic modelling previously carried out. This update also addresses comments, where still applicable, made by the Environment Agency in their review of the 2019 planning model.

6.1.3. The Post Development model has been developed from the Updated Baseline Emm Brook model for which a separate Technical Note has been prepared and submitted to the Environment Agency (Document No. 32441-HMTN-01).

6.1.4. The Post Development model has been run for the 20%, 5%, 1%, 1% (plus 25%, 35% and 70% climate change), and 0.1% AEP events.

6.1.5. The key differences between the Baseline and Post Development models are: the proposed SWDR route including bridge crossings and culverts, a realigned PROW & new footbridge, a flood compensation area, and a diverted Emm Brook & tributaries in the eastern half of the scheme.

6.1.6. The results of the hydraulic modelling indicate that the Proposed Highway has the capacity to exacerbate flood risk to neighbouring properties, unless mitigation is incorporated into the development.

6.1.7. The measures that can effectively mitigate the potential flood risk impacts consist of an online flood compensation area comprising of two basins which will be located within a SANG area to the south of the SWDR route. The compensation area will attenuate fluvial flows and provide sufficient compensation for the loss of floodplain storage as a result of the Proposed Highway.

6.1.8. In order to maximise the viability of the floodplain compensation area the culverts proposed at its outlet and downstream of the SANG on the Emm Brook (below the sports hub access) have been proposed with dimensions that restrict flows and hold them up within the compensation area. The culverts in question are:

- Outlet from the first basin (Culvert F) – 0.3m diameter
- Outlet from the second basin (Culvert H) – 0.45m diameter
- Culvert beneath the sports hub access road (Culvert K) – 2.1m diameter

6.1.9. A comparison of the Baseline and Post Development (with mitigation) model results indicate that flood levels and extents are increased within the SANG area as designed. There is also a slight increase in flood extent and levels upstream of the proposed bridge over the Emm Brook. However, there is no exacerbation of flood risk to existing properties in the vicinity of these locations. Future development within the SDL should take account of the post development flood extents.

6.1.10. Overall, the mitigation measures will provide a net benefit in terms of reducing fluvial flood risk extents and flood levels downstream of the study area and ensuring that flood risk upstream of the study remains unaffected. The results also indicate that the risk of flooding for existing properties within the study area does not change.

Appendix A

LOCATION PLAN

480500 481000 481500 482000 482500 483000 483500

169000 168500 168000 167500 167000

N

WOKINGHAM

Wokingham

Reading Road
Holt La
Rectory Road
Shire Road
Keephatch Road
Rose Street
London Road
Rances La
Murdoch Road
Millar's La
Eastheath
Chapel Green
Garden Cottage
Grays Farm
Enchanted Barn
Holme Green
Redlake La
Meadows Farm
Big Wood House
Waterloo Ro
Britton's Farm
Wood's Farm
Locks Farm
Eastheath Postead Road

Coventry
Cambridge
Worcester
Oxford
Luton
LONDON
Reading
Canterbu
Brighton and Ho
Portsmouth

0 250 500 750 1000 m

KEY:

- Indicative Site Boundary
- Site Location
- Eastern Gateway Highway Alignment
- SWDR Highway Alignment

REV	DATE	DRW	DESCRIPTION	CHK	APP
A	16/09/20	GL	FIRST ISSUE	JH	MQ

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CLIENT: WOKINGHAM BOROUGH COUNCIL

ARCHITECT: -

PROJECT: SWDR - CENTRAL AND WESTERN SECTION

TITLE: LOCATION PLAN

DRAWN:	CHECKED:	APPROVED:

QGIS FILE:	SCALE @A3:	DATE:
66439-LOC-001.qgz	1:10000	16/09/20

PROJECT No:	DRAWING No:	REV:
70066439	66439-LOC-001.qgz	A

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481000 481500 482000 482500 483000

168500 168000 167500 167000

N

Emm Brook (Main River)

Emm Brook (Ordinary Watercourse)

Upper Emm Brook Tributary (Ordinary Watercourse)

Thames Water Balancing Pond

Emm Brook Tributary (Ordinary Watercourse)

Luckley Brook (Ordinary Watercourse)

0 250 500 750 1000 m

KEY:

- SWDR Highway Alignment
- Eastern Gateway Highway Alignment
- PROW Diversion Alignment

Watercourse Network

- B (Bridge)
- C (Circular Culvert)
- I (Irregular Culvert)
- R (Rectangular Culvert)
- S (Normal Channel)
- W (Weir)
- Watercourse Extents

REV	DATE	DRW	DESCRIPTION	CHK	APP
A	05/10/20	JH	FIRST ISSUE	MQ	RL

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CLIENT: WOKINGHAM BOROUGH COUNCIL

ARCHITECT: -

PROJECT: SWDR - CENTRAL AND WESTERN SECTIONS

TITLE: LOCATION PLAN - PROPOSED HIGHWAY AND PROW AND EXISTING WATERCOURSES

DRAWN:	CHECKED:	APPROVED:

QGIS FILE:	SCALE @A3:	DATE:
66439-LOC-002.qgs	1:8,000	05/10/20

PROJECT No:	DRAWING No:	REV:
70066439	66439-LOC-002	A

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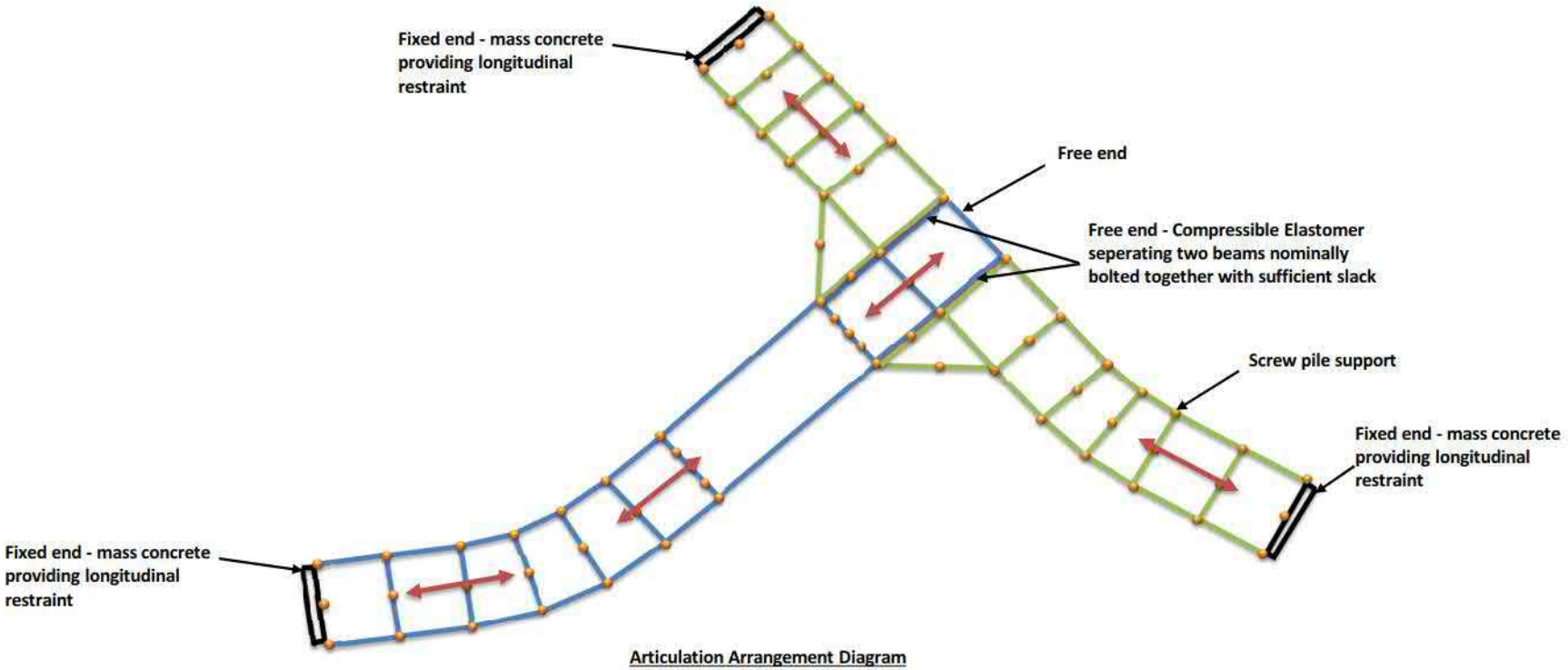
Appendix B

PROW DESIGN DRAWINGS



Articulation Arrangement Diagram

POST AND RAIL FENCE WITH DOG-MESH TO FORM CONTINUITY FROM PARAPET FOR FULL LENGTH OF REALIGNED PATH

WIDTH RESTRICTION BOLLARD

EARTH APPROACH RAMP

1 IN 20

2000 LANDING

4000 LANDING

EMM BROOK

GROUND EXCAVATED TO FORM BACKWATER CREATING NEW HABITAT FOR FISH AND INVERTEBRATES. SEE NOTE 5

A-A 5002

B-B 5002

C-C 5002

EMM BROOK TOP OF BANK

INDICATIVE SANG FOOTPATH ALIGNMENT DESIGNED BY OTHERS

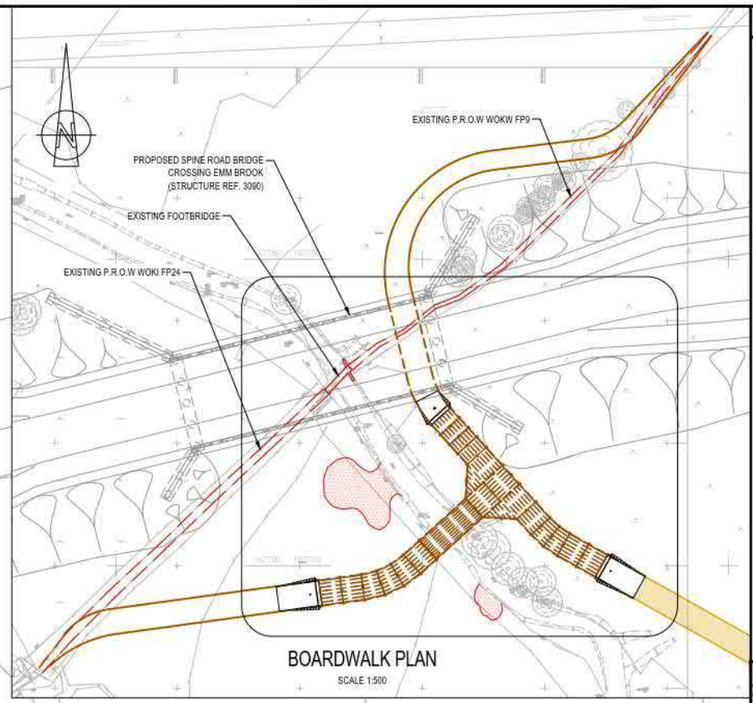
POST AND RAIL FENCE WITH DOG-MESH TO FORM CONTINUITY FROM PARAPET FOR FULL LENGTH OF REALIGNED PATH

SUPPORT LOCATIONS AND SPACING SHOWN ARE INDICATIVE AND ARE TBC AT DETAILED DESIGN

CLEAR WIDTH FROM INSIDE FACE OF HANDRAILS 4000 MIN

STRUCTURE DIMENSIONS ARE BASED ON PRELIMINARY DESIGN CALCULATIONS AND ARE TO BE CONFIRMED DURING THE DETAILED DESIGN PHASE

PLAN
SCALE 1:100



BOARDWALK PLAN
SCALE 1:500

SCALE 1:500

SCALE 1:100

DO NOT SCALE

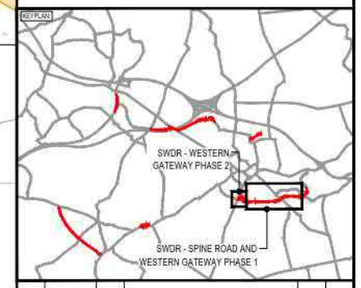
NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. ALL LEVELS ARE IN METRES AOD UNLESS NOTED OTHERWISE.
3. TO BE READ IN CONJUNCTION WITH DRAWING WMHP-TG-SRWG1-DR-SE-5002
4. FOOTPATH AND BOARDWALK ALIGNMENT SHOWN ON DRAWING ARE INDICATIVE AND ARE TBC AT DETAILED DESIGN .
5. SIZE AND LOCATIONS OF BACKWATERS ARE INDICATIVE. DETAILS TO BE CONFIRMED AT DETAILED DESIGN.

KEY

- INDICATIVE SCREW (HELICAL) PILE LOCATIONS
- PROPOSED BOARDWALK ALIGNMENT
- PROPOSED RE-ALIGNED PROW FOOTPATH
- INDICATIVE SANG FOOTPATH ALIGNMENT

KEY PLAN



REV.	DATE	BY	DESCRIPTION	CHK	APP
P01	17/08/2020	TCH	FIRST ISSUE	KL	CMF

DRAWING STATUS: SUITABLE FOR REVIEW & COMMENT — S3

DESIGNER:
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Consulting Civil, Structural and Geotechnical Engineers

CONTRACTOR: Balfour Beatty

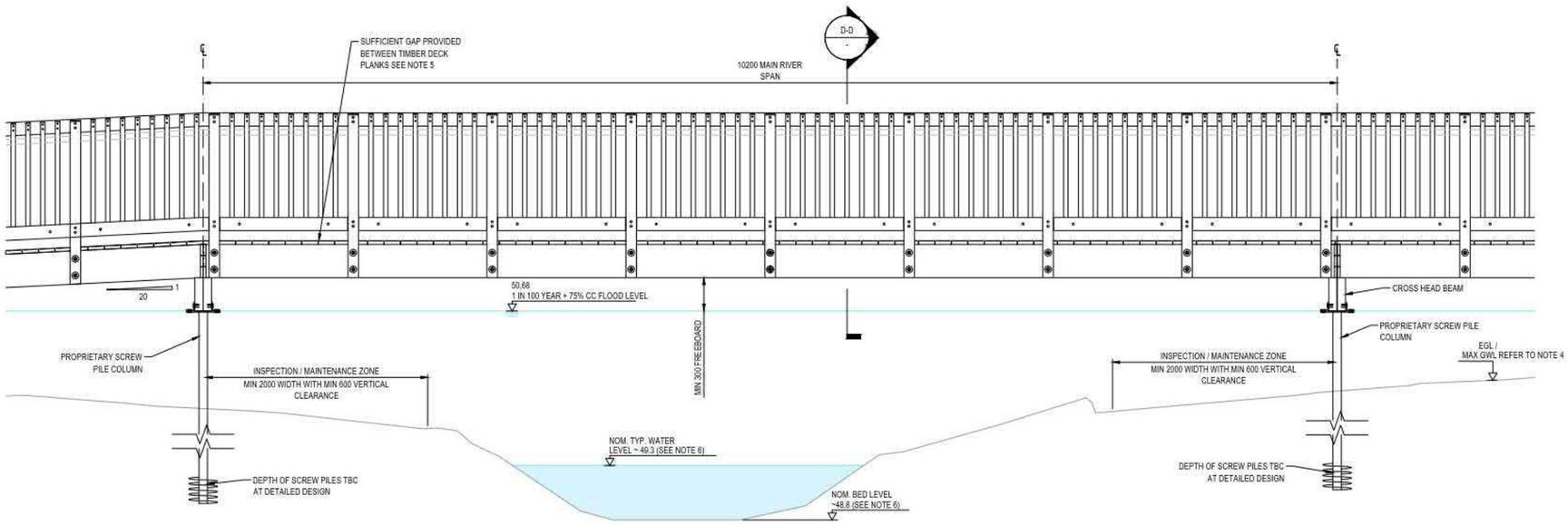
CLIENT: WOKINGHAM BOROUGH COUNCIL
Shute End, Wokingham, Berkshire RG40 1BN
Tel: (0118) 974 6000 Web: www.wokingham.gov.uk

PROJECT:
WOKINGHAM MAJOR HIGHWAYS PROGRAMME
SPINE ROAD AND WESTERN GATEWAY PHASE 1

TITLE:
SWDR SPINE ROAD GYPSY LANE BOARDWALK
STRUCTURE REFERENCE: 3094
AIP GENERAL ARRANGEMENT

SCALE @ A1:	CHECKED:		APPROVED:
N/A	KL		CMF
PROJECT NO:	DESIGNED:	DRAWN:	DATE:
C118047	EPM	TCH	August 20

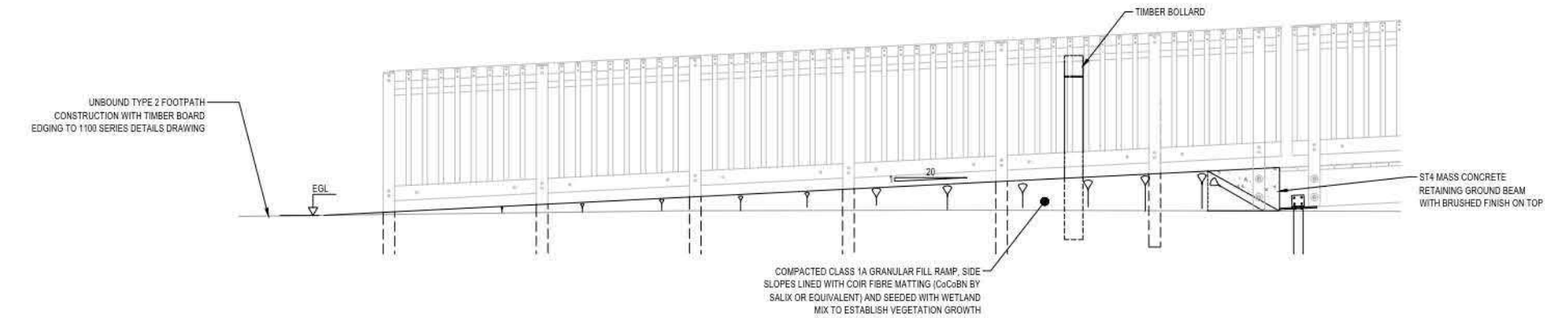
DRAWING No: WMHP-TG-SRWG1-DR-SE-5001 — REV: P01



ELEVATION A-A - MAIN RIVER SPAN

(REF -5001)

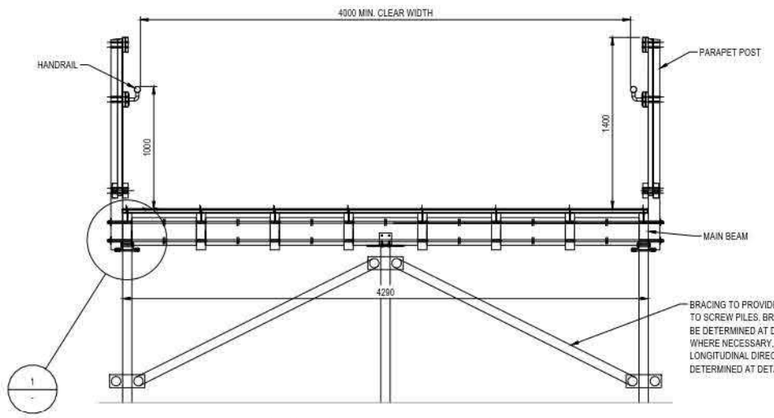
SCALE 1:25



ELEVATION B-B - TYPICAL RAMP APPROACH / TERMINATION

(REF -5001)

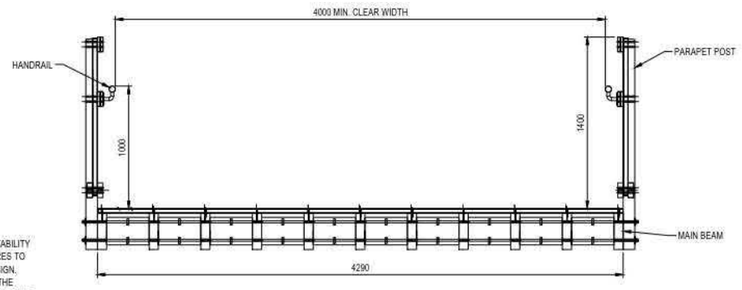
SCALE 1:25



SECTION C-C - BOARDWALK RAMP

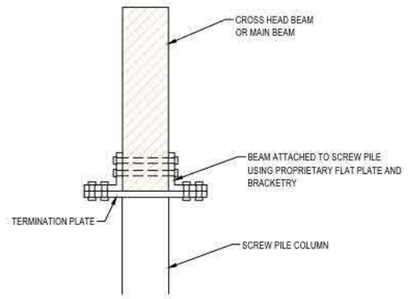
(REF -5001)

SCALE 1:25



SECTION D-D - MAIN RIVER SPAN

SCALE 1:25



DETAIL 1

TYPICAL SCREW PILE CONNECTION TO TIMBER

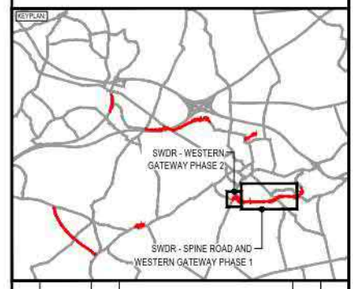
(DETAIL TO BE CONFIRMED AT DETAILED DESIGN)

SCALE 1:5

DO NOT SCALE

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. ALL LEVELS ARE IN METRES AOD UNLESS NOTED OTHERWISE.
3. TO BE READ IN CONJUNCTION WITH DRG. WMHP-TG-SRWG1-DR-SE-5001
4. GROUND WATER MONITORING TO FROM DECEMBER 2019 TO MARCH 2020 INDICATES GWL TO VARY BETWEEN GROUND LEVEL TO 0.75mbgl.
5. TIMBER PLANKS PLACED WITH SUFFICIENT GAP (MAX 12mm) TO ALLOW FOR DRAINAGE AND TO PROVIDE SUNLIGHT TO VEGETATION BELOW.
6. NOMINAL RIVER WATER AND BED LEVELS BASED ON RECORDED LEVELS OF 49.223mAOD / 48.75mAOD RESPECTIVELY AT EXISTING PROW FOOTBRIDGE AND 49.290mAOD / 48.85mAOD RESPECTIVELY AT LOCATION 46m UPSTREAM. SURVEYED ON 04/04/2015 BY "MURPHY SURVEYS", AS SHOWN ON DRAWING "11868_REACH A_WOKINGHAM_LS_3".



REV.	DATE	BY	DESCRIPTION	CHK	APP.
P01	17/08/2020	TCH	FIRST ISSUE	KL	CMF

DRAWING STATUS: SUITABLE FOR REVIEW & COMMENT — S3

DESIGNER:
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CONTRACTOR:
Balfour Beatty

CLIENT:
WOKINGHAM BOROUGH COUNCIL
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Tel: (0118) 974 6000 Web: www.wokingham.gov.uk

PROJECT:
WOKINGHAM MAJOR HIGHWAYS PROGRAMME
SPINE ROAD AND WESTERN GATEWAY PHASE 1

TITLE:
SWDR SPINE ROAD GYPSY LANE BOARDWALK
STRUCTURE REFERENCE: 3094
AIP SECTIONS AND DETAILS

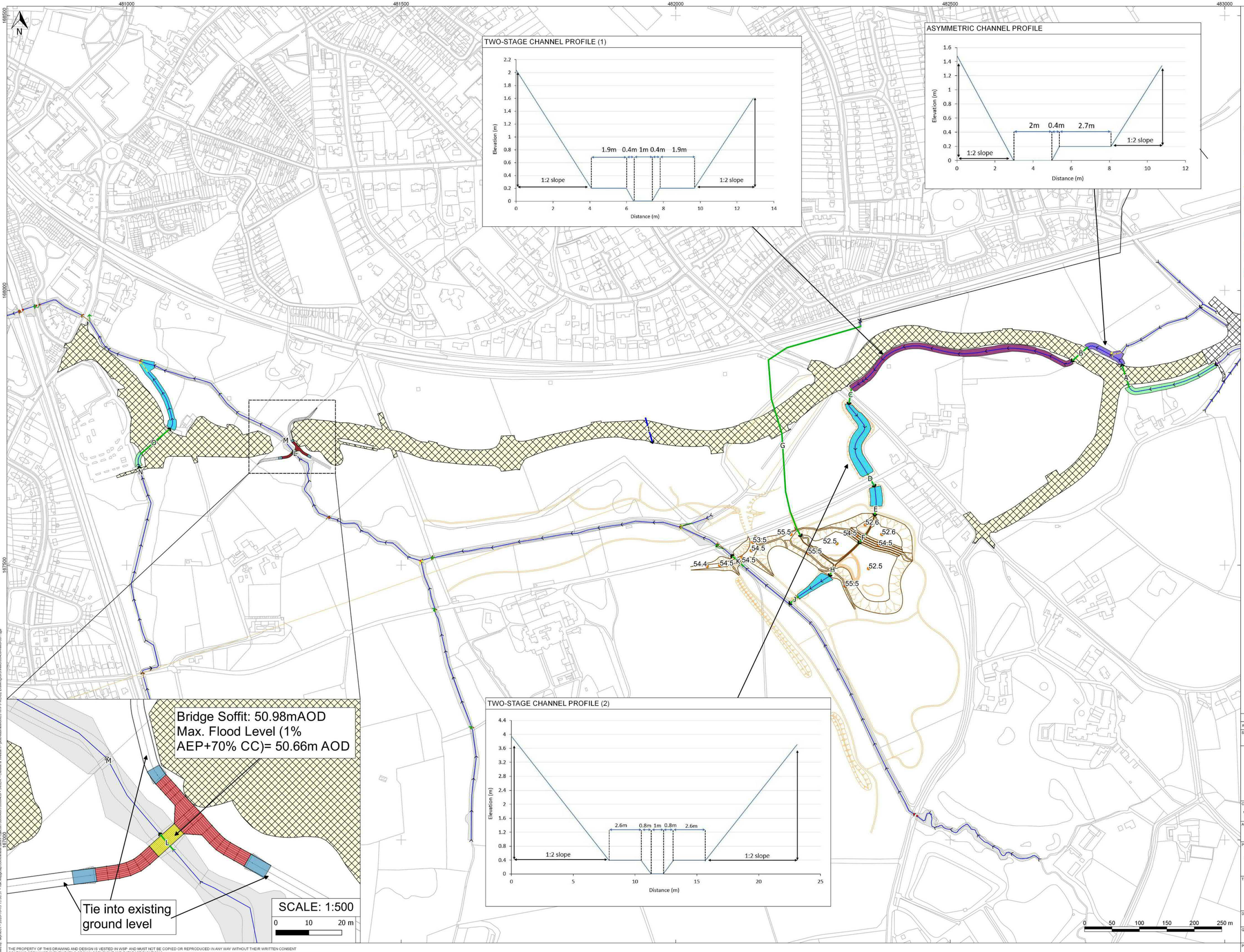
SCALE @ A1:	CHECKED:	APPROVED:
N/A	KL	CMF

PROJECT NO:	DESIGNED:	DRAWN:	DATE:
C118047	EPM	TCH	August 20

DRAWING No.: WMHP-TG-SRWG1-DR-SE-5002 — REV.: P01

Appendix C

HYDRAULIC MODEL SCHEMATIC



KEY:

- SWDR Highway Alignment
- Eastern Gateway Alignment

Watercourse Details:

Watercourse Network

- B (Bridge)
- C (Circular Culvert)
- I (Irregular Culvert)
- R (Rectangular Culvert)
- S (Normal Channel)
- W (Weir)
- X (Connector)
- Watercourse Extents

Proposed Culvert and Bridge Locations

- Eastern Gateway
- SWDR
- Overland Flow Culvert

Proposed Channel Profile

- Normal Channel
- Asymmetric Channel
- Two-Stage Channel (1) - Bench level at 0.2m
- Two-Stage Channel (2) - Bench level at 0.4m

Proposed PROW Diversion:

- Timber Boardwalk Ramp
- Clear Span Section (Timber Boardwalk) - Soffit Level = 50.98m AOD
- Ramp from Existing Ground Level

SANG and Sports Hub Access Road Alignment:

- Area of SANG and Sports Hub Access Road Alignment included within model
- Proposed Levels within SANG area
- Wider SANG Masterplan

REV.	DATE	DRW	DESCRIPTION	CHK	APP
A	13/10/20	JH	FIRST ISSUE	MG	RL

STATUS: FOR INFORMATION ONLY

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CLIENT: WOKINGHAM BOROUGH COUNCIL

ARCHITECT: -

PROJECT: SWDR - CENTRAL AND WESTERN SECTIONS

TITLE: HYDRAULIC MODEL SCHEMATIC

DRAWN:	CHECKED:	APPROVED:
QGIS FILE: 66439-HMS-001.qgs	SCALE @A1: 1:3,000	DATE: 13/10/20
PROJECT No: 70066439	DRAWING No: 66439-HMS-001	REV: A

Appendix D

CONSORTIUM DRAWINGS

Key

- Site boundary
- Existing trees and hedgerow to be retained
- Proposed avenue trees
- Proposed feature tree planting
- Proposed open space trees
- Proposed orchard trees
- Woodland planting
- Native shrub planting
- Woodland edge planting
- Native hedgerow planting
- Ornamental planting
- Amenity grass
- Long mown grass
- Wildflower meadow
- Flowering lawn
- Wetland meadow grassland
- Marginal planting
- Bulb planting
- Proposed swales
- Proposed wet attenuation basin
- Proposed semi wet attenuation basin
- Proposed dry attenuation basin
- Proposed parkland railings
- Proposed knee rail around wet basin
- Proposed 1.2m high post and rail SANG Boundary fence (Dog Proof) with gates
- Hard landscape area with seating
- Footpath
- Proposed parking
- Allotments
- Power line (Overground)
- Power line (Underground)
- Local Equipped Area for Play (LEAP)
- Multi Use Games Area (MUGA) and teen facility
- Local Landscaped Area for Play (LLAP)
- Neighbourhood Equipped Area for Play (NEAP)
- Ancient Woodland
- Pumping Station
- Existing Public Right of Way

0 250m

Revisions
F - 29/05/2020 ARW/NHA General updates and co ordination
G - 02/06/2020 ARW/NHA General updates and co ordination
H - 26/08/2020 JN/NHA General updates and co ordination

Phase 2 Landscape Masterplan
South Wokingham

Client: Kier Ventures Ltd, Kingacre Estates Ltd and Miller Homes Limited

DRWG No: P19-0052_07 Sheet No _ REV: H

Drawn by : JN/NHA Approved by: NHA/TH

Date: 26/08/2020

Scale: 1:2,000@A0

Pegasus Design

BASIN RSc
VOL. = 800m³
DEPTH = 1.0 m
INVERT = 51.50 m AOD

PREVIOUS PROPOSED EXTENT OF SCHOOL

1:3 EMBANKMENT TO EXISTING FENCELINE

NO KNOWN RPZs ASSOCIATED WITH FOLIAGE

FOOTBRIDGE FB2

FOOTBRIDGE FB1

BASIN PS, R7a, LC & 4b-2
VOL. = (560+555+560+639)
2,314 m³ Min.Required
DEPTH = 2.0 m INVERT
@ 52.5 m AOD

EMBANKMENT TO PREVENT LUDGROVE SCHOOL ACCESS ROAD FROM FLOODING

FOOTBRIDGE FB3

EMM BROOK

POINT OF DISCHARGE TO EMM BROOK IL: 51.69

FLOW AND WATER LEVEL CONTROL WEIR

FOOTBRIDGE FB4

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File name: I:\UK.WSPGROUP.COM\CENTRAL DATA\PROJECTS\70001570\3 70001567 - SOUTH WOKINGHAM SDL CONSORTIUM 2\03 WHPUE DEVELOPMENT\01 DRAWINGS\3 - DRAWINGS\70001684-D-101 TO 103.DWG, printed on 21 May 2020 10:00:42, by Palmer, Chris

DO NOT SCALE

NOTES:

1. ALL DIMENSIONS IN METRES UNLESS STATED OTHERWISE. ALL LEVELS ARE IN METRES ABOVE ORDINANCE DATUM UNLESS STATED OTHERWISE. ALL DIAMETERS ARE IN MILLIMETRES UNLESS STATED OTHERWISE.
2. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT ARCHITECT AND ENGINEERING DETAILS, DRAWINGS AND SPECIFICATIONS.
3. ANY DISCREPANCIES SHOULD BE REPORTED TO THE ARCHITECT AND/OR ENGINEER IMMEDIATELY.
4. MASTERPLAN TAKEN FROM PEGASUS P18-0963_06S FRAMEWORK PLAN.
5. FOR THE LANDSCAPING, THE INFORMATION FROM THE PEGASUS PLAN: HOLME PARK SANG – LANDSCAPE STRATEGY – DWG. NO P19_052-08 – SOUTH WOKINGHAM HAS BEEN USED.

KEY:

HIGHWAYS, CIVIL ENGINEERING, DRAINAGE AND EARTHWORKS:

- MASTERPLAN BOUNDARY
- ADDITIONAL LAND FORMING PART OF APPLICATION
- EXISTING EMM BROOK
- PROPOSED CULVERT
- PROPOSED HEADWALL
- PROPOSED FOOTBRIDGE (2m WIDE – TIMBER ON STEEL BEAM)
- PROPOSED EARTHWORKS (CUT)
- PROPOSED EARTHWORKS (FILL)
- PROPOSED BASIN
- PROPOSED CIRCULATION ROUTE (2m WIDE)
- BASIN RSb VOL. =615 m³ DEPTH = 1.3 m INVERT = 52.20 m AOD — BASIN REFERENCE LABEL
- +55.5 — EXISTING SPOT LEVELS
- +55.5 — PROPOSED SPOT LEVELS

REV	DATE	BY	DESCRIPTION	CHK	APP
P03	20/05/20	CLP	BASIN UPDATED TO WBC LANDSCAPE COMMENTS	CP	CP
P02	02/04/20	CLP	SPORTS HUB ACCESS ROUTE UPDATED	CP	CP
P01	NI	YO	SANG BASIN LAYOUT UPDATED ON WBC COMMENTS	CP	CP

DRAWING STATUS: S0 - WORK IN PROGRESS

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wsp.com

CLIENT: SOUTH WOKINGHAM SDL CONSORTIUM

ARCHITECT: -

SITE/PROJECT: SOUTHERN DEVELOPMENT LAND - PHASE 2

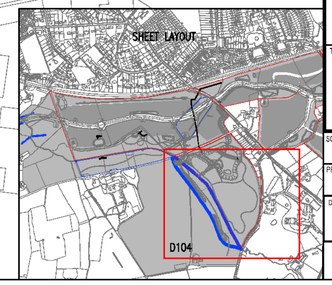
TITLE: SURFACE WATER STRATEGY
HOLME PARK SANG - PROPOSED LEVELS

SCALE @A1:	CHECKED:	APPROVED:
1:1000	CP	CP

PROJECT NO:	DESIGNED:	DRAWN:	DATE:
70001684	YO	YO	May 20

DRAWING No: 70001684-D-104 REV: P03

SHEET LAYOUT



Appendix E

HYDRAULIC MODEL EXTENTS

481000 481500 482000 482500 483000

168500 168000 167500 167000

N

A1_E A2 A3 A4 A5

B_E110 C C6 C7 C8 D F

1 2 3 4 5 6 7 8 9

0 250 500 750 1000 m

KEY:

- Proposed Highway Alignment
- Watercourse Network

Inflows

- HT
- QT
- Active Model Domain
- Atlas Key
- SANG and Sports Hub Access Road Alignemnt
- Proposed PROW Footbridge

REV	DATE	DRW	DESCRIPTION	CHK	APP
A	02/10/20	JH	FIRST ISSUE	MQ	RL

STATUS: FOR INFORMATION ONLY

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www.wsp.com

CLIENT: WOKINGHAM BOROUGH COUNCIL

ARCHITECT: -

PROJECT: SWDR - CENTRAL AND WESTERN SECTIONS

TITLE: POST DEVELOPMENT HYDRAULIC MODEL EXTENTS: OVERVIEW

DRAWN:	CHECKED:	APPROVED:

QGIS FILE:	SCALE @A3:	DATE:
66439-HME-101.qgs	1:8,000	02/10/20

PROJECT No:	DRAWING No:	REV:
70066349	66439-HME-101	A

482500

483000

160000

N

A2

A5

A4

0 50 100 150 200 m

KEY:

- Proposed Highway Alignment (Included in ground model)

1d Watercourse Network:

- B (Bridge)
- BW (Bridge with weir overspill)
- C (Circular Culvert)
- CW (Circular Culvert with weir overspill)
- I (Irregular Culvert)
- Q (User defined: depth-discharge)
- R (Rectangular Culvert)
- RW (Rectangular Culvert with weir overspill)
- S (Normal Channel)
- W (Weir)
- X (Connector)
- Unclassified
- 1D Culvert/Bridge Cross Sections
- 1d Channel Cross Sections
- 1D Water Level Lines
- Channel Bank Points

1D Inflows:

- HT
- QT

1d / 2d Links:

- CN
- HQ
- HX
- SX
- SX
- Active Model Domain
- Inactive Model Domain

Proposed PROW Footbridge:

- 2D Layered Flow Constriction - Point File
- 2D Layered Flow Constriction - Region File

SANG and Sports Hub Access Road:

- Area included within model (ground model amended)
- Wider SANG Masterplan
- 2D Gully Line to represent low flow channel
- 2D Gully Points to represent low flow channel

REV.	DATE	DRW	DESCRIPTION	CHK	APP
A	02/10/20	JH	FIRST ISSUE	MG	RL

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CLIENT: WOKINGHAM BOROUGH COUNCIL

ARCHITECT: -

PROJECT: SWDR - CENTRAL AND WESTERN SECTIONS

TITLE: POST DEVELOPMENT HYDRAULIC MODEL EXTENTS: SHEET 1

DRAWN:	CHECKED:	APPROVED:
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PROJECT No: 70066439	DRAWING No: 66439-HME-101-1	REV: A

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482500

168000

N

A1_E

C7

C6

0 50 100 150 200 m

KEY:

- Proposed Highway Alignment (Included in ground model)

1d Watercourse Network:

- B (Bridge)
- BW (Bridge with weir overspill)
- C (Circular Culvert)
- CW (Circular Culvert with weir overspill)
- I (Irregular Culvert)
- Q (User defined: depth-discharge)
- R (Rectangular Culvert)
- RW (Rectangular Culvert with weir overspill)
- S (Normal Channel)
- W (Weir)
- X (Connector)
- Unclassified
- 1D Culvert/Bridge Cross Sections
- 1d Channel Cross Sections
- 1D Water Level Lines
- Channel Bank Points

1D Inflows:

- HT
- QT

1d / 2d Links:

- CN
- HQ
- HX
- SX
- SX
- Active Model Domain
- Inactive Model Domain

Proposed PROW Footbridge:

- 2D Layered Flow Constriction - Point File
- 2D Layered Flow Constriction - Region File

SANG and Sports Hub Access Road:

- Area included within model (ground model amended)
- Wider SANG Masterplan
- 2D Gully Line to represent low flow channel
- 2D Gully Points to represent low flow channel

REV	DATE	DRW	DESCRIPTION	CHK	APP
A	02/10/20	JH	FIRST ISSUE	MG	RL

STATUS: FOR INFORMATION ONLY

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Fax: +44 (0) 1256 318 70
www.wsp.com

CLIENT: WOKINGHAM BOROUGH COUNCIL

ARCHITECT: -

PROJECT: SWDR - CENTRAL AND WESTERN SECTIONS

TITLE: POST DEVELOPMENT HYDRAULIC MODEL EXTENTS: SHEET 2

DRAWN:	CHECKED:	APPROVED:
QGIS FILE: 66439-HME-101.qgs	SCALE @A1: 1:1,000	DATE: 02/10/20

PROJECT No.:	DRAWING No.:	REV:
70066439	66439-HME-101-2	A

482000

482500

168000

N

A1_E

C7

C6

0 50 100 150 200 m

KEY:

- Proposed Highway Alignment (Included in ground model)

1d Watercourse Network:

- B (Bridge)
- BW (Bridge with weir overspill)
- C (Circular Culvert)
- CW (Circular Culvert with weir overspill)
- I (Irregular Culvert)
- Q (User defined: depth-discharge)
- R (Rectangular Culvert)
- RW (Rectangular Culvert with weir overspill)
- S (Normal Channel)
- W (Weir)
- X (Connector)
- Unclassified
- 1D Culvert/Bridge Cross Sections
- 1d Channel Cross Sections
- 1D Water Level Lines
- Channel Bank Points

1D Inflows:

- HT
- QT

1d / 2d Links:

- CN
- HQ
- HX
- SX
- SX
- Active Model Domain
- Inactive Model Domain

Proposed PROW Footbridge:

- 2D Layered Flow Constriction - Point File
- 2D Layered Flow Constriction - Region File

SANG and Sports Hub Access Road:

- Area included within model (ground model amended)
- Wider SANG Masterplan
- 2D Gully Line to represent low flow channel
- 2D Gully Points to represent low flow channel

REV.	DATE	DRW	DESCRIPTION	CHK	APP
A	02/10/20	JH	FIRST ISSUE	MG	RL

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CLIENT: WOKINGHAM BOROUGH COUNCIL

ARCHITECT: -

PROJECT: SWDR - CENTRAL AND WESTERN SECTIONS

TITLE: POST DEVELOPMENT HYDRAULIC MODEL EXTENTS: SHEET 3

DRAWN:	CHECKED:	APPROVED:
QGIS FILE: 66439-HME-101.qgs	SCALE @A1: 1:1,000	DATE: 02/10/20
PROJECT No: 70066439	DRAWING No: 66439-HME-101-3	REV: A

Created by: jaxNOR - 2020-10-02 19:29:54 - N:\GPD\Committed data\Projects\70066439 - SWDR - Central & Western - post-submission\01 WIP\FROG Drawing\[QGIS\66439-HME-101.qgs

482000

482500

167500

N

0 50 100 150 200 m

KEY:

- Proposed Highway Alignment (Included in ground model)

1d Watercourse Network:

- B (Bridge)
- BW (Bridge with weir overspill)
- C (Circular Culvert)
- CW (Circular Culvert with weir overspill)
- I (Irregular Culvert)
- Q (User defined: depth-discharge)
- R (Rectangular Culvert)
- RW (Rectangular Culvert with weir overspill)
- S (Normal Channel)
- W (Weir)
- X (Connector)
- Unclassified
- 1D Culvert/Bridge Cross Sections
- 1d Channel Cross Sections
- 1D Water Level Lines
- Channel Bank Points

1D Inflows:

- HT
- QT

1d / 2d Links:

- CN
- HQ
- HX
- SX
- SX
- Active Model Domain
- Inactive Model Domain

Proposed PROW Footbridge:

- 2D Layered Flow Constriction - Point File
- 2D Layered Flow Constriction - Region File

SANG and Sports Hub Access Road:

- Area included within model (ground model amended)
- Wider SANG Masterplan
- 2D Gully Line to represent low flow channel
- 2D Gully Points to represent low flow channel

REV.	DATE	DRW	DESCRIPTION	CHK	APP
A	02/10/20	JH	FIRST ISSUE	MG	RL

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www.wsp.com

CLIENT: WOKINGHAM BOROUGH COUNCIL

ARCHITECT: -

PROJECT: SWDR - CENTRAL AND WESTERN SECTIONS

TITLE: POST DEVELOPMENT HYDRAULIC MODEL EXTENTS: SHEET 4

DRAWN:	CHECKED:	APPROVED:
QGIS FILE: 66439-HME-101.qgs	SCALE @A1: 1:1,000	DATE: 02/10/20

PROJECT No:	DRAWING No:	REV:
70066439	66439-HME-101-4	A

482000

N

KEY:

- Proposed Highway Alignment (Included in ground model)

1d Watercourse Network:

- B (Bridge)
- BW (Bridge with weir overspill)
- C (Circular Culvert)
- CW (Circular Culvert with weir overspill)
- I (Irregular Culvert)
- Q (User defined: depth-discharge)
- R (Rectangular Culvert)
- RW (Rectangular Culvert with weir overspill)
- S (Normal Channel)
- W (Weir)
- X (Connector)
- Unclassified
- 1D Culvert/Bridge Cross Sections
- 1d Channel Cross Sections
- 1D Water Level Lines
- Channel Bank Points

1D Inflows:

- HT
- QT

1d / 2d Links:

- CN
- HQ
- HX
- SX
- SX
- Active Model Domain
- Inactive Model Domain

Proposed PROW Footbridge:

- 2D Layered Flow Constriction - Point File
- 2D Layered Flow Constriction - Region File

SANG and Sports Hub Access Road:

- Area included within model (ground model amended)
- Wider SANG Masterplan
- 2D Gully Line to represent low flow channel
- 2D Gully Points to represent low flow channel

55.99

51.788
52.125
51.094
51.113
50.911
51.49
51.136
51.348
51.088
51.678
51.536
51.769
51.473
51.415
51.782
51.909
51.628
52.266
51.805
52.302
51.786
52.189
52.498
52.066
52.077
52.028
52.486
52.075
52.76
52.934
52.682
52.983
53.386
53.053
52.76
52.38
52.95
52.81
53.04
52.764
53.139
53.095
53.123
53.026
53.563
53.257
53.524
53.296
52.4
52.36
52.314
52.246
52.172
52.118
52.1
52.17
53.68
53.3
53.93
53.49
52.83
52.84
52.72
52.66

0 50 100 150 200 m

REV	DATE	DRW	DESCRIPTION	CHK	APP
A	02/10/20	JH	FIRST ISSUE	MG	RL

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ARCHITECT: -

PROJECT: SWDR - CENTRAL AND WESTERN SECTIONS

TITLE: POST DEVELOPMENT HYDRAULIC MODEL EXTENTS: SHEET 5

DRAWN:	CHECKED:	APPROVED:
QGIS FILE: 66439-HME-101.qgs	SCALE @A1: 1:1,000	DATE: 02/10/20
PROJECT No.: 70066439	DRAWING No.: 66439-HME-101-5	REV.: A

481500

N

50.291
50.125
49.987
50.023
50.030
49.942
49.9
49.734
50.23
49.99
50.199
50.006
49.977
49.8
50.233
50.265
50.224
50.247
50.291
50.325
50.18
50.197
50.331
50.461
50.472
50.741
50.754
50.694
50.836
50.958
52.08
52.014
51.948
50.956
50.907
50.962
52.035
51.49
51.136
51.348
51.088
51.678
51.536
51.769
51.473
51.415
51.782
51.909
51.628
52.266
51.805
52.302
51.786
50.917
51.216
51.788
51.788
51.975
52.125
51.094
51.121
50.911
51.113

0 50 100 150 200 m

KEY:

- Proposed Highway Alignment (Included in ground model)

1d Watercourse Network:

- B (Bridge)
- BW (Bridge with weir overspill)
- C (Circular Culvert)
- CW (Circular Culvert with weir overspill)
- I (Irregular Culvert)
- Q (User defined: depth-discharge)
- R (Rectangular Culvert)
- RW (Rectangular Culvert with weir overspill)
- S (Normal Channel)
- W (Weir)
- X (Connector)
- Unclassified
- 1D Culvert/Bridge Cross Sections
- 1d Channel Cross Sections
- 1D Water Level Lines
- Channel Bank Points

1D Inflows:

- HT
- QT

1d / 2d Links:

- CN
- HQ
- HX
- SX
- SX

- Active Model Domain
- Inactive Model Domain

Proposed PROW Footbridge:

- 2D Layered Flow Constriction - Point File
- 2D Layered Flow Constriction - Region File

SANG and Sports Hub Access Road:

- Area included within model (ground model amended)
- Wider SANG Masterplan
- 2D Gully Line to represent low flow channel
- 2D Gully Points to represent low flow channel

REV	DATE	DRW	DESCRIPTION	CHK	APP
A	02/10/20	JH	FIRST ISSUE	MQ	RL

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PROJECT: SWDR - CENTRAL AND WESTERN SECTIONS

TITLE: POST DEVELOPMENT HYDRAULIC MODEL EXTENTS: SHEET 6

DRAWN:	CHECKED:	APPROVED:
QGIS FILE: 66439-HME-101.qgs	SCALE @A1: 1:1,000	DATE: 02/10/20

PROJECT No.:	DRAWING No:	REV:
70066439	66439-HME-101-6	A

N

49.551
49.541
49.841
49.874
50.089
49.751
50.291
50.125
49.987
50.023
50.036
49.942
49.9
50.23
49.73
49.99
50.199
50.006
49.977
49.8
50.265
50.233
50.224
50.291
50.18

0 50 100 150 200 m

KEY:

- Proposed Highway Alignment (Included in ground model)

1d Watercourse Network:

- B (Bridge)
- BW (Bridge with weir overspill)
- C (Circular Culvert)
- CW (Circular Culvert with weir overspill)
- I (Irregular Culvert)
- Q (User defined: depth-discharge)
- R (Rectangular Culvert)
- RW (Rectangular Culvert with weir overspill)
- S (Normal Channel)
- W (Weir)
- X (Connector)
- Unclassified
- 1D Culvert/Bridge Cross Sections
- 1d Channel Cross Sections
- 1D Water Level Lines
- Channel Bank Points

1D Inflows:

- HT
- QT

1d / 2d Links:

- CN
- HQ
- HX
- SX
- SX
- Active Model Domain
- Inactive Model Domain

Proposed PROW Footbridge:

- 2D Layered Flow Constriction - Point File
- 2D Layered Flow Constriction - Region File

SANG and Sports Hub Access Road:

- Area included within model (ground model amended)
- Wider SANG Masterplan
- 2D Gully Line to represent low flow channel
- 2D Gully Points to represent low flow channel

REV.	DATE	DRW	DESCRIPTION	CHK	APP
A	02/10/20	JH	FIRST ISSUE	MG	RL

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PROJECT: SWDR - CENTRAL AND WESTERN SECTIONS

TITLE: POST DEVELOPMENT HYDRAULIC MODEL EXTENTS: SHEET 7

DRAWN:	CHECKED:	APPROVED:
QGIS FILE: 66439-HME-101.qgs	SCALE @A1: 1:500	DATE: 02/10/20
PROJECT No: 70066439	DRAWING No: 66439-HME-101-7	REV: A

481000

N

49.24
49.54
50.36
50.42
50.42
51.36
50.43
51.49
51.42
50.48
50.7
51.28
50.668
50.81
50.656
50.577
51.042
50.967
51.381
51.283

0 +50 +100 +150 +200 m

KEY:

- Proposed Highway Alignment (Included in ground model)

1d Watercourse Network:

- B (Bridge)
- BW (Bridge with weir overspill)
- C (Circular Culvert)
- CW (Circular Culvert with weir overspill)
- I (Irregular Culvert)
- Q (User defined: depth-discharge)
- R (Rectangular Culvert)
- RW (Rectangular Culvert with weir overspill)
- S (Normal Channel)
- W (Weir)
- X (Connector)
- Unclassified
- 1D Culvert/Bridge Cross Sections
- 1d Channel Cross Sections
- 1D Water Level Lines
- Channel Bank Points

1D Inflows:

- HT
- QT

1d / 2d Links:

- CN
- HQ
- HX
- SX
- SX
- Active Model Domain
- Inactive Model Domain

Proposed PROW Footbridge:

- 2D Layered Flow Constriction - Point File
- 2D Layered Flow Constriction - Region File

SANG and Sports Hub Access Road:

- Area included within model (ground model amended)
- Wider SANG Masterplan
- 2D Gully Line to represent low flow channel
- 2D Gully Points to represent low flow channel

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A	02/10/20	JH	FIRST ISSUE	MG	RL

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PROJECT: SWDR - CENTRAL AND WESTERN SECTIONS

TITLE: POST DEVELOPMENT HYDRAULIC MODEL EXTENTS: SHEET 8

DRAWN:	CHECKED:	APPROVED:
QGIS FILE: 66439-HME-101.qgs	SCALE @A1: 1:500	DATE: 02/10/20
PROJECT No.: 70066439	DRAWING No.: 66439-HME-101-8	REV: A