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HS2

High Speed Rail (Crewe – Manchester) Environmental Statement

Volume 5: Appendix WR-006-00007

Water resources and flood risk

MA06: Hulseheath to Manchester Airport

Hydraulic modelling report - Timperley Brook

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Department for Transport

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1 Introduction

1.1 Background

1.1.1 This appendix presents the results of the hydraulic modelling carried out for Timperley Brook in the Timperley Brook catchment. Timperley Brook runs through the Hulseheath to Manchester Airport community area (MA06).

1.1.2 The hydraulic modelling has been used to inform the Flood risk assessment, Volume 5: Appendix WR-005-0MA06 for this community area.

1.1.3 The Millington Clough and tributaries hydraulic modelling report (covering Agden Brook in the Pickmere to Agden and Hulseheath area (MA06) (Volume 5: Appendix WR-006-00001)) is also relevant to this area.

1.1.4 The water resources and flood risk assessments include both route-wide and community area specific appendices. The route-wide appendices comprise:

- a Water Framework Directive (WFD) compliance assessment (Volume 5: Appendix WR-001-00000); and
- a Draft water resources and flood risk operation and maintenance plan (Volume 5: Appendix WR-007-00000).

1.1.5 For the Hulseheath to Manchester Airport area the Water resources assessment, Volume 5: Appendix WR-003-0MA06 should also be referred to.

1.1.6 Additional information is included in Background Information and Data (BID):

- Water resources assessment baseline data that is reported for MA06 (BID WR-004-0MA06)[1]; and
- Water Framework Directive compliance assessment baseline data (BID WR-002-00001)[2].

1.2 Aims

1.2.1 The aim of this study was to develop a hydraulic model of Timperley Brook at the proposed Timperley Brook crossing to simulate peak flood levels, with and without the Proposed Scheme. This report also aims to document the methods used, the results, assumptions and limitations.

[1] High Speed Two Ltd (2022), High Speed Rail (Crewe – Manchester), *Background Information and Data, Water resources assessment baseline data,* BID WR-004-0MA06. Available online at: http://www.gov.uk/government/collections/hs2–phase–2b–crewe–manchester–environmental–statement

[2] High Speed Two Ltd (2022), High Speed Rail (Crewe – Manchester), *Background Information and Data, Water Framework Directive compliance assessment data,* BID WR-002-00001. Available online at: http://www.gov.uk/government/collections/hs2–phase–2b–crewe–manchester–environmental–statement.

1.2.2 The outputs from the study have been used to inform the flood risk assessment for the Hulseheath to Manchester Airport area, that is reported in Volume 5, Flood risk assessment Appendix WR-005-0MA06. The hydraulic model has also informed the preliminary design of the Proposed Scheme, with the specific objective of ensuring that the design of hydraulic structures (for example: viaducts, bridges, and culverts) takes account of flood risk issues, as detailed in the Environmental Impact Assessment Scope and Methodology Report (SMR): Technical Note: Flood risk (see Volume 5: Appendix CT-001-00001).

1.3 Objectives

1.3.1 The objectives of this study were to:

- develop an understanding of existing hydraulic conditions at the proposed watercourse crossings, including channel and floodplain characteristics, hydraulic structures and flow paths, through desk study and, where possible, by conducting a site visit;
- estimate peak flows, and hydrographs, at the Proposed Scheme crossing locations, associated with the following Annual Exceedance Probabilities (AEP): 5.0%, 1.0%, 1.0% + climate change (CC) and 0.1%; and
- develop a hydraulic model, using the information available at this stage, to estimate the flood levels associated with these peak flows for the range of hydrological estimates, both before and after construction of the Proposed Scheme.

1.4 Justification of approach

1.4.1 A risk-based approach has been adopted, whereby the level of modelling detail supporting the flood risk assessment at a specific site reflects the magnitude of the likely impacts of the Proposed Scheme on peak flood levels and the sensitivity of nearby receptors to flooding.

1.4.2 Timperley Brook is a main river at the Proposed Scheme crossing, however, flood zone information is only available approximately 800m downstream from the crossing. There are several local receptors both upstream and downstream of the proposed crossing. Manchester Airport car park (less vulnerable) is located upstream of the crossing and Runger Lane and Brook's Drive (less vulnerable) and Davenport Green Wood (less vulnerable) are located downstream of the crossing. More vulnerable residential properties are at risk approximately 500m downstream of the crossing at Brooks Drive. Due to the small size of the catchment and receptors at risk, a direct rainfall 2D hydraulic modelling approach has been adopted at this crossing. Input hyetographs were derived using the Revitalised Flood Hydrograph 2 (ReFH2) software. Upstream of the 2D direct rainfall domain, two sub-catchments have been included as inflows to account for flows from areas of car parking at Manchester Airport and from the M56.

1.5 Scope

1.5.1 The scope of the study was to undertake detailed hydraulic modelling to enable assessment of the impact of the Proposed Scheme on the local environment. The model aimed to be detailed enough to allow assessment of different options for the crossing locations, to allow the management of flood risk and correct sizing of crossing structures.

1.5.2 This report focuses on a 3.8km reach of Timperley Brook, extending predominantly downstream of the Proposed Scheme. The Proposed Scheme crossing comprises of an inverted siphon under the proposed Manchester Airport station. A culvert is proposed to connect the outfall from the M56 drainage system to Timperley Brook. A description of the location and type of scheme is provided in Section 2.

1.5.3 The scope of the report includes:

- discussion of all relevant datasets, in terms of their quality and gaps;
- details of the hydrological analysis undertaken, the approach used and the calculation steps;
- details of how the hydrological analysis has been integrated with the hydraulic modelling;
- identification and justification of the hydraulic modelling methodology selected; and
- a description of the hydraulic modelling parameters, assumptions, limitations and uncertainty.

2 Qualitative description of flood response

2.1 Sources of information

2.1.1 The following sources of information were obtained from the Environment Agency:

- flood map for planning (rivers and sea)[3];
- risk of flooding from surface water (RoFSW)[4] map; and
- flood defence asset information.

2.1.2 Additional information from the lead local flood authority (LLFA) and publicly available sources included:

- Trafford Metropolitan Borough Council Preliminary Flood Risk Assessment (PRFA) (2017)[5];
- Manchester City, Salford City and Trafford Councils Hybrid Strategic Flood Risk Assessment (SFRA) (2008)[6]; and
- Trafford Metropolitan Borough Council Local Flood Risk Management Strategy (LFRMS) (2017)[7].

2.2 Description of the study area

Study area

2.2.1 Figure 1 and Figure 2 show the 2.2km long reach of Timperley Brook in the study area and in Figure 3 the Environment Agency Flood Zone and surface water flooding maps. The upstream boundary, shown on Figure 2 is located at the inlet of the existing culvert under the M56. The downstream boundary is located at Duncalf Farm, north of Clay Lane. The model includes Timperley Brook and Tributaries of Timperley Brook 1, 2 and 3.

[3] Environment Agency (2021), *Flood map for planning.* Available online at: https://flood-map-for-planning.service.gov.uk.

[4] Environment Agency (2021), *The risk of flooding from surface water.* Available online at: https://flood-warning-information.service.gov.uk/long-term-flood-risk/map.

[5] JBA Consulting (2011), *Trafford Council Preliminary Flood Risk Assessment.* Available online at: https://webarchive.nationalarchives.gov.uk/20140328094439/http://www.environment-agency.gov.uk/research/planning/135532.aspx.

[6] JBA Consulting (2010), *Manchester City, Salford City and Trafford Councils Level 2 Hybrid Strategic Flood Risk Assessment.* Available online at: https://www.trafford.gov.uk/planning/strategic-planning/docs/manchester-salford-and-trafford-councils-level-2-hybrid-sfra-level-1-sfra-march-2011.pdf.

[7] Trafford Council (2014), *Trafford Local Flood Risk Management Strategy.* Available online at: https://beta.trafford.gov.uk/planning/strategic-planning/docs/lfrms-trafford-final-2014.pdf.

2.2.2 The primary hydraulic control of Timperley Brook is the 1.067m diameter culvert beneath the M56, upstream of the Proposed Scheme (see Figure 1). A review of ground levels and with the checking of model results, confirms that the selected upstream and downstream boundaries are sufficiently far upstream and downstream to not impact peak water levels at the Proposed Scheme crossing.

Hydrological description

2.2.3 The Timperley Brook catchment upstream of the Proposed Scheme crossing comprises largely of Manchester Airport car park[8], an impermeable surface, and a small area of the M56. Due to building of Manchester Airport, there is no longer an upstream rural catchment discharging into Timperley Brook, as shown in Figure 2.

2.2.4 The Flood Estimation Handbook (FEH)[9] shows that there are no gauging stations present within the catchment.

2.2.5 The FEH estimates a standard annual average rainfall for the catchment is 820 mm.

Proposed Scheme

2.2.6 The Proposed Scheme crosses Timperley Brook with an inverted siphon beneath the Proposed Scheme station, west of the M56. Further detail on the Proposed Scheme can be found in the Volume 2, Map Books: maps CT-06-357a.

Features of note

2.2.7 The existing crossing of Timperley Brook under the M56 is a 1,067mm diameter culvert which limits the flows that can be transferred downstream (see Figure 1).

2.2.8 An existing flood storage area is located approximately 6km downstream of the Proposed Scheme crossing. This feature is not included in this model as it does not have an effect on the downstream boundary of the model. However, it is an important feature to note as it is part of a flood alleviation scheme that protects some properties downstream of the Proposed Scheme, on the Timperley Brook.

[8] Manchester Airport (2019), *Manchester Airport Surface Water Drainage Management Plan.*

[9] Centre for Ecology and Hydrology (2021), *Flood estimation handbook web service.* Available online at: http://fehweb.ceh.ac.uk.

Figure 1: Baseline study area, Environment Agency Flood Zones and RoFSW at Timperley Brook

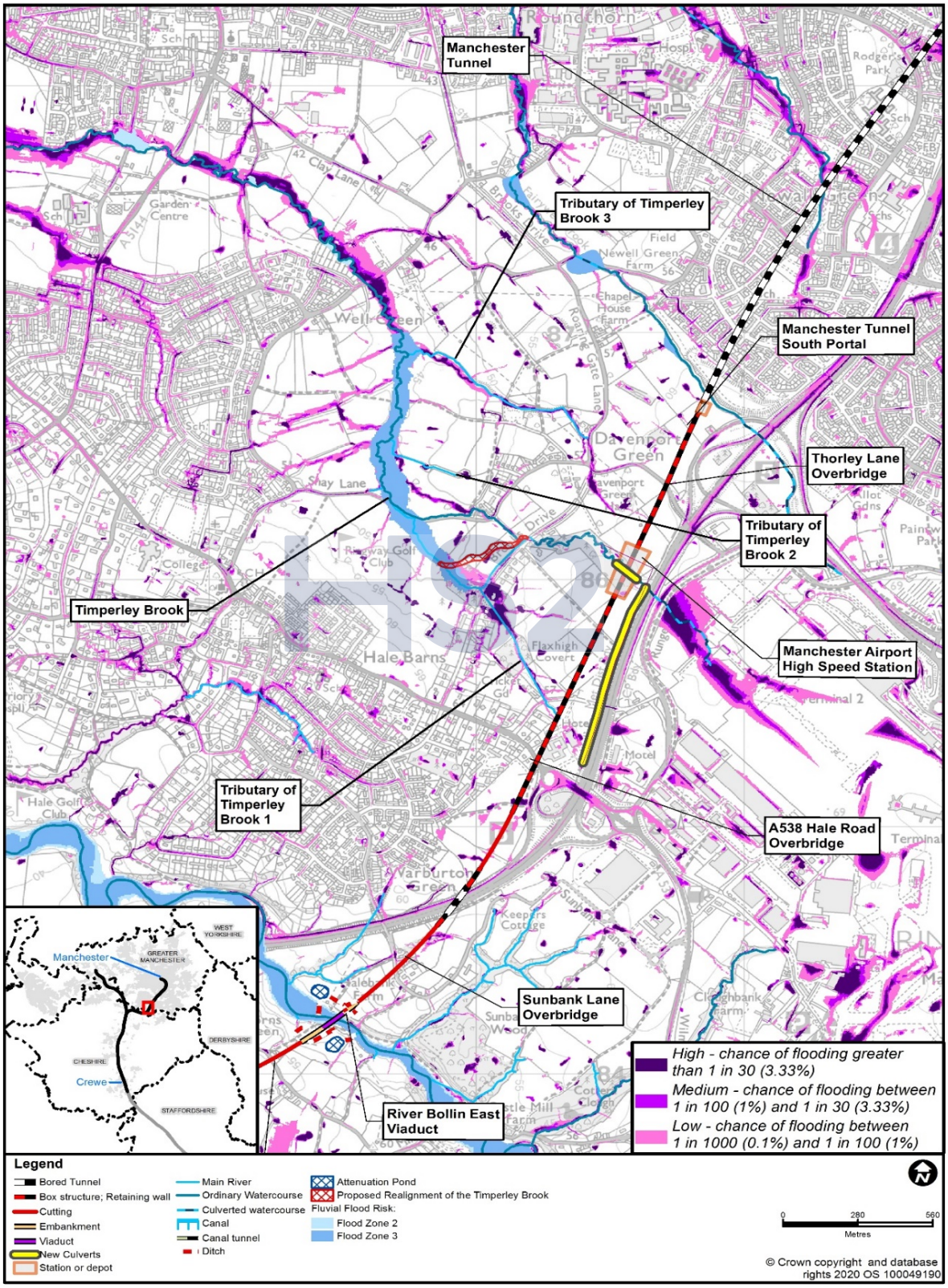
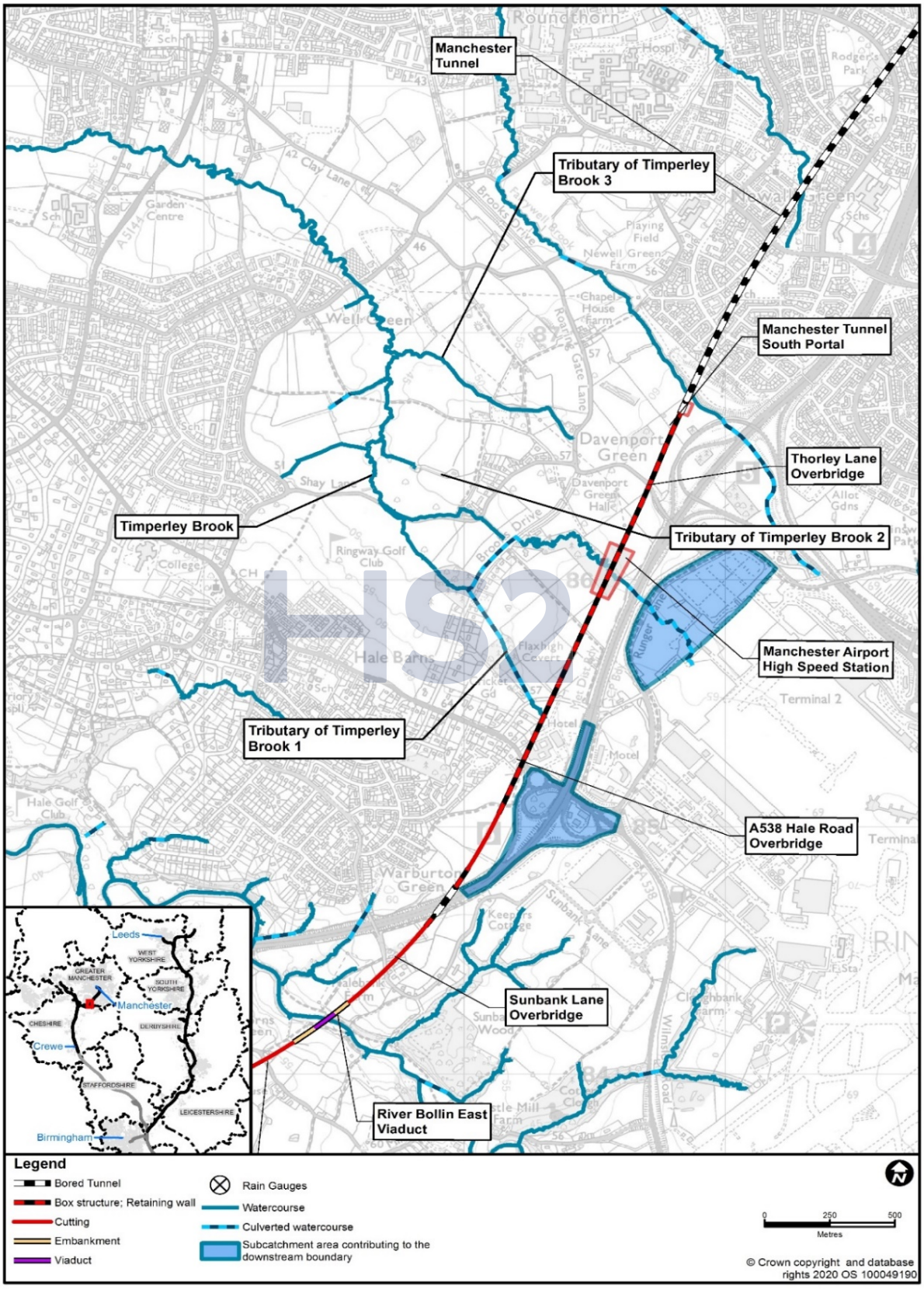


Figure 2: Timperley Brook upstream subcatchment areas



2.3 Existing understanding of flood risk

Flood mechanisms

2.3.1 Downstream of the Proposed Scheme crossing, the Environment Agency Flood Zones follow a floodplain corridor approximately 50m wide for approximately 3km. In the area of the Proposed Scheme and along the Timperley Brook, current Environment Agency mapping shows that there are no flood zones as the floodwaters either remain in-bank or have not been modelled, as shown in Figure 1. The RoFSW[4] shows a similar pattern of flooding downstream of the Proposed Scheme crossing. Upstream of the Proposed Scheme crossing, the RoFSW indicates deep flooding of the Manchester Airport car park.

2.3.2 Available information does not indicate the presence of any flood defence assets within the model extent.

Analysis of historical flooding

2.3.3 No specific information on historical flood incidents has been identified from the SFRA, PFRA, and Section 19[10] reports within 10km of the Proposed Scheme. However, there is public information from local news articles showing that one of the airport runways has been subject to shallow surface water flooding. Local news articles show that flooding occurred in September 2018. Local news articles also recorded flooding on the surrounding road network (A555 and M60) in July 2019[11], November 2019 and February 2020. This is reportedly due to excess rainfall and not related to flooding from the Timperley Brook watercourse. These flood events may be subject to a Section 19 report in the future.

Availability of existing hydraulic models

2.3.4 The Environment Agency has provided a 1D model, prepared in 2001, that covers the area downstream of the Manchester Airport High Speed station that is part of the Proposed Scheme. This was an in-bank model with limited metadata supporting how the model was built. In addition to the limited background information, the underlaying bathymetry was considered to be too old to be used for this study as the river sections could have significantly changed during the 20 year period since the model was constructed.

[10] Section 19 of the Flood and Water Management Act 2010 sets out the requirement for that on becoming aware of a flood in its area, a LLFA must investigate and report on which risk management authorities have relevant flood risk management functions and whether each authority has exercised those functions in response to the flood.

[11] BBC News (July 2019), *Heavy rain causes travel disruption in North West*. Available online at: https://www.bbc.co.uk/news/uk-england-manchester-49149281.

2.4 Site visit

2.4.1 No site survey was required to inform the proposed hydraulic analysis. A site walkover visit was undertaken in October 2020 that confirmed some of the basic assumptions applied in the model such as position, approximate dimensions, presence of structures etc.

2.4.2 The hydraulic model will be updated during design development, in accordance with the HS2 Ltd requirements, a further site visit will be undertaken by a hydraulic modeller to ensure a site-specific topographical survey specifications can be developed.

3 Model approach and justification

3.1 Model conceptualisation

3.1.1 A 2D hydraulic modelling approach was chosen for the model as the Environment Agency 1D hydraulic model was considered out-of-date and no recent 1D survey data was available. The existing culvert beneath the M56 and the Proposed Scheme siphon have been incorporated as 1D elements within the 2D model.

3.1.2 The 2D model domain has been extended sufficiently downstream to ensure that any effects caused by the model boundary do not affect water levels in the area of the Proposed Scheme. The model has not been extended upstream of the airport as Timperley Brook catchment upstream of the Proposed Scheme crossing comprises the Manchester Airport car park[12], an impermeable surface, and a small area of the M56 (see Section 8). This area has been considered sufficient for the estimate of the peak flows using the modified rational method and a time of concentration, without the need to model the drainage system itself.

3.1.3 High resolution 0.2m to 1m LiDAR data has been used to define the channel and to take account of the watercourse capacity and conveyance in the 2D model domain. The modelling has not taken into account any compensation storage required as a result of the interaction of the Proposed Scheme with the floodplain. This is a conservative approach that is considered sufficient for this design stage of the crossing and for the impact assessment to receptors.

3.2 Software

3.2.1 Infoworks Integrated Catchment model (ICM) (version 4.0.3.8010) has been used. The use of ICM is in line with standard practice to use the latest available build at the time modelling commenced, while Infoworks ICM is industry standard software.

3.3 Topographic survey

3.3.1 No additional topographic survey was commissioned for this study but will be required during design development to inform detailed design, including survey data to define the channel cross section and all key existing structures (see Section 4.2).

3.4 Input data

3.4.1 The elevation data for the study area was produced using 0.2m grid LiDAR flown specifically for HS2 Ltd and covers 500m either side of the centre line for the route of the Proposed

[12] Manchester Airport (2019), *Manchester Airport Surface Water Drainage Management Plan.*

Scheme. Where required, additional 1m grid LiDAR data provided by the Environment Agency was used. This was used in areas further away from the proposed crossing to provide full coverage of the 2D model extents.

4 Technical method and implementation

4.1 Hydrological assessment

4.1.1 Limited flow records are available for Timperley Brook[13]. Given the small catchment size (0.27 km^2) upstream of the Proposed Scheme crossing, a surface water modelling approach has been adopted where direct net rainfall is applied to the rural 2D domain.

4.1.2 The critical ReFH2 winter storm duration for the direct rainfall modelling downstream of the proposed crossing has been used for estimating the rainfall hyetographs for the 2D direct rainfall. A winter profile has been adopted throughout the Proposed Scheme at this early stage in scheme development, as it results in general in conservative reasonable water level estimates.

4.1.3 The upstream Flood Estimation Handbook (FEH) catchment area (1.64km^2) has not been modelled in the 2D domain as there is no longer a rural catchment (due to the construction of Manchester Airport)[8].

4.1.4 Two upstream sub-catchments were modelled using the ICM Infoworks Wallingford Runoff Routing method[14] for determination of direct rainfall. This method was used due to the large impermeable areas within these two sub-catchments. One sub-catchment represents an impermeable area of the M56 (0.11km^2) that discharges into Tributary of Timperley Brook 1. The other represents the airport car park and an area of the M56 (totalling 0.16km^2) that discharge into Timperley Brook. No throttling effect or attenuation of flows from the airport drainage system has been modelled at this stage; this ensures a precautionary approach in the design.

4.1.5 Table 1 shows the combined peak flows from the two upstream catchments used for the computational hydraulic modelling work.

Table 1: Peak flows used for hydraulic analysis for all model inflows

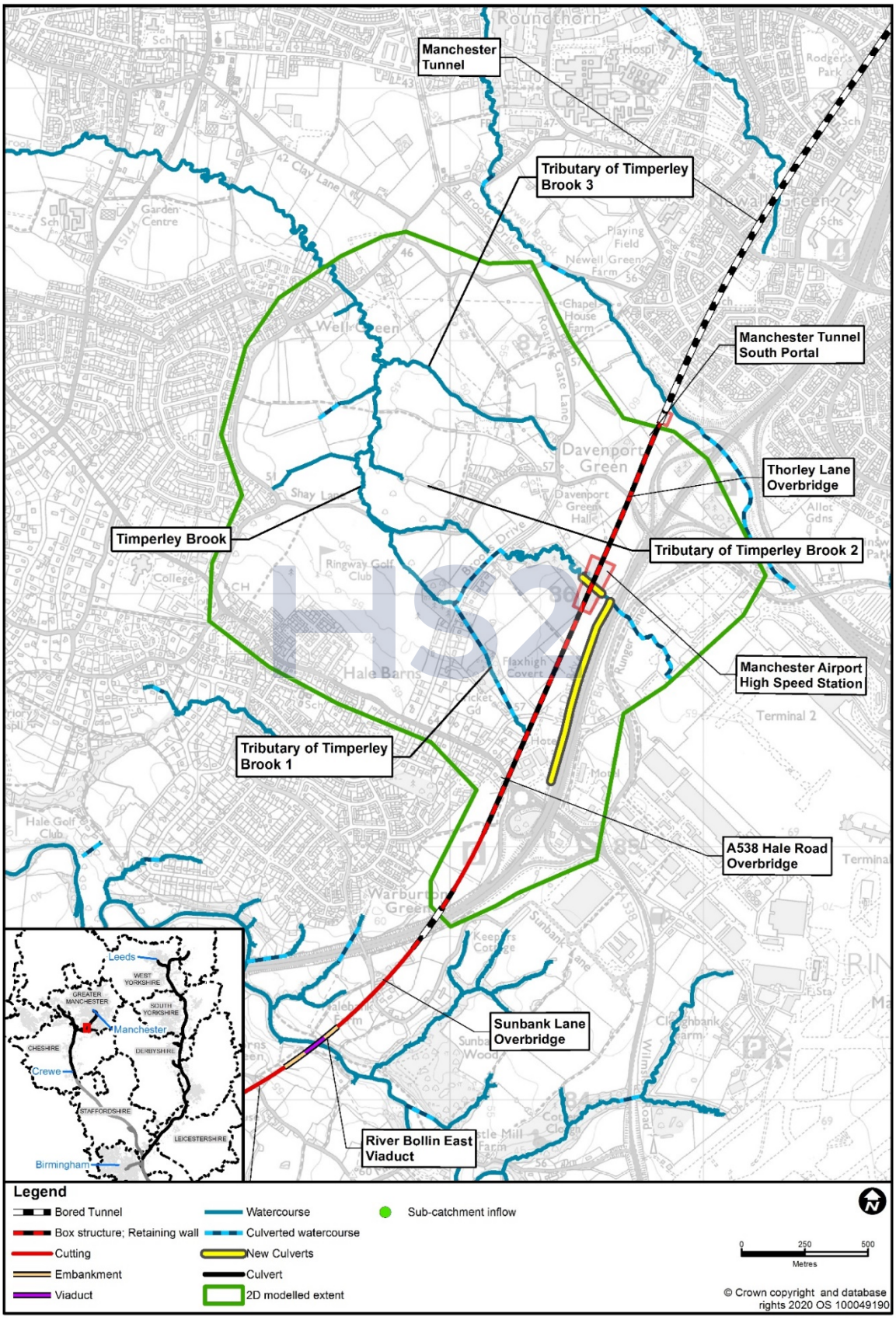
AEP	Return period	Combined peak flow (m^3/s) Timperley Brook inflow
0.5%	20 year	2.1
1.0%	100 year	2.3
1.0% + CC	100 year + CC	2.7
0.1%	1000 year	2.8

[13] HR Wallingford Ltd (1981), *The Wallingford Procedure for design and analysis of urban drainage.*

4.2 Hydraulic model build – baseline model

4.2.1 Figure 3 shows the existing and proposed model schematic.

Figure 3: Model schematic



1D representation

4.2.2 The existing 1,067mm diameter culvert beneath the M56 has been modelled as a 1D element. The size is based on a motorway drainage drawing provided by Highways England: abstracts from a historical drawing M50D/20/01/09H 12/01/1971 on HADDMS (Highways Agency Drainage Data Management System).

4.2.3 No other structures have been identified that could affect the sizing of the siphon or the impact as a result of the Proposed Scheme.

2D representation

4.2.4 The model element size is variable, with a minimum area set to 20m^2 and a maximum area set to 104m^2. Element size and alignment for the 2D model grid was optimised to ensure appropriate representation of the flow pathways whilst maintaining reasonable run times.

4.2.5 A 48% runoff coefficient has been used for infiltration based on the Hydrology of Soil Type (HOST) soil classification.

Inflow boundaries

4.2.6 No inflow boundaries were included as the contribution from Manchester Airport was modelled as direct rainfall using the Wallingford Runoff Routing method.

Downstream boundary

4.2.7 Unrestricted flow out of the 2D domain has been set based on inspection of the LiDAR and mapping along the 2D domain boundary, that indicates that flood waters cannot backup and impact on the zone of influence.

Key structures

4.2.8 All structures for which there was sufficient information were represented in the model, as indicated in Table 2. This structure is shown in Figure 3.

Table 2: Key structures present within the baseline modelled extent of Timperley Brook

Structure reference	Structure description	Modelling representation and justification
M56 culvert	Culvert under M56 and Runger Lane 22.0m (L) x 1.067m (D)	Modelled as a 1067mm diameter conduit

Roughness

4.2.9 Roughness is represented by Manning's n, selected based on Ordnance Survey (OS) Mastermap data and aerial photography in line with the recommended values stated within Chow, 1959[15].

4.3 Hydraulic model build – Proposed Scheme

4.3.1 The Proposed Scheme model has been edited from the baseline to include the following design elements.

Culverts and inverted siphon

4.3.2 The Proposed Scheme crossing has been modelled as a 1D twin 1.35m wide by 1.35m high inverted siphon, that provides sufficient pressure flow conditions for the design storm. Upstream of the siphon, an extension of the existing culvert beneath the M56 is modelled. The existing culvert under the M56 is 1.067m in diameter. However, the extended culvert has been modelled as a 1.35m wide by 1.35m high box culvert. This is to ensure free flow conditions for the design storm.

4.3.3 A new manhole is proposed at the boundary between the M56 culvert and the extended culvert. This manhole will receive flows from the culvert beneath the M56 and from a new culvert that will convey runoff from an M56 outfall (725m to the west of the Proposed Scheme crossing).

Topographic changes

4.3.4 The Proposed Scheme has been modelled as a raised 2D impermeable wall along the footprint of the embankment to prevent propagation of flood waters.

Replacement floodplain storage areas

4.3.5 Although there are only localised changes between baseline and post-development, provision for replacement floodplain storage has been made based on the 1.0% AEP + CC levels on a precautionary basis. The indicative requirement for the replacement floodplain storage was estimated using high-level calculations based on the Proposed Scheme layout and available hydraulic modelling results. This replacement floodplain storage will be part of the realignment of the Timperley Brook downstream of the Proposed Scheme. The proposed two-stage meandering channel will provide the required replacement floodplain storage and has a much greater volume than the combined volume of the existing channel

[15] Chow, V.T. (1959), *Open-channel hydraulics,* McGraw-Hill, New York.

reach that will be discontinued along with any requirement for compensation storage. The meandering channel has not been included within the hydraulic modelling.

4.3.6 The Proposed Scheme will be refined during design development. Further assessment will be undertaken to refine the understanding of flood risk impacts from the Proposed Scheme, following collection of additional data. If necessary, the mitigation design will be revised such that no parties are affected by an unacceptable increase in flood risk.

Channel realignments and diversions

4.3.7 Upstream of the Proposed Scheme inverted siphon, a new culvert will connect the outlet of the existing M56 Timperley Brook culvert to the inverted siphon. This will ensure that the channel crosses the Proposed Scheme at a ninety-degree angle.

4.3.8 Downstream of the Proposed Scheme crossing and north of Brooks Drive, the Timperley Brook will be realigned to create a wider and more natural meandering watercourse. This will provide mitigation for the adverse effects on hydromorphology from the inverted siphon and extended motorway culvert. The proposed realignment has not been modelled at this stage but will be incorporated into the hydraulic modelling during design development.

Production of flood extents

4.3.9 Flood extents have been derived using the direct output option available in Infoworks ICM, producing maximum flood depth and stage. The outputs have undergone a Proposed Scheme minus baseline calculation. The resulting layer was converted to polygons and cleaned to remove all bow ties (where two polygons overlap) and any dry islands that are less than 50m^2. The differences were mapped to indicate the potential impacts of the Proposed Scheme.

Modelling assumptions made

4.3.10 LiDAR described in Section 3.1 is assumed to be correct.

4.3.11 A 2D modelling approach is assumed to be sufficient for estimating the 5%, 1% and 0.1% AEP events.

4.3.12 The area contributing to the Timperley Brook siphon crossing provided by Manchester Airport surface water drainage management plan[8] has been assumed to be correct. Further checks will be undertaken as part of design development in the form of manhole surveys and with the request of as-built drawings from Manchester Airport.

4.3.13 The 1.067m diameter sizing of the Timperley Brook culvert beneath the M56 is based on motorway drainage drawings provided by Highways England and is assumed to be correct. The culvert is also assumed to be maintained (i.e. no blockage).

4.4 Climate change

4.4.1 The climate change allowance for Timperley Brook is a 40% increase in peak rainfall intensity for direct rainfall modelling as the catchment is less than 5km^2 in size. This increase has been applied as an uplift in rainfall intensity to each increment of the net rainfall hyetograph.

4.4.2 The H++ allowance for Timperley Brook is 60% increase in rainfall intensity for direct rainfall modelling and this has been used for the purpose of sensitivity analysis.

5 Model results

5.1.1 The model has been run for the 5.0%, 1.0%, 1.0%+CC, and 0.1% AEPs. The 1.0% AEP + CC simulation is based on a 40% increase in peak rainfall intensity.

5.1.2 The water level difference has been mapped for 5.0% AEP and 1.0% AEP + CC. These flood maps are included in Annex A.

5.1.3 The modelled flood extents with and without the Proposed Scheme for the 5.0% AEP and the 1.0% AEP + CC events are presented in the Volume 5, Water resources and flood risk Map Book: maps WR-05-322a and WR-06-322a respectively.

5.1.4 The modelled impact of the Proposed Scheme, without mitigation, on peak flood levels indicates the potential for:

- a decrease in peak flood level of approximately 10mm downstream of the Proposed Scheme crossing; and
- no change in peak flood level upstream of the Proposed Scheme.

5.1.5 The modelling has shown no change to peak flood levels upstream of the proposed Timperley Brook siphon, therefore flood risk to the airport and the airport car park is unchanged.

5.1.6 Model results indicate that the current proposed design achieves the freeboard requirements for top of rail level.

6 Model proving

6.1 Run performance

6.1.1 A time-step of 30 seconds was applied in the model with a cumulative mass balance error within +/-1.0% for all model runs undertaken.

6.2 Calibration and verification

6.2.1 There is no gauge situated within an appropriate distance of this location to provide calibration or verification data.

6.3 Validation

6.3.1 Flood extents generated for this study are similar to those shown by the Environment Agency RoFSW for the 1% and 0.1% AEP events.

6.4 Sensitivity analysis

6.4.1 Analysis was undertaken to assess the sensitivity of the 1.0% AEP + CC Proposed Scheme model outputs to the following scenarios:

- use of H++ climate change scenario of 60%;
- increase in roughness (channel, structures and floodplain) (Manning's n) by 20%;
- decrease in roughness (channel, structures and floodplain) (Manning's n) by 20%;
- increase in downstream boundary normal depth slope by 20%; and
- increase in upstream contributing area from Manchester Airport by 20%.

6.4.2 Sensitivity tests indicate that the Proposed Scheme hydraulic design is not unduly sensitive to changes in key input parameters. In all cases, changes in peak water levels are less than 15mm.

6.5 Blockage analysis

6.5.1 Blockage of 50% at the Proposed Scheme crossing of Timperley Brook was simulated by only modelling one of the twin inverted siphons (therefore representing full blockage of the other). The blockage scenario results were compared to the 0.1% AEP results for the Proposed Scheme model. This comparison indicated that there is no increase in peak flood level upstream of the Proposed Scheme and a maximum decrease of 13mm in peak level immediately downstream of the crossing. This is due to the fact that the siphons have been sized to be able to carry all flood flows in one barrel to allow the other to be taken out of service for maintenance.

6.6 Run parameters

6.6.1 There is no deviation used from the default run parameters recommended in Infoworks ICM, for all model runs.

7 Limitations

7.1.1 Land access for new topographic and structure surveys was not possible and so the model was built using available LiDAR information supplemented by Mastermap and OS map data. The culvert dimensions were taken from the 1968 Ministry of Transport as built drawing (M50D/20/01/09/H).

7.1.2 All channels have been represented in 2D, and therefore, the river channel conveyance may not be fully represented in the model. This is likely to have resulted in a conservatively high estimate of peak flood levels.

7.1.3 Calibration was not possible due to a lack of available historical data.

8 Conclusions and recommendations

8.1.1 The model results indicate that increases in peak flood levels from construction of the Proposed Scheme, without mitigation, are not likely to occur. Any potential loss of floodplain will be mitigated by replacement floodplain storage.

8.1.2 The modelling, without mitigation, has shown no change to peak flood levels upstream of the proposed Timperley Brook siphon, therefore flood risk to Manchester Airport including areas of airport car parking is unchanged. Two sensitivity runs were undertaken to assess peak flood levels at the airport when a larger inflow from the airport is applied, or there is a blockage of the twin siphons. When the upstream inflow from Manchester Airport was increased by 20%, the peak water level increased 15mm at the inlet of siphon, with no change to peak flood levels at the airport. When there was a 50% blockage of the siphons, there was no increase in peak flood level upstream of the siphons. This demonstrates that, even without mitigation measures, peak flood levels are unchanged to local receptors when the airport inflow is increased, or the siphon is blocked. This gives confidence that a Proposed Scheme design can be refined during design development to ensure there is no change in flood risk at Manchester Airport.

8.1.3 The modelling has shown small localised increases in peak flood levels at the embankment of Proposed Scheme that are not associated with the Timperley Brook watercourse. This is a result of the direct rainfall modelling approach, where small flow paths defined in the topography result in surface runoff that can be interrupted by the Proposed Scheme. These flow paths are not associated with a watercourse and will be addressed using toe drains at the foot of the Proposed Scheme embankment.

8.1.4 Blockage and sensitivity analyses indicate that the results are not unduly sensitive to changes in key input variables.

8.1.5 The model results indicate that the Proposed Scheme achieves the freeboard requirements for top of rail level.

8.1.6 During design development, the hydraulic modelling of the watercourse should be revisited. Topographic survey data of the channel and structures should be collected and used to refine the model to cover the full extent reported in this document. The Manchester Airport catchment contributing to the upstream of the model should be refined during design development following delivery of detailed airport drainage information. The ICM modelling software allows for the inclusion of urban drainage, that could be used to incorporate the more detailed airport drainage information, including any throttles on their outflows. The updated model should be used to develop the detailed hydraulic design of the Proposed Scheme with a view to reducing impacts in peak flood levels as far as is reasonably practicable. The model should also be used to verify the magnitude of residual impacts (if any) of the final scheme design, for consenting purposes.

Annex A: Flood level impact map

The water level difference has been mapped for 5.0% AEP and 1.0% AEP +CC events see Figure A 1 and Figure A 2.

Figure A 1: Timperley Brook impact map for 5.0% AEP (1 in 20 year)

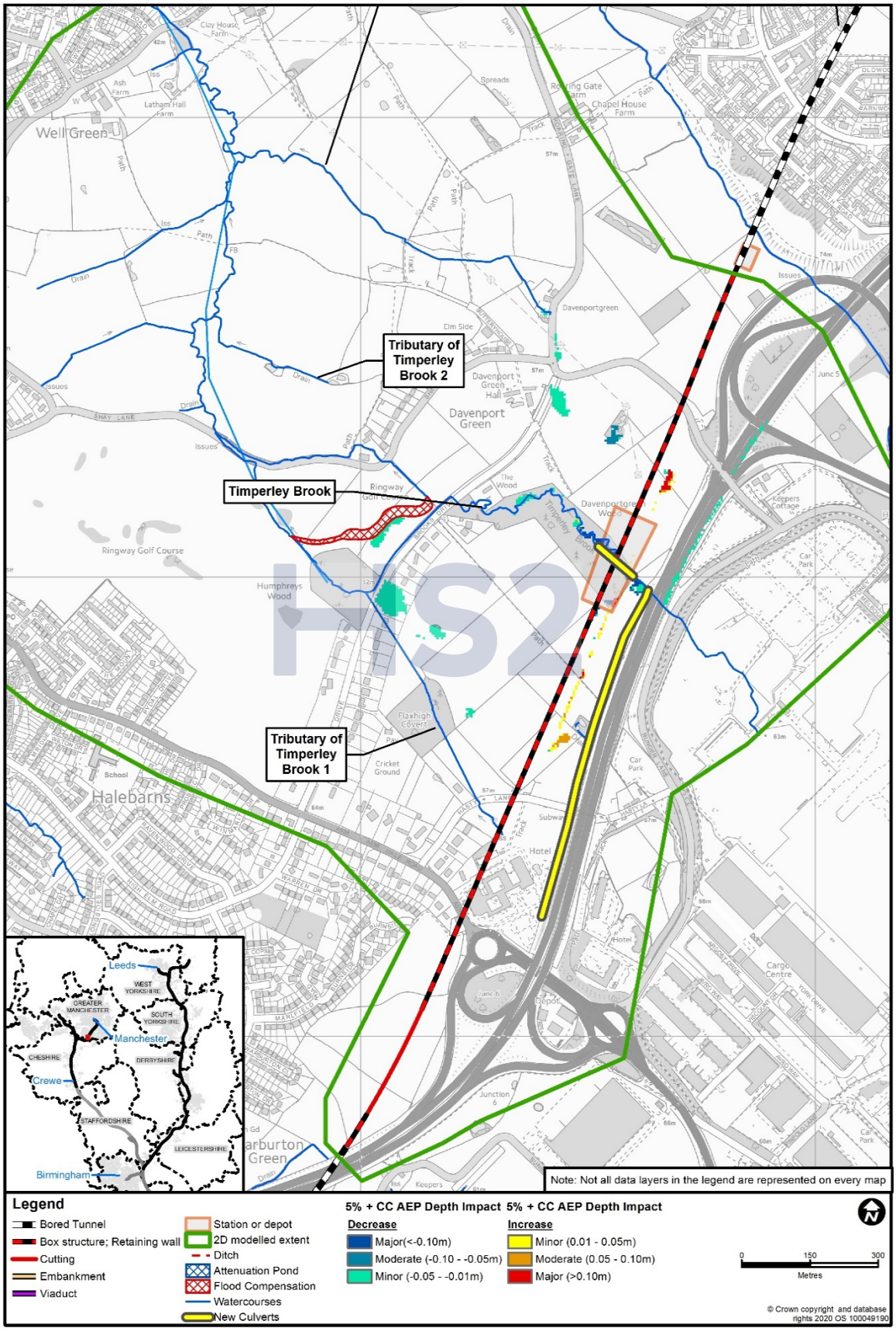
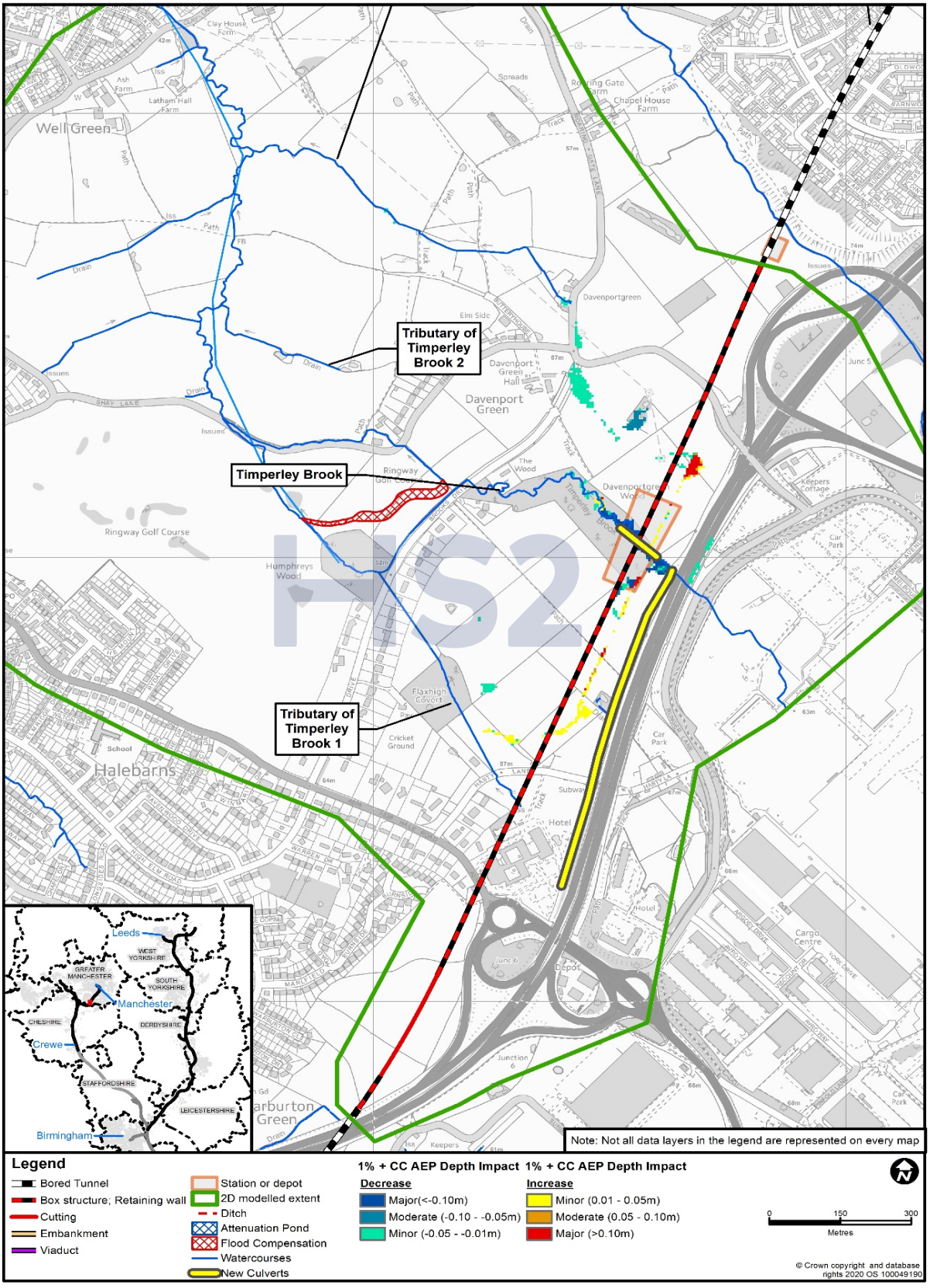


Figure A 2: Timperley Brook impact map for 1.0% AEP + CC event (1 in 100 year plus climate change)



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