In Parliament – Session 2022 - 2023

HS2

High Speed Rail (Crewe – Manchester)

Supplementary Environmental Statement 2 and Additional Provision 2 Environmental Statement

Volume 5: Appendix WR-005-0MA07

Water resources and flood risk

Flood risk assessment

MA07: Davenport Green to Ardwick

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Department for Transport

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1 Introduction

1.1 Structure of this appendix

1.1.1 This report is an appendix to the water resources and flood risk assessment which forms part of Volume 5 of the Supplementary Environmental Statement 2 (SES2) and Additional Provision Environmental Statement (AP2 ES) for the Davenport Green to Ardwick (MA07) community area.

1.1.2 This appendix provides details of changes to the flood risk assessment (FRA) since the production of the High Speed Two (HS2) (Crewe – Manchester) Environmental Statement (ES)[1] (the main ES) and the HS2 High Speed Rail (Crewe – Manchester) Background Information and Data (BID)[2] (the main BID reports) which accompanied the main ES published in 2022.

1.1.3 An assessment of the impact of the original scheme on flood risk was undertaken as part of the water resources and flood risk assessment reported in the main ES Volume 2: Community Area report: Davenport Green to Ardwick (MA07).

1.1.4 This appendix should be read in conjunction with Volume 5, Appendix: WR-005-0MA07 of the main ES for the Davenport Green to Ardwick (MA07) community area.

1.1.5 In order to differentiate between the original scheme and subsequent changes, the following terms are used:

- 'the original scheme' – the hybrid Bill scheme submitted to Parliament in 2022, which was assessed in the main ES;
- 'the SES1 scheme' – the original scheme with any changes described in SES1 that are within the existing powers of the Bill;
- 'the AP1 revised scheme' – the original scheme as amended by SES1 changes and AP1 amendments;
- 'the SES2 scheme' – the original scheme with any changes described in SES1 (submitted in July 2022) and the SES2; and
- 'the AP2 revised scheme' – the original scheme as amended by SES1 and SES2 changes (as relevant) and AP2 amendments.

[1] High Speed Two Ltd (2022), High Speed Rail (Crewe – Manchester), *Environmental Statement.* Available online at: https://www.gov.uk/government/collections/hs2-phase2b-crewe-manchester-environmental-statement.

[2] High Speed Two Ltd (2022), High Speed Rail (Crewe – Manchester), *Background Information and Data.* Available online at: https://www.gov.uk/government/collections/hs2-phase2b-crewe-manchester-environmental-statement.

1.1.6 The purpose of this document is to report any changes or updates to environmental information and scheme design or assumptions that have occurred since the main ES, which will result in a change in effects and/SATor the introduction of new effects on flood risk receptors.

1.1.7 This FRA considers SES2 changes to baseline data and three AP2 amendments which were identified in the Davenport Green to Ardwick (MA07) community area that had implications for flood risk.

1.1.8 A separate report for the hydraulic modelling of the River Mersey described in this assessment can be found in SES2 and AP2 ES Volume 5, Appendix: WR-006-00009.

1.1.9 Maps relevant to this report are contained in the SES2 and AP2 ES Volume 5 Water resources and flood risk Map Book: Map Series WR-05 – Modelled Baseline and Post Development Flood Extent 1 in 100 (1%) including climate change (CC) Annual Probability of River Flooding and Map Series WR-06 – Modelled Baseline and Post Development Flood Extent 1 in 20 (5%) Annual Probability of River Flooding.

1.2 Assessment methodology

1.2.1 This FRA has been carried out in general accordance with the requirements of the National Planning Policy Framework (NPPF)[3]. The NPPF aims to prevent inappropriate development in areas at risk of flooding. Where development is necessary in such areas, the NPPF requires local planning authorities to ensure any development is safe from flooding, does not increase flood risk elsewhere and reduces flood risk where possible.

1.2.2 The methodology, design criteria and data sources used in this FRA are set out in the main ES Environmental Impact Assessment Scope and Methodology Report (SMR)[4] and the SES2 and AP2 ES Volume 5, Appendix: CT-001-00005 Water resources and flood risk technical note, Updated guidance on flood risk assessment.

[3] Ministry of Housing, Communities and Local Government (2021), *National Planning Policy Framework*. Available online at: https://www.gov.uk/government/publications/national-planning-policy-framework--2.

[4] High Speed Two Ltd (2021), High Speed Rail (Crewe – Manchester), *Environmental Statement, Environmental Impact Assessment Scope and Methodology Report,* Volume 5, Appendix CT-001-00001. Available online at: https://www.gov.uk/government/collections/hs2-phase2b-crewe-manchester-environmental-statement.

Part 1: Supplementary Environmental Statement

2 Flood risk baseline

2.1.1 The original flood risk baseline is set out in the main ES, Volume 5, Appendix: WR-005-0MA07.

2.1.2 In the main ES, hydraulic modelling was carried out due to the presence of the Palatine Road vent shaft within the River Mersey floodplain. This modelling was carried out using the UK Climate Projections 2009 (UKCP09) CC allowances. The guidance for application of the UKCP09 was to use the Upper End allowance, which in this case was an increase in peak river flows of 70%.

2.1.3 In July 2021, the Environment Agency published revised guidance for assessing the impact of CC on peak river flows to reflect the UK Climate Projections 2018 (UKCP18)[5]. The revised guidance indicates that for essential infrastructure, the Environment Agency's 'Higher Central' allowance for peak river flow should be used. The revised guidance provides peak river flow allowance by management catchment instead of river basin district. The River Mersey is located within the Upper Mersey Management Catchment.

2.1.4 The baseline environmental information has been updated to include the new CC guidance. The corresponding peak river flow CC allowance for the Upper Mersey Management Catchment is 53%. This leads to a reduction in the peak river flows which need to be applied compared to the main ES.

2.1.5 There are no other changes in baseline relevant to flood risk.

[5] Environment Agency (2022). *Flood risk assessments: climate change allowances*. Available online at: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances.

3 Flood risk assessment

3.1 River Mersey

3.1.1 This FRA focuses on:

- assessing the change in impact of the SES2 scheme, compared to the original scheme, on peak flood levels and extents relative to the SES2 baseline. This incorporates a reduction in the CC allowance from a 70% increase in peak river flow to a 53% increase in peak river flow, in accordance with the updated Environment Agency guidance;
- determining whether changes to flood risk impacts relative to those reported in the main ES have the potential to lead to new or different significant flood risk effects;
- determining whether the embedded mitigation and additional mitigation measures included in the SES2 scheme can be refined in the event that new or different significant effects are identified, without resorting to additional Bill powers to mitigate the change in flood risk impact; and, if not,
- establishing what additional mitigation may be required in order to reduce the change in flood risk impact as far as reasonably practicable.

3.1.2 Modelling undertaken in support of the main ES using the calibrated 1D-2D model of the River Mersey predicted that the original scheme would lead to the overtopping of a wall along Ford Lane, Northenden in the 1 in 100 year + CC event. This resulted in new flooding to receptors in the Northenden area (as shown in Figure 9 of the Flood risk assessment, Volume 5, Appendix: WR-005-0MA07 of the main ES). The modelled impact of the SES2 scheme on River Mersey peak flood levels and extents relative to the SES2 baseline is shown in Figure 1. In the SES2 scheme, running the same model with the reduced CC allowance for peak river flow predicts that the wall along Ford Lane will no longer overtop and so the receptors in Northenden are no longer considered to be at risk of flooding. The increased peak flood levels to the north of the River Mersey remain similar to those set out in the main ES, with no new or different significant effects.

3.1.3 A comparison of the revised modelling outcomes with those of the original FRA (Volume 5, Appendix: WR-005-0MA07 of the main ES) is presented in Table 1. In the SES2 scheme, the reduction in the CC allowance has led to the removal of 31 of the previously reported significant effects.

Figure 1: Impact map for the area around Palatine Road during a 1.0% annual exceedance probability (AEP) + 53% CC flood event

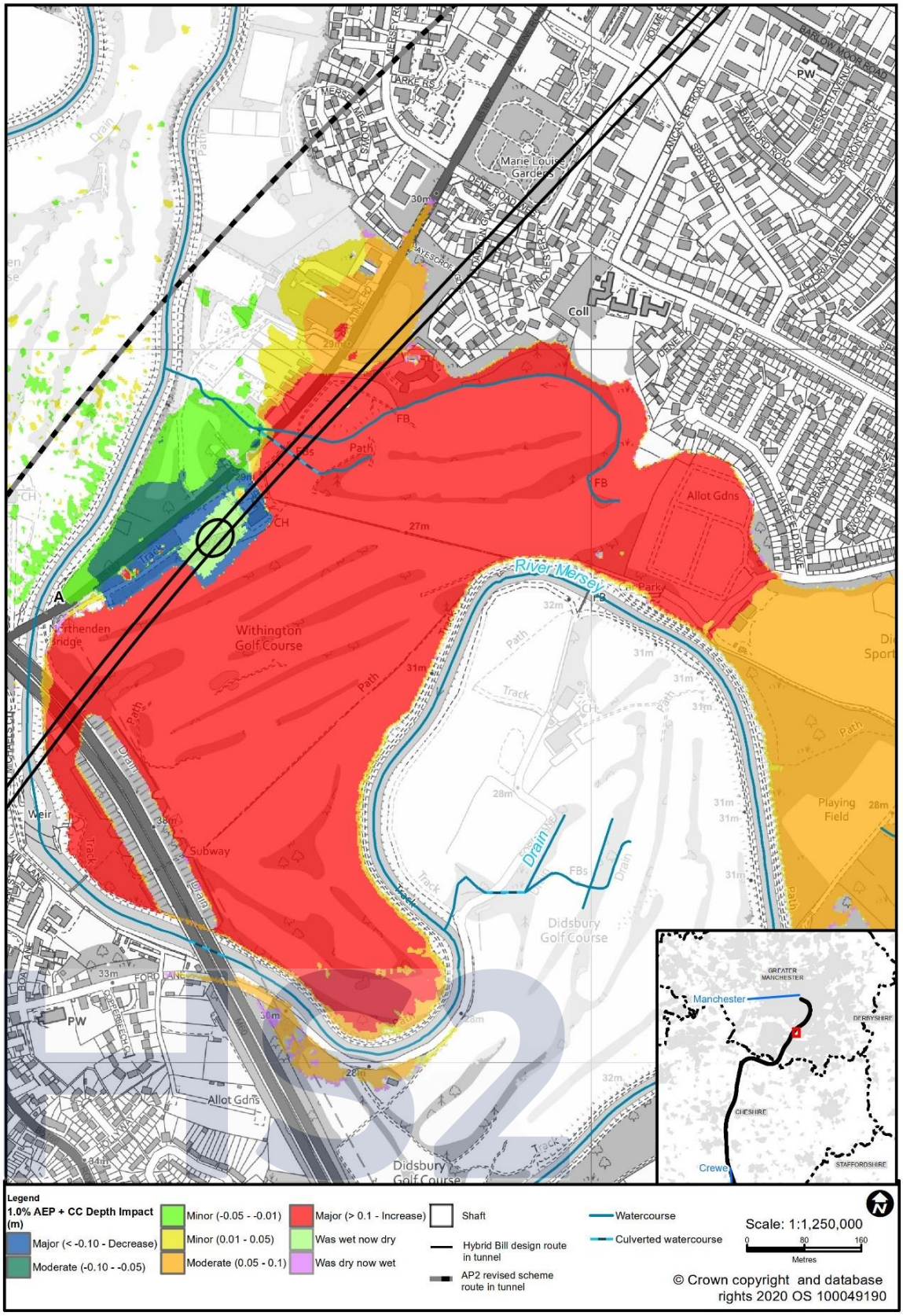


Table 1: Comparison of predicted significant effects in the original ES and in the SES2 scheme

Location	Number and type of receptor reported in main ES	Receptor value	Impact, effect and significance as reported in main ES	Impact, effect and significance following SES2 baseline change	Change in significance of effect in SES2 scheme
Ford Lane, Northenden	Secondary electricity sub-station	Very high	Major impact, Major adverse effect, significant	Negligible impact, Negligible effect, not significant	Significant effect removed
	22 residential properties	High	Major impact, Major adverse effect, significant	Negligible impact, Negligible effect, not significant	Significant effect removed
	1 commercial property	Moderate	Major impact, Moderate adverse effect, significant	Negligible impact, Negligible effect, not significant	Significant effect removed
	4 residential properties	High	Moderate impact, Moderate adverse effect, significant	Negligible impact, Negligible effect, not significant	Significant effect removed
	Mill Lane and Allanson Road	Moderate	Major impact, Moderate adverse effect, significant	Negligible impact, Negligible effect, not significant	Significant effect removed
	Car park	Low	Major impact, Minor adverse effect, not significant	Negligible impact, Negligible effect, not significant	Significant effect removed
Palatine Road area	Secondary electricity sub-station	Very high	Moderate impact, Major adverse effect, significant	Moderate impact, Major adverse effect, significant	No change in effect reported in main ES
	Secondary electricity sub-station	Very high	Minor impact, Moderate adverse effect, significant	Minor impact, Moderate adverse effect, significant	No change in effect reported main ES
	4 residential properties	High	Major impact, Major adverse effect, significant	Major impact, Major adverse effect, significant	No change in effect reported main ES
	2 residential properties	High	Moderate impact, Moderate adverse effect, significant	Moderate impact, Moderate adverse effect, significant	No change in effect reported main ES
	1 commercial property	Moderate	Major impact, Moderate adverse effect, significant	Major impact, Moderate adverse effect, significant	No change in effect reported main ES
	3 residential properties	High	Minor impact, Moderate adverse effect, significant	Minor impact, Moderate adverse effect, significant	No change in effect reported main ES
	Palatine Road	Moderate	Major/Moderate impact, Moderate adverse effect, significant	Major/Moderate impact, Moderate adverse effect, significant	No change in effect reported main ES
	1 commercial property	Moderate	Minor impact, Minor adverse effect, not significant	Minor impact, Minor adverse effect, not significant	No change in effect reported main ES

Location	Number and type of receptor reported in main ES	Receptor value	Impact, effect and significance as reported in main ES	Impact, effect and significance following SES2 baseline change	Change in significance of effect in SES2 scheme
	2 car parks	Low	Minor decrease, Negligible effect, not significant	Minor decrease, Negligible effect, not significant	No change in effect reported main ES
	1 residential property	High	Moderate decrease, Moderate beneficial effect, significant	Moderate decrease, Moderate beneficial effect, significant	No change in effect reported main ES
	Palatine Road	Moderate	Major decrease, Moderate beneficial effect, significant	Major decrease, Moderate beneficial effect, significant	No change in effect reported main ES
Area south of J5 of M60 (Northenden)	1 residential property	High	Minor impact, Moderate adverse effect, significant	Negligible impact, Negligible effect, not significant	Significant effect removed
	Cycle track	Moderate	Minor impact, Minor adverse effect, not significant	Negligible impact, Negligible effect, not significant	Significant effect removed
East of Didsbury flood storage basin (Stenner Lane)	4 residential properties	High	Moderate impact, Moderate adverse effect, significant	Moderate impact, Moderate adverse effect, significant	No change in effect reported main ES
	1 commercial property	Moderate	Moderate impact, Moderate adverse effect, significant	Moderate impact, Moderate adverse effect, significant	No change in effect reported main ES
	Stenner Lane	Moderate	Moderate impact, Moderate adverse effect, significant	Moderate impact, Moderate adverse effect, significant	No change in effect reported main ES

4 Flood risk management measures

4.1.1 The approach to flood risk mitigation in the original scheme is set out in the main ES Volume 5, Appendix: WR-005-0MA07. The need for additional measures arising from the SES2 scheme is considered below.

4.1.2 In the main ES, replacement floodplain storage (RFS) is proposed for the River Mersey on a precautionary basis. This is included to address the potentially significant flood risk effects caused by the loss of floodplain storage, due to the encroachment of the Palatine Road vent shaft site into the River Mersey floodplain and the Didsbury flood storage basin. Since the peak river flow CC allowance in SES2 has been reduced, the RFS provided within the original scheme remains in line with the NPPF.

4.1.3 In the main ES, it was reported that detailed modelling has shown that during an extreme flood event, when the capacity of the flood storage basin is exceeded, water begins to overtop Palatine Road. The raised ground surrounding the Palatine Road vent shaft changes the pattern of flood conveyance in the local area. This leads to increases in peak flood level to several high value receptors. The SES2 revised baseline has reduced the number of significant effects on receptors due to an increase in peak flood level in the original ES from 52 to 21.

4.1.4 Additional mitigation for these significant effects has been put forward as an AP2 amendment, Palatine Road vent shaft relocation (AP2-007-003). The assessment of the AP2 revised scheme is set out in Section 7 of this report. If the AP2 amendment (AP2-007-003) is not carried forward, then additional mitigation will be required.

4.1.5 The avoidance and mitigation options that could reduce flood impacts and may still be required for the SES2 scheme include:

- refinement of the design to reduce the flood risk effects, including review of the vent shaft compound size and elevation;
- measures to control conveyances of flood flows, such as the provision of flood walls or bunds, along:
  - the boundary of Withington golf course to the north of the Palatine Road vent shaft;
  - the Fielden Park Brook; and
  - around essential infrastructure.
- additional capacity in the bottom outlet structures from the Didsbury flood storage basin into the River Mersey; and
- an increased conveyance of Fielden Park Brook (Tributary of River Mersey 2) beneath Palatine Road.

Part 2: Additional Provision 2 Environmental Statement

5 AP2 amendments and flood risk implications

5.1.1 Table 2 shows the AP2 amendments in the Davenport Green to Ardwick (MA07) community area that have implications for flood risk.

Table 2: AP2 amendments with implications for flood risks

AP2 amendment	Description	Implications
AP2-007-002	Change to Bill powers required for modifications to Manchester Tunnel Altrincham Road vent shaft.	Potential for impact due to raising of land in flood zone 2.
AP2-007-003	Change to Bill powers required for relocation of vent shaft and headhouse from Palatine Road to The Hollies.	Relocation of vent shaft from Didsbury flood storage basin to River Mersey floodplain. The proposed vent shaft relocation places the vent shaft to the north-west of the Britannia Country House Hotel, on the disused playing fields of the former Hollies School. Therefore, for the AP2 revised scheme, the relocated vent shaft will be known as The Hollies vent shaft.
AP2-007-005	Change to Bill powers required for modifications to the Birchfields Road vent shaft headhouse.	Potential for increased groundwater flood risk due to proposed new basement structure.
AP2-007-008	Additional land permanently required for changes to design elements managed by the Manchester tunnel north portal main compound.	Interruption to surface water flow path due to relocation of sectioning auto-transformer station (SATS).

5.1.2 This FRA focuses on:

- potential changes to peak flood levels and flood extents caused by the raising of land associated with larger headhouse at Altrincham Road within flood zone 2 of Baguley Brook leading to new or different significant flood risk effects;
- assessing the significance of any changes to peak flood levels and flood extents associated with The Hollies vent shaft leading to new or different significant flood risk effects and identifying the additional mitigation required to manage these risks;
- potential localised rise in groundwater levels upgradient of the proposed new basement at Birchfields Road vent shaft leading to new or different significant groundwater flood risk effects; and
- potential changes to peak flood levels and flood extents due to interruption of surface water flow path at Rondin Road that could lead to new or different significant flood risk effects.

6 Flood risk baseline

6.1.1 The flood risk baseline is set out in the main ES Volume 5, Appendix WR-005-0MA07. A summary of the flood risk relevant to each amendment is set out below.

6.2 Change to Bill powers required for modifications to Manchester Tunnel Altrincham Road vent shaft (AP2-007-002)

6.2.1 The flood risk baseline for Baguley Brook is set out in the main ES Volume 5, Appendix WR-005-0MA07. A summary of the sources of flooding relevant to the vent shaft modifications (AP2-007-002) amendment is set out below.

6.2.2 The main rivers have mapped flood zones indicated by the Environment Agency's Flood map for planning (rivers and sea) dataset. This dataset was used to assess the receptors at potential risk from river flooding, as the AP2 revised scheme crosses beneath Baguley Brook in tunnel, with the Altrincham Road vent shaft located on the edge of flood zone 2.

6.2.3 The receptors upstream and downstream of the original scheme that are at potential risk from the Baguley Brook, as set out in the main ES are listed below. The relative vulnerability to flooding of each receptor (as defined in NPPF and Table 55 of the SMR[4]) is also indicated:

- commercial offices (less vulnerable);
- gas governor station (essential infrastructure);
- residential properties along Beechpark Avenue (more vulnerable); and
- Beechpark Avenue (less vulnerable).

6.3 Change to Bill powers required for relocation of vent shaft and headhouse from Palatine Road to The Hollies (AP2-007-003)

6.3.1 As described in Section 2, the baseline environmental information has been updated to include the new CC guidance. The guidance indicates a higher central peak river flow allowance for the Upper Mersey Management Catchment of 53%. Hydraulic modelling of the River Mersey has been updated taking into account the updated CC allowance and the proposed vent shaft relocation (AP2-007-003).

6.3.2 The flood risk baseline is set out in Part 1 above. Due to the location of The Hollies vent shaft, the following receptors have been identified as at potential risk from the River Mersey. The relative vulnerability to flooding of each receptor (as defined in NPPF and Table 55 of the SMR[4]) is also indicated:

- Palatine Road/The Hollies area:
  - two secondary electricity sub-stations (essential infrastructure);
  - nine residential properties along Palatine Road (more vulnerable);
  - one commercial property along Palatine Road (less vulnerable);
  - hotel along Palatine Road (more vulnerable);
  - Palatine Road (less vulnerable);
  - two car parks (less vulnerable);
  - disused sports pitches (water compatible);
  - Beeches Mews (less vulnerable);
  - fourteen residential properties around Beeches Mews, The Beeches and Beeches Court (hereafter known collectively as Beeches Mews) (more vulnerable);
  - Northenden golf course (water compatible); and
  - Northenden golf course club house (more vulnerable).
- East of Didsbury flood storage basin (Stenner Lane):
  - four residential properties (more vulnerable);
  - one commercial property (less vulnerable);
  - Stenner Lane (less vulnerable);
  - allotments (water compatible); and
  - Didsbury Sport Ground (water compatible).

6.4 Change to Bill powers required for modifications to the Birchfields Road vent shaft headhouse (AP2-007-005)

6.4.1 The flood risk baseline is set out in the main ES Volume 5, Appendix WR-005-0MA07. A summary of the sources of flooding relevant to the vent shaft modifications (AP2-007-005) amendment is set out below.

6.4.2 The vent shaft modifications (AP2-007-005) amendment is located on an area classified by the British Geological Survey susceptibility to groundwater flooding data set (as set out in the main ES Volume 5, Appendix: WR-005-0MA07) as having 'limited potential for groundwater flooding to occur'. However, it is immediately adjacent to an area with 'potential for groundwater flooding to occur at surface'.

6.5 Additional land permanently required for changes to design elements managed by the Manchester tunnel north portal main compound (AP2-007-008)

6.5.1 The Environment Agency's Risk of flooding from surface water dataset for the 1 in 1000 (0.1%) AEP flood event dataset indicates that a surface water flow path crosses the original scheme from Rondin Road to Blind Lane. The receptors at risk from surface water flooding near Rondin Road are set out below. The relative vulnerability to flooding of each receptor (as defined in NPPF and Table 55 of the SMR[4]) is also indicated:

- two secondary electricity sub-stations (essential infrastructure);
- railway assets: train care facility (less vulnerable);
- commercial property on Rondin Road – to be demolished as part of the original scheme but assumed to be replaced with planning allocations (MA07/111, MA07/110, MA07/299, MA08/038, MA08/129) for residential and commercial properties in the future (more vulnerable);
- Blind Lane (less vulnerable); and
- industrial wasteland (water compatible).

7 Flood risk assessment

7.1.1 The overall approach to flood risk mitigation on the original scheme is set out in the main ES Volume 5, Appendix: WR-006-MA07. The need for additional measures arising from the AP2 amendments identified in Section 5 is considered below.

7.2 Change to Bill powers required for modifications to Manchester Tunnel Altrincham Road vent shaft (AP2-007-002)

7.2.1 The vent shaft modifications (AP2-007-002) will require raising of a section of land on the western side of the vent shaft to allow for the construction of the headhouse, associated infrastructure and realignment of the Brownley Brook culverted watercourse. Part of this land raising will take place within flood zone 2 associated with Baguley Brook (as shown on Figure 2).

7.2.2 A hydraulic modelling review has been carried out on the existing Environment Agency Baguley Brook model. The flood zones shown in the area around the vent shaft are not based on the latest Environment Agency model, which starts to the west of the motorway, and does not cover the area around the vent shaft. The flood zones are therefore likely to have come from an earlier model.

7.2.3 A review of the local topography has therefore been carried out to understand the mechanism for flooding in the area around the Altrincham Road vent shaft. The topography in this area, along with some long section profiles, are presented in Figure 3. The flooding originates from Baguley Brook (located to the west of the motorway). As peak flood levels increase, Baguley Brook overtops its banks. The flood water passes beneath the motorway, either through the gyratory that forms Junction 3a, or via other underpasses beneath the motorway embankment in this area. The flood water then flows north and south towards the lower lying land (see long section A-A' in Figure 3).

7.2.4 The flood zone 2 area suggests that flood flows would then cross the railway and into the land required for the construction of the modifications to Altrincham Road vent shaft (AP2-007-002). However, as shown in long section A-A' in Figure 3, the topography shows that the railway is in a cutting in this area. If flood flows were to enter the railway cutting from the north, the water would flow along the railway cutting to the east and away from the land required for this amendment (see long section B-B' in Figure 3). Therefore, there is no pathway for flood flows to enter the land required for the construction of this amendment. This means that the land required for the construction of this amendment is not susceptible to river flooding.

Figure 2: Environment Agency flood zones of Baguley Brook at Altrincham Road vent shaft

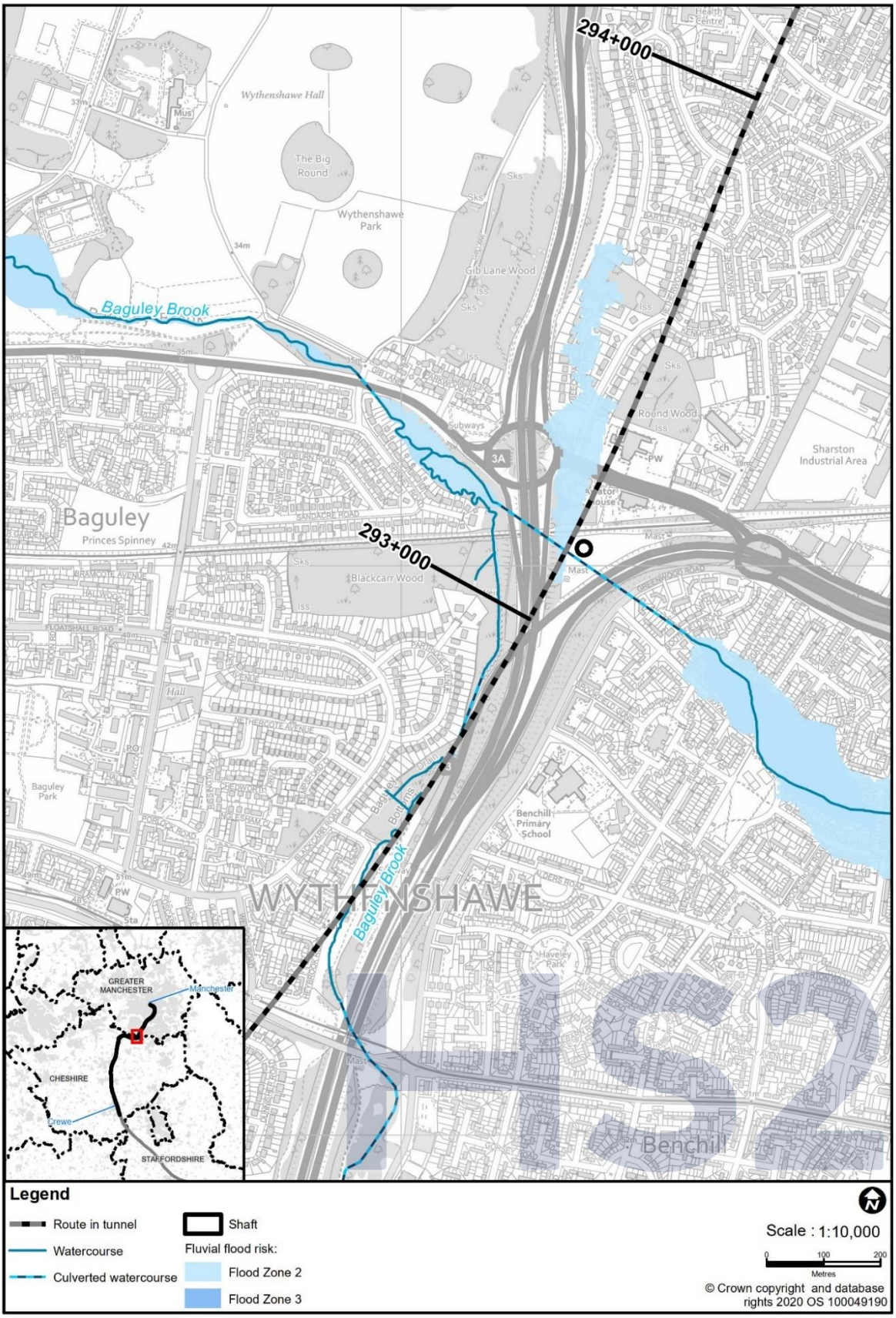
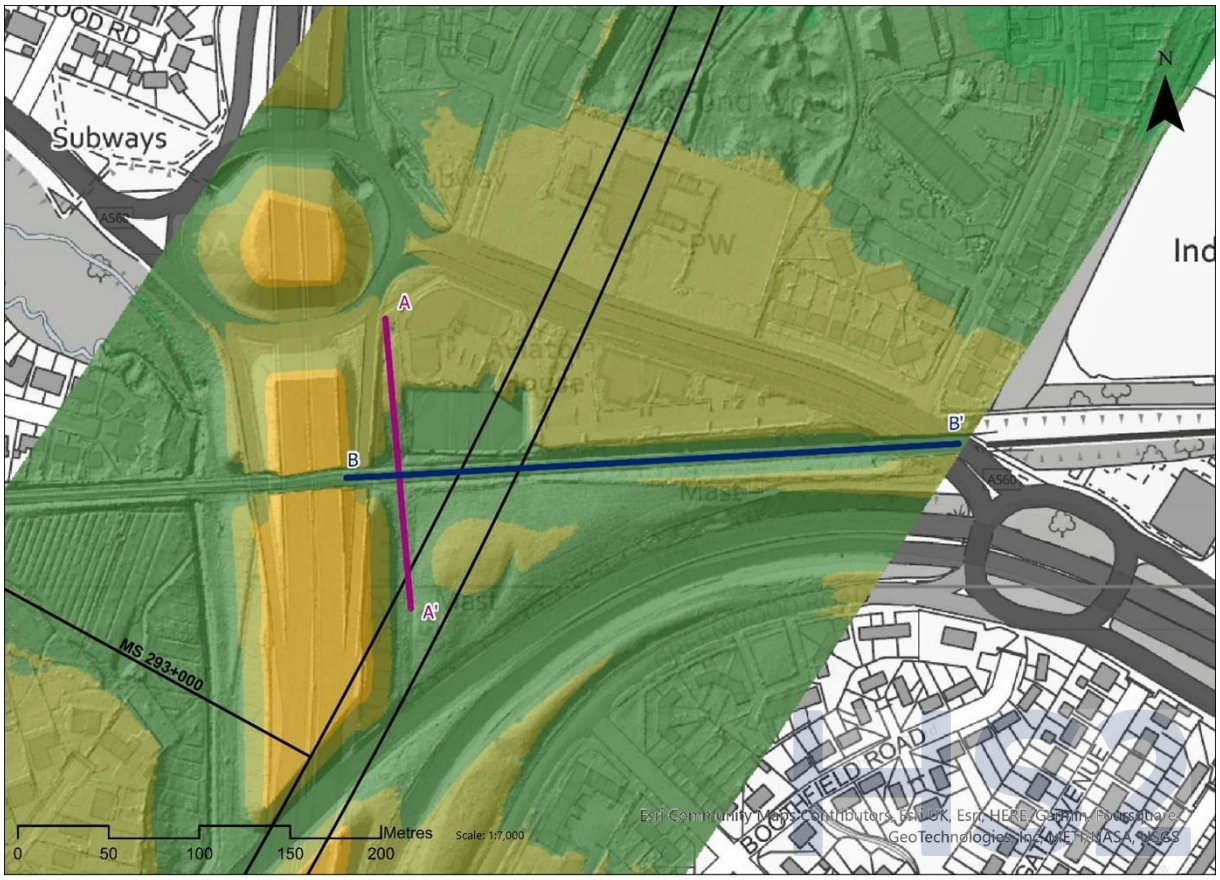
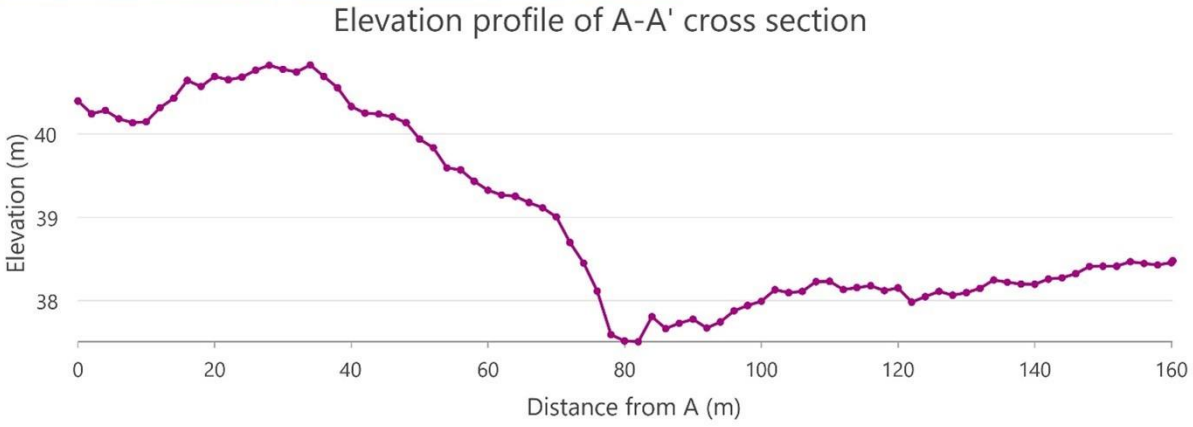
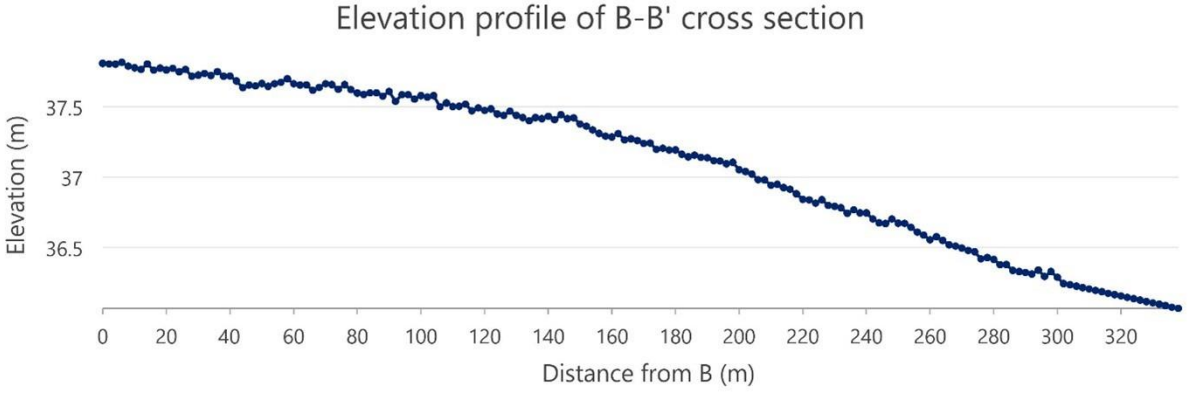


Figure 3: Land elevation data around the Altrincham Road vent shaft







7.2.5 As part of this amendment the culverted Brownley Brook will be realigned around the vent shaft. The culvert realignment will be designed to ensure that the hydraulic capacity of the culvert is maintained. At present, details of the size, shape, capacity or route of this culverted watercourse are not available. Further surveys will be undertaken during design development to identify the location and nature of this culvert to allow design refinement to ensure no increase in flood risk due to this realignment. The design refinement will be carried out in consultation with the lead local flood authority to ensure potential constraints and opportunities are considered.

7.2.6 This assessment concludes that there will be no impact from the realignment of the culverted watercourse or raising of the land for the construction of the AP2 revised scheme on flood risk in the local area. Therefore, no new or different significant effects on flood risk are anticipated due to this amendment (AP2-007-002).

7.3 Change to Bill powers required for relocation of vent shaft and headhouse from Palatine Road to The Hollies (AP2-007-003)

7.3.1 In the main ES, the hydraulic model predicted that the original scheme, which was located within the Environment Agency's Didsbury flood storage basin[6], could potentially lead to significant flood risk effects at 52 receptors (which are already affected by flooding in a 1 in 100 year + CC event).

7.3.2 As set out in Section 3, the change in SES2 baseline change has reduced the number of potential significant effects on flood risk associated with the Palatine Road vent shaft from 52 to 21 (which are all already affected by flooding in a 1 in 100 year + CC event). This amendment has been brought forward to relocate the Palatine Road vent shaft to disused land to the rear of Britannia Country House Hotel, which avoids the Environment Agency's Didsbury flood storage basin. The AP2 revised scheme shaft and its associated raised compound will be known as The Hollies vent shaft.

7.3.3 The Hollies vent shaft and operational compound is designed to be elevated to above the 1 in 1000 year peak flood level with an allowance of 300mm freeboard. The permanent operational site will lead to the permanent loss of floodplain storage of approximately 46,600m^3 in the 1 in 100 year + CC event, and 42,300m^3 in the 1 in 100 year event. There will also be a raised temporary construction compound that will be elevated to the 1 in 100 year peak flood level. This temporary compound will be removed at the end of the construction period, and the land lowered back to its original level. During construction, the raised construction compound would lead to the additional temporary loss of floodplain storage of

[6] A flood risk management asset used by the Environment Agency to regulate flows within the River Mersey during flood events.

approximately 17,700m^3 in the 1 in 100 year event. Therefore, during the period of construction there would be a total loss of floodplain storage of approximately 60,000m^3 in the 1 in 100 year event.

7.3.4 The raised temporary compound and vent shaft would displace flood storage once the Didsbury flood storage basin and/or the River Mersey flood defences are overwhelmed, displacing floodwater in the River Mersey floodplain. Hydraulic modelling of the River Mersey at The Hollies vent shaft has informed the design and assessment of the AP2 revised scheme. The modelling has been used to determine the likely impact of the vent shaft and compound on the peak flood levels in the 1.0% AEP + CC. This modelling uses the linked 1D-2D model, calibrated against the 2021 Storm Christoph event, created for the original scheme assessment, presented in the main ES. Details of the hydraulic modelling are reported in the SES2 and AP2 ES Hydraulic modelling report – River Mersey, Volume 5, Appendix: WR-006-00009.

7.3.5 The detailed modelling shows that the presence of the AP2 revised scheme will lead to localised changes in the conveyance of water through the floodplain but to a lesser extent than the original scheme, and will therefore remove some of the previously reported significant effects. The SES2 and AP2 ES Hydraulic modelling report – River Mersey, Volume 5, Appendix: WR-006-00009 provides further information and detailed flood mapping that identifies each receptor potentially impacted by these changes in conveyance. A summary of the new, different, removed and remaining impacts is set out in Table 3.

7.3.6 A review of the baseline and AP2 revised scheme changes in peak flood flows downstream of the vent shaft site suggests that the permanent loss of floodplain storage due to the presence of the AP2 revised scheme leads to an 0.1% increase in peak flood flows (0.5m^3/s increase in peak flood flow, compared to a baseline flow of 568m^3/s) downstream of Princess Road during the 1 in 100 year + CC event (see Figure 4). The total volume of flood flow passed downstream during this 1 in 100 year + CC event is 42,400m^3 (approximately 90% of the loss in floodplain storage due to the operational site: 46,600m^3).

7.3.7 The permanent operational site also leads to an 0.1% increase in peak flood flows (0.3m^3/s increase in peak flood flow, compared to a baseline flow of 286.5m^3/s) downstream of Princess Road during the 1 in 100 year event. The total volume of flood flow passed downstream during this 1 in 100 year event is 35,900m^3 (approximately 85% of the loss in floodplain storage due to the operational site: 42,300m^3).

7.3.8 During construction, the additional loss of floodplain storage due to the additional presence of the raised construction compound, leads to an 0.2% increase in peak flood flows (0.5m^3/s increase in peak flood flow compared to a baseline flow of 286.5m^3/s) (see Figure 5). The total volume of flood flow passed downstream during construction in a 1 in 100 year event is 55,600m^3 (approximately 93% of the loss in floodplain storage due to the construction and operational site: 60,000m^3).

7.3.9 The AP2 revised scheme model 2D extent ends just downstream of Princess Road bridge and is therefore not sufficiently downstream to identify any potential downstream impacts. The 2D extent of the 2018 Environment Agency regional model extends downstream of Princess Road to the Manchester Ship Canal. This model has a coarser resolution and is not considered to be sufficiently robust to predict the impacts of such a small increase in peak flows, with a reasonable degree of accuracy.

7.3.10 Notwithstanding this, it remains possible that there could be localised increases in peak flood levels in areas already affected by flooding which may contain vulnerable receptors. On a precautionary basis, this is therefore assessed as having potential minor impacts on peak flood level, which could impact sensitive receptors, leading to potential adverse flood risk significant effects, which are significant.

Figure 4: Peak flood flow downstream of Princess Road bridge (at small weir approx. 620m downstream of bridge) during the 1 in 100 year + CC event with the AP2 revised scheme operational site

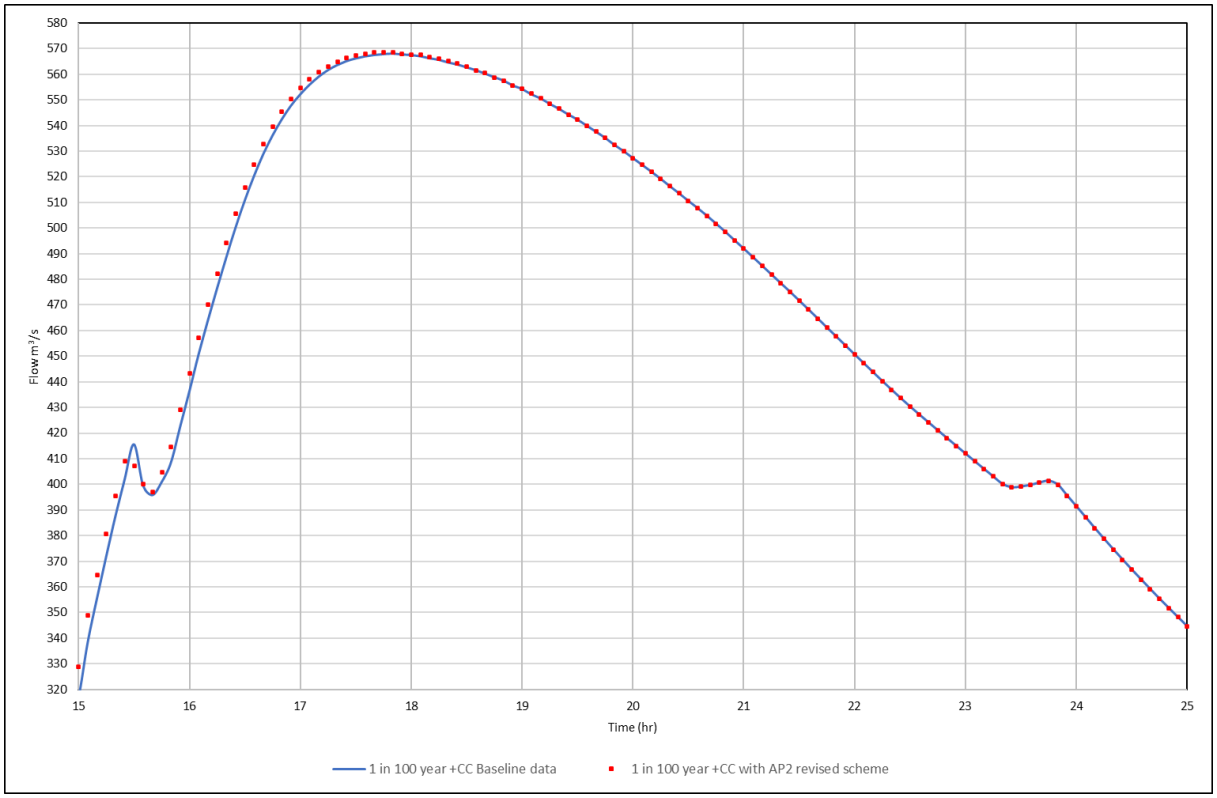


Figure 5: Peak flood flow downstream of Princess Road bridge (at small weir approx. 620m downstream of bridge) during the 1 in 100 year and 1 in 20 year event with the AP2 revised scheme operational site

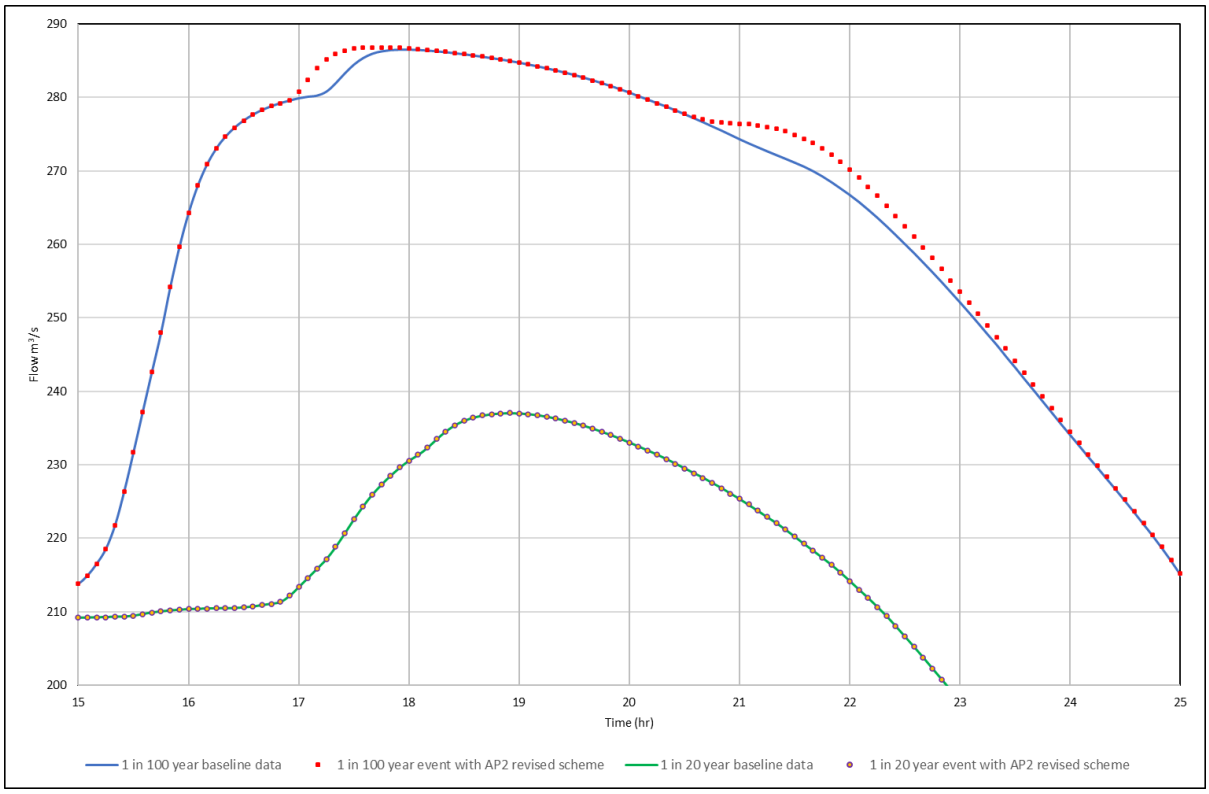
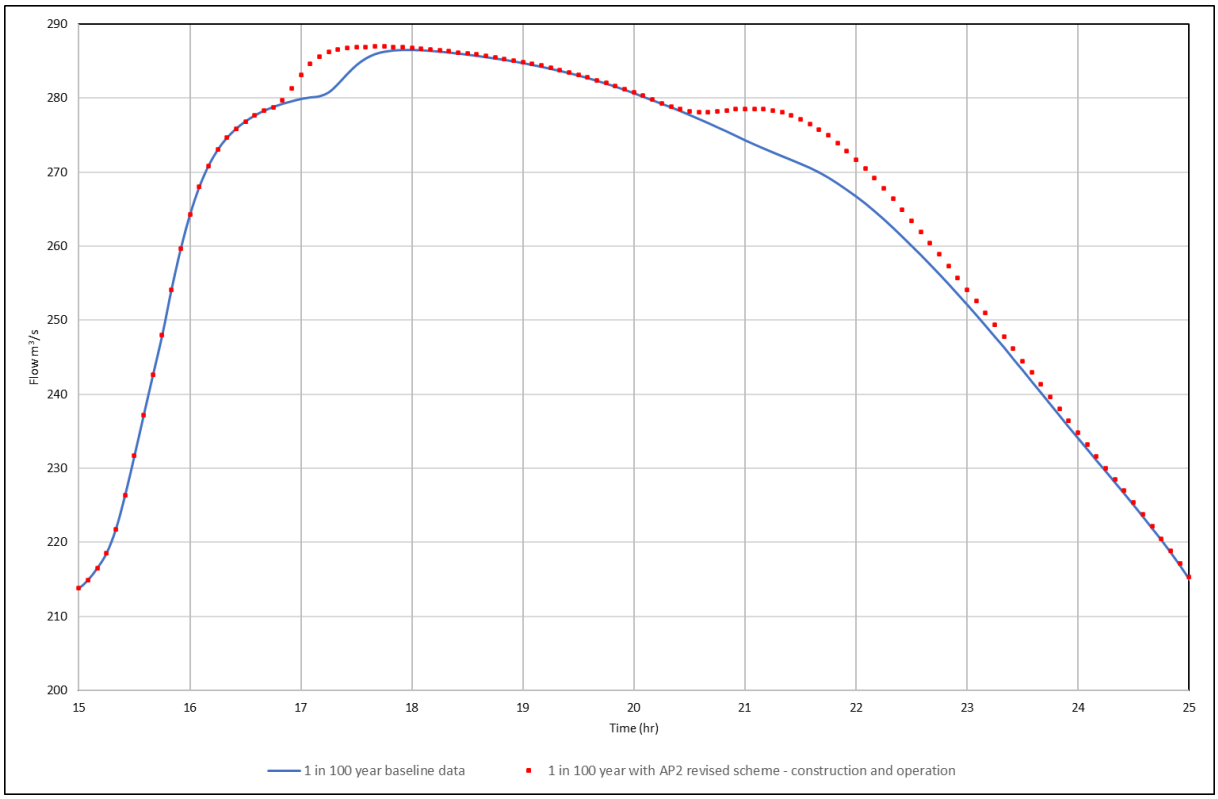


Figure 6: Peak flood flow downstream of Princess Road bridge (at small weir approx. 620m downstream of bridge) during the 1 in 100 year event with the AP2 revised scheme operational and construction sites



7.3.11 The presence of the AP2 revised scheme leads to increases in peak flood levels, during the 1 in 100 year + CC event, to receptors identifiable in the linked 1D-2D model, which are already at risk of flooding in the SES2 baseline. The changes in flood risk compared to those reported in the main ES are set out in Table 3.

Table 3: New, different and removed significant effects during the 1 in 100 year + CC event compared to the SES2 scheme

Location	Number and type of receptor reported in main ES	Receptor value	Impact, effect and significance as reported in main ES	Impact, effect and significance for the AP2 revised scheme	Change in significance of effect in AP2 revised scheme
Palatine Road area	Two multi-occupancy residential properties (western two blocks of Riverside Court)	High	Minor impact, Moderate permanent adverse effect, significant	Minor impact, Moderate permanent adverse effect, significant	No change, significant effect remains
	One commercial property (Withington golf club – club house)	High	Major impact, Moderate permanent adverse effect, significant	Minor impact, Minor permanent adverse effect, not significant	Effect reduced to not significant

Location	Number and type of receptor reported in main ES	Receptor value	Impact, effect and significance as reported in main ES	Impact, effect and significance for the AP2 revised scheme	Change in significance of effect in AP2 revised scheme
	Secondary electricity sub-station	Very high	Moderate impact, Major permanent adverse effect, significant	Negligible impact, Negligible effect, not significant	Significant effect removed
	Secondary electricity sub-station	Very high	Minor impact, Moderate permanent adverse effect, significant	Negligible impact, Negligible effect, not significant	Significant effect removed
	Four residential properties (along western side of Palatine Road and Ashfield lodge)	High	Major impact, Major permanent adverse effect, significant	Negligible impact, Negligible effect, not significant	Significant effect removed
	Two residential properties (along the western side of Palatine Road and eastern block of Riverside Court)	High	Moderate impact, Moderate permanent adverse effect, significant	Negligible impact, Negligible effect, not significant	Significant effect removed
	One residential property (second eastern block of Riverside Court	High	Minor impact, Moderate permanent adverse effect, significant	Negligible impact, Negligible effect, not significant	Significant effect removed
	Palatine Road	Moderate	Major impact, Moderate permanent adverse effect, significant	Negligible impact, Negligible effect, not significant	Significant effect removed
	Palatine Road	Moderate	Moderate impact, Moderate permanent adverse effect, significant	Negligible impact, Negligible effect, not significant	Significant effect removed
	One commercial property (Britannia hotel)	Moderate	Minor impact, Minor permanent adverse effect, not significant	Negligible impact, Negligible effect, not significant	Not significant, effect removed
	Two car parks (belonging to Britannia hotel)	Low	Minor decrease, Negligible effect, not significant	Negligible impact, Negligible effect, not significant	Not significant, effect removed
	One residential property (along the	High	Moderate decrease, Moderate permanent	Negligible impact, Negligible effect, not significant	Significant effect removed

Location	Number and type of receptor reported in main ES	Receptor value	Impact, effect and significance as reported in main ES	Impact, effect and significance for the AP2 revised scheme	Change in significance of effect in AP2 revised scheme
	western side of Palatine Road)		beneficial effect, significant		
	Palatine Road	Moderate	Major decrease, Moderate permanent beneficial effect, significant	Negligible impact, Negligible effect, not significant	Significant effect removed
East of Didsbury flood storage basin (Stenner Lane)	Four residential properties on Stenner Lane	High	Moderate impact, Moderate permanent adverse effect, significant	Negligible impact, Negligible effect, not significant	Significant effect removed
	One commercial property on Stenner Lane	Moderate	Moderate impact, Moderate permanent adverse effect, significant	Negligible impact, Negligible effect, not significant	Significant effect removed
	Stenner Lane	Moderate	Moderate impact, Moderate permanent adverse effect, significant	Negligible impact, Negligible effect, not significant	Significant effect removed
Downstream of Princess Road	Unquantified potential sensitive receptors	Assumed high or very high	None	Minor impact, Moderate permanent adverse effects, significant	New significant effects

7.3.12 Detailed information for the 5.0% AEP event is provided in SES2 and AP2 ES Hydraulic modelling report – River Mersey, Volume 5, Appendix: WR-006-00009. Increases in peak flood levels of greater than 100mm are observed immediately surrounding the shaft site. The receptors in these areas are all considered to be water compatible (low value) and consist of existing woodland, areas designated for grassland or woodland mitigation planting as part of the AP2 revised scheme, and an existing tennis court. The major impact on these low value receptors leads to minor adverse effects, which are not significant.

7.3.13 The AP2 revised baseline modelling suggests that under existing conditions, the flood defences along the River Mersey overtop at approximately the 1.0% AEP event. Therefore, the detailed information for the 1.0% AEP event was also reviewed to understand if there are any changes to flood extents and flood depths due to the AP2 revised scheme, when flood defences are overtopping. This assessment includes the raised land associated with the operational site and construction site.

7.3.14 The construction site and presence of the AP2 revised scheme lead to increases in peak flood levels during the 1 in 100 year event at local receptors that are already at risk of flooding in the baseline as shown in Table 4.

Table 4: New and different significant effects during the 1 in 100 year event

Number and type of receptor	Receptor value	Impact, effect and significance for the AP2 revised scheme
Two multi-occupancy residential properties on Palatine Road (western two blocks of Riverside Court – same receptors as those reported for the 1 in 100 year + CC event above)	High	Different minor impact, Moderate permanent adverse effect, significant
Commercial property (Northenden golf course club house)	High	New moderate impact, Moderate permanent adverse effect, significant
12 residential properties and two multi-occupancy residences at Beeches Mews	High	New minor impact, Moderate permanent adverse effect, significant

7.3.15 Additional modelling is underway and will continue during the passage of the Bill, to identify avoidance and mitigation measures to reduce the impact of the AP2 revised scheme on peak flood levels at Beeches Mews, western two blocks of Riverside Court, Northenden golf course, and peak flood flows downstream of Princess Road, as far as reasonably practicable. The options under investigation are discussed further in Section 8.

7.3.16 Further topographical survey, other surveys as required, hydraulic modelling, design and refinement of mitigation measures will be undertaken during design development and will, as far as reasonably practical, ensure no impacts on peak flood levels at Beeches Mews, western two blocks of Riverside Court and downstream of Princess Road. The preferred mitigation measures will be selected in consultation with the other design disciplines, the Environment Agency, and other stakeholders to ensure all potential constraints and opportunities are considered.

7.4 Change to Bill powers required for modifications to the Birchfields Road vent shaft headhouse (AP2-007-005)

7.4.1 To assess the possible changes to groundwater levels and flow, and the associated change in groundwater flood risk, a high-level assessment has been undertaken. The assessment of the Birchfields Road vent shaft modifications (AP2-007-005) reviews the groundwater conditions along the route of the AP2 revised scheme. Further details of groundwater level changes are set out in the SES2 and AP2 ES Volume 5, Water resources assessment Appendix: WR-003-0MA07.

7.4.2 The vent shaft modifications (AP2-007-005) include a new basement structure to house the horizontal fans at Birchfields Road. This 8.5m deep basement will be constructed within a continuous piled box of approximately 64m by 27.9m. The piles will extend through the superficial glacial till deposits into the underlying Appleby Group, Collyhurst Sandstone Formation Principal Aquifer. This structure could therefore form a permanent barrier to groundwater movement in the glacial till in this area. Groundwater levels could rise on the north-eastern side of the vent shaft, potentially causing groundwater flooding at the surface at times of high groundwater levels, or groundwater flooding of any existing basements.

7.4.3 A drainage solution has been included within the design. The drainage will allow groundwater to flow around the basement structure of the new proposed fan room. The channel will also facilitate re-infiltration of water on the south-western side of the basement. This mitigation will be reviewed following site and ground investigations and if necessary, the design updated during design development in consultation with the Environment Agency and the Local Lead Flood Authority. With this embedded mitigation in place, no new or different significant effects are anticipated due to this amendment.

7.5 Additional land permanently required for changes to design elements managed by the Manchester tunnel north portal main compound (AP2-007-008)

7.5.1 The main ES reported that the HS2 route will cross the Rondin Road surface water flow path in the Manchester tunnel north portal area. The original scheme included a land drainage ditch to convey flows from the north side of the route to the south side of the route. This allowed the surface water flow path to be maintained and therefore the risk of surface water flooding to local receptors was considered negligible, not significant.

7.5.2 The Ardwick modifications (AP2-007-008) amendment includes the relocation of the SATS compound, which in the original scheme was located on the north side of the HS2 alignment adjacent to Midland Street. The SATS compound will be relocated on the south side of the HS2 alignment adjacent to the tunnel portal, within the Rondin Road surface water flow path. Associated changes will be made to the Ardwick access road. The local drainage solution proposed in the main ES to convey flows from the north side of the original scheme has been redesigned to ensure that the surface water flow path is maintained.

7.5.3 The Ardwick access road retaining wall in this amendment has the potential to form a barrier to groundwater flow in the glacial till (Secondary (Undifferentiated) aquifer). This may result in localised elevated groundwater levels upgradient of the structure, potentially leading to an increased risk of groundwater flooding to the eastern side of the wall around the existing Siemens Ardwick Train Care Facility. Drainage has been provided along the back of this retaining wall to help facilitate the movement of groundwater to reduce the risk of groundwater flooding.

7.5.4 Therefore, no new or different significant effects on flood risk are anticipated due to this amendment (AP2-007-008).

8 Additional flood risk management measures

8.1.1 No new or different flood risk effects have been assessed as a result of the Altrincham Road vent shaft modifications (AP2-007-002), Birchfields Road vent shaft modifications (AP2-007-005) or Ardwick modifications (AP2-007-008). Mitigation in the form of drainage has been embedded into the design and no additional flood risk management measures are required.

8.2 Change to Bill powers required for relocation of vent shaft and headhouse from Palatine Road to The Hollies (AP2-007-003)

8.2.1 The flood risk assessment has identified two flood risk impact mechanisms associated with the relocation of the vent shaft (AP2-007-003). The mitigation measures for the associated effects are presented below.

Impacts of changes in local flood conveyance

8.2.2 The raised ground for the operational site of The Hollies vent shaft changes the pattern of flood conveyance in the local area. During the 1.0% AEP + CC event, this leads to minor increases in peak flood level to two high value residential receptors along Palatine Road, already at risk of flooding. Mitigation is therefore required. The next stage of the design development process will involve topographical survey to confirm the threshold levels of the properties identified using the hydraulic model as being potentially at significant increased risk of flooding. If the effects are confirmed, mitigation could include property level resilience measures to help protect these individual properties from flooding.

8.2.3 In addition, detailed modelling has shown that during a 1 in 100 year event as the flood defences begin to overtop, the AP2 revised scheme would lead to earlier overtopping of flood defences on Northenden golf course, and earlier circumvention of the Beeches Mews flood wall. Therefore, further mitigation is required. Additional flood risk management measures will be developed during the passage of the hybrid Bill to reduce any residual impacts on peak flood levels, during the 1 in 100 year event, as far as reasonably practicable.

8.2.4 The avoidance and mitigation options could include extending the existing Beeches Mews flood wall, to maintain the level of flood protection currently in place. Due to the existing flood risk at Northenden golf course club house, additional local mitigation is unlikely to be possible. However, mitigation options being investigated to address the loss of floodplain storage (see section below), may also provide some mitigation for the increase in flood level at this site.

Impacts of loss of floodplain storage

8.2.5 The loss of floodplain storage due to the presence of The Hollies vent shaft leads to a 0.1% increase in flow passed downstream of Princess Road bridge during the 1 in 100 year and 1 in 100 year + CC events. Similarly, during construction, the presence of The Hollies vent shaft and the associated raised construction compound will lead to a 0.2% increase in flow passed downstream of Princess Road bridge during the 1 in 100 year event. This has the potential to lead to minor increases in peak flood level overtopping flood defences downstream of the AP2 revised scheme in areas already at risk of flooding.

8.2.6 Additional modelling is underway and will continue during the passage of the Bill, to identify avoidance and mitigation measures to offset the loss of flood storage and avoid increasing the peak flow in the River Mersey downstream of Princess Road.

8.2.7 The mitigation options that could reduce flood impacts include: provision of volume for volume replacement flood storage in the immediate vicinity of the vent shaft; and, lowering land elsewhere within the River Mersey catchment to create a managed washland area. These options will be investigated in more detail by extending the 2D domain of the AP2 revised scheme hydraulic model during the passage of the Bill.

8.2.8 Further topographical survey, other surveys as required, hydraulic modelling, including incorporation of the replacement flood storage, design development, and refinement of the avoidance and mitigation measures will be undertaken during passage of the Bill and design development to ensure no significant effects on flood risk.

9 Summary of significant flood risk effects

9.1.1 The assessment work carried out to date, has shown that vent shaft relocation (AP2-007-003) has removed the majority of the 21 significant effects associated with the Palatine Road vent shaft. Permanent flood risk effects remain on two residential receptors on Palatine Road (western two blocks of Riverside Court) during the 1 in 100 year + CC event. In addition, during the 1 in 100 year event, new permanent moderate adverse significant effects have been identified at 14 residential properties and one commercial property and different adverse significant effects have been identified on the two residential receptors on Palatine Road (western two blocks of Riverside Court).

9.1.2 The assessment work carried out to date has also identified the potential for increased flood flow downstream of Princess Road, which could result in new permanent adverse effects on flood risk to unquantified sensitive receptors that are already affected by flooding within the wider River Mersey floodplain.

9.1.3 The assessment work carried out to date has identified potential mitigation measures to remove the significant effects on the 14 residential receptors around Beeches Mews. However, until such time as additional topographic surveys have been carried out to confirm threshold levels, residual adverse significant effects will remain on three receptors in the immediate vicinity of The Hollies vent shaft: two multi residential properties on Palatine Road (western two blocks of Riverside Court); and, one commercial property (Northenden Golf Course club house). Residual significant effects will also remain on the unquantified receptors downstream of Princess Road. Further modelling will be carried out being the passage of the Bill to identify further avoidance and mitigation measures.

9.2 Conclusions

9.2.1 This assessment indicates that, subject to the implementation of the avoidance and mitigation measures identified, and the measures included in the draft water resources operation and maintenance plan (Volume 5, Appendix WR-007-00000), the AP2 amendments AP2-007-008, AP2-007-002 and AP2-007-005 will not result in any significant adverse effects on flood risk in the Davenport Green to Ardwick (MA07) community area.

9.2.2 The Hollies vent shaft and associated raised compound will occupy land within the defended River Mersey floodplain. Detailed modelling shows that the presence of the AP2 revised scheme will result in localised changes to the conveyance of water during peak flood events and lead to the removal of 19 of the 21 significant effects reported for the SES2 scheme. Significant effects remain on two residential receptors on Palatine Road (western two blocks of Riverside Court). In addition, the loss of floodplain storage leads to a modelled increase in peak flood flow, of approximately 0.1%, downstream of Princess Road, and 0.2% downstream of Princess Road during the construction period. This has the potential to lead to minor increases in peak flood level downstream in areas already at risk of flooding, that

may contain unquantified sensitive receptors. This is assessed to lead to potential significant effects on unquantified receptors downstream.

9.2.3 During the 1 in 100 year event, the AP2 revised scheme will lead to earlier overtopping and/or circumvention of existing flood defences. New permanent moderate significant effects have been identified at 14 residential properties (Beeches Mews) and one commercial property (Northenden golf course club house) and different significant effects on the two residential receptors on Palatine Road (western two blocks of Riverside Court).

9.2.4 Additional modelling is underway to identify avoidance and mitigation measures to reduce the impact of the AP2 revised scheme on peak flood levels as far as reasonably practicable. Due to the existing flood risk at Northenden golf course, additional mitigation is unlikely to be possible and the significant effect is likely to remain.

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