HS2 Hillingdon Traffic and Construction Impacts

London West Midlands

HS2 Hillingdon Traffic and Construction Impacts

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List of acronyms

AP Additional Provision
ATFS Auto Transformer Feeder Station
CCB Consolidated Construction Boundary
C221 Contract 221 (Consultant responsible for preparation of the Hybrid Bill concept design between Euston Portal and West Ruislip for the)
C222 Contract 222 (Consultant responsible for preparation of the Hybrid Bill concept design west of West Ruislip)
DOT Department of Transport
EA Environment Agency
ECI Early Contractor Involvement
EMR Environmental Minimum Requirements
ES Environmental Statement
GGBS Ground Granulated Blast furnace Slag
GI Ground Investigation
HA Highways Agency
HB Hybrid Bill
HGV Heavy Goods Vehicle
HS2 High Speed Two
LBH London Borough of Hillingdon
LOD Limits of Deviation
NR Network Rail
PRoW Public Right of Way
PSC Professional Services Consultant
PSF Professional Service Framework
SES Supplementary Environmental Statement
SMR Scope and Methodology Report
SP Sustainable Placement
TBM Tunnel Boring Machine
TfL Transport for London

1 Executive summary

1.1.1 C221 (Mott MacDonald) were appointed by High Speed Two (HS2) Limited to look at options to reduce construction traffic in the West Ruislip area of Hillingdon and consider ways to reduce the volume of excavated material (EM) taken to local sustainable placement (SP).

1.1.2 The scope of works is required to comply with assurances made by the Secretary of State for Transport to Transport for London (TfL) on 7th December 2015 and London Borough of Hillingdon (LBH) on 23rd January 2016.

1.1.3 A total of 17 options were considered during a series of six workshops. This report presents discussion of these and divides them into two categories, based on the outcome of discussions at the workshops:

a. Options to be carried forward and considered by the Promoter for inclusion within contractual documentation

b. Options considered and rejected

1.1.4 A joint HS2, LBH and TfL position statement was released on the 4th April 2016 stating that the study has been collaborative and a number of measures are being looked at with the aim of reducing Heavy Goods Vehicles (HGV) to a maximum of 550 (2 way movements) per day at Swakeleys Road roundabout.

1.1.5 This report has assessed a number of options. It indicates that reducing two-way HGV movements to a peak of 550 per day could be achieved subject to the results of ground investigations and ecological surveys in the area.

1.1.6 The reduction in construction traffic could primarily be achieved through measures such as reusing excavated material from Copthall cutting to construct Harvil Road road embankment and importing fill earlier in the programme for Gatemead and West Ruislip embankments.

1.1.7 Sustainable placement may also be significantly reduced by using excavated material from Copthall Cutting for the Harvil Road embankment and potential beneficial use at Ruislip and Uxbridge Golf Courses.

1.1.8 This report incorporating TfL and LBH comments will be included in a HS2 summary report and sent to the Promoter (of High Speed 2) who will assess it.

2 Introduction

2.1 General

2.1.1 C221 were appointed by High Speed Two (HS2) Limited to look at options to minimise construction traffic in the West Ruislip area of Hillingdon and consider ways to reduce the volume of excavated material taken to local sustainable placement (SP).

2.1.2 A total of 17 options were considered during a series of six collaborative workshops attended by representatives of HS2, TfL and LBH. This report presents discussion of these and divides them into two categories, based on the outcome of discussions at the workshops:

a. Options to be carried forward and considered by the Promoter for inclusion within contractual documentation

b. Options considered and rejected

2.1.3 The proposals outlined within this report have the potential to change the significant environmental effects reported within the HS2 Main Environmental Statement (ES) and subsequent Supplementary Environmental Statements (SES) and Additional Provision (AP) Environmental Statements. The report notes where each of the options, if implemented, may result in different effects to those reported in these documents, and identifies where further assessment is required in order to confirm whether this is the case, and if additional approvals or agreements would be required. HS2 will be continuing to assess the likely environmental effects of the proposals included within this report, particularly with respect to implications of potential reductions in HGV movements on the traffic and transport and air quality effects.

2.1.4 It should be noted that the environmental effects of the options detailed within this report, if implemented, will need to be mitigated through the Environmental Minimum Requirements (EMRs). The controls contained in the EMRs will ensure that impacts which have been assessed in the ES will not be exceeded, unless any new impacts in excess of those assessed in the ES:

- result from a change in circumstances which was not likely at the time of the ES; or
- would not be likely to be environmentally significant;
- result from a change or extension to the project, where that change or extension does not itself require environmental impact assessment under:
  - article 4(1) and paragraph 24 of Annex 1 to the EIA Directive;4 or
  - article 4(2) of and paragraph 13 of Annex 2 to the EIA Directive;5 or

- would be considered as part of a separate consent process (and therefore further EIA if required).

2.2 Traffic Flows

2.2.1 Within the main Hybrid Bill (HB) Environmental Statement HS2 assessed a maximum of 1860 two-way HGV movements over a 12 month peak period at Swakeleys Road, between the A40 roundabout and the junction with Harvil Road. The review and rescheduling of construction activities undertaken for AP2 reduced the assessed maximum two-way HGV movements down to 1460 over a 9 month period. This was assessed conservatively for environmental purposes and the maximum expected peak is considered to be approximately 1060 HGVs over a 6-7 month period, as can be seen in the Histogram below (Figure 2.1):

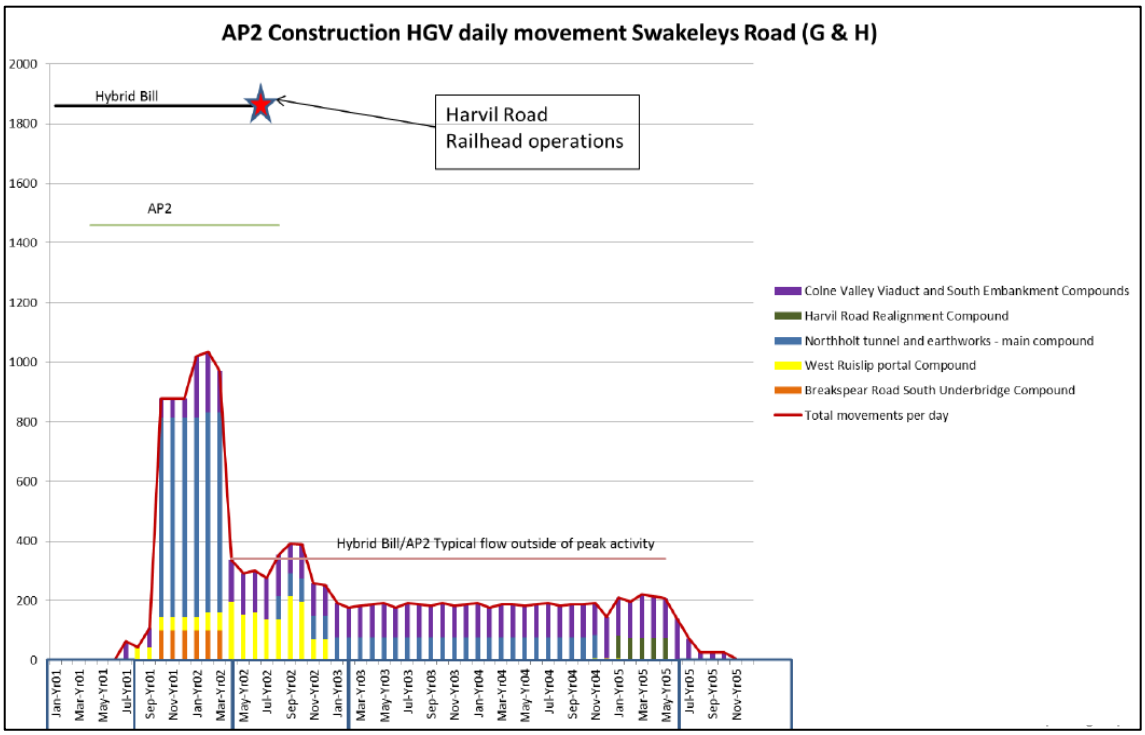

Figure 2.1 AP2 HGV daily 2-way movements

2.2.2 The majority of the peak movements are associated with the importation of approximately 250,000m^3 of engineering fill for the construction of Gatemead, West Ruislip Retained and Harvil Road Embankments.

2.3 Sustainable Placement

2.3.1 It is intended that all the excavated material from tunnelling (approx. 1.2M m^3) will be removed by rail with, under current assumptions, approximately

930,000m^3 of material from the Copthall cutting to be sustainably placed locally up to a height of 3m. Of this, approximately 370,000m^3 will be placed within the triangle of land between Harvil Road and Breakspear Road South, to the south east of the Northolt Tunnel and Earthworks Main Compound. Based on the above, the project is able to remove nearly 60% of excavated material by rail, with this potentially rising if sufficient train paths were available or using additional temporary storage.

2.3.2 In addition to increasing the amount of excavated material removed by rail this study aimed to reduce the amount created and to find beneficial reuse for this material, primarily aiming to reduce the area of sustainable placement at the Harvil Road and Breakspear Road South triangle.

3 Options to be carried forward and to be considered by the Promoter for inclusion within contractual documentation

3.1 Re-use of excavated material from Copthall Cutting to construct Harvil Road Embankments

Description

3.1.1 This option considers the possibility of reusing excavated material from the Copthall Cutting for construction of Harvil Road embankment north from Harvil Road HS2 Overbridge, at the western end of Copthall Cutting.

3.1.2 The type of excavated material from Copthall Cutting is assumed at present (based on desk study only and no site specific ground investigation results) to comprise London Clay. See Figure 3.1 below.

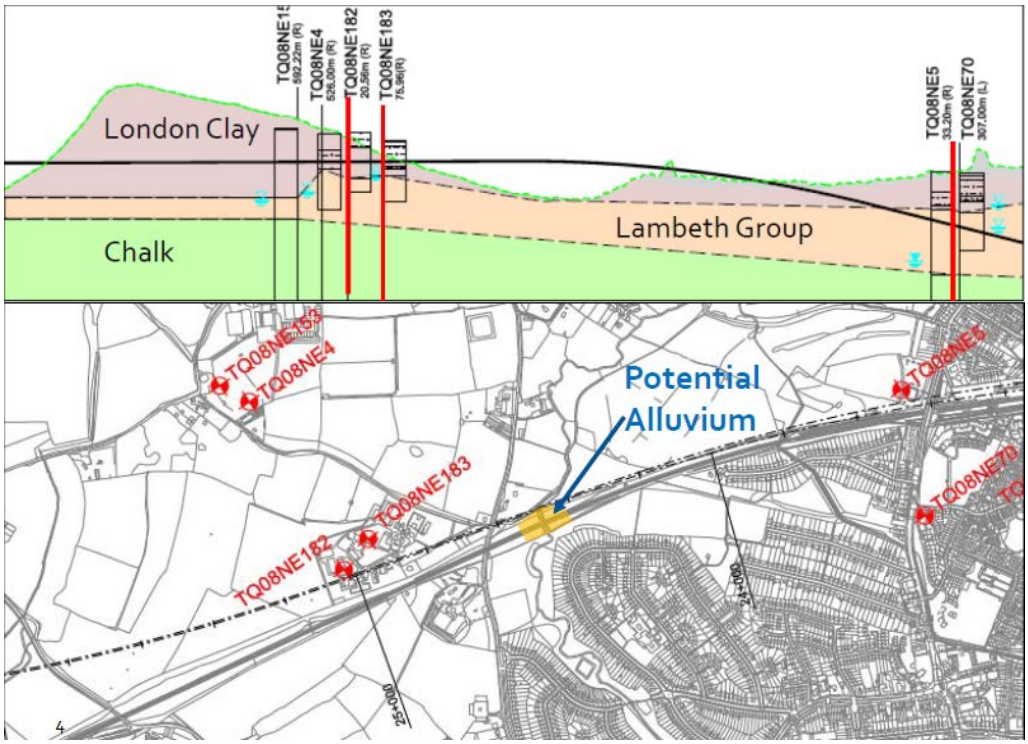

Figure 3.1 Geology – 3No. Historic boreholes on section of route

3.1.3 The proposed embankment is based on the criteria set out in the Table 3-1 and the profile in Figure 3.2 below.

Structure	Max Height (m)	Slope	Assumption
Harvil Road Embankment	12	1 in 2	Free draining granular material

Table 3-1 – Harvil Road Embankment Criteria

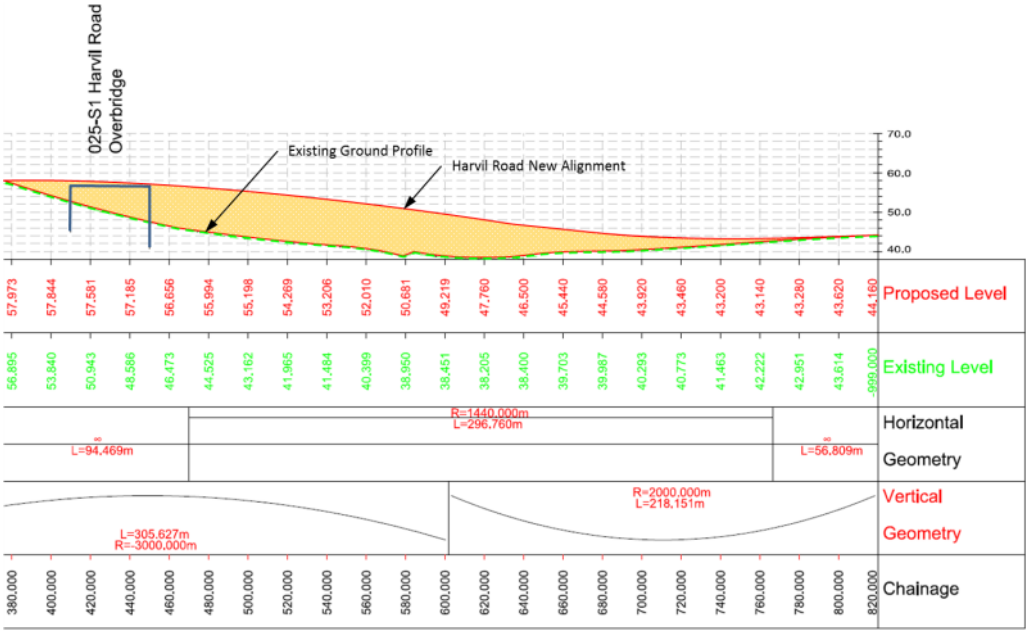

Figure 3.2 Longitudinal section of embankment along re-aligned Harvil Road

Objectives Met

3.1.4 It is considered that the excavated London Clay material from Copthall Cutting may be suitable for the Harvill road embankment construction, provided that the work is carried out in accordance with placing and compacting Class 2A material (Specification for Highways Works Series 600, Highways England) with a minimum 1 in 3 (vertical : horizontal) slope.

3.1.5 This excavated material may require treatment prior to placing but this cannot be determined until appropriate Ground Investigation (GI), with testing, is undertaken (particularly to understand the natural moisture content, plasticity and sulphate content).

3.1.6 Due to its potentially high plasticity, London Clay exhibits significant shrinkage (on drying) and swelling (on wetting) behaviour as evidenced by known subsidence and heave problems in the Greater London area.

3.1.7 The sulphate content must be determined as, when mixed with lime or cement for stabilisation or concrete structure, Ettringite crystals form that

swell causing heave. This was a major issue during construction of parts of the M40.

3.1.8 The total volume of material required for the Harvil Road highway embankment (inclusive of maintenance access track embankments) is 110,000m^3 of which 74,000 m^3 could be from the reuse of excavated material. The difference relates to the need for granular material, as noted below in 3.1.11, 3.1.13 and 1.1.1.

3.1.9 This represents a potential reduction in importation of fill for Harvil Road embankment of 67%.

Construction, Programme & Cost

3.1.10 Excavated material will be available for use as a fill direct from the works or from temporary storage within the sustainable placement site to the south of the Chiltern Lines, transported via internal haul road to the embankment site.

3.1.11 An imported granular fill (class 6N) will still be required as a permeable backfill to the abutment walls of Harvil Road overbridge.

3.1.12 An embankment slope of 1:3.5 (vertical: horizontal) may be considered once more detailed site specific site investigation and trial compaction results are available. This would equate to a reduction in fill of approx. 10,000 m^3.

3.1.13 The proposed height of the Harvill road embankment is up to 12.3m. Based on the desk study, it is likely to be founded on natural London Clay. It would be prudent to allow for a basal granular starter layer below the full base area of the embankment for sections over 8m in height.

3.1.14 If EM was to be used a capping layer will be required, this could either be imported material or a layer of clay treated with lime (and cement) just below the road subbase, to minimise clay swelling potential on penetration of surface water via joints or the subbase that would cause local heave and large differential deflections of the pavements. In addition, several layers of geogrid should be placed below treated clay against possible lateral swelling of clay that may cause minor longitudinal cracking of the pavements. The typical cross section is shown in Figure 3.3 below.

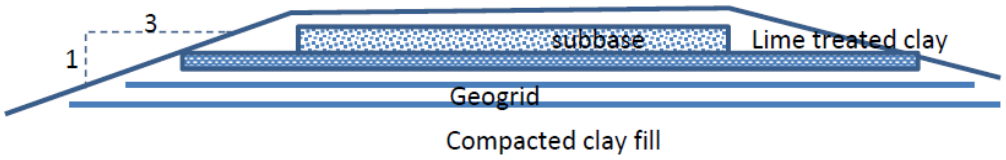

Figure 3.3 Possible cross section of an embankment with compacted clay fill

3.1.15 During periods of wet weather, lime may be added to assist with the workability and placement of the bulk fill material. Lime [or Ground Granulated Blast furnace Slag (GGBS)] stabilisation would be required to be carried out to Highways Agency (HA) Standard Vol 4, 2.18.

3.1.16 Depending on the extent of treatment required, the period for construction of the road may be marginally extended, with comparable costs to importation of fill.

Environment

3.1.17 In addition to the information described elsewhere in this section, this initial environmental review also assumes the following;

- No additional area beyond the existing HS2 construction area will be required for either storage of excavated materials or its treatment.

3.1.18 The effect of reducing HGV movements during the peak periods may reduce air quality effects predicted in the ES, but this will need to be confirmed.

3.1.19 No additional loss of habitats is predicted for the excavation, storage, treatment or placement of the fill material.

3.1.20 It is assumed that the area of SP would be reduced, with the maximum height retained at 3m. The ecological impact could be potentially reduced (less hedgerow, trees and grassland lost).

Dependencies / Risks

3.1.21 The suitability of the EM will be dependent on the results of appropriate Ground Investigation (GI), particularly with respect to plasticity and chemical testing of London Clay.

3.1.22 The decrease in slope angle may require the construction of retaining structures at the base of the slopes in certain areas, to contain the works within the Limits of Deviation (LOD).

3.1.23 Based on a typical dosage of between 1 and 3% the importation of lime (and cement) will require between 50 and 100 HGVs or up to 5 per day over the construction period.

3.1.24 The additional stages needed to form the embankment, combined with treatment of the clay and possible retaining structures, could increase the period of construction for the embankment. Completion of Harvil Road realignment, which includes the embankment north of the HS2 overbridge, is a prerequisite to the demolition of the existing Chiltern Line overbridge and

subsequent connection of the EM railhead western track connection to Network Rail (NR). While a significant delay to this could potentially lead to delay to the start of tunnelling for the Northolt West tunnels, it is considered that any additional time could be accommodated within the overall programme.

Conclusions & Next Actions

3.1.25 EM for use as fill could be transported to site without using public highways. This would reduce the number of HGVs which would otherwise be used for the importation of fill by between 175 and 200 vehicles per day, equating to 350-400 two-way daily HGV movements over a period of 2 months.

3.1.26 Using EM for fill would also reduce the volume of material to go to sustainable placement by approximately 74,000 m^3.

3.1.27 Early implementation of GI and surveys will be required to validate and refine the above assessment and conclusions.

3.1.28 Further development of the design and environmental impact issues required.

3.2 Construction of bridge structures instead of railway embankments – River Pinn to Breakspear Road

Description

3.2.1 A number of options were considered to construct viaducts or extended bridges instead of the embankments at Gatemead and West Ruislip, in order to reduce the amount of imported fill required, currently 40,000 m^3 and 70,000 m^3, respectively. See Figure 3.4 below for plan of currently proposed embankments.

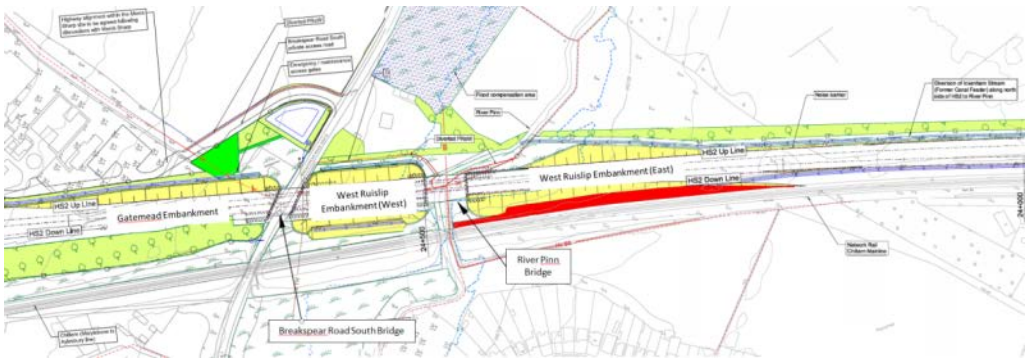

Figure 3.4 Plan showing Gatemead and West Ruislip Embankments

3.2.2 The Breakspear Road South Bridge span remains unchanged in all options. It has a minimum construction depth, to provide highways headroom clearance and is skewed to the HS2 alignment. Due to the proximity of the Colne Valley Viaduct the HS2 track cannot be raised and lowering Breakspear Road South would require major utility diversions, highway re-alignment and re-construction of the adjacent NR Chiltern Lines Bridge. It is therefore not included as part of any viaduct section.

3.2.3 It should be noted that the design is at the conceptual stage, detailed issues associated with track transitions between embankments and fixed structures are not addressed. All sketches are indicative.

3.2.4 Option 1 - Gatemead Viaduct and West Ruislip Embankment - Figure 3.5

- To allow for access beneath the viaduct for maintenance, the viaduct would not start until the approach embankment from the west is approximately 4.8m (rail level) above existing ground level.
- The length of the viaduct would be approximately 100m.

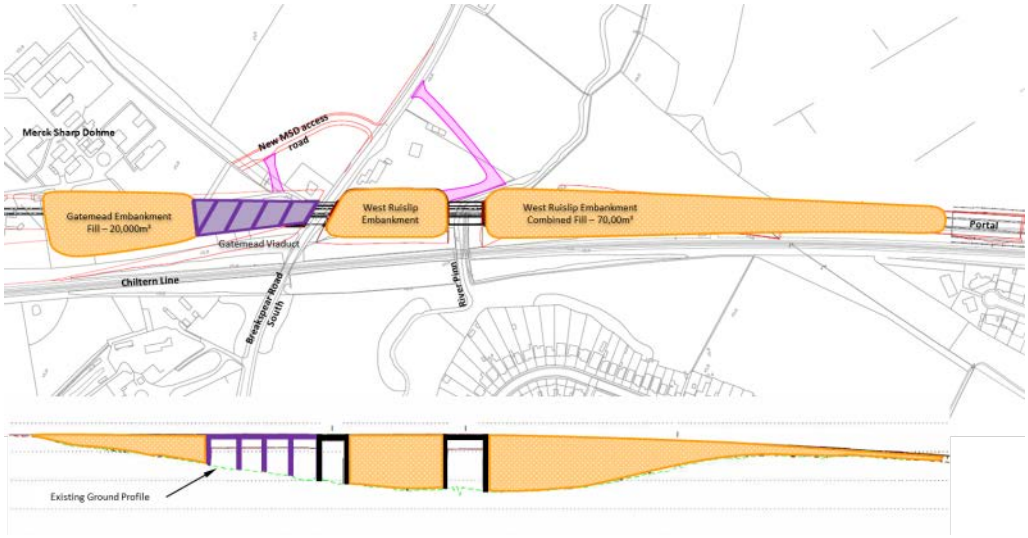

Figure 3.5 Option 1 - Gatemead Viaduct and West Ruislip Embankment

3.2.5 Option 2 - Gatemead Embankment and West Ruislip Full Length Viaduct - Figure 3.6

- The West Ruislip Embankment is formed of two distinct sections separated by the River Pinn.
- The western embankment, between the River Pinn and Breakspear Road South is approximately 100m in length, has a 2m high wall along its northern toe, to preclude scour during flooding, and is founded upon the slope of the existing Chiltern Lines embankment along its southern edge.

- The western embankment height is approximately 7.5m along the HS2 centreline and the River Pinn Underbridge could be extended to form a viaduct structure approximately 100m long to a transition zone at about 40m from the skew, minimum headroom, crossing of Breakspear Road South.
- The eastern embankment extends from the River Pinn east abutment to the cut/fill line, a distance of approximately 170m. The bridge wing wall and embankment retaining wall at the north east corner of the River Pinn bridge extends for approximately 50m, to avoid re-alignment of the river, an Environment Agency (EA) requirement, before becoming a fill embankment. A viaduct to replace this section of embankment would be approximately 155m in length.
- The height of the eastern embankment is a maximum of approximately 8m on the HS2 centreline, reducing along the southern flank where it is founded on the slope of the existing Chiltern Lines embankment.
- The overall length of a full West Ruislip viaduct would be approximately 290m, including the section over the River Pinn itself.
- The need to remove the alluvium in the location of the River Pinn would be avoided.
- The need to provide an additional area for flood alleviation may be avoided as the flood plain for the River Pinn would not be obstructed by an embankment.

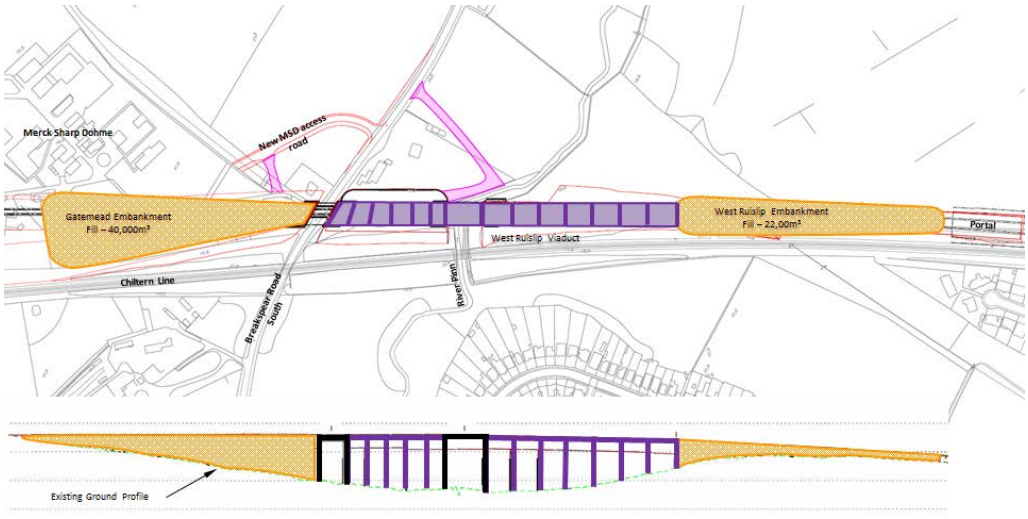

Figure 3.6 Option 2 - Gatemead Embankment and West Ruislip Full Length Viaduct

3.2.6 Option 3 - Gatemead Viaduct and West Ruislip Full Length Viaduct - Figure 3.7

- This option combines the viaducts from options 1 and 2 giving an overall length of approximately 390m, including the section over the River Pinn itself.
- The need to remove the alluvium in the location of the River Pinn would be avoided.
- The need to provide an additional area for flood alleviation may be avoided as the flood plain for the River Pinn would not be obstructed by an embankment.

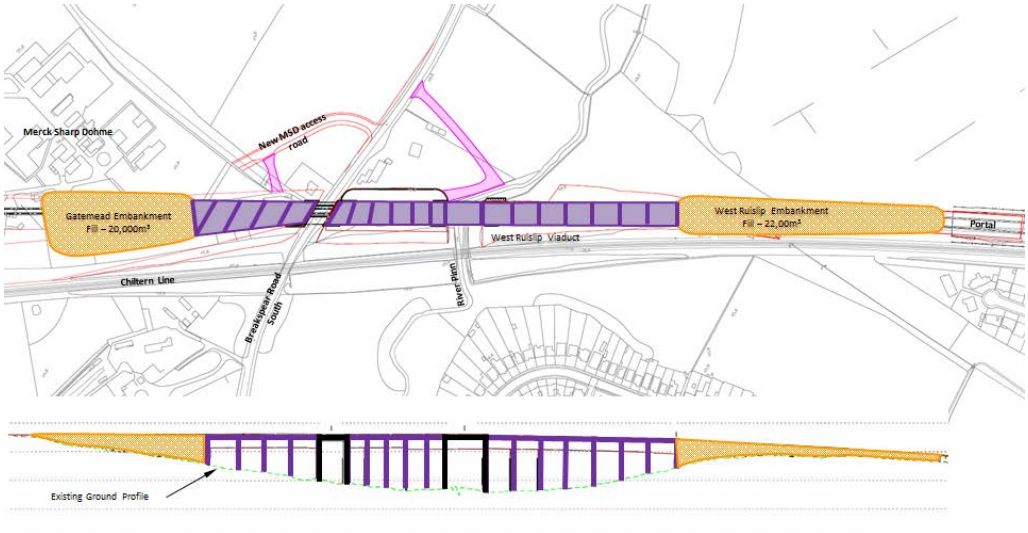

Figure 3.7 Option 3 - Gatemead Viaduct and West Ruislip Full Length Viaduct

3.2.7 Option 4 - Gatemead Viaduct and West Ruislip Infill Viaduct and East Embankment - Figure 3.8

- This option limits the viaduct to between the Breakspear Road Bridge and the River Pinn Bridge, which would form part of the viaduct. This gives an overall viaduct of approximately 125m, including the section over the River Pinn itself.
- The need to remove some of the alluvium in the location of the River Pinn may be avoided.
- The need to provide an additional area for flood alleviation may be avoided.

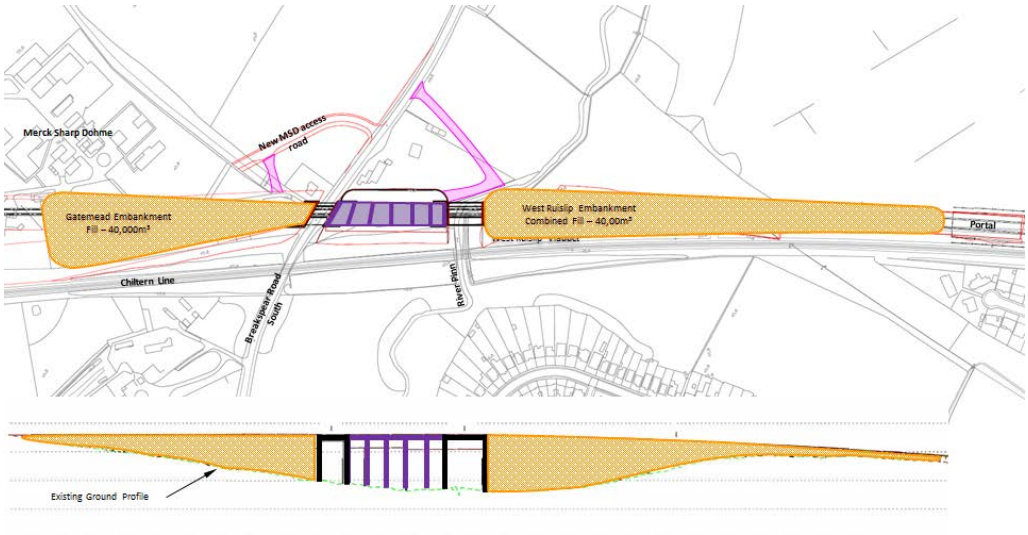

Figure 3.8 Option 4 - Gatemead Viaduct and West Ruislip Infill Viaduct and East Embankment

3.2.8 Option 5 - River Pinn three span bridge - Figure 3.9

- The need to remove the alluvium in the location of the River Pinn would be avoided.
- The length of the bridge would be approximately 100m.
- The need to provide an additional area for flood alleviation may be avoided.

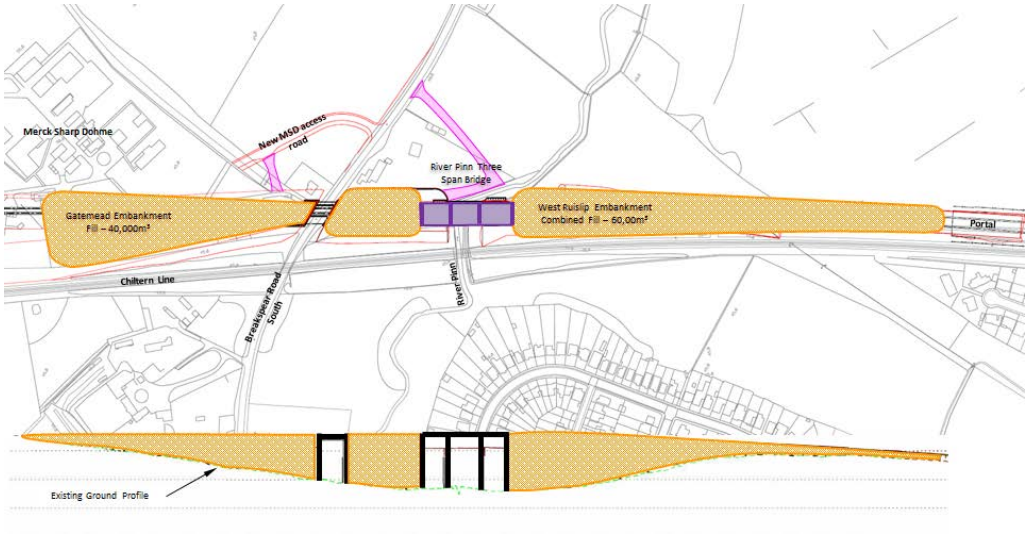

Figure 3.9 Option 5 - River Pinn three span bridge

3.2.9 Option 6 - River Pinn increased span bridge – Figure 3.10

- Span increased from 36m to 50m, too great to use precast beams, requiring a longer period to construct.

- The increase in span allows for better clearance for the Public Right of Way (PRoW) access and bridge across the River Pinn.
- The need to remove some of the alluvium in the location of the River Pinn may be avoided. It is not possible to quantify this as the extent of the Alluvium is unknown.

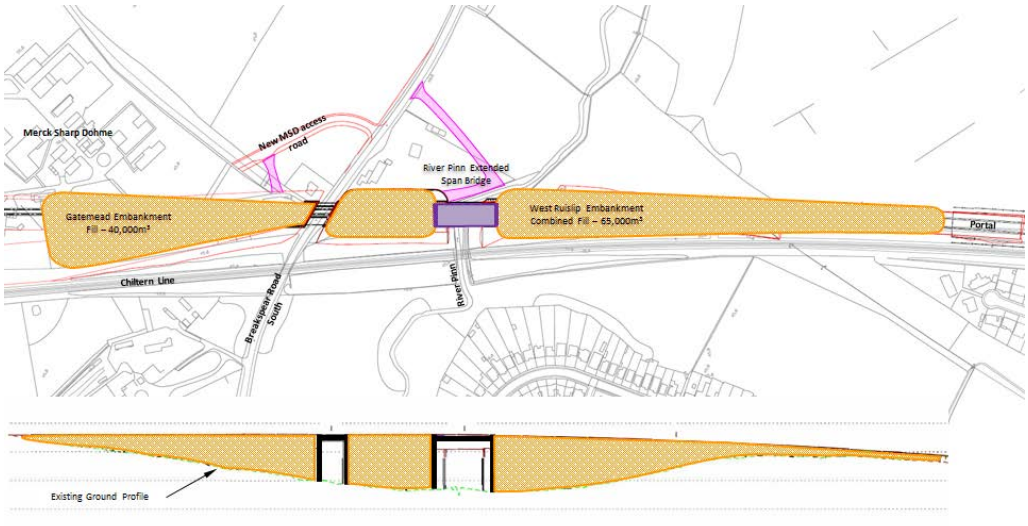

Figure 3.10 Option 6 - River Pinn increased span bridge

Objectives Met

3.2.10 All the options reduce the use of fill material and most reduce the quantity of EM going to SP, as shown in tables 3-2 and 3-3.

3.2.11 Taking into account the additional material requirements for construction of the viaducts or bridge structures, the total number of HGVs required for each option would be reduced by between 1,500 and 5,700No. vehicles. However, while the average number of HGVs per day based on the overall construction period would be reduced, the peak figure would remain similar, at between 300 and 400No. (2-way) movements per day, as it is driven primarily by the rate of import of fill which would be carried out over a shorter period of time within the overall option construction period, once the viaduct or bridge abutments have been completed. See Table 3-2 below.

		Reduction in EM to SP (m3)	Reduction in Imported Fill (m3)	Reduction in No. HGVs	Av. HGV Movements per day	Reduction in HGV Movements per day
Base Case	EM					
	Fill					
	HGVs	0	0	0	178	0
Option 1	EM	-2,500				
	Fill		20,000			
	HGVs			1,500	150	28
Option 2	EM	9,900				
	Fill		60,000			
	HGVs			5,300	96	82
Option 3	EM	7,400				
	Fill		80,000			
	HGVs			5,900	90	88
Option 4	EM	15,800				
	Fill		42,000			
	HGVs			5,700	114	64
Option 5	EM	10,200				
	Fill		22,000			
	HGVs			3,600	120	58
Option 6	EM	12,000				
	Fill		17,000			
	HGVs			3,700	110	68

Table 3-2 Comparison of Quantities for Alternative Options

(Note: peak number of movements would remain at between 300 and 400 per day due to the short peak demand periods)

Construction, Programme & Cost

3.2.12 Construction of all options is possible but different options have different issues.

3.2.13 All options assume inclusion of adequate space to accommodate the temporary requirement for construction traffic and tunnel logistics within the design of the structures.

3.2.14 A comparison of relative construction periods and additional costs relative to the HB base case is shown below in Table 3-3.

3.2.15 Completion of the structures between the tunnel logistics support area at Copthall cutting and the tunnel portal is critical for the start of tunnelling as the logistics route for both the EM conveyor and construction rail track run along these structures.

	Construction Period			Total Lag between	Overall Construction Period		Add. Time	Total Cost	Add. Cost
	Gatemead	West Ruislip	River Pinn						
Base Case	Embankment	Embankment	Original Span						
	25 wks	22 wks	33 wks	8 wks	41 wks	9.5 mths	0 mths	£14.4	-
Option 1	Viaduct	Embankment	Original Span						
	37 wks	22 wks	33 wks	8 wks	45 wks	10.5 mths	1 mths	£20.7	£6.3
Option 2	Embankment	Full Length Viaduct	Incl. in viaduct						
	25 wks	47 wks	0 wks	8 wks	55 wks	12.8 mths	3 mths	£27.9	£13.5
Option 3	Viaduct	Full Length Viaduct	Incl. in viaduct						
	37 wks	47 wks	0 wks	8 wks	55 wks	12.8 mths	3 mths	£34.2	£19.8
Option 4	Embankment	Infill Viaduct + East Embankment	Incl. in viaduct						
	25 wks	32 wks	0 wks	12 wks	44 wks	10.2 mths	1 mths	£22.3	£7.9
Option 5	Embankment	Embankment	3 Span Bridge						
	25 wks	22 wks	41 wks	8 wks	49 wks	11.4 mths	2 mths	£17.6	£3.2
Option 6	Embankment	Embankment	Increased Span Bridge						
	25 wks	22 wks	45 wks	8 wks	53 wks	12.3 mths	3 mths	£15.0	£0.6

Assumptions:

1 For comparison purposes element construction periods combined (no breaks), but with lag between elements
2 Elements assumed to be constructed concurrently with max. lag as indicated.
3 Option 4 lag greater due to confined working between Breakspear Road South Bridge and River Pinn
4 All activities based on one gang, except West Ruislip viaduct - 2 gangs due to length
5 Option 6 - beams assumed to be cast in-situ, too large for precasting

Table 3-3 Comparison of Programme and Costs for Alternative Options

3.2.16 All the options to replace embankments with viaducts or extended bridges take longer to construct, by up to 3 months and incur additional costs.

3.2.17 All the bridge and viaduct structures cost more than embankments due to the increased engineering, piling and concrete structures.

Environment

3.2.18 In addition to the information described elsewhere in this section, this initial environmental review also assumes the following;

- Reduction in volume of material going to SP would marginally reduce the area of SP but not the overall height, by up to 4%.

- Piling will be required to construct the viaduct(s).
- No additional area beyond the existing HS2 construction area will be required.

3.2.19 The effect of reducing HGV movements during the peak periods may reduce air quality effects predicted in the ES, but this will need to be confirmed.

3.2.20 Noise from the piling activities may increase the potential for noise disturbance to local residents, which could require an increase in noise mitigation or barriers.

3.2.21 Additional piles may increase the risk of potential for effects on groundwater.

3.2.22 There will be increased potential for ecological habitat restoration and enhancement along the River Pinn corridor.

3.2.23 Views from local PRoWs will be different allowing increased views to the existing Chiltern Line embankment. The views of HS2 during operation will not change from the south, due to the existing Chiltern Line embankment located to the south. However, this may be subject to a requirement for road access for maintenance and possible security fencing at the base of the viaduct structures.

3.2.24 There would be greater scope for replanting trees as less space would be permanently taken up by a viaduct or bridge compared to the embankment.

3.2.25 There would be reduced flood risk, as it is preferable to span the floodplain rather than obstruct flood flows and displace flood water. However, there would still be a requirement for replacement floodplain storage to mitigate piers, albeit smaller than the area provided in the hybrid Bill.

3.2.26 During operation, the change in structure from embankment to viaduct is likely to result in an increase of radiated sound, however it is expected that this could be offset through design of the track system. Design of the noise barrier in this location requires further consideration.

Dependencies / Risks

3.2.27 To accommodate the construction and rail systems railhead eastbound link, the Gatemead embankment widens in plan towards the west. If this is changed to a viaduct this will require a deck with increasing width, incurring additional complexity of design and construction, and additional cost.

3.2.28 The western section of the West Ruislip embankment is also wider than required for HS2 operations and carries the eastbound link from the Copthall

Cutting railhead to the eastbound Chiltern Lines. It also carries the conveyor, narrow gauge railway and site access route from the West Ruislip Portal to the Copthall Cutting railhead. A viaduct would therefore be wider than required solely for HS2 operations and early completion is critical to the Project Programme for the start of tunnelling.

3.2.29 The design of a viaduct to include a large noise barrier on the parapet edge would require careful consideration. The current scheme includes a 5m high noise barrier to the south. Viaduct barriers can be located slightly closer to the rail than the usual 5m offset, which could reduce the barrier to approx. 4.5m high. However, there are currently no noise fence barriers on viaducts greater than 4m - the tallest being on the Colne Valley viaduct.

Conclusions & Next Actions

3.2.30 Replacing the West Ruislip and/or Gatemead embankments with viaducts would reduce the quantity of fill material to be imported by between 17,000 and 80,000 m^3. This would reduce the total number of HGV lorries and the average number of movements (two-way) per day (see Table 3-2 above), but the peak number of movements would remain at between 300 and 400 due to the short peak demand periods for this. As noted in 3.2.11 above, this is because the import of fill would be carried out over a shorter period of time within the overall option construction period, once the viaduct or bridge abutments have been completed.

3.2.31 The short length of viaduct to replace the Gatemead embankment (Option 1) achieves minimal saving in terms of reduction in HGV movements and importation of fill material, with an increase in removal of EM and disproportionate increase in cost.

3.2.32 The viaduct and bridge replacement options for the West Ruislip embankment would reduce the quantity of Alluvium to be removed and compensatory flood storage requirement by varying degrees, together with reductions in HGV movements. However, the cost and construction programme for all options is increased.

3.2.33 As these options are predicted to increase the duration of critical path programme items by 1 to 3 months they are not recommended for implementation. However, it is understood that these options are to be considered further by the HS2 Engineering Delivery Team and detailed design contractor, at the early contractor involvement phase of the project, to understand whether programme modifications could enable implementation of the bridge structures and whether there is sufficient benefit to justify the cost..

3.2.34 The feasibility of the Network Rail connection locations associated with the viaduct options will need to be determined.

3.3 Use of excavated material for interval embankment between HS2 and Chiltern Lines

Description

3.3.1 The HS2 embankment between the Breakspear Road South and River Pinn overbridges runs alongside the existing NR Chiltern Line embankment. There is scope to use EM to infill the ground between the embankment structures, see Figure 3.11 below.

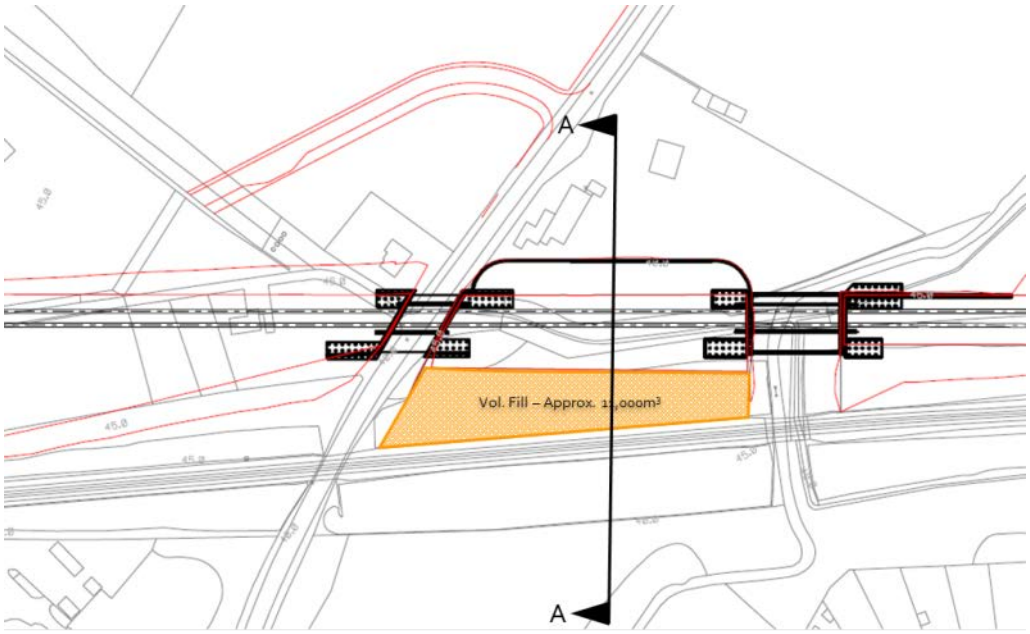

Figure 3.11 Use of the interval between HS2 and NR for fill

Objectives Met

3.3.2 EM could be used for infilling between the embankments; however the volume is relatively small at approximately 11,000 m^3, which would equate to approximately 20 two way HGV movements per day over a period of 3

months, if assumed to be EM from the immediate adjacent works which would otherwise be removed by road.

Construction, Programme & Cost

3.3.3 Transport and placement of the EM may be difficult. The material must be brought over Breakspear Road South from the Copthall Cutting and can only be placed once the permanent HS2 embankment structure is complete, duplicating the operation.

3.3.4 The detailed logistics of carrying out this operation will need further review at detailed design to ensure it is cost effective and of sufficient benefit.

3.3.5 The programme and cost implications are likely to be minimal.

Environment

3.3.6 In addition to the information described elsewhere in this section, this initial environmental review also assumes the following;

- No additional area beyond the existing HS2 construction area will be required
- The area of the SP areas would be reduced by 11,000m^3.

Dependencies / Risks

3.3.7 This will not be a feasible option, or would be limited, if the West Ruislip and Gatemead embankments are converted to viaducts. There are no other interval areas in the design.

3.3.8 Approval will be required from NR for the additional surcharge load imposed on their embankment by the EM infill.

3.3.9 The interface with the eastern connection to the Chiltern Lines will need to be examined.

Conclusions & Next Actions

3.3.10 This will be discussed with Network Rail and implemented, if feasible.

3.4 Commence importation of material earlier in the programme

Description

3.4.1 The importation of engineering fill for construction of the Gatemead, West Ruislip and Harvil Road Embankments over a limited timescale results in a spike in the number of HGV lorry movements per day on the road network (approx. 770 per day over 6 months).

3.4.2 Spreading the period over which this import occurs would lower the peak number of HGVs on the roads per day but not reduce the total number.

Gatemead and West Ruislip embankments

3.4.3 For Gatemead and West Ruislip embankments, material can be imported in two phases.

- Phase 1 – see Figure 3.12 below;
  - Import for permanent construction of part embankments earlier during construction of bridges, approx. 6 months period (66,000 m^3 – approx. 40%)
  - Temporary importation & storage within embankment footprint (33,000 m^3 – approx. 20%)
- Phase 2;
  - Complete embankments between bridges & behind abutments, approx. 4 months. Balance of fill imported as previously planned following completion of bridges (73,000 m^3 – 40%)

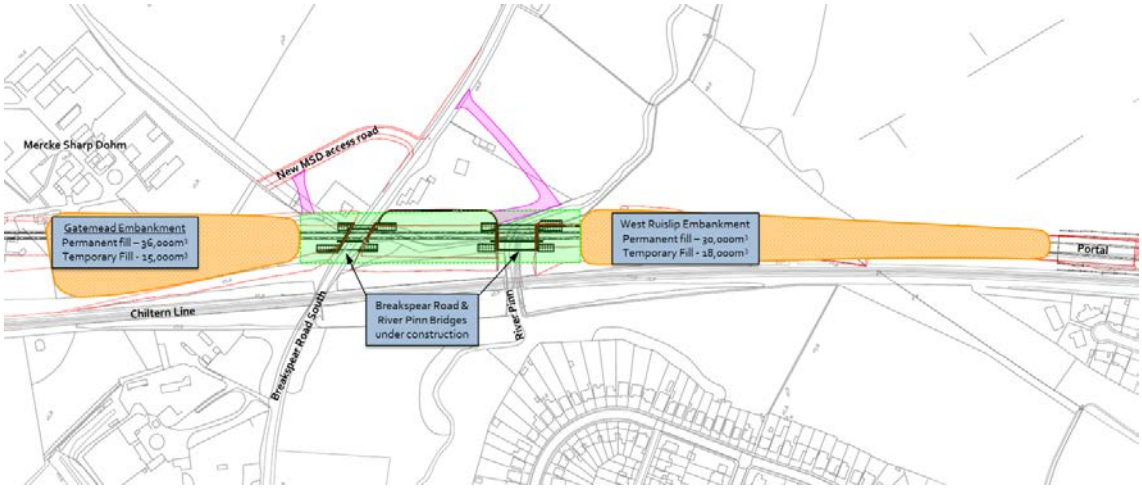

Figure 3.12 Early Importation of Fill - Gatemead & West Ruislip Embankments

Harvil Road Embankments

3.4.4 At Harvil Road it would be possible to import 100% of the fill requirement for the road embankment during construction of the bridges – approx. 9 months.

3.4.5 This would only be undertaken if it was unfeasible to reuse material excavated from the Copthall Cutting for the embankment, as this option reduces the total number of HGVs (see Section 3.1).

3.4.6 It is proposed that material would be temporarily stored at Colne Valley Viaduct / ATFS site until required. Figure 3.13 below shows the construction stages.

- Stage 1
  - Form temporary Harvil Road diversion
  - Form Colne Valley Viaduct / ATFS site, incl. access/exit roads off Harvil Road
- Stage 2
  - Import fill for Harvil Road highway works
  - Build Harvil Road bridges
- Stage 3
  - Place fill for highway
  - Build new road & install utilities
- Stage 4
  - Divert traffic onto new road
  - Handover site for Colne Valley Viaduct construction, to meet their programme

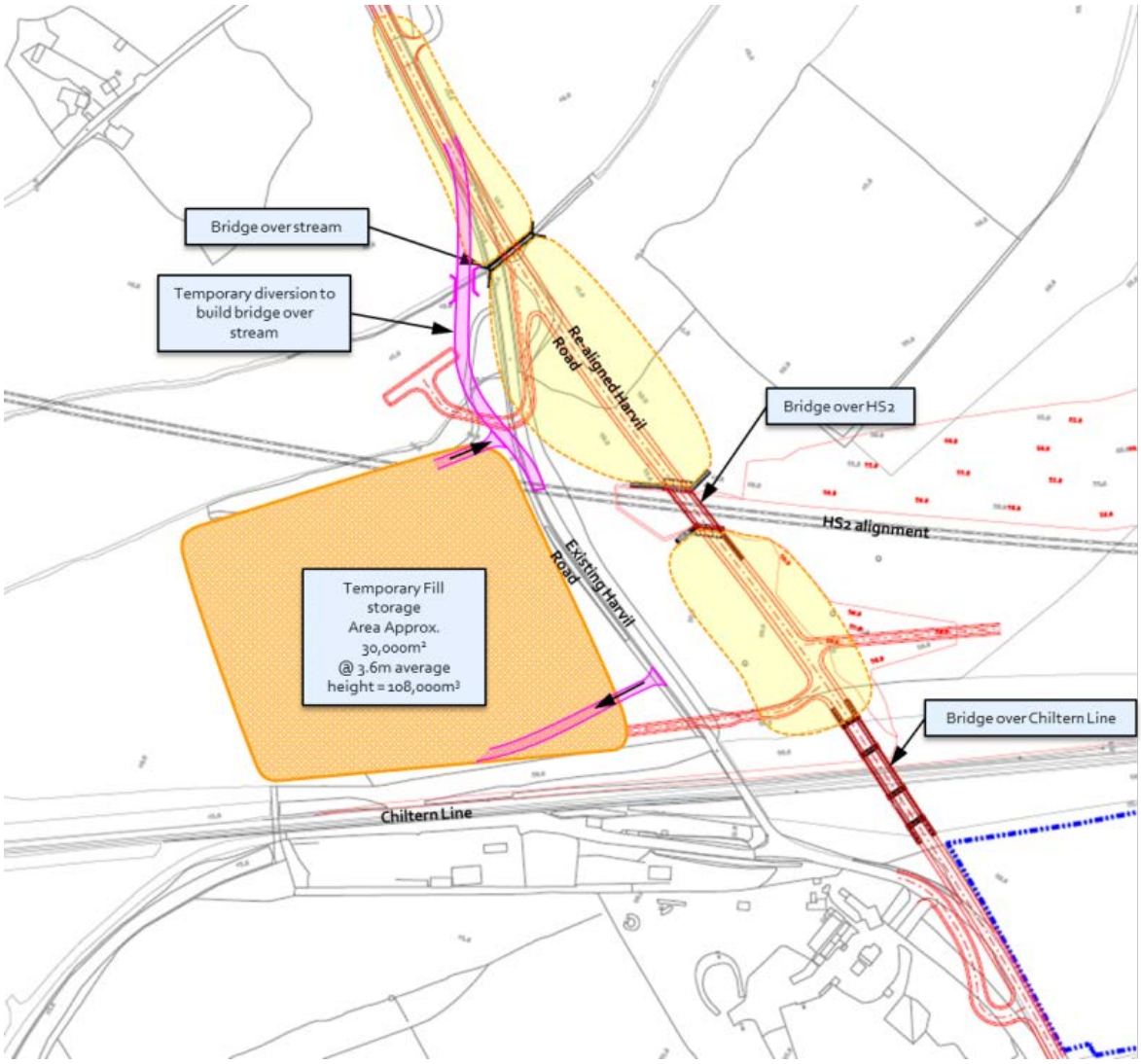

Figure 3.13 Early Importation of Fill – Harvil Road Embankment

Objectives Met

3.4.7 Introducing the measures outlined above would reduce the peak lorry numbers per day due to the importation of fill as shown in Table 3-4 below;

Embankment	Two-way peak daily HGV reductions
Gatemead and West Ruislip	140
Harvil Road	120

Table 3-4 Two-way peak daily HGV reductions

3.4.8 Figure 3.14 below shows the HGV numbers for fill importation if early importation was used for all embankments.

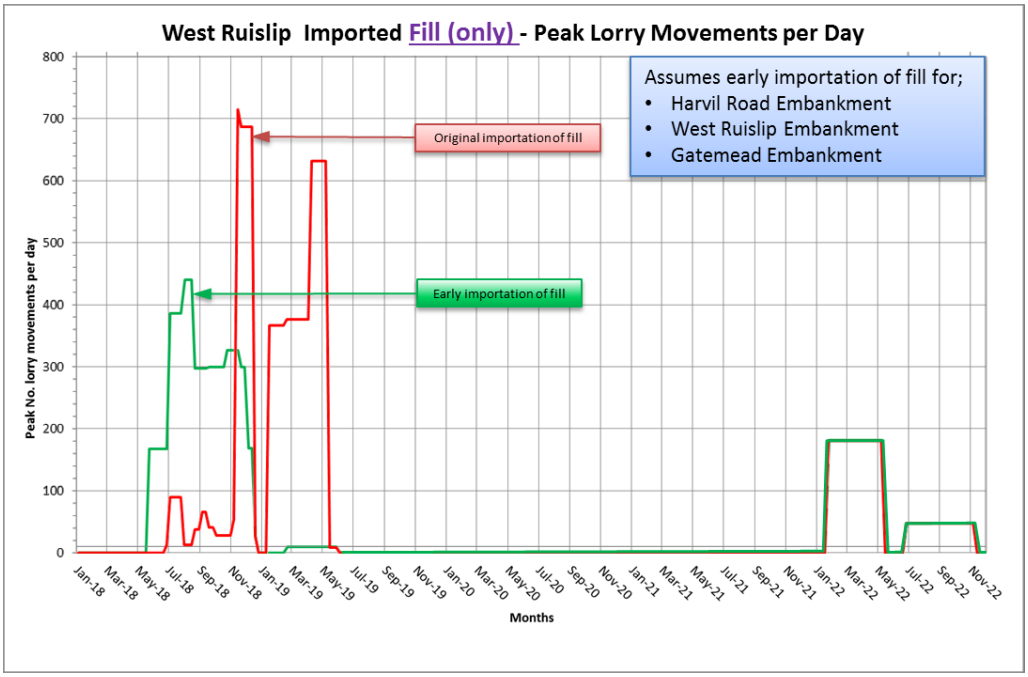

Figure 3.14 Combined peak lorry movements per day - Comparison (Based on AP2 programme)

3.4.9 Note: the peaks shown in 2022 relate to the importation of fill for the ATFS site at Harvil Road.

Construction, Programme & Cost

3.4.10 With careful management of the peak (levelling), a potential reduction in total of 350 to 400 HGV movements per day may be possible.

3.4.11 Early importation of fill to temporary storage prior to permanent placement is possible within the programme without impacting critical path items.

3.4.12 There would be some additional cost associated with double handling of material, although not considered significant against the overall estimate.

Environment

3.4.13 In addition to the information described elsewhere in this section, this initial environmental review also assumes the following;

- No additional area beyond the existing HS2 construction area will be required.

3.4.14 The effect of reducing HGV movements during the peak periods may reduce air quality effects predicted in the ES, this will require confirmation.

3.4.15 No other likely environmental effects identified.

Dependencies / Risks

3.4.16 There is a risk that the ecology surveys and assessments for the temporary storage area at Harvil Road must be completed, and then the site cleared, prepared and ready to receive the material in time to achieve the benefit of spreading the lorry numbers over time.

3.4.17 Confirmation that the additional surcharge from the temporary storage of material on the Gatemead and West Ruislip embankments will not adversely affect the permanent structure will require verification.

3.4.18 Continued dialogue to understand changes and interaction with other construction elements, particularly the Colne Valley viaduct works in time to achieve the benefit of spreading the lorry numbers over time.

Conclusions & Next Actions

3.4.19 Implementation of this proposal is beneficial to reducing peak traffic numbers, although not the total number.

3.4.20 Further work is needed to determine methodology to deliver, place and stockpile material to avoid degradation, minimise potential wastage, assist future handling and minimise temporary visual impact.

3.4.21 Additionally this solution needs to be modelled at detailed design within the programme to understand if any amendments to other work would be required, although this change is not considered to impact programme critical activities.

3.5 Retention of Railway 'Up-Sidings' at Ickenham Road for importation of fill

Description

3.5.1 An existing siding off the Chiltern Lines runs west from Ickenham Road for approximately 200m, see Figure 3.15 below.

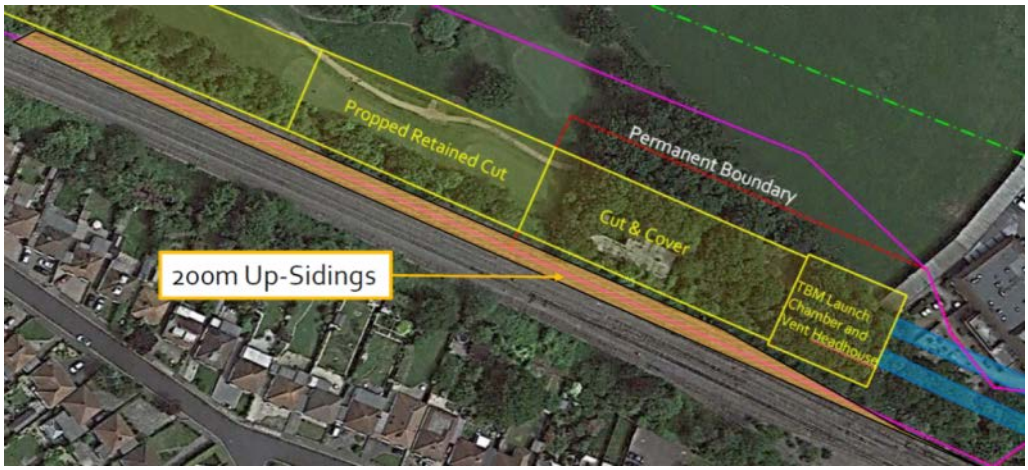

Figure 3.15 Chiltern Line 'Up Sidings' west of Ickenham Road

3.5.2 Although expansion of the sidings into a railhead at the golf course were reviewed using the existing 200m long sidings with only minor modification was considered to be the most practical solution.

3.5.3 The proposal would be to use this siding for the importation of fill material by rail for construction of the West Ruislip embankment.

Objectives Met

3.5.4 The West Ruislip Portal will be constructed before the fill material will be required at the West Ruislip Embankment.

3.5.5 There is a potential window of up to 6 months during which the siding could be used before access would be cut off by the diaphragm walling and excavation of the portal structure. Assuming up to two deliveries per week, at 300m^3 per train (equivalent un-bulked volume), this would equate to a total volume of 15,000 m^3, equivalent to approximately 14 HGVs per day (or 28No. 2-way movements) over 6 months.

3.5.6 The early importation of fill would be dependent on locating and preparing a suitable temporary storage area within close proximity of the siding and/or embankment.

Construction, Programme & Cost

3.5.7 Due to the proximity of the existing siding to the portal structure it will need to be removed or decommissioned, during construction of the southern diaphragm walls.

3.5.8 Following construction of the diaphragm walls, the cut and cover and retained cut sections of the portal structure will be constructed, presenting a physical

obstacle (deep excavation) between the siding and the route to the West Ruislip embankment, for the full length of the siding.

3.5.9 Transfer of the fill material from a train could be by direct side discharge adjacent to the track (see Figure 3.16 below) for subsequent reloading into lorries for transfer to the temporary storage area.

Figure 3.16 Side discharge rail wagons

3.5.10 A self-discharge (Redland / Lafarge) train could be used to discharge at a single location at the end of the siding.See Figure 3.17 below.

Figure 3.17 Lafarge self-discharge train

3.5.11 Alternatively grab plant could be used (see Figure 3.18 below) to unload from the train directly into lorries and taken to a temporary storage area.

Figure 3.18 Grab handling of material from rail wagons

3.5.12 All options would require a prepared access along the full length of the siding for lorries and loading/unloading plant, ideally a concrete hardstanding in the

case of the side tipping option to facilitate re-loading into lorries and reduce contamination.

3.5.13 There may be a risk of the fill material 'sticking' in the side and self-discharging wagons as they are designed for granular aggregates not engineering fill which will contain material with variable particle sizes and water content.

3.5.14 The adjacent Ruislip golf course would be a suitable location for temporary storage but, with space required for construction of the portal, there will be limited capacity within existing LODs. Additional golf course land would need to be temporarily acquired.

3.5.15 Double or triple handling of the material, reloading it from the rail discharge point, transporting to either the permanent fill location or, if taken to temporary storage, reloading and transporting again, will incur additional cost in respect of the plant and infrastructure required.

Environment

3.5.16 The effect of reducing HGV movements during the peak periods may reduce air quality effects predicted in the ES, but would need to be confirmed once the scheme has been developed further.

3.5.17 Additional train movements, operation of plant to unload the trains at the Ickenham Road siding, and the redistribution of haul traffic within the site is unlikely to cause significant noise effects, but will need to be confirmed.

Dependencies / Risks

3.5.18 It is considered that only one track approximately 200m in length could be used, due to proximity to the portal retaining wall, which will limit the capacity.

3.5.19 The ability to provide train paths at the appropriate time and frequency has yet to be assessed. These may be the same paths that would be used during the later phase, but would be limited if concurrent with early commissioning of the railhead in the Copthall cutting.

3.5.20 Dependent on being able to be carried out early in the programme which may not be achievable due to site access limitations, particularly for temporary storage on the golf course.

3.5.21 In order to produce sufficient benefits to justify the construction this would potentially involve work outside Bill limits and may require planning permission.

3.5.22 Potential impact on railway operations.

Conclusions & Next Actions

3.5.23 Further review required by HS2 and their contractor at Early Contractor Involvement (ECI) stage, together with engagement with NR operations, to confirm the feasibility and potential benefit.

3.5.24 Access to a usable loading/discharge area adjacent to or on Ruislip golf course to be determined.

3.6 Early Construction of Initial West Ruislip Railhead Siding

Description

3.6.1 Construction of a single ended siding at West Ruislip Railhead, early in the programme, for importation of fill material or export of excavated material, see Figure 3.19 below.

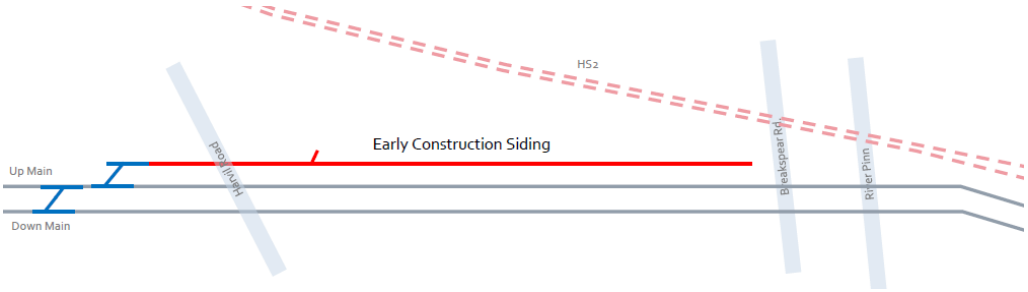

Figure 3.19 Early Construction of Rail Siding at West Ruislip Railhead

3.6.2 The siding would be a precursor to the subsequent West Ruislip EM Railhead, see Figure 3.20 below.

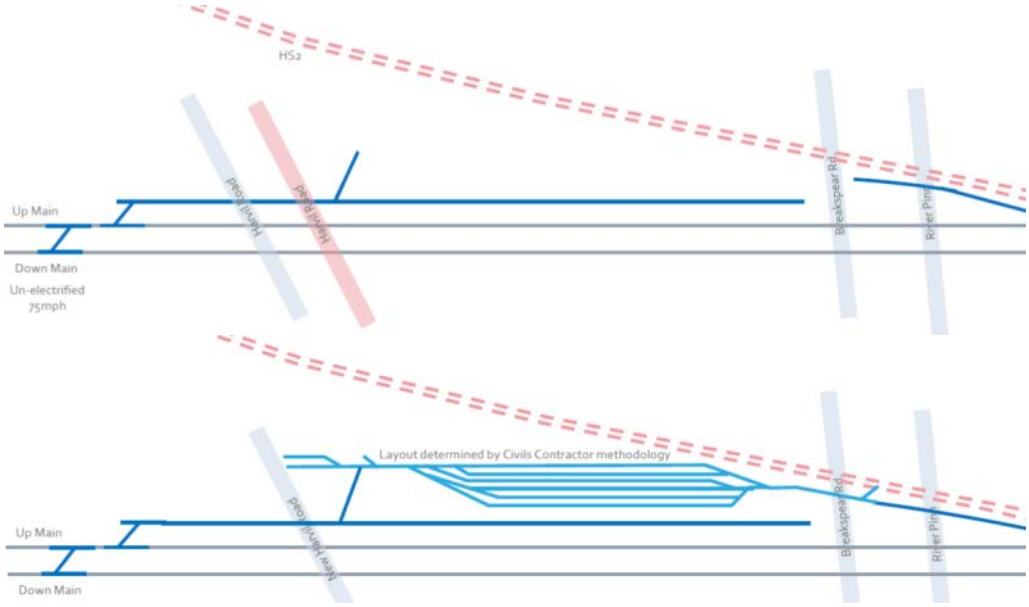

Figure 3.20 Full EM Railhead – following completion of new Harvil Road Bridge

Objectives Met

3.6.3 Potential for removal of EM by rail rather than taken to SP or import of fill material, but only if the operation can be carried out without interference with ongoing excavation of Copthall cutting (Phase 1) for full EM railhead.

3.6.4 There is a potential opportunity to design and install one of the West Ruislip Railhead 'reception sidings' early. This infrastructure would enable freight trains to be used to import or export materials to the West Ruislip site, aiding the construction of the railhead site and material movement to and from the surrounding area.

3.6.5 Assuming one train can be worked per day, each train would carry approximately 600m^3 of material, equivalent to 60-70 HGVs (or 120-140 No. 2 way movements).

3.6.6 If the siding were to be used for export of material there may be opportunities to reduce the Harvil Road / Breakspear Road triangle area of sustainable placement, given that 1No train per day would move 12,000 – 15,000m^3 per month.

Construction, Programme & Cost

3.6.7 Suitable access and temporary stockpile area would probably be required adjacent to the siding for loading or unloading however, taking into

consideration the topography, this would require significant excavation north of the siding to create the necessary space.

3.6.8 The loading or unloading of material would be as described in Sections 3.5.9 and 3.5.10 above.

3.6.9 Concurrent import of fill and export of EM will not be practical due to different requirements for plant and storage requiring greater space than is available until excavation of the Copthall Cutting is significantly advanced.

3.6.10 The availability of this siding would be earlier than construction of the embankments and requirement for fill. Importation of fill would therefore need to be stockpiled, requiring additional transport, HGVs on the road and further re-handling.

3.6.11 Additional costs would be incurred for either importation of fill or export of EM due to double or triple handling.

3.6.12 This option requires the design and construction of connections to Network Rail, the siding and loading facilities to be installed sufficiently early in the programme to enable additional excavated material to be removed / material to be imported.

Environment

3.6.13 No additional loss of habitats is predicted for the excavation, storage, treatment or placement of the fill material.

3.6.14 If the area of SP was reduced then the ecological effects could be potentially reduced (less hedgerow, trees and grassland lost).

Dependencies / Risks

3.6.15 Risk of delay to early NR approval and implementation of rail connection, and consequent delay to the HS2 construction programme.

3.6.16 Careful planning required for subsequent construction of full EM railhead to prevent abortive works.

3.6.17 Single ended siding restricts train movement and train path flexibility, limiting volumes of import or export.

3.6.18 The ability to provide train paths at the appropriate time and frequency has yet to be assessed; these are likely to be limited.

Conclusions & Next Actions

3.6.19 It is understood the projects preference would be the early removal of EM by rail to reduce SP rather than importation of fill. It is unlikely the siding could be used for both.

3.6.20 Progress design with Network Rail and clarify intended use and volume which could be moved.

3.7 Construction of West Ruislip Railhead Siding and Railhead with eastern rail connection west of Breakspear Road South

Description

3.7.1 A permutation of the Option described under Section 3.6 and discussed at the workshops, would be to relocate the eastern end connection of the siding off the trace west of Breakspear Road South, see Figure 3.21 below.

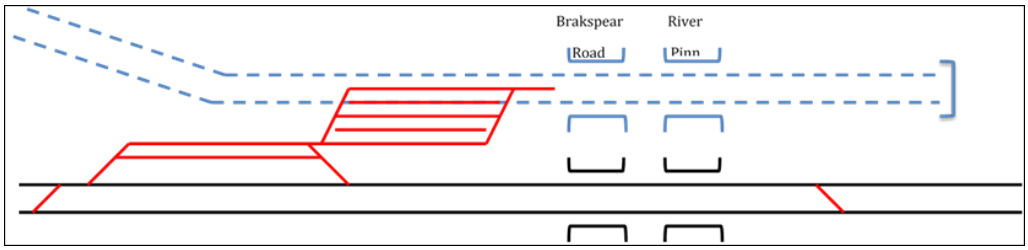

Figure 3.21 Railhead eastern rail connection west of Breakspear Road South

Objectives Met

3.7.2 The potential advantage would be that it would remove the trace construction from the programme critical path, allowing for later construction of the trace using rail borne fill.

Construction, Programme & Cost

3.7.3 Construction of the railhead is driven by excavation of Copthall cutting, which is started as soon as feasible in the programme. Once a railhead is operational it is fully utilised for removal of excavated material and then rail systems so there is no opportunity to import fill.

3.7.4 A connection east of Breakspear Road South could reduce the length of usable railhead and would require a shunting operation for trains to come out of the railhead siding, downgrading the railhead operation efficiency.

3.7.5 Transfer of EM from the tunnel portal to the railhead is by conveyor which requires support structures, particularly over Breakspear Road South and the

River Pinn, as well as vehicular access for maintenance along its full length, see Figure 3.22 below.

Figure 3.22 Conveyor support structure - left, adjacent vehicle access (Crossrail) - right

3.7.6 The construction of temporary support structures would obstruct construction of the permanent structures and require additional lorry movements for installation and removal.

3.7.7 Additional land would be required, particularly to avoid the temporary obstruction preventing construction of the permanent works in time to support rail systems fit-out, incurring additional cost. See Figure 3.23 below.

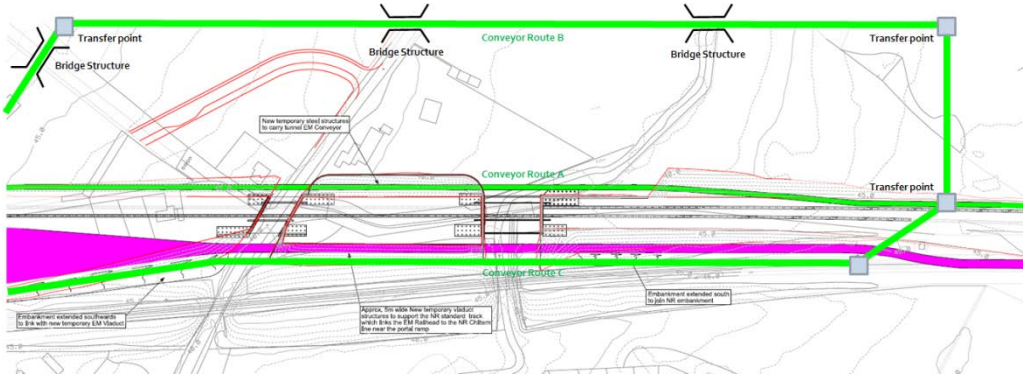

Figure 3.23 Alternative conveyor route options

3.7.8 The tunnelling operation support logistics require a significant area for the delivery, storage and despatch of not just tunnel segments but also numerous temporary works materials and consumables. As currently proposed this is located within the Copthall cutting and either requires a construction rail access to the portal, which would again require the construction of temporary structures as noted in 3.7.5 for the EM conveyor, or all transport would have

to be by road, increasing the number of HGV movements on the local road network, see Table 3-5 below.

Additional HGV movements (2-way) to portal via Ickenham Rd				
	@ Average tunnel rate		@ Peak tunnel rate	
Segments	30	No. per day	60	No. per day
Misc supplies	6	No. per day	12	No. per day
Cement for grout	2	No. per day	4	No. per day
Total per tunnel	38	No. per day	76	No. per day
Total two tunnels	76	No. per day	152	No. per day

Table 3-5 Additional HGV movements to portal via Ickenham Road

3.7.9 Delivery of segments from the precast factory at Harvil Road, or a remote location, would require a significant increase in the West Ruislip Portal Compound site for interim storage and the transfer of all the miscellaneous tunnel support requirements to tunnel rail transport.

3.7.10 Additional costs would be incurred associated with the additional temporary infrastructure, transport and potentially land, marginally offset by a reduction in width of the Breakspear Road South and River Pinn bridges.

3.7.11 The EM railhead and the tunnel logistics area are critical for the start of tunnelling. Both these are located within the Copthall cutting and the time taken to excavate the necessary areas and establish them exceeds the time taken to construct the structures along the trace to the tunnel portal. The proposal to provide alternative temporary routes and structures does not therefore provide any programme benefit.

3.7.12 A reduced EM railhead would be incapable of handling the volumes of EM generated once tunnelling commences and would result in significant quantities being diverted to temporary storage within the Northolt Tunnel and Earthworks Compound and the 'triangle' SP area between Harvil Road and Breakspear Road.

Environment

3.7.13 There would be an overall increase in environmental impacts associated with increase in lorry movements indicated in 3.7.6 above and loss of habitats associated with increased land take.

3.7.14 There would also potentially be additional negative environmental impacts of 24/7 noise and light pollution closer to housing, as the temporary structures would not be built along the trace.

Dependencies / Risks

3.7.15 These are included alongside the construction descriptions above.

Conclusions & Next Actions

3.7.16 This proposal would not benefit the programme, but rather complicate the logistics support by introducing additional lorry movements and incur additional costs.

3.7.17 Not recommended to be taken further but may be reviewed by HS2 and their contractor at ECI stage, together with engagement with NR operations.

3.8 Use of material to reinstate southern holes at Uxbridge Golf Course

Description

3.8.1 Potential to utilise up to 135,000m^3 of excavated material within Uxbridge Golf Course for redesign of southern holes, see Figure 3.24 below. This would enable the area of SP at the Harvil Road/ Breakspear Road triangle to be reduced by approximately one third, from that shown in current plans.

Figure 3.24 Location map - Uxbridge Golf Course

Objectives Met

3.8.2 Reduces EM going to SP and diverts to beneficial use. It is assumed that with cooperation from Hillingdon the material could be delivered using haul roads through the golf course, avoiding the need to increase HGV traffic on Harvil Road.

Construction, Programme & Cost

3.8.3 Potential additional costs related to transport and unloading/placement.

3.8.4 Transport route and placement area(s) within the golf course to be determined during discussions with London Borough of Hillingdon.

Environment

3.8.5 This initial environmental review is based on the following assumptions;

- Excavated material would be placed in a field to the west of Harvil Road.
- The material would be transported to the location of the golf course southern holes; any haul road would be part of the planning application / agreement with LBH and the golf course.
- Placement of the material will be subject to a separate planning application.

3.8.6 There is potential for loss of habitats due to the placement of the fill material, although this would also need to be confirmed.

3.8.7 If the area of SP was reduced then the ecological effects could be potentially reduced (less hedgerow, trees and grassland lost).

Dependencies / Risks

3.8.8 Needs planning permission but consistent with a previous application.

3.8.9 Proposal would need to be developed by HS2 working in partnership with LBH.

3.8.10 It is assumed that an on-site haul route would be feasible but if this was not possible using off road trucks will add to number of HGVs on the public roads.

Conclusions & Next Actions

3.8.11 HS2 and LBH need to formulate a proposal and agreement.

3.9 Use of material in the reconstruction of Ruislip Golf Course and to create a bund

Description

3.9.1 Proposal to use EM to form a bund between the HS2 trace and the Ruislip Golf Course, either within the current Limits of Deviation or within the 60m

exclusion zone required for all new or redesigned golf courses adjacent to rail lines.

3.9.2 The bunds are assumed to have slopes at a minimum of 1:4 and need to allow for an access road at the foot of the slope alongside the Canal feeder diversion, to avoid interference with construction activities.

3.9.3 The footprint of the bunds do not extend east of the canal feeder as this area, up to Ickenham Road, will be required for plant and equipment for construction of the portal structure, in addition to access. It would also mean crossing the canal feeder, footpath and ponds which are in an area designated for ecological mitigation.

3.9.4 A bund within the LODs would only be 1m in height and accommodate approximately 2,500m³ of EM, see Figure 3.25 below.

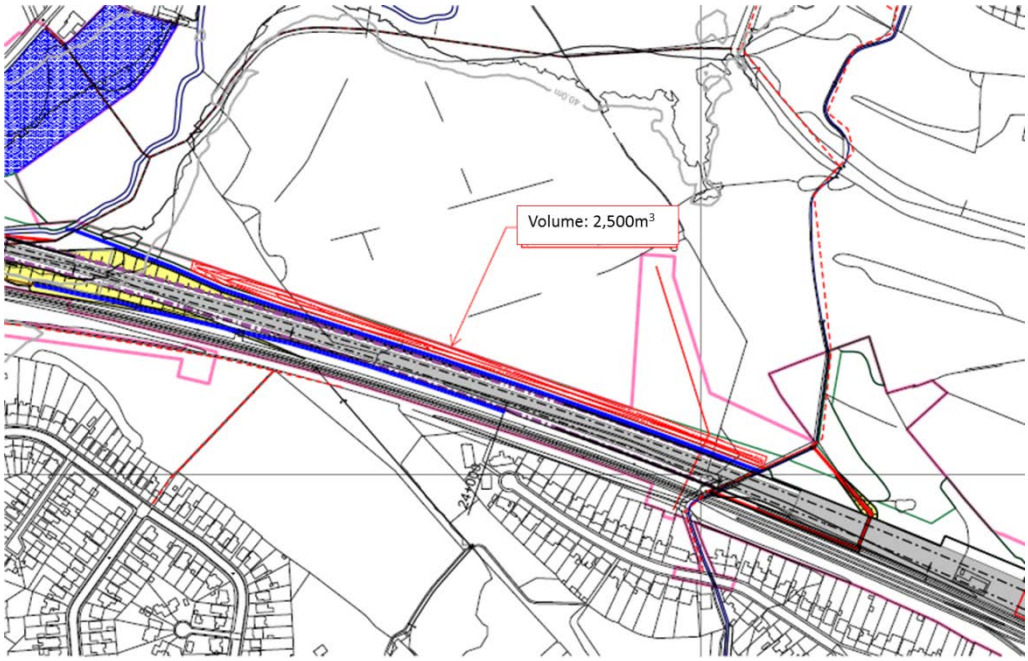

Figure 3.25 Bund within LOD

3.9.5 A bund extending beyond the LODs but within the 60m exclusion zone would accommodate approximately 60,000m³ of EM, see Figure 3.26 below.

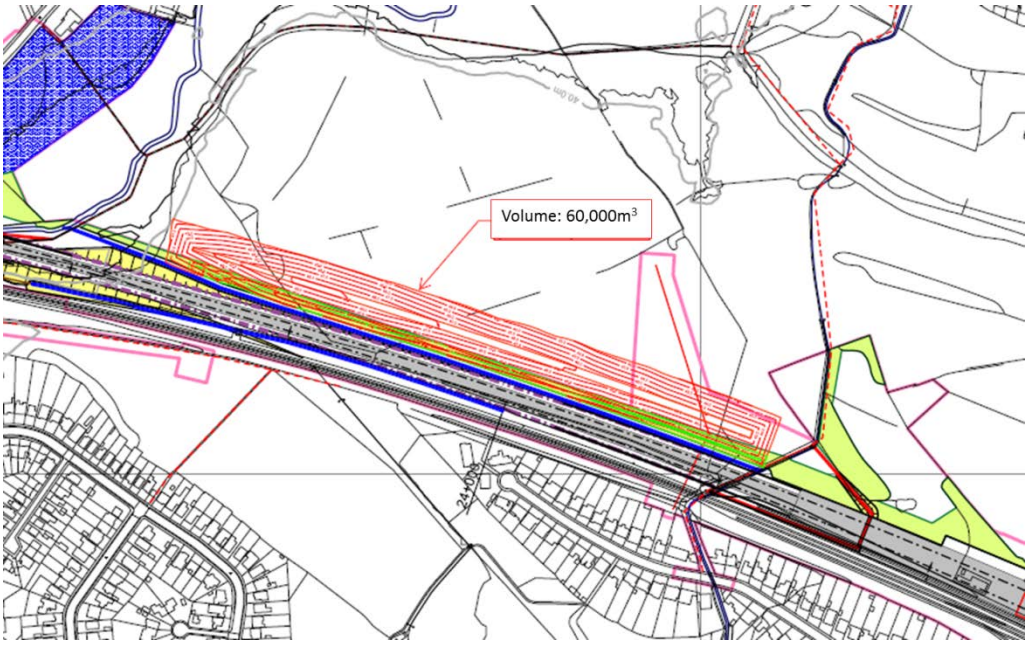

Figure 3.26 Bund within 60m exclusion zone

3.9.6 In addition, EM may be used during the reconstruction of the golf course following the temporary occupation by HS2 during construction.

Objectives Met

3.9.7 As there is negligible benefit for a bund only within LODs (approx. 2.5% of portal EM), it is assumed the option to place up to 60% of material excavated from the portal (60,000m^3) outside LODs but within the 60m exclusion zone would be pursued. This would be equivalent to a reduction of approx. 40 HGVs per day on Ickenham Road, Swakeleys Road and the A40 over 8 months.

Construction, Programme & Cost

3.9.8 To avoid adding HGVs to the road network EM for this purpose would come from excavation of the West Ruislip Portal. The option provides no reduction in SP.

3.9.9 Minimal quantity of material could be placed within LODs without impact on construction activities.

3.9.10 To place material outside LODs within the 60m exclusion zone could be carried out without impact to construction activities, but would require planning permission and potentially additional ecological and ground survey work to be concluded before the start of excavation.

3.9.11 No programme impact, but reduction in costs associated with disposal of EM.

Environment

3.9.12 In addition to the information described elsewhere in this section, this initial environmental review also assumes the following;

- It will be possible to plant on the bund, although there may be some restrictions on planting on the southern side of the bund nearer to the HS2 railway.

3.9.13 The effect of reducing HGV movements during the peak periods may reduce air quality effects predicted in the ES, but this will need to be confirmed.

3.9.14 Additional trees and other habitats may be lost beyond hybrid Bill limits within Ruislip Golf Course and Old Priory Meadows SBI.I

3.9.15 Amended landscape and visual mitigation will also be required.

Dependencies / Risks

3.9.16 Where outside bill limits would require separate planning application and LBH support.

3.9.17 Possible amendment/relocation of some ecological mitigation.

3.9.18 Proposal would potentially clash with early importation of fill by rail (Section 3.5), as the areas for temporary storage of material would be the same.

Conclusions & Next Actions

3.9.19 HS2 and LBH to agree proposal for a bund within the 60m exclusion zone, together with associated ecological mitigation, in order to reduce two way movements by 80 HGVs per day.

3.9.20 Discuss use of additional EM for golf course remodelling with LBH, in order to reduce two way movements by a further 50 HGVs per day.

3.10 Relocation of segment factory from Harvil Road to an independent site

Description

3.10.1 The proposal is to not establish a temporary factory on Harvil Road for the manufacture of precast concrete tunnel linings for the Northolt West tunnels, but have them made elsewhere and delivered direct to the West Ruislip Portal by road.

3.10.2 Transport by rail is not considered feasible due to the additional demands this would place on the railhead on top of the export of EM and the dearth of train paths to satisfy this demand.

Objectives Met

3.10.3 The objective of reducing HGV traffic numbers is not met as the number of lorry movements to import tunnel segments from a remote site will be greater than the number forecast for a pre-casting facility located at Harvil Road.

Construction, Programme & Cost

3.10.4 For the HB scheme, based on a pre-casting facility at Harvil Road, the number of associated HGV and LGVs will be as follows;

- Approx. 15,800 No. 28 tonne HGV lorries will be required for delivery of materials for the manufacture of tunnel segments – aggregates, cement, rebar/fibres, gaskets (allowing 10% material wastage), 5 days per week.
- This is equivalent to between 20 and 25 No. HGVs per day over the approximate 28month manufacturing period.
- There will be approximately 75 No. operatives with a further 15 to 25 staff, supervision, maintenance and security, etc. working in the factory per shift, 5 days per week, 24 hours per day. Their transport to work will predominately be site buses operating between the site and key transport interchanges, e.g. West Ruislip Chiltern Line and London Underground station, with a few private cars. The number of vehicles will therefore be in the order of 10 to 15 No per shift, or 30 to 45 per day based on 3 shifts per day.
- Construction of the precast factory will be carried out over a period of approximately 12months, including installation and commissioning of the plant and equipment, concrete testing and casting of test rings prior to the start of full production. The initial land clearance and construction of the infrastructure will take approximately 6 months and will require between 5 and 10 No. HGVs per day.
- Demolition of the facility on completion of tunnelling will be done over a period of approximately 4 months and will also require between 5 and 10 No. HGVs per day.

3.10.5 For importation of segments from an independent site three HGVs will carry the segments for two rings (each ring is made up of 10 segments and a key weighing a total of 45 tonne), as a minimum. Averaged over the tunnel

construction period this equates to approximately 34 No. per day however, this will increase by two or three times this number (up to 102No.) to satisfy the peak tunnel Tunnel Boring Machine (TBM) construction demand.

3.10.6 There are few permanent large capacity commercial segment casting facilities, two are in the Republic of Ireland, one is in England;

- Shay Murtagh, Raharney, Eire – supplier of segments to Crossrail Contract 310.
- F.P.McCann, Banagher, Eire – supplier of segments to Dublin Port Tunnel
- Buchan, Burton Upon Trent, UK. Requiring a journey of over 130miles.

3.10.7 The alternative to using an existing commercial supplier would be to establish a precast factory at a new location under the control of the tunnel contractor.

Environment

3.10.8 This initial environmental review is based on the following assumptions;

- No significant impact identified for current location.
- The alternative location of segment factory is not known.
- There would be an increase in HGV lorry movements to provide road borne segment deliveries.
- The area for the Northolt Tunnel and Earthworks Main Compound would be reduced, although some area would still be required for storing segments unless these were stored at an enlarged site at the Ruislip Golf Course.

3.10.9 The off-site location for the factory would be outside hybrid Bill limits, and would require a planning permission unless an existing facility was used.

3.10.10 The additional HGV traffic on local roads used to transport segments could be on routes not permitted by the hybrid Bill powers, and potentially a source of additional significant noise, air quality and community impacts, although this would need to be confirmed.

3.10.11 The reduction in area of the Northolt Tunnel and earthworks main compound would reduce the area of existing vegetation (hedgerows, trees and grass areas) lost and associated mitigation measures required.

3.10.12 The reduction in need for associated ecological mitigation measures will affect the no net loss calculation.

3.10.13 Possible increase in carbon footprint due to potential increase in overall transport distances.

Dependencies / Risks

3.10.14 Commercial supply will incur additional cost, for profit allowances, haulage and increased risk with quality control and damage due to double handling.

3.10.15 An independent remote casting factory controlled by the tunnel contractor will also incur additional costs associated with land, in addition to the increased risk of damage due to double handling.

3.10.16 Cost and programme risks associated with an independent casting factory related to finding a suitable location, the period needed to negotiate use of the site and planning permission, before the facility can be established. This could result in insufficient stock cast prior to the start of tunnelling and potential significant impact on the overall programme.

3.10.17 Will require permission for road deliveries to the tunnel portal.

3.10.18 Produces local benefit in terms of Harvil Road worksite land take but will increase overall number of HGVs in the area.

Conclusions & Next Actions

3.10.19 Relocating the tunnel segment precast factory would reduce the area of land required at Harvil Road.

3.10.20 It would increase HGVs movements within the area, although this would be partially offset by reduced numbers of other vehicles, there would still be additional HGV numbers.

3.10.21 This option would require the factory to be located on additional land somewhere nearby the area or segments being delivered from distant existing facilities.

3.10.22 C221 (Mott Macdonald) would not recommend this proposal.

4 Traffic Management Options

4.1 Consideration of extending HGV movement hours to reduce movements at peak times, or during school holiday periods

Description

4.1.1 Proposal to extend the working day for HGV movements, up to a 12 hour day, during certain periods e.g. school holidays, to reduce periods of peak movement.

Objectives Met

4.1.2 Subject to discussion between LBH and the contractor to secure the necessary authorisation, this proposal could be beneficial by spreading the HGV movements over a longer period thereby reducing the peaks.

Construction, Programme & Cost

4.1.3 Construction and programme would not be affected however, there may be an additional cost related to rescheduling of resources and out of hours work payments.

Environment

4.1.4 This initial environmental review is based on the following assumptions;

- Extending the duration of HGV movement will have a pro-rata increase/decrease on the peak hour flows and during the extended hours of operation.
- This option is to be examined further by LBH, and has therefore not yet been assessed for traffic impacts.

4.1.5 The effect of reducing HGV movements during the peak periods may reduce air quality effects predicted in the ES, this will require confirmation.

4.1.6 No other likely effects identified.

Dependencies / Risks

4.1.7 Planning sufficiently in advance of the works may be difficult.

4.1.8 Uncertainty with respect to LBH approval

Conclusions & Next Actions

4.1.9 HS2 / LBH to determine whether this produces significant benefit.

4.1.10 Understanding of detailed programme.

4.2 Use of alternative traffic route – Long Lane

Description

4.2.1 The proposal is to use Long Lane as a primary access route for construction vehicles accessing West Ruislip portal and thus avoid the right turn movement from the High Road into Swakeleys Road and use of the Swakeleys Road corridor.

4.2.2 This would entail adding up to 180 HGVs (2 way flows)/day on Long Lane during the peak construction period of up to 18 months with substantially lower flows in the remaining years of HS2 construction. Alternatives to this proposal would be to limit the use of Long Lane to outside school-drop off and pick-up times, inter-peak period for vehicles leaving the HS2 construction sites. However this would still entail the same number of total vehicles but distributed over a longer time period.

4.2.3 This has been assessed subjectively to evaluate the issues and identify associated risks, but has also taken on board some issues previously identified and since confirmed in the LBH Ickenham Pump study (January 2016).

Objectives Met

4.2.4 The route from West Ruislip via Swakeleys Road to the A40/Swakeleys roundabout junction was originally selected as forming the most direct route to the A40 and destinations to the west. Swakeleys Road to the west of Breakspear Road also already carries HGV traffic associated with the heavy commercial land uses off New Year's Green Lane and off Harvil Road (ie Amenity tip and Skip Lane).

4.2.5 The High Road, Ickenham/Long Lane/Swakeleys Road junction operates close to capacity but with HS2 construction traffic would not noticeably impact on junction capacity.

4.2.6 The use of Long Lane would offer an alternative but less direct route via the Hillingdon Circus junction and would also pass the library and the two campuses of the Douay Martyr's School located on each side of Long Lane.

4.2.7 The north section of Long lane is also identified as a “strategic route on road” forming part of the London Cycle Network as shown in Figure 4.1 below.

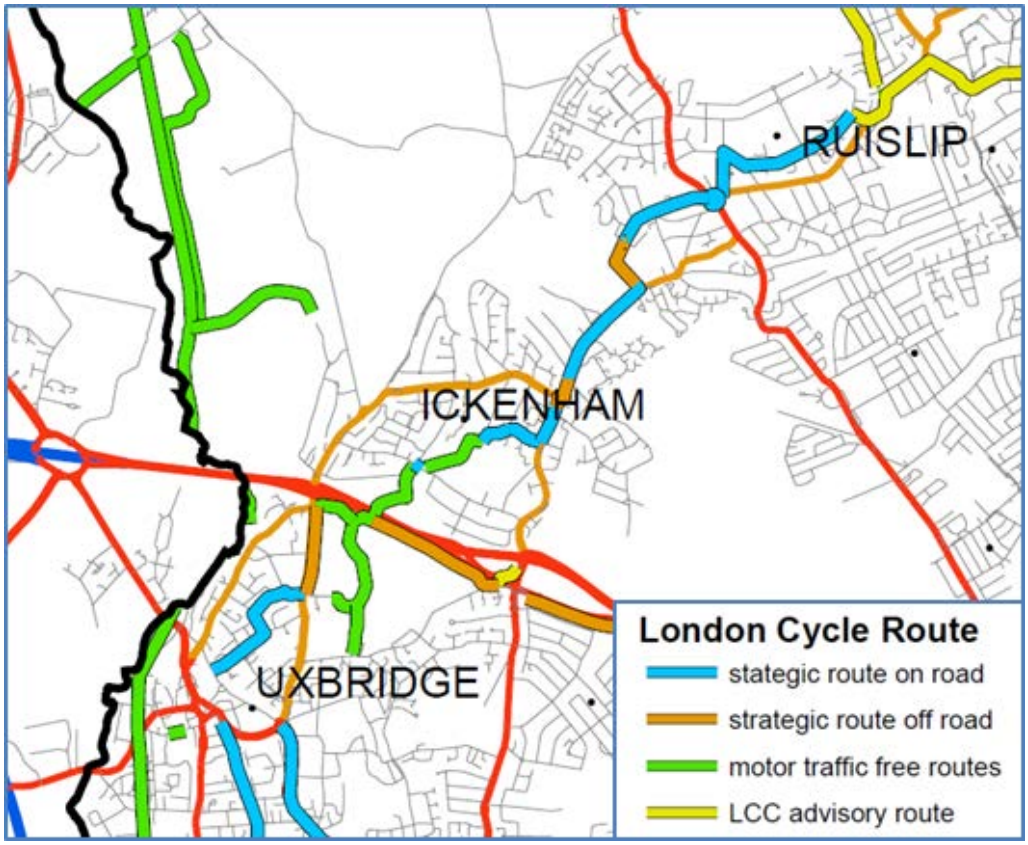

Figure 4.1 Extract from London Cycle Network

4.2.8 Thus as well as forming a less direct route to the west via the A40 junctions, the Long Lane route has a number of more sensitive receptors and existing uses than the Swakeleys Road corridor route.

4.2.9 The A40 Long Lane was therefore not selected as the primary access route for the West Ruislip portal due to concern for Heavy frontage activity over some sections with schools (and bus stops), commercial, and residential uses and safety concerns for cyclists/pedestrians.

4.2.10 Traffic counts on Long Lane on weekdays indicate that in general, the AM/PM peak periods have high volumes of traffic flowing through the route, plus considerable traffic in the inter-peak hours.

4.2.11 In terms of varying the timing of movements to and from the HS2 sites a lack of capacity on the Long Lane route in the inter-peak period means that early morning or late evening is the only time when there is spare capacity on the

route. However, as the area is residential in nature, and with two school sites, the additional HS2 construction HGVs during some periods would generate significant new effects and would need to be assessed further.

4.2.12 As with the current access strategy using the Swakeleys Road corridor, mitigation measures in the form of potential improvements to the Swakeleys Road /High Road junction were considered to accommodate additional HGV movements while maintaining safe access for other traffic, but it was apparent from an early stage that any modifications at the junction would be difficult to implement, and potentially introduce other safety issues. This was further confirmed by the analysis in the Ickenham Pump Study (LBH January 2016). This also further reviewed accidents in the vicinity of the Swakeleys Road /High Road junction. The problems with identifying enhancements at this junction

Construction, Programme & Cost

4.2.13 In terms of construction, programme and cost the use of the Long Lane route as an alternative to using the Swakeleys Road corridor would not be expected to reduce any mitigation measures that may be required on the Swakeleys Road corridor, and would potentially involve further mitigation.

4.2.14 There would be no notable effect on the HS2 construction programme or cost as the scale of movements to the West Ruislip sites, although intense for a limited period, is relatively small compared to the overall HS2 flows.

Environment

4.2.15 Reassigning HS2 HGV movements from the Swakeleys Road corridor to the Long Lane route would result in lower flows on Swakeleys Road but potentially result in additional effects on the Long Lane route.

4.2.16 Mitigation on Long Lane may include measures such as additional pedestrian crossings in the vicinity of the school sites and associated speed reduction measures.

4.2.17 Diverting some HGV movements during the peak periods may reduce air quality effects predicted in the ES, but will need to be confirmed.

4.2.18 No other likely effects identified.

Dependencies / Risks

4.2.19 Detailed management of the junction needs to be discussed with LBH to understand the potential safety implications and visibility of using Long Lane.

Conclusions & Next Actions

4.2.20 The following is noted as part of using Long Lane as primary access;

- Early morning or late evening is the only time when there is spare capacity on this route.
- Use of Long Lane for HS2 construction traffic may have the potential to give rise to new significant effects.
- Putting more HGVs on Long Lane may introduce a safety risk to cyclists and pedestrians, particularly in the area surrounding Douay Martyr's School.

4.2.21 Based on the above, the use of Long Lane is not recommended as the primary access construction route for West Ruislip Portal construction-related movements.

4.2.22 There may be potential to use Long Lane in a limited manner only for off-peak periods but this may result in new effects around the school locations which would need to be mitigated.

4.2.23 The limited use of this option will need to be discussed with Hillingdon as part of HS2's commitment to undertake traffic modelling and agree traffic management measures to mitigate traffic impacts where required.

5 Options considered and rejected

5.1 Bund within the Copthall Cutting on completion of construction

Description

5.1.1 Backfill within the Copthall Cutting with EM temporarily stockpiled within an area of SP, to form a bund between HS2 and the Chiltern Lines, after construction is completed and the site has been used by Rail Systems for fitout in 2025/6 (as per original Bill proposal).

Objectives Met

5.1.2 Reduces quantity of EM placed in permanent SP.

Construction, Programme & Cost

5.1.3 The Main Works Civil Contractor will have demobilised and the Rail Systems contract will have to take on the scope of works.

5.1.4 By the time the EM can be taken to the area in the Copthall Cutting it will have been "temporarily" stored for approximately 6 years.

5.1.5 It will involve 14,000 additional on-site dumper truck moves, so long as the temporary bridge over the Chiltern Lines is retained, together with associated infrastructure.

5.1.6 If the temporary bridge over the Chiltern Lines is not retained the transport route between the temporary stockpile and permanent placement areas will require dumper trucks or HGVs to use Harvil Road.

5.1.7 Reloading, transporting and placing this material, together with re-landscaping of the "temporary" stockpile area, will incur additional cost.

Environment

5.1.8 This initial environmental review is based on the following assumptions;

- Backfilling would be done once the railway system installation works have been completed.
- Re-excavation of approximately 120,000 m^3 of EM placed up to 6 years previously.
- Approximately 14,000 additional onsite HGV movements, assuming bridge over the Chiltern Line be left in place longer along with supporting construction infrastructure within the Northolt Tunnel and Earthworks Main Compound.
- Works would take approximately 2 months to complete.
- Approximate 35% reduction in the volume of SP between Harvil Road and Breakspear Road South, representing a reduction in area of approximately 50,000m^2.

5.1.9 The additional HGV movements of excavated materials have a potential for increased dust and other pollutant emissions, although this would need to be confirmed.

5.1.10 In the 6 years since the sustainable placement of the excavated materials and the excavation of the Copthall Cutting vegetation would have developed in those areas that would now be lost.

5.1.11 The mitigation measures originally put in place would either be lost or would not be fully developed until after these works had been completed.

5.1.12 New significant effects would occur that had previously been reduced to a level that was not significant by the mitigation measures associated with planting and management measures.

5.1.13 The duration of the PRoW diversions identified in the ES may increase.

Dependencies / Risks

5.1.14 This will be an additional activity which may interfere with the completion of Rail Systems fitout and the ultimate commissioning of the railway.

Conclusions & Next Actions

5.1.15 Following the workshops and discussions with local residents HS2 has decided not to pursue this option.

5.2 Use of Chiltern Line to deliver fill from running line overnight

Description

5.2.1 This proposal is for the delivery of fill material by train during night time "white" periods (engineering hours) with the train stopped on the main line for off-loading.

Objectives Met

5.2.2 Occasional use for unloading of up to 600m^3 per train (equivalent un-bulked volume) could lead to a moderate reduction in HGV movements.

Construction, Programme & Cost

5.2.3 Fill would be imported overnight (between 1am and 5am), requiring overnight possessions of railway ("white" period).

5.2.4 Due to the limited time period over which this operation can take place the unloading of the material will be crucial.

5.2.5 The fill would be left in place until the next working day once unloaded from the train, depending on the method of unloading.

5.2.6 Using unloading grabs (see Section 3.5.10) will take time which would either limit the quantity which can be delivered at one time, or would require a number of machines operating at different locations along the length of the train.

5.2.7 Self-discharge trains or side tipping wagons used for trackside delivery are designed for track ballast, see Sections 3.5.9 and 3.5.10. The fill material will be a different specification and must also be transported away from the track and immediate lineside restrictions. Direct discharge wagons may not be suitable for this type of material and subsequent reloading and transport to the point of use may also have to be undertaken in "white" periods due to the proximity to operational tracks.

5.2.8 A dedicated reception site would be required, located within the existing Consolidated Construction Boundary (CCB).

Environment

5.2.9 Residential areas to the south of the construction works (e.g. Hoylake Crescent and the Greenway) are likely to be disturbed by noise related to the unloading of the trains during the night time, but will need to be confirmed.

5.2.10 Additional lighting will be in the vicinity of the reception facility during night-time operation, with potential visual effects.

5.2.11 The effect of reducing HGV movements during the peak periods may reduce air quality effects predicted in the ES, but this will need to be confirmed.

Dependencies / Risks

5.2.12 Requires Network Rail approval and overnight possessions.

5.2.13 Needs a suitable reception site

5.2.14 Consideration of environmental impacts on local residents

Conclusions & Next Actions

5.2.15 Following the workshops and discussions with local residents HS2 has decided not to pursue this option.

5.3 Alternate routing options for construction traffic movements

Description

5.3.1 Three alternate routing options for construction traffic movements were assessed.

5.3.2 Option 10.1 – Harvil Road compounds exit via Moorhall Road based on the following assumptions;

- All HS2 traffic accessing Harvil Road compounds, West Ruislip embankment, Gatemead embankment and any other HS2 construction traffic to enter via Swakeleys road and exit via Moorhall Road/Moorfield Road.
- HS2 traffic for the Breakspear Road South construction compound to enter/exit via Swakeleys road.

5.3.3 Option 10.2 – Harvil Road compounds exit via Moorhall Road, West Ruislip compound access/exit via Long Lane, based on the following assumptions;

- All HS2 traffic for Harvil Road compounds, West Ruislip embankment, Gatesmead embankment and other HS2 construction traffic (via Harvil Road) will enter and exit via Swakeleys road and Moorhall Road/Moorfield Road.
- Vehicles for West Ruislip compound to enter/exit via Long Lane

5.3.4 Option 10.3 – Harvil Road compounds exit via Swakeleys Road, West Ruislip exit via West End Road; Breakspear Road South compound via Long Lane, based on the following assumptions;

- All HS2 Traffic for Harvil Road compound enter/exit via Swakeleys road
- All HS2 Traffic for West Ruislip compound to enter /exit via West End Road
- All HS2 Traffic for Breakspear Road South enter and exit via Long Lane

5.3.5 Table 5-1 Comparison of Traffic Flows on Key Routes below provides a comparison of the traffic flow on the key routes for different routing options described above, based on AP2 ES numbers.

Table 5-1 Comparison of Traffic Flows on Key Routes

Scenario/Strategy	Routing Options	Peak HGV/Hour flows (2 way)						
		Swakeleys Road	Harvil Road	Breakspear Road	Ickenham High Road	Moorhall Road	Long Lane	West End Road
AP2	Primary access via Swakeleys Road	106	96	6	4	0	0	0
Option 10.1	Access for Harvil Road via Swakeleys Road but exit via Moorhall Road; Breakspear Road South – West Ruislip access via Swakeleys Road	56	96*	6	4	50	0	0
Option 10.2	Access for Harvil Road via Swakeleys Road but exit via Moorhall Road; Breakspear Road South via Swakeleys Road – West Ruislip access/exit via Long Lane	56	70*	6	30***	20	30	0
Option 10.3	Access for Harvil Road via Swakeleys Road; Breakspear Road South access/exit via Long Lane – West Ruislip access/exit via West End Road	56	56	20**	30****	0	20	30

5.3.6 Key assumptions used when assessing the traffic flows in the table above;

- *Flow on Harvil Road includes movement from Moorhall Road
- ** Flow for Breakspear Road South is via Long Lane - B467
- *** Flow to WR compound via Long Lane and Ickenham High Road
- **** Flow to WR compound via West End road and Ickenham High Road

Comparison of revised routing options

5.3.7 Table 5-2 Pros and Cons of the alternate Routing Strategies provides the pros and cons of the alternate routing strategies.

Table 5-2 Pros and Cons of the alternate Routing Strategies

Scenario/Strategy	Routing Options	Pros	Cons
AP2	Primary access via Swakeleys Road		
Option 10.1	Access for Harvil Road via Swakeleys Road but exit via Moorhall Road; Breakspear Road South – West Ruislip access via Swakeleys Road	• Multiple access option for Harvil Road • Minimal flows on Breakspear and Ickenham Road	• More traffic on Moorhall Road (this is CFA7 construction route)
Option 10.2	Access for Harvil Road via Swakeleys Road but exit via Moorhall Road; Breakspear Road South via Swakeleys Road – West Ruislip access/exit via Long Lane	• Multiple access option for Harvil Road • More direct traffic to West Ruislip portal via Long Lane	• More traffic on Moorhall Road (this is CFA7 construction route) • There is heavy frontage activity on Long Lane
Option 10.3	Access for Harvil Road via Swakeleys Road; Breakspear Road South access/exit via Long Lane – West Ruislip access/exit via West End Road	• Multiple access option for Harvil Road but all traffic can access/exit via Swakeleys Road • Dedicated access/exit route for Breakspear Road and West Rusilip Compound via Long Lane and West End Road respectively. • Distributed flow of traffic over the network	• There is heavy frontage activity on Long Lane • West End Road also has heavy frontage activity • Will potentially have impact on more junction on the new routes

Reason not taken forward

5.3.8 The proposed alternate routes assist in reducing the flows to 550 HGV (2way) movements at Swakeleys Road/A40 roundabout however; these routes already have high levels of background traffic and adding more construction traffic would have the potential to introduce new significant effects which would need to be re-assessed in accordance with the SMRs.

Reference to meeting where dismissed

5.3.9 These alternative traffic routes were discussed at workshop 1 held on 3rd February and at workshop 2 held on 13th February it was agreed to not progress this option any further. Although it was decided to explore the potential limited use of Long Lane.

5.4 Gyratory and/or tidal flow on road network

Description

5.4.1 Three options were identified to use of gyratory and/or tidal flows for construction traffic movements to route vehicles in the less busy direction of flow.

5.4.2 Option 11.1 – Harvil Road and Breakspear Road inbound only via Swakeleys Road – exit via Moorhall Road, based on the following assumptions;

- HS2 traffic for Harvil Road compounds, West Ruislip embankment, Gatesmead embankment and other HS2 construction traffic to enter via Swakeleys road and exit via Moorhall Road/Moorfield Road.
- C222 traffic not considered.

5.4.3 Option 11.2 – Harvil Road and West Rusilip access via Swakeleys Road – Harvil Road exit via Moorhall Road and West Ruislip exit via Long Lane; Breakspear entry/exit via Swakeleys Road, based on the following assumptions;

- HS2 traffic for Harvil Road compounds, West Ruislip embankment, Gatesmead embankment and other HS2 construction traffic (via Harvil Road) to enter via Swakeleys road and exit via Moorhall Road/Moorfield Road.
- HS2 traffic for Breakspear Road to enter/exit via Swakeleys.
- HS2 traffic for West Ruislip to enter via Swakeleys Road and exit via Long Lane.
- C222 traffic not considered.

5.4.4 Option 11.3 – Harvil Road compounds inbound via Swakeleys Road exit via Moorhall Road, West Ruislip inbound via Long Lane - exit via West End Road; Breakspear Road compound via Swakeleys Road, based on the following assumptions;

- Vehicles for Harvil Road: Enter via Swakeleys Road and exit via Moorhall Road.
- Vehicles for West Ruislip compound to enter via Long Lane and exit via West End Road.
- Vehicles for Breakspear Road enter and exit via Swakeleys Road.

5.4.5 The use of West End Road and Long Lane involve routes that have not been previously designated or assessed as construction route by HS2 as previously not considered suitable due to the presence of sensitive receptors.

5.4.6 Table 5-3 below provides a comparison of the traffic flow on the key routes for the different tidal flow options described above.

Table 5-3: Comparison of traffic flow on key routes scenarios for tidal flows

Scenario/Strategy	Routing Options	Peak HGV/Hour flows (2 way)						
		Swakeleys Road	Harvil Road	Breakspear Road	Ickenham High Road	Moorhall Road	Long Lane	West End Road
AP2	Primary access via Swakeleys Road	106	96	4	6	0	0	0
Option 11.1	Access for Harvil Road and Breakspear Road via Swakeleys Road but exit via Moorhall Road; West Ruislip access via Swakeleys Road	55	28	10	30	38	0	0
Option 11.2	Access for Harvil Road and West Ruislip via Swakeleys Road but Harvil Road exit via Moorhall Road; West Ruislip exit via Long Lane; Breakspear Road access/exit via Swakeleys Road	55	28	20	30	28	15	0
Option 11.3	Access for Harvil Road via Swakeleys Road but exit via Moorhall Road; West Ruislip entry via Long Lane and exit via West End Road; Breakspear Road access/exit via Swakeleys Road	48	28	20	15	28	15	15

5.4.7 Table 5-4 below provides the pros and cons of the different tidal flow options.

Table 5-4 Pros and Cons of the Different Tidal Flow Options

Scenario/Strategy	Routing Options	Pros	Cons
AP2	Primary access via Swakeleys Road		
Option 11.1	Access for Harvil Road and Breakspear Road via Swakeleys Road but exit via Moorhall Road; West Ruislip access via Swakeleys Road	• Tidal flows on Harvil Road and Breakspear Road	• More traffic on Moorhall Road
Option 11.2	Access for Harvil Road and West Ruislip via Swakeleys Road but Harvil Road exit via Moorhall Road; West Ruislip exit via Long Lane; Breakspear Road access/exit via Swakeleys Road	• Tidal flows on Harvil Road and Ickenham High Road • Impact on A40 spread over three junctions	• More traffic on Moorhall Road • More traffic on Long Lane • Heavy frontage activity on Long Lane
Option 11.3	Access for Harvil Road via Swakeleys Road but exit via Moorhall Road; West Ruislip entry via Long Lane and exit via West End Road; Breakspear Road access/exit via Swakeleys Road	• Tidal flows on Harvil Road; Breakspear Road; and Long Lane/West End road • Lower flow on Swakeleys Road that that provided in the assurance • Impact on A40 spread over four junctions	• More traffic on Moorhall Road • More traffic on Long Lane • More traffic on West End road • Heavy frontage activity on Long Lane and West End road. • Potentially more junction being impacted by distributed traffic flows

Reason not taken forward

5.4.8 Creating tidal/gyratory flows would reduce traffic on Swakeleys road/roundabout however; there would be greater impacts on the alternate routes.

5.4.9 These routes already have high levels of background traffic and adding more construction traffic would introduce new significant effects that would need to be re-assessed in accordance with the SMRs.

Reference to meeting where dismissed

5.4.10 This option was discussed at workshop 1 held on 3rd February and at workshop 3 held on 24th February and it was agreed to not progress further.

5.5 Use of TfL West Ruislip Depot

Description

5.5.1 This proposal by TfL/LUL was for an alternative location for the West Ruislip Railhead & Logistics centre to support High Speed 2 Construction and Logistics.

5.5.2 TfL/LU proposed the use of land adjacent to their rail connected facility at Ruislip Depot, close to the HS2 alignment.

5.5.3 A full description and assessment of this proposal is contained in Technical Note: *C241-PBR-CL-NOT-010-400001 (P02) - Review of Alternative West Ruislip Railhead and Logistics Centre*.

Reason not taken forward

5.5.4 This option would not eliminate the requirement for a railhead at Harvil Road as the HS2 Rail Systems railheads need to be located with direct access to both the conventional rail network and the HS2 rail network.

5.5.5 There are extensive negative impacts relating to additional and onerous risks to the HS2 construction programme. These are risks that do not exist for the current proposal as described under the hybrid Bill. Primarily, these risks are associated with construction and operation of a conveyor system adjacent to live railway infrastructure.

5.5.6 Using this area would not remove the requirement for Sustainable Placement as a conveyor or logistics tunnel could not be constructed in time between Copthall Cutting and the West Ruislip Depot.

5.5.7 The site is geographically remote and isolated from the HS2 works by the existing operational railway lines. This would create programme risk from assurance and possession access uncertainty.

5.5.8 A number of improvements would be required to be delivered by TfL on HS2's behalf prior to Hybrid Bill Royal assent, placing the start of tunnelling milestone at significant risk.

5.5.9 Construction traffic routes would be through built up areas.

Reference to meeting where dismissed

5.5.10 This option was discussed at workshop 4 held on the 11th March. It was agreed this would not be progressed, as the construction of siding at West Ruislip Railhead earlier in the programme was considered to be a better option.

5.6 Use of larger capacity HGVs

Description

5.6.1 Review of traffic numbers using larger capacity HGVs for movement of material than the 34tonne vehicles with a carrying capacity of 8.5m^3 (unbulked in-situ volume) currently assumed for transport of EM.

5.6.2 Potential to use;

- 38tonne with 10 m^3 carrying capacity
- 44tonne with 12 m^3 carrying capacity

5.6.3 Figure 5.1 below indicates the reduction in traffic numbers using larger HGVs. A 38tonne vehicle results in a 16% reduction and a 44tonne vehicle results in a 35% reduction over the AP2 peak traffic flows.

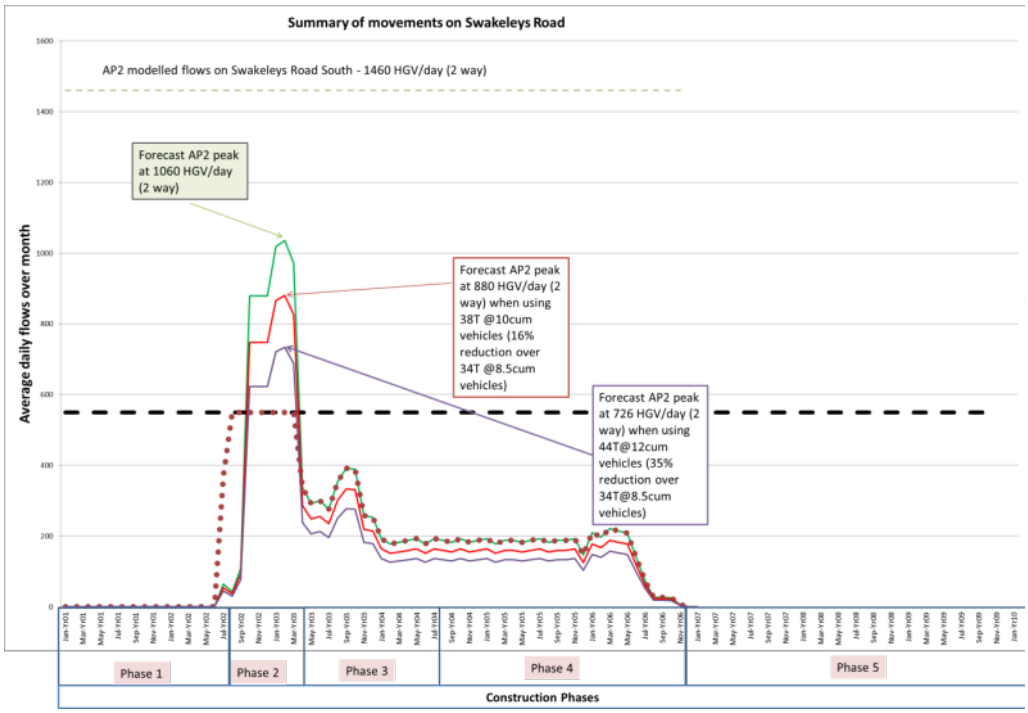

Figure 5.1 reduction in traffic numbers using larger HGVs

Reason not taken forward

5.6.4 Although use of larger vehicles results in a reduction in volume of traffic flows, this would not necessarily result in a proportional reduction in traffic impact on Swakeleys roundabout.

5.6.5 Due to the larger dimensions of the vehicles, additional time would be spent manoeuvring the vehicles entering and exiting Swakeleys road and the roundabout.

5.6.6 There is a potential issue with the availability of larger vehicles and qualified drivers in addition to the additional costs associated with procurement of these vehicles, as well as increased safety concerns.

Reference to meeting where dismissed

5.6.7 This option was discussed at workshop 1 held on 3rd February and at workshop 3 held on 24th February it was agreed to not progress further.

5.7 Use of "treated" EM in lieu of imported fill for West Ruislip and Gatemead Embankments

Description

5.7.1 Re-use of suitable excavated material, or a method of treatment which will achieve the required engineering properties, for West Ruislip and Gatemead embankments.

5.7.2 The HS2 Technical Standard requires that the top 5m of an embankment below formation to be imported granular fill material with the remainder as treated cohesive material, subject to the properties of this material.

5.7.3 Due to embankment heights this option would only be suitable to replace a small proportion of the imported granular fill for the West Ruislip Retained Embankment.

Reason not taken forward

5.7.4 The HS2 Technical Standard notes that to meet both the stiffness and compaction requirements, the lower embankment cohesive material are likely to need treatment and specifies that even treated cohesive fill, such as London Clay with excessive plasticity prior to treatment (w_l>65% or I_p>40%), **cannot** be used as HS2 mainline embankment fill.

Reference to meeting where dismissed

5.7.5 This option was discussed at workshop 2 held on 13th February and it was agreed to not progress further.

5.8 Reduce excavated volumes by using steeper cut slopes

Description

5.8.1 The cutting at Copthall is currently based on a safe slope gradient of 1V:4H. The review considered increasing the gradient of the permanent cutting slopes to reduce the volume of excavated material to be removed.

Reason not taken forward

5.8.2 Due to the expected desiccation of the slope surface and HS2 lineside vegetation requirements, shallow slips could be expected on slopes steeper than 1V:4H.

5.8.3 In the long term, strains following excavation stress relief could become excessive and deeper failure may occur.

Reference to meeting where dismissed

5.8.4 This option was discussed at workshop 2 held on 13th February and it was agreed to encourage the ECI contractor to review this following completion of the ground investigation but not to progress it further as part of this study.

5.9 Use of the same HGVs for both import of fill and export of excavated material

Description

5.9.1 To reduce overall traffic movements use the same HGV vehicles for the importation of fill and removal of excavated material.

Reason not taken forward

5.9.2 Contamination of imported engineering fill with variable EM, requiring vehicles to be cleaned between movements.

5.9.3 Source and destination locations for fill and EM will be significantly different, incurring additional travel time and cost.

5.9.4 Contractor entities will likely be different for each operation.

5.10 Change fit-out strategy to provide programme gain for civil works

Description

5.10.1 Review rail systems fit-out works to determine potential time savings to allow a later start of tunnelling for the Northolt West tunnels.

5.10.2 A later tunnel start date would provide more time for construction of the Copthall cutting and intermediate infrastructure, particularly the embankments which require the importation of fill material over a limited time period resulting in a peak number of HGV vehicle movements.

Reason not taken forward

5.10.3 The rail systems fit-out works is already on the critical path, interlinked with numerous other activities within the overall HS2 programme, with no leeway for delay.

Reference to meeting where dismissed

5.10.4 This option was discussed at workshop 3 held on 24th February and at workshop 4 held on 11th March it was agreed to not progress further.

5.11 Shorten the Northolt West tunnel drives to provide programme gain for preceding civils works

Description

5.11.1 Reducing the length of the Northolt West tunnels, driven from the West Ruislip portal, the implication is that the start of tunnelling date could be later allowing more time for time for the preceding civils works (as described in para 5.10.2 above).

Reason not taken forward

5.11.2 Shortening the Northolt West tunnels would result in the Northolt East tunnels becoming longer, increasing their construction period and consequential negative impact to the overall programme.

5.11.3 Changing the relative tunnel drive lengths changes the junction point where the TBMs for both Northolt West and East tunnels would be removed. The alternative shaft locations are unsuitable and locating an additional shaft site would require the acquisition of additional land (outside of the Bill powers) and potentially incur additional cost if Greenpark Way shaft still required.

Reference to meeting where dismissed

5.11.4 This option was discussed at workshop 3 held on 24th February and at workshop 4 held on 11th March it was agreed to not progress further.

6 Measures to reduce vehicles associated with workforce traffic

6.1.1 HS2's Traffic Management Plans will include proposals for transport of construction workforce. Construction workforce travel plans will aim to

encourage the use of sustainable modes of transport such as low emissions shuttle buses to from West Ruislip and / or Ickenham Stations, as shown in Figure 6.1 and Figure 6.2 below. The plans will also include targets to reduce individual car journeys by the construction workforce.

Figure 6.1 Potential mini-bus route from West Ruislip Station

Figure 6.2 Potential mini-bus route from Ickenham Station

6.1.2 Construction workforce travel plans will be prepared by the lead contractors with the aim of encouraging the use of sustainable modes of transport to reduce the impact of workforce travel on local residents and businesses.

6.1.3 The plans will include:

- consideration of the surrounding road network
- key issues to consider for each compound/ construction site or group of sites
- anticipated workforce trip generation and how it may change during the construction process
- travel mitigation measures that will be introduced to reduce the impact of construction workforce on the transport network
- targets to reduce individual car journeys for the construction workers

6.1.4 Travel planning will consider measures to reduce vehicle use such as provision of on-site services, such as catering, to reduce the requirement to travel off site during the working day. Use of public transport and cycling will be encouraged with incentives and schemes such as interest-free loans for cycle purchase.

6.1.5 In addition, the Code of Construction Practice requires HS2 to appoint a travel plan co-ordinator who will act as a single point of contact for stakeholders.

6.1.6 Workforce travel patterns will be surveyed, monitored and reviewed.

7 Conclusions

7.1 HGV reductions from options to be carried forward

7.1.1 These are options which have merit with respect to reducing HGV numbers and could be progressed further during development of the detailed design.

7.1.2 Harvil Road embankment - reuse of excavated material, dependent upon the results of the GI. This could reduce the peak 2-way HGV movements per day by approximately 350 to 400 over a period of approximately 2 months.

7.1.3 Early importation of fill material for Harvil Road would reduce the peak lorry numbers per day by approximately 60 lorries per day or 120 movements (peak 2-way flow), but would be a secondary option to that proposed in 7.1.2 above.

7.1.4 Early importation of fill material for Gatemead and West Ruislip embankments would reduce the peak lorry numbers per day by approximately 70 lorries per day or 140 movements (peak 2-way flow).

7.1.5 Use of excavated material for interval embankment between HS2 and Chiltern Lines. This will reduce the peak 2-way HGV movements per day by approximately 20 over a period of approximately 3 months. This would have to be agreed with Network Rail.

7.1.6 With the agreement of LBH, and Network Rail, excavated material from the West Ruislip portal could be used to form a bund within the 60m railway exclusion zone along the southern boundary of the Ruislip golf course, reducing the number of HGVs by 40 per day or 80 movements (peak 2-way flow). This could be further increased by using additional material for the re-design of the golf course.

7.1.7 The reduction of maximum daily two-way HGV movements from the above measures are summarised in the table Table 7-1 below.

Initiative	Maximum Daily Two-way daily HGV movement reduction
Harvil Road embankment - reuse of excavated material.	350 - 400
Early partial importation of fill material for Gatemead and West Ruislip embankments.	140
Use of Excavated Material for interval embankment.	20

Table 7-1 Reductions in HGV movements

7.1.8 Construction of bridge structures instead of railway embankments – River Pinn to Breakspear Road could potentially reduce HGVs by up to 90 2-way HGV movements per day, dependent on the option chosen. However, some of these options have a considerable cost and a more detailed design and construction study needs to be carried out to understand whether they can be implemented within the programme. As at present these options are predicted to increase the duration of critical path programme items by 1 to 3 months they are not recommended for implementation.

7.1.9 The histogram below (Figure 7.1) indicates the peak number of HGV movements for all lorries in West Ruislip. (A table of the figures behind this histogram can be found in Appendix A). These numbers are based on;

1. Harvil Road embankment - reuse of excavated material (Section 3.1).

2. Early partial importation of fill material for Gatemead and West Ruislip embankments (Section 3.4). Harvil Road option not included as reuse of material is prioritised.
3. Use of EM for interval embankment (Section 3.3).
4. Material from the West Ruislip portal (approx. 60%) used to form a bund within the 60m exclusion zone (Section 3.9).
5. HGV numbers for construction of the Colne Valley viaduct works (from C222).
6. Review of HGV numbers in spring 2022 for construction of the Auto Transformer Feeder Station (ATFS).

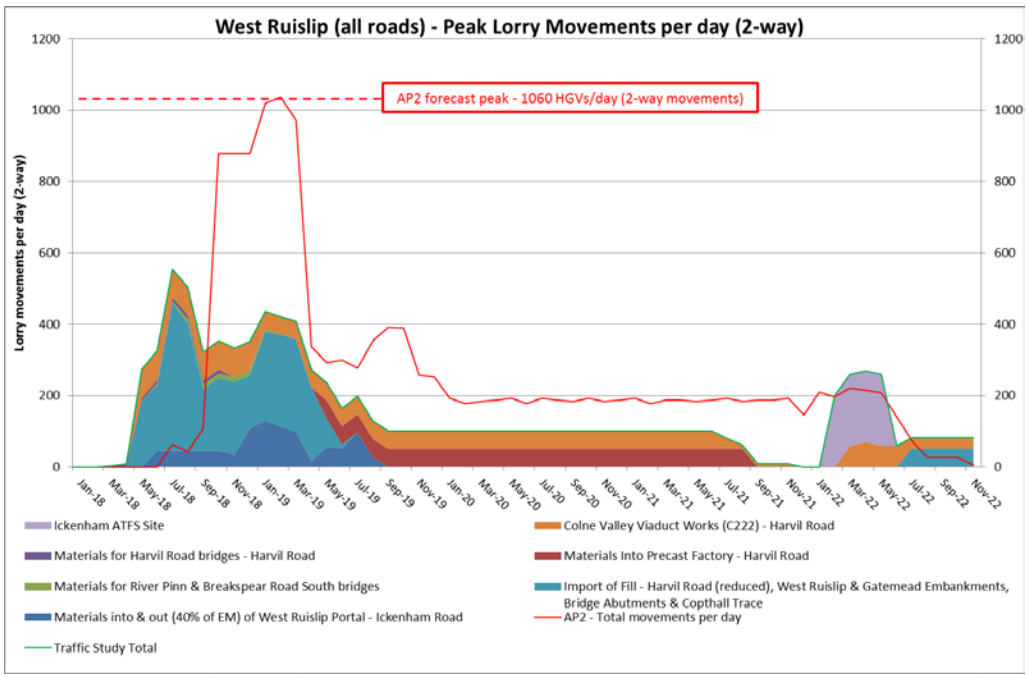

Figure 7.1 Peak lorry movements – West Ruislip (based on AP2 programme)

7.1.10 With careful management of the peak (levelling), it is believed that the peak of 550 movements per day can be maintained.

7.2 Reductions in Sustainable Placement

7.2.1 The options considered indicate the following potential reductions in volumes of excavated material going to sustainable placement;

Section	Option	Potential Reduction in volume SP
3.1	Re-use of excavated material from Copthall Cutting to construct Harvil Road Embankments	74,000m^3
3.2	Construction of bridge structures instead of railway embankments – River Pinn to Breakspear Road	Up to 16,000 m^3 dependent on option selected
3.3	Use of excavated material for interval embankment between HS2 and Chiltern Lines	11,000 m^3
3.6	Early Construction of Initial West Ruislip Railhead Siding	12,000 to 15,000m^3 per month
3.8	Use of material to reinstate southern holes of Uxbridge Golf Course	135,000 m^3

7.2.2 By implementation of these options sustainable placement could be reduced from 370,000m^3 to less than 150,000m^3 at the Harvil Road / Breakspear Road Triangle. Early implementation of a siding at West Ruislip Railhead and/or a greater number of train paths than previously assumed would enable sustainable placement to be further reduced.

7.3 Cost and programme implications

7.3.1 **Use of EM for Harvil Road embankment**. Depending on the extent of treatment required the period for construction of the road may be marginally extended, but would not impact the critical path for tunnelling or rail systems. The costs would be comparable to the importation of fill.

7.3.2 **Viaduct replacement for embankment options**. All the options to replace embankments with viaducts or extended bridges take longer to construct, by up to 3 months and incur additional costs, due to the increased engineering, piling and concrete structures. Completion of these structures is key to providing the logistics support route to the tunnel portal, delay will impact the start of tunnelling which is on the critical path.

7.3.3 **Use of EM for interval embankment between HS2 and Chiltern Lines**. The programme and cost implications are likely to be minimal.

7.3.4 **Commence importation of material earlier in the programme**. This is possible without impacting critical path items, but there would be some additional cost associated with double handling of material, although not considered significant against the overall estimate.

7.3.5 **Retention of Railway 'Up-Sidings' at Ickenham Road for importation of fill**. Some additional costs would be incurred associated the plant and infrastructure required for transferring the material from the sidings to temporary storage and on to permanent placement. There would be no programme impact.

7.3.6 **Early Construction of Initial West Ruislip Railhead Siding**. Additional costs would be incurred for either importation of fill or export of EM due to double or triple handling of material. The option is dependent on early implementation in the programme to maximise benefit.

7.3.7 **Construction of West Ruislip Railhead Siding and Railhead with eastern rail connection west of Breakspear Road South**. This proposal would not benefit the programme, but rather complicate the logistics support by introducing additional lorry movements and incur additional costs.

7.3.8 **Use of material to reinstate southern holes at Uxbridge Golf Course**. Potential additional costs related to transport and unloading/placement, no programme implications.

7.3.9 **Use of material in the reconstruction of Ruislip Golf Course and to create a bund**. No programme impact.

7.3.10 **Relocation of segment factory from Harvil Road to an independent site**. Potential cost and programme risks associated with delay to establishing facility, resulting from additional time to find a suitable location, negotiation of use and planning permission. This could result in insufficient stock cast prior to the start of tunnelling and subsequent impact on the overall programme.

7.4 Further Work

7.4.1 Subject to the agreement of HS2 and LBH further work would need to be undertaken to conclude the practicality and benefit of the following;

- GI and tests for use of EM for Harvil Road embankment
- Construction of bridge structures beside the River Pinn
- Early siding at West Ruislip railhead

- Use of existing West Ruislip Up-siding
- Use of EM at Uxbridge and Ruislip golf courses

Appendix A

The tabulation below shows the peak number of HGV movements for all lorries in West Ruislip, used to generate the histograms in Section 7.1.9, Figure 7.1.

	Dec-17	Jan-18	Feb-18	Mar-18	Apr-18	May-18	Jun-18	Jul-18	Aug-18	Sep-18	Oct-18	Nov-18	Dec-18	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Sep-20	Oct-20	Nov-20	Dec-20
Ickenham ATFS Site																																					
Colne Valley Viaduct Works (C222) - Harvil Road	0	0	0	0	0	80	80	80	80	80	80	80	80	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Materials for Harvil Road bridges - Harvil Road	0	0	0	3	9	9	9	11	11	11	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Materials Into Precast Factory - Harvil Road	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	51	51	51	51	51	51	51	51	51	51	51	51	51	51	51	51	51	51	51
Materials for River Pinn & Breakspear Road South bridges	0	0	0	0	0	0	6	6	13	13	13	14	14	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Import of Fill - Harvil Road (reduced), West Ruislip & Gatemead Embankments, Bridge Abutments & Copthall Trace	0	0	0	0	0	184	184	413	355	173	204	204	150	248	258	258	206	79	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Materials into & out (40% of EM) of West Ruislip Portal - Ickenham Road	0	0	0	0	0	0	46	46	46	46	46	34	107	131	113	100	18	56	53	97	27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Traffic Study Total	0	0	0	3	9	273	325	555	505	323	354	333	351	436	422	408	274	236	164	198	128	101	101	101	101	101	101	101	101	101	101	101	101	101	101	101
AP2 - Total movements per day	0	0	0	0	0	0	0	64	43	109	879	879	879	1019	1036	972	337	292	300	276	354	391	390	258	253	193	178	183	188	193	178	193	188	183	193	183	188

	Jan-21	Feb-21	Mar-21	Apr-21	May-21	Jun-21	Jul-21	Aug-21	Sep-21	Oct-21	Nov-21	Dec-21	Jan-22	Feb-22	Mar-22	Apr-22	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22
Ickenham ATFS Site														199	199	199	199						
Colne Valley Viaduct Works (C222) - Harvil Road	50	50	50	50	50	50	30	10	10	10	10	0	0	0	60	70	60	60	30	30	30	30	30
Materials for Harvil Road bridges - Harvil Road	0	0	0	0	0	0	0	0	0	0	0												
Materials Into Precast Factory - Harvil Road	51	51	51	51	51	51	51	51	0	0	0												
Materials for River Pinn & Breakspear Road South bridges	0	0	0	0	0	0	0	0	0	0	0												
Import of Fill - Harvil Road (reduced), West Ruislip & Gatemead Embankments, Bridge Abutments & Copthall Trace	0	0	0	0	0	0	0	0	0	0	0	0	0					0	52	52	52	52	52
Materials into & out (40% of EM) of West Ruislip Portal - Ickenham Road	0	0	0	0	0	0	0	0	0	0	0												
Traffic Study Total	101	101	101	101	101	101	81	61	10	10	10	0	0	199	259	269	259	60	82	82	82	82	82
AP2 - Total movements per day	193	178	188	188	183	188	193	183	188	188	193	147	209	197	221	215	208	140	73	27	27	26	6