The Hampstead Road Bridge Study Report - Minimising the Proposed Height Increase

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1 Executive Summary

1.1.1 This report was provided to the Euston Integrated Programme Board (EIPB) in partial fulfilment of an assurance given by High Speed Two Limited (HS2 Ltd.) to Transport for London (TfL) during the House of Commons Select Committee stage of the Hybrid Bill (hB) relating to the minimising the increase in heights and narrowing of A400 Hampstead Road Bridge (HRB). The report brings together the technical material discussed and developed through multiple workshops. It is intended to provide technical information on alternative bridge options and also provide details of the preferred HS2 Ltd. option.

1.1.2 As per the assurance offered, the study has sought to identify options to minimise the increase in height of the road levels of A400 Hampstead Road due to the HS2 works at either end of Hampstead Road Bridge. In addition to this principal aim, the study also examines provision of a revised carriageway configuration as proposed by TfL.

1.1.3 Representatives from HS2 Ltd., Network Rail (NR), Department for Transport (DfT), TfL and LBC have attended five collaborative workshops organised by HS2 Ltd. in order to ensure that the stakeholders are involved in the options comparison and decision making process. These workshops have been minuted by Arup, with minutes and notes circulated to stakeholders.

1.1.4 The first workshops focused on determining the assumptions and requirements to be addressed. These define the study boundaries and highlight the importance of community impact, during construction, after completion of the High Speed (HS) station and for the potential B2 (NR) station works stage, as well as in the longer term.

1.1.5 The other workshops were sift workshops where the options were presented, including confirmation of their technical feasibility, and assessment of their impact on the requirements and sift criteria. The options were then compared to the Hybrid Bill (hB) September 2015 design as a baseline scheme.

1.1.6 In this report, the minimisation of the height increase is therefore referred to as 'lowering' of the road levels in comparison to the hB September 2015 scheme which raises the current levels of A400 Hampstead Road between 3.5m and 4.5m at either end of HRB compared with existing levels.

1.1.7 This report lists, and briefly describes, the options considered at the first sift (8 options and additional sub-options). The options taken forward following the first sift are described more extensively, including the main benefits and disadvantages they present relative to the hB September 2015 scheme. Following initial sifts, 4 options were retained:

- Option 1: Provision of a 3 span weathering steel plate girder and reinforced concrete slab concrete bridge in an alternative alignment to the hB September 2015 proposal, enabling the existing NR bridge to be retained during construction;
- Option 5a-5: Provision of 2 no. adjacent 3 span half-through box girder bridges each

carrying a carriageway, cycle lane and footway in each direction along the hB September 2015 alignment;

- Option 7: Keeping the existing HRB above the NR tracks and providing an extension of it over the HS tracks. Two sub-options are retained for this scheme: one that proposes a 2 span arched bridge over HR tracks and one that proposes a 5 span weathering steel plate girder and reinforced concrete slab concrete bridge over HS tracks;
- Option 8: Provision of a 3 span weathering steel plate girder and reinforced concrete slab concrete bridge as proposed at hB September 2015, but using optimised solutions such as higher steel grade to achieve a reduced height increase of the bridge.

1.1.8 A summary table comparing these 4 no. options is included in section 6.

1.1.9 The Euston Integrated Programme Board (EIPB) discussed a high level summary of options at their meeting on 19 May 2016. This meeting requested a high level strategic meeting between HS2 Ltd., TfL, and LBC going forward. This meeting took place on 25 May 2016 and concluded that options 1 and 8 should be assessed further. Since this meeting a further workshop has taken place on these options and the considerations are reflected in this report.

1.1.10 Based on this further work and on information available in this study, the preferred HS2 Ltd. option is to proceed with option 8 – an optimised Hybrid Bill Sept 2015 solution which reduces the height increase by 0.5-1m. HS2 Ltd. are content to provide commitments to this effect immediately. Upon agreement of those involved in this study, and following the sharing of this report with the Promoter, HS2 Ltd. propose to share this report and our preferred option with the public at the earliest opportunity.

1.1.11 In response to the HS2 position regarding its preferred option 8, TfL and LBC have provided the following statement: "TfL and LB Camden note that Option 8 is HS2's current preferred option for the Hampstead Road Bridge. TfL and LB Camden's position is that further work on the options should be carried out before any final decision is taken including undertaking engagement with residents. Further work is needed to better understand the suggested benefits or disbenefits of the options prior to any decision being made, and the impact on the outcomes of the other studies being undertaken. Network rail has provided the following statement "Further work is still required on the other options before a decision could be made. The potential benefits of Option 7 that could reduce the immediate impact on the conventional railway and significantly reduce the level of possessions required to undertake the work to HRB are of significant interest to NR. We accept that all of these benefits are unproven and the potential disbenefits of Option 7 to the redevelopment of the conventional station need to be explored."

2 Introduction

2.1.1 The aim of this study is to identify the options that would achieve lower road levels at either end of the re-provided HRB in order to reduce the impact on local residents and neighbouring buildings as well as on non-motorised users (NMU) of A400 Hampstead Road.

2.1.2 This partially discharges assurances made to TfL and LBC during the House of Commons Select Committee Stage of the HS2 hybrid Bill (hB) in December 2015.

2.1.3 Representatives of High Speed Two Limited (HS2 Ltd.), Network Rail (NR), Department for Transport (DfT), Transport for London (TfL) and London Borough of Camden (LBC) have attended five collaborative workshops in order to ensure stakeholders have an input into the options comparison and decision making process

Assurances made by HS2 as part of the Select Committee process

2.1.4 The Petition Assurance Letter to TfL (dated 7 December 2015) stated the following:

The promoter will require the Nominated Undertaker to design the replacement Hampstead Road Bridge with 4 vehicular lanes plus segregated cycle lanes and pedestrian walkways.

The promoter will require the Nominated Undertaker to engage actively with the GLA, TfL and Network Rail to carry out a study ("the HR Bridge study") to assess proposals for minimising the height increase of the Hampstead Road Bridge as a result of the HS2 works

Upon completion, the HR Bridge study will then be submitted to the EIPB for comment. This will be no later than May 2016.

The Promoter will require the Nominated Undertaker to use reasonable endeavours to incorporate the comments of the EIPB in the final HR Bridge study.

The final HR Bridge study will then be submitted to the Promoter for his consideration. The Promoter will then notify the EIPB of his decision in regards to the implementation of the proposals contained within the plan, no later than one month from the date of the plan's submission

In the light of the Promoter's decision, if the GLA and TfL consider that the discharge of their statutory functions requires them to petition in the House of Lords, the Promoter will ensure that this does not affect their membership of the EIPB or ESSRB.

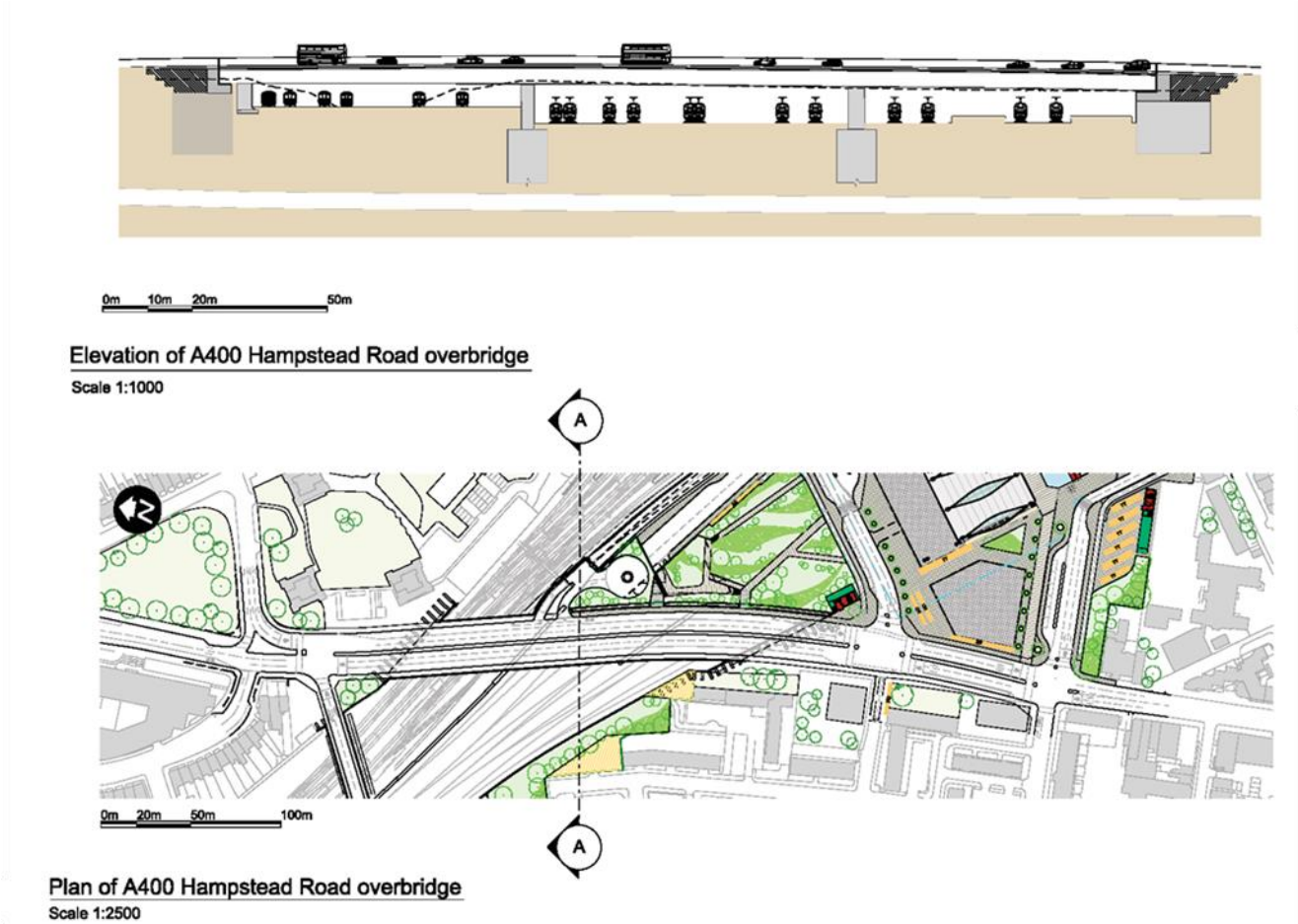
3 Existing Scheme

3.1.1 The proposed HRB is required due to the HS rail corridor increasing the width of the cutting, which the existing HRB currently spans.

3.1.2 The proposed hB September 2015 scheme is a 3 span steel plate girder with composite concrete deck. It crosses the conventional rail corridor in a single span and the new HS rail corridor in 2 spans.

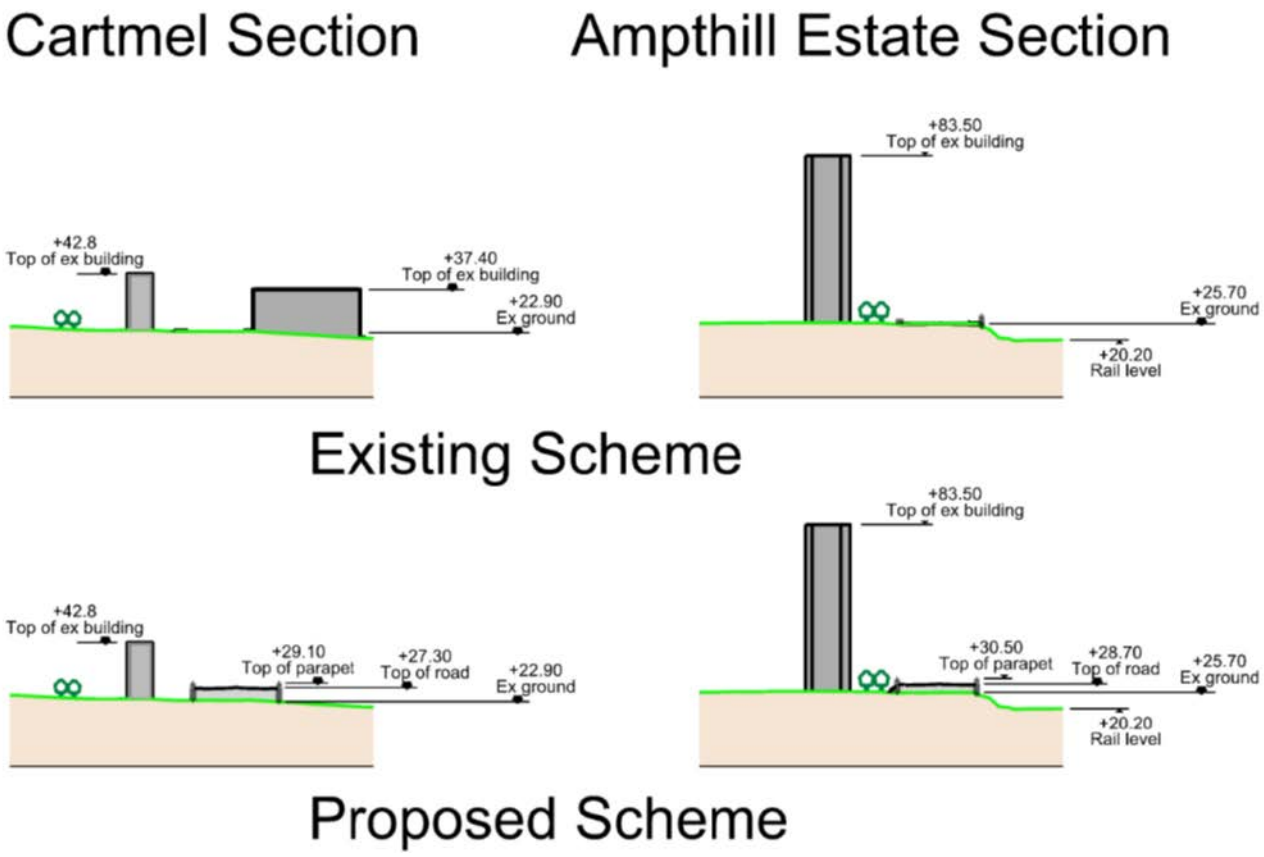
3.1.3 Due to NR and HS2 Ltd clearances, as well as their track arrangement and length of proposed spans, the proposed hB scheme results in a significant increase of A400 Hampstead Road levels at either end of the bridge (4.7m increase in road level at Cartmel and 2.9m increase in road level at Ampthill Estate).

Figure 1: Elevation and plan of hB September 20156 Scheme



3.1.4 This has an adverse impact on the residents of Cartmel and Ampthill Estate especially at Ground Floor level as shown in the figure below.

Figure 2: Existing vs proposed road levels and building levels



3.1.5 The alternative options put forward aim to reduce this increase, but may not present all other benefits that the hB September 2015 scheme does such as:

- Full pedestrian connectivity from Euston Station onto HRB and along A400 Hampstead Road (including the bus stop on HRB) as shown in Figure 3;
- Permeability and low visual impact while on A400 Hampstead Road as shown in the photomontages of Figure 4;
- Keeping A400 Hampstead Road operational throughout construction.

Figure 3: Pedestrian connectivity of hB September 2015 scheme

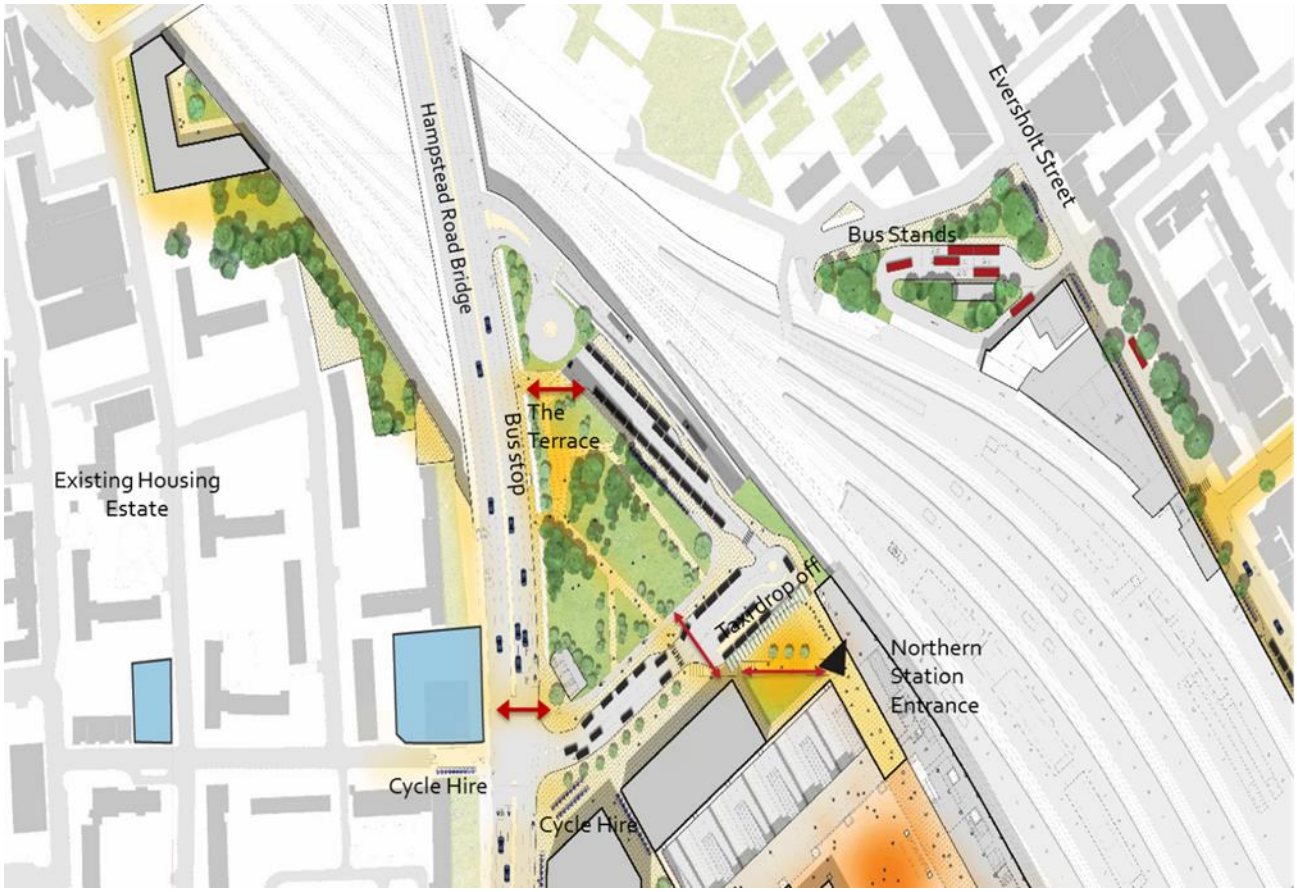


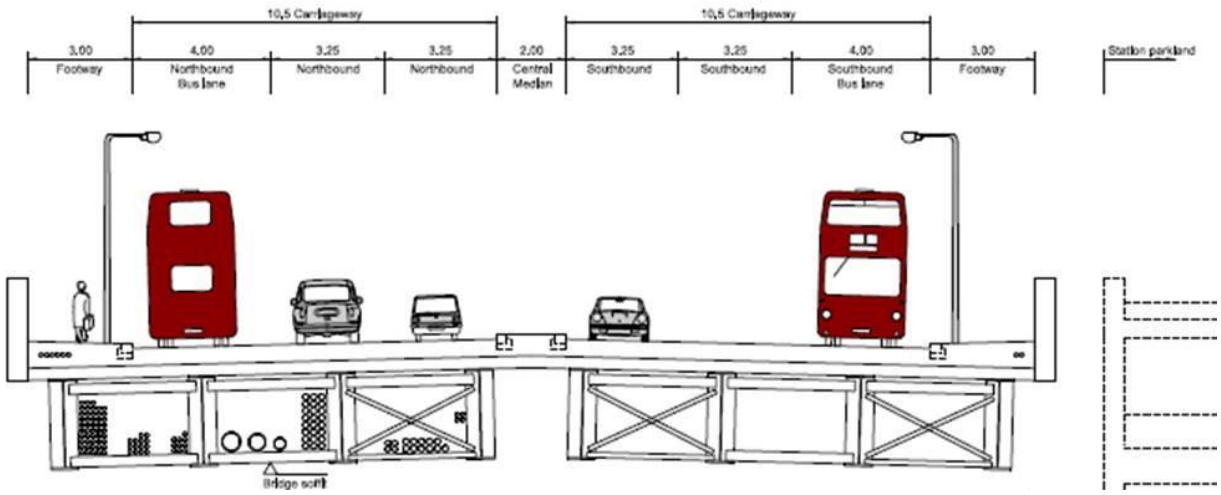
Figure 4: Photomontages showing visual impact of hB September 2015 scheme

3.1.6 The proposed hybrid Bill September 2015 scheme carries in each direction:

- 1 no. 3m wide pedestrian footway;
- 1 no. 4m wide bus and cycle lane; and
- 2 no. 3.25m wide general traffic lanes

3.1.7 The three lane dual carriageway includes a 2m wide central median.

Figure 5: hB September 2015 proposed lane layout



3.1.8 Following the hB submission, TfL have modified their requirements for A400 Hampstead Road to include in each direction:

- 1 no. 3m wide pedestrian footway;
- 1 no. 2.5m wide segregated cycle lane (including 0.5m separator from bus lane);
- 1 no. 3m wide bus lane; and
- 1 no. 3.25m wide general traffic lane.

3.1.9 The dual carriageway includes a 2m wide central median.

3.1.10 This layout reduces the width of the bridge in between parapet faces from 29m to 25.5m. It is noted that the arrangement is defined by TfL, but the widths are assumptions based on good practice and subject to confirmation from TfL.

3.1.11 This width reduction gives the modified requirement for the final bridge configuration. However, it does not enable a minimum operational width during construction. Achieving a minimum operational width during construction will lead to a wider permanent bridge arrangement. Refer to section 4.4.

4 Assumptions, Requirements and Constraints

4.1 Introduction

4.1.1 During the initial workshops, on the 10th and 18th of March 2016, the requirements that need to be fulfilled by the proposed options, as well as the assumptions to be made and the constraints to be considered, were discussed and agreed with stakeholders. Refer to Appendix I for sift workshop minutes.

4.2 Requirements

4.2.1 The requirements discussed and agreed with stakeholders are not fundamentally different from those of HRB at hB. The HRB alternative option must:

1. Incorporate TfL requirement for reduced and narrower bridge. TfL to confirm agreed width of traffic lanes, cycle ways and footway for this. Most options can accommodate a narrower carriageway without changing the option rationale (additional requirement from assurance);
2. Not constrain future station development or construction (hB requirement);
3. Must provide minimum clearances with future-proofing and TSI requirements: 6.5m clearance for HS2 and 5.3m clearance for NR. The 6.5m clearance for HS2 tracks results from a derogation from HS2 standards as per C220-ARP-SA-RFI-000-000219 P01 (hB requirement);
4. Be constructible above LUL Northern Line without LUL blockades (hB requirement);
5. Provide for hB September 2015 proposed utilities crossing both railways (includes reinforcement for OSD and utilities on NR cable gantry) (hB requirement);
6. Provide continuity of operation of utilities throughout construction (hB requirement);
7. Provide continuity of operation of conventional rail without full closures beyond agreed engineering hours, possessions and blockades (hB requirement);
8. Provide continuity of operation of A400 Hampstead Road without full closures beyond those agreed in the Environmental Statement (ES). All closures to be confirmed by TfL and LBC before proceeding (hB requirement);

9. Provide for an access ramp to HS station basement in stage B1 (not necessarily from HRB) (hB requirement);
10. Acknowledge new HS track plan (hB requirement);
11. Permit retention/replacement of GTB. Aspiration and consideration in comparing the schemes for early replacement of GTB for construction vehicles to be led away from residential areas (hB requirement);
12. Carry highways loading and impact railway loading. Abnormal load limit needs to be met for future-proofing. (Existing NR bridge may not withstand abnormal loading) (hB requirement);
13. Be safe for pedestrians and other road users in both permanent and temporary states (hB requirement);
14. Minimise disruption for pedestrian access especially from the Ampthill Estate entrance. Aspiration for access to be continued for pedestrians down HRB (hB requirement);
15. Align with the Euston Area Plan (EAP) (hB requirement); and
16. Minimise impact on local residents and residential properties (hB requirement).

4.2.2 In addition to the above requirements, the quantity and quality of the northern open space are to be considered.

4.3 Assumptions

4.3.1 Although the aim of this study is to test several options by reducing the constraints on the bridge design in order to achieve road level reductions at either end of the bridge, the assumptions below were agreed with stakeholders:

1. The levels used are extracted from the 3D topographical survey. Level reductions will be expressed comparatively to the hB September 2015 baseline scheme. Absolute levels are subject to survey accuracy;
2. NR and HS proposed track alignments are fixed both in plan and elevation;
3. HS Euston Station platforms and fire escape are fixed; and
4. Additional loading or partial works to the existing NR HRB bridge (such as changes to road build-up, drainage or parapets) are to be avoided

4.4 Constraints

Junction with the northern HS station taxi rank

4.4.1 It should be noted that a road level rise (approx. 1.5m minimum) at the south of HRB is necessary to meet the junction that serves the northern taxi rank.

4.4.2 The level of the taxi rank is driven by the station clearance to the HS tracks below which results in a road surface level of approximately +25.0m OD.

4.4.3 In order to respect maximum gradients and achieve the required vertical curvature, the minimum level of the road surface level at the junction between A400 Hampstead Road and the taxi junction is approximately +24.80m OD.

4.4.4 As a result, the steepest gradients along the alignment of A400 Hampstead Road are independent from the final road level at the abutment location. The main driver for these levels is not the levels of A400 Hampstead Road either end of HRB but the level of the tie-in with Granby Terrace at the North as shown in Figure 6 and the northern taxi rank junction at the South as described above and shown in Figure 7. Figures 6 and 7 are extracts from highways drawings.

4.4.5 The level at the tie-in with Granby Terrace is governed by the road level of Granby Terrace Bridge. Additional studies will be required to confirm whether this level could be lowered but the currently proposed structural form of an arch gives a slender structural depth which is required to give sufficient clearances to NR with a road level which is compatible with Hampstead Road and does not cause the road level to rise.

4.4.6 The level at the tie-in with the taxi rank junction is governed by the clearance to HS tracks and structural depth of slab. This cannot be lowered while fulfilling the assumptions listed in section 4.3.

Figure 6: Alignment constraints of North approach to HRB

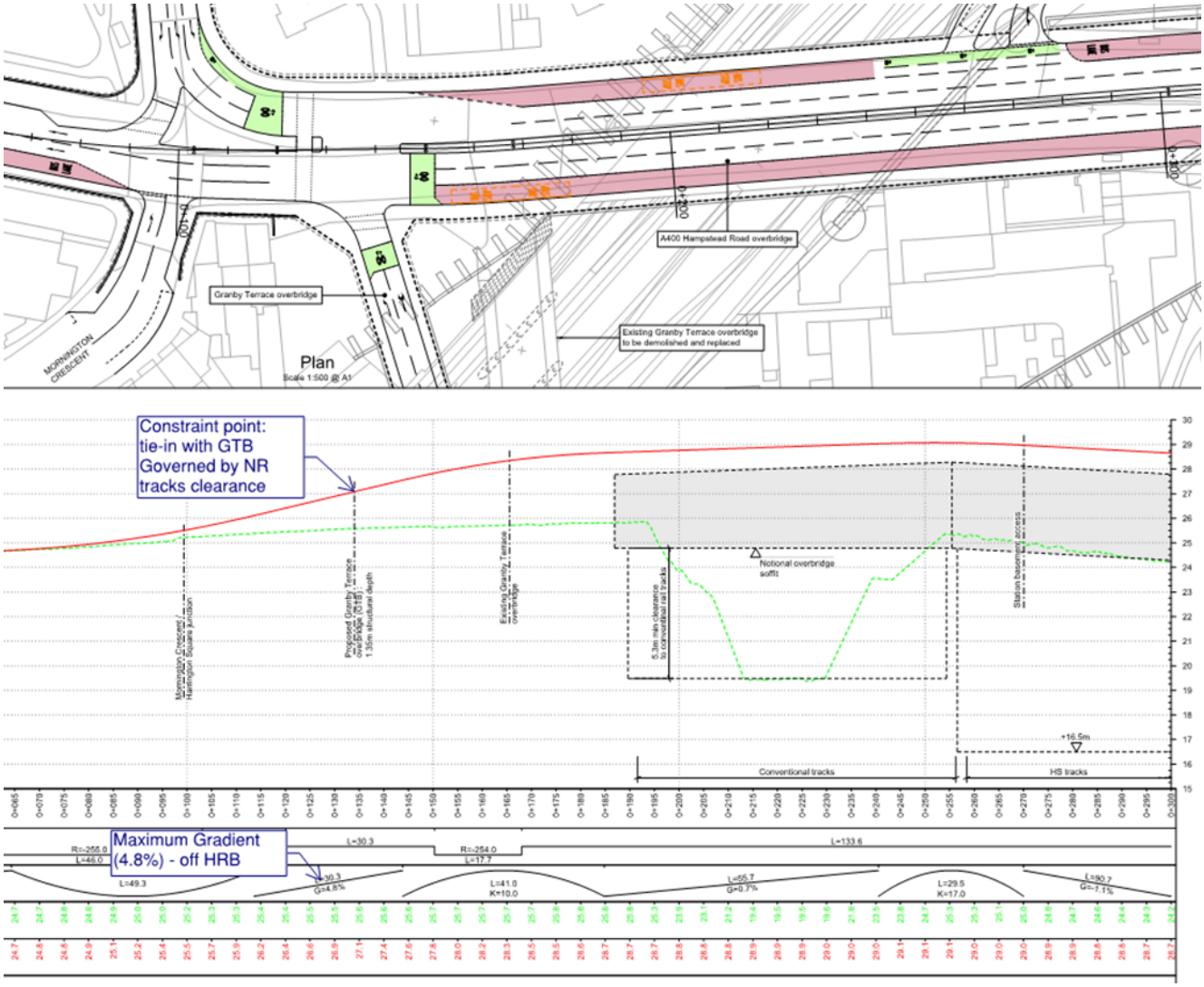
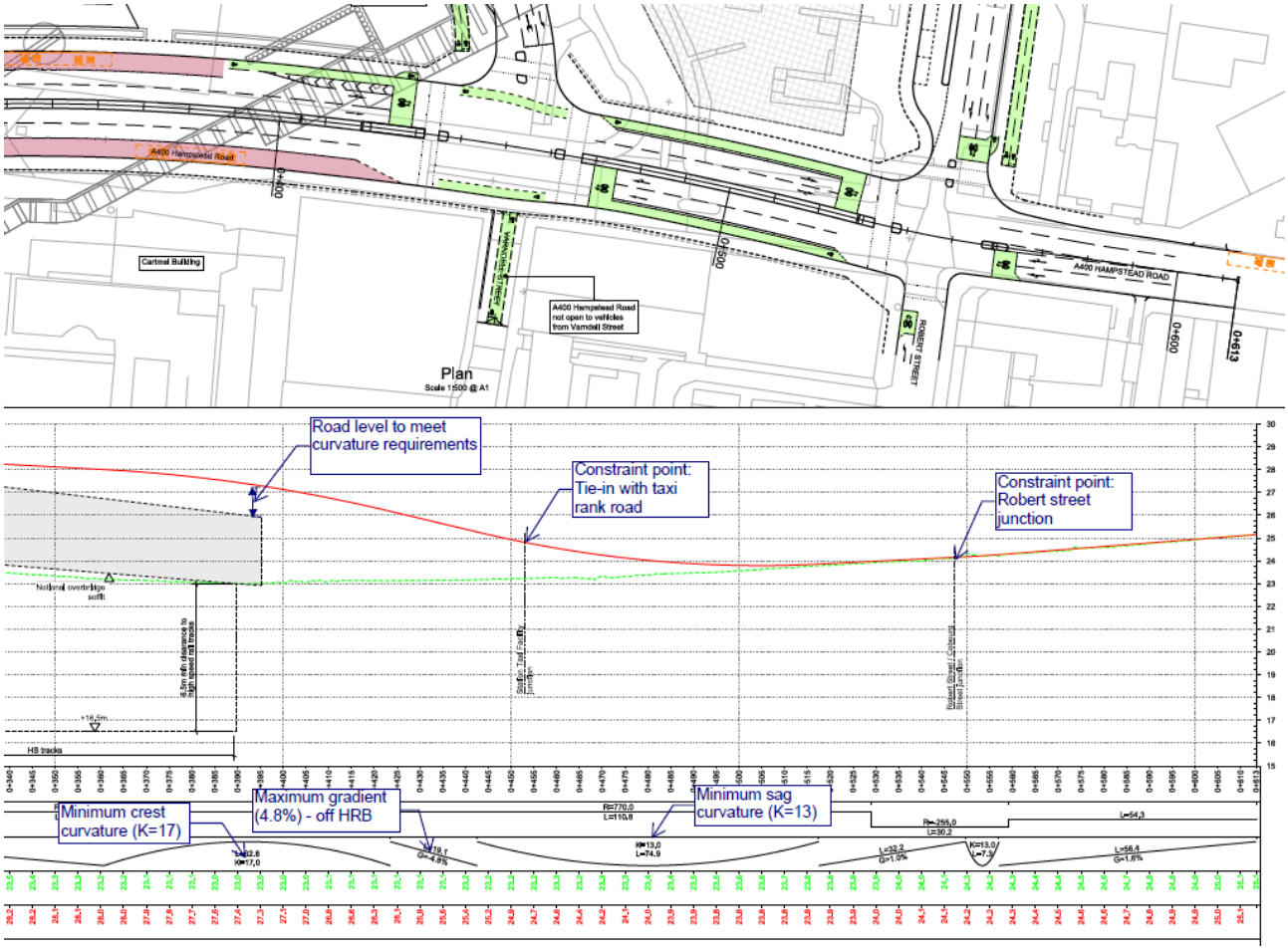


Figure 7: Alignment constraints of South approach to HRB



4.4.7 It should be noted that the current hB September 2015 scheme, as well as the options proposed in this study, are all within the maximum gradient for cyclists of 5% as stated in the *London Cycling Design Standards 2014. Section 7.1.3:*

'For cycle tracks, a maximum gradient of 3 per cent is recommended but this can rise to 5 per cent over a distance of up to 100 metres. Where it is unavoidable, a gradient of up to 7 per cent over a distance of no more than 30 metres is acceptable.'

4.4.8 A gradient of 4.8% is only proposed over a length of 30m at the Northern approach to HRB and over a length of 19m at the Southern approach to HRB. The effective gradient over 250m from Robert Street to Cartmel is approximately 2.5%

4.4.9 This is also compliant with the Design Manual for Roads and Bridges (DMRB).

Open Space

4.4.10 The lowering of HRB has a direct impact on the provision of both open space and train operating company (TOC) parking to the north of the station.

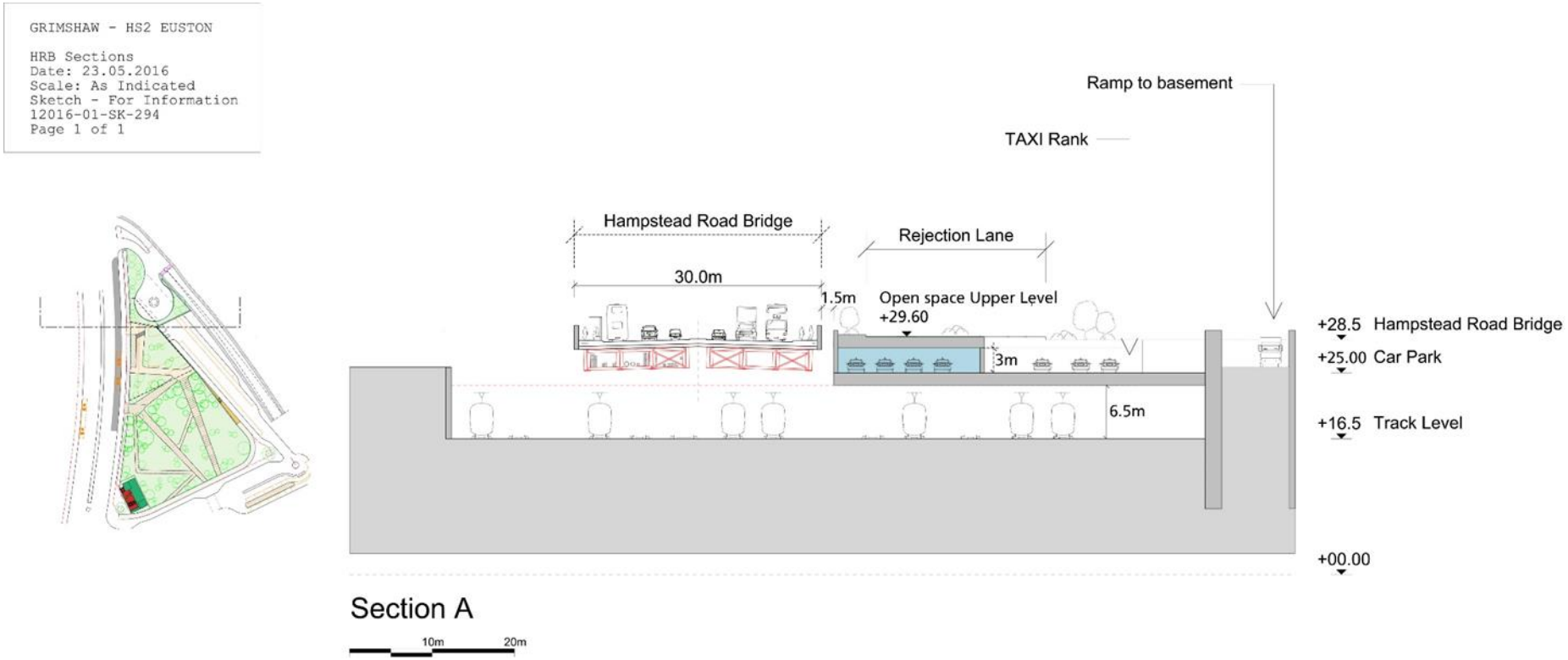
4.4.11 This was discussed during the sift workshops when TfL and LBC have challenged whether the TOC parking can be moved elsewhere or the open space rearranged and redesigned to fit in with the lowering of the bridge. This design element will need to be reassessed and considered further as part of the wider HS Euston Station design as noted in section 7.

4.4.12 The current layout allows for a 2 level arrangement with the TOC parking and taxi rank being at the lower level (+25mOD) and the top level (+29.6mOD) being used as an open space and in part for the ramp rejection turnaround. The open space is proposed to be landscaped and contoured to allow a pedestrian route across this area.

4.4.13 The levels are governed by a clearance to HS tracks of 6.5m, the required structural depth of the reinforced concrete slab, a minimum clearance of 2.8m in the TOC parking which allows for a standard maintenance vehicle to access and an extra 0.2m to allow for services attached to the soffit of the parking area.

4.4.14 Above this is the structural slab and landscape finishes which bring the upper level to +29.60m OD. Stepped access brings this down to +28.50m OD where it connects to HRB as shown in the section below.

Figure 8: Section through open space and relative levels



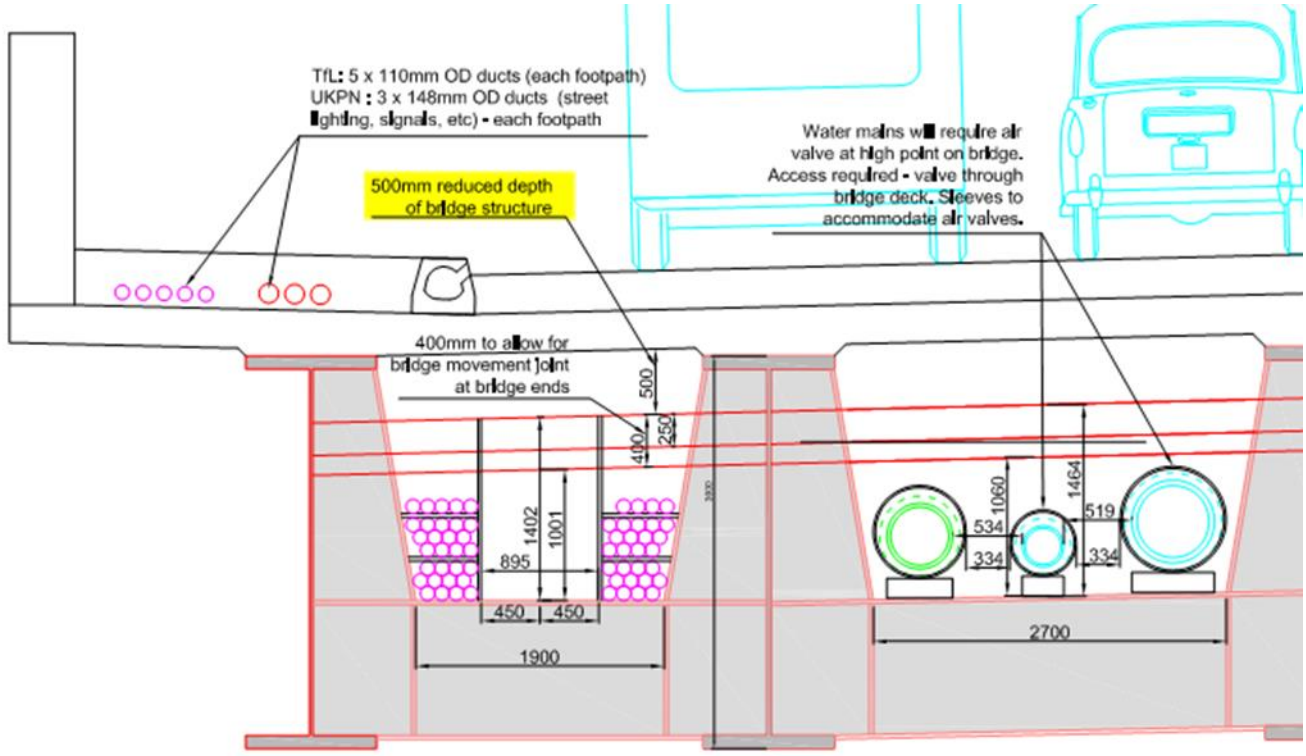
4.4.15 Any bridge lowering from the hB September 2015 scheme would therefore preclude a dual level in this location if a connection is required between the finished level of HRB and the level of the open space as currently proposed. Any bridge lowering would also require the readjustments of the taxi rank and ramp areas.

Relationship between lowering and utilities

4.4.16 In the current scheme, the utilities are positioned in between the weathering steel girders. The current girder depth allows the utilities to fit in this space and also allows for utilities inspection as required by utilities companies.

4.4.17 Any bridge lowering from the hB September 2015 scheme in excess of 0.8m to 1m would no longer allow for the above and would therefore either have to adopt a different structural form (to be able to fit the utilities in HRB) or provide an alternative permanent utilities crossing. It is to be noted the values of 0.8m to 1m assume the transverse stiffeners can be optimised from being 1m deep to 700 or 500mm deep. Indeed, any bridge lowering from the hB September 2015 scheme in excess of 0.5m assumes a reduction in the depth of the transverse stiffeners.

Figure 9: Minimum space for utilities



4.4.18 Apart from the size of utilities and the geometrical constraint developed above, consideration is to be given to the utilities maintenance, as well as access for structural inspection of the bridge super structure whereby every surface should be both visible and within reach.

4.4.19 The water mains will require air valves along the bridge at high points, as with a lowered bridge design, the water mains will have to follow the curvature of the bridge creating high points which is a change from the AP03 design. These air valves will need to be extended through the bridge deck to the road surface.

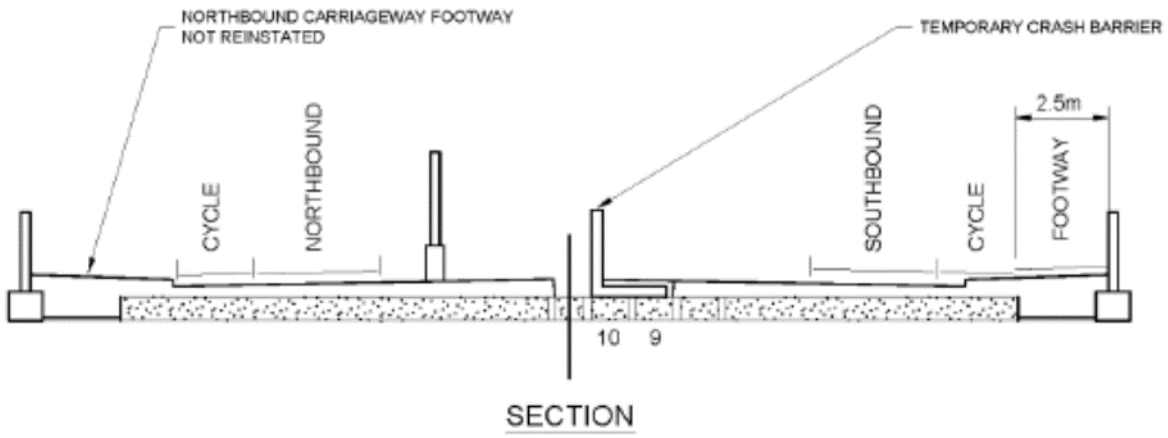
4.4.20 Refer to Appendix B for further sketches of this constraint.

4.4.21 It should be noted that for all bridge options considered within this report (with the exception of Option 8), the alignments and configurations of each utility diversion route, whether temporary or permanent, will need to be reviewed in detail and redesigned. This will require new consultations with each of the utility companies affected to enable them to reassess the impact on the resilience of their networks and prepare revised network designs accordingly.

Relationship between narrowing and phased construction

4.4.22 The current hB September 2015 proposal allows for A400 Hampstead Road to remain operational by opting for a staged construction whereby one half of the bridge is constructed, while the other half carries traffic as shown in the following figure:

Figure 10: Step 1: split the existing bridge and install temporary crash barrier



(phased utilities diversions onto temporary utility bridges)

Figure 11: Step 2: move traffic onto existing southbound half and demolish northbound bridge

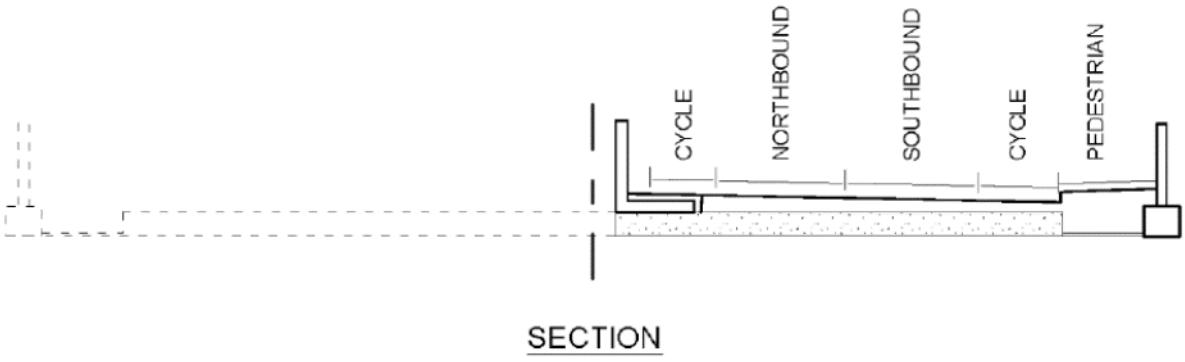


Figure 12: Step 3: construct new northbound bridge, move traffic onto it and demolish existing southbound bridge

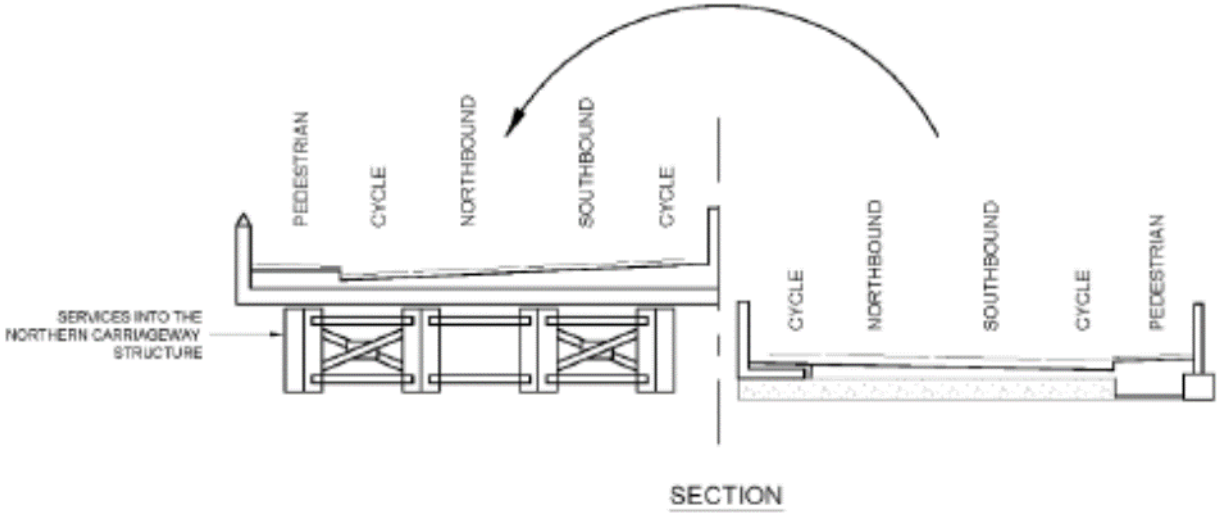
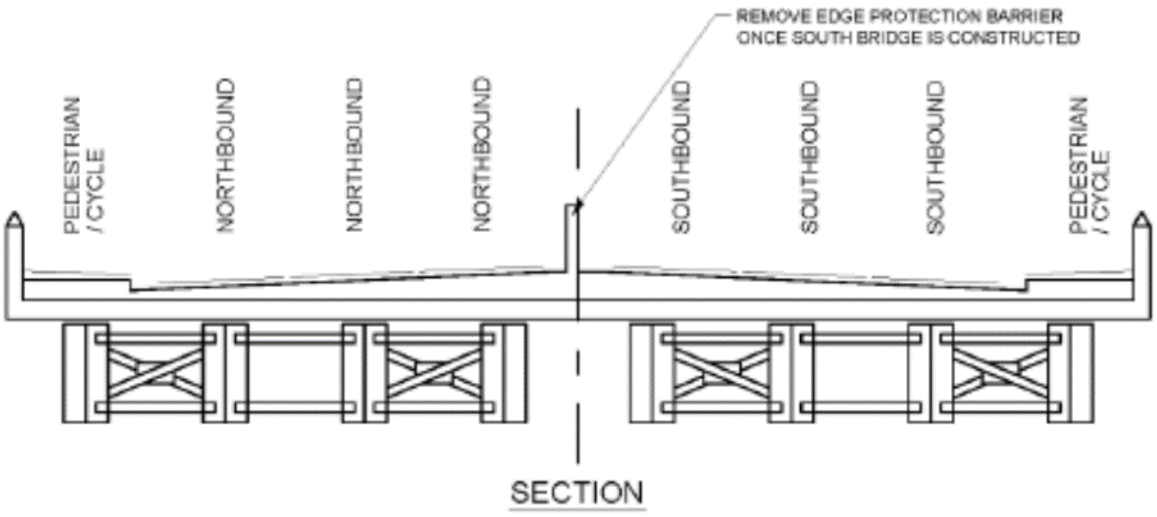


Figure 13: Step 4: construct new southbound bridge and open new HRB to traffic



4.4.23 This is enabled by the bridge being wide enough to carry a TfL approved minimum carriage way (14.5m) on half its width. However, it should be noted that the location of the construction joint in the existing bridge constrains this sequence and available width. This location is subject to confirmation by survey.

4.4.24 This final arrangement is the hB lane configuration so will easily accommodate the TfL revised criteria with adjustments to footways and central reserves.

4.4.25 Narrowing the bridge to comply with the assurance (total width of 25.5m which is smaller than twice the minimum operational width of 14.5m) would preclude the bridge being built in stages while keeping A400 Hampstead Road open and would therefore require longer closures to A400 Hampstead Road for any option chosen.

4.4.26 In addition to the above, narrowing the bridge would require modification of the weathering steel girders spacing which would result either in an asymmetrical bridge or in reduced space between girders for the utilities to fit in the northbound carriageway alone. Further consideration is to be given to the relative importance of these two aspects should the bridge be narrowed.

5 Options Selection

5.1 Options considered at first sift of options

5.1.1 At the first sift workshops on the 4th and 18th of April 2016, 8 no. options and additional sub-options were considered and presented with their main characteristics including benefits and disadvantages in particular in terms of road levels at either end of HRB in comparison to the baseline hB September 2015 scheme. This enabled stakeholders to select the options to explore further and confirm their priorities

5.1.2 Some of these options cover the full length of the proposed HRB (Options 1, 2, 3 and 8) and some split the challenge into two, separately looking at options to span the NR tracks and spanning the HS tracks with several possible combinations.

- Option 1: Realignment of A400 Hampstead Road hence HRB approximately 15m further away from Euston Station;
- Option 2 (**PARKED at 1ST SIFT**): Tunnelled option for A400 Hampstead Road;
- Option 3 (**PARKED at 1ST SIFT**): Demolish and not replace HRB. Permanent use of alternative routes for traffic and utilities crossings;
- Option 4 (**PARKED at 1ST SIFT**): Transverse arched support to HRB;
- Option 5: Realign top extension to B1 ramp and connection to HRB and provide edge support to HRB which enables the following structural schemes:
  - Option 5a: Half-through bridge;
  - Option 5b (**PARKED at 1ST SIFT**): Cable-stayed bridge;
  - Option 5c (**PARKED at 1ST SIFT**): Arch bridge over NR and half-through bridge over HS;
  - Option 5d (**PARKED at 1ST SIFT**): Arch bridge over NR and plate girder bridge over HS; and
  - Option 5e (**PARKED at 1ST SIFT**): 3 span arch bridge.
- Option 6: Additional piers and shorter spans:
  - Option 6a (**PARKED at 2nd SIFT**): Additional piers in NR throat (and a variant reusing existing piers and/or foundations but re-decking);
  - Option 6b: Additional piers in HS throat; and
  - Option 6c (**PARKED at 2nd SIFT**): Options 6a and 6b combined.
- Option 7: Keep existing NR HRB; and
- Option 8: Optimised hB September 2015 scheme.

5.1.3 At the first sift workshop, the stakeholders parked Options 2 and 3 due to the wide scale disruption they would have on vehicular and pedestrian traffic, local residents and utilities diversions.

5.1.4 Options 4, 5b, 5c, 5d and 5e were also parked due to their significant visual impact, the requirement to have longer closures of A400 Hampstead Road and the difficult maintenance regime of utilities they impose.

5.1.5 For more information on these options, refer to the first sift workshop minutes in Appendix A and to the HS2 Ltd report to EIPB dated 12th of May 2016.

5.1.6 Options 1, 5a, 6c (with modified sub-option 6a of reusing the existing NR piers), 7 and 8 were selected by the stakeholders to be taken forward and were explored in more detail and described further in the second sift of options on the 11th of May 2016. These options are expanded below.

5.1.7 A commentary assessing the environmental impacts of these options I included in Appendix H.

5.2 Option 1 – Realignment of HRB

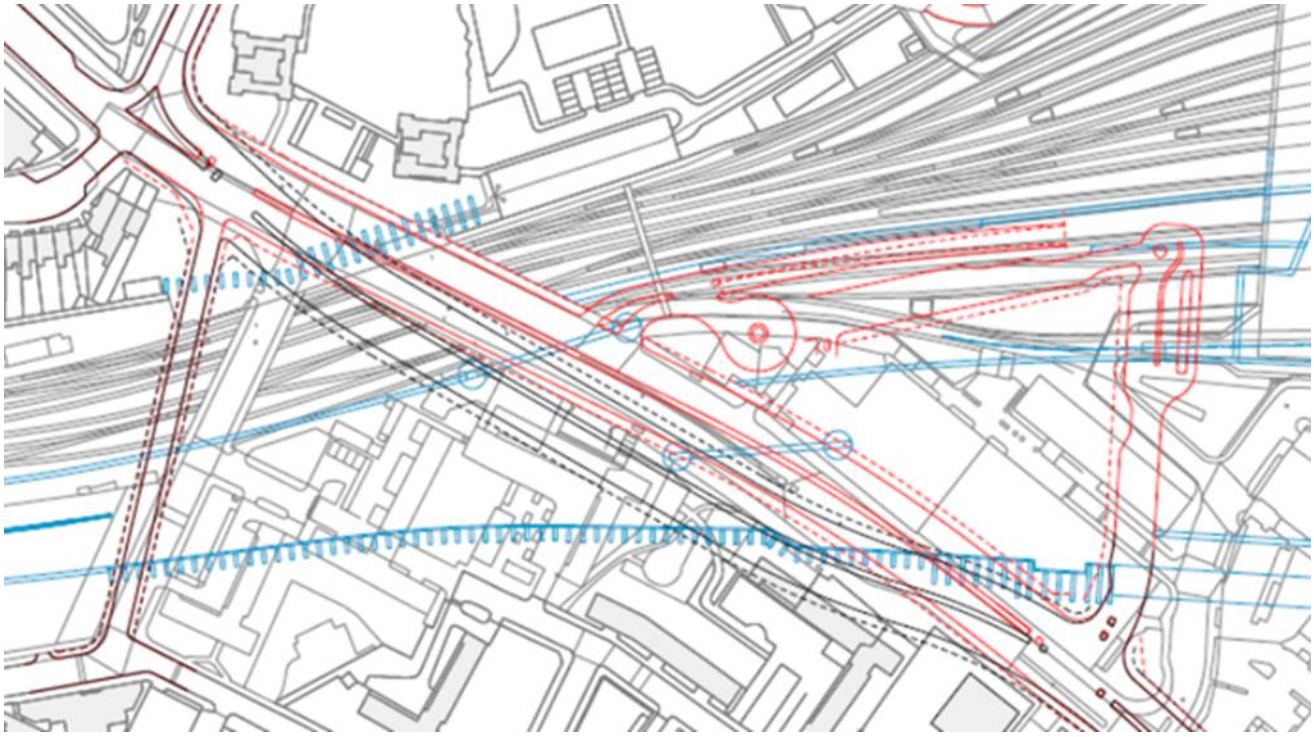
Description

5.2.1 Option 1 looks at realigning A400 Hampstead Road approximately 15m further away from Euston Station than the hB proposal while the existing HRB is kept operational.

5.2.2 This option is the only option apart from the hB September 2015 scheme that enables A400 Hampstead Road to be kept open with only short occasional closures for the construction of the bridge approaches.

5.2.3 Due to the change in the track layout further North-West, the realigned bridge would have shorter spans than the currently proposed bridge at hB September 2015. As a result, the structural depth can be reduced and the bridge can be made 500mm lower.

Figure 14: Plan of realigned HRB



5.2.4 Suggested construction sequence:

1. Build new northbound bridge (offline, using a self-propelled modular transporter) while traffic uses the existing southbound carriageway;
2. Move all HRB utilities and start running traffic onto new northbound deck;
3. Demolish existing bridge in one go;
4. Build new southbound bridge (foundations, piers and deck);
5. Move utilities that are in NR gantry on southbound deck; then
6. If needed, move some utilities from northbound to southbound deck and open full bridge to traffic.

Table 1: Sift criteria for Option 1

Sift Criteria	
Approx. Road Height reduction Cartmel	Approximately 0.5m
Approx. Road Height reduction Ampthill	Approximately 0.5m
A400 Hampstead Road Open	Yes
Construction Period	Faster by 12-18 months1
Ped / Cycle connectivity	Yes
Permit GTB Replacement	Yes with potential changes (revised alignment and potential alterations to spans and structural depth)
Visual Impact	Reduced
NR B2 Station Flexibility	Yes
NR Disruption	Reduced
Safety in temporary and permanent state	Yes
Maintenance	As baseline
Compatible with EAP	Yes
Compatible with OSD	Yes
Cost of structure	Slightly Reduced
Impact on local community	Reduced overall
Impact on utilities	No temporary diversion
Impact on material by rail	Positive (potential further reduction of 10000 to 15000 two-way lorry movements)
Within existing Bill Powers	No

Main benefits

1. A400 Hampstead Road operational;
2. Reduced disruption due to the fact that utilities no longer need to be temporarily diverted;
3. No utilities in Ampthill Estate and no temporary utilities bridges;
4. Faster programme – up to18 months saving of HRB construction programme. Overall disruption to all local residents and road users reduced further;

[1] For the construction of the bridge itself, programme for the station may be constrained by other works. It is also noted that preconstruction programme, including obtaining consents and approvals could be longer than for scheme within Bill Powers.

5. Benefit to material by rail (further reduction of 10000 to 15000 two-way lorry movements – refer to Appendix G for further information);
6. Bigger open space (approximately 15m in the location of the current HRB alignment) and connectivity through HRB maintained; and
7. Opportunity for an alternative haul road and therefore reduction of construction traffic in the Regents Park Estate.

Main disadvantages

1. Requires demolition of Cartmel residential block, and relocation of its residents within LBC;
2. Total lowering of road levels is approximately 0.5m. However, this is coupled with alternative vertical alignments and reduced proximity to existing and future buildings compared to the hB September 2015 scheme. For example, the realigned HRB would be approximately 15m further from Ampthill Estate at the location of the cutting as shown in the figures below. Moreover, optimisation as per Option 8 could be adopted for this option to give a potentially reduced road level as discussed in Option 8.

Figure 15: View of hB September 2015 scheme from Ampthill Estate

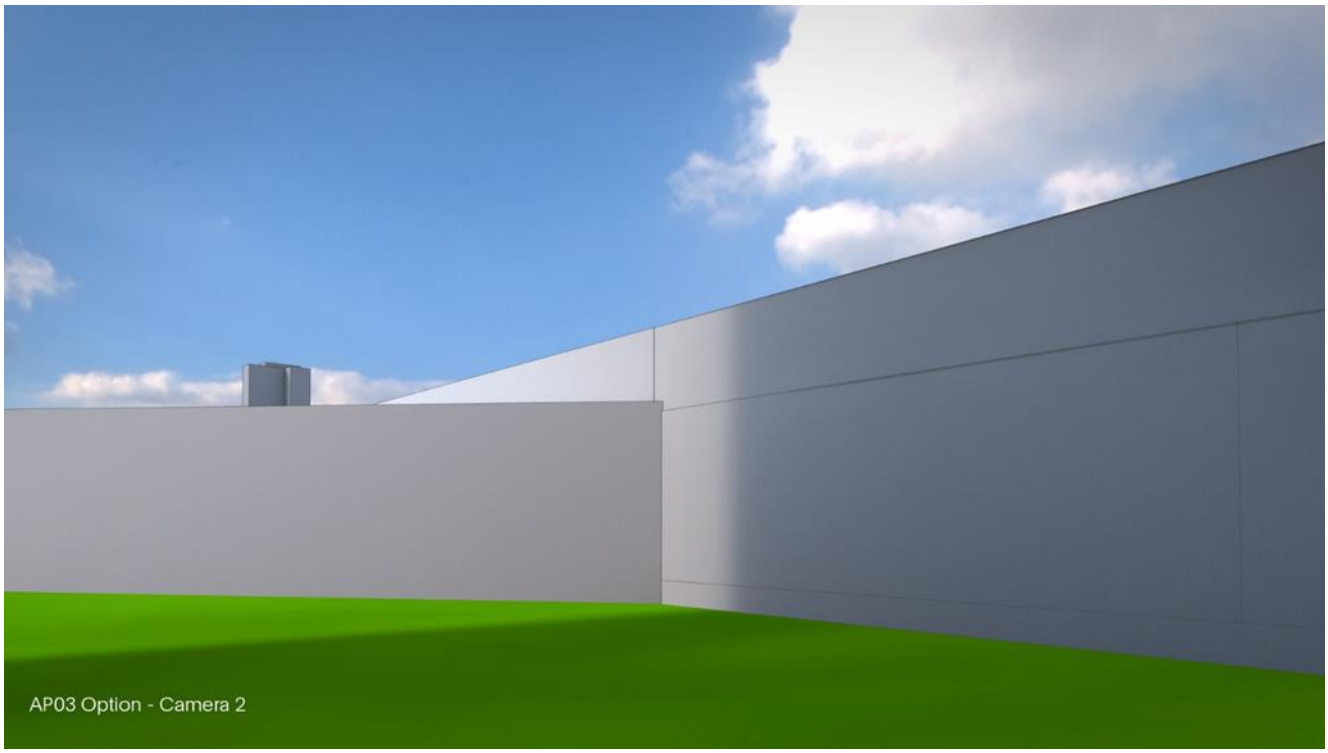
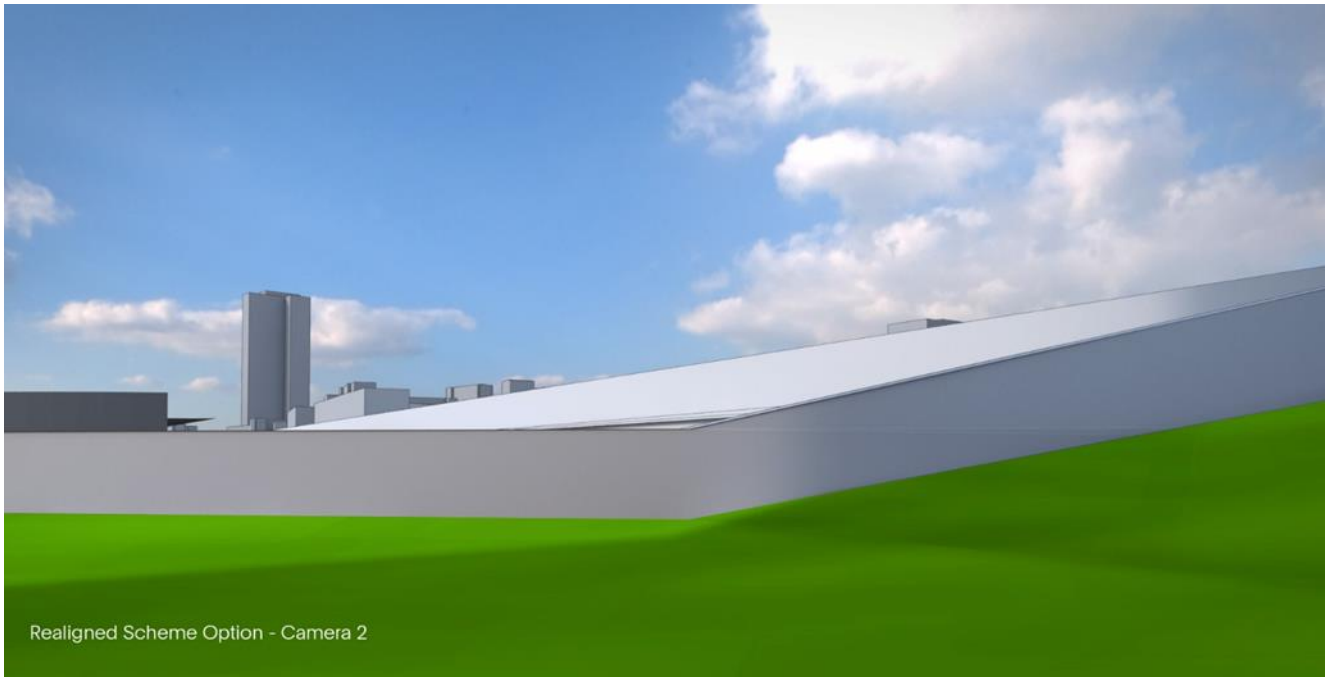


Figure 16: View of option 1 scheme from Ampthill Estate



Risks and considerations

1. Following a request from LBC, an alternative option of realigning the bridge while providing a narrower bridge and therefore trying to avoid the demolition of Cartmel was explored. It was confirmed that this option was not viable due to geometrical constraints. Refer to Appendix A for further information.

2. Landscaping around the bridge approaches, as well as the use of battered slopes against the side parapets walls, are to be developed further to achieve an enhanced public realm area.

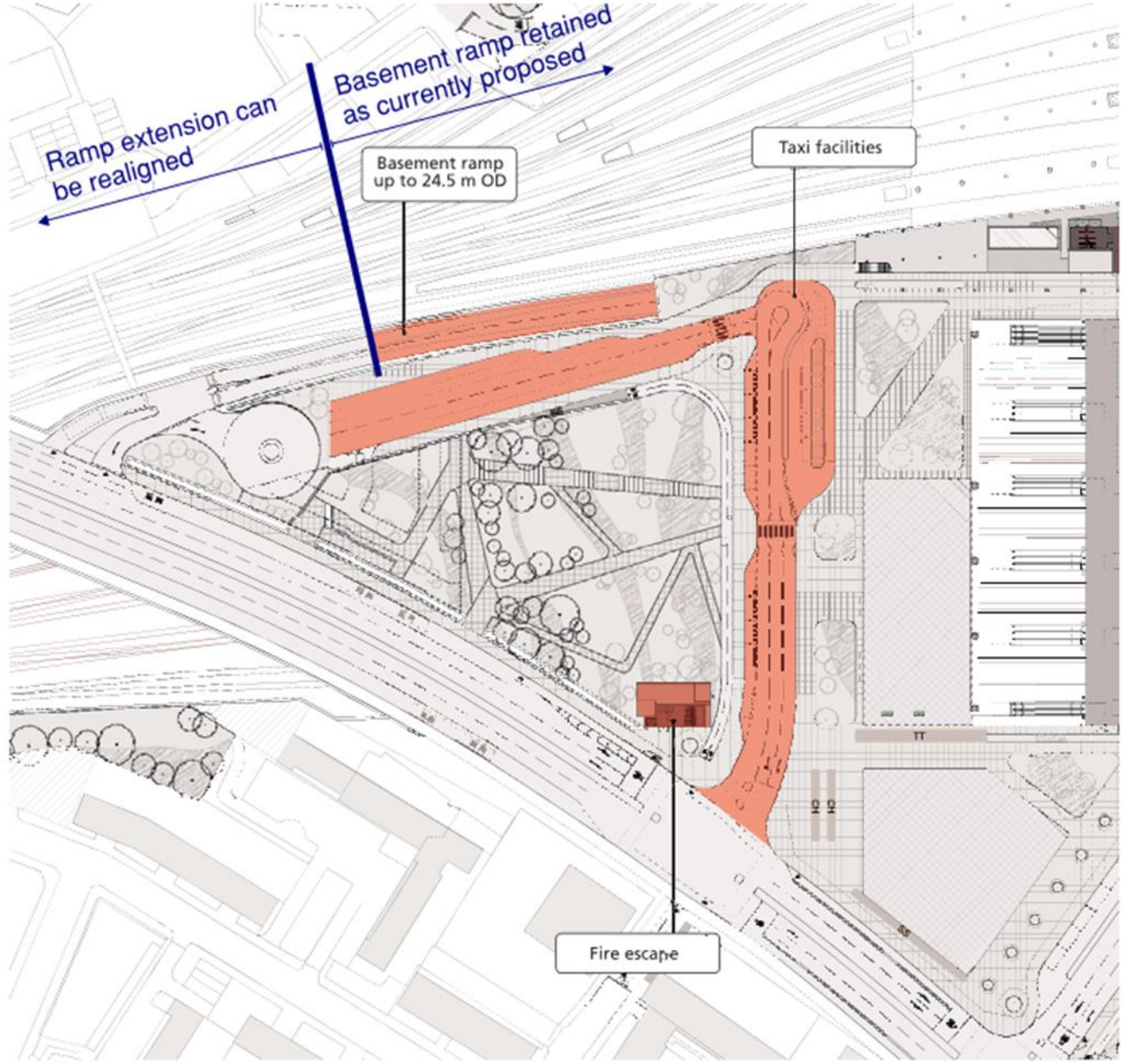
3. The re-provision of Cartmel would need be explored further including the timing of the planning and design process, the number of units to be re-provided, the location of the re-provided building and the phasing around residents relocation.

5.3 Option 5 – Realign top extension of B1 ramp

5.3.1 All sub-options of option 5 are edge supported structures. This included arched structures, cables stayed bridges and half-though girder decks. Edge structures allow the deck to span transversely therefore requiring a more slender structural depth and achieving lower levels for A400 Hampstead Road.

5.3.2 However, any lowering scheme reliant on edge support will require further realignment of the top extension to the HS station basement access ramp for the station in phase B1 ('B1 ramp') as it is unable to connect to HRB as currently proposed.

Figure 17: Realignment of top extension to B1 ramp



5.3.3 This creates several disadvantages in addition to the TOC parking being precluded by the lowering of HRB as described in section 4.4:

1. Northern open space reduced due to the B1 ramp realignment options occupying additional space than proposed at hB September 2015. The quality of the open space also needs to be considered when opting for a realignment option;
2. Poor taxi / lorry segregation in the station area;

3. Poor public realm and pedestrian routes from Euston Station severed through the open space, onto HRB and along A400 Hampstead Road severed. The proposed bus stop on HRB may no longer be viable; and

4. Poor highway and junctions layout – may not be approved by TfL.

Option 5a – Half through girders

Description

5.3.4 Option 5a uses 4m to 6m high solid and impermeable steel box girders which extend above road level to support the road.

5.3.5 Several sub-options were considered for this scheme with varying cross sections including options with 2, 3 or 4 lines of support as well as options where the footway cantilevers outside the steel girders. A sketch of these sections is included in Appendix D. The different cross sections give rise to different structural depths, with a larger number of supports giving lower structural depths. In addition, having shorter spacing between the supports gives lower structural depths. Hence, options with cantilever foot /cycle ways that reduce the span between the supports to the minimum vehicle carriageway give the lower structural depths (a reduction in road level of approximately 1.5m).

5.3.6 The various sub-options provide different height reductions, levels of permeability and lengths of closures for A400 Hampstead Road:

1. The further the main girders are spaced, the deeper the transverse structure and therefore less lowering benefit is achieved.

2. With 2 lines of support only, phased construction is precluded and A400 Hampstead Road will require longer closures of several months.

3. The more lines of support, the worse it becomes for visual impact and permeability.

5.3.7 At the second sift of options, sub-option 5a-5 was selected and this is the one that is assessed in the table below.

5.3.8 Option 5a-5 has 2 no. independent structures with 4 no. lines of support and girders positioned at the sides of the bridges with no cantilevers required as shown in the figure below.

5.3.9 This avoids physical separation of the pedestrians, cycles and vehicles, however it results in a reduction of road level of approximately 1m as the span between the supports is approximately 15m.

Figure 18: Option 5a-5 cross-section

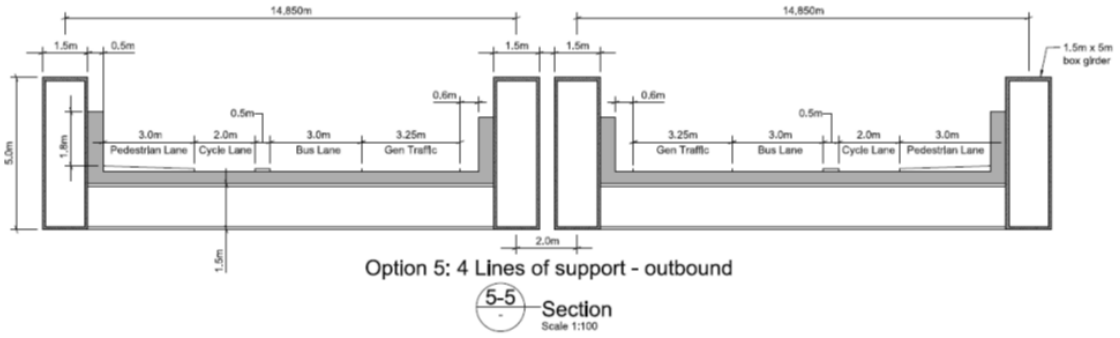


Table 2: Sift criteria for Option 5a-5

Sift Criteria	
Approx. Road Height reduction Cartmel	Approximately 1m (Varies depending on number of lines of support and footway layout – 5a-5: 1m)
Approx. Road Height reduction Ampthill	Approximately 1m (Varies depending on number of lines of support and footway layout – 5a-5: 1m)
A400 Hampstead Road Open	No – approx. 6 months closure (Varies depending on number of lines of support -)
Construction Period	Similar to baseline
Ped / Cycle connectivity	Not from Euston Station
Permit GTB Replacement	Yes with potential changes
Visual Impact	Increased (solid and impermeable)
NR B2 Station Flexibility	Yes
NR Disruption	Similar to baseline
Safety in temporary and permanent state	Yes
Maintenance	More difficult
Compatible with EAP	No
Compatible with OSD	Yes
Cost of structure	Increased
Impact on local community	Increased
Impact on utilities	As baseline
Impact on material by rail	As baseline
Within existing Bill Powers	Yes

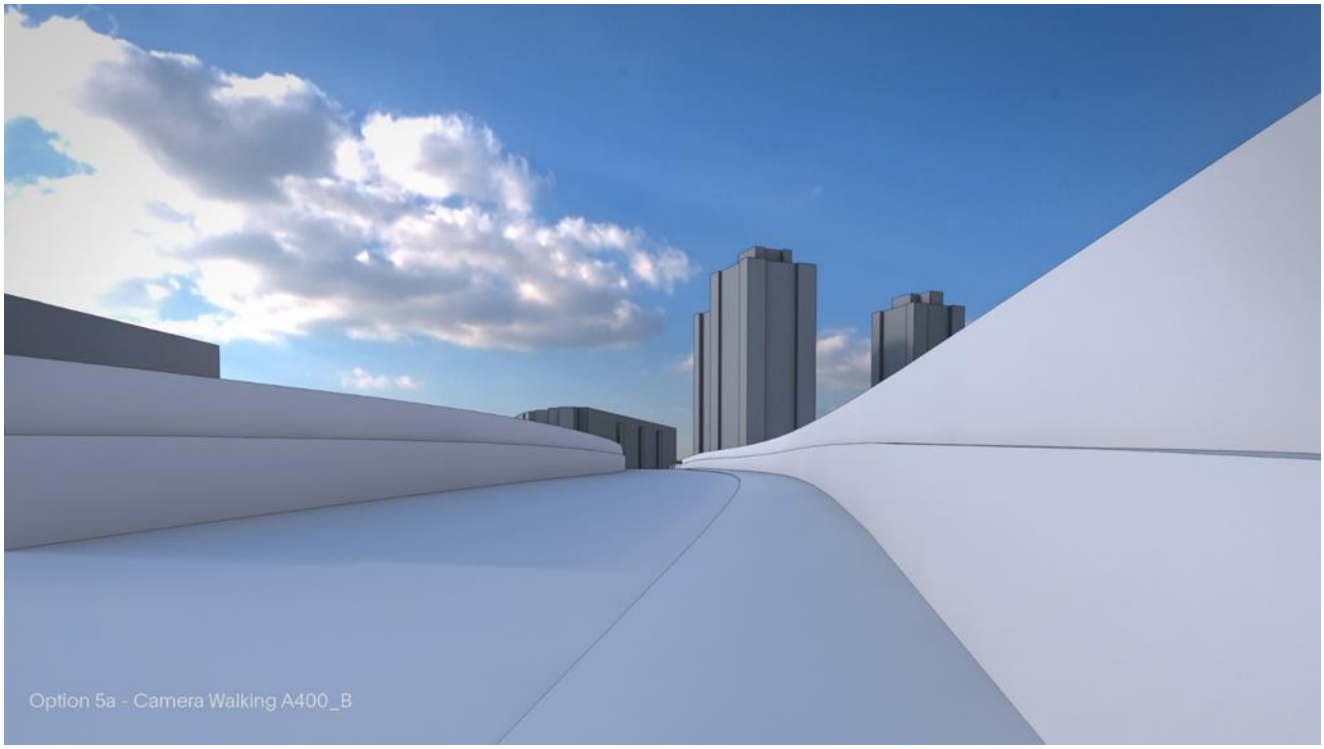
Main benefits

1. Maximum road lowering

Main disadvantages

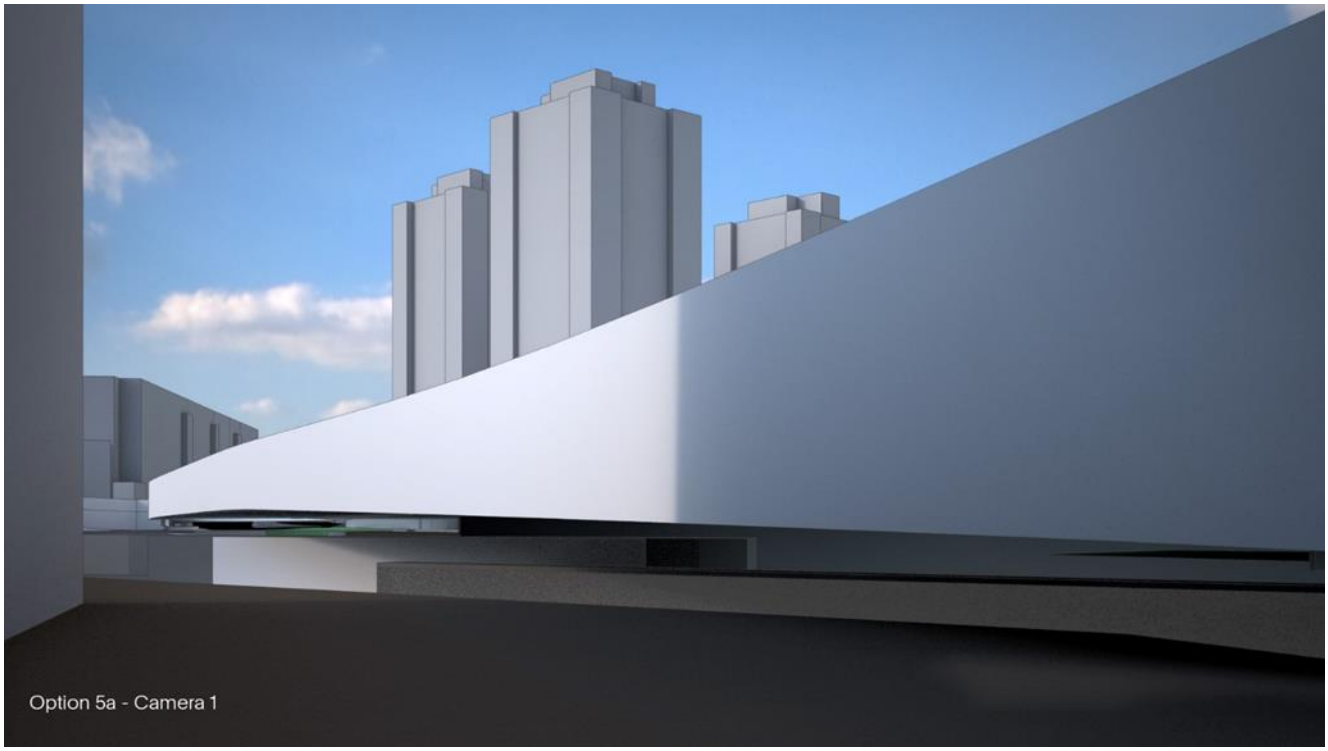
1. Much reduced permeability along entire length of HRB (approx. 200m);

Figure 19: Pedestrian view while on HRB option 5a-5



2. No B1 Ramp onto HRB;
3. Although road levels are lower, visual impact is increased;

Figure 20: View of Option 5a-5 scheme from Cartmel



4. Bus stop on A400 Hampstead Road as proposed at hB September 2015 is precluded; and

5. No maintenance access for utilities.

Risks and considerations

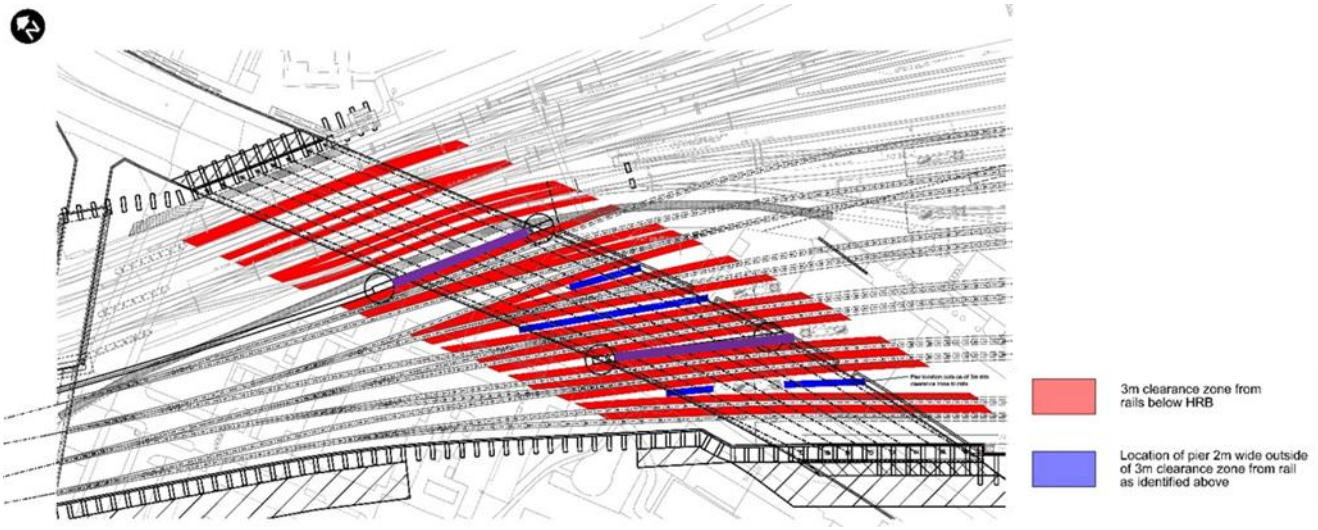
5.3.10 The sub-options considered have varying levels of permeability and different time closures of A400 Hampstead Road. However, none of the sub-options provide an enhanced pedestrian connectivity from Euston Station and the ability to cross A400 Hampstead Road.

5.4 Option 6 – Additional piers

5.4.1 The main driver to having shorter spans would be to achieve a reduced structural depth and therefore lowering the alignment of HRB.

5.4.2 However, the main disadvantage and challenge of having shorter spans is the positioning of the piers around the conventional and HS tracks.

Figure 21: Clearances and additional piers positions



5.4.3 Several structural forms would be adequate for shorter spans:

1. Precast prestressed beams, with in-situ RC slabs, span up to 45m but this would require the beams to be around 2.3m deep
2. Composite weathering steel plate girders as currently proposed with girders of 1.5 to 1.6m instead of 3m due to the reduced spans
3. In situ RC options (including post-tensioning) which have been considered in the past and rejected as they would require extensive formwork above the conventional tracks

Option 6c modified – Keep existing NR piers and use additional piers in HS spans

Description

5.4.4 Option 6c modified would retain the existing piers in the NR throat and aims at achieving a continuous bridge with a thinner deck structure compared to hB over both NR and HS throats while utilising the existing piers to avoid substantial disruption of the NR operations.

5.4.5 This option could provide a reduction of road level of 1.5m at either end of the bridge compared to the hB September 2015 scheme and provides safe pedestrian connectivity onto HRB and North/South with a reduced overall visual impact. However, this option requires a separate permanent utilities bridge due to the reduced space in the deck solutions explored.

5.4.6 The proposed solution uses pad foundations in the HS throat with the aim of reducing construction time and challenging locations for caissons.

Table 3: Sift criteria for Option 6c modified

Sift Criteria	
Approx. Road Height reduction Cartmel	Approximately 1.5m
Approx. Road Height reduction Ampthill	Approximately 1.5m
A400 Hampstead Road Open	No – closures required
Construction Period	Increased (up to 18 months)
Ped / Cycle connectivity	Yes
Permit GTB Replacement	Yes
Visual Impact	Reduced
NR B2 Station Flexibility	Horizontal track layout options reduced, however all options for B2 platforms levels remain viable
NR Disruption	Increased
Safety in temporary and permanent state	Yes
Maintenance	Similar
Compatible with EAP	Yes
Compatible with OSD	Yes
Cost of structure	Increased
Impact on local community	As baseline
Impact on utilities	Separate permanent bridge needed
Impact on material by rail	Worse (increased programme)
Within existing Bill Powers	Yes

Main benefits

1. Maintained permeability and pedestrian connectivity;
2. Reduced impact on open space and connection of B1 ramp.

Main disadvantages

1. A separate permanent utilities bridge will be needed as per option 7 (refer to section 5.5 for further details);
2. Constrains NR horizontal track alignment, but does not restrict station options for Stage B2;
3. TOC parking / northern open space reduced;
4. Impact on platform environment / fire escape; and

5. Longer closures of A400 Hampstead Road and/or extension of construction period are likely (refer to section 5.5 for further details).

Risks and considerations

1. Existing piers are not designed to withstand impact loading and their overall structural condition, as well as that of the foundations, will need to be confirmed before taking this option forward.
2. The method of demolition of the existing bridge deck will need to have minimal impact on the existing piers.
3. GTB can not be replaced as currently proposed therefore more work needs to be done to address this challenge.

5.5 Option 7 – Keep existing NR HRB

Description

5.5.1 The rationale behind keeping the existing NR bridge is to retain the current level of A400 Hampstead Road by taking advantage of the existing derogations on HRB. Indeed, if HRB is not replaced at this stage, there is no urgent requirement to meet current NR clearances.

Figure 22: Picture of the existing HRB over NR

5.5.2 The main challenge and risk of this option is that the responsibility of replacing the bridge spanning the conventional tracks is remains with NR. If the B2 station scheme requires changes to horizontal track layout or vertical clearances then this would have to be implemented as part of the B2 station scheme. Also, the connection between the existing and new structures, as well as the impact of the new bridge onto the existing structure and foundations will be challenging.

5.5.3 It is also important to ensure the existing bridge is not affected by the new bridge to be constructed adjacent to it. Underpinning of the existing abutment may therefore be necessary and a movement joint will be required between the existing and the new structures.

5.5.4 A significant benefit of retaining the existing HRB is that possessions are not required for its removal. Possessions for bridge removal would likely be possessions for all tracks, that is, a full station closure, to ensure safe demolition of the bridge deck. Possessions would still be required for any underpinning work and for the construction of the temporary and permanent utility bridges substructure, but these are not likely to be full-station possessions. Hence, the retention of the bridge could yield significant benefits in terms of reduced disruption to classic (NR) services and possessions costs in the short term. However, some possessions and full station closures will be required should the existing HRB be replaced in the future or if its presence is identified as a constraint to Stage B2 for Euston Station or further OSD. Further consideration is required on the amount and length of possessions required for the implementation and maintenance of this option as the design and methods of construction are clarified in later design stages.

Table 4: Sift criteria for Option 7

Sift Criteria	
Approx. Road Height reduction Cartmel	N/A
Approx. Road Height reduction Ampthill	Total (3.5m) (As existing road levels)
A400 Hampstead Road Open	Yes*
Construction Period	Longer* (up to 18 months)
Ped / Cycle connectivity	Yes
Permit GTB Replacement	Yes – existing retained
Visual Impact	Lower road level at Ampthill estate but with permanent utilities bridge. Lower road level at Cartmel.
NR B2 Station Flexibility	Horizontal track layout options reduced, however all options for B2 platforms levels remain viable
NR Disruption	Reduced in terms of blockades
Safety in temporary and permanent state	Yes – risk to underpinning abutment
Maintenance	Similar to baseline*
Compatible with EAP	Yes
Compatible with OSD	Yes
Cost of structure	Slightly increased
Impact on local community	Increased (programme increased)
Impact on utilities	Separate permanent bridge needed

Sift Criteria	
Impact on material by rail	Worse (programme increased)
Within existing Bill Powers	Yes

*Keeping A400 Hampstead Road open, as well as the construction period and the maintenance regime are dependent on the sub-option chosen over HS tracks.

5.5.5 Option 7 was considered with 2 sub-options over HS tracks: one option was 2 pairs of arches and the other was plate girders (Option 6b). Refer to Appendix F for sketches of these two sub-options.

Figure 23: Existing bridge + 2 spans of arches

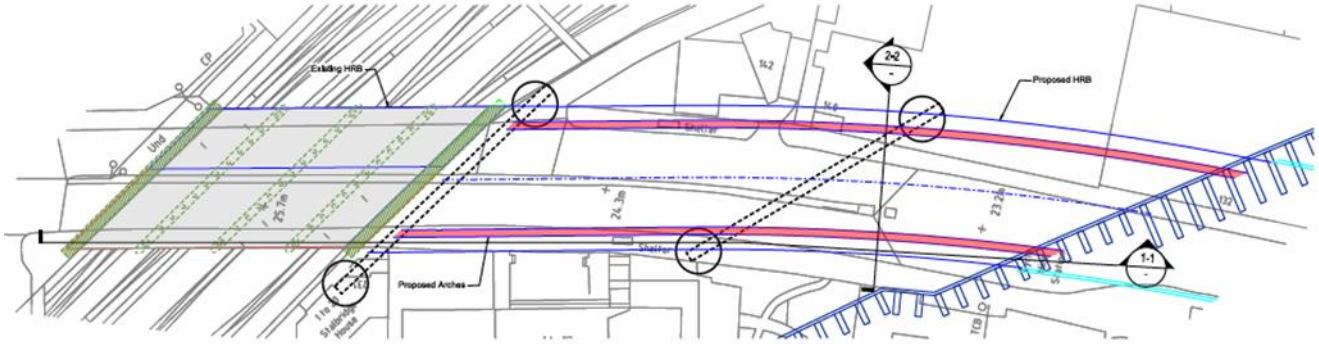


Figure 24: Existing bridge + additional piers

5.5.6 Option 6b provides an easier maintenance regime and is less visually intrusive than having 2 pairs of arches over HS tracks.

5.5.7 However, it would result in a longer construction programme, as well as a potentially longer closure of A400 Hampstead Road if pad foundations are used.

5.5.8 Should caissons be used, this would follow the same principles as the AP03 scheme where the southbound lanes are closed while the southern caissons are constructed and then the northbound lanes are closed while the northern caissons are constructed. This staged construction would allow for A400 Hampstead Road to remain operational with a single lane running in each direction as per the AP03 scheme but would also lead to an increase in the

baseline programme as the number of caissons have increased. As per the baseline scheme, a temporary bridge would be required to allow for traffic to run above the site for the construction of the piers linking the caissons together.

5.5.9 With the construction of additional caissons and that of the separate permanent utilities bridge, the baseline programme could be extended by up to 18 months.

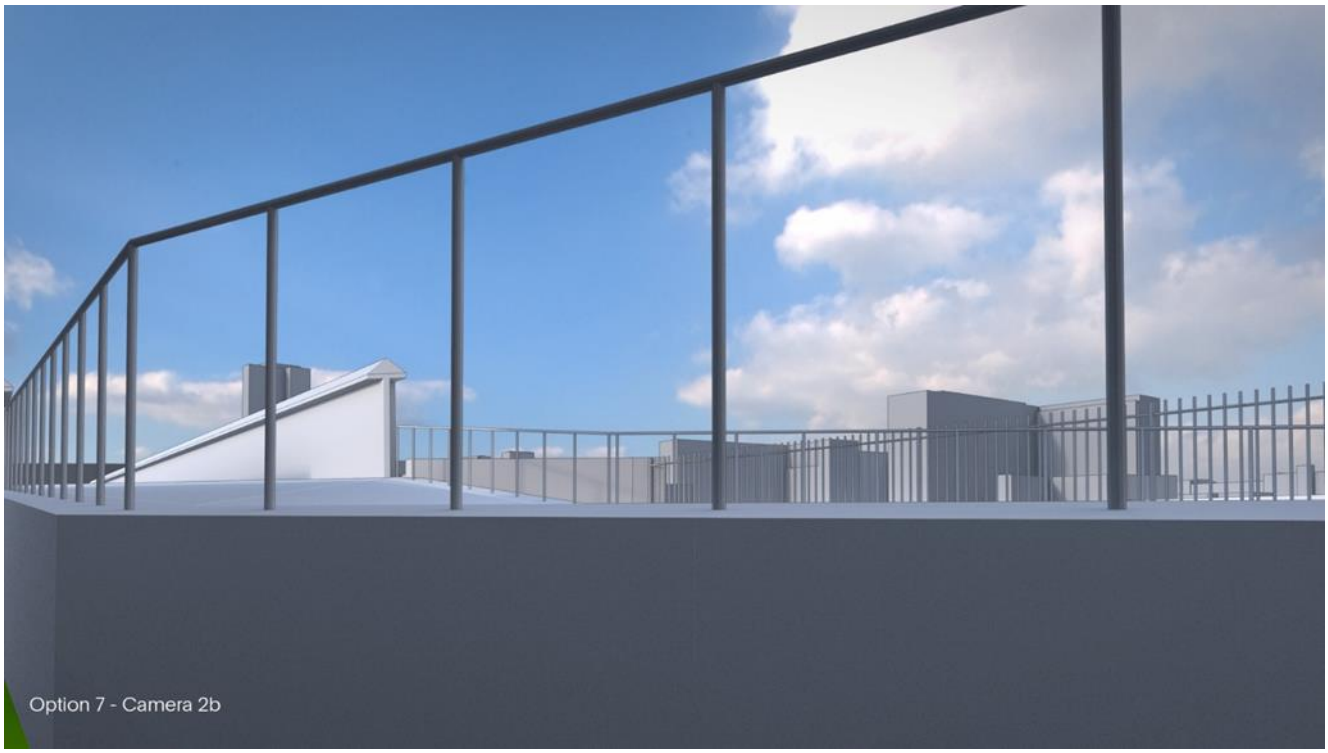
Main benefits

1. Maintained permeability and pedestrian connectivity;
2. Granby Terrace Bridge replacement works no longer required over the West Coast Main Line;
3. Reduced possession risk; and
4. Potentially no barrettes for northern abutment.

Main disadvantages

1. A separate permanent utilities bridge will be needed as shown in Figure 25 (refer to Appendix E for further details)
   - This will require the HS station fire escape to be moved
   - And will create additional visual impact especially from Ampthill Estate:

Figure 25: View of Option 7 scheme and the permanent utilities bridge from Ampthill Estate



2. Constrains later NR track plan;
3. Defers works to the future and introduces a geometrical constraint for a future bridge over the NR tracks. Repeated disruption to traffic and residents should be considered;
4. NR retain responsibility of maintenance and eventual replacement of the existing HRB;
5. Existing HRB may not be able to withstand abnormal highways loading (no change from existing);
6. TOC parking / northern open space reduced; and
7. Reduced design life (NR span not replaced).

Risks and considerations

1. The railway clearance and highway alignment requirements call for a change in drainage strategy from Beeny blocks to deck gullies in order to reduce the road build-up required on the bridge. In addition, the proposed alignment results in a low point at the interface between the two bridges, which will require the water to be taken down to track level at the interface between the two bridges.
2. In order to achieve the tie-in between Granby Terrace and A400 Hampstead Road, the existing GTB will also need to be retained and extended to span over HS tracks. This will present the same interface challenges being resolved for HRB.
3. Due to the lower level of the HS tracks, the existing abutment will need to be underpinned before excavation for the HS tracks.
4. The interface between the existing and new bridge could result in a poor movement joint detail depending on the structural form and thus width and layout of the new bridge.

5.6 Option 8 – Optimise hB September 2015 scheme

Description

5.6.1 The design of HRB at hB was for the purposes of gaining Powers. Hence, the geometry was required to allow some future design development. The design for hB was at a preliminary design stage and utilised simplified analysis models and conventional material grades and some structured engineering judgement.

5.6.2 This level of design is as per the general HS2 route and in most circumstances adequate for hB level design.

5.6.3 However, due to the particular constraints and issues at Euston, in addressing the requirements of this study an optimisation of the hB September 2015 scheme was carried out.

5.6.4 This took the form of a range of activities:

- More refined analysis: an analysis model of all girders, cross girders, stiffeners and concrete deck was created. The staged construction of push launch over the railway as well as steel and concrete phased construction was modelled. This is a level of design more usually carried out at scheme or detailed design. This refinement confirmed most assumptions and allowed some reduced conservatism in some assumptions in the hB September 2015 design, for example in the size of cross members and deck slab.
- Higher grade materials: the steel grade assumed for the main girders in the hB September 2015 design was S355. This is the most commonly available and used grade. This is the default assumed steel grade in design as it is most economic and most readily available, particularly for weathering steel. With a more refined analysis it was possible to assess the effect of increased steel grades. S460 gives the maximum increase in ultimate limit stress of the steel material and was adopted. It is noted that this material is more expensive than S355, but is also less readily available. Hence, there is some programme risk if special milling is required.
- Wider and thicker flanges: the bottom flange (and top flange over the supports) was varied with wider and thicker options considered. This has some beneficial effect, but requires further optimisation as the width increase benefit is limited by shear lag effects and also lift weight considerations. Increase in thickness of the flanges has a limiting effect as the ultimate limit stress of the steel material reduces with thickness as does the through thickness properties.
- More girders: this was considered, however the number and distribution of the utilities resulted in an optimal arrangement of the girders being as hB September 2015.

5.6.5 For the limited additional time for this study the most significant benefit was gained from increased material grade. Wider and thicker flanges were also used.

Table 5: Sift criteria for Option 8

Sift Criteria	
Approx. Road Height reduction Cartmel	0.5 to 1m
Approx. Road Height reduction Ampthill	0.5 to 1m
A400 Hampstead Road Open	Yes
Construction Period	As baseline
Ped / Cycle connectivity	Yes

Sift Criteria	
Permit GTB Replacement	Yes
Visual Impact	As baseline
NR B2 Station Flexibility	Yes
NR Disruption	As baseline
Safety in temporary and permanent state	Yes
Maintenance	As baseline
Compatible with EAP	Yes
Compatible with OSD	Yes
Cost	Increased (higher steel grade)
Impact on local community	As baseline
Impact on utilities	As baseline
Impact on material by rail	As baseline
Within existing Bill Powers	Yes

Main benefits

5.6.6 As hB September 2015 scheme:

1. Maintained permeability and pedestrian connectivity;
2. Reduced visual impact; and
3. Allows flexibility of NR track plan.

Main disadvantages

5.6.7 As the girder depth reduces, the inspection of the structure and access for maintenance, inspection and replacement of the utilities is reduced. There is a limit at which utilities access is not viable. This will limit will need discussion with the utilities companies, but it is likely to limit the reduction in girder depth to approximately 0.5m to 1m.

Risks and considerations

5.6.8 Undertaking optimisation of the design at this stage of the scheme development reduces the opportunity to mitigate future design development risks. This is standard practice at this stage of design and therefore could be applied to any of the options.

5.6.9 Higher grade steel has limited availability, particularly for the volumes of material considered.

5.6.10 The transverse members have been reduced in depth compared with hB. There is potential for more refined analysis to examine these in detail in particular.

5.6.11 The limiting criterion in the reduction in girder depth is the access to utilities. This is the space required for the placement and safe arrangement of ducts, but also for safe access and maintenance by the utilities providers within the deck.

5.6.12 A box girder deck could be used. This gives more bending efficiency and hence a reduced structural depth compared with the hB plate girder scheme. However, this is more expensive than the hB plate girder scheme. Box girders are also heavier to lift, and hence would require higher capacity craneage. Box girders would be of a depth that would not allow access for maintenance of utilities or inspection of the structure. Hence, they would be sealed and utilities in sleeves only. Gas and water are not usually carried within sealed box girders due to risk of leakage and hence safety. Discussions with the utilities providers would be needed regarding these utilities and potentially alternate locations within the bridge would have to be identified. Hence, the adoption of box girders is not considered in this study but could be at later stages of design.

5.6.13 The optimisation of the plate girder structure is a function of a number of factors and also a function of detailed design and contractor preference. This will therefore require constant review to confirm the level of benefits from design optimisation during further design stages.

5.7 Options Retained at Sift 2

5.7.1 During the second sift of options on the 11th of May 2016,

- Whilst recognising the direct impact it would have on residents, Option 1 was retained due to the potential wider scale benefits that could possibly be delivered;
- Option 5a-5 was retained despite its impact on NMUs as an example of structures with edge support;
- Option 6c modified was parked due to the numerous risks it introduces;
- Option 7 was retained as a less risky example of utilising the existing structure; and
- Option 8 was retained as an improvement of the baseline scheme.

6 Options comparison table

Table 6: Options comparison table

Sift Criteria	Option 1 (realignment)	Option 5a-5 (Through-girders)	Option 7 (Keep existing)	Option 8 (Optimised)
Approx. Road Height reduction south side	Approximately 0.5m	Approximately 1m	Approximately 1m*	0.5 to 1m
Approx. Road Height reduction north side	Approximately 0.5m	Approximately 1m	Total (3.5m)	0.5 to 1m
A400 Hampstead Road Open	Yes	Yes (4 planes)	Yes*	Yes
Construction Period	Faster (12-18 months)	Similar to baseline	Longer* (up to 18 months)	As baseline
Ped / Cycle connectivity	Yes	Not from Euston Station	Yes	Yes
Permits GTB Replacement	Yes (changes)	Yes (changes)	Yes (retained)	Yes
Visual Impact	Reduced	Unfavourable	Reduced	As baseline
NR B2 Station Flexibility	Yes	Yes	Horizontal track layout options reduced, however all options for B2 platforms levels remain viable	Yes
NR Disruption	Reduced	Similar to baseline	Blockades reduced	As baseline
Safety in temporary and permanent state	Yes	Yes	Yes – risk in underpinning	Yes
Maintenance	As baseline	More difficult	Similar to baseline*	As baseline
Compatible with EAP	Yes	No	Yes	Yes

Compatible with OSD	Yes	Yes	Yes	Yes
Cost of structure	Slightly reduced	Increased	Slightly increased	Increased
Impact on local community	Reduced overall	Increased	Increased (programme)	As baseline
Impact on utilities	No temporary diversion	As baseline	Permanent bridge needed	As baseline
Impact on material by rail	Positive	As baseline	Worse (programme)	As baseline
Within existing Bill Powers	No	Yes	Yes	Yes
Note	**Cartmel re-provided at significant cost**	**B1 ramp options and redesign of open space.**	***Sub-option dependent**	**Risk for future design stages**

7 Plan for further work

7.1.1 As specified by the assurance, a study was undertaken to identify and assess several options with the potential of lowering HRB and reducing its impacts on road users and the local community.

7.1.2 HS2's preferred bridge lowering proposal is Option 8 for which the study agreed that the following aspects would need to be considered further:

- Availability of higher grade steel materials;
- Optimisation of flange width / thickness and transverse girders with consideration of lift weights;
- Consideration of box girder decks; and
- Consultation with utilities companies, confirmation of utilities layout and approval from utilities companies particularly regarding minimum access requirements and hence girder depth.

7.1.3 Although some level of detail was necessary to consider the viability, if the Promoter should decide that an option other than Option 8 (as preferred by HS2 Ltd) should be considered, following additional aspects would need to be considered further.

7.1.4 Should Option 1 be selected, the following aspects will need to be considered further:

- Re-provision of Cartmel including space available, location, phasing, planning requirements, programme impacts and general landscaping of the area;
- Re-design of GTB especially highways design and tie-in with the realigned A400 Hampstead Road;
- Clarification of consents requirements and timings;
- Construction vehicles and new haul road to reduce impact on Regents Park Estate;
- Consultation with utilities companies, confirmation of utilities layout and approval from utilities companies particularly regarding minimum access requirements and hence girder depth; and
- Examination of environmental impacts, in particular, whether the option(s) can be delivered within Bill powers and Environmental Minimum Requirements

7.1.5 Should Option 5a-5 be selected, the following aspects will need to be considered further:

- B1 ramp realignment and reconfiguration of open space;
- Re-provision of bus stop on A400 Hampstead Road;

- Consultation with utilities companies, confirmation of utilities layout and approval from utilities companies particularly regarding maintenance access requirements; and
- Examination of environmental impacts, in particular, whether the option(s) can be delivered within Bill powers and Environmental Minimum Requirements

7.1.6 Should Option 7 be selected, the following aspects will need to be considered further:

- Choice of sub-option over HS tracks;
- Interface of new and existing bridge including highway alignment and drainage of A400 Hampstead Road down to track level;
- Interface between separate permanent utilities bridge and B1 ramp as well as grade level slab;
- Moving of the station fire escape and redesign of the station evacuation strategy;
- Ramp design from the separate permanent utilities bridge;
- General landscaping around the Ampthill Estate area;
- Consultation with utilities companies, confirmation of utilities layout and approval from utilities companies particularly regarding minimum access requirements particularly at the north side of the separate permanent utilities bridge; and
- Examination of environmental impacts, in particular, whether the option(s) can be delivered within Bill powers and Environmental Minimum Requirements

7.1.7 It is considered that these aspects are all matters for detailed design and should be considered following the appointment of a contractor when the construction means and methods are also developed further. The proposed plans and specifications for the HRB will of course be submitted to the LBC for approval as the relevant planning authority under Schedule 17 of the Bill.

7.1.8 For all options apart from option 7, the design of the hB 2015 Granby Terrace Bridge (GTB) will have to be reviewed and revised to ensure compatibility with revised highway alignments. For option 7, the existing NR GTB will be retained to be compatible with unchanged road levels at Ampthill Estate but the south-western span and abutment of GTB will need to be amended to allow HS construction.

7.1.9 For any of the lowering options, apart from option 8, the open space usage and layout is to be revisited. Confirmation will be needed as to whether TOC parking is required, where it should be located and whether the quality of the open space provided is acceptable.

8 List of acronyms

CAU	Commitments, Assurances and Undertakings
CSB	Cable Stayed Bridge
DfT	Department for Transport
EAP	Euston Area Plan
EIPB	Euston Integrated Planning Board
ETM	ERM, Temple Group and Mott MacDonald
GTB	Granby Terrace Bridge
hB	hybrid Bill
HRB	A400 Hampstead Road Bridge
HS	High Speed
HS2 Ltd	High Speed Two Limited
LBC	London Borough of Camden
LUL	London Underground Ltd
NMU	Non-Motorised Users
NR	Network Rail
OSD	Over Site Development
PC	Precast Concrete
PT	Post-Tensioned
RC	Reinforced Concrete
SPMT	Self-Propelled Modular Transporter
TfL	Transport for London
TOC	Train Operating Companies

Appendix A – Option 1 and minimal traffic width

At the request of LB Camden, an alternative option of realigning the bridge while providing a narrower bridge and therefore trying to avoid the demolition of Cartmel was explored. It was confirmed that this option was not viable due to geometrical constraints. As shown in the figure below, even by:

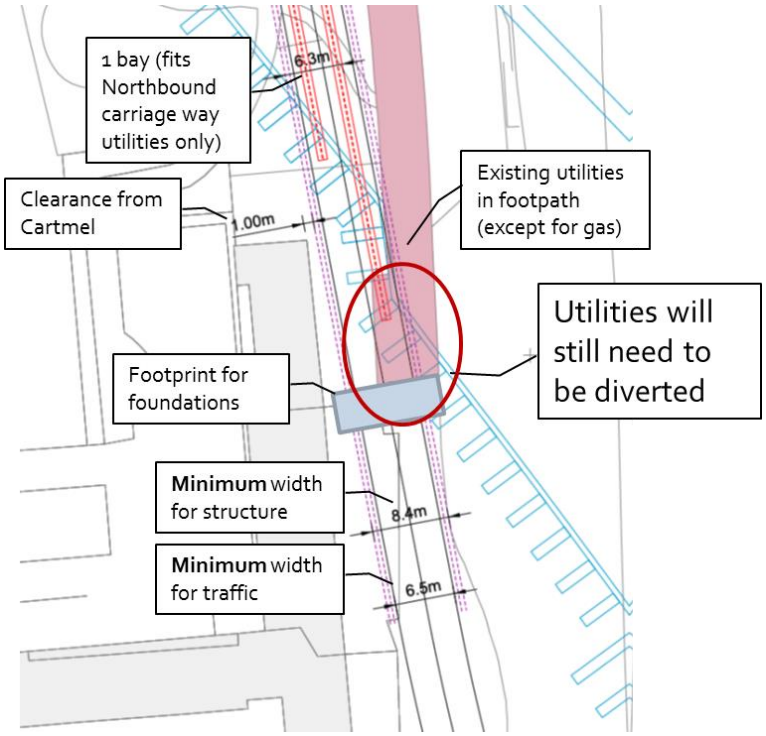
- placing an extreme minimal clearance of 1m from Cartmel and
- assuming a minimal traffic width of 6.5m (non-compliant with TfL current requirements),

the realigned bridge and its foundations would still clash with the existing utilities in the footway of A400 Hampstead Road.

This would deny the main benefit of this option of avoiding a temporary utilities diversion and the associated benefits of:

- reduced disruption to the community;
- shorter construction programme; and
- the subsequent benefit on material by rail.

Figure 26: Clash of minimal realigned bridge with existing utilities



Appendix B – Utilities space proofing

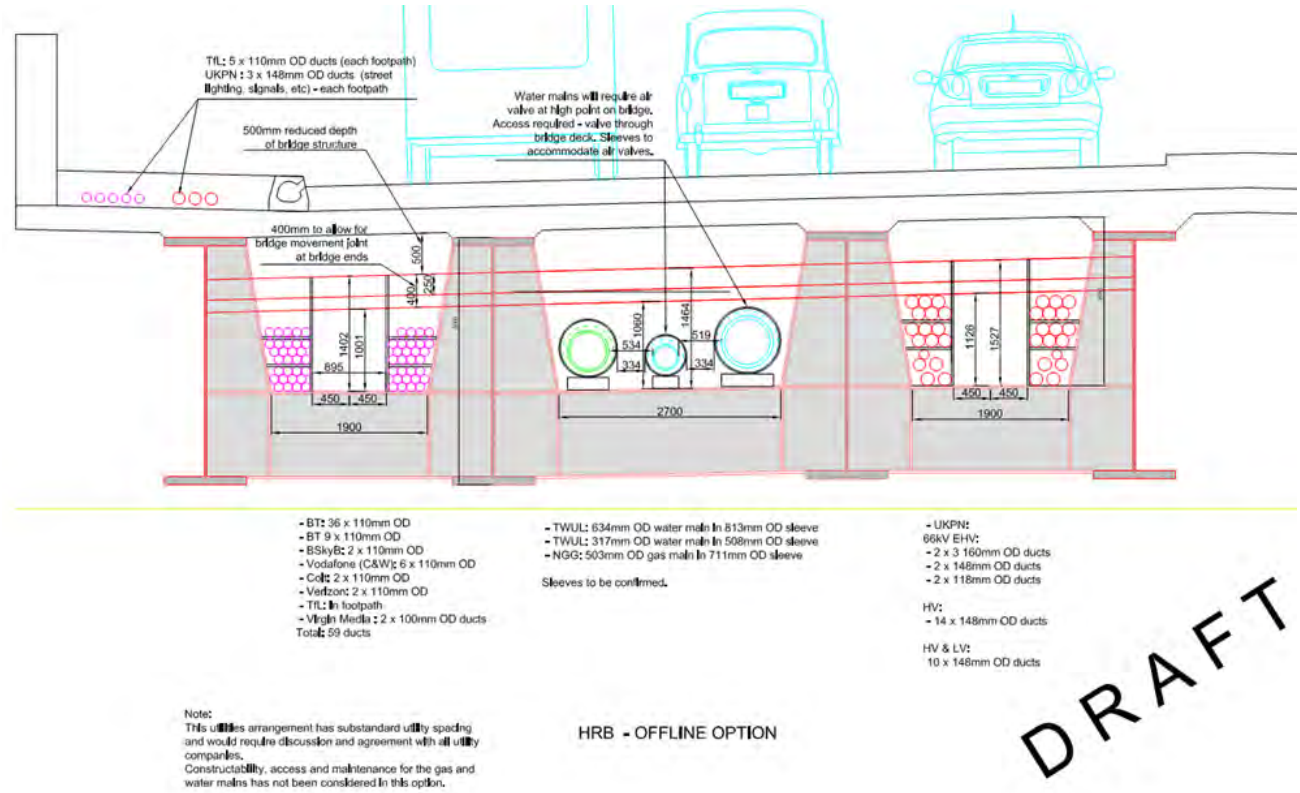
This Appendix considers the impact on utilities should the level of HRB be lowered, from the AP03 design by 500mm. Any further reduction would create pinch points for utilities at either end of the bridge due to bridge deck movement joints which are lower at either ends of the bridge.

The spacing and arrangement of the utilities in this case would need to be discussed and agreed with each utility company. Constructability, access and maintenance requirements, in particular for the gas and water, has not been considered in this case and further design is required.

The water mains will require air valves along the bridge at high points, as with a lowered bridge design, the water mains will have to follow the curvature of the bridge creating high points which is a change from the AP03 design. These air valves will need to be extended through the bridge deck to the road surface.

The below cross section shows the AP03 design with a line indicating a 500mm reduction in clearance within the bridge.

Figure 27: possible utilities arrangement with lowered HRB design.



Risks:

Utility companies will not accept the proposed arrangements for permanent bridge due to:

- Confined space for access;
- Clearances / spacing between their own utilities as well as other companies;
- Combination of utilities in shared space (e.g. UKPN near NGG / telecoms). This would require a joint agreement between utility companies in this shared space;
- Combination impact on maintenance and operation of their assets;
- Routing of utilities impacting their networks; and
- Other reasons.

Considerations / caveats

- All utility numbers and sizing are based on AP03 and further discussions with utility companies since then;
- Should the water mains have a high point along the bridge, this will require air valves through the bridge deck;
- Arrangement of utilities with bridges and approach will need to discussed and agreed with the utility companies;
- Further design will be required combined with detailed design; and
- Details of the interface at the bridge abutments are subject to further design and considerations given to accessibility for maintenance and repairs.
- Combined kerb / drainage system is acceptable to TfL, otherwise a gully and pipe system will be required which will have impacts on the bridge design.

Appendix C - B1 ramp top extension realignment and junction options

This appendix includes engineering layouts of options for bringing the basement ramp up to the northern garden area to utilise the station taxi road and remove the basement access from Hampstead Road Bridge. Also is an option for re-routing the service vehicles from the south whilst still having the basement access ramp off of Hampstead Road. The idea behind this is to try and mitigate the possible left turn conflict between cycles and service vehicles entering the basement. Below I've put my initial thoughts on the advantages and disadvantages of each option. Plans are 1:1000 @ A3.

Option 01: Right turn pocket from Hampstead Road

Option 01 would ban the left turn from Hampstead Road into the station basement. Instead all delivery vehicles come from the south along Hampstead Road and a right turn lane incorporated into the central median. However, as this is situated on the proposed bridge there are geometric issues that may mean this scheme is difficult to implement.

The scheme shown narrows the northbound bus lane and both the general traffic lanes to 3.0m each in order to accommodate a 3m right turn pocket.

Advantages:

No mixing of taxis and service vehicles around station taxi facilities;

Maintains AP03 scheme vision of connecting the station, northern green space and Hampstead Road;

Maintains AP03 scheme vehicle set down bays;

Maintains AP03 scheme taxi rank length;

Maintains AP03 scheme TOC parking facility;

Maintains AP03 scheme cycle facilities (cycleways and cycle parking etc);

Reduces left turn conflict between cyclists and vehicles by banning the left turn into the service yard from the north.

Disadvantages:

Will only work with under deck structure form of bridge. Arch / truss would not work;

Narrows traffic lanes and bus lane to create right turn pocket;

Likely to require departures from DMRB standards;

Requires all service vehicles to come from the south;

Option 02: Service road adjacent Hampstead Road Bridge

This option brings a service road from the basement connecting into the station taxi road. Service vehicles will have a waiting / security area off the station taxi road, adjacent the station fire escape at the corner of the station taxi road and Hampstead Road. Security checks will happen in this area with a turnaround facility for rejected vehicles positioned to send them back to Hampstead Road via the station taxi road.

Advantages:

Removes need for connection to Hampstead Road Bridge;

Removes / moves left turn conflict with cyclists on Hampstead road, moving the left turn conflict to a signalised junction where it is easier managed;

Still allows access to area north of taxi facilities that can be landscaped etc.;

Allows for any type of bridge on Hampstead Road.

Disadvantages:

Mixing taxis and service vehicles on station taxi road;

Reduces set down bay numbers form AP03 scheme - AP03 scheme: 11 bays; Option 02 scheme : 9 bays;

Removes connectivity from northern green area to Hampstead Road;

Service road will require fencing / possible fully covered structure due to its proximity to Hampstead Road in order that people can't drop down from Hampstead Road into the service road after the security facilities. If fully covered, this would need to be high enough to allow the highest vehicles to enter the basement (4-5m high). If fenced only, then still likely to need to be 2-3m in height along both sides of the service road;

Reduces taxi rank length from AP03 scheme;

Loss of TOC parking facility. This could still be incorporated but would require additional area from the green space to accommodate;

Possible loss of cycleway / cycle parking facilities in northern green space;

Junction capacity is unknown at this time, the additional service vehicles being put through the station taxi road arm may compromise the junction.

Option 03: Service road adjacent taxi rank

Option 03 also brings a service road from the basement connecting into the station taxi road but locates it adjacent the vehicle set down and taxi rank. Again, service vehicles will have a waiting / security area off the station taxi road as with Option 02 but situated nearer to the set down facility. The same principle for security and rejection is used as in Option 02.

Advantages:

Removes need for connection to Hampstead Road Bridge;

Removes / moves left turn conflict with cyclists on Hampstead road, moving the left turn conflict to a signalised junction where it is easier managed;

Allows for any type of bridge on Hampstead Road.

Disadvantages:

Mixing taxis and service vehicles on station taxi road;

Significantly reduces set down bay numbers form AP03 scheme - AP03 scheme : 11 bays; Option 03 scheme : 6 bays;

Severs connectivity to northern area for pedestrians;

Service road will require fencing after the security facilities. Fencing likely to need to be 2-3m in height along both sides of the service road;

Reduces taxi rank length from AP03 scheme;

Loses Toc parking facility.

Possible loss of cycleway / cycle parking facilities in northern green space;

Service road geometry requires large land take;

Junction capacity is unknown at this time, the additional service vehicles being put through the station taxi road arm may compromise the junction.

ASSUMPTIONS

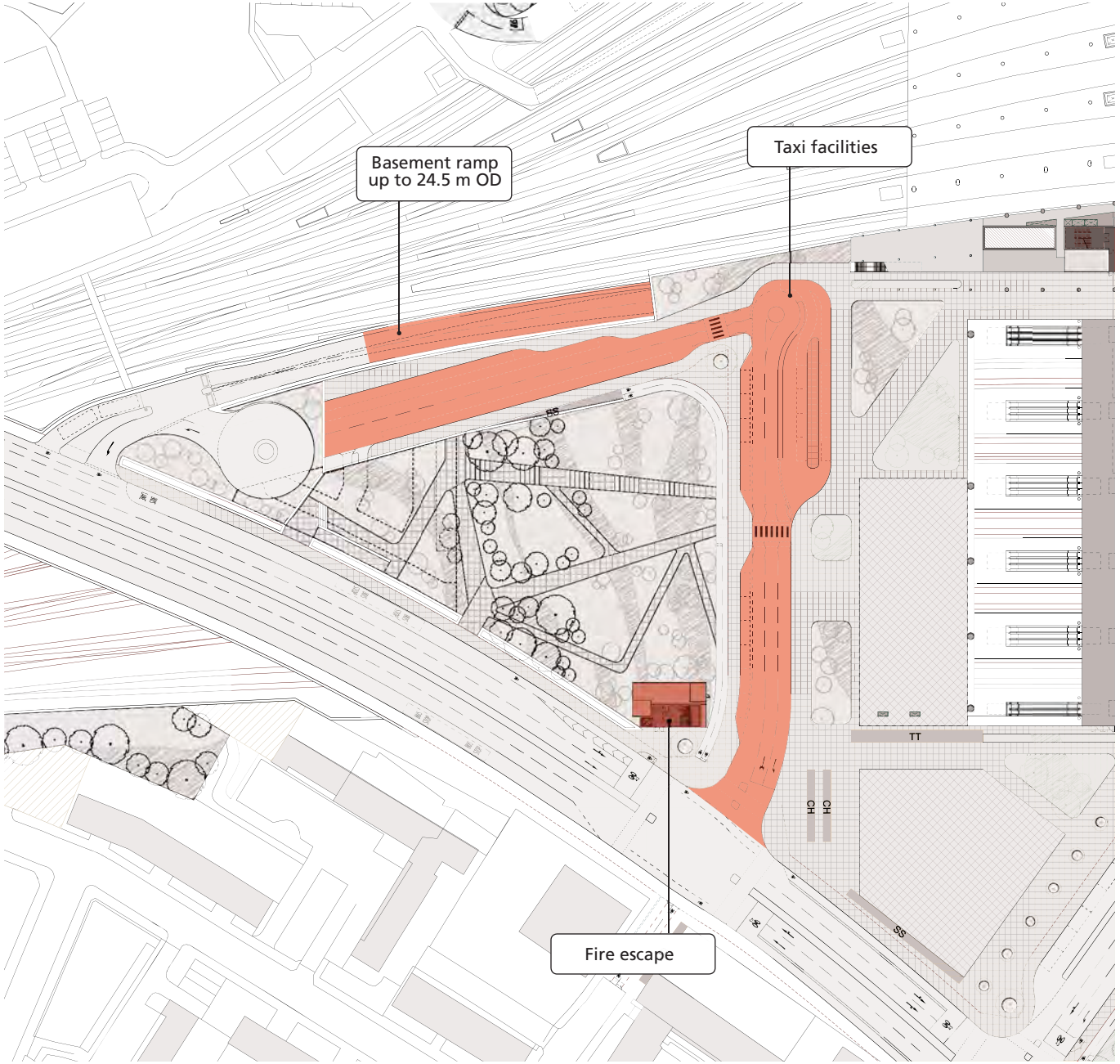
- Lowering HRB to around 24.0 m OD implies a need to change the bridge structure and the arrangement of the Northern Gardens.

1. Fix design elements: changing them would cause major coordination issues.

- Basement ramp: needs to stay as is up to +24.50 m OD;
- Taxi facilities: needs to stay in place but could be modified slightly.
- Northern fire escape: it connects all the subgrade levels thus changing it would mean reconfiguring basement and platform levels.

2. Flexible design elements: these elements could be rearranged according to the new configuration of HRB.

- TOC parking: it could be relocated if needs be.
- Bicycle parking could be redistributed accross the site if needs be.
- Northern gardens could be redesigned to adapt them to the new level changes.



GRIMSHAW - HS2 Euston

HRB Lowering - Possible layouts for the Northern gardens, taxi facilities and basement entrance.

Date - 04.04.2016
Scale 1:1000 @ A3
Sketch - For information
12016_SK_00470

Note: Sketch is indicative only to demonstrate design development.

Impacts on the Northern gardens

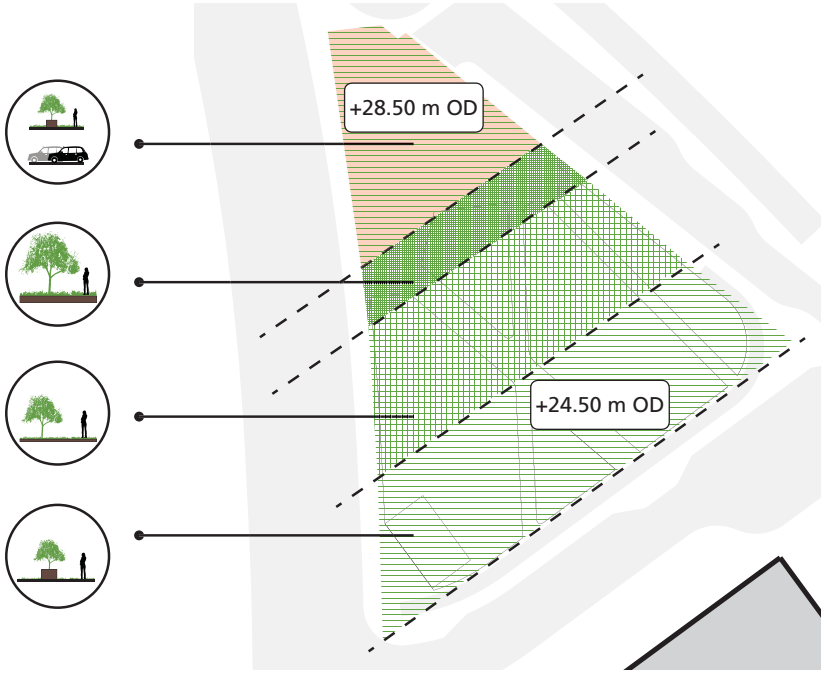
AP03 scheme

Car park below

Big trees - deep soil

Medium trees + grass

Planters are needed + grass



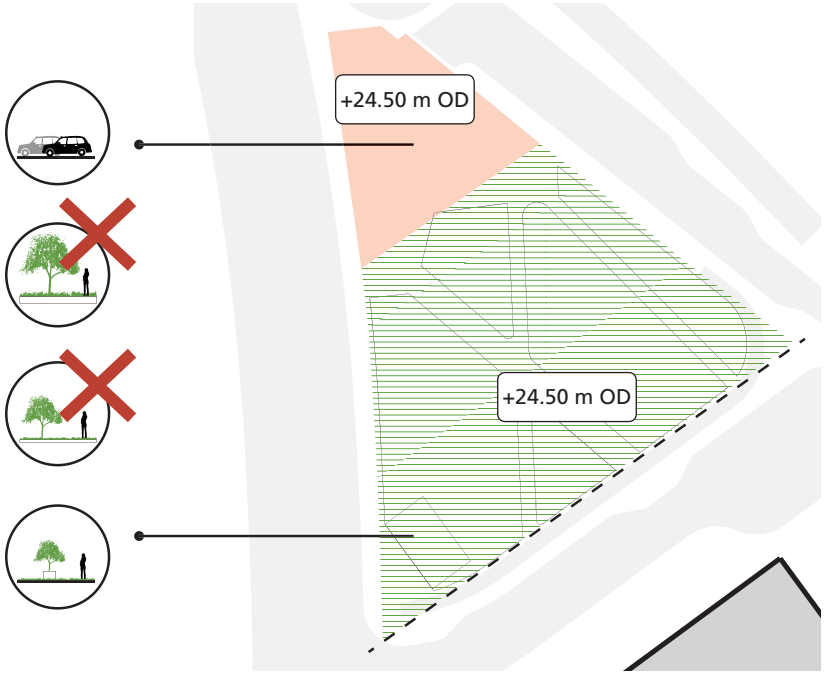
Lowering HRB

Car park at grade

Big trees - deep soil

Medium trees + grass

Planters are needed + grass



GRIMSHAW - HS2 Euston

HRB Lowering - Possible layouts for the Northern gardens, taxi facilities and basement entrance.

Date - 04.04.2016
Scale 1:1000 @ A3
Sketch - For information
12016_SK_00470

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GRIMSHAW - HS2 Euston

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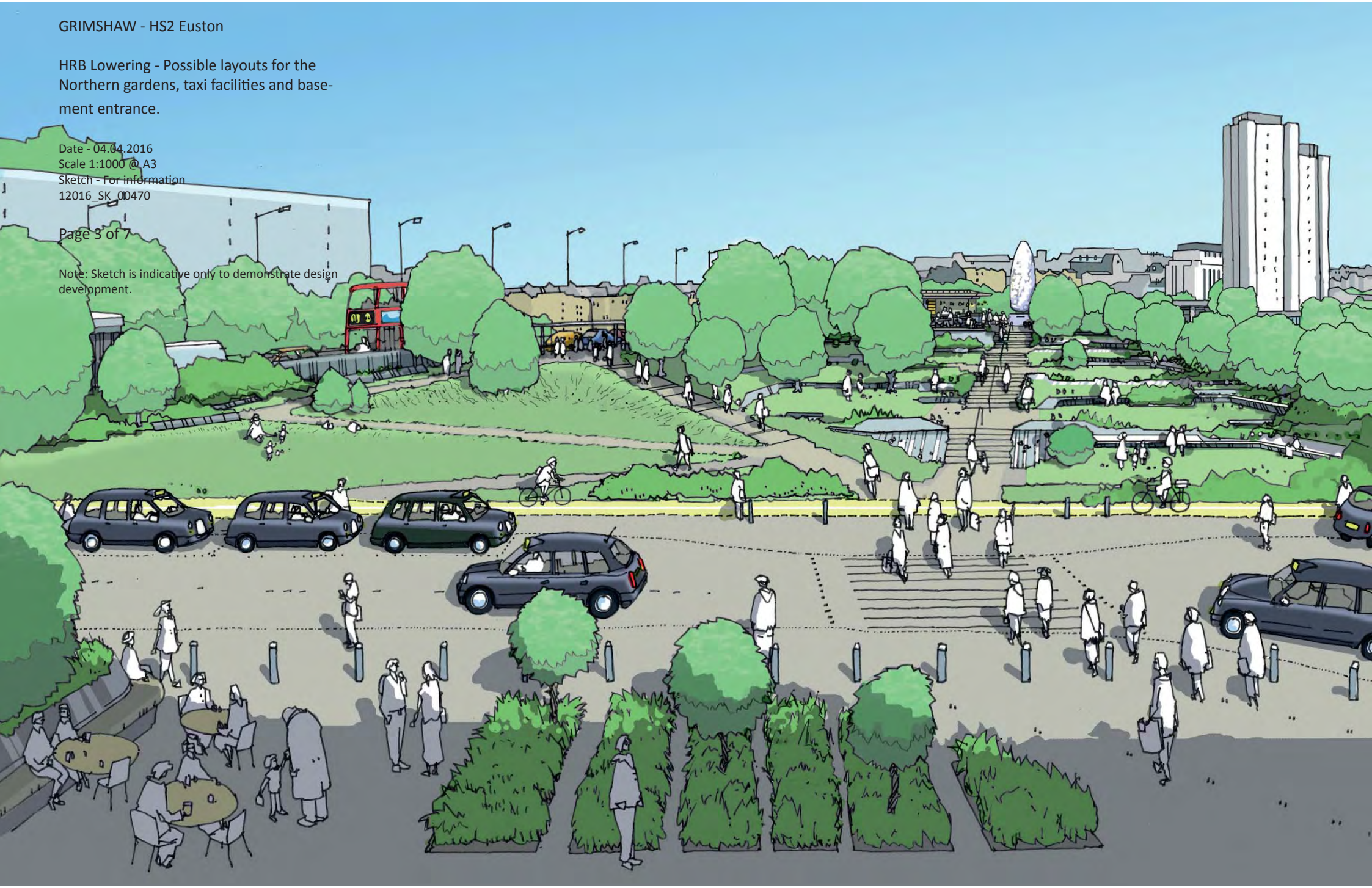
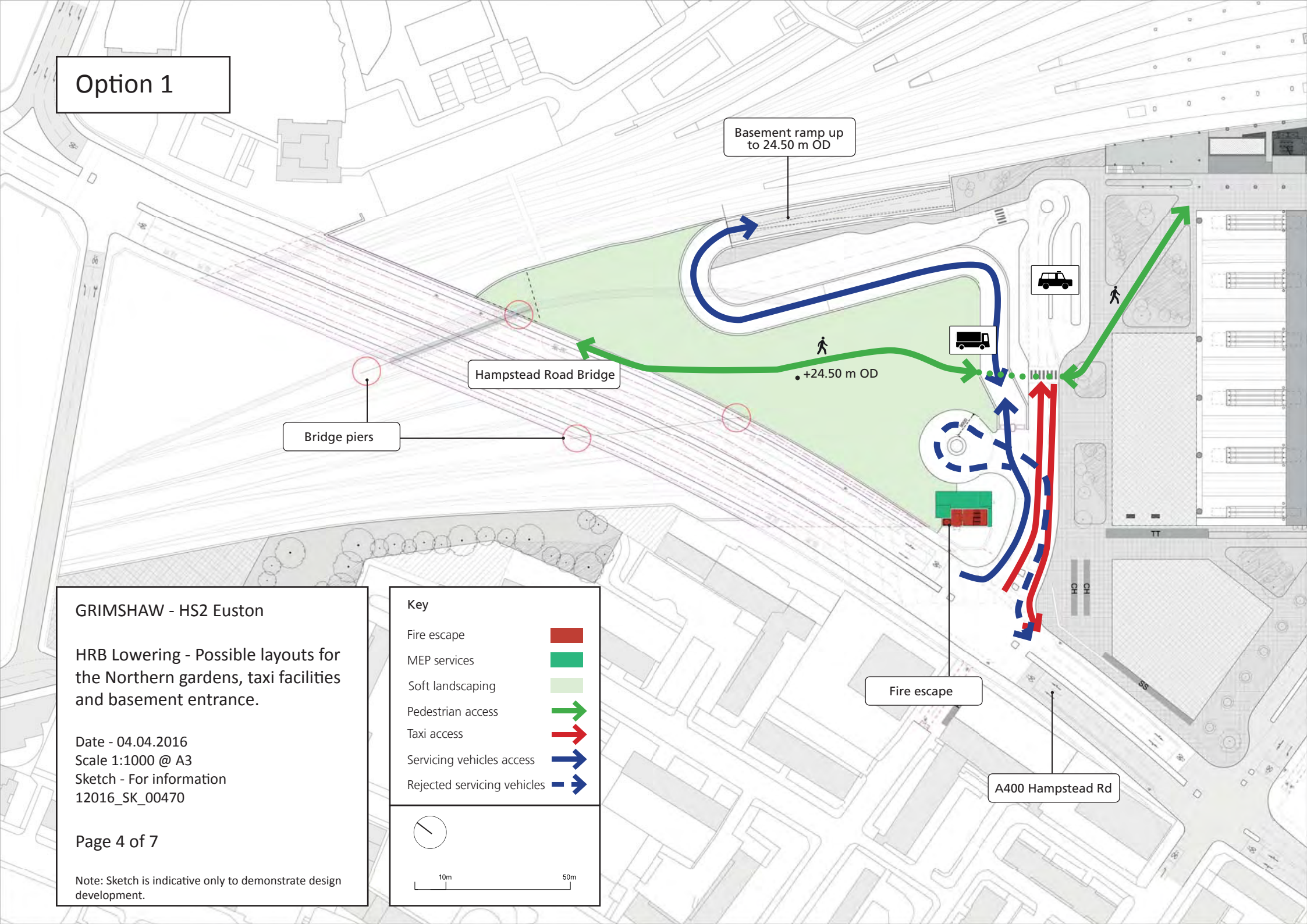


Option 1



GRIMSHAW - HS2 Euston

HRB Lowering - Possible layouts for the Northern gardens, taxi facilities and basement entrance.

Date - 04.04.2016
Scale 1:1000 @ A3
Sketch - For information
12016_SK_00470

Page 4 of 7

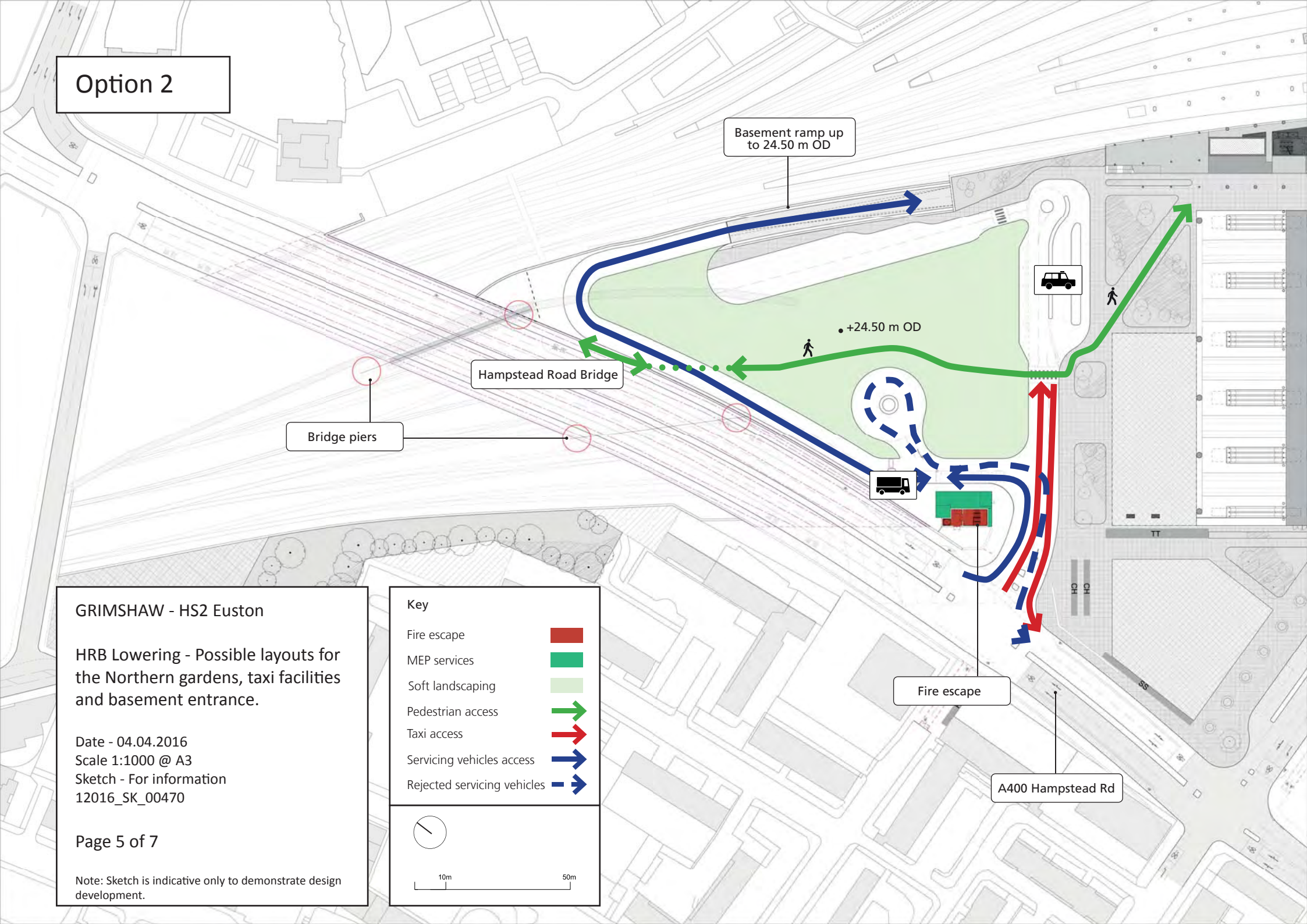
Note: Sketch is indicative only to demonstrate design development.

Key

- Fire escape
- MEP services
- Soft landscaping
- Pedestrian access
- Taxi access
- Servicing vehicles access
- Rejected servicing vehicles

10m 50m

Option 2



GRIMSHAW - HS2 Euston

HRB Lowering - Possible layouts for the Northern gardens, taxi facilities and basement entrance.

Date - 04.04.2016
Scale 1:1000 @ A3
Sketch - For information
12016_SK_00470

Page 5 of 7

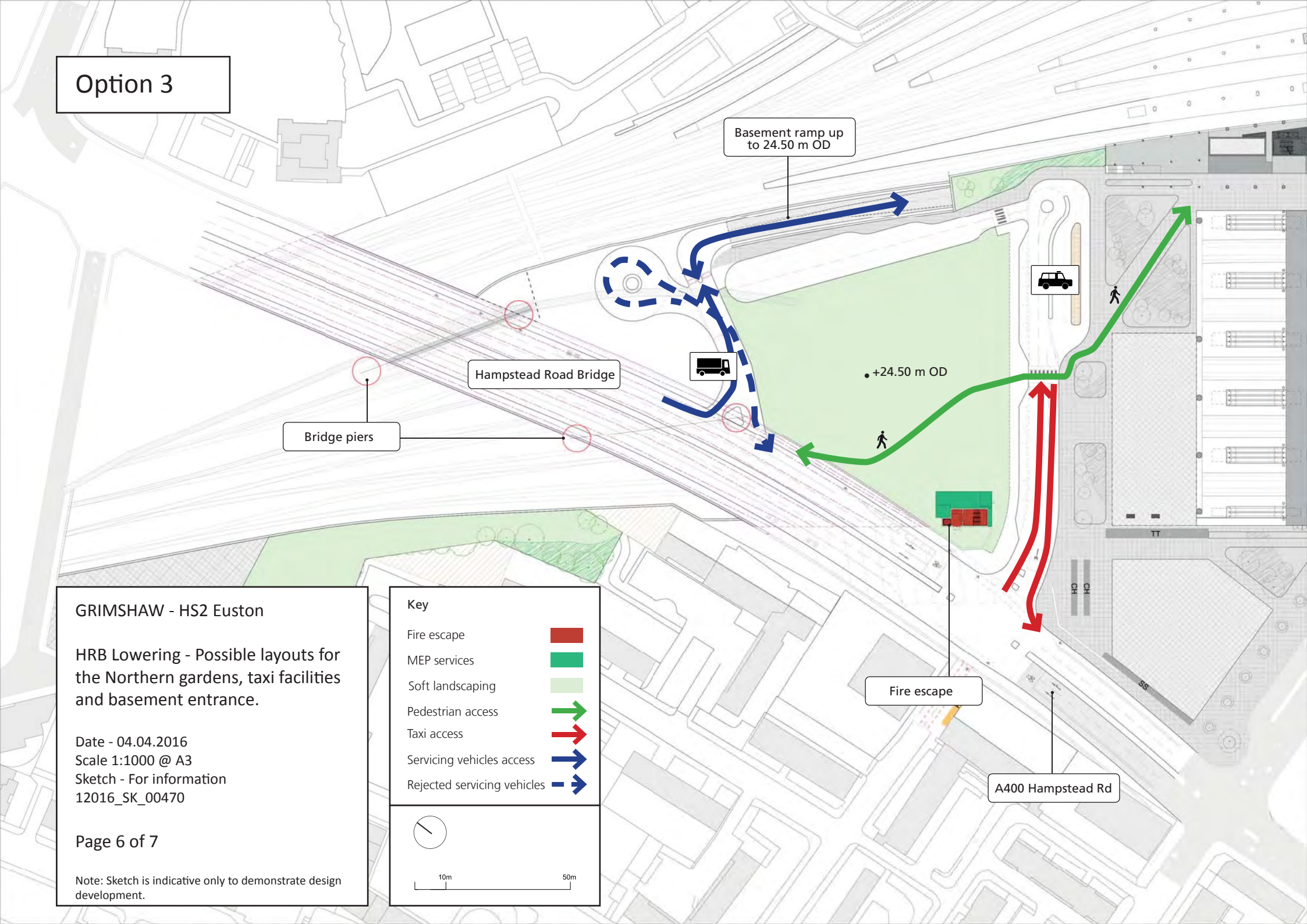
Note: Sketch is indicative only to demonstrate design development.

Key

- Fire escape
- MEP services
- Soft landscaping
- Pedestrian access
- Taxi access
- Servicing vehicles access
- Rejected servicing vehicles

10m 50m

Option 3



GRIMSHAW - HS2 Euston

HRB Lowering - Possible layouts for the Northern gardens, taxi facilities and basement entrance.

Date - 04.04.2016
Scale 1:1000 @ A3
Sketch - For information
12016_SK_00470

Page 6 of 7

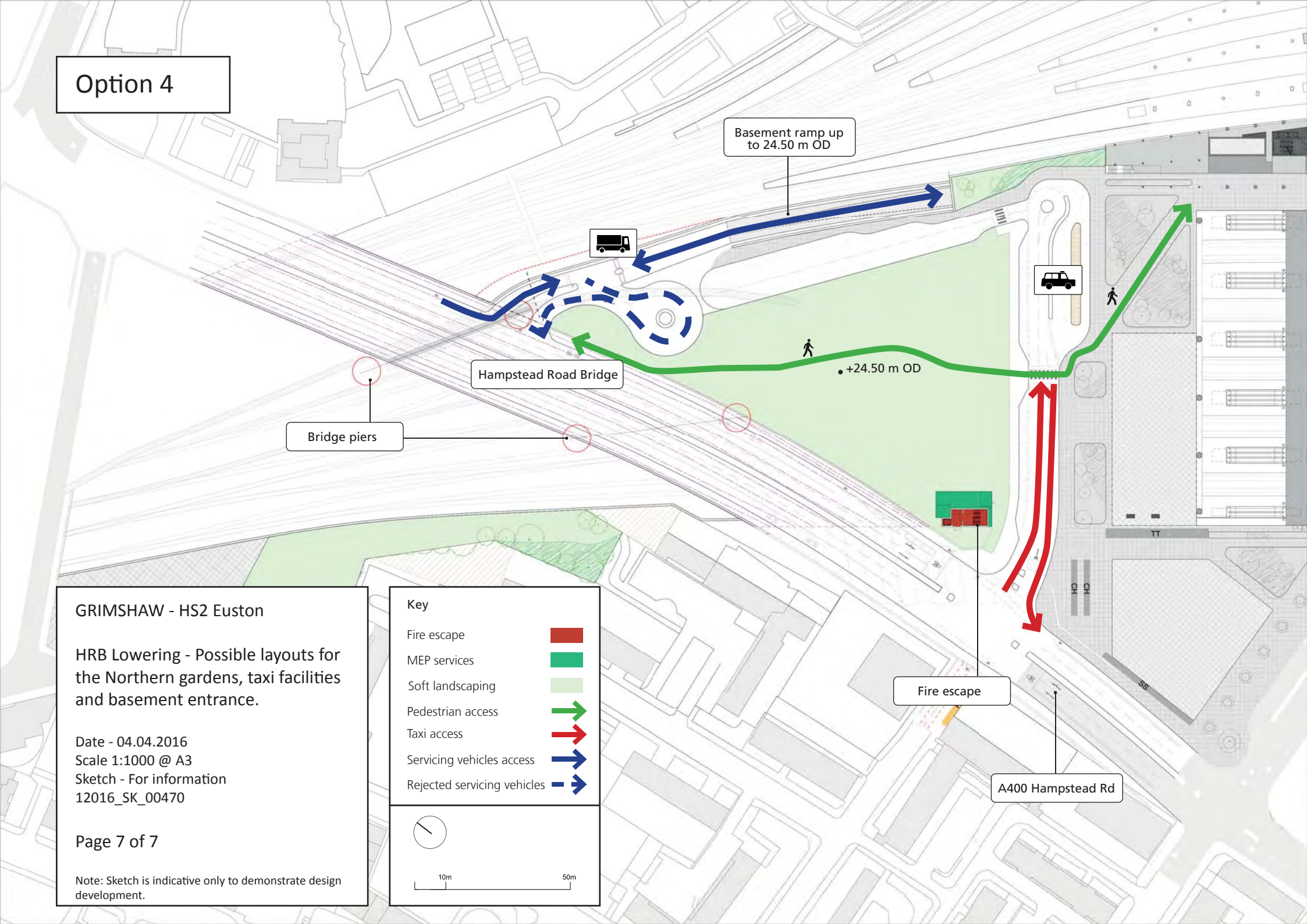
Note: Sketch is indicative only to demonstrate design development.

Key

- Fire escape
- MEP services
- Soft landscaping
- Pedestrian access
- Taxi access
- Servicing vehicles access
- Rejected servicing vehicles

10m 50m

Option 4



GRIMSHAW - HS2 Euston

HRB Lowering - Possible layouts for the Northern gardens, taxi facilities and basement entrance.

Date - 04.04.2016
Scale 1:1000 @ A3
Sketch - For information
12016_SK_00470

Page 7 of 7

Note: Sketch is indicative only to demonstrate design development.

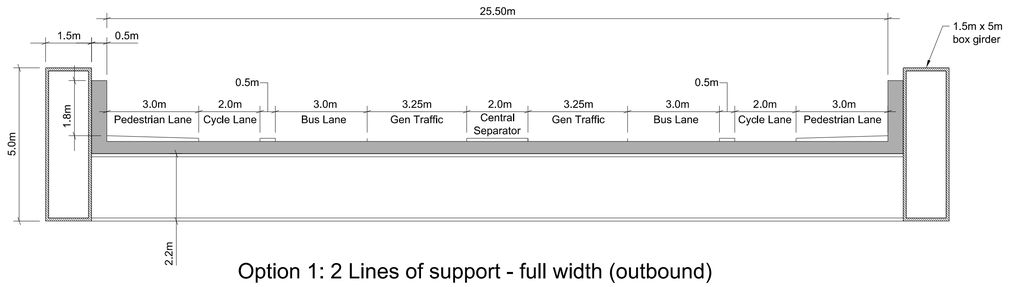
Key

- Fire escape
- MEP services
- Soft landscaping
- Pedestrian access
- Taxi access
- Servicing vehicles access
- Rejected servicing vehicles

10m 50m

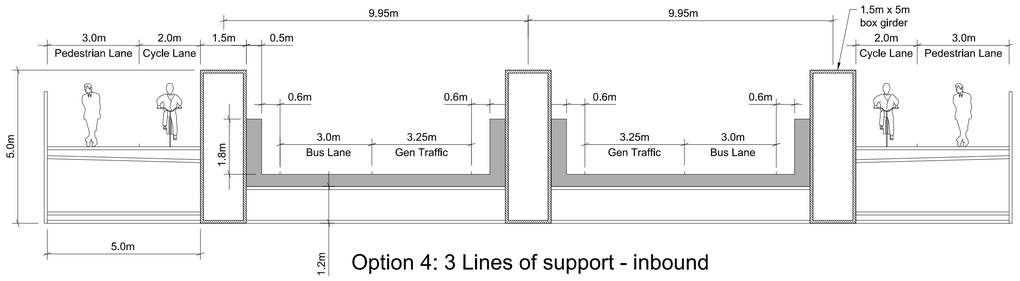
		AP03		Option 01	Option 02	Option 03	Option 04
Bridge Structure	**HRB Structure flexibility**	AP03 design is incompatible with lowering HRB for structural reasons		Structure is independent from ramp entrance	Structure is independent from ramp entrance	Ramp entrance location on top of one of the bridge piers might imply that some structure options need to be discarded.	Ramp entrance location on top of one of the bridge piers might imply that some structure options need to be discarded.
Transport	**Lanes between station and green space**	3 lanes for the taxi facilities		5 + security wall. The green open space is almost inaccessible from the South.	3 lanes for the taxi facilities + 2 lanes for the servicing entrance. The green open space becomes an island.	3 lanes for the taxi facilities	3 lanes for the taxi facilities
	Taxis disruption	Two separate entrances for taxis and servicing vehicles.		Taxis and servicing vehicles share the connection to A400 Hampstead road bridge. Limited taxi rank.	Taxis and servicing vehicles share the connection to A400 Hampstead road bridge. Limited taxi rank.	Two separate entrances for taxis and servicing vehicles. Limited taxi rank.	Two separate entrances for taxis and servicing vehicles. Limited taxi rank.
	Servicing efficiency	81 m from Hampstead Road to basement ramp		223 m from Hampstead Road to basement ramp	249 m from Hampstead Road to basement ramp	72 m from Hampstead Road to basement ramp	78 m from Hampstead Road to basement ramp
	TOC parking	1,200 sqm of TOC parking located below the Northern gardens.		The TOC parking would either need to be relocated somewhere else or kept in place substracting 1,200 sqm from the green space.	The TOC parking would either need to be relocated somewhere else or kept in place substracting 1,200 sqm from the green space.	The TOC parking would either need to be relocated somewhere else or kept in place substracting 1,200 sqm from the green space.	The TOC parking would either need to be relocated somewhere else or kept in place substracting 1,200 sqm from the green space.
	Bike parking	Bicycle parking facility.		The bicycle facility would need to be relocated somewhere else or redistributed across the site.	The bicycle facility would need to be relocated somewhere else or redistributed across the site.	The bicycle facility would need to be relocated somewhere else or redistributed across the site.	The bicycle facility would need to be relocated somewhere else or redistributed across the site.
	General safety	Controlled junctions and segregated traffic favour pedestrian general safety.		Congested junctions + more vehicle traffic at grade compromise pedestrian general safety.	Congested junctions + more vehicle traffic at grade compromise pedestrian general safety.	Controlled junctions and segregated traffic favour pedestrian general safety.	Controlled junctions and segregated traffic favour pedestrian general safety.
Fire	**Fire escape**	The fire escape is a fix element.		The fire escape is a fix element.	The fire escape is a fix element.	The fire escape is a fix element.	The fire escape is a fix element.
Green space	**Soft landscaping area**	5870 m2		6095 m2 (There is not enough soil depth for planting trees).	5723 m2 (There is not enough soil depth for planting trees).	6154 m2 (There is not enough soil depth for planting trees).	6898 m2 (There is not enough soil depth for planting trees).
	Accessibility	Level changes compromise accessibility.		Flat surfaces are in general easily accessible.	Flat surfaces are in general easily accessible.	Flat surfaces are in general easily accessible.	Flat surfaces are in general easily accessible.

Appendix D - 5a sub-options sketch



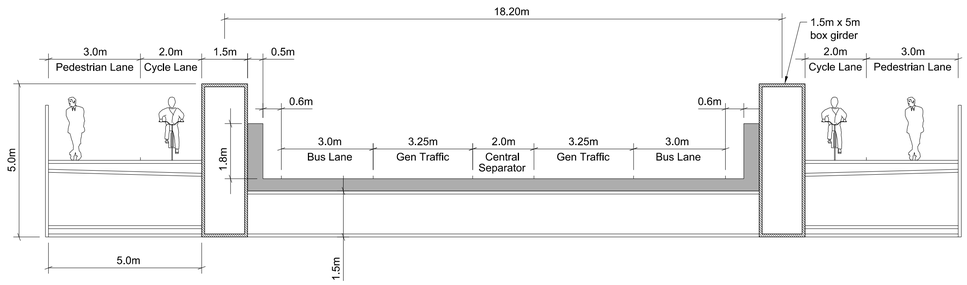
Option 1: 2 Lines of support - full width (outbound)

1-1 - Section
Scale 1:100



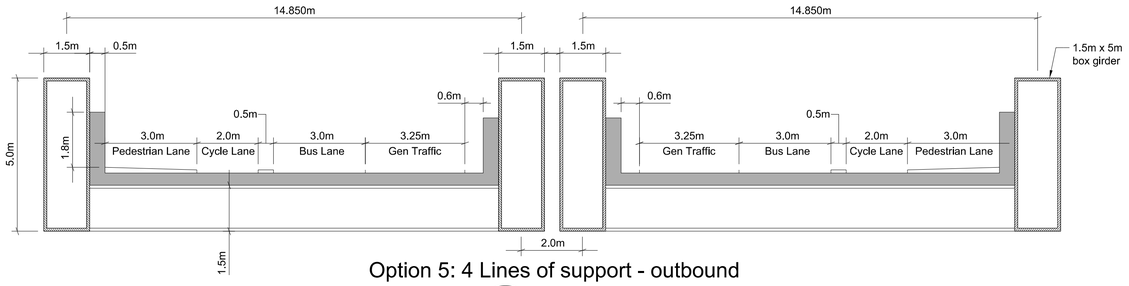
Option 4: 3 Lines of support - inbound

4-4 - Section
Scale 1:100



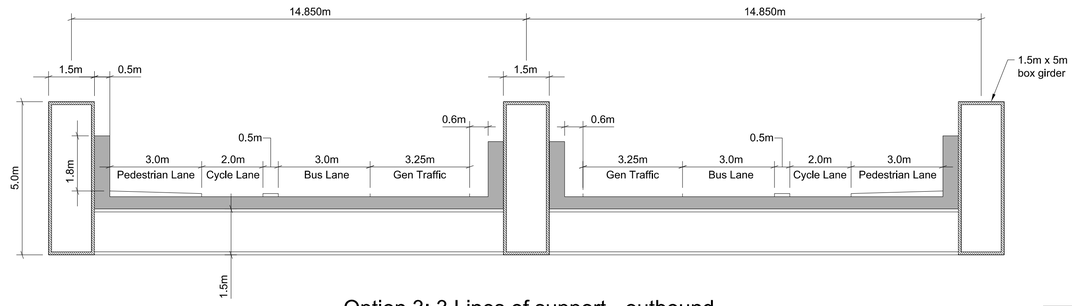
Option 2: 2 Lines of support - cantilevers (inbound)

2-2 - Section
Scale 1:100



Option 5: 4 Lines of support - outbound

5-5 - Section
Scale 1:100



Option 3: 3 Lines of support - outbound
* If 4 lines of support space between the two brides for the flanges to fit

3-3 - Section
Scale 1:100

Cross sections of half - through girders sub - options

Work-in-progress

Rev	Description	Drawn	Checked	Con App	HS2 App
P00.1		---			

Legends/Notes:

Notes:

All dimensions and sizes are indicative

Registered In England
Registration No. 06791686
Registered office:
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Creator/Originator
Ove Arup & Partners International Ltd

Zone: Euston Approach

Design Stage: ERD

Drawing Title: Hampstead Road Bridge Options - Lowering Sections

Project/Contract: Euston Tunnels and Approaches

Discipline/Function: Bridges

Drawn	Checked	Approved
RP		

Date	Scale	Size
13/05/2016	AS SHOWN	A1

Drawing No.: P1S1-ARP-BR-DSK-SS01_SL12-228059

Rev.: P00.1

Appendix E - Permanent utilities bridge options

The existing A400 Hampstead Road overbridge (HRB) carries many utilities, with major trunk routes for main utility companies (TWUL, BT, NGG and UKPN), as well as many other telecoms companies. Any redesign of HRB will need to consider the impact on utilities and consultation will be necessary with all utility companies to incorporate their requirements.

Following the submission of AP03, further bridge options have been assessed, namely maintaining the existing HRB and extending it with a new arch or new plate girder bridge.

This appendix summarises the various impacts on the utilities and considers options with respect to different bridge options.

Table 7 identifies both the existing utilities within HRB and the proposed permanent diversion necessary as a result of HS2 Ltd.'s proposals.

Existing and proposed utilities within HRB

Table 7: Existing and proposed utilities within HRB

Existing Utilities in HRB							**Permanent diversion in HRB**											
															Pipe Sleeve			
UDR Ref.	**Company**	**No.**	**Dia.**	**Material**	**Utility**	**Bridge Side**	**Route**	**Bridge Side**	**No. ducts / pipe**	**comment**	**Dia.**			**Material**	**Utility**	**Nom D mm**	**OD mm**	**ID mm**	**Spacer mm**
EUS-01-0008	BT	9	4"	Duct	Telecoms	East / South bound	Hampstead Road Bridge	West / Northbound	9	from network design	110	mm	OD		telecoms				
		39	4"	Duct	Telecoms	West / North bound	Hampstead Road Bridge	West / Northbound	36	from network design	110	mm	OD		telecoms				
EUS-01-0028	NGG	1	18"	steel	low pressure gas main	West / North bound	Hampstead Road Bridge	West / Northbound	1	from network design	500	mm	ND	PE in steel sleeve	low pressure gas main	700	680	711	56
		1	125 mm	PE	low pressure gas main	East / South bound													

Existing Utilities in HRB							**Permanent diversion in HRB**											
															Pipe Sleeve			
UDR Ref.	**Company**	**No.**	**Dia.**	**Material**	**Utility**	**Bridge Side**	**Route**	**Bridge Side**	**No. ducts / pipe**	**comment**	**Dia.**			**Material**	**Utility**	**Nom D mm**	**OD mm**	**ID mm**	**Spacer mm**
EUS-01-0037	TWUL	1	16"	C.I.	Trunk water main	East / South bound	Hampstead Road Bridge	West / Northbound	1	from AP03	634 (tbc)	mm	ND	PE in steel sleeve	Trunk water main (due to OSD demand)	800	813	778	56
		1	6"	C.I.	Distribution water main	East / South bound	Hampstead Road Bridge	West / Northbound	1	from AP03	315 (tbc)	mm	ND	PE in steel sleeve	Distribution water main	500	508	478	56
		1	6"	C.I.	Distribution water main	West / North bound													
EUS-01-0053	UKPN	5	?		LV and HV	West / North bound	Hampstead Road Bridge	West / Northbound	5 (tbc)						LV and HV				
		8	?		LV and HV	East / South bound	Hampstead Road Bridge	West / Northbound	8 (tbc)						LV and HV				

Existing Utilities in HRB							**Permanent diversion in HRB**											
															Pipe Sleeve			
UDR Ref.	**Company**	**No.**	**Dia.**	**Material**	**Utility**	**Bridge Side**	**Route**	**Bridge Side**	**No. ducts / pipe**	**comment**	**Dia.**			**Material**	**Utility**	**Nom D mm**	**OD mm**	**ID mm**	**Spacer mm**
		18	?	Oil filled cables	HV and 66kV EHV	Utility / cable bridge	Hampstead Road Bridge	West / Northbound	2 x 7	two HV banks to have 1000mm separation centre to centre of outermost ducts					HV				
									2 x 3	two 66kV banks with 450mm separation centre - centre of inner most duct	160	mm	OD		66kV XLPE				
									2 x 1		125	mm	ID		pilot				
									2 x 1		100	mm	ID		pilot				
xxxx	UKPN	-	-	-	New HS2 station supply from St	-	Hampstead Road Bridge	East / Southbound	4 (tbc)		148	mm	OD		11kV				

Existing Utilities in HRB							Permanent diversion in HRB									Pipe Sleeve			
UDR Ref.	**Company**	**No.**	**Dia.**	**Material**	**Utility**	**Bridge Side**	**Route**	**Bridge Side**	**No. ducts / pipe**	**comment**	**Dia.**			**Material**	**Utility**	**Nom D mm**	**OD mm**	**ID mm**	**Spacer mm**
					Pancras sub														
EUS-01-0010	BSkyB	0	?	Duct	Telecoms	N/A	Hampstead Road Bridge	West / Northbound	2	from network design	100	mm	OD	PVC	Telecoms from GTB				
EUS-01-0014	Vodafone (C&W)	?	?	Duct	Telecoms	East / Southbound	Hampstead Road Bridge	West / Northbound	6	from network design	96.5	mm	OD	PVC	Telecoms				
EUS-01-0016	Colt	4 (assumed, as indicated by C3 response)	?	Duct	Telecoms	West / Northbound	Hampstead Road Bridge	West / Northbound	2	from network design	96.5	mm	OD	PVC	Telecoms				

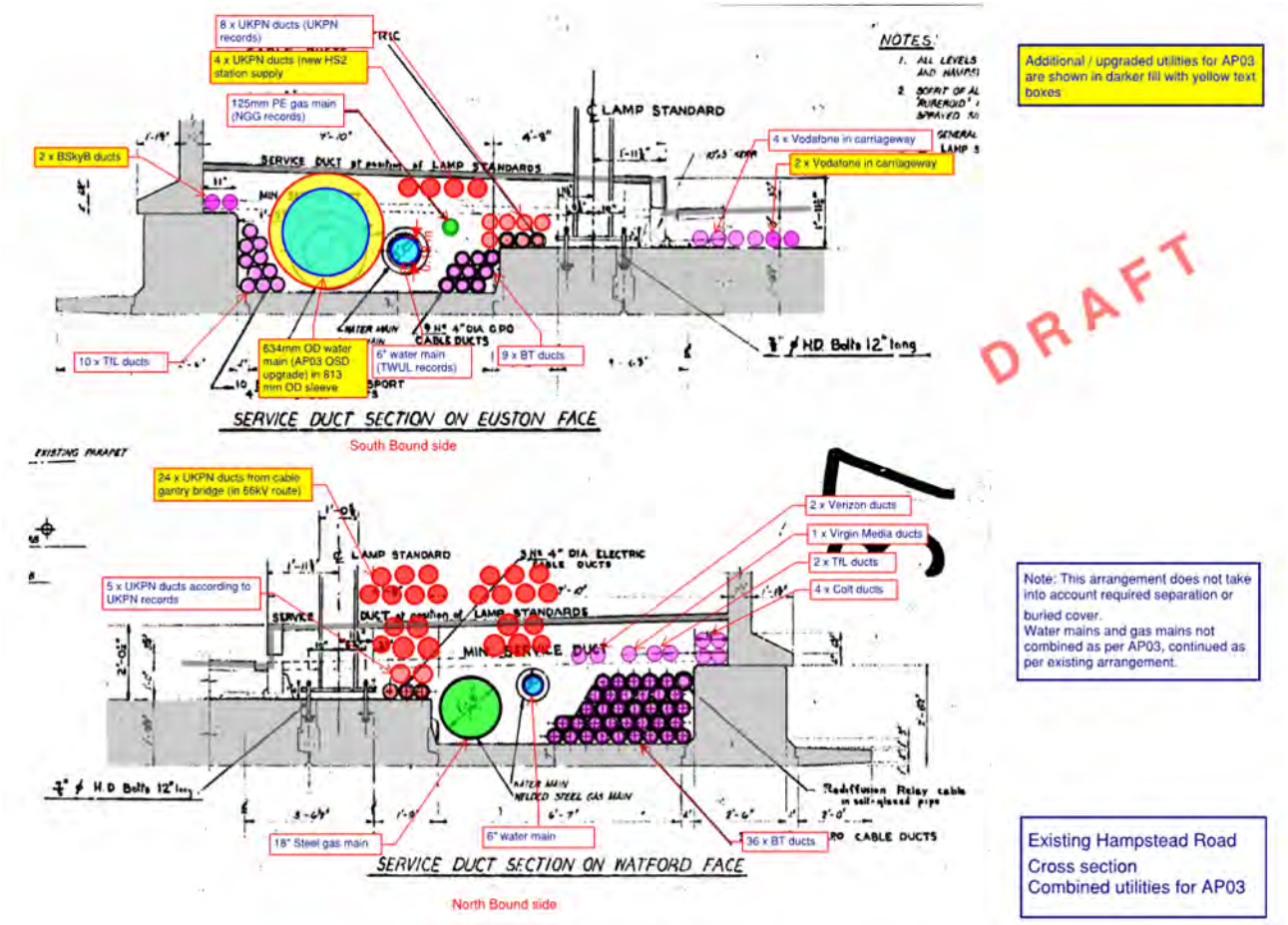
Existing Utilities in HRB							**Permanent diversion in HRB**												
															Pipe Sleeve				
UDR Ref.	**Company**	**No.**	**Dia.**	**Material**	**Utility**	**Bridge Side**	**Route**	**Bridge Side**	**No. ducts / pipe**	**comment**	**Dia.**			**Material**	**Utility**	**Nom D mm**	**OD mm**	**ID mm**	**Spacer mm**
EUS-01-0022	Level 3	?	?	Duct	Telecoms	Utility / cable gantry	Track level diversion	-	-	Track level diversion	-	-	-	-					
EUS-01-0057	Verizon	?	?	Duct	Telecoms	West / North bound	Hampstead Road Bridge	West / Northbound	2	from network design	110	mm	OD	PVC	Telecoms				
EUS-01-0063	Virgin Media	2	?	?	Telecoms	East / South bound	Hampstead Road Bridge	West / Northbound	2	from network design					Telecoms				
		3	110 mm OD	Duct	Telecoms	West / North bound													
Other	TfL	10	4"		Traffic signalling	East / South bound	Hampstead Road Bridge	West / Northbound	4 (tbc)	from record plans	110				Traffic Signalling				

Reference numbers cross refer to report C220-ARP-UT-REP-01A-00003, AP03 Euston Incremental Staging Option: Utilities Design Report (UDR).

Existing Utilities

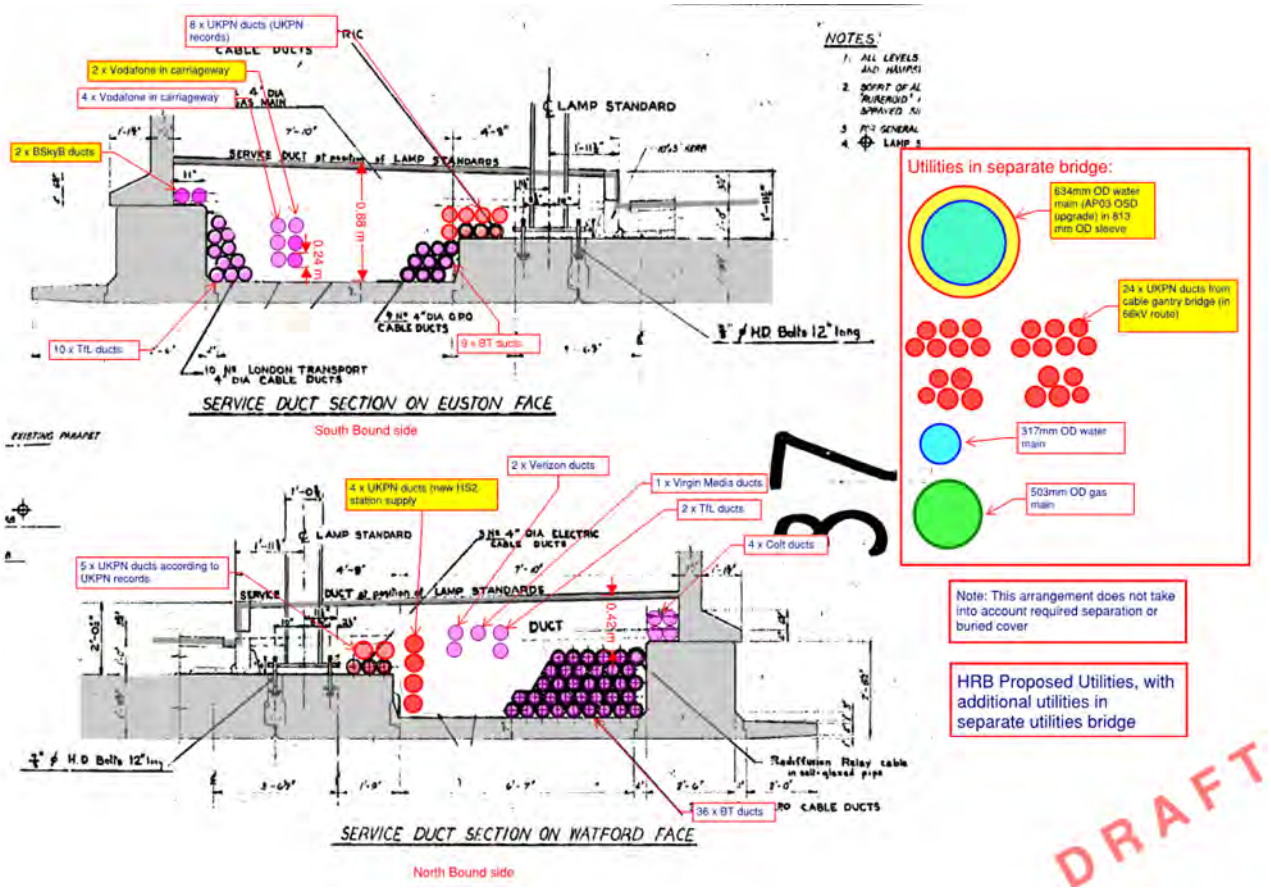
The existing HRB carries utilities within both footways. There is insufficient space for the additional and upgraded utilities from AP03 to be incorporated in to the existing HRB footways. Existing utilities are shown in the cross sections below with the additional and upgraded utilities noted in yellow boxes.

Figure 28: Cross section of existing HRB with all utilities including additional and upgraded utilities from AP03



As a consequence of the insufficient space, a permanent utilities bridge was considered to take these additional and upgraded utilities. The utilities considered and the effect on the existing HRB cross section is shown below.

Figure 29: Cross section of existing HRB with additional and upgraded utilities from AP03 located within a permanent utilities bridge

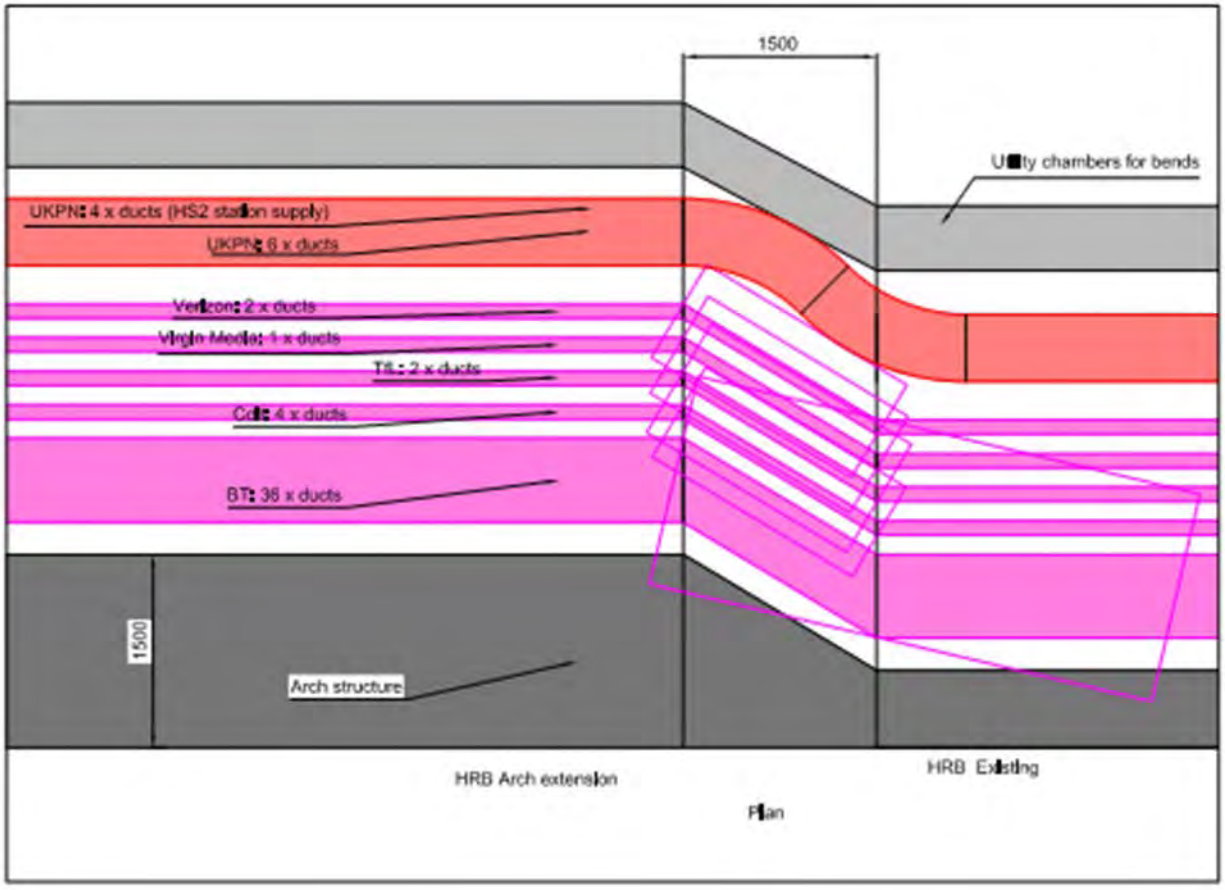


HRB interface between existing and new bridges

With the extension of the HRB, two options for the extension were considered; an arch option and plate girder option. The utilities would remain within the footway, but there would be an interface between new and existing bridges that would need to be considered. These interfaces are shown below.

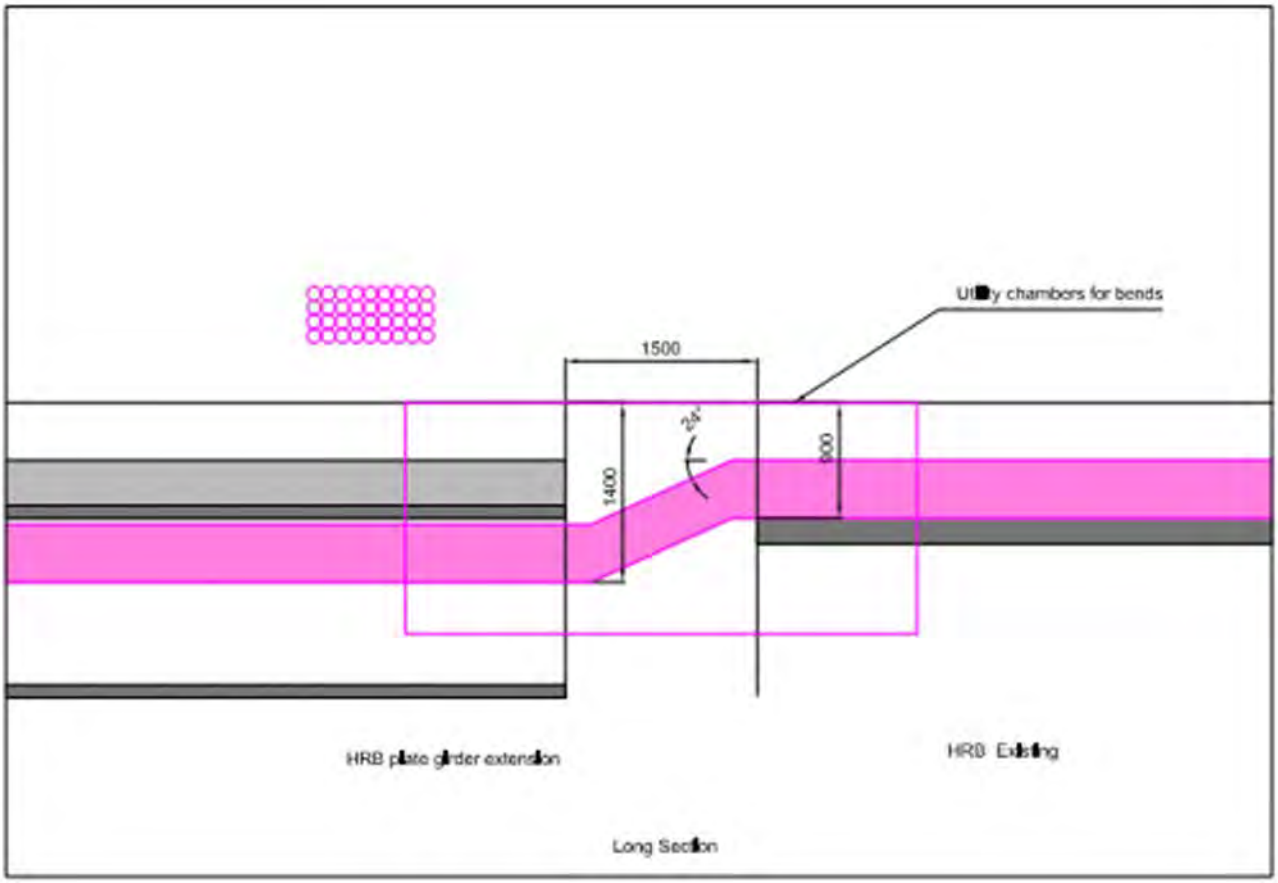
The arch option would have the arch structure at the kerbline. This would require utilities to bend at the interface to meet the existing HRB footway. Due to space constraints, it would not be feasible to do this given the number and size of utilities and chambers. BT in particular would require a large chamber due to the number of their ducts.

Figure 30: Plan of the interface of the existing and new HRB and routing of utilities.



The plate girder option would have similar problems for utilities at the interface between the new and existing HRB. With a plate girder option, the utilities would be below the deck and the utilities would need to bend and rise up to the position of the utilities in the existing HRB. Chambers would be required for each individual utility to make this vertical transition due to the bends. There is insufficient space for all chambers. BT in particular would require a large chamber due to the number of their ducts. This is shown below.

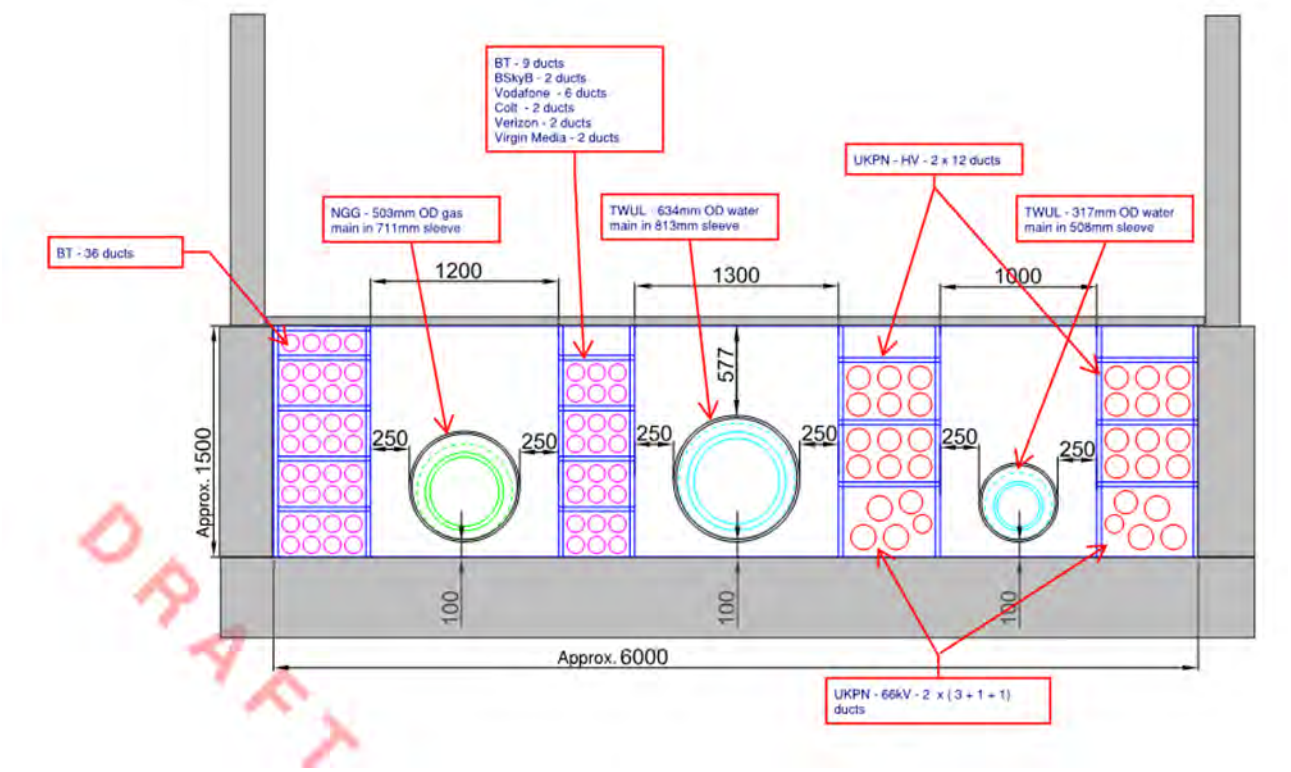
Figure 31: Long section of the interface of the existing and new HRB and routing of utilities.



Permanent Utility Bridge

As the horizontal and vertical transition issues (stated previously) preclude utilities being maintain in the bridge, the permanent utilities bridge will need to accommodate all utilities with just minor utilities remaining within the existing bridge such as LV for street lighting as well as traffic signalling. A cross section of the permanent utility bridge is below. This arrangement takes into account some information that has been provided by the utility companies, such as separation between two BT duct banks for diversity and separation between UKPN HV and EHV duct banks. This arrangement has not been discussed with any of the utility companies, but would require discussion and agreement if taken further.

Figure 32: Cross section of permanent utility bridge



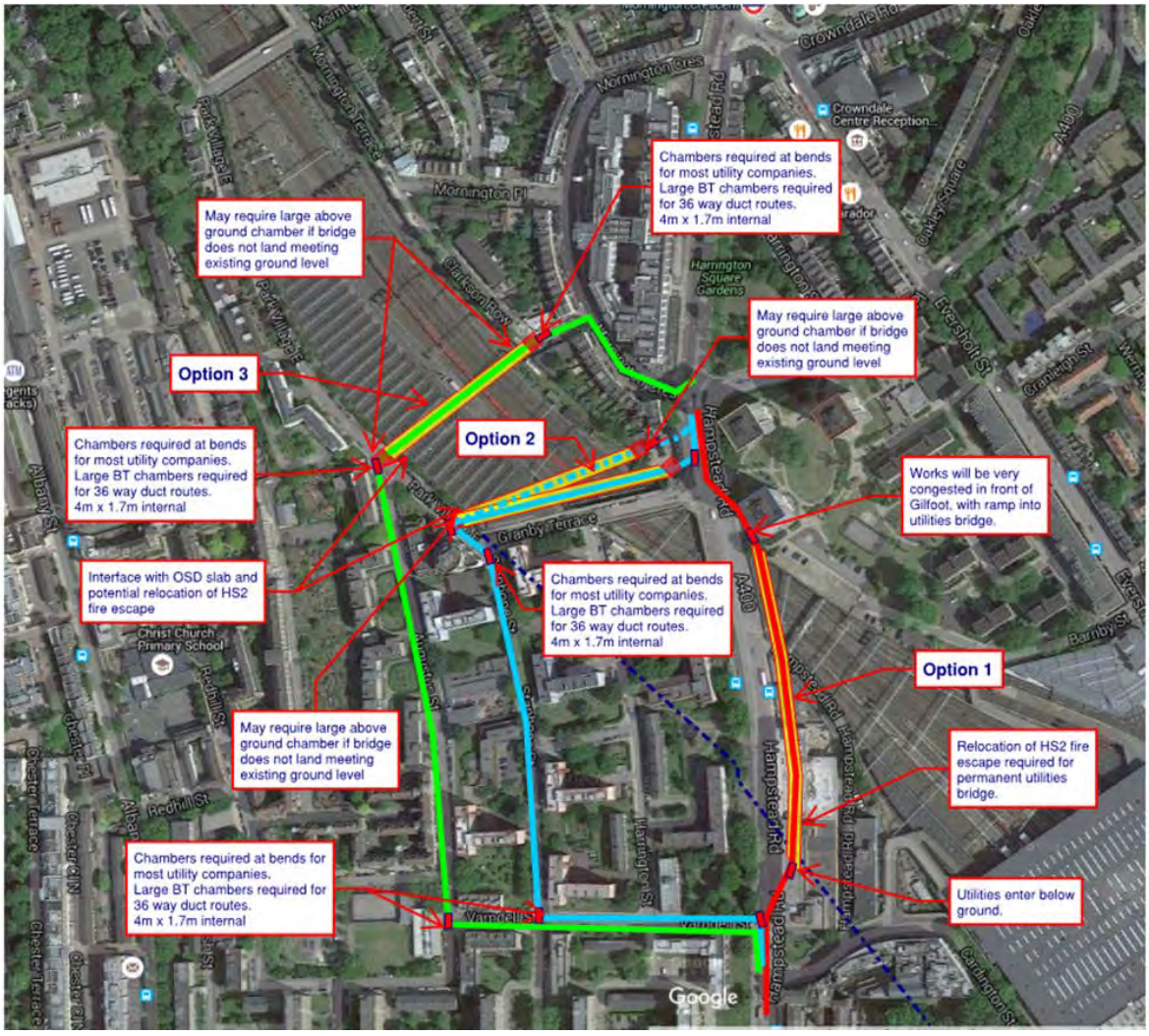
Permanent Utility Bridge routes

There were a number of locations considered for the permanent utility bridge. Three options are shown below. They each have their complexities and issues. HRB is not just a major traffic route, but many of the utilities main trunk routes go across HRB as well.

- Option 1 is adjacent to HRB on the south / east side.
- Option 2 is adjacent to GTB on the north / west side with utilities routed through Varndell Street and Stanhope Street.
- Option 3 is further north from GTB with utilities routed through Varndell Street, Augustus Street, Clarkson Row and Mornington Crescent.

All options would require discussion with the utility companies to ensure that the routing would be acceptable for their networks.

Figure 33: Route options for the permanent utility bridge

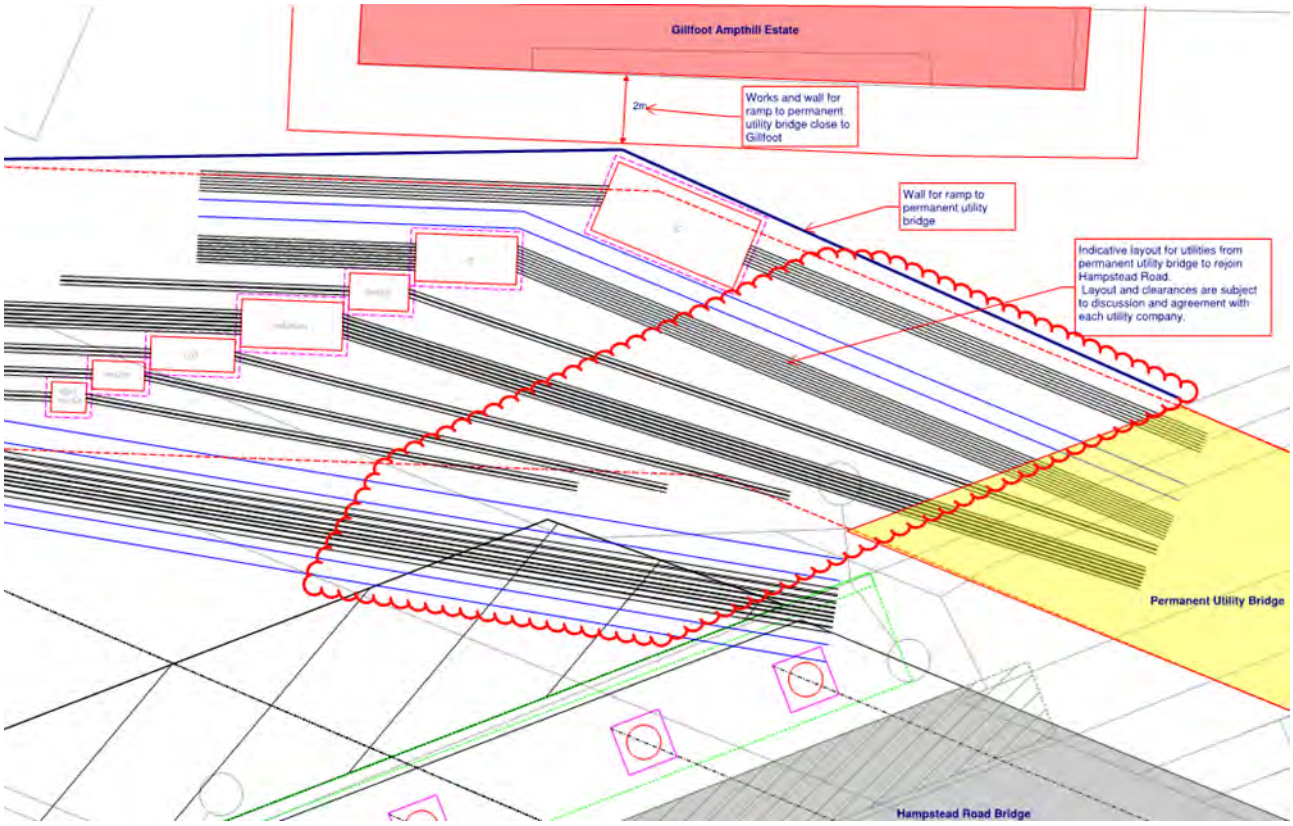


Option 1 – South side of HRB.

This route has the following impacts:

- A ramp would be require in front of Gillfoot to rejoin the utilities from the permanent utility bridge into A400 Hampstead Road. The ramp will be approximately 2m high at the bridge.
- The number and size of utilities will require multiple chambers near the bridge. This makes the ramp very wide and will require works very close to the entrance of Gillfoot.
- The HS2 fire escape, adjacent to the taxi rank at the south end, along with the triangular area will require relocating / redesigning to allow for the permanent utility bridge to go through this area.

Figure 34: Plan of utilities arrangement for permanent utility bridge (north side)

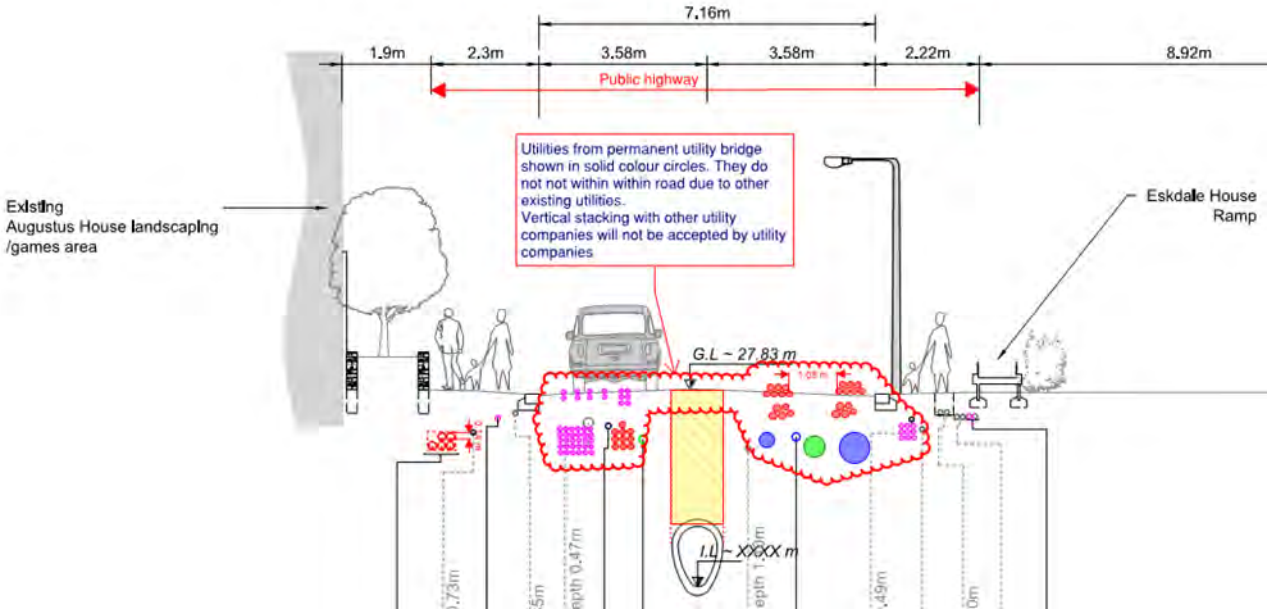


Option 2 – North of GTB

This route has the following impacts:

- Large amount of utilities to be added to Stanhope Street and Varndell Street. The cross section below shows that the utilities swill not physically fit given the number and size of utilities. This cross section does not take into account existing and proposed chambers and manholes, BT will require large manholes due to number of ducts.
- The bridge on the western side of the tracks will have an interface with the OSD slab and would require repositioning / redesign of the HS2 fire escape.
- Where the bridge lands at Park Village East, a large above ground chamber may be required due to the height of the bridge above the tracks. This would have an impact on the road alignment.

Figure 35: Cross section of Stanhope Street with additional utilities from permanent utility bridge



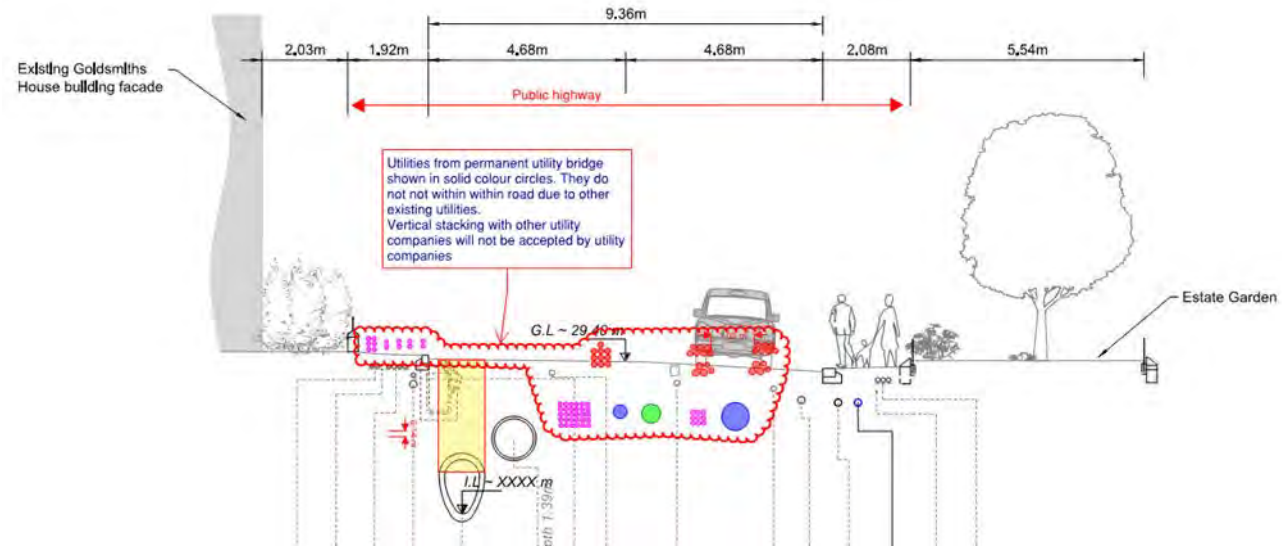
Based on the above, this option is considered unfeasible.

Option 3 – Further north of GTB

This route has the following impacts:

- Large amount of utilities to be added to Augustus Street and Varndell Street (to the south) and Clarkson Row and Mornington Crescent (to the north). The cross section below shows that the utilities will not physically fit given the number and size of utilities. This cross section does not take into account existing and proposed chambers and manholes. BT will require large manholes due to number of ducts.
- The bridge on the western side of the tracks will have an interface with the OSD slab and would require repositioning / redesign of the OSD plots.
- Where the bridge lands at Park Village East and Clarkson Row, a large above ground chamber may be required due to the height of the bridge above the tracks. This would have an impact on the road alignment.

Figure 36: Cross section of Stanhope Street with additional utilities from permanent utility bridge



Based on the above, this option is considered unfeasible.

Risks and considerations

Risks:

Utility companies will not accept the proposed arrangements of either the permanent utilities bridge or realigned HRB due to:

- Confined space for access;
- Clearances / spacing between their own utilities as well as other companies;
- Combination of utilities in shared space (eg UKPN near NGG / telecoms). This would require a joint agreement between utility companies in this shared space;
- Combination impact on maintenance and operation of their assets;
- Routing of utilities impacting their networks; and
- Other reasons.

Considerations / caveats

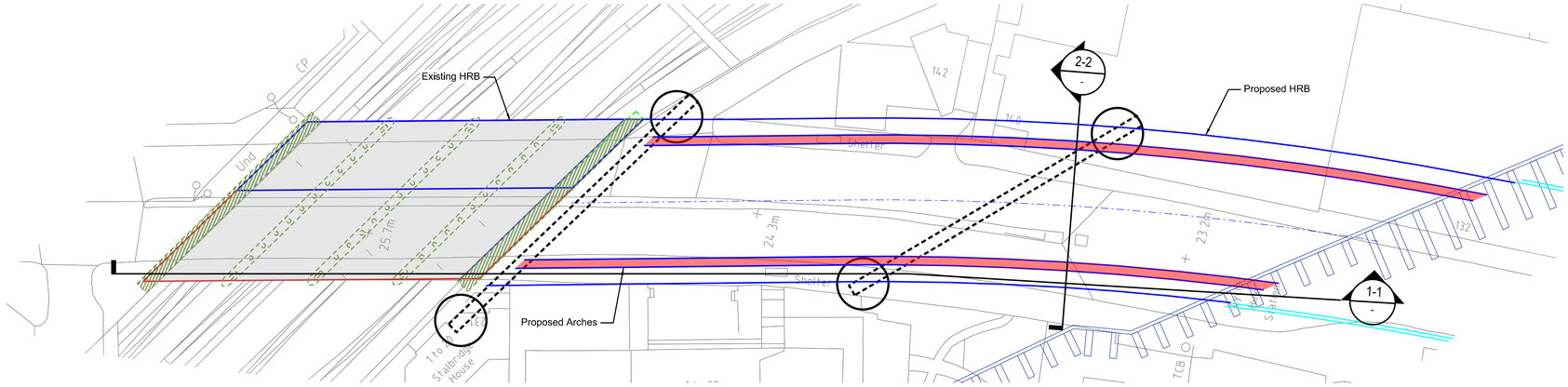
- All utility numbers and sizing are based on AP03 and further discussions with utility companies since then;
- Should the water mains have a high point along the bridge, this will require air valves through the bridge deck;
- Arrangement of utilities with bridges and approach will need to discussed and agreed with the utility companies;
- Further design will be required combined with detailed design;
- Details of the interface at the bridge abutments are subject to further design and considerations given to accessibility for maintenance and repairs; and
- Combined kerb / drainage system is acceptable to TfL, otherwise a gully and pipe system will be required which will have impacts on the bridge design.

Appendix F – Option 7 sub-options

Key:

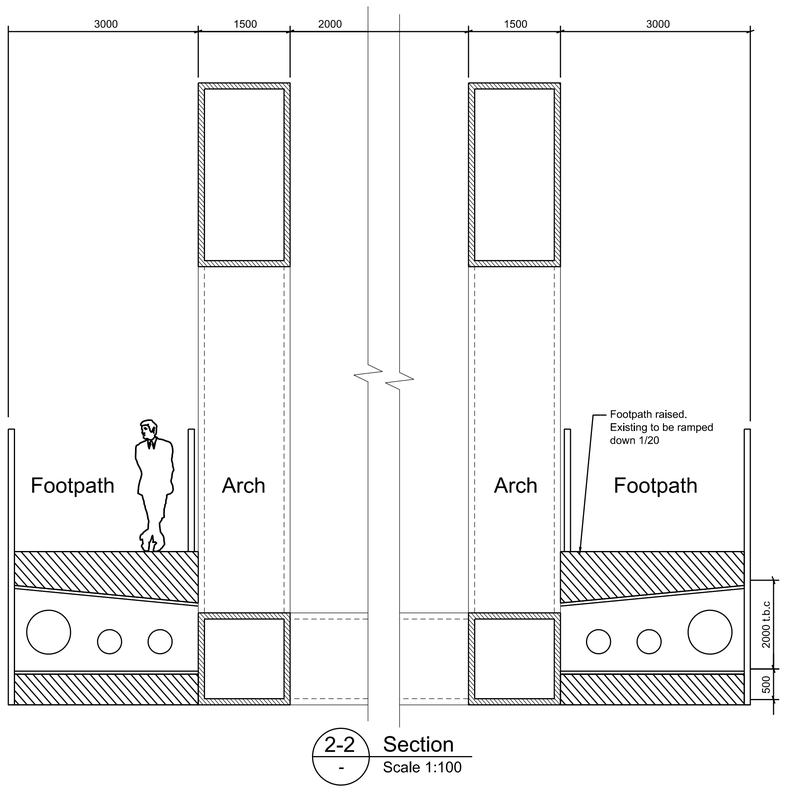
Location of Arches

Caissons

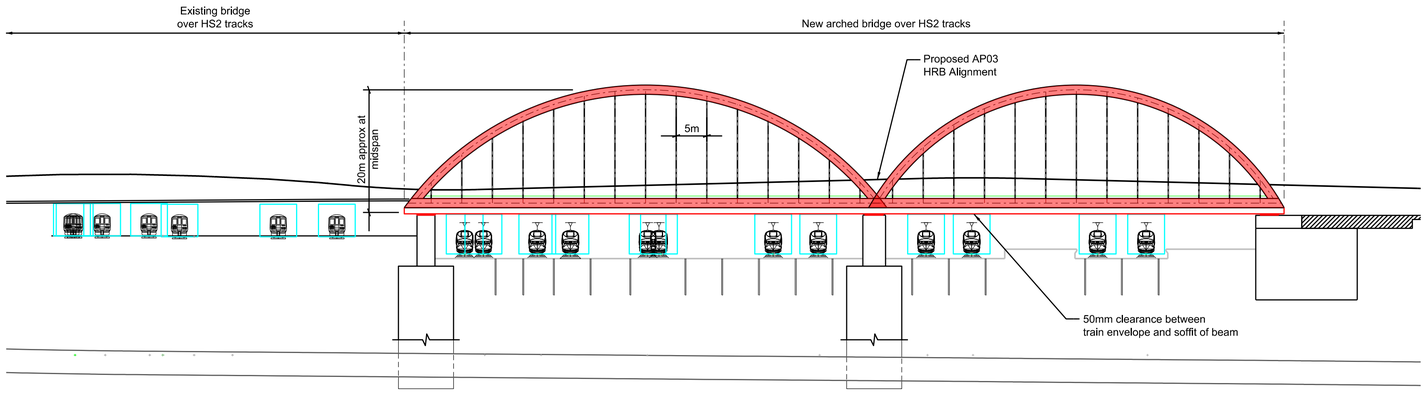


Plan
Scale 1:500

A permanent utilities bridge will be required with this scheme



2-2 - Section
Scale 1:100



1-1 - Elevation
Scale 1:350

Rev	Description	Drawn	Checked	Con App	HS2 App

Legends/Notes:

Registered in England
Registration No. 06791686
Registered office:
One Canada Square,
London, E14 5AB

Creator/Orlginator
Ove Arup & Partners International Ltd

Zone: Euston Approach

Design Stage: ERD

Drawing Title: New Arched Bridge Option

Project/Contract: Euston Tunnels and Approaches

Discipline/Function: Bridges

Drawn	Checked	Approved

Date	Scale	Size
	AS SHOWN	A1

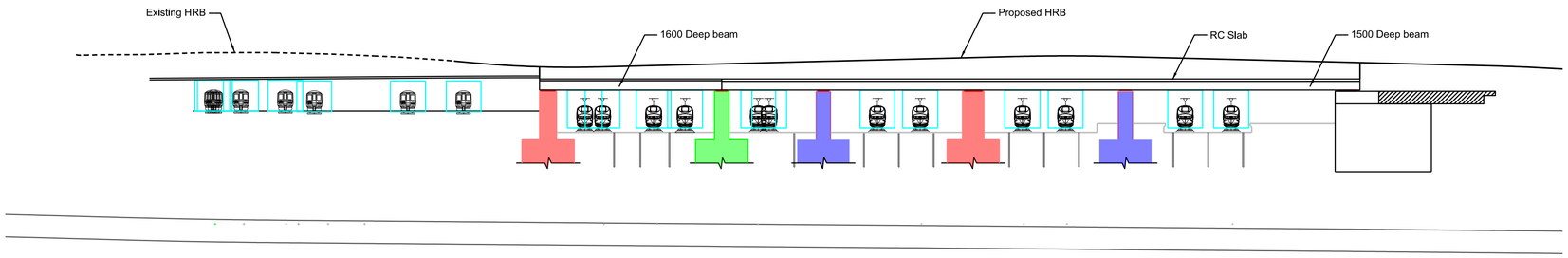
Drawing No.: SKETCH 0013

Rev.

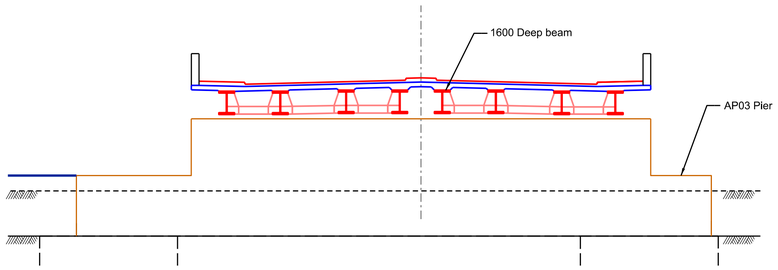
AP03 proposed piers

Additional proposed piers

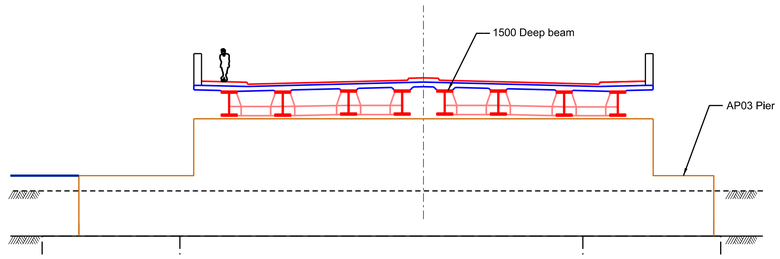
Additional half pier



1-1 Elevation
Scale 1:500

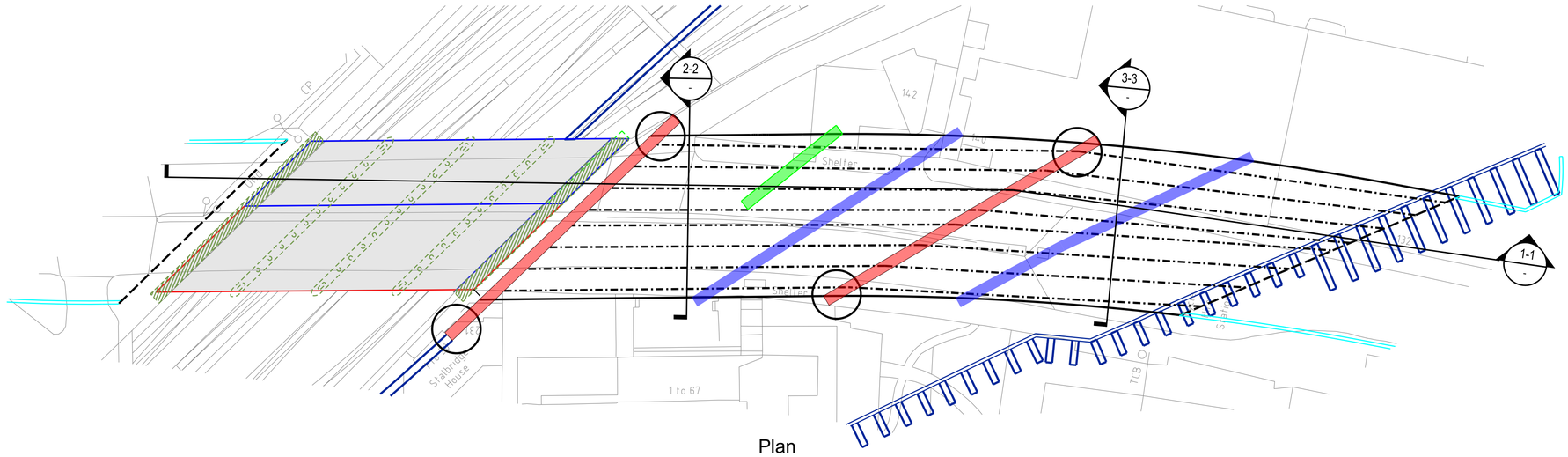


2-2 Section
Scale 1:200



3-3 Section
Scale 1:200

A permanent utilities bridge will be required with this scheme



Plan
Scale 1:500

Rev	Description	Drawn	Checked	Con App	HS2 App

Legends/Notes:

Registered in England
Registration No. 06791686
Registered office:
One Canada Square,
London, E14 5AB

Creator/Originator
Ove Arup & Partners International Ltd

Zone: Euston Approach

Design Stage: ERD

Drawing Title: Existing Bridge and Additional Piers

Project/Contract: Euston Tunnels and Approaches

Discipline/Function: Bridges

Drawn	Checked	Approved

Date	Scale	Size
	AS SHOWN	A1

Drawing No.: SKETCH 0014

Rev.:

Appendix G – Impact on material by rail

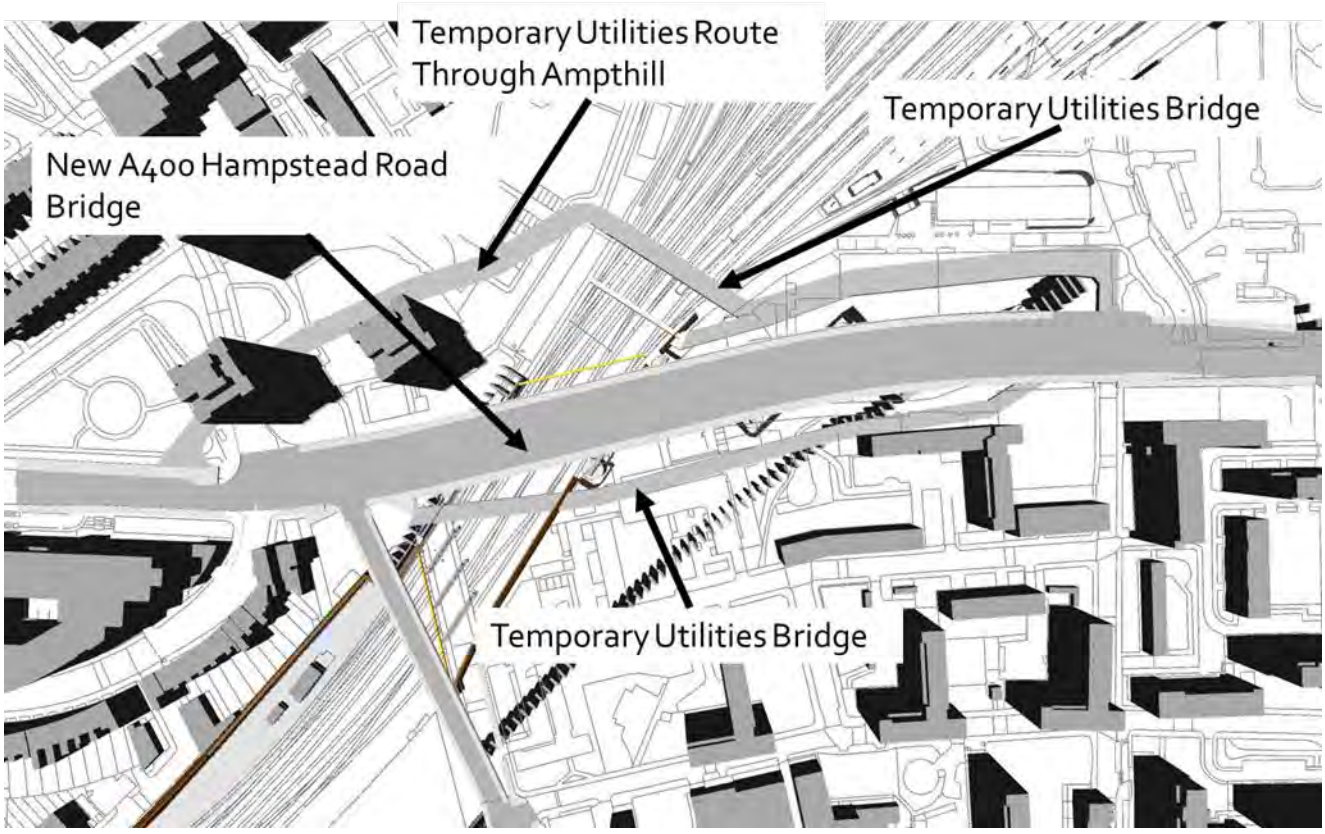
This appendix summarises the relationship between the options remaining after the second sift of options and the separate CAU of transporting material by rail.

Material by Rail – Constraints and Considerations in hB September 2015 scheme

The main benefit of transporting material by rail is to reduce the number of Heavy Goods Vehicles from HS2 Euston on London's roads and the subsequent traffic and environmental impacts.

The possibility and volume of material transported by rail is closely linked to the construction sequence and timing of activities. For example, the temporary utilities routes prevent excavation of Zone 5 or Area 2 and hence make excavation of these zones on or close to the project critical path and too late for Material by Rail.

Figure 37: hB September 2015 scheme and Material by Rail



The Material by Rail study conducted under the CAU work stream concluded that transporting material by rail requires change to the hB September 2015 construction sequence to enable removal by sidings and/or the use of platforms 13 and/or 18 within the Network Rail Station footprint.

Refer to EIPB Material by Rail report for further information.

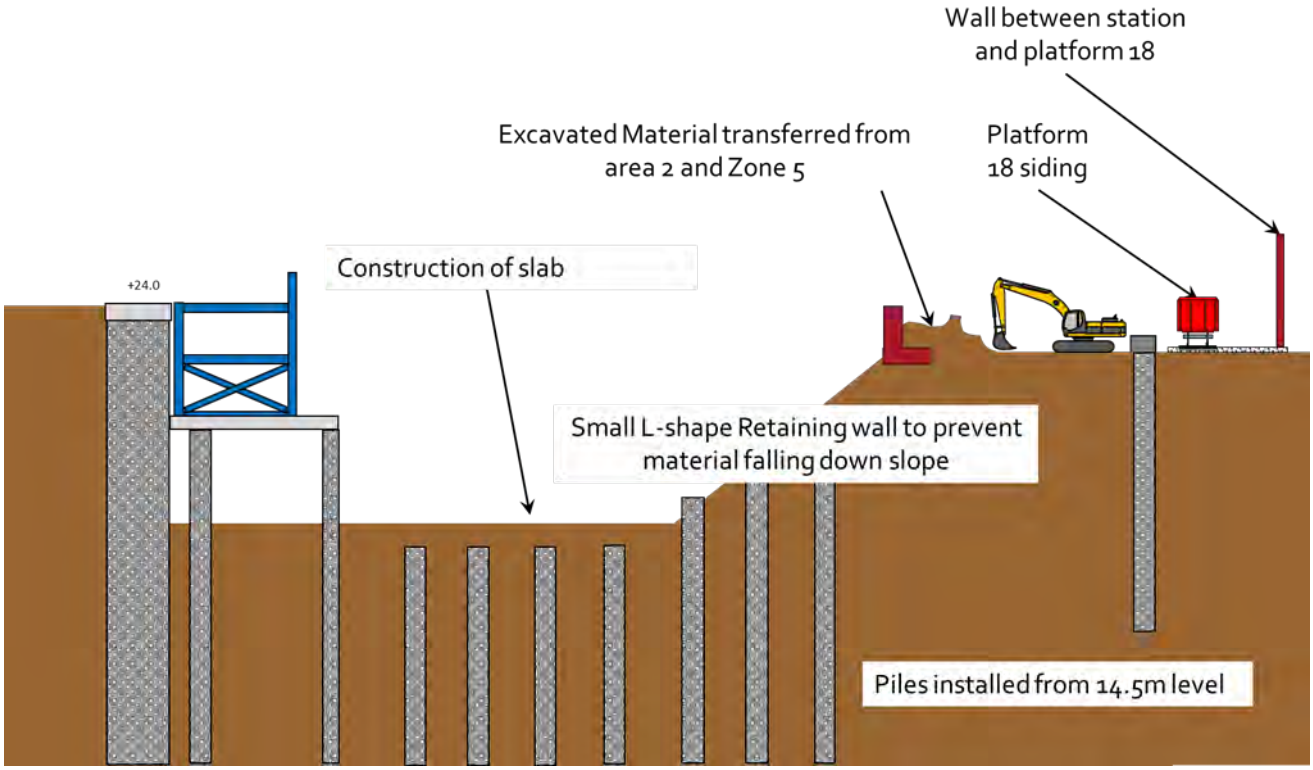
The various options considered for the lowering of HRB adopt different construction sequences and result in different milestones to those of the hB baseline programme. The impact that these options may have on transporting material by rail was therefore considered.

Option 1 – HRB realigned

It is envisaged that the option 1 programme is as such that the works to HRB are finished in Q2 2021 which enables the excavations works of Zone 5 to start at that time.

In addition, Option 1 does not require a temporary diversion of utilities hence, Area 2 and Zone 5 can be excavated by rail (approx. 110,000 to 140,000m3) as access to Platform 18 siding it is still available through berm by platform 18 as shown in the figure below:

Figure 38: Option 1 and Material by Rail



Option 5a-5 – Half-through girders

Option 5a-5 follows the same plan alignment and phased construction sequence as the baseline hB September 2015 scheme and does not benefit the overall construction programme.

Option 5a-5 also requires the temporary diversion of utilities as proposed in the baseline scheme.

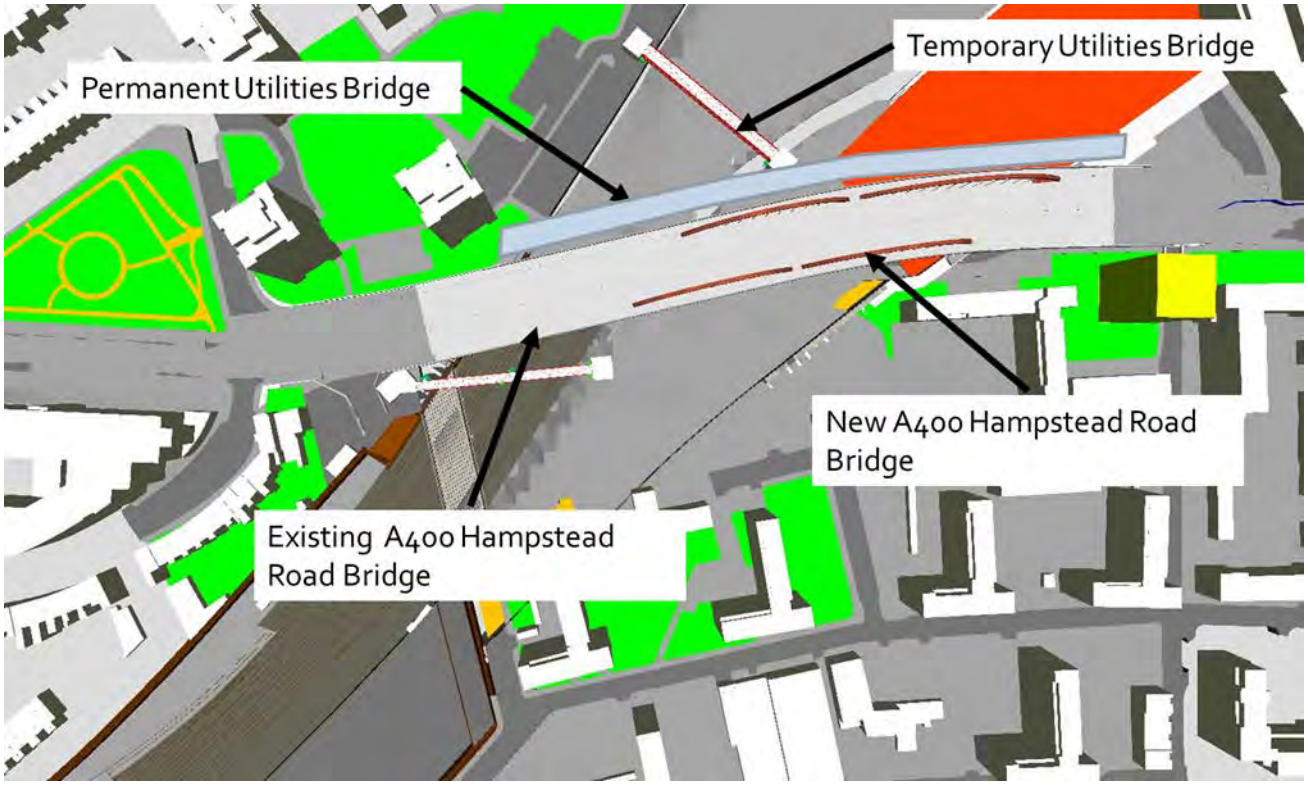
This option therefore has no impact (beneficial or detrimental) to the transportation of materials by rail compared to the hB September 2015 scheme.

Option 7 – Keep existing NR HRB

Option 7 follows the same plan alignment and phased construction sequence as the baseline hB September 2015 scheme and does not benefit the overall construction programme.

It is also most likely that Option 7 will require the temporary diversion of utilities as proposed in the baseline scheme despite the provision of a permanent utilities bridge. This is due to the proximity of this proposed bridge to the new extension to HRB.

Figure 39: Option 7 and Material by Rail



There is potential for this option to have a detrimental impact on the transportation of material by rail depending on the final layout of the permanent utilities bridge including the time and means of its construction as well as its interface with the B1 ramp and station area.

Option 8 – Optimising the hB September 2015 scheme

The optimisation of the hB September 2015 scheme does not affect the proposed plan alignment, construction sequence or overall construction programme.

This option therefore has no impact (beneficial or detrimental) to the transportation of materials by rail compared to the hB September 2015 scheme.

Appendix H – Commentary on Environmental Impacts

The below commentary has been provided by ETM on 25 May 2016 for inclusion into the Hampstead Road Bridge Lowering Interim Report. ETM representatives have attended the HS2 Ltd HRB Lowering workshops up to and including the Sift 2 workshop on 11 May 2016.

Commentary

This relates only to the lowering options that remain to be taken forward after the Sift 2 Workshop. The commentary compares each option with the baseline hB September 2015 scheme. For the purposes of this appraisal, it has, reasonably, been assumed that the environmental impacts of the hB September 2015 scheme are the same as those reported in the SES2 and AP3ES. The potential impacts of the options considered below on the design and functionality of the proposed open space/public realm/taxi and parking provision between HRB and the HS2 station have not been fully examined at this stage. Any references to these below are preliminary comments.

Option 1 – HRB Realignment

Option 1 would offer limited reduction in environmental impacts, by removing the need for a utilities corridor through the Ampthill Estate and the construction of temporary utility bridges therefore reducing visual and construction impacts for residents of lower floors of Gillfoot, in particular. By increasing the lateral separation and by a slight lowering of the bridge, permanent visual impacts are also reduced.

There would be an increase in the area of the proposed northern open space, but no real change to its functionality.

The removal of Cartmel may allow for a haul road from A400 Hampstead Road direct to the Carriage Shed construction compound, reducing construction traffic through the Regent's Park Estate. It may also allow for some additional removal of excavated material by rail [over and above material by rail options already being considered], but will also increase the total quantum of demolition and construction materials inward, so is considered neutral.

Demolition of Cartmel, 70 dwellings, would be a major adverse community impact, but some replacement housing could be provided on part of the cleared site. Further work is required to confirm that this could be programmed to avoid the need for decanting residents away from Regent Park Estate while avoiding construction impacts on the residents. However, it is to be noted that, except for ground floor flats, the residents of Cartmel did not require rehousing under the hB September 2015 scheme.

- Cannot be delivered within Environmental Minimum Requirements or the Powers in the hybrid Bill.

Option 5a sub option 5 – Replace HRB with Half-Through Girder Bridge

Option 5a-5 would offer reduced carriageway levels, but visual impact would be generally worse than the hB September 2015 scheme: If not worse, it will be no better at the northern, Ampthill Estate end, because of the need for four through girders above road level.

This scheme has major adverse impact from the loss or disruption to the function of the proposed northern open space, with very limited opportunities for mitigation within the Bill powers.

In addition, pedestrian and cyclist safety on HRB is seriously compromised by the creation of a '200m long walled corridor'.

This scheme does not provide any reduction in adverse environmental impacts during construction and still requires a temporary diversion of utilities through Ampthill Estate.

- Unlikely to be deliverable within Environmental Minimum Requirements.

Option 7 – Retain Existing NR HRB

Option 7 would retain existing levels at the northern end, but would require a permanent utilities bridge in this location. This option also still requires Ampthill utilities corridor.

Temporary and permanent visual impacts from Gillfoot are similar to hB September 2015 scheme.

Depending on the construction method, it will either require a long period of closure of HRB or a longer overall construction programme.

The construction impacts on Ampthill residents might reduce slightly, but this would depend on the extent of strengthening works to NR Bridge, especially the potential need for night working.

The reduction of carriageway/parapet heights across the new extension of the bridge and adjacent to Cartmel would marginally reduce permanent visual impacts.

The area of northern open space would be reduced and the permanent utility bridge could compromise the functionality of the open space.

The overall construction impacts are likely to be broadly similar to the hB September 2015 scheme, apart from potential major traffic disruption.

- Not clear if can be delivered within Environmental Minimum Requirements.

Option 8 – hB September 2015 Design Optimised

Assuming that the potential bridge height reductions are in the order of 500mm and that minor improvements will be possible to the interface with the Ampthill Estate outside Gillfoot, Option 8 would offer slight improvements to the permanent visual impacts of the proposed HRB.

This option would require no substantive change to the proposed northern open space and there would be no significant changes to the impacts during construction.

- Can be delivered within Environmental Minimum Requirements.

Appendix I – Sift workshops – Presentations

A400 Hampstead Road Bridge

Kick off Meeting for Study

10th March 2016

Agenda

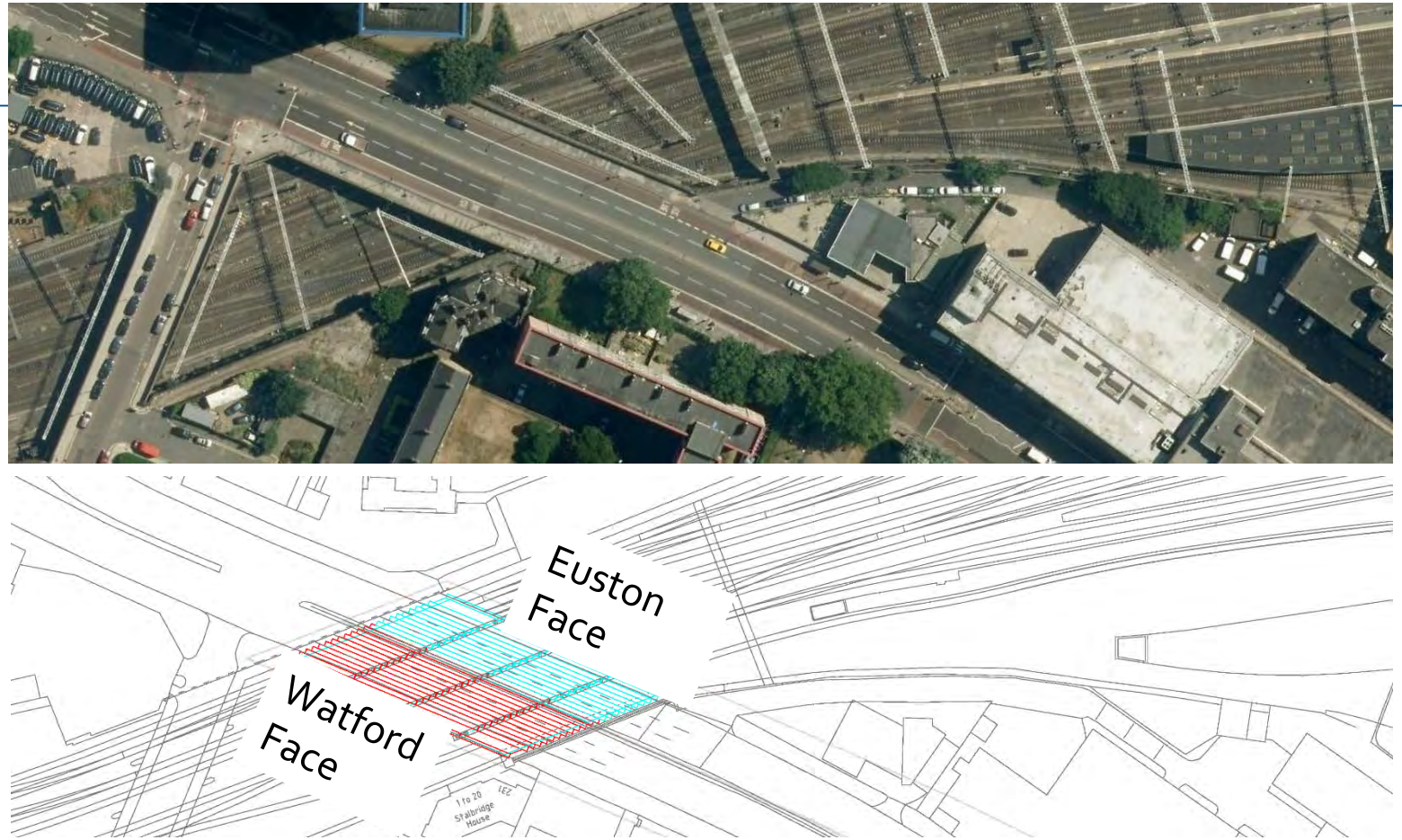
1. Introductions
2. Purpose of meeting
3. Resume of AP03 Design
4. Review of Scope/Remit
5. Proposed Programme of work and key dates
6. Assumptions
7. Further meetings
8. Any other business

1. Introductions

2. Purpose of meeting

3. Résumé of AP03 Design

Existing A400 Hampstead Road Bridge



- 6 lanes (4 traffic and 2 bus lanes) and wide footway over utilities trough

Existing A400 Hampstead Road Bridge

- Road Level
  - 6 lane bridge comprising two general traffic lanes and a bus lane (northbound) and two general traffic lanes and a bus lane (southbound).
  - Cyclists currently use the bus lanes
  - There are existing footways on both sides of the bridge
- Track Level
  - Foundations span Northern Line tunnels (north and southbound) below ground level
  - 4 span bridge bearing on 2 abutments & 3 concrete piers over 6 conventional lines
  - 21 Pre-stressed concrete beams in each span
  - Beams post tensioned transversely together after erection and ducts grouted (Bonded System).

Existing A400 Hampstead Road Bridge from Track level

Overview

- Hampstead Road Bridge (HRB) needs to be replaced to cross a wider Euston station approach
- Replaced bridge has the same road functionality as existing
- Design is heavily constrained by existing infrastructure (LU/ conventional track layout/ utility routes)
- Compliant rail clearances and long spans give deeper structure than current bridge so road levels are raised compared with existing
- Prefabrication is used to minimise community disruption
- Construction sequence keeps utilities continuity and keeps Hampstead Road open for vehicles, cyclists and pedestrians
- Construction constrained by work over operational railway which requires possessions and night-time work
- AP3 scheme allows access to high speed station ramp
- Compared with 2013 scheme, AP3 scheme is less visually intrusive, and allows pedestrian linkage from Regent's Park Estate to open spaces

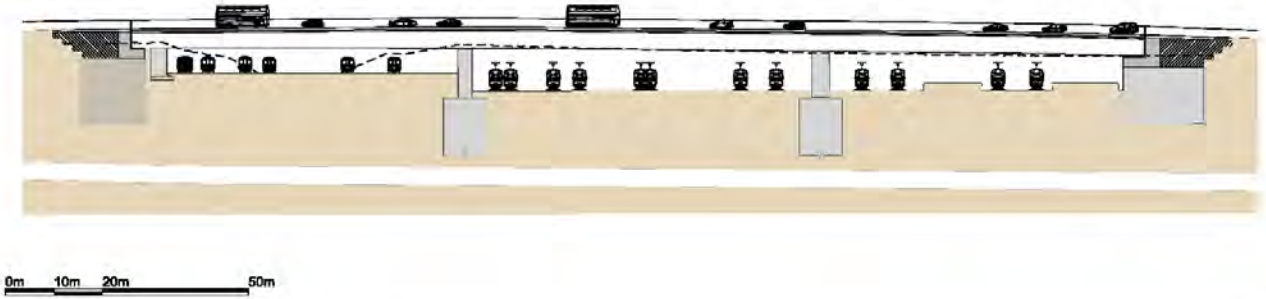
A400 Hampstead Road Bridge key requirements

- HS2 rail approach is wider than existing, hence a longer bridge is required
- Width is governed by:
  - Requirement to reprovide the existing six lane road configuration + 2 pedestrian footways with cyclists using the bus lanes; and
  - Need to allow continued use by vehicles, cyclists and pedestrians during staged construction, which means narrower bridge structure is not possible.
- Minimise impact of construction on conventional rail lines and operations
- Rail clearances to current standards
- Pier locations and span lengths dictated by HS2 and conventional track positions
- Minimise impacts on LUL tunnels with foundations spanning LUL tunnels
- Ensure continuity of service of utilities along Hampstead Road

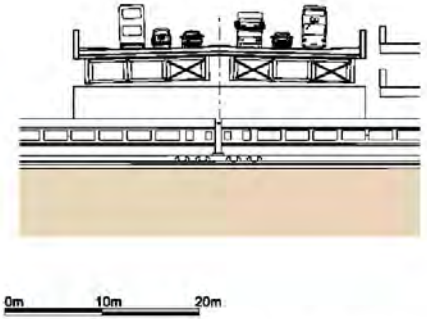
A400 Hampstead Road Bridge Opportunities

- The promoter will continue to review the design of the bridge with a view to reducing the height and the visual impact of the bridge.
- One option would be placing more piers, which could make a reduced structural depth and hence, lower road level possible. However:
  - introducing new piers within the conventional railway would lead to significant disruption to the conventional station with blockades and
  - night-time work, and staged construction of replacement bridge deck and piers would not be possible and hence Hampstead Road would have to be closed.

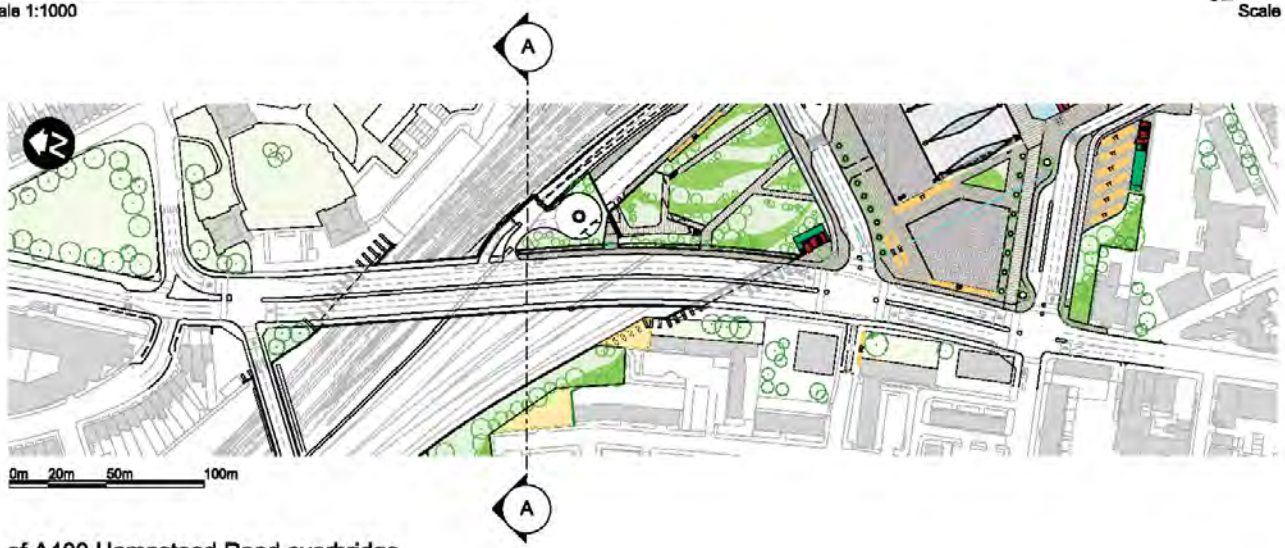
AP03 Proposal for Hampstead Road Bridge



01 Elevation of A400 Hampstead Road overbridge
Scale 1:1000



02 Section A-A of A400 Hampstead Road overbridge
Scale 1:500



03 Plan of A400 Hampstead Road overbridge
Scale 1:2500

[AP3 CFA1 Map Book, 2015]

AP3 Proposal- Photomontages

Current baseline (2015)

Operation (2026) - Summer verifiable photomontage

View of Hampstead Road Bridge looking south from Harrington Square Junction with Mornington Crescent
[AP3 CFA1 Map Book, 2015]

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Public Realm – Connectivity

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2013 hybrid Bill Truss Scheme - Complete

Current baseline (2013)

Operation Year 1 (2026) - summer verifiable photomontage

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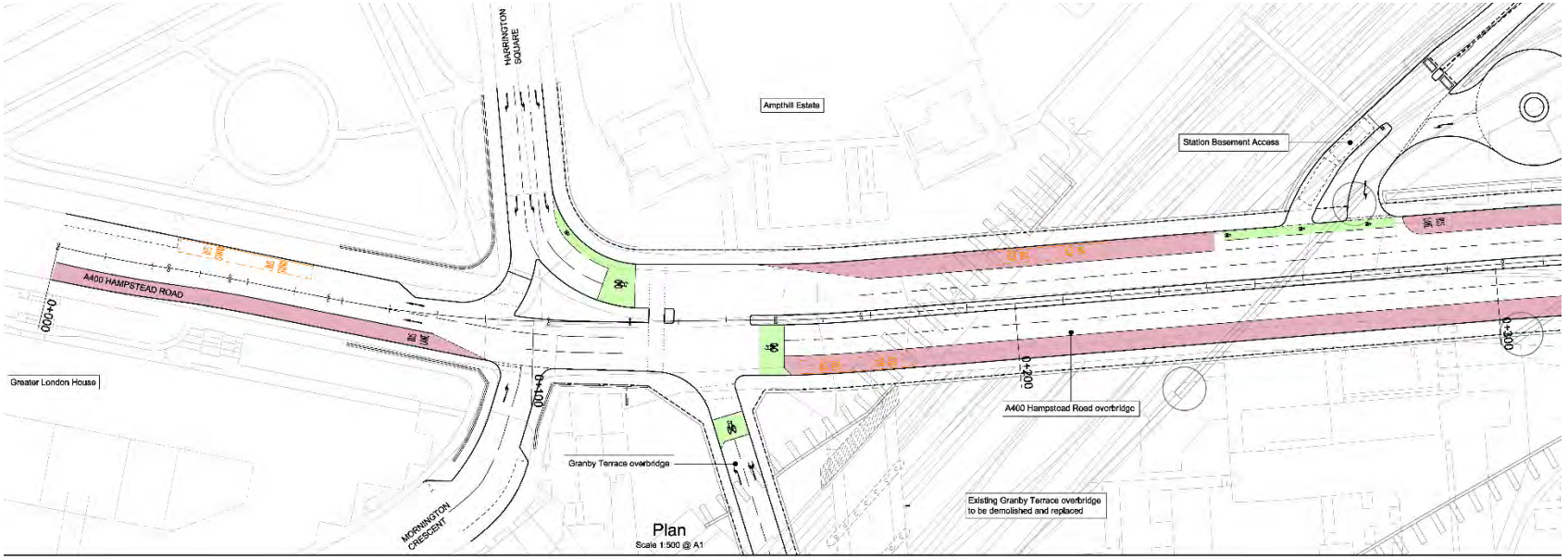
Road Levels – East Approach



- Granby Terrace Bridge structural form chosen to minimise Hampstead Road level
- 2.9m road level increase at abutment adjacent to Ampthill Estate relative to existing condition
- 300mm road level increase at Harrington Square / Mornington Crescent Junction relative to existing condition

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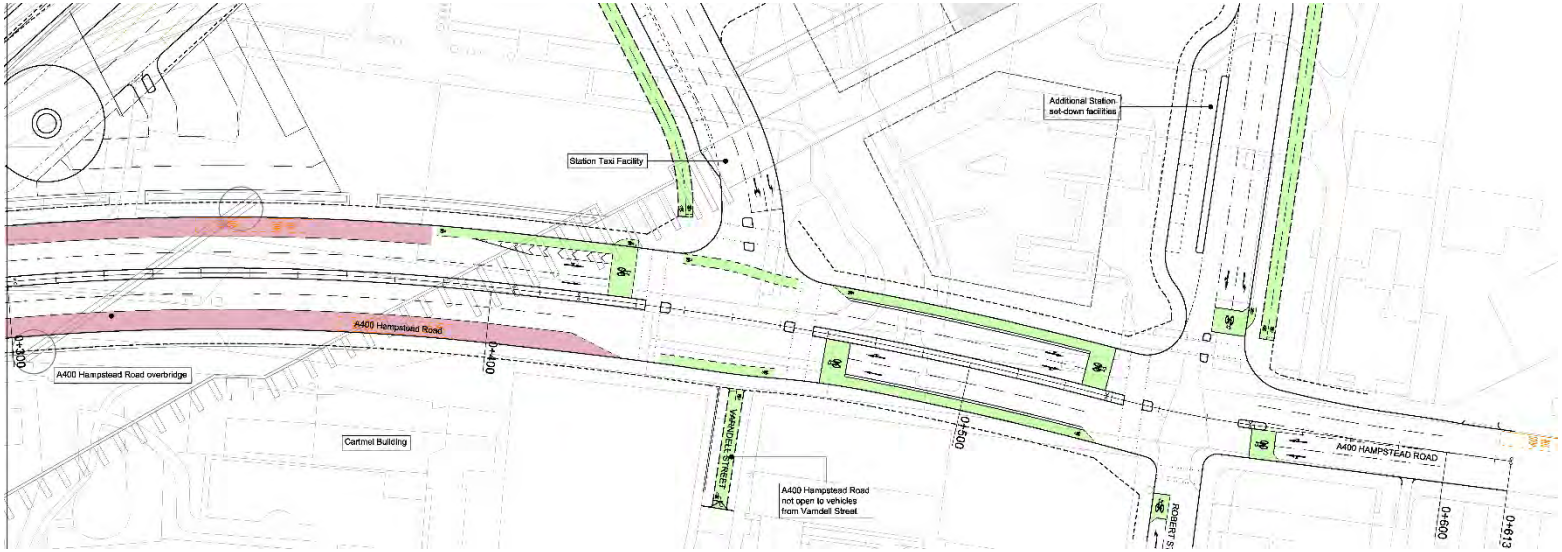
Road Levels – West Approach



- No change in road levels at Robert Street
- 4.7m road level rise at Cartmel for west abutment to provide required HS rail clearance

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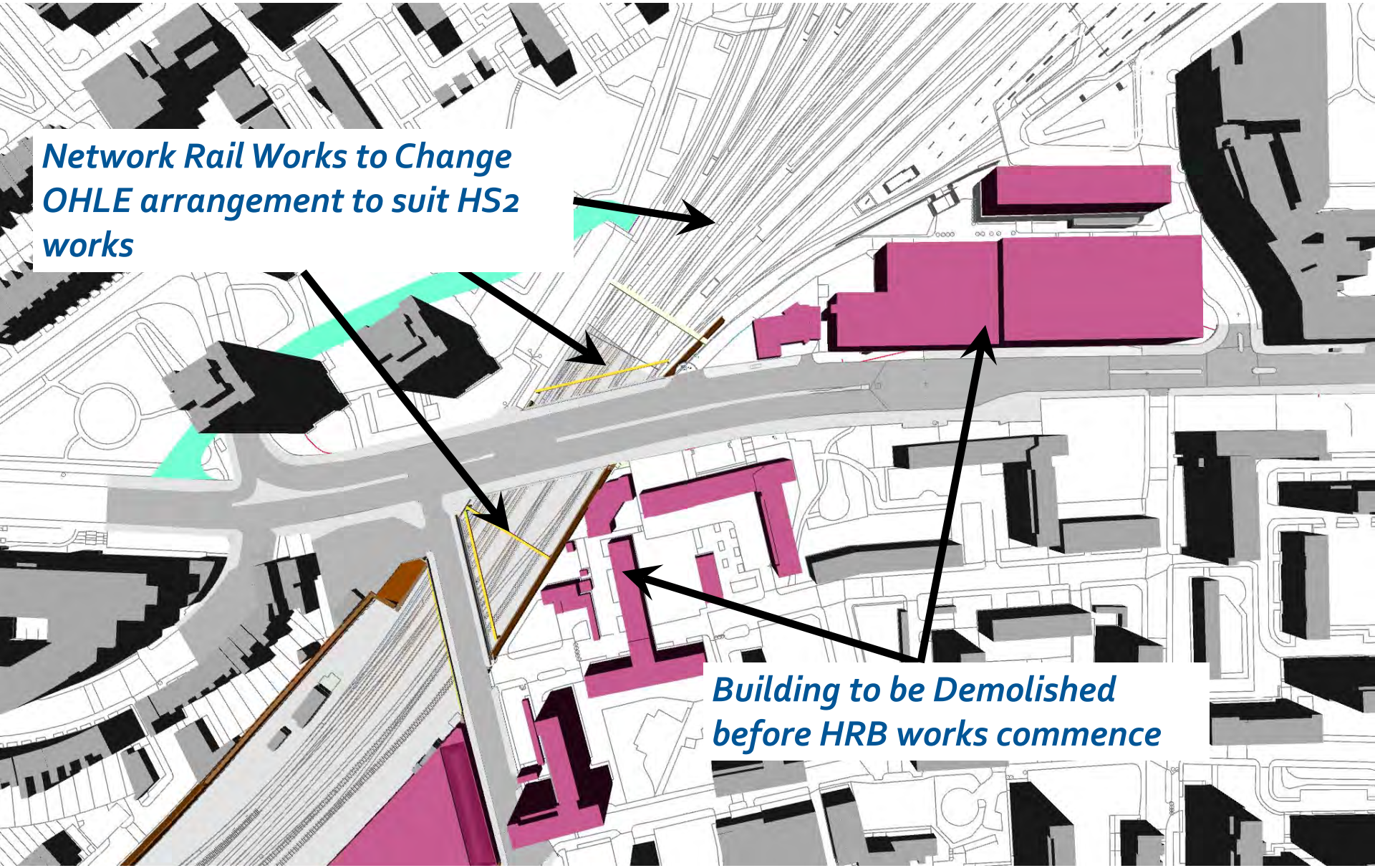
Construction Programme

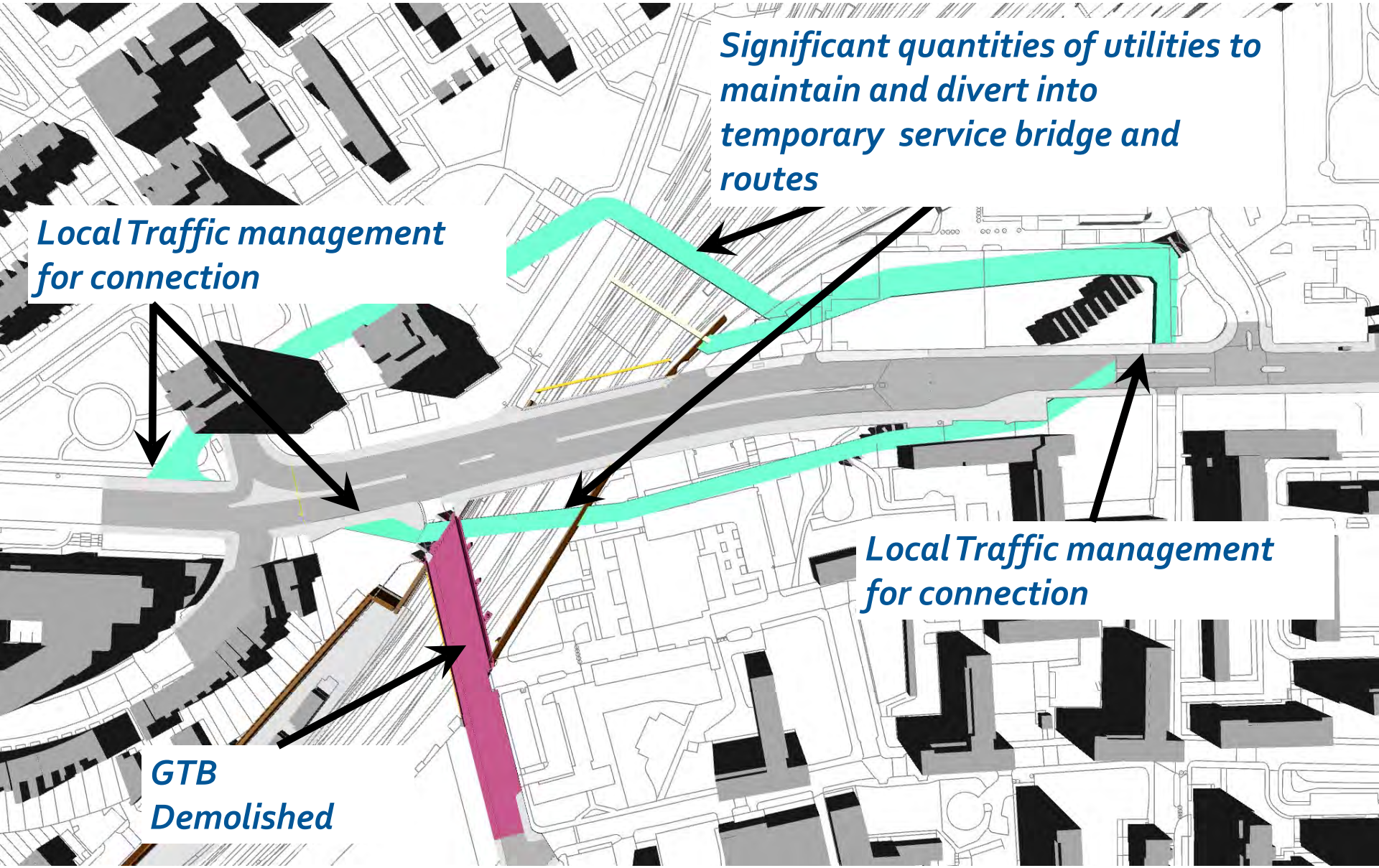
- Existing Hampstead Road is route for a large number of strategic and local utilities
- Constructing the high speed tracks requires widening the approach which will sever these routes
- To provide continuity of operation, temporary utilities diversions and bridges are required.
- Utilities diversion are required before works to A400 Hampstead Road bridge itself
- Works over the railway are subject to possessions which constrain bridge works and leads to night-time work
- Ensuring Hampstead Road remains open requires staged works which add complexity and time

Detailed Phasing of Construction Work

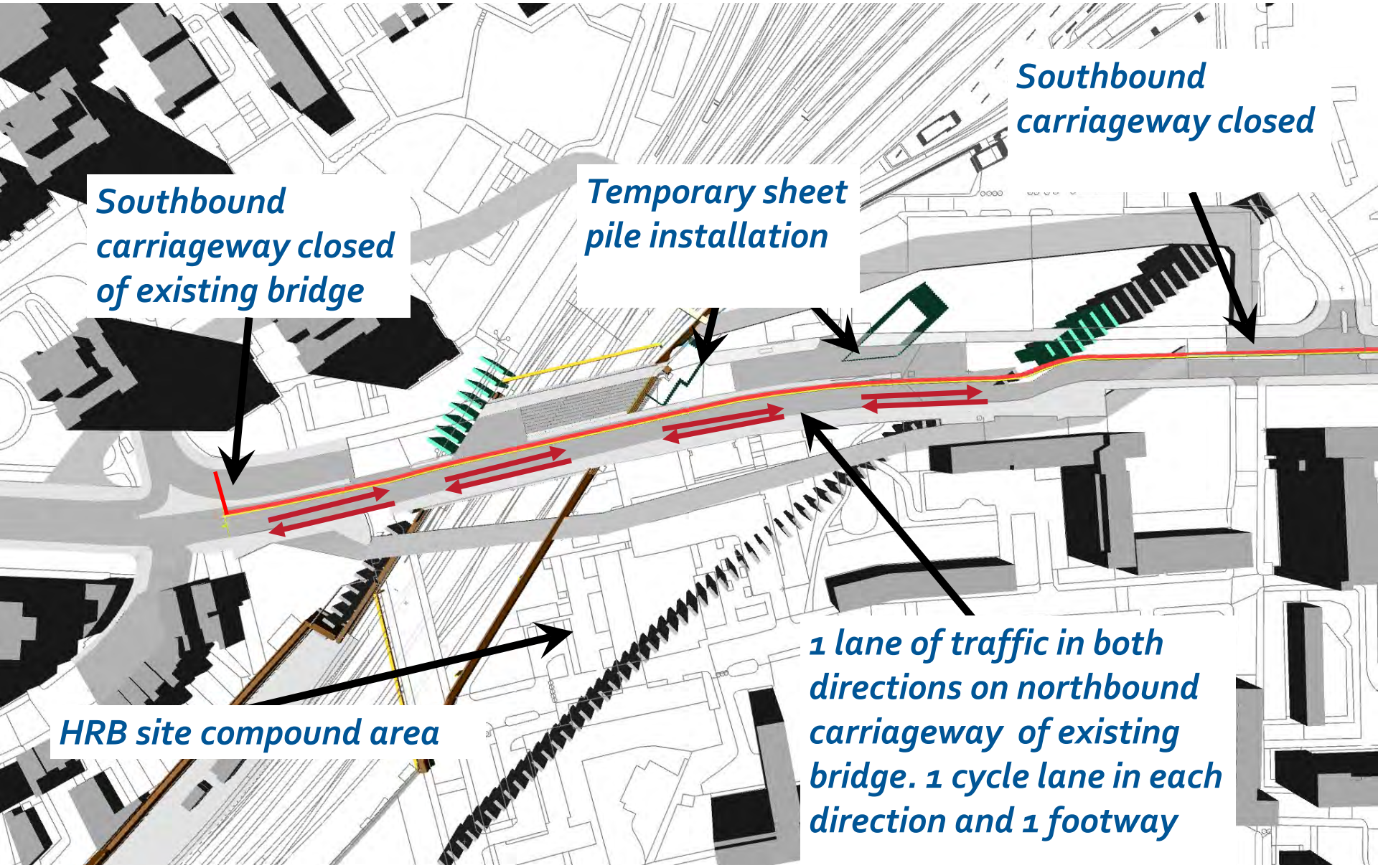
Stage 1


Network Rail Works to Change OHLE arrangement to suit HS2 works
Building to be Demolished before HRB works commence

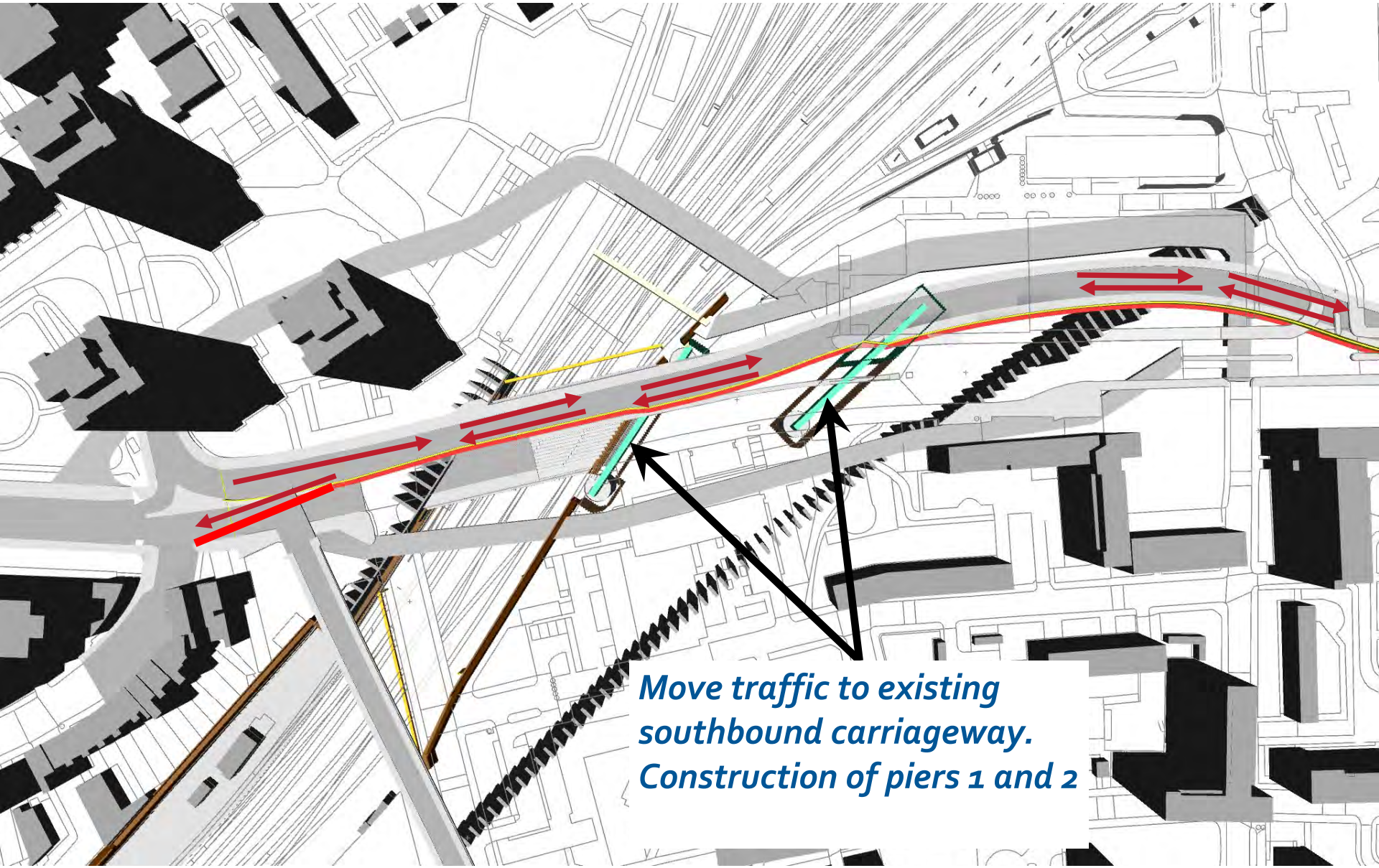
Stage 2


Significant quantities of utilities to maintain and divert into temporary service bridge and routes
Local Traffic management for connection
Local Traffic management for connection
GTB Demolished

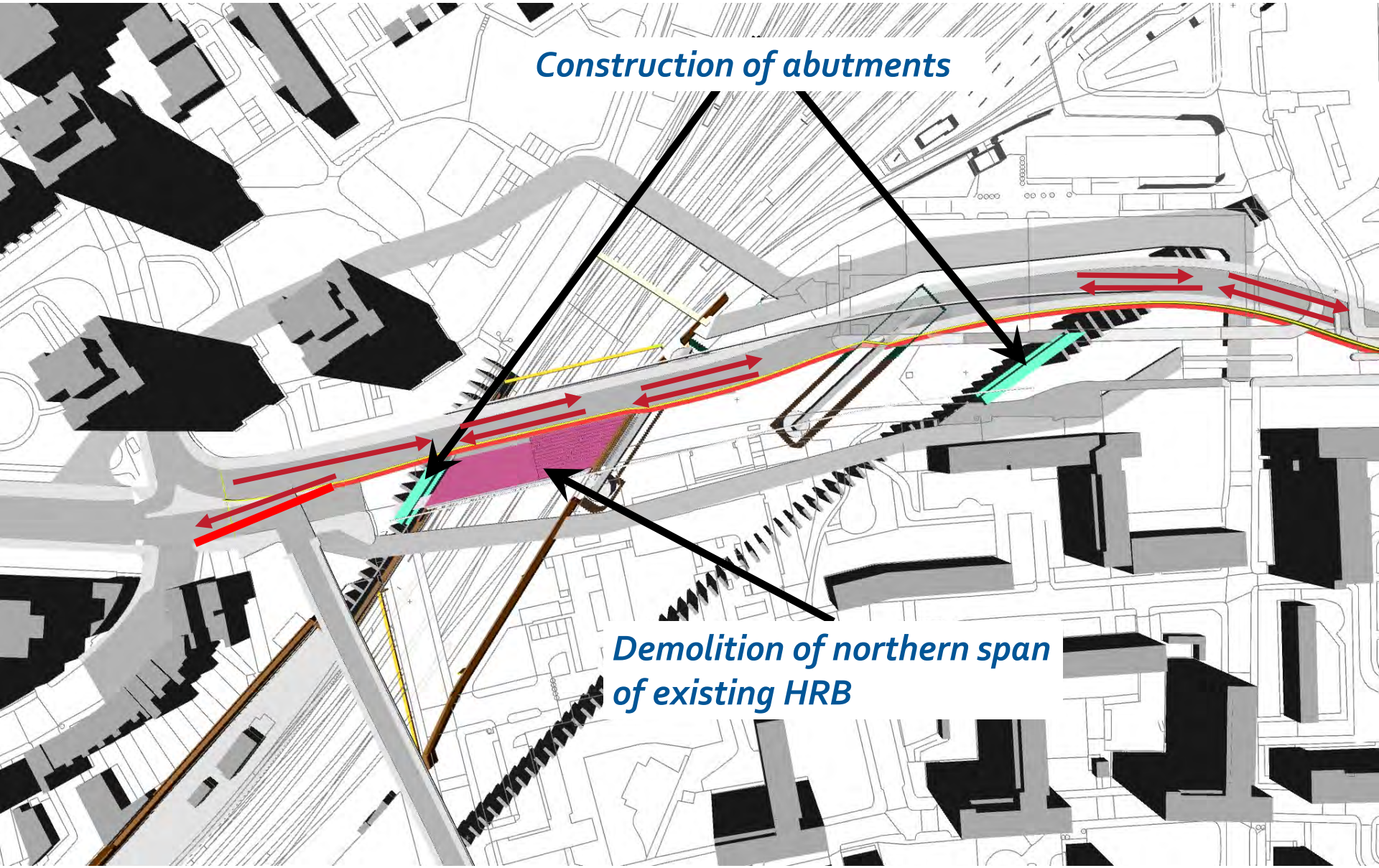
Stage 3


Southbound carriageway closed
Temporary sheet pile installation
Southbound carriageway closed of existing bridge
HRB site compound area
1 lane of traffic in both directions on northbound carriageway of existing bridge. 1 cycle lane in each direction and 1 footway

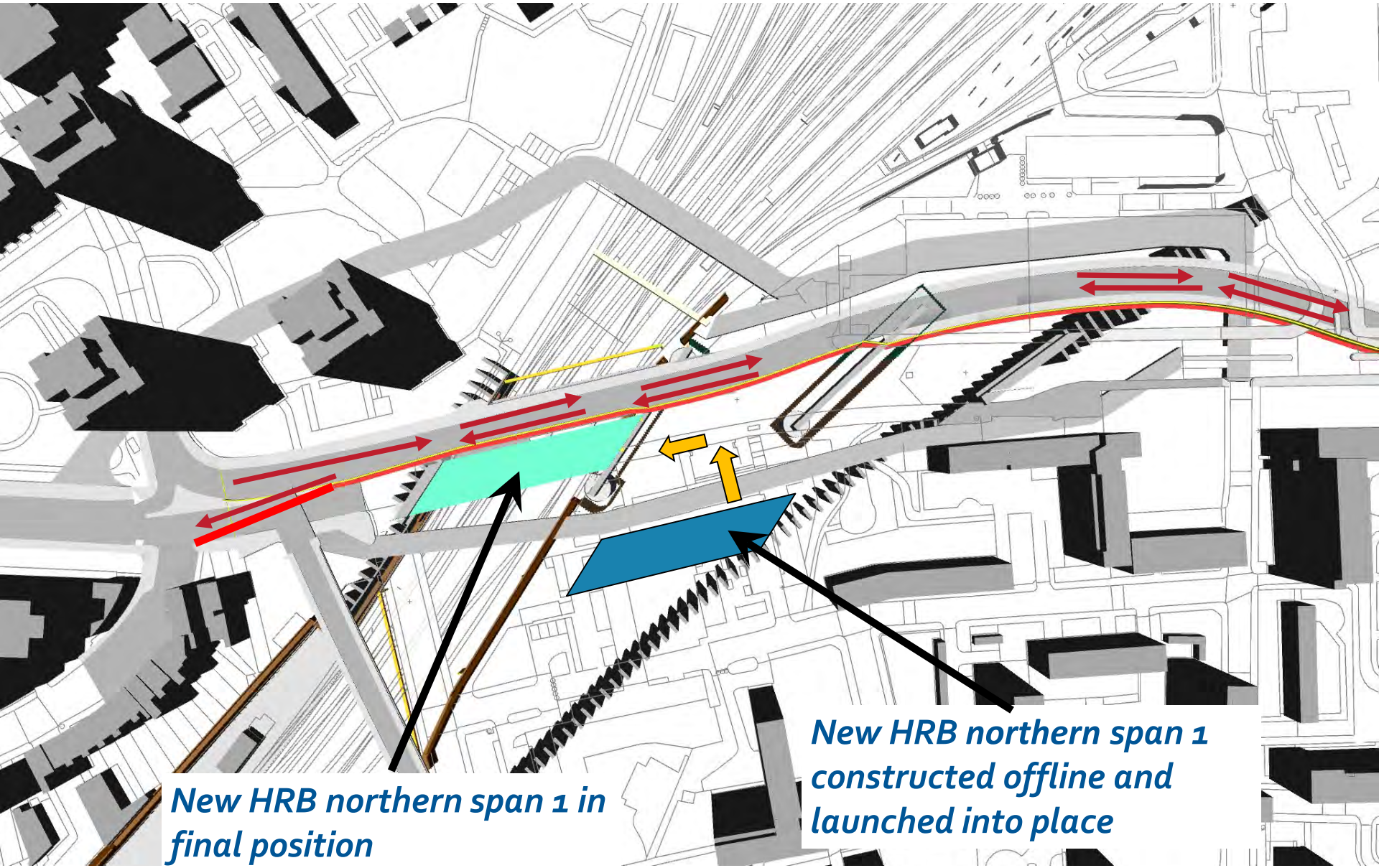
Stage 4


Move traffic to existing southbound carriageway. Construction of piers 1 and 2

Stage 5


Construction of abutments
Demolition of northern span of existing HRB

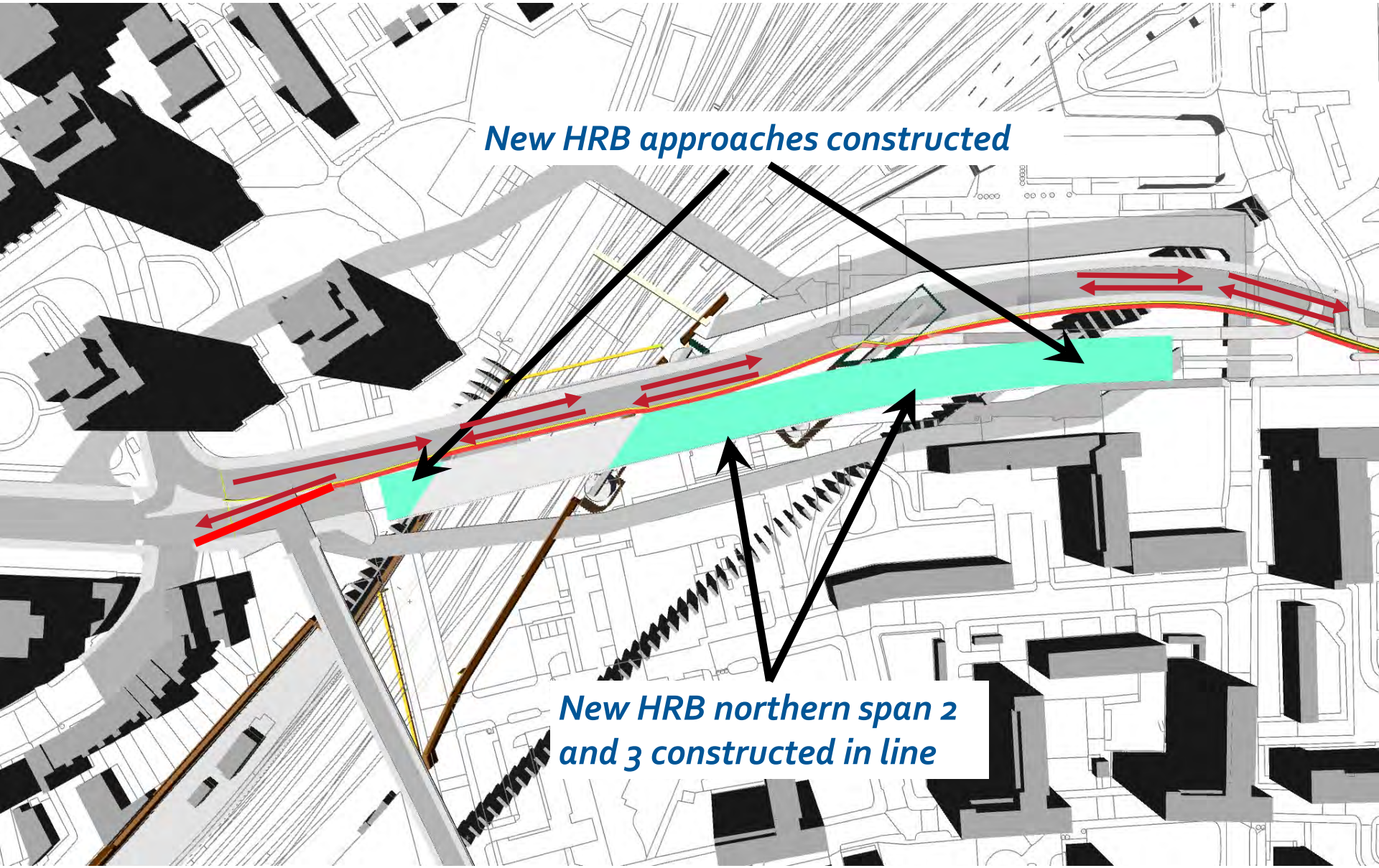
Stage 6


New HRB northern span 1 in final position
New HRB northern span 1 constructed offline and launched into place

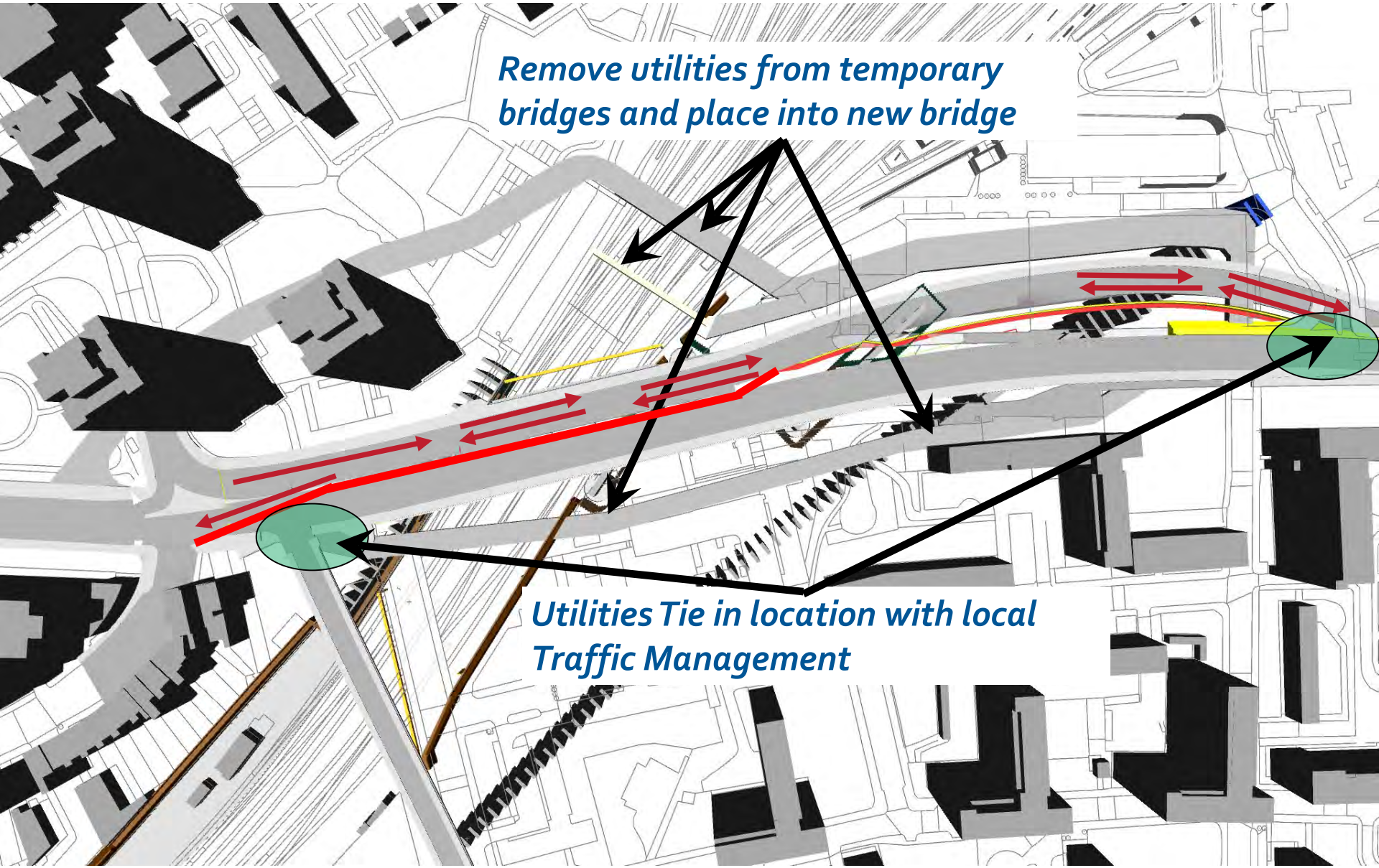
Launching method using Jacks

Launching method using self propelled modular trailers (SPMT)

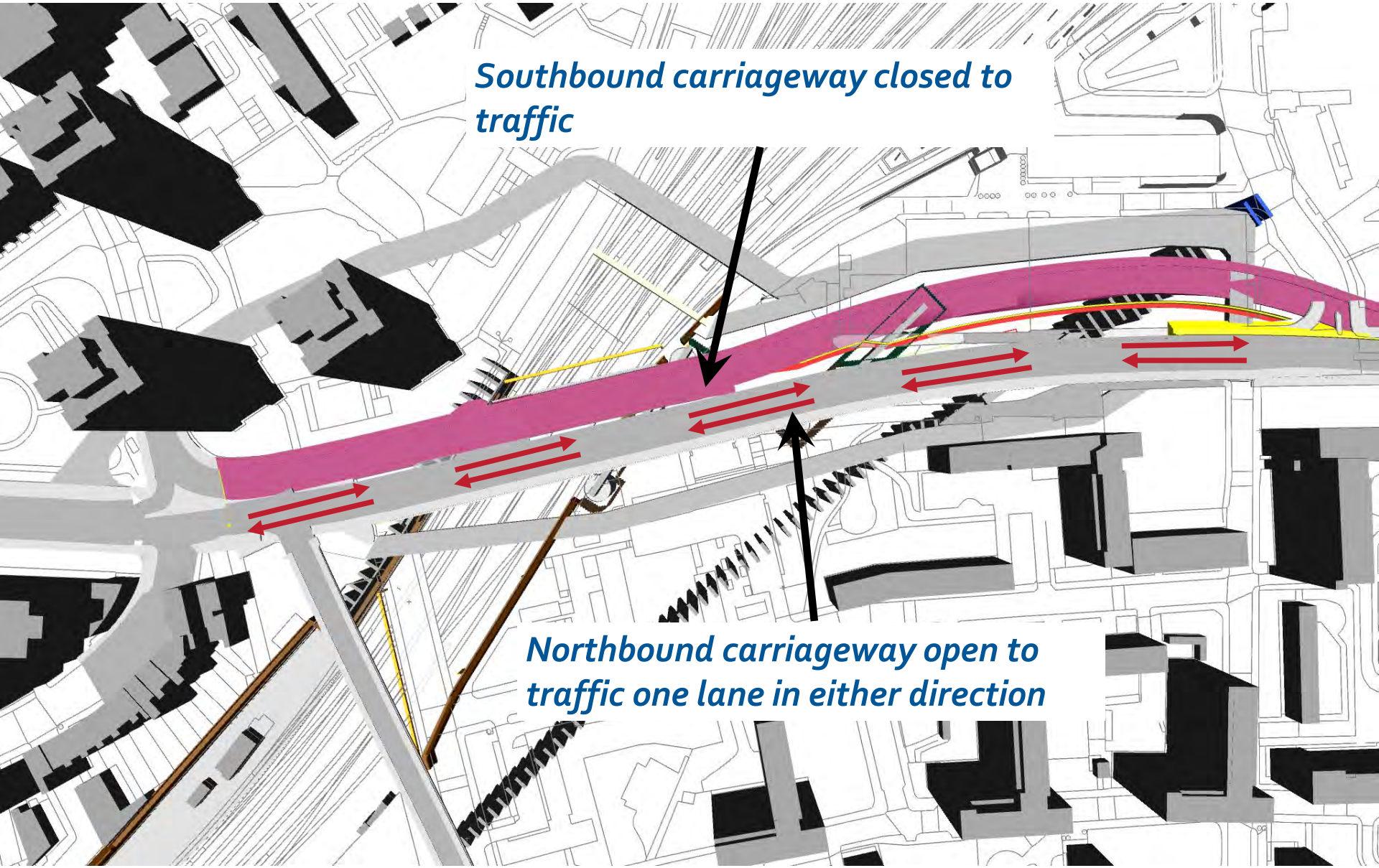
Stage 7


New HRB approaches constructed
New HRB northern span 2 and 3 constructed in line

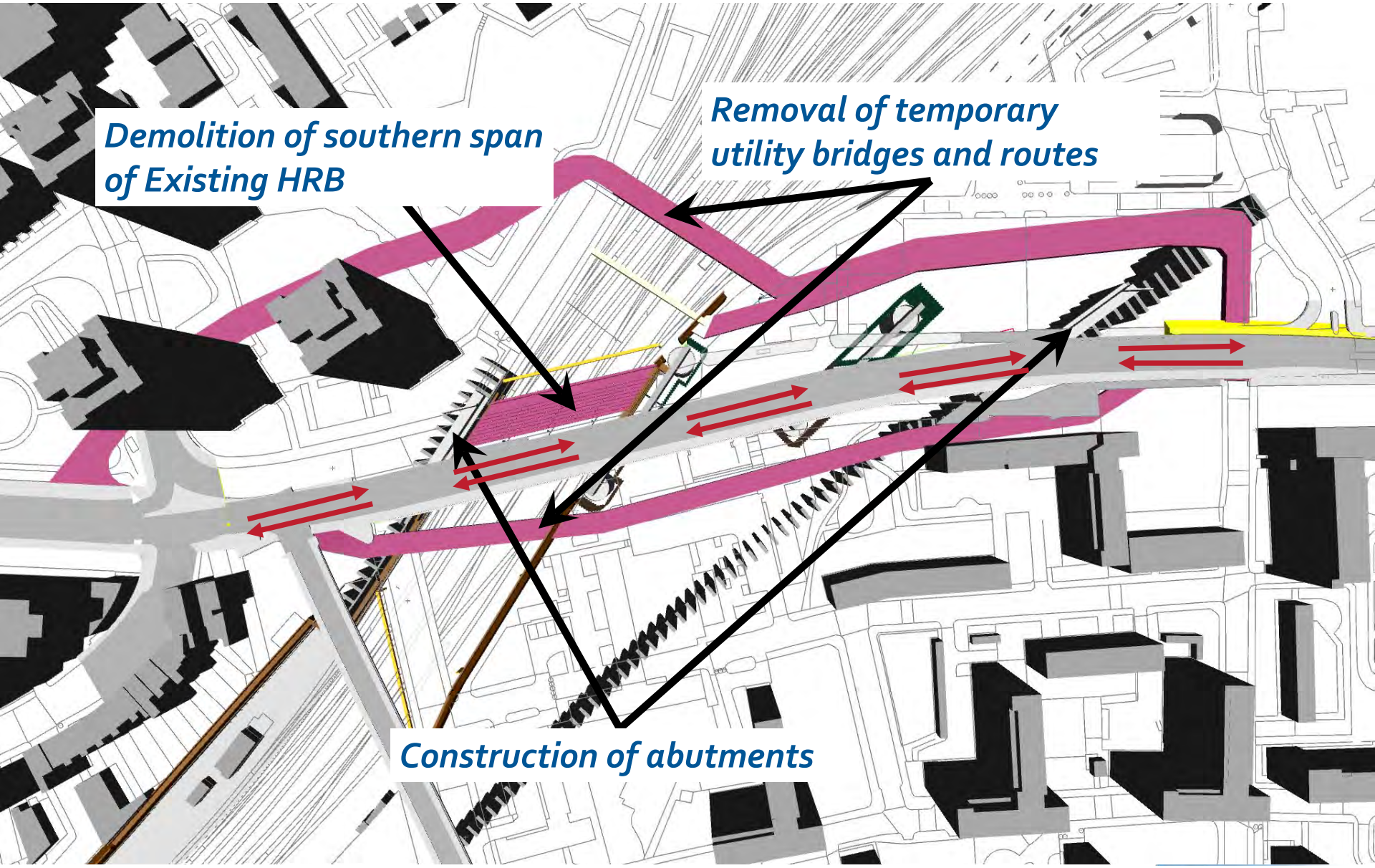
Stage 8


Remove utilities from temporary bridges and place into new bridge
Utilities Tie in location with local Traffic Management

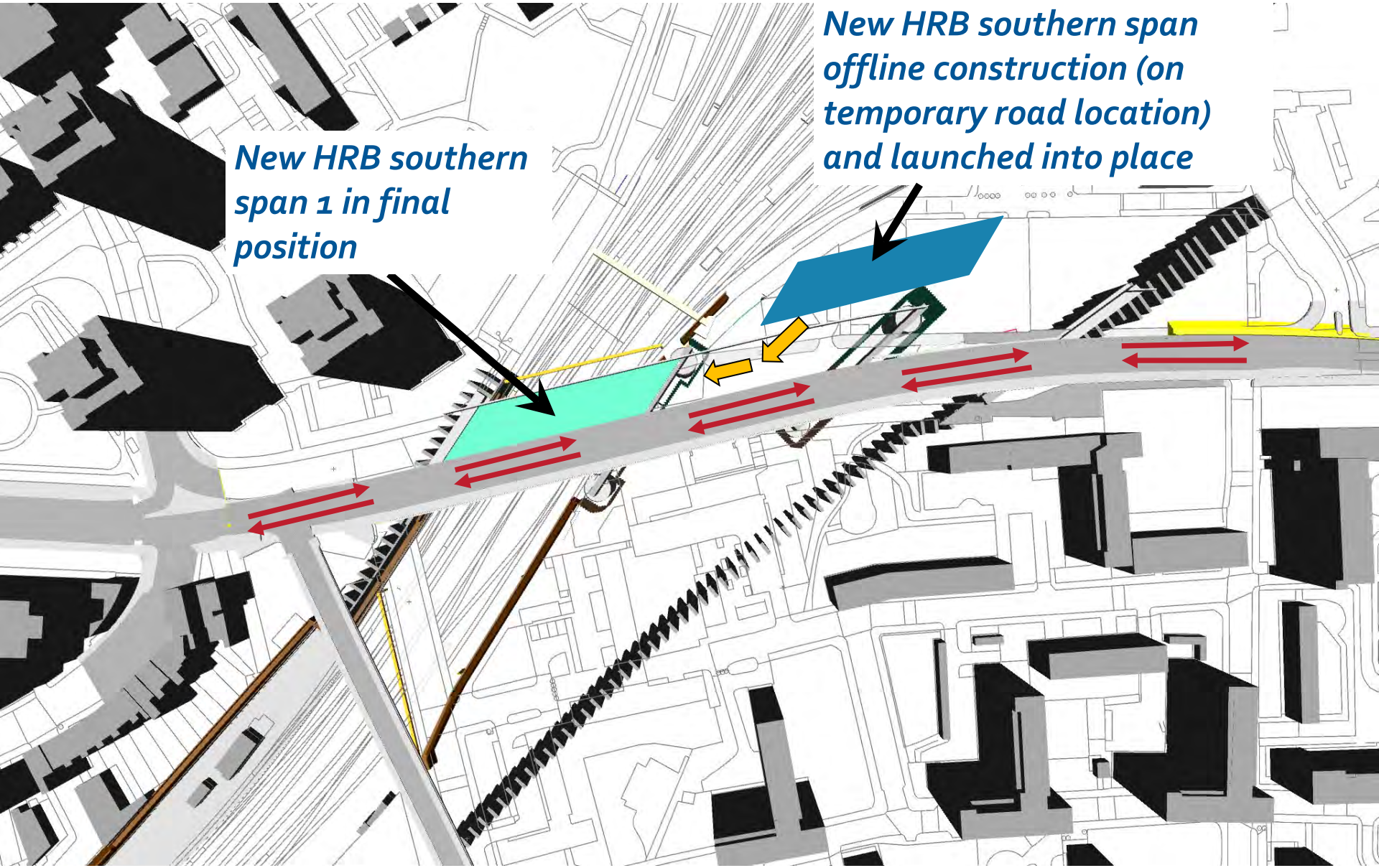
Stage 9


Southbound carriageway closed to traffic
Northbound carriageway open to traffic one lane in either direction

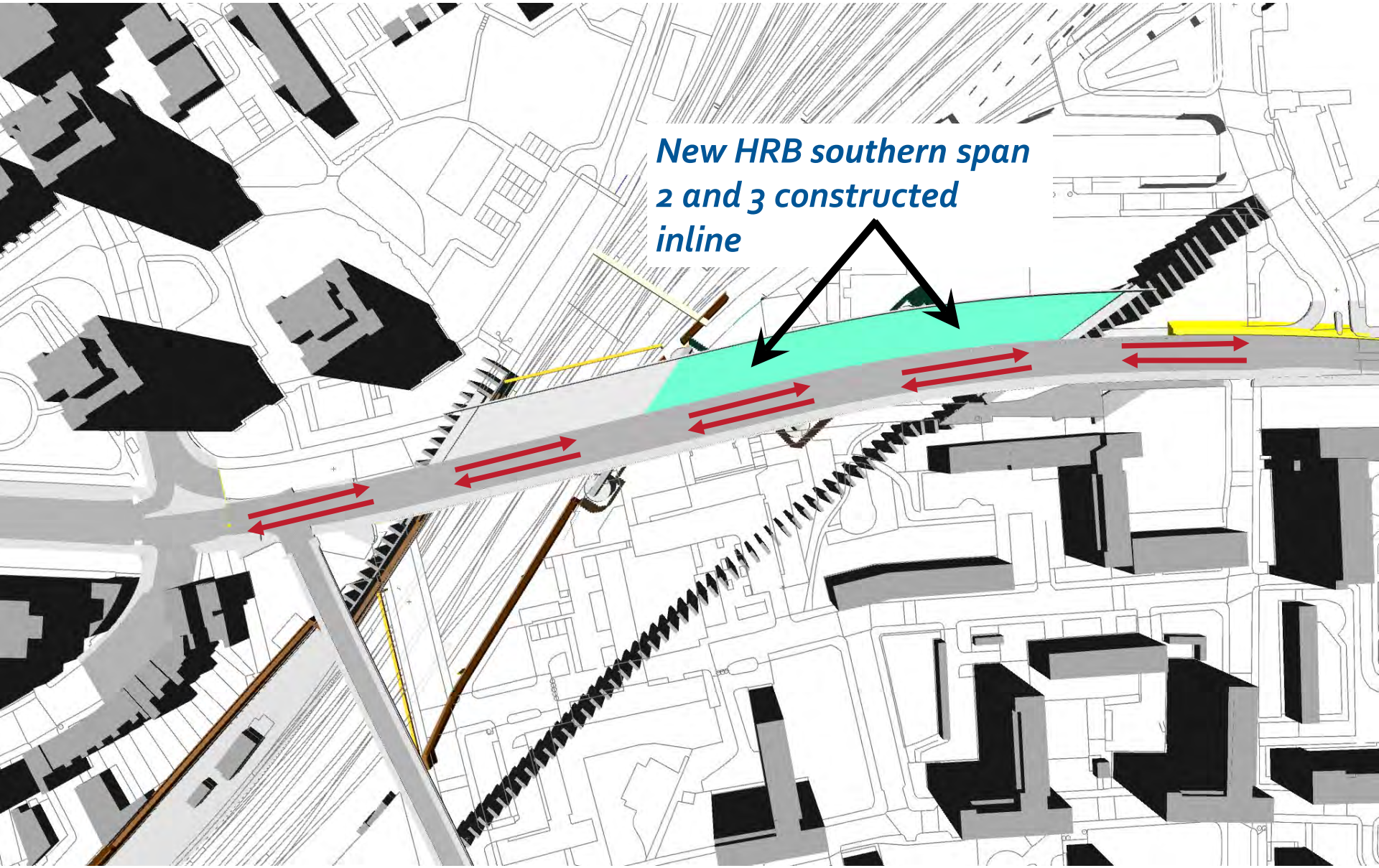
Stage 10


Demolition of southern span of Existing HRB
Removal of temporary utility bridges and routes
Construction of abutments

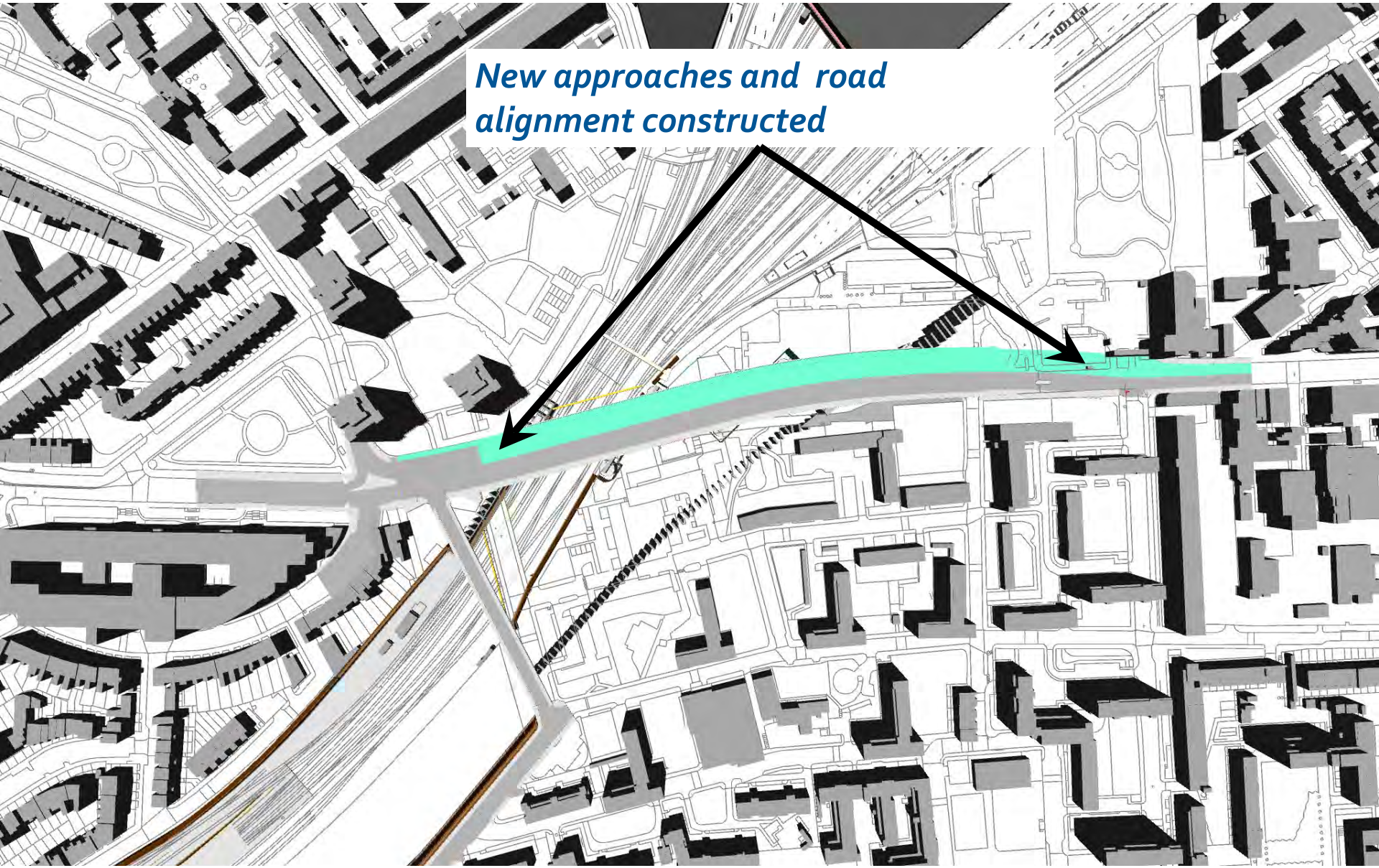
Stage 11


New HRB southern span offline construction (on temporary road location) and launched into place
New HRB southern span 1 in final position

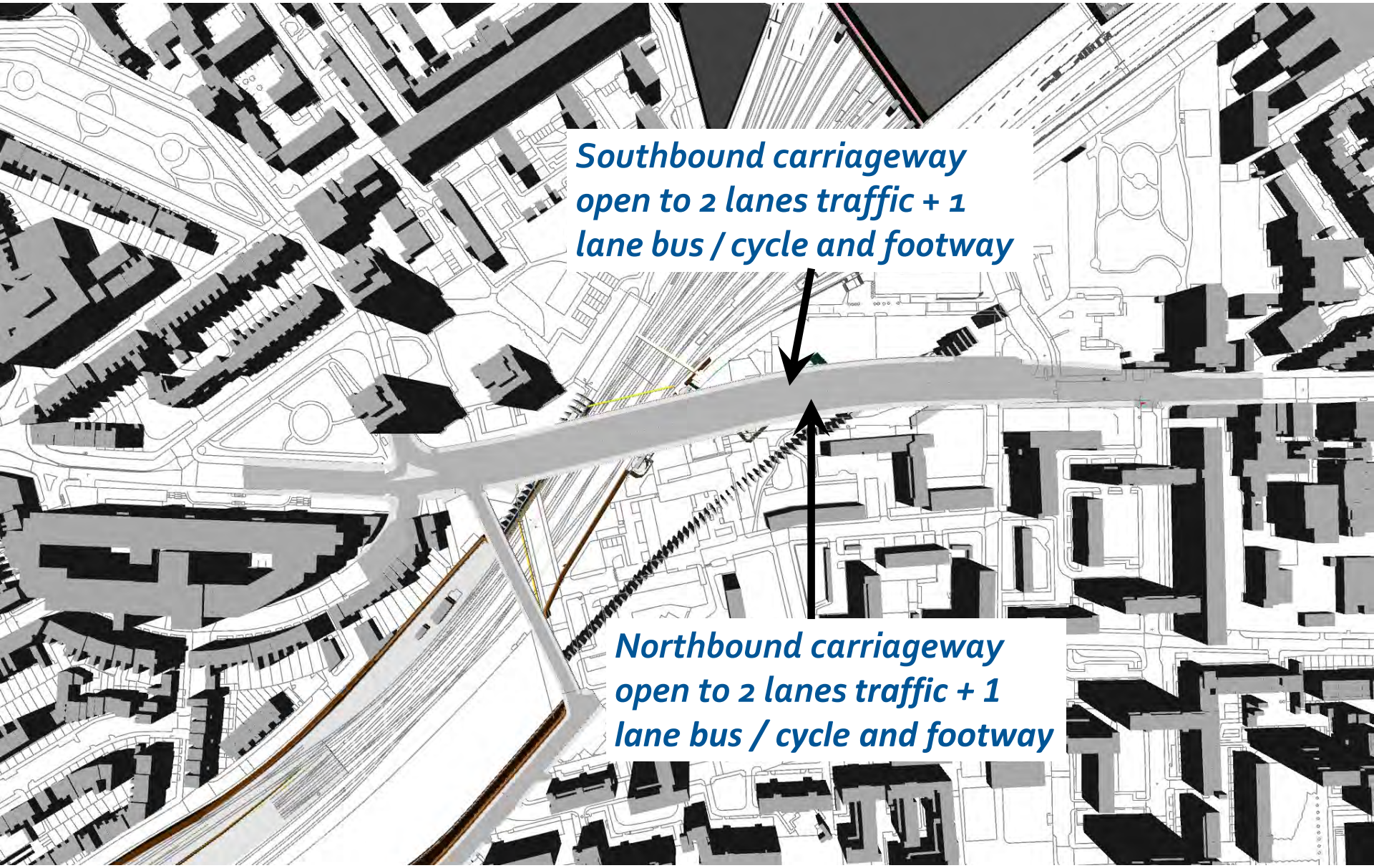
Stage 12



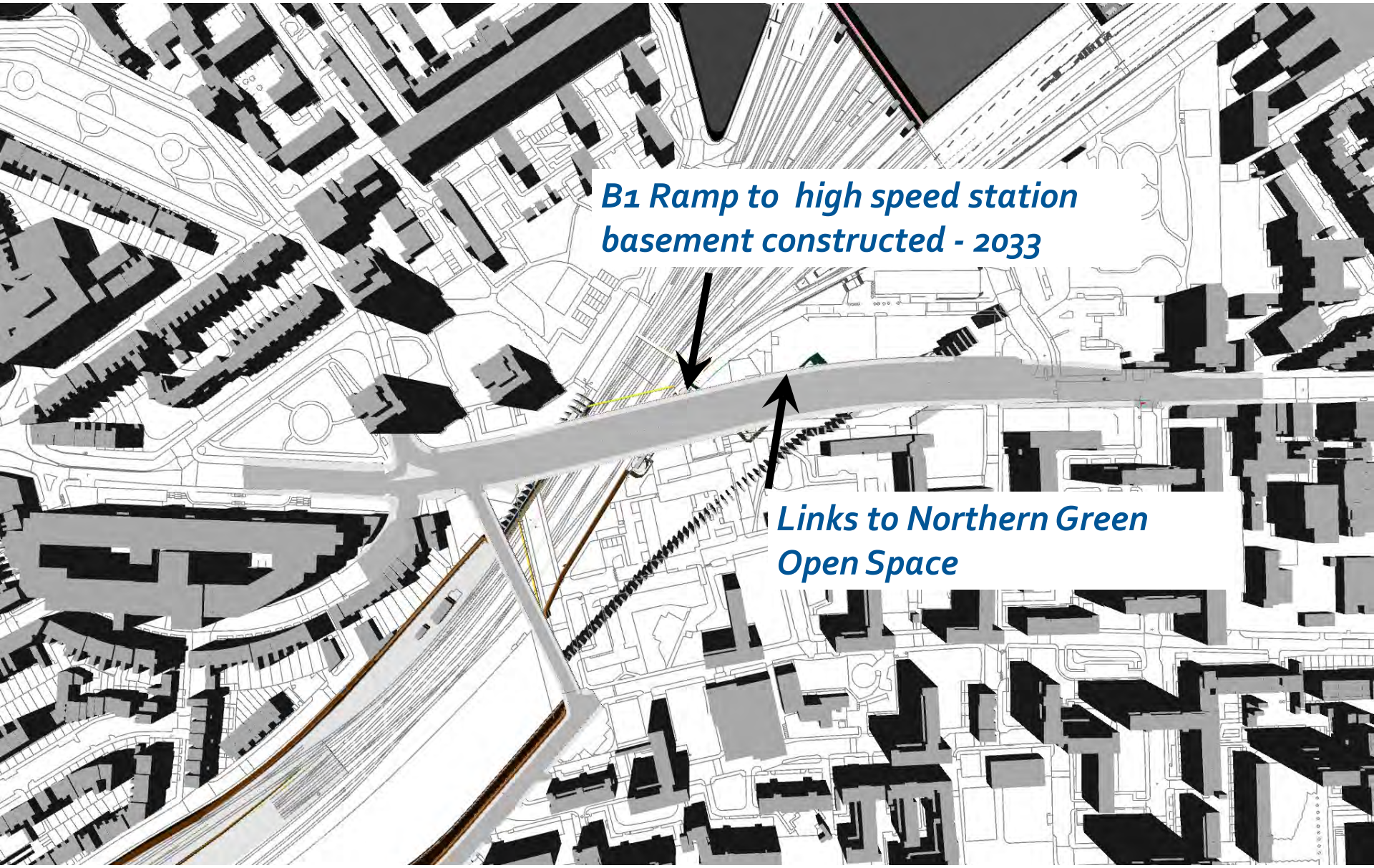
Stage 13

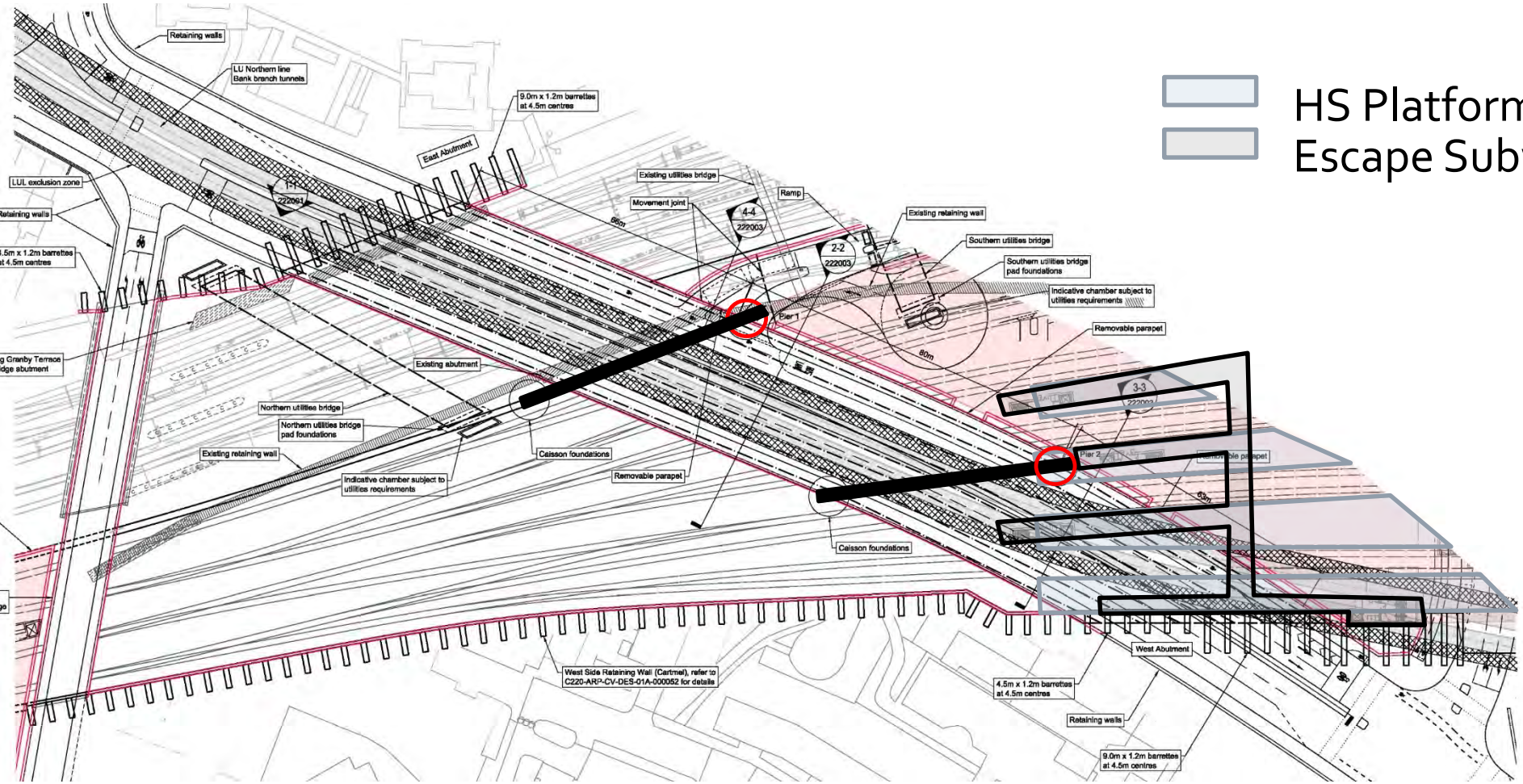


Stage 14 – A400 bridge works complete



HRB Completion




HS Platforms
Escape Subw
Retaining walls
LU Northern line
Bank branch tunnels
9.0m x 1.2m barrettes
at 4.5m centres
East Abutment
LUL exclusion zone
1-1
222061
Existing utilities bridge
Movement joint
Ramp
4-4
222003
2-2
222003
Existing retaining wall
Southern utilities bridge
Southern utilities bridge
pad foundations
Indicative chamber subject to
utilities requirements
Pier 1
Removable parapet
80m
3-3
222003
Existing abutment
Northern utilities bridge
Northern utilities bridge
pad foundations
Existing retaining wall
Caisson foundations
Indicative chamber subject to
utilities requirements
Removable parapet
Pier 2
Caisson foundations
West Side Retaining Wall (Cartmel), refer to
C220-ARP-CV-DES-01A-000052 for details
West Abutment
4.5m x 1.2m barrettes
at 4.5m centres
Retaining walls
9.0m x 1.2m barrettes
at 4.5m centres

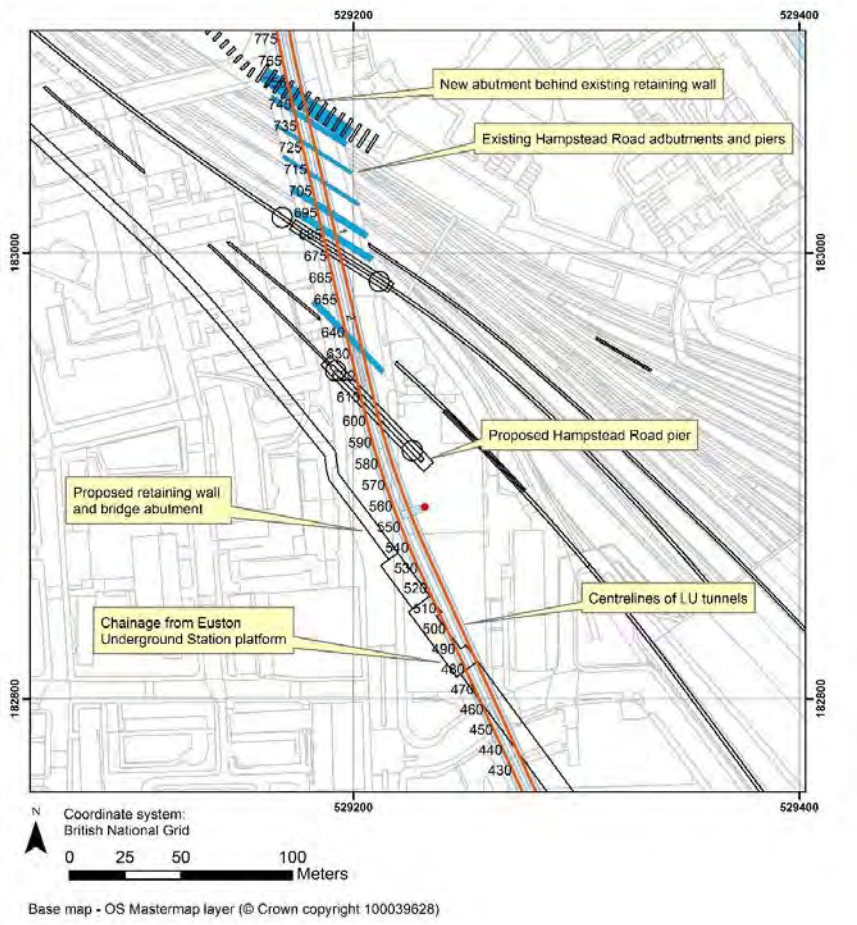
Narrower bridge - DRAFT

- TfL requirements
  - Permanent – currently replace existing provision
  - Temporary – do not close Hampstead Road
- Existing southbound carriageway currently used for temporary traffic whilst northbound carriageway reconstructed – required for 2 lane traffic + 2 cycle lanes + 1 footway
- If new total bridge width is narrower than existing then in the temporary case the bridge width would be too narrow for 2 lane traffic + 2 cycle lanes + 1 footway
- To meet the temporary usage requirements, the physical width of the bridge is unlikely to be able to be reduced significantly. Usage of the space could be changed. E.g. right turn lane on to the Station Ramp
- Utilities currently provided in northbound carriageway – narrower bridge would risk utilities in both sides of the bridge hence longer temporary utilities diversion period and more complex change over in Hampstead Road
- A narrower bridge would still need to meet Station Ramp and Northern open space
- Foundations would be the same to clear LUL tunnels.

Impact on LU Bank Branch Northern Line tunnels [1/2]

- The proposed HS works comprise a 10m excavation, the deconstruction of buildings and the staged removal and re-construction of A400 Hampstead Road overbridge over the Northern line Bank branch running tunnels.
- New bridge large diameter caisson / piled foundations are outside lateral LUL exclusion zones.
- New Bridge piers span across the tunnels between the foundations.

Impact on LU Bank Branch Northern Line tunnels [2/2]



HRB Road Level - Can HRB have more spans? [1/2]

- The original scheme for HRB was based on short replacement spans (30/40m) above the classic tracks, and longer spans over the HS tracks (to suit the split track fan arrangement).

During AP3 design it was considered that it would be better to duplicate the longer HS span over the classic tracks as:

- Once the classic rail enabling works had been completed there would be no need to re-enter the classic throat to rearrange track work if the bridge spanned clear over the gap, thereby minimising passenger disruption;
- The existing piers and foundations would not comply with modern code requirements (impact load etc) and therefore could not be reused;
- A new bridge as included in the hB would have to reuse the existing pier locations (to suit track work) and possibly foundation form and load limitations (to suit LUL tunnels beneath). The reconstruction of new foundations and piers under the existing bridge location and within the existing track layout would be time consuming and result in extensive classic rail closures; and

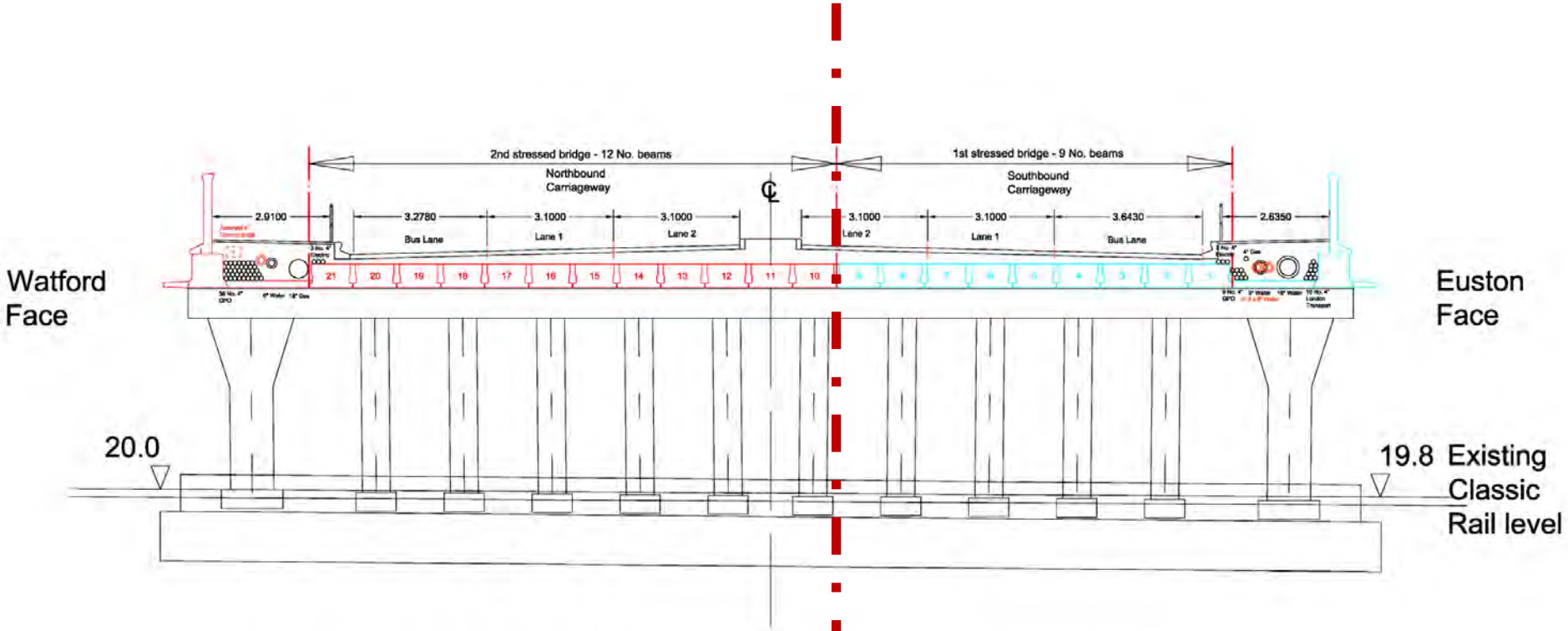
HRB Road Level - Can HRB have more spans? [2/2]

- Reconstruction of the bridge created an opportunity to increase flexibility for future classic track arrangement if no intermediate piers were included, and also created an opportunity to improve vertical gauge clearance (not as much as NR would have liked?)

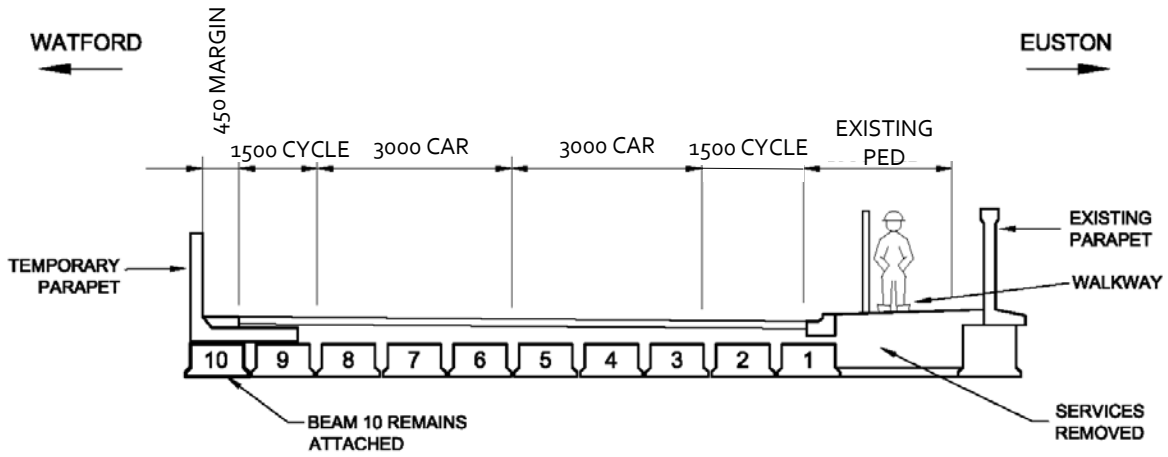
This resulted in 3 long span through bridges (trusses or arches), which have minimum deck depth (since it spans between supporting structure either side). Subsequently the basement ramp was introduced making the through structure untenable for at least one span; also the OSD along the east side of the bridge makes a through structure undesirable.

Bridge demolition

- The existing bridge is made up of longitudinally prestressed concrete beams with lateral post tensioning tying the beams together to form monolithic spans

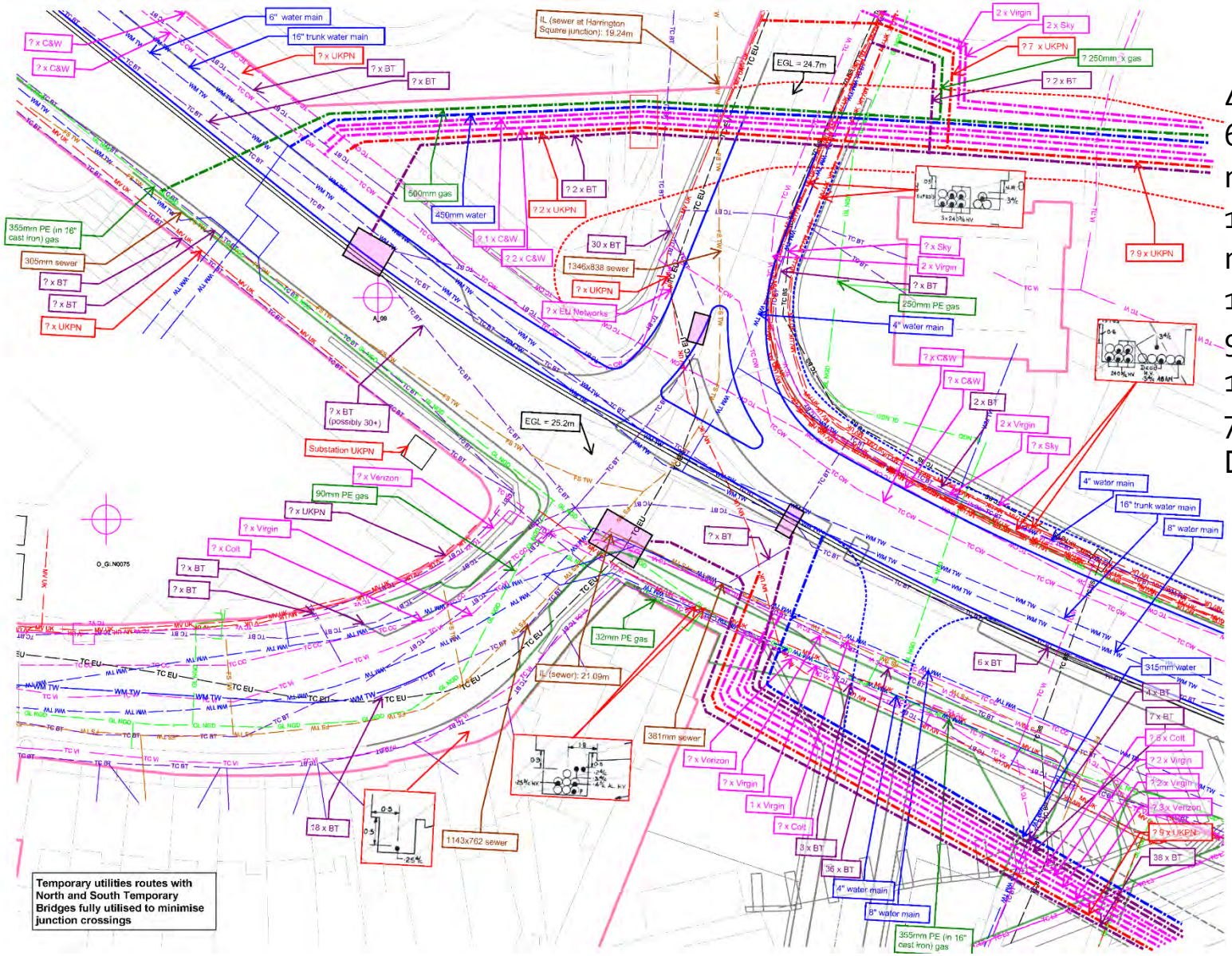


Bridge demolition phasing



- Install new H4a barrier onto beams 10 and 9
- Traffic to run on beams 1 to 10.

HRB Temporary Utilities Diversions (North



4 x 100mm BT ducts
6" Thames Water main
16" Thames Water main
100mm Gas Main
9 x 100mm UKPN
10 x 100mm TfL ducts
7 x 100mm Comms Duct

38 x 100mm BT ducts
6" Thames Water main
18" Gas Mains
9 x 100mm UKPN Ducts
9 x 100mm Comms Ducts

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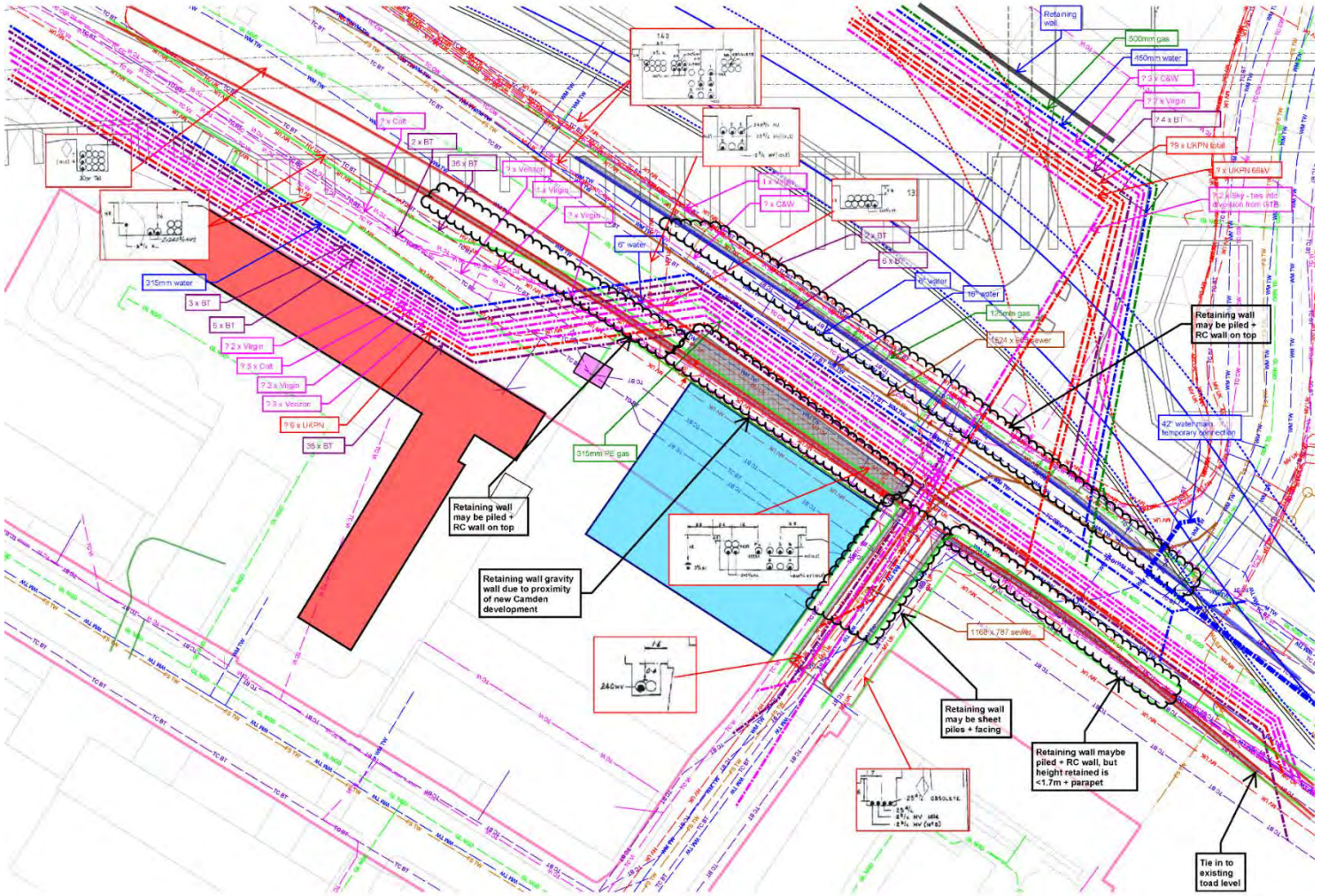
HRB Temporary Utilities Diversions (South side)



4 x 100mm BT ducts
6" Thames Water main
16" Thames Water main
100mm Gas Main
9 x 100mm UKPN
10 x 100mm TfL ducts
7 x 100mm Comms Duct

38 x 100mm BT ducts
6" Thames Water main
18" Gas Mains
9 x 100mm UKPN Ducts
9 x 100mm Comms Ducts

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4. Review of Scope/Remit

5. Proposed Programme of work and key dates

6. Assumptions

7. Further meetings

- Workshops
- Catch-up/Strategic meetings

8. Any other business

HRB Lowering Study – Options Workshop

18/03/16

Agenda

1. Introductions
2. Aims for the workshop
3. Confirm assumptions/fixed constraints
4. Workshop options and constraints
5. Confirm sift process for next meeting
6. Confirm scope
7. Further Meetings
8. Any other business

1 Introductions

2 Aims for the Workshop

3 Confirm assumptions/fixed constraints

- Constraints – Must haves for Select Committee Review

- Criteria – for assessment of options

3.1 Constraint Assumptions (?)

1. 2 x 2 traffic lanes + cycleways + footway
2. Must not constrain future station development or construction
3. Must provide minimum clearance (UK for classic, TSI for HS)
4. ~~Must provide for Dec 2014 classic service timetable~~
5. Must be constructable above LUL Northern Line without blockades – if option s required then potential for short closures if piggybacking
6. Must provide for existing utilities crossing railway (as part of a total solution)
7. Must provide for an access ramp to HS Station basement
8. Must acknowledge new HS track plan (ie station plan below HRB) for support structure
9. Must permit replacement of GTB
10. Must carry highways loading and withstand lateral railway loading
11. Must be safe and access for pedestrian and road users – if possible, depending on duration. Especially access to Ampthill estate
12. Must not preclude Euston Area Plan
13. Retain Cartmel

3.2 Criteria – for assessment of Options

1. Sensitive to local community during construction and in use
2. Road Impact on road and connectivity – closures, disruptions
3. Must have compliant road alignment and geometry
4. Must have acceptable / compliant interface with railway systems (e.g. signal sighting)
5. Impact on construction programme – especially bridge completion and hand over to HS2 systemwide contractor
6. Impact on classic rail operations – possessions, risks, compensation etc
7. Demolitions (rehousing) required ~~(is Cartmel non-demolition a constraint?)~~
8. Construction road / rail access
9. Structural depth

3.3 Assumptions

- 1.8m high H4a parapets
- Full or ½ station blockades (full or ½ rail track access) Full only at Xmas and BH
- Weekend / night possession regime

4 Workshop

- Brief:
  - Lower bridge
  - Narrower bridge

Topics for brain storm collaboration

- 4.1 Bridge structural form
  - Single span – arch, truss, suspension
  - Long span – cable-stayed, truss, multiple arch
  - Medium span – truss, composite steel/concrete, precast segmental
  - Sort span - composite steel/concrete, through deck, precast prestressed beams

Thoughts on Structural Form…

Topics for brain storm collaboration

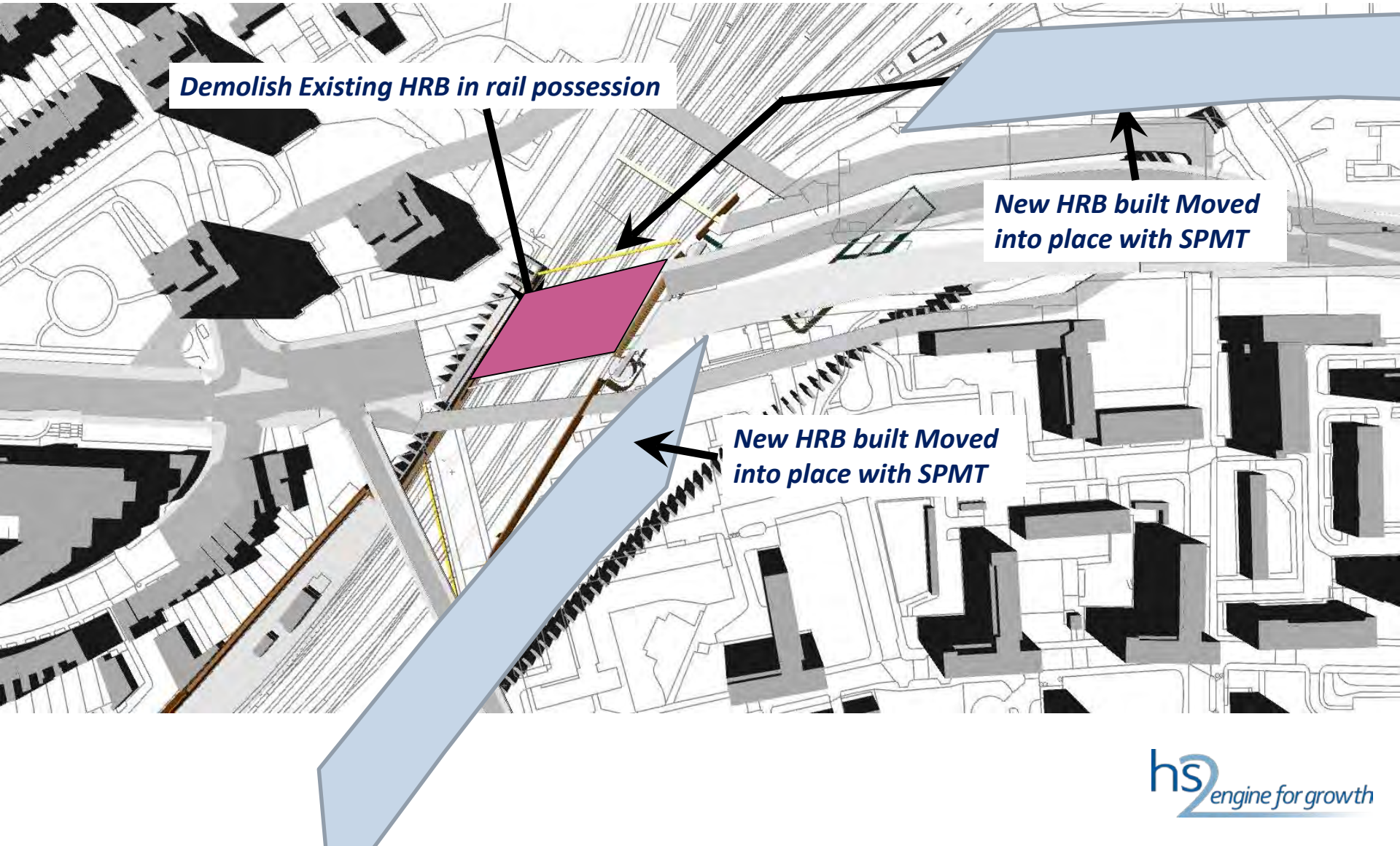
- 4.2 Bridge alignment
  - Fully off line – north or south
  - Half off line – 1 side at a time
  - On line – 1 side at a time

Off-line Aignment

Topics for brain storm collaboration

- 4.3 Construction Options
  - Build in one – lateral slide / wheels / large lift
  - Road closure / rail closure – fast build
  - Launch ½ bridge / full bridge
  - Off line construction – lateral slide / big lift (1/2 width of road?)

Complete Bridge built offline (Either Station or Area 2)



5 Sift Process

- Initial Sift:
  1. Does the option inherently give a lower road level
  2. Does the option inherently make for a narrower bridge
  3. Does the option work geometrically (site / clearances)
  4. Does the option provide functionality for road / rail / ramp

- If the option does **not** enable lower or narrower as a result of its different characteristics to the existing scheme or if the option does not satisfy the geometric requirements it is **automatically** parked.

5.1 What Options should progress

- 5.1.1 Structural Form:
  - baseline
  - short span conventional
  - retain existing HRB
  - forms enabled by moving Station Ramp
- 5.1.2 Alignment:
  - ~~½ off-line~~
  - baseline
- 5.1.3 Construction Options:
  - baseline all others within the above permutations

7. Further meetings

- Sift Meeting: 4 / 4 / 16
- Catch-up/Strategic meetings:

8. Any other business

HRB Lowering Study – SIFT Workshop 01

04/04/2016

Agenda

1. Introductions
2. Purpose of meeting
3. Proposed sift criteria
4. Option by option sift
5. Conclusion from sift
6. Way forward
7. Any other business

1 Introductions

2 Purpose of Meeting

- Conclude first sift of options

3 Proposed sift criteria

- ✓ Does not preclude EAP
- ✓ Does not preclude further OSD
- ✓ Beneficial to Cartmel
- ✓ Beneficial to Amptill
- ✓ Pedestrian/Cycle connectivity
- ✓ Permits GTB replacement
- ✓ Visual Impact
- ✓ NR disruption
- ✓ A400 Hampstead Road open
- ✓ Beneficial to construction period

4 Option by option sift

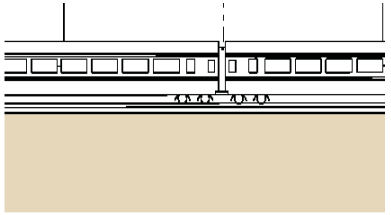
0. Existing Scheme
1. Off-line Construction
2. Tunnel
3. Demolish HRB
4. Transverse support to HS spans
5. Realign B1 ramp
6. Additional Piers
7. Keep existing HRB

4 Option by option sift
Existing scheme

0m 10m 20m 50m

Elevation of A400 Hampstead Road overbridge

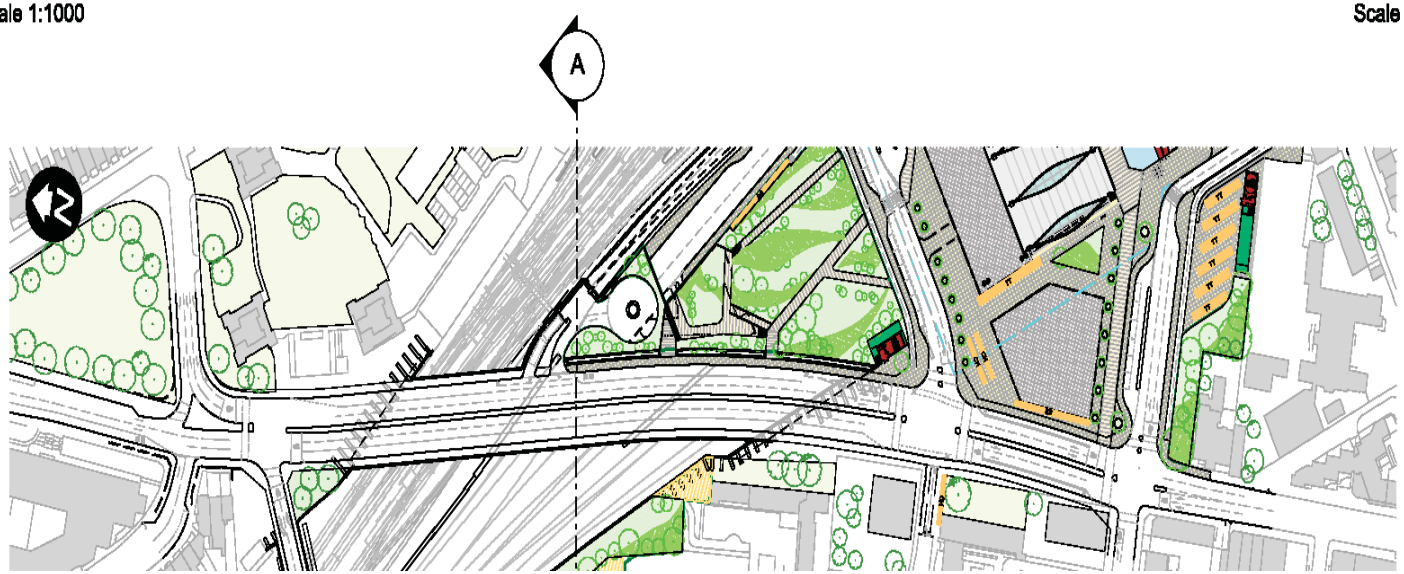
Scale 1:1000



0m 10m 20m

02 Section A-A of A400 Hampstead Road ove

Scale 1:500



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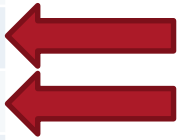
4 Option by option sift Existing scheme

- 3 spans (single span over NR)
- 3m deep steel plate girders

CURRENT SCHEME	
Does not preclude EAP	Yes
Does not preclude OSD	Yes
Impact on Cartmel	To be improved
Impact on Ampthill	To be improved
Ped / Cycle connectivity	Yes
Permit GTB Replacement	Yes
Visual Impact	Baseline
NR B2 Station	Neutral
NR Disruption	Neutral
A400 Hampstead Road Open	Yes
Construction Programme	Baseline

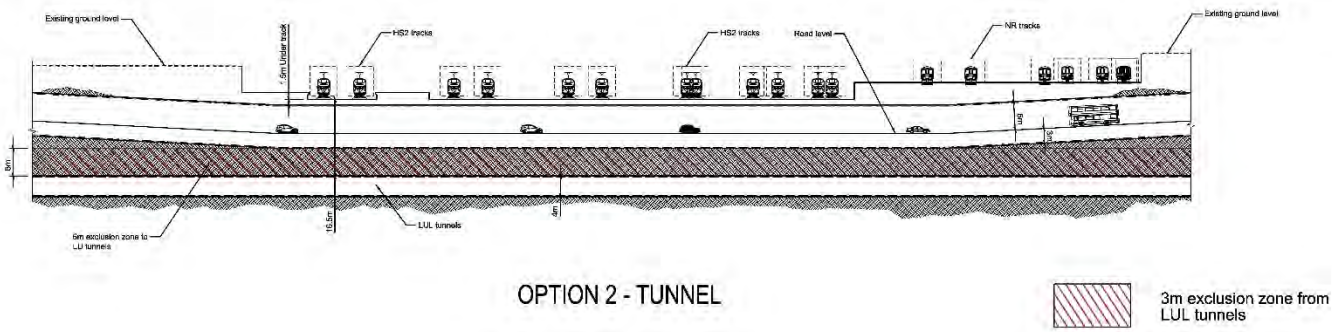


4 Option by option sift
Option 1 – Offline construction

Scheme Not Taken Forward

Key Requirements		Pros	Cons
Does not preclude EAP	No	No temporary utilites diversions	**Requires demolition of Cartmel, Ryedale and other properties.**
Does not preclude OSD	No	No temporary bridges	
Impact on Cartmel	Demolition	No disruption to A400 Hampstead Road	Risks
Impact on Ampthill	Positive		Alignment to be approved to standards
Ped / Cycle connectivity	YEs		
Permit GTB Replacement	No		
Visual Impact	Neutral		
NR B2 Station	As baseline		
NR Disruption	Reduced		
A400 Hampstead Road Open	Yes		
Construction Period	Faster		

4 Option by option sift
Option 2 – Tunnel

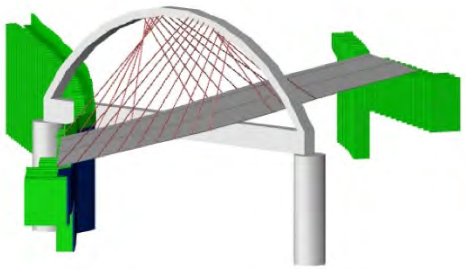


Key Requirements		Pros	Cons
Does not preclude EAP	Changes	Offline construction for railway	Increased cost compared with baseline
Does not preclude OSD	Yes	Some utilities in tunnel	LUL tunnel clash
Impact on Cartmel	Positive		Impact on residents / roads for portal construction
Impact on Ampthill	Positive		Ped / cycle not preferred in tunnel
Ped / Cycle connectivity	Poor – not in tunnel		Portals effect utilities in the roads
Permit GTB Replacement	?		Gas unlikely in tunnel so alternative route required
Visual Impact	Improved		B1 ramp precluded
NR B2 Station	Lower throat risk for tunnel		HS alignment cannot raise to give greater cover to tunnel
NR Disruption	Positive		No pedestrian connectivity
A400 Hampstead Road Open	Positive		Long cut and cover approaches result in demolitions and road disruptions
Construction Period	Longer		9m clearance between track base slab and LUL exclusion zone which is not sufficient for approx. 10m height tunnel required.
			Reduced access to station
			Tunnel SCL so risk to LUL tunnels during construction
			Ventilation shaft not easily accessible – hence portal vents

4 Option by option sift
Option 3 – Demolish HRB

Key Requirements		Pros	Cons
Does not preclude EAP	No	Off-line works	Widescale disruption to utilities – not viable
Does not preclude OSD	Yes		Widescale disruption to traffic – not viable
Impact on Cartmel	Positive		No B1 ramp
Impact on Ampthill	Positive		No local north-south connection for ped/cycle apart from GTB
Ped / Cycle connectivity	Poor		Widescale Bus route disruption
Permit GTB Replacement	Yes		Reduced permeability across the station
Visual Impact	Improved		Not EAP compliant
NR B2 Station	Improved		Not ES compliant
NR Disruption	Reduced		
A400 Hampstead Road Open	No		
Construction Period	Reduced		

4 Option by option sift
Option 4 – Transverse support to HS



Key Requirements		Pros	Cons
Does not preclude EAP	Yes	Avoid half utilities diversions	Cost
Does not preclude OSD	Yes	Faster construction as foundations can be constructed without utilities diversions	TOC parking
Impact on Cartmel	Positive	Less community disruption	Northern open space reduced – requires reprovision
Impact on Ampthill	Neutral	Iconic / landmark structure	Access for maintenance difficult over rail and road
Ped / Cycle connectivity	Yes	Improved span arrangement compared to Option (4)	Visually striking (approx. 30m high)
Permit GTB Replacement	Neutral	Potential for similar scheme over NR	No benefit over NR (unless Option (2)
Visual Impact	Change		No benefit to Ampthill (unless Option (2)
NR B2 Station	Neutral		Highly asymmetric
NR Disruption	Neutral		Wider deck due to cable connections / clearance and utilities in footway
A400 Hampstead Road Open	No		Southern utilities route impacted
Construction Programme	Reduced		Impact on construction Zone 5
			Risks
			Viewing corridors
			B1 Ramp connection

4 Option by option sift
Option 5 – Realign B1 Ramp

- Aim: edge support = reduced deck depth
- Disadvantages:
  - TOC parking precluded
  - Northern open space reduced
  - Poor taxi / lorry segregation
  - Poor public realm
  - Poor highway layout – may not be approved

4 Option by option sift
Option 5 – Realign B1 Ramp

ASSUMPTIONS

1. Fix design elements: changing them would cause major coordination issues.

- Basement ramp: needs to stay as is up to +24.50 m OD;
- Taxi facilities: needs to stay in place but could be modified slightly.
- Northern fire escape: it connects all the sub-grade levels thus changing it would mean reconfiguring basement and platform levels.

2. Flexible design elements: these elements could be rearranged according to the new configuration of HRB.

- TOC parking: it could be relocated if needs be.
- Bicycle parking could be redistributed accross the site if needs be.
- Northern gardens could be redesigned to adapt them to the new level changes.

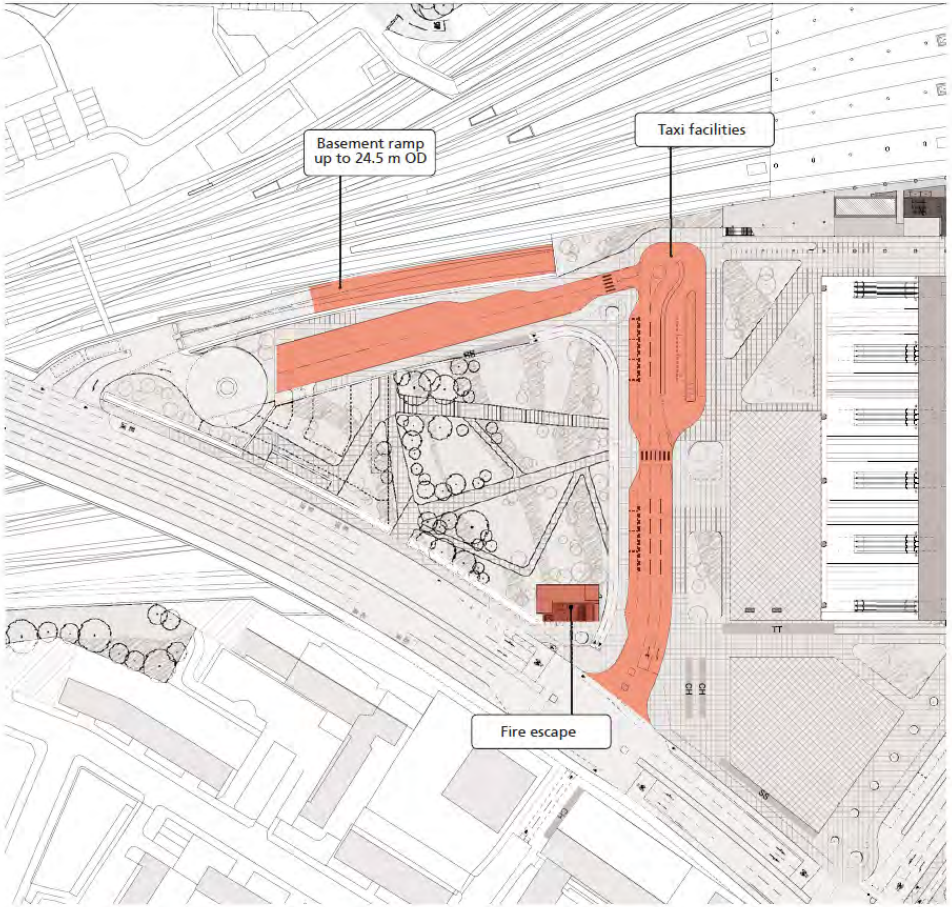
GRIMSHAW - HS2 Euston

HRB Lowering - Possible layouts for the Northern gardens, taxi facilities and basement entrance.

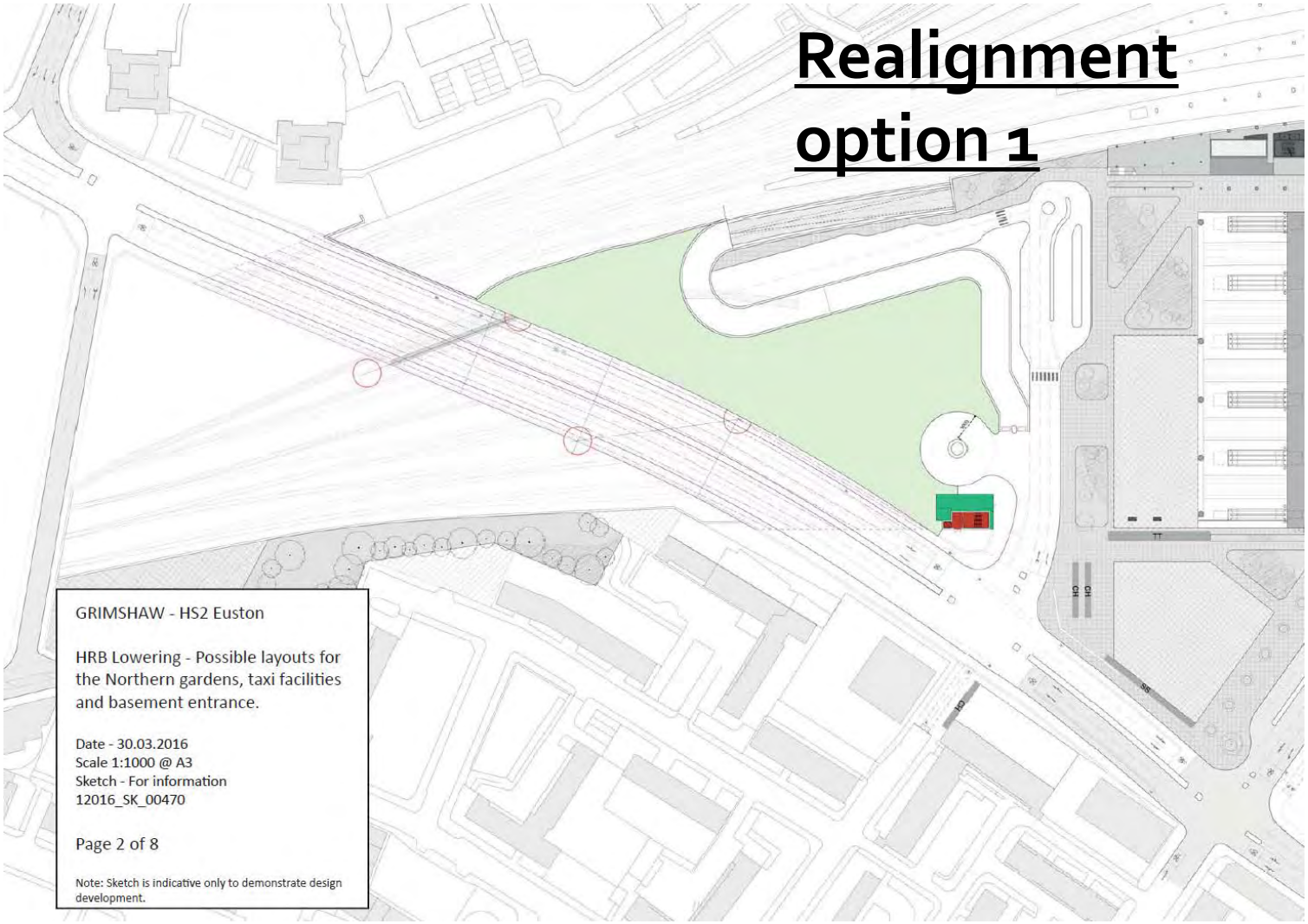
Date - 30.03.2016
Scale 1:1000 @ A3
Sketch - For information
12016_SK_00470

Page 1 of 8

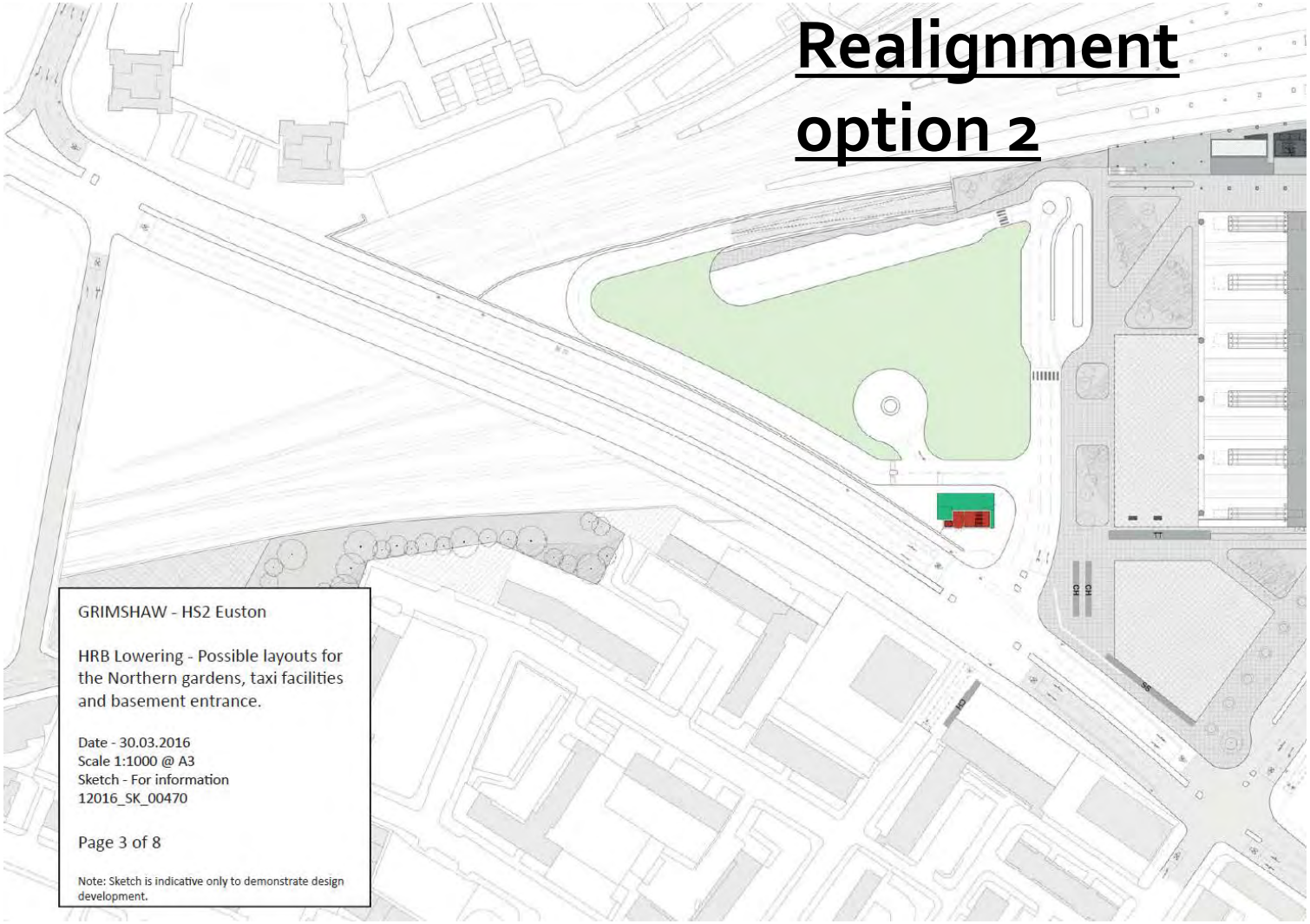
Note: Sketch is indicative only to demonstrate design development.



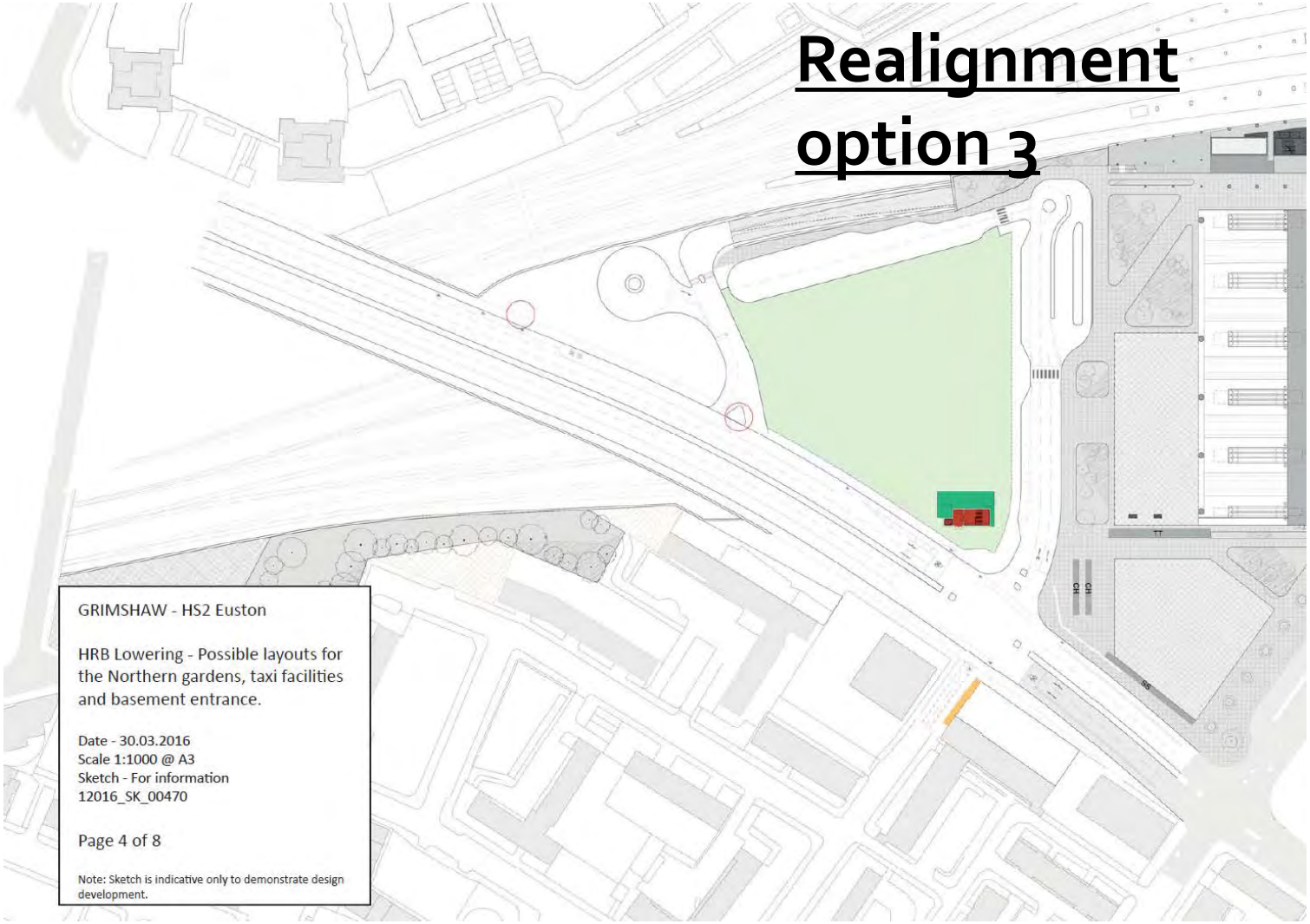
4 Option by option sift
Option 5 – Realign B1 Ramp



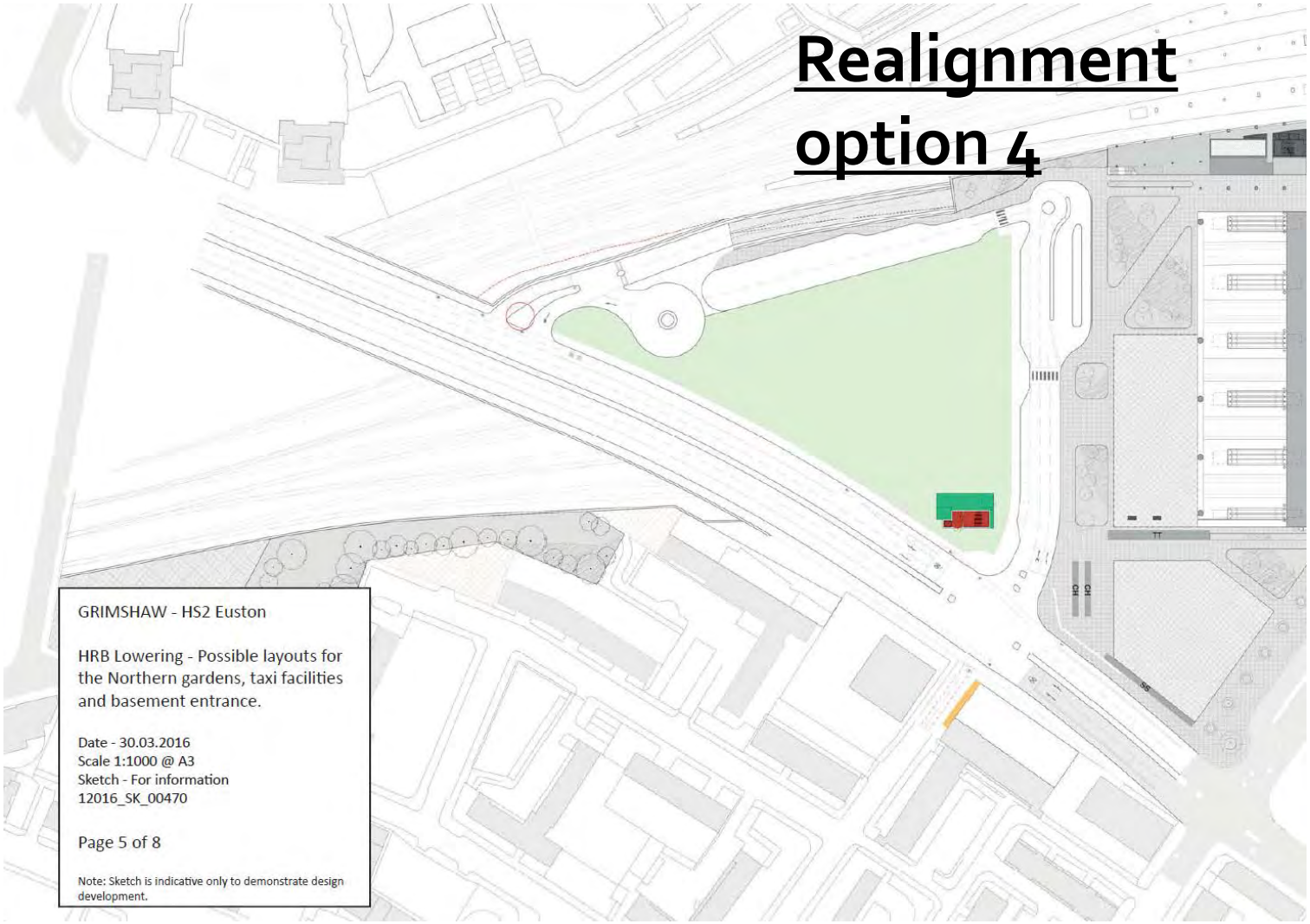
4 Option by option sift
Option 5 – Realign B1 Ramp



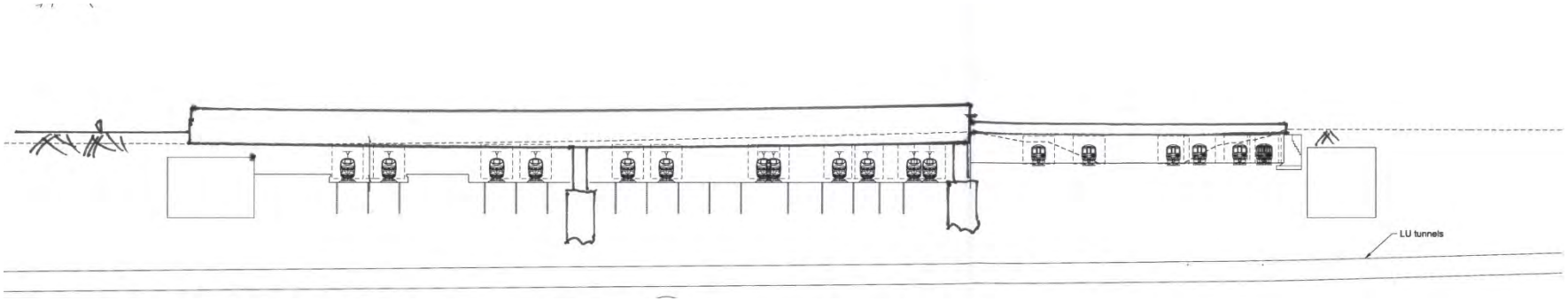
4 Option by option sift
Option 5 – Realign B1 Ramp



4 Option by option sift
Option 5 – Realign B1 Ramp

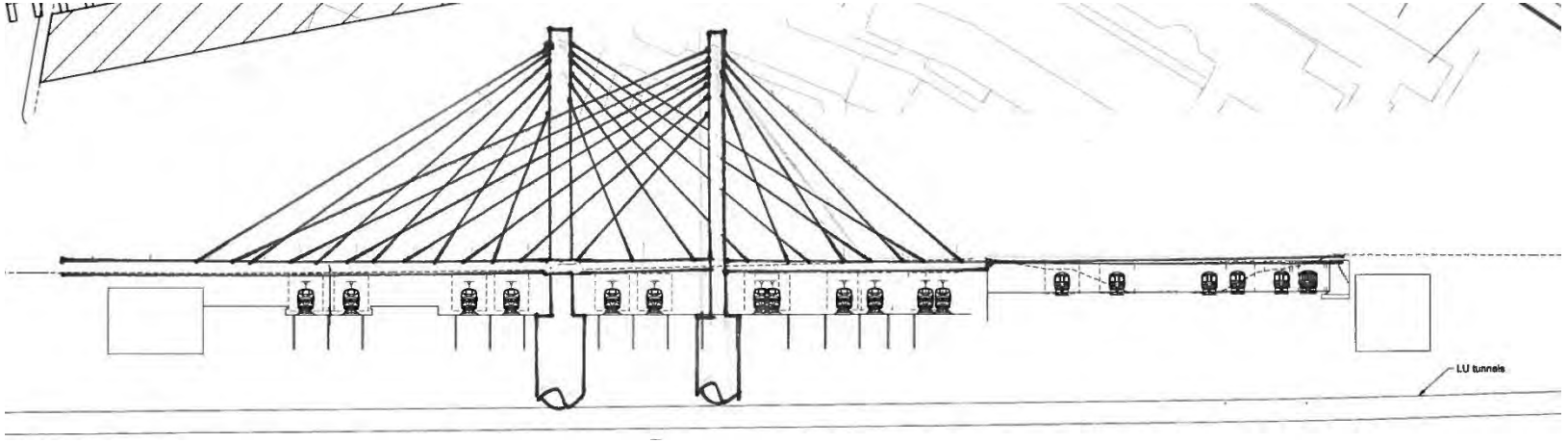


4 Option by option sift
Option 5a – Half through Girder



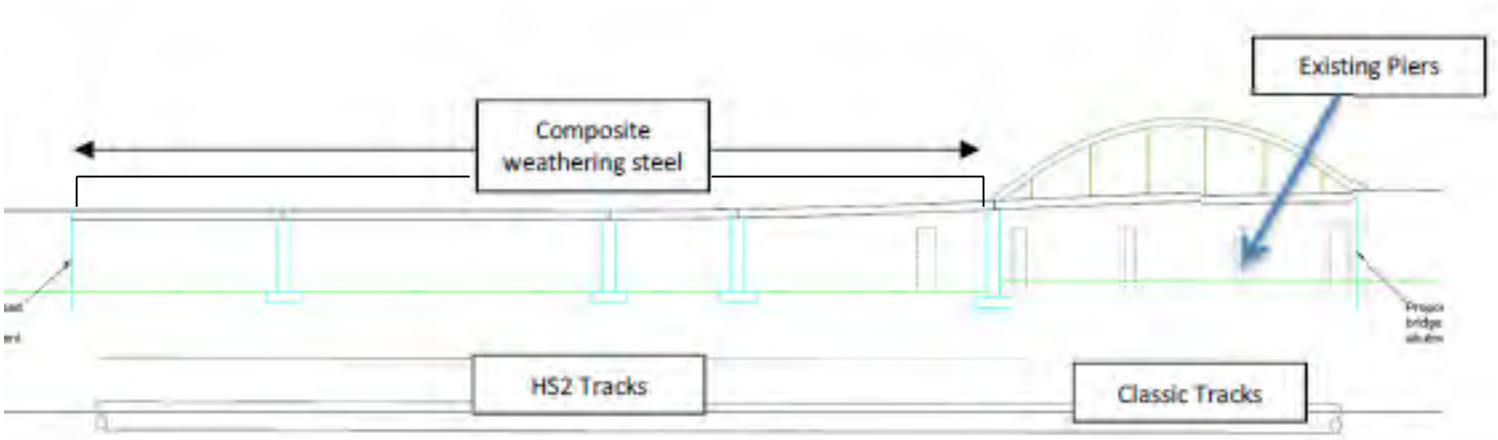
Key Requirements		Pros	Cons
Does not preclude EAP	Yes	Easy to launch	Cannot have staged construction if 2 planes of support
Does not preclude OSD	Yes	Visually uniform	If 4 planes of support then poor connectivity
Impact on Cartmel	Positive		Utilities in footways
Impact on Ampthill	Positive		Poor maintenance access
Ped / Cycle connectivity	Yes		No B1 Ramp onto HRB
Permit GTB Replacement	Yes		
Visual Impact	Neutral (plus)		
NR B2 Station	As baseline		
NR Disruption	As baseline		
A400 Hampstead Road Open	Not if 1 stage		
Construction Period	Neutral		

4 Option by option sift
Option 5b – 2 plane CSB



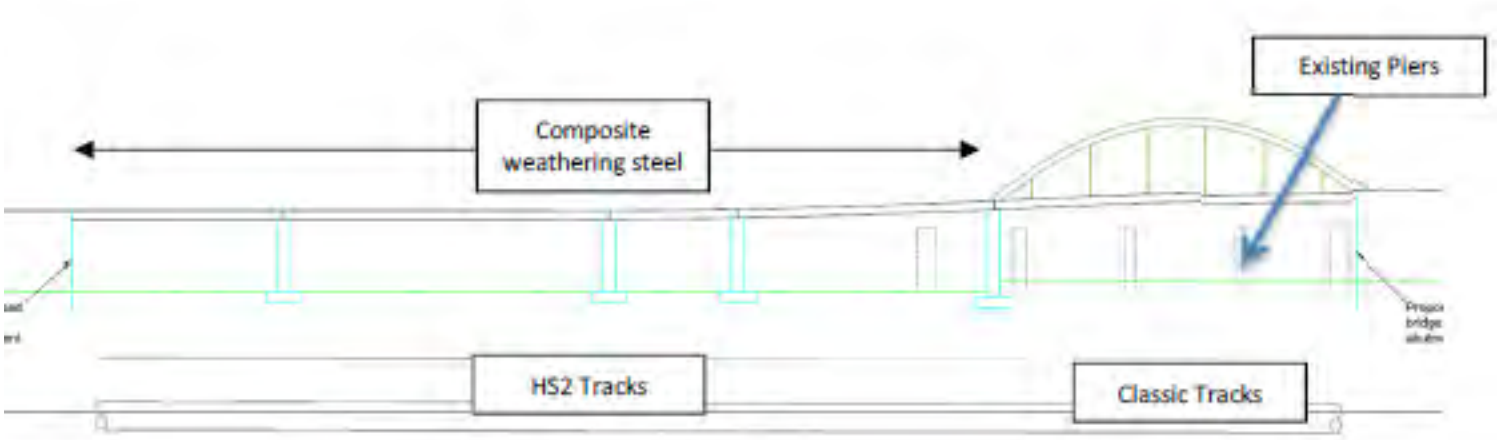
Key Requirements		Pros	Cons
Does not preclude EAP	Yes	As 3(a)	As 3(a)
Does not preclude OSD	Yes	Allows B1 Ramp	Cost higher
Impact on Cartmel	Positive		More maintenance (at height and over rail)
Impact on Ampthill	Positive		Visually intrusive tower (approx. 60m for single tower)
Ped / Cycle connectivity	Yes		Maintenance of cables?
Permit GTB Replacement	Yes		
Visual Impact	Greater		Risks
NR B2 Station	As baseline		Viewing corridors compromised
NR Disruption	As baseline		
A400 Hampstead Road Open	No		
Construction Period	Longer		

4 Option by option sift
Option 5c – NR arch + through HS



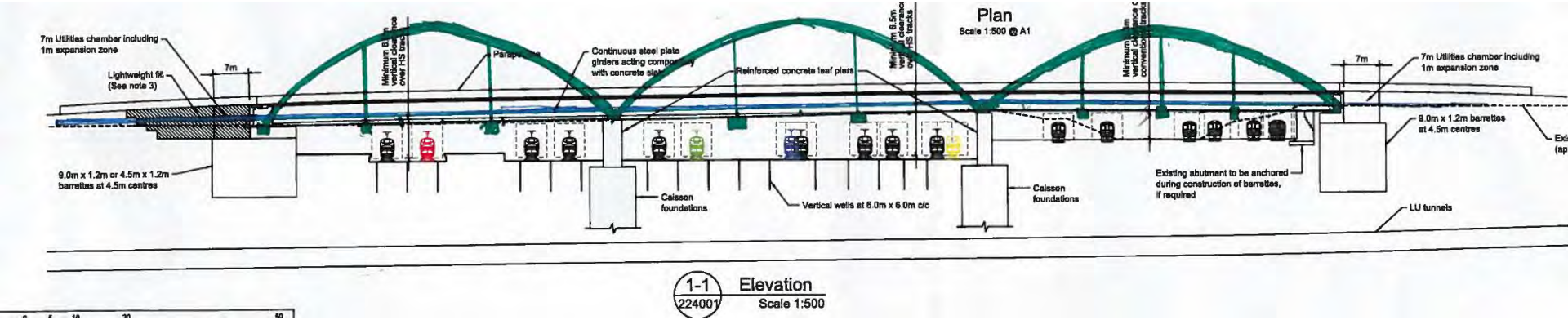
Key Requirements		Pros	Cons
Does not preclude EAP	Yes	As 3(a)	As 3(a)
Does not preclude OSD	Yes	Lower cost than all arch or CSB	No staged construction unless closure of HR
Impact on Cartmel	Positive		Increased deck width (approximately 34m)
Impact on Ampthill	Positive		Arch may require propping during construction.
Ped / Cycle connectivity	Yes		Continuing maintenance of Arches above deck level
Permit GTB Replacement	Yes		
Visual Impact	Greater		
NR B2 Station	As baseline		
NR Disruption	As baseline		
A400 Hampstead Road Open	No		
Construction Period	As baseline		

4 Option by option sift
Option 5d – NR arch + plate girders HS



Key Requirements		Pros	Cons
Does not preclude EAP	Yes	As 3(a)	Less benefit to Cartmel compared with (3 a-c)
Does not preclude OSD	Yes	Lower cost than all arch or CSB	Increased deck width (approximately 34m)
Impact on Cartmel	Neutral (plus)	Allows B1 ramp onto HR	Arch may require propping during construction.
Impact on Ampthill	Positive		Continuing maintenance of Arches above deck level
Ped / Cycle connectivity	Yes		
Permit GTB Replacement	Yes		
Visual Impact	Greater		
NR B2 Station	As baseline		
NR Disruption	As baseline		
A400 Hampstead Road Open	No		
Construction Period	As baseline		

4 Option by option sift
Option 5e – NR arch + HS arch

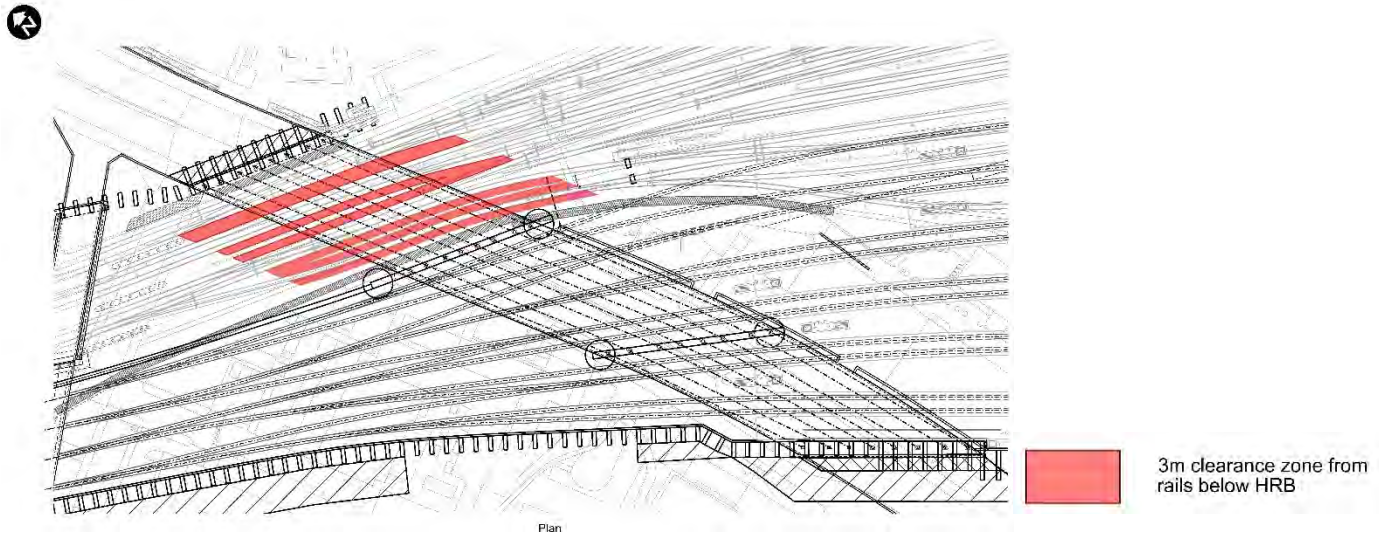


Key Requirements		Pros	Cons
Does not preclude EAP	Yes	As 3(a)	Less benefit to Cartmel compared with (3 a-c)
Does not preclude OSD	Yes	Allows B1 ramp onto HR	Increased deck width (approximately 34m)
Impact on Cartmel	Neutral (plus)		Arches may require propping during construction.
Impact on Ampthill	Positive		Continuing maintenance of Arches above deck level
Ped / Cycle connectivity	Yes		
Permit GTB Replacement	Yes		
Visual Impact	Greater +		
NR B2 Station	As baseline		
NR Disruption	As baseline		
A400 Hampstead Road Open	No		
Construction Period	As baseline		

4 Option by option sift
Option 6 – Additional piers

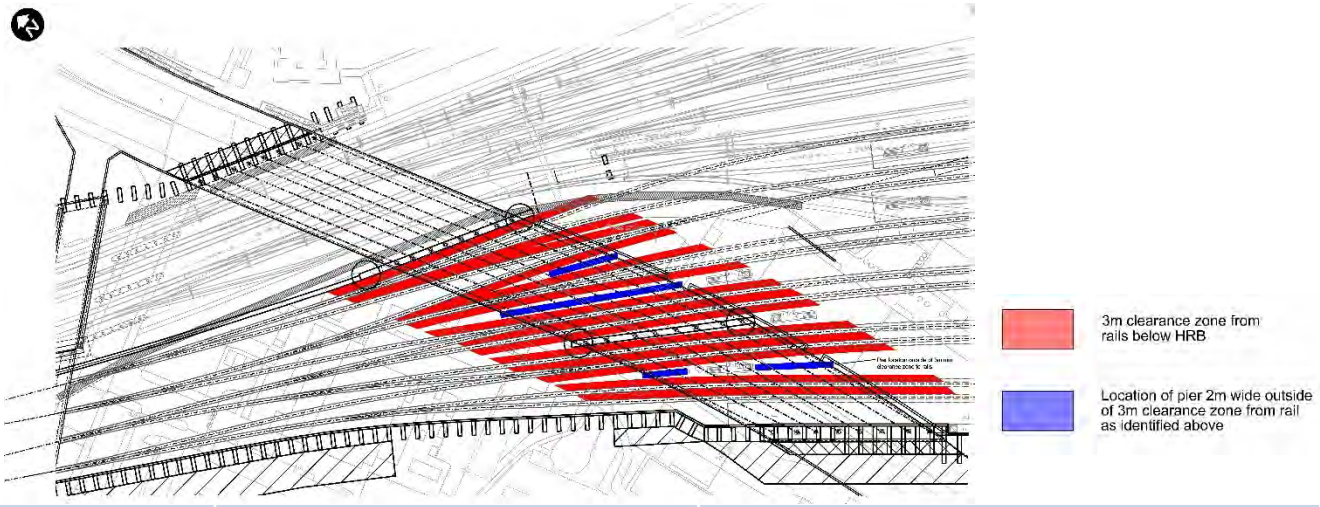
- Shorter spans = reduced structural depth
- Challenge: Piers positioning
  - Clearance from tracks
  - Design to impact loading

4 Option by option sift
Option 6a – Additional piers in NR



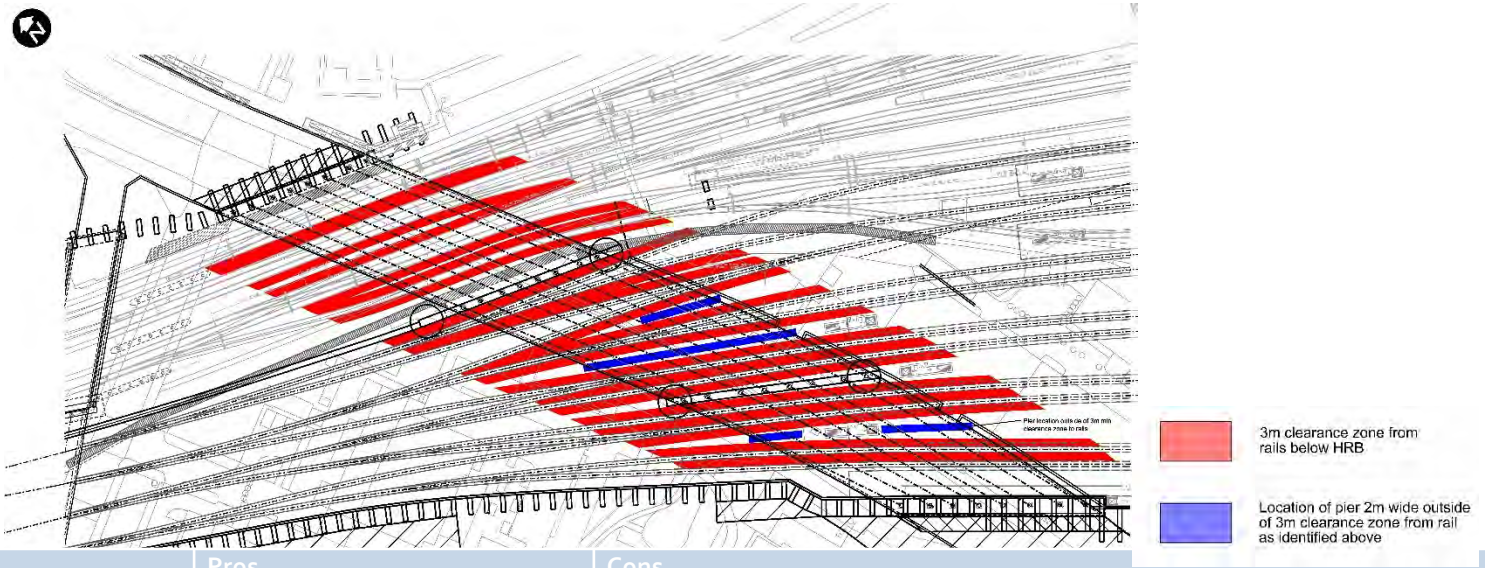
Key Requirements		Pros	Cons
Does not preclude EAP	Yes	Reduces spans thus depth of beam	Precludes NR B2 station unless foundations low
Does not preclude OSD	Yes	Allows B1 Ramp	TOC parking / Northern open space reduced
Impact on Cartmel	Neutral (plus)	Same impact on LUL as baseline	Pier to sustain NR impact loads (hence larger than existing)
Impact on Ampthill	Very Positive	Faster due to road / rail closures	Constrains later NR track plan
Ped / Cycle connectivity	Same as B/L	No change to utilities diversions	Does not comply with the ES
Permit GTB Replacement	Risk		Little benefit to Cartmel without also doing 1(b)
Visual Impact	Neutral (plus)		No significant benefit for through structure.
Enables NR B2 Station	No		
NR Disruption	9m blockade		Risks
A400 Hampstead Road Open	No		Pier in NR does not fit
Construction Period	Increased		GTB cannot be replaced

4 Option by option sift
Option 6b – Additional piers in HS



Key Requirements		Pros	Cons
Does not preclude EAP	Yes	Smaller cranage	Clashes with NR escape stairs
Does not preclude OSD	Yes	Allows B1 Ramp	Span arrangements not balanced so effect of additional piers not fully effective
Impact on Cartmel	Positive (little)	Same impact on LUL as baseline	Road Alignment smooth makes level reduction not fully effective
Impact on Ampthill	Neutral	No change to utilities diversions	
Ped / Cycle connectivity	Yes		**Risks**
Permit GTB Replacement	Yes		Pier in HS does not fit with current alignment and min clearances
Visual Impact	Positive		
NR B2 Station	Neutral		
NR Disruption	Neutral		
A400 Hampstead Road Open	Yes		
Construction Period	Neutral		

4 Option by option sift
Option 6c – Additional piers in NR & HS



Key Requirements		Pros	Cons
Does not preclude EAP	Yes	Smaller cranage	Clashes with NR escape stairs
Does not preclude OSD	Yes	Allows B1 Ramp	Span arrangements not balanced so effect of additional piers not fully effective
Impact on Cartmel	Positive	Same impact on LUL as baseline	
Impact on Ampthill	Positive	No change to utilities diversions	**Risks**
Ped / Cycle connectivity	Yes		Piers do not fit with current alignment and min clearances
Permit GTB Replacement	Yes		
Visual Impact	Positive		
NR B2 Station	Neutral		
NR Disruption	9m blockade		
A400 Hampstead Road Open	Yes		
Construction Period	Neutral		

4 Option by option sift
Option 7 – Keep existing HRB

Key Requirements		Pros	Cons
Does not preclude EAP	No	Lower cost	Not B2 compatible and defers works to others
Does not preclude OSD	Yes	Reduced position risk	Poor movement joint details
Impact on Cartmel	Positive	Potentially no barrettes for Northern abutment	Poor utilities connection
Impact on Ampthill	Positive		TOC parking / Northern open space reduced
Ped / Cycle connectivity	Yes		Reduced design life (NR span not replaced)
Permit GTB Replacement	No	Same impact on LUL as baseline	Potential of road level rise on HRB existing to tie into
Visual Impact	Neutral (plus)	No change to utilities diversions	HS, hence capacity check and parapet change
NR B2 Station	Does not enable		
NR Disruption	Low		Risks
A400 Hampstead Road Open	Yes		Highways alignment may not work
Construction Period	Faster		GTB cannot be replaced
			Existing foundation undermined

4 Option by option sift
Any other ideas?

Option 8: optimise proposed scheme.

5 Conclusions from sift

OPTION	1 Offline	2 Tunnel	3 Transv.	4 Remove	5a Half through	5b CSB	5c Arch + half thr.	5d Arch + girder	5e 3 no. arches	6a Piers in NR	6b Piers in HS	6c Piers in both	7 Keep HRB
Does not preclude EAP	✗	Change	✗	✗	✗	?	✗	✓	?	✓	✓	✓	✓
Does not preclude OSD	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Level Impact on Cartmel	✗	✓	✓	✓	✓	✓	✓	-	✓	-	✓	✓	✓
Level Impact on Ampthill	✓	✓	-	✓	✓	✓	✓	✓	✓	✓	-	✓	✓
Ped / Cycle connectivity	✓	✗	✓	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓
Permit GTB Replacement	✗	?	✓	✓	✓	✓	✓	✓	✓	✓	?	✓	?
Visual Impact	-	✓	?	✓	✗	✗	✗	✗	✗	✓	✓	✓	✓
NR B2 Station	-	✓	✓	✓	✓	✓	✓	✓	✓	✗	✓	✗	✗
NR Disruption	-	✓	✓	✓	-	-	-	-	-	✗	-	✗	✓
A400 Hampstead Road Open	✓	✓	✗	✗	✗	✗	✗	✗	✗	✓	✓	✓	?
Construction Period	✓	✗	✓	✓	-	✓	✗	✗	✗	✗	✗	✗	✓
Open space	-	?	-	?	✗	?	✗	✗	✗	-	-	-	-
B1 Ramp	-	✗	✓	✗	✗	?	✗	✗	✗	✓	✓	✓	✗
ES compliance	-	-	-	-	-	?	-	-	-	-	-	-	-
HS2 Cost	-	?	✗	✓	-	✗	✗	✗	✗	-	-	-	✓
Maintenance	-	-	✗	✓	-	✗	✗	✗	✗	✗	-	-	-
Progress?	✗	✗	✗	✗	✗	?	✗	-	✓	-	✓	-	✓

6 Way forward

- Sift meeting 02:
- Options Report P01:

7 Any other business

HRB Lowering Study – SIFT Workshop 02

20/04/2016

Agenda

1. Introductions
2. Purpose of meeting
3. Proposed sift criteria
4. Option by option sift
5. Conclusion from sift
6. Way forward
7. Any other business

1 Introductions

2 Purpose of Meeting

- Conclude sift of options with stakeholder agreement

Requirements 1/2

1. 2 x 2 traffic lanes + cycleways + footway
2. Must not constrain future station development or construction
3. Must provide minimum clearance (UK for classic, TSI for HS Note: current derogations to AP03 scheme)
4. Must be constructable above LUL Northern Line without blockades – if options required then potential for short closures if piggybacking
5. Must provide for utilities crossing railway (as part of a integrated solution) [Utilities requirement as per AP03 scheme]
6. Must provide continuity of operation of utilities
7. Must provide continuity of operation of conventional rail without extreme full closures
8. Must provide continuity of operation of Hampstead Road without extreme full closures

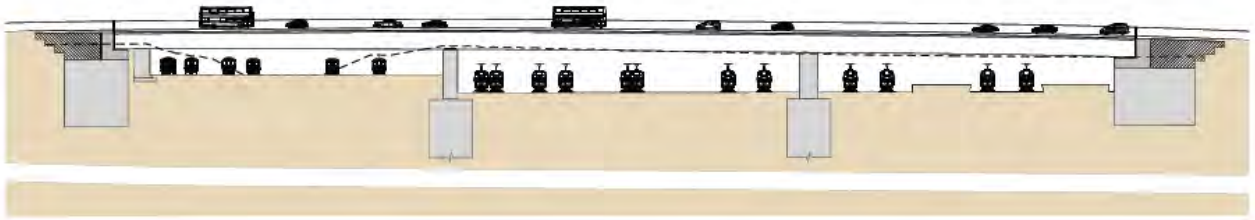
Requirements 2/2

1. Must provide for an access ramp to HS Station basement
2. Must acknowledge new HS track plan (ie station plan below HRB) for support structure
3. Must permit retention / replacement of GTB
4. Must carry highways loading and withstand lateral railway loading
5. Must be safe for pedestrian and road users
6. Minimise disruption for access for pedestrian and road users, especially access to Ampthill estate
7. Must not preclude Euston Area Plan
8. Retain Cartmel
9. Minimum road level raise at Cartmel to meet taxi road junction

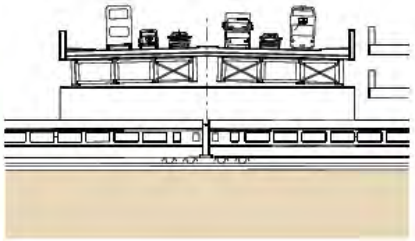
4 Option by option sift

0. AP03 Scheme
1. Realigned Hampstead Road
2. Tunnel
3. Demolish HRB
4. Transverse support to HS spans
5. Through structures
6. Additional Piers
7. Keep existing HRB
8. Optimise AP03 Scheme

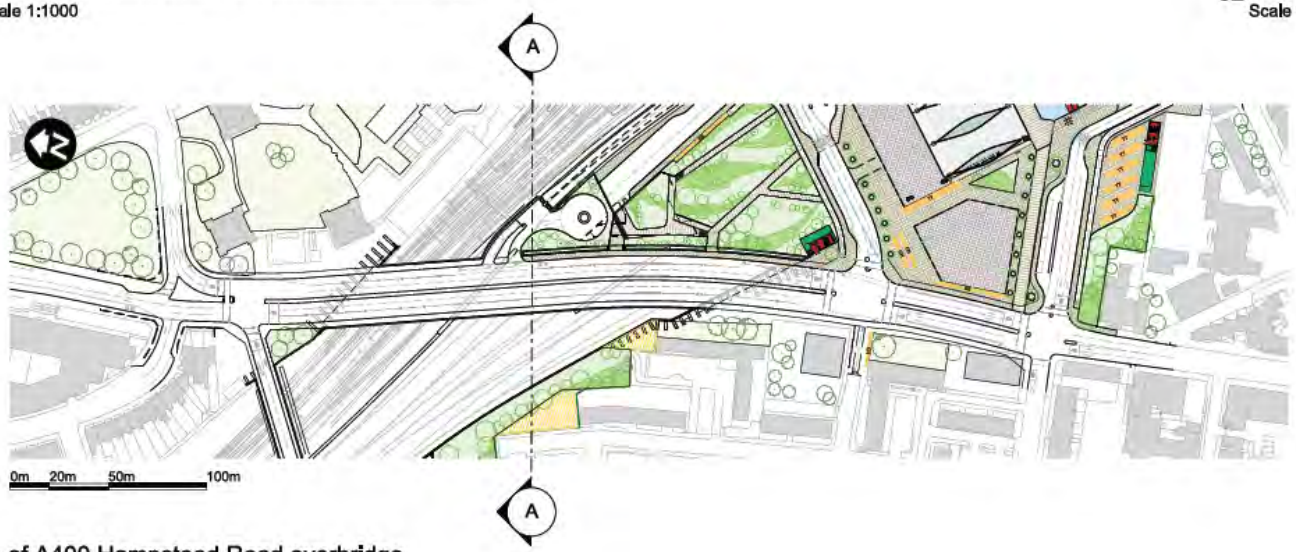
4 Option by option sift AP03 scheme



01 Elevation of A400 Hampstead Road overbridge
Scale 1:1000



02 Section A-A of A400 Hampstead Road overbridge
Scale 1:500

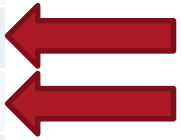


03 Plan of A400 Hampstead Road overbridge
Scale 1:2500

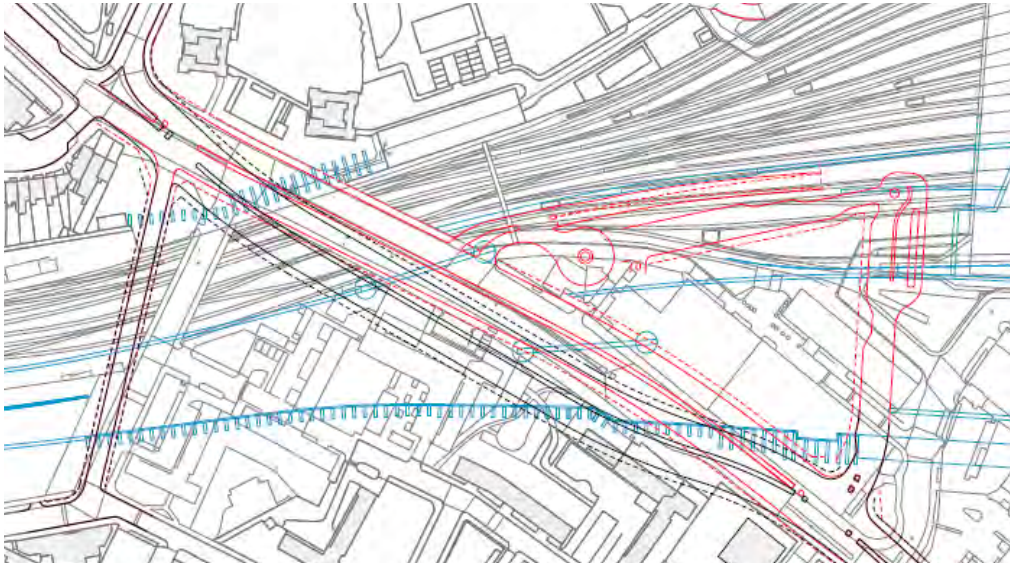
4 Option by option sift Existing scheme

- 3 spans (single span over NR)
- 3m deep steel plate girders

CURRENT SCHEME	
Does not preclude EAP	Yes
Does not preclude OSD	Yes
Impact on Cartmel	To be improved
Impact on Ampthill	To be improved
Ped / Cycle connectivity	Yes
Permit GTB Replacement	Yes
Visual Impact	Baseline
NR B2 Station	Neutral
NR Disruption	Neutral
A400 Hampstead Road Open	Yes
Construction Programme	Baseline

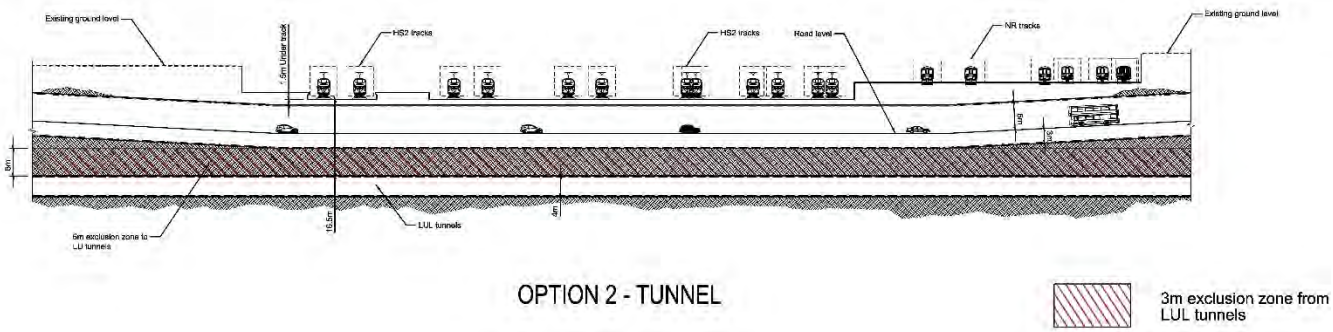


4 Option by option sift
Option 1 – Realigned Hampstead Road



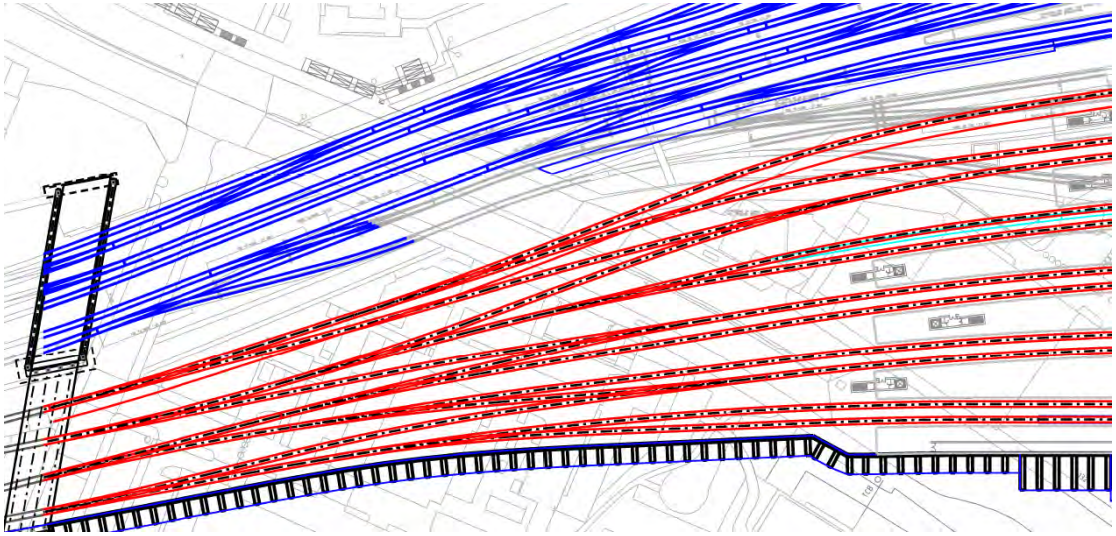
Key Requirements		Pros	Cons
Does not preclude EAP	Yes	No temporary utilites diversions	**Requires demolition of Cartmel.**
Does not preclude OSD	Yes	No temporary bridges	
Impact on Cartmel	Demolition	No disruption to A400 Hampstead Road	Risks
Impact on Ampthill	Positive		Alignment to be approved to standards
Ped / Cycle connectivity	Yes		
Permit GTB Replacement	No		
Visual Impact	Neutral		
NR B2 Station	As baseline		
NR Disruption	Reduced		
A400 Hampstead Road Open	Yes		
Construction Period	Faster		

4 Option by option sift
Option 2 – Tunnel



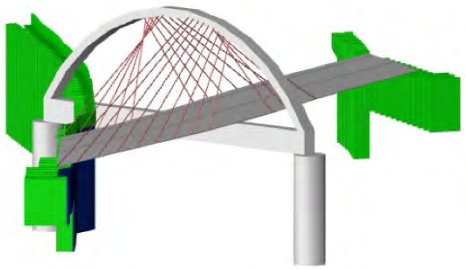
Key Requirements		Pros	Cons
Does not preclude EAP	Changes	Offline construction for railway	Increased cost compared with baseline
Does not preclude OSD	Yes	Some utilities in tunnel	LUL tunnel clash
Impact on Cartmel	Positive		Impact on residents / roads for portal construction
Impact on Ampthill	Positive		Ped / cycle not preferred in tunnel
Ped / Cycle connectivity	Poor – not in tunnel		Portals effect utilities in the roads
Permit GTB Replacement	?		Gas unlikely in tunnel so alternative route required
Visual Impact	Improved		B1 ramp precluded
NR B2 Station	Lower throat risk for tunnel		HS alignment cannot raise to give greater cover to tunnel
NR Disruption	Positive		No pedestrian connectivity
A400 Hampstead Road Open	Positive		Long cut and cover approaches result in demolitions and road disruptions
Construction Period	Longer		9m clearance between track base slab and LUL exclusion zone which is not sufficient for approx. 10m height tunnel required.
			Reduced access to station
			Tunnel SCL so risk to LUL tunnels during construction
			Ventilation shaft not easily accessible – hence portal vents

4 Option by option sift
Option 3 – Demolish HRB



Key Requirements		Pros	Cons
Does not preclude EAP	No	Off-line works	Widescale disruption to utilities – not viable
Does not preclude OSD	Yes		Widescale disruption to traffic – not viable
Impact on Cartmel	Positive		No B1 ramp
Impact on Ampthill	Positive		No local north-south connection for ped/cycle apart from GTB
Ped / Cycle connectivity	Poor		Widescale Bus route disruption
Permit GTB Replacement	Yes		Reduced permeability across the station
Visual Impact	Improved		Not EAP compliant
NR B2 Station	Improved		Not ES compliant
NR Disruption	Reduced		
A400 Hampstead Road Open	No		
Construction Period	Reduced		

4 Option by option sift
Option 4 – Transverse support to HS



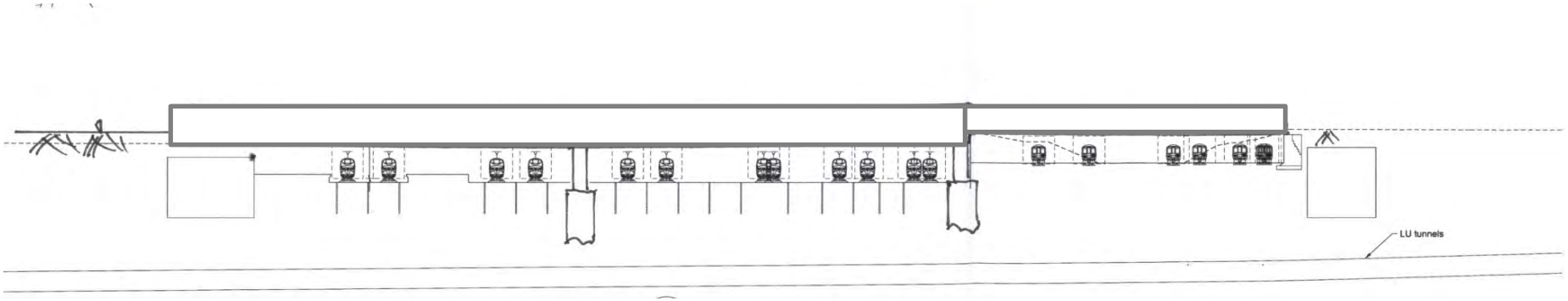
Key Requirements		Pros	Cons
Does not preclude EAP	Yes	Avoid half utilities diversions	Cost
Does not preclude OSD	Yes	Faster construction as foundations can be constructed without utilities diversions	TOC parking
Impact on Cartmel	Positive	Less community disruption	Northern open space reduced – requires reprovision
Impact on Ampthill	Neutral	Iconic / landmark structure	Access for maintenance difficult over rail and road
Ped / Cycle connectivity	Yes	Improved span arrangement compared to Option (4)	Visually striking (approx. 30m high)
Permit GTB Replacement	Neutral	Potential for similar scheme over NR	No benefit over NR (unless Option (2)
Visual Impact	Change		No benefit to Ampthill (unless Option (2)
NR B2 Station	Neutral		Highly asymmetric
NR Disruption	Neutral		Wider deck due to cable connections / clearance and utilities in footway
A400 Hampstead Road Open	No		Southern utilities route impacted
Construction Programme	Reduced		Impact on construction Zone 5
			Risks
			Viewing corridors
			B1 Ramp connection

4 Option by option sift
Option 5 – Realign B1 Ramp

- Aim: edge support = reduced deck depth
- Disadvantages:
  - TOC parking precluded
  - Northern open space reduced
  - Poor taxi / lorry segregation
  - Poor public realm
  - Poor highway layout – may not be approved
- Allows a range of structural options to be considered

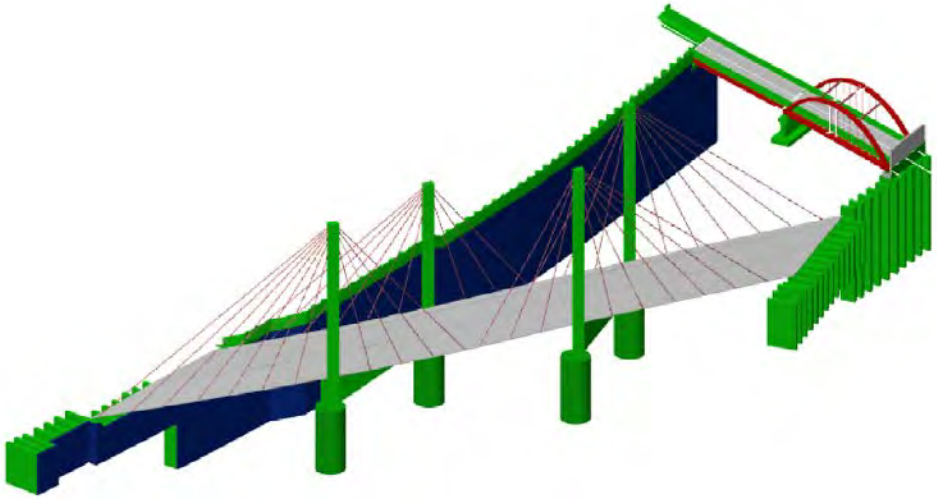
4 Option by option sift

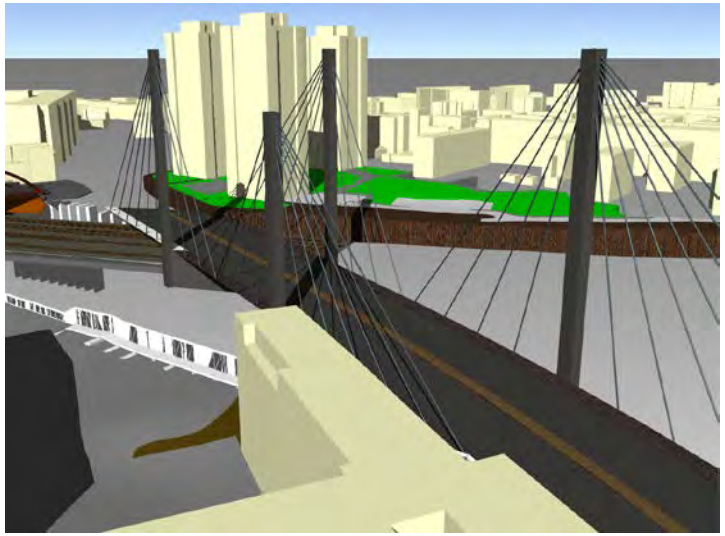
Option 5a – Half through Girder (HS2 and NR)



Key Requirements		Pros	Cons
Does not preclude EAP	Yes	Easy to launch	Cannot have staged construction if 2 planes of support
Does not preclude OSD	Yes	Visually uniform	If 4 planes of support then poor connectivity
Impact on Cartmel	Positive		Utilities in footways
Impact on Ampthill	Positive		Poor maintenance access
Ped / Cycle connectivity	Yes		No B1 Ramp onto HRB
Permit GTB Replacement	Yes		
Visual Impact	Neutral (plus)		
NR B2 Station	As baseline		
NR Disruption	As baseline		
A400 Hampstead Road Open	Not if 1 stage		
Construction Period	Neutral		

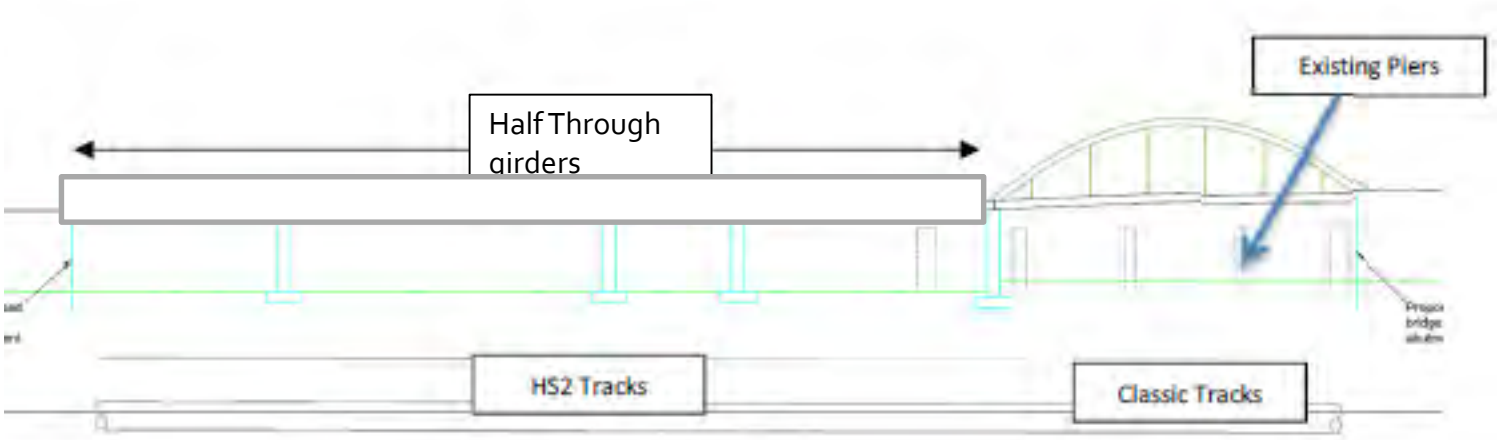
4 Option by option sift
Option 5b – 2 plane CSB





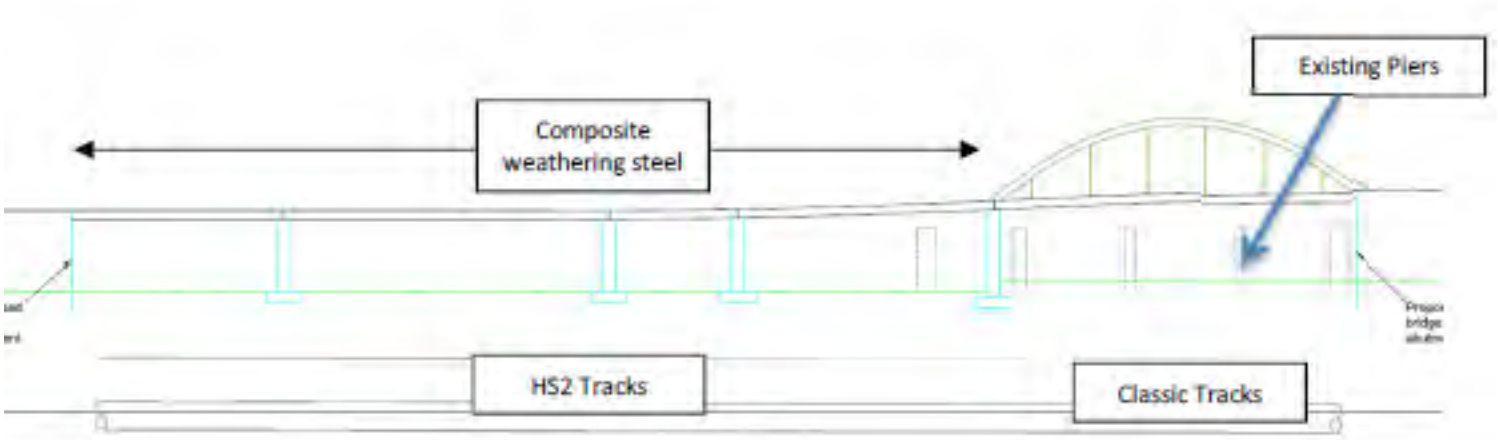
Key Requirements		Pros	Cons
Does not preclude EAP	Yes	As 3(a)	As 3(a)
Does not preclude OSD	Yes	Allows B1 Ramp	Cost higher
Impact on Cartmel	Positive		More maintenance (at height and over rail)
Impact on Ampthill	Positive		Visually intrusive tower (approx. 60m for single tower)
Ped / Cycle connectivity	Yes		Maintenance of cables?
Permit GTB Replacement	Yes		
Visual Impact	Greater		**Risks**
NR B2 Station	As baseline		Viewing corridors compromised
NR Disruption	As baseline		
A400 Hampstead Road Open	No		
Construction Period	Longer		

4 Option by option sift
Option 5c – NR arch + through HS



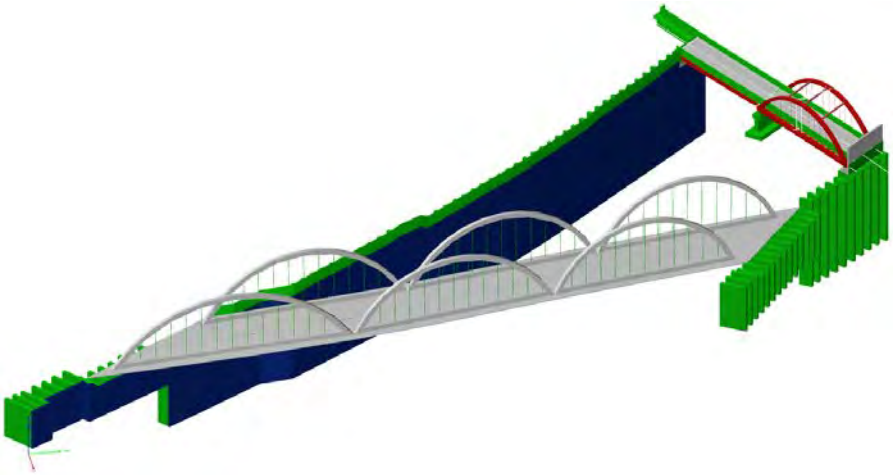
Key Requirements		Pros	Cons
Does not preclude EAP	Yes	As 3(a)	As 3(a)
Does not preclude OSD	Yes	Lower cost than all arch or CSB	No staged construction unless closure of HR
Impact on Cartmel	Positive		Increased deck width (approximately 34m)
Impact on Ampthill	Positive		Arch may require propping during construction.
Ped / Cycle connectivity	Yes		Continuing maintenance of Arches above deck level
Permit GTB Replacement	Yes		
Visual Impact	Greater		
NR B2 Station	As baseline		
NR Disruption	As baseline		
A400 Hampstead Road Open	No		
Construction Period	As baseline		

4 Option by option sift
Option 5d – NR arch + plate girders HS



Key Requirements		Pros	Cons
Does not preclude EAP	Yes	As 3(a)	Less benefit to Cartmel compared with (3 a-c)
Does not preclude OSD	Yes	Lower cost than all arch or CSB	Increased deck width (approximately 34m)
Impact on Cartmel	Neutral (plus)	Allows B1 ramp onto HR	Arch may require propping during construction.
Impact on Ampthill	Positive		Continuing maintenance of Arches above deck level
Ped / Cycle connectivity	Yes		
Permit GTB Replacement	Yes		
Visual Impact	Greater		
NR B2 Station	As baseline		
NR Disruption	As baseline		
A400 Hampstead Road Open	No		
Construction Period	As baseline		

4 Option by option sift
Option 5e – NR arch + HS arch

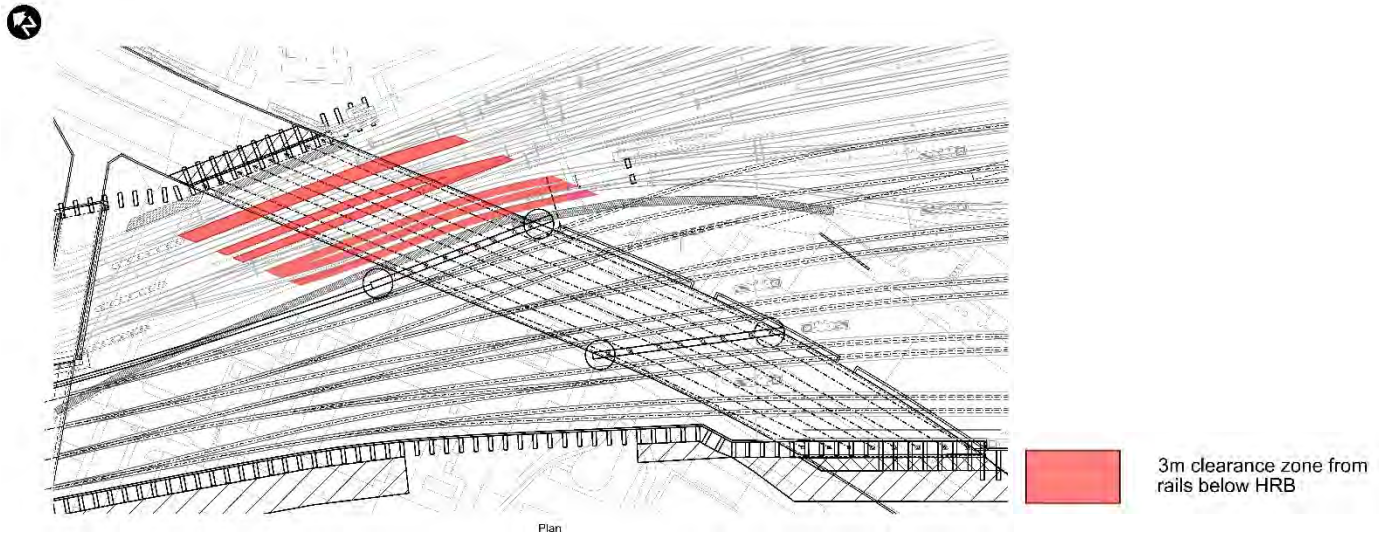


Key Requirements		Pros	Cons
Does not preclude EAP	Yes	As 3(a)	Less benefit to Cartmel compared with (3 a-c)
Does not preclude OSD	Yes	Allows B1 ramp onto HR	Increased deck width (approximately 34m)
Impact on Cartmel	Neutral (plus)		Arches may require propping during construction.
Impact on Ampthill	Positive		Continuing maintenance of Arches above deck level
Ped / Cycle connectivity	Yes		
Permit GTB Replacement	Yes		
Visual Impact	Greater +		
NR B2 Station	As baseline		
NR Disruption	As baseline		
A400 Hampstead Road Open	No		
Construction Period	As baseline		

4 Option by option sift
Option 6 – Additional piers

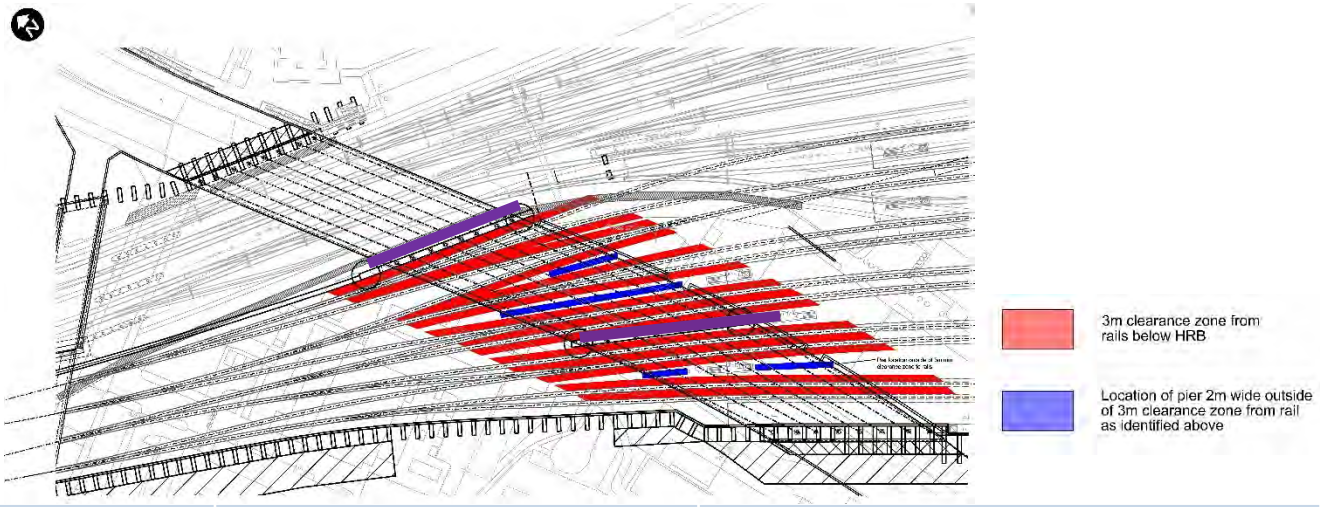
- Shorter spans = reduced structural depth
- Challenge: Piers positioning
  - Clearance from tracks
  - Design to impact loading

4 Option by option sift
Option 6a – Additional piers in NR



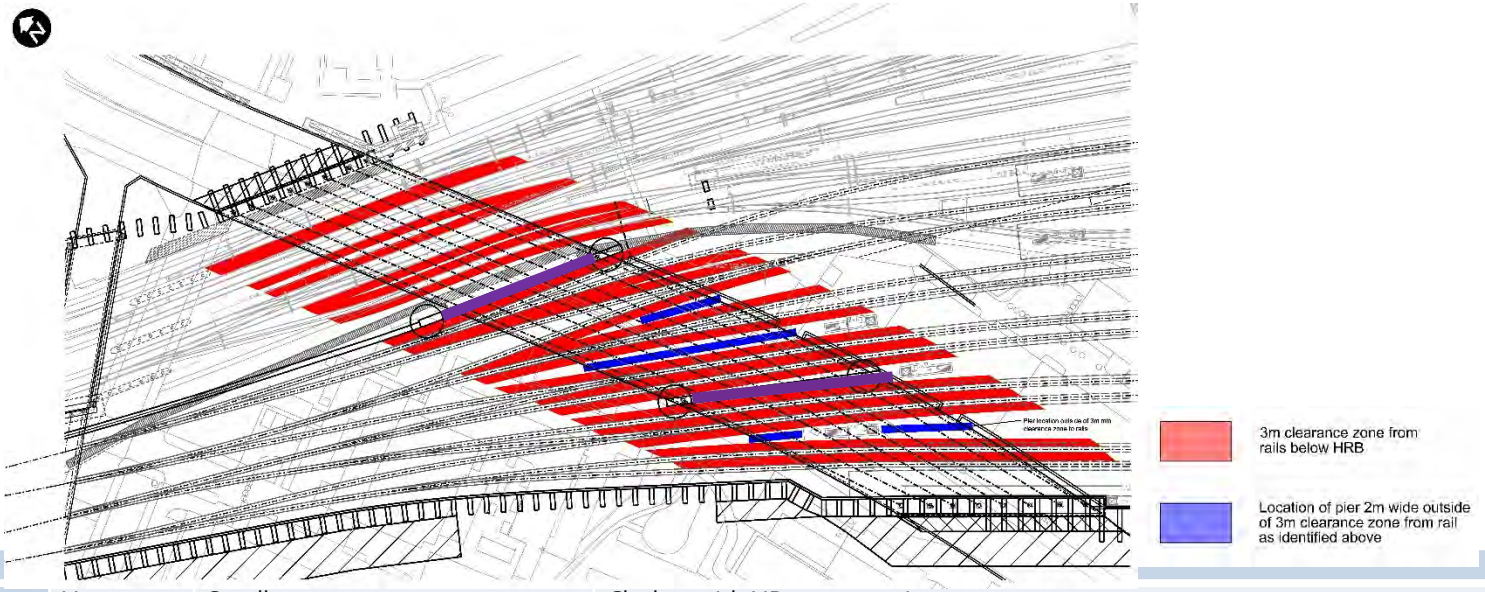
Key Requirements		Pros	Cons
Does not preclude EAP	Unknown	Reduces spans thus depth of beam	Precludes NR B2 station unless foundations low
Does not preclude OSD	Yes	Allows B1 Ramp	TOC parking / Northern open space reduced
Impact on Cartmel	Neutral (plus)	Same impact on LUL as baseline	Pier to sustain NR impact loads (hence larger than existing)
Impact on Ampthill	Very Positive	Faster due to road / rail closures	Constrains later NR track plan
Ped / Cycle connectivity	Same as B/L	No change to utilities diversions	Does not comply with the ES
Permit GTB Replacement	Risk		Little benefit to Cartmel without also doing 1(b)
Visual Impact	Neutral (plus)		No significant benefit for through structure.
Enables NR B2 Station	No		
NR Disruption	9m blockade		Risks
A400 Hampstead Road Open	No		Pier in NR does not fit
Construction Period	Increased		GTB cannot be replaced

4 Option by option sift
Option 6b – Additional piers in HS



Key Requirements		Pros	Cons
Does not preclude EAP	Yes	Smaller cranage	Clashes with NR escape stairs
Does not preclude OSD	Yes	Allows B1 Ramp	Span arrangements not balanced so effect of additional piers not fully effective
Impact on Cartmel	Positive (little)	Same impact on LUL as baseline	Road Alignment smooth makes level reduction not fully effective
Impact on Ampthill	Neutral	No change to utilities diversions	
Ped / Cycle connectivity	Yes		**Risks**
Permit GTB Replacement	Yes		Pier in HS does not fit with current alignment and min clearances
Visual Impact	Positive		
NR B2 Station	Neutral		
NR Disruption	Neutral		
A400 Hampstead Road Open	Yes		
Construction Period	Neutral		

4 Option by option sift
Option 6c – Additional piers in NR & HS



Key Requirements			
Does not preclude EAP	Yes	Smaller cranage	Clashes with NR escape stairs
Does not preclude OSD	Yes	Allows B1 Ramp	Span arrangements not balanced so effect of additional piers not fully effective
Impact on Cartmel	Positive	Same impact on LUL as baseline	
Impact on Ampthill	Positive	No change to utilities diversions	**Risks**
Ped / Cycle connectivity	Yes		Piers do not fit with current alignment and min clearances
Permit GTB Replacement	Yes		
Visual Impact	Positive		
NR B2 Station	Neutral		
NR Disruption	9m blockade		
A400 Hampstead Road Open	Yes		
Construction Period	Neutral		

Benefit of Additional Piers in NR

	Level of soffit	Road Level (above existing ground level at Ampthill)
AP03 scheme	5.3m above NR rail	+ 2.8m
Short span scheme	5.3m above NR rail	+1.5m
Long span scheme (through)	5.3m above NR rail	+ 2.0m
Retain NR bridge	4.9m above NR rail	+0.0m

Indicative construction durations and closures required for additional piers in NR

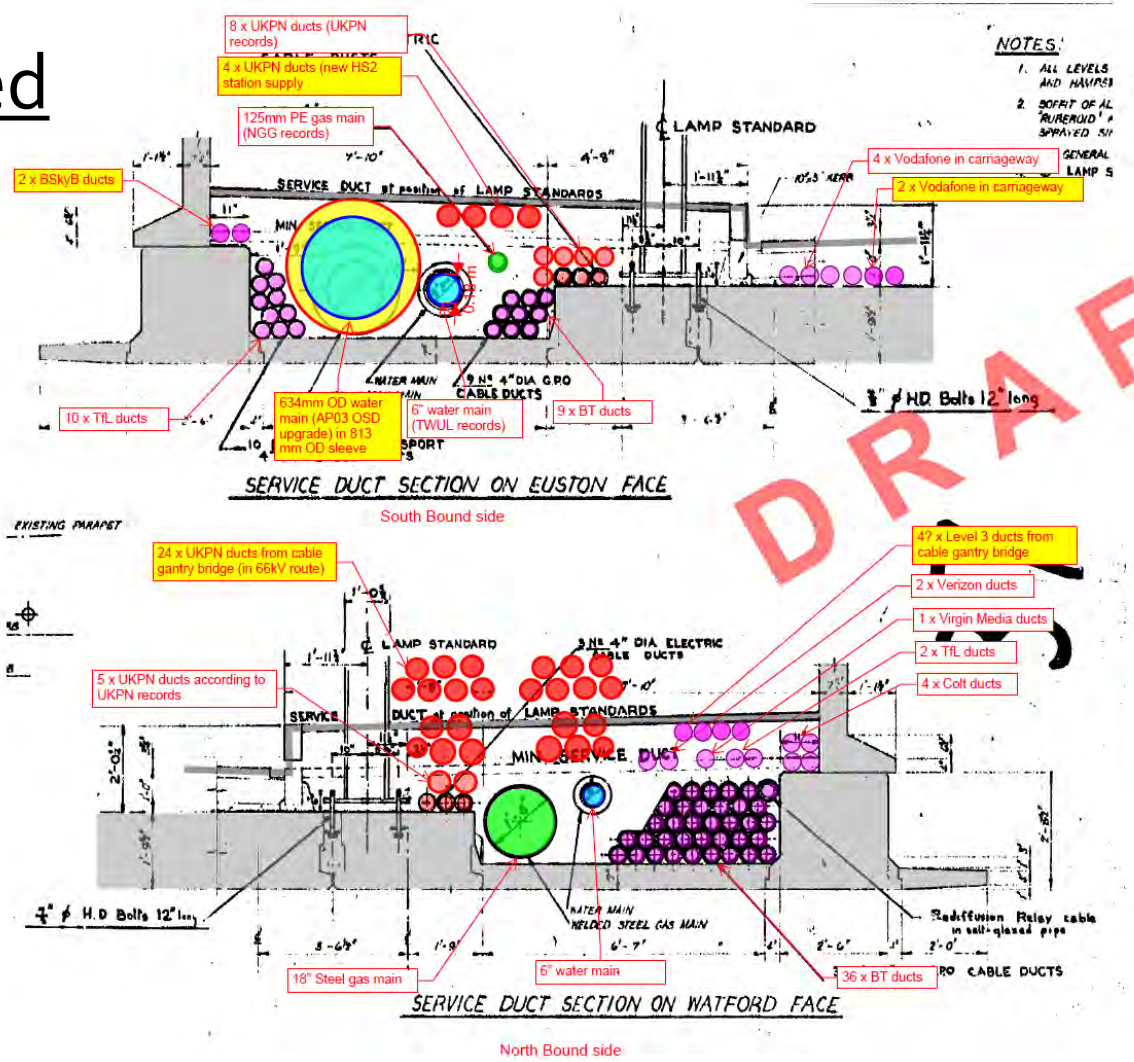
		NR Rail Closure	
		Half	Full
Road Closure	Half	18 months	8 months
	Full	12 months	6 months

4 Option by option sift
Option 7 – Keep existing HRB

Key Requirements		Pros	Cons
Does not preclude EAP	No	Lower cost	Not B2 compatible and defers works to others
Does not preclude OSD	Yes	Reduced position risk	Poor movement joint details
Impact on Cartmel	Positive	Potentially no barrettes for Northern abutment	Poor utilities connection
Impact on Ampthill	Positive		TOC parking / Northern open space reduced
Ped / Cycle connectivity	Yes		Reduced design life (NR span not replaced)
Permit GTB Replacement	No	Same impact on LUL as baseline	Potential of road level rise on HRB existing to tie into
Visual Impact	Neutral (plus)	No change to utilities diversions	HS, hence capacity check and parapet change
NR B2 Station	Does not enable		
NR Disruption	Low		Risks
A400 Hampstead Road Open	Yes		Highways alignment may not work
Construction Period	Faster		GTB cannot be replaced
			Existing foundation undermined

5 Option by option Description
Option 7 – Keeping NR existing bridge

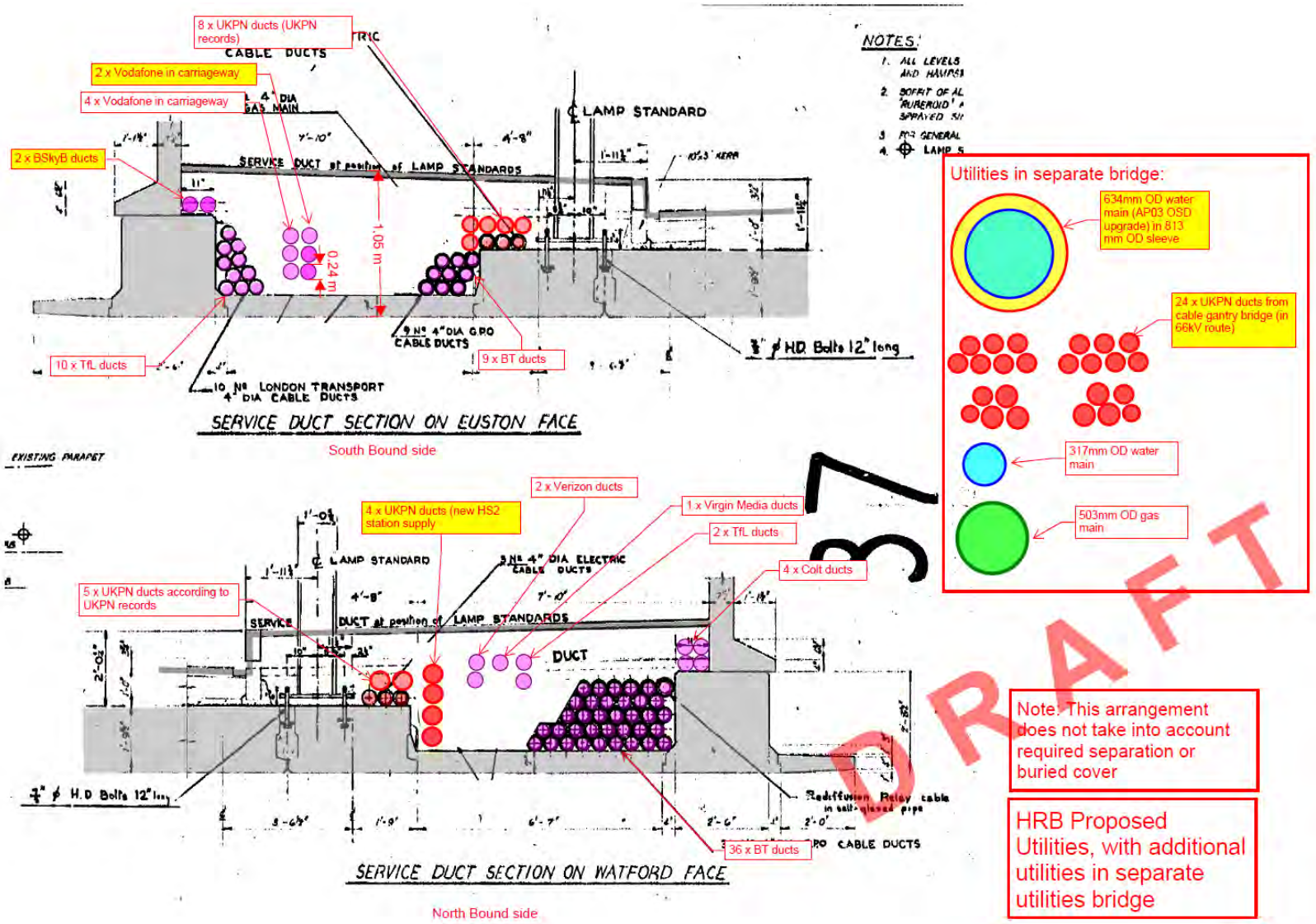
Proposed (AP03) Utilities



Note: This arrangement does not take into account required separation or buried cover

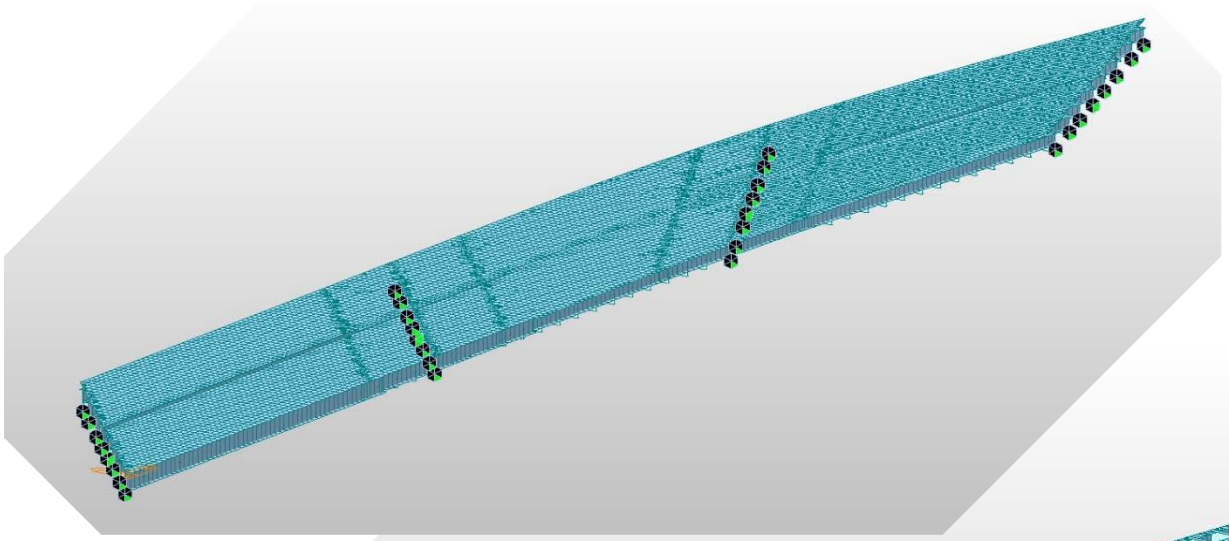
HRB Proposed Utilities

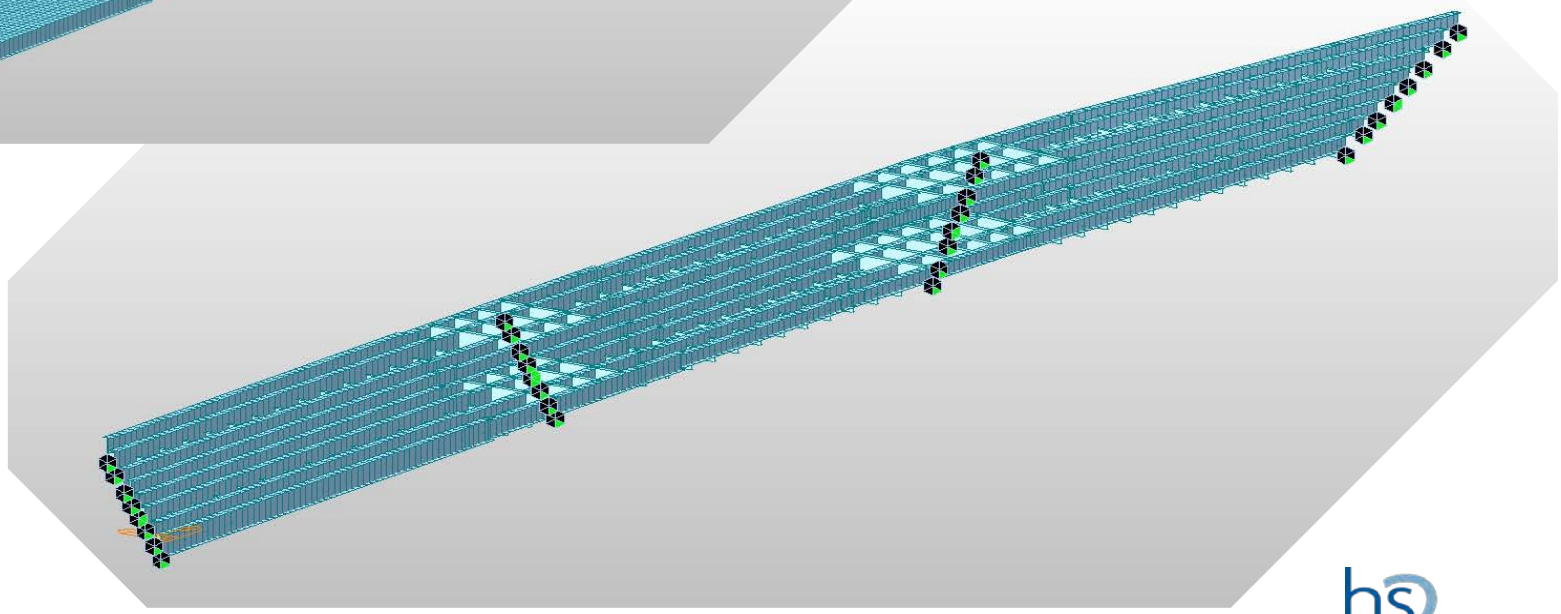
5 Option by option Description
Option 7 – Keeping NR existing bridge



4 Option by option sift

Option 8: Optimise AP03 Scheme





4 Option by option sift
Any other ideas?

6 Way forward

- Sift meeting 02:
- Options Report P01:

7 Any other business

HRB Lowering Study – SIFT Workshop 03

11/05/2016

Agenda

1. Introductions
2. Purpose of meeting
3. Recap of options considered
4. Options developed
5. Conclusion from sift
6. Way forward
7. Any other business

1 Introductions

2 Purpose of Meeting

- Conclude second sift of options

3 Recap of options considered

Option	Status	Comment
1. HRB Realignment	**Taken forward**	**Narrower bridge / impact on Cartmel**
2. Tunnel	Parked	Wide disruptions
3. Demolish & do not replace	Parked	Permanent wide disruptions
4. Transverse support	Parked	Visually intrusive + HRB closure
5a. Half Through girders	**Taken forward**	**Cross sections of options**
5b. Cable stayed bridge	Parked	Visually intrusive + HRB closure
5c. NR arch + HS half through	Parked	Visually intrusive + HRB closure
5d. NR arch + girders	Parked	Visually intrusive + HRB closure
5e. 3 pairs of arches	Parked	Visually intrusive + HRB closure
6a. Additional piers in NR	6c	Look into keeping existing piers
6b. Additional piers in HS	6c	Impact on station
6c. 6a + 6b	**Taken forward**	**6a modified + 6b**
7. Keep existing NR HRB	**Taken forward**	**Utilities route options**
8. Optimise AP03	**Taken forward**	**Consider risk**

4 Options Developed
Option 1 – HRB Realigned

4 Options Developed
Option 1 – HRB Realigned

Main Benefits

- **Lower** bridge – shorter spans (limited by utils)
- A400 Hampstead Road **operational** (reduced short term closures)
- No need to divert **utilities** through Ampthill
- Shorter **programme** and reduced overall disruption
- Reduction in temporary **traffic management**
- Benefits to **material by rail** (further reduction of ~10000 to 15000 two-way lorry movements)
- Bigger **open space** and retained **pedestrian connectivity** from station to HRB
- Potential reduction of **construction traffic** through Regent Park Estate

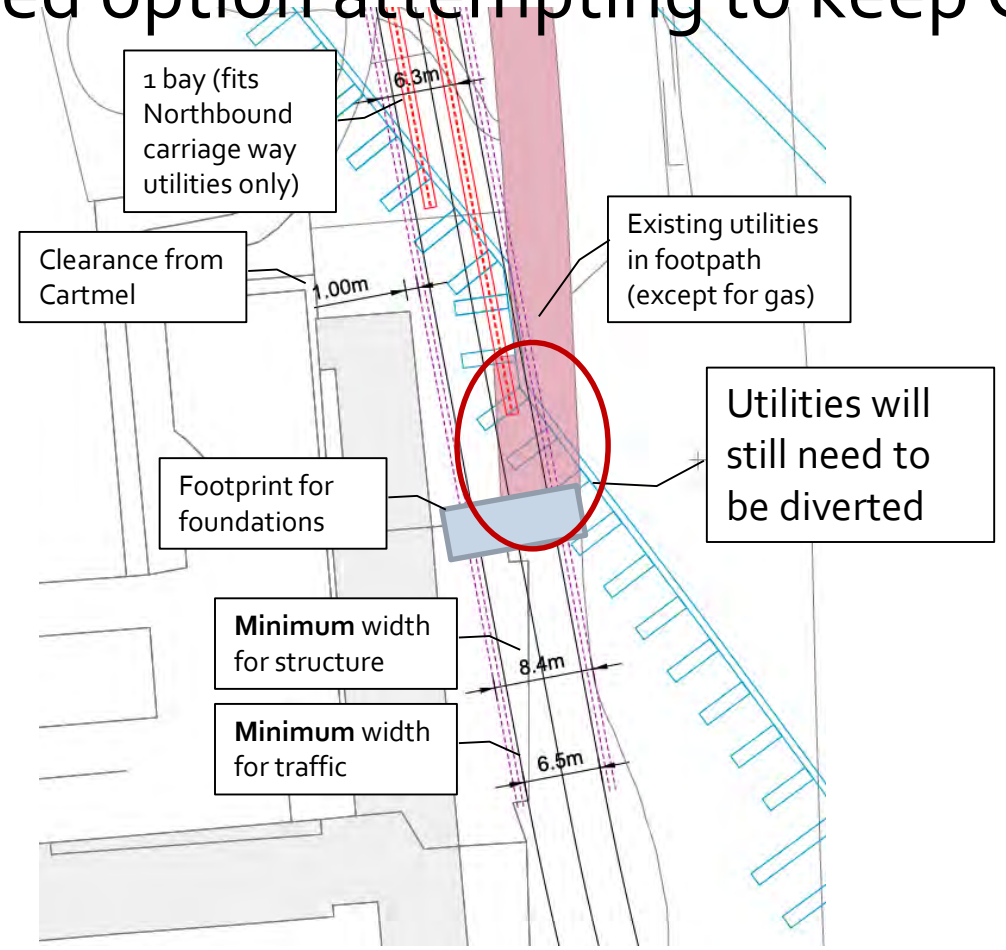
4 Options Developed
Option 1 – HRB Realigned

1. Realigned option attempting to keep Cartmel

2. Realigned option replacing Cartmel

4 Options Developed
Option 1 – HRB Realigned

1. Realigned option attempting to keep Cartmel



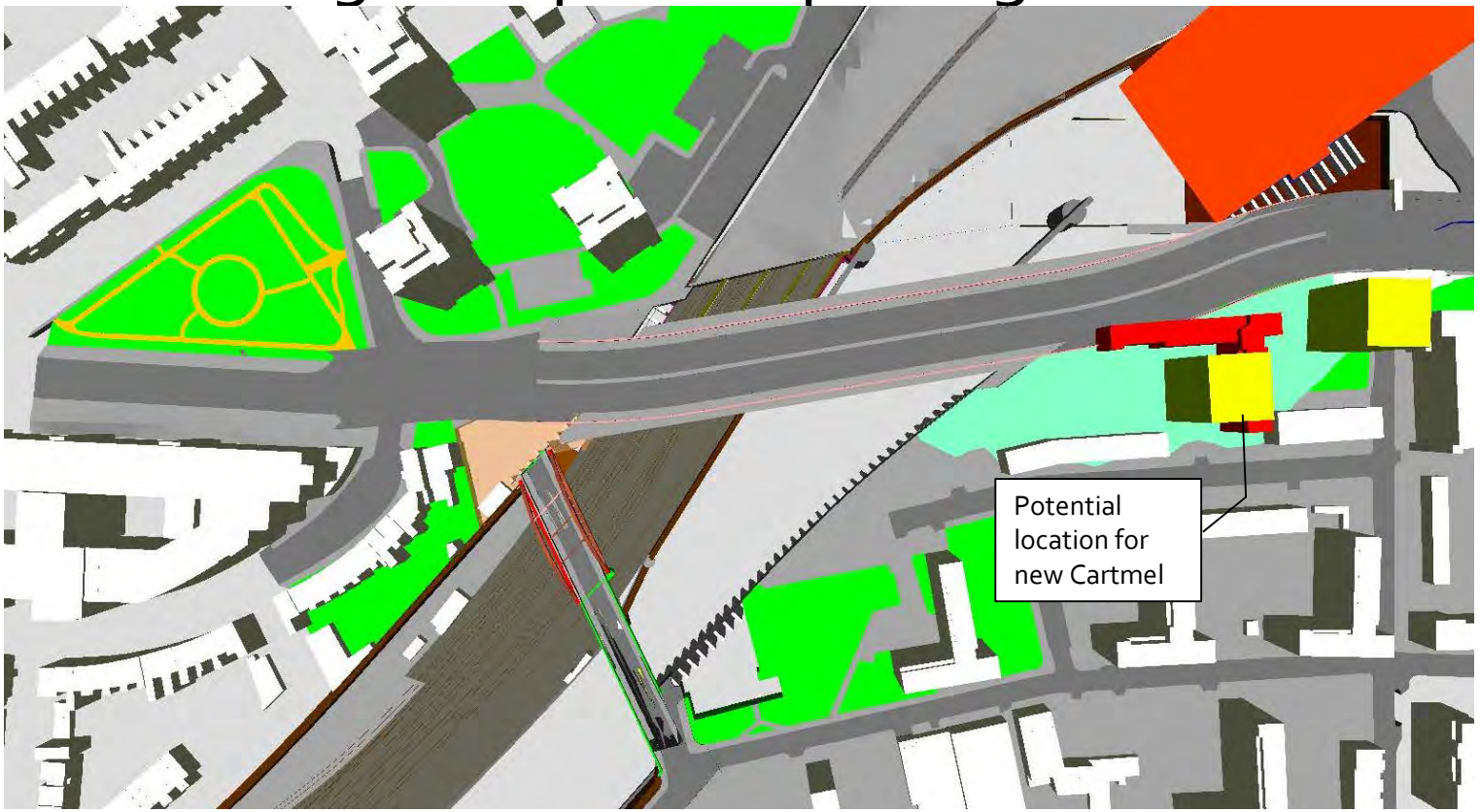
4 Options Developed
Option 1 – HRB Realigned

Disadvantages of realigning keeping Cartmel

- **All utilities** (from both the northbound and southbound carriageway) need to be moved through Ampthill estate before any demolition.
- No reduction in construction period and overall disruption due to utilities work
- Greater overall impact to Cartmel residents (closer bridge – 1m clearance only)

4 Options Developed
Option 1 – HRB Realigned

1. Realigned option attempting to keep Cartmel
2. Realigned option replacing Cartmel



4 Options Developed
Option 1 – HRB Realigned

1. Realigned option attempting to keep Cartmel
2. Realigned option replacing Cartmel

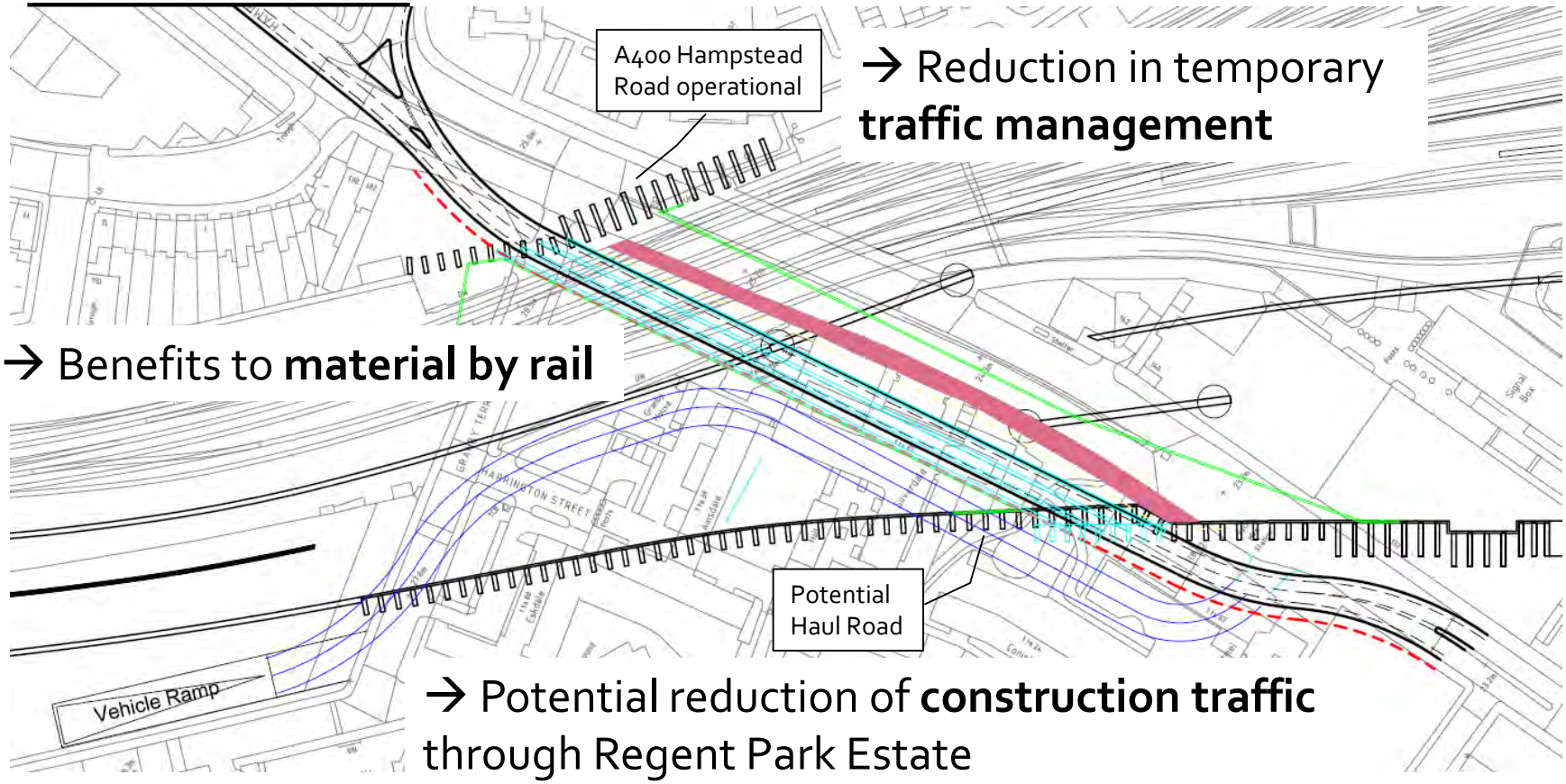
4 Options Developed
Option 1 – HRB Realigned

Disadvantages of realigning and replacing Cartmel

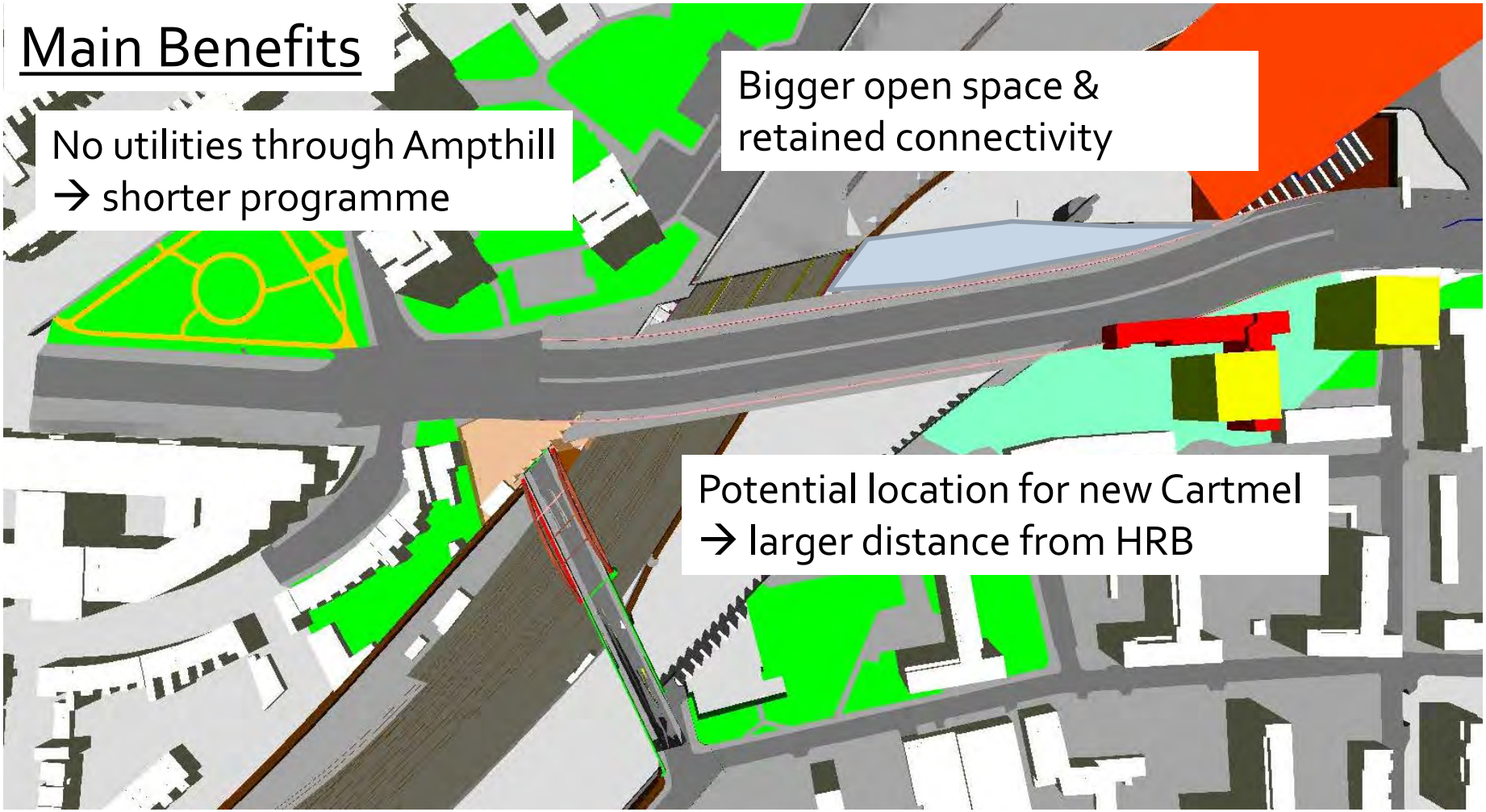
- Additional rehousing of local residents (re-provision of Cartmel)

4 Options Developed
Option 1 – HRB Realigned

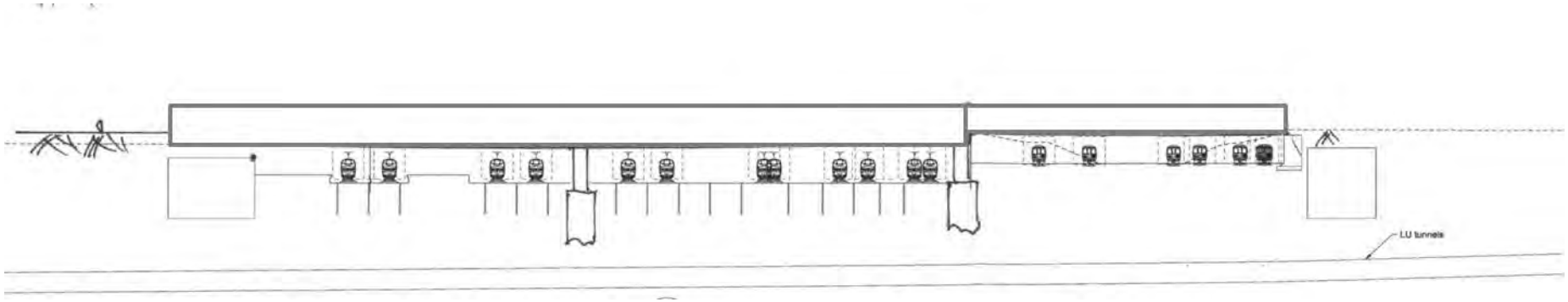
Main Benefits



4 Options Developed
Option 1 – HRB Realigned



4 Options Developed
Option 5a – Half Through girders

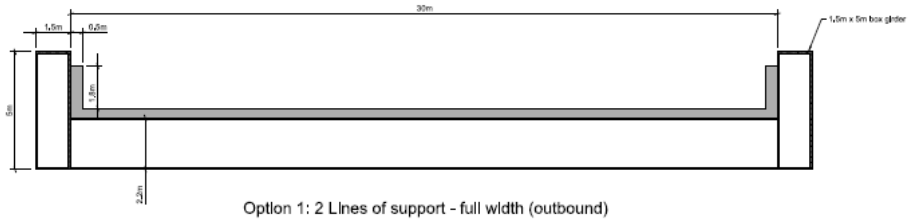


4 Options Developed
Option 5a – Half Through girders

Main Benefits

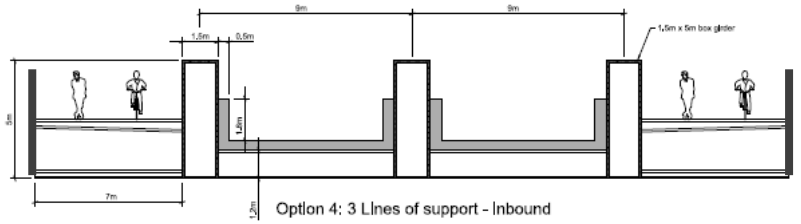
- Lower bridge – transverse spanning

4 Options Developed
Option 5a – Half Through girders



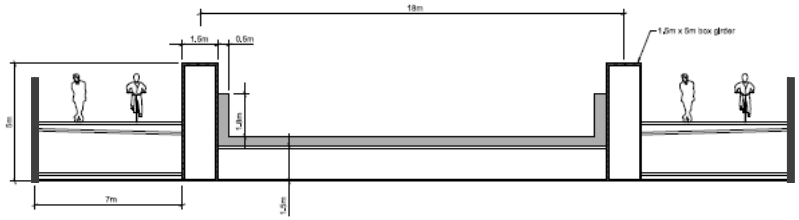
Option 1: 2 Lines of support - full width (outbound)

1-1 Section
- Scale 1:100



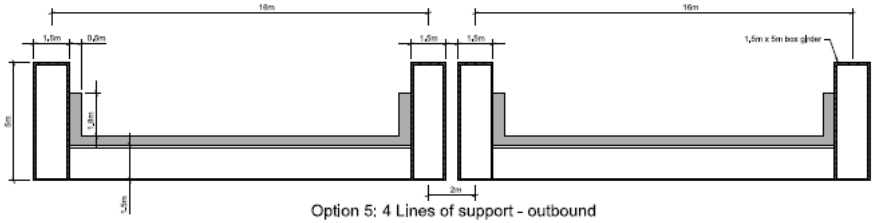
Option 4: 3 Lines of support - Inbound

4-4 Section
- Scale 1:100



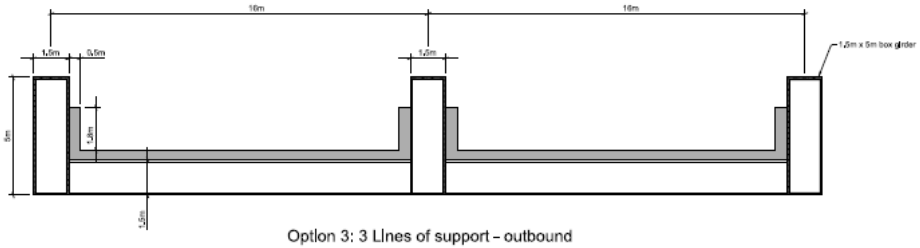
Option 2: 2 Lines of support - cantilevers (Inbound)

2-2 Section
- Scale 1:100



Option 5: 4 Lines of support - outbound

5-5 Section
- Scale 1:100



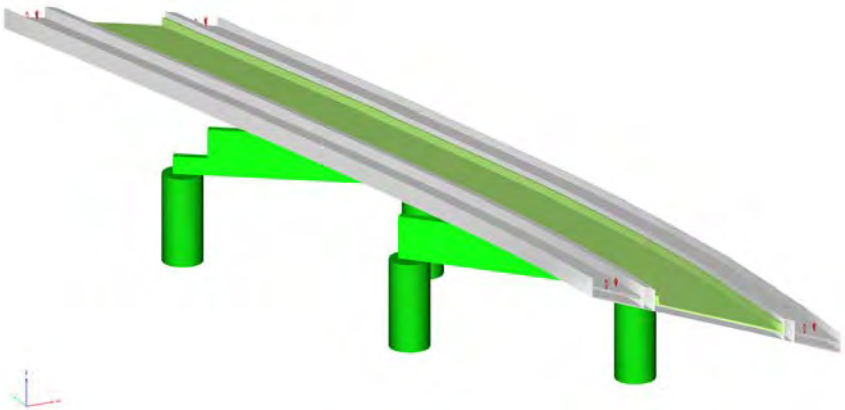
Option 3: 3 Lines of support – outbound

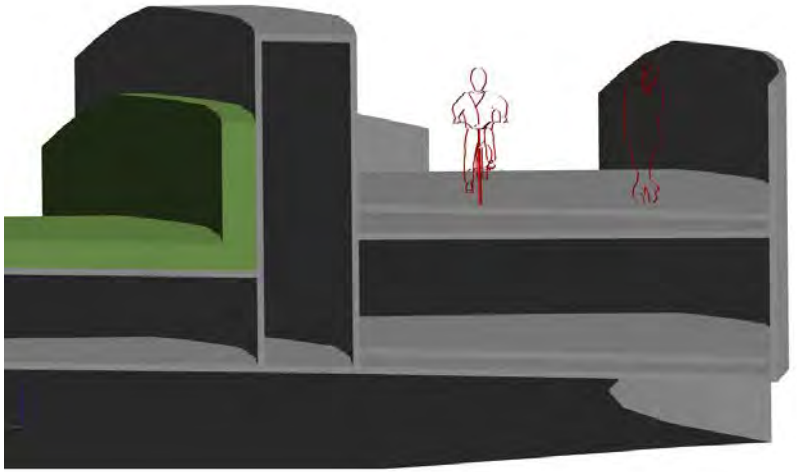
* If 4 lines of support space between the two brides for the flanges to fit

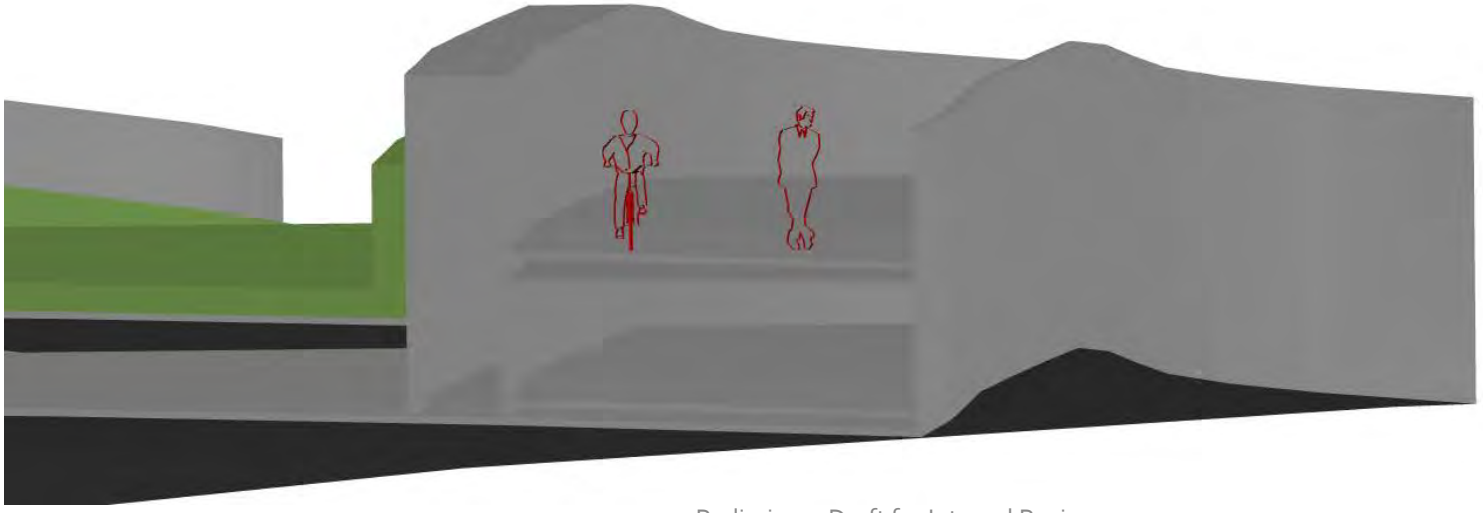
3-3 Section
- Scale 1:100

Cross sections of half - through girders sub - options

4 Options Developed
Option 5a – Half Through girders







4 Options Developed
Option 5a – Half Through girders

Main Disadvantages

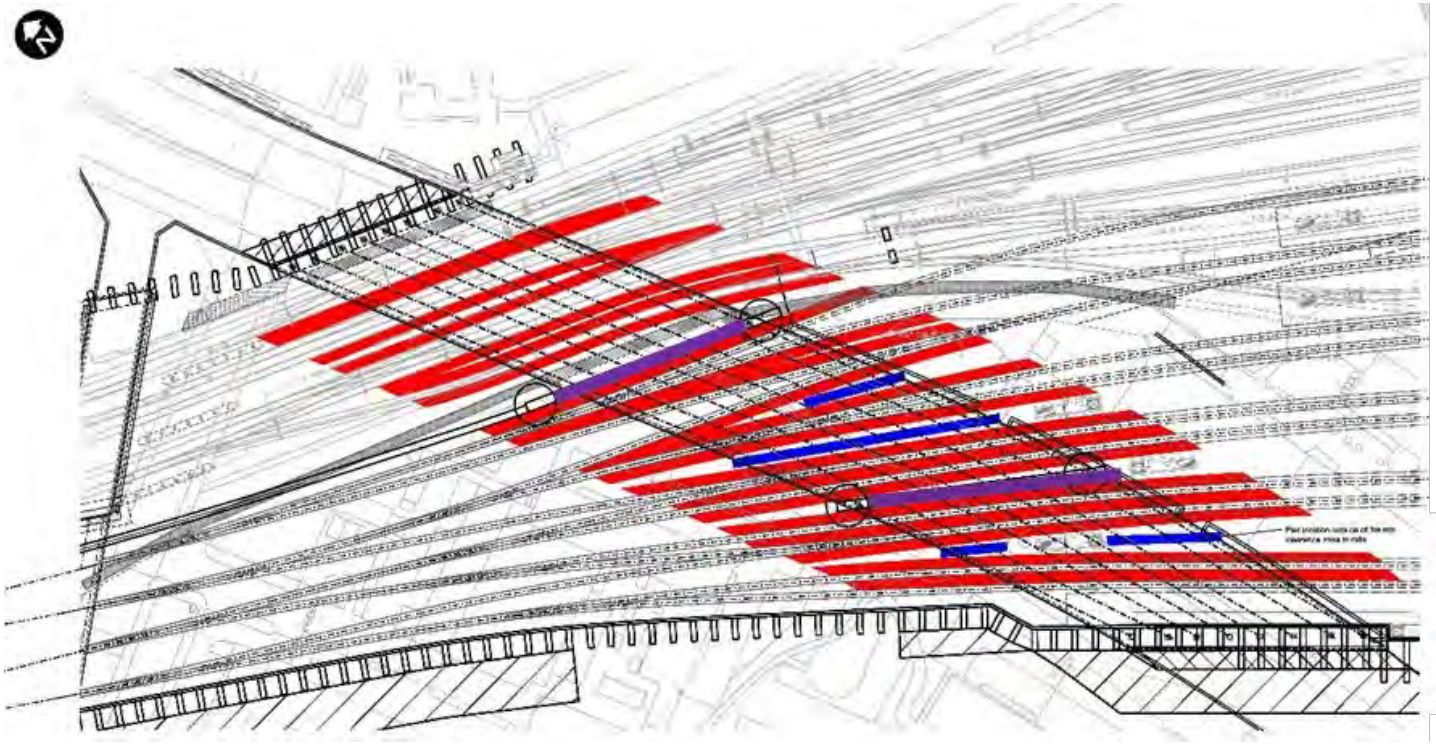
- B1 ramp realigned
  - Open space reduced
  - Poor taxi/lorry segregation
  - Poor pedestrian connectivity
  - No bus stop on HRB
- 200m corridor for pedestrians – security risk
- No permeability due to girders
- Poor maintenance access (transverse girders)

4 Options Developed
Option 6c – Additional piers

1. Keeping existing NR piers

2. Additional HS piers on pads

4 Options Developed
Option 6c – Additional piers



3m clearance zone from rails below HRB

Location of pier 2m wide outside of 3m clearance zone from rail as identified above

4 Options Developed
Option 6c – Additional piers

Main Benefits

- Lower bridge – shorter spans
- No visual impact
- Maintained permeability and pedestrian connectivity

4 Options Developed
Option 6c – Additional piers

1. Keeping existing NR piers

   Current Spans: 4 no. between 11m and 14.5m

Proposed Structural Form of New deck	Height (mm)	Spacing (mm)	Comment
Precast pre-stressed beams	500	970	More lowering benefit Less space for utilities Difficult interface with HS spans
Weathering steel girders	750	4000	Less lowering benefit More space for utilities Better interface with HS spans

4 Options Developed
Option 6c – Additional piers

1. Keeping NR existing piers
2. Additional HS piers
   - Caissons for all additional piers

     → increased construction time
   - Pads for additional piers

4 Options Developed
Option 6c – Additional piers

1. Keeping existing NR piers

2. Additional HS piers on pads

<u>Note:</u>

Given the shallower structural depth of the new deck structures above NR and HS tracks

→ Permanent utilities bridge required

4 Options Developed
Option 6c – Additional piers

Main Disadvantages

- Future loading requirements not met
- Permanent utilities bridge required
- Constrains NR track plan
- A400 Hampstead Road closed for 2 years
- Structural uncertainty around existing piers and foundations
- Approval risks of keeping the NR piers
- Open space reduced
- Impact on platform environment / fire escape

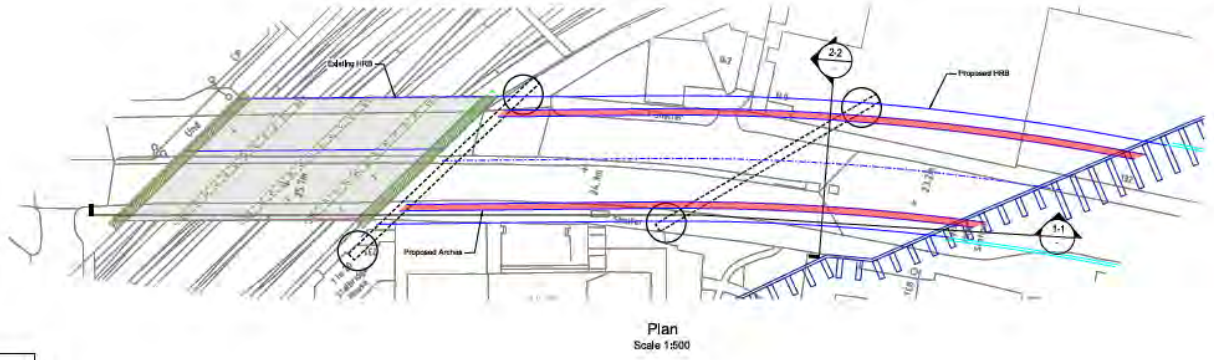
4 Options Developed
Option 7 – Keeping NR existing bridge

4 Options Developed
Option 7 – Keeping NR existing bridge

Main Benefits

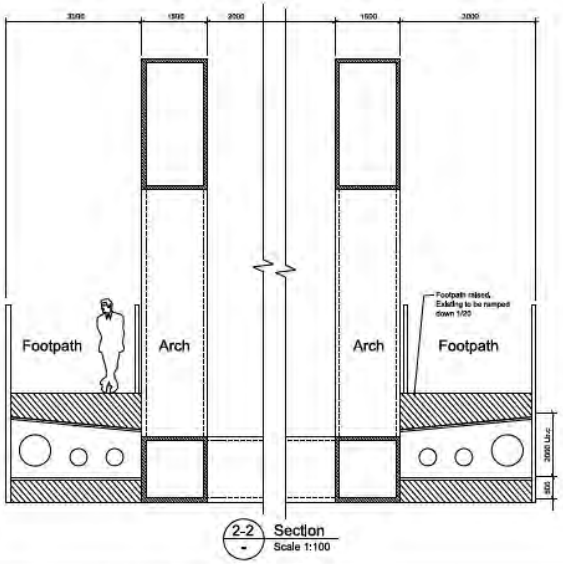
- Lower bridge – shorter spans
- No visual impact
- Maintained permeability and pedestrian connectivity

4 Options Developed
Option 7 – Keeping NR existing bridge

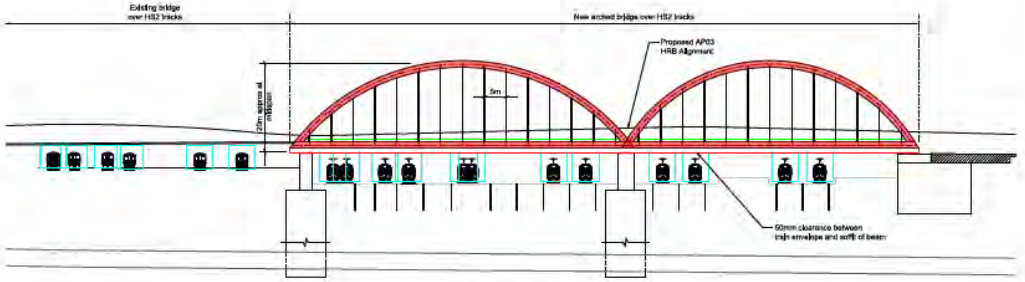


Plan
Scale 1:500

A permanent utilities bridge will be required with this scheme

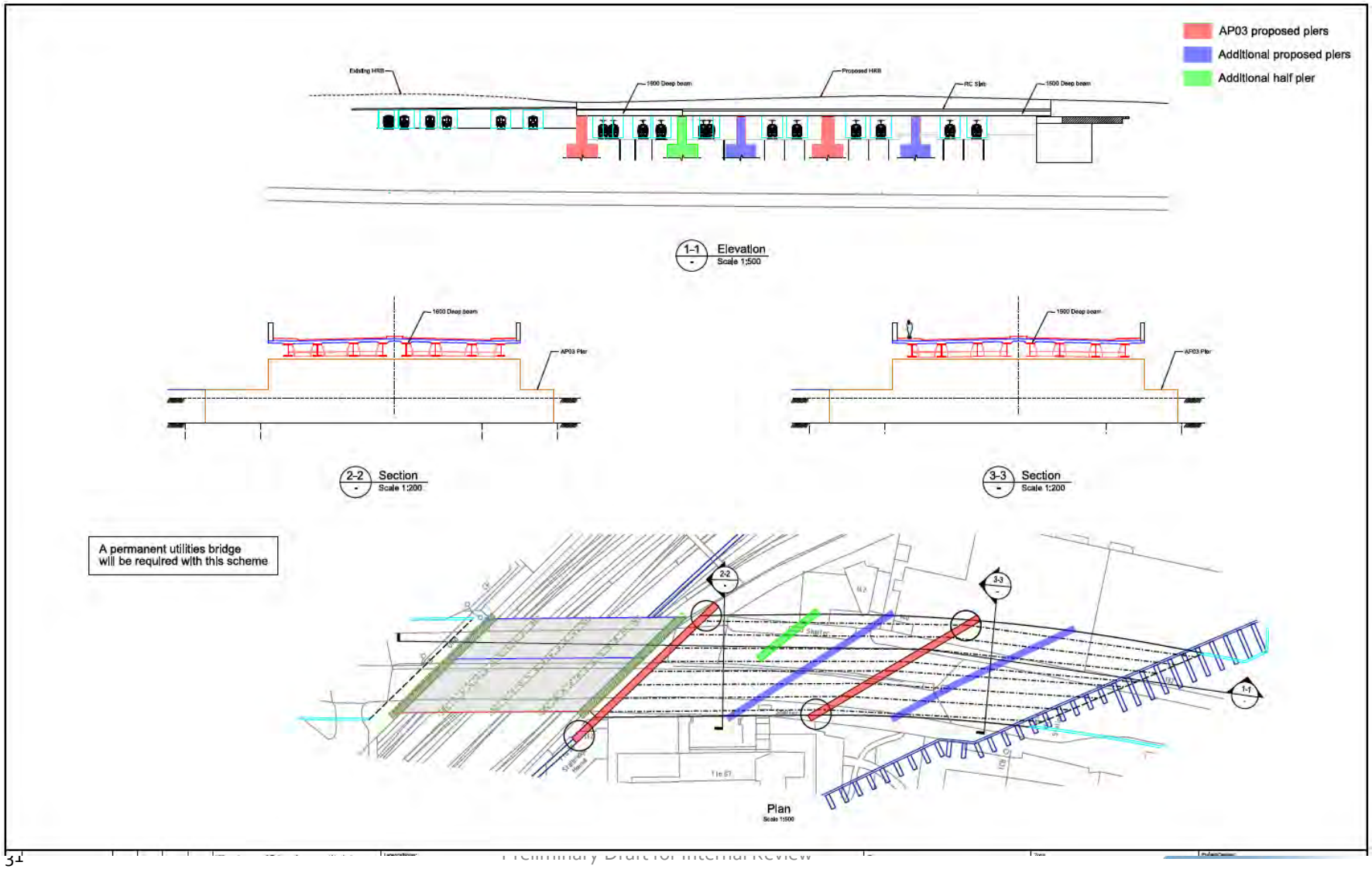


2-2 Section
Scale 1:100

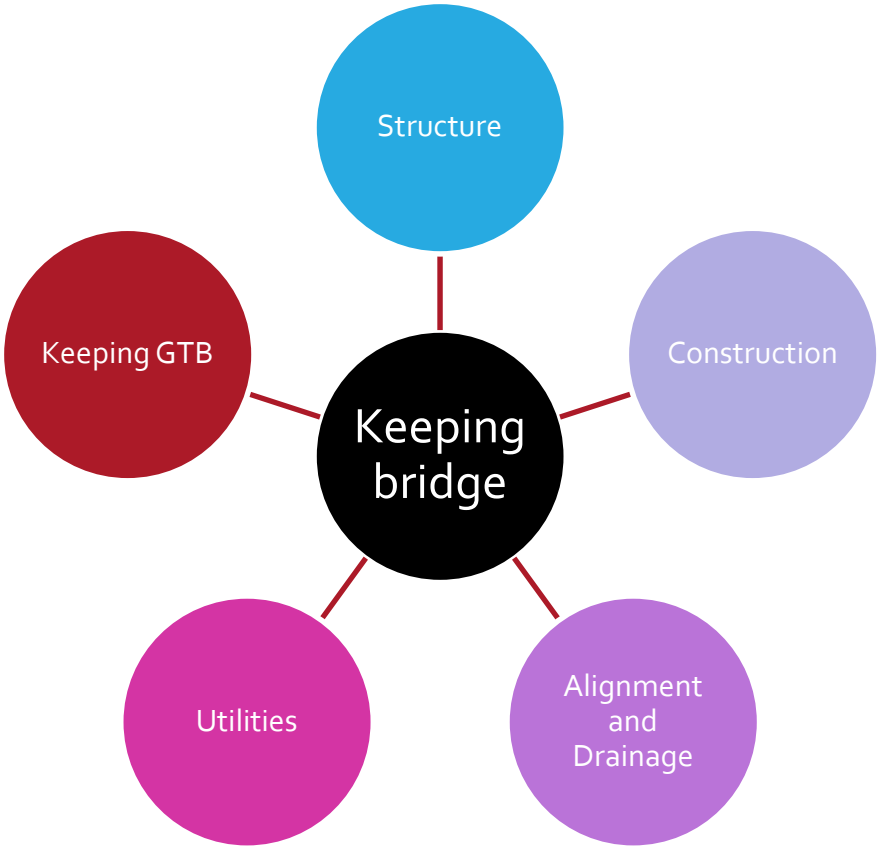


1-1 Elevation
Scale 1:350

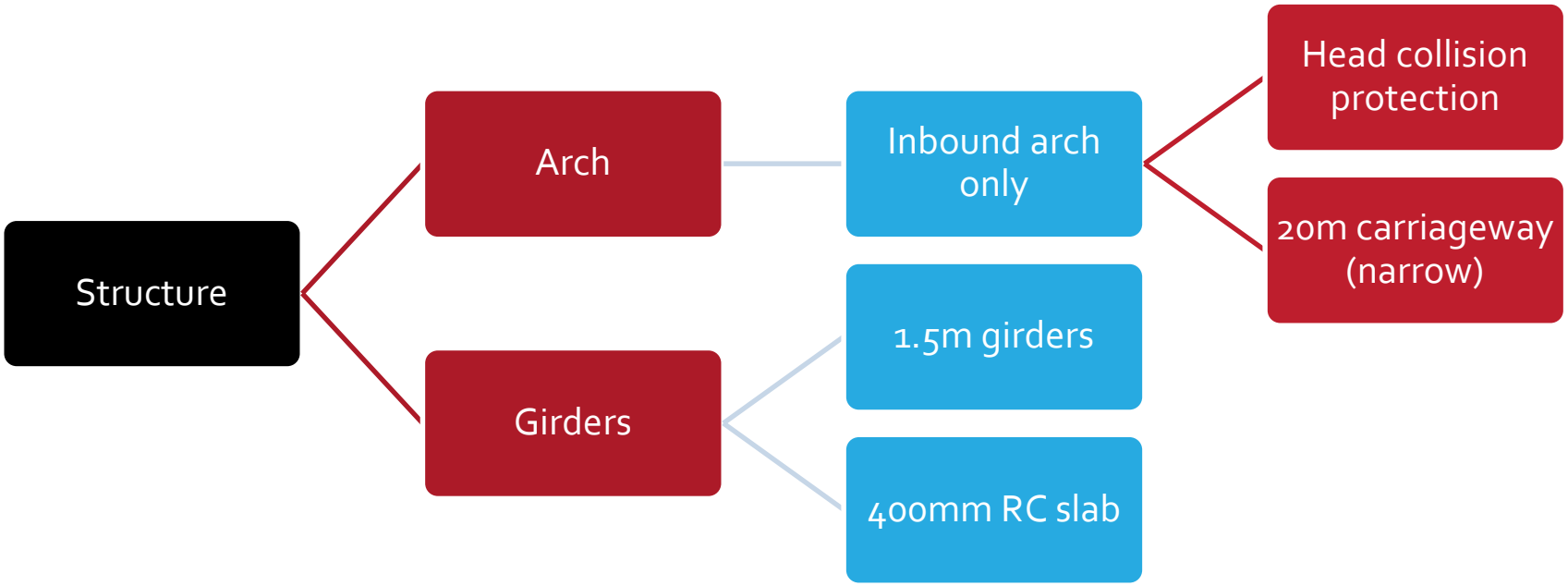
4 Options Developed
Option 7 – Keeping NR existing bridge



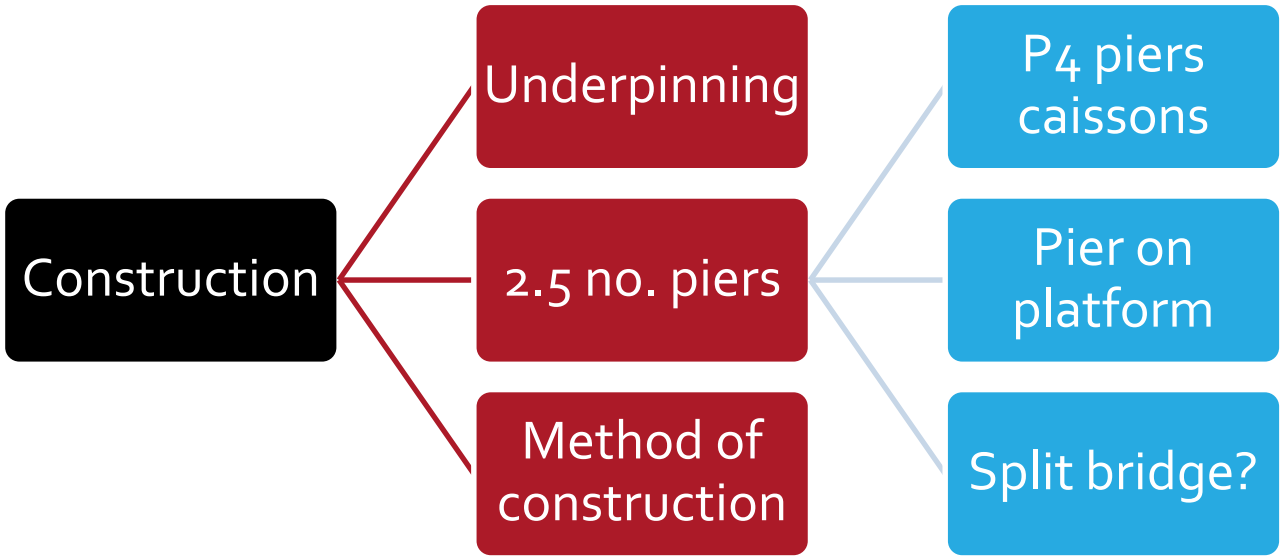
4 Options Developed
Option 7 – Keeping NR existing bridge



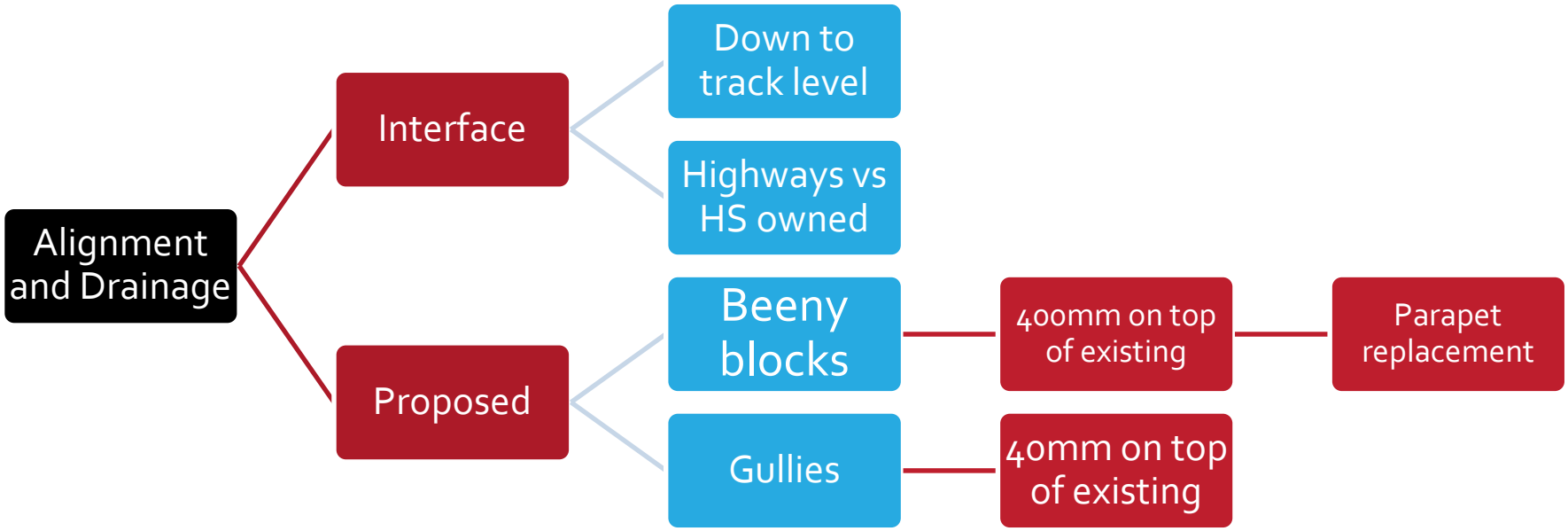
4 Options Developed
Option 7 – Keeping NR existing bridge



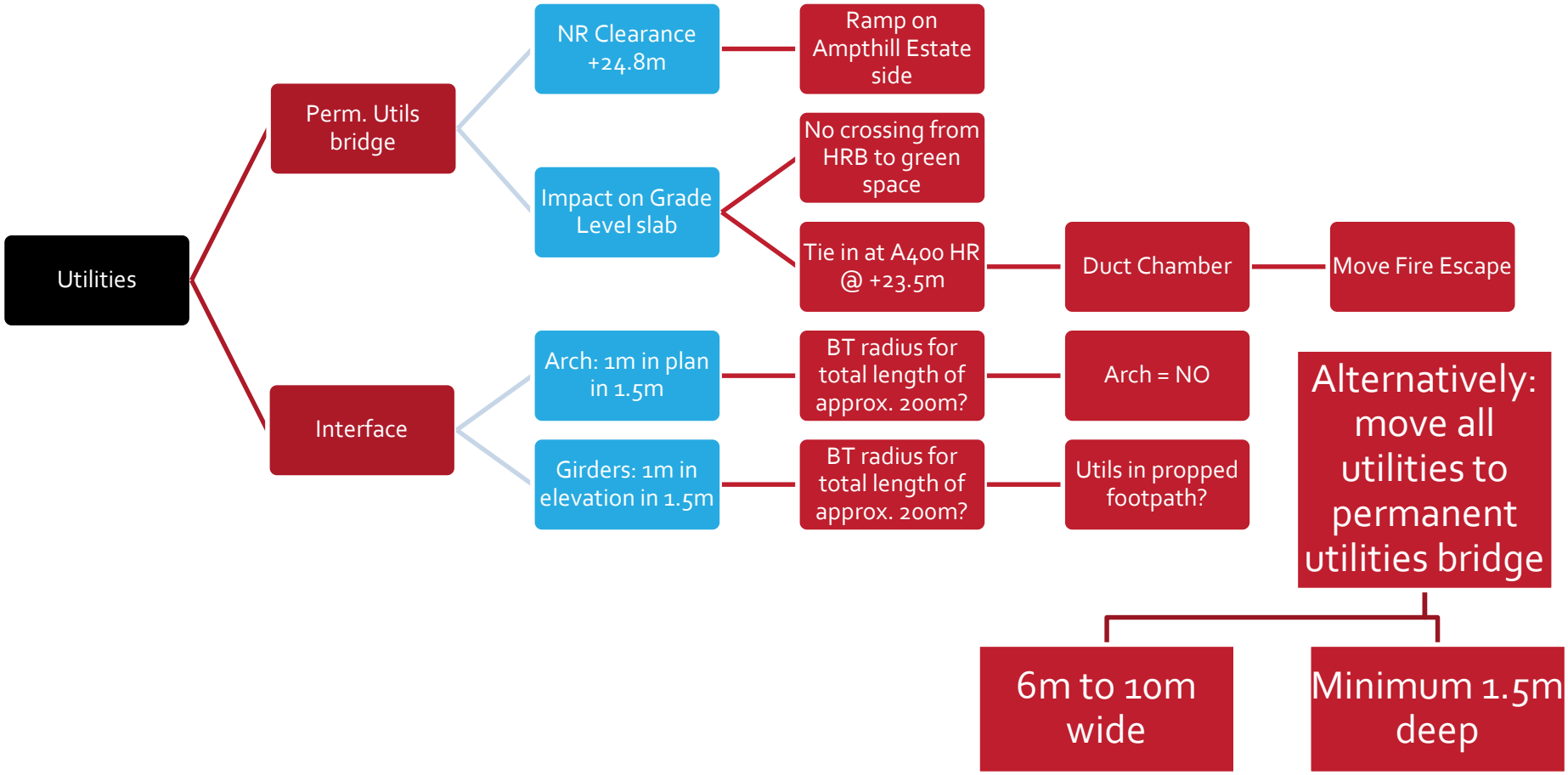
4 Options Developed
Option 7 – Keeping NR existing bridge



4 Options Developed
Option 7 – Keeping NR existing bridge



4 Options Developed
Option 7 – Keeping NR existing bridge



4 Options Developed
Option 7 – Keeping NR existing bridge

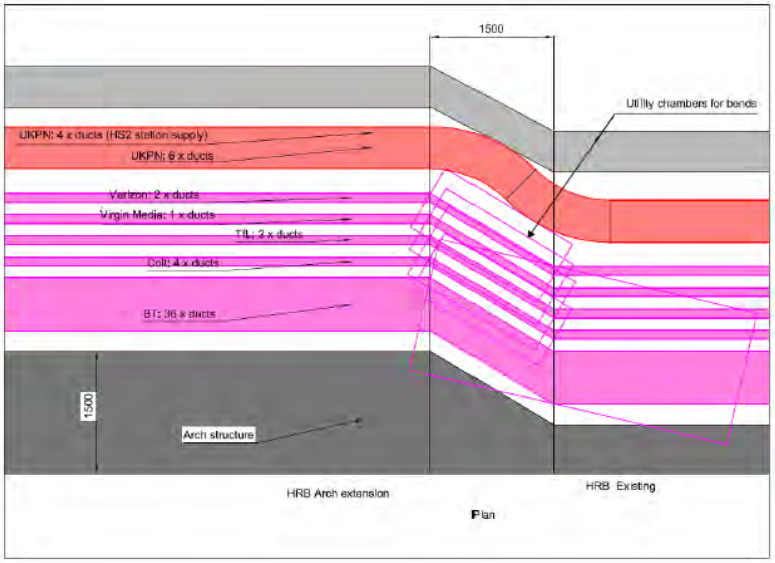
Utilities interface

Arch

HRB with Arch extension

Assumptions:

- BT 36 way chamber size based on proposed chamber for new HRB cable pulling (36way)
- Max bends in telecoms ducts is 2 x 22.5 deg on a duct run.
- UKPN shown with 1.3m bend radius
- Potential for combined utility chamber but would require agreement will all affected utility companies and TfL.

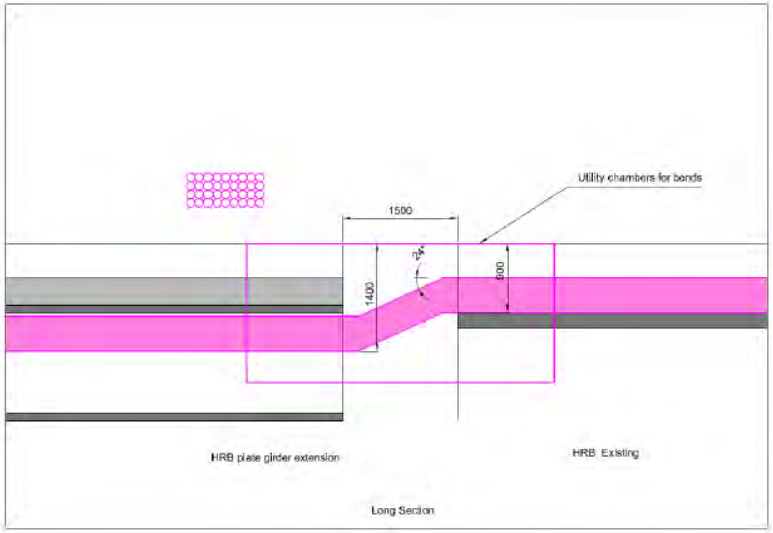


Girders

HRB with Plate Girder extension

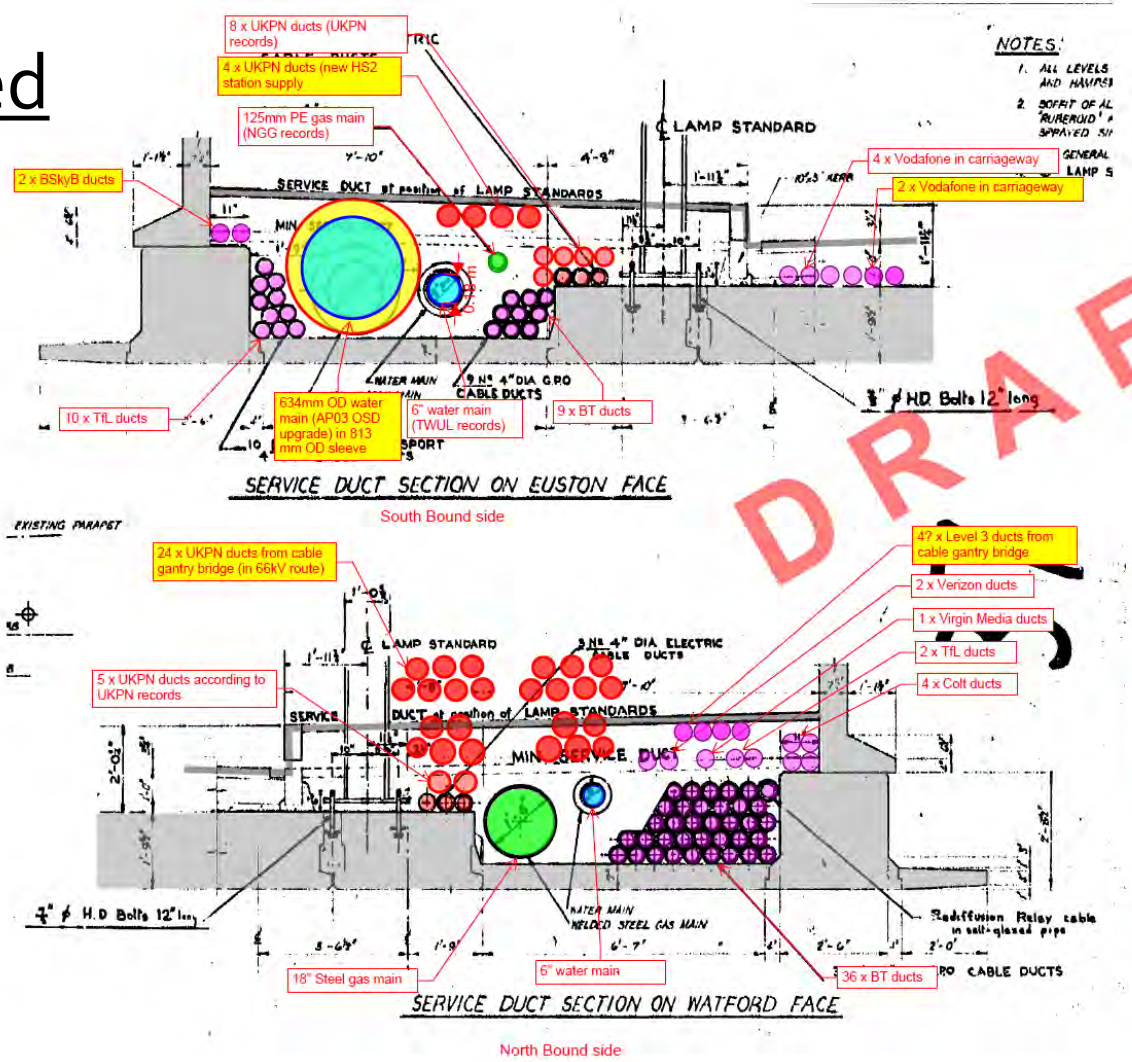
Assumptions:

- BT 36 way chamber size based on proposed chamber for new HRB cable pulling (36way)
- Max bends in telecoms ducts is 2 x 22.5 deg on a duct run.
-



4 Options Developed
Option 7 – Keeping NR existing bridge

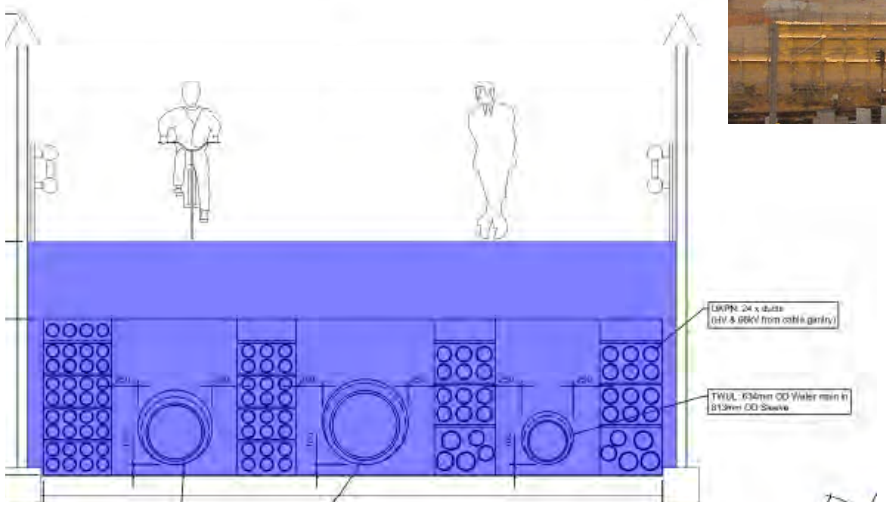
Proposed Utilities



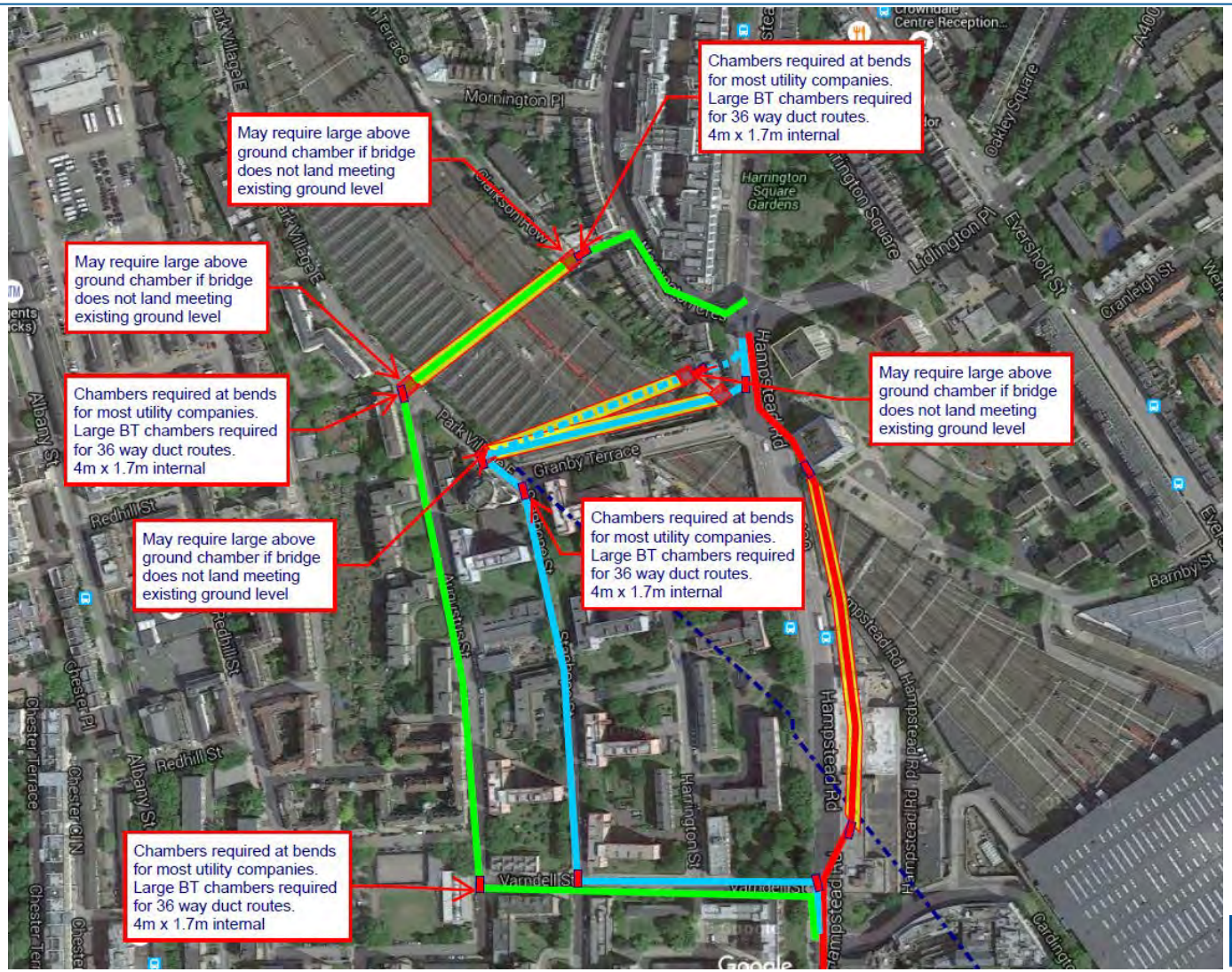
Note: This arrangement does not take into account required separation or buried cover

HRB Proposed Utilities

4 Options Developed
Option 7 – Keeping NR existing bridge

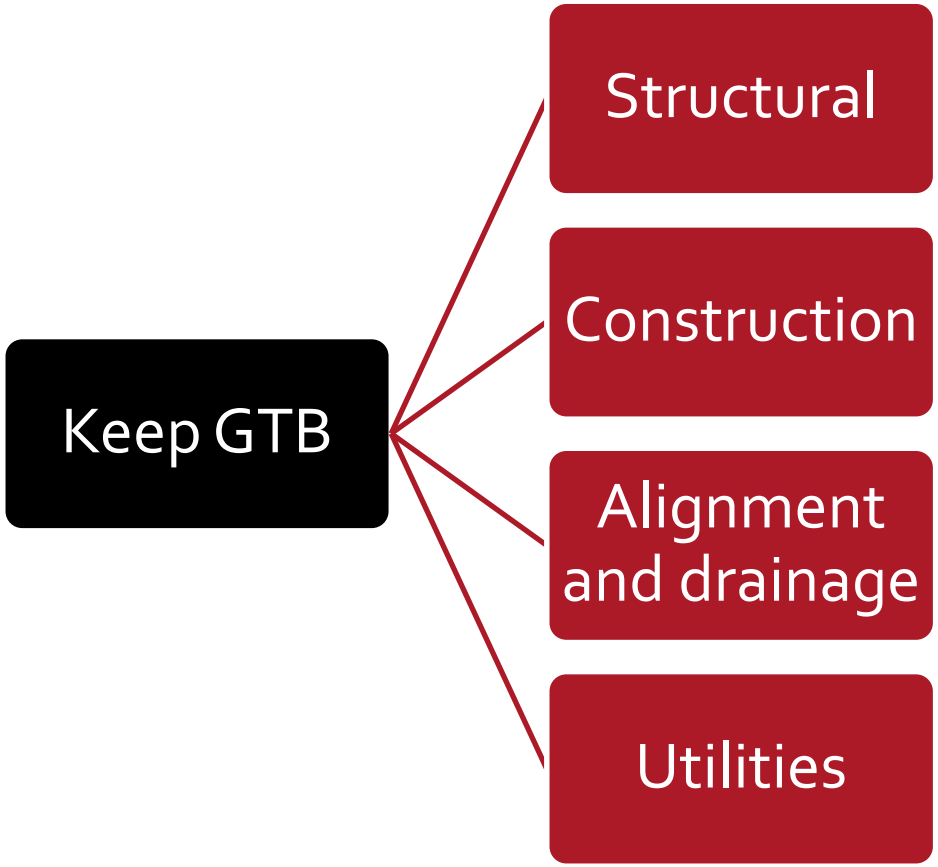


4 Options Developed
Option 7 – Keeping NR existing bridge



hs2 engine for growth

4 Options Developed
Option 7 – Keeping NR existing bridge

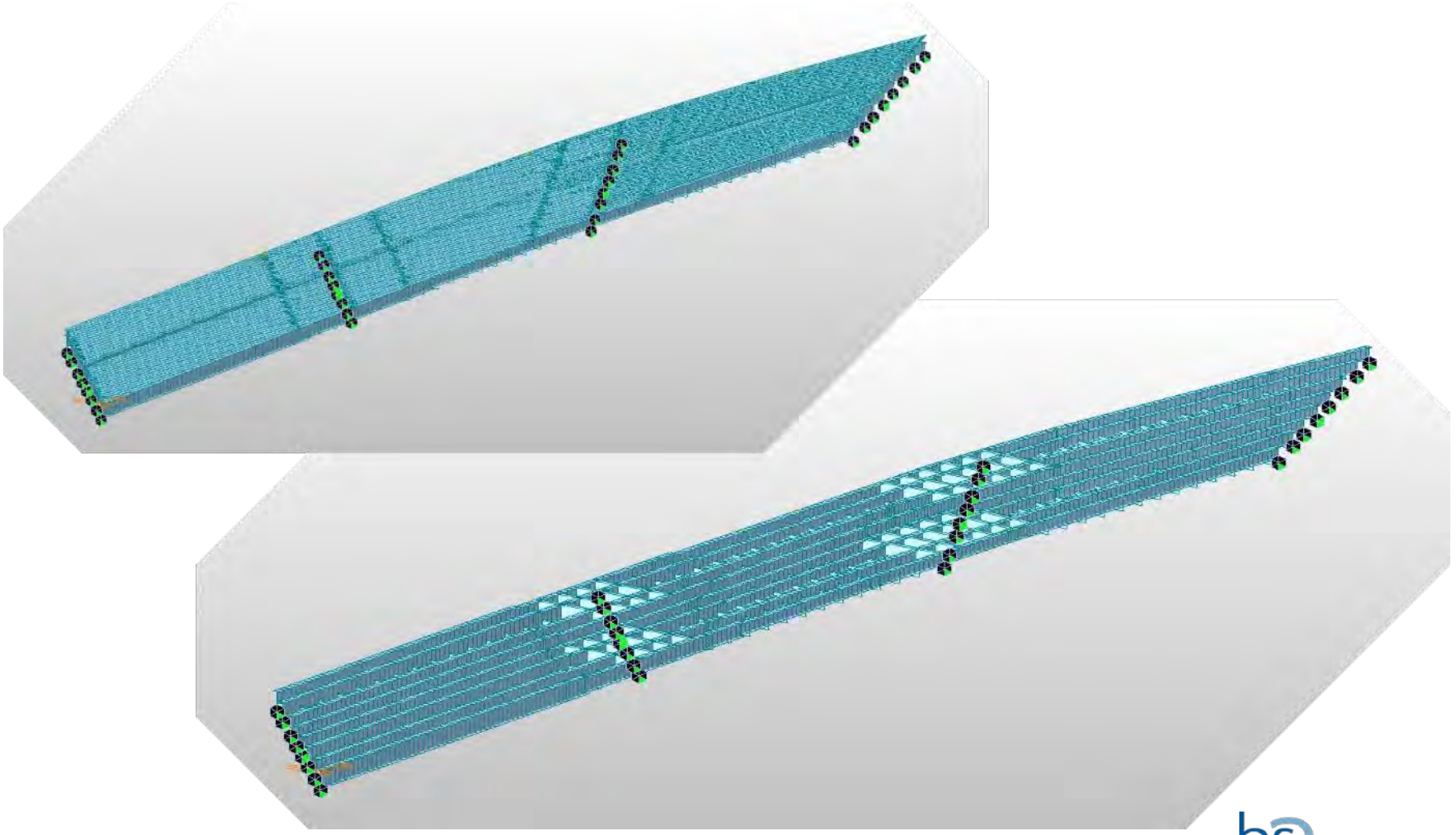


4 Options Developed
Option 7 – Keeping NR existing bridge

Main Disadvantages

- Permanent utilities bridge required
- Constrains NR track plan
- A400 Hampstead Road closures (depends on sub-option)
- Deferring works and responsibility to others
- Open space reduced
- Impact on platform environment / fire escape

4 Options Developed
Option 8 – AP03 optimised



5 Conclusion from sift

6 Way forward

7 Any other business

Appendix J – Stakeholders Feedback

HS2 Hampstead Road Bridge Study

TfL and LB Camden Response for inclusion within HS2 Interim Report for June 2016 EIPB Meeting (C220-HS2-BR-REP-01A-000001 Revision –P03)

17 June 2016

TfL and LB Camden recognise the work undertaken by HS2 Ltd and its consultants on this study. However, both authorities have a number of major concerns with the position presented in this report. These are set out below.

1. The report does not make any recommendations or provide clear conclusions. Four options still remain despite it being agreed at a meeting with HS2 Ltd and the DfT on 25 May 2016 that only 2 options would be progressed. The 2015 assurances, given to both TfL and LB Camden, do state that a plan of proposals would be considered for implementation by the Promoter after being reviewed by the EIPB.

2. The onus should, therefore, clearly be on HS2 Ltd to reach a preferred solution in advance of TfL and LB Camden's appearance at the House of Lords Select Committee in September. A report back to the EIPB with a clear recommendation/preferred option as to the way forward needs to be made before being submitted to the Secretary of State. The reporting process would be incomplete without this course of action. The EIPB needs clear recommendations and conclusions in order to provide its views.

3. To address points 1 and 2, a programme of works with timelines (including public engagement with the local community as an integral part of the decision-making process) and the governance process needs to be set out. Section 6 "Plan for Future Options" does not currently do this.

4. Where not addressed, the points raised in the joint TfL/Camden May 2016 response still stand.

5. The purpose of the study was to address major concerns TfL and LB Camden have regarding the height increase of the AP03 Hampstead Road Bridge as well as the wider negative impacts on the local community resulting from the utilities replacement and highway disruption occurring during construction. With all four options offering no more than a 1 metre reduction in height at the southern end, and on the basis that the disbenefits of Options 5a-5 and 7 outweigh the benefits, TfL and LB Camden believe that the study should take forward for further scrutiny the optimised AP03 scheme (Option 8) along with Option 1.

6. Further work to understand better the overall benefits and disbenefits of these two options is critical to allow the scheme promoter and EIPB membership to form reasoned views on the report and plan.

7. To date, little, if no, workshop time has been spent exploring the possibilities to further reduce the height of Option 1 and how any disbenefits of this option would be mitigated. The report states that Option 1 can only achieve a 0.5m reduction. Further work is required to demonstrate what can and can't be done in this respect, for example by changing the layout of the service basement access or using higher quality steel as proposed in Option 8.

8. Work is needed to be undertaken by HS2 Ltd to understand the disruption to the highway network that the bridge options will have. Construction of the bridge will impact upon general traffic flows, bus services and HS2 Ltd's construction vehicles. These need to be much better understood.

9. Work is also required to understand the impacts on the local community, utilities, open space and the wider environment. More analysis on the potential benefits of reducing construction lorries to/from Regent's Park Estate is required. Lastly, HS2 Ltd needs to make it clear how Option 1 would be progressed in relation to the ES and Hybrid Bill process.

10. The interrelationship with the various other Euston assurance studies should be recognised including that Option 1 could significantly increase the amount of material removed by rail.

11. The report needs to set out a clear plan for how HS2 Ltd will engage with the local community on the preferred bridge option.

12. TfL and LB Camden consider Option 7 as having unacceptable impacts and as such state that it should not be taken forward any further (see point 6a below).

    a) Option 7 has wider major disbenefits as set out in pages 39 and 40 of the report, some of which some are set out below
        i. Option 7 will require permanent utility bridges across the approach tracks and through the Amptill Estate
        ii. Option 7 is a 'short-termist' approach that fails to take a long term comprehensive approach to the development of Euston (including station development and OSD) and constrains the future B2 scheme. For example, adopting Option 7 would mean that it would be too low to meet current NR OLE requirements
        iii. Option 7 is likely to require the full closure of Hampstead Road to traffic for an extended period compared to the current AP03 scheme, causing unacceptable highway impacts. Hampstead Road is a key lorry route for HS2 works. Therefore HS2 works will be put at greater risk.

13. As well as requiring possessions for underpinning work, Option 7 will also require possessions for the construction of the permanent utility bridges spanning the rail tracks. Any future works to the utilities within this permanent utility bridge will also have possession impacts on the station and rail services – both High Speed and classic. The workshops have not considered the possession impacts of any of the options in detail.

Conclusions

14. TfL and LB Camden consider that Options 1 and 8 should be taken forward for further work and the Promoter should be providing firm commitments around agreeing the remit, timescales and joint working relationship with both TfL and LB Camden. TfL and LB Camden are also seeking a firm commitment that agreed changes will be incorporated into the scope for the final design for Euston in advance of the House of Lords Select Committee hearings in September.

15. The work undertaken by HS2 Ltd to date has determined that the height of these bridge options can be reduced by at least 0.5 metres. TfL and LB Camden believe that there are opportunities to further reduce the height and that further work is needed to explore these.

16. Further work is needed to be undertaken by HS2 Ltd to understand the disruption to the highway network that the bridge options will have. Construction of the bridge will impact upon general traffic flows, bus services and HS2 Ltd's construction vehicles. These need to be much better understood.

17. Further work is needed to be undertaken by HS2 Ltd to understand the impacts on the local community, utilities, open space and the wider environment.

18. The interrelationship with the various other Euston assurance studies should be recognised and work should be undertaken to join these up.

HS2 Hampstead Road Bridge Study

LBC and TfL detailed transport comments on: 160516 - HRBL - Interim report P03

23 June 2016

General comments

Please number paragraphs and bullet points, to ease identification.

Please ensure all notes are clearly legible on the report illustrations

Executive Summary

The final submitted report needs to set out recommendations for a plan to be committed to or not committed to by the Promoter. The assurance states that a plan will be submitted to the Promoter and the EIPB needs clear recommendations and conclusions in order to provide its views. The report cannot be considered 'complete' or considered compliant with the assurance without this.

5th paragraph - should refer to technical feasibility, rather than 'viability'. The options were compared but not 'rated' (final line).

The options need to be described in more detail, especially in terms of key aspects (such as relative heights and distances to key residential windows) upon which the decisions to proceed or not proceed ('park') were taken, as requested at the last workshop meeting by Camden (7th and 8th paragraphs).

10th paragraph- At the last workshop on the 8th June 2016 (as referred to), TfL and Camden advised that far more work was required to assess option 1 in particular and that the report needed firm recommendations and conclusions, clear steps for progression of further work to progress the plan needed for the Promoter and timetable for this work, governance mechanisms and how public engagement will be included in this process.

11th paragraph - Add to first sentence that DfT also warned re resulting costs of possessions. Delete final sentence. This is unclear and was neither discussed, nor agreed.

12th paragraph - The further work required with utility companies needs to be included in the above-mentioned timetable.

13th paragraph - Further information re GTB is needed to guide EIPB and this review needs to be included in the timetable as an integral part of the bridge options assessment.

Existing Scheme

Section 2, 3rd paragraph. State the height increases in metres relative to the existing bridge heights and ground floor/basement (if applicable) windows at Ampthill and Cartmel with accompanying illustrations.

4th paragraph, 2nd bullet- detail what the 'reduced visual impact' is in relation to the measurements set out above.

Figure 3 - the key issues are the impacts of the bridge in relation to Ampthill and Cartmel. Detail the relationship in terms of relative heights (with illustrations clearly showing these measurements).) of the ground floor/basement (if applicable) windows in the blocks and the height of the main bridge structure (usually the height of the top of the lateral walls to the bridge, plus any other significant structure, if applicable).

8th paragraph, page 14- Explain whether a 2m wide central median is needed and, if so, whether it could be reduced in width.

10th paragraph - explain when the uncertainty re minimal operational width during operation will be clarified and include in timetable. Include whether this could contribute towards a height reduction from the resulting less substantial structure.

Assumptions, requirements and assumptions

Section 3.1- Requirement 1: It is not clear what is meant by 'Most options are not constrained by width of carriageway' – please reword or expand.

Section 3.3 - Constraints- 4th paragraph, 3.3.1- Indicate whether the levels to GTB and the northern taxi rank junction can be changed or whether they are fixed (and why, if the latter applies).

3.3.1, 5th paragraph, State what the maximum gradients (and over what distance) the maximum gradient proposed is and why it cannot meet the 3% recommended TfL standard, if that is the case.

3.3.2, 2nd and 3rd paragraphs - London Borough of Camden and TfL have challenged whether the TOC parking can be moved elsewhere, reduced, rearranged or removed, which should be made clear. LB Camden and TfL have also said that arrangements for the taxi facility and green space could be re-designed to fit in with lowering of the bridge.

3rd and 4th paragraphs - specify levels referred to.

5th paragraph - It is not clear what this paragraph means. What does 'any lowering' mean in practice? Suggest this paragraph be deleted, as Camden and TfL challenge the validity of assertions made as stated above- better to state that further work is required and it was decided to 'park' work on this for further investigation if the preferred option merits such work and including whether the taxi ramp and ramp could be readjusted. Include this in the timetable mentioned above.

3.3.3 - Paragraphs 1 and 6: Did the ES assume a 'worst case' scenario for utilities space needs, as with other areas? Need to indicate whether there may be scope to reduce over-generous depths to accommodate utilities and the timetabling for clarification of this work and whether this could contribute to bridge height reductions.

3.3.4 - 2nd paragraph - Indicate what the available width constraints are in measurements and what further tolerance there is for width reduction. Timetable when this will be clarified.

3rd paragraph - Explain whether a central reserve is still needed and, if so, whether it could be reduced in width.

4th paragraph - Explain the assertion made here, as the preclusion referred to does not flow from the previous text, only that 'constraints' exist. (N.B. see seek clarification sought upon 3.3.4, para 2 above).

5th paragraph - Indicate in the timetable when the further clarification referred to will be made and whether this could contribute towards a bridge height reduction.

Options Selection (Section 4)

To help EIPB readers, please clearly identify in bold whether each option is 'parked' (this term is explained in the report) or still under consideration at the start of each option description and assessment.

Option 1

Far more detail is needed to explain the proposal, its benefits and disadvantages and the mitigations of the disadvantages (i.e. how and where it is proposed to re-provide the housing removed and rehouse the residents temporarily and/or permanently), plus relevant timescales and processes. Also, the report needs to state whether any opportunities exist to further reduce the bridge height in this option as little if no workshop time has been spent on exploring these and discussing what can and can't be done. These matters are integral to enabling the EIPB to being able to express a view.

4.1.1, 2nd paragraph, - Specify what 'short occasional closures' means in terms of duration and frequency of occurrence.

Table 1- Construction period - Need to state whether the footnote statement would reduce or eradicate the construction period saving or not and whether this would prejudice the realisation of other benefits suggested by this option.

Specify what 'potential changes' means in terms of GTB replacement permitted.

Section 4.1.2 - Main benefits need significant expansion and explanation. The further reductions in 'overall disruption to all local residents and road users' is one of the key issues and needs much more detail (bullet 4). The disruption to the highway (e.g. impact on general traffic flows, bus services, vulnerable road users, severance, HS2 construction vehicles) needs to be set out in more detail and how the impacts on the community would be reduced. This analysis would also apply to any other options taken forward.

Explain the revision to open space in more detail and specify the increased space referred to in bullet 6.

How many lorries are removed from the Regents Park Estate as a result of the haul road and over what period? (bullet 7).

Disadvantages-

The report needs to explain how bullet 1 is proposed to be addressed.

Bullet 2 needs to explain the relationships in more detail with measurements at identified points and figures 14 and 15 need commentary, clear legible annotation and measurements to explain what they are intended to illustrate.

Are there any other disadvantages? (not just the 'main' ones). Will any residents be impacted by traffic on the haul road, for example?

The report needs to explain how this option would be progressed in relation to the Hybrid Bill powers and ES.

How would future work be progressed and how would this be timetabled?

Option 5

The number of this option needs amending to make it clear that it is a secondary design issue.

3rd para – This section needs to be completely rewritten so as to reflect the comments made by LB Camden and TfL in the workshops. LB Camden and TfL do not accept the assertions made (see also section 3.3 comments). This section should not refer to 'disadvantages' but instead state that this issue was 'parked' as referred to in section 3.3 comments and that further assessment would be needed to investigate implications upon TOC parking, northern open space, taxi/lorry segregation/arrangements, public realm and pedestrian routes and highway and junction layouts.

Option 7

Option 7 has major wider disbenefits as set out in pages 39 and 40 of the report and repeated and expanded below:

i. Option 7 will require permanent utility bridges across the approach tracks and through the Ampthill Estate which would be highly disruptive to residents (contrary to the inspiration for the assurance to reduce impacts on residents)
ii. Option 7 constrains the future B2 scheme. The supporting piers of the existing bridge dictate the track layout and prevent changing access to many platforms. Replacing the structure in B2 becomes challenging and costly, as it now has to tie into an HS2 structure (which definitely can't be replaced) which is at a low road level. Option 7 is a 'short-termist' approach that fails to take a long term comprehensive approach to the development of Euston (including station development and OSD) and constrains the future B2 scheme. Therefore the new bridge will be:
    - too low to meet current NR OLE clearance requirements
    - unable to meet any aspiration for track lifting to smooth the vertical curve (required to assist the location of pointwork)
iii. Option 7 is likely to require the full closure of Hampstead Road to traffic for an extended period compared to the current AP03 scheme, causing unacceptable highway impacts. Hampstead Road is a key lorry route for HS2 works. Therefore HS2 works will be put at greater risk.
iv. Option 7 extends the bridge construction programme by up to 18 months which has been stated by both HS2 Ltd and the DfT as of critical importance.
v. Option 7 requires a join between the new and old bridge. This could result in a poor movement joint detail. The join will be a low point on the bridge

and therefore will the location for water-build up. Water will be needed to be taken down to track level somehow.

vi. Option 7 requires an extension to Granby Terrace Bridge with similar height and joining issues facing Hampstead Road Bridge

vii. NR and TfL will have a higher maintenance cost for the joined bridge.

viii. Option 7 will require the HS fire escape to be moved and will result in the loss of TOC parking unless this can be provided elsewhere.

For the above reasons, TfL and LB Camden do not consider Option 7 to be either appropriate to be taken forward, or within bill powers. In fact page 79 of the report states that 'it is not clear if [Option 7] can be delivered within Environmental Minimum Requirements'.

4.4.1, 4th paragraph - The first sentence needs to be qualified as the 'significant benefit' referred to fails to take a comprehensive long term approach to the redevelopment of Euston Station and that such possessions may be required in the future work (as indicated by disadvantage bullets 2, 3 and 7 in paragraph 4.4.3 of the report). Such work may be required in the future under Stage B2 for Euston and/or OSD and the retention of the existing bridge may serve as a constraint and add costs to future redevelopment at Euston for want of adopting a long term approach at this stage. In any case, Option 7 would require possessions for underpinning work. Option 7 will also require possessions for the construction of the permanent utility bridges spanning the rail track. Any future works to the utilities within this permanent utility bridge will also have possession impact on the station and rail services (both High Speed and Classic). The workshops have not discussed and analysed the possession impacts of any of the options in detail.

Table 4 needs to be amended. It is disputed that this option is compatible with the EAP and that it can be carried out within existing Bill powers. NR station flexibility comments need to reflect the comments made above re 4th paragraph of 4.4.1

Section 5- Options comparison table

Summary table of options (Table 6) needs to be updated in light of comments on tables above.

Section 6- Plan for further work

Further work needs to be set out to address need for firm recommendations and conclusions in this report, clear steps for progression of further work (with timetables) to progress the plan needed for the Promoter and timetable for this work, governance mechanisms and how public engagement will be included in this process.

Only options 1 and 8 should remain following the meeting with DfT in May 2016.