Materials by rail - ESSB report

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1 Executive Summary

1.1 Purpose of the study

1.1.1 Assurances given to the London Borough of Camden (LBC) and Transport for London (TfL) during the House of Commons Select Committee stage of the Hybrid Bill included a commitment from the SoS/DfT to, develop a Plan that seeks to maximise, as far as reasonable practicable, the volume of excavated and construction material moved by rail, in order to reduce numbers of Heavy Goods Vehicles from HS2 Euston on London's roads and the traffic/environmental impacts they will cause.

1.1.2 This report is in line with these assurances. The report summarises the technical material discussed and developed to date through a series of joint workshops and takes account of Euston Integrated Programme Board (EIPB) comments where possible. The report seeks to outline areas where members are agreed and any areas where there remain points of difference. Sections 12.2 and 12.3 of this report have been drafted by TfL, LBC and Network Rail to enable their views, where different from HS2/DfT to be fully reflected. The report also provides details of the HS2 options and proposed plan going forward.

1.1.3 The construction of the HS2 Euston station is a major construction project in an environmentally sensitive area. The overall project budget for the station is estimated at £2.25 bn. (excluding risk, contingency and property costs). Construction will be in two stages; Stage A, 2017 to 2026 to support the start of services to Birmingham and the North West, and Stage B1 from 2027 to 2033 to support the wider HS2 network. The Environmental Statement supporting the Hybrid Bill assumes that all construction materials (except some track material) is to be moved by road. The use of rail would reduce the number of vehicles using roads and therefore relieve some impacts in respect of construction vehicles, which are matters of local concern and were the subject of numerous petitions. This report focusses primarily on options for the movement of material by rail and does not seek to reiterate other mitigation activities HS2 is committed to providing.

1.1.4 Representatives of HS2 Ltd., Network Rail, DfT, Transport for London and London Borough of Camden have attended ten collaborative workshops with technical experts from all organisations. In addition HS2 has held two community events, a summary of the views and questions expressed at these events is provided in section 12.

1.2 HS2 Position

1.2.1 This study has sought ways to maximise, as far as reasonably practical, the movement of material by rail. Whilst recognising that decision making rests with the Secretary of State (as detailed in the assurances), this study leads HS2 to an initial conclusion that it would be

possible and reasonable to implement both the platform 13 and platform 18 options with the current AP3 scheme [1] subject to confirmation that:

- The passenger impacts can be mitigated to a reasonable level;
- The construction programme impacts can be mitigated; and
- Network Rail approve of the use of the platforms.

1.2.2 Subject to a decision from the Secretary of State, HS2 proposes the following course of action:

- HS2 and DfT continue to work with Network Rail to get clarity on passenger impacts and options for mitigation [2]
- HS2 continues to work over the next two years (including during further project development and detailed design/contractor design) to seek ways to mitigate the construction programme impacts. This will include engagement with LBC regarding options on construction arrangements, including working hours.

1.3 Sift process

- Workshop attendees proposed and considered every site potentially viable for material removal and delivery on the West Coast Main Line (WCML) corridor between Primrose Hill Tunnel and Euston. At each stage the sift criteria and results were agreed between all workshop members.
- At the end of the first stage 11 options were identified and sifted. During the pre (geometrical) sift four options were discounted (see section 8), a further option was discounted following sift 1 (see section 9)[3].
- In Sift 2 the six remaining sites were examined further, which resulted in one option (Camden Carriage Sidings) being parked[4] and identified three options that all workshop members agreed were technically feasible and should be taken forward for further development, as they provided practical means of and despatching materials to and from site in viable quantities. These options were:

[1] These conclusions are based on the scheme currently before parliament ahead of considerations by the House of Lords Select Committee and progression of further detailed design.
[2] Refer to NR's comments in Section 12.3. "This analysis [of AP3 arrangements with Line X temporarily closed] does not include any consideration of freight trains running into and out of Euston for the transport of HS2 materials. Until the baseline timetable and performance impacts are established, it is not possible for Network Rail to validate the outputs of the ESSRB report. Network Rail are currently establishing the length of time it would take to run sensitivities on the analysis which would take account of materials trains. Due to the availability of resources and the dependency upon the baseline report this activity could only commence in October 2016 and would report its findings at a date yet to be determined."
[3] The group did note however that one option (Primrose Hill East) could potentially be used to accommodate excavations from the Adelaide Road vent shaft saving road movement of this material. HS2 will report back separately to the ESSRB on this
[4] Camden Carriage Sidings may however still be used to stable materials freight trains during the day if route capacity to and from Willesden is not available

- Backing out road 2 (BOR2): A new siding to the east of the main line tracks north of Granby Terrace (south of Park Village East and adjacent to the DB Schenker Carriage Shed). Used during Stage A 2018 - 2026
- Using the relocated Platform 18 within the Network Rail Station footprint. Used during Stage A 2018 - 2026
- Using platform 13 within the reduced Network Rail station Stage B2 footprint. Used during Stage B1 2026 – 2033

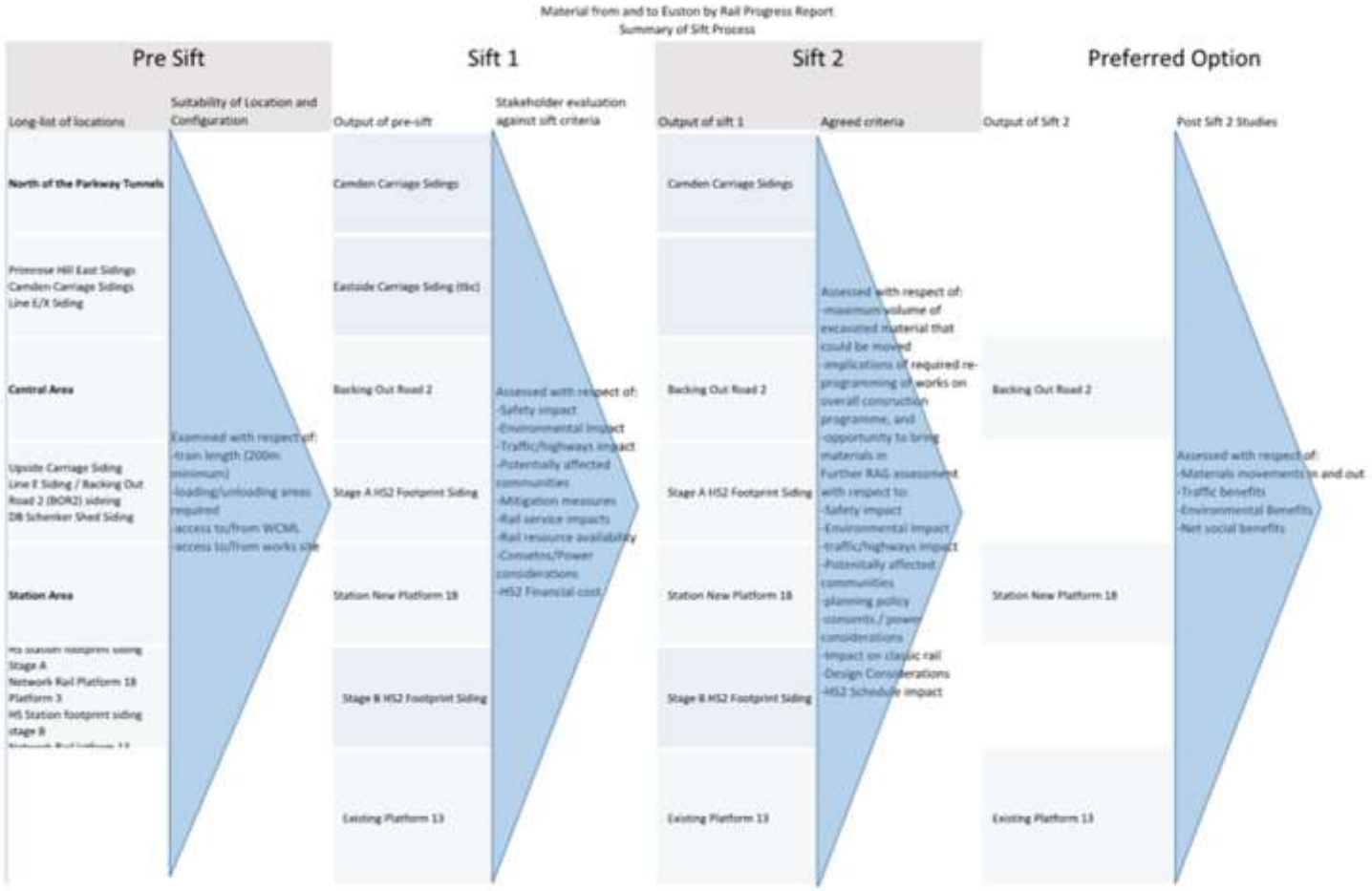
1.3.1 The sift processes are summarised in Figure 1.

1.3.2 The three options handle differing volumes of material, impact different HGV routes (see Annex F) and carry different risks concerning consents, impacts on passenger train operations, environmental impacts, costs, construction programme. An overview of these assessments is provided below. The baseline for the assessments is the AP3 scheme and associated Environmental Statement.

1.3.3 Please note, whilst the three options are assessed individually in the report below, they are not mutually exclusive and could be delivered independently or collectively.

1.3.4 The report presents details on all three options detailed above in line with discussions at the workshops. However, HS2's current position in relation to these options is detailed in 1.2 above.

Figure 1: Sift Process and Result Summary



1.4 Lorries by Activity

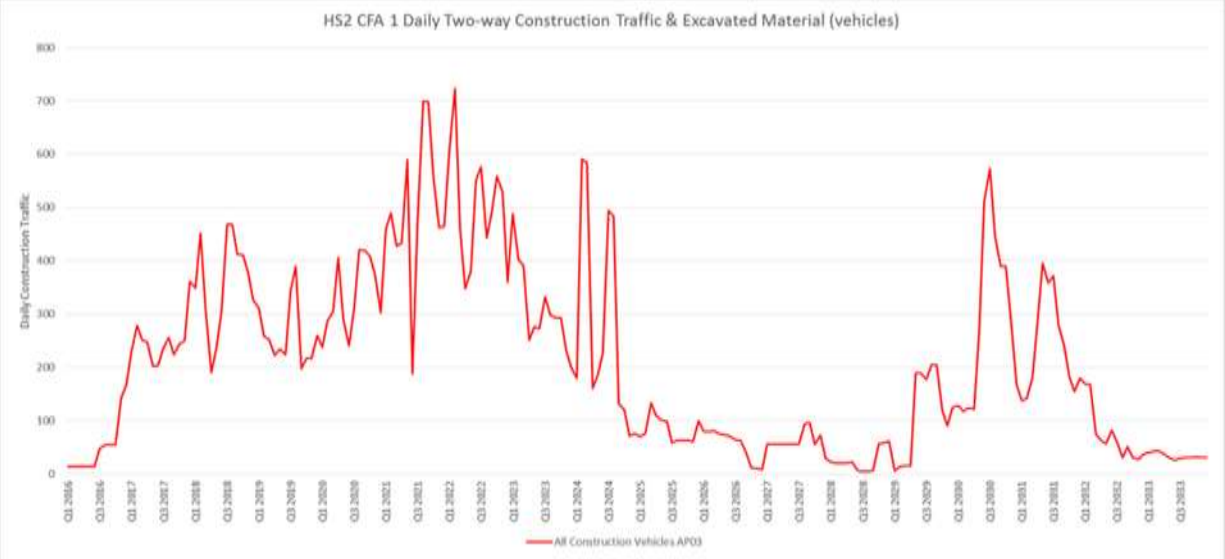
1.4.1 The estimated number of lorries (HGVs gross vehicle weight over 7.5T) for the duration of the works that would be used if all materials were transported by road, based on the AP3 programme, are given in Table 1.

Table 1: Number of lorries used on the Euston Station and approach projects, based on AP3 assessment assumptions.

Activity	Quantity of Material	No. of Lorry Loads	Two-Way Lorry Trips	Percentage
Demolition[5]	153,190 m3	30,638	61,276	8.3
Excavation	1,174,601 m3	138,188	276,376	37.6
Concrete	565,058 m3	94,176	188,353	25.6
Steel Reinforcement	84,769 t	2,825	5,650	0.8
Miscellaneous Material Imported	Various	101,984	203,968	27.7
Total	**As above**	**367,811**	**735,622**	**100.0**

1.4.2 The daily lorry movements are variable over the duration of the project as outlined in Figure 2 below. As can be seen, the peak daily two-way lorry trips is estimated at just over 700.

Figure 2: AP03 Daily Lorry Movements



[5] HS2 estimate that up to 90% of demolition material will be reused on site during construction

1.5 Material removal and delivery

1.5.1 The three options assessed looked at the amount of materials exported and materials imported (steel reinforcement and miscellaneous) that they would be able to facilitate. These are summarised below in Table 2.

1.5.2 If all three options were implemented 33% of exported material could be moved by rail rather than road. When combined with the ability to import materials by rail, this could reduce the number of one-way lorry trips by over 60,000, which is equivalent to 16.7% of total HS2 two-way lorry trips. This also reduces the peak number by approx. 130 lorry movements as detailed in the graph below. The breakdown for each option if implemented in isolation is shown in section 7.2.

Figure 3: AP03 Daily Lorry Movements and lorries remaining on highway with combined options

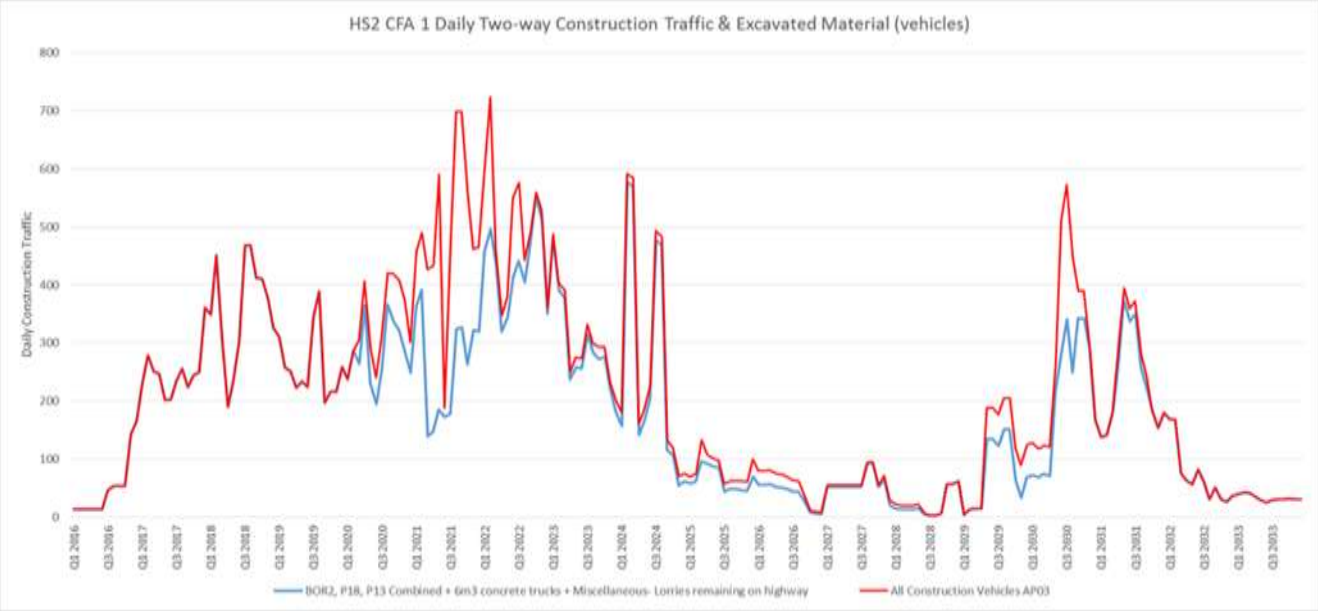


Table 2: Siding location and the amount of lorries that can be removed from the road network

	Material Exported				**Material Imported**	**Total**
	Material exported m³ (t)		**% of Total material exported***	**One way Lorry Trips removed (% total)**	**One-Way Lorry Trips removed (% total)**	**In+out Vehicle trips removed (% total)**
BOR2	56,510 m³	113,020 t	4.8	6,648 (1.8%)	Not possible	1.8%
Platform 18	253,540 m³	507,080 t	21.6	29,828 (8.1%)	11,000 (3.0%)	11.1%
Platform 13	77,280 m³	154,560 t	6.6	9,091 (2.5%)	5,000 (1.3%)	3.8%
Total	**387,330 m³**	**774,660 t**	**33**	**45,568 (12.4%)**		**16.7%**

*as % of total of 1,174,601m³ unbulked (excluding piling arisings)

1.5.3 In relation to the peak level of lorry traffic, BOR2 alone would result in maximum daily lorry movements of just under 620 compared to the AP3 peak of 720. Platform 18 alone would result in maximum daily movements of approximately 580. In combination, the maximum daily lorry movements would also be approximately 580, as the main excavation periods for each option do not coincide. Platform 13 occurs outside the peak traffic period and does not affect the peak traffic levels.

1.5.4 It should be noted that:

- This assessment assumes that it would be possible to import miscellaneous materials by rail. This would require both a consolidation centre and available train paths. Although neither of these can be guaranteed, on the basis that these can be delivered an allowance has been included in this assessment.
- The opportunities of the other assurance studies (such as Hampstead Road Bridge) might further increase the amount of material which can be removed by rail. This data has not been included as these studies are not yet complete.
- The amounts of material and vehicle movement numbers presented all assume concrete delivery vehicles with a 6m³ capacity as this is the basis of the assumptions in the ES. Although independent of any decision on rail access for construction, the potential impact of using 8m³ capacity concrete vehicles is considered in later sections of this report. However, further work needs to be conducted to see if this is feasible.

1.6 Construction programme impacts

1.6.1 There are construction programme impacts for each of the possible siding locations. This is caused by the construction of the new siding locations and changes to the current AP3 programme. Using the construction programme set out in AP3 as a basis, preliminary assessment of each of the three options indicates unmitigated programme impacts in the order of 6 months as detailed in Table 3.

Table 3: Unmitigated programme impact caused by changes to AP03 programme to allow for material to be disposed of by rail

Option	Estimated Unmitigated Programme Impact	
BOR2	6 months	Concurrent impact on Stage A programme
PL 18	6 months	
PL 13	6 months	Impact on Stage B1 programme

1.6.2 Programme delays result in additional cost to the scheme (as discussed below) and potential delays to the realisation of the economic benefits.

1.6.3 A number of potential mitigations might be possible in order to reduce this estimated programme impact. These could include:

- Additional out of hours construction activities
- Additional freight trains running at night
- Increase concurrent construction activities during the day

1.6.4 It should be noted that such measures may cause different effects.

1.7 Construction and operation costs

1.7.1 All three options will require additional infrastructure, which will result in additional construction costs. The additional construction costs for each option are shown in Table 4.

Table 4: Addition cost associated with, the construction and operation of sidings.

	BOR2	**Platform 18**	**Platform 13**
Construction Costs	£9m	£6m	£6m
Misc incurred site costs e.g. prelims	£3m	£2m	£2m
Design & Management	£2m	£1.5m	£1.5m
(Risk & Contingency)	(£6m)	(£4m)	(£4m)
Total (excl. risk and contingency)	£14m	£9.5m	£9.5m
Estimate Base Date 3Q2012			

1.7.2 Construction costs include decommissioning and re-commissioning of platforms and all associated civil/infrastructure works. They exclude rail transport costs (rail path, loco, operational disruption and TOC charges.

1.7.3 Haulage costs will depend on the final destination or source points for materials, which may be different for road and rail options. At this stage there is insufficient data to evaluate this with confidence, but the working group has assumed that road and rail transport costs for excavated materials are broadly comparable.

1.8 Disruption impacts and costs

1.8.1 Each of the three options potentially causes operational impacts on the classic railway (passenger trains) resulting directly from the interaction of the additional freight trains with passenger services.

1.8.2 Platform 18 and 13 options require the temporary decommissioning of one classic platform. All of the schemes will require the movement of freight trains across the station approach from the WCML slow lines to the west side of the station. To minimise the timetable conflicts with passenger services freight train movements could take place both during off peak hours and overnight. This may in turn require some extended and night time working in the station.

1.8.3 This operational issue will be similar for platform 13 in Stage B1, when the classic rail station is reduced to 13 platforms.

1.8.4 All parties agree that the operation of freight trains will impact on the existing train services. These range from an impact on performance, lengthening of journey times or reduction in passenger train services. These impacts could be significant[6] but until some modelling has been undertaken there is no basis upon which this can be formally quantified.

[6] Based on professional judgement and experience, DfT Rail Group estimate that the impact could be in the range £24m to £46m.

1.8.5 Network Rail is in the process of verifying that the current timetables can be delivered on the reduced track layout post 2018, but this work will not be available until October 2016. IN the meantime DfT has engaged an independent consultant (Tracsis) who will seek to provide an earlier assessment.

1.9 Economic benefits

1.9.1 There are economic benefits associated with the removal of HGVs from the local road network, in terms of congestion, road safety, emissions and other impacts. The options above have been quantified using the sensitive lorry mile assessment used by DfT in allocation of English freight mode shift grants. The workshops agreed to the use of this methodology. Figures appropriate to London and other major conurbations have been used. The results are shown in Table 5 [7]. Recognising the potential to transport miscellaneous materials by rail, an allowance for the maximum credible benefits of this are also included in Table 5.

Table 5: Economic benefits for the reduction of lorries caused by using materials by rails (2024 values, 2015 prices)

Option	No. of lorry movements removed (one-way)	Two-way lorry miles removed	Benefits £m London (medium – congestion band 4)	Benefits £m London (high – congestion band 5)	Percentage of total lorry movements removed
Material exported:					
Backing Out Road 2	6,648	345,696	£2.091	£4.764	1.8%
Platform 18 siding	29,828	1,551,056	£9.383	£21.377	8.1%
Platform 13 siding	9,092	472,784	£2.860	£6.516	2.5%
TOTAL	45,568	2,369,536	£14.334	£32.657	12.4%
Material imported:					
Potential use of rail for miscellaneous materials	16,000	800,000	£7.409	£17.244	4.4%
Total including potential use of rail for miscellaneous materials	1,568	3,169,536	£21.743	£49.901	16.7%

1.9.2 Whilst use of the DfT methodology was agreed between the parties, TfL and LBC suggest that using other transport impact methodologies adopted for London specific projects could indicate economic costs greater than those presented above.

[7] The numbers presented in the table assume concrete delivery vehicles with a 6m³ capacity as this is the basis of the assumptions in the ES. Later sections of this report provide details of the economic benefits of using 8m³ capacity concrete delivery vehicles.

1.10 Concrete Lorries

1.10.1 This report has focussed on the use of rail as a means of moving material, however, it has also identified the potential to reduce the number of HGVs through the use of larger capacity concrete vehicles.

1.10.2 Under the AP3 scheme, HS2 Ltd. does not plan to install a concrete batching plant into the Euston site due to space constraints. Instead concrete will be delivered by road, making up over 25% of total lorry movements. Using larger capacity vehicles (8m3 instead of 6m3) would reduce total HGV movements by 6%.

1.10.3 However, further work is required to consider the feasibility of this including consideration of vehicle availability and overlaps with wider commitments on engine type. A decision on the use of larger vehicles should be viewed as independent of the decision of material by rail – one does not exclude the other.

1.10.4 Whilst this report using AP3 assumptions as the baseline, for completeness, section 11 to this report provides the data associated with this study assuming 8m3 concrete trucks.

Table 6: Summary of the impact of using rail for both exporting and importing construction materials

Option	Excavated Material out (% of total)		Material Exported 1 way Lorry Trips Removed (% total)	Materials Imported 1 way Lorry Trips Removed (% total)	Total 1 way Vehicle Trips Removed (% total)	Number of Years Operational	Unmitigated Programme Impact (months) Using AP3 Programme	Construction Cost £m (excluding risk and contingency)	Economic benefits (High) (*excludes import economic benefits). Figures in parenthesis are medium benefits
	m³	Tonnes							
BOR 2	56,510 m³	113,020 t (4.8%)	6,648 (1.8%)	N/A	6,648 (1.8%)	1.5 – 2 years Stage A	6 Stage A concurrent with plat 18	£14m	£4.7m (£2.1m)
Platform 18	253,540 m³	507,080 t (21.6%)	29,828 (8.1%)	11,000 (3%)	40,828 (11.1%)	1.5 – 6 years Stage A	6 Stage A concurrent with plat BOR 2	£9.5m	£21.4m* (£9.4m)
Platform 13	77,280 m³	154,560 t (6.6%)	9,091 (2.5%)	5,000 (1.3%)	14,091 (3.8%)	1.5 – 2 years Stage B1	6 additional Stage B1	£9.5m	£6.5m* (2.9m)
Potential Import of Material by Rail									£17.2m (7.4m)
Total assuming all options implemented	387,330 m³	774,660 t (33%)	45,568 (12.3%)	16,000 (4.3%)	61,568 (16.7%)	1.5 - 6 years Stage A 1.5 – 2 years Stage B1	12 months	£33m	£49.9m (£21.7m)

2 Introduction / details of assurances

2.1.1 **Assurances made by HS2 as part of the Select Committee process**

2.1.2 *'HS2 recognises that the impact of construction traffic is of particular concern for the London Borough of Camden and its residents and businesses. A critical source of construction movements is the need to remove excavated material from construction sites.*

2.1.3 *The Environmental Statement which accompanied the scheme proposals was based upon moving all excavated material by road, representing a worst case for the purposes of environmental assessment.*

2.1.4 *Nevertheless, there may be opportunities both to reduce the amount of excavated and construction material and for this material to be removed by rail, thereby reducing the amount of construction related traffic on the roads. In order to determine the level of material that could be removed by rail, further work is required with rail partners, the London Borough of Camden and Transport for London. This further work, as reflected in the following assurances, will be taken into account in HS2's tendering processes.*

2.1.5 *Furthermore, the Promoter is committed to minimising waste produced during construction. In this regard the Promoter is willing to offer the following assurances:*

2.1.6 ***Movement of materials***

2.1.7 The Secretary of State will require the Nominated Undertaker to:

- *Seek to maximise, in so far as reasonably practicable and within existing Bill powers the volume of excavated and construction material from the construction of Euston Station and approaches to be brought in and removed by rail whilst balancing the wider environmental impacts to the local community and on passenger services.*
- *Engage actively with the London Borough of Camden, the Greater London Authority and Transport for London to develop a plan for the bringing in and removal of such excavated and construction materials to and from Euston Station by rail. This plan will include consideration of options that would require separate planning permissions that may be granted by the London Borough of Camden or the Greater London Authority;*
- *Upon completion, "the plan" will be submitted to the Euston Integrated Programme Board and the ESSRB for comment. This will be no later than May 2016. The Promoter will require the Nominated Undertaker to use all reasonable endeavours to incorporate comments from the EIPB and ESSRB into the plan; and*
- *The plan will then be submitted to the Secretary of State for his consideration. The Secretary of State will then notify the EIPB of his decision in regards to implement the proposals contained within the plan, no later than one month from the date of the plans submission.'*

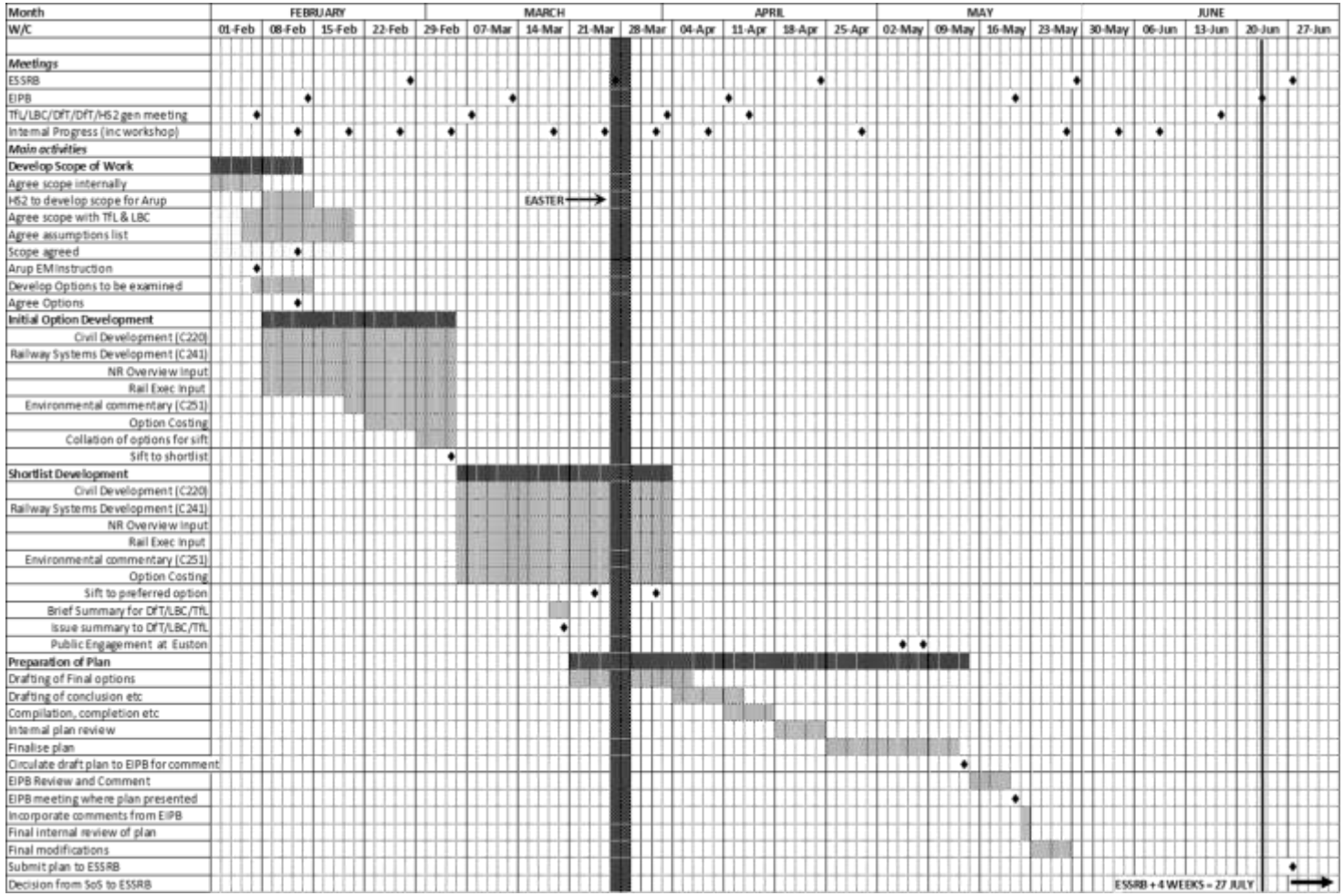
3 Report Programme

3.1.1 The programme for delivery of this report is provided below. This includes all meetings and papers leading up to the submission of this paper to ESSRB. It also outlines the anticipated dates for submissions to the Secretary of State.

3.1.2 Milestones included:

- Sift 1 meeting 3rd March 2016
- Sift 2 meeting 24th and 31st March 2016
- Engagement with the Community 12-14 May 2016; and
- Report to EIPB and ESSRB 23rd May 2016 /29th June 2016.

Figure 4: Programme for the Material by rail workshops, writing of the reports and reviews



4 The location for sidings for removal and delivery of materials.

4.1.1 The assessment looked at locations close enough to the Euston worksites that materials could be directly loaded or off loaded from the rail siding location to the worksite, or site haul road or conveyor could provide transportation of materials to the worksite. Any locations which required the use of road vehicles to ferry load were excluded from this study. These locations were broken down into three main areas, which had sub areas for the siding locations (See appendix A for drawings).

- North of the Parkway Tunnels
  - Primrose Hill East Sidings;
  - Camden Carriage Sidings; and
  - Line E/X siding.
- Central Area
  - Up side Carriage Siding (Between Park Street tunnels and Mornington Street Bridge);
  - Line E Siding or Backing Out Road (BOR) 2 sidings; and
  - DB Schenker Shed Sidings.
- Station Area
  - HS Station footprint siding stage A;
  - Network Rail Platform 18 sidings;
  - Platform 3 Siding;
  - HS Station footprint siding stage B; and
  - Network Rail Platform 13 sidings.

5 The Sift Process

5.1 Introduction

5.1.1 The Sift process has been adopted by the DfT and has been implemented throughout the HS2 project. It enables the assessment and selection of options by a like for like comparison. Therefore it was decided that this process should be adopted to enable the selection and elimination of siding location. The workgroup agreed on a number of geometrical constraints and Sift Criteria for the comparison and assessment of the various siding locations. The outcomes of the sift were also agreed by workshop members.

5.1.2 The selection was broken into 3 stages

- Pre (Geometrical) Sift;
- Sift 1; and
- Sift 2.

5.2 Pre (Geometrical) Sift

5.2.1 The pre (geometrical) sift looked at the location of the siding and the physical area which would be required in terms of;

- train length of 200m minimum;
- loading / unloading areas required for loading train wagons (minimum width 15m);
- access to and from the West Coast Main Line (WCML); and
- access to and from the works site.

5.2.2 If the siding location was assessed that it did not meet these requirements it was discounted at this stage and no further works were undertaken. This allowed for a more detailed study on options that remained.

Schemes Withdrawn

5.2.3 The Pre (geometrical) sift led to the following options to be withdrawn from further consideration in the study.

Option 1 Primrose Hill (East) Siding

5.2.4 This siding was discounted due to:

- Location of the site was within a cutting to the north and conventional rail track to the south and it lacks the area required to load a train. Therefore a loading area could not be constructed;

- Access to and from the WCML would have required reopening a disused section of tunnel. The state of this tunnel was unknown at the time of the assessment but it was believed to be flooded;
- Access to and from the worksite was limited by having to cross the WCML or having to use the same section of disused tunnel as above; and
- It was also noted that the area was close to the Adelaide Nature Reserve and the residents of Adelaide Road.

Option 3 Parkway Line E/X

5.2.5 This siding was discounted due to:

- Location of the site was within a cutting and a disused tunnel portal to the west, and conventional rail track to the east; it lacks the area required to load a train. The existing track levels are currently on a slope and this would require build up of the area by approximately 2m to ensure a level siding to allow for loading of a train. Therefore a loading area could not be constructed;
- Access to and from the worksite was limited and would have required using the Park Street tunnels. These tunnels remain operation apart from a 3-year closure to allow for the construction of the HS2 approach and the convention Line X diveunder. This closure would limit the time which this siding could be used to a period of approximately 2-years; and
- Proximity to line E and live OLE may have safety implication to the operation of Network Rail when loading or unloading a train.

Option 5 DB Schenker Shed

5.2.6 This siding was discounted due to:

- The track geometry. To access the WCML the siding would have to tie in to the track to the DB Schenker shed side of Mornington Street Bridge. This means that the siding length which could be used for loading was limited to 117m, therefore reducing the size of train to a less than acceptable length; and
- It was also noted that as the siding would cross the worksite it would have a negative effect on the construction programme or be of limited used as it would have to be removed to allow for the construction of the diveunder south approach structure.

Option 11 – Existing Platform 3

5.2.7 This siding was discounted due to:

- Access to the siding location from the worksite would be limited to using conveyor belts within the service routes within the basement of the existing station. This would

make the impact on the servicing of the trains within existing Euston Station unacceptable;

- The requirement for a blockade of platform 4 tracks to allow for the safe loading and unloading of a train stabled in platform 3; and
- The construction interface with the travelling public would increase due to the need to keep platform 2 operational.

5.3 Sift 1

5.3.1 Following the pre (geometrical) sift. The remaining seven siding options were assessed in more detail in terms of how the rail access would work to and from the site (stabled within the site or train path day or night) and the method of loading excavated material onto the train (conveyor belt, moving train, static day). These option were assessed against the sift criteria as shown in Table 7.

Table 7: Sift Criteria

Option Templates Criteria	**Issues to consider at Sift 1**		
Option descriptions	**Geometrical fit on site**	**Rail connectivity**	
Safety impact	Any increase / decrease in safety risk to current operating railway	Road safety Public safety	Work site safety
Environmental impact	Fit to current E.S. Heritage / Conservation impact	Air quality Noise issues	Landscape / Visual impact Ecology issues
Traffic / Highways impact	Potential volume available for removal by rail (Opportunity for delivery by rail) Congestion		
Potentially affected communities	Day / night time working hours		
Mitigation measures	How impacts can be mitigated		
Planning policy	Compatibility with EAP		
Rail service impact	Impact on "peak" services (2018?) Impact on "off peak" services (2018?) Impact on current / future freight		Operational reliability and resilience Train availability
Rail resource availability	Efficiency of rail resource use	Availability of freight paths	
Consents / Power considerations	Additional powers/planning consents likely to be required Land consideration (additional land requirements)		

Option Templates Criteria	**Issues to consider at Sift 1**		
Option descriptions	**Geometrical fit on site**	**Rail connectivity**	
Design considerations	Wider impact of design changes resulting from siding schemes		
HS2 Financial cost and economic benefits / dis-benefits	Capital cost Economic issues Road safety impacts Loss of amenity	Additional construction cost Congestion AQ impacts Noise, dust, vibration	Time costs associated with less direct routes for pedestrian and cyclists No. of people affected
HS2 programme impact	Programme extension		
Risks	Differential risks between options		

Sift 1 Assessment

- After the pre (geometrical) sift, works were undertaken to see how the siding operations and configurations worked. These were seen as sub options to the location and increase the number of options to 13 but still retained the 7 locations that passed the pre (geometrical) sift.
- The sift 1 assessment was undertaken within a workshop where each of the stakeholders marked the scheme as either pass or fail against the sift criteria. The results were tallied up, and then debated to identify on which schemes were taken scheme would move forward into the Sift 2 assessment. Table 8 shows the result of the assessment in which it was agreed that 4.3.1 (in grey) was discounted.

Table 8: Sift 1 result table

Option Number	**Location**	**Loading Options**	**Train Movements**
2.1.3	Camden Carriage Sidings	Static train	Stabled
2.3.3	Camden Carriage Sidings	Conveyor	Stabled
4.3.1	Eastside Carriage Siding (tbc)	Conveyor	Day time
6.1.1	Backing Out Road 2	Static train	Day time
6.2.2	Backing Out Road 2	Moving train	Night time
7.1.1	Stage A HS2 Footprint Siding	Static train	Day time
7.2.2	Stage A HS2 Footprint Siding	Moving train	Night time
8.1.1	Station New Platform 18	Static train	Day time
8.2.2	Station New Platform 18	Moving train	Night time

Option Number	Location	Loading Options	Train Movements
9.1.1	Stage B HS2 Footprint Siding	Static train	Day time
9.2.2	Stage B HS2 Footprint Siding	Moving train	Night time
10.1.1	Existing Platform 13	Static train	Day time
10.2.2	Existing Platform 13	Moving train	Night time

Schemes discounted

Option 4 – Eastside Carriage Siding

5.3.2 This siding was discounted due to:

- Safety impact, due to the need of having a conveyor working above the operational railway so that excavated material could be removed from the site west of the WCML to the sidings to the east of the WCML.
- Rail service impact, as the location of the siding would require occupation of the existing eastside carriage siding it would mean that this site could not be used to stable passenger trains; and
- Lacking an area on which the train could be loaded. As the location of the site is constrained by retaining walls both sides and the alignment of line X along the south west side meant that the loading area for trains would be limited to a length of only 115m.

5.4 Sift 2

5.4.1 Following sift 1 assessment. The remaining six siding options were assessed in more detail in terms of the maximum volume of excavated material that could be removed, re-programming the works to suit removal of excavated material by rail and the implications of this on the overall construction programme, and the potential for sidings to be used for incoming construction material. These options were assessed against the sift Red Amber Green (RAG) criteria as shown in Table 9.

Table 9: Sift RAG Criteria

	Sift Criteria	"RAG" Assessment		
		Red	Amber	Green
1.	Safety impact (construction)	Major impact on construction safety risk	Minor impact on construction safety risk	No impact on construction safety risk
2.	Environmental impact	Would cause a significant adverse environmental impact – exceeds limits set out in the ES and SES 2	Would cause adverse environmental impacts – additional night time working etc but within limits set out in the ES and SES 2	No detrimental environmental impact (CFES). Positive environment benefits due to reduction in HGV.
3.	Traffic / Highways impact (incl. safety by proxy)	No significant reduction in construction traffic. (< 30% of excavated material in area served removed by rail)	Some reduction in construction traffic. (between 30% - 70% of excavated material in area served removed by rail)	Reduction in number of lorries (between 30% - 70% of excavated material in area served removed by rail) and potential for reduction of inbound construction traffic
4.	Potentially affected communities	No significant reduction in construction traffic. (< 30% of excavated material in area served removed by rail)	Some reduction in construction traffic. (between 30% - 70% of excavated material in area served removed by rail)	Reduction in number of lorries (between 30% - 70% of excavated material in area served removed by rail) and potential for reduction of inbound construction traffic
5.	Planning policy	Does not comply with EAP & Camden aspirations for Euston	Could be tempered to fall within EAP	Complies with EAP
6.	Consents / Power considerations	Requires new and/or additional hybrid Bill powers	Requires additional planning consents	Falls within hybrid Bill submission
7.	Impact on classic Rail	Major impact on time table, operational reliability and resilience. *(Quantum of services reduce 2014 timetable)	Minor impact on time table but risk of reduction in PPM – reliability and resilience	No impact on time table, operational reliability and resilience.

	Sift Criteria	"RAG" Assessment		
8.	Design considerations	Requires major redesign of permanent work including realignments of HS2	Requires further design for temporary work conditions	Requires no new design
9.	HS2 Financial cost	Cost benefit evaluation to be carried out post Sift 2		
10.	HS2 Schedule impact	Delay to construction schedule and /or construction sequence for Stage A (> 6 months)	Some changes to construction schedule and / or construction sequence for Stage A (between 3 to 6 months)	Minimal changes in construction schedule and /or construction sequence for Stage A (< 3 months)

Sift 2 Assessment

5.4.4 The sift 2 assessment was undertaken within workshop 6 and 7. Each siding location together with its operational and loading configurations was debated within the workshop with all the stakeholders that were present and a RAG given. The result of this can be seen in Table 10.

Table 10: Sift 2 RAG Criteria Results Table

Area	#Option Number	Siding location	1. Safety	2. Environmental	3. Traffic / highways	4. Affected communities	5. Planning policy	6. Consents & powers	7. Impact on classic rail	8. Design considerations	9. HS2 financial cost	10. HS2 schedule impact
North of Parkway	2.3.2	Camden Carriage Siding										
Central Area	6.1.1	BOR2										
Stage A – Station Area	8.1.1	Station New Platform 18										
	7.1.1	Stage A – Station Footprint Siding										
Stage B1 – Station Area	9.1.1	Stage B1 – Station Footprint Siding										
	10.1.1	Existing Platform 13										

5.4.5 This led to the following schemes being taken forward:

- BOR2
- Platform 18
- Platform 13

5.4.6 These are discussed in greater detail in section 11.

Schemes discounted

Option 2 – Camden Carriage Siding

5.4.7 This siding was discounted due to:

- Safety impact, due to the need of having a conveyor working over or/and close to the operational railway so that excavated material could be supplied to the site;
- Environment/ Affected communities, the operational requirements of the siding would require 24hour working of the loading and stabling of freight train. This siding location is close to the Gloucester Avenue residential area, therefore increase the impact to the local area;
- Rail service impact, to maintain supply for excavated material to the siding it would be required to extend the closure of line X till 2023 due to the space required to install a conveyor belt within the Park Street Tunnels; and
- Rail service impact, would require the decommissioning of the siding for passenger trains (overhead cables removed), therefore requiring stock to be stabled elsewhere. There would be a risk that the siding could not meet the current network standards when re-commissioned, as current grandfather rights would not apply.

Schemes "parked"

5.4.8 These are schemes which were not discounted but due to a better option being available were not taken any further.

Option 7 – Stage A HS Station Footprint siding.

5.4.9 This siding was parked due to:

- The volume of excavated material from Option 8 - Station New Platform 18 being greater;
- The programme impact of Option 8 - Station New Platform 18 being lesser; and
- The fact that Option 8 - Station New Platform 18 could be used for materials in whereas Option 7 could not.

Option 9 – Stage B HS Station Footprint siding.

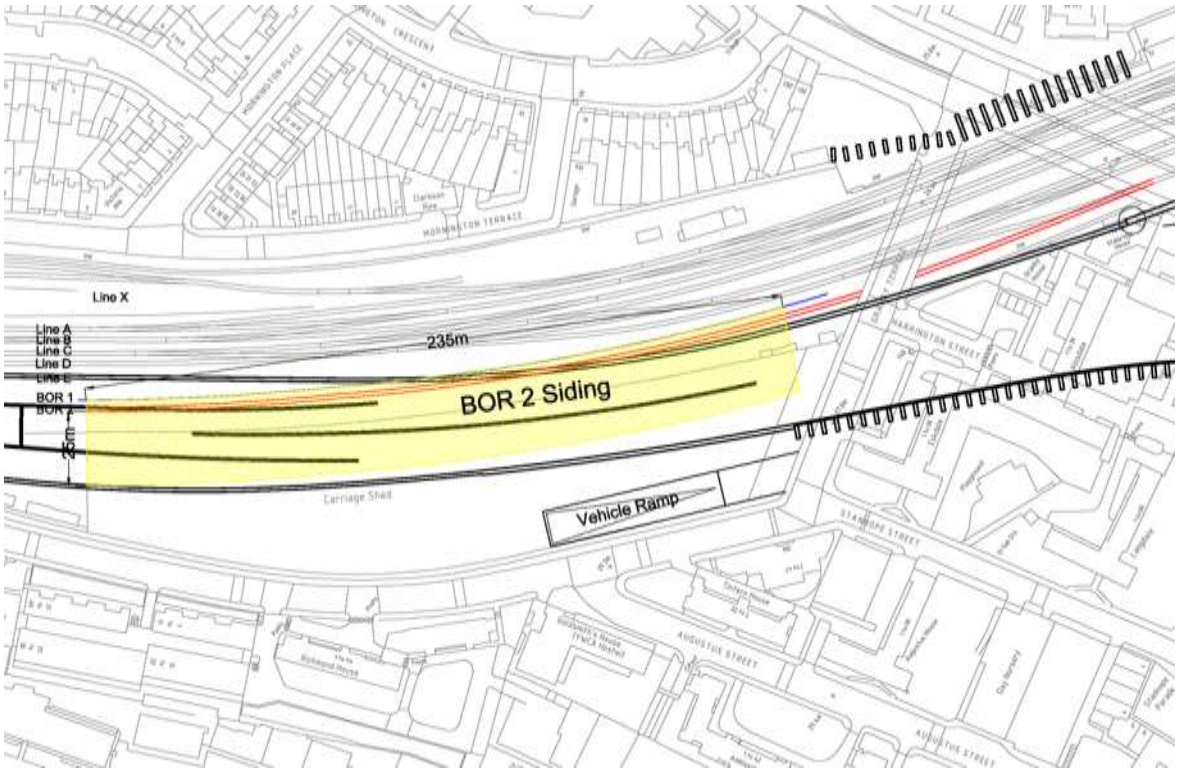
5.4.10 This siding was parked due to:

- The volume of excavated material from Option 10 - Station New Platform 13 being greater;
- The programme impact of Option 10 - Station New Platform 13 being lesser; and
- The fact that Option 10 - Station New Platform 13 could be used for materials in whereas Option 7 could not.

6 Schemes taken forward

6.1 Option 6 – BOR 2 siding

Figure 5: BOR 2 Sidling Location



6.1.1 The Backing Out Road 2 (see Figure 5) siding is located in area 1a alongside Line D, the WCML down fast line and on top of the new diveunder south approach structure. The siding could serve the tunnel portal, diveunder north, diveunder south and Mornington Street Bridge construction. The siding has a loading length of 235m which can service a train with 13 "mussel" wagon (See appendix B for specification of "mussel" wagon). Trains will be static with site plant moving to load the wagons during the day. At night it may be possible to have a moving train and a static loading point. The siding has the facility of stock piling 2 days' worth of excavated material, however this would be located on the roof slab of diveunder south and weight limits would have to be enforced to ensure the safety of the structure and workforce below.

Rail Access

6.1.2 The rail access to the siding will be from the WCML slow lines which serve the east side of the classic station. Freight trains will arrive by crossing the station throat into platform 18 (or 17 if 18 is occupied) and then backing up into the new siding to the north of the station. Departures will follow the same route in reverse.

6.1.3 These train movements involve crossing both slow down lines and the fast up and down lines into the station. There will not be paths available, either on the slow approach lines, or traversing the station during peak operating hours (7-10am, 4:30 – 7:30pm) necessitating train movements outside peak hours.

Programme and Siding usage

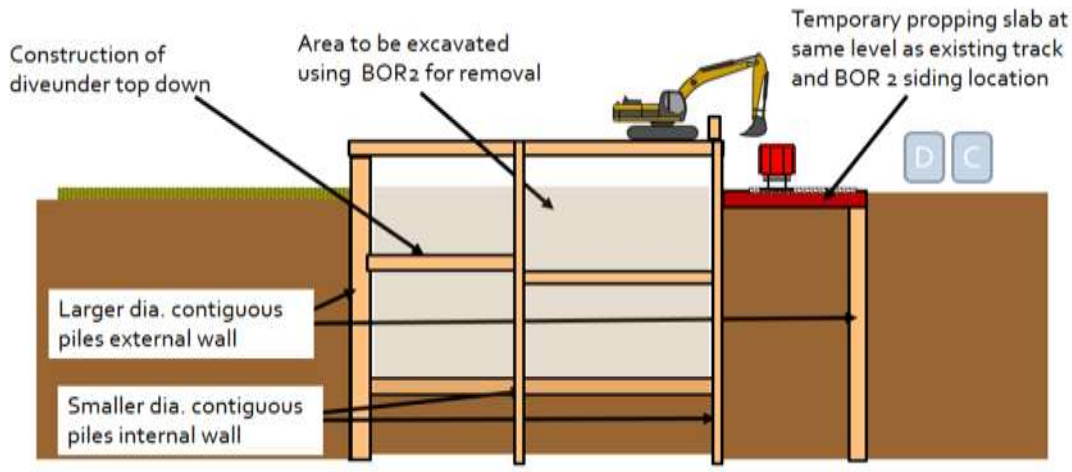
6.1.4 The amount of excavated material that could be removed by rail using BOR2 with the AP03 programme was insignificant, due to a clash between the siding location and the construction works (See Appendix C) Therefore it was decided that a maximum excavated material programme should be produced. This programme looked at the best possible use for this siding and what effect it would have on safety, programme and cost.

6.1.5 It was agreed between the stakeholders attending the workshops that BOR 2 could only be used for the removal of excavated material for Diveunder south. Diveunder north and the tunnel portal areas would still have to remove their excavated material by road. This was due to the programming of the works, which meant that a BOR2 could not be used to meet the AP03 programme and the requirements for reopening Line X in December 2021. It was also agreed between the stakeholders that BOR2 could not be used to bring in materials due to having to remove the siding early to allow for the completion of the excavation of Diveunder south.

6.1.6 This programme changed the construction sequence to allow for the installation of BOR 2 siding. The new construction sequence would require a temporary propping slab which the siding was founded on and the need to excavate the diveunder in 2 halves.

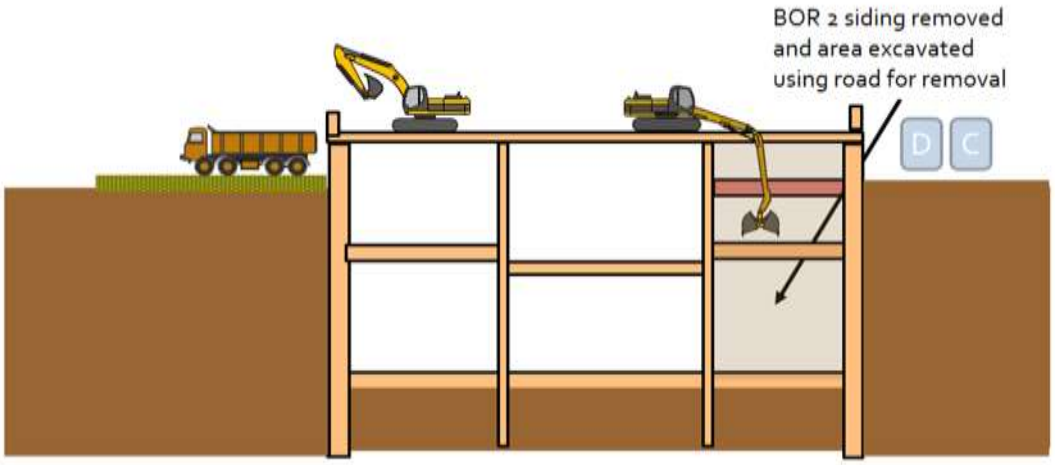
6.1.7 The first stage of works is shown in Figure 6. It shows the temporary propping slab and the excavation and top down construction of Diveunder south.

Figure 6: Use of BOR 2 Siding for excavated material



6.1.8 Once this section of structure is completed the siding will have to be decommissioned. The structure is then completed by demolishing the temporary slab, and excavating and constructing the rest of the structure (see Figure 7).

Figure 7: Decommissioning of BOR2 Siding



6.1.9 The siding is of limited use and can only be used for the removal of excavated material due to its location.

The effect of using BOR 2 Siding

6.1.10 It is estimated that BOR 2 siding can remove 6,648 two way lorry movements (see Table 11 for greater breakdown).

Table 11: BOR2 siding predicted volume of excavated material removed by rail

Ref	Options	Tonnage removed by rail	% of area exc. volume	% of total exc. volume	Delay on AP03 schedule	Loaded Lorries off road
56	4.8	113,020 t (56,510 m3)	56	4.8	6 months	6,648

6.1.11 However the use of the siding for removal of materials from site will have a negative impact on the construction programme with a potential unmitigated delay to construction in this area of the order of 6 months.

6.1.12 This takes account of:

- Re-sequencing of work prior to installation of the new siding including preparation of piling mat and piling of walls and foundations;
- Construction of a temporary deck to support the new siding and to provide temporary

stability to the adjacent excavation, and construction of the new siding;

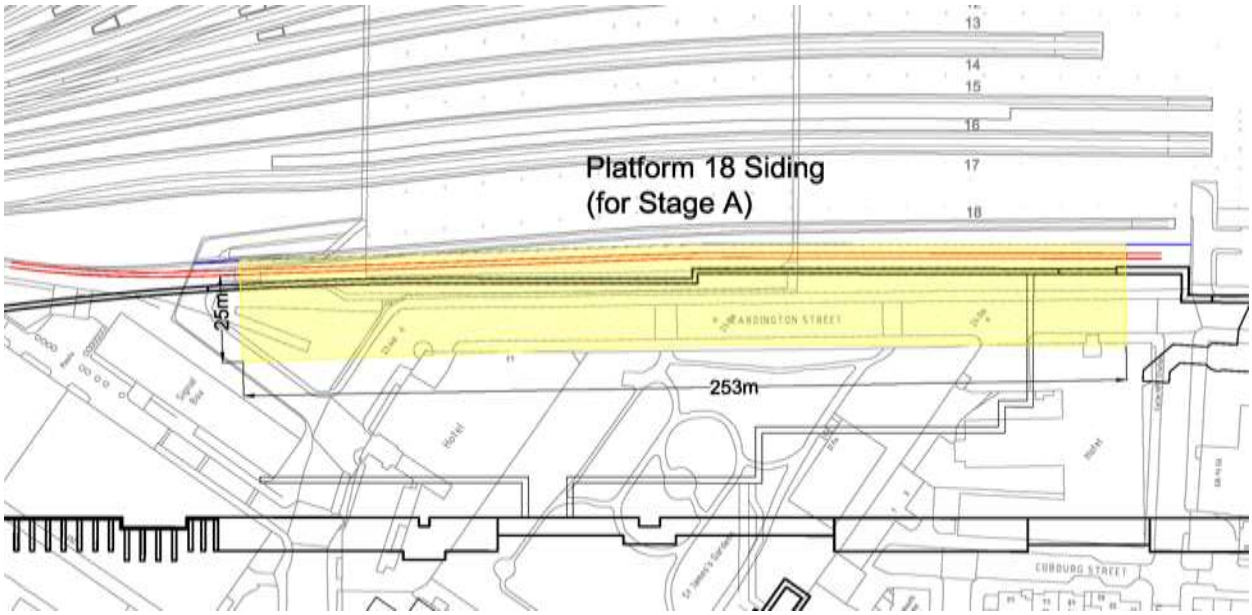
- Re-sequencing of excavation works to match geometrical constraints associated with the siding and its loading apron;
- Decommissioning and removal of siding and demolition of temporary deck; and
- Re-sequencing of final excavation works beneath the siding location (excavated material to be removed by rail).

6.1.13 It may be possible to recover this delay within the construction programme following the excavation works, however this falls outside the terms of reference of this study.

6.1.14 It is estimated that the extra over cost of BOR siding is £20m and breakdown of this figure can be found in section 8.1.

6.2 Option 8 – Platform 18 siding

Figure 8: Platform 18 siding



6.2.1 Platform 18 siding (see Figure 8) is located on the alignment of the proposed new classic platform 18 which corresponds to the old classic platform 17 alignment. It therefore replaces the new platform 18 during the Stage A construction period leaving 17 operating classic platforms. This siding will service the construction of the first stage of the HS2 station (6 platforms) south of Hampstead Road Bridge. Due to the construction programme the siding will not service area 3a, the new LUL concourse at the extreme south end of the site as this is constructed much later than the main HS2 station.

6.2.2 The siding has an approximate loading length of 250m which can service a train with 14 "mussel" wagons which equates to some 900t of material (See Appendix B for specification of

"mussel" wagon). Trains will be static with site plant moving to load the wagons during the day. At night it may be possible to have a moving train and a static loading point. The siding has the facility of stock piling 2 days' worth of excavated material.

6.2.3 The siding is effectively outside the construction works area, alongside the eastern boundary of the site. It therefore has no direct physical impact on the station construction, however provision for access to the siding for loading and unloading will form a constraint to construction. Whilst the siding could be made available as soon as the west bay of the convention Euston Station is demolished and OLE dismantled, access to the siding will not be available until:

- Services diversions out of Cobourg Street are completed; and
- Piling of the temporary east wall to the Stage A station is completed.

Rail Access

6.2.4 The siding will be accessed from the WCML slow lines which serve the east side of the classic station. Freight trains will arrive by crossing the station throat directly into the platform 18 siding, and depart similarly.

6.2.5 The train movements involve crossing both the slow down line and the fast up and down lines into the station. There will not be paths available either on the slow approach lines or traversing the station during peak operating hours (7-10am and 4:30 -7:30pm), necessitating train movements outside peak hours.

6.2.6 For excavation works, it is anticipated that between 4 & 6 freight trains will be required on a daily basis. This will mean that train movements will take place throughout the 24 hour period (excluding peak hours) and that as a result extended hours and 24 hour working will be required to match these train movements.

6.2.7 If this scheme was undertaken with BOR2 siding and the excavation of Diveunder south the total number of daily train movements to be accommodated could rise to eight, due to the excavation works overlapping. Therefore to provide some flexibility of time tabling, it is anticipated that an integrated operating approach will be adopted for platform 18 and BOR2 to enable head shunt and stabling activities.

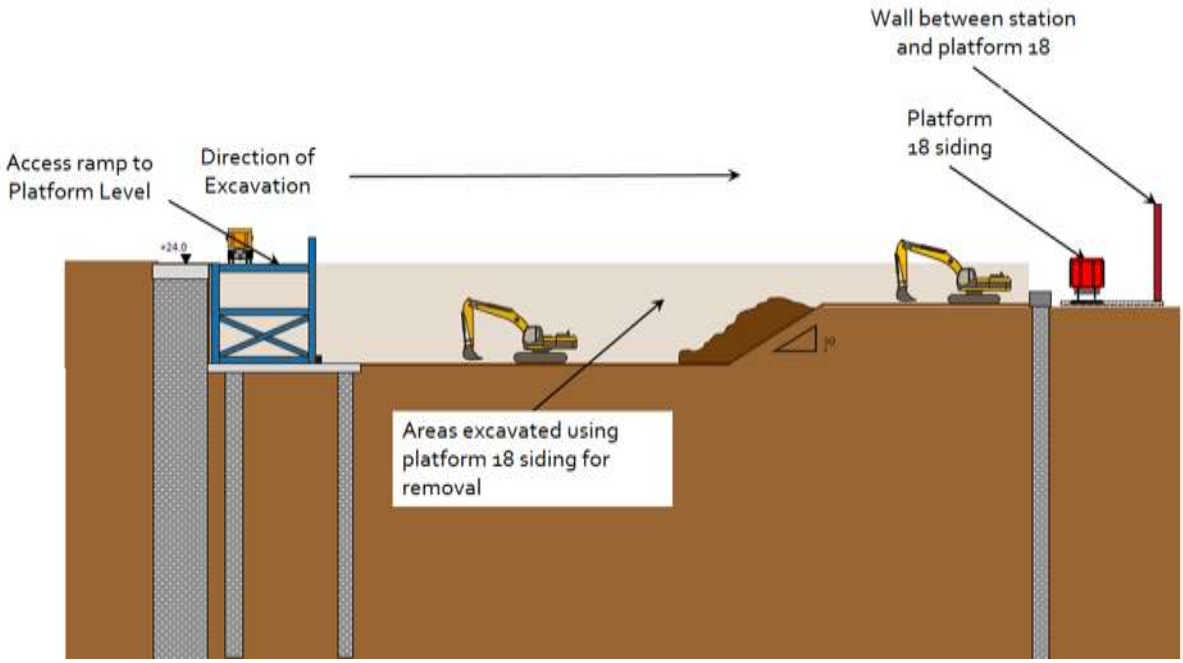
Programme and Siding usage

Bulk excavation

6.2.8 The amount of excavated material that could be removed by rail using Platform 18 with the AP03 programme was insignificant, due to a clash between the siding location and the construction works (See Appendix D) Therefore it was decided that a maximum excavated material programme should be produced. This programme looked at the best possible use for this siding and what effect it would have on safety, programme and cost.

6.2.9 This programme changed the construction from a South to North direction to a West to East direction. It also delays the start of excavation works until all the eastern contiguous piled wall by platform 18 was completed, see Figure 9.

Figure 9: Platform 18 Cross section excavation to -1 level



6.2.10 The programme also changed the construction technique from top down to bottom up to allow for the excavation of basement areas (see Figure 10 and Figure 11).

Figure 10: Platform 18 cross section basement excavation

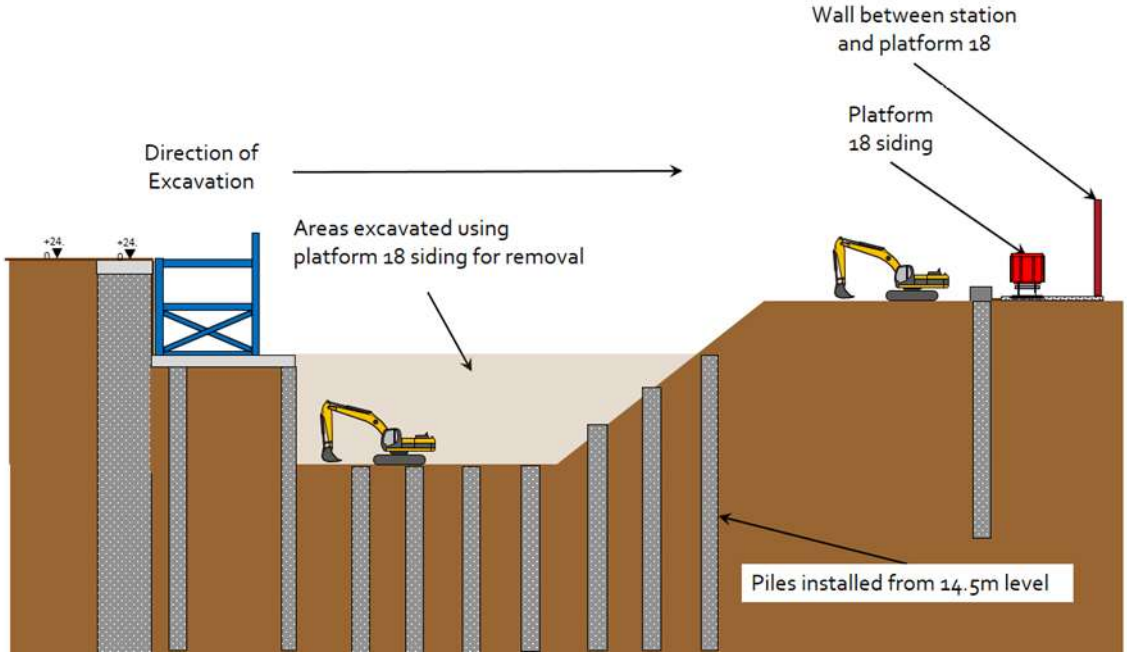
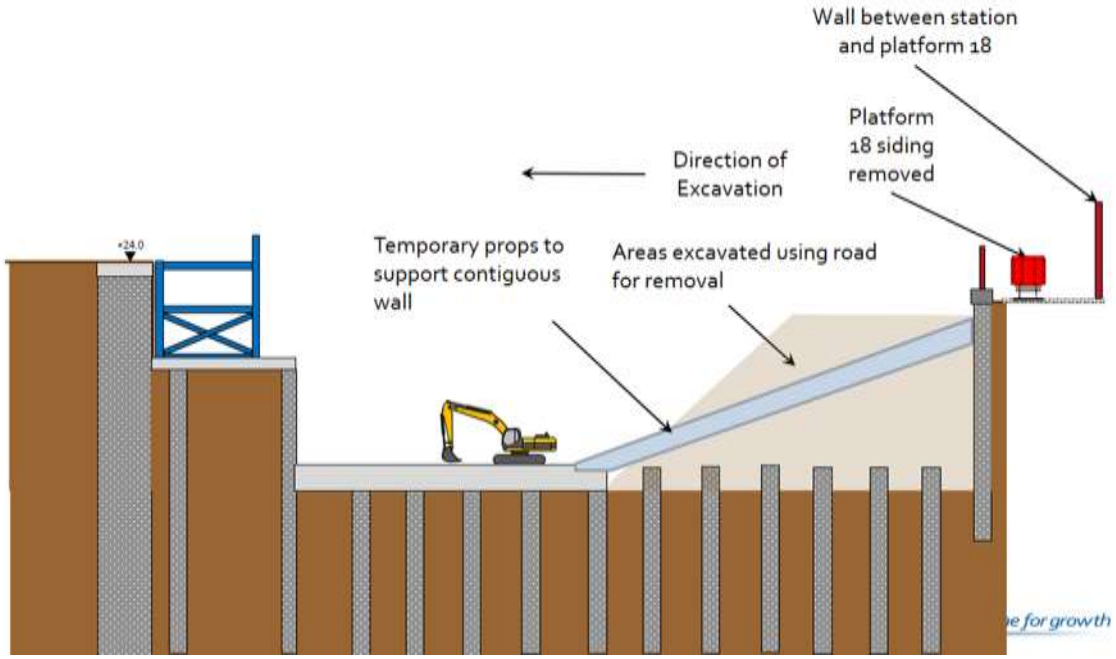


Figure 11: Platform 18 cross section basement excavation with props Piling arisings



6.2.11 Pile arisings (approximately 10% of excavated volumes) will not be removed by rail as for the majority of the piling works Platform 18 will not have been constructed.

Demolition materials

6.2.12 Due to the timing of the demolition the Platform 18 siding will not be available.

6.2.13 Softstrip items such as windows, window frames, plaster board, soft flooring, etc. will have to be disposed from site using road vehicles and where possible this material will be recycled.

6.2.14 Hazardous materials such as asbestos will also be disposed from site using road vehicles using the correct skips.

6.2.15 Hard materials such as concrete, brick, stone, etc. will, where possible, be crushed and stored on site so that this can be used at a later date in the formation or as working platforms for tracked plant. This material is then excavated as part of the mass excavation and therefore the majority of this material will be disposed of by rail. This reduction of lorry movements has been included in the excavated material figures as shown in Table 12.

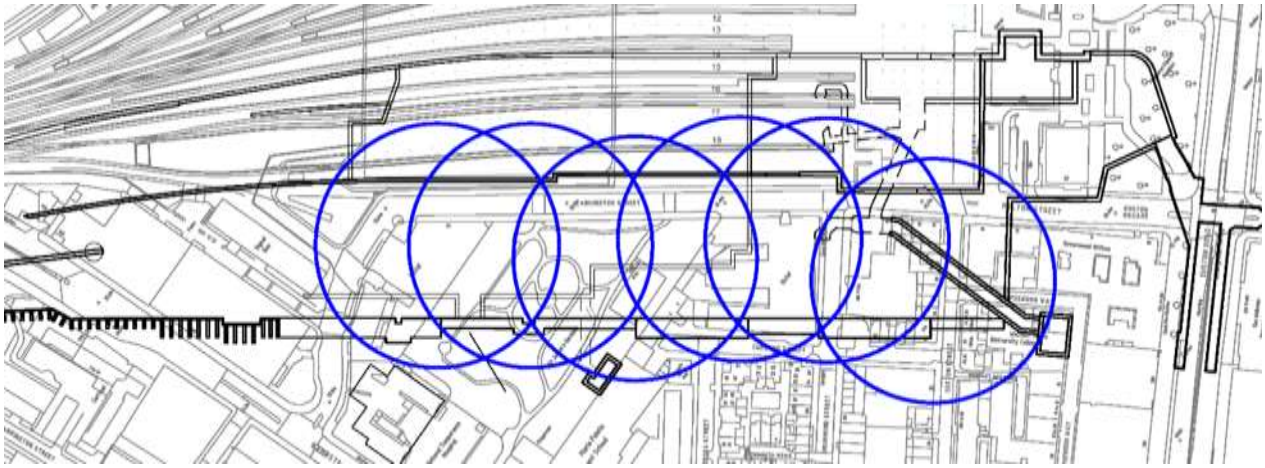
6.2.16 Due to the timing of the installation of the barrettes and the majority of piling the Platform 18 siding will not be available.

6.2.17 Working platforms such as piling mats use a granular material such as crushed demolition arisings. It is envisaged that the project will use materials generated from building demolition within work sites. If further working platform materials or other granular material is required and the siding is in operational use then this material could be brought in by rail. However if this is required at the same time as bulk excavation is occurring the bulk excavation material will take preference. As this process has the greatest reduction in the number of lorry movements removed from the road.

Other Materials

6.2.18 It is not possible for concrete to be delivered to site by rail (see chapter 12), so there is an opportunity for palletised materials to be delivered. As construction progresses access to the siding at platform 13 is increasingly impeded by adjacent structures. However materials which could be batched off site, and palletised could then be lifted from trains by tower crane (see Figure 12). This could well apply to a significant proportion of the miscellaneous materials subject to the availability of an offsite rail side logistics centre and the continued availability of platform 18.

Figure 12: Tower Cranes required for the offloading of materials



The effect of using Platform 18 Siding

6.2.19 It is estimated that the use of platform 18 siding for bulk excavation can remove 29,828 two-way lorry movements (see Table 12 for greater breakdown).

Table 12: Platform 18 predicted volume of excavated material removed by rail

Ref	Options	Tonnage removed by rail	% of area exc. volume	% of total exc. volume	Delay on AP03 schedule	Loaded Lorries off road
8.1.1	Station New Platform 18	507,080 t (253,540 m3)	65	21.6	6 months	29,828

6.2.20 The use of this siding, particularly for removal of excavated material will have a negative impact on the construction programme with a potential unmitigated delay to construction in this area of the order of 6 months.

6.2.21 This takes account of:

- The constraints of sequence of works prior to creating access to the siding including;
  - Utilities diversion;
  - Demolition of a section of the existing Euston Station;
  - Decommissioning of power/OLE;
  - Creation of piling mat on Cobourg Street; and
  - Piling of east wall.

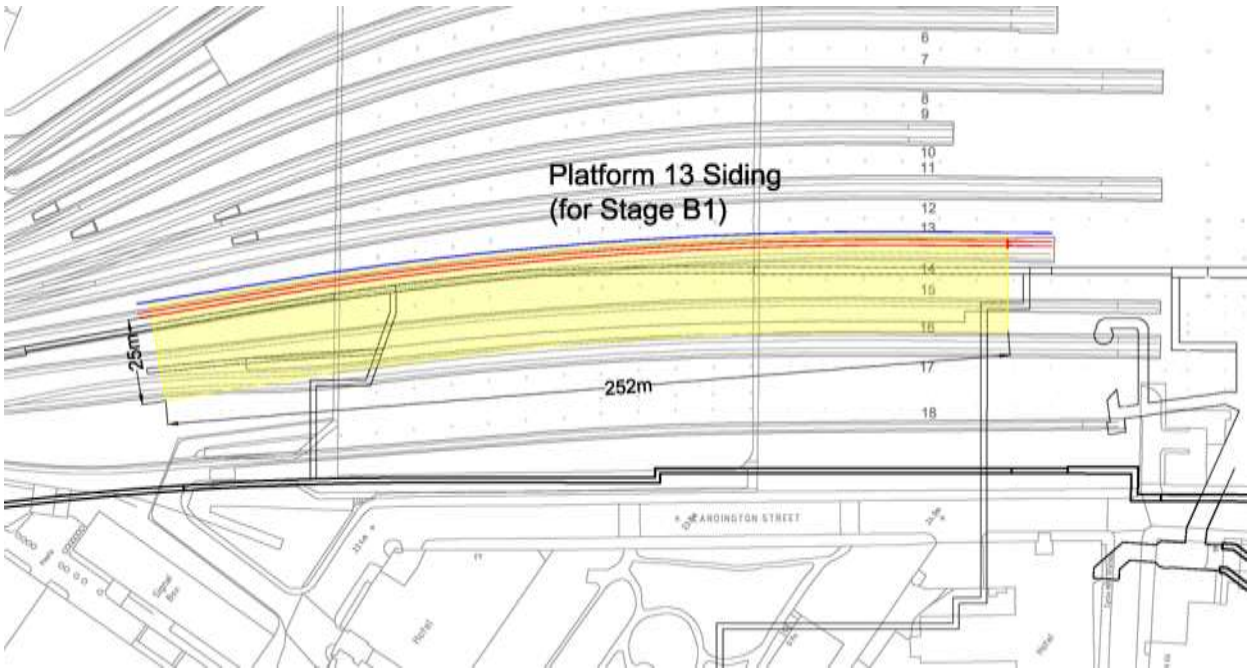
- Re-sequencing of excavation works to retain a loading apron at classic track level (20.5m – excavation down to 15.0,OD); and
- Re-sequencing with changed methodology of excavation of the basement area.

6.2.22 The spoil from the final excavation of the loading apron area may be removed by road.

6.2.23 It may be possible to recover this delay within the construction programme for example 24 hour working for bulk excavation works, however this falls outside the terms of reference of this study.

6.2.24 It is estimated that the extra over cost (not include rail transport cost) for platform 18 siding is £13.5m and a breakdown of this figure can be found in section 8.1.

Figure 13: Platform 13 siding



6.2.25 Platform 13 siding (see Figure 13) is located on the alignment of the classic platform 13. This siding will service the construction of the second stage (B1) of the HS2 station (7 platforms) south of Hampstead Road Bridge. This reduces the number of operational classic platforms from 13 to 12 during the construction period.

6.2.26 The siding has an approximate loading length of 250m which can service a train with 14 "mussel" wagons which equates to some 900t of material (See appendix B for specification of "mussel" wagon). Trains will be static with site plant moving to load the wagons during the day. At night it may be possible to have a moving train and a static loading point. The siding has the facility of stock piling 2 days' worth of excavated material.

6.2.27 The siding will service the construction of the second part of the HS2 station south of Hampstead Road Bridge, construction area 4.

6.2.28 The siding is effectively outside the construction works area and therefore has no direct physical impact on the station construction. It could potentially be available throughout the remaining construction period. The siding will therefore be able to support both materials removal from site by rail and materials supplied to site by rail. However provision for access to the siding for loading and unloading will form a constraint to construction.

6.2.29 The siding will be made available as soon as the west bay of the Euston Station is demolished, and the power, OLE, and rail systems decommissioned. However access from the site will not be available whilst the permanent east side retaining wall is being constructed.

Rail Access

6.2.30 The siding will be accessed from the WCML slow line, which serves the east side of the classic station. Freight trains will arrive by crossing the station throat directly into the platform 13 siding, and depart similarly.

6.2.31 These train movements involve crossing both the slow down line and the fast up and down lines into the station. There will not be paths available either on the slow approach lines or traversing the station during peak operating hours (7-10am and 4:30 – 7:30pm), necessitating train movements outside peak hours.

6.2.32 For excavation works, it is anticipated that between 4 & 6 freight trains will be required on a daily basis. This will mean that train movements will take place throughout the 24 hour period (excluding peak hours) and that as a result extended hours and 24 hour working will be required to match these train movements.

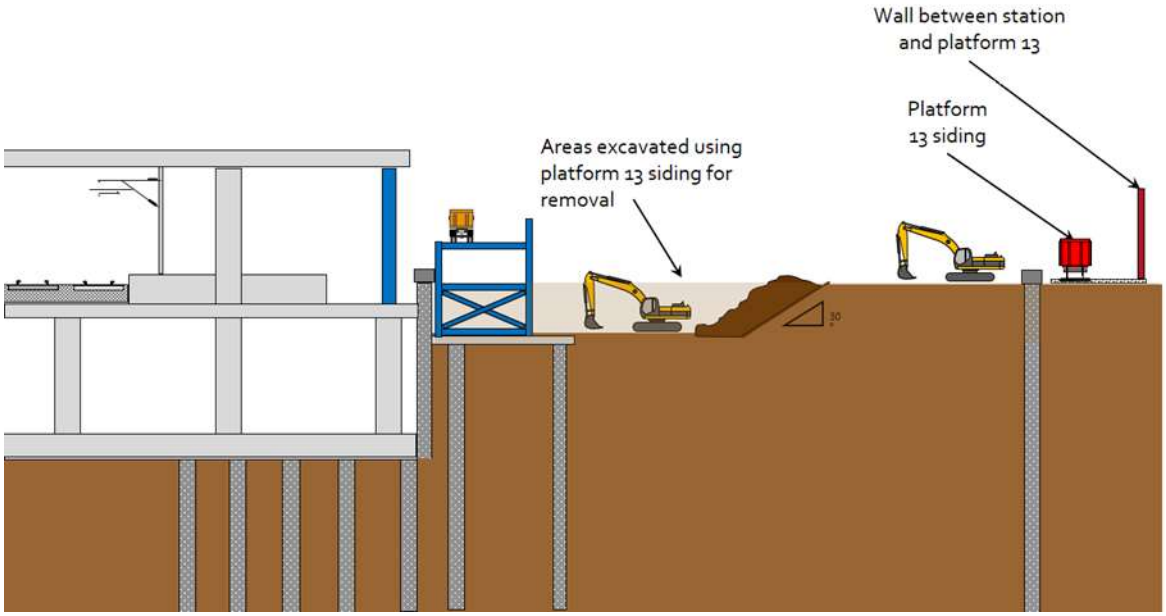
Programme and Siding usage

Bulk excavation

6.2.33 The amount of excavated material that could be removed by rail using Platform 13 with the AP03 programme was insignificant, due to a clash between the siding location and the construction works (See Appendix E). Therefore it was decided that a maximum excavated material programme should be produced. This programme looked at the best possible use for this siding and what effect it would have on safety, programme and cost.

6.2.34 This programme changed the construction from a South to North direction to a West to East direction. It also delayed the start of excavation works until all of the eastern contiguous piling works by platform 13 were completed (see Figure 14).

Figure 14: Cross section through platform 13



6.2.35 The use of the siding, particularly for removal of excavated material will have a negative impact on construction programme with a potential unmitigated delay to construction in this area of the order of 6 months.

Piling arisings

6.2.36 Pile arisings (approximately 10% of excavated volumes) will not be removed by rail as the majority of the piling works for Platform 13 will not have been constructed.

Working Platform materials or other granular materials

6.2.37 Due to the timing of the installation of the majority of piling the Platform 13 siding will not be available.

6.2.38 Working platform such as piling mats use a granular material such as crushed demolition arising. Therefore it is envisaged that the project will use materials store from the demolition of building which the works site. If further working platform materials or other granular material is required and the siding is in operational use then this material could be brought in by rail. However if this is required at the same time as bulk excavation is occurring the bulk excavation material will take preference. As this process has the greatest reduction in the number of lorry, movements removed from the road.

Other Materials

6.2.39 It is not possible for concrete to be delivered to site by rail (see chapter 7), there is an opportunity for palletised materials to be delivered. As construction progresses access to the siding at platform 13 is increasingly impeded by adjacent new structures. However, materials

which could be batched off-site, and palletised could then be lifted from trains by tower crane. This could well apply to a significant proportion of the miscellaneous materials subject to the availability of an off-site rail logistics centre and the continued availability of platform 13.

The effect of using Platform 13 Siding

6.2.40 It is estimated that using platform 13 siding for bulk excavation it can remove 9,092 two way lorry movements (see for greater breakdown).

Table 13: Platform 13 predicted volume of excavated material removed by rail

Ref	Options	Tonnage removed by rail	% of area exc. volume	% of total exc. volume	Delay on AP03 schedule	Loaded Lorries off road
10.1.1	Existing Platform 13	154,560 t (77,280 m3)	33	6.6	6 months	9,092

6.2.41 This takes account of:

- Re-sequencing of construction prior to excavation including creation of piling mats, piled retaining walls, and piled foundations;
- Re-sequencing of excavation works to retain a loading apron at classic track level (20.5mOD – excavation down to 15.0mOD);
- Re-sequencing with changed construction methodology of the deeper excavation of the basement; and
- Interference of excavation methodology with new basement access ramp construction.
- The spoil from the final excavation of the apron area may be removed by road.

6.2.42 It is estimated that the extra over cost (not including rail transport cost) for platform 13 siding is £13.5m and breakdown of this figure can be found in section 8.1 Cost and programme.

7 Post-sift 2 Studies

7.1 Materials Supply and Removal by rail

Materials removal by rail

7.1.1 The material movement by rail studies have initially focused on material removal by rail, this being the largest logistical challenge faced during construction.

7.1.2 Materials removed from site include demolition materials, excavated materials, pile arising's, and general waste, together with items brought to site and subsequently removed (such as plant and false work).

7.1.3 Demolition materials will generally be segregated and crushed on site, to give a material suitable for re-use during construction e.g. working platforms (piling mats). It is anticipated that up to 90% of demolition material will be re-used reducing the number of vehicles required for disposal to landfill or material recovery facilities. Whilst for Stage A, the station area, the quantity of crushed material may well prove sufficient for piling mats. However it is anticipated that additional material for piling mats will be required in area 1a (and subsequently area 4). This may be an opportunity for rail delivery to be considered. Subject to siding availability (existing tracks for area 1a and early access to platform 13 for area 4).

7.1.4 Generally demolition takes place in advance of rail siding availability, therefore the 10% residual material that are not able to be used on site will have to be taken away by road.

7.1.5 Excavated material will be removed by rail wherever possible. It is anticipated that spoil will be handled either directly by excavator or indirectly using large dumper trucks (MOXYs) with trains loaded from a long apron alongside the siding.

7.1.6 There are a number of areas where removal of spoil by rail will not prove possible, these areas include:

- Dive under north – The bulk excavation takes places before BOR2 siding is established;
- Site area 2 (between Granby Terrace Bridge (GTB) and Hampstead Road Bridge (HRB)) – The bulk excavation takes places after BOR2 and Platform 18 sidings are decommissioned;
- Station Stage A area 3 zone 5 – As programmed Zone 5 is only available after HRB is completed, therefore platform 18 siding has been decommissioned; and
- Station Stage A area 3a – As programmed access to the siding is not possible for excavated material due to the construction of the station in Zone 1 which is programmed to occur at the same time.

7.1.7 Parallel studies of the potential acceleration of construction programme for Site Area 2 and Station Stage A area 3 zone 5 indicate that there may be opportunities to include excavation of these zones within the material by rail category – these are separately identified as opportunities for future consideration.

7.1.8 Pile arisings have not been included in the spoil quantities for rail removal. Generally piling will take place before sidings are available for freight trains. Also the rate of production of pile arisings is relatively slow and the volumes small making them incompatible with removal by rail.

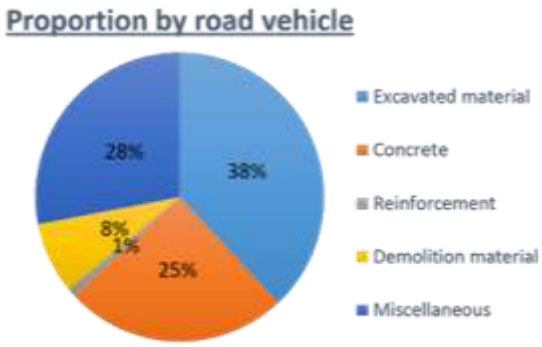
7.1.9 General waste will probably be segregated by type on site for containerised removal. Again quantities of waste generated for landfill is small in relation to train capacity making its removal by train inefficient.

Imported Materials

7.1.10 The materials schedule in Figure 15 categorises material supply into rebar, concrete and miscellaneous (other categories are for materials removal). These categories reflect the categories used for transport assessments in the Environmental Statement.

Figure 15: Materials Schedule

Material by vehicle	%
Excavated material	38
Miscellaneous (including general waste)	28
Concrete	25
Demolition material	8
Reinforcement	1
System wide fit out	By rail*



Concrete

7.1.11 For material supply the majority of vehicle movements relate to concrete deliveries.

7.1.12 For the purposes of transport analysis, (and the prediction of lorry movements), it has been assumed that all concrete structures will be cast insitu. (This is obviously an over simplification as there will be many opportunities for supply of precast concrete elements – however at the current stage of design development – interim preliminary design – it is not appropriate to designate precast versus insitu).

7.1.13 Two alternative methods for concrete supply by rail were investigated:

- Wet concrete by rail; and

- Dry materials to be mixed on site by rail (on site batching plant or on train mixed).

Wet concrete by Rail

7.1.14 This option was rejected as impractical. Currently concrete pours on site will be in the region of up to 1000m³ requiring three train loads of concrete. A typical concrete batching plant can produce 100m³/hr of wet concrete, therefore taking three hours to load a train of 300m³. The time taken for train movements from offsite batching plant to site would be in excess of one hour. The train would take around 3 hours to discharge its concrete load. Therefore, the concrete would have to be kept "live" for a minimum 4.5hours. BS 8500-2 requires "concrete to be delivered within 2 h after the time of loading where transported in truck mixers or agitators, or within 1 h after the time of loading where non-agitating equipment is used, unless a shorter time is specified or a longer time permitted by the specifier". Therefore delivering wet concrete by train would be outside these time limits.

Dry material by rail to be batched on site

7.1.15 Whilst clearly dry materials to batch as concrete can be supplied to site by rail, there are significant issues relating to the scale of site batching plant required at Euston.

7.1.16 The on train batching system (see Figure 16) (as supplied to Crossrail) provides for a train typically 500m long carrying up to 270m³ of concrete which can be batched at a rate of up to 70m³ per hour. This train based system is generally used for line side works and works in tunnels including tunnel linings, slab track, and line side structures and foundations. It has insufficient capacity to support the programmed 1000m3 concrete pours construction at Euston, particularly given the constraint on siding and train length (approx. 300m).

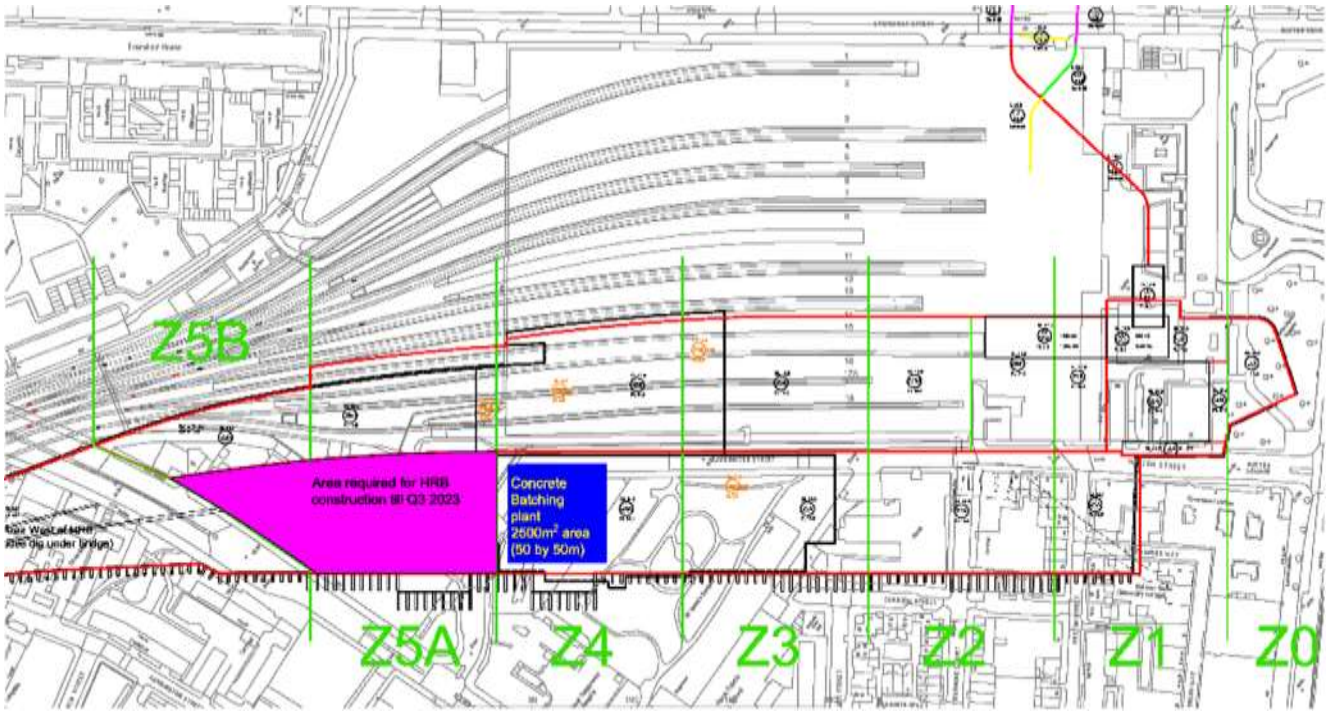
7.1.17 The temporary site batching plant served by rail has similar limitations. Layouts of batching plants (see Figure 17) indicate a long thin site arrangement to match the length of supply train. This would cover a significant area of site. Due to the tight nature of the site being bounded by an operational station and live road the possible location of a batch site are limited to within footprint of the new HS2 station construction site. This would have a negative impact to the construction programme.

7.1.18 For a site contained between road and railway such as Euston there is no off construction site location available alongside one of the siding options.

7.1.19 This option has therefore been parked as there is insufficient space available.

Figure 16: Example of Dry mix concrete trains

Figure 17: Location a size of concrete batching plant shown in blue



7.1.20 Euston is fortunate in that two rail served batching plants are close by (2.5 miles) at Kings Cross each having capacity of the order of 120m³-160m³ per hour. These are reinforced by other rail served plants in the vicinity (Paddington, Westbourne Park etc).

Miscellaneous Materials

7.1.21 There is an opportunity for palletised materials to be delivered to site by rail to the Euston Project. Lorries would have to deliver materials to an off-site logistic centre where palletised material, or materials that can be lifted directly, will be loaded onto a train. These materials will form a 'mixed load' and are transported to the site by rail. Once there, they will lifted off

by tower cranes or telehandlers and transferred to the areas required. This arrangement would require the continued availability of platform 18.

7.1.22 Whilst it is not possible to precisely quantify this opportunity for material supply to site it has been estimated as follows:

- Materials to site can only be transported by rail for Platform 18 and 13 sidings. (BOR2 not available);
- Deliveries by rail can only be received when sidings are no longer in use for excavated material;
- For materials supplied and then subsequently removed from site such as scaffolding and form work, it must be assumed they are to be removed by road by their supplier; and
- Plant and equipment will be delivered by road.

7.1.23 It is therefore estimated that of the miscellaneous lorry movements taking place after excavation is completed in the Stage A station area from 2022 there is a potential opportunity for up to 30% of the lorry supply movements to be replaced by rail movements using Platform 18 sidings. This could reduce the number of lorry trips by just under 2000 two-way movement per year or about 11000 two-way movements in total. Similar for stage B1 and Platform 13 lorry movements could be reduced by 2000 two-way movements per a year or about 5000 two-way movements in total.

7.1.24 It should be noted that an offsite logistic centre with rail head would be required. Therefore there may be additional costs associated with these proposals as this is not normal industry procedure.

7.2 Traffic and Environmental Benefits

Introduction and context

7.2.1 The impacts of transporting excavated material by rail, thereby removing HS2 construction traffic from the road network, has been assessed for the following options:

- Backing Out Road 2 (Stage A);
- Sidings at Platform 18 (Stage A); and
- Sidings at Platform 13 (Stage B1).

Traffic impacts

7.2.2 The number of vehicles by type of material transported assumed in AP3 is set out in Table 14.

Table 14: Lorries by activity

Activity	Quantity of material	No. of Lorries (one way)	Percentage
Demolition	306,380 t	30,638	8%
Excavation	1,174,601 m3	138,188	38%
Concrete	565,058 m3	94,176	25%
Reinforcements	84,769 t	2,825	1%
Miscellaneous	Various	101,984	28%
Total	As above	367,811	100%

7.2.3 For each of the options, the number of vehicles removed from the highway network is set out in Table 15. For the Platform 18 and Platform 13 options, construction vehicles will enter or leave the highway network via the National Temperance Hospital compound. Therefore construction vehicles will be reduced on A400 Hampstead Road, A501 Euston Road, A41 and then via the M1 to Tyttenhanger in Herefordshire.[8] For the Backing Out Road 2 option, construction vehicles will enter or leave the highway network via the Carriage Shed sidings with construction vehicles reduced on Stanhope Street, Robert Street, Varndell Street and then the A400 Hampstead Road, A501 Euston Road, A41 and the M1 as for the other options. When these options are combined with transporting a proportion of the miscellaneous material to site, there is a further reduction in HS2 construction vehicles as set out in Table 15.

[8] Tyttenhanger was assumed to be the destination for excavate material for the purposes of AP03

Table 15: Lorries removed by option

	Material Exported				Material Imported	Total
	Material exported m³ (T)		% of Total material exported*	One way Lorry trips removed (% total)	One-Way Lorry Trips removed (% total)	In+out Vehicle trips removed (% total)
BOR2	56,510 m³	113,020 t	4.8	6,648 (1.8%)	Not possible	1.8%
Platform 18	253,540 m³	507,080 t	21.6	29,828 (8.1%)	11,000 (3.0%)	11.1%
Platform 13	77,280 m³	154,560 t	6.6	9,091 (2.5%)	5,000 (1.3%)	3.8%
Total	**387,330 m³**	**774,660 t**	**33**	**45,568 (12.4%)**	**16,000 (4.3%)**	**16.7%**

7.2.4 The reductions for each option across the AP3 programme, are shown graphically in Figure 18 to Figure 21.

Figure 18: Lorries removed from highway network – Backing Out Road 2 & 6m3 concrete trucks & Miscellaneous in

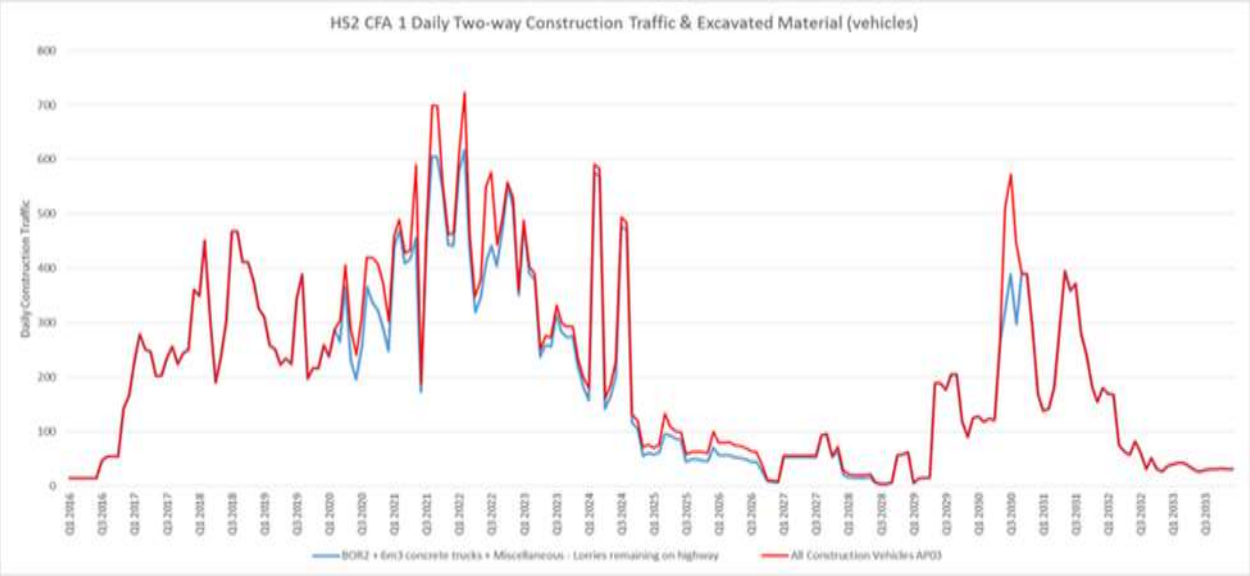


Figure 19: Lorries removed from highway network – Platform 18 & 6m3 concrete trucks & Miscellaneous in

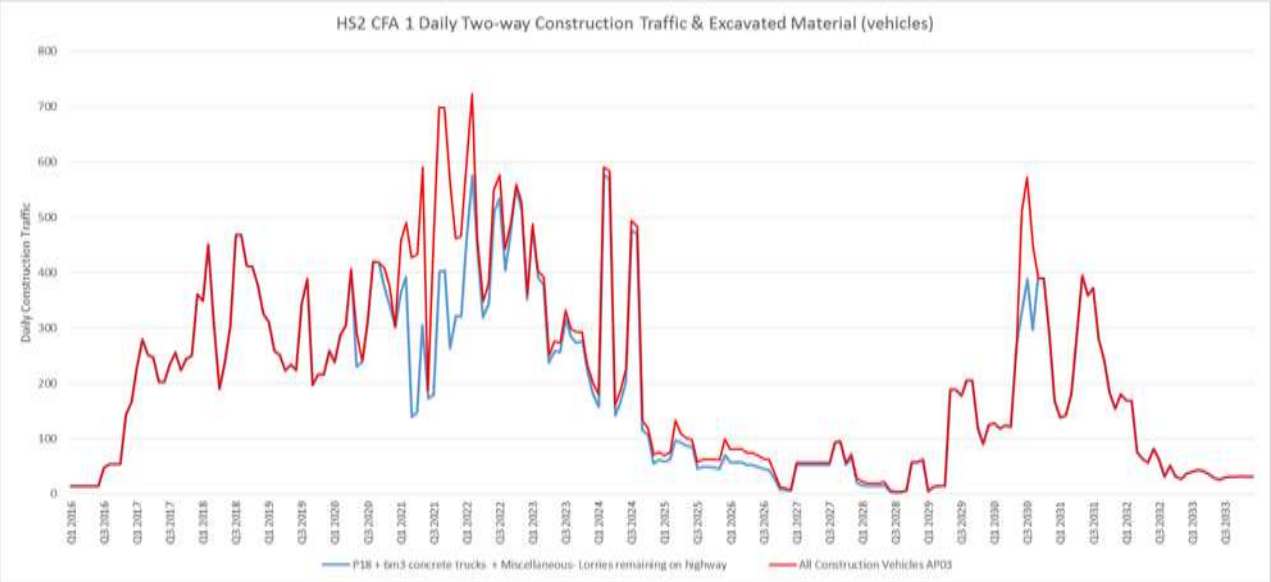


Figure 20: Lorries removed from highway network – Platform 13 & 6m3 concrete trucks & Miscellaneous in

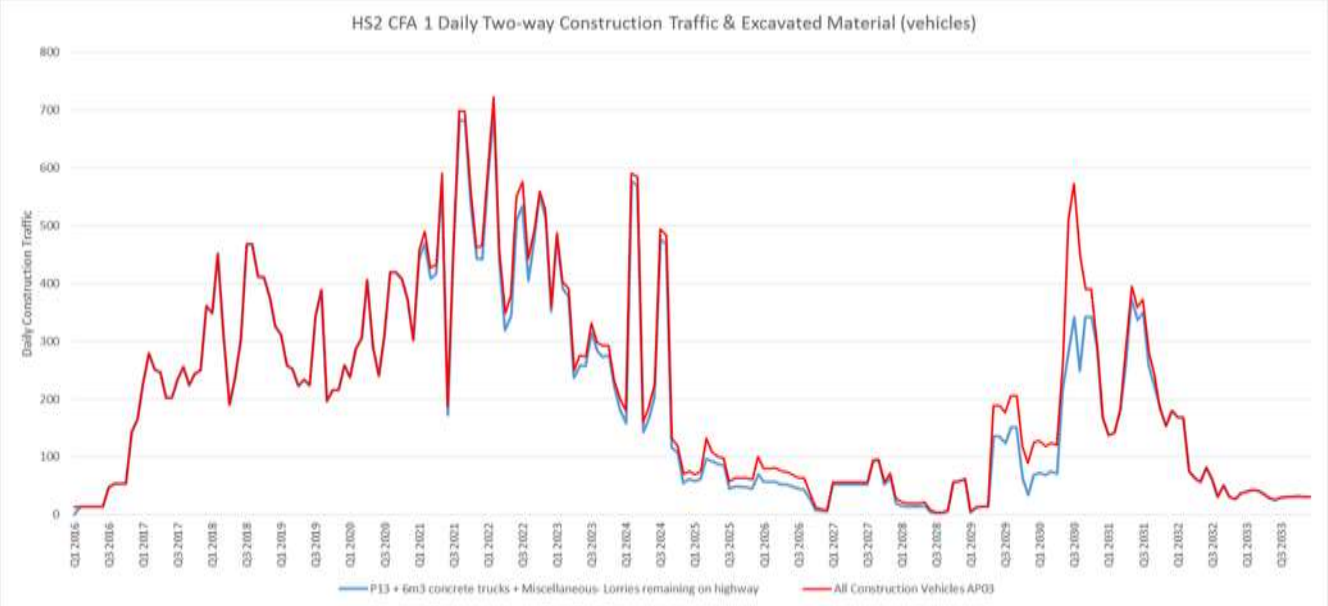
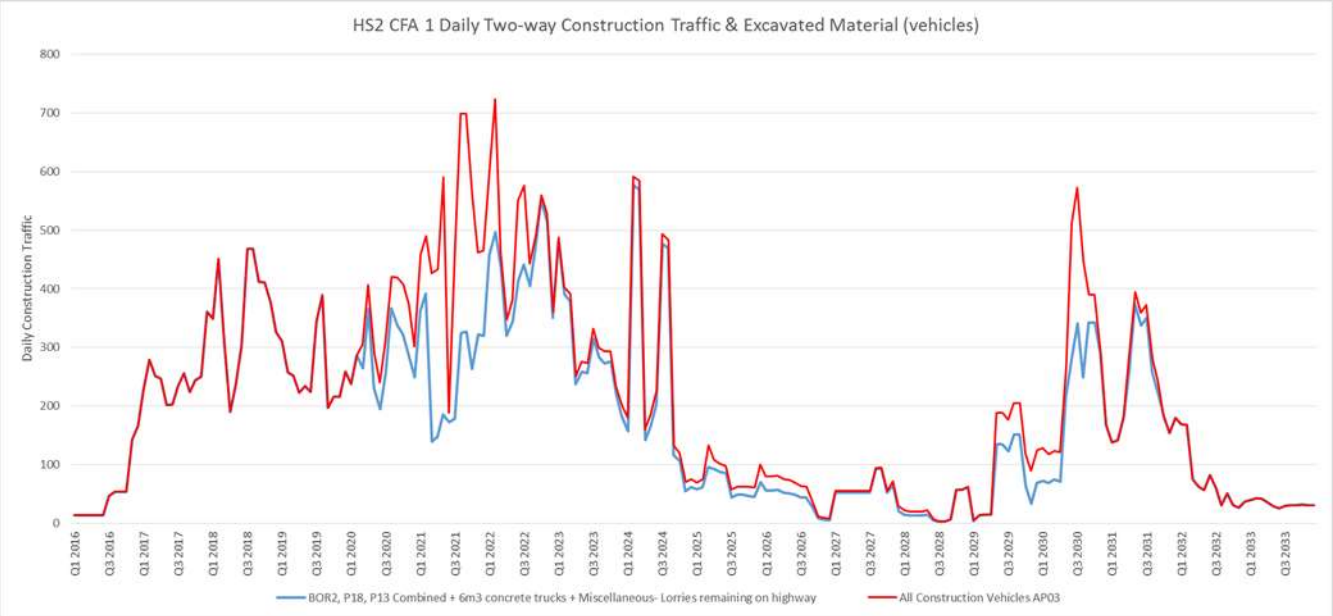


Figure 21: Lorries removed from highway network – Backing Out Road2, Platform 18 & Platform 13 & 6m3 concrete trucks & Miscellaneous in



Social and environmental benefits

7.2.5 Removing trucks from the highway network has benefits to both society in general along with benefits to the environment. There are existing methods of quantifying these benefits in monetary terms, based largely on the DfTs WebTAG guidance. Following discussions at the sifting workshops, the application of the DfT's Mode Shift Benefit (MSB) values[9] was investigated which quantifies the net social benefit of transferring freight from road to rail or water and identifies how each component of this benefit contributes to the overall benefit. MSBs are used by the Department for Transport, the Scottish Government and the Welsh Government as a way of allocating freight mode shift grants and represent these bodies valuation of the benefits of removing one lorry mile of freight from road and transferring it to rail or water.

7.2.6 The costs imposed by freight operators on other groups in society are referred to as 'marginal external costs' and comprise:

- Congestion costs;
- Accident costs;

[9] Mode Shift Benefit Values: Technical Report, Department for Transport 2009 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/51151/msb-technical-report.pdf and Mode Shift Benefit Values: Refresh, Department for Transport 2014 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/389725/mode-shift-benefit-values-refresh.pdf

- Noise costs;
- Climate change costs;
- Air pollution costs;
- Infrastructure costs;
- Other costs;
- Net costs of increasing freight on rail; and
- Marginal tax on road freight.

7.2.7 The MSB values net off the environmental cost for rail haulage, (noise, air pollution and climate impacts), together with lost revenue to the Exchequer in terms of Vehicle Excise Duty and Fuel Duty (the loss of this revenue which could otherwise be spent on public goods and services is in effect an external cost). This taxation adjustment is included to avoid double counting in grant applications since it also appears in the financial costs for haulage operations. Whilst, for the purposes of assessing the gross social costs of road haulage it could be appropriate to remove taxation, we have included it in our estimates to represent a conservative benefit.

7.2.8 Table 1 in the 2014 refresh updates the vales on a 'national' UK basis. However, in order to reflect the impact of construction traffic in central and inner London, there was a need to revert back to the more detailed 2009 Technical report, for example to quantify 'London and Conurbation'[10] congestion benefits, based on high congestion levels. However, as the 2014 refresh benefits are in 2020 values at 2015 prices and the 2009 report gives benefits in 2015 values at 2010 prices, there was a need to adjust the 2009 figures. Following discussions with DfT, TfL and LBC, it was agreed that the price base should be adjusted to 2015 prices using a GDP deflator[11]; this gives a factor of 8.9% to update to a 2015 price base. It was also agreed that congestion values should be adjusted on a consistent basis by factoring the 2015 values (from the 2009 report) to a common future year. It was agreed this future year should be the mid-point of construction impact measured by numbers of lorries during construction of Stage A and B1 of Euston station; this mid-point year is 2024.

7.2.9 To uprate congestion figures from 2015 to 2024, TfL and LBC referenced two studies:

- Atkins 2008[12] concludes that between 2015 and 2025, the cost of congestion for

[10] TfL has argued that these values should be adjusted to better reflect London values. However, it is the DfT and HS2 Ltd's view that these numbers already reflect London values and are therefore appropriate. Indeed the use of the London High values for the entire route is already an upside estimate.
[11] See GDP Deflator series in 'Annual Parameters' section in https://www.gov.uk/government/publications/webtag-tag-data-book-december-2015

[12] http://www.ied.co.uk/images/uploads/Economic_costs_of_congestion_-_final_for_issue_tcm9-35329.pdf

London will increase by 41%.

- INRIX and the Centre for Economics and Business Research 2014[13] estimated that the cost of congestion in London would increase by 71% between 2013 and 2030.

7.2.10 The 2014 study implies an increase in the cost of congestion in London of 3.2% per annum. Between 2015 and 2024 this provides an update factor for the cost of congestion 33%. To uprate other external values from 2020 to 2024 a factor of 7% was applied, in line with expected increase in GDP per person (source from the DfT webTAG databook[14]).

7.2.11 TfL has noted that DEFRA published guidance related to pollution[15] in September 2015. This gives damage costs by pollutant, location and source in 2015 prices. TfL has argued that the high valuation of £190,000 per tonne of NOx should be used. This relates to the high central range and is for inner London (a large proportion of the excavated material route is for outer London) and therefore reflects a high value. Based on an approximate split of 50% of the route in inner London and 50% in Outer London gives a central value of 28 pence per lorry mile removed and a high value of 45 pence. Nevertheless, for the purposes of this assessment, we have adopted TfL's proposed cost saving of 55 pence per lorry mile removed.

7.2.12 The final values per lorry mile adopted, adopting the uplifts to 2024 for congestion (33%), other external benefits (7%) and the DEFRA pollution guidance, are set out in Table 16.

Table 16: 2024 MSB Values London & Conurbations (Pence per Lorry Mile removed, 2015 prices)[16]

	Motorways	**A Roads**	**Other**
Congestion	£6.18 (£2.48)[17]	£19.90 (£8.27)	£22.96 (£8.01)
Accidents	£0.01	£0.06	£0.06
Noise	£0.193	£0.199	£0.196
Pollution	£0.589	£0.589	£0.589
Greenhouse Gases	£0.07	£0.000	£0.161
Infrastructure	£0.080	£0.299	£1.830
Other (roads)	£0.060	£0.060	£0.060
Taxation	-£0.335	-£0.394	-£0.492
Rail	-£0.085	-£0.085	-£0.085

[13] http://inrix.com/press/traffic-congestion-to-cost-the-uk-economy-more-than- 300-billion-over-the-next-16-years/
[14] https://www.gov.uk/government/publications/webtag-tag-data-book-december-2015

[15] https://www.gov.uk/guidance/air-quality-economic-analysis

[16] All values taken from Table 1 in 2014 refresh except: Congestion from Table 4 in 2009 report updated by 8.9% (GDP deflator) and Pollution which uses TfL value of 55 pence
[17] Figures in parentheses refer to Congestion band 4 (assumed to be medium congestion)

7.2.13 The approach and results have been reviewed by economists at the DfT. They acknowledge that there are a range of uncertainties (up and down) around the benefit estimates and suggest the largest single uncertainty is around the appropriate level of congestion to assume in calculating the benefits (level 5 labelled "high" or level 4 labelled "medium"). While the high level of congestion figures are for the very busiest places and times (e.g. morning peak), these values have been applied over the entire 25 mile route including beyond the M25 and over the entire range of time that excavated material will be removed. Therefore DfT analysts consider the high values to be at the high end of the possible range and recommend a range of estimates should to be considered. This was raised by DfT at a workshop (7 June '16) and further communicated at the Material by Rail Strategic Meeting (16 June '16).

7.2.14 The most recent DfT estimates of external costs of congestion (webTAG databook, December 2015) are significantly lower than those being used in this analysis; using the highest possible cost of congestion from the 2015 databook for London, would significantly reduce the environmental benefits, supporting the use of a range of benefits.

7.2.15 Based on previous work undertaken around Euston, using outputs from a detailed highway assignment model, the DfT concluded that the London "high" estimates were reasonably robust, as they were broadly similar to the findings using the detailed modelling and were also slightly lower, reflecting the inclusion of rail and taxation dis-benefits.

Application of MSB values to derive social and environmental benefits

7.2.16 The pence per lorry mile removed from the highway network were based on the values from Table 1 in the 2014 refresh for all components with the exception of air pollution (using the TfL values) and congestion, which was taken from Table 4 in the 2009 report for 'London and Conurbations', suitably updated to a common 2015 price base. The values were then updated to 2024 values as reported in Table 16 using a factor of 7% for all values except congestion, in line with expected increase in GDP per person; congestion values were increased by 33% based on INRIX and the Centre for Economics and Business Research 2014.

7.2.17 For congestion, levels 5 was taken to represent a realistic representation of congestion in the Euston area. However, over the full course of the 25 mile route and over the course of the day this may produce an overestimate so a range between congestion level 4 "medium" and 5 "high" is referred to.

7.2.18 For the excavated material route to Tyttenhanger in Hertfordshire, roads were classified into motorways, 'A' roads and 'Other' roads. For the approximate distance of 25 miles, 13 miles were assumed to be on motorway (M1), 11.5 miles on 'A' roads and 0.5 miles on 'Other' roads (in the Camden area). An allowance of an additional 2 miles (on 'A' roads) was also added to reflect the fact that inbound lorries would travel to the Lorry Holding Area in the ZSL car park. It should be noted that the assessment is predicated on Tyttenhanger as the destination for excavated material vehicles; as the assumed route travel comprises approximately 50% Motorway (with correspondingly lower congestion values than 'A' roads), other destinations may accrue higher benefits.

7.2.19 AP3 assumed a spread of batching plants for concrete, with 60% of concrete trucks to/from Kings Cross, 15% from the west (Acton, Maida Vale), 15% from the south (Battersea), 5% from further south (Wandsworth) and 5% from the east (Silvertown). The one-way distances travelled are approximately 2.5 miles for Kings Cross, 7 miles for Acton, 6 miles for Battersea, 8 miles for Wandsworth and 9.5 miles for Silvertown. For the purposes of this assessment, concrete lorries were assumed to travel 80% of their travel distance on 'A' roads and 20% on other roads.

7.2.20 Miscellaneous 'materials in' were assumed, for the purpose of this evaluation, to travel an average of 25 miles (one way) with 80% of their travel distance on 'A' roads and 20% on other roads.

7.2.21 Table 17 indicates that the net social benefit ranges depending on individual option. For the combined option, and assuming congestion band 5 for high level congestion, the net social benefit would be in the order of £50m. It should be noted that these benefits are for the entire programme and are not discounted to net present values. Congestion level 5 was taken to represent a realistic representation of medium and high congestion in the Euston area.

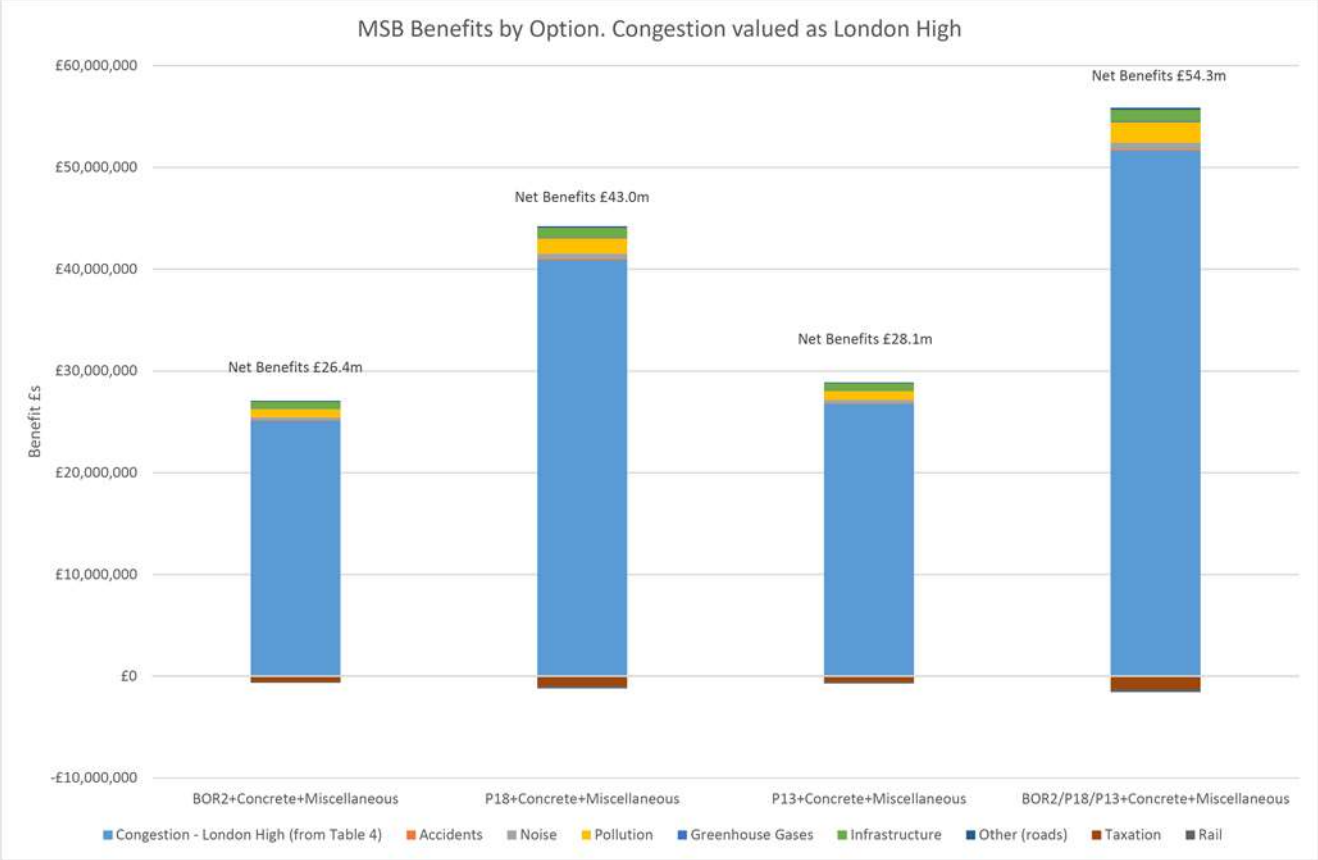
Table 17: Economical benefits for the reduction of lorries caused by using materials by rail

Option	No. of lorry movements removed (one-way)	Two-way lorry miles removed [1]	Benefits £m London (medium – congestion band 4)	Benefits £m London (high – congestion band 5)	Percentage of total lorry movements removed
Material exported:					
Backing Out Road 2	6,648	345,696	£2.091	£4.764	1.8%
Platform 18 siding	29,828	1,551,056	£9.383	£21.377	8.1%
Platform 13 siding	9,092	472,784	£2.860	£6.516	2.5%
TOTAL	45,568	2,369,536	£14.334	£32.657	12.4%
Materials Imported					
Potential use of rail for miscellaneous materials	16,000	800,00	£7.409	£17.244	4.4%
Total including potential use of rail for miscellaneous materials	61,568	3,169,536	£21.743	£49.901	16.7%

1 Assumes an average 25 mile distance travelled

7.2.22 These benefits, across the AP3 programme and assuming congestion band 5 relating to a high level of congestion, are shown graphically in Figure 22.

Figure 22: Mode Shift Benefits (MSB) and dis-benefits by option (London High Congestion)



8 Summary of Options – costs/benefits/programme impact

8.1 Cost and Programme

Construction Cost:

8.1.1 For each of the three preferred options high level construction costs have been estimated on the basis of the outline descriptions below:

8.1.2 Backing Out Road 2 – Construction works £9m

- Construction
  - Excavation of siding area to and from level platform;
  - Construct temporary concrete slab to support siding;
  - Construct new ground level slab adjacent to siding to act as apron (50% deeper); and
  - Construct new siding to connect into line E switch.
- On completion
  - Remove new siding; and
  - 1 stage B1 Station East Side Siding.

8.1.3 Station Stage A Platform 18 – Construction works £6m

- Construction
  - Remove and recover OLE (and systems);
  - Construct new protection wall between line 18 and new platform 17 (active);
  - Demolish roof above and restructure to suit new temporary wall location; and
  - Demolish edge of parcel deck and sub structure to suit new temporary wall location.
- On completion
  - Reinstate platform and canopy; and
  - (Stage B1 Station siding new platform 13 similar).

8.1.4 Station Stage B1 Platform 13 – Construction works £6m

- Construction
  - Remove and recover OLE (and systems);

- Construct new protection wall between line 13 and new platform 12 (active);
- Demolish roof above and restructure to suit new temporary wall location; and
- Demolish edge of parcel deck and sub structure to suit new temporary wall location.

- On completion
  - Reinstate platform and canopy.

8.1.5 The cost of these options are summarised in Table 18 below.

Table 18: Summary of Cost

		BOR2	**Platform 18**	**Platform 13**
Construction Costs		£9m	£6m	£6m
Productivity & Programme Impacts		£3m	£2m	£2m
Design & Management		£2m	£1.5m	£1.5m
Risk & Contingency		£6m	£4m	£4m
	Total	£20m	£13.5m	£13.5m

Estimate Base Date 3Q2012

Excludes rail transport (rail path, loco, operational disruption & TOC charges) costs.

9 Moving excavated material by rail: Impact on the existing rail network.

9.1.1 The work to examine the feasibility of moving materials into and out of Euston has included industry experts from DfT,HS2,TfL, LBC, Arup and Network Rail, referred to as the 'working group'. The assumptions made have not been fully validated by the normal industry process, but represent 'best professional judgement' on how the amount of material moved by rail can be maximised whilst minimising the effect on the existing network.

9.1.2 To accommodate the changes arising from HS2, from 2018 the number of approach tracks to Euston reduces from 6 to 4, and the layout in the Euston area changes. This is a significant change, and is being modelled in detail by Network Rail to reach conclusions by October. This will identify the performance impact on the present network and train service. In theory at least it is only then that the further impact of freight trains could be assessed. Whilst this will produce an answer in a form recognised by the process it is vital in the context of the bill to reach a swifter conclusion.

9.1.3 The operation of freight trains has a range of possible impacts on the existing services, which range from an impact on performance, lengthening of journey times, or reduction in passenger train services. This impact could be significant but until some modelling has been undertaken, there is no basis upon which this could be quantified at this stage, other than using professional judgement.

9.1.4 DfT have commissioned work from Tracsis using Railsys[18], to inform the West Midlands franchise process. Whilst not as far reaching as NR's process, the working group accepts that using this model, and overlaying an assumed spoil train plan provides at least an order of magnitude of the incremental effects that freight trains will have on an already constrained layout, and what mitigations may need to be implemented to keep the existing train service reliability at a tolerable level. The model can only be regarded as indicative at this stage, given that this work will use a model that NR is not party to, with paths that have not been 'proved' .The working group understands this whilst recognising the limitations.

9.1.5 The working group has identified that the operation of spoil by rail could have an impact on programme. The working group recognises that in order to maximise rail movement and minimise impact on programme, trains will need to be operated into and out of the loading points at night, and possibly at the weekend. This is not reflected in the present environmental commitments, and therefore to achieve this will require consultation and as necessary appropriate planning consents from LBC.

[18] Railsys© is a widely used industry rail performance model

9.1.6 The work to date has only considered the movement of material from Euston to a point at Willesden. In reality the scale of tunnelling works for HS2 means that the network in the London area will be heavily constrained in any event, but these wider impacts have not been considered.

9.1.7 The working group feels that the impact on the present rail network will have to be mitigated by a series of detailed operating measures; for example ensuring that the freight trains observe their operating plan rigidly, have sufficiently powerful traction to avoid an unduly slow exit from Euston.

9.1.8 The working group has made considerable progress in developing a solution, but further analysis is required. DfT and HS2 will, as detailed above, work with the Tracsis model which allow for a more quantified estimate of the performance impact on the present network, including the impact of additional freight paths.

10 Risk and opportunities

10.1 A400 Hampstead Road Bridge (HRB) Reduction in Level Study

10.1.1 The HRB lowering study produced an option (Option 1) which both lowers the road levels of the bridge and reduces the construction programme. This reduction of programme means that the excavation areas between HRB and Granby Terrace Bridge (Area 2) and the station area close to HRB (Zone 5) can occur earlier. This early excavation could mean that approximately 29,000 two-way lorry movements (250,000t) of excavated material could be removed by rail instead of road. These are preliminary estimates and further works would be required to confirm these figures or the possibility of increasing them.

Table 19: Predicted volume of excavated material removed by rail if HRB options scheme is used

Ref	Options	Area of extra excavation	Tonnage removed by rail	% of area exc. volume	% of total exc. volume	Loaded Lorries off road
8.1.1	Station New Platform 18 with HRB constructed offline	Zone 5 Area 2	250,000 t (~125000 m3)	~32	~12.5	~14,500

10.2 Provision of platforms

10.2.1 Options relating to the use of platforms 13 and 18 assume that Network Rail will provide the use of those platforms. To date, no commitments have been made by Network Rail to this effect.

10.3 Programme delay

10.3.1 Measures to mitigate the programme delay, such as extended working hours, may not be feasible or approved.

11 Material by rail traffic benefits assuming 8m3 concrete trucks rather than 6m3.

11.1 Introduction

11.1.1 Whilst the study has focused on reducing HGVs by moving material by rail, the report has also identified the potential to reduce the number of HGVs by using 8m3 concrete lorries rather than 6m3 lorries. The use of 8m3 capacity vehicles has been confirmed as appropriate by the industry (most concrete delivery fleets within the M25 have 8m3 concrete delivery fleets; indeed, 12m3 articulated concrete trucks may be available depending on any site and access constraints. However, it was decided to present both 6m3 and 8m3 analyses as 6m3 is the assumption made for AP3 assessment purposes and there are other issues to be considered (with TfL and LBC) before HS2 are able to commit to 8m3 concrete lorries.

11.1.2 If HS2 Ltd were to employ 8m3 rather than 6m3 concrete trucks, there would be a reduction in the number of vehicle movements of 25%. Even though these trucks travel a much shorter distance than excavated material trucks, the route is entirely through central and inner London. AP3 assumed a spread of batching plants for concrete, with 60% of concrete trucks to/from Kings Cross, 15% from the west (Acton, Maida Vale), 15% from the south (Battersea), 5% from further south (Wandsworth) and 5% from the east (Silvertown). The one-way distances travelled are approximately 2.5 miles for Kings Cross, 7 miles for Acton, 6 miles for Battersea, 8 miles for Wandsworth and 9.5 miles for Silvertown. For the purposes of this assessment, concrete lorries were assumed to travel 80% of their travel distance on 'A' roads and 20% on other roads.

11.1.3 HS2 will continue to progress this analysis and considers that the outcome, and any appropriate commitments, can be progressed independently of the material by rail decision. HS2 will continue to engage with TfL and LBC on this issue and will provide a final position in advance of the House of Lords petition hearing.

11.2 Traffic and Environmental Benefits

11.2.1 In addition, to assessing the impacts of moving material by rail using AP3 assumptions, the impact of using larger concrete trucks capable of transporting 8m3 of concrete (6m3 trucks were assumed in AP3) has also been assessed.

Table 20: Lorries removed by option

Option	No. of Lorry Movements Removed (one-way)	Two-Way Lorry Miles Removed	Benefits £m London (high)	Percentage of Total Lorry Movements Removed
8 cubic metre concrete trucks	23,544	203,656	£4.390m	6.0%

12 Feedback

12.1 Public engagement event

12.1.1 HS2 held 2 engagement events on 11 and 13 May to gauge public feeling on HS2's proposals to move materials by rail to and from the Euston construction site. The events were 4 hours long and were held in the HS2 Euston office in the former National Temperance Hospital at 110 Hampstead Road. Attendees spoke to HS2 engineers and sustainability experts to ask questions about the event exhibits and were encouraged to leave comments on cards.

12.1.2 The comments received on cards and verbally are summarised below.

1. Proposals to move materials by rail rather than by road were welcomed universally.
2. The events did not provide figures on volumes of material to be moved or on numbers of lorries to be replaced by trains. There was much criticism about this.
3. None of the attendees expressed concern about proposals to run trains during the night to enable more material to be moved by rail, though one person did ask about railhead noises.
4. There was disappointment that only diesel locomotives can be used to haul spoil trains. This is because site loading facilities would not be practical to operate with the overhead electrification system necessary for electric locomotives
5. There were questions on how, if the decision was made to progress with using rail to move materials, this requirement would be enforced.
6. There were many questions on lorry routes regarding lorry numbers, what lorries would be carrying and when they would run.
7. The absence in proposals of a concrete batching plant on site to remove ready mix concrete lorries from the roads was queried. It was explained that this option was examined but found to be not feasible because of the space required for such a plant and the lack of free area on the site.
8. There was positive feedback about being able to talk to engineers about HS2.
9. One attendee asked when the Silverdale block will be demolished (June to September 2018).
10. A number of attendees asked when they would be able to see the background work that has been completed in examining the viability of moving materials by rail. Some went further to say that the further information might influence how

they petition in the House of Lords. There will be a report available at the end of June 2017.

11. There were questions on when a decision would be made on whether to progress moving material by rail. A decision will be made in a few months' time.

12.2 TfL and London Borough Of Camden

Draft TfL and LB Camden input to Section 12.2 of the

HS2 draft Material By Rail - ESSRB report

1. Introduction

1.1. The workshops demonstrated very clearly that taking positive measures to create rail facilities on site will remove at least 100,000 HGV movements from the local roads. However this still only represents 20% of all material HGV movements that the project will generate, and even this proportion is not yet committed. There is clearly a lot of work still to do to increase this towards an acceptable value.

2. TfL and LB Camden's expectations for The Plan

2.1. The undertakings to Camden and TfL stated explicitly that '*This plan….will include consideration of ambitious options that would require, amongst other things, separate planning permissions that might be granted by the London Borough of Camden or the Greater London Authority.*' This will need to be part of a continuing joint workstream that builds on the plans developed to date to maximise the opportunities to move as much material by rail as is reasonable.

2.2. TfL and LB Camden therefore suggest that ESSRB agrees that the Plan should incorporate the following elements:

A. Commitment to establish materials loading sidings at Backing Out Road 2, Platform 18 (both for Phase A) and Platform 13 (Phase B1), and an associated logistics plan that commits to the removal of at least 61,000 HGV two way trips by transferring outwards excavated materials to rail, and for 90% of demolition material to be reused on site and then exported off site by rail

B. Commitment that construction materials brought in by rail will be maximised, by establishing a logistics centre on the London periphery and diverting at least 30% of inbound construction materials from there to Euston

C. Working closely with TfL and LB Camden, HS2 Ltd. should develop their strategy to minimise the number of vehicles transporting concrete to/from the Euston construction area

3. Future committed development

3.1. HS2 Ltd. should be required to work with TfL and LB Camden over the next two years during project development and Early Contractor Involvement to continue to seek ways to maximise materials by rail, and to identify new opportunities (which may require further consents from LB Camden or GLA) as the project develops (similar to the strategy adopted for the Olympics). HS2 Ltd. should be set timescales for delivery of the commitments, procedures and governance arrangements, including arrangements for future public engagement

3.2. This will also include further work with LB Camden and TfL on Phase B1 of the project, which the report demonstrates has not yet been the subject of detailed exanimation.

3.3. HS2 Ltd. should ensure incorporation of the Hampstead Road Bridge project into the Material By Rail workstream to ensure the project synergies are exploited to divert further excavated materials volumes to rail.

3.4. HS2 Ltd. should also be required to implement the following commitments it made during the workshops:

- Consider the use of Camden Carriage Sidings to stable freight trains during the day if this assists the objective of maximising use of rail to carry material
- Investigate the potential to use a disused tunnel entrance at Primrose Hill to receive excavation from Adelaide Rd vent shaft site to avoid road movement and mitigate other adverse impacts caused by work associated with this site.

4. Synopsis

4.1. From March 2016 TfL and LB Camden have participated in joint workshops organised by HS2 Ltd. (and also attended by Arup, Network Rail and DfT) to establish strategies for maximising the movement of Euston HS2 station materials by rail. Good progress has been made, but the need to reach firm conclusions on the Plan to be submitted to the Secretary of State is now critical. We are therefore disappointed that HS2 Ltd. has not expressed any firm conclusions on the options contained in the report.

4.2. In this section TfL and LB Camden set out their joint response to this Materials By Rail Report, which was issued late by HS2 Ltd for comment, at 21.00 on Monday 13th June. Wider comments and the text for this section were provided to HS2 Ltd. as requested on Friday 17th June. While we accept many of its findings, we disagree with some of the report's wording and findings, and have suggested revisions, but will not see the final version before it is submitted.

4.3. TfL and Camden therefore cannot formally accept the Material By Rail report at this time.

5. Key Points

5.1. This section sets out our analysis of the report and any areas of disagreement. In summary:

- *Practicality*: The workshops concluded it is practical to use rail for construction materials and excavated spoil. More work is still needed to increase the rail share.
- *Recommendations*: There are no conclusions or recommendations and no expression of HS2's position in the report. This is at odds with the December 2015 assurances received by both LB Camden and TfL, whereby a Plan would be identified and targets established for its possible implementation by the Promoter (TfL only). We consider that each of the three options identified demonstrates significant benefits and reduces HGV movements. All three should be incorporated into the Plan.
- *Costs*: The three options' capital costs are overestimated by HS2 Ltd. as they include elements for risk and contingency, which are central overheads
- *Programme* impacts are stated against the AP3 schedule. HS2's new Baseline 6 programme reduces these considerably. Programme impacts are therefore overstated and without mitigation. HS2 opening dates are not affected by MBR.
- *Economic benefits*: HS2 Ltd. estimates rail's environmental benefits are at least £38m. This is understated and we think these will be at least £65m (using the report's volume assumptions).
- *Operational costs*: Rail and road costs are agreed to be equal for evaluation. HS2 Ltd. uses the closest disposal point to Euston. Other destinations will increase this
- *Concrete*: represents 25% of all HGV moves into site, and is all by road. We need commitments to minimise the impacts through further work on measures such as using onsite temporary batching plants and the use of larger lorries

- *Materials in*: 30% of construction material can be railborne. We wish to see work to increase this, and plans for the logistics centre needed to deliver it developed
- *Rail service disruption*: The workshops agreed freight paths that minimise overall disruption are practical. Work is required to confirm acceptable paths.
- *Hampstead Road Bridge*: some options significantly increase excavated material volumes by rail. The studies must be combined as their outputs overlap
- *Community feedback*: confirmed proposals to move materials by rail were welcomed unanimously, and out of hours freight is not an issue of local concern

5.2. There is clearly more work to be done on developing plans to further increase volumes of excavated materials transported from site by rail, and construction materials in. In compliance with the terms of the undertakings, the onus must remain on HS2 Ltd to continue to work with TfL and LB Camden to maximise the use of rail and minimise the number of HGVs on Camden's roads to reduce impacts on the local community including road safety.

6. Report Process

6.1. HS2 Ltd. provided TfL and Camden with undertakings in December 2015, which amongst other things committed to carrying out this joint Materials By Rail (MBR) study. In particular the undertaking contained the following commitment:

6.2. We note that this report cannot be construed as a 'Plan' as it contains no firm HS2 Ltd. commitments or

> 6.1.2 *In addition to 6.11, engage actively with the London Borough of Camden, the Greater London Authority and Transport for London to develop the scoping brief for and a plan that seeks to maximise, in so far as reasonably practicable the volume of excavated and construction material from the construction of the HS2 Euston Station and approaches to be brought in and removed by rail whilst balancing the wider environmental impacts to the local community and on passenger services. This plan, carried out in accordance with the scoping brief, will include consideration of ambitious options that would require, amongst other things, separate planning permissions that may be granted by the London Borough of Camden or the Greater London Authority. The plan will include the identification of targets to measure future progress.*

endorsement. Furthermore there is no identification of targets to measure progress. In this respect therefore the undertaking has not yet been fully delivered abnd we consider that HS2 Ltd. is in breach of its assurance..

6.3. The Final Report was originally promised to TfL and LB Camden by Thursday 9th June. We were advised on 10th June that delivery would be delayed until morning of Monday 12th, and the report was actually received at 21.00. The response date was set back one day to Friday 17th (and, as with all other deadlines, TfL and LB Camden have met this).

6.4. The draft report is a rework of the EIPB Report, but contains many grammatical errors and is internally inconsistent. We have commented in detail on all of the report, but have not seen evidence that our previous comments have been incorporated in the current draft.

6.5. At this stage, therefore, TfL and LB Camden are unable to fully endorse the report.

7. Support for the conclusions of the Materials By Rail Report

7.1. The results of the sift process, which determined three viable core options (Platform 18 and Backing Out Road 2 which diverts 310,000 m^3 to rail in Stage A and Platform 13, which diverts for 77,000 m^3 to rail in

for stage B1), are agreed by TfL and LB Camden. In addition TfL and LB Camden have agreed with HS2 Ltd. that the use of Camden Carriage Sidings for *stabling* of materials trains (rather than for loading) is retained as an option for further development.

7.2. Some options being considered for the reconstruction of Hampstead Road Bridge identify that it is possible to enable more materials to be moved by rail, and TfL and LB Camden Ltd. have asked HS2 Ltd. to ensure that this is acknowledged during the sift process which will select the preferred option. TfL and LB Camden have requested that these synergies are exploited by bringing the two workstreams together, where this would assist the maximisation of materials by rail.

8. Report Recommendations

8.1. The report avoids any conclusions or recommendations, and suggests that the decisions on options to take forward will be taken by ESSRB. This is not consistent with the formulation of a 'Plan' in the undertaking, and we do not believe that HS2 Ltd. is correct in omitting a commentary setting out its views. In the absence of this we believe that we are justified in assuming that each of the three options is broadly acceptable to the project.

9. Demolition materials

9.1. TfL and LB Camden endorses HS2 Ltd.'s planned re-use of Phase A demolition materials to assist piling works, and possibly to recycle them for re-use on site. However, we require HS2 Ltd. to commit to the export of surplus material by rail in place of the original plan to use road. In Phase B1 the situation changes, as there is less demolition material available for re-use. Rail should be used to import any fill materials at the beginning of the Phase B1 construction period. We will continue to pressure HS2 Ltd. to commit that 90% of all demolition materials for construction use on site, and that they should then be removed by rail rather than road.

10. Transport of concrete

10.1. Transport of concrete by road represents 25% of all HGV movements into and out of the HS2 construction sites. HS2 Ltd. has suggested that, if it uses larger capacity lorries, up to 25% of these lorry movements could be saved. TfL and LB Camden strongly supports this strategy, but the proposal needs considerable development work by HS2 Ltd. to progress this to a commitment, including managing the safety implications and defining the traffic impacts of vehicle routing by determining the source points for the concrete. TfL and LB Camden (and consultees) also wish to see further consideration of the possibility of carrying out bulk concrete batching on site, which HS2 Ltd. has so far rejected.

11. Construction programme impacts

11.1. HS2 Ltd.'s report states that the use of rail for materials export would delay the Phase A and B1 construction programme by six months. This calculation uses the AP3 programme, which HS2 Ltd. has been revising. Workshops have been told that the revised unmitigated programme impact is likely to reduce to around 2 months, and TfL and LB Camden believe will actually be eliminated once combined with the revised Hampstead Road Bridge programme and other programme efficiencies, such as 24 hour working, that could result from using rail.

11.2. TfL and LB Camden are also aware that HS2 Ltd. believes that the Euston tunnelling programme is delayed and that as a result track fit out materials may be delivered to the Euston site by road rather than rail (as forecast in the ES). This is evidence that other pressures on the programme already exist, and that suitable mitigations can be found that counteract these impacts on the planned opening dates.

Therefore, TfL and LB Camden consider that it would be appropriate for the ESSRB to discount potential programme impacts from their consideration of the options being considered.

12. Construction and Operational Cost Impacts

12.1. TfL and LB Camden believe that HS2 Ltd. has wrongly inflated the stated option construction costs with risk and contingency in parts (but not all) of the report, contrary to its practice when producing evidence to the Select Committee. The overall capital cost of providing rail loading facilities that can serve both excavated material out and construction materials in is around 1% of the total Euston construction cost, and is covered by the environmental benefits it generates within the local area.

12.2. The workshops have agreed, at least for the purposes of this study, that the costs of movement by road or rail are broadly comparable. Therefore we believe that overall financial cost impact to the project of switching traffic from road to rail is broadly cost neutral. However we stress HS2 Ltd. has chosen to use the physically closest disposal location to Euston, just outside the M25, and that any other spoil destination will generate even higher benefits than those assessed in the studies.

13. Disruption costs

13.1. The workshops debated the impact of running additional freight trains into Euston station and agreed that it is possible to robustly timetable freight trains into and out of the station by avoiding morning and evening peak times. It was also agreed that there would be some impact of running freight trains during the inter peak period. DfT initially provided some unacceptably high cost estimates but agreed that this should be examined in more detail to produce realistic estimates directly linked to the impacts of freight trains.

13.2. However TfL and LB Camden reject any suggestion that running planned freight trains inevitably disrupts passenger services. This is incorrect; compliantly timetabled freight trains (as would be the case at Euston) will not impact on other services providing they all run to time. In the event that events elsewhere delay passenger services TfL and LB Camden accept that there may be some marginal incremental delay caused by running the freight trains. However, only those few trains running into and out of Euston station at that time might be affected. In any case the freight impacts are incremental to the constraints of the reduced capacity station throat generated by the HS2 station works, which is likely to have a much greater overall impact on passenger train performance

13.3. TfL and LB Camden therefore reject any assertion that options to move material by rail generate considerable additional performance cost. We note that at other London termini (including Kings Cross, St Pancras, Victoria and Paddington) freight trains operate into and out of the station approaches with no apparent detriment to passenger services.

14. Economic and environmental cost benefits

14.1. TfL and LB Camden have agreed in the workshops that methodologies used by DfT to calculate the economic/environmental benefits of using rail rather than road should be taken into account in the overall evaluation of moving materials by rail. HS2 Ltd. has assessed the maximum economic benefit of moving materials by rail as £38m, given current option volumes. TfL and LB Camden believe that using more appropriate valuations of local congestion impacts would indicate economic benefits rise to at least £65m.

14.2. TfL and LB Camden believe that the report does not represent the correct position in terms of lorries saved from the roads, and understates the impact of the initiatives identified in the report. Our reworking of Table 16 on page 52 shows the following calculation:

Option	No. of lorry movements removed (one-way)	Two-way lorry miles removed	Benefits £m London (high)	Percentage of total lorry movements removed
Material exported:				
Backing Out Road 2	6,648	345,696		1.8%
Platform 18 siding	29,828	1,551,056		8.2%
Platform 13 siding	9,092	472,784		2.5%
TOTAL	45,568	2,369,536	£24.976	12.6%
Material imported:				
Potential use of rail for miscellaneous materials	30,595	1,529,760	£25.210	8.4%
Demolition				
90% re-used on site and removed by rail	27,574	1,433,858	£15.113	7.6%
TOTAL	103,737	5,333,154	£65.299	28.6%

14.3. The changes are generated by correctly including all of the demolition material, which HS2 Ltd. has confirmed will be moved by rail, and by using a reasonable aspiration for moving 30% of imported miscellaneous materials to site by rail. This was proposed by HS2 Ltd at a recent workshop held on 2nd June 2016.

14.4. Using HS2's own methodology this generates environmental benefits of £65m, and we believe these would increase further if future congestion cost factors were taken into account. This demonstrates that significant environmental benefits could arise from establishing a flexible and well-managed railhead and that further development of plans for this will most likely increase this.

14.5. Congestion is increasingly significant in London, and HS2 Euston construction exacerbates this through local road closures, trunk road lane restrictions and at the sheer volume of HGVs daily movements associated with the project. Combined with doubts over the availability of sufficient Euro VI HGVs and the new Mayor's announcement on emissions and widening of the Ultra Low Emission Zone, TfL remains very concerned about the practicality of total reliance on road to support construction, especially given London's projected growth over this period.

14.6. The economic/environmental impact of the residual road movements not transferred to rail is valued around at least £144m (using the same methodology), which provides a strong incentive for continuing to seek to maximise rail movements.

15. Construction materials into site

15.1. In the report HS2 Ltd. documents a notional approach to delivering construction materials to site by rail, based on data presented at a workshop on 2nd June. TfL and LB Camden point out that very little work has yet been done by HS2 Ltd. on the logistics necessary to achieve this, and as yet has not indicated any firm commitment to do so. A London perimeter logistics centre where materials can be loaded may be required, and platforms 18 and 13 may be occupied by the project for a longer period. However, there is a very significant benefit in terms of more than 30,000 HGVs removed and the economic benefits delivered. We would point out to ESSRB that this is precisely the methodology that has been used by Network Rail in the reconstruction of Birmingham New Street.

15.2. TfL and LB Camden believe that the Plan should fully commit to the movement of as much construction material into Euston as possible. To do this they propose to work with HS2 Ltd. to develop the proposals

to define the facilities required and the products that will be moved by rail, and that the Plan should require to commit HS2 Ltd. to maximise the rail volume of all construction material. They believe that there are considerable benefits to HS2 Ltd.'s contractors in improving the right time delivery of critical products.

16. Stage B1

16.1. The report and workshops have undertaken relatively little work on the use of rail to move materials in Stage B1. The proportion of excavated material that can be moved by rail is relatively low (33% of the total Phase B1 volume of excavated material). TfL and LB Camden need to see HS2 Ltd. required to carry out more work on new methodologies that increase this proportion of material that can be loaded to rail towards at least 66%. The technology to achieve this would be able to be used equally within the similar platform 18 option, and represents the best way of increasing the volume of material that can be moved by rail.

17. Hampstead Road Bridge

17.1. The HRB working group has identified at least one option (Option 1 – creation of a new parallel structure to the existing bridge) which has significant advantages, but which also opens up the areas to the north of the bridge to removal of material by rail. The report estimates that a further 14,500 HGV trips during Stage A can be removed if this opportunity is exploited. There are good prospects for this figure to be exceeded in further development.

18. It is therefore essential that the development of the HRB options is carried out in conjunction with development of the MBR options, and TfL and LB Camden would suggest to ESSRB that this is added as an essential element of the Plan. HS2 Ltd. should be required to adopt options that maximise the potential to increase volumes of materials by rail.

12.3 Network Rail

Introduction

12.3.1 As system operator, Network Rail welcomes the invitation to contribute to the ESSRB report and the workshops that have informed it.

12.3.2 Rail freight plays a vital role in Britain's economy and Network Rail is enhancing the network as part of its Railway Upgrade Plan. In 2014, 22.1bn net tonne kilometres of freight were moved in the UK, ranking fourth in the European Union for volume of freight moved on the railway network. Passenger demand is also experiencing an upward trend, the number of passenger journeys has increased overall by 129.8% since 1994-95, with Long Distance journeys recording the highest increase of 150.6% and the WCML carries the busiest mixed traffic railway in Europe. Not since the 19th century has the growth in passenger journeys on the railway been so strong.

12.3.3 The Euston HS2 Enabling Works project will place further constraints on the operation of what is already a congested railway. As the report outlines, the extent of impact to current operations as a result of the delivery of HS2 is currently being assessed through a process of industry recognised analysis[19]. Results from this process will not be available prior to October 2016.,Forming a baseline, the analysis, which will provide a critical input to the decision which the industry takes will have to be reappraised in order to more accurately assess the introduction of the material by rail service as proposed in this report.

1. Timetabling

12.3.4 Considerable changes are to be made to the existing conventional track layout in the Euston area in order to make space for construction of the new HS2 station and infrastructure. Today, Euston operates with 18 platforms and 6 approach tracks, including grade separation. The future configuration states are as follows:

- December 2018 – 18 platforms, 4 approach tracks, including loss of grade separation;
- December 2021 – 18 platforms, 5 approach tracks, grade separation reinstated;

12.3.5 Network Rail has been remitted to ensure that this constrained track layout is able to accommodate the quantum of passenger services in the December 2014 timetable without unduly compromising performance. In order to meet this requirement, Network Rail is undergoing a three phase study:

1. **Signalling Performance Assessment** – determines how trains can operate on the new layout (line speeds, running times etc.): completed March 2016;

[19] See chapter 9

2. **December 2018 timetable development –** creating a concept timetable to prove/disprove that the new layout has the requisite capacity: draft output completed June 2016;

3. **Performance modelling –** uses a multitude of inputs, including from the processes above, to determine the impact of the new layout on key performance metrics such as the Public Performance Measure (PPM): in progress, results due October 2016;

12.3.6 This analysis does not include any consideration of freight trains running into and out of Euston for the transport of HS2 materials. Until the baseline timetable and performance impacts are established, it is not possible for Network Rail to validate the outputs of the ESSRB report. Network Rail are currently establishing the length of time it would take to run sensitivities on the analysis which would take account of materials trains. Due to the availability of resources and the dependency upon the baseline report this activity could only commence in October 2016 and would report its findings at a date yet to be determined.

12.3.7 London North Western (LNW) Route, responsible for operation and maintenance of the WCML, have also made it clear that they are not willing to accept the introduction of any materials trains until the baseline performance impacts are understood and the implementation of associated mitigation measures inclusive of a clear and acceptable plan to support essential maintenance activity are agreed and funded.

Train paths

12.3.8 Network Rail does not recognise the train paths for materials trains that have been identified in the ESSRB report.

12.3.9 The train pathing analysis conducted in the development of this report is not fully cognisant of the constrained December 2018 track layout and the revised Train Planning Rules (TPRs) associated with it. Furthermore, the destination for materials trains has not been firmly established. Collectively resulting in an inability to accurately determine whether particular paths are feasible or not.

Platforming – use of Platform 18 (new)

12.3.10 The three phase timetable and performance study outlined above is based on 18 platforms operating at Euston in December 2018. Until this work is completed in October 2016, it is not possible to validate operation of the timetable with 17 platforms.

12.3.11 Any reduction in platform capacity will limit Network Rail's capability to effectively recover from unplanned disruption. This capability will already be undermined by the reduction in approach tracks.

Platforming – use of Platform 13 (Stage B1)

12.3.12 For the reasons already mentioned, Network Rail is unable to validate whether Platform 13 can be utilised for HS2 Stage B1 materials trains. The Capacity Plus study, led by Network

Rail, is determining the train service that will operate on the WCML following the start of HS2 Phase 1 services in 2026. Capacity Plus outputs will determine the requirement for platform capacity at Euston in the future.

12.3.13 Unprecedented growth on the WCML is projected to continue, which could drive a requirement for the maximum available number of conventional platforms at Euston to be utilised for passenger services.

2. Performance

12.3.14 There is a considerable amount of planned disruption at Euston to accommodate HS2 enabling works and construction. Planned half station and full station blockades will have a considerable impact on passengers. The constrained track layout, due to be commissioned in December 2018, is likely to increase the probability of unplanned disruption[20].

12.3.15 The combination of planned and unplanned disruption, and associated performance impacts, could have a significant impact on the passenger and freight growth of the railway.

12.3.16 The operation of materials trains at Euston is likely to accentuate this problem, for the following reasons:

- More trains on the network means that the impact of secondary delays will be greater and take longer to recover from, due to greater congestion;
- The increased quantum of trains will lead to intensified use of assets and the maintenance of them. Intensification of use can be associated with an increase in asset failure rates and associated negative impacts on performance;

12.3.17 As well as possible passenger impacts highlighted above, further degradation in performance would have financial ramifications for Network Rail. A reduction in performance would lead to increased Schedule 8 payments from Network Rail to Train Operating Companies (TOCs) and Freight Operating Companies (FOCs), which are mandated as part of the Network Code. It is worth noting that Schedule 8 rates for disruption on the WCML are considerably higher than elsewhere on the network.

12.3.18 Network Rail is obliged to meet targets for performance as agreed with the Office of Rail & Road (ORR), the independent regulator. If they are not met, Network Rail incurs significant financial penalties. These targets do not account for the operation of materials trains at Euston, which impairs Network Rail's ability to successfully meet them.

12.3.19 The operation of materials trains will impact upon the operation of the conventional network in many areas. This is not fully acknowledged in the ESSRB report. The impacts include, but are not limited to:

[20] See chapter 9

- **Platform availability** – the report does not specify the period during which Platforms 13/18 would be taken out of use and if they could be re-commissioned for Network Rail use after completion of HS2 works;
- **Station operations** – there are various hazards associated with materials trains operating in a major passenger terminus – air and noise pollution from locomotives and machines, as well as the risk of excavated spoil and imported materials spilling out of wagons. Appropriate protections need to be put in place to protect passengers and railway staff. Network Rail is committed to protecting and where possible enhancing the passenger experience. Any impact to that will require assessment and funded mitigation which has not been covered in this report
- **Maintenance** – the ESSRB report raises the prospect of train movements at night, which could clash with the maintenance regime for the railway. There are also increased maintenance costs associated with the more intense usage of assets (increased failure rates) caused by the increased quantum of trains operating. The risk of excavated material spilling out on to tracks further increases maintenance liability and is a hazard for lineside staff;
- **Signalling/train operations** – the ESSRB report does not consider how the operation of materials trains would be carried out during minor and major periods of disruption on the WCML, including prioritisation and classification of trains.

12.3.20 The ESSRB report does not account for the increased costs associated with degraded performance on the WCML.

3. Environmental benefits

12.3.21 Long distance rail travel is particularly sensitive to poor performance, as there are often other viable alternatives, such as road and air travel (which are less environmentally friendly). Demand on WCML Anglo-Scottish services has still not fully recovered from the disruption caused by the temporary closure of Lamington Viaduct.

12.3.22 Network Rail understands that there are environmental benefits associated with reducing the number of lorries on the road for HS2 construction (Section 1.6, Table 4). However, this quantification does not take account of the possible impact which reductions in service provision for passenger and goods can have in triggering the risk of modal shift from rail to road.

12.3.23 The ESSRB report focusses on the environmental costs and benefits purely in the London & South East England area. It is important to recognise that the WCML stretches from London to Glasgow, and intersects with suburban networks in major conurbations across Britain. If the WCML performs poorly, the impact of increased car and aeroplane usage will be felt across a far larger area of the country than just London & South East England.

12.3.24 The ESSRB report does not fully account for the negative environmental impacts associated with degraded performance on the WCML.

4. Euston HS2 Enabling Works project

12.3.25 Network Rail is undertaking works on behalf of HS2 Ltd. under the Protective Provisions Agreement (PPA) to enable HS2 construction activities in the Euston area. The remit for these works does not account for the material trains options in the ESSRB report. Detailed design is in progress with site works due to start later in 2016.

12.3.26 If it is decided that materials trains are to operate, an impact assessment will be undertaken. There is a risk that this assessment could necessitate re-work of designs and/or changes to works already carried out. This could have a negative impact on cost and programme for the Euston HS2 Enabling Works project.

12.3.27 The ESSRB report does not take account of this risk and the possible costs associated with it.

5. Summary

12.3.28 Network Rail supports the development of High Speed 2 and the benefits it will bring in providing increased capacity new and faster journeys and the socio-economic opportunities it will enable. Network Rail will continue to work with HS2 Ltd. and the Department for Transport to help ensure that the complex major programme of works is delivered safely and efficiently whilst minimising impacts on the environment and local communities wherever possible.

12.3.29 Whilst recognising the effort HS2 Ltd have undertaken in assessing the practicality of utilising more rail for construction, it is not possible to fully validate whether it is possible to operate materials trains in the manner described in the ESSRB report. If progressed further the baseline December 2018 timetable and associated performance analysis planned for October 2016 needs to be established and then reappraised in order to provide a greater understanding of the proposed service. Without a complete understanding of the issues Network Rail is unable to support the proposals in this report.

6. Report clarifications

- General – the existing railway should be referred to as 'conventional' rather than 'classic';
- Section 1.4 – what locations are deemed to be available?;
- Section 1.5 - it is essential that the requirements for Network Rail maintenance activity are understood before exploring these options further;
- Section 1.6 – they also exclude increased maintenance costs;
- Section 1.7 - the impact on station operations and maintenance is as yet unknown;

- Section 1.7 – 'could' reads 'are expected to be';
- Section 1.6, Table 4 – NR does not recognise the figures in this table and the methodology used to quantify them;
- Section 1.7 – NR does not recognise Railsys as an accurate tool for measuring performance. NR is employing the Industry standard TRAIL modelling tool for measuring performance impacts;
- Section 1.8 – this table does not account for the likely costs associated with a degradation in performance on the railway, including but not exclusively:
  - Increased Schedule 8 payments;
  - Financial penalties from the ORR;
  - Reduced income through the fare box due to reduced passenger numbers;
  - Environmental costs associated with modal shifts away from rail travel;

12.3.30 Section 4 – 'Parkway Tunnels' should read Park Street Tunnels;

12.3.31 Section 4 – 'DB Schenker Shed' should read Down Side Carriage Shed;

12.3.32 Section 5.2 – this process does not incorporate the needs for maintenance;

12.3.33 Section 5.2.2 – 'Eastside Carriage Siding' should read Up Sidings;

12.3.34 Section 5.2.2 – the operation of the December 2018 timetable is dependent on being able to utilise the Up Sidings for stabling trains throughout the day;

12.3.35 Section 5.3.1, Table 10 – NR believes that any option will have some degree of impact on the conventional railway, so should be rated at least an 'amber';

12.3.36 Section 5.3.2.1 – Line X is to be reinstated in December 2021 at the latest as agreed with HS2 Ltd. and DfT, NR will not accept any option which would result in this milestone not being met;

12.3.37 Section 6.1 – 'Line D' should read Line E;

12.3.38 Section 6.1 - how are these trains going to be weighed before they depart Euston?;

12.3.39 Section 6.2 - how are these trains going to be weighed before they depart Euston?;

12.3.40 Section 6.2.1 – this could potentially have a significant impact on capacity, especially with the loss of grade separation at Euston;

12.3.41 Section 6.2.1 – to clarify, BOR2 cannot be utilised on its own, it requires Platform 18 to be used for materials trains also;

12.3.42 Section 6.2.3 – and provision of the mitigations to station operations this will trigger;

12.3.43 Section 6.3 - how are these trains going to be weighed before they depart Euston?;

12.3.44 Section 6.3 – but it has a significant impact on Network Rail station operations;

12.3.45 Section 6.3.1 – this will have impacts on capacity and maintenance access which have not yet been quantified;

12.3.46 Section 7.1.2.2 – all loads for bringing materials into Euston need to comply with gauging restrictions;

12.3.47 Section 7.1.2.4 – separate wagons will need to be used for taking out excavated materials and bringing in construction materials;

12.3.48 Section 7.1.2.4 – please present the statistics outlined in the penultimate paragraph of this section in tabular form;

12.3.49 Section 7.2.2 – 'Herefordshire' should read Hertfordshire;

12.3.50 Section 7.2.4 – NR does not recognise the figures in this table and the methodology used to quantify them;

12.3.51 Section 8.1 – please provide programme dates for each option covering the following:

12.3.52 Date platform/siding is taken out of use;

12.3.53 Construction period;

12.3.54 Period when platform/siding will be used for HS2 materials trains;

12.3.55 Date platform/siding is reinstated or decommissioned;

12.3.56 Section 8.1 – NR has not validated the costs presented in this table;

12.3.57 Section 9 – 'best professional judgement' should read structured expert judgement;

12.3.58 Section 9 – and limitations for maintenance access;

12.3.59 Section 9 - NR does not recognise Railsys as an accurate tool for measuring performance. NR is employing the Industry standard TRAIL modelling tool for measuring performance impacts;

12.3.60 Section 9 – it should be made clear that whilst it is not possible for NR to provide a validated quantification at this stage, there are potentially very significant costs associated with a degradation in performance on the WCML caused by the operation of materials trains;

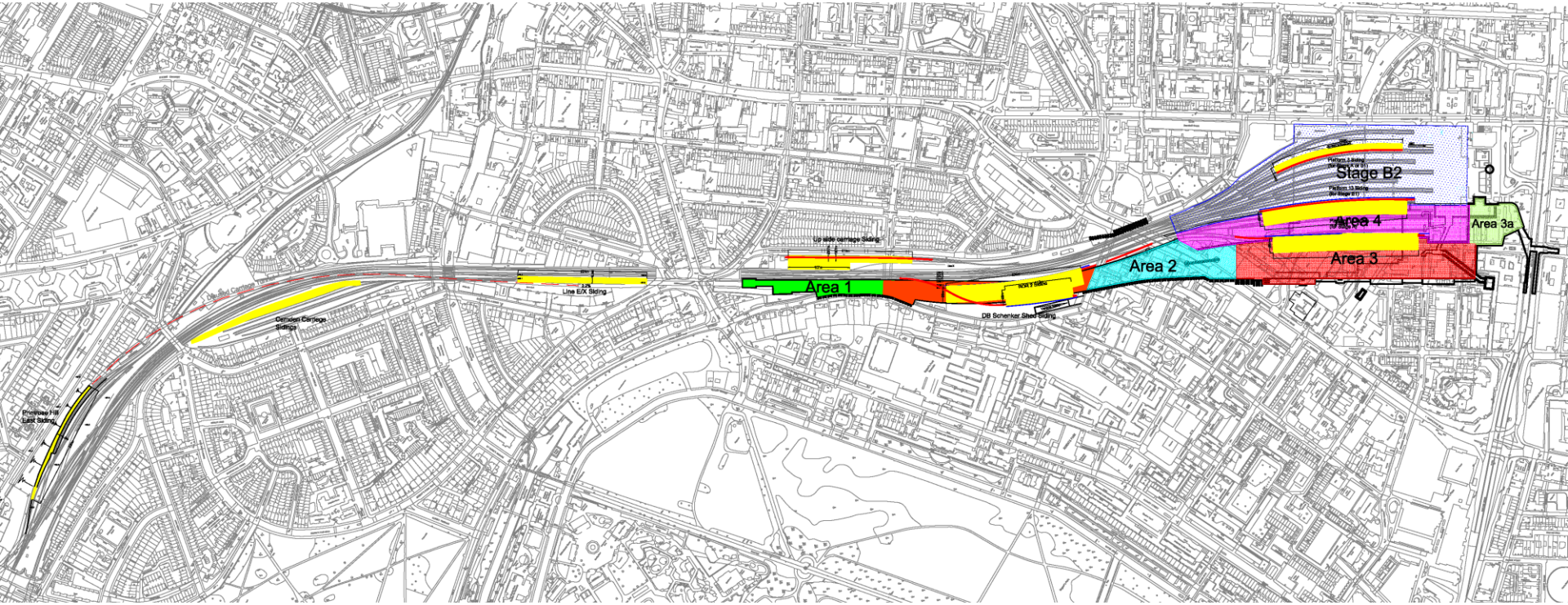
12.3.61 Section 10.2 – NR will be prepared to commit to a reduction in platforms only when the impacts on capacity and performance are fully understood, and associated mitigation measures are agreed, funded and implemented;

12.3.62 [1] Breakdown of materials trains could lead to severe perturbation on the WCML, especially as they will have to cross from one side of Euston throat to the other – the recent breakdown of a freight train on the WCML Fast Lines in the Bushey area led to the prolonged operation of a 2-track railway (usually 4-track), causing significant delays.

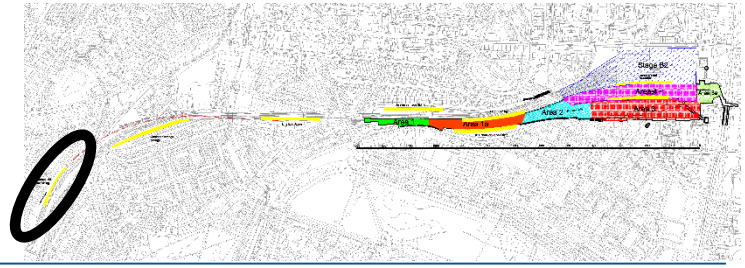
Appendix A

3. Siding options résumé

Key Plan



Option 1 – Primrose Hill (East) Siding

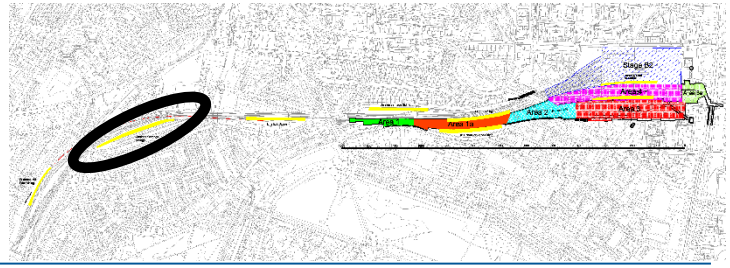


Location	Primrose Hill (East) Siding
Rail access	North access only
Loading method	Moxy (large dumper truck) or conveyor
Train movements	WCML slow lines day or night
Excavation train loading type	Static train
Capacity	Siding = 220m long 10 no. wagons = 635t Siding length = 220m
Stock pile facility	tbc
Train stabling facility	none
Road access	Very limited
Serving area	Area 1 and 1a

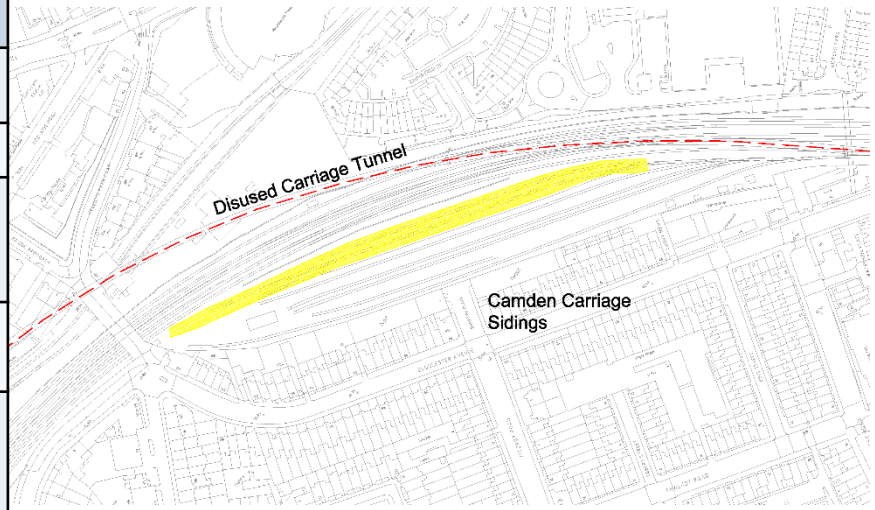
Availability

Pre 2017	2018				2019				2020				2021				2022				2023				2024			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
					Piling at Portal																							
									Excavation – Area 1 and 1a																			

Option 2 – Camden Carriage Sidings



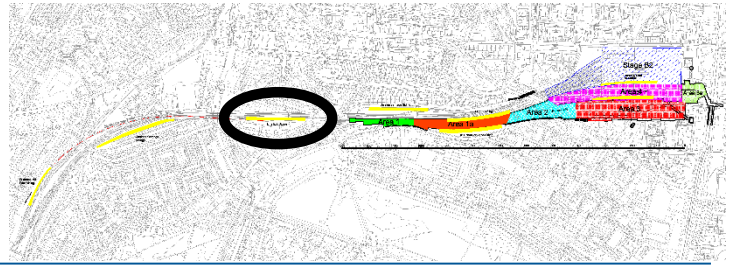
Location	Camden Carriage Sidings
Rail Access	Additional north access under investigation
Loading method	Moxy (large dumper truck) or conveyor
Train movements	South access from WCML line D fast lines At night via station to fast or slow lines (direct access to fast lines under investigation)
Excavation train loading type	Static train
Capacity	Siding = 200m long 9 no. wagons = 285t Siding length = 200m (With north access) Siding length = 360m (Without north access)
Stock pile facility	Apron space subject to stabling provided – substantial stock piling available
Train stabling facility	3 trains (tbc)
Road access	Very limited
Serving area	Area 1 and 1a (possibly 3 with conveyor)



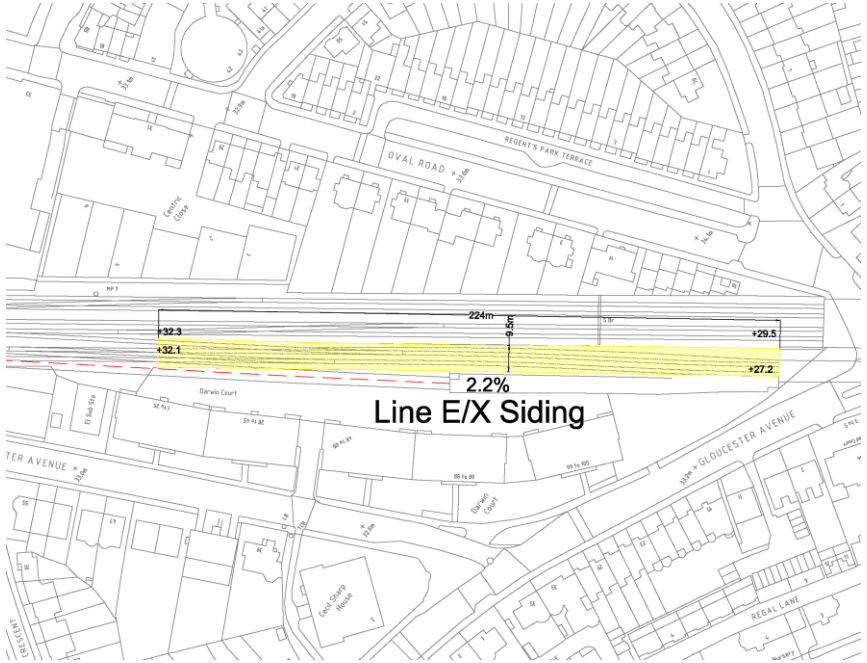
Availability

Pre 2017	2018				2019				2020				2021				2022				2023				2024			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
					Piling at Portal																							
									Excavation – Area 1 and 1a																			

Option 3 – Parkway Line E/X



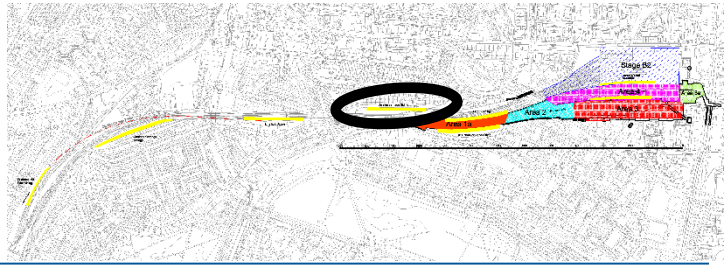
Location	Parkway Line E/X
Rail Access	North access only
Loading method	Moxy (large dumper truck) or conveyor
Train movements	North onto WCML Line D (night) or north into CCS for stabling
Excavation train loading type	Static train
Capacity	9 wagons (assuming top and tailing of trains) = 570t Siding length = 224m
Stock pile facility	tbc
Train stabling facility	none
Road access	Very limited
Serving area	Area 1 and 1a



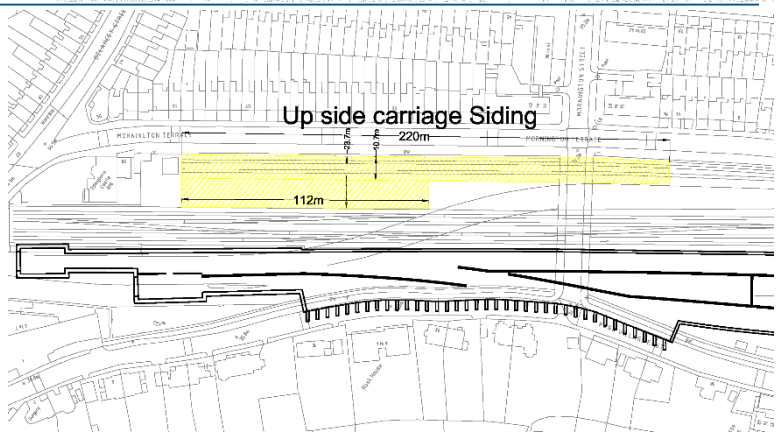
Availability

Pre 2017	2018				2019				2020				2021				2022				2023				2024			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
					Piling at Portal																							
									Excavation – Area 1 and 1a																			

Option 4 – Eastside Carriage Siding



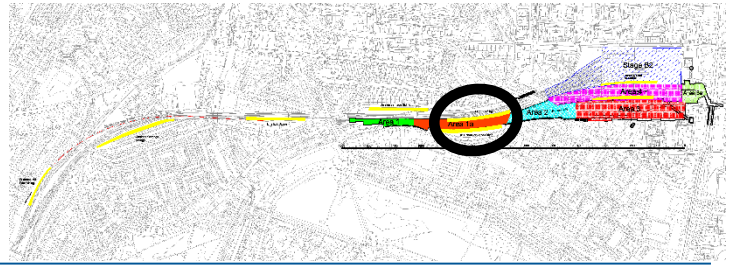
Location	Eastside Carriage Siding
Rail Access	South access only into low numbered platforms
Loading method	Conveyor (over WCML)
Train movements	To WCML slow lines via station day or night
Excavation train loading type	Static train
Capacity	Siding = 260m long 12 wagons = 762t Siding length = 220m
Stock pile facility	tbc
Train stabling facility	None (all available space used for apron)
Road access	none
Serving area	Area 1 and 1a



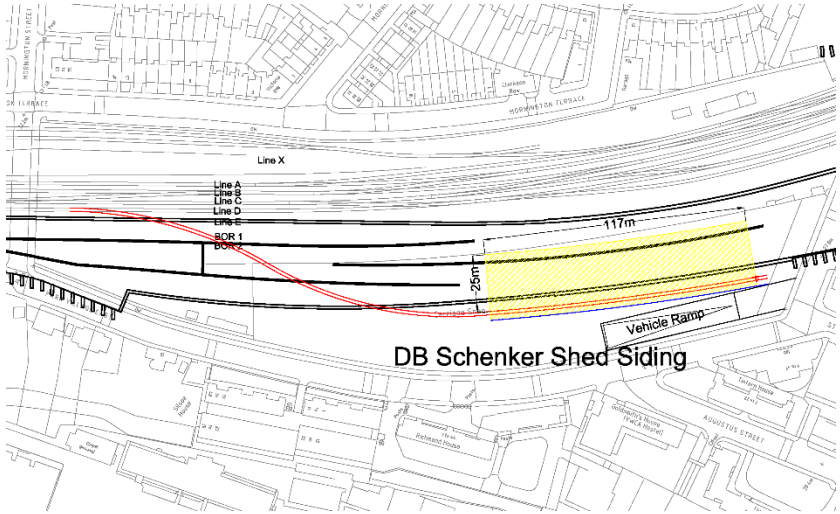
Availability

Pre 2017	2018				2019				2020				2021				2022				2023				2024			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4

Option 5 – DB Schenker Shed Option



Location	DB Schenker Shed Option
Rail Access	Current access to the carriage shed is from Lines E (& X) to the north. New connection required to Lines D
Loading method	Moxy (large dumper truck)
Train movements	To WCML fast lines (night only)
Excavation train loading type	Static train
Capacity	Siding = 250m long 12 wagons = 762t Siding length = 117m
Stock pile facility	2 days (tbc)
Train stabling facility	None
Road access	From Granby Terrace via the new site compound ramp
Serving area	Area 1 and 1a



Availability

Pre 2017	2018				2019				2020				2021				2022				2023				2024			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4

Piling and pile cap construction

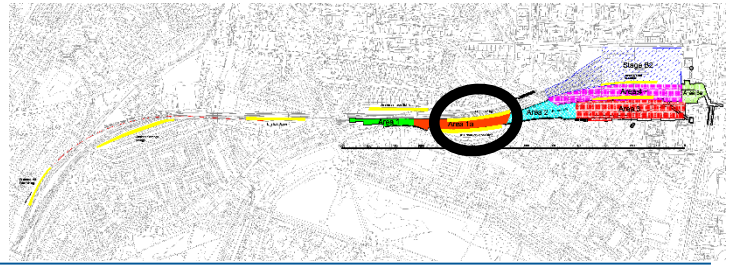
Ground level slab construction

Level -1 / -2 excavation

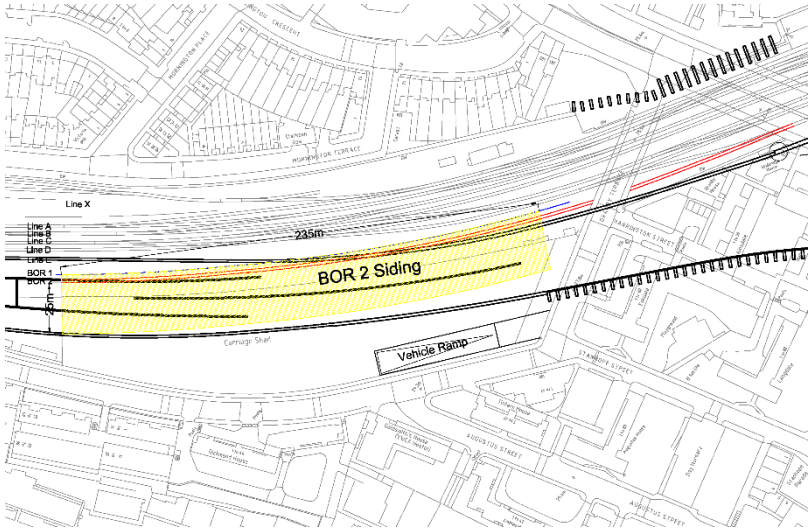
Slabs (Top and intermediate) construction

hs2 engine for growth

Option 6 – Backing out Road 2



Location	Backing out Road 2
Rail Access	South access only
Loading method	Moxy (large dumper truck)
Train movements	To WCML slow or fast using high numbered classic platforms
Excavation train loading type	Static train (or moving at night using station Platform 10)
Capacity	Siding = 330m long 16 wagons = 1016t Siding length = 235m
Stock pile facility	2 days (tbc)
Train stabling facility	None
Road access	From Granby Terrace using the new site compound ramp
Serving area	Area 1 and 1a



Availability

Pre 2017	2018				2019				2020				2021				2022				2023				2024			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4

Piling and pile cap construction

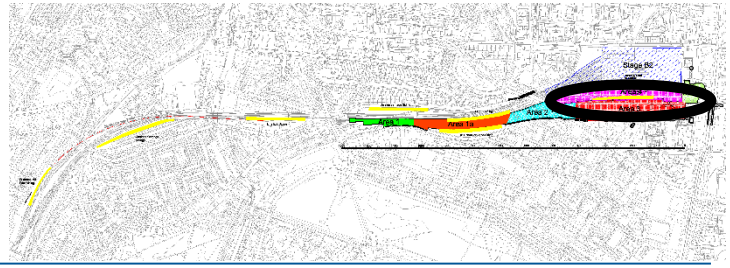
Ground level slab construction

Level -1 / -2 excavation

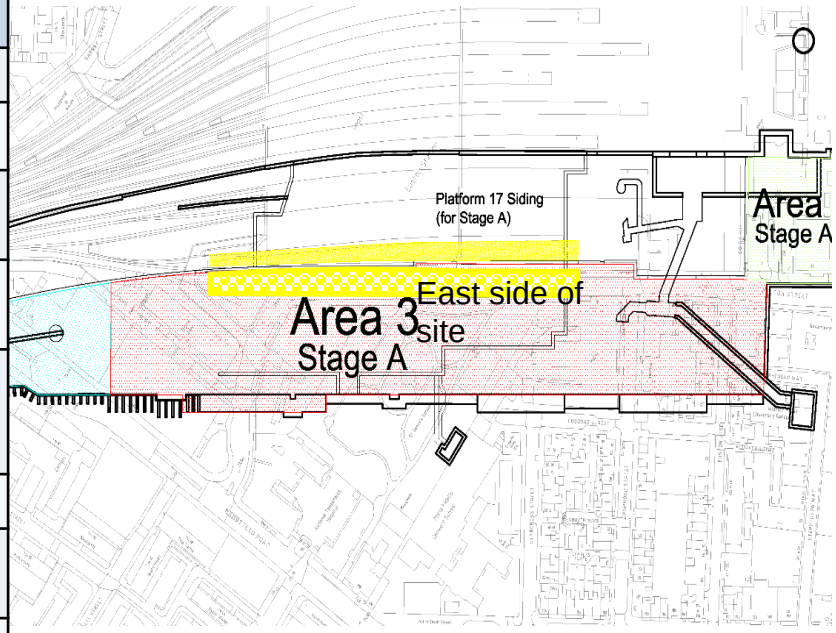
Slabs (Top and intermediate) construction

hs2 engine for growth

Option 7 – Station Stage A – East Siding



Location	East Siding
Rail Access	North access only
Loading method	Moxy (large dumper truck)
Train movements	Directly from WCML fast or slow lines (day or night)
Excavation train loading type	Static train (or moving train using backing over lane 2 at night)
Capacity	Siding = 330m long 16 wagons = 1016t Siding length = 253m
Stock pile facility	tbc
Train stabling facility	none
Road access	From Hampstead road via site compound and new access ramp
Serving area	Area 3



Availability

Pre 2017	2018				2019				2020				2021				2022				2023				2024			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4

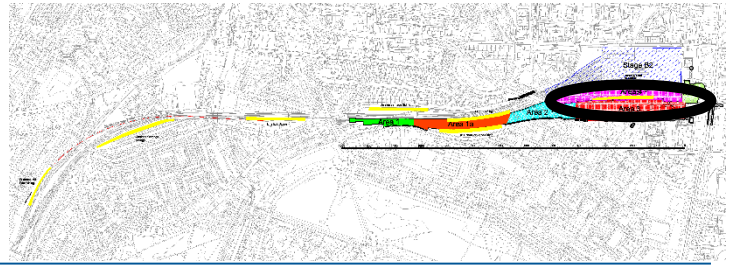
Piling

Track level slab work

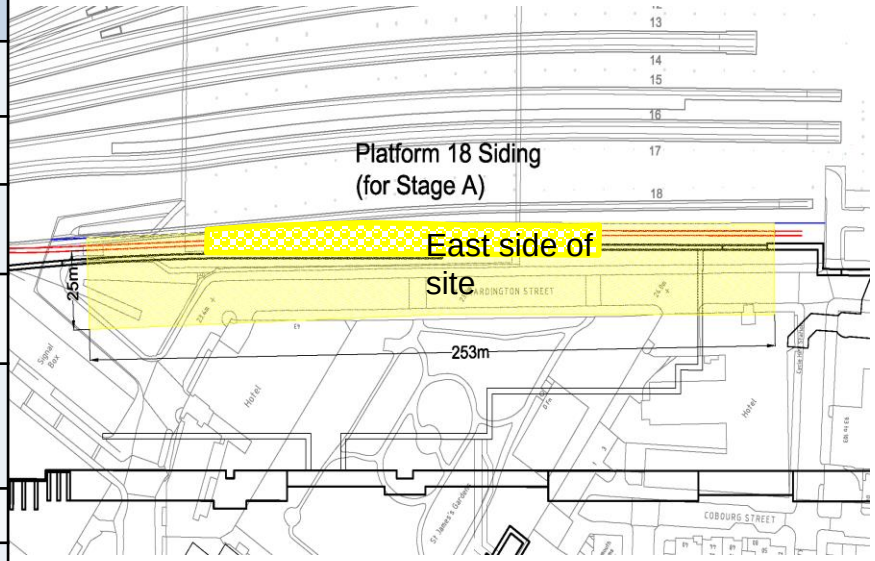
Below track excavation / Basement Slab

Zone 2 Concourse construction

Option 8 – Station New Platform 18



Location	Station New Platform 18
Rail Access	North access only
Loading method	Moxy (large dumper truck)
Train movements	Directly from WCML fast or slow lines (day or night)
Excavation train loading type	Static train (or moving train using backing over lane 2 at night)
Capacity	Siding = 330m long 16 wagons = 1016t Siding length = 253m
Stock pile facility	tbc
Train stabling facility	none
Road access	From Hampstead road via site compound and new access ramp
Serving area	Area 3



Availability

Pre 2017	2018				2019				2020				2021				2022				2023				2024			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4

Piling

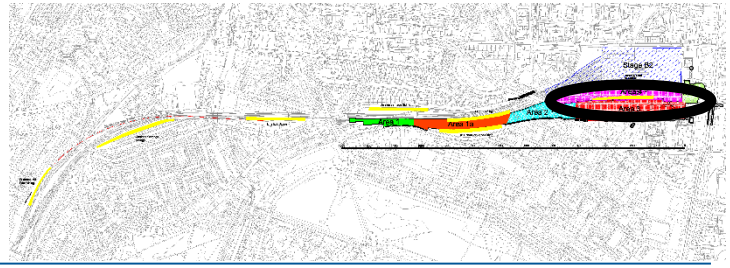
Track level slab work

Below track excavation / Basement Slab

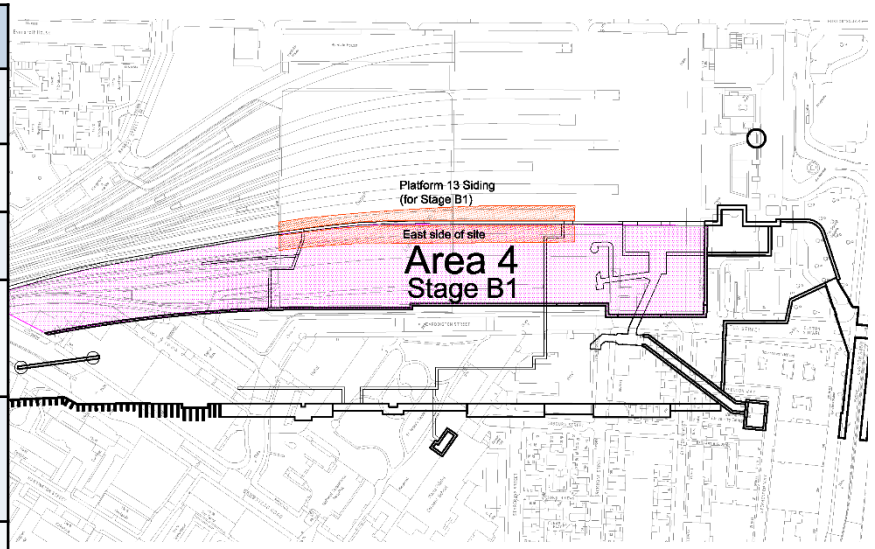
Zone 2 Concourse construction

hs2 engine for growth

Option 9 – Station Stage B1 – East Side Siding



Location	East Side Siding
Rail Access	North access only
Loading method	Moxy (large dumper truck)
Train movements	Directly from WCML fast or slow lines
Excavation train loading type	Static train
Capacity	Siding = 330m long 16 wagons = 1016t Siding length = 252m
Stock pile facility	tbc
Train stabling facility	none
Road access	From Hampstead road across Stage A station deck and down new access ramp
Serving area	Area 4



Availability

2027				2028				2029				2030				2031				2032				2033			
Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4

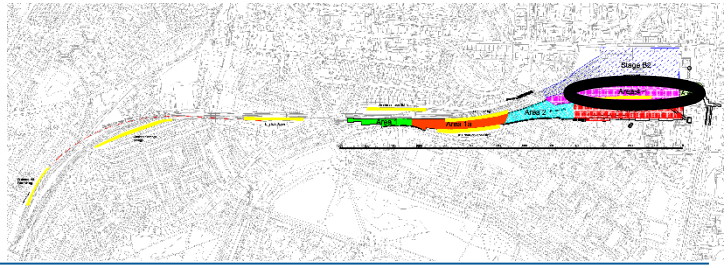
Piling (Zone 2-3)

Ground level slab construction

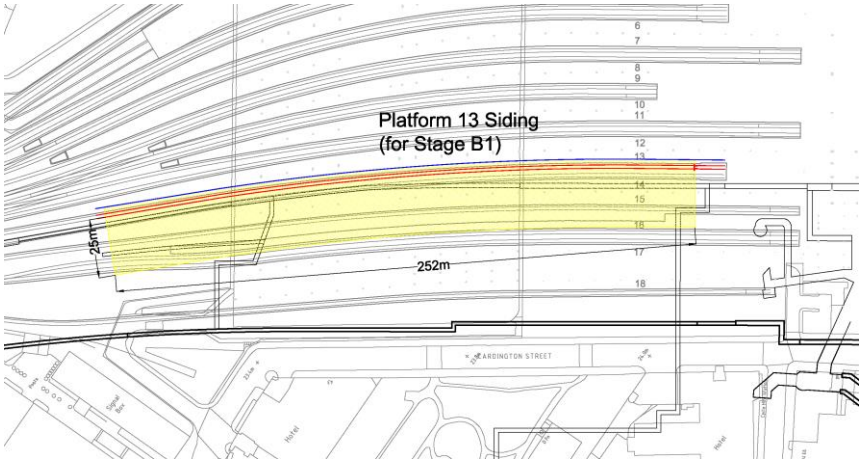
Excavation below track

Zone 2 / 3 Concourse level construction

Option 10 – Existing Platform 13



Location	East Side Siding
Rail Access	North access only
Loading method	Moxy (large dumper truck)
Train movements	Directly from WCML fast or slow lines
Excavation train loading type	Static train
Capacity	Siding = 330m long 16 wagons = 1016t Siding length = 252m
Stock pile facility	tbc
Train stabling facility	none
Road access	From Hampstead road across Stage A station deck and down new access ramp
Serving area	Area 4



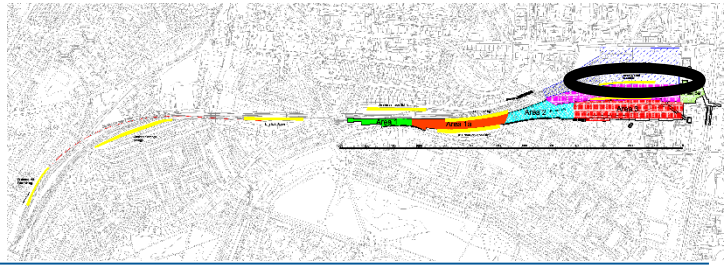
Availability

2027				2028				2029				2030				2031				2032				2033			
Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4

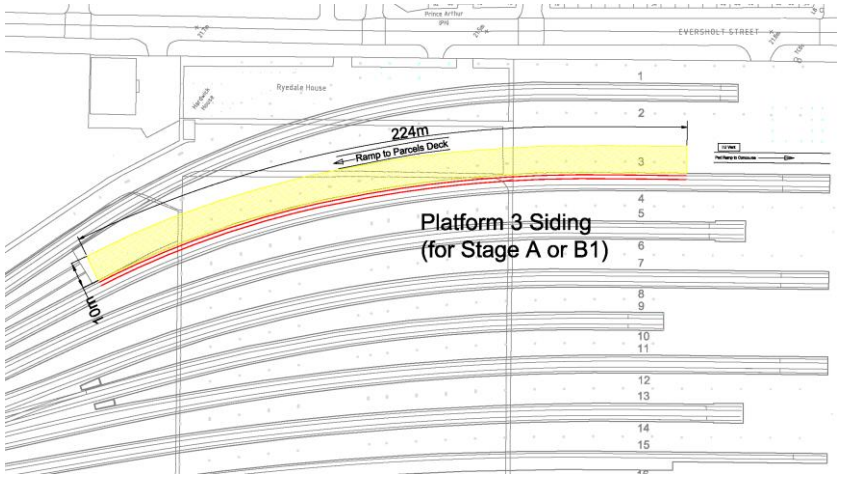
- Piling (Zone 2-3)
- Ground level slab construction
- Excavation below track
- Zone 2 / 3 Concourse level construction

hs2 engine for growth

Option 11 – Existing Platform 3



Location	Existing Platform 3
Rail Access	North access only
Loading method	Conveyor via new tunnel under classic station.
Train movements	Directly from WCML slow lines at all stages (days or nights) Fast lines once line X is reinstated
Excavation train loading type	Static train
Capacity	Siding = 230m long 11 wagons = 698t Siding length = 224m
Stock pile facility	tbc
Train stabling facility	none
Road access	none
Serving area	Area 3 (Stage A) and Area 4 (Stage B1)



Availability

Pre 2017	2024				2025				2026			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4

2030				2031				2032				2033			
Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4

Appendix B

Appendix B – **IEA/IOA Network Rail Bogie Box** “Mussel” wagon

Length over buffers:
IOA: 13970mm

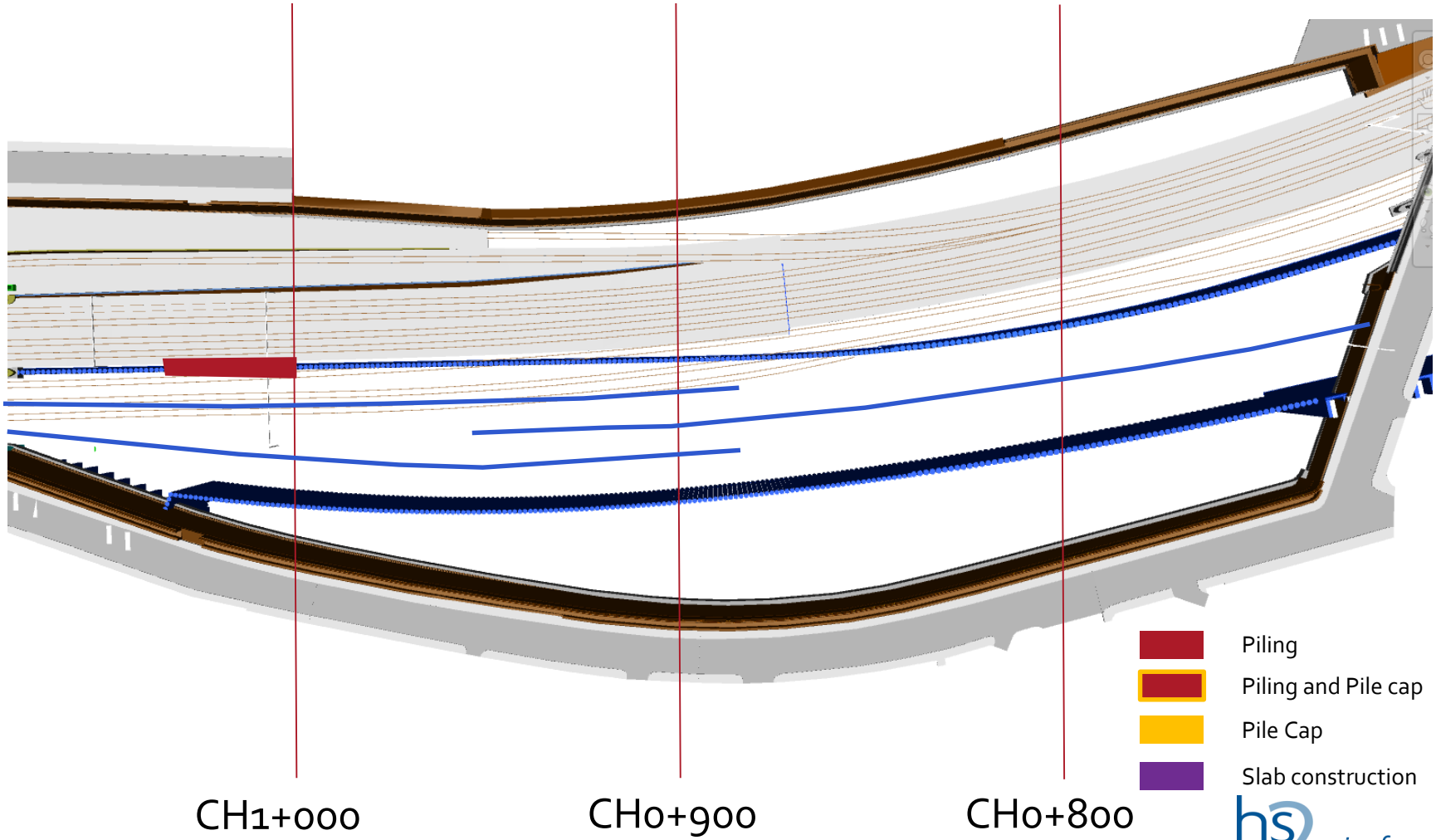
Bogie centres:
IOA: 8520mm

Height from rail:
IOA: 3212mm

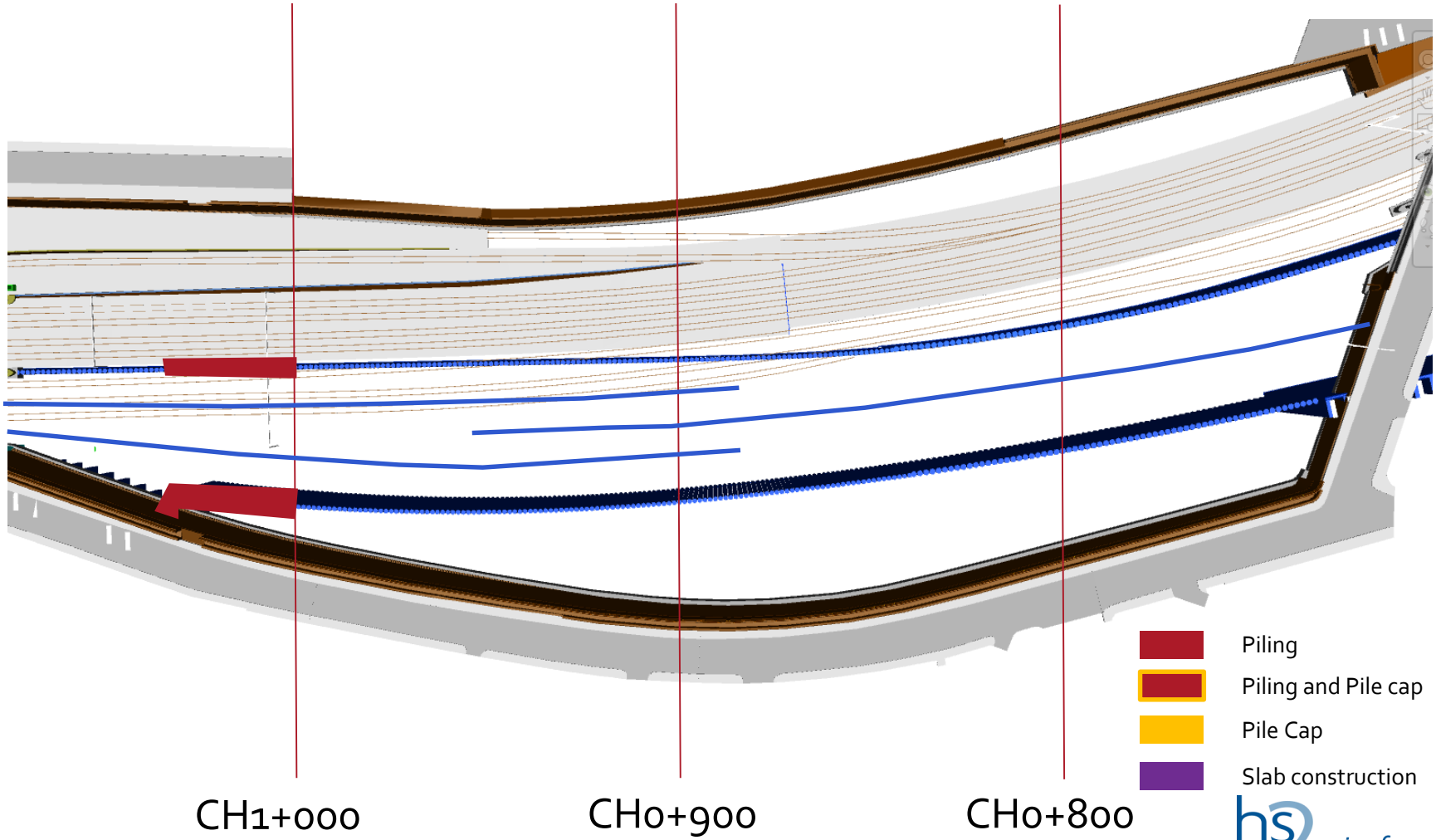
Payload
75 tonnes

Appendix C

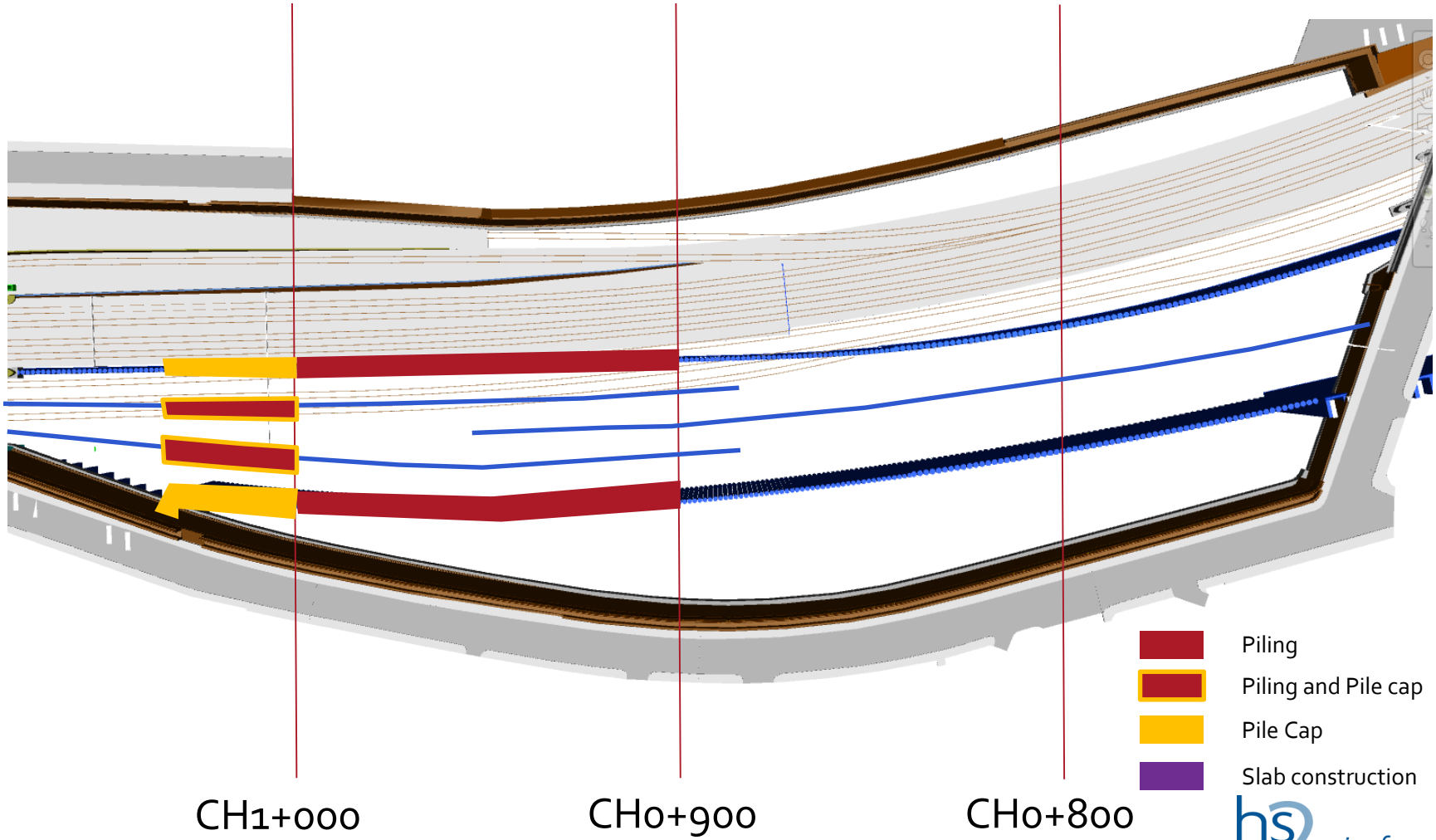
6.1.1 Backing Out Road 2 (static)- AP03 Programme Q2 2019



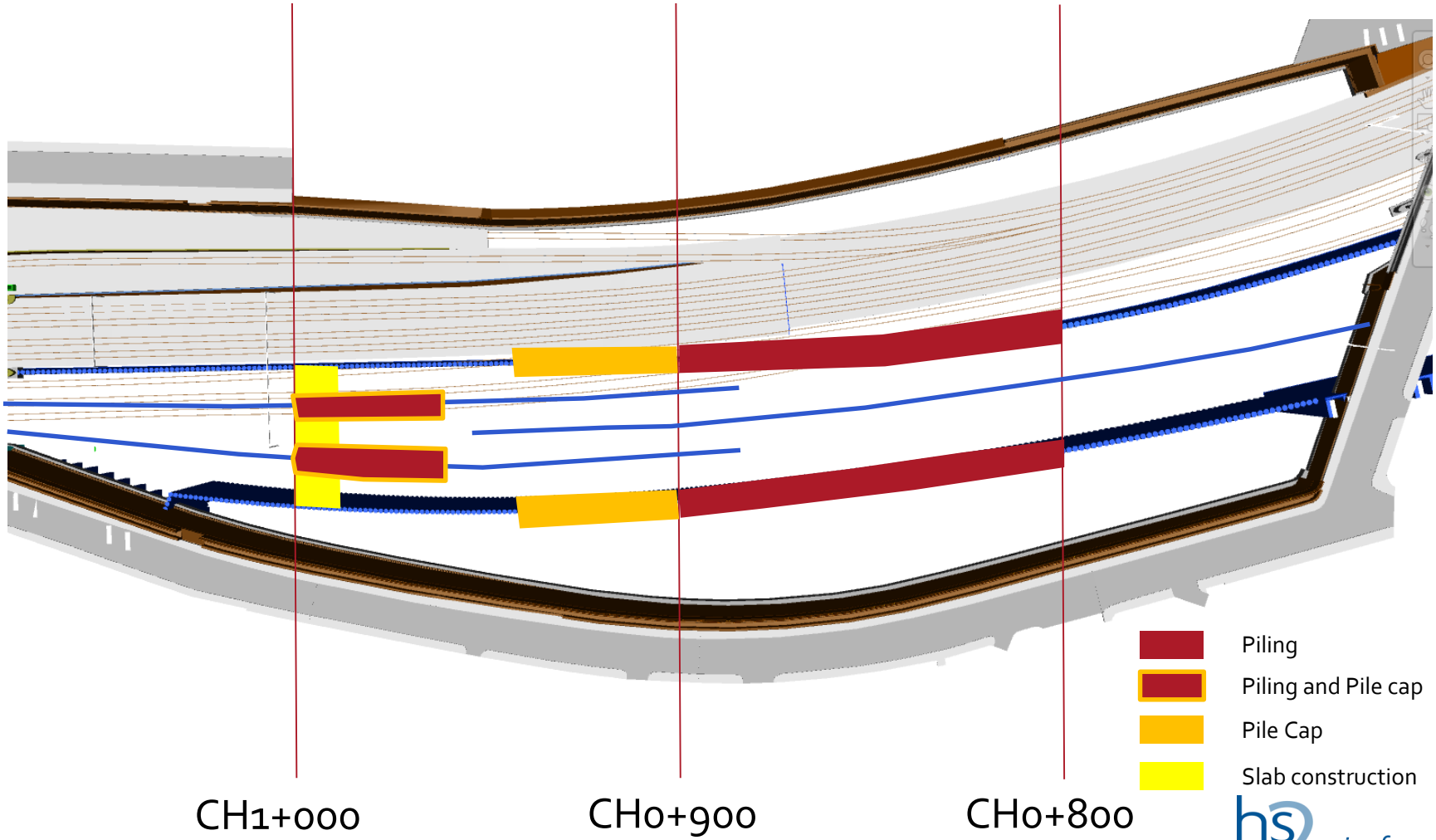
2019 Q3


Piling
Piling and Pile cap
Pile Cap
Slab construction
CH1+000
CH0+900
CH0+800

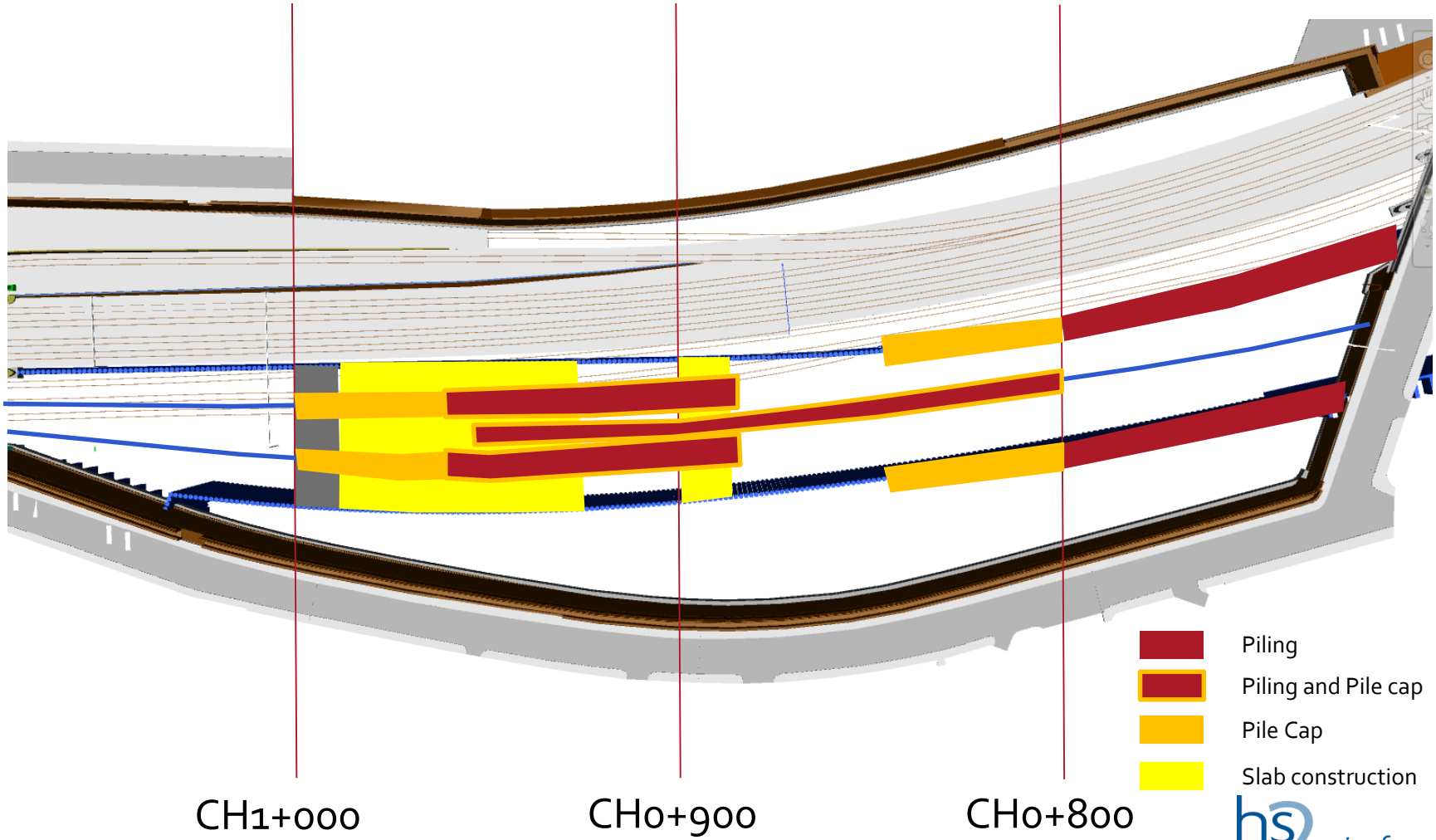
Q3 2019 to Q2 2020



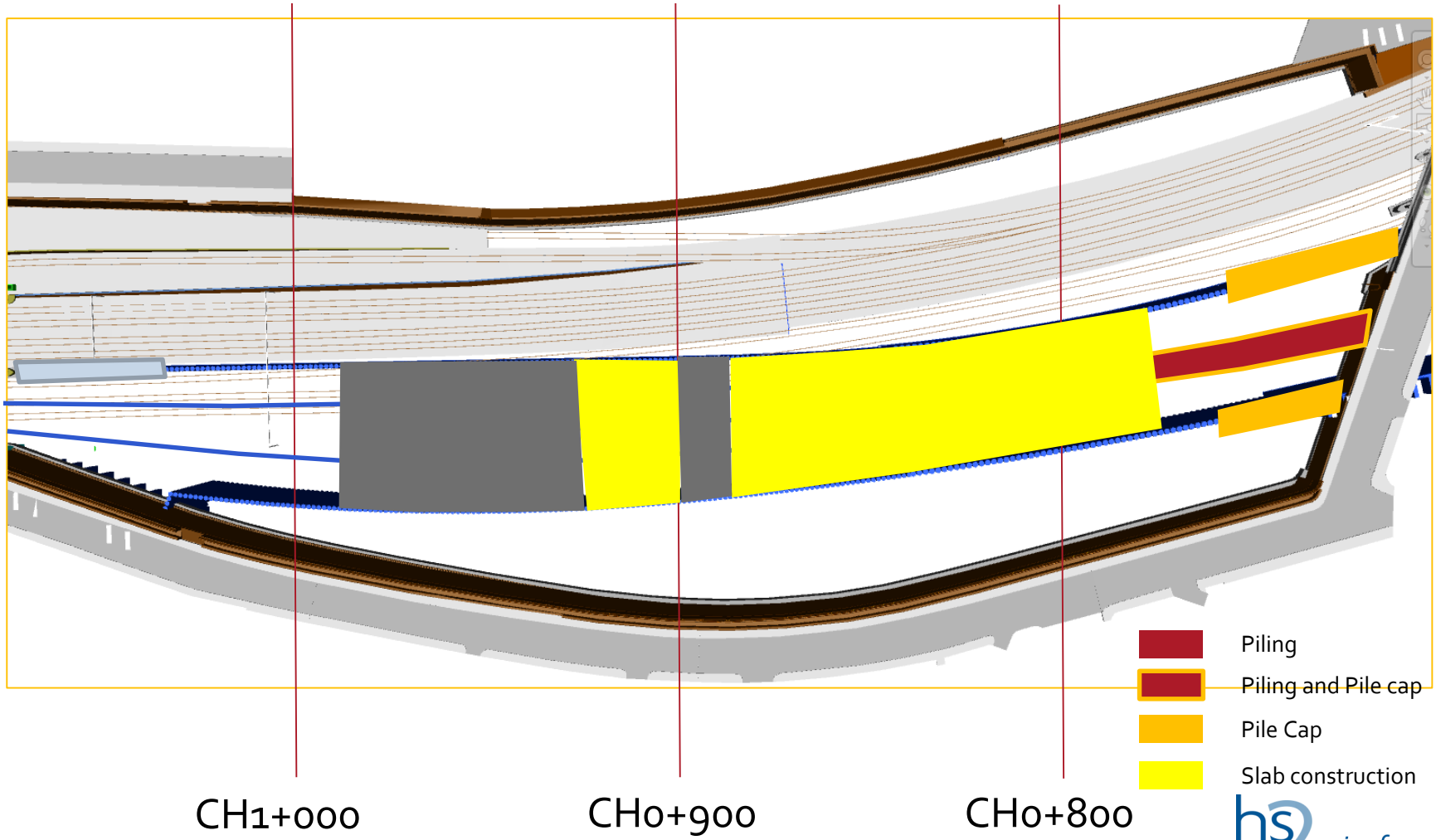
Q2 2020 to Q1 2021



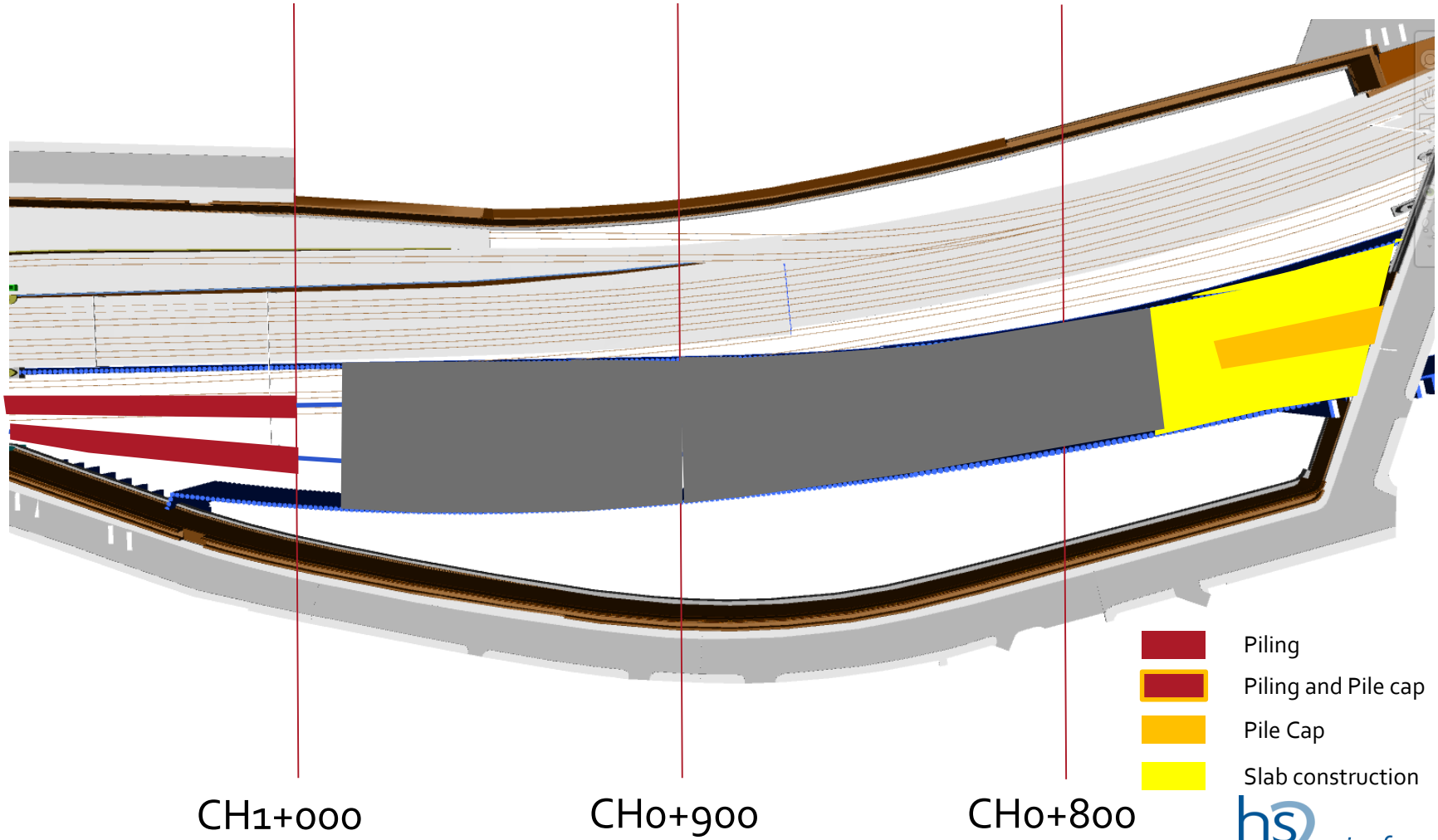
Q1 2021 to Q3 2021



Q3 2021 to Q1 2022

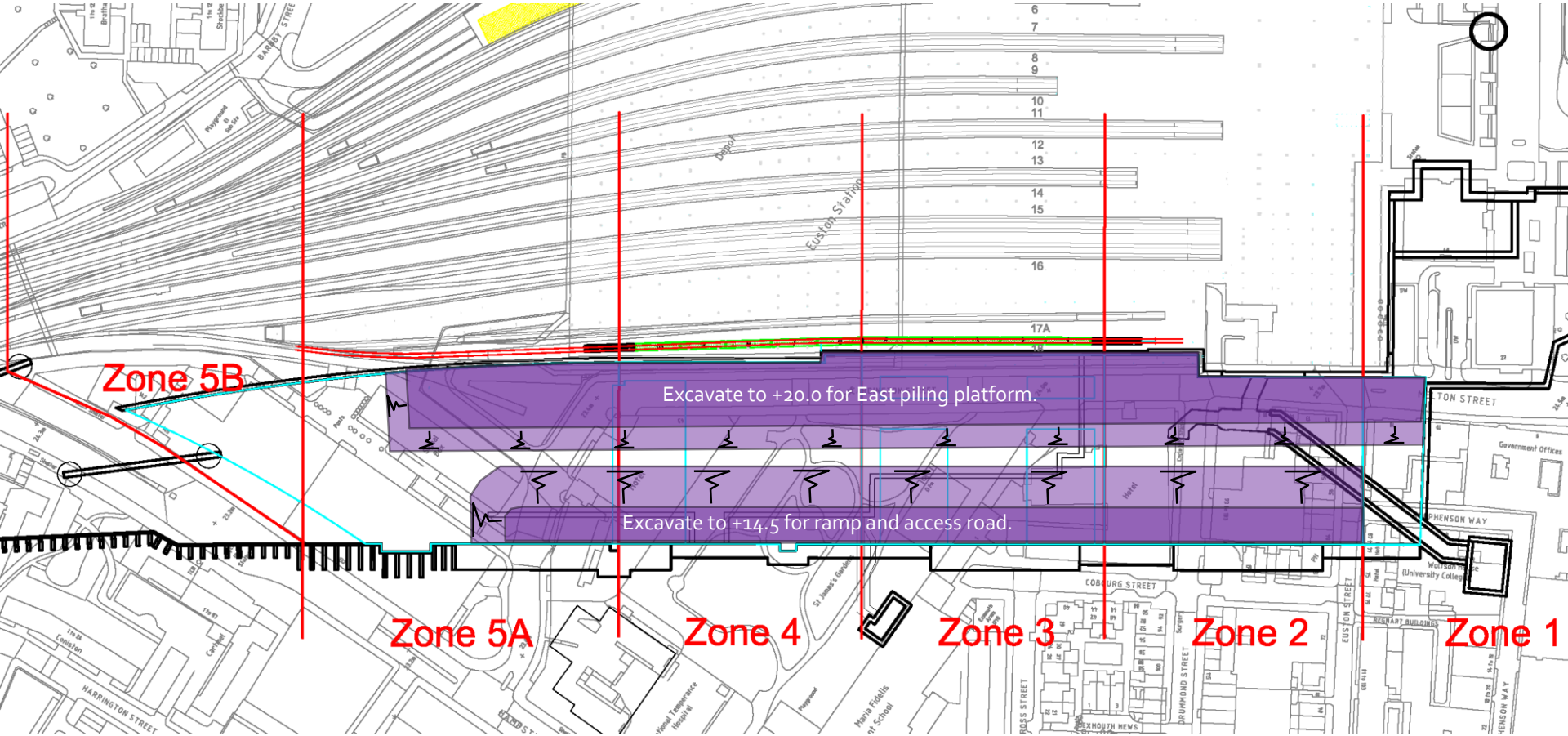


Q2 2022 to Q3 2022



Appendix D

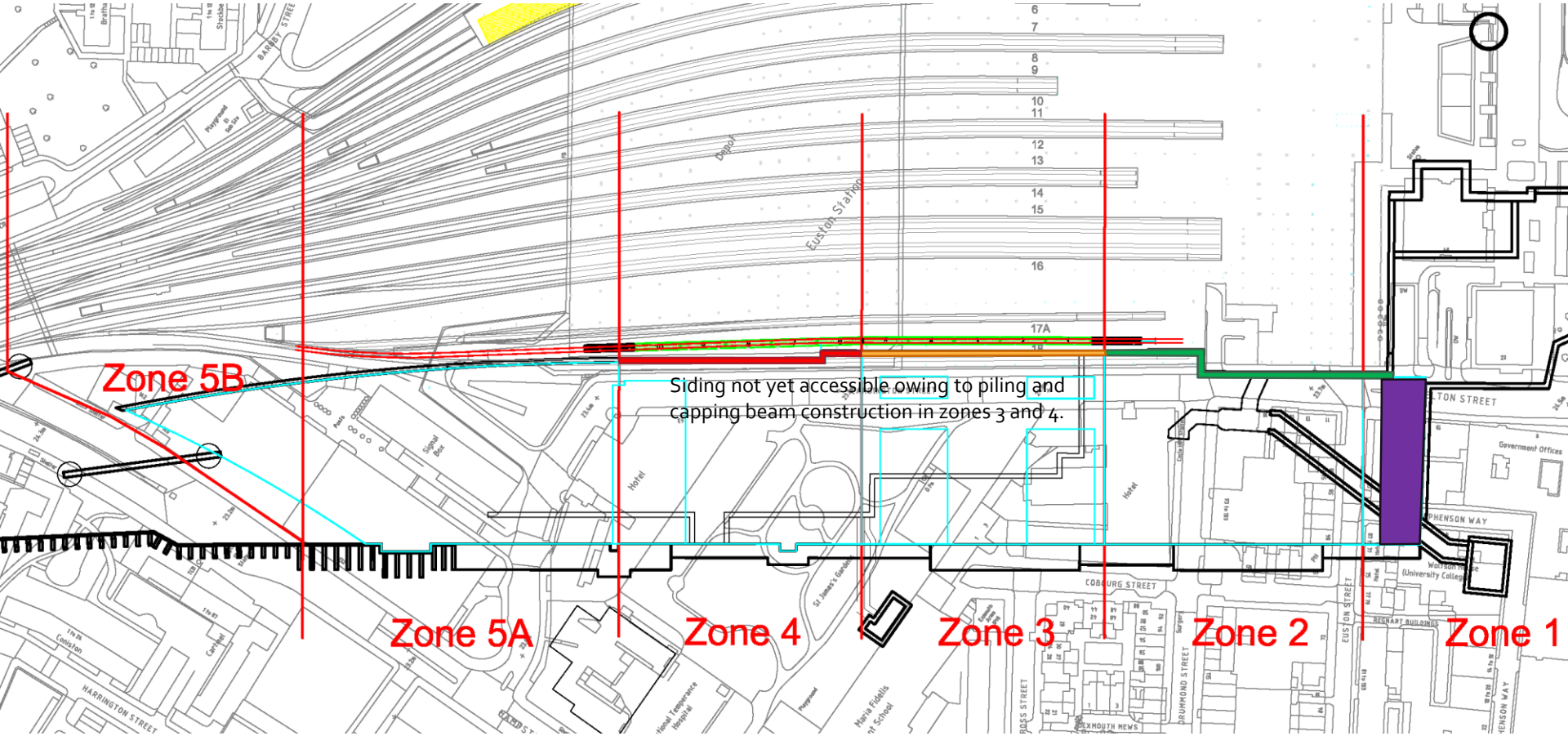
3f Stage A Station Excavation AP03
Prior to main excavation commencing



These slides visualise the AP03 programme for the Area3 construction of east retaining wall, excavation and platform level slab

hs2 engine for growth

3f Stage A Station Excavation AP03 Q4 2020



Install East Piles Z4

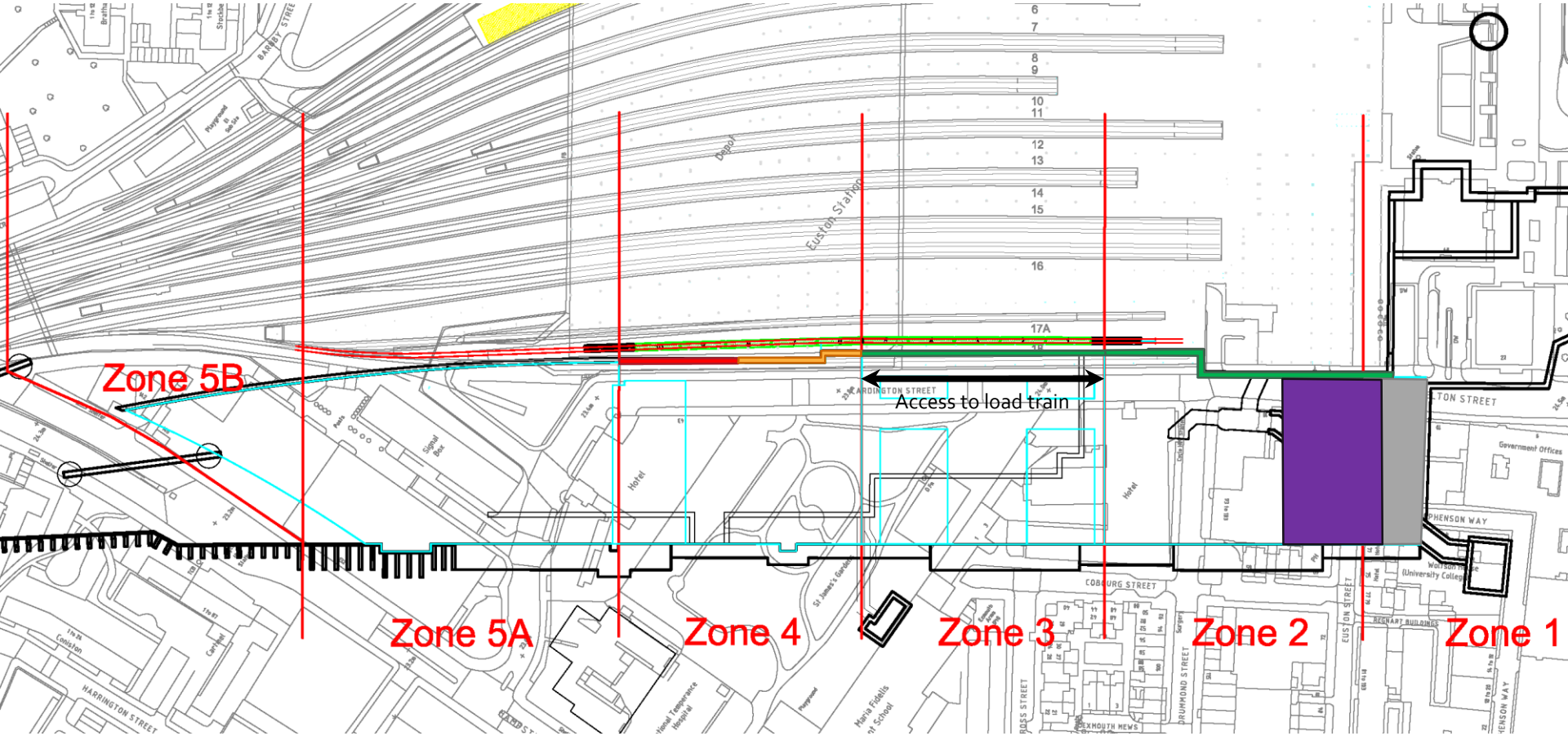
Install East Capping Beam Z3

Excavate Z1 600 m³ / day

Works to East wall ongoing in zones 3 and 4. Therefore no access to a train in P 18.
Z1 excavation has to go out by road.

hs2 engine for growth

3f Stage A Station Excavation AP03
Q1 2021



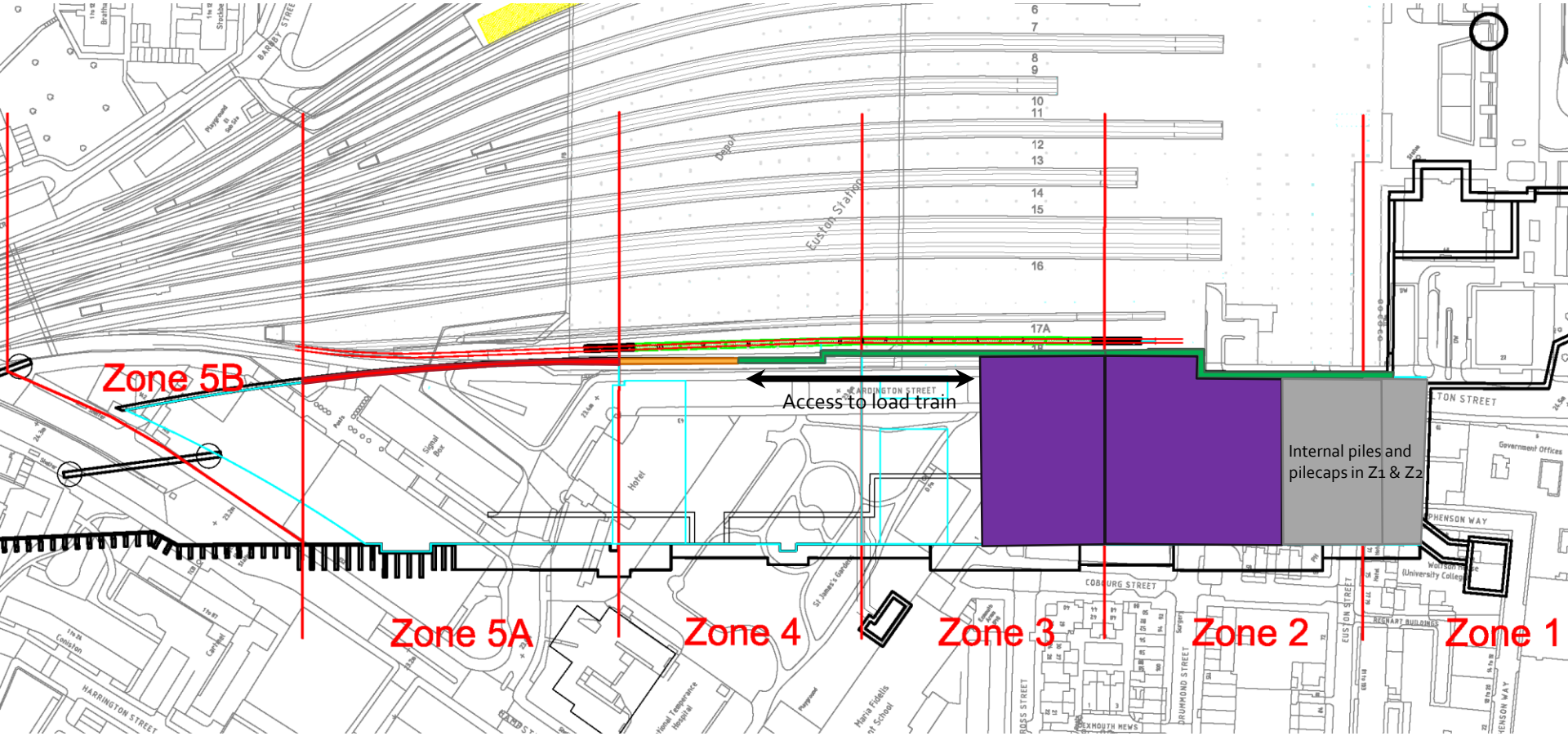
Install East Piles and Capping Beam Z4

Excavate Z2
600 m³ / day

Works to East wall ongoing in zone 4. Therefore access to half a train in P 18 loaded via zone 3. 150m3 per half train. Therefore 4 trains per day needed.

hs2 engine for growth

3f Stage A Station Excavation AP03
Q2 2021



Install East Piles and Capping Beam Z5A

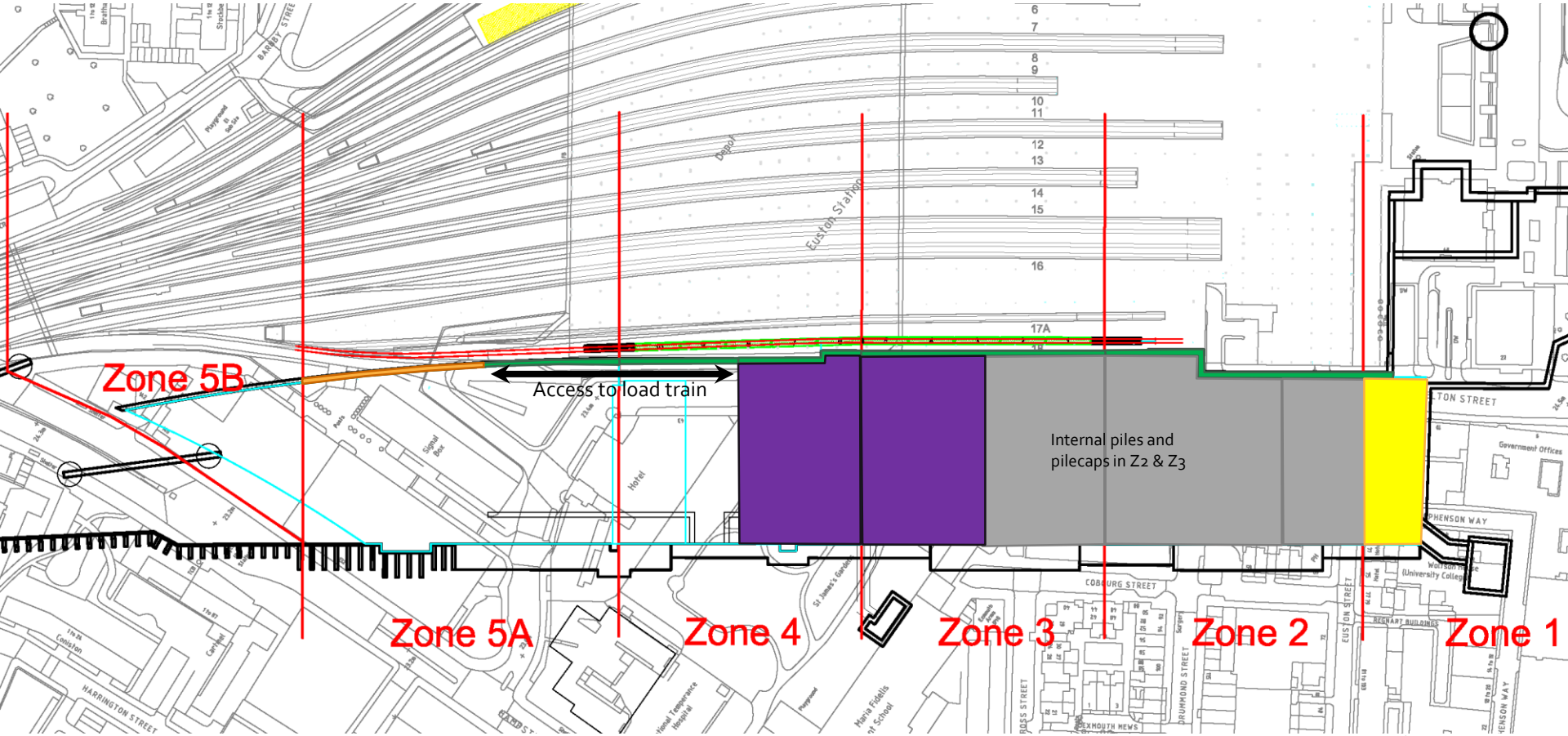
Install East Capping Beam Z4

Excavate Z2 and Z3
600 m³ / day

Works to East wall ongoing in zone 4 and 5A. Therefore access to ¾ of a train in P 18 loaded via zone 3 and part of zone 4.
225m³ per 3/4 train. Therefore 3 trains per day needed.

hs2 engine for growth

3f Stage A Station Excavation AP03 Q3 2021



Install East Capping Beam Z5A

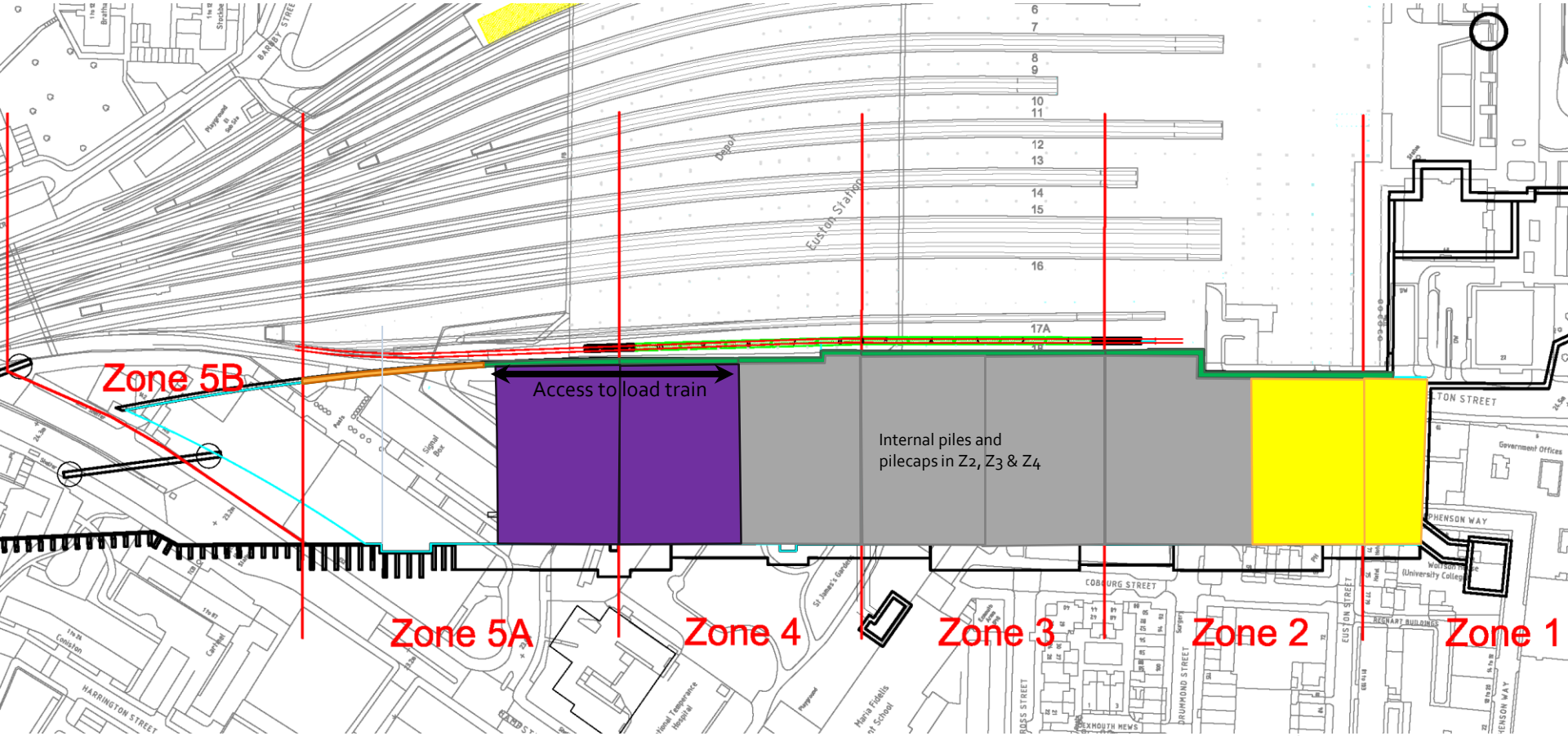
Excavate Z3 and Z4 600 m³ / day

Platform level slab at +15.5 in Z1

Works to East wall ongoing in zone 5A. Therefore access to 1/2 a train in P 18 loaded via parts of zones 4 and 5A plus some movement of train. 150m³ per 1/2 train. Therefore 4 trains per day needed.

hs2 engine for growth

3f Stage A Station Excavation AP03 Q4 2021



Install East Capping Beam Z5A

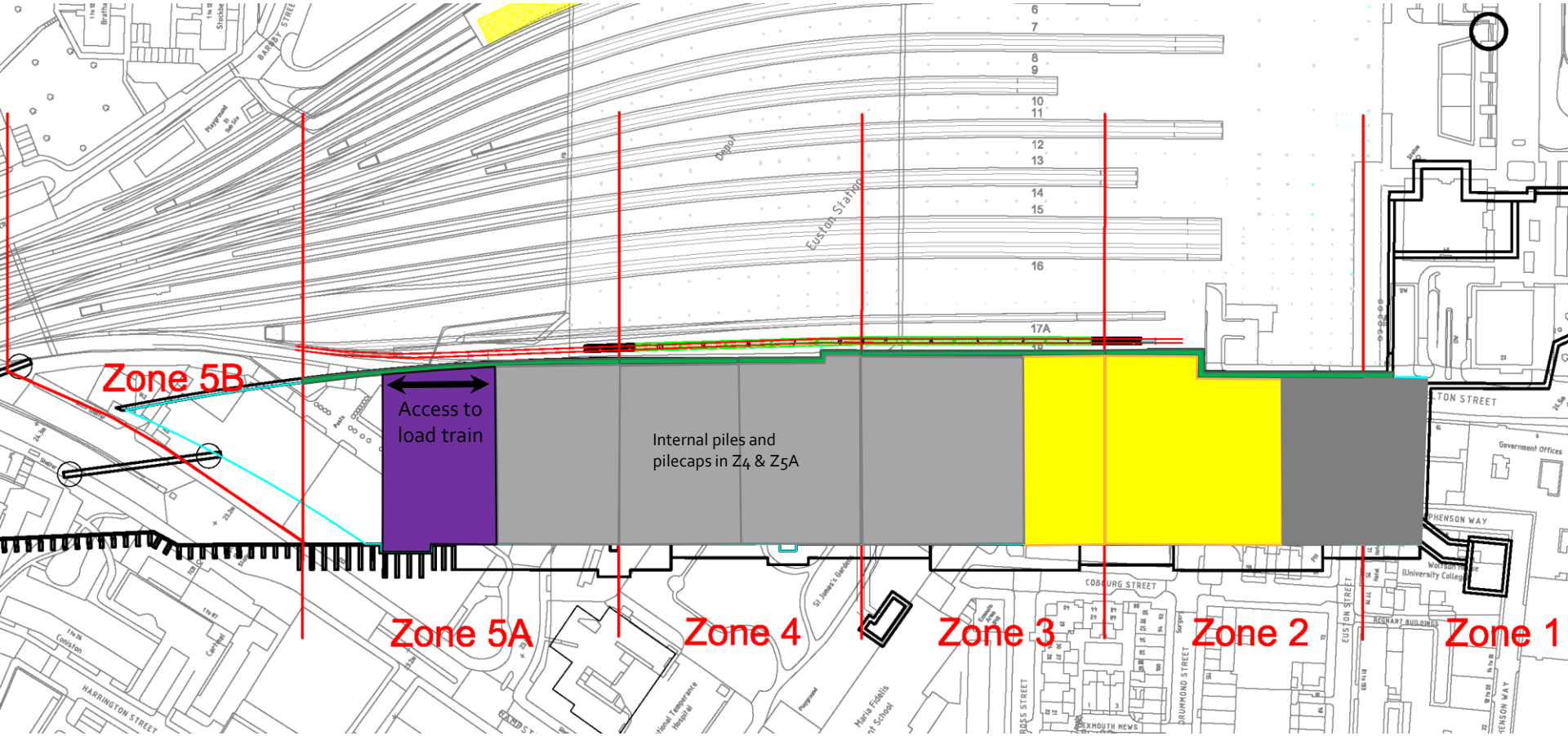
Excavate Z4 & 5A 600 m³ / day

Platform level slab at +15.5 in Z1 & Z2

Works to East wall capping beam ongoing in zone 5A. Therefore access to 1/2 a train in P 18 loaded via parts of zones 4 and 5A plus some movement of train. (Loading point is now within excavation area) 150m³ per 1/2 train. Therefore 4 trains per day needed.

hs2 engine for growth

3f Stage A Station Excavation AP03 Q1 2022



Excavate Z5A
600 m³ / day

Platform level slab
at +15.5 in Z2 & Z3

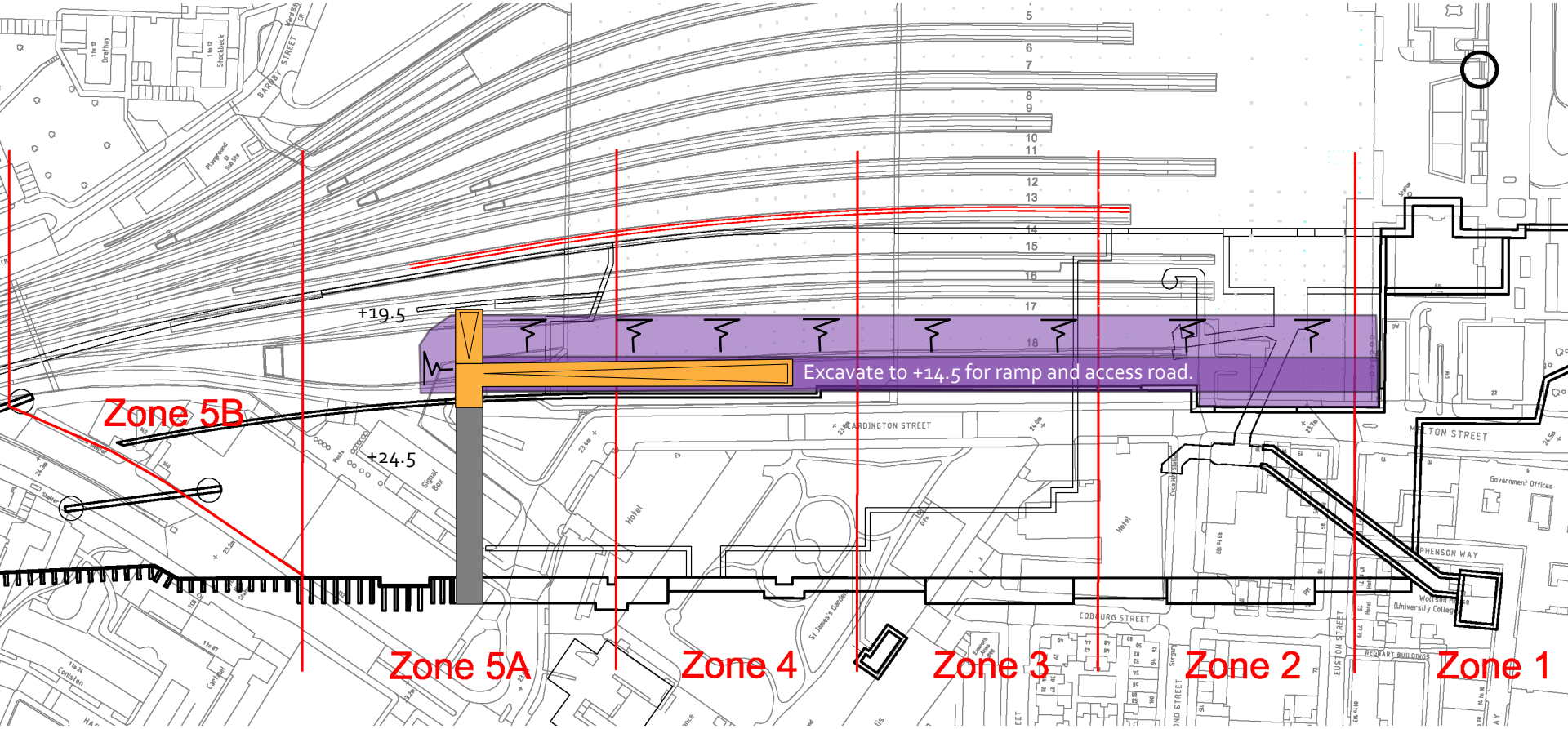
Works to East wall complete. Access to 1/4 train in P 18 from loading point in dig area of 5A.
75m³ per 1/4 train. Therefore 8 trains per day needed.

hs2 engine for growth

Appendix E

10.1.1 Stage B1 – Platform 13 Siding - Station Excavation AP03

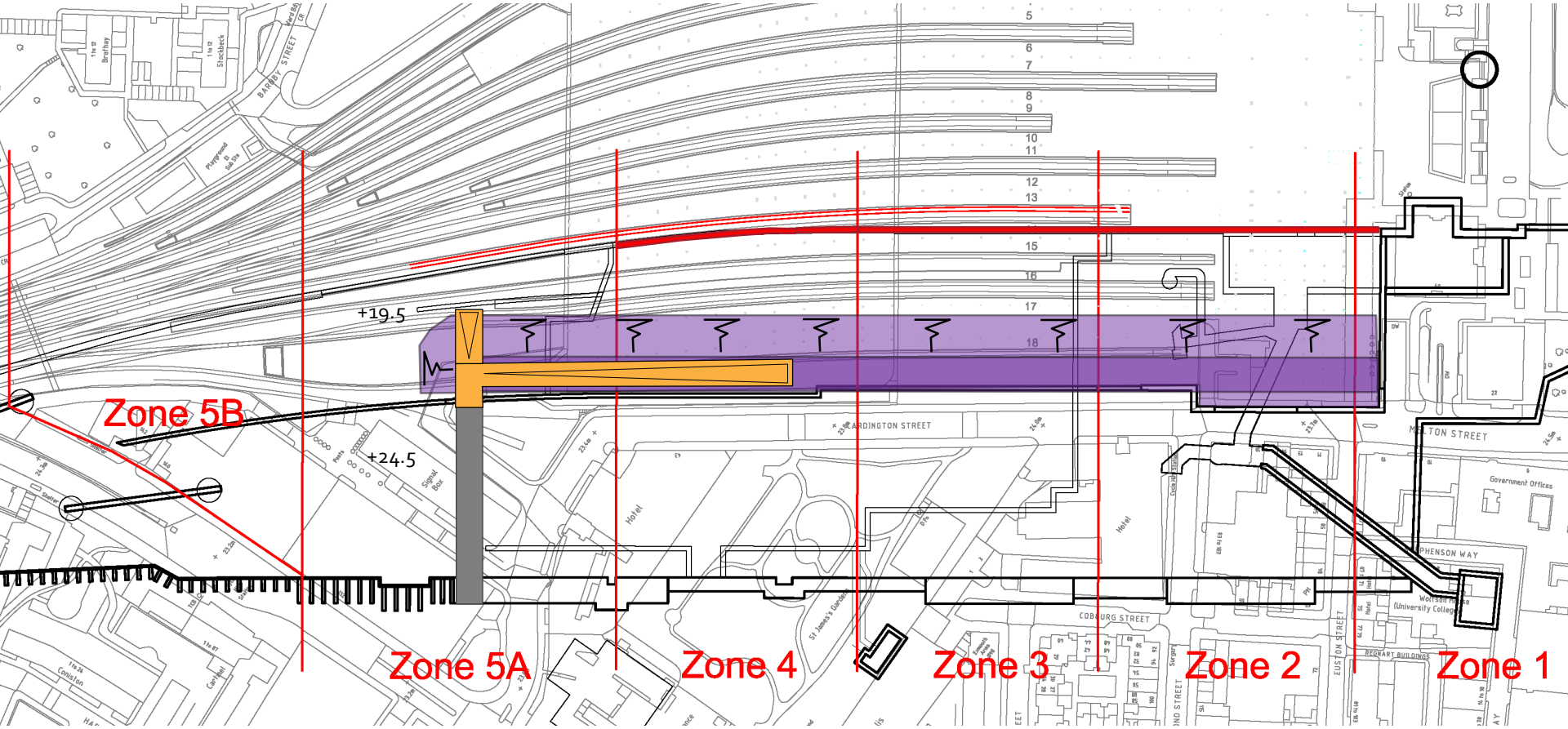
Prior to Q4 2028 excavate to 14.5 for ramp & access road



These slides visualise the AP03 programme for the Area 4 construction of east retaining wall, excavation and platform level slab.

10.1.1 Stage B1 – Platform 13 Siding - Station Excavation AP03

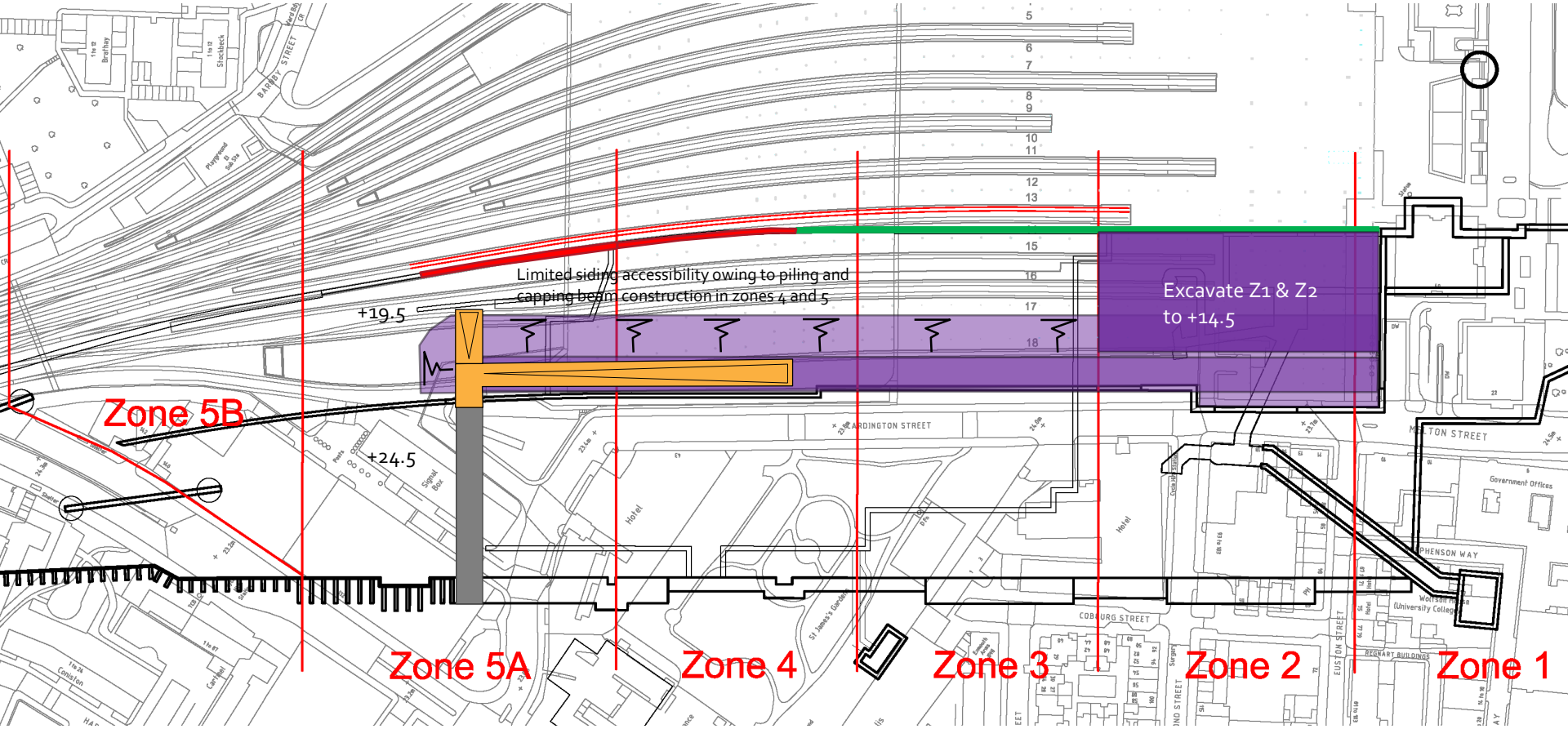
Q4 2028 to Q1 2029 Piles and capping beam to East wall Zones 2 to 4



These slides visualise the AP03 programme for the Area 4 construction of east retaining wall, excavation and platform level slab.

10.1.1 Stage B1 – Platform 13 Siding - Station Excavation AP03

Q2 2029 to Q3 2029 Excavation Zones 1 & 2

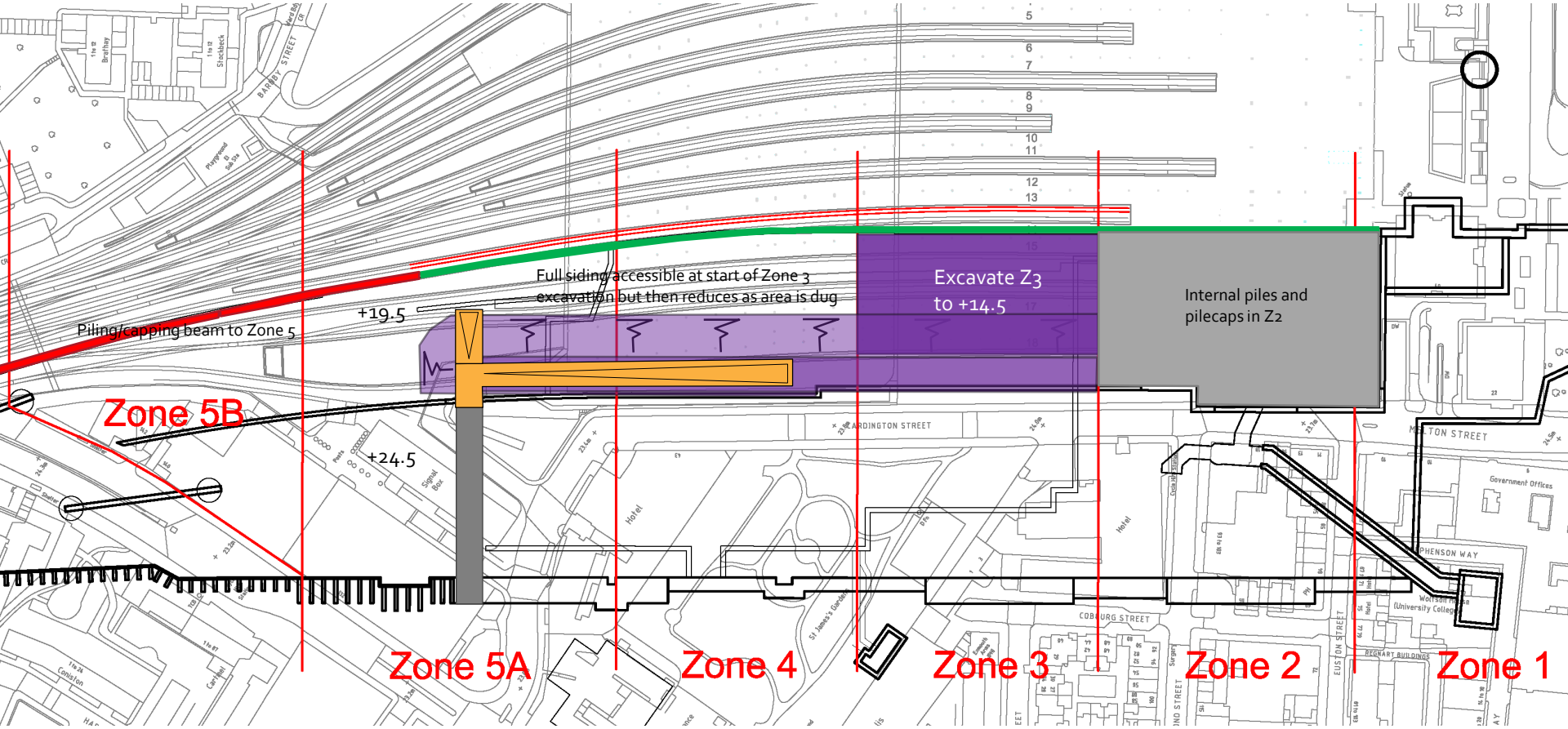


Excavate Z1 & Z2

These slides visualise the AP03 programme for the Area 4 construction of east retaining wall, excavation and platform level slab.

10.1.1 Stage B1 – Platform 13 Siding - Station Excavation AP03

Q4 2029 Excavation Zone 3

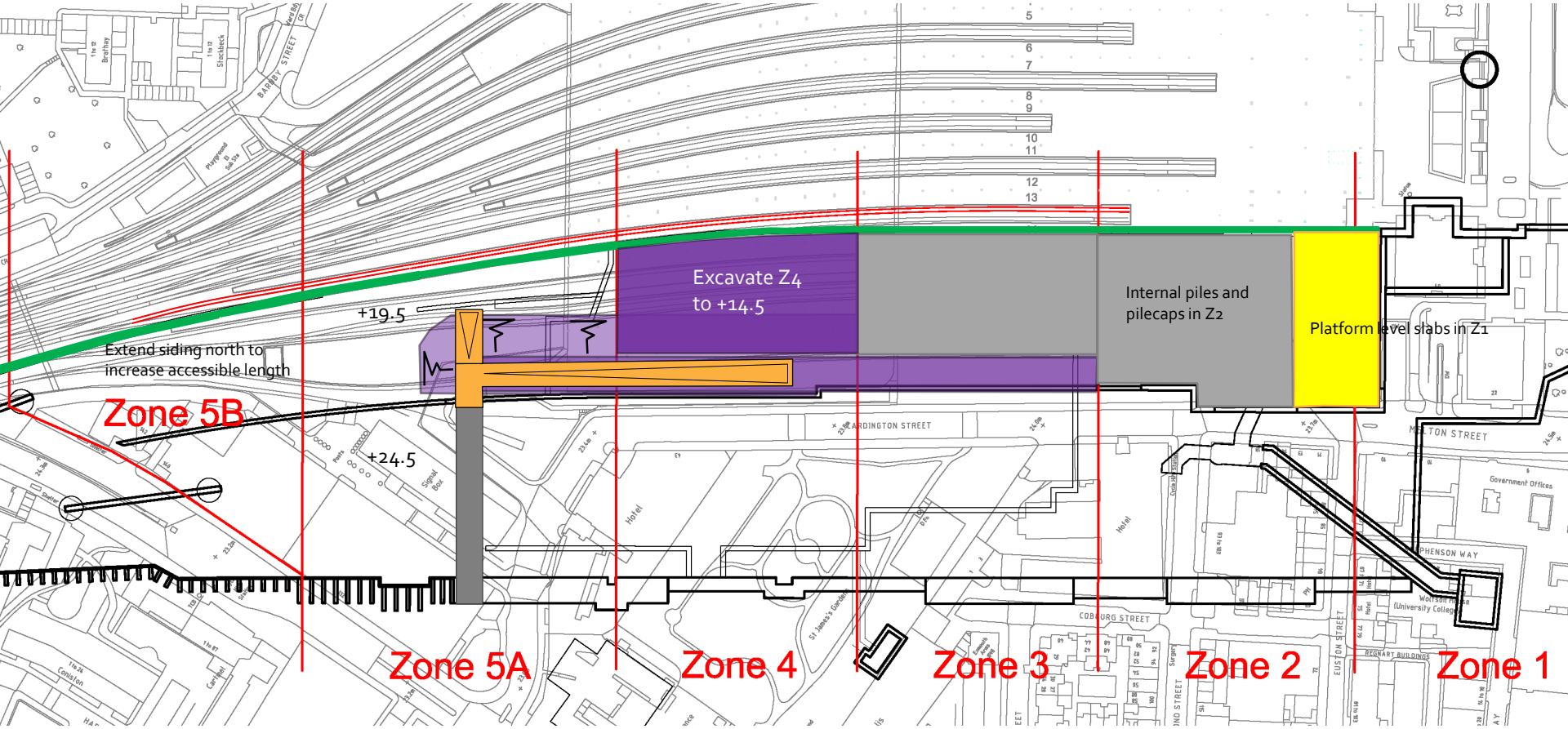


Excavate Z3

These slides visualise the AP03 programme for the Area 4 construction of east retaining wall, excavation and platform level slab.

10.1.1 Stage B1 – Platform 13 Siding - Station Excavation AP03

Q1 and Q2 2030 Excavation Zone 4

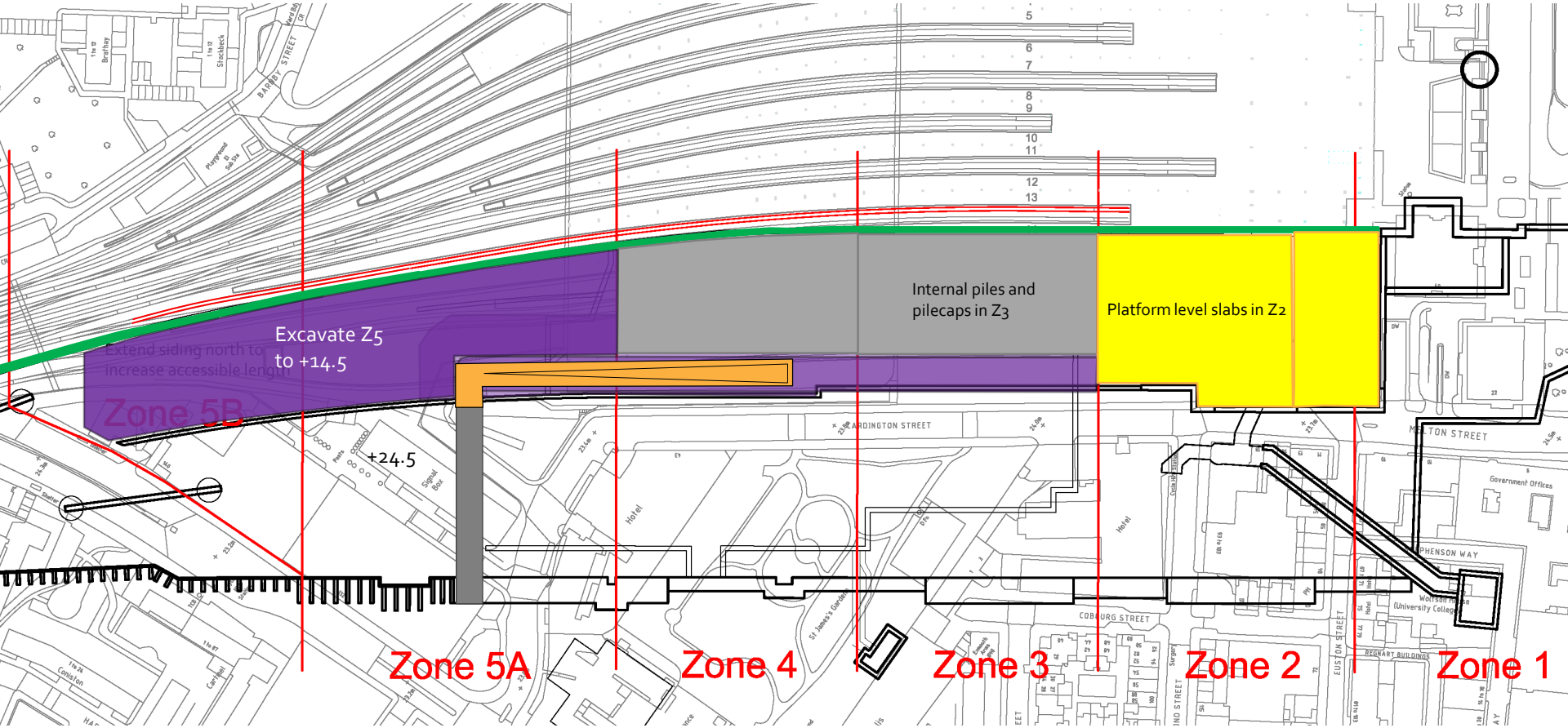


Excavate Z4

These slides visualise the AP03 programme for the Area 4 construction of east retaining wall, excavation and platform level slab.

10.1.1 Stage B1 – Platform 13 Siding - Station Excavation AP03

Q3 and Q4 2030 Excavation Zone 5



Excavate Z5

These slides visualise the AP03 programme for the Area 4 construction of east retaining wall, excavation and platform level slab.