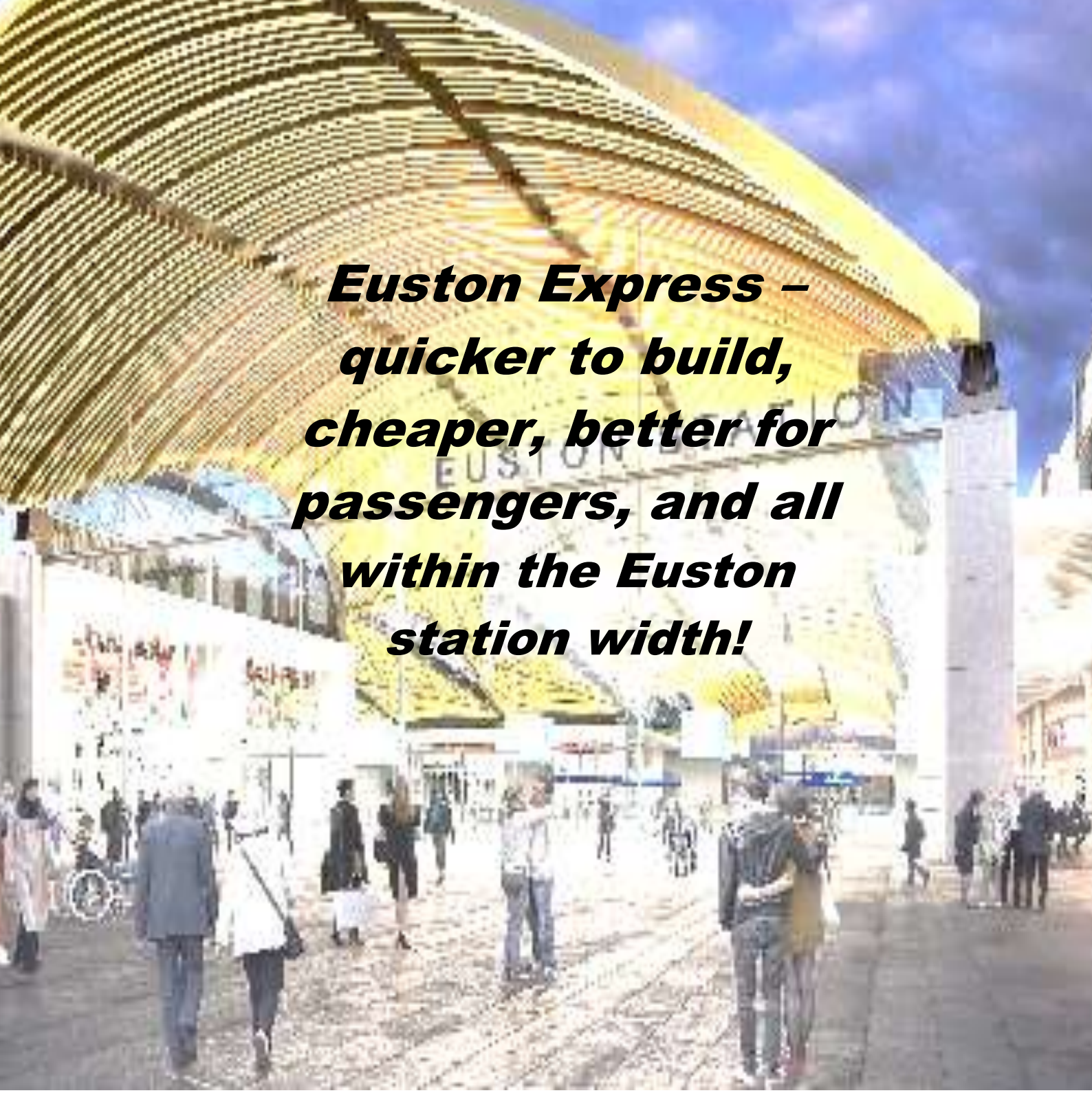


RE-VISIONING EUSTON: THE EUSTON EXPRESS PROJECT

BETTER FOR THE ECONOMY, THE NATION, PASSENGERS, CAMDEN AND LONDON – AND FOR HS2

September 2015

RE-VISIONING EUSTON: THE EUSTON EXPRESS PROJECT

PROJECT DESCRIPTION - SEPTEMBER 2015

Contents **Page No**

List of Figures

Cover picture from Department for Transport

EUSTON EXPRESS

Executive Summary

1. Euston Express would provide a robust, incremental, lower cost and lower impact scheme for the London end of HS2 to terminate at Euston, but without the massive environmentally damaging and costly new construction in a sensitive city environment of the HS2 Ltd. scheme. It follows the example used by high speed lines in France and Germany which generally use their classic lines, sometimes upgraded, for the last 5 or 10 km into city termini.

The project

2. Euston Express comprises the construction of two short HS2 tunnels east from Old Oak Common, to surface within 2 miles onto the West Coast Main Line formation near Queens Park station, with other WCML lines diverted onto little used parallel lines and new train paths provided so that WCML and HS2 services both use the existing tracks from there into Euston.

3. Crucially, the existing station width footprint can accommodate the forecast number of trains from both HS2 and WCML, with some additional platforms created if necessary where existing platforms are very wide. Some platforms would be lengthened to the south to accommodate eventual 400m HS2 trains. A deck above the station platforms would provide access and exits from trains and the station amenities for all train services there (WCML and HS2) as well as improved access to Underground, bus, taxi, cycles etc.

4. A comparison table of the key elements in the Euston Express and the HS2 scheme follow at the end of this summary

Passenger numbers and train services

5. Euston Express has analysed forecasts and data from both HS2 Ltd. and Network Rail about future growth in demand and the number of trains required up to 2040 and beyond. Interestingly, the growth in commuter traffic and actual passenger numbers may well be greater than those of HS2, but the six tracks and 18 to 22 platforms available when Euston Express is complete can cope with these numbers within the width of the station footprint.

6. Clearly it is as important to ensure that passenger interchange between rail and Underground, bus, cycle and walking is as easy and convenient as possible, and Euston Express believes that this will necessitate an integrated WCML station taking into account access to Crossrail 2 and any relevant changes to the road layouts and use in the adjacent areas.

Trains

7. Euston Express would use UK gauge trains, called classic compatible, which can run virtually anywhere on the UK network as well as on HS2 at high speed. There is no benefit in HS2's proposal to purchase a separate number of 'European gauge' trains which, for Phase 1, could only operate between Euston and Birmingham. There is no cost benefit in European gauge trains, and purchasing two types will certainly be more costly than one. Using classic compatible trains enables Euston Express to operate these trains on the last four miles of the West Coast Main Line into Euston.

8. Thus, eliminating the need for captive 'European gauge' GC trains for the first decades of the HS2 project , and the need for a 'European gauge' approach to Euston vanishes, along with separate 'European gauge' platforms, and all the related approaches, demolition and construction complexities, impacts and costs.

9. HS2 Ltd. specify[1] train speeds as 360 kph maximum. This is higher than the standard 300 kph on the French high speed lines, which were originally designed to operate at 270 kph and only after some years' successful operation, was speed increased to 300 kph on the original Paris Lyon section. Whereas this section takes 2 hours, London to Birmingham will take just 49 minutes[1]. Euston Express classic compatible trains can be built to achieve 360 kph but manufacturers tell us that increasing the speed from 300 to 360 kph can increase the cost by up to 50%. We question whether this is justified to save a few minutes to Birmingham, especially when trains will have to operate at lower speeds in the long HS2 tunnels through the Chilterns.

10. **Thus the additional infrastructure costs for European gauge approaches to new city centre termini such as Euston are additional costs driven by the European gauge specification, and therefore should properly be ascribed to that design option.**

The longer term

11. Euston Express would provide a cost effective solution for the London terminus of HS2 and integrating it with the WCML services.

12. There may come a time, however, in 20 or 30 years' time, when there is a more comprehensive high speed network in the UK reaching Scotland, the North East and perhaps elsewhere, and when there is an identified need to connect to HS1 to provide through services to the South East and the continent. This could justify the construction of European gauge trains, which could be double deck as the TGV Duplex. At that stage, a new East-

[1] HS2 technical appendix

West connection to HS1 could be built – to European (GC) gauge, with one or more stations in the London area. To achieve a reasonable business case, it would have to carry domestic Thameslink-type services as well. Euston Express proposed that passive provision be made for such a link within the tunnels between Old Oak common and Queens Park. At this stage, a higher operating speed of, say, 360 kph would be justified by the longer distances to be travelled on high speed lines.

Benefits for passengers

13. Disruption to passengers during construction would be much less and of shorter duration, than the HS2 Ltd. Scheme since many of the existing platforms would be unchanged. Construction of a deck above stations has been done successfully at other stations, including London Victoria Brighton lines, whilst retaining train operation below. Extending platforms southwards to take longer HS2 trains can similarly be done whilst other parts of the platforms are in use.

14. Euston Express would also integrate the HS2 services with those of the West Coast Main Line giving passengers one station with services and access to Underground, bus, taxis and cycles integrated, including provision for interchange with Crossrail 2.

15. Construction time at Euston would be significantly reduced compared with HS2 Ltd.'s proposal, where one can envisage 15 to 20 years of works from start of the HS2 platform and approaches excavations to completion of any improvements for WCML passengers.

Benefits for the community

16. The community around Euston is very concerned about the damage that the HS2 scheme at the west of Euston and its approaches would cause. Construction of the HS2 station and underground services area below would involve massive excavation and construction work; rebuilding and lengthening of Hampstead Road Bridge could take years, due to the complexity and range of services to be diverted and the need to raise the height by several metres. Works between this bridge and the portal affect many properties either temporarily or permanently. Overall, HS2 estimate that there will be the need for 650 lorry movements a day in and the same out over several years just for spoil removal, with parking for them planned to be near London Zoo. It is very unreasonable to expect any urban community to permit this to happen when an alternative scheme that works can be done with minimal intrusion by using the existing railway tracks with permanent works confined within the railway ownership boundaries.

17. Euston Express also proposed access to all parts of the station from the North side, to facilitate passenger flows and better incorporate the new station into the surrounding community.

Development opportunities

18. Euston Express is a project designed to create a station terminus that works for the community and passengers. There would be retail opportunities on the deck above the tracks and elsewhere. The extent to which new tower block for offices are built over the station is a separate issue for the local authorities, as is any proposal to develop areas around or above the tracks for housing.

Next steps

19. This paper was prepared before changes announced by HS2 Ltd. in early September could be analysed. Euston Express will respond to any such new information as quickly as possible. It is likely that this will form part of a revised petition against additional provisions in the HS2 Bill.

20. This Report is being sent to ministers, HS2 and other interested parties, urging them to consider these proposals seriously and enter into detailed discussion on how they can be implemented.

Further information:

Lord Berkeley
House of Lords
London SW1

Contact Tel 07710 431542, berkeleyafg@parliaemnt.uk

It will be posted on Lordsoftheblog Lord Berkeley.

Key elements in Euston Express proposal compared with HS2 scheme

	Euston Express	HS2
HS trains		
Size of HS trains: Classic compatible	All	12
Captive to HS lines	None	remainder
HS train passenger capacity and lengths	Same as HS2	
Number of HS trains	Same as HS2	
HS trains minimum commercial operating top speed.	360kph 300kph recommended	360 kph
Euston approaches	on WCML from Queens Park	Tunnel to Park St, then on surface through residential area
Work on WCML	DC tunnel re-bore Track slewing Flyunder for Bakerloo	Some N of Euston
Euston terminus		
HS2 station.	Within Euston station width	Extensive development and land take
Extension to South towards Euston Road	Yes	Yes
Integrate HS2 station with Existing WCML services	Yes	No
Truck movements from Euston and approaches	Existing station works only, using rail where possible	650 in and 650 out daily
Construction time	**less than HS2**	
Cost	**£1.5 to £2 bn Less than HS2**	

The authors

This proposal has been compiled by Lord Berkeley and Jonathan Roberts. Lord Berkeley is very grateful to Jonathan Roberts who has done much of the work and on a pro bono basis, and to all those from parliament, local government, the rail industry and local residents who have contributed or commented.

Lord Berkeley[2] is a civil engineer and worked on the construction of the Channel Tunnel, before becoming Chairman of the Rail Freight Group. He is also a Board member of the European Rail Freight Association and is a regular contributor to debates and legislation on rail issues in the House of Lords.

Jonathan Roberts is Managing Director of Jonathan Roberts Consulting[3] and is an acknowledged expert on the logistics, planning and the politics of transport, as well as an authority on UK's railways.

The authors were motivated to undertake the work necessary to develop Euston Express by concerns about the unnecessary upheaval and waste of money in the HS2 proposal for the Euston area and approaches, and by its failure to properly integrate the HS2 services with those of the West Coast Main Line and public transport in the area.

They have not received any funding for this work.

[2] http://www.parliament.uk/biographies/lords/lord-berkeley/3526
[3] http://www.jrc.org.uk/

1. The Euston context – and HS2's problem

The context for the Euston Express project is as an incremental, lower cost and lower impact and risk scheme, compared to recent HS2 options for Euston terminus and approaches. Euston Express would also be quicker to deliver, and cause much less disruption to both passenger and residents affected by the HS2 scheme.

HS2 is intended as a top priority national enabling project, offering new intercity transport capacity on one of Britain's busiest corridors, a lever for national economic growth, and re-balancing UK's northern and southern capabilities and connectivity.

To appreciate the importance of Euston Express as a proposition, it is necessary to recognise that a settled scheme for HS2 in the Euston area has yet to be devised.

There have been multiple HS2 Ltd. proposals so far, all of which have encountered combinations of problems ranging from affordability, to constructability, to causing major environmental impacts in a high density part of Central and Inner London. The project could fail unless HS2 Ltd. can find a viable, affordable and deliverable scheme to reach a Central London station, one which incurs low construction impacts relative to the scale and cost of works and identified regeneration and economic growth benefits. The possibility of an Old Oak terminus for HS2, or adoption of alternative termini or through running, has been posed by others. HS2 would in large measure divert existing West Coast Main Line (WCML) intercity flows from Euston in Phase 1, and from St Pancras and Kings Cross in Phase 2. So there is much merit in enabling many or all HS2 trains to terminate at Euston, at least for Phase 1 with a continuing role beyond then.

It can be debated whether HS2 Phase 2 trains should somehow head to other London stations. The option of not all HS2 trains ending up at Euston is available for consideration by the Select Committee. Euston Express as a proposition could co-exist with another London station – it is assumed that any such other station would be reached via Old Oak's additional platforms originally intended for HS2-HS1 trains.

If there were fewer trains aimed at Euston, then fewer platforms would be required there, and possibly fewer track changes as well on the approaches. However Euston Express has been developed as a proposal providing adequate capacity for the complete HS2 scheme (Phases 1 and 2), as well as continuing to accommodate 'classic' West Coast main line (WCML) and commuter services within the present station width.

1.1 The four failed Euston proposals

There have been at least four proposals for Euston terminus in recent years:

- An original Network Rail and developer proposal to rebuild Euston station in 2007/8. The announcement of HS2 with its current European gauge

specifications meant that this scheme lapsed. Potentially it also passed the whole rebuilding cost of the station to HS2.

- The 'Option 8' scheme in the HS2 Phase 1 Bill, which was for a two-part terminus. The HS2 European-gauge element would have been built using platforms 14-18 of the existing station, with new platforms occupying non-railway land to the west (11 platforms). This did not include a rebuild of the remaining part of the West Coast Main Line station.

    - In combination, the exclusion of a rebuild for the WCML station, the construction impacts of HS2 on the Euston terminus, the neighbouring approach lands and on HS2's new approaches, plus the failure to respond sufficiently to LB Camden's Euston Area Plan (EAP) priorities, created an unacceptable scheme.

    - On the station approaches, as in all the HS2 schemes, a disruptive new terminus approach in deep cutting would be built for 'European gauge' trains on the west side of the WCML approaches, with its own impacts of land take and large construction in an environmentally sensitive area.

- A 'level deck' scheme advocated in 2014, up to 3.5m deeper across the existing terminus site (with consequential vast amounts of demolition and spoil removal), in order to create a 'developer-friendly' environment. HS2 could not make this scheme affordable, so it was abandoned.

- A reversion to something similar to HS2 Ltd.'s 'Option 8', however including an envisaged but not funded rebuild of the remaining WCML station elements. This scheme is expected to be incorporated into Additional Provisions 4 to the Hybrid Bill; however, it would drag construction well into the 2030s, with over 20 years of continuous demolition and construction in the Euston terminus area, and with large scale land take and other construction impacts along the Euston approaches. This too is causing strongly adverse comments, and looks likely to breach HS2 budget limits and acceptable construction timescales. It will not achieve Camden's full EAP priorities.

- Every one of these HS2 Ltd.'s Euston proposals would bring severe and prolonged impacts on local residents and businesses, as well as passengers using the station.

1.2 Being successful at Euston is vital for HS2

If HS2 cannot succeed at Euston, the whole project is in trouble. One option is to terminate the HS2 line at Old Oak Common, on the basis that there is sufficient capacity on Crossrail to take passengers into central London destinations. However, there is limited evidence that terminating at Old Oak Common would work apart from in the early years; the split between passengers for different parts of London choosing Old Oak Common and Crossrail compared with Euston and the Underground h been estimated at between 30% and 50%; the number of stations between these points

and, say, Tottenham Court Road is similar but the interchange times and other factors, as well as the capacity of Old Oak Common to cater for the ultimate HS2 capacity make this a less than optimum solution.

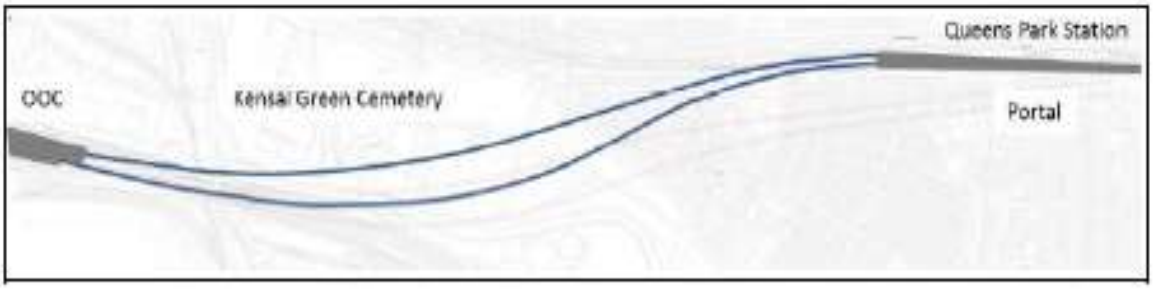
In addition, many passengers will want HS2 services to reach Euston since HS2 Phase 1 is in many respects tracks 5 and 6 of the WCML, albeit designed for limited stop, high speed train operation.

2. The Euston Express alternative

Euston Express is designed to offer a robust, incremental, lower cost and lower impact scheme. It comprises constructing two short HS2 tunnels east from Old Oak Common, to surface within 2 miles onto the West Coast Main Line formation near Queens Park station, with other WCML lines diverted onto other tracks in the formation, and new train paths provided so that WCML and HS2 services both use the existing tracks from there into Euston.

Crucially, we demonstrate that the existing station width footprint can accommodate the forecast number of trains, with some additional platforms created within the footprint. Some platforms would be lengthened to accommodate eventual 400m HS2 trains. A deck above the station platforms would provide access and exits from trains and the station amenities for all train services there, as well as improved access to Underground, bus, taxi, cycles etc.

Fig 1: Change to the HS2 tunnel alignment east of Old Oak Common.[4]



The rest of this document sets out the concept and the detailed proposals of Euston Express, as well as comparing it with what we understand to be HS2 Ltd.'s approach.

2.1 European high speed rail policy

It should be noted that in many respects the Euston Express proposal mirrors practice in France and Germany, where high speed trains travel over well-established conventional tracks for parts of their journey, particularly when the costs of forcing through brand new lines in pre-existing and sensitive urban areas would be unjustified by the extreme disruption and expense. For example, in Paris, all four high speed lines (LGVs) join conventional lines 5 to 10 km outside the terminus stations, with the high speed trains using these tracks and stations as their termini.

This of course has the advantage of enabling the best possible interchange with suburban and metro lines. We know of very few high speed lines in Europe which go right into city centres, either to new stations or to enlarged existing ones.

Of course a few minutes are lost compared with going at 300 kph and braking hard before the buffers, but minutes are also lost with long walks between different trains or metros, or between different stations, as is proposed at Birmingham.

HS2 Ltd. specify train speeds as 360 kph maximum. This is higher than the standard 300kph on the French high speed lines, which were originally designed to operate at 270kph and only after some years' successful operation was speed increased to 300 kph on the Paris Lyon section. Whereas this section takes 2 hours, London to Birmingham will take just 49 minutes. Euston Express classic compatible trains can be built to achieve 360 kph but manufacturers tell us that increasing the speed from 300 to 360 kph can increase the cost by up to 50%. We question whether this is justified to save a few minutes to Birmingham, especially when trains will have to operate at lower speeds in the long HS2 tunnels through the Chilterns.

Euston Express therefore follows these continental examples, and proposes that the initial build of HS trains should be designed for 300kph maximum, thereby saving the estimated 50% additional cost of 360kph trains, Similarly, Euston Express would use the conventional West Coast Main Line (WCML) tracks for the last few kilometres into Euston; luckily, it is possible to accommodate both WCML and HS2 services on these tracks and on platforms within the existing station width. This paper explains how this would be done.

There are four key elements to Euston Express described below:

- The size of trains
- The number of trains
- Euston approaches
- Euston terminus.

3. The size of trains

3.1 HS2 Ltd.'s proposal

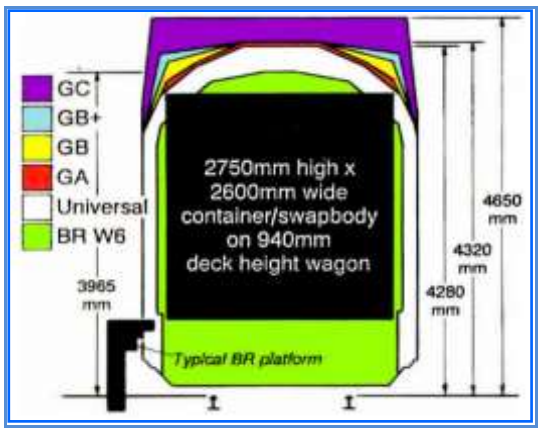
HS2 Ltd. is proposing the use of two different sizes of passenger train:

- A 'captive European gauge' train for inter-conurbation expresses within England. These trains would provide direct services between London / Birmingham / Manchester / Sheffield-Leeds. They would be built to a European ***vehicle loading gauge*** with maximum capacity on a single deck. The ***tracks*** are the same as UK – 4ft 8½ins/1,435 mm –but it is the generally larger widths of the ***vehicles*** which matter here. HS2 has suggested the possibility of five seats abreast (3+2 seating), though the trains would not be much wider (ca. 0.2m, 8ins) compared to a UK-gauge train where four seats are the normal Intercity limit. HS2 has stated that double-deck trains will not be used because of delays with alighting and boarding if passengers must reach two train decks.

- A 'classic compatible' train – i.e. UK-network sized – with adjustable step level for UK platform heights (such as used by existing classic compatible Eurostar trains). These trains must fit within the UK loading gauge to allow through trains beyond the limits of the new HS lines.

- The new lines must themselves be built to the GC gauge, called in this paper the European gauge, because of European laws, but existing lines and platforms need not be changed.[4] There is no requirement to operate any particular size of train on a GC gauge line, and there is no such thing as a GC gauge train.

Fig 2 Diagram of the comparative widths and heights of UK-gauge trains (e.g., BR W6) compared with various different European sizes, of which 'GC' is the largest.



[4] There is no legal requirement to adapt existing lines to GC gauge, so an approach to Euston from the Queens Park area for HS2 trains using existing lines is legally quite possible. New lines, including Euston Express's proposed tunnels from Old Oak Common to Queens Park would of course be built to GC gauge.

Note that there is a platform edge location problem if 'European gauge' trains are used within Britain, as well as the obvious height variations. A 'classic compatible' train is designed to fit within the UK platform and loading gauge, because it is essentially a W6 width at platform level even if parts of the vehicle body might be slightly wider.

'European gauge' train bodies need dedicated tracks in the UK. Their width below platform level would require much trackside equipment relocation, while on many UK main lines the passing gap with other trains would be too narrow. This precludes their operation on most classic lines of the UK. UK's W6 gauge trains could operate on a 'European loading gauge' line such as HS2, but will need the adjustable step described above.[5]

HS2 Ltd. has suggested that it might be cheaper to buy a European-gauge sized train than a 'classic compatible' one. However at least half the trains must be built for classic-compatible through running, so a design will be required for these anyway. In discussions with four train suppliers, Lord Berkeley has established that at least one one (Hitachi) considers that an existing train design e.g. IEP/AT300 or Javelin, will be adaptable at low design cost, to suit HS2 design speeds and other parts of the specification.

HS2 Ltd.'s initial plan is for 12 European gauge trains to operate between Birmingham and London Euston entirely on new GC gauge track with over 50 classic compatible trains to operate both on HS2 and beyond on the classic network to Manchester, Liverpool, Glasgow, Leeds etc. Even if a European gauge train is thought to be cheaper, it will still need the special signalling, telecommunications and other items specific to the UK, to be developed for just 12 train sets. We suggest that there would need to be some very robust evidence to justify having two different types of train for HS2, at least until there was a long stretch of high speed line built, perhaps several decades hence.

Thus the additional infrastructure costs for European gauge approaches to new city centre termini are additional costs driven by the European gauge specification, and therefore should properly be ascribed to that design option.

3.2 Speed of trains

There is a further factor to consider, that while the HS2 lines are being designed for a 400 km/h maximum speed (250 mph), HS2 Ltd. has advised that the maximum train design speed will be 360 km/h and maximum timetabled speed 320 km/h. 320 km/h is comparable to existing HS standards across Europe, and means that special train designs to accommodate large on-board electrical transformers are not required.

[5] The UK's previous 'love affair' with European gauge – Brunel's Great Western Railway – was eradicated by 1892. It had incurred complicated track layouts with three rails, to allow different width trains to share the same platforms. This principle could be applied to modified platforms at Euston, for European and UK width trains, but the existing Euston approaches would not accommodate European width trains.

The first generation of Eurostar trains currently operating between London and Paris/Brussels and Marseilles were built as classic compatible rolling stock, and operate at 300 kph, with transformers etc. compatible with the UK classic gauge. So existing train designs can do the job – including UK-network sized trains.

However, Euston Express questions the need to operate at 360kph at least in Phases 1 and 2 of HS2, since some manufacturers have suggested that this could add up to 50% to the cost of the trains.

3.3 Consequences of train design on HS2's infrastructure requirement

With an incremental approach, it is not rational to invest in entirely new and costly infrastructure work on the Euston approaches and in Euston terminus, unless and until a need – and alternative options – were assessed and modelled for the 2040s or later. Euston Express's own modelling points to the late 2030s/early 2040s as being the right time to invest in some additional capacity – but that would be more for additional WCML commuter capacity, than for HS2. The train volume requirement is discussed in Section 4.

Euston Express considers that a 22-platform station to be operationally feasible within the existing terminus width. Diversion of 6-8 inner commuter trains per hour to Crossrail 1 via the planned WCML-Old Oak link would also reduce Euston terminus capacity pressures. This strongly suggests that the driving force for HS2's proposal for a new terminus is not the immediate or even medium term travel and train volumes –– but the size of the European gauge 'captive' trains, which cannot use existing UK-network gauge tracks or existing platforms.

Eliminate the need for captive 'European gauge' GC trains for the first decades of the HS2 project , and the need for a 'European gauge' approach to Euston vanishes, along with separate 'European gauge' platforms, and all the related approaches, demolition and construction complexities, impacts and costs.

Beyond 2040, there might be a number of options for an extended high speed network, or for more limited stop commuter services.

Euston could become more of a 'Grandes Lignes' terminus, if it were decided that all HS2 trains should head there, or alternatively some HS trains or limited stop commuter services, or both, might head elsewhere with a more polycentric London, e.g. towards Stratford or Ebbsfleet, and HS1.

Similarly, an expanded high speed network to Scotland and connecting to HS1 and Stratford and the continent could then justify the construction of a fleet of European high speed trains captive to the high speed network, but these would only be useful if there were a continuous stretch of high speed line, in the same way as SNCF only built double deck and faster TGVs for its original Sud-Est Paris-Lyon high speed line when the growth in passenger demand and the expansion of the French HS network justified it. This is discussed further in Section 4.

4. The number of trains

4.1 Demand studies

There is a large volume of available data for this. Network Rail's (NR's) own demand studies, the 2011 London & South East Route Utilisation Strategy, which looked to 2031, and the 2013 Long Term Planning Process, which looked to 2043, demonstrated that the biggest change is in London commuting requirements. This will be largely focused on the 'classic' WCML, including places such as Birmingham if they become commuter suburbs for London. Uncertainty centres on:

- Economic and home/job location changes over the intervening period, and particularly in relation to London commuting.

- HS2's own economic and jobs generative capability, at locations across the route and beyond.

HS2 Ltd. has designed HS2 to carry 18 trains per hour (tph). Its own planning, and Government decisions, have now removed the Heathrow spur from consideration, with that future airport passenger access focused via Old Oak Common interchange. That releases 2 HS trains per hour (tph) for national services to and from Central London, from 16 tph to a planning maximum of 18 tph.

Present demand and NR's forecast for future demand is described below. In addition, the WCML corridor is the UK's main freight artery, with high rail freight volumes, although these are not permitted to cross London during peak periods.

Basically there are four types of passenger services presently using the WCML corridor:

- Intercity trains at up to 13 tph in peaks, and 9 tph off peak.

- Outer suburban and 'shire' express services at 6 tph in peaks and 5 tph in off-peak.

- Inner suburban services at 5 tph in peaks and 2 tph in off-peak.

- Euston-Watford DC local services (which run on the LUL and NR third rail DC power system) at 3 tph all day.

Looking ahead, in a matured HS2 Phase 1 (so beyond 2026 in initial passenger volume), HS2 Ltd. has projected 10 HS tph in a busy hour, and 13 tph on the WCML fast tracks with a split of 7 tph Intercity or 'Intershire' services, and 6 tph for outer commuters. Euston Express has factored down the 6 tph for outer commuters, to an initial 5 tph, as TfL's proposal for direct WCML-Crossrail trains will attract some outer commuters to that different service, which is direct to the West End, City and Canary Wharf.

Relating train numbers to passengers, 7-8 Intercity trains would equate to roughly 3,000 passengers at 85% load factor, depending on train length, which also fits with

Network Rail's foreseen 2031 pre-HS2 total WCML long distance demand being 6,500 passengers in the high peak hour. Other passengers would be expected to use HS2 services.

4.2 Commuter services

For changes in commuter demand through to 2043, which is Network Rail's long term planning horizon, Euston Express has assessed the position as follows:

- Network Rail demand estimate for 2031: capacity gap of 2,400 passengers in the high peak hour.[6] At approximately 500-550 seated passengers per 8-car train, this is 5 additional trains. With 12-car trains, it would be 3 additional trains.

- There is a further 4,500 capacity gap on top of 2,400, for high peak hour in 2043[7]. At 750-800 seated passengers per 12-car train, this is a further 6 trains.

- Actual growth rate has been higher recently. Therefore an assumption of 5 additional trains (at 12-cars each if required) is adopted for our HS2 Stage 1 forecasts, and a slower growth rate assumed to 2043 with more London area housing provided by then; therefore the overall 2043 passenger growth rates are assumed to be closer to those forecasts, with a further 6 trains needed.

- The split of trains between Inner and Outer Suburban is taken as +3 Inner in 2031 and + 2 Outer (allowing that Inner will also see a general increase in passenger demand with trains through to Crossrail 1).

- For 2043, and with more Home Counties developments, the split is taken as another +2 Inner trains and +4 Outer.

- Off peak train volume is taken as 60%-75% of peak volume, except for Euston-Watford DC. TfL is planning for Euston-Watford to become 4 tph all day by 2020.

- Finally, for Intercity/Intershire WCML growth on to 2043 with a further 600 passengers per hour projected by Network Rail, a further 2 trains are nominated, either franchise or open access. HS2 is itself working towards 16 basic HS tph on the main route, with a further 2 tph slots available (ex Heathrow), for the HS2 main line.

4.3 Combining growth projections

The combination of service types and line occupation on the approaches is set out in Fig 3, by planning period. A separate discussion then follows, on devising changes to the Euston approaches, to accommodate these foreseen train numbers, including HS2 services, within the existing railway curtilage if possible. Some of the track utilisation set out in Fig 3 anticipates this discussion.

[6] 2011 NR LSE RUS estimate for 2031.
[7] NR LTPP forecasts

Fig 3. Projected train service volumes at Euston terminus

WCML service	Current peak	Current offpeak	Tracks now	HS2 Stage 1: WCML peak	Long term peak	Long term offpeak
Service and note reference no.	**tph**	**tph**		**tph**	**tph**	**tph**
					ca. 2040s	**ca. 2040s**
Euston-Watford DC (1)	3	3	DC line	4	4	4
Freight	to Wembley	via Camden	Slow line	via Camden	to Wembley	via Camden
Inner commuter (excl. via WLL)	5	2	Slow line	2 QP + 6 Crossrail	2 QP + 8 Crossrail	2 QP + 4 Crossrail
Outer commuter > revised inners (2)	-	-	-	1 call Q.Park	1 call Q.Park	0 + 1 Crossrail
Outer commuter	3	2	Slow line	2 call Q.Park	2 call Q.Park	2 call Q.Park
Sleeper (3)	-	-	Fast line	2 in period	2 in period	-
Slow lines commuter growth (4)	-	-	-	Discussed in text commentary		
Total via combined DC & slow	**11**	**7**		**9** + 2 sleeper	**9** + 2 sleeper	**8**
Outer commuter / 'shire express'	3	3	Fast line	3	3	3
Outer commuter growth (4, 7)	-	-	Fast line	2	6	3
Inter-city (7)	13	9	Fast line	7	7	5
Sleeper (3)	2 in period	-	Fast line	-	-	-
Open access / franchise growth (6)	-	-	Fast line	1	3	3
Total via fast line	**16** + 2 sleeper	**12**		**13**	**19**	**14**
All WCML lines total	**27** + 2 sleeper	**19**		**22** + 2 sleeper	**28** + 2 sleeper	**22**
HS2 lines - inter-conurbation	-	-	-	**6** tracks A, D	**9** tracks X, E	**?**
HS2 lines - national services	-	-	-	**4** tracks A, D	**7** tracks X, E	**?**
HS2 lines - growth/open access	-	-	-	**0** tracks A, D	**2** tracks X, E	**?**

5. Euston approach tracks

5.1 Rationalising the 'classic' tracks

The ability to use the existing Euston approach tracks is a huge advantage. Trains which fit the UK-network gauge will by definition need little or no adjustment to existing track approaches as a consequence of the train design. It is recognised that re-signalling is likely to be required, but this is an inevitable Network Rail cost in any event, as part of station platform adjustment and line speed works, and as part of a 'digital railway'.

The basic Euston approaches layout is still rooted in the original 1960s electrification with extensive modification in the WCML upgrade around 2000. The core Euston Express proposition is that the WCML is relatively lightly populated by trains, and has a 5/6 track set of in- and out- lines (three inbound, two/three outbound) on the Euston approaches, where 4 (two each way) would be adequate now and foreseeably. Other track elements can be adjusted to create a 6th track throughout. The direct consequence is that, by reorganising the existing Euston approaches, UK-network compatible HS2 trains can use two redefined and released tracks, and share the existing approaches.

5.2 WCML train service levels

The WCML fast lines have an upper limit of 20 trains per hour in the London area (3 minute headways) and the slow lines(4 minute headways NW of Camden) so 15 tph, and 35 tph in total. There used to be 13 tph hourly capacity limits on both pairs of lines, however these appear to be been removed. There are other important factors to account for on the slow lines. These include freight trains, where large growth is also expected, and the potential (by ca. 2026) to divert 6-8 tph inner commuter trains to Crossrail 1 via the planned WCML-Old Oak link (which is supported by TfL).

Freight trains run at different speeds to passenger trains, thus constraining slow line capacity. Freight trains can use the WCML slow lines even in peak periods, though they are barred from cross-North London lines in peaks and may be held at Wembley or Ripple Lane Yards. The assessment of future train path requirements is set out in Fig 3. This includes provision for further commuting growth and additional intercity franchise or open access services bids for WCML slots.

5.3 WCML track rationalisation for Euston Express

The specific Euston approaches proposition starts with the foreseen service levels set out above, and aims to provide track with margin above growth expectations, and with enough slack to ensure reliability as well as capacity.

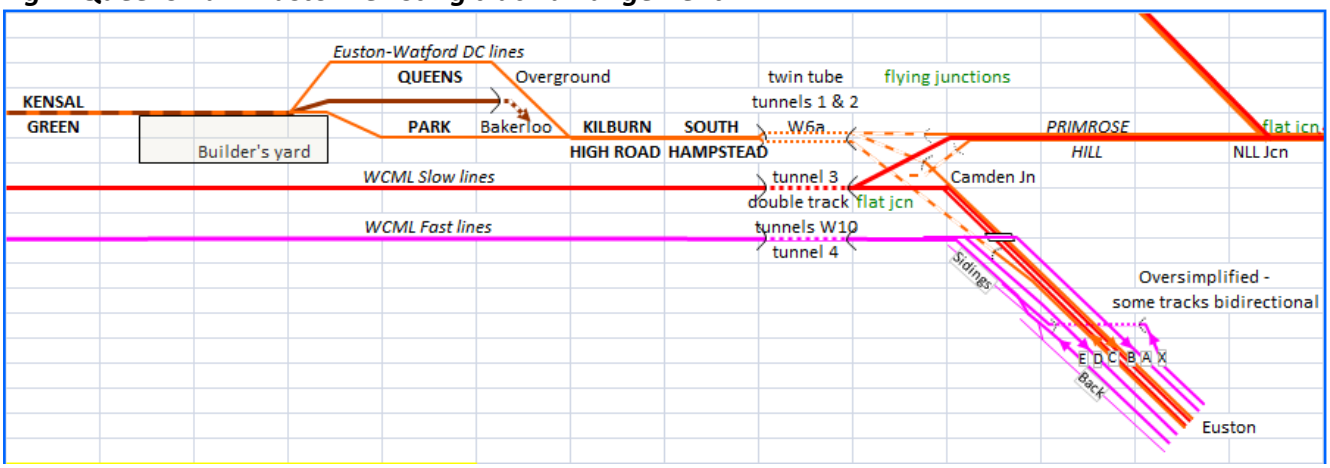
The stages of alterations required for the Euston Express proposal are set out in the section.

The initial limiting factor is the Primrose Hill tunnels. These have six tracks in four tunnels. From north to south these are:

(1) Single main line sized tube tunnel at W6a gauge, for the Watford local 'DC' line towards Euston and the North London Line (NLL), electrified with 3rd rail.
(2) Second single main line sized tube tunnel at W6a gauge, for the Euston and NLL local 'DC' line towards Watford, electrified with 3rd rail.
(3) Twin-track W10 gauge tunnel, for commuter trains and cross-London freight – the WCML 'slow lines', with overhead line electrification (OHLE) at 25kV AC.
(4) Twin-track W10 gauge tunnel, for intercity and outer commuter trains – the WCML 'fast' lines, also with OHLE at 25kV AC.

A simplified diagram of the current layout is set out in Fig 4:

Fig 4: Queens Park-Euston: existing track arrangement

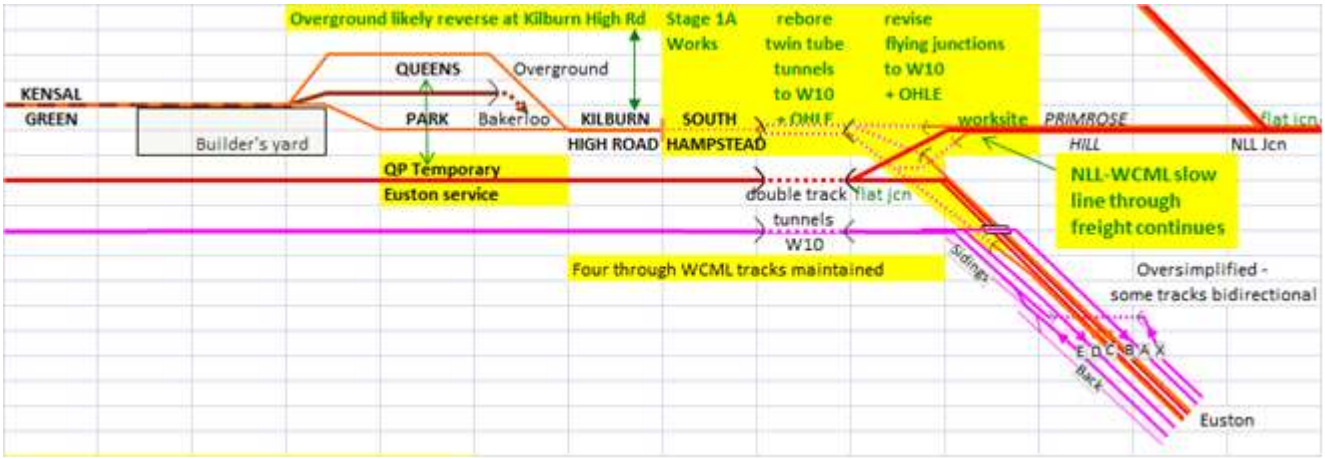


Tunnels 1 and 2 are normally used only by 3 'DC' trains per hour (tph) in each direction. TfL aims to increase this London Overground service to 4 tph in the next few years, but this is still a hugely under-used resource. It is possible to re-bore the tunnels to install overhead line electrification (OHLE) and permit W10 size gauge for freight trains. OHLE and W10 gauge would be required also on the DC spurs to the North London Line, at the Primrose Hill end of the tunnels, for use by cross-London freight.

5.3.1 Stage 1A

The first series of changes are illustrated in Fig 5:

Fig 5: Queens Park-Euston Stage 1A: temporary DC closure with tunnel and flying junction revision



Works in the Queens Park area (described below, undertaken with Stage 1A) would create:

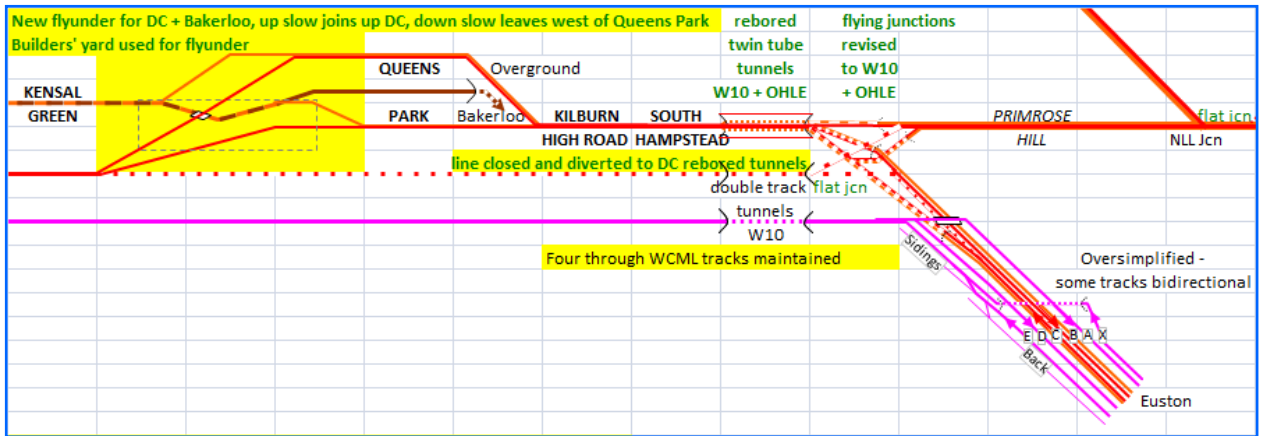
(1) A flying junction for the up WCML slow track to join the up DC line without impeding 'down' DC and Bakerloo trains

(2) A diverging new junction near Queens Park for the down WCML slow track to re-join its formation.

5.3.2 Stage 1B

Re-bored DC tunnels could then accommodate the DC and slow line future volumes, and allow WCML slow line trains to call at Queens Park for interchange with the Bakerloo Line, relieving Euston of some commuter flows. Fig 6 shows this stage:

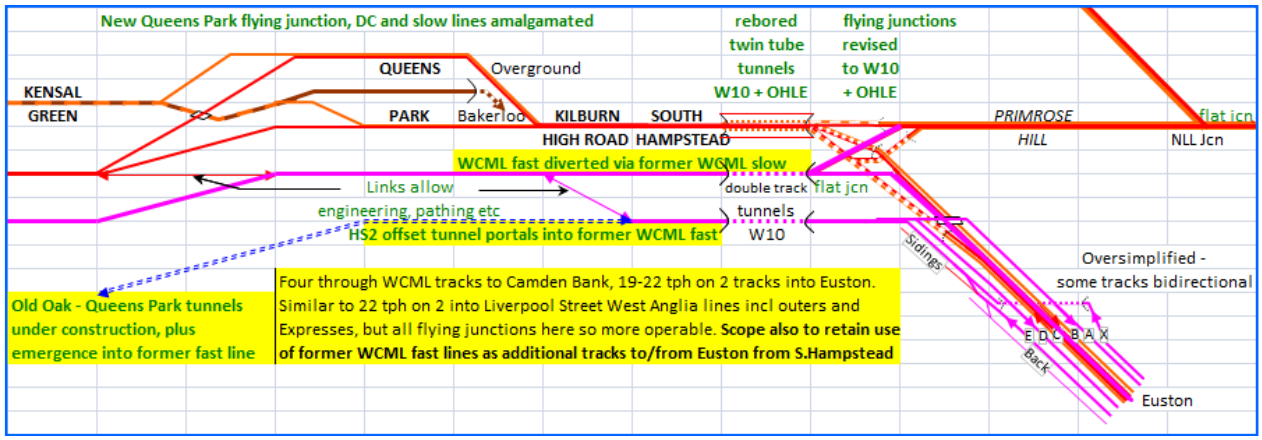
Fig 6: Queens Park-Euston Stage 1B: new DC/Bakerloo flyunder and WCML slow-DC direct lines



Having released the slow line tracks through tunnel 3, it would be possible to realign the WCML fast lines to use those slow line tracks in the Queens Park area. In turn this would free the fast tracks and tunnel 4 for use by HS2 trains built to a 'classic compatible' size, to join the WCML in the Queens Park and Kilburn area (Fig 7).

5.3.3 Stage 1C

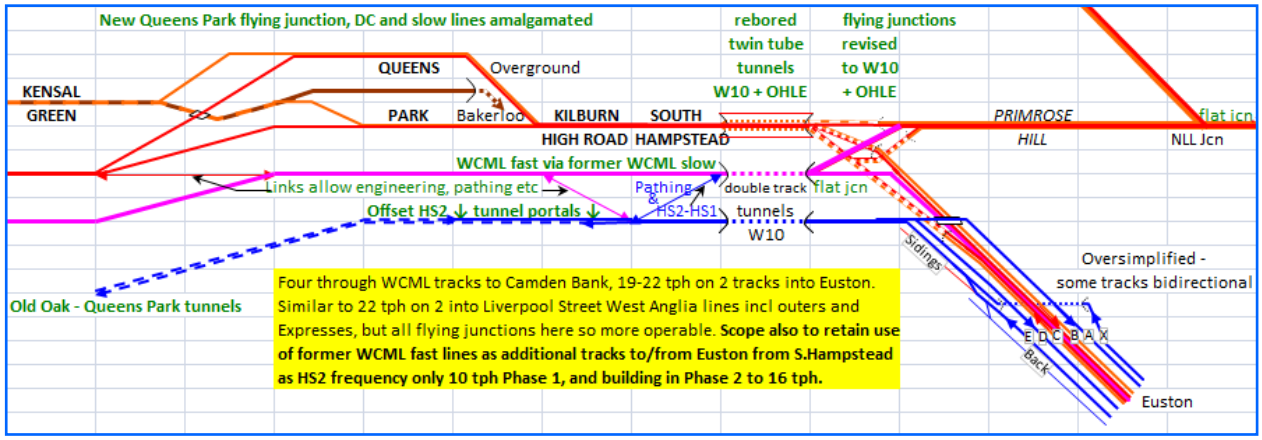
Fig 7: Queens Park-Euston Stage 1C: WCML fast via former WCML slow tunnel, HS2 approach works



5.3.4 Stage 2

This design assumes that, mid-2020s to early 2030s, the combination of a few WCML slow and DC trains, plus WCML fasts, could if needed be catered for in a two track approach to Euston. This would represent about 19 initial trains per hour in total, and allows for +3 tph growth in volume to 22 tph by the early 2030s, as shown in Fig 8:

Fig 8: Queens Park-Euston Stage 2: HS2 initial services, most WCML fast via former WCML slow



However, until HS2 uses its full design capacity, it would also be feasible to run some WCML fast services over the HS2 approaches (the former fast lines). Some sharing of the, by then, HS2 approaches by WCML fasts would keep the basic WCML approach volumes below 20 tph per pair of tracks.

By way of comparison, other 20 tph London approaches include, as examples, into Paddington (20 tph foreseen on fast lines by 2020s), Liverpool Street (22 tph from West Anglia, 28 tph by 2019 from Great Eastern), Thameslink (24 tph from 2018 with multiple junctions), Charing Cross (28 tph), Waterloo (20-24 tph on main line approaches).

At this stage of assessment, full separation of WCML slow/DC, WCML fast, and HS2 services is projected to occur in the late 2030s. This would be the final incremental change, allowing the described full 6 track sequence of up/down parallel railways.

5.3.5 Stage 3

The proposed ultimate track layout for the surface approaches is shown in Figures 9 and 10, in a two-stage construction process:

Fig 9: Queens Park-Euston Stage 3: full separation underway for service groups, elements 1-3 in place

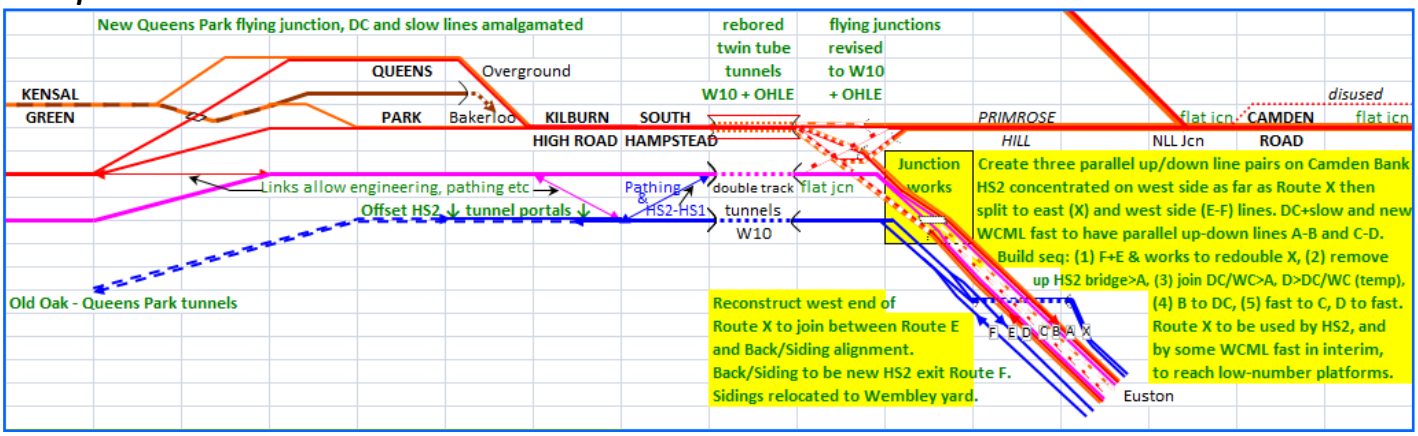
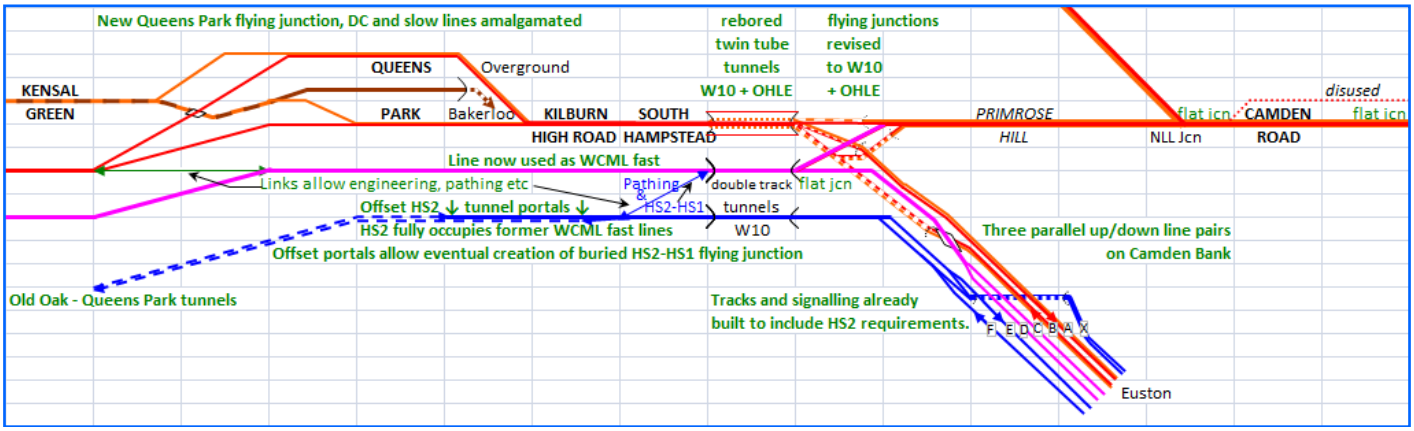


Fig 10: Queens Park-Euston Stage 3: complete HS2 / WCML fast / WCML slow+DC segregation in normal use



5.3.6 HS2 Ltd.'s views

HS2 Ltd. has agreed in its Response to the Euston Express Petition dated 6th May 2015[8] that it is feasible to create a new link between Old Oak HS2 station and the WCML fast tracks near Queens Park. This confirmation is of fundamental importance. Unfortunately, However, HS2 Ltd. deems it necessary to create a massive twin tunnel portal near Queens Park, some 26-28m wide, for HS2 up and down tracks in separate 8m wide tunnels to emerge ***simultaneously,*** with a further 8m between them. It appears that HS2's engineers do not have the same willingness to offer tighter engineering margins such as adopted by Crossrail's engineers, where tunnel structures are within 1 metre of each other. The HS2 'grand portal' would incur wide disruption and temporary line closures, long timescales and excessive costs. Euston Express does not consider that this is a realistic approach.

There is ***no*** reason why individual HS2 single bore tunnels should not emerge at different locations between Queens Park and South Hampstead. In turn this would permit a 10m formation 'take' at any one location – feasible with far less disruption and much less cost and construction complexities, and quicker overall timescales. It would also allow passive provision for a future HS2-HS1 tunnel continuation, with buried 'flying junctions' in this sector. This is the style of engineering that Euston Express favours.

5.3.7 Euston approaches works sequencing

The sequencing is largely as described above. The principle is to ensure there are generally four tracks available for use, except for *occasional* large-scale weekend or holiday possessions.

Stage 1A is the DC tunnels re-bore and OHLE works, Fig 5.

- Tunnel re-bore would preferably be undertaken from a work site in the former Camden sidings area near the closed Primrose Hill station, so is more remote

[8] HS2's response to Euston Express Petition C221-MMD-CV-REP-010-200019 PO2 6 May 2015, page 12

from existing housing than a South Hampstead works site, and with scope for spoil removal by rail.

- The likely DC service option is a suspension of the DC service east of Kilburn High Road, where there is an existing reversing crossover. DC trains would run Watford-Kilburn High Road. It is possible to stop WCML slow line services at their own platforms at Queens Park, which are used occasionally, to provide a direct train service between Queens Park and Euston for DC line passengers requiring Euston.

- On this basis, a substitute local bus service should run from Chalk Farm tube to Kilburn High Road via Swiss Cottage and South Hampstead. An existing bus route (31) already links Chalk Farm and Kilburn High Road via Swiss Cottage and South Hampstead, and this might be strengthened. There is also the Bakerloo Line via Queens Park, and the North London Line interchange at Willesden Junction. Though ticketing would be permitted by parallel bus and tube lines.

- There is the potential for retaining a through bi-directional DC service via the single-track tunnel 2, with the low service frequency, then swapping over when tunnel 1 works are completed. However, containing the re-bore works without detriment to the other track throughout the works area might be problematic, especially at the Camden flying junction zone. It may also be more time efficient to undertake both re-bores simultaneously, as this work may be on a critical path.

Stage 1B is the flying junction at Queens Park, **(Fig 6)** to enable the up WCML slow line to join the up DC line. This should be undertaken at the same time as Stage 1A.

- The Travis Perkins builders' yard west of Queens Park between the WCML slow and DC lines would be acquired – it is two tracks wide and occasionally wider. This would permit the creation of a 'flyunder' to carry (1) the up Bakerloo line from a new junction with the DC closer to Kensal Green station, in the direction of Queens Park station (these trains must be routed out of the way of the new incoming up slow line), and (2) a parallel down line from Queens Park (Bakerloo/DC down junction) towards Kensal Green for the DC and Bakerloo combined service to Stonebridge Park, Harrow and Watford.

- A 'flyunder' is adopted to avoid intrusion alongside residential properties and to avoid impact on intermediate roads which cross over the WCML and DC lines. A flyunder can also adopt steep gradients as only urban electric multiple units would be expected to use these new lines.

- A bridge is then built over the 'flyunder', level with the WCML up slow and up DC line, at a gentle skew, to carry the up WCML trains on the slow lines into a junction with the DC line before the Bakerloo shed is reached, and before Queens Park station.

- It is expected that any future residual WCML inner commuter trains would call at Queens Park cross-platform interchange with the Bakerloo Line, to increase passenger travel benefits and connectivity into the West End and to enable diversion of some commuters away from a busy Euston.

- In the event of a major operational crisis at Euston, It would also be possible to use Queens Park station (and the reversing crossover at Kilburn High Road or elsewhere, for instance the North London Line spur towards Camden Road) to terminate some commuter trains there, while offering onwards tube links.

- Construction of the majority of this junction would not impede train services. The final connecting-up may require weekend line closures.

Stage 1B would conclude with the construction of the new slow to DC track and signalling connections, installation of OHLE on the DC lines from east of Kensal Green to South Hampstead, and any further immunisation required for Bakerloo signals. The up line connection would probably be built ahead of the down link, so that up services could run via the new combined DC/slow line while the down links were constructed.

Multiple tracks will still be operable; the up/down DC, up slow via the up DC, the down slow until a final 'connection weekend', and the up/down fast. On completion of the down DC to down slow link, the slow lines are released for other use eastwards from Queens Park to Camden flying junctions. As above, the majority of the new connections should be constructible without impeding any train services.

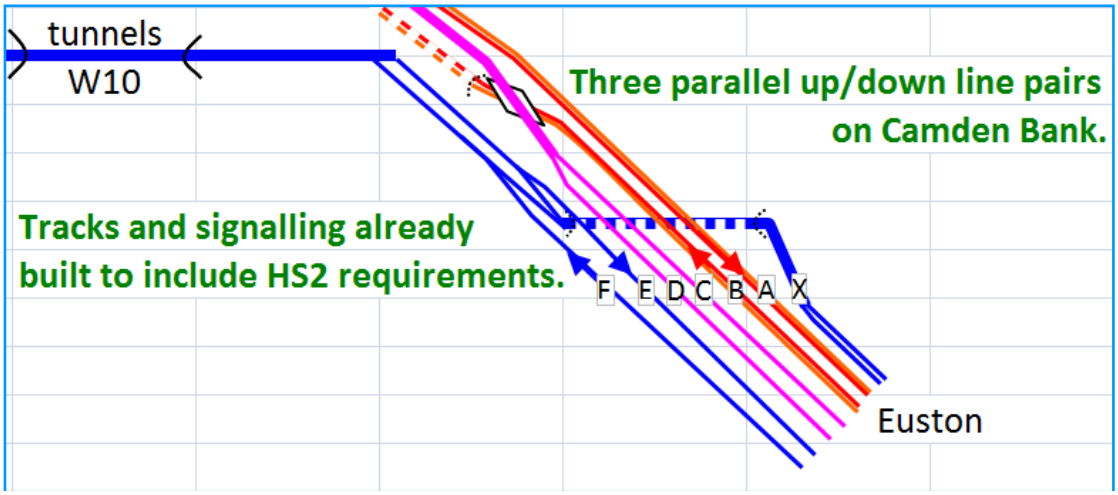
Stage 1C is the diversion of WCML fast trains onto the WCML slow lines (Fig 7), excluding any changes to track arrangements on Camden Bank. The previous WCML fast lines in the Euston and Camden area are retained for use by some WCML fast trains, from the South Hampstead area west of Primrose Hill tunnels. The former fast lines, further west, are removed in order to make way for the offset HS2 tunnel portals and track ramps to/from the new Old Oak tunnels. The offset tunnel portals minimise HS2 land take and engineering complexity in the Queens Park-Kilburn area.

In **Stage 2**, HS2 trains would start to use the former WCML fast tracks and reaches Euston terminus with UK-network 'classic compatible' trains. Effective line capacity would be 35 tph combining the various available approaches on Camden Bank. This is in excess of demand foreseen at this stage of rail service development, and would allow trains to leave or arrive in close sequence.

5.3.8 The final layout of the approach to Euston

The final incremental stage of surface works on Camden Bank is currently foreseen for the late 2030s. This is **Stage 3 (Fig 10)**. It would create segregated up/down track pairs for HS2, WCML fast and WCML slow/DC services, with adequate platform availability allocated for each service group. A snapshot of the final arrangement is shown in Fig 11.

Fig 11: Full segregation in normal operation between HS2, WCML fast, and WCML slow/DC



Spare/emergency platforms at Euston would be used as appropriate between service groups

The fundamental change is to guarantee two parallel tracks for each service group, aligned so that platform entry/exit operational and conflicting train constraints at Euston are minimised. The main change to achieve this outcome is that HS2 is kept to the west side of Camden Bank, until Track X is reached – the fast line underpass for the Euston low-number eastern platforms. This underpass would be redoubled – it was previously double track – and would be used for access to those platforms, which will be close to the proposed main Crossrail 2 station entrance, so benefit HS2's proposed inter-conurbation high capacity trains. This would free up Track A for use by other WCML services, while the Track A fast up flyover is no longer required.

Other tracks are realigned successively. Track E, currently mainly northbound, is changed in purpose and becomes mainly southbound towards the terminus. A separate set of lines, the Back Road and the Sidings Line, are converted into a new outbound Track F, and Track X is realigned at its western end to emerge between E and F. Overall, a double-track flying junction is created for all HS2 parts of Euston terminus. The sidings (mainly used by London Midland trains) are relocated to Stonebridge/ Wembley yard, instead of trains to/from the sidings blocking the principal lines.

Keeping all future HS2 on the west side of Camden Bank permits changes to the purpose of the other tracks. Track A becomes the up DC/WCML slow, with a spur replacing the up fast line flyover. Track B becomes the down DC/WCML slow, although for construction sequence purposes this might initially have to use Track D (released from WCML fast use), so that trains can still run while a final surface link is created between Track B and the down DC/WCML slow. That link would incorporate a bridge over that line, to allow the current WCML slow lines/future WCML fast to pass over Track B to join with Tracks C-D.

As noted, stage works will require temporary connections to maintain operability with at least four tracks at any time, but a construction sequence is possible. The changes would establish the final HS2 access on Camden Bank.

5.3.9 Longer term developments

Any long term further growth in either HS2 train service volumes (currently designed by HS2 Ltd. as limited to 18 tph, but technology may improve) or in Home Counties-London commuting volumes beyond a Network Rail 2043/GLA London 2050 scenario, would have to be accommodated by more radical options.

No one is yet visualising such options in detail, though the earlier 'Euston Cross' scheme offered one version. In a developed form, the requirement for additional capacity might point to another, limited stop cross-London commuter railway underground. This could either accommodate more commuters from NW of London, or free up terminal platforms at Euston, or both.

TfL Board Member Charles Belcher, and London's Acting Transport Commissioner, Mike Brown, have already referenced the possibility of a 'Crossrail 3' being required eventually from SE London approaches (so possibly pointing generally N/NW/W across London), in a London Assembly evidence session on 8th July 2015.

6. Euston terminus

We have demonstrated that the Euston approaches are manageable, with capacity to embrace HS2 as well as a restructured WCML service. Limited HS2-HS1 Services would also be feasible, initially using surface connections via Queens Park and the Primrose Hill-Camden Road link with the North London Line, with classic-compatible trains.

The ultimate challenge is to successfully combine within Euston station:

- The incremental and variable spread of national rail train services into Euston over the next two decades, including both HS2 and the growing commuter requirements, and consequential passenger flows and crowd handling.

- A terminus capacity solution adaptable to long term variables in demand as result, by the 2040s some service patterns may be looking for other stations and routes across London.

- A sympathetic approach to the local environment, adding character and quality to the area, learning from the successes of the close-by Kings Cross Lands, St Pancras International, and Kings Cross improvements.

- Camden Council's Euston Area Plan economic growth ambitions.

- An operable interchange having adequate and reserve capacity, to link with Underground, buses, taxis and other surface modes.

- Servicing support for the terminus and other developments foreseen in and around the station.

- A design enabling constructability in a practical timescale.

- Overall project affordability and value for money.

6.1 Factors to address for Euston station

There are nine specific factors to address for Euston Station. These are:

1. **Overall strategy**:
   A range of topics, but primarily where have HS2 Ltd.'s schemes fallen down, what care and consideration has been given to WCML and DC services, and how can Euston Express address matters better?

2. **Development topics**:
   Has overlaying large-scale property development aspirations led to an over-complex design and construction brief? How could the interplay of railway requirements and development scope be handled differently? What is the realistic timescale to achieve useful net economic gain in the Euston terminus and approaches zones?

3. **Main line train volumes**:
   Changes to demands from HS and commuter lines will affect track and platforming requirements, as well as train turnaround times, which are very different for commuter and long distance trains.

4. **Passenger volumes**:
   These will determine the station circulating requirements, to handle the foreseeable volumes of different types of passengers. Again, the needs of commuters and long distance travellers are different, and will requires assessment both on the main line rail side but also their access and distribution to Underground, bus, taxi, cycling and walking modes.

5. **Investment in passenger distribution**:
   A revised overall terminus for HS and WCML passengers will be required in the future, with improved connections to the Underground, new and improved Underground lines, and new and improved surface access services and routes. How can Euston Express achieve this more easily and more efficiently?

6. **Servicing the station and developments**:
   Multiple servicing requirements will overlay each other, and this must be addressed on a coherent basis.

7. **Environment and ambience**:
   The HS2 schemes imply large-scale impacts in extent and duration of works,

throughout the surrounding area. Euston Express must do this much better, and create a distinctive presence which also respects the Camden EAP.

8. **Construction sequencing**:
   This is a sub-set of the previous point, but is important in its own right, as operability and constructability must go hand-in-hand.

9. **Affordability and timescales**:
   Unless work at Euston terminus compress its timescales, costs will expand in proportion. This flaw should be addressed through the Euston Express proposal.

6.2 Overall strategy proposed by Euston Express

The overall strategy should be geared to the expected railway service impacts. To define a terminus without regard to the scaling over time of train service and passenger demand, has been a fundamental failing in the Euston plans. HS2 Ltd. has demanded a complete terminus adequate for the entire future HS train service from the start, even though this won't really be used all at once, but will build up to full volume over several decades. As discussed above, the driving force for this has been HS2's preference for some 'captive European gauge' trains from the start, when this is not needed.

It should also be noted that Parliament is being asked by HS2 Ltd. to approve a station design and associated costs for Phases 2 and beyond of HS2, when these later phases have not yet been designed.

It is appreciated that the new HS2 Phase 1 main line between the major UK conurbations should be built at once to cater for the maximum foreseen capacity. There will not be another good or economic opportunity to refit it for full volumes. However, within dense urban areas such as London a different philosophy is appropriate and practicable. This is because 'classic compatible' HS2 services can share existing tracks, and because the HS2 services will be only part of a total train volume on the rail approaches to termini. In the case of Euston, they would be a minority, albeit growing in number over time towards a design maximum of 18 trains per hour each way.

Euston is also about the other West Coast Intercity services, possibly rather more 'Intershire' in character in future but HS2 Ltd. still foresees long distance 'classic' trains using the WCML. There is also the potential expansion of open access operations using the released capacity on the WCML. The biggest call on Euston capacity is the combined commuting flows on the DC and WCML trains, where large growth is expected. However the foreseen demand and capacities can be addressed differently, as discussed below.

The Euston Express proposal supports the use of Euston as a terminus for HS2 Phase 1 services. It is after all where the present WCML trains begin and end, and much of HS2 is essentially WCML tracks 5 and 6 albeit largely segregated until northern connections are offered near Lichfield and, with a Phase 1A, near Crewe. In the future, Phase 2 in whatever form that emerges is also seeking to use Euston as a terminus.

However, by the late 2030/early 2040s, Euston Express expects that general growth in demand and in London connectivity with higher numbers of population and jobs will be pointing towards more ***through*** railways being required, not more termini.

The case for a 'captive European gauge' train service should be considered in that context. The introduction of any such captive European gauge trains should be postponed in the UK until the 2040s; even then, they can only be justified by further new high speed railway to make a through network which will have to be built to European dimensions. Euston Express therefore proposes a strategy of retaining Euston as a terminus for 'classic compatible' HS services, and allowing further re-growth of WCML and commuter services into Euston, and, if eventually required, into cross-London commuter tunnels.

The second key point arising is that Euston need not expand much or at all beyond its existing width footprint at any foreseeable period in the future. That is to say the same terminus size or one a little larger, after allowing for some longer platforms being required to accommodate eventual 400m long HS trains. This element may require early construction, to facilitate a complete east-west Underground concourse below.

6.3 Development topics

Hand in hand with the desired scale of the HS2 terminus has been the aspiration for large-scale development in the Euston terminus area, to try to achieve some of the economic growth which HS2 is supposed to deliver. There are numerous conflicts, which do not make the task any easier.

6.3.1 Euston's constraints

- The Euston Road conflicts with and constrains Euston station's 'natural' pedestrian environment – which otherwise might fully embrace the adjoining south-side University zone within the station's development-capable catchment as a pedestrian-priority area. There isn't even any Euston tube station access to the south-side at present!

- Unlike the north-side development opportunities that are the Kings Cross Lands (which are also behind St Pancras), the immediate northern hinterland for Euston terminus and the Euston rail approach along 'Camden Bank' is a mass of mainly high value inner London residential properties and inner city businesses. Intrusive railway demolition and construction works for HS2 and Euston terminus lasting up to 15 years will be wholly unwelcome there, and could reduce the Gross Value Added.

- HS2's 'European gauge' demolition swathe on the west side would have to be balanced by strong benefits not just to Camden Council but to the locality, to generate <u>any</u> locally-appreciated mitigation. So far HS2 has been unable to afford Camden's schedule of desires, let alone the community's own preferences.

- The demolition and construction impacts of the HS2 terminus and approaches are truly vast, and within a densely inhabited residential and active business area. Any serious attempt at large-scale new commercial development over the station, to achieve a low level-deck, incurs excavation on a scale difficult to imagine.

    - The western Melton Street side at Euston is 3.5-4m higher than the eastern Eversholt Street, though the station is already excavated within its walls. To achieve a level deck at Eversholt Street road level, solely within terminus limits, multiply by 5.5m depth x 210m wide x 425m long to get a flavour. This is 500,000 cubic metres to be removed (ca. 65,000 lorry movements, at 15 tonnes per lorry, counting both directions of travel). Although later plans from HS2 may alter the dimensions of excavation, a new plant floor under the HS2 station is unlikely to reduce the volume of spoil to be excavated.

    - The scale of an enlarged HS2 station platform area, new approach cuttings, and removal of some Camden Bank material across the WCML approaches, are excluded from the estimate. Also add more lorries for demolition of the existing station structure, excavation of new Underground passenger concourses and other passages, and then large-scale construction materials inwards for the entire new station.

    - Network Rail has just invested over £0.5 billion to eliminate the low ceiling, bunker effect of the former Birmingham New Street design, yet this is what the low level-deck appearance would be at Euston's platform level!

- **Development payback would need to be world-scale to begin to balance the books, over several decades, even assuming that such a scale of development were acceptable locally. It is understandable that HS2 is now seeking a more amenable development in the vicinity of the terminus. A higher development deck could avoid vast excavation and yet be manageable architecturally.**

- **Additional development lands should not themselves be incorporated within a Hybrid Bill seeking permission for a railway; they would have to be expropriated on the basis of a separate planning application. Therefore, once the case falls for a larger-scale Euston terminus (upon which development might be proposed), any development beyond the railway 'limits of deviation' will require a distinctive and separate application for powers.**

- **A free-standing development proposition is desirable in all reasonable circumstances, requiring consultation and negotiation with all interests about the appropriate type and scale of developments. There should be integration of this development footprint with neighbouring zones, to avoid perceptual barriers and to support easy east-west pedestrian and cycle links across the current physical barriers.**

6.3.2 Euston's illogicalities

- What does HS2 itself add in the way of stimulus? Just hanging development aspirations on HS2's back does not guarantee that there is automatically a consistent synergy between railway and development.

- At Old Oak Common, HS2 Ltd. had strongly resisted funding an eastern bridge access to/from the Interchange station, from Hythe Road/Scrubs Lane, even though this is seen by TfL and local authorities and the Development Corporation as a vital link opening eastern development lands. It took a difficult agreement just before Select Committee hearings in July 2015, to secure contributions from HS2 towards this element of what is one of the nation's densest development zones.

- So although HS2 is mandated to support and assist economic development, there is evidence that HS2 strives to keep within its 'red line' construction zone and do an economic minimum beyond that.

- Nor is it as though Euston is a blank sheet where the added economic activity secured locally can be guaranteed to achieve greatest utility there, given the absence of vacant development lands as found at Kings Cross and St Pancras. The activity might just be diverted from elsewhere.

    - Phase 2 HS2 trains (Intercity trains from the East Midlands, Yorkshire and the North East and Scotland) will be taken away from the termini where it can be argued that they are already achieving development utility, at Kings Cross and St Pancras. If there is any merit in an argument that it is worthwhile attracting Intercity trains to a station for development purposes, then this could be an *economic transfer*, not a net gain, to the disbenefit of terminus catchments further along the Euston Road, and no net gain for Central London nor Camden.

    - Any additional development gain from achieving journey time savings on faster HS2 (ex WCML) trains – which would at least revisit the same terminus – might be less worthwhile than the development gain from increasing total passenger capacity into Euston, where the tube, WCML and Overground commuter services may contribute as least as much development opportunity per additional passenger, because those peak-time passengers are likely to be seeking Central London jobs.

    - The same HS2 passenger if alighting instead at Old Oak Common might be just as content to assist development gain there – in a less intrusive location and one where the Mayor and other stakeholders are actively seeking development-led growth and such change causes less impact on the existing community.

    - So the development opportunities nominally assigned to HS2 need to be questioned.

A narrow focus on an HS2-leveraged level of development opportunity is the wrong rationale for a terminus-zone development at Euston, because HS2 is not the biggest volume stimulus, even though in its present form it is a stimulus for partial station enlargement and redevelopment.

- Largest existing stimuli are:
  - The Underground with a typical 10,200 passenger exits at Euston and Euston Square in a weekday AM high peak single hour in 2014 - with a through two-way tube lines' capacity of over 136,000 in that hour with space for 5 passengers standing per sq. metre – though a proportion of the 10,200 will be heading for main line departures.
  - WCML and DC commuter flows at 8,800 high peak hour arrivals in 2011, with planning capacity for 10,600 in Network Rail's estimates.
  - Third will be the combination of buses, cycling and walking.
  - Fourth is the WCML long distance high peak arrivals in 2011, with 3,300 passengers in 2011 and 5,800 planning capacity.

- With HS2 Phase 1, the relative volumes change to:
  - The Underground potentially now at full capacity without new lines being open (though Crossrail 2 might be under construction), with over 185,000 capacity on a similar planning basis – proportionally this might point to 13,800 high peak alighters at Euston.
  - WCML and DC commuter lines heading towards their 2031 inward high peak demand (as set out in the 2011 LSE Route Utilisation Strategy) of 12,100 passengers, with train capacity lagging behind unless additional units were acquired and/or a WCML-Crossrail link were created.
  - An initial HS2 Phase 1 volume of 3,000-3,500 ex WCML passengers plus HS2's generated growth in addition (ca. 2,000 in the long term), and a further 3,000 long distance passengers staying on WCML trains.
  - Buses, cycling and walking, including additional capacity for those.

- With HS2 Phase 2, where a Crossrail 2 is also required to handle distribution from the London northern termini, the relative volumes change to:
  - The classic Underground still at 185,000 capacity in one hour.
  - Crossrail 2 at 30 tph and 9-car trains, with 90,000 capacity two-way in one hour, so pointing TfL Underground and Crossrail passenger exit flows towards 20,000 in one hour, if in proportion.
  - WCML and DC commuter lines now forecast by Network Rail for 2043 at up to 16,600 high peak arrivals (excluding any WCML-Crossrail service).
  - Long distance up by a further 600 passengers prior to HS2 diversion of Midland and East Coast Intercity trains and further high-speed generated growth. With estimates for HS2, discussed in section 4.3, HS with about 10,700 arrival passengers in the high peak hour remains in a minority of passengers capable of stimulating any development at the station and its effective catchment.
  - Further enlargement of buses, cycling and walking facilities.

- **Overall, HS2 at Euston is both a minority of passengers and will be time-lagged in terms of passenger growth, while a significant proportion of its passengers will be diverted from nearby existing termini where development is already proceeding.**

6.3.3 Euston's opportunities

- There is no underlying public support for retaining the Euston terminus structure and associated buildings, which is seen as a 1960s failed opportunity to achieve major quality development.

- The local planning authority is keen to maximise development outputs, and talks of the potential for Euston redevelopment to deliver 6,000 jobs, 1,000 homes and £400 million of economic value.

- Euston Express understands that, but is concerned that Camden Council is seeing HS2 as the lever rather than the bulk of opportunity arising with the tube capacity enhancement, Crossrail 2, commuter trains and surface access, which will have impacts on development timescale, geography and scope. There is also the risk of double counting HS development benefits if Intercity trains move from Kings Cross and St Pancras to Euston.

6.3.4 Euston Express's view

- We welcome TfL studies into putting more of the Euston Road into tunnel in key locations. This could unlock south-side development opportunities.

- This is the reverse direction of pedestrian movement to the high-tech and science campus emerging north of Kings Cross and St Pancras with Google and others, and with the British Library and the new Francis Crick Institute alongside - but the potential opportunity for Euston can be based on the same principles if not necessarily the same geography.

- Looking northwards, the scope exists to build over the existing railway cutting – Euston Express has a vision for this – to integrate both sides of the railway, and to create a northern development entrance and exit for an improved Euston, to Mornington Crescent and the 'Camden Unlimited' territory, as a continuous high quality central and inner London environment integrated between the University/Fitzrovia/Regents Park via a new linear strategy – a 'Mornington Boulevard' rather than just 'Mornington Crescent'.

- To have to sacrifice any of this existing quality territory to an even wider railway (even if subsequently rebuilt over), for the sake of some 'European gauge' trains, would be a desecration, and worse, a period of damage occupying the best part of two decades. The task of any development, including HS2's eventual role in that, should be to add value from the start, not to subtract.

- Development must take into account protected sightlines for St Paul's Cathedral.

In summary, unless it is desired that any Euston development were paused until the mid/late 2020s to take place – i.e., post HS2 Phase 1 works - the initial years' development stimulus has to be the existing tube, commuter and long distance flows. Any development should therefore respect the functional routeing of Londoners and commuters within the Euston station area, and consider where existing and future station entrances and exits should be located.

Given this weighting of passengers, new development should consider northern and southern accesses:

- **Southwards, cross-Euston Road accessibility to join the University campus.**

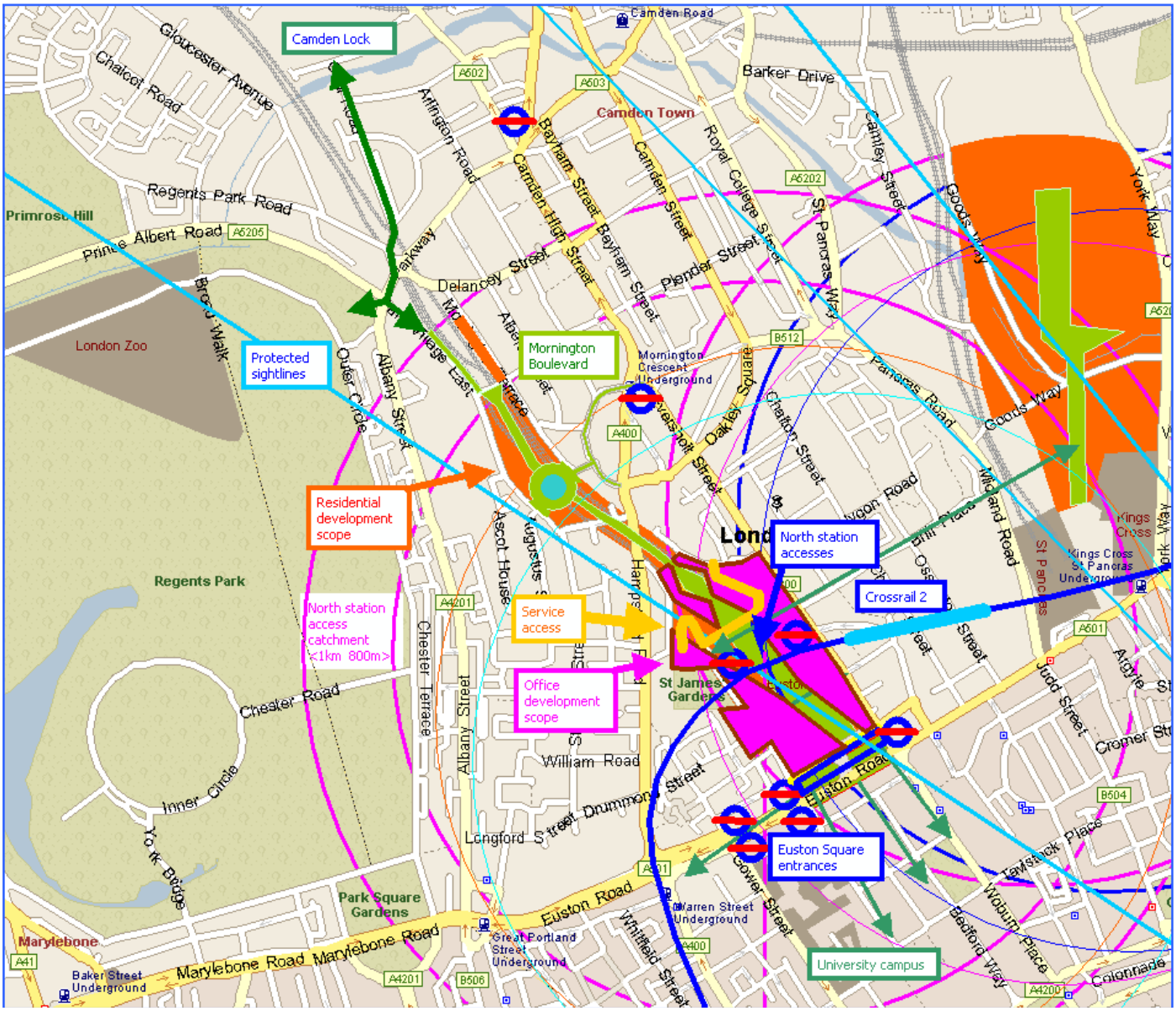
- **New northern accesses for Euston station, because of 12-car commuter trains, and eventual 200-400 metre HS trains.**

- **Northern accesses support development extension northwards with over-railway decking along the WCML corridor - a 'Mornington Boulevard' - towards Mornington Crescent tube and the 'Camden Unlimited' catchment.**

- **Higher environmental quality adjoining the terminus (e.g. Eversholt Street, Melton Street/Hampstead Road), and access over the station and along the Boulevard development spine with mixed office and housing development, including an upper piazza and linkages between the eastern and western residential zones.**

- **A high-level concept plan is shown in Fig 12.**

Fig 12: Euston Express vision of possible development scope in Euston station catchment



6.4 Train volumes

Euston and its approaches are underused compared to the intensity of use of other London termini. Providing that capacity will be available in due course for an ultimate level of HS2 services – foreseen as 18 trains per hour each way – then interim stages of construction and capacity can be devised, as described in **Section 4**. Euston Express's strategy, which incorporates the WCML-Crossrail 1 link for 6-8 inner commuter trains an hour, reduces the required line and platform capacities approaching Euston.

It is acknowledged that this would reduce the commuter contribution to local development scope, but here the issue is the danger of the Underground distribution network getting into severe difficulty beyond HS2 Phase 1, when Crossrail 2 becomes imperative. The WCML-Crossrail 1 link is a vital capacity safety valve. The combination of the link plus Euston distribution congestion might in turn limit the

upper scope for development, or alternatively in the longer term, in the 2040s, a full development might require a supplementary scheme such as Crossrail 3 (now being considered in outline) or a direct railway access from HS1 for Javelin commuter services to access Euston. Either way, we expect a strong commuter element to be present throughout the future decades of Euston station.

We have discussed already that HS2 should be understood as starting off with a minority of the total main line passenger volumes at Euston with HS2 Phase 1, though a larger minority once HS Phase 2 arrives. For the purpose of train service and capacity planning, the incremental requirements at Euston are highlighted by this, with growth expected throughout the 2030s and into the 2040s. Euston Express proposes that a phased approach to line capacity and large scale project works should reflect this fact, as discussed in **Sections 4 and 5**. This will also support the affordability criterion.

The growth is fast with commuter volumes as well as High Speed. As noted above, Network Rail has forecast that the commuter flow arriving was to be 12,100 in 2031 *in the single busiest hour*, on suburban and DC trains, rising to 16,600 in 2043 (+32%). The long distance flows on intercity trains will in future be split between HS2 and WCML, and these were forecast (without HS2) as 6,500 passengers in 2031 in the single busiest hour, and 7,100 passengers in 2043.

A share of this long distance volume will therefore transfer to HS2. Based on HS2's Phase 1 suggested service pattern, this looks like roundly 3,000 WCML passengers and 3,500 HS2 passengers around 2031, before HS2 generated growth is allowed for. TfL has modelled the eventual HS2 volume on Phase 1 routes as up to 12,000 passengers in a full 3 hour AM peak, which would imply for comparative purposes about 5,200 HS intercity passengers in the busiest hour (based on a 43% ratio for the busiest hour), of which 1,700 would be additional HS travel.

TfL also modelled HS2 Phase 2 as eventually handling about 25,000 passengers in a full 3 hour AM peak, which points to about 5,500 additional HS arrival passengers over and above HS2 Phase 1 (10,700 in total), in the high peak hour. The consequence is that, by this stage, trains on principal HS flows might be aimed at 1,000+ capacity, requiring 400m long platforms.

6.4.1 Platforming

Platforming requirements therefore come to the fore. There are two main factors:

- The physical number of trains to be accommodated, with their projected layout/return departure times, which will vary by type of service, and which will influence the overall number of platforms required.

- The passenger handling requirements for different train types, against foreseen passenger demand – generally this requires designing for the high peak period.

Euston Express's discussions with HS2 Ltd. and DfT has defined that HS2 trains are expected to average two train arrivals and departures per platform, per hour, with some trains being quicker, and others being slower. It should be possible to organise platforming so that, if required, a slower turnaround is balanced with a quicker turnaround with the following train, so ensuring that 2 trains per hour (tph) is handled.

With 18 tph being the maximum HS frequency planned, this requires 9 platforms as the operational minimum. Practicalities such as the risk of perturbations and technical problems with trains, in turn require an operational margin, where the industry view is to provide 2 spare platforms if possible. This isn't possible at every terminus, but can be incorporated at Euston.

Turning to the WCML and DC operations, a similar number of platforms plus 2 spares are required with the opening of HS2 Phase 1, based on the table shown in **Fig 3**:
9 short-turnaround commuter services per hour (others being sent to Crossrail 1), and 13 varying turnaround longer distance services, ranging from outer commuter and 'Intershire' services with efficient turnaround, to remaining Intercity services with longer terminal times. There are also 2 sleeper trains, of which (if they continue to use Euston) at least one must be removed from Euston before the high peak at 08:15; the other might have to utilise one of the spare platforms until departure to carriage sidings, but preferably is also removed before 08:15.

The platforming requirements have been validated by an analysis of train operations and turnaround times at other London termini with a mix of Intercity and commuter operations.

A table summarises this assessment for Euston in Fig 13:

Fig 13 Train headway times

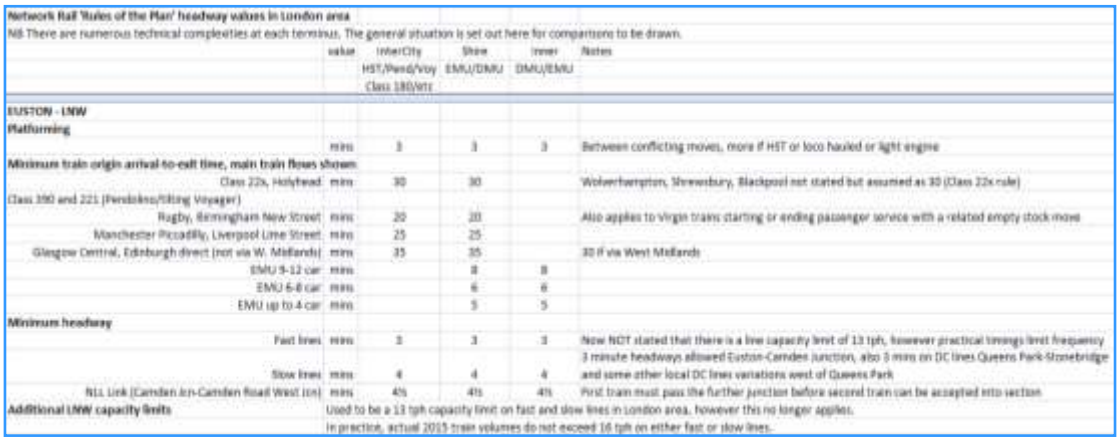
Network Rail 'Rules of the Plan' headway values in London area					
NB There are numerous technical complexities at each terminus. The general situation is set out here for comparisons to be drawn.					
	value	InterCity	Shire	Inner	Notes
		HST/Pend/Voy	EMU/DMU	DMU/EMU	
		Class 180/etc			
EUSTON - LNW					
Platforming					
	mins	3	3	3	Between conflicting moves, more if HST or loco hauled or light engine
Minimum train origin arrival-to-exit time, main train flows shown					
Class 22x, Holyhead	mins	30	30		Wolverhampton, Shrewsbury, Blackpool not stated but assumed as 30 (Class 22x rule)
Class 390 and 221 (Pendolino/tilting Voyager)					
Rugby, Birmingham New Street	mins	20	20		Also applies to Virgin trains starting or ending passenger service with a related empty stock move
Manchester Piccadilly, Liverpool Lime Street	mins	25	25		
Glasgow Central, Edinburgh direct (not via W. Midlands)	mins	35	35		30 if via West Midlands
EMU 9-12 car	mins		8	8	
EMU 6-8 car	mins		6	6	
EMU up to 4 car	mins		5	5	
Minimum headway					
Fast lines	mins	3	3	3	Now NOT stated that there is a line capacity limit of 13 tph, however practical timings limit frequency
Slow lines	mins	4	4	4	3 minute headways allowed Euston-Camden Junction, also 3 mins on DC lines Queens Park-Stonebridge and some other local DC lines variations west of Queens Park
NLL Link (Camden Jcn-Camden Road West Jcn)	mins	4½	4½	4½	First train must pass the further junction before second train can be accepted into section
Additional LNW capacity limits	Used to be a 13 tph capacity limit on fast and slow lines in London area, however this no longer applies.				
	In practice, actual 2015 train volumes do not exceed 16 tph on either fast or slow lines.				

The main Intercity turnround times are converted into a formula, by defining a basic train turnround element, and then a margin which is a function of the number of

whole hours incurred in the previous journey, to provide a margin for a reliable depature time on the next journey.

The overall time should be sufficient at a minimum, for Intercity operations, for new staff being available, train cleaning and re-stocking. There is an additional element allowed for HS2 trains if they are to operate for a substantial distance on existing 'classic' lines. It should be noted that any HS2 trains only running Euston-Birmingham should effectively be on commuter turn-round margins, as the total journey time will be about 50 minutes.

Fig 14 Proposed turnround planning margins for Euston



Network Rail 'Rules of the Plan' headway values in London area NB There are numerous technical complexities at each terminus. The general situation is set out here for comparisons to be drawn.	value	InterCity HST/Pend/Voy Class 180/Vtc	Shire EMU/DMU	Inner DMU/EMU	Notes
EUSTON - LNW					
Platforming					
	mins	3	3	3	Between conflicting moves, more if HST or loco hauled or light engine
Minimum train origin arrival-to-exit time, main train flows shown					
Class 22x, Holyhead	mins	30	30		Wolverhampton, Shrewsbury, Blackpool not stated but assumed as 30 (Class 22x rule)
Class 390 and 221 (Pendolino/Tilting Voyager)					
Rugby, Birmingham New Street	mins	20	20		Also applies to Virgin trains starting or ending passenger service with a related empty stock move
Manchester Piccadilly, Liverpool Lime Street	mins	25	25		
Glasgow Central, Edinburgh direct (not via W. Midlands)	mins	35	35		30 if via West Midlands
EMU 9-12 car	mins		8	8	
EMU 6-8 car	mins		6	6	
EMU up to 4 car	mins		5	5	
Minimum headway					
Fast lines	mins	3	3	3	Now NOT stated that there is a line capacity limit of 13 tph, however practical timings limit frequency
Slow lines	mins	4	4	4	3 minute headways allowed Euston-Camden Junction, also 3 mins on DC lines Queens Park-Stonebridge and some other local DC lines variations west of Queens Park
N1L Link (Camden Jn-Camden Road West Jn)	mins	4½	4½	4½	First train must pass the further junction before second train can be accepted into section
Additional LNW capacity limits	Used to be a 13 tph capacity limit on fast and slow lines in London area, however this no longer applies. In practice, actual 2015 train volumes do not exceed 16 tph on either fast or slow lines.				

Overall, we are forecasting a requirement for 18 platforms in general use and up to 4 platforms as spares for operability (2 for HS2, 2 for WCML/DC). This is if HS2 and WCML did not share platforms, when the combined provision of spare platforms appears to be luxurious compared to most London termini.

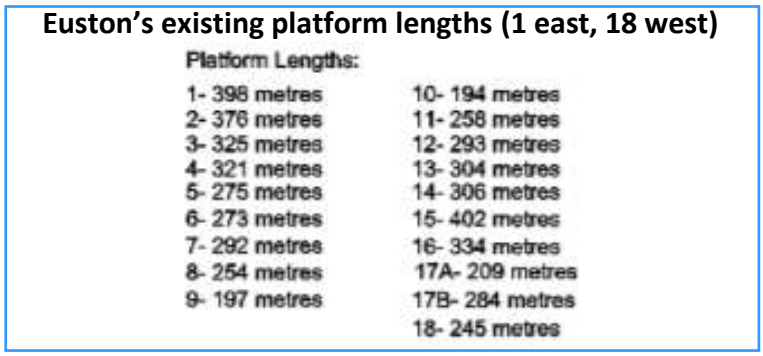
In the basic Euston Express proposal, tracks and platforms are inter-available, and it is feasible to reduce the number of spare platforms, to 3 or 2, shared between HS2 and WCML. There are also other reserve platforms available for use if there were severe perturbations or if Euston were shut in an emergency – WCML passengers could be detrained at Queens Park where there would be 4 main line platforms available with the Euston Express proposal (2 DC/slow and 2 former slow/now fast). Trains could continue to Kilburn High Road or Primrose Hill for reversing. Old Oak Common HS2 station is also planned to have 6 platforms – including 2 generally unused as originally intended for the HS2-HS1 link line.

A further benefit of track and platform sharing is that during London area engineering possessions, HS trains can use the WCML tracks to reach Euston, rather than be forced to terminate at Old Oak Common.

Euston Express therefore considers that the maximum requirement for platforms at Euston is 22 for a combined HS2 and WCML service plan, which gives up to 4 spare platforms in normal circumstances, depending on final platform design. This is based on construction of the WCML-Crossrail 1 link which removes 6-8 tph from Euston.

Provision for this maximum number of platforms can be accommodated within the existing east-west station footprint, though additional platform lengths on the north-south are required at some platforms for the eventual proportion of HS trains requiring full-length 400m, 1,000+ passenger capacity. At present, Euston station has 18 platforms, with lengths ranging from 398m to 194m.

Fig 15. Euston existing platform lengths



In future, platforms will require a minimum length of 220m to accommodate 12-car commuter trains, 285m for 11-car Pendolino trains, a range of 215m to 430m for HS2 trains and, in Euston Express's judgment, a long term potential for further lengthening of selected commuter and classic Intercity trains to 13 or 14 cars (300-340m) if demand continues to grow beyond 2050 on the classic network.

To avoid complications with large scale rebuilding of the Euston throat (approach tracks to the station) – a substantial problem facing HS2 with its western side approach widening and implications of major bridgeworks including Hampstead Road – Euston Express proposes that the existing station platform levels should be extended southwards towards the Euston Road. This would venture into the area currently occupied by the bus station and underground taxi rank, and also involves the widely anticipated demolition of existing tower blocks in the station forecourt and their replacement over the tracks by 21st Century designs.

The platform extensions also create scope for a full Underground station circulating concourse east to west, to tie in Crossrail 2 access on the east, the existing tube station access in the centre, and Euston Square station on the south west. Passenger circulation is covered in more detail in **Section 6.4**.

6.4.2 Platform widths

These are an integral part of Euston Express's thinking. It is desired to minimise the amount of reconstruction required. Euston's existing platforms 1, 2 and 3, and the western side platforms 14-18, are very wide and offer other scope for reconstruction, such as sidings between platforms 15 and 16, and a double platform faced track 17.

It is considered possible to add 3-4 platforms to the existing footprint, taking the station to 21-22 platforms, which should be adequate as discussed above providing that both HS2 and WCML share approach tracks and platforms. It may then be practicable to minimise the scale of reconstruction required in terms of platform track works, by concentrating on rebuilds of track and platform widths on the western and eastern elements of the station – the locations foreseen by Euston Express as being used by HS2's 'classic compatible' trains – and make fewer changes to the rest of the platforms, though with platform extensions where these are required.

Euston Express therefore considers that the existing track, platform and station throat layout could be adapted with minimum change, apart from adding the 3 to 4 additional platforms within the existing wider areas at the East and West sides of the station, and lengthening these and others as necessary to accommodate 400m HS2 trains and longer WCML trains. There are also a number of alternative options, depending on the extent to which the layout should be future proofed for possible changes in demand in the 2040s.

A further option is to undertake a phased rebuild across the complete station, working within the nominal 213m external station width. This converts to an internal width of about 210m. The underlying objective of a complete rebuild would be to achieve high passenger circulation volumes throughout the station, and reduce conflict between arriving and departing passenger flows with high capacity trains. The redesign process would be different from HS2's though with the same outcome in mind:

- Allow, as with HS2, a different circulation level for entry and exit passengers to/from the platforms. Broadly, a high level departure concourse (which could be integrated with the proposed piazza) would allow passengers to descend by escalator and lift to platforms, while arrivals would exit onwards and downwards to the Underground concourse or upwards to the piazza or Euston Express's proposed northern access.

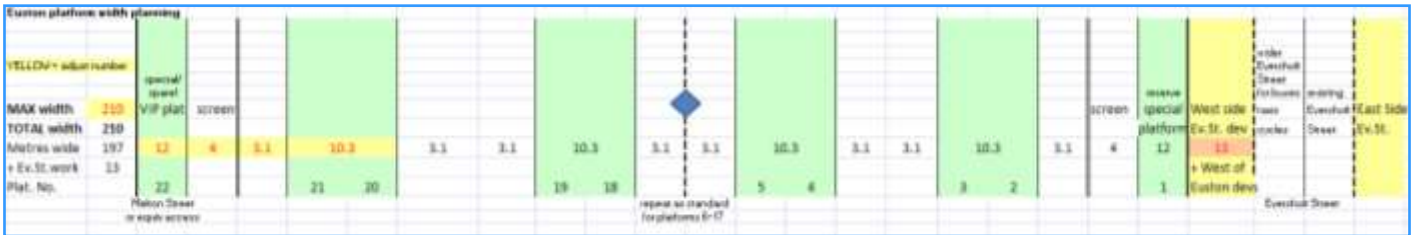
- Instead of HS's 12m wide platforms with 3 banks of 3 escalators per pair of platforms, there would be 4 banks of 2 escalators, extending further along the platforms and enabling passengers not to have to crowd to three locations. It should be born in mind that the HS2 passenger volume per linear metre of train is likely to be less than that of a commuter train; the extent to which HS2 passengers should be offered 8 or 9 escalators for a 400m long train, compared with two for passengers leaving Eurostars at St Pancras International that are 394m long. Again, two may be too few, but if four spread along the platform reduces the platform width by 2m and the consequent costs of rebuilding platforms, this is an option that should be looked at. And if HS2 passengers need 8 or 9 escalators for a 400m long train, then surely commuters and WCML longer distance passengers, who may be in just as much of a hurry as HS2 passengers, deserve similar provisions of escalators!

- This allows island platform widths to be reduced to about 10.3m each, but narrowing at the northern end as they do at present – since there will be fewer passengers there.

- Euston Express's thinking allows for wider platforms on the extreme western and eastern sides of the station, accessible by vehicles, and usable as specialised VIP hospitality or alternatively detention platforms in case of serious problems.

- A standard alternation of 2 tracks and one island platform within a full rebuild, would allow up to 22 platforms, and also a 13m width in hand to expand Eversholt Street and achieve better environmental management and architectural treatment of what is currently a 'Berlin Wall' along the west side of that road.

Euston platform width assessment within station's existing east-west footprint Fig 15



An important point arising is that the station can be rebuilt within the existing footprint. It does not require additional land take on the western side. Euston Express acknowledges that some land on the western side has already been set aside for station expansion, and would not have a problem if that were to be used for additional reserve platforms, but it does appear entirely unnecessary, would be limited in platform length, and in our view should probably be used only for development purposes authorised separately.

HS2 Ltd. has also suggested that all platforms must be straight to allow for the safe connecting and reconnection of half-trains. Although no doubt desirable, Euston Express considers that this is an unnecessary requirement when the cost of achieving it is very high. There are many stations in the UK, including we believe at Euston, where trains are connected and disconnected with passengers on board and where the station platforms are on a curve. There is no reason not to allow this at Euston.

6.4.3 Allowing for eventual 'European gauge' access to Euston terminus

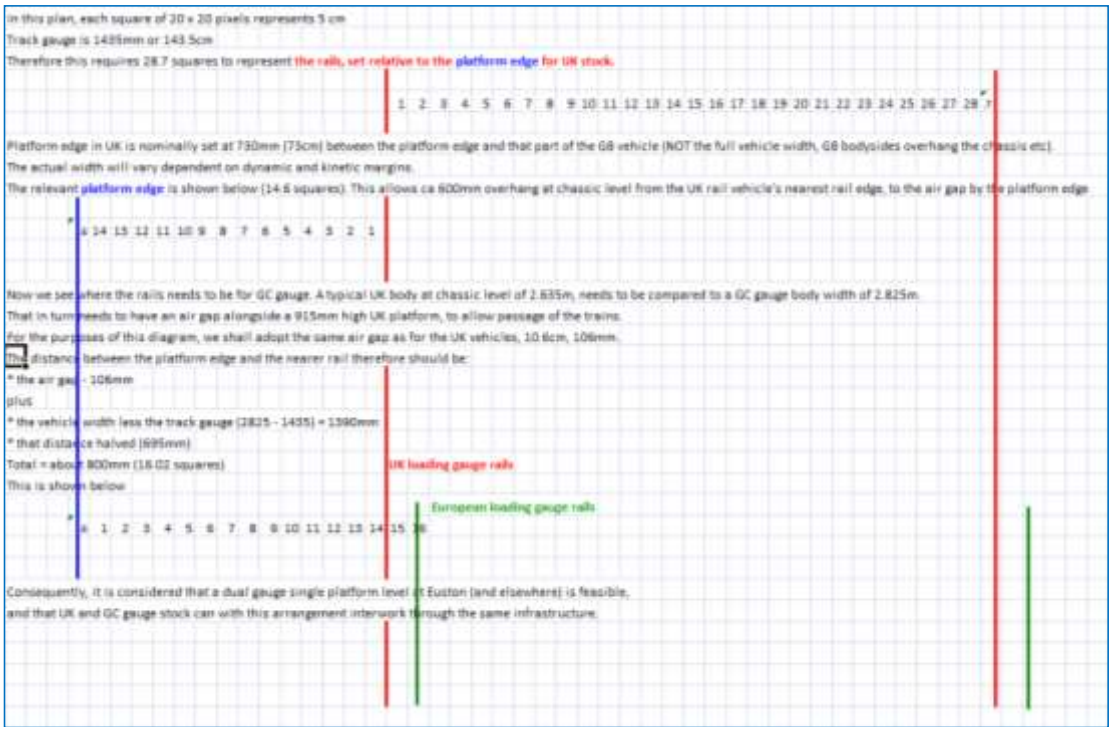
Euston Express has also considered the 'what if?' question, about the late 2030s/2040s if it were desired then to convert some platforms and approaches to a European loading gauge. If by then there were overhead development and fixed pillars around the station platforms, then moving those would be most unlikely.

Consequently if Euston should have the eventual opportunity to permit access by European 'European gauge' trains, the elements of that which cannot be changed in the late 2030s would need to be built in from the start. Therefore we shall address here the terminus, not the approaches where more options are available. It is

assumed that HS trains would approach/depart via tracks E & F and via track X **(see Fig 11).**

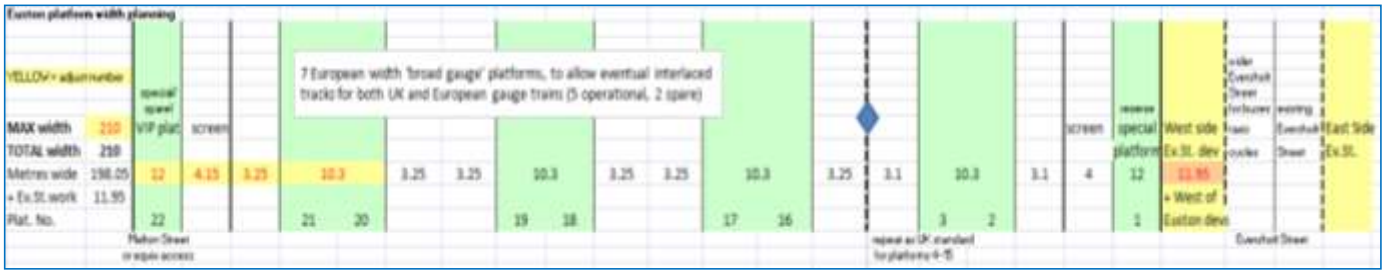
With either station rebuild option, these tracks point to the eastern and western groups of platforms. The critical feature for platform design is that the 'European gauge' trains require about 800 millimetres (mm) clearance, if alongside a UK-gauge platform, instead of about 730 millimetres for a UK-sized train – **see Fig 16.** This is possible at the same platform by using interlaced tracks (one overlapping the other). The diagram below shows this.

Fig 16. Accommodating European gauge trains alongside UK platforms



HS2 Ltd.'s view is that eventually a mix of about half and half 'classic compatible' and 'European gauge' trains could be required. At 9-10 tph out of 18 tph, this would be up to 5 platforms plus a spare platform, so 6 in total, or 7 in the worst case that 2 HS spare platforms were required simultaneously by 'European gauge' trains. To simplify structure widening requirements alongside tracks, this would logically point to the western side high number platforms, not via the Track X underpass to the low number eastern side platforms. So it is proposed that the rebuilt western platform zone from about platform 14 (present configuration)/16 (future configuration), to new platform 22, should be designed to 'European gauge' widths from the start, to allow passive provision for such trains in the future. Fig 17 demonstrates this, with 3.25 metres width track space for each line, rather than 3.1 metres. Space to improve Eversholt Street reduces only marginally, from 13 to nearly 12 metres.

Fig 17. Platform widths to accommodate European gauge trains



The track approaches from Queens Park and Primrose Hill tunnels would require review about the feasibility of inserting 'European gauge'. Euston Express considers that in such an event, it would be rational to make use of either/or a combination of:

- A Crossrail 3-compatible proposal to divert more Euston commuter services into a new cross-London tunnel, which would free up space in the Primrose Hill tunnels and Camden Bank, for 2-3 UK structure gauge tracks and 2 'European gauge' tracks, instead of the 6 tracks described earlier. 'European gauge' trains would then have an unencumbered run to Euston terminus.

- A revised HS2-HS1 tunnel, joining near Queens Park/Kilburn and using the proposed passive provision there for tunnel junctions.

- Another Primrose Hill single tunnel bore, to achieve a new 'European gauge' tunnel in one direction, and in turn allowing the existing fast line bore (future HS2 'classic compatible' tunnel) to become 'European gauge' in the other direction, and with track displacement elsewhere.

These would be options to be developed then, not now, since the point of the Euston Express proposal is to be incremental and affordable during each stage of works, and the top priority requirements for London commuting – which will be the biggest driver for railway investment business cases – have not yet been worked through.

6.5 Passenger volumes

We have already described the foreseen passenger volumes at Euston in the high peak and the 3 hour AM peak period, at various dates. Combining the various capacity expansion proposals for London Underground, London Overground, a new Crossrail, refilling WCML classic capacity, and then adding in HS2 Phases 1 and 2, and taking away 6-8 tph commuter trains into Crossrail 1, points to HS2 never being more than 30% of the cumulative passenger arrival volume at the various Euston stations (and generally less than that). This estimate also excludes the contribution of surface transport including buses, walking and cycling.

Cumulative exit rail passenger volumes in a 3 hour AM peak period could be 40,000 in the high peak hour by the 2040s, and 100,000 in a full 3 hour AM peak, with these figures excluding new interchange flows such as Crossrail 2 to the tubes. Entry volumes

would also be very considerable. So it is the conventional tube and rail (and Crossrail) services that deserve the greatest attention in terms of stimulus for (1) adequacy of passageways, interchange facilities, station quality, information, staffing and so on, and (2) for development stimulus.

They highlight that the Euston station and interchange investments should spread the passenger volumes over a sufficient area of Euston so that risks of congestion and crowding are reduced as far as possible, with a high concern for passenger flow management. Separation of entry and exit flows is desirable, and adequate space for passenger marshalling. **Euston Express proposes a high level piazza over the terminus with retail facilities and a pedestrianised boulevard to assist with that, with access available that way to the reorganised Euston terminus platforms, as well as other Underground and Crossrail connections**.

A full passenger flow capability to and from platforms as diverse as Euston Square and Crossrail 2 will be required. A northern access for Euston terminus, the existing tube platforms and Crossrail 2 will be highly desirable – and would help to offer a good stimulus for development north of the terminus along the suggested 'Mornington Boulevard' towards 'Camden Unlimited'.

Euston Express proposes that for surface travel:

- Through general vehicle traffic should be prohibited from Eversholt Street, with that road and its western frontage improved using the spare width achieved by a Euston terminus with up to 22 reorganised platforms. General traffic would instead use Hampstead Road.

- Taxis could be located (as at Paddington terminus) at the new development heart, here by the northern access entrance/exit, with a taxi hub on the proposed high-level service road for the station, trains and developments. This can be adapted from the former Red Star service road.

- Buses would use Eversholt Street as the main pick up and set down location, in place of the present bus station. A bus stand zone could be located where the present Barnby Street Royal Mail depot is located (this is within the existing red line construction area for Euston terminus, and an alternative site is required for this in any event).

- There would be other bus stops on the Euston Road, which itself would be more accessible from the cross-station Underground concourse, and with Euston Road potentially having the Euston Road underpass extended in tunnel past the station as part of a TfL project to put this part of the Central London ring road underground as part of 'place-shaping' initiatives.

- Greater accessibility for bus, two-wheel and pedestrian circulation along and across the present Euston Road would open up the University campus for easy

access to the multiple Euston stations, and for development opportunities. Much expanded cycle parking facilities would be a design objective.

- Integration of the proposed Mornington Boulevard with access from Euston Road and south of that, will create a new linear corridor from Oxford Street to Camden and Regents Park.

- A lateral, high quality east-west pedestrian link should be defined between the Euston zone and St Pancras/Kings Cross stations and development lands. Routes such as Brill Place may help this objective.

6.6 Investment in passenger distribution

Euston Express believes that it is desirable to construct a deck over the platforms for most of their length. This would allow for the easiest passenger circulation, as well as retail facilities, and for existing to the north along with taxi and cycle access. A full width passenger circulation under the tracks to reach the various Underground lines would also greatly assist passenger flows; HS2 platforms should be included in this, although the greater flows will be from commuters.

Euston Express has demonstrated that the growth in passenger numbers from the HS2 services is likely to be outstripped by growth in commuters and longer distance classic line trains on WCML. It therefore seems desirable to use the opportunity of the additional trains from HS2 to improve the arrangements for passenger distribution to the existing Underground lines, whilst making provision for the projected Crossrail 2 and build the planned connection to Euston Square Underground station.

Arrangements for improved connections to buses and taxis, must also be included, as well as for cyclists and pedestrians.

Clearly a better pedestrian link to Euston and St Pancras stations is also very desirable, as is an entrance to Euston from the North on both sides of the tracks.

It is not therefore possible to allocate costs of such passenger improvement to HS2, Network Rail, TfL or others without a much more detailed design and plan, but to avoid possibly ten years of construction upheaval that the HS2 Ltd. scheme much entail, it is important to plan these many and necessary passenger improvements as one project to be completed in the shortest possible time and with minimum inconvenience to passengers. The Euston Express project does enable this to be achieved.

6.7 Servicing the station and developments

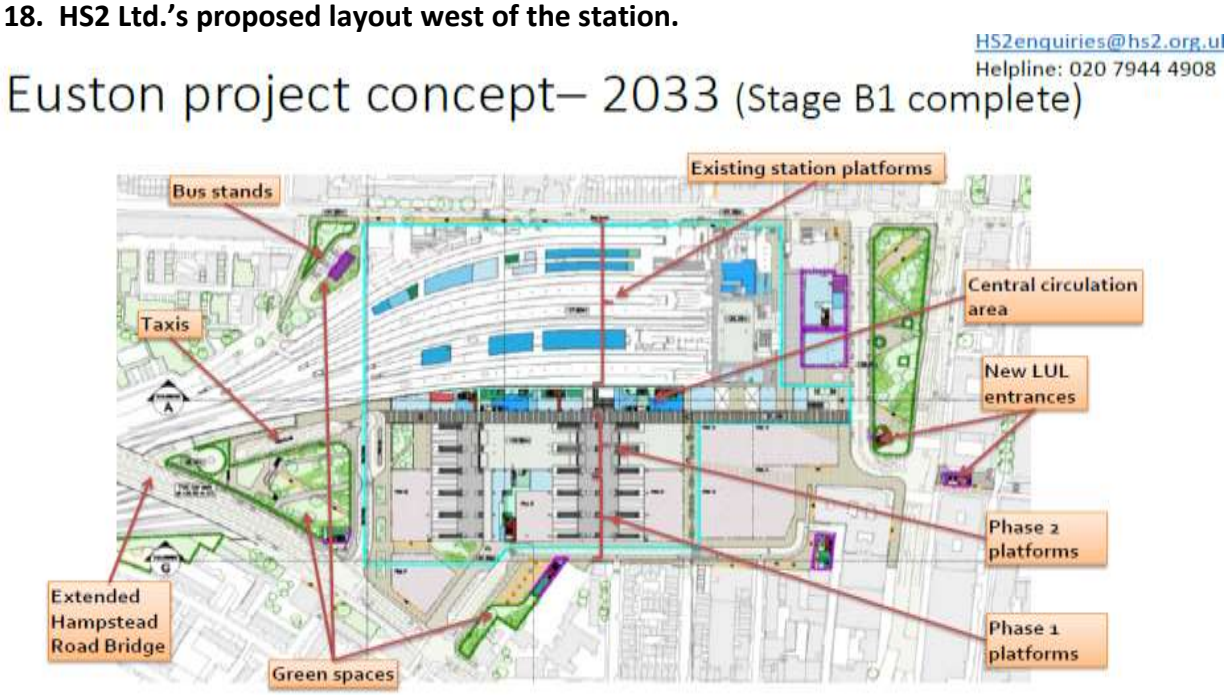
Servicing of the station and associated developments can be achieved through access to the station deck from the northern end either from the East or West side,

depending on the arrangements for road layouts, bus, and taxi and cycle access along both sides of the station.

6.8 Environment and ambience

The environmental effects of the Euston Express scheme are overall much reduced compared with the HS2 Ltd. scheme, since it removes the works on the West side of Euston station and its approaches almost completely, and leaves the residential and business buildings untouched.

Fig 18. HS2 Ltd.'s proposed layout west of the station.



During construction, at Euston station itself, it is not yet clear to what extent and time the HS2 Ltd. works will affect either local residents or the travelling public, but the massive excavation works for the new platforms and the service rooms underneath would not be required for Euston Express. Both schemes would benefit from a deck about the tracks, and one spanning the whole station would certainly be preferable. There is already a deck over part of the station, and it seems sensible to use this if it is in reasonable condition.

The HS2 Ltd. scheme requires alterations to Hampstead Road Bridge, the demolition and excavations around the buildings on the west side of the railway between this bridge and the tunnel portal are all time-consuming works and will inflict considerable inconvenience on residents. Hampstead Road Bridge is reported to be carrying more services than any other bridge in London; these will all need temporary diversion and reinstating in a longer and higher bridge; this work alone could take a number of years to complete.

Further away from Euston, the only significant works required by Euston Express are the reboring of the two DC line tubes at Hampstead Tunnel. HS2 Ltd.'s consultant's

Report[9] emphasise the difficulty of doing this work, but it is worth recalling that a similar tunnel relining was successfully completed on the City and South London Railway from Euston to Clapham Common[10] between August 1922 and April 1924. Each tube was 7.25 miles long, so 14.5 single track miles were converted, using some 22,000 tunnel segments in total. The two Hampstead Tunnel DC line tunnels are 0.82 and 0.72 miles long so, 90 years after the City and South London Line tunnels were re-bored at a rate of 0.7 miles a month, it should be possible to re-bore the two DC tunnels in a time which did not have a serious and adverse effect on the overall construction programme. Similar tunnel reconstructions work has been undertaken more recently in Ipswich and Southampton tunnels to create a higher loading gauge for freight trains. In some cases, one track was retained for operations during the works.

Other works west of Hampstead tunnels involve the construction of a flyunder for the Bakerloo line west of Queens Park station, and the slewing of tracks from fast to slow to DC lines as described earlier. All this work is standard railway work and can generally be undertaken during weekend possessions, with tracks remaining open during weekday.

The tunnel portals and ramps would be separate structures to reduce their width and can be constructed within the railway boundary. The Travers Perkins builder's yard west of Queens Park station would be used as a work site with temporary bridge(s) constructed across the line for access to the works, although some materials could be brought by rail in the completed tunnels from Old Oak Common.

Construction access to all the sites would need to be discussed and agreed with the local authorities and the residents affected consulted on options. Clearly as much material in and out would be taken by rail, but inevitably there will be some additional road traffic during the construction period. Euston Express believes, however, that this will overall be very much less than the works proposed by HS2 to the west of Euston station and its approaches, where we understand that some 650 trucks in and 650 out a day for spoil removal alone will be somehow have to use the local roads.

Once construction is complete, the environmental effects of Euston Express would be little different from the present West Coast Main Line tracks, except that there will be more trains running on the tracks.

6.9 Construction sequencing

Tunnels would be bored from Old Oak Common towards the Queens Park portals and all construction materials and spoil dealt with from the Old Oak Common end. Some materials for the construction of the portals and approaches could also be brought by rail in the completed tunnel.

[9] HS2's response to Euston Express Petition C221-MMD-CV-REP-010-200019 PO2 6 May 2015, page 41 et seq

[10] http://www.davros.org/rail/culg/northern.html

The sequence of works between Queens Park area and Euston has been set out earlier. Depending on other works than Network Rail may wish to undertake, **the overall construction time should be no longer than for the HS2 Ltd. scheme**. At Euston Station, the Euston Express works, deck construction and additional platforms, can be phased between the three parts of the station platforms. This would allow at least two thirds of the current station platforms to remain operational.

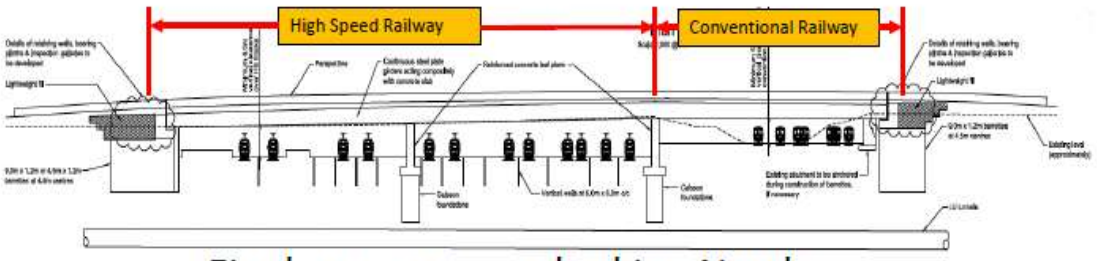
7. Cost and affordability

Euston Express has been given little information about the detailed costs of the HS2 Ltd. scheme apart from their consultant's commentary[11] on an earlier version of the Euston Express proposal. This document did not cover Euston station at all, did not provide comparative costings of the HS2 Ltd. scheme, and was incorrect in a number of assumptions about Euston Express.

Firstly, Euston Express does not require GC gauge infrastructure where this is not necessary because it is new construction. So the tunnels from Old Oak Common to Queens Park would be built to GC gauge, but the remainder of the works would be built to accommodate classic compatible trains.

The HS2 document also omitted any information about the cost of rebuilding and lengthening and raising Hampstead Road Bridge.

Fig 19 Cross section of Hampstead Road Bridge in HS2 Ltd. scheme



Secondly, considerable sums would be saved by a staggered portal arrangements for the HS2 lines near Queens Park.

So it was a pity that HS2 Ltd. did not seek to discuss their findings with Euston Express before publishing their 200+ page 'rebuttal'. We suggest an order of magnitude of cost comparison between the two schemes below:

[11] HS2's response to Euston Express Petition C221-MMD-CV-REP-010-200019 PO2 6 May 2015

	HS2 Ltd. scheme	Euston Express	Saving £m
Trains			
Classic compatible	yes	yes	
Captive to GC gauge	yes	no – use classic compatible	50
Tunnels Old Oak Common to Portal[12]	£564m	£155m	409
Portals - assume portals and ramps the same price			none
Construction from portal			
To Euston HS2 estimate	£500m		
Euston Exp DC tunnels		£99m[13]	
Bakerloo line diveundr		£41m	
locate Bakerloo depot		£100m	260
Track work OOC to Euston	No info from HS2, assume the same		none
Hampstead Road Bridge Reconstruction, including cost of services diversions	£100m	nil	100
Station platforms, plant room etc	£500m	£100m	400
Land purchase and compensation OOC to Euston	£500m estimate	nil	500
Deck over station	common to both		none
Extension platforms to south	common to both		none
Underground connections	not priced		
Estimated saving			**£1,719m**

Given the uncertainty of the data about both the HS2 scheme and comparators with Euston Express, a saving of between £1.5 and £2 bn would seem reasonable at this time.

[12] Tunnelling costs from HS2's response to Euston Express Petition C221-MMD-CV-REP-010-200019 PO2 6 May 2015 page 104. Euston Express tunnels from Appendix J..

8. Next steps

This paper was prepared before changes announced by HS2 Ltd. in early September. Euston Express will respond to any such new information as quickly as possible. It is likely that this will form part of a revised petition against additional provisions in the HS2 Bill.

This Report is being sent to ministers and HS2 urging them to consider these proposals seriously and enter into detailed discussion on how they can be implemented.

It is also being sent to many organisations and individuals who have been consulted or may be interested.

Further information:

Lord Berkeley
House of Lords
London SW1

Contact Tel 07710 431542, berkeleyafg@parliaemnt.uk

It will be posted on Lordsoftheblog Lord Berkeley.