

HS2

High Speed Two Phase 2b

South Yorkshire Parkway &
Connectivity Study: Additional Work

July 2019



Department for Transport

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High Speed Two (HS2) Limited,
Two Snowhill
Snow Hill Queensway
Birmingham B4 6GA

Telephone: 08081 434 434

General email enquiries: HS2enquiries@hs2.org.uk

Website: www.hs2.org.uk

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1 Executive summary

- 1.1.1 This report provides details of the additional work undertaken by HS2 Ltd since the production of the High Speed Two Phase 2b South Yorkshire Parkway & Connectivity Study in July 2017. All additional work has been undertaken by HS2 Ltd at the request of the Department for Transport (DfT).
- 1.1.2 In July 2017, the HS2 Ltd work to assess the feasibility of a potential parkway station on the HS2 mainline identified a shortlist of four potential parkway station locations on the Phase 2b M18 / Eastern route – Wales, Bramley, Mexborough and Hemsworth. However, based on the criteria considered, the work did not identify a clear standout location. The work also suggested that a parkway station might not deliver additional benefits to the overall value for money assessment of the HS2 business case.
- 1.1.3 The HS2 Ltd work to consider potential service extensions in July 2017 looked at the feasibility of extending classic compatible HS2 services terminating at Sheffield Midland station to a number of destinations on the conventional network north of Sheffield Midland. This work showed that service extensions resulted in a lower level of increases in HS2 passenger numbers than a parkway station on the HS2 mainline. This reflects the relatively lower improvements in journey time delivered by service extensions, and the more limited markets being served. There were marginally positive increases in benefits and revenues to the overall value for money assessment of the HS2 business case.
- 1.1.4 HS2 Ltd has been instructed by DfT to undertake three additional pieces of work on potential South Yorkshire service enhancements since July 2017. These are:
- An assessment of whether the case for a South Yorkshire parkway station would change in a scenario where Northern Powerhouse Rail (NPR) were also to operate in 2033 (for example, by providing additional services between Sheffield and Leeds).
 - Analysis of a proposition put forward by Sheffield City Region for a parkway station on a re-aligned high speed mainline in the Dearne Valley.
 - A review of the HS2 mainline parkway station options to assess how the Phase 2b scheme design proposals have changed since the July 2017 work, and the implications of any changes on the mainline station options.
- 1.1.5 Our first piece of work assessed whether the case for a South Yorkshire parkway station would change in a scenario where NPR were also to operate in 2033. This

work indicates that a scenario of NPR does not change any of the conclusions previously reached by HS2 Ltd in July 2017, namely:

- A new parkway station on the high speed mainline between East Midlands Hub and Clayton Junction (for example at Mexborough or Bramley) outperforms one north of Clayton junction (at Hemsworth) in terms of HS2 South Yorkshire passenger numbers, benefits and revenues. However, similar to the results of the previous work done by HS2 Ltd, mainline parkway station options at Mexborough and Hemsworth served by HS2 services, and with additional connectivity facilitated by NPR, result in slightly negative impacts on overall HS2 benefits.
- A station located on the conventional rail network between Sheffield and Clayton Junction served by HS2 services appears to perform worse than HS2 mainline parkway station options in terms of HS2 passenger numbers. However, it does show marginally positive increases in benefits and revenues to the overall value for money assessment of the HS2 business case.

1.1.6 It is therefore recognised that there may be further work that could be undertaken with national and regional stakeholders (including Network Rail and Transport for the North) on the potential balance between HS2 serving a station on the conventional rail network between Sheffield and Clayton Junction and other services in the region, including NPR. As part of this work, further engagement with the region could be undertaken to understand the strategic case for serving a station via the conventional rail network in this area.

1.1.7 Our second piece of work assessed a proposition put forward by Sheffield City Region for a parkway station on a re-aligned high speed mainline in the Dearne Valley. This indicates that a high speed station here should not be taken forward for further consideration. This is due to the need to significantly realign the HS2 mainline, the impact on Clayton Junction and the increases in journey time that would occur for services between London and Leeds, including those not calling at a parkway station in this location.

1.1.8 The third and final piece of work has reviewed the HS2 mainline parkway station options to assess how the Phase 2b scheme design proposals have changed since our July 2017 work. In doing so, HS2 Ltd was specifically instructed by DfT to specifically consider two further criteria: the feasibility and impacts of providing passive provision for a parkway station on the HS2 network; and the ability of station options to be integrated with a potential future NPR network. This work indicates that:

- Our previous shortlist of four stations can be reduced to two – Wales and Hemsworth.
- Based on the Phase 2b scheme design proposals at the time of the assessment, a compliant alignment could be achieved at both Wales and Hemsworth should the Secretary of State instruct HS2 Ltd to include passive provision for a parkway station in the Phase 2b scheme at either location.
- Providing passively for a station at either Wales or Hemsworth would, however, result in significant additional costs and impacts compared to the design of the scheme that doesn't include passive provision for a parkway station.

1.1.9 HS2 Ltd has undertaken significant work since November 2016 to investigate the scope for enhancing HS2 services to South Yorkshire. This has included considering the feasibility of a potential parkway station on the HS2 mainline in South Yorkshire. Based on the analysis undertaken during this work, in which South Yorkshire is served by the M18 / Eastern route (including a spur to Sheffield Midland station and a junction back onto the HS2 mainline at Clayton), HS2 Ltd has not been able to identify a clear economic or strategic case for the inclusion of a parkway station to serve the South Yorkshire market on the HS2 mainline.

2 Introduction

- 2.1.1 This report builds upon the 'High Speed Two Phase 2b South Yorkshire Parkway & Connectivity Study' (July 2017), in which HS2 Ltd investigated the scope for enhancing HS2 services to South Yorkshire via either a parkway station, or by extending HS2 services terminating at Sheffield Midland station to travel onwards to other destinations on the conventional rail network. Advice on this work was provided to the Department for Transport (DfT) in July 2017.¹
- 2.1.2 This report provides details of the further work undertaken by HS2 Ltd, at the request of DfT, since the production of the South Yorkshire Parkway & Connectivity Study.

2.2 Findings of previous HS2 Ltd work

- 2.2.1 On the subject of a potential parkway station on the HS2 mainline, HS2 Ltd identified a shortlist of four potential parkway station locations on the Phase 2b M18 / Eastern route – Wales, Bramley, Mexborough and Hemsworth. However, based on the criteria considered, the HS2 Ltd work did not identify a clear standout location, and also suggested that a parkway station might not deliver additional benefits to the overall value for money assessment of the HS2 business case.
- 2.2.2 Nonetheless, some HS2 mainline parkway station options showed high numbers of new HS2 passengers. HS2 Ltd therefore concluded that, given the distributed demand in the area, the wider strategic context, and the long-term development and investment plans of the region, further work should be undertaken with regional partners, including Sheffield City Region and Transport for the North (TfN), to understand whether it was possible for them to come to an agreed position in terms of the location of a potential parkway station and potential funding.
- 2.2.3 The HS2 Ltd work to consider potential service extensions looked at the feasibility of extending classic compatible HS2 services terminating at Sheffield Midland to a number of destinations on the conventional rail network north of Sheffield Midland station. Destinations assessed included Meadowhall, Barnsley, Rotherham, Wakefield and a new station on the conventional rail network near Goldthorpe / Thurnscoe. This work showed that service extensions resulted in a lower level of increases in HS2 passenger numbers than a parkway station on the HS2 mainline, reflecting the relatively lower improvements in journey time delivered by service

¹ The DfT did not publish this advice at the time given their decision that further work was required by HS2 Ltd and others to look into potential HS2 service enhancements in South Yorkshire.

extensions, and the more limited markets being served. There were marginally positive increases in benefits and revenues to the overall value for money assessment of the HS2 business case.

2.2.4 In providing advice to DfT, HS2 Ltd indicated that more work was required to consider the implications of extending HS2 services, particularly the operational and cost impacts, but that there was a longer time horizon for this work as it was unlikely to be necessary to incorporate any changes within a HS2 Phase 2b hybrid Bill.

2.3 Additional work by HS2 Ltd

2.3.1 Since July 2017, and following the delivery of its South Yorkshire Parkway & Connectivity Study, HS2 Ltd has been instructed by DfT to undertake three additional pieces of work. These are described below.

- An assessment of whether the case for a South Yorkshire parkway station would change in a scenario where Northern Powerhouse Rail (NPR) were also to operate in 2033.
- Analysis of a proposition put forward by Sheffield City Region for a parkway station on a re-aligned high speed mainline in the Dearne Valley.
- A review of the HS2 mainline parkway station options to assess how the Phase 2b scheme design proposals have changed since the July 2017 work, and the implications of any changes on the mainline station location options. In doing so, HS2 Ltd were specifically instructed by DfT to take into account: the feasibility and impacts of providing passive provision for a parkway station on the HS2 network; and the ability of parkway station options to be integrated with a potential future NPR network.

2.3.2 This report summarises the findings of these pieces of work.

2.4 Structure of report

2.4.1 Following this introductory section, this report adopts the following structure:

- **Section 3** summarises the outcomes of work by HS2 Ltd to consider whether a scenario of NPR operating alongside HS2 would change any of the conclusions of HS2 Ltd's previous work.
- **Section 4** summarises the work done by HS2 Ltd to assess a proposition put forward by Sheffield City Region for a parkway station on a re-aligned high speed mainline in the Dearne Valley.

- **Section 5** details the work done by HS2 Ltd to review the previous mainline parkway station options based on an updated Phase 2b scheme design.

2.4.2 This report is supported by one annex. This is:

- Annex A: Assumptions, caveats and limitations associated with modelling work to consider whether a scenario of NPR operating alongside HS2 changes the case for a parkway station in South Yorkshire.

3 Consideration of a scenario in which NPR is operational in 2033

3.1.1 In April 2018, and following previous work by HS2 Ltd to look into the feasibility of a potential parkway station in South Yorkshire, DfT instructed HS2 Ltd to assess whether the case for a parkway station would change in a scenario where NPR were also to operate in 2033.

3.2 Modelling potential demand

3.2.1 HS2 Ltd worked with TfN and DfT to develop a new 'HS2 plus NPR' base case for this work. This involved adding a representation of NPR services over and above the existing HS2 reference case that was developed for the HS2 Ltd July 2017 work. This new base case provided a baseline train service specification (TSS) against which to model the impact of parkway station options. A representation of this base case is shown in Figure 2 (shown on page 11).

3.2.2 HS2 Ltd undertook four model runs to test the case for different parkway options against the new base case. The modelling was undertaken using HS2 Ltd's PLANET Framework Model (PFM, version 7.1), which is used to assess the HS2 value for money appraisal.²

3.2.3 The outcomes of this work should be considered in conjunction with the outcomes of the HS2 Ltd July 2017 work.

3.2.4 In order to inform the modelling work to be undertaken and the train services to be tested, three strategically different types of parkway station were identified:

² It is noted at the outset that there are a number of assumptions, caveats and limitations associated with the modelling of these tests. These are summarised in Annex A.

1. A station on the conventional rail network north of Sheffield and south of Clayton Junction, able to be served by HS2 and / or NPR services using the conventional rail network north of Sheffield Midland station (representative station from previous work: **Meadowhall**).
2. A parkway station on the HS2 mainline between East Midlands Hub and Clayton Junction, served by HS2 mainline services only (representative station from previous work: **Mexborough Parkway** or **Bramley Parkway**).
3. A parkway station on the HS2 mainline north of Clayton Junction, and therefore able to be served by both high speed mainline services and services from Sheffield Midland station joining the HS2 mainline from the conventional rail network via Clayton Junction (representative station from previous work: **Hemsworth Parkway**).



Figure 1: Types of parkway station tested during HS2 plus NPR modelling work

3.2.5 A summary of the tests undertaken is shown in Table 1. Each test is described in more detail in the sections that follow Table 1.

Table 1: Summary of HS2 plus NPR TSS scenarios tested

Test	Objective	Sheffield Midland services (tph)	Parkway services (tph)	Total South Yorkshire services (tph)	Sheffield Midland services to London (tph)	Parkway services to London (tph)	Total South Yorkshire services to London (tph)
SY1: HS2 + NPR base case scenario	New reference case for modelling (without parkway)	4	0	4	2	0	2
SY2: A station on conventional network north of	To understand if scenario of NPR changes case for a	4	2	6 ³	2	2	4 ³

³ This includes two services that will stop at both Sheffield Midland and Meadowhall.

Test	Objective	Sheffield Midland services (tph)	Parkway services (tph)	Total South Yorkshire services (tph)	Sheffield Midland services to London (tph)	Parkway services to London (tph)	Total South Yorkshire services to London (tph)
Sheffield and south of Clayton Junction	stop / extension service on conventional network between Sheffield and Clayton Junction.						
SY3: A parkway station on HS2 mainline between East Midlands Hub and Clayton Junction	To assess if scenario of NPR changes case for a parkway station on HS2 mainline.	4	3	7	2	2	4
SY4: A parkway station on HS2 mainline north of Clayton Junction served by services using both high speed mainline and conventional network north of Sheffield	To understand if being able to stop both mainline services and services using conventional network north of Sheffield at Hemsworth improves its performance relative to previous best performers of Mexborough and Bramley.	4	5	9 ⁴	2	4	6 ⁴
SY5: A station on conventional network between Sheffield and Clayton Junction plus a parkway station on HS2 mainline between East Midlands Hub and Clayton Junction	Provides a comparison with number of services provided at Hemsworth in SY4.	4	5	9 ⁵	2	4	6 ⁵

⁴ This includes two services that will stop at both Sheffield Midland and Hemsworth Parkway.

⁵ This includes two services that will stop at both Sheffield Midland and Meadowhall.

New HS2 plus NPR base case (SY1)

- 3.2.6 This scenario formed the new baseline for testing parkway station locations, and was based on the existing HS2 reference case (PFM 7.1) plus the addition of a representation of the proposed NPR network ('Network D')⁶. This new baseline is shown in Figure 2.
- 3.2.7 The new HS2 plus NPR base case represents the extension of the two HS2 London-Sheffield services to Leeds (2tph). Other than this, the HS2 services remain unchanged from the Phase 2b reference case in PFM 7.1.
- 3.2.8 Core NPR enhancements to existing east-west rail services (as per the NPR 'Network D' specification provided by NPR) have been made as part of the new base case.
- 3.2.9 Further journey time improvements were also applied to NPR services between Leeds-Hull, Sheffield-Hull, and the Sheffield-Doncaster section of the Cleethorpes services in order to match NPR ambitions.
- 3.2.10 All parkway tests were then modelled with reference to this base case, which is shown in Figure 2.
- 3.2.11 It should be noted that this representation of NPR was developed solely for the purposes of testing parkway stations, and reflects a representation of NPR in 2017. It did not seek to be a complete representation of NPR proposals, which were still under development at the time of HS2 Ltd doing this work.

⁶ 'Network D' coding reflects a representation of NPR in 2017. Subsequent development work and economic modelling has been undertaken for the NPR Strategic Outline Business Case now being considered by Government.

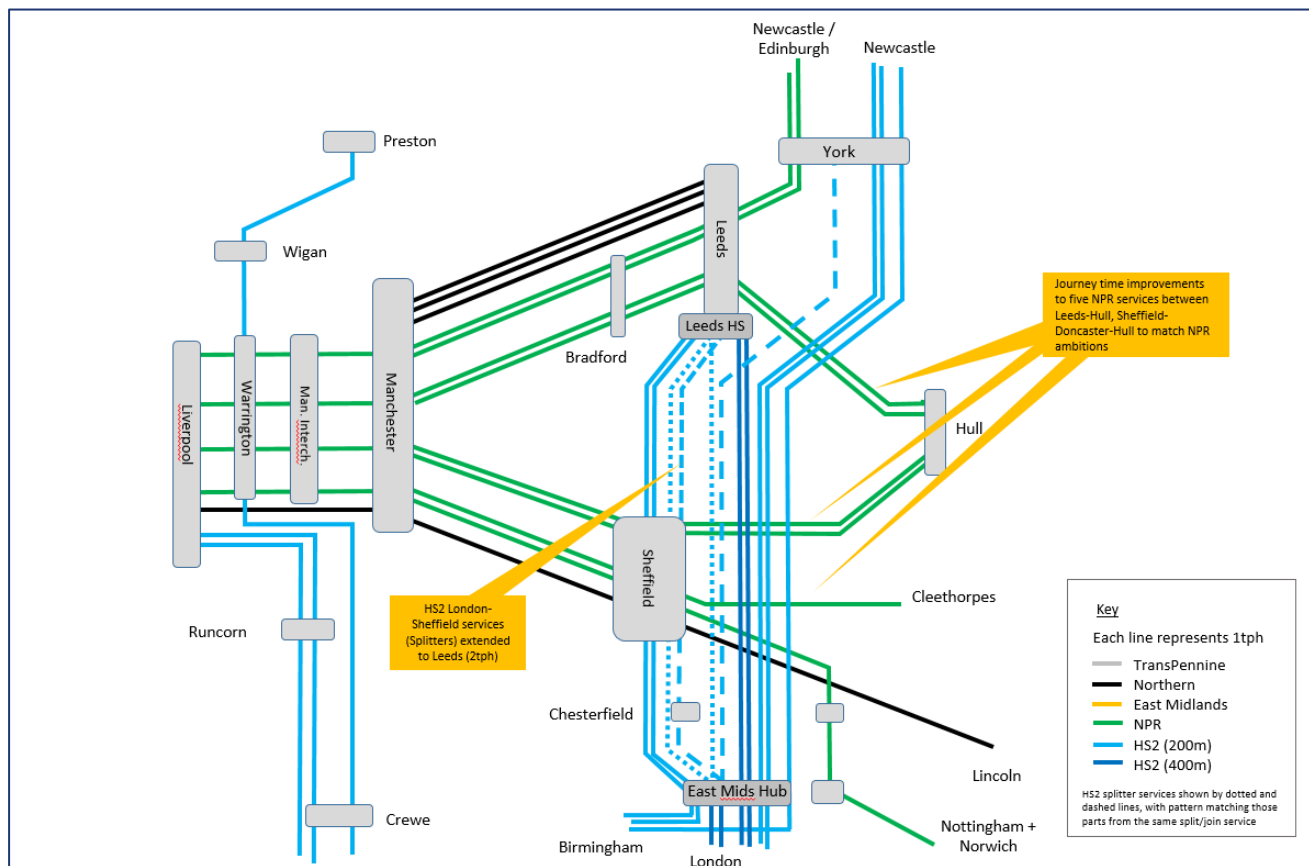


Figure 2: Test SY1: New HS2 plus NPR base case

A station on the conventional network north of Sheffield and south of Clayton Junction (SY2)

3.2.12 This test looked at a station location on the conventional rail network north of Sheffield Midland station and south of Clayton Junction, served by London-Sheffield-Leeds services using the conventional network north of Sheffield Midland station only. The purpose was to understand if adding a scenario of NPR changes the case for a stop / extension of service on the conventional rail network north of Sheffield and south of Clayton Junction.

3.2.13 In this test, 2tph from London-Sheffield-Leeds stop at the existing Meadowhall station on the conventional network. This provides a comparison with the July 2017 work that looked at extending London-Sheffield terminating services to Meadowhall. The Meadowhall location was chosen for testing as this was the best performing extension of service location in the previous HS2 Ltd work. The TSS tested represents a total of two hourly London services to and from Meadowhall. The TSS is shown in Figure 3.

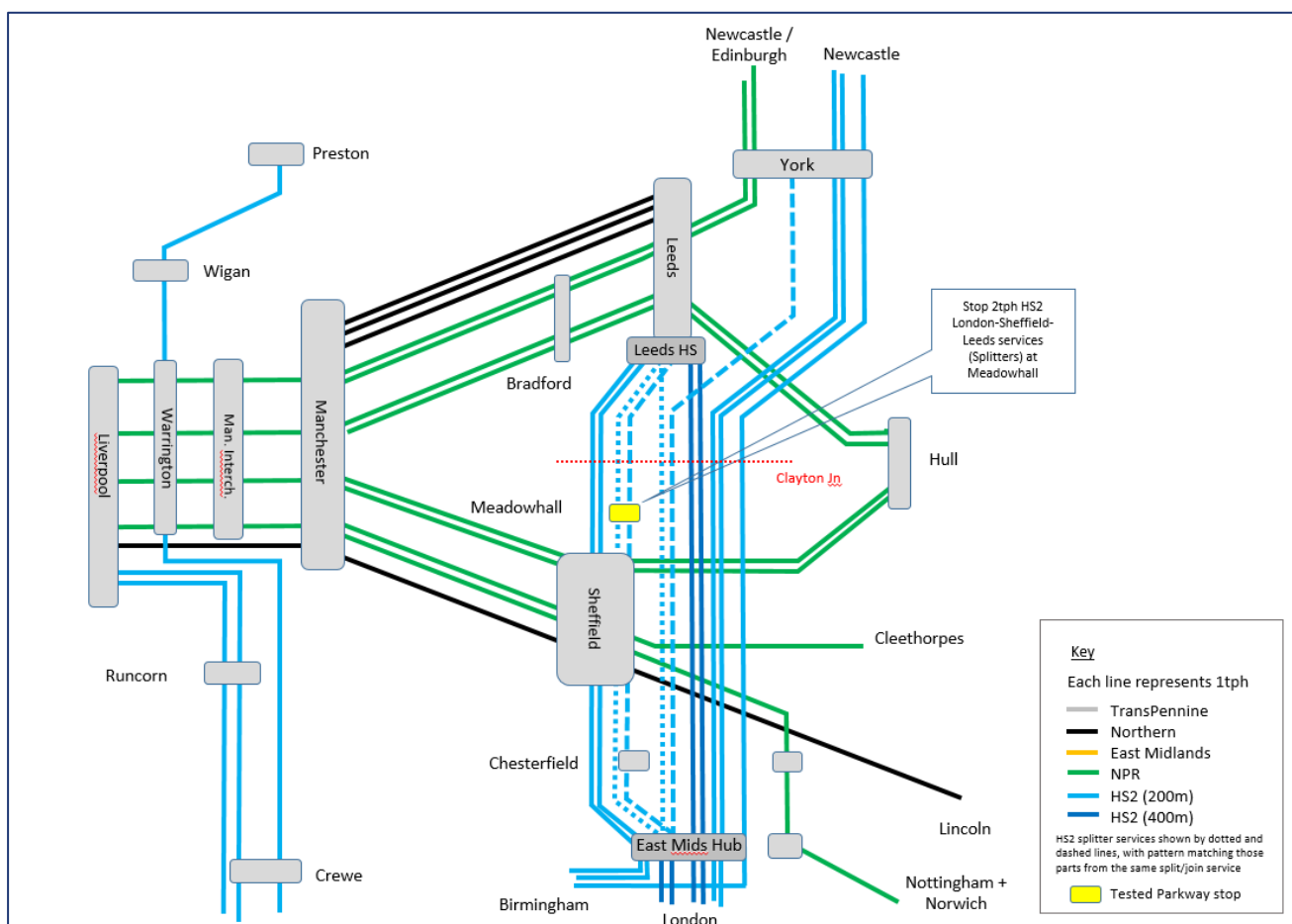


Figure 3: Test SY2: A station on the conventional network north of Sheffield and south of Clayton Junction

A parkway station on the HS2 mainline between East Midlands Hub and Clayton Junction (SY3)

3.2.14 This test considered a parkway station location on the high speed mainline between East Midlands Hub and Clayton Junction that would be served by high speed mainline services only. The purpose of this test was to assess if a scenario of NPR changes the case for a parkway station on the HS2 mainline.

3.2.15 Mexborough and Bramley were the best performing shortlisted mainline parkway station locations in the previous HS2 Ltd work in terms of South Yorkshire passengers and benefits. This test sought to understand if an NPR scenario affects these results.

3.2.16 Mexborough was chosen as the location for the test given it would have the additional benefit of also being served by NPR and conventional rail services between Sheffield and Doncaster. In this test, 3tph HS2 mainline services call at this location (2tph London-Leeds / York, 1tph Birmingham-York and the North-East). This represents a total of two hourly London services to and from the parkway. The TSS is shown in Figure 4.

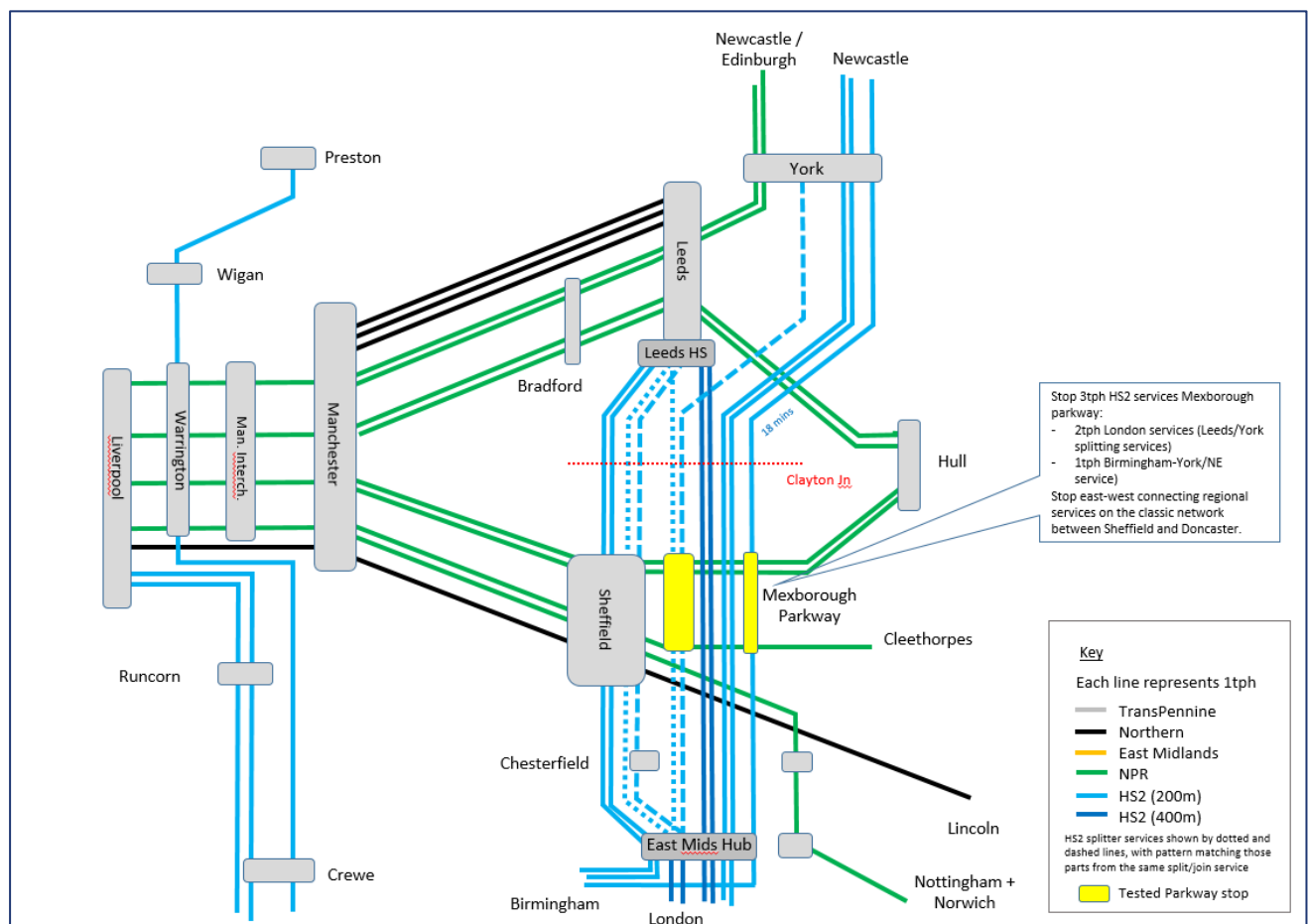


Figure 4: Test SY3: A parkway station on the HS2 mainline between East Midlands Hub and Clayton Junction

A parkway station on the HS2 mainline north of Clayton Junction served by both high speed services and services using the conventional network between Sheffield and Clayton Junction (SY4)

- 3.2.17 This test considered a parkway station location on the high speed mainline north of Clayton Junction (Hemsworth) served by both high speed mainline services and services from Sheffield Midland station joining the HS2 mainline from the conventional network via Clayton Junction.
- 3.2.18 In the previous HS2 Ltd work, Hemsworth parkway was the worst performing shortlisted parkway location on the HS2 mainline in terms of HS2 South Yorkshire passengers and benefits. This work, however, did not consider the potential for also stopping services using the conventional network between Sheffield and Clayton Junction at this location, due to it being north of Clayton Junction.
- 3.2.19 The purpose of this test was to understand if being able to stop both mainline services and services using the conventional network between Sheffield and Clayton Junction at Hemsworth improves its performance relative to the previous best parkway station performers (in terms of passenger numbers and benefits) of Mexborough and Bramley.
- 3.2.20 This test considered a parkway station at Hemsworth with the same 3tph mainline services as for Mexborough and Bramley from the previous HS2 Ltd previous work **plus** also stopping 2tph London-Sheffield-Leeds services using the conventional network between Sheffield and Clayton Junction. The tested stopping pattern therefore provides a total of 5tph at Hemsworth: 2 tph mainline London services (to Leeds / York); 1tph mainline Birmingham service (to York and the North East); and 2tph London-Sheffield-Leeds services using the conventional network between Sheffield and Clayton Junction. This represents a total of four hourly London services to and from the parkway. The tested TSS is shown in Figure 5.

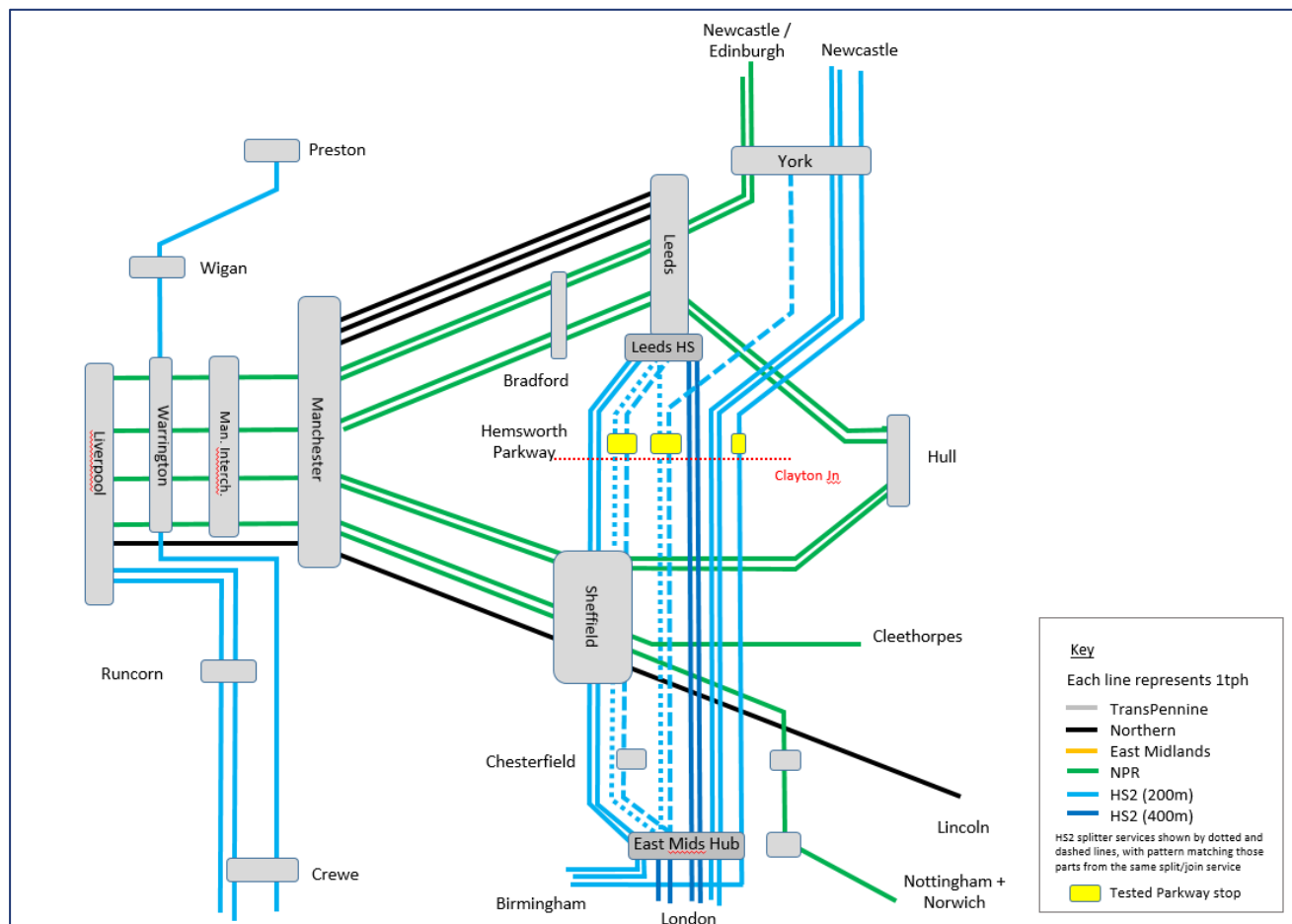


Figure 5: Test SY4: A parkway station on the HS2 mainline north of Clayton Junction served by both high speed services and services using the conventional network between Sheffield and Clayton Junction.

A station on the conventional network between Sheffield and Clayton Junction plus a parkway station on the HS2 mainline between East Midlands Hub and Clayton Junction

3.2.21 This test considered a parkway station on the high speed mainline between East Midlands Hub and Clayton Junction (Mexborough) **and** a station on the conventional network between Sheffield and Clayton Junction (Meadowhall). The purpose of this test was to act as a comparison for the test which looked at serving a station at Hemsworth with 5tph (SY4). If the Hemsworth station location surpasses other parkway locations (in terms of passenger numbers and benefits) because 2tph have been added that use the conventional network between Sheffield and Clayton Junction, this test seeks to understand if this is unique to Hemsworth (it being north of Clayton Junction) or if it is just stopping extra services that matters. This is therefore a test option that combines stopping 3tph mainline services at Mexborough, with stopping 2tph using the conventional network between Sheffield

and Clayton Junction at Meadowhall, to provide 5tph across two locations. The tested TSS is shown in Figure 6.

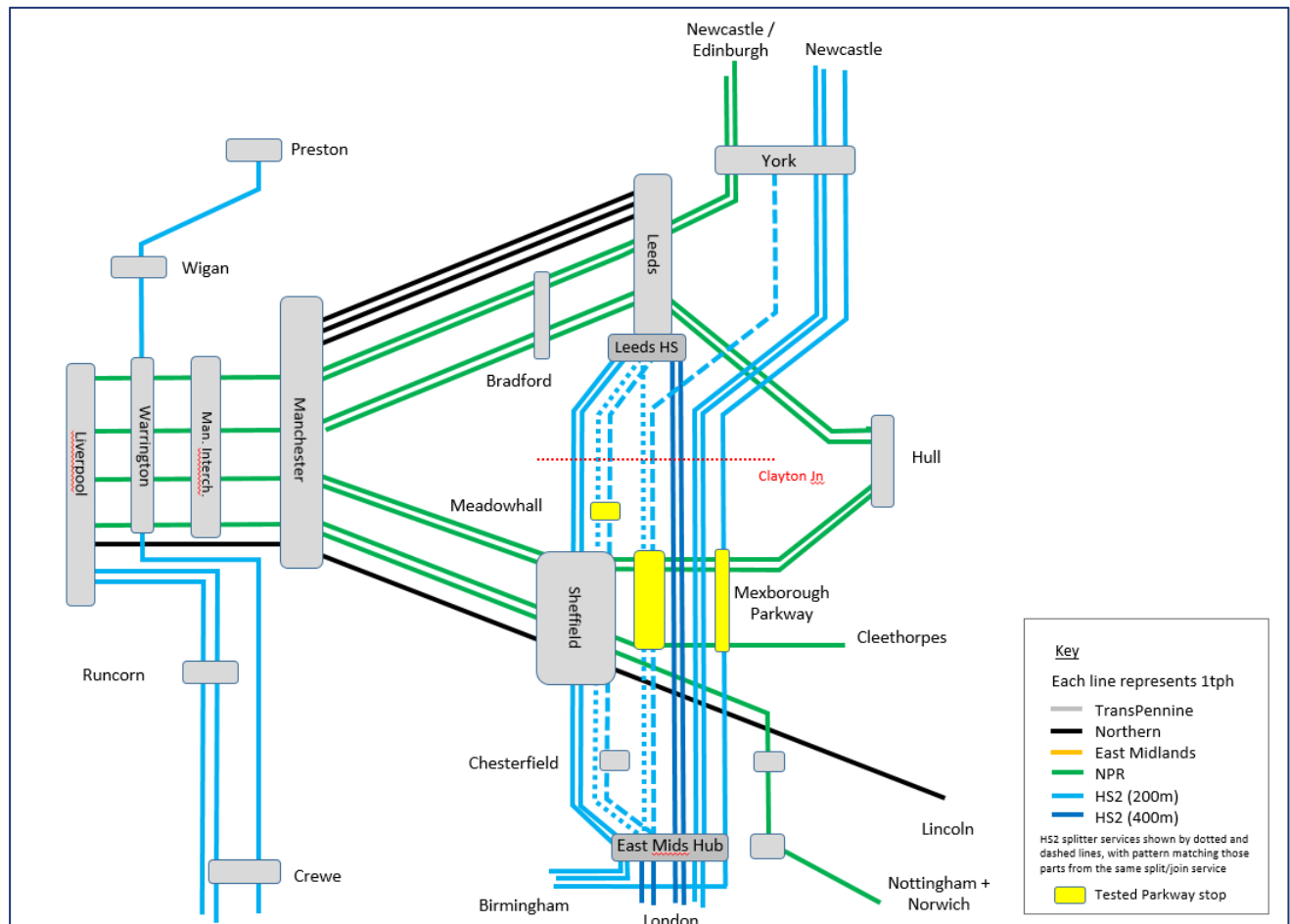


Figure 6: Test SY5: A station on the conventional rail network between Sheffield and Clayton Junction plus a parkway station on the HS2 mainline between East Midlands Hub and Clayton Junction

3.3 Results of modelling

3.3.1 Each of the above tests has been modelled using PFM version 7.1 to ascertain an estimate of their impact in terms of passenger demand, benefits and impacts on the overall value for money assessment of the HS2 business case.

3.3.2 Table 2 summarises the number of HS2 boarders for the tests undertaken.

Table 2: Daily HS2 boardings (2037) under tested parkway options

Daily HS2 boarders (2037)	HS2 + NPR base case (SY1)	Meadowhall 2tph (SY2)	Mexborough 3tph (SY3)	Hemsworth 3tph + 2tph loop (SY4)	Mexborough 3tph + Meadowhall 2tph (loop (SY5)
Sheffield Midland	9,670	8,460	8,720	9,240	7,900
Meadowhall	-	1,750	-	-	1,400
Hemsworth	-	-	-	2,490	-
Mexborough	-	-	4,090	-	3,880
Total South Yorkshire (ex Chesterfield)	9,670	10,210	12,800	11,730	13,180
Chesterfield	910	890	890	890	870
Total South Yorkshire (inc Chesterfield)	10,580	11,110	13,690	12,620	14,050
Toton	18,190	18,220	18,000	17,960	18,030
Leeds	20,290	20,300	18,870	19,230	18,930
York	10,090	10,080	9,470	9,570	9,480
All other stations	283,060	283,280	284,460	283,330	284,320
All HS2 boardings	342,210	342,980	344,480	342,700	344,810

3.3.3 Table 3 summarises the change in daily boarders relative to the HS2 plus NPR base case for the tests undertaken. In doing so, this table shows the change in daily boarders from a scenario in which HS2 and NPR were operating but there was no parkway station.

Table 3: Daily HS2 boardings (2037) under tested parkway options – change v. base case

Daily HS2 boarders (2037) change relative to HS2 + NPR base case	HS2 + NPR base case (SY1)	Meadowhall 2tph (SY2)	Mexborough 3tph (SY3)	Hemsworth 3tph + 2tph loop (SY4)	Mexborough 3tph + Meadowhall 2tph (loop (SY5)
Sheffield Midland		-1,210	-960	-400	-1,780
Meadowhall		1,750	0	0	1,400
Hemsworth		0	0	2,500	0

Daily HS2 boarders (2037) change relative to HS2 + NPR base case	HS2 + NPR base case (SY1)	Meadowhall 2tph (SY2)	Mexborough 3tph (SY3)	Hemsworth 3tph + 2tph loop (SY4)	Mexborough 3tph + Meadowhall 2tph (loop (SY5)
Mexborough		0	4,090	0	3,880
Total South Yorkshire (ex Chesterfield)		540 (5.6%)	3,130 (32.4%)	2,100 (21.3%)	3,510 (36.3%)
Chesterfield		-20	-20	0	-40
Total South Yorkshire (inc Chesterfield)		520 (5.0%)	3,110 (29.4%)	2,000 (19.2%)	3,470 (32.8%)
Toton		30	-190	-200	-160
Leeds		10	-1,420	-1,100	-1,360
York		-10	-620	-500	-600
All other stations		220	1,390	300	1,260
All HS2 boardings		770 (0.2%)	2,270 (0.7%)	500 (0.1%)	2,600 (0.8%)

3.3.4 The total number of daily HS2 boarders in South Yorkshire increases in all scenarios that have been tested. The results of each scenario are discussed below.

A station on the conventional network north of Sheffield and south of Clayton Junction (location 1 in Figure 1) (SY2)

3.3.5 Adding a scenario of NPR and stopping the two trains per hour between London, Sheffield and Leeds at Meadowhall increases the number of HS2 South Yorkshire passengers by 5.6% when compared to the HS2 plus NPR base case. The impact on the overall HS2 benefits is +0.2% (see Table 4 below).

3.3.6 The forecast increase in HS2 South Yorkshire passenger numbers is very similar to that achieved in the previous work when HS2 Ltd considered extending the two London-Sheffield services to Meadowhall (increase in passengers of 5.4%). The number of passengers travelling from Meadowhall to London is broadly similar whether you are extending terminating HS2 services to Meadowhall or whether you are stopping London-Sheffield-Leeds services at Meadowhall. The increase in passengers and benefits as a result of passengers going from Meadowhall to Leeds is largely cancelled out by slowing HS2 services between Sheffield and Leeds to stop at Meadowhall.

A parkway station on the HS2 mainline between East Midlands Hub and Clayton Junction (location 2 in Figure 1) (SY3)

- 3.3.7 In the previous HS2 Ltd work, potential parkway stations at Mexborough and Bramley were the best performing locations in terms of the number of HS2 South Yorkshire passengers and potential benefits. This was largely due to their proximity to population areas and transport connections to the wider region.
- 3.3.8 In addition to a parkway station at Mexborough being served by three HS2 trains per hour on the HS2 mainline, this additional work has considered the impact of an NPR scenario on Mexborough, given its direct conventional rail connection to NPR Sheffield-Hull services.
- 3.3.9 Under a scenario of HS2 plus NPR, a parkway station at Mexborough is forecast to continue to provide an increase in South Yorkshire HS2 passengers (+32.4%), relative to the HS2 plus NPR base case. This increase is slightly higher than in the previous HS2 Ltd work (where a parkway station at Mexborough served by three HS2 services per hour resulted in a 30.4% increase in HS2 South Yorkshire passengers). The slight increase in passengers from the previous work reflects the additional connectivity benefits of this location under a scenario of NPR.
- 3.3.10 As with the previous work, a parkway station at Mexborough served by HS2 services and with additional connectivity facilitated by NPR results in a slightly negative impact on overall HS2 benefits (-0.1%, vs. -0.2% previously).

A parkway station on the HS2 mainline north of Clayton Junction served by both high speed services and services using the conventional network between Sheffield and Clayton Junction (location 3 in Figure 1) (SY4)

- 3.3.11 In the previous HS2 Ltd work, a potential parkway station at Hemsworth was the worst performer amongst the shortlisted mainline parkway station locations in terms of HS2 South Yorkshire passengers and benefits. This work, however, did not consider the potential for also stopping services using the conventional network between Sheffield and Clayton Junction at this location, due to it being north of Clayton Junction, which provides connectivity from the conventional rail network north of Sheffield Midland station back onto the HS2 mainline.
- 3.3.12 This additional work considered a potential parkway station at Hemsworth that is served by the same three high speed train services per hour service as previously tested for Mexborough and Bramley, plus two additional trains per hour that stop at Hemsworth as part of HS2 London-Sheffield-Leeds services travelling on the conventional network between Sheffield and Clayton Junction.

- 3.3.13 This option increases the number of South Yorkshire HS2 passengers by 21.3% when compared against the HS2 plus NPR base case. Overall HS2 benefits reduce slightly (-0.3%) due to the impact of stopping five HS2 services at the parkway station on destinations further north. Stopping services at the parkway would increase journey times from London and Birmingham to destinations including Leeds, York and Newcastle, decreasing the benefits accrued from these services.
- 3.3.14 Despite adding a scenario of NPR and stopping the additional two services using the conventional network between Sheffield and Clayton Junction per hour at Hemsworth, this location still performs below the best performing Mexborough and Bramley parkway options from the previous HS2 Ltd 2017 work (increases in HS2 South Yorkshire passengers of 30.4%), without a scenario of NPR.
- 3.3.15 Table 4 summarises the estimated impact of each tested option on the value for money appraisal of the overall HS2 business case.

Table 4: Impact on value-for-money assessment of parkway station options tested

Full Network impacts (2037 Demand Cap) (£million)	HS2+NPR base case (SY1)	Meadowhall 2tph (SY2)	Mexborough 3tph (SY3)	Hemsworth 3tph + 2tph loop (SY4)	Mexborough 3tph + Meadowhall 2tph (loop) (SY5)
Transport benefits (business)	58,160	58,292	58,054	57,939	58,151
Transport benefits (other)	18,460	18,475	18,461	18,449	18,470
Other quantifiable benefits	413	413	416	412	415
Loss to Government of indirect taxes	-4,132	-4,136	-4,124	-4,118	-4,127
Net Transport Benefits (PVB)	72,901	73,044	72,806	72,682	72,910
Revenues	43,138	43,202	43,014	42,969	43,062
Change relative to HS2+NPR base case (£million)	HS2+NPR base case (SY1)	Meadowhall 2tph (SY2)	Mexborough 3tph (SY3)	Hemsworth 3tph + 2tph loop (SY4)	Mexborough 3tph + Meadowhall 2tph (loop) (SY5)
Transport benefits (business)		132	-106	-221	-9
Transport benefits (other)		15	1	-11	10
Other quantifiable benefits		-0	2	-1	2

Loss to Government of indirect taxes		-4	8	14	5
Net Transport Benefits (PVB)		143	-95	-219	8
% change		0.2%	-0.1%	-0.3%	0.0%
Revenues		64	-124	-169	-76

3.4 Findings of modelling

3.4.1 As highlighted in the HS2 Ltd July 2017 advice to Government, our work to consider potential parkway stations on the HS2 mainline and HS2 service extensions on the conventional network north of Sheffield considered the impact on HS2 passenger numbers in South Yorkshire and the benefits to, and impacts on, the overall value for money assessment of the HS2 business case.

3.4.2 The inclusion of an NPR scenario does not significantly change the conclusions of our previous work (see Section 2.2 above). Based on the assessments and tests undertaken:

- A parkway station on the HS2 mainline between East Midlands Hub and Clayton Junction (for example at Mexborough or Bramley) outperforms one north of Clayton Junction (at Hemsworth) in terms of HS2 South Yorkshire passenger numbers, benefits and revenues. However, similar to the results of the previous work done by HS2 Ltd, mainline parkway station options at Mexborough and Hemsworth served by HS2 services, and with additional connectivity facilitated by NPR, result in slightly negative impacts on overall HS2 benefits.
- A station located on the conventional rail network between Sheffield and Clayton Junction served by HS2 services appears to perform worse than HS2 mainline parkway station options in terms of passenger numbers. It does, however, show marginally positive increases in benefits and revenues to the overall value for money assessment of the HS2 business case.

3.4.3 It is therefore recognised that there may be further work that could be undertaken with national and regional stakeholders (including Network Rail and TfN) on the potential balance between HS2 serving a station on the conventional rail network between Sheffield and Clayton Junction and other services in the region, including NPR. As part of this work, further engagement with the region could be undertaken to understand the strategic case for serving a station via the conventional network in this area.

4 Assessment of alternative SCR parkway station option on HS2 mainline

- 4.1.1 In April 2018, HS2 Ltd was instructed by DfT to consider a request from Sheffield City Region (SCR) to assess a proposed high speed mainline parkway station at the intersection between the Midland Mainline and a re-aligned HS2 mainline between Goldthorpe and Thurnscoe.
- 4.1.2 An indicative location for the proposed SCR alternative station is shown in Figure 7.
- 4.1.3 HS2 Ltd undertook a high level assessment of this alternative option, using the approach and methodology undertaken to assess the long list of HS2 mainline parkway station locations that were previously considered. For details of how this work was undertaken, see our July 2017 work.
- 4.1.4 The proposed HS2 station was assumed to be on viaduct and embankment and would cross over the Midland Mainline and conventional rail station.

4.1.5 A station in this location would result in a significant change to the HS2 mainline (approximately 15km), thereby not meeting the original remit of the HS2 Ltd work which was to consider potential parkway station locations on the Phase 2b M18 / Eastern route. To serve the proposed station, the HS2 mainline would move to the east, running through, or in closer proximity to, Mexborough, Harlington, Barnburgh, Thurnscoe and Clayton.

4.1.6 The change in mainline alignment would result in a reduction in mainline speed (to less than 250kph), adding approximately three minutes to the journey time on services between London and Leeds, even for services not stopping at the proposed parkway.

4.1.7 The proposed location of the station would also be in direct conflict with the location of Clayton Junction, which connects the existing rail network north of Sheffield Midland station back onto the HS2 mainline to Leeds, York and the north-east. Were the station to be progressed, Clayton Junction would need to be moved further north, would have reduced design speed and would be located closer to South Kirby.

4.1.8 Due to the need to significantly realign the HS2 mainline, the strategic impact on the location of Clayton Junction and the increases in journey time that would occur for services between London and Leeds, including those not calling at a parkway station in this location, this alternative mainline parkway station location was not progressed for further consideration by HS2 Ltd.

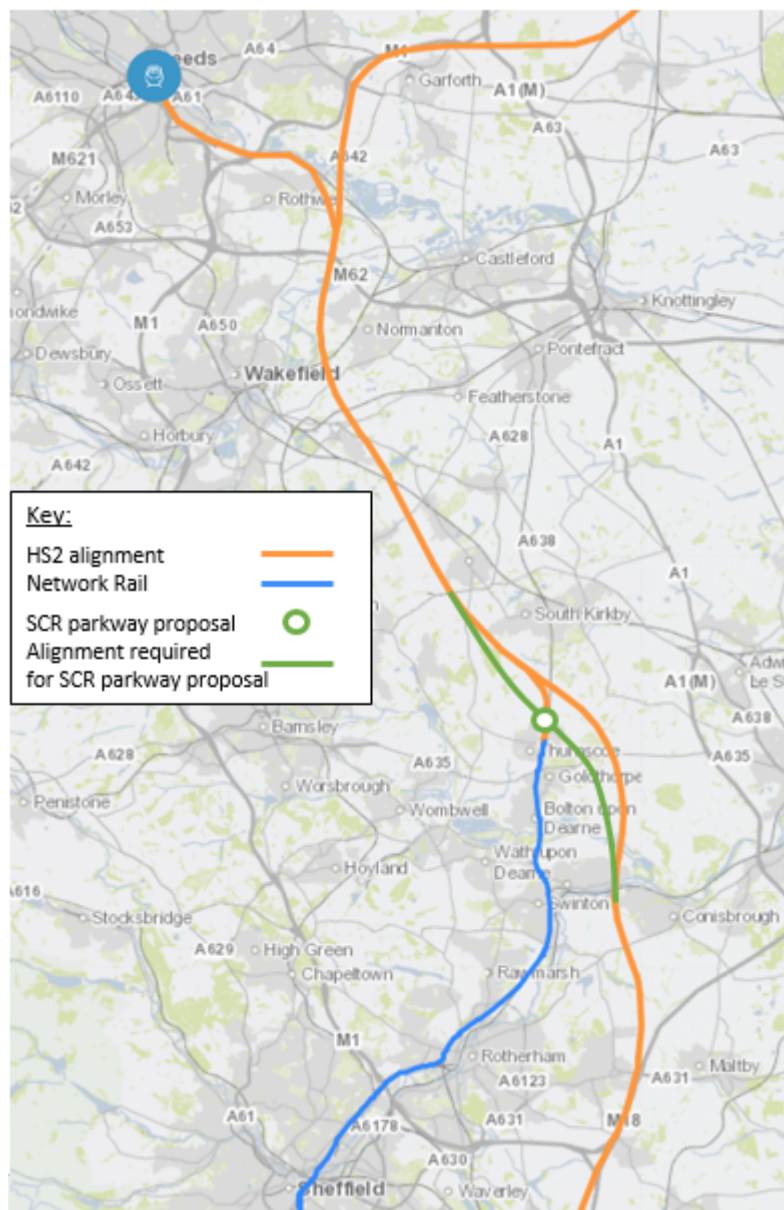


Figure 7: Alternative SCR parkway station location on a re-aligned HS2 mainline

5 Review of parkway options based on updated Phase 2b scheme design

5.1.1 In September 2018, HS2 Ltd were instructed by DfT to undertake a review of the four previously shortlisted parkway stations on the HS2 mainline to assess how the Phase 2b scheme design proposals have changed since the HS2 Ltd July 2017, and any implications of these changes.

5.1.2 In addition to the criteria considered throughout our previous South Yorkshire Parkway & Connectivity Study work, HS2 Ltd were instructed by DfT to also specifically consider:

- The feasibility and impacts of providing passive provision for a parkway station on the HS2 network; and
- The ability of station options to be integrated with a potential future NPR network.

5.1.3 This work did not revisit the economic case for a parkway station (i.e. no further modelling of potential passenger demand and the impacts on the overall HS2 business case was undertaken as part of this work). Nor did this work revisit options to extend HS2 services on the conventional rail network north of Sheffield Midland station.

5.2 Methodology and assumptions

Methodology

5.2.1 The point of comparison for this further work is between the scheme design at the announcement of the Phase 2b preferred route in November 2016 (which informed the HS2 Ltd July 2017 work) and the HS2 Ltd hybrid Bill design at the time of the assessment.

5.2.2 During this period, key changes to the design of the scheme included:

- Greater knowledge about the construction of the scheme and the rail systems work that would be required to build and operate the scheme.
- Greater information regarding environmental mitigation proposals.
- More detail on the design of Clayton Junction.
- Further understanding of NPR aspirations and how these could be integrated with HS2 proposals.

- The inclusion of the electrification of the Midland Mainline between Clay Cross and Sheffield Midland Station in the scope of the HS2 Phase 2b scheme.

Assumptions

5.2.3 Whilst taking into account the updated scheme design proposals, the assumptions for this additional work largely remain the same as those that underpinned the previous work reported to DfT in July 2017, namely:

- That South Yorkshire is served by the M18 / Eastern route of Phase 2b running from Derbyshire to West Yorkshire.
- That the Midland Mainline (MML) between Clay Cross and Sheffield Midland station will have been electrified. The Secretary of State instructed HS2 Ltd to include this in the scope of the Phase 2b scheme in summer 2018.
- That HS2 is able to use the existing rail network between Sheffield Midland station and Clayton Junction without additional investment being funded from the HS2 budget. And that this section of the conventional rail network will have been electrified.
- That only HS2 mainline services will call at each parkway station location (unless otherwise stated).

5.2.4 The engineering assumptions that underpinned this additional work to assess the provision of a parkway station remain as per the previous HS2 Ltd work, namely:

- two station platforms will be provided (in addition to the baseline of two through lines);
- a station loop length (4-tracking section) of a minimum of 3km (1.9 miles);
- station loop turnouts at a minimum of 130kph (82mph);
- the concourse area for the station is a minimum of 4,250m² (13,9432 feet);
- car parking is provided for 1,700 spaces and a station forecourt is included for drop-off, pick-up and transport interchange;
- there is road access to the station and a new roundabout / junction is provided to the existing highway network; and
- the aim is to avoid slowing down the design speed of through lines so there is no impact on non-stopping services.

5.2.5 For the purposes of this work, passive provision has been defined as: doing the minimal construction works for the Phase 2b hybrid Bill scheme to afford the least disruption to the operational railway should the parkway station and station loops be fully constructed after Phase 2b is operational in 2033.

5.3 Review of previous parkway station long list

5.3.1 Following the instruction from DfT, HS2 Ltd reviewed the previous parkway station long list to ensure that previous decisions to park options at the long listing stage remained valid in light of how the Phase 2b proposals have changed since July 2017.



Figure 8: Previous parkway station long list

5.3.2 Four options were previously parked at the long listing stage, following engagement with the Sheffield City Region HS2 Growth Strategy Board: Fitzwilliam and Clayton in the northern part of the study area; and Hickleton and Hooton Roberts in the central area.

Fitzwilliam (north area)

5.3.3 Fitzwilliam was previously parked given the land take and impacts that would result in locating the station in close proximity to the HS2 Phase 2b Eastern Leg Rolling Stock Depot (RSD) that was being proposed at the time at Crofton. In light of the subsequent change in the RSD location away from Crofton, HS2 Ltd reconsidered the Fitzwilliam location.

5.3.4 There would remain significant impacts of locating a potential parkway station at Fitzwilliam due to the close proximity of the Nostell Priory and Parkland, National Trust and the non-existent major highway access at the location. It was reported previously that a parkway station at this location would require a new highway (A-road) to connect to the A638 and that the new highway would have to continue towards Barnsley to effectively serve the regions of Barnsley and Wakefield. Thus, it was noted that out of the northern group of potential locations, Hemsworth had better road access and less significant impacts. This assessment remains valid.

Clayton (north area)

5.3.5 Previous work indicated that a potential parkway station located at Clayton would require the provision of a new road network for access to South Yorkshire, would require a new M18 / Eastern route alignment with a reduced mainline speed, and would interface with the location of the proposed junction between the conventional network north of Sheffield Midland station and the HS2 mainline that will enable services travelling beyond Sheffield Midland station to re-join the HS2 mainline. The emerging design for the Clayton Junction confirms that locating a parkway station at Clayton is very challenging from an engineering and rail systems perspective. The rationale for parking Clayton at long listing stage therefore remains valid.

Hickleton and Hooton Roberts (central area)

5.3.6 A parkway station at Hickleton was previously assessed as requiring a new Phase 2b M18 / Eastern route mainline alignment with a reduced mainline speed. It was stated that the new alignment would increase environmental impacts.

5.3.7 Similarly, our previous work revealed that a parkway station at Hooton Roberts would also require a new HS2 mainline alignment which would increase

environmental impacts. At station at Hooton Roberts would also need to be located on a viaduct.

- 5.3.8 The Phase 2b route alignment for the hybrid Bill design has not significantly changed at Hickleton and Hooton Roberts. Therefore the rationale behind parking these options previously remains valid.

5.4 Initial review of shortlisted parkway station locations

- 5.4.1 HS2 Ltd previously identified a shortlist of four potential parkway station locations on the M18 / Eastern route – Wales, Bramley, Mexborough and Hemsworth.
- 5.4.2 Based on the additional criteria that HS2 Ltd were specifically instructed by DfT to consider as part of this additional work (see paragraph 5.1.2), it is possible to reduce the number of shortlisted stations to Wales and Hemsworth.
- 5.4.3 A parkway station at Bramley, located alongside Junction 1 of the M18, between the motorway and Bramley, would have no conventional rail connectivity, and would therefore not provide for integration with the proposed NPR network. Providing passively for a parkway station at Bramley would also require a longer length of mainline realignment and platform loops than the other shortlisted stations. Additional residential and commercial demolitions would also be required as a result of the parkway station.
- 5.4.4 The provision of a parkway station at Mexborough, located at the interface between the HS2 route and the conventional railway line between Sheffield and Doncaster and between the towns of Mexborough and Conisbrough, would have the largest sustainability and community impacts. Additional construction compounds would be required to facilitate the construction of the station and associated viaducts, increasing community impacts in a very constrained area.
- 5.4.5 Providing passive provision for a station at Mexborough would involve amendments to the mainline and full construction of the loop with the viaduct for the station. The level of disruption required to the operational HS2 mainline and the local community means that it would be more practical to construct a fully operational station before HS2 services commenced in 2033. Providing passively for a parkway station at Mexborough would therefore not be practicable as part of the Phase 2b scheme.

5.4.6 A station at Wales would have good existing transport connectivity, including conventional rail links, potentially providing connectivity between Sheffield and Leeds via Wales, and the possibility of extending NPR services between Manchester and Sheffield onwards to Wales to enhance connectivity with NPR. The station at Wales would also require the lowest length of mainline realignment and platform loops to enable passive provision.

5.4.7 Hemsworth's parkway station location north of Clayton Junction provides an opportunity to stop HS2 mainline services and for potential NPR services travelling between Sheffield and Leeds to call at the station. This location has a lower level of sustainability impacts.

5.4.8 HS2 Ltd therefore recommended that further design work should be undertaken on potential parkway station locations at Wales and Hemsworth.

5.5 Further design work on shortlisted station locations

5.5.1 Further work undertaken by HS2 Ltd has assessed the technical design changes that would be required to the Phase 2b scheme in order to include passive provision for either of the remaining shortlisted parkway station locations in the Phase 2b hybrid Bill scheme.

5.5.2 This work has also sought to understand the scale of infrastructure that would be required to enable a potential parkway station at Hemsworth to effectively fulfil both HS2 and NPR train service aspirations.

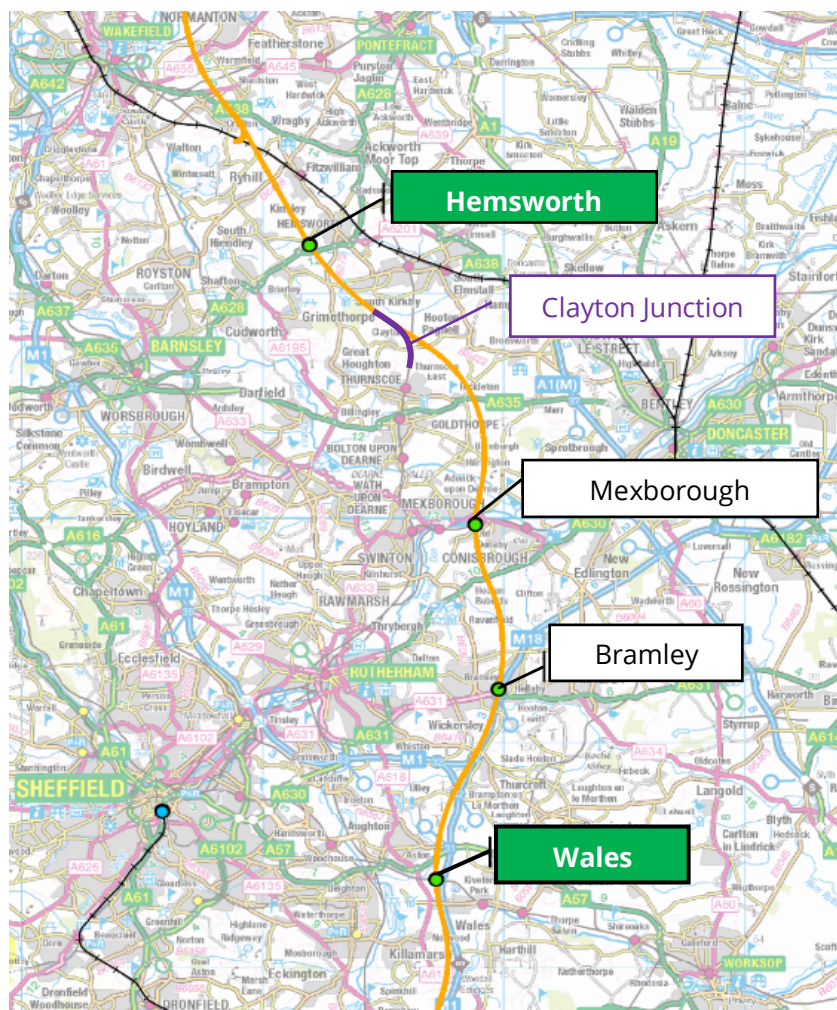


Figure 9: Previously shortlisted parkway station options

Assumptions

5.5.3 The assumptions underpinning this work remained consistent with those that underpinned the HS2 Ltd work in July 2017 and those set out in paragraphs 5.2.3 and 5.2.4 above.

5.5.4 Key assumptions that differ from our previous work included:

- Application of revised loop lengths and turnout speed requirements for each parkway station location to minimise landtake and environmental impacts.
- The baseline train service specification for HS2 at each parkway location included 3 x HS2 services calling at the parkway via the HS2 mainline; a London to Leeds 200m service; a London to York 200m service⁷; and a Birmingham to Newcastle 200m service.

Wales

5.5.5 Based on our July 2017 work, a parkway station at Wales would be located at the interface between the HS2 route and the classic railway line between Sheffield and Worksop. The station would lie to the north-west of Wales and to the west of the M1.

5.5.6 Passive provision requirements at Wales would involve changes to the HS2 mainline alignment, the provision of earthworks for structures, cuttings and embankments, track drainage, cable troughing, and the installation of overhead line equipment (OLE) gantries. Provision for the future installation of 4-tracking would also need to be provided.

5.5.7 Our further technical design work indicates that, based on the Phase 2b scheme design proposals at the time of the assessment, a compliant alignment could be achieved at Wales should the Secretary of State instruct HS2 Ltd to include passive provision for a parkway station in the Phase 2b scheme at this location. It would be possible for this station to accommodate the 3tph HS2 services within the Phase 2b timetable, albeit with extended journey times and a reduction in turnaround time at the end destination for each of the services calling at the station.

5.5.8 A station at Wales would provide conventional rail connectivity. It would also have the potential to provide additional NPR connectivity between Sheffield and Leeds via an interchange at Wales, and for Manchester to Leeds and East Midlands Hub by extending the Manchester to Sheffield NPR services onwards to Wales.

⁷ These 200m services are a part of the 400m service from London that splits at East Midlands Hub as per the Phase 2b reference case TSS (published in the July 2017 Phase Two Economic Case).

5.5.9 However, the required realignment of the HS2 mainline would result in increased impacts and significant costs for both passive and active provision for a station at Wales. These impacts include those set out below.

- The need for platforms to be on a straight section of track would result in the location of the station moving south by approximately 0.5km from the location looked at in the HS2 Ltd July 2017 work.
- The need for a horizontal and vertical realignment of the Phase 2b route in this area. The length of mainline change would be approximately 10km, with the extent of platform loops between 6km and 7.5km.
- The need to review the alignment of the spur from the HS2 mainline to the HS2 infrastructure maintenance facility at Staveley.
- The station would be located on viaduct and embankment.
- A cut and cover tunnel would be required through Wales, adding to construction complexity. A new viaduct would also be required at Killamarsh Pond. The more complex construction and additional earthworks quantities would lengthen the construction programme in this area.
- The introduction of the station would have implications for the B6059 School Road and Cherry Tree Road. The currently proposed overbridge would need to be omitted and replaced with the cut and cover tunnel.
- The introduction of the station would result in a different set of property impacts from those anticipated as a result of the Phase 2b scheme in this area. There would also be increased impacts on Nor Wood Ancient Woodland Inventory Sites (AWIS) and Killamarsh Pond, and greater landscape impacts.
- There would be an impact on the rail systems infrastructure being proposed in this area.

5.5.10 Based on the further technical design work that has been undertaken, it is estimated that the new infrastructure and changes required to the M18 / Eastern route alignment to passively provide for a station at Wales would result in an increase in the region of £386m for the cost of scheme on this part of the Phase 2b route. It is estimated that fully providing a new parkway station at Wales, along with the associated changes that would be required to the HS2 mainline, would result in a cost increase in the region of £665m.⁸

5.5.11 The increased costs associated with both the passive and active provision of a parkway station at Wales would be driven by a number of issues. These include, but are not limited to: additional rail systems infrastructure costs; the need for a cut and

⁸ Costs based on 1Q15 and include optimism bias (OB) at 44%. Figures shown reflect estimated incremental increase against emerging cost estimate in 2018/19 for this part of the Phase 2b route. If any of the parkway station options were to be taken forward, further work would be required to develop cost estimates.

cover tunnel for Wales; the increased length of mainline alignment change that would be required; a deeper retained cut south of Nor Wood AWIS; the increased amount of viaduct structures that would be required to site the parkway station; and the need for a new four-track viaduct over Killamarsh Pond.

Hemsworth

- 5.5.12 Based on our July 2017 work, a parkway station at Hemsworth would be located off the A628 to the south-west of Hemsworth. The station would be in a cutting and on embankment, with the platforms situated between the route crossing over the A628 and crossing under Barnsley Road.
- 5.5.13 Passive provision for a station at Hemsworth would involve changes to the mainline alignment, the provision of earthworks for the necessary structures, cutting and embankments, track drainage, cable troughing and the installation of OLE gantries. Provision for 4-tracking would also need to be provided.
- 5.5.14 As with Wales, our further technical design work indicates that, based on the Phase 2b scheme design proposals at the time of the assessment, a compliant alignment could be achieved at Hemsworth should the Secretary of State instruct HS2 Ltd to include passive provision for a parkway station in the Phase 2b scheme at this location.
- 5.5.15 However, changes to the Phase 2b scheme, in particular the development of the design for the Clayton Junction, and the need for the parkway station platforms to be located on a straight, would move the location of the proposed station approximately 1km to the north of the location previously considered in the HS2 Ltd July 2017 work. The change in the location of the station would require a longer access road to the station from the A628.
- 5.5.16 It would be possible for this station to accommodate the 3tph HS2 services within the Phase 2b timetable, albeit with extended journey times and a reduction in turnaround time at the end destination for each of the services calling at the station.
- 5.5.17 The location of the proposed Hemsworth parkway station north of Clayton Junction provides the potential for the station to be served by both HS2 high speed mainline services and potential services delivered by NPR using the existing rail network between Sheffield Midland station and Clayton Junction, ensuring connectivity with NPR.
- 5.5.18 However, in addition to the need to move the station away from the previously assessed site, the introduction of a parkway station at Hemsworth would also result

in a realignment of the HS2 mainline with increased impacts and costs for both passive and active provision for a parkway station.

- 5.5.19 Provision for the station would require design integration with Clayton Junction, given the proximity of the station location to the junction between the conventional rail network north of Sheffield and the HS2 mainline. This would require additional tracks to be provided to enable 4-tracking of the HS2 mainline between Clayton Junction and the Hemsworth parkway station loops for circa 1.5km, resulting in the realignment of Clayton Junction. Several highway structures would also require widening to accommodate the required four-tracking of the railway.
- 5.5.20 The additional land take that would be required to provide for a parkway station and the associated increase in the volume of earthworks material to be handled would result in additional surplus material that would require removal, increasing the length of the construction programme and the number of construction vehicle movements in this area.
- 5.5.21 The amended mainline alignment and introduction of the station would require a small number of additional demolitions compared against the number required for the Phase 2b scheme in this area. There would also be setting impacts on the Vissitt Manor listed building, and the longer station access road would impact on Holgate Hospital.
- 5.5.22 The location of the station would be partially in floodplain and a siphon would be needed for the River Went tributary.
- 5.5.23 There would also be an impact on the rail systems infrastructure being proposed in this area, particularly on the systems handover arrangements between the conventional and high speed rail networks.
- 5.5.24 Based on the further technical design work that has been undertaken, it is estimated that the new infrastructure and changes required to the M18 / Eastern route alignment to passively provide for a station at Hemsworth would result in an increase in the region of £141m for the cost of scheme on this part of the Phase 2b route. It is estimated that fully providing a new parkway station at Hemsworth, along with the associated changes that would be required to the HS2 mainline, would result in a cost increase in the region of £396m.⁹

⁹ Costs based on 1Q15 and include optimism bias at 44%. Figures shown reflect estimated incremental increase against emerging cost estimate in 2018/19 for this part of the Phase 2b route. If any of the parkway station options were to be taken forward, further work would be required to develop cost estimates.

- 5.5.25 The increased costs associated with both the passive and active provision of a station at Hemsworth would be driven by the 'new' location of the station 1 km to the north, the longer access road that would be needed to the station, and the additional four tracking that would be required between Clayton Junction and the parkway station loops.
- 5.5.26 Our further work also indicates that if a parkway station option at Hemsworth was to provide for NPR services, as well as HS2 services, then the station would require four platforms and two through lines, i.e. six lines.
- 5.5.27 With HS2 services and NPR services calling at the station within close proximity, the station would require two platforms in each direction to 'flight' the services and maintain headway requirements in order not to impact on other HS2 mainline services. The provision of additional platforms and lines would likely require further alignment changes to the HS2 mainline, increases in the station infrastructure and increases in the footprint of the parkway station and car parking requirements. Further assessment and more detailed design work would be required to understand the additional infrastructure requirements and environmental impacts of ensuring a parkway station at Hemsworth could provide for both HS2 and NPR services.

5.6 Findings of further technical design work

- 5.6.1 Based on the additional sifting criteria we have been specifically instructed to consider by DfT, it is possible to reduce the number of shortlisted parkway stations to Hemsworth and Wales.
- 5.6.2 Further technical design work indicates that, based on the Phase 2b scheme design proposals at the time of the assessment, a compliant alignment could be achieved at Wales should the Secretary of State instruct HS2 Ltd to include passive provision for a parkway station in the Phase 2b scheme at this location. However, the required realignment of the railway results in increased impacts and significant costs for both passive and active provision for a parkway station at Wales.
- 5.6.3 Again based on the Phase 2b scheme design proposals at the time of the assessment, further technical design work indicates that a compliant alignment could be achieved at Hemsworth should the Secretary of State instruct HS2 Ltd to include passive provision for a parkway station in the Phase 2b scheme at this location. However, the current alignment for the railway, and the inclusion of Clayton Junction in the scheme, would move the station location 1km to the north compared to the location that formed the basis for previous advice to DfT in July 2017. Further

work would need to be undertaken to assess the impact of the revised location on previously assessed benefits and impacts associated with a parkway station at Hemsworth. The required realignment of the railway also results in increased impacts and significant costs for both passive and active provision for a parkway station at Hemsworth.

- 5.6.4 A high level assessment indicates that a parkway station at Hemsworth could deliver both HS2 and NPR train service aspirations. However, four platforms and two through lines would need to be provided. More detailed design work would be required to fully understand the cost implications and impacts of doing this. Any further work undertaken to consider the infrastructure requirements needed to facilitate both HS2 and NPR services at Hemsworth would also need to be cognisant of the change that would be required to the proposed parkway station location in order to ensure a compliant scheme design.
- 5.6.5 As set out in paragraph 5.1.3, this technical design work has not revisited the economic case for a parkway station in South Yorkshire. The outcomes of this technical work do not alter the conclusions of any of the previous advice from HS2 Ltd regarding the case for a potential South Yorkshire parkway station.

6 Annex A: HS2 plus NPR modelling work - assumptions, caveats and limitations

- 6.1.1 The economic analysis set out in Section 3 of this report complements previous advice provided by HS2 Ltd to the Department for Transport (DfT) in the report: 'High Speed Two Phase 2b South Yorkshire Parkway and Connectivity Study (July 2017)'.
- 6.1.2 The additional analysis presented in Section 3 was designed to assess the impact of an indicative Northern Powerhouse Rail (NPR) train service specification on the case for a South Yorkshire parkway station, and whether the consideration of a scenario with NPR might change earlier HS2 Ltd advice. As such, the analysis reported in Section 3 should be considered in conjunction with the HS2 Ltd advice and findings reported to DfT in July 2017.
- 6.1.3 The parkway station locations selected for testing in this additional work have been agreed in discussions with DfT but without any engagement with South Yorkshire stakeholders. The locations considered have been chosen in order to represent the three broad strategically different types of station, rather than seeking to assess the relative merits of those particular locations, nor indicate preference for these three options over other locations not tested. The three broad types of station tested are locations that can be served by either:
- services using the conventional rail network north of Sheffield and south of Clayton Junction only;
 - services using the HS2 mainline only; or
 - services using both the HS2 mainline **and** services using the conventional rail network between Sheffield and Clayton Junction.
- 6.1.4 Given time constraints, the number of tests considered has been limited. A full range of location and train service specification (TSS) options has not been assessed as part of this work.
- 6.1.5 The Planet Framework Model (PFM) coding used for modelling the HS2 and NPR base case was provided to HS2 Ltd by Transport for the North ('Network D').¹⁰

¹⁰ 'Network D' coding reflects a representation of NPR in 2017. Subsequent development work and economic modelling has been undertaken for the NPR Strategic Outline Business Case now being considered by Government.

- 6.1.6 No consideration has been given to Wider Economic Impacts (WEIs) in the benefits appraisal, as such the results represent net transport user benefits only.
- 6.1.7 This work has not considered any infrastructure, capital expenditure (capex) or operational expenditure (opex) requirements for any of the scenarios or, as a result, calculated any indicative Benefit-Cost Ratios.
- 6.1.8 No assessment of operability has been undertaken. A full operability assessment would be required to assess the deliverability of these services before any investment decisions on a parkway station is made.
- 6.1.9 The PFM modelling is based on indicative journey time estimates. All of these journey times are subject to change once the full feasibility and timetabling of any services via these routes has been undertaken.

www.hs2.org.uk

High Speed Two (HS2) Limited

Two Snowhill
Snow Hill Queensway
Birmingham
B4 6GA

Freephone 08081 434 434

Minicom 08081 456 472

Email HS2enquiries@hs2.org.uk

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