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High Speed Rail Scotland Summary Report

March 2016

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Executive Summary

The appraisal of a high speed rail connection between Glasgow and Edinburgh was presented to ministers as initial advice on 8 May 2014. It has subsequently been updated to take account, as intended, of the findings of the 'Broad options for upgraded and high speed railways to the North of England and Scotland' study undertaken by HS2 Ltd.

The appraisal assesses the proposal for a direct Glasgow to Edinburgh high speed rail link which emerged from initial feasibility work carried out by Transport Scotland when considering potential options for linking Scotland to the high speed network being developed by HS2 Ltd.

Transport Scotland's initial feasibility work identified an opportunity to share much of the infrastructure that would be required for a cross-border route with that required for a Glasgow to Edinburgh high speed route. It also identified the possibility of constructing a high speed Glasgow to Edinburgh link as an "advanced build" of part of a cross-border high speed network.

In November 2012 Scottish Ministers announced their intention to develop the case for high speed rail in Scotland[1] and in July 2013 Transport Scotland commissioned AECOM, supported by Connected Economics, to assess the business case for a Glasgow to Edinburgh high speed link in line with Transport Scotland's Scottish Transport Appraisal Guidance (STAG)[2].

Three options were progressed to the detailed appraisal stage including non-rail, conventional rail and high speed rail based interventions in accordance with the STAG. The appraisal found that a high speed rail link between Glasgow and Edinburgh performed well in relation to the Transport Planning Objectives[3].

The appraisal found that Scenario D1[4], the addition of a small piece of link infrastructure to that required for an extension of high speed rail into Scotland on a western alignment, was the best performing high speed rail option. However, the appraisal identified that whilst there could be a business case for an advance build of these high speed routes between Glasgow and Edinburgh, as part of a wider high speed rail network, they would be unlikely to offer good value for money as a free standing scheme. Accordingly, with no certainty that the HS2[5] would be extended into Scotland nor an identification of potential routes for it to do so, it was therefore not possible in May 2014 to reach a conclusion on the best option.

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[1] Speeches by Nicola Sturgeon MSP: http://www.transport.gov.scot/system/files/uploaded_content/images/tsc_basic_pages/Rail/Speech_by_Nicola_Sturgeon_MSP__Deputy_First_Minister_and_Cabinet_Secretary_for_Infrastructure_Investment_and_Cities_at_the_Faster_and_Further_Conference__12_November_2012__Grand_Central_Hotel_Glasgow.pdf and Keith Brown MSP: http://www.transport.gov.scot/system/files/uploaded_content/images/tsc_basic_pages/Rail/Speech_by_Keith_Brown_MSP__Minister_for_Transport_and_Veterans_at_the_Faster_and_Further_Conference__13_November_2012__Grand_Central_Hotel_Glasgow.pdf at *"Faster and Further Conference*", Glasgow, November 2012.

[2] STAG – http://www.transport.gov.scot/stag.

[3] Transport Planning Objectives can be found in Table 2.1.

[4] Scenario D1 can be found in Table 4.7.

[5] HS2 is defined in Figure 1.1.

In late 2013, the Secretary of State for Transport and the Scottish Ministers agreed to promote work on the identification of potential high speed rail routes to Scotland. In January 2014, HS2 Ltd were remitted to carry out a feasibility study of a broad range of options for delivering improved to journey times between the north of England and Scotland, including journeys from London to Glasgow and Edinburgh of three hours or less. HS2 Ltd's 'Broad options for upgraded and high speed railways to the north of England and Scotland Report' published in March 2016 does not set out a preferred option or cross-border route and the options identified have only been developed to an early stage for future feasibility assessment. However, the report enables the conclusion to be drawn that if high speed rail were to be extended to Scotland on a west coast alignment then there is a business case for adding the small additional piece of infrastructure required to provide a high speed link between Glasgow and Edinburgh.

The Broad options study has not altered the conclusion of Transport Scotland's appraisal that the benefits of a high speed rail route between Glasgow and Edinburgh are not considered to be sufficient in themselves to cover the very high cost of building a high speed link between Glasgow and Edinburgh as a free standing scheme.

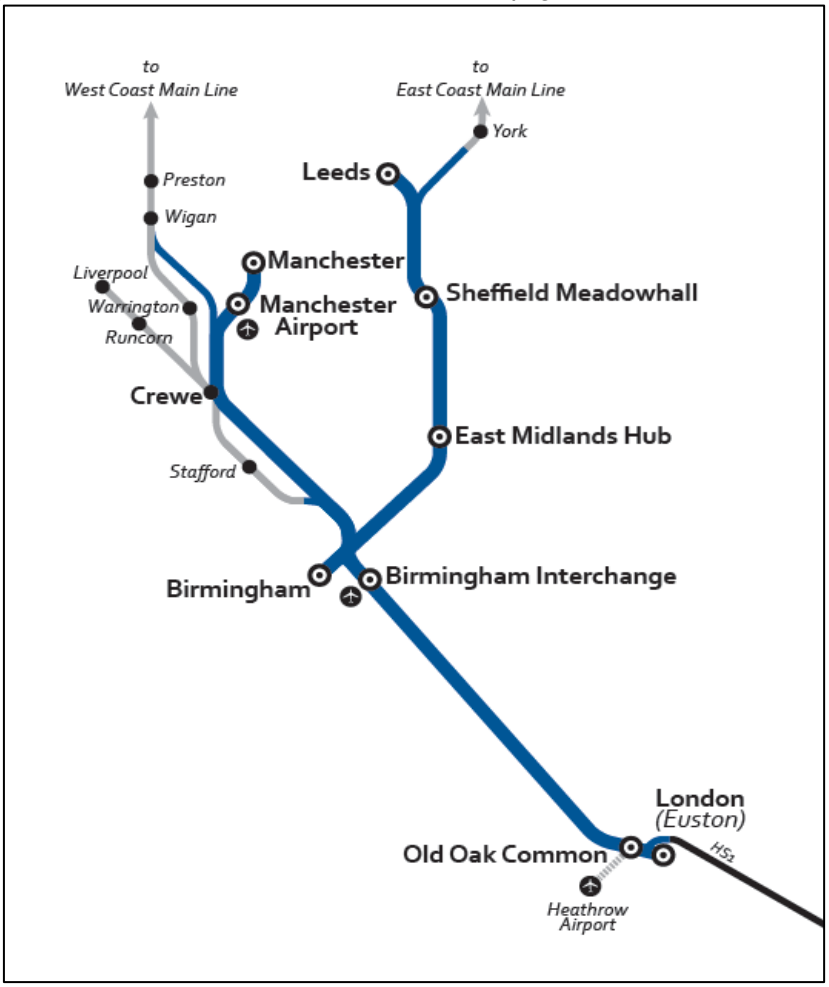
A high speed route between Glasgow and Edinburgh is therefore possible, but its feasibility is dependent on a commitment to extend high speed rail to Scotland. Further work will therefore be required to identify whether high speed rail will be extended to Scotland by: one of four new continuous high speed routes identified by HS2 Ltd; the lower cost west coast variant; or via a series of high speed bypasses of the West Coast Main Line that could eventually be joined together at a later date to create a continuous high speed route.

1. Introduction

In 2010, the UK Department for Transport (DfT) announced proposals to construct a new high speed rail line in the UK[6] with work being progressed by HS2 Ltd, a company at arms' length from DfT. The scheme, "High Speed 2" (HS2), proposes to:

- construct a new high speed rail line between London and Birmingham (HS2 Phase 1) by 2026;
- bring forward construction of the new high speed line section between Birmingham and Crewe (Phase 2a) by 2027[7]; and
- continue the new high speed line via a "Y" configuration to Manchester and Leeds by 2033 (HS2 Phase 2).

Figure 1.1 – HS2 Phases 1, 2a and 2 *(Figure sourced from HS2 Ltd)*



Stations in bold font will be directly served by high speed trains. High speed trains will extend beyond the high speed network (illustrated by the blue lines in Figure 1.1) onto the existing network (illustrated by the grey lines), to serve stations in the north of England and Scotland.

[6] Department for Transport, *High Speed Rail*. Command Paper (CM 7827) https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/228887/7827.pdf.

[7] Department for Transport High Speed Two: East and West. The next steps to Crewe and beyond. Command Paper (CM 9157) https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/480712/hs2-east-and-west.pdf.

In June 2011, the Scottish Partnership Group for High Speed Rail (now called the High Speed Rail Scotland Group) was formed by the then Minister for Transport and Veterans to develop and promote Scotland's inclusion in a Britain-wide high speed rail network. The Group comprises key civic and business partners from across Scotland[8].

In December 2011, the Group published the 'Fast Track Scotland' report[9], which came to the conclusion that the investment case for high speed rail is strong, but stronger if Scotland is included, and made the case for Scotland's inclusion in the UK's High Speed Rail (HSR) network.

A direct Glasgow to Edinburgh high speed rail link emerged as a potential opportunity arising from initial feasibility work carried out by Transport Scotland when considering options for linking Scotland to the high speed route being developed by HS2 Ltd. This initial feasibility work found there could be an opportunity to share much of the track required for a cross-border high speed route to create a high speed rail link between Glasgow and Edinburgh. For example, if HS2 were to be extended into Scotland via the west coast (illustrated in Figure 1.2) it would only require a short section of additional infrastructure (illustrated by the red line in Figure 1.3) to create a high speed link between Glasgow and Edinburgh.

Figure 1.2 - HS2 extension via west coast

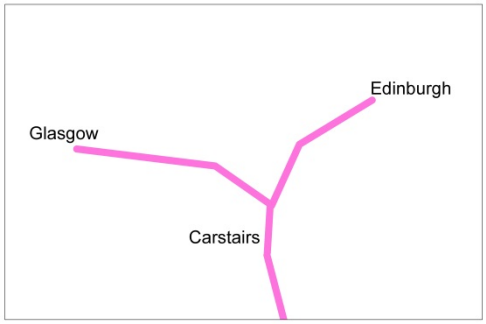
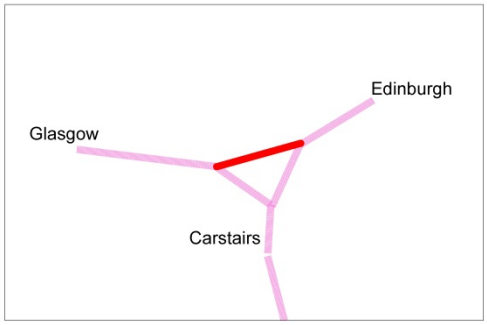


Figure 1.3 - Additional infrastructure required



This initial feasibility work identified the possibility that the section of the HS2 extension north of Carstairs plus the additional infrastructure required for a high speed link between Glasgow and Edinburgh could be commissioned as an "advanced build" as part of a UK wide high speed network, before the link to England was completed. Consequently, Transport Scotland commissioned Atkins to develop an outline programme based on potential delivery by 2022 or 2024[10].

[8] High Speed Rail Scotland Group comprises Glasgow City Council, the City of Edinburgh Council, Regional Transport Partnerships, Network Rail, Scottish Chambers of Commerce, Confederation of British Industry (CBI) Scotland, Scottish Trades Union Council (STUC), Scottish Council for Development and Industry (SCDI), Transform Scotland, Scottish Futures Trust, Scottish Enterprise and Transport Scotland.

[9] Scottish Partnership Group for High Speed Rail, 2011. *Fast Track Scotland, Making the Case for High Speed Rail Connections with Scotland* http://www.transport.gov.scot/sites/default/files/documents/rrd_reports/uploaded_reports/j202923/j202923.pdf.

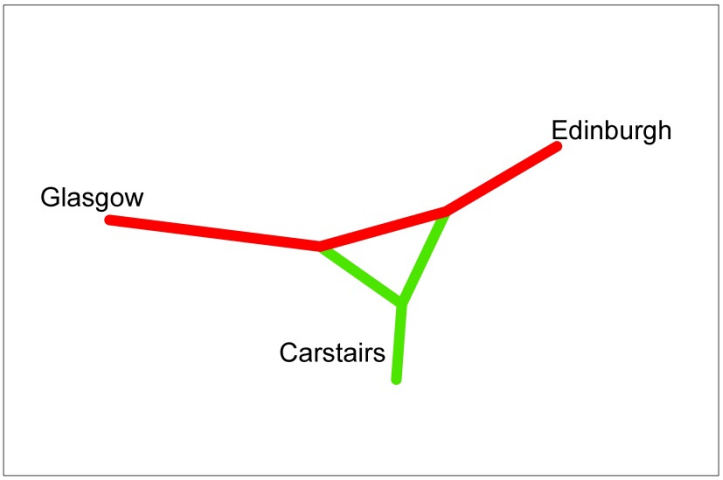
[10] Transport Scotland: Edinburgh to Glasgow High Speed Rail Commentary on outline programme. http://www.transport.gov.scot/system/files/uploaded_content/images/tsc_basic_pages/Rail/Atkins-Commentary_on_Outline_Programme.pdf

In November 2012, the Scottish Ministers announced their intention to further develop the case for high speed rail in Scotland[11].

The initial Glasgow to Edinburgh scheme concept has the following principal elements:

- a high speed rail link between Glasgow and Edinburgh (illustrated by red line in Figure 1.4);
- a high speed rail link from the Glasgow to Edinburgh route to the WCML just to the south of Carstairs (shown in green in Figure 1.4). This is to bypass the congested northern section of the WCML between Carstairs and Glasgow;
- use of classic compatible rolling stock[12], to negate any immediate requirement to clearance for larger European sized high speed trains on the route through the Glasgow and Edinburgh city limits;
- running into existing stations in Glasgow and Edinburgh to reduce initial cost, while leaving options open in relation to long term location of dedicated high speed terminals in the two cities; and
- potential for a small number of intermediate stops.

Figure 1.4 – Principal elements of Glasgow to Edinburgh High Speed Rail Link



Transport Scotland commissioned ARUP to undertake an engineering and environmental review of the route options identified by Transport Scotland and commissioned AECOM supported by SYSTRA and Connected Economics, to assess the business case.

[11] Speeches by Nicola Sturgeon MSP: http://www.transport.gov.scot/system/files/uploaded_content/images/tsc_basic_pages/Rail/Speech_by_Nicola_Sturgeon_MSP__Deputy_First_Minister_and_Cabinet_Secretary_for_Infrastructure_Investment_and_Cities_at_the_Faster_and_Further_Conference__12_November_2012__Grand_Central_Hotel_Glasgow.pdf and Keith Brown MSP: http://www.transport.gov.scot/system/files/uploaded_content/images/tsc_basic_pages/Rail/Speech_by_Keith_Brown_MSP__Minister_for_Transport_and_Veterans_at_the_Faster_and_Further_Conference__13_November_2012__Grand_Central_Hotel_Glasgow.pdf at *"Faster and Further Conference*", Glasgow, November 2012.

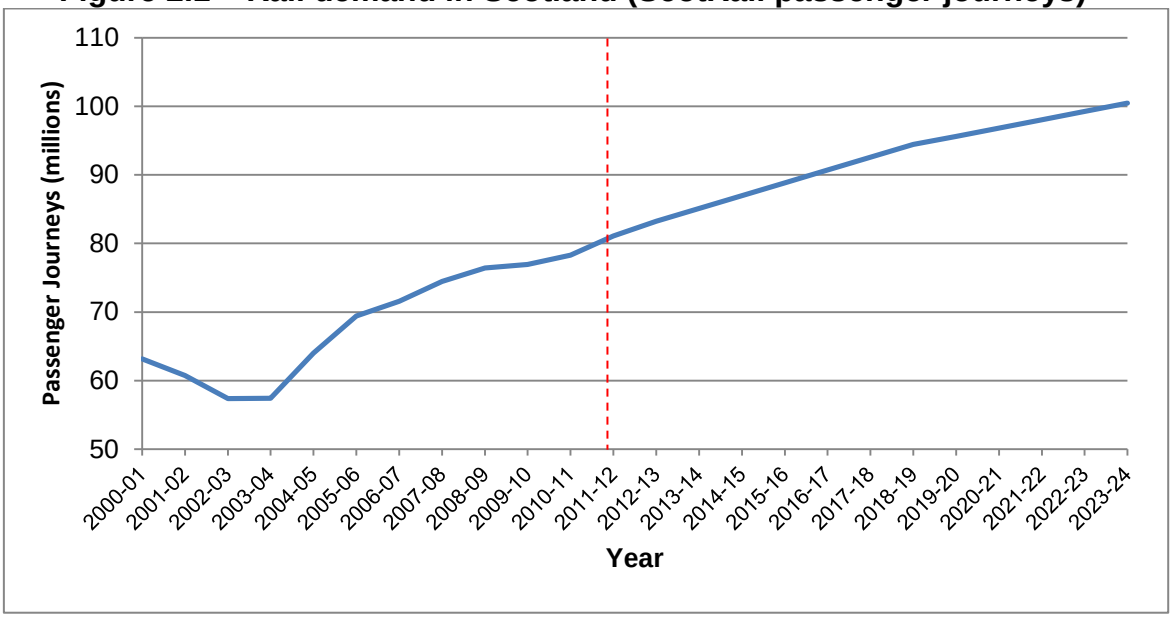
[12] Classic Compatible Rolling Stock is built to the GB loading gage so can run on the existing classic mainline rail network

2. The Strategic Case for Intervention

2.1. Rail Network performance, capability and capacity

The recent re-instatement of the Airdrie-Bathgate line, and plans for the EGIP[13] Phase 1 improvements (including train lengthening to eight carriages) will help to address the known capacity issues on the rail network between Glasgow and Edinburgh in the short term. However, rail demand across Scotland has shown strong growth over the past decade and it is expected that growth will continue in future, beyond the 2012-13 baseline as shown in Figure 2.1[14].

Figure 2.1 – Rail demand in Scotland (ScotRail passenger journeys)[15]



Travel demand between Glasgow and Edinburgh is split between end to end demand, and demand from intermediate stations into either city. Finding an adequate balance between these demands, on an intensively used double track railway, is an issue. Modelling undertaken as part of this appraisal indicates that total peak hour ridership on the busiest route sections is close to the passenger capacity of trains by 2027 and exceeds it by 2037, despite committed investment including service changes and additional carriages. However, individual trains in the busiest times within the peak are likely to be loaded in excess of capacity by the mid-2020s. On the Glasgow to Edinburgh via Shotts line, there is the problem of accommodating faster passenger services, whilst also providing adequate freight paths.

[13] The Edinburgh to Glasgow improvement Programme http://www.transport.gov.scot/project/egip.
[14] To note that the data reported are those that were available when the appraisal was concluded.
[15] Source: ORR data and TS Forecast Growth

The existence of four largely independent rail routes[16] between the two cities provides alternatives for passengers if one route is disrupted (although a problem at the Edinburgh end can affect all four since they share the same tracks between Haymarket and Edinburgh Waverley). Pressures are also apparent elsewhere as indicated in Network Rail's Scottish Route Utilisation Strategy[17] which highlights the lack of capacity for passengers from Stirling to Glasgow and Edinburgh, affecting both local services and longer distance trains from the North of Scotland. Service frequency, journey times and wider capacity issues are also highlighted as problems.

The track capacity of the WCML is also an issue. The busy section of route between Carstairs and Glasgow Central has eight major junctions and serves long distance and local passenger services together with substantial volumes of freight. This means that train speeds are limited, capacity for train paths is constrained, and that there is a higher risk of delays and disruption on this section of track. Glasgow Central is also constrained, and would probably require either expansion of the upper level station, or diversion of existing services to its low level station.

The four tracks between Haymarket and Edinburgh Waverley are congested and opportunities to increase the number of tracks are constrained by the proximity to Edinburgh Castle and Princes Street Gardens. The south lines experience higher utilisation than the north lines so the main approach to increasing the number of trains into Edinburgh relies upon distributing services more evenly between them.

2.2. Road Network performance, capability and capacity

The A1 road is a single carriageway between Dunbar and Berwick-upon-Tweed, and the M74 experiences peak period congestion through South Lanarkshire (between Junction 6 – Hamilton, and Junction 12 – A70 Douglas Water).

The M8 is predominantly a 2-lane motorway between the two cities. Access into the city of Edinburgh from the motorway network is frequently congested and is capacity constrained. Parts of the Glasgow motorway network also experience regular peak period congestion on approach to the city centre.

2.3. Connectivity

Connectivity is a function of journey time, frequency, capacity, and connections. AECOM's earlier work on the Glasgow-Edinburgh Collaboration Initiative (GECI)[18] noted that the current 50 minute plus journey time between Glasgow and Edinburgh is at the far end of acceptability for travel to work[19] and too long to facilitate the creation of a single economic unit, which was also noted in the Strategic Transport Projects Review.[20] The achievability of this is challenged by congestion on the road and rail networks in Scotland's Central Belt.

[16] The four routes between Glasgow and Edinburgh: via Falkirk; via Airdrie, via Shotts and via Carstairs.
[17] Network Rail, 2011. *Scotland Route Utilisation Strategy Generation Two.*
[18] AECOM 2011. *Glasgow Edinburgh Economic Linkages, Final Report.* Report for Scottish Enterprise
[19] NB this appraisal does not take EGIP Phase 1 improvements to this journey time into account.
[20] Transport Scotland, 2008. *Strategic Transport Projects Review, Report 2.*

Competitive connections between the Central Belt and the rest of Scotland are important to ensure that the wider benefits of improved Glasgow to Edinburgh linkages can be spread to other areas. The need for improved connections was reflected in the Strategic Transport Projects Review (STPR) final report, which noted that:

> "Improving the connectivity between the cities of the Central Belt and between them and the other urban centres in Scotland would therefore help to underpin economic growth and spread the benefits of that growth. It is important that access to or from centres more distant from the Central Belt including Inverness and Aberdeen should be considered in terms of the potential to improve service frequencies or reduce overall journey times." [21]

2.4. Environment

Any transport intervention will be challenged to respond to Scotland's Climate Change targets. The Climate Change (Scotland) Act 2009 introduces an ambitious requirement to reduce emissions by at least 80 per cent by 2050. This target is designed to drive new thinking, new solutions and new technologies putting Scotland at the forefront of building a sustainable low carbon economy.

2.5. Economic performance

Glasgow and Edinburgh have a strong and symbiotic economic relationship and connection which plays out through many different types of economic, social and cultural linkages. The economies have important and complementary specialisms and trade between them appears to be greater than expected given their relative size and economic make up. Economic studies show that the benefits of being close to areas of economic activity decline rapidly with distance[22]. Similarly, travel patterns show commuting and business trips drop off quickly as the generalised costs of travel increase, particularly in the range currently offered by public transport options between the two cities[23]. This implies that there could be a substantial economic payoff from improved connections between the cities.

[21] Transport Scotland 2009. *Strategic Transport Projects Review, Final Report.* Other background reports available from http://www.transportscotland.gov.uk/strategy-and-research/strategic-transport-projects-review

[22] See for example Graham, Gibbons and Martin, 2009; *Transport Investment and the Distance Decay of Agglomeration Benefits.* (http://personal.lse.ac.uk/gibbons/Papers/Agglomeration%20and%20Distance%20Decay%20Jan%202009.pdf). This paper finds that the benefits of proximity are roughly increased by 50% in the consumer and producer services sector when economic activity is brought 20% closer.

[23] The generalised cost of a rail trip between Edinburgh and Glasgow is approximately £24 for a return trip (although this depends a little on the time period and type of traveller). Recent work for HS2 Ltd drawing on rail travel patterns across Great Britain shows that this point roughly marks the beginning of acceptable commuting journeys after which many more trips occur. It also shows that business trip making is relatively sensitive to journey time in this range. (http://www.kpmg.com/UK/en/IssuesAndInsights/ArticlesPublications/Documents/PDF/Market%20Sector/Building%20and%20Construction/hs2-regional-economic-impact-1.pdf, page 38)

Previous work undertaken by AECOM for Scottish Enterprise as part of GECI in June 2011, considering the relationship between the cities and their economic performance found the following:

> "The linkage between wider Edinburgh and wider Glasgow is strong and appears to be performing relatively well. Each city accounts for a large share of trade for the other, evidenced through freight tonnage statistics and other travel data. This is broadly what we would expect of two cities around 60 kilometres apart and relatively geographically isolated from other cities. The inter-urban transport network between the two cities is in good shape, but will come under increasing pressure as the structure and sizes of the economies change." [24]

In summary, there is evidence that the development of a single economic area including Glasgow and Edinburgh can drive up productivity and innovation, and provide cheaper and better services to the rest of Scotland and the world.

2.6. Study approach

In July 2013, Transport Scotland commissioned AECOM, supported by SYSTRA and Connected Economics, to assess the business case for a high speed rail link between Glasgow and Edinburgh, which was undertaken in line with Transport Scotland's Scottish Transport Appraisal Guidance (STAG)[25]. Standard STAG appraisal includes assessment of both transport economic benefits, including journey time savings and road traffic accident reductions, and certain wider economic benefits, such as agglomeration. However, recent work, including that undertaken by Connected Economics for HS2 Ltd[26], has indicated that the standard methodology may under-estimate the consequences of major transport investment on economic performance.

The appraisal undertaken by AECOM aimed to answer three key questions:

- Is high speed rail an appropriate solution to meet the needs of Scotland in the 21st Century?
- Under what circumstances is there a business case for high speed rail in Scotland?
- Does high speed rail perform better than alternative solutions in meeting future needs?

It was recognised that the case for a high speed rail link between Glasgow and Edinburgh is very dependent on whether, when and in what form a cross-border high speed rail line is extended into Scotland. Accordingly, it was assessed against a number of alternative baseline scenarios, including whether it was constructed as an integral part of a cross-border high speed network, or in advance. The scope of the appraisal was restricted to the impacts of a high speed rail link between Glasgow and Edinburgh and makes no assessment of the impacts of a cross-border high speed rail network beyond the limited duration of an advance build as these were being progressed separately by HS2 Ltd.

[24] AECOM, 2011. *Glasgow Edinburgh Economic Linkages, Final Report.* Report for Scottish Enterprise
[25] STAG – http://www.transport.gov.scot/stag.
[26] KPMG and Connected Economics, 2013. *HS2 Regional Economic Impacts*. HS2 Ltd.

2.7. Vision and Transport Planning Objectives

An overall project vision was developed early in the study and discussed with stakeholders. The project aim was to improve transport connectivity to, from and within the Central Belt, in order to move toward a single, internationally competitive, economic area, creating benefits across Scotland.

The analysis of opportunities and problems led on to the development of specific Transport Planning Objectives (see Table 2.1) against which the performance of options could be assessed.

Table 2.1 – Transport Planning Objectives

Objective 1: Improve journey times and journey time reliability between central Scotland and England for the movement of people and goods.
Objective 2: Improve transport connectivity between Glasgow and Edinburgh.
Objective 3: Improve transport connectivity to, within and across the Central Belt to create benefits across Scotland.
Objective 4: Provide capacity for people travelling between Glasgow and Edinburgh, such that future levels of demand can either be accommodated, or sustainably managed, on the transport network.
Objective 5: The proposed intervention should complement plans for HS2 and other committed transport projects in order to contribute to a future integrated transport system.

Consideration was given to the adoption of quantified metrics to assess the performance of alternative options relative to the objectives. However, there are many uncertainties, and there is therefore insufficient evidence at this time to set SMART Transport Planning Objectives in accordance with STAG. Accordingly, no quantitative indicators were defined. However, as additional evidence became available during the study, the assessment of the relative performance of different options was refined using quantitative information.

3. Potential Solutions

3.1. Option development

Early in the study an initial "long list" of options was developed, which were considered to have potential to contribute to achieving the Transport Planning Objectives. These comprised three broad groupings of options: non-rail; conventional rail; and high speed rail transport interventions.

The non-rail options considered:

- an ultra-high speed MAGLEV link;
- a series of strategic road improvement options;
- measures to improve Anglo-Scottish air links; and
- an option to provide faster bus/coach links between Edinburgh and Glasgow.

The conventional rail options considered:

- a new conventional speed rail line between Glasgow and Edinburgh;
- EGIP Phase 2;
- upgrades to the routes from Glasgow Central to Edinburgh via Shotts and Carstairs; and
- through services from west of Glasgow and east of Edinburgh.

The high speed rail options considered:

- variations in journey time;
- variations in service frequency;
- potential for intermediate stations;
- potential to develop through services from East Lothian to Glasgow;
- potential to develop through services from Ayrshire/ Renfrewshire to Edinburgh; and
- potential uses for track capacity that would be released on the existing line between Glasgow and Edinburgh via Falkirk (as a result of end to end passengers switching to high speed rail); and on the line from Carstairs to Glasgow Central (due to Anglo-Scottish trains being re-routed onto the new line).

3.2. Solutions taken forward

Three sets of interventions were taken forward into the final detailed appraisal stage:

- M8 Improvements;
- EGIP Phase 2; and
- a representative Glasgow to Edinburgh high speed rail package.

While these represent a single potential solution from each of the non-rail, conventional rail and high speed rail categories, this was not a pre-determined outcome. The sifting process showed that these were the most promising options.

M8 Improvements

The M8 Improvements option consists of the following package of measures between Edinburgh and Glasgow:

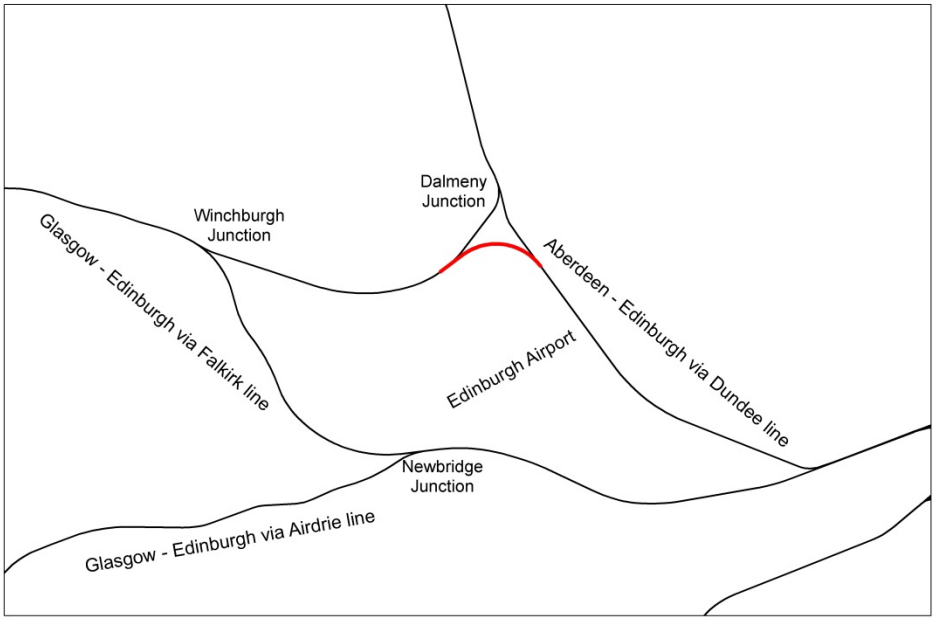
- additional running lane between M8 Junction 6 (Newhouse) and M8/A720 Edinburgh Bypass to provide a full three running lane plus hard shoulder motorway standard road between Glasgow and western Edinburgh.
- existing single lane junction slip roads upgraded to two lanes.
- between Junction 3A and A720, lane control and variable speed control would be introduced.
- between Junction 3 and A720, introduction of hard shoulder running capabilities during peak hours, eastbound only (this assumes a 50mph speed limit when in operation).

Again, the potential to include other interventions in a package to complement M8 improvements was assessed, but none of the options considered made a positive contribution to the case for this option.

EGIP Phase 2

The EGIP Phase 2 option is an existing Transport Scotland scheme building on the committed EGIP Phase 1 programme. Its main aim is to improve the capability and capacity of the route from Glasgow Queen Street to Edinburgh via Falkirk by increasing the frequency of fast trains from four to six per hour. It is envisaged that the two additional trains would stop only at Haymarket, with an end to end journey time of 37 minutes. In order to provide the infrastructure capacity to accommodate the extra trains, the Almond Chord (illustrated by the red line in Figure 3.1) would be constructed to distribute trains more evenly between the north and south lines between Haymarket and Edinburgh Waverley. The existing network is illustrated by the black lines in Figure 3.1.

Figure 3.1 – Almond Chord - potential conventional rail network upgrade



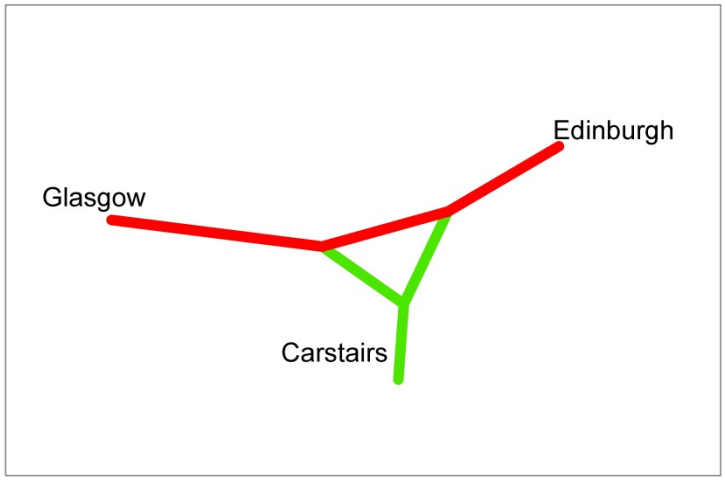
During the sifting process, the potential to include additional or complementary conventional rail measures was assessed as part of a package. However, based on the available evidence, these would detract from the benefits of EGIP Phase 2.

Representative Glasgow to Edinburgh high speed rail package

The representative Glasgow to Edinburgh high speed rail package contains the best performing components based on the evidence that is currently available and the various high speed rail options that were considered. It is recognised that, if in deciding to take this package forward, much more work would be needed on the detailed specification of the option and further studies would be needed to address a range of issues in order to develop the optimum solution. At this stage, the aim is to develop a package which provides a fair representation of the potential benefits and costs of a high speed rail solution, which can then be compared on an equitable basis with alternative conventional rail and non-rail options.

The proposal is for a high speed shuttle service that would operate between Glasgow Central and Edinburgh Waverley with an intermediate stop at Haymarket. This shuttle service would operate at a frequency of five trains per hour in the morning and evening peaks and four trains per hour at other times. The end to end journey time has been estimated to be 28 minutes at this point in the appraisal.

Figure 3.2 – Principal elements of Glasgow to Edinburgh High Speed Rail Link



The WCML between Carstairs and Glasgow Central is severely congested and does not have capacity to meet identified growth. Additional capacity could be created by bypassing this congested section of the WCML and diverting long distance passenger trains over the new route, freeing up capacity on the existing WCML for additional regional passenger services and freight. This bypass could be created by constructing the link between the Glasgow to Edinburgh high speed rail line and the WCML (illustrated by the green lines in Figure 3.2) which would enable the existing cross-border passenger services running on the WCML[27] and between Glasgow and Edinburgh[28] to be diverted onto the high speed line. This would result in a journey time saving of approximately 10 minutes and 20 minutes respectively.

Almost all end to end passengers on the existing Glasgow to Edinburgh via Falkirk service would switch to the new high speed shuttle service. This would provide an opportunity to change the pattern of services on the route via Falkirk, which could be used to provide additional services between Glasgow and Stirling into Glasgow Queen Street station as well as longer distance services from Aberdeen and Inverness. Additionally, it would allow a refocusing of the route via Falkirk to concentrate on meeting demands of intermediate locations.

[27] Services currently operated by Virgin Trains (west coast) and First Trans Pennine Express.
[28] Services currently operated by Arriva Cross Country and Virgin Trains East Coast.

4. Option Appraisal

4.1. Baseline for assessment

In order to provide a consistent basis for comparing options, they need to be appraised relative to a baseline (or "without project") scenario. This is normally defined as the continuation of existing infrastructure and services with the addition of committed investments. Accordingly, the three non-rail, conventional rail and high speed rail options, were assessed against a baseline which includes Transport Scotland's and other agencies' committed investment programmes for Control Periods 5 and 6 (2014 to 2019 and 2019 – 2024 respectively).

4.2. Non-rail Option appraisal (M8 improvements)

Transport Planning Objectives

The performance of the M8 Improvements option in relation to the Transport Planning Objectives is set out in Table 4.1.

Table 4.1 - Performance of M8 Improvements

Objective 1 Journey time and journey time reliability to England	**Objective 2** Edinburgh – Glasgow connectivity	**Objective 3** Connectivity to, from, across Central Belt	**Objective 4** Capacity to meet demand	**Objective 5** Fit with wider transport plans
+1	+1	+2	+1	0

- Objective 1 - M8 Improvements do not significantly improve connections to and from England so perform less well against Option 1 than other alternatives.
- Objective 2 - M8 Improvements would improve car journey times between Glasgow and Edinburgh but, with city centre to city centre journey times of approximately one hour, the option performs less well than the other alternatives.
- Objective 3 - M8 Improvements would improve accessibility and connectivity to, within and, to some extent, across the Central Belt, showing a strong performance.
- Objective 4 - M8 Improvements would provide additional road network capacity but would only have a very limited effect on rail demand and on emerging capacity issues.
- Objective 5 - M8 Improvements would not impair other transport schemes and the option is considered to have little impact on other programmes.

Environment

The widening of the M8 to dual three lane standard throughout would have a significant effect on all environmental sub-criteria (as summarised in Table 4.2). Overall, works to widen the M8 motorway are likely to require significant land take, including currently undisturbed habitats, as well as bringing the road infrastructure closer to existing buildings and residences. It would also have significant effects on the water environment, agriculture, soils, landscape, visual receptors and cultural heritage.

Table 4.2 - Environmental impacts of M8 improvements

Impact type	Impact	STAG score
Noise	Negligible increase in noise and vibration due to existing high volumes of traffic on the M8.	-
Global Air Quality	Small increase in CO2 emissions totalling 0.4 million tonnes over the appraisal period.	-1
Local Air Quality	Minor Adverse impact on local air quality.	-1
Water Quality, Drainage and Flood Defence	Negative impacts during construction from earthworks and the risks associated with the storage and use of materials. Spills and leaks during operation could contaminate water resources. The majority of these impacts could be mitigated.	-2
Geology	A number of Opencast Coal prospecting sites would be partially sterilised.	-2
Biodiversity and Habitats	Additional land take would affect various habitats and could impact on protected species. The widening of the motorway corridor may increase the barrier effect on ecological populations.	-2
Landscape	Significant local adverse impact on landscape and townscape, increasing the impacts of the motorway on surrounding areas.	-2
Visual Amenity	Negative impact is expected given the number of properties in the vicinity of the road.	-1
Agriculture and Soils	A mix of land classes would be affected and the overall impact is considered to be Moderate Adverse.	-2
Cultural Heritage	Impacts on known and potentially on unknown cultural assets.	-2
Physical Fitness	No significant impact.	0

Safety

M8 improvements would generate a small increase in vehicle kilometres with a potential negative impact on transport safety. Accident dis-benefits with a value of £97 million are forecast. No significant security impacts are anticipated.

Economy

Table 4.3 - Economic performance of M8 improvements (£ million)

Heading	M8 Improvements
Transport Economic Efficiency	
Present Value of Benefits £	330
Present Value of Costs £	(457)
Net Present Value (NPV) £	(127)
Benefit to Cost Ratio (BCR)	0.72
Wider Economic Benefits (WEBs)	
Present Value of WEBs £	260
NPV (with WEBs) £	133
BCR (with WEBs)	1.29

Note: negative values in brackets

Table 4.3 indicates that this option has a negative Net Present Value in relation to its Transport Economic Efficiency impacts, but the incorporation of wider economic benefits results in a positive Net Present Value and a benefit to cost ratio of 1.29.

Integration

M8 Improvements are expected to have a slight positive impact on public transport by improving reliability and moderately positive effects on the movement of goods between terminals.

Accessibility and Social Inclusion

The M8 corridor caters for traffic making a wide range of movements and therefore improvements to it have a much broader effect in improving accessibility than the rail-based options. It provides improved accessibility to both Glasgow and Edinburgh from a wide range of locations.

Deliverability

No detailed technical work has been undertaken on this scheme, but it is assumed to be technically feasible for the purposes of the appraisal given other UK experience of motorway widening.

4.3. Conventional Rail Option Appraisal (EGIP Phase 2)

EGIP is a well-established Transport Scotland programme. Phase 1 is already funded and will be fully implemented by 2019. Phase 2 includes the construction of the Almond Chord (discussed in section 3.2) and electrification of the line from Winchburgh Junction to Edinburgh via the new chord. This would enable two additional fast trains per hour to operate between Glasgow and Edinburgh, stopping only at Haymarket.

Transport Planning Objectives

The performance of EGIP Phase 2 in relation to the Transport Planning Objectives is set out in Table 4.4.

Table 4.4 - Performance of EGIP Phase 2 against Transport Planning Objectives

Objective 1 Journey time and journey time reliability to England	**Objective 2** Edinburgh – Glasgow connectivity	**Objective 3** Connectivity to, from, across Central Belt	**Objective 4** Capacity to meet demand	**Objective 5** Fit with wider transport plans
0	+2	+1	+2	+2

- Objective 1 – EGIP Phase 2 does not contribute to the objective of improving journey time and journey time reliability between central Scotland and England.
- Objective 2 - EGIP Phase 2 improves transport connectivity between Glasgow and Edinburgh, but to a significantly lesser extent than the high speed option.
- Objective 3 – EGIP Phase 2 improves connectivity across the Central Belt and to the north. By occupying additional paths out of Glasgow Queen Street it may make it more difficult to improve services to the North of Scotland.
- Objective 4 - EGIP Phase 2 provides adequate passenger capacity to accommodate forecast demand in 2037 (the latest forecasting year in the appraisal) and is consistent with other committed transport investments.
- Objective 5 - EGIP Phase 2 contributes positively to wider transport plans.

Environment

The environmental impacts of EGIP Phase 2 are summarised in Table 4.5.

Key impacts during the construction of the EGIP Phase 2 works would be noise, the presence of workers, plant causing disturbance to wildlife and the potential for pollution to water courses. Impacts would be localised and of relatively short duration.

Table 4.5 - Environmental impacts of EGIP Phase 2

Impact type	Impact	STAG score
Noise and Vibration	Small increase in the number of people annoyed by rail noise.	-
Global Air Quality	Impacts of electric power would depend on generation source. There would be small changes in emissions from road vehicles and diesel trains. Overall additional carbon emissions are likely to be approximately 0.5 million tonnes over 60 years.	-1
Local Air Quality	As the additional services would be electrically operated, the impact is assessed to be Neutral.	0
Water Quality, Drainage and Flood Defence	Main impacts are likely to be on surface water and groundwater receptors during construction of the Almond Chord. Suitable mitigation is likely to reduce the impacts.	-1
Geology	The route does not impact on any sites designated for their geological importance or mineral prospecting sites.	0
Biodiversity and Habitats	There will be limited impacts, primarily during construction of the Almond Chord and during the electrification works.	-1
Landscape	The route would not have major landscape impacts.	-1
Visual Amenity	There would be limited negative impact.	-1
Agriculture and Soils	There would be limited impacts, mainly due to the new Almond Chord infrastructure.	-1
Cultural Heritage	The route is predicted to have a Moderate Adverse impact on cultural heritage assets, partly due to the risk to unrecorded cultural assets.	-2
Physical Fitness	No significant impact is expected.	0

Safety

There would be small impacts on road safety. No significant impact on personal security is expected.

Economy

The economic performance of EGIP Phase 2 is shown in Table 4.6. It indicates that the option has a positive benefit to cost ratio of 1.37 in relation to its direct transport economic impacts and this is improved further to 1.79 when wider economic benefits are included.

Table 4.6 - Economic performance of EGIP Phase 2 (£ million)

Heading	EGIP Phase 2
Transport Economic Efficiency	
Present Value of Benefits £	641
Present Value of Costs £	(467)
Net Present Value (NPV) £	174
Benefit to Cost Ratio (BCR)	1.37
Wider Economic Benefits (WEBs)	
Present Value of WEBS £	192
NPV (with WEBS) £	367
BCR (with WEBS)	1.79

Note: negative values in brackets

Integration

By providing increased frequency between Glasgow and Edinburgh, EGIP Phase 2 would improve transport integration by providing what might be termed a “turn up and go” frequency, facilitating better integration with other transport services at those locations. EGIP Phase 2 would also help strengthen city centre locations in Glasgow and Edinburgh as strategic locations for office-based activities, although to a lesser extent than a high speed rail option.

Accessibility and Social Inclusion

EGIP Phase 2 improves accessibility to Glasgow from Edinburgh and the western Central Belt beyond Glasgow. Similarly accessibility to Glasgow from Edinburgh and East Lothian is enhanced.

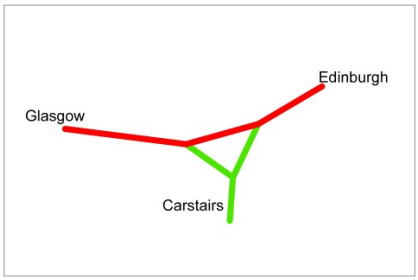
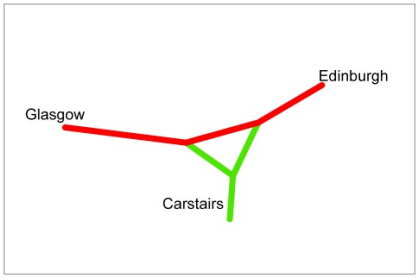
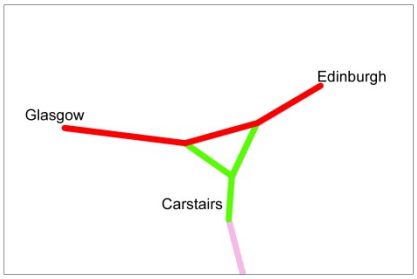
Deliverability

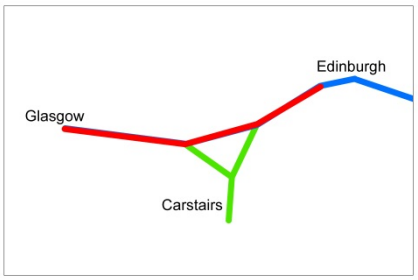
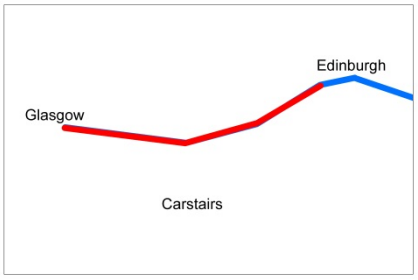
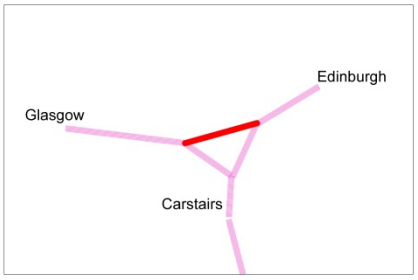
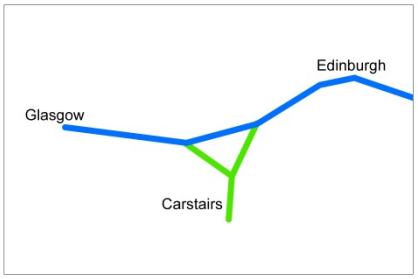
EGIP Phase 2 involves significant infrastructure works, though to a lesser degree than the high speed rail option. However, these have previously been developed in some detail so risk issues should be well understood.

4.4. High Speed Rail Option Appraisal (Glasgow to Edinburgh High Speed Rail Link)

The notion of a Glasgow to Edinburgh high speed rail link originated as an opportunity to make a marginal addition to the infrastructure that would already be required to create a cross-border extension of HS2 to Glasgow and Edinburgh. Since there were uncertainties about whether, or by which route, HS2 would be extended into Scotland, it was necessary to test this against a range of possible scenarios of HS2 and against multiple baselines. These baseline scenarios are defined in Table 4.7. For appraisal purposes it was assumed that an extension of HS2 into Scotland would be complete by 2033. The scenarios all assume that the listed assumptions about HS2 and the committed investments to the existing network would proceed. In each case, the appraisal considered the additional benefits, costs and other impacts that would occur relative to the baseline scenario.

Table 4.7 – Baseline scenarios for representative high speed rail package

HS Scenario	Description	Diagram
A	A Glasgow to Edinburgh high speed route and the link to the WCML south of Carstairs (illustrated by the red and green lines respectively) are built, opening in 2025. HS2 Phases 1 and 2 open in 2026 and 2033 respectively, but HS2 is not extended into Scotland.	
B	A Glasgow to Edinburgh high speed route and the link to the WCML south of Carstairs (illustrated by the red and green lines respectively) are built, opening in 2025. No phases of HS2 are built.	
C1	A Glasgow to Edinburgh high speed route and the link to the WCML south of Carstairs (illustrated by the red and green lines respectively) are implemented as an advance build of part of the northern part of a HS2 extension into Scotland via the west coast, opening in 2025. The remainder of the HS2 extension into Scotland (illustrated by the pink line) opens in 2033.	

HS Scenario	Description	Diagram
C2	A Glasgow to Edinburgh high speed route and the link to the WCML south of Carstairs (illustrated by the red and green lines) are implemented as an advance build of part of the northern part of an HS2 extension into Scotland via the east coast, opening in 2025. The remainder of the HS2 extension into Scotland (blue line) opens in 2033.	
C3	A Glasgow to Edinburgh high speed route of Carstairs (illustrated by the red lines) is implemented as an advance build of part of the northern part of an HS2 extension into Scotland via the east coast, opening in 2025. *(NB: the new link to the WCML bypassing the congested section between Carstairs and Glasgow is not built. West coast services continue to run on the existing WCML)*. The remainder of the HS2 extension into Scotland (blue line) opens in 2033.	
D1	HS2 is extended into Scotland (pink line) via the west coast. A small additional piece of infrastructure (red line) is built at the same time as this to create a high speed link between Glasgow and Edinburgh. The opening year is 2033.	
D2	HS2 is extended into Scotland (blue line) via the east coast. The high speed link to the WCML south of Carstairs (green line) is built at the same time as this. The opening year is 2033.	

Scenarios that could be wholly delivered by an HS2 extension into Scotland and would not require any additional high speed rail to be built either as an addition to, or an advance of, any HS2 extension were out with the scope of this study.

Each of the representative high speed rail packages (A to D2) was assessed against: the Transport Planning Objectives, the five STAG criteria (Environment, Safety, Economy, Integration, Accessibility and Social Inclusion) and its deliverability.

Transport Planning Objectives

Table 4.8 shows the performance of each representative high speed rail package in relation to the Transport Planning Objectives and each of the scenarios.

Table 4.8 – Performance of High Speed package against Planning Objectives

HS Scenario	**Objective 1** Journey time and journey time reliability to England	**Objective 2** Edinburgh – Glasgow connectivity	**Objective 3** Connectivity to, from, across Central Belt	**Objective 4** Capacity to meet demand	**Objective 5** Fit with wider transport plans
A	+2	+3	+3	+3	+2
B	+2	+3	+3	+3	+2
C1	+1	+3	+3	+3	+2
C2	+1	+2	+2	+2	+2
C3	0	+2	+2	+2	+2
D1	0	+3	+3	+3	+2
D2	+1	+1	+1	+1	+2

- Objective 1 - Scenarios A and B are free standing and therefore benefits are attributed in full. Scenarios C1, C2 and C3 are advance builds of an HS2 extension and therefore benefits are only attributed for the duration of the advancement and consequently reduced. Scenarios C3 and D1 do not provide any improvement in journey time to England so does not perform well. For Scenario D2 it is HS2 that is primarily responsible for improving connectivity so benefits attributed to this scenario are reduced since they are attributed to HS2.
- Objective 2 – All scenarios perform well except D2 where HS2 is primarily responsible for improving connectivity so benefits attributed to this scenario are reduced since they are attributed to HS2.
- Objective 3 - All scenarios perform well except D2 where HS2 is primarily responsible for improving connectivity so benefits attributed to this scenario are reduced since they are attributed to HS2.
- Objective 4 - All scenarios perform well except D2 where HS2 is primarily responsible for meeting demand so benefits attributed to this scenario are reduced since they are attributed to HS2.
- Objective 5 – All scenarios perform well.

Environment

The overall environmental impacts of the Glasgow to Edinburgh high speed package would be very similar in all the scenarios as the same infrastructure is provided and the service patterns are similar. The main difference between the scenarios is in which infrastructure elements are provided by the Glasgow to Edinburgh high speed rail package and which, if any, form part of an HS2 extension into Scotland.

Accordingly, the Environmental Assessment was conducted in relation to Scenario A (summarised in Table 4.9), where all elements of the reference package would be provided as part of the Glasgow to Edinburgh high speed package.

Table 4.9 - Environmental impacts of representative High Speed Rail package

Impact type	Impact	STAG score
Noise and Vibration	There is some increase in the number of people annoyed by rail noise.	-
Global Air Quality	Impacts of electric power generation would depend on power source. There would be small changes in emissions from road vehicles and diesel trains. Overall increase in carbon emissions is predicted to be 3.4 million tonnes over 60 years.	-1
Local Air Quality	Minor impact - the majority of trains would be electrically powered and changes in road traffic would be small.	-1
Water Quality, Drainage and Flood Defence	Main impacts are likely to be on surface water and groundwater receptors during construction. Potentially high impacts on Medwin Water/ River Clyde and North Calder Water. Suitable mitigation is likely to reduce these.	-2
Geology	The route does not impact on any sites designated for their geological importance, but would probably sterilise a number of coal prospecting sites. It could also impact on Mossband Farm Surface Coal Mine.	-2
Biodiversity and Habitats	The route has the potential to create barriers to movement and impact on a number of habitats including one SSSI and one SWT Nature Reserve.	-2
Landscape	The route would not impact on any nationally designated landscapes but would impact on two locally designated landscapes and a number of features designated for their historic and cultural value.	-2
Visual Amenity	After mitigation there would be some negative impact.	-2
Agriculture and Soils	Land capability varies across the route and the overall impact is likely to be Moderate Adverse.	-2
Cultural Heritage	The route would have a Moderate Adverse impact on cultural heritage assets.	-2
Physical Fitness	No significant impact is expected.	0

Safety

Overall, there would be small impacts on road safety. No significant impact on personal security is expected.

Economy

The major differentiator between the high speed rail scenarios is in their economic performance, as shown in Table 4.10.

Table 4.10 - Economic performance of high speed rail Package (£ million)

Heading	Scenario						
	HS2 not extended into Scotland Scenarios		Advanced Build of an HS2 extension into Scotland Scenarios			Integral Part of HS2 extension into Scotland Scenarios	
	A HS2 Phase 1&2 only	**B** No HS2	**C1** HS2 extends to Scotland via west coast	**C2** HS2 extended into Scotland via east coast	**C3** HS2 extended into Scotland via east coast, No Carstairs Link	**D1** HS2 extended into Scotland via west coast	**D2** HS2 extended into Scotland via east coast
Transport Economic Efficiency							
Present Value of Benefits £	2,619	2,468	2,397	636	593	2,142	210
Present Value of Costs £	(9,916)	(10,267)	(4,058)	(5,289)	(1,550)	(2,336)	(3,568)
Net Present Value (NPV) £	(7,297)	(7,800)	(1,661)	(4,654)	(957)	(194)	(3,357)
Benefit to Cost Ratio (BCR)	0.26	0.24	0.59	0.12	0.38	0.92	0.06
Wider Economic Benefits (WEBs)							
Present Value of WEBs £	909	819	664	266	214	532	136
NPV (with WEBs) £	(6,388)	(6,981)	(997)	(4,388)	(743)	338	(3,221)
BCR (with WEBs)	0.36	0.32	0.75	0.17	0.52	1.14	0.10

Note: negative values in brackets

Analysis of the distribution of the benefits shows that a high proportion relate to the creation of a Glasgow to Edinburgh high speed link and the consequent use of released track capacity to provide improved services on the existing rail network. The benefits attributed to any HS2 extension are excluded from this study. Since some of the benefits of Scenario C1, C2, C3, D1 and D2 are delivered by HS2; which is outside the scope of this study, it lowers the level of benefits attributed.

- Scenario C1 includes the cost of the additional infrastructure required to create a high speed line between Glasgow and Edinburgh, plus the additional cost of bringing forward the construction and operation (from 2033 to 2025) of part of an HS2 extension into Scotland via a west coast corridor. It is the second best performing high speed rail scenario with a BCR of 0.75 once wider economic benefits are included.

- Scenario C2 includes the cost of the additional infrastructure required to create a link to the WCML south of Carstairs, plus the additional cost of bringing forward the construction and operation of part of an HS2 extension into Scotland via an east coast corridor.

- Scenario C3 only relates to the additional cost of bringing forward the construction of part of an HS2 extension into Scotland via an east coast corridor.

- Scenario D1 only relates to the provision of the additional infrastructure items that would need to be added to that required for an extension of HS2 into Scotland via a west coast corridor in order to create a high speed link between Glasgow and Edinburgh. This is the best performing high speed rail scenario with a BCR of 1.14 once wider economic benefits are included.

- Scenario D2 only relates to the additional infrastructure items that would need to be added to that required for an extension of HS2 into Scotland via the east coast corridor in order to create a link to the WCML.

Integration

A high speed rail link between Glasgow and Edinburgh would provide benefits to people making trips between Edinburgh and locations in Ayrshire, Renfrewshire and Lanarkshire who would be able to interchange at Glasgow Central Station. High speed rail would also help strengthen city centre locations in Glasgow and Edinburgh as strategic locations for office-based activities.

Accessibility and Social Inclusion

A high speed rail link between Glasgow and Edinburgh would improve accessibility to Edinburgh from Glasgow and areas to the west and south of the city, including Ayrshire, Renfrewshire and Lanarkshire, by creating a faster link from Glasgow Central to Edinburgh Waverley. Similarly Midlothian and East Lothian would obtain improved access to Glasgow. The additional trains provided as part of the released capacity measures would improve access from north of the Central Belt to both Edinburgh and Glasgow. Additionally, the potential increase in longer distance services from Aberdeen and Inverness would further improve access to Glasgow. There would also be some positive impacts on the rail route between Glasgow and Edinburgh via Falkirk.

Deliverability

In general the high speed rail infrastructure and service proposals are based on well-established technologies and no major technical barriers to implementation have been identified.

The affordability of the overall high speed rail package would be better assessed as part of the overall appraisal of an extension of HS2 into Scotland.

Public Acceptability

When the Glasgow to Edinburgh high speed rail study was being carried out, it was considered to be at too early a stage to require formal consultation. However, discussions with focus groups and with current and potential users of rail services in the Glasgow - Edinburgh corridor were undertaken, together with in-depth interviews with representatives of businesses in the two cities.

Focus group respondents stated that a Glasgow to Edinburgh high speed rail package would have positive impacts on:

- the economy of both cities
- perceptions of Glasgow
- business and investment
- tourism
- land and property prices in Glasgow.

Concerns were expressed in relation to environmental impact, noise and property prices close to stations. Concerns were also raised about the possible level of fares.

Businesses advised that a Glasgow to Edinburgh high speed rail package would be good for local economies and nearly half those interviewed stated that it would benefit their specific organisation. Some expressed concern over whether investment in this rail project would divert funding from local commuter services and routes outside the Central Belt. The project was only considered by surveyed businesses to have an overall positive impact on the UK as a whole if it was part of a wider high speed rail network that connected to London.

5. Appraisal Summary

Table 5.1 Transport Planning Objectives

Objective 1 Journey time and journey time reliability to England	**Objective 2** Edinburgh – Glasgow connectivity	**Objective 3** Connectivity to, from, across Central Belt	**Objective 4** Capacity to meet demand	**Objective 5** Fit with wider transport plans

5.1. Non-Rail Options

The M8 Improvements option performs strongly on Objective 3, improving connectivity to, from and within the Central Belt, but less well in relation to the other objectives. The key drawbacks of this option are the lack of improvements extending to the city centres and the potential issues of capacity and congestion where the option interfaces with the adjoining road network, such as the Edinburgh City Bypass (A720). Benefits are less widespread, less focused on the wider city areas and brings less freight and logistics benefits compared with the rail based options.

This option has significant negative environmental impacts, although it is considered that these can be reduced to acceptable levels through appropriate mitigation.

This option has some safety dis-benefits but no significant personal security impact.

This option has a benefit to cost ratio of 0.72 rising to 1.29 when wider economic benefits are included, but despite the approximate cost being equal to that of the conventional rail option, it provides lower transport benefits.

5.2. Conventional Rail Options

The EGIP Phase 2 option performs reasonably well across most of the objectives (particularly Glasgow to Edinburgh connectivity) and supports sustainable land use development patterns. It does not significantly improve connectivity out with the Central Belt and, by using scarce capacity out of Glasgow Queen Street Station, makes it more difficult to improve services to the north of Scotland. It does not improve links to England.

This option would have the least environmental impact.

This option would have very small safety benefits and has a neutral personal security impact.

This option has a benefit to cost ratio of 1.37 rising to 1.79 when wider economic benefits are included.

5.3. High Speed Rail Options

A Glasgow to Edinburgh high speed rail package performs well against all the Transport Planning Objectives, including improvements to the accessibility of Glasgow and Edinburgh from the north of Scotland. This improvement in connectivity has the potential to boost the economic potential of the region, helping Scotland to maintain its competitive advantage in the face of challenges from other regions of the UK. It also supports sustainable land use development patterns.

This option has significant negative environmental impacts, although it is considered that these can be reduced to acceptable levels through appropriate mitigation.

This option would have very small safety benefits and has a neutral personal security impact.

Scenario D1 has a BCR of 0.92, which increases to 1.14 with the inclusion of wider economic benefits. This does not include the benefits from a cross-border high speed rail since these would be delivered by an extension of HS2 into Scotland which is out with the scope of this appraisal. However, the benefits are not considered to be sufficient in themselves to cover the very high cost of building a high speed link between Glasgow and Edinburgh as a standalone scheme.

The Glasgow to Edinburgh high speed rail appraisal has highlighted that benefits would occur irrespective of whether this is delivered as a standalone project or by an extension of HS2 into Scotland. The results of the economic appraisal of a Glasgow to Edinburgh high speed rail package is, however, very dependent on which baseline scenario is assumed and, critically, the timing, routing and nature of any cross-border extension of HS2 to Scotland. This dependency can only be addressed with certainty as part of an appraisal into whether HS2 is extended to Scotland. Accordingly, clarity on the extension of HS2 to Scotland, its route and timing is needed before a decision on a high speed link between Glasgow and Edinburgh can be made.

The appraisal found that if HS2 were to come to Scotland on a west coast alignment, it would be worth adding the small additional piece of infrastructure required to provide a high speed Glasgow to Edinburgh link, utilising and sharing the HS2 infrastructure required for a cross-border route (Scenario D1). Further work would be required to demonstrate if there were to be net benefits from implementing any elements of this HS2 extension in advance, as explored in Scenario C1.

6. Conclusion and Recommendation

Comparison of the relative Benefit to Cost Ratios of the Non-rail, Conventional Rail and High Speed options in tables 4.3, 4.6 and 4.10 has shown that though the Conventional Rail Option has the highest BCR it does not perform as well in meeting the Transport Planning Objectives in Table 4.4.

The appraisal has shown that the Glasgow to Edinburgh high speed rail package is the best performing option relative to the Transport Planning Objectives in Tables 4.1, 4.4 and 4.8. The improvement in connectivity offered by high speed rail has the potential to boost the economic potential of the region, helping Scotland to maintain its competitive advantage in the face of challenges from other areas of the UK.

The appraisal found that if HS2 were to come to Scotland on a west coast alignment, it would be worth adding the small additional piece of infrastructure required to provide a high speed Glasgow to Edinburgh link, utilising and sharing the HS2 infrastructure required for a cross-border route (Scenario D1). Since Scenario D1 depends on the extension of HS2 into Scotland it could not be constructed as a standalone project as it would be remote from any other railway. Further work would be required to demonstrate if there were to be net benefits from implementing any elements of this HS2 extension in advance, as explored in Scenario C1.

The benefits of a high speed rail route between Glasgow and Edinburgh are not considered to be sufficient in themselves to cover the very high cost of building a high speed link between Glasgow and Edinburgh as a free standing scheme.

The current uncertainty regarding the timing, routing and nature of any cross-border extension of HS2 into Scotland is of critical importance to the project. This is an uncertainty that can only be addressed as part of an appraisal into whether HS2 is extended to Scotland. Accordingly, clarity on the extension of HS2 to Scotland, its route and timing is needed before a decision on a high speed link between Glasgow and Edinburgh can be made.

When the findings from this appraisal were presented to Scottish Ministers on 8 May 2014 there was no certainty that HS2 would be extended into Scotland and therefore it was not possible at that time to reach a clear conclusion. The focus was then switched to the high speed rail study[29] that had been commissioned by the Secretary of State for Transport on 1 November 2013 and the outputs from this appraisal were shared with HS2 Ltd to input to that study.

This is discussed further in Appendix A.

[29] www.gov.uk/government/uploads/system/uploads/attachment_data/file/254493/131101-hs2-options-scotland.pdf

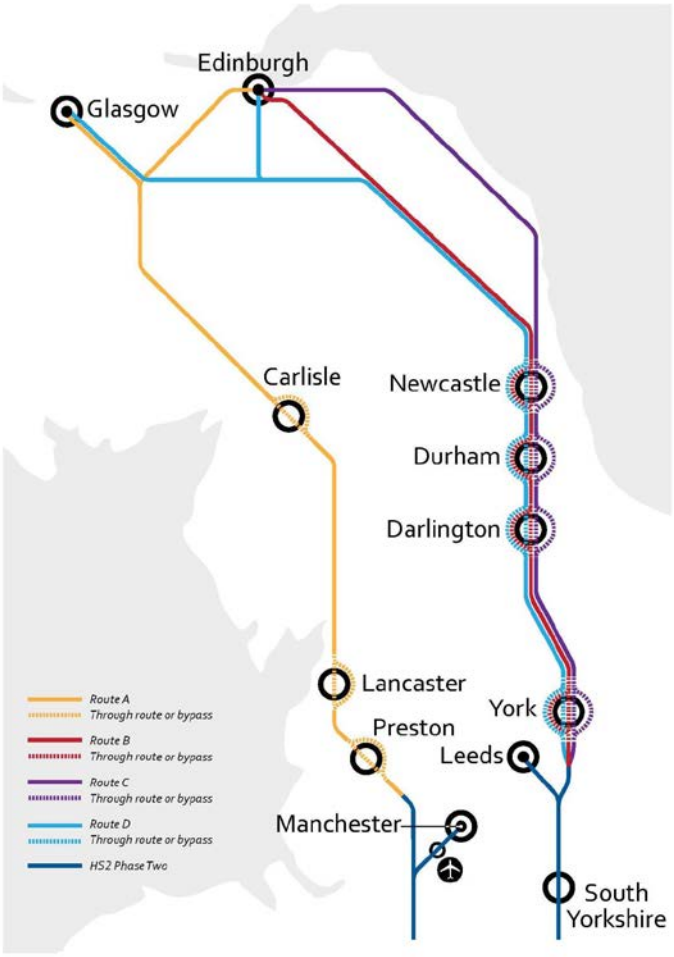
Appendix A– Implications Arising from HS2 Ltd'd Study

A.1 Outputs from HS2 Ltd's Broad Options Study

On 1 November 2013, the DfT commissioned HS2 Ltd to undertake a study that would identify upgraded and high speed railways to the north of England and Scotland[30]. The work undertaken by that study was overseen by a Steering Group comprising HS2 Ltd, the DfT, Transport Scotland, Network Rail and the Scotland Office. The earlier work carried out by Transport Scotland was shared with HS2 Ltd to inform their Broad options study.

HS2 Ltd identified four, new, continuous high speed routes that could be implemented between the northern extent of HS2 Phase 2 to central Scotland. These are illustrated in Figure A.1.

Figure A.1 – Continuous High Speed Routes *(Figure Sourced from HS2 Ltd)*

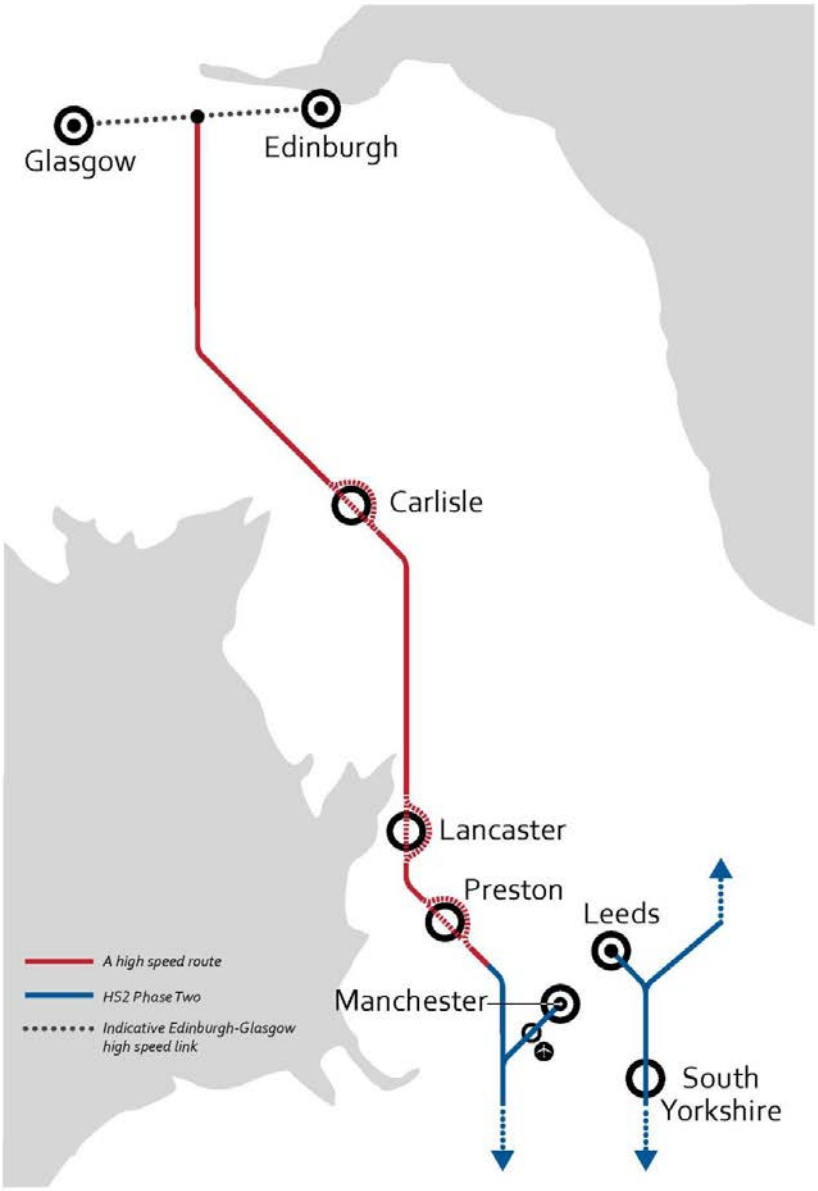


Route A (illustrated by the orange line) follows a western alignment to serve Glasgow and Edinburgh equally. Routes B and C (illustrated by, respectively, the red and purple lines) follow an eastern alignment as far as Edinburgh with the presumption that high speed trains serving Glasgow would travel on the high speed route previously identified by Transport Scotland. Route D (illustrated by the light blue line) also follows an eastern alignment that splits near Peebles to serve both Glasgow and Edinburgh equally.

[30] www.gov.uk/government/uploads/system/uploads/attachment_data/file/254493/131101-hs2-options-scotland.pdf

The UK and Scottish Governments subsequently asked HS2 Ltd to investigate a lower cost option that still achieved the 3 hour journey time target. A lower cost variant of Route A was identified that could be implemented between the northern extent of HS2 Phase 2 and central Scotland (illustrated by the red line in Figure A.2). This route presumes a connection with the Glasgow to Edinburgh high speed route previously identified by Transport Scotland. The cost reduction principles used to identify this route could also be applied to the eastern routes.

Figure A.2 – Lower cost variant of Route A *(Figure Sourced from HS2 Ltd)*



HS2 Ltd identified that it would be possible to achieve a 3 hour journey time between London and both Glasgow and Edinburgh with a package of upgrades to the WCML comprising of a series of high speed bypasses of the congested and slower sections. The northern section of the WCML between Carstairs and Glasgow is severely congested and has no additional capacity to accommodate identified growth. It would be possible to

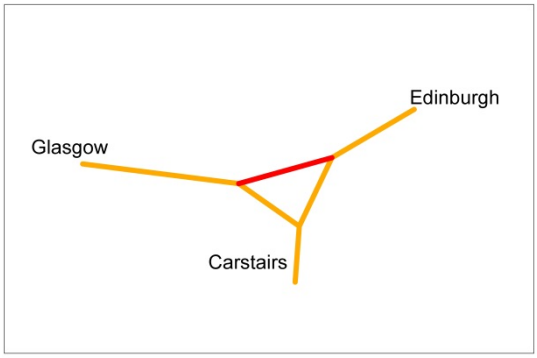
include this in the overall package of high speed bypasses, which would also facilitate a high speed rail link between Glasgow and Edinburgh.

A.2 Implications of HS2 Ltd's Broad Options Study to Scotland

HS2 Ltd presented its findings in 'Broad options for upgraded and high speed railways to the North of England and Scotland Report', published in March 2016. The report does not set out a preferred option or route and the options identified have only been developed to an early stage of feasibility assessment and appraisal, therefore the costs are not directly comparable with the Transport Scotland appraisal, which has been developed further. The HS2 Ltd study was informed by the previous work undertaken by Transport Scotland.

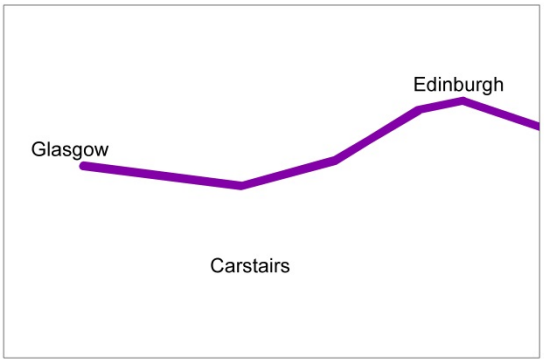
If HS2 were to be extended into Scotland by Route A, as illustrated by the orange line in Figure A.3, it would be possible to add the small additional piece of infrastructure, as illustrated by the red line in Figure A.3, identified by Transport Scotland in Scenario D1 (see Table 4.7) to create a high speed link between Glasgow and Edinburgh. It would also be possible to build the section north of Carstairs in advance as identified in Scenario C1 (see Table 4.7).

Figure A.3 –Scenario D1 added to HS2 Route A



If HS2 were to be extended to Glasgow (via Edinburgh) by either of the new eastern Routes B or C, as illustrated by the purple line in Figure A.4, this would incorporate a high speed link between Glasgow and Edinburgh. It would be possible to link this high speed line to the WCML just south of Carstairs to bypass the congested section of the WCML between Carstairs and Glasgow as identified in Scenario D2 (see Table 4.7).

Figure A.4 –HS2 Route B or C extended to Glasgow



It would also be possible to build the Glasgow to Edinburgh high speed route in advance of HS2 being extended to Scotland in the east (see Scenario C3 in Table 4.7). Additionally,

the Glasgow to Edinburgh high speed route and link to WCML could be built in advance of HS2 being extended to Scotland in the east (See Scenario C2 in Table 4.7).

Route D, as illustrated by the blue line in Figure A.1, would not be capable of providing a competitive journey time between Glasgow and Edinburgh.

A.3 Commentary

HS2 Ltd did not set out a preferred option or cross-border route. However, as the route options identified by HS2 Ltd follow the same broad transport corridors previously identified by Transport Scotland, this has confirmed Transport Scotland's Appraisal conclusion that if high speed rail were to be extended into Scotland on a west coast alignment that there is a case for adding the small additional piece of infrastructure required to provide a high speed link between Glasgow and Edinburgh.

The HS2 Ltd study has not altered the conclusion that the benefits of a high speed rail route between Glasgow and Edinburgh are not considered to be sufficient in themselves to cover the very high cost of building it as a free standing scheme.

A high speed route between Glasgow and Edinburgh is therefore possible, but its feasibility is dependent on a commitment to extend HS2 into Scotland.

Glossary of Terms

BCR	–	Benefit to Cost Ratio
Control Period	–	A five year funding period for Network Rail
DfT	–	Department for Transport
ECML	–	East Coast Main Line
EGIP	–	Edinburgh Glasgow Improvements Programme
GECI	–	Glasgow Edinburgh Collaboration Initiative
HSL	–	High Speed Line
HSR	–	High Speed Rail
HS2	–	The proposed high speed rail line running north from London
HS2 Phase 1	–	The proposed high speed rail line between London and Birmingham
HS2 Phase 2	–	The proposed high speed rail lines from Birmingham to Manchester and Leeds
InfraCo	–	Infrastructure Company
MAGLEV	–	A high speed fixed track system using magnetic levitation technology
NPV	–	Net Present Value
PVB	–	Present Value of Benefits
PVC	–	Present Value of Costs
SMART	–	Specific, Measurable, Achievable, Relevant and Time-bound
SSSI	–	Site of Special Scientific Interest
STAG	–	Scottish Transport Appraisal Guidance
SWT	–	Scottish Wildlife Trust
TPH	–	Trains per hour
TS	–	Transport Scotland
WCML	–	West Coast Main Line
WEBs	–	Wider Economic Benefits

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