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Strategic Transport Projects Review
Edinburgh – Glasgow Rail Improvements

October 2007

Final Report

Authorisation

Jacobs UK Ltd in association with Tribal Consulting has great pleasure in presenting this document.

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Version History				
Version No.	**Date**	**Change Details**	**Author**	**Approver**
001	30 July 2007	None	KMcK	GKD
002	6 Aug 2007	Section 2	KMcK	JM
003	15 August	Amendments	KMcK	GKD
004	27 August 2007	Amendments	KMcK	GKD
005	10 September 2007	Amendments	KMcK	GKD
006	14 Sep 2007	Amendments	KMcK	GKD
007	2 Oct 2007	Final Draft	KMcK	GKD
008	4 Oct 2007	Final	KMcK / NM	GKD

Contents

Executive Summary

Introduction

The Strategic Transport Projects Review (STPR) is a nationwide study for Scotland which will recommend a programme of interventions for implementation between 2012 and 2022. This study is a key part of the STPR and examines potential improvements to the current rail services between Edinburgh and Glasgow and is being published in advance of the main study in recognition of the potential to achieve early benefits.

Edinburgh is the second largest financial centre in the UK after London and houses the global headquarters for firms such as the Royal Bank of Scotland, HBoS and Standard Life. It has a population of almost 460,000 and is the home of the Scottish Parliament and the Scottish Government. The city creates seventy per cent more wealth per head of population than Scotland as a whole. Tourism is important for the city and with Edinburgh Castle it incorporates a UNESCO World Heritage Site.

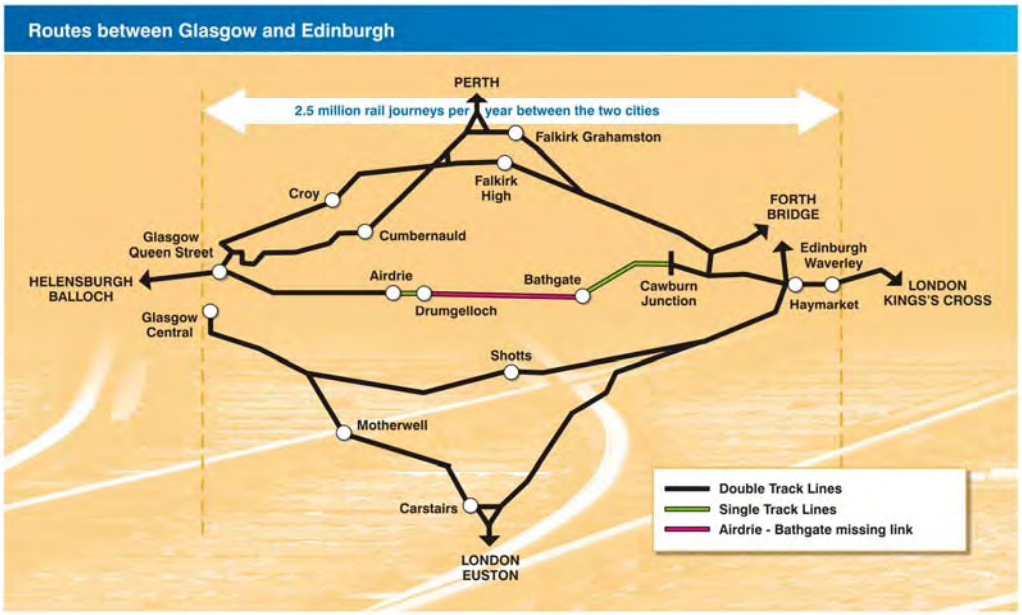
Glasgow is Scotland's largest city, with a population of almost 580,000 and is the largest manufacturing and office centre in Scotland. Key employers include National Australia Group (owners of Clydesdale Bank), British Telecom, Lloyds TSB, Scottish Power and the BBC. It is home to three Universities and nine colleges of further education. Tourism is growing in importance to the city and it is bidding to host the 2014 Commonwealth Games.

The corridor across the 42 miles between these two cities encompasses much of Central Scotland and includes the areas of East Dunbartonshire, North Lanarkshire, South Lanarkshire, Falkirk and West Lothian. This includes major towns such as Motherwell, Cumbernauld, Falkirk and Livingston. People choosing to live in many of the towns within the corridor have access to the job markets, leisure and cultural opportunities within both cities. Edinburgh Airport is located within the corridor to the west of Edinburgh, and is an important international gateway for much of Scotland. In 2003 the airport handled around 7.5 million passengers, a growth of 36 per cent since 2000.

Rail Connections

The figure below shows that the two cities are today linked by three rail routes which have a dual role, serving intermediate communities as well as meeting the need for Edinburgh-Glasgow journeys.

Routes between Glasgow and Edinburgh



- The route via Falkirk High (known as the E&G) provides the fastest rail journey time of around 50 minutes and a high frequency service with four trains per hour. There are a number of stops located along the route and some of these are key points for commuter traffic;

- The route via Shotts provides a link for intermediate communities into both Edinburgh and Glasgow, but the journey time of around 80 minutes and the frequency of one train per hour means that this is not a competitive option for city to city travel; and

- The route via Carstairs is the longest of the routes and is fully electrified. It is served by a mixture of Intercity and regional services which provide journey opportunities between the cities and intermediate stations such as Motherwell. While journey times of between 60 and 70 minutes are achieved, the frequency of service is low. This route is fully electrified.

Transport Scotland is funding the construction of a fourth route that will link from Airdrie and Drumgelloch in the west to Bathgate in the east by reinstating a former railway alignment. This will allow electrified services to link Glasgow, North Lanarkshire, West Lothian and Edinburgh and it is to be completed in 2010. The route is aimed at connecting the areas in between rather than providing for significant city to city traffic. Transport Scotland has also provided funding towards the provision of a new tramway in Edinburgh that will provide a link from the airport to the city centre and beyond, with key interchanges with the heavy rail network at Edinburgh Park and Haymarket. The project is being taken forward by City of Edinburgh Council and is expected to be completed in 2011.

Scotland's Railways, published by the Scottish Executive in 2006, acknowledges the important role that rail plays between Scotland's two biggest cities in "*underpinning the interaction between the two cities, providing for essential commuter flows and facilitating access to cross border rail and air services as well as other connecting routes within Scotland*". The report also identified a number of key constraints to future growth such as:

- capacity constraints on the approaches to Glasgow Queen Street station in Glasgow and the western approaches to Edinburgh;
- growth on the route via Falkirk is already leading to some overcrowding on services, which will only get worse if action is not taken;
- continued growth on these and other routes will mean capacity at Glasgow Queen Street station is likely to be a constraint beyond 2011;
- population growth in areas, such as West Lothian, will also drive up demand for better services on the other routes; and
- there is a growing need for improvements in connections from the areas to the west of Glasgow.

Ministerial Statement

On 27 June 2007 the Minister for Transport, Infrastructure and Climate Change made a commitment to Parliament to significantly improve connectivity between the two cities by focussing on improvements to the reliability, attractiveness and journey time of the Edinburgh to Glasgow rail route and to consider possible alternatives to the Edinburgh Airport Rail Link.

Over the last few months, Transport Scotland, Network Rail and First ScotRail have worked closely with Jacobs to assess how the Minister's commitment might be delivered. For this study we have considered a range of potential improvements to the existing rail routes plus new high-speed routes. We have also considered alternatives to the Edinburgh Airport Rail Link (EARL). For this report we have followed the Scottish Transport Appraisal Guidance (STAG) process, starting with a review of demand to travel and an assessment of the issues and opportunities on the routes.

Demand to Travel & Passenger Opinion

In terms of demand, the major demand to travel flows is to and from the following key points:

- Between Edinburgh and Glasgow city centres;
- Between Edinburgh city centre and Haymarket/West End;
- Between Edinburgh city centre and West Edinburgh;
- Between Edinburgh city centre and West Lothian;
- Between Glasgow city centre and the A80 corridor;
- Between Glasgow city centre and Haymarket/West End;
- Between Forth Bank (Linlithgow/Bo'ness/etc) and Edinburgh Western Approaches;
- Between West Lothian and West Edinburgh; and
- Between West Lothian and South Edinburgh.

These key flows reflect the overall demand to travel. In terms of rail travel only, around 37 per cent of all journeys on the E&G line are between Edinburgh (Waverley and Haymarket) and Glasgow (Central and Queen Street). The remaining 63 per cent is made up of journeys between intermediate stations and one of the two cities, or between intermediate stations themselves. The commuter usage of the E&G line is significant with 88 per cent of the 12-hour boardings at stations such as Lenzie occurring during the AM peak.

In terms of what rail passengers want, Passenger Focus recently surveyed those travelling on the route via Falkirk. Sixty eight per cent of those surveyed would prefer faster links between Edinburgh and Glasgow with less stops whilst thirty two per cent were happy with the current service. On the Glasgow to Edinburgh via Shotts route, the passenger priorities were much the same. However, sixty six per cent were keen to see an increase in frequency of service with trains running every 30 minutes to meet their needs. Twenty per cent of those surveyed said they would definitely make more journeys as a result of an increased frequency.

Planning Objectives

Having considered these and various other findings, the following planning objectives for the study were set.

Planning Objective 1

A programme of cost effective improvements to strengthen the connectivity between the centres of Edinburgh and Glasgow through:

- *Reducing rail journey times between the city centres of Edinburgh and Glasgow;*
- *Improving rail system capacity between Edinburgh and Glasgow;*
- *Improving attractiveness of rail travel experience; and*
- *Improving reliability of rail services between Edinburgh and Glasgow*

Planning Objective 2

An effective linkage between the rail network and Edinburgh Airport

Intervention Packages

Working with the key industry stakeholders, a list of potential interventions ranging from minor timetable improvements through to major national infrastructure enhancements was compiled. Due to the complex interactions between potential choices of infrastructure, timetable and rolling stock improvements, individual options were grouped to create twelve packages exploring a range of short, medium and long term interventions to address the planning objectives. These packages are described below.

Short Term Interventions (up to 2010)[1]

Package A1 – E&G Revised Stopping Pattern 1

This package offers improved end to end journey times on the Edinburgh to Glasgow via Falkirk High route, potentially reducing the current 50-minute end to end journey time to 46/47 minutes in the inter-peak. This is based on a revised inter-peak stopping pattern with reduced intermediate calls at Falkirk High, Polmont and Linlithgow. This package does not offer additional seating capacity and there are no changes to the peak services with this package.

[1] For the short term measures, with the exception of Package B2 and B3, it is assumed that the packages do not require capital investment for infrastructure enhancement. It is also assumed that current rolling stock is sufficient for A1 and A2.

Package A2 – E&G Revised Stopping Pattern 2

This package offers improved end to end journey times on the Edinburgh to Glasgow via Falkirk High route through a reduced frequency of calls at Falkirk High and a mix of 'fast' and 'stopping' services. For the 'fast' services, it is estimated that journey times could be reduced from 50 minutes to 42 minutes, while the 'stopping' services would have an increased journey time to 53 minutes (both journey times are in the inter-peak only). This implementation of this package may require strengthening of off-peak services. This option would not provide any additional seating capacity and there are no changes to the peak services with this package.

Package B1 – Hourly Services via Carstairs

This package would provide additional services between Glasgow Central and Edinburgh Waverley via Carstairs, which, when added to the existing Intercity services on this route, would give an hourly frequency. The indicative journey time on this route would be 65 minutes assuming stops at Motherwell and Haymarket and it would require rolling stock to be sourced. This package also has the ability to improve the rail option for North Lanarkshire to Edinburgh flows and reduces cross Glasgow transfers – thus freeing capacity on the existing E&G The number of seats would be increased by up to two hundred every second hour.

Package B2 – Caledonian Express[2]

This package offers an improved timetable, improved journey time and approximately two hundred additional seats per hour on the Edinburgh to Glasgow via Shotts route through the implementation of the 'Caledonian Express' semi-fast services, which would offer an hourly semi fast service in addition to the existing service on this route. These new services would provide an Edinburgh to Glasgow service taking around 67 minutes.

Medium Term Interventions (2010 – 2014)

The medium term measures would require capital investment for infrastructure enhancement and additional rolling stock.

Package B3 – Caledonian Express + Hourly Services via Carstairs (B1+B2)

This combination would provide improved journey times, two Edinburgh to Glasgow trains per hour 'semi-fast', additional seating capacity on the Edinburgh to Glasgow via Carstairs and Shotts route as well as better connections at Glasgow Central Station. As with B1 this package also has the ability to improve the rail option for North Lanarkshire to Edinburgh flows and reduces cross Glasgow transfers – thus freeing capacity on the existing E&G. It would require some infrastructure changes and journey times would be as B1 and B2 but the combination of both packages would deliver up to four hundred additional seats per hour.

[2] It should be noted that either B1 or B2 could be delivered in the short term but not both. If both are to be implemented (see package B3), the infrastructure works required will extend the delivery timescale into the medium term horizon

Package C1 – Electrification of E&G/Dunblane/Alloa

This package offers improved journey times on both the peak and off peak services on the Edinburgh to Glasgow via Falkirk High route through electrification of the route (and key diversionary routes). This package retains the current stopping and timetable pattern though other variants are possible. This package offers an indicative journey time reduction from 50 minutes to 46 minutes city to city with additional journey time benefits for passengers travelling from Glasgow and Edinburgh to Dunblane, Stirling and Alloa. However, there would be no increase in seating capacity with this package.

Package C2 – E&G Line Development (conflict removal)

This package offers a mix of 'fast' and 'stopping' services as well as additional capacity to allow six trains per hour on the Edinburgh to Glasgow via Falkirk High route. This would be achieved by tackling the physical network constraints on the E&G line through a range of infrastructure improvements and using existing rolling stock.

As with Package C1, journey time improvements would benefit not only city to city passengers but passengers travelling to and from Dunblane/Stirling and Alloa. The additional capacity would also allow an interchange at Gogar with the tram to allow access to Edinburgh Airport. 'Fast' services would see journey times reduce from 50 minutes to 42 minutes. Meanwhile, 'stopping' services would be able to retain the current journey time of 50 minutes end to end. This package would also provide four hundred additional seats per hour or eight hundred additional seats per hour if six-car sets are used.

Package D – Electrification of Shotts Line

This package offers improved journey times and enhanced frequency of services on the Edinburgh to Glasgow via Shotts line through revision of the stopping pattern and electrification of the remainder of the route that is currently not electrified, as well as other infrastructure enhancements along the route. This package would reduce journey times on the Shotts line from 84 minutes to 55 minutes with four hundred additional seats per hour being provided or eight hundred additional seats per hour if six-car sets are used.

Long Term Interventions (2014 – 2022)

Package C3 – E&G Line Development & Electrification

This package combines the benefits of C1 and C2 and would deliver six services per hour between Edinburgh and Glasgow on the E&G line. It offers improved journey times through a mix of 'fast' and 'stopping' services on the Edinburgh to Glasgow via Falkirk High route. It also provides additional seating capacity, allows for increased frequency of services and creates an improved interchange with the tram to allow access to Edinburgh Airport. These benefits would be achieved through electrification of the route and significant infrastructure enhancements. The indicative journey time could be reduced significantly from 50 minutes at present to 37 minutes for 'fast' services and to 47 minutes for 'stopping' services. Four hundred additional seats per hour could be provided, though this could be increased to eight hundred if six-car sets are used. A number of component parts of this package are deliverable within the medium term horizon and the full package could potentially be delivered by 2016.

Package E - E&G Major Upgrade and Tilting Trains

This package offers a step change in seating capacity, service frequency, journey time and overall performance of the Edinburgh to Glasgow via Falkirk High route and associated services through a programme of electrification and major infrastructure enhancements including increasing the linespeed to 125mph. The indicative journey time would reduce significantly from 50 minutes to 34 minutes with additional journey time savings and benefits on other routes. It would also provide additional seating capacity with an increase of nine hundred seats per hour. A total of six services per hour would be provided between Edinburgh and Glasgow.

Package F –New/Upgraded High Speed Route

This package provides a high speed link between Edinburgh Waverley and Glasgow Central providing improved journey time, increased service frequency and additional seating capacity through significant infrastructure enhancements to the existing route via Carstairs as well as major new railway construction. However, this route would be longer than the E&G route so journey times would remain slightly longer than Package E.

The fastest journey time from city centre to city centre would be significantly reduced from the current 50 minutes to 35 minutes for 'fast' services and reduced to 40 minutes for services stopping at Motherwell. Substantial additional seating capacity would be provided with 1,400 additional seats per hour, which could be increased to 2,200 additional seats per hour with longer trains.

Package G – New High Speed Route

This package provides a brand new dedicated high-speed route between Edinburgh and Glasgow offering a step change in journey time, service frequency and performance through major construction works. This could provide a journey time of 27 minutes between the two cities; the quickest journey time of all the options considered. Additional seating capacity of 1,400 to 2,200 per hour could also be provided. For the purposes of testing, it has been assumed that this route is high-speed conventional rail, but this could equally be any high-speed technology such as Maglev.

The table below shows comparative journey time reductions achievable through implementation of each of the packages on a route basis.

Route	Package	Fastest Journey Time		
		Short Term (2010)	Medium Term (2014)	Long Term (2022)
E&G *(current 50 mins)*	**A1**	46 / 47 mins inter peak only		
	A2	42 mins inter peak only		
	C1		46 mins	
	C2		42 mins	
	C3		37 mins	
	E			34 mins
Shotts / Carstairs *(current 84 mins Shotts and 60 – 65 mins Carstairs)*	**B1**	65 mins		
	B2	67 mins		
	B3	67 mins (Shotts) 65 mins (Carstairs)		
	D		55 mins (Shotts - fast)	
Alternative Routes	**F**			35 mins
	G			27 mins

The following table shows the comparative additional seating capacity which could be provided through implementation of each of the packages.

Route	Package	Additional seats per hour per direction between Glasgow and Edinburgh[3]		
		Short Term (2010)	Medium Term (2014)	Long Term (2022)
E&G *(current seating around 800 interpeak and 1600 peak)*	**A1**	None		
	A2	None		
	C1		None	
	C2		400 (up to 800 if 6-car)	
	C3		400 (up to 800 if 6-car)	
	E			900
Shotts / Carstairs (*current seating around 150 interpeak and 300 peak Shotts only)*	**B1**	200		
	B2	200		
	B3	400		
	D		400 (up to 800 if 6-car)	
Alternative Routes	**F**			Minimum of 1,400 Possible 2,200
	G			Minimum of 1,400 Possible 2,200 +

Complementary Packages

Two additional packages were developed for further consideration. These packages consist of a range of measures to improve the attractiveness and quality of the services on the Edinburgh to Glasgow routes. These were split into two areas comprising improvements to customer services, such as through ticketing and station facilities, and relocation, addition or reconstruction of key stations. Included within this latter category was the potential to provide a new station at Gogar to better link Edinburgh Airport with the rail network as an alternative to EARL.

[3] Based on an EMU having the same capacity as existing Class 170 DMU

Performance of the Packages

The estimates of benefits and costs of the packages are as robust as time would allow and are based on standard rail industry models and techniques. Further timetable development work is required to fully test the interactions with other services that operate over these corridors. This will also inform the infrastructure development process by value engineering the requirements to support particular timetable options.

The packages have been assessed against the planning objectives and against the five government objectives, and this is reported using a seven point scale, comprising:

- major benefit (+ + +) these are benefits or positive impacts which, depending on the scale of benefit or severity of impact, the planner feels should be a principal consideration when assessing a proposal's eligibility for funding;

- moderate benefit (+ +) the proposal is anticipated to have only a moderate benefit or positive impact. Moderate benefits and impacts are those which taken in isolation may not determine a proposal's eligibility for funding, but taken together could do so;

- minor benefit (+) the proposal is anticipated to have only a small benefit or positive impact. Small benefits or impacts are those which are worth noting, but the planner believes are not likely to contribute materially to determining whether a proposal is funded or otherwise;

- no benefit or impact (neutral) the proposal is anticipated to have no or negligible benefit or negative impact;

- small minor cost or negative impact (-) the proposal is anticipated to have only a small cost or negative impact. Small costs or impacts are those which are worth noting, but the planner believes are not likely to contribute materially to determining whether a proposal is funded or otherwise;

- moderate cost or negative impact (- -) the proposal is anticipated to have only a moderate cost or negative impact. Moderate costs /negative impacts are those which taken in isolation may not determine a proposal's eligibility for funding, but taken together could do so;

- major cost or negative impacts (---) these are costs or negative impacts which, depending on the scale of cost or severity of impact, the planner should take into consideration when assessing a proposal's eligibility for funding.

Transport Scotland
Strategic Transport Projects Review

The table below shows the performance of the packages against the planning objectives. It also shows the comparative capital cost ranges, net present value and BCR figures.

Package	Planning Objective 1a ***Reducing rail journey times between the city centres of Edinburgh and Glasgow***	Planning Objective 1b ***Improving rail system capacity between Edinburgh and Glasgow***	Planning Objective 1c ***Improving attractiveness of rail travel experience***	Planning Objective 1d ***Improving reliability of rail services between Edinburgh and Glasgow***	Planning Objective 2 ***An effective linkage between the rail network and Edinburgh Airport***	**Capital Cost**	**NPV**	**BCR**
A1	+	Neutral	+/-	Neutral	Neutral	None	<£10m	**1.3**
A2	++	Neutral	++/-	Neutral	Neutral	None	£25m to £50m	**2.7**
B1	+	+	+/Neutral	-	Neutral	None	£10m to £25m	**1.2**
B2	+	+	+/Neutral	-	Neutral	£10m to £50m	£150m to £200m	**3.8**
B3	+	+	++/Neutral	+	Neutral	£10m to £50m	£100m to£150m	**1.8**
C1	+	Neutral	++	+/-	Neutral	£250m to £500m	£50m to£100m	**1.3**
C2	++	++	++	++	++	£500m to £1bn	-£50m to -£100m	**0.9**
D	+	++	++/Neutral	+/-	Neutral	£100m to £250m	£50m to £100m	**1.4**
C3	++	++	++	++	++	£500m to £1bn	£50m to £100m	**1.1**
E	+++	+++	+++	+++	++	£1bn to £1.5bn	-£100m to -£150m	**0.9**
F	++	+++	+++	++	Neutral	£1.5bn to £3bn	-£1bn to -£1.5bn	**0.4**
G	+++	+++	+++	++	Neutral	£7bn +	-£3bn to -£4bn	**0.3**

The table above shows that in the **short term** on the E&G route, packages A1 and A2 perform relatively well in terms of reducing journey time, but provide no additional seating capacity and no direct improvement to linkage to Edinburgh Airport. Packages A1 and A2 offer no improvement to services in the peak. There is a negative impact on passengers using intermediate stations due to the reduction in stops. However A2 offsets this by providing new intermediate journey opportunities, though journey times for some intermediate journeys increase. These packages also offer the opportunity for an additional express service through Stirling which helps boost the Benefit Cost Ratio. A2 performs better, but there may be a need to increase train length to 6-cars on the stopping services due to the differential demand loadings that are likely to occur. The present timetable operating on the E&G route is optimised for all trains using the route and any alterations to individual trains are likely to have an impact on other services using the route e.g. Stirling/Dunblane etc.

On the Carstairs and Shotts lines, packages B1 and B2 perform relatively well against the objectives, but do not address the issue of linkage to Edinburgh Airport and introduce additional services through existing heavily trafficked sections of route. Package B1 provides increased seating capacity together with a more frequent timetable, leading to a better spread of passenger loadings. This package also has the ability to improve the rail options for North Lanarkshire to Edinburgh flows and reduces cross Glasgow transfers – thus freeing capacity on the existing E&G. Furthermore, it offers an easier interchange in central Glasgow for passengers from the south of Glasgow, Renfrewshire and Ayrshire. However, the ability of the service to give a high BCR is limited by its frequency. Package B2, the Caledonian Express, provides a very significant improvement to journey time for both current users and new passengers from key intermediate points into the cities. It provides a high BCR but as with B1 does not address the issue of linkage to Edinburgh Airport.

The tables show that in the **medium term**, on the Shotts and Carstairs routes Package B3 performs relatively well against the objectives. The additional infrastructure included within these options, addresses the impacts on the heavily trafficked sections. The BCR is significantly impacted by the costs of providing this infrastructure but remains significantly positive. This package provides a step change in the connectivity between Glasgow Central and Edinburgh Waverley.

On the E&G route, Package C1 provides some benefits when measured against the objectives, particularly in terms of journey time and attractiveness improvements, but it does not provide additional capacity nor does it improve the linkage to Edinburgh Airport. The potential environmental benefits of electrification are however noted.

Package C2 provides additional capacity to and provides enhanced access to Edinburgh Airport. However, the high level of infrastructure provision increases costs to a level where they outweigh the benefits, giving a BCR below 1.

Package D provides an enhanced version of B2 by increasing frequency to two semi-fast services per hour via Shotts and increases attractiveness through new rolling stock and general upgrading. The remaining forty seven per cent of the route would be electrified and there would be a significant journey time benefit to the stopping services compared with the current diesel traction units. The provision of a two train per hour service would give a step change in provision between Glasgow Central and Edinburgh Waverley, but it offers no improvement to access to Edinburgh Airport and would route additional services through already busy sections of route.

In the **longer term**, Package C3 combines the benefits of C1 and C2 by providing improved journey times, increased seating capacity, allows for increased frequency of services and creates an improved interchange with the tram at Gogar to allow access to Edinburgh Airport directly from Glasgow and has the potential environmental benefits of electrification. A number of component parts of this package could be delivered early, with the full package being delivered by 2016.

Packages E, F and G all perform well against the objectives. However packages F and G do not offer improved linkage to Edinburgh Airport. Each of these packages offers significant improvements to seating capacity and journey time. The potential for wider economic benefits resulting from these considerable reductions in journey time have been analysed. This has suggested that a reduction of 15 minutes could add around £300 million to the benefits. Taken together with the BCR results, this suggests that the E&G line remains the best option for long term development and that even when these wider economic benefits are taken into consideration, investment in a major new line is unlikely to result in a positive BCR. While major new lines bring many benefits, they are likely to have a significant negative environmental impact and result in severance of intermediate communities.

In terms of the complementary packages, a number of potential enhancements to customer services have been identified that could improve any of the above packages. A number of options for providing improvements to the accessibility of intermediate stations have been identified, some of which would also result in operational benefits. These are primarily aimed at providing more Park-&-Ride capacity.

Specifically, the option to provide a new station at Gogar adjacent to Edinburgh Airport would give significant benefits both in the shorter term by allowing services to and from Fife and the North-East more immediate access to the airport via a short tram ride, together with the planned connection to the tram from Edinburgh Park serving Dunblane/Stirling and Airdrie-Bathgate areas, and in the longer term by combining with the implementation of the Dalmeny Chord to allow wider access to the airport from Falkirk and the West of Scotland.

Conclusions

The key conclusions of the study are:

- The short term packages do provide journey time improvements and additional benefits but they do not offer an improved link between the rail network and Edinburgh airport in the short term.

- In the short term, A2 has the biggest impact on reducing journey times but there may be difficulties in implementing it and it only provides benefits in the off-peak period.

- Package B2 performs well and would take some pressure from the E&G route. The BCR is high but it only benefits a relatively small proportion of the study area.

- B3 provides a step change in connectivity for Glasgow Central to Edinburgh. and could be seen as an intermediate step to achieving Package D, which has enhanced cross connectivity potential with the Glasgow suburban electrified network.

- For the E&G line, Package C3 represents the most cost-effective way of achieving the benefits set out within the planning objectives in the medium term. It offers additional seat capacity and services with the benefits of electrification and an improved link between the rail network and Edinburgh airport.

- For the long term, a bespoke new route is unlikely to offer better value for money than continued investment in the E&G route. However, the options put forward could be augmented by further service alterations and additions that have a wider impact across the study area and beyond. Packages E, F and G should therefore be referred back to the main STPR study with the analysis developed to date for further consideration.

1 Introduction & Context

This report provides one of the early strands of the Strategic Transport Projects Review (STPR), which is looking at ways to achieve the three strategic outcomes set out in the National Transport Strategy and its accompanying documents – Scotland's Railways, the Freight Action Plan and the Bus Action Plan. These strategic outcomes are:

- Improving journey times and connections;
- Reducing emissions; and
- Improving quality, accessibility and affordability

The STPR is a nationwide study considering a variety of modes of transport, and will recommend a programme of interventions for implementation between 2012 and 2022. This Edinburgh to Glasgow rail report will make a significant contribution to achieving the three key strategic outcomes.

The STPR review is expected to be completed in summer 2008. Two significant areas for transport investment have been brought forward ahead of the full review – the Forth replacement crossing and this report on rail improvements between Edinburgh and Glasgow. In both cases, the economic and political priority given to such investment is clear, and advancing the feasibility work allows the benefits from the ultimate investment to be secured more quickly.

The full review considers all the key transport connections within Scotland and considers travel by a range of modes of transport. This report does not seek to repeat those findings which will be published on Transport Scotland's website in due course. Instead, this report complements that broad picture, by focussing in more detail on the busiest key corridor, Edinburgh to Glasgow, and one key mode, rail that provides a significant alternative to car travel into and between these increasingly congested cities.

Scotland's Railways (December 2006), the Ministers' Transport Statement to Parliament (June 2007) and the High Level Output Specification (July 2007) all set out the importance of investment in rail in the Edinburgh to Glasgow corridor. This report takes that strategic direction to the next stage of development, setting out options for improvements in the short, medium and long term, and assessing the impacts of such improvements. It also provides Ministers with options on alternative ways of accessing Edinburgh Airport, in place of the Edinburgh Airport Rail Link. The context for the report was set out in the Statement by the Minister for Transport, Planning and Climate Change to the Scottish Parliament on 27 June 2007:

"Edinburgh Airport needs an effective public transport link, but it does not need a tunnel under its main runway. I have therefore asked Transport Scotland to investigate alternatives to EARL…and to report back to Ministers in the autumn.

"I want to focus on our priority for the rail network, which is to improve the reliability, attractiveness and journey time of the Edinburgh to Glasgow route, which will improve significantly the connectivity between those two fine and important cities. Transport Scotland will work with Network Rail and First ScotRail on a range of measures including infrastructure improvements such as; a new station at Gogar as an alternative link to the airport, improvements at Dalmeny and firm proposals for the most cost effective ways to improve reliability for the expected continuing growth in rail passenger numbers".

As within the STPR more generally, we have followed the Scottish Transport Appraisal Guidance (STAG), as set out in Appendix A. Best practice is to follow as inclusive approach as possible. In the time available for this report, however, direct involvement by a wide range of stakeholders has had to be limited. To balance this we have used the evidence already provided by a wide range of bodies in previous work, such as reports produced by the Regional Transport Partnerships, Local Authorities, the Edinburgh Glasgow Collaboration Project and Scottish Enterprise, and contributions to the consultations undertaken in the preparation of both Scotland's Railways and Network Rail's Route Utilisation Strategy. We have also been able to use work being undertaken in parallel by Network Rail on the routes, First ScotRail's expertise on timetabling and operational opportunities, and draw on initial work undertaken jointly by Transport Scotland, Network Rail and TIE Ltd on alternatives to EARL. .

In essence, we have analysed the problems and opportunities associated with rail within the Edinburgh to Glasgow corridor. We used this analysis to form SMART objectives for the work, building on the Ministers' statement above. Through a combination of using previous relevant work and initiating fresh ideas we identified a wide range of options for achieving the objectives.

However, changes within the rail industry involve complex interactions between infrastructure, rolling stock and timetables, and so we grouped options into packages associated with timetable changes – the visible result from a customer perspective. This is set out in Chapter 9. We then appraised how well each package achieved the objectives set, and used this to make recommendations on a range of improvements in Chapter 10.

2 Background

2.1 Overview

Edinburgh is the second largest financial centre in the UK after London and houses the global headquarters for firms such as the Royal Bank of Scotland, HBoS and Standard Life. It has a population of almost 460,000 and is the home of the Scottish Parliament and the Scottish Government. The city creates seventy per cent more wealth per head of population than Scotland as a whole. Tourism is important for the city and with Edinburgh Castle it incorporates a UNESCO World Heritage Site.

Glasgow is Scotland's largest city, with a population of almost 580,000 and is the largest manufacturing and office centre in Scotland. Key employers include National Australia Group (owners of Clydesdale Bank), British Telecom, Lloyds TSB, Scottish Power and the BBC. It is home to three Universities and nine colleges of further education. Tourism is growing in importance to the city and it is bidding to host the 2014 Commonwealth Games.

The level of demand for air travel in the Edinburgh airport catchment area has increased rapidly in the past few years. In 2003 Edinburgh airport handled 7.5 million passengers per annum representing growth of 36 per cent since 2000, this compares with the 11 per cent UK national growth figures in the same period. This trend is forecast to continue and it is forecast that by 2030 Edinburgh Airport will handle 21 million passengers per annum. As Scotland's busiest airport, Glasgow airport is key to the continued success of the Glasgow and wider Scottish economy. BAA forecasts that passenger numbers at Glasgow airport will increase from 8.8 million per annum in 2006 to between 12 and 15 million by 2015, and further to between 17 and 24 million per annum by 2030, with more than half of these travelling direct to and from international destinations

Figure 2.1.1 – Locational Context

The rail link plays an important role in contributing towards the Scottish economy by *"underpinning the interaction between Scotland's two largest cities, providing for essential commuter flows and facilitating access to cross border rail and air services as well as other connecting routes within Scotland*[4]."

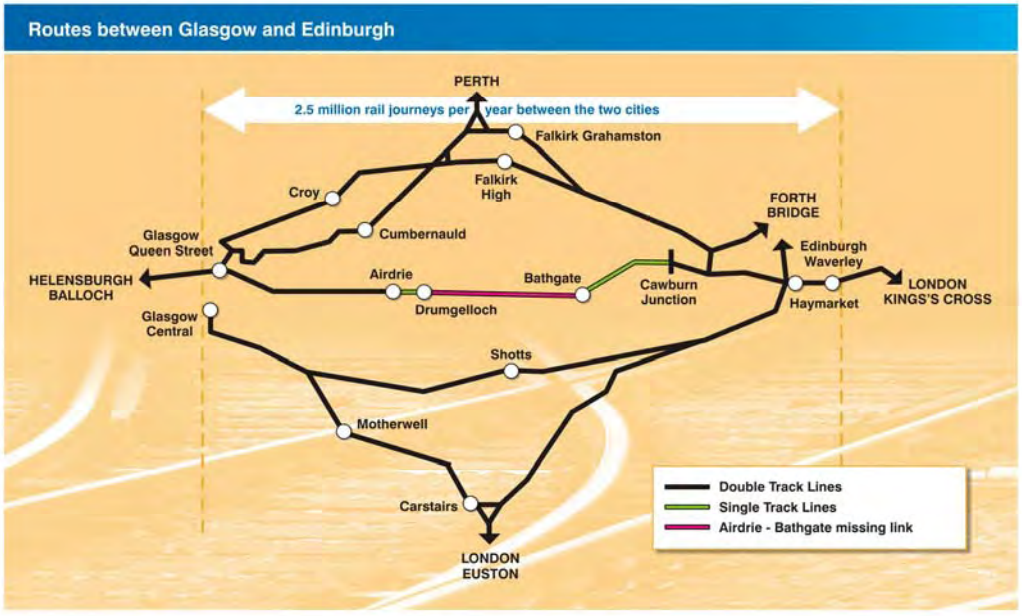
The Edinburgh to Glasgow route is the most heavily patronised inter-urban rail route in Scotland[5] with over 2.5m rail passenger journeys between the two cities per annum as well as significant intermediate flows. The demand for travel on this corridor is forecast to grow significantly in the future years, and the focus of this study is therefore on improving the rail connections between the two cities to serve that demand, to improve connections, to encourage further growth and to enhance the contribution that rail makes to the Scottish economy even further,

There are three rail routes operating between Edinburgh and Glasgow at present:

- Edinburgh to Glasgow via Falkirk High
- Edinburgh to Glasgow via Shotts; and
- Edinburgh to Glasgow via Carstairs

Completion of the new Airdrie to Bathgate rail line, due in 2010, will provide a fourth route.

Figure 2.1.2 – Edinburgh – Glasgow Rail Routes



Each of the routes serves multiple markets that vary across the day but the route via Falkirk High offers the fastest journey time and most frequent service of all the routes between the two cities at present.

[4] Scotland's Railways, Scottish Executive December 2006
[5] Scotland Route Utilisation Study, Working Paper Base Year and Predicted Rail Demand, 2006

The table below shows the route length and journey time for each route:

Table 2.1.1 – Edinburgh – Glasgow Rail Routes

Rail Route	Route Miles	2007 Journey Time (city centre to city centre)
E-G via Falkirk High	47 ¼	50 min
E-G via Shotts	47 ¼	84 min
E-G via Carstairs	57	64 min westbound 58 min eastbound
E-G via Airdrie/Bathgate (expected opening 2010)	44 ¼	74 min (planned)

2.2 Issues to consider

Applying the principles of STAG and its problem-led rather than solution-led approach, we have considered:

- Characteristics of the four rail routes including their constraints (Chapter 3);
- Characteristics of key rail stations (Chapter 4);
- The Social, Economic and Environmental context (Chapter 5);
- The Demand for Travel (Chapter 6); and
- The Problems, Issues, Constraints and Opportunities (Chapter 7)

This information provides the basis for the setting of planning objectives and option generation.

3 The Rail Routes

In this section we highlight the key features of the rail routes between Edinburgh and Glasgow covering the infrastructure, the rolling stock, the passenger and freight services operated and a summary of passenger characteristics.

3.1 Edinburgh to Glasgow via Falkirk High

Summary of route

Starting at Edinburgh Waverley and running to Glasgow Queen Street via Falkirk High, this route has historically been known as the E&G. With the exception of the Edinburgh approach, which has four tracks from Haymarket West Junction, the route is twin-track throughout and offers the most frequent service level and fastest journey time of all the routes, taking a timetabled 50 minutes to cover the 47 ½ miles. A schematic of the route is shown on the following page.

Passenger Services

First ScotRail provides a 15 minute frequency service using three vehicle Class 170 "Turbostar" trains, which are extended to six vehicles during the peak periods. It is a city centre to city centre service that also serves the significant communities of Polmont, Falkirk High, Croy and Linlithgow; the latter station having been named 12th busiest station in Scotland.[6]

The Edinburgh-Glasgow services account for only a quarter of the services operating on all or part of the route. Other services include Glasgow to Stirling & Dunblane, Glasgow to Aberdeen and Inverness, Glasgow to Cumbernauld, Glasgow to Anniesland, Edinburgh to Dunblane and Edinburgh to Bathgate. During the peak periods additional rolling stock is provided on the base services and there are a few additional services to key locations to maximise the use of available network capacity.

The table below from Network Rail's Route Utilisation Strategy (RUS) for Scotland shows average load factors for peak trains in both directions. Load factors of 75 to 90 per cent during the 3-hour peak are likely to be 100 per cent or over during the high peak hour. The figures imply significant overcrowding in the Glasgow to Edinburgh direction (AM high peak hour). The average load factor is modelled to be 69 per cent on departure from Glasgow suggesting that given fluctuations in train loadings over the year, some trains may be full on departure from Glasgow[7].

[6] Network Rail, Scotland Route Utilisation Study 2007, Working Paper, Base Year and Predicted Rail Demand: (2004/05 figures apply)
[7] Network Rail, Scotland Route Utilisation Study 2007, Working Paper, Base Year and Predicted Rail Demand: (2004/05 figures apply)

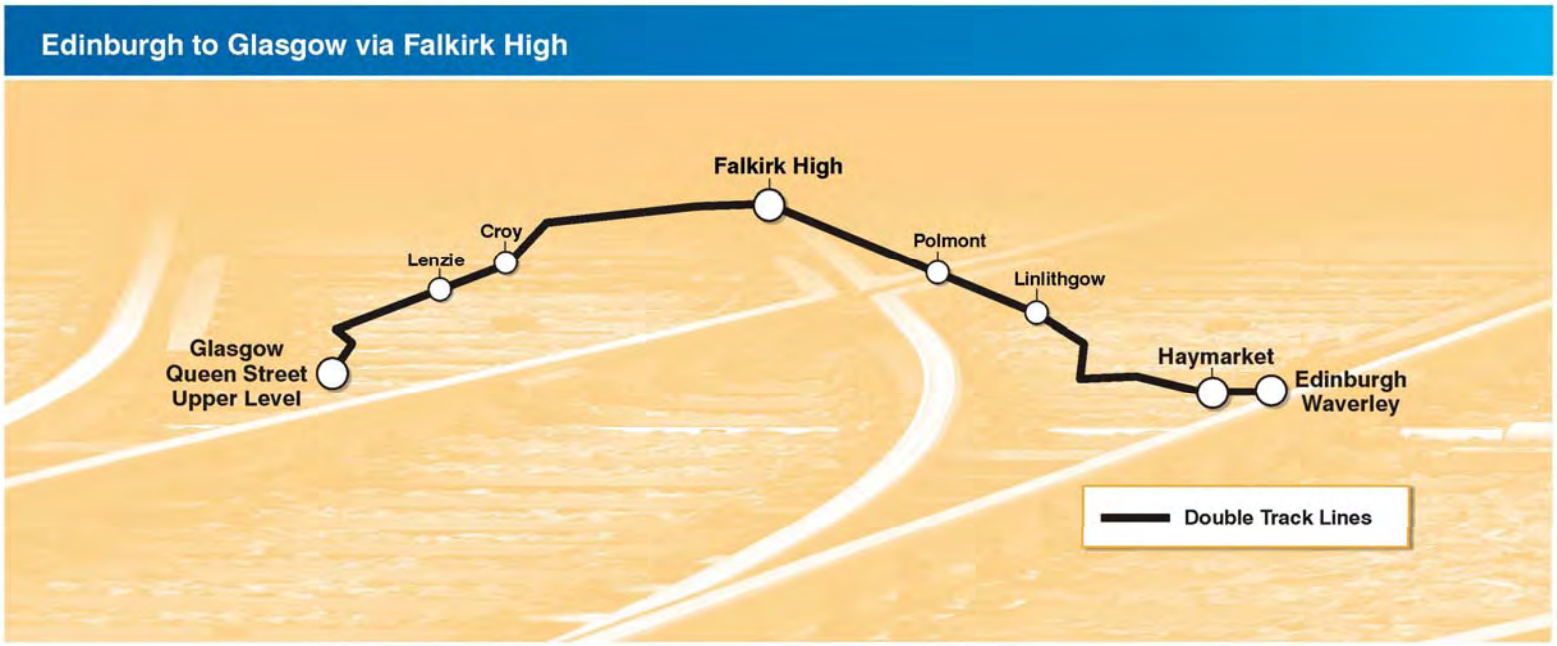


Figure 3.1.1 – Edinburgh – Glasgow Rail Route via Falkirk High

Table 3.1.1 - 2004/05 AM Peak and High Peak Load Factors

Service Group	AM Peak Load Factor / (Average Weekday Passengers)	AM High Peak Load Factor / (Average Weekday Passengers)
Edinburgh to Glasgow via Falkirk High	77% (2,480)	98% (1,500)
Glasgow to Edinburgh via Falkirk High	88% (2,490)	106% (1,110)

Table 3.1.2 below illustrates an increasing demand in future years[8] and implies increasingly severe overcrowding unless action is taken.

Table 3.1.2 - 2004/05 Predicted AM Peak Load Factors

Service Group	Base	2011	2016	2026
Edinburgh to Glasgow via Falkirk High	77%	80%	84%	93%
Glasgow to Edinburgh via Falkirk High	88%	88%	93%	99%

The table above presents load factors during the 3 hour AM peak but it is important to note that Load Factors of 75 to 90 per cent during the 3 hour peak are likely to be 100 per cent or over during the high peak hour, demonstrating that severe overcrowding on these services is likely to worsen if the issue is not addressed.

Freight

There are currently about 12 coal trains daily (each way) using the E&G between Polmont Junction and Winchburgh Junction en route to Longannet Power Station. These services will be re-routed with the re-opening of the Stirling – Alloa – Kincardine route, leaving a relatively small amount of freight traffic on the E&G.

[8] Network Rail, Scotland Route Utilisation Study 2007, Working Paper, Base Year and Predicted (2016) Rail Demand: (2004/05 figures apply)
Note: Predicted loading figures do not take account of Airdrie to Bathgate rail scheme

Infrastructure

The table below illustrates the infrastructure characteristics of the route:

Table 3.1.3 – Infrastructure Characteristics of route via Falkirk High

Route Miles	Journey Time	Electrified	Gauge / Route Availability	Line speed	Headway [9]
47 ¼	50 min	No (except Haymarket East Junction to Edinburgh Waverley)	W7/8 RA10	100mph Max with local restrictions	3 mins Glasgow Queen Street to Greenhill Upper Junc 4 mins Greenhill Upper Junc to Haymarket 3 mins Haymarket to Edinburgh Waverley

The Passenger Market

Approximately 54 per cent of passengers on this route are travelling for leisure purposes, around half of whom are visiting friends or relatives. Around 35 per cent are commuting or travelling to a place of education. Whilst only a relatively small number of passengers state that they are travelling on employer's business, this is also a valuable customer segment.

Passengers on this route are more likely to be female (61 per cent) and 38 per cent fall into the 25-34 age bracket with 13 per cent of passengers aged 45 or over. More than half of all passengers describe themselves as semi regular users who travel at least every two or three months but not more than 2-3 times a month, while one quarter of passengers are regular users of the service i.e. travelling at least once or twice a week.

Passenger Focus recently surveyed passengers on the Edinburgh – Glasgow Queen Street via Falkirk route to find out what passenger priorities for the service were. On this route the top four priorities are:

- Value for money for price of ticket;
- Ticket buying facilities;

[9] December 2007 Rules of the Plan

- Provision of information about train times / platforms; and
- Personal security at the station.

Value for money is the most important area to improve, as suggested by this gap analysis. The areas where the gap between experience and expectation is least are:

- Punctuality / reliability of the train;
- Length of time the journey was scheduled to take (speed); and
- Being able to get a seat on the train.

For seat availability, experience exceeds expectation and for the other four factors there is only a very small (or no) gap between the two when weighted by importance.

A number of route specific questions were put to passengers on the Edinburgh – Glasgow Queen Street main line route, covering car parking and possible changes to the route relating to frequency, peak journeys and through trains.

This section summarises the results of these route specific questions:

- 61 per cent of passengers surveyed have access to a car they could drive;
    - of these, 38 per cent sometimes drive to the station;
    - of the 62 per cent who do not drive, 19 per cent would like to drive – some 6.7 per cent of the total sample interviewed, higher than some other routes monitored;
- two thirds of respondents who would like to drive to the station but do not do so cite lack of parking at the station as the reason; 21 per cent mention the cost of parking
- Of those who drive to the station and park there;
    - 30 per cent do so every weekday during peak times
    - 18 per cent do so at least once a week
    - 21 per cent of those who drive to the station and park there never do so at peak times
    - on average, those who drive to the station do so just under twice per week at peak times (0630 to 0930)
    - 30 per cent can always find a space
    - 33 per cent are able to find a space most of the time

- non-availability of spaces is a problem from a sizeable minority (27 per cent can hardly ever get a space and 10 per cent never can)
- In spite of greater difficulty finding car parking spaces, only 16 per cent would be prepared to pay more to guarantee a parking space at the station
- 46 per cent would not be prepared to pay anything to park at the station. The average price respondents would be prepared to pay is £1.50 per day (this includes those who would not be prepared to pay anything)
- 45 per cent of passengers who drive to the station and park there would still travel by train if the cost of the car park exceeded what they were prepared to pay – 55 per cent would not
- 20 per cent of passengers who drive to the station and park there would travel after 09:30 if parking were free at that time (but 54 per cent would not and 21 per cent could do this sometimes) – the percentage who would change their travel time is much higher for leisure travellers (47 per cent) than commuters (8 per cent)

In terms of changes to services:

- 68 per cent would prefer faster links between Edinburgh and Glasgow with less stops and 32 per cent prefer the current service
- Passengers on this route were told that a link to Edinburgh Airport was being planned and were asked their preferred frequency of service. Around 1 in 4 opted for one train per hour, around half for two trains per hour and around 1 in 4 for three trains per hour. A half hourly service is the preferred option here, with three quarters of passengers content with that frequency

In response to an open ended question, the top priorities on this route as seen by passengers are felt to be:

- Reliability/punctuality/less delays (14 per cent);
- More seats/less crowding (10 per cent);
- Cheaper tickets/lower prices (9 per cent);
- No other suggestions generate more than 5 per cent response; and
- 42 per cent do not identify any priority for improvement.

Issues/Opportunities and Constraints

Network Rail has recently completed a GRIP1 study into the potential for electrification of the core route as well as some key diversionary routes.

Looking ahead, there are plans for major land release around the small town of Winchburgh that includes an aspiration for a new rail station on the E&G. The size of the enlarged town is likely to require a service similar to that provided for Linlithgow which would place further operational and capacity burden on the route.

There are a number of constraints[10] affecting this route including:

- Number of platforms, platform lengths and passenger circulation and access at Glasgow Queen Street Station;
- Conflicting movement on the approaches to Glasgow Queen Street, Haymarket and Edinburgh Waverley Station;
- Conflicting movements at various junctions including Cowlairs South, Cowlairs West, Greenhill, Polmont, Winchburgh, Newbridge and Haymarket East;
- Interaction between fast and stopping trains between Glasgow Queen Street and Greenhill Junction, and between Edinburgh Waverley and Polmont Junction; and
- Overcrowding on existing services and predicted increased overcrowding future services.

3.2 Edinburgh to Glasgow via Shotts

Summary of route

From Edinburgh Waverley to Glasgow Central via Shotts, this route is the same length as the E&G at 47 ¼ miles but the journey takes almost twice as long at 90 minutes. Whilst it provides a direct link between the two cities, it is primarily used to link intermediate settlements into Edinburgh and Glasgow, and as a freight corridor. A schematic of the route is shown on page 33.

Passenger Services

Trains call at 19 stations between the two cities. Between Uddingston and Glasgow Central the route shares the West Coast Main Line used by the Glasgow – England services, and trains on the Glasgow/Lanarkshire suburban rail network. Train services are provided by First ScotRail on an hourly basis using Class 156 DMUs. Other passenger trains between Edinburgh Waverley and Midcalder Junction are the 2 hourly GNER service to Glasgow Central and the hourly Virgin Cross Country service to destinations in England.

[10] Steer Davis Gleave, Edinburgh Glasgow Scoping Study, August 2006

Table 3.2.1 below from Network Rail's Route Utilisation Strategy (RUS) for Scotland shows average load factors for peak trains in both directions. Load factors of 75 to 90 per cent during the 3-hour peak are might be 100 per cent or over during the high peak hour. The table below shows severe overcrowding occurring most weekdays on the AM high peak hour services from Edinburgh to Glasgow via Shotts. Services on this route meet the demand from intermediate stations for travel into both Glasgow and Edinburgh. Over-crowding in the morning peak is worse for westbound passengers with the average load factor reaching 78 per cent on departure from Cambuslang. There is only one service arriving between 08:00 and 09:00 (its last stop before Glasgow is Bellshill) and on this service, passengers often stand for probably more than 20 minutes[11].

Table 3.2.1 –2004/05 AM Peak and High Peak Load Factors

Service Group	AM Peak Load Factor / (Average Weekday Passengers)	AM High Peak Load Factor / (Average Weekday Passengers)
Edinburgh to Glasgow via Shotts	78% (630)	103% (300)
Glasgow to Edinburgh via Shotts	58% (460)	65% (430)

Table 3.2.2 below illustrates the forecast of worsening of overcrowding on Shotts line services[12].

Table 3.2.2 – Predicted AM Peak Load Factors

Service Group	Base	2011	2016	2026
Edinburgh to Glasgow via Shotts	78%	82%	85%	94%
Glasgow to Edinburgh via Shotts	58%	Not Known	Not Known	Not Known[13]

[11] Network Rail, Scotland Route Utilisation Study 2007, Working Paper, Base Year and Predicted (2016) Rail Demand: (2004/05 figures apply)
Note: Predicted loading figures do not take account of Airdrie to Bathgate rail scheme
[12] Network Rail, Scotland Route Utilisation Study 2007, Working Paper, Base Year and Predicted (2016) Rail Demand: (2004/05 figures apply)
Note: Predicted loading figures do not take account of Airdrie to Bathgate rail scheme
[13] The figures for Glasgow to Edinburgh via Shotts for 2011, 2016 and 2026 were are not readily available and were unobtainable in the timescales of this study

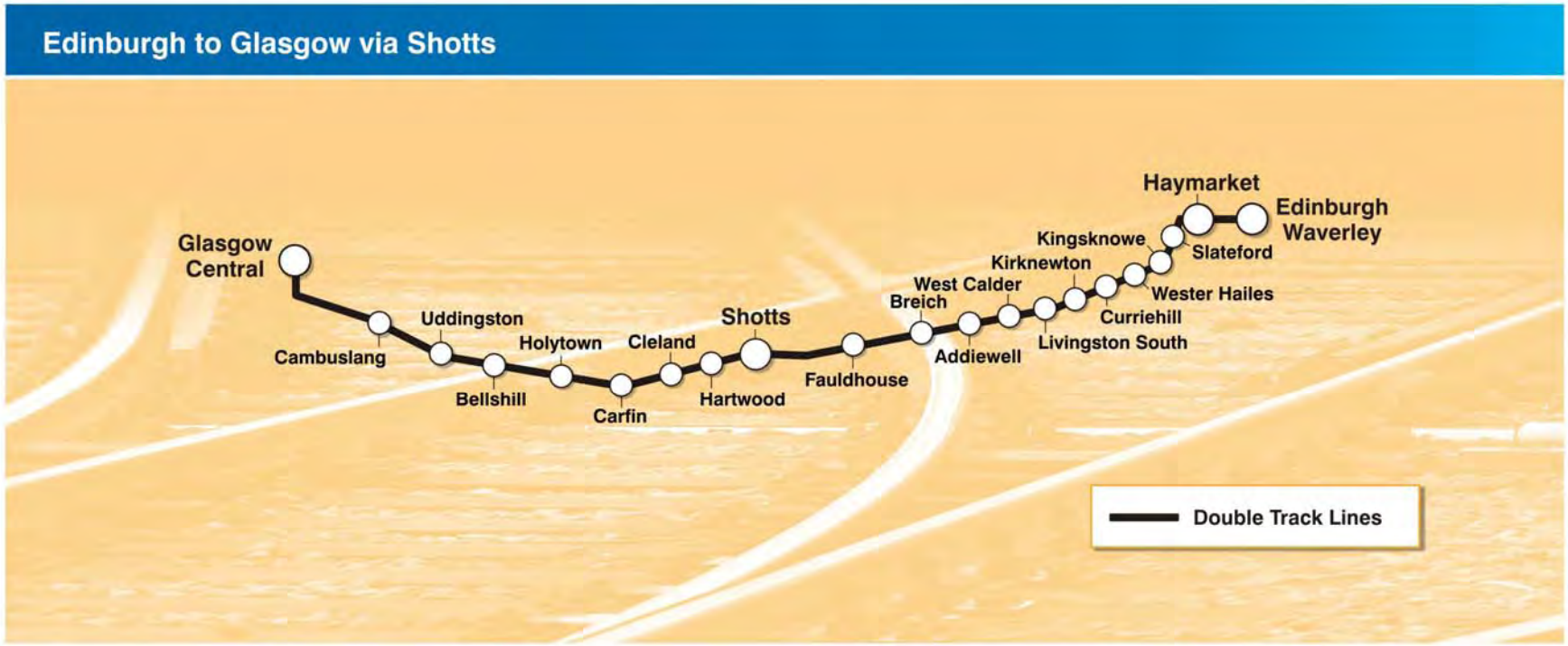


Figure 3.2.1 – Edinburgh – Glasgow Rail Route via Shotts

Freight

Freight services also use the route and require to be incorporated into the day time timetable plan. This is particularly important in terms of managing the interaction of freight between Edinburgh and Glasgow and minimising conflict with E&G services on the line via Falkirk and East and West Coast Main Line Services on the line via Carstairs. The current passenger service offers the slowest of all four rail routes between Edinburgh and Glasgow.

Infrastructure

Table 3.2.3 below shows the infrastructure characteristics of the route:

Table 3.2.3 – Infrastructure Characteristics of the route via Shotts

Route Miles	Journey Time	Electrified	Gauge / Route Availability	Line speed	Headway
47 ¼	90 min	Section from Holytown Jnc to Midcalder Jnc is not electrified (22 miles)	W9 RA10	70mph Max with restrictions (higher between Rutherglen to Uddingston and Midcalder Jcn to Slateford)	4min Glasgow Central to Holytown Jnc; 8min Holytown Junc to Midcalder Junc; 5min Midcalder Junc to Slateford; 3min Slateford to Haymarket; and 2min Haymarket to Edinburgh

The Passenger Market

Almost half of passengers travelling on this route are making a leisure trip, usually either visiting friends/relatives or shopping, whilst a further 20 per cent are on personal business. Only 4 per cent are on employer's business[14].

Passenger Focus recently surveyed passengers on the Edinburgh – Glasgow Central via Shotts establish what passenger priorities for the service were. On this route the top four priorities are:

- Ticket buying facilities;

[14] First ScotRail

- Provision of information about train times / platforms;
- Value for money for price of ticket; and
- Frequency of the trains on the route.

Ticket buying facilities are by far the most important area to improve. The areas where the gap between experience and expectation is least are:

- Connections with other forms of transport;
- Punctuality / reliability of the train;
- Personal security at the station;
- Ease of getting to/ from the station; and
- Being able to get a seat on the train.

For seat availability, experience exceeds expectation and for the other four factors there is little or no gap between the two when weighted by importance.

A number of route specific questions were put to passengers on the Edinburgh – Glasgow Central via Shotts route, covering car parking and possible changes to the route relating to frequency, peak journeys and through trains.

This section summarises the results of these route specific questions.

- 49 per cent of passengers surveyed have access to a car they can drive (this is lower than some other routes but the passengers on this route are younger than others (31 per cent aged 16-24 and 14 per cent commuting to school or college)
    - of these, 51 per cent sometimes drive to the station
    - of the 49 per cent who do not drive, only 18 per cent would like to drive – only 2 per cent of the total sample interviewed
- there are no consistent constraints that prevent parking at the station (but only 4 respondents gave a response to this question so the base is very low)
- Of those who drive to the station and park there
    - 35 per cent do so every weekday during peak times
    - 22 per cent do so at least once a week
    - 16 per cent never park at peak times
    - on average, those who drive to the station do so just two and a half times per week at peak times (0630 to 0930)

  - 47 per cent can always find a space
  - 30 per cent are able to find a space most of the time
  - non-availability of spaces is a problem for a very small minority
  - Only 6 per cent would be prepared to pay more to guarantee a parking space at the station; this is clearly a function of the general lack of difficulty in finding a parking space at present
  - 80 per cent would not be prepared to pay anything to park at the station (again almost certainly a function of the current easy availability of parking spaces). The average price respondents would be prepared to pay is £0.30 per day (this includes those who would not be prepared to pay anything)
  - Only 31 per cent would still travel by train if the cost of the car park exceeded what they were prepared to pay – 69 per cent would not
  - 15 per cent would travel after 09:30 if parking were free at that time (but 65 per cent would not and 11 per cent could do this sometimes) – this figure is much higher for leisure travellers (42 per cent) than commuters (7 per cent)

In terms of changes to services:

- 66 per cent believe that trains should run every 30 minutes on this route to meet their needs, with another 10 per cent opting for every 45 minutes and 16 per cent once per hour.
- More frequent trains are likely to increase the number of journeys
  - 20 per cent say they would definitely make more journeys
  - 36 per cent possibly more
  - Only 1 in 3 saying increased frequency would have no effect (11 per cent Don't Knows)
- A similar result occurs when respondents are asked about reaction to a less frequent service.
  - 34 per cent say they would definitely make fewer journeys
  - 27 per cent probably making fewer journeys
  - Only 1 in 4 would make the same number (with 15 per cent Don't Knows)

- Given the choice, 52 per cent would prefer faster links with less stops, whilst 48 per cent would prefer the current journey

- The mean reduction in journey times that would be seen as worthwhile would be 16 minutes, with 1 in 3 opting for 15 minutes, 1 in 3 opting for more than 15 minutes and just 20 per cent opting for less than 15 minutes

- 22 per cent would like trains to run earlier in the morning than at present (64 per cent would not)

- 52 per cent would like trains to run later in the evening (34 per cent would not). Clearly, extending the time of evening services is more important to passengers on this route than extending the time of morning services

Issues/Opportunities and Constraints

Many of the stations generate little traffic and are located distant to residential areas or areas of economic activity. This means there is scope to review the calling patterns of train services on this route[15]. There are plans that are well advanced to introduce an additional hourly limited stop service – the Caledonian Express – to provide faster links to Edinburgh and Glasgow for the major intermediate stations[16]. The Caledonian Express service is planned to take 67 minutes calling at up to 5 stations en route. There is an aspiration to reduce this to 60mins but even this remains 10mins longer that the current best journey time on the E&G.

There are a number of constraints affecting the route including:

- The route is double track throughout apart from the Edinburgh approaches and the Glasgow Central to Rutherglen section, where it is multiple track, with no opportunities for fast trains to pass slower trains;

- Around 53 per cent of the route (the sections at either end), is electrified but the central section is not;

- Single line section of approximately half a mile in length at Midcalder Junction is a significant operating constraint;

- Signalling headways reflecting differential speed profile of route;

- Ancillary movements to and from depots;

- High number of intermediate stops and variable distances between any two stations;

- Platform operational capacity at Glasgow Central, Edinburgh Waverley and Haymarket;

[15] SDG, Edinburgh – Glasgow Scoping Study, August 2006
[16] Caledonian Express Study

- Conflicting movements at junctions including Rutherglen Central, Rutherglen East, Newton West, Uddingston, Mossend West, Mossend East, Holytown, Midcalder and Slateford;
- The rolling stock (Class 156) does not make best use of the route capability, having a top speed of 75mph and poor acceleration from station stops;[17]
- Breich and Addiewell stations have low passenger usage; and
- Overcrowding is an issue on some existing and future services[18]

3.3 Edinburgh to Glasgow via Carstairs

Summary of route

From Edinburgh Waverley to Glasgow Central via Carstairs this electrified route provides for the extension of East Coast Main Line services to Glasgow, which provides opportunities for travel between the two cities. In the west, much of the route is also part of the West Coast Main Line. It is the longest of all four routes in terms of length at 57 miles. It is an indirect route between the two cities and superficially does not look to be an obvious route for passengers on end to end journeys.[19] A schematic of the route is shown on the following page.

Passenger services

This is the only route that serves Motherwell. Most trains between Edinburgh and Glasgow on this route are provided by a 2 hourly extension of the GNER London-Edinburgh services using Mallard Mk4 rolling stock and Class 91 electric locomotives. Virgin Trains also use the route to run services to England using Class 220 (non tilting) and Class 221 (tilting) 'Voyager' diesel units. First ScotRail operate a number of services on the line, which are extensions of North Berwick services. These are operated by a dedicated fleet of five refurbished Class 322 EMUs. One of the primary purposes of the services via Carstairs is to provide position moves for unit maintenance in Glasgow.

Unfortunately details of passenger loadings for this route were not available in the time available for publication of this report.

[17] SDG, Edinburgh – Glasgow Scoping Study, August 2006
[18] Network Rail, Scotland Route Utilisation Study 2007, Working Paper, Base Year and Predicted (2016) Rail Demand: (2004/05 figures apply)
[19] SDG Edinburgh – Glasgow Scoping Study 2006

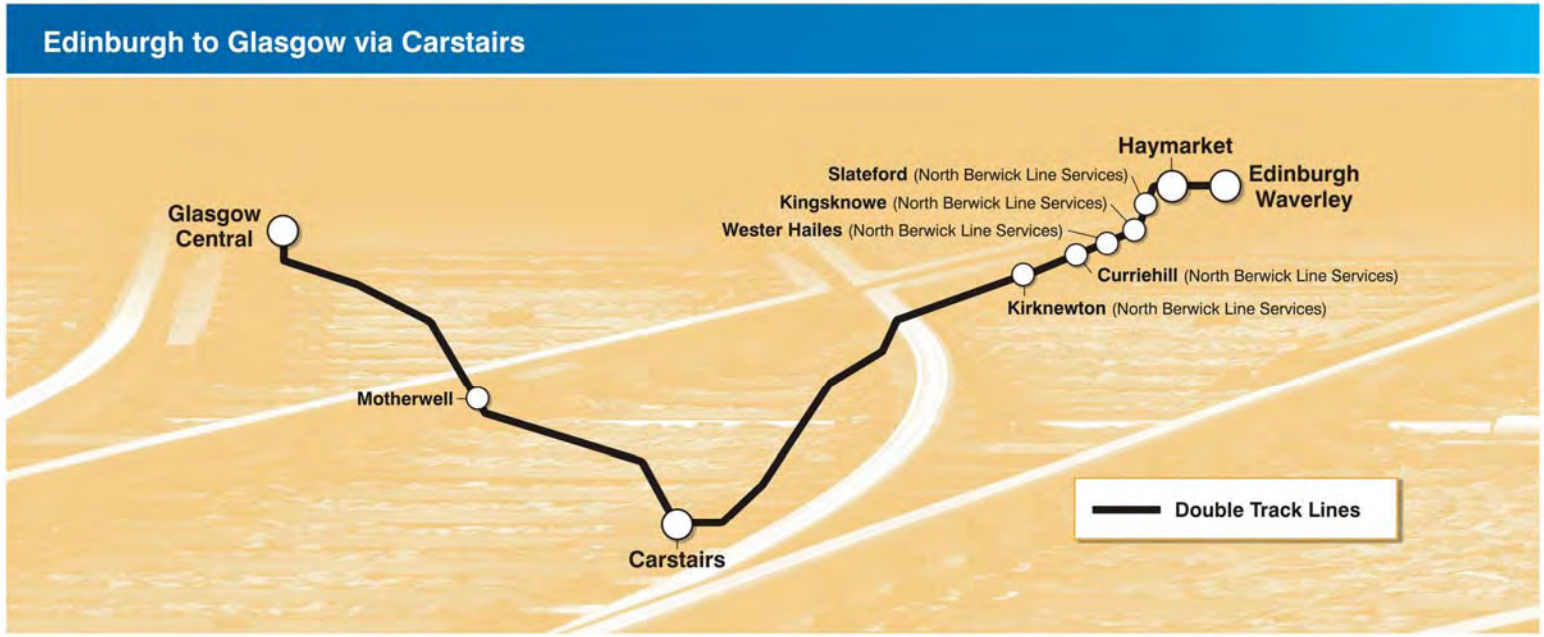


Figure 3.3.1 – Edinburgh – Glasgow Rail Route via Carstairs

Freight

Freight trains account for 23 per cent of the train paths with English Welsh and Scottish Railways (EWS), Direct Rail Services (DRS) and Freightliner all using the route.

Infrastructure

The route is mainly double track, except between Edinburgh Waverley and Haymarket and Glasgow Central and Rutherglen East junction section where it is multiple track and a single line section at Carstairs. At Carstairs, the curvature restricts the line speed to 15mph. The table below shows the infrastructure characteristics of the route:

Table 3.3.1 –Infrastructure characteristics of the route via Carstairs

Route Miles	Journey Time	Electrified	Gauge / Route Availability	Line Speed	Headways
57	64 min to Glasgow 58 min to E'burgh	Yes	W9/10 RA10	95mph Max with restrictions	2 mins Glasgow Central to Newton; 3 mins Newton to Law Junc; 4mins Law Junc to Carstairs; 8mins Carstairs to Midcalder Junc; 4mins Midcalder Junc to Slateford; 3 mins Slateford to Haymarket; and 2 mins Haymarket to Edinburgh

Issues/Opportunities and Constraints

There are a number of infrastructure constraints on this route:

- The route is indirect;
- Capacity and passenger circulation issues at Glasgow Central and Waverley Station as mentioned elsewhere in the report;

- The rolling stock (GNER) used is designed for long distance intercity operation and therefore is not best suited for services between Glasgow and Edinburgh due to the door positioning/operation and the internal layout of the trains;
- The rolling stock used (First ScotRail Class 322) is an outer suburban type unit with a high density of seating;
- The current single line section of approximately half a mile in length at Carstairs is a significant current operating constraint;
- The suburban services and freight services do impact on the route's ability to provide a fast service between the two cities;
- Limited loop opportunities to provide overtaking of slower services is a limitation;
- The signalling between Midcalder Junction and Carstairs only allows 8 minute headways;
- Conflicting movements at several junctions along the route including Rutherglen Central, Rutherglen East, Newton West, Uddingston, Lesmahagow, Law, Carstairs, Midcalder and Slateford; and
- Carstairs 15mph speed restriction.

3.4 Edinburgh to Glasgow via new Airdrie – Bathgate Line

Summary of route

Due to reopen throughout in winter 2010 this route is not primarily aimed at providing for city centre to city centre journeys, but at serving the intermediate communities travelling to Glasgow and Edinburgh. The route will provide improved direct access to Glasgow and Edinburgh for people living in the Airdrie to Uphall corridor, offering a public transport alternative to the M8.

The journey time from Edinburgh to Glasgow is planned to take 74 minutes over the 44¼miles. It has a planned maximum line speed of 80mph throughout apart from the section between Newbridge and Bathgate, which will allow some 90mph running. The route will have up to 18 station stops and will be electrified throughout and double tracked except between Edinburgh Waverley and Haymarket, where it is multiple track, although only the southern pair will be electrified and therefore available for use by EMU services. A schematic of the route is shown on the following page.

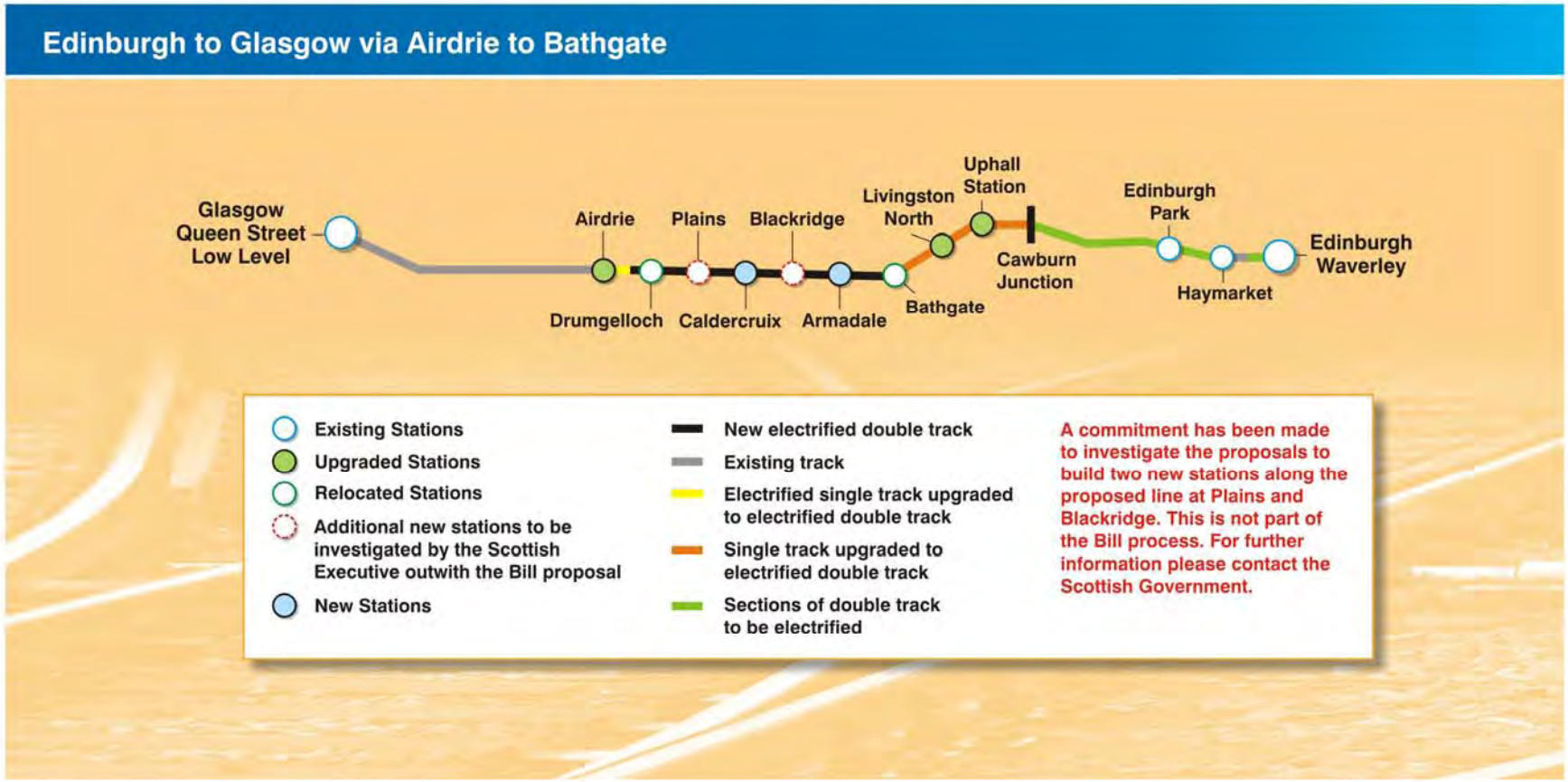


Figure 3.4.1 – Edinburgh – Glasgow Rail Route via Airdrie/ Bathgate

Passenger Profile

As this corridor does not currently exist, data is not readily available. However, in order to provide an estimate, the profile for the Edinburgh – Bathgate and North Clyde Lines have been used. Assuming this is a reasonable proxy, then the gender is predominantly female, 60 per cent, and reasonably spread across age groups. 24 per cent will be travelling to/from either work or place of education and 44 per cent are on leisure trips, the majority visiting friends/relatives. As is generally the case, punctuality is likely to be the most important factor of service, however, value for money is more highly placed than for other corridors, second most important on North Clyde and third on Bathgate services[20] suggesting that this is likely to be a key factor for future passengers on this route.

3.5 Rolling Stock

The routes discussed above have a variety of rolling stock used as noted within each route profile. Table 3.5.1 below summarises the rolling stock classes and their key performance characteristics.

Table 3.5.1 – Rolling Stock Characteristics

Class	Type	Max Speed (mph)	Seats per train (1st / 2nd class)
156	2-car DMU	75	0 / 150
158	2-car DMU	90	15 / 123
170	3-car DMU	100	18 / 172 express 0 / 210 suburban
322	4-car EMU	100	0 / 293
GNER	Class 91 locomotive and Mk 4 coaches	140	Over 500

[20] First ScotRail

3.6 Reliability

A definition of "Public Performance Measure (PPM)" is the percentage of scheduled trains that arrived within five minutes of booked schedule, having run the entire route and having called at all intermediate stations. The value is calculated as a composite of:

- percent reliability (did the train run in the first place?); and
- percent punctuality (assuming it ran, did it arrive within five/ten minutes?).

Tables 3.6.1 and 3.6.2 below reports PPM over the last few years for a number of Train Operating Companies (TOCs), along with comparator data, and where the data is available, for service groups within those TOCs. As part of the Express services, the E&G uses a 0 to 10 for Passenger Charter purposes. However, in order to provide a more accurate standpoint for comparison with some other services, the percentage of trains arriving within a five-minute cutoff for PPM is also reported. This needs to be borne in mind if a target result for its future performance is to be specified.

"Right time" performance, relates to the number of trains that arrive precisely on time, as measured by the timetable. There is some data reported on this for Scotland, although not down to the E&G's level.

Table 3.6.1 – Performance GB Regional Operators

Operator / Route	Measure (mins)	2000	2001	2002	2003	2004	2005	2006	2007	Note
Scotrail (all services)	0 to 5	92.1	86.8	82.2	82.1	85.5	83.1	85.8	88.8	1
First Scotrail E&G[21]	0 to 5	-	-	-	-	74.2	69.2	80.1	82.2	2
	0 to 10	-	-	-	-	90.6	88.5	92.8	93.3	2
First Scotrail Shotts	0 to 5	-	-	-	-	86.3	81.2	81.6	86.9	2
Carstairs	Data unavailable as FSR only run two/three trains per day and GNER information is not available within timescales									
Comparator	-	89.1	81.7	79.1	80.5	82.8	82.6	85.0	87.6	3

[21] First Scotrail provided E&G services from 2004 onwards

Table 3.6.2 – Performance GB Long Distance Operators

Operator / Route	Measure (mins)	2000	2001	2002	2003	2004	2005	2006	2007	Note
GNER (all)	0 to 10	86.8	71.1	70.0	70.8	74.1	77.5	83.5	82.7	4
GNER (Anglo Scottish only)	0 to 10	-	-	-	61	69	70	76	76	5
Virgin WC all	1 to 10	81.7	62.8	68.7	73.5	74.8	72.1	83.5	86.0	4
Virgin WC (Anglo Scottish only)	1 to 10	-	-	-	58.7	68.7	68.8	76.5	80.5	6
Virgin XC	1 to 10	78.3	54.6	62.5	61.7	72.2	77.8	80.9	83.9	7
Comparator	1 to 10	83.8	69.1	70.2	70.6	73.4	79.1	82.2	84.8	8

Notes:

[1] Table 8.9

[2] This data are as-reported directly by First Scotrail.

[3] This data are as-reported in the Scottish Transportation Statistics, Table 8.9. The comparison is provided in the interests of being able to report like-with-like as much as possible. The operating characteristics of First ScotRail is that it is much more like the other regional TOCs in England & Wales than it is like a long-distance operation such as GNER's.

[4] This data are as-reported in the Scottish Transportation Statistics, Table 8.9

[5] This data are as-reported by GNER.

[6] This data are as-reported by Virgin Trains Ltd.

[7] This data are as-reported in the Scottish Transportation Statistics, Table 8.9. Separate Anglo-Scottish data for Virgin West Coast is not available.

[8] This data are as-reported in the Scottish Transportation Statistics, Table 8.9. This is provided in order to ensure that as much as possible, comparisons of like-with-like are possible.

4 Rail Stations & Accessibility

This chapter sets out background information on the major stations that are served by trains that link Edinburgh and Glasgow. It comments on their current effectiveness and potential future issues and also provides an overview of accessibility issues considered as part of this study. Station usage figures are taken from the Office of Rail Regulation (ORR) published data.

4.1 Rail Stations Review

Croy

This station is located to the south-east of the village of Croy on the E&G line and in 2005/6 had around 829,000 total entries and exits. It is served by 4 trains per hour off-peak comprising the Dunblane/Stirling to Glasgow Queen Street service and some Edinburgh to Glasgow Queen Street services. The 153-space car park is filled during the peak and overflows into adjacent temporary areas but there are opportunities to provide an extension to this facility and proposals have already been developed for this by SPT. The station acts as a 'parkway' station serving large parts of Cumbernauld and environs. In this context the location of Croy is more dependent on achieving effective Park-&-Ride opportunities than serving a walk-in catchment.

Edinburgh Haymarket

This station is located in the west end of Edinburgh and was the 7th busiest in Scotland (2005/6) with around 1,658,000 total entries and exits. It comprises of four through platforms together with a single bay platform to the north. It is served by a variety of local, regional and mainline services. The station serves the west city centre and west end area of Edinburgh and will provide a future interchange with the tram[22].

Transport Scotland is currently working with First ScotRail and Network Rail to ensure that a robust scheme to improve accessibility, capacity, and through flow and station facilities at Haymarket is developed during 2007/8. The works include a new footbridge, concourse, additional gates and improved facilities as well as passenger lifts. The design and development phase is expected to be completed by Spring 2008, with the aim of implementing the accessibility improvements in 2009.

The various options under consideration would create a coordinated and integrated train, tram, bus and taxi facilities with real time information, but with varying degrees of development of the area surrounding the station. Following the public consultation, the Council has indicated a preferred option to take forward. For the purposes of this study, we have considered the transport aspects of an improved interchange only, as it would be for the Council and private developers to take forward the wider aspects. It is also noted that these improvements are in tandem with the provision of the new tram stop that will be provided at Haymarket. This scheme will impact on the existing 101-space car park and double decking may be required to retain that level of parking provision with the tram in place.

[22] CEC Haymarket Interchange Study Website

Edinburgh Park

This station is located close to Hermiston Gait on the south side of the Edinburgh Park area on the western approach line to Haymarket and in 2005/6 had around 353,000 total entries and exits. This is a comparatively new station and is served by 4 trains per hour off-peak comprising the Dunblane/Stirling to Edinburgh service and the Bathgate to Edinburgh service. The station will provide a future interchange with the tram. There is no dedicated station car park.

Edinburgh Waverley

This station is located in central Edinburgh and was the 2nd busiest in Scotland (2005/6) with around 14,645,000 total entries and exits. It is served by a variety of local, regional and mainline trains. It comprises of a through station with a number of terminal platforms. Edinburgh Waverley is currently being upgraded to provide an additional two through platforms and upgrade the west end station throat.

Falkirk Grahamston

This station is located close Falkirk town centre and is on the line to Stirling and is one of the key E&G diversionary routes and in 2005/6 had around 941,000 total entries and exits. It is served by 3 trains per hour off-peak comprising the Dunblane/Stirling to Edinburgh service and the terminating services to Glasgow Queen Street via Cumbernauld. There is a 340 space car park adjacent to the station.

Falkirk High

This station is close to Falkirk town centre of Falkirk on the E&G line and in 2005/6 had around 580,000 total entries and exits. It is served by 4 trains per hour off-peak comprising the Edinburgh to Glasgow Queen Street service. The 219-space car park is filled during the peak and there are significant constraints to providing any extension to this facility. The station serves the south side of the town well and acts as a 'parkway' station serving other trip origins.

Glasgow Central

This station is located in central Glasgow and was the busiest in Scotland (2005/6) with around 29,380,000 total entries and exits. It is served by a variety of local, regional and mainline trains. It comprises a fourteen platform terminal station at high level and a two platform through station at low level. There is a multi-storey car park adjacent to the station.

Glasgow Queen Street

This station is located in central Glasgow and was the 3rd busiest in Scotland (2005/6) with around 3,735,000 total entries and exits. It comprises a seven platform terminal terminal station at high level and a two platform through station at low level. It is served by a variety of local and regional trains. The small car park is generally full during most of the day and there is no available land to extend the car park. There are proposals being developed to exploit the 'air space' above the existing station throat; between the south face of Buchanan Galleries and the Cathedral Street bridge, and that above the existing station car park. This could potentially incorporate a new platform to the east of the existing platforms.

Lenzie

This station is located close to the western edge of Lenzie on the E&G line and in 2005/6 had around 793,000 total entries and exits. It is served by 2 trains per hour off-peak on the Dunblane/Stirling to Glasgow Queen Street service. The 149-space car park is filled during the peak and there is little opportunity to provide an extension to this facility, however a 23 space car park extension is being provided from September 2007 following the re-location of maintenance staff accommodation. The station serves the west side of the town well, but is less well located for the east side and potential new housing developments at Woodilee. There is therefore potential to consider relocation of the station.

Linlithgow

This station is located to the east of the centre of Linlithgow on the E&G line and in 2005/6 had around 1,088,000 total entries and exits. It is served by 4 trains per hour off-peak on the Dunblane/Stirling to Edinburgh service and some Edinburgh to Glasgow Queen Street services. The 91-space car park is filled during the peak and the station is heavily constrained due to surrounding roads and development. The station serves the east side of the town well, but is less well located for the west side. The limiting ability of the Park-&-Ride capacity to cope with demand is also noted. There may therefore be some opportunity to consider the replacement of Linlithgow station with a new 'parkway' station on the outskirts of the town.

Motherwell

This station is located adjacent to the town centre on the West Coast Main Line and in 2005/6 had around 1,052,000 total entries and exits. It is served by local train services linking it to other towns in Lanarkshire and with Glasgow together with some services on the West Coast Main Line and all of the East Coast Main Line services extending to Glasgow via Carstairs.. There are no current Park-&-Ride facilities although a major plan for redeveloping the interchange is being progressed by SPT and includes a new facility. The station is well placed to serve the local area, but it suffers from a lack of space within the station forecourt leading to congestion and pedestrian/vehicle conflict. Nearby bus stops provide for integration but these are impacted by the forecourt operation and do not provide an attractive option for travellers. It is planned that the station will be fully DDA compliant by 2008/9 and proposals for additional car parking to the north-west of the station are being evaluated.

Polmont

This station is located between Polmont and Reddingmuirhead on the E&G line and in 2005/6 had around 607,000 total entries and exits. It is served by 4 trains per hour off-peak on the Dunblane/Stirling to Edinburgh service and some Edinburgh to Glasgow Queen Street services. The 101-space car park is filled during the peak and there are limited opportunities to provide an extension to this facility. The station is relatively well placed to serve the local area, but its location relative to Polmont Junction has been noted in terms of operational impacts. There is an opportunity to consider moving the station and/or junction to provide a better operational configuration.

4.2 Accessibility

Transport is essential for providing access to employment, health services, education and leisure pursuits. Disabled people are particularly dependant on public transport, with only 39 per cent holding a full driving licence, compared to 70 per cent of the population as a whole.[23] However spontaneous travel is difficult or impossible for many disabled people. Disabled people worry more about transport than any other issue and want frequent, reliable and safe transport.[24]

A consultation carried out by the Strategic Rail Authority (SRA) in 2005 highlighted the importance of providing a clear, well lit and signposted route which provides access to facilities and platforms for ambulant disabled people and those who use wheelchairs. The importance of tactile paving has also been emphasised by disabled groups and the Mobility Access Committee Scotland.

A consistent message from the disabled representative organisations at the Scottish Rail Accessibility Forum and through the SP Equal Opportunities inquiry[25] has been the need to improve the information available regarding access to train and rail services.

- Problems with access to train platforms;

[23] Social Focus on Disability, Scottish Executive, 2004
[24] MOIRA (*Attitudes of Disabled People to Public Transport)* May 2002
[25] Scottish Parliament Equal Opportunities inquiry “Removing Barriers and Creating Opportunities” 2006

- Concerns over the need to book in advance to ensure ramps etc available;
- Limited staff at stations to help people;
- Disabled people can get stranded if lifts or other support are not working or available;
- A view that the 2020 deadline for accessibility requirements for public transport is too slow; and
- Need for affordable, accessible and integrated provision of transport.

In the further development of any options arising from this study, significant importance will be placed upon accessibility and disabled access issues such as the aforementioned.

5 Economic and Environmental Context

5.1 The Economy

All options generated as part of this study will be appraised against the five Government objectives including the economy and the environment. The purpose of this chapter is to provide a broad background on each.

General

A brief review of the economic performance of Glasgow, Edinburgh and the corridor linking the two main cities is presented in the table below. A definition of the corridor is provided further on within this section:

Table 5.1.1 – Economic Overview

	Edinburgh	Glasgow	The Corridor	Scotland
Population (2005)	457,800	578,800	1,048,600	5,094,800
GVA £ million (2004)	12,528	13,529	15,378	82,952
GVA per head £ (2004)	27,614	23,420	13,500	16,334
GVA growth 1995 to 2004 % p.a.[26]	6.2%	6.0%	4.6%	4.6%
Employment (2005) (000s)	317.1	410.9	405.5	2,391.4
Employment growth no's(1998 – 2005) (000s)	39.1	63.7	48.2	229.5
Employment growth % 1998 - 2005	14.0%	18.3%	13.5%	10.6%
No. of businesses ('workplaces'), 2005	18,800	21,100	28,500	172,100
Businesses per '000 population	41	36	27	34
Growth in no. of businesses 1998 - 2005	1,900	1,400	1,900	9,400
Business growth % 1998 - 2005	11.3%	6.9%	7.2%	5.8%

[26] Note this is in current terms.

Edinburgh

Over 457,000 people (9 per cent of Scotland's population) live within the Edinburgh city boundary.[27] Edinburgh's population has increased by nearly 22,000 since 1990 and growth has accelerated since 2003, expanding by over 2 per cent (or 9,400 persons) between 2003 and 2005. At around 276,000 (60 per cent of the total population), Edinburgh's 'working age' population[28] is greater than the comparative figure for Scotland as a whole (55 per cent). In part, this reflects the importance of the city as a magnet for students and young people who are drawn to work in the city's key industries. Indeed nearly 19 per cent of the city's population is in their twenties, around one and a half times as high as Scotland as a whole (12 per cent). Edinburgh is reputedly the most prosperous UK city outside London.[29] Edinburgh creates 70 per cent more wealth per head of population than Scotland as a whole. GVA per head in the city was £27,600 in 2004 compared with £16,300 for Scotland as a whole. Indeed City of Edinburgh GVA was ranked second highest of all the 133 UK NUTS 3 Regions, behind only Inner London – West.

Edinburgh residents were paid £26,200 p.a. in salaries in 2006[30] which is nearly 16 per cent higher than the Scottish average. However wages paid by businesses located in the city were lower at £24,800 p.a, although this is still 10 per cent higher than the Scottish average. Around one third of the working age population in Edinburgh are educated to degree level, almost double the Scottish average.

Edinburgh's business base is in good health - growing strongly and is reasonably well diversified. Total employment in the city in 2005 was almost 320,000[31], and has grown by 14 per cent (or almost 40,000 employees) over the seven years since 1998. This strong employment growth was driven mainly by financial services, the public sector and tourism.

Over 100,000 people are employed by the financial services sector which expanded by 30,000 jobs, and accounted for 70 per cent of the city's total employment growth between 1998 – 2005. The area is ranked as the second largest financial centre in the UK, after London. Royal Bank of Scotland, HBoS and Standard Life all have their headquarters in Edinburgh. The city is also one of the largest fund management bases in Europe.

Over 90,000 people are employed in public services[32] which have also been growing strongly, with employment increasing by over 15,000 in the seven years to 2005.

Tourism is extremely important to the city and to Scotland. Edinburgh Castle is Scotland's most visited tourist attraction and the city is also a UNESCO World Heritage Site combining a medieval old town, Georgian terraces and breath-taking modern architecture.

[27] ONS mid year population estimates for 2005
[28] Aged 20 to 59 years
[29] ODPM 2004, M Parkinson "A Tale of 8 Cities."
[30] ONS annual survey of hours and earnings - resident analysis
[31] ABI Employee Analysis (2005)
[32] Public administration, health and education.

Edinburgh is home to a relatively high number of Scottish businesses, and also has a fast pace of business formation. Nearly 11 per cent of Scotland's entire business base (or 18,800 'workplaces') were in Edinburgh in 2005.[33] The number of Edinburgh-based businesses grew twice as fast as the total stock of businesses across Scotland over the seven years to 2005. Business growth was dominated by financial services and the hotels & restaurant sectors.

Glasgow

Glasgow is Scotland's largest city with a population of almost 580,000.[34] Glasgow's population declined sharply in the 1980s and 1990s but the pattern of depopulation stabilised, and, since 2000 the city has witnessed moderate growth of 1,800 people.

Glasgow's 'working age' population[35] – at around 340,000 (or 58 per cent of the total population) – is greater than the comparative figure for Scotland as a whole (55 per cent). In part, this reflects the number of young families in the city as well as its student population. Indeed nearly 23 per cent of the city's population, or 131,000 people, is under twenty.

Glasgow is also Scotland's largest city in terms of economic importance. In 2004, Glasgow created over 16 per cent of Scotland's total wealth, or nearly £14 billion measured in terms of gross value added (GVA). This was marginally more in terms of GVA than Edinburgh. Although per head of population, Edinburgh (£27,600) contributes 20 per cent more than Glasgow (£23,400). Wealth generated by both cities has been growing strongly, at an annual average rate of approximately 6 per cent per annum compared to 4.6 per cent[36] for Scotland as a whole.

Glasgow residents received average earnings of £21,000 p.a. in 2006[37] which is 7 per cent lower than the average wage in Scotland. However wages paid by businesses located in the city were slightly higher at £22,000 and only 3 per cent lower than the Scottish average. This suggests that many of the higher earning jobs are filled by commuters.

[33] ABI workplace analysis
[34] ONS mid year population estimates for 2005
[35] Aged 20 to 59 years
[36] Note this is current prices
[37] ONS annual survey of hours and earnings - resident analysis

Glasgow is Scotland's largest centre of employment with 411,000 jobs[38] in the city in 2005. The rising levels of economic activity over the last decade has seen employment rise by 64,000 (or 18 per cent) between 1998 and 2005. This strong employment growth was driven mainly by financial services and the public sector. The public sector[39] is Glasgow's largest employer, with over 130,000 employees in 2005. Financial services have been Glasgow's fastest growing sector, partly spurred by the creation of a new International Financial Services District. More than 105,000 people are employed in financial services in the city and employment in this sector expanded by nearly 30,000 jobs (or by 40 per cent) in the seven years to 2005. This compared with a Scottish and Edinburgh average of 35 per cent over the same time period.

Key employers include the National Australia Group (owners of Clydesdale Bank), British Telecom, Lloyds TSB, Scottish Power and the BBC.

Tourism is also extremely important to the city and major attractions include the Kelvingrove Museum, Glasgow Science Centre, Museum of Transport, Gallery of Modern Art and the world famous Burrell Collection.

The education sector is also extremely important to the city which has three universities (Glasgow, Strathclyde and Glasgow Caledonian), five higher education institutions in total, and nine Further Education colleges with a total student population of 168,000 – this is second only to London.[40] Around one fifth of the working age population in the city are educated to degree level, broadly comparable with the Scottish average.

Retailing is also a key sector in Glasgow employing nearly 38,600 people in 2005. Glasgow's retail centre provides a function to much of the west (Paisley and Greenock) and the east (East Kilbride, Hamilton and Motherwell).

Over 12 per cent of Scotland's entire business base (or 21,000 'workplaces') were in Glasgow in 2005. The stock of businesses in Glasgow increased by nearly 7 per cent over the period 1998 to 2005. This is significantly faster than the growth across Scotland as a whole (5.8 per cent), but markedly slower than the growth in Edinburgh (11.3 per cent). Business growth was concentrated in financial services and in public administration, education and health sectors.

Edinburgh – Glasgow Corridor

The corridor connecting Edinburgh and Glasgow has been defined using the following local authorities – East Dunbartonshire, North Lanarkshire, South Lanarkshire, Falkirk and West Lothian.

[38] ABI Employee Analysis (2005)
[39] Public administration, health and education.
[40] Source: Scottish Enterprise 'Geographic Profile'

The Corridor has a total population of just over one million[41] (or 21 per cent of Scotland's entire population). The population declined sharply in the 1980s, stabilised in the 1990s and has witnessed growth of 14,000 people since 2000 to take the population to a level that is now higher than that of 1981. The corridor has a working age population of over 576,000 which represents 55 per cent of the total population. This is similar to Scotland as a whole.

The corridor generates almost 19 per cent of Scotland's wealth which represented over £15 billion[42] of GVA in 2004. GVA grew by an average of 4.6 per cent p.a. over 1995 to 2004 which is also the same rate of growth as across Scotland as a whole.[43] GVA per head in the corridor at £13,500 is 17 per cent below the Scottish average. All local authorities which comprise the Corridor have GVA per head below the Scottish average.

There are over 400,000 people employed within the corridor with three sectors accounting for more than 65 per cent of employment – distribution, hotels and catering, financial services and the public sector. Employment grew by almost 14 per cent or 48,200 jobs between 1998 and 2005 – this is equivalent to over 20 per cent of all the jobs created in Scotland over the same time frame. This growth was driven by the public sector and financial services employment.

In 2006 earnings of residents in the corridor vary from £21,200 in West Lothian to £25,800 in East Dunbartonshire, with the relatively high earnings in East Dunbartonshire reflecting commuting into Glasgow.

The corridor is home to over 28,500 'workplaces' or 17 per cent of Scotland's total number of businesses. This is slightly less than would be expected given its population share. The corridor has 27 businesses per '000 population, compared to 34 per '000 population in Scotland as a whole.

5.2 Regeneration & Growth

Regeneration is concerned with the development of policies and programmes which can bring about economic, social or physical change in particular areas. Sustained regeneration cannot happen without economic opportunity being available to people and the cities are considered to be key drivers of economic development.

In December 2004 the Scottish Executive established a £318 million Community Regeneration Fund (CRF) to run for three years to bring improvements to Scotland's most deprived areas and help individuals and families escape poverty.

Edinburgh

The National Planning Framework acknowledges that the West Edinburgh area is nationally important in economic, transport and environmental terms. The existence of Edinburgh Airport and the road and rail routes that connect West Edinburgh to the rest of the country place the area in a strategically important location.

[41] ONS mid year population estimates for 2005
[42] Also includes West Dunbartonshire
[43] Note this is current prices

A number of factors combine to give West Edinburgh a competitive advantage of other UK investment locations and the area is one of the most important development zones in Scotland. There are currently 20,000 jobs located in the area and permitted developments could provide capacity for another 20,000 to 30,000.

The West Edinburgh Planning Framework indicates that greater levels of in-migration or in-commuting from outside the Lothians may be necessary to overcome labour supply issues in Edinburgh.

The CRF budget for the three year programme in Edinburgh is £20 million and is allocated to six priority areas – North Edinburgh, Craigmillar, South Edinburgh, West Edinburgh, Restalrig and Leith. The key thematic priorities are getting people into work, improving childcare opportunities, enterprise development and engaging young people.

Glasgow

The Executive's regeneration policy statement[44] identifies the Clyde Corridor as the current national regeneration priority, which includes the areas covered by the Clyde Gateway and Clyde Waterfront initiatives. These projects have the potential to stimulate economic growth on a national scale and act as drivers for smaller community regeneration projects throughout the wider city region.

The scale of relative deprivation in Glasgow is such that the city received 40 per cent of the Scottish CRF total in 2005/6. This funding is concentrated on those areas within the bottom 15 per cent of datazones on the Scottish Index of Multiple Deprivation (SIMD). The themes for CRF include:

A Healthy Glasgow - Increasing the rate of improvement of the health status of people living in the most deprived communities – in order to improve their quality of life, including their employability prospects

A Learning Glasgow - Improving the confidence and skills of the most disadvantaged children and young people in order to provide them with the greatest chance of avoiding poverty when they leave school

A Safe Glasgow - Regenerating the most disadvantaged neighbourhoods, so that people living there can take advantaged of job opportunities and improve their quality of life.

A Vibrant Glasgow - To improve access to high quality services for the most disadvantaged groups and individuals in rural communities – in order to improve their quality of life and enhance their access to opportunity

A Working Glasgow - Increasing the chances of sustained employment for vulnerable and disadvantaged groups in order to lift them permanently out of poverty

[44] "People and Place: Regeneration Policy Statement" Scottish Executive, February 2006

Edinburgh – Glasgow Corridor

The Clyde Gateway project encompasses parts of Lanarkshire and the planned M74 extension runs through the area. When the transport improvements are complete, the Gateway area will be one of the best connected urban centres in Scotland, in close proximity to Glasgow city centre.

The CRFs in each of the local authority areas comprising the Glasgow to Edinburgh corridor have their own specific priorities, but these can be generalised into the following topics:

- Promoting safer communities;
- Addressing unemployment and economic and social exclusion;
- Reducing health inequalities;
- Increasing attainment levels amongst school leavers and the workforce; and
- Improving housing and the environment

In West Lothian, some £2.36m of CRF has been made available over the period 2005 to 2008 which has been targeted towards the following priority areas – Armadale Central, Craigshill, Breich Valley, Knightsridge, Blackburn, Polkemmet, Boghall, Newlands and Deans.

The Regeneration Outcome Agreement for Falkirk outlines details for £2.7m of expenditure on regeneration projects in the region over 2005 to 2008. This spending is to be concentrated on the priority areas of Camelon, Dawson, Denny, Grangemouth, High Flats, Maddiston, Westquarter, Thornhill Road.

Some £33.26 million of expenditure has been made available for regeneration in North Lanarkshire through the CRF. The region is one of ten areas that receive additional funding due to having high concentrations of deprivation.

Some £21.86 million of expenditure has been made available for regeneration in South Lanarkshire through the CRF. The region is one of ten areas which receive additional funding due to having high concentrations of deprivation.

The Regeneration Outcome Agreement for East Dunbartonshire outlines details for £828,000 of expenditure on regeneration projects in the region over 2005 to 2008. This expenditure is to be targeted on two areas – Hillhead and Twechar. These areas represent 5 per cent of the total population of East Dunbartonshire and are the only areas within the region which contain datazones ranked within the 15 per cent most deprived in Scotland.

5.3 Social Issues

A brief overview of the social position of the two cities and the Corridor is provided with the data presented in Tables 5.3.1 and 5.3.2. The Scottish Index of Multiple Deprivation (SIMD) identifies small area concentrations of multiple deprivation across all of Scotland. The 2006 index contains 37 indicators across seven domains with the data presented at data zone level to enabling small pockets of deprivation to be identified. The data zones, which have a median population size of 769, are ranked from most deprived (1) to least deprived (6,505) on the overall SIMD and on each of the individual domains. The result is a comprehensive picture of relative area deprivation across Scotland

Table 5.3.1 – Social Issues

	Edinburgh	Glasgow	The Corridor	Scotland
Total population	457,800	578,800	1,048,600	5,094,800
Working age population	295,500	372,800	576,600	3,122,500
In employment	228,000	239,800	493,900	2,346,800
All economically active	238,700	260,200	522,100	2,479,800
All economically inactive	56,800	112,600	131,600	642,700
Economically Inactive but want a job	10,900	36,200	37,600	185,100

Table 5.3.2 – Economic Activity & Unemployment Rates

	Edinburgh	Glasgow	The Corridor	Scotland
Economic activity rate - working age	80.8%	69.8%	79.9%	79.4%
% who are economically inactive - working age	19.2%	30.2%	20.1%	20.6%
Employment rate	77.2%	64.3%	75.6%	75.2%
Unemployment rate (not employed but currently seeking work)	4.5%	7.9%	5.4%	5.4%

Table 5.3.3 – Income and Unemployment Deprivation[45]

	Edinburgh	Glasgow	The Corridor	Scotland
Percentage of the population that are:				
Income Deprived	11.4%	24.7%	13.7%	13.9%
Employment Deprived	9.6%	20.2%	14.0%	12.9%

[45] SIMD 2006

Table 5.3.4 – Education, Health and Access to Services – Share of Scotland's 15 per cent Most Deprived areas[46]

	Edinburgh	Glasgow	The Corridor	Scotland
Education	8.8%	31.3%	22.2%	100%
Health Deprived	6.0%	34.8%	20.0%	100%
Deprived of Geographic access to services	0.2%	0.1%	12.2%	100%

Edinburgh

Resident employment in Edinburgh is high with over 77 per cent of working age people in employment and conversely, resident unemployment – at only 4.5 per cent in 2006[47] - is amongst Scotland's lowest for the working age population. The total number of benefit claimants fell from 40,600 in February 2001 to 39,750 in February 2007 and 25 per cent of all claimants are aged 25 to 34.[48] Some 19 per cent of the total working age population are defined as economically inactive and a quarter of these (or 11,000 people) would like to work.[49] Public transport improvements are likely to make a significant difference to the ability of these people to access and retain jobs.

Edinburgh has relatively low levels of income and employment deprivation with 11 per cent and 10 per cent classified as income or employment deprived. The Scottish average is 14 per cent and 13 per cent respectively. This is likely to reflect the opportunities available within Edinburgh and its recent growth,

Table 5.3.4 shows the proportion of Scotland's 15 per cent most deprived areas within Edinburgh, Glasgow and the Corridor on the domains of education, health and access to services. As with income and employment deprivation, Edinburgh has a relatively low share of Scotland's 15 per cent most deprived areas on the education and health measures. There is also very little deprivation in Edinburgh in terms of access to services.

Glasgow

Glasgow has managed to increase employment and significantly reduce levels of economic inactivity over the last decade. However resident employment rate in Glasgow – at 64.3 per cent - is still well below the national average of 75.2 per cent and unemployment remains stubbornly high. Over 30 per cent of the working age population are inactive compared with 19 per cent in Edinburgh city and 20 per cent for Scotland as a whole. A third of people who are economically inactive (or 36,200 people) state they would like to work.[50] Public transport improvements are likely to make a significant difference to the ability of these people to find and retain jobs.

[46] SIMD 2006
[47] Source: APS Oct 2005 to September 2006.
[48] Source ONS
[49] Annual Population Survey September 2005 to October 2006.
[50] Annual Population Survey September 2005 to October 2006.

Glasgow city has relatively high levels of deprivation. In terms of income and employment, the proportion of the population which is deprived in Glasgow is almost 25 per cent and 20 per cent respectively. These proportions are almost twice the Scottish average (14 per cent income deprived and 13 per cent employment deprived).

On the education and health domains, approximately 31 per cent and 35 per cent respectively of the 15 per cent most deprived areas in Scotland are located in Glasgow. Glasgow has very little deprivation in terms of access to services.

Edinburgh – Glasgow Corridor

Resident employment in the Corridor at almost 76 per cent is just above the Scottish average of 75 per cent.[51] Some 20 per cent of the total working age population are defined as economically inactive and nearly 30 per cent (or 37,600 people) would like to work.[52]

The proportion of the population who are income and employment deprived in the Corridor is very similar to the Scottish average at 14 per cent for both income and employment.

In terms of the Corridor's share of Scotland's 15 per cent most deprived areas, the Corridor is more deprived than Edinburgh, but less deprived than Glasgow. Approximately 20 to22 per cent of the 15 per cent most deprived areas in Scotland fall within the Corridor in terms of education and health deprivation. In terms of access to services 12 per cent of the 15 per cent most deprived areas lie within the Corridor. As would be expected, the Corridor performs relatively poorly on this indicator compared to Glasgow and Edinburgh.

5.4 Agglomeration Benefits and Competing in Europe

The current method of assessing the impact of a transport infrastructure project on the economy is through Transport Economic Efficiency Analysis (TEE). The distributional impacts, in terms of who potentially gains and who potentially loses, are captured by the Economic Activity and Locational Impact assessment (EALI). The TEE covers the direct costs of a project and measures the main user benefits in terms of time savings and savings in vehicle operating costs.

The Transport Economics, Analysis and Research team within Transport Scotland have undertaken some high level analysis on the potential agglomeration benefits that could accrue from providing reduced journey times between Edinburgh and Glasgow to inform this report.

[51] Source: APS Oct 2005 to September 2006.
[52] Annual Population Survey September 2005 to October 2006.

For the purposes of this section, the focus is on the economic valuation of time savings from a potential reduction in journey time between Edinburgh and Glasgow. The analysis is restricted to the current fastest route; the Edinburgh to Glasgow via Falkirk High. The reduction is assumed to be pro-rata for all parts of the route, which is a simplification of the actual case, but is considered to be sufficient for this broad analysis. This analysis does not include construction costs or impacts on operating costs and does not take into account any savings in (non-rail) vehicle operating costs from reduced road travel. What it does show is indicative levels of economic benefits from reducing average journey time on the rail route.

These benefits are, as is standard in appraisal, expressed in 2002 prices and summed and discounted over 60 years. Future exogenous rail demand growth is important in performing this calculation, although the journey time improvements increase demand in themselves. The chart below shows the economic impact with 0 per cent, 2 per cent and 3 per cent patronage growth assumptions. The 2 per cent value perhaps best reflects the long-term trend of railway patronage growth, although it is noted that recent growth has been higher.

The results of this analysis are shown below in Figure 5.4.1. So, from this it can be seen that a five minute reduction in journey time, in the central case, is associated with benefits of around £300m and a 10 minute reduction with benefits of £590m.

In recent years, a view has emerged that conventional transport economic efficiency analysis may under-estimate the overall economic impact of Transport. The DfT in "Transport, Wider Economic Benefits and Impacts on GDP" considers four ways in which transport improvements can influence GDP and how they might be included into transport appraisal. These were business time savings increasing productivity, agglomeration effects increasing productivity, competition effects and effects in the labour market[53].

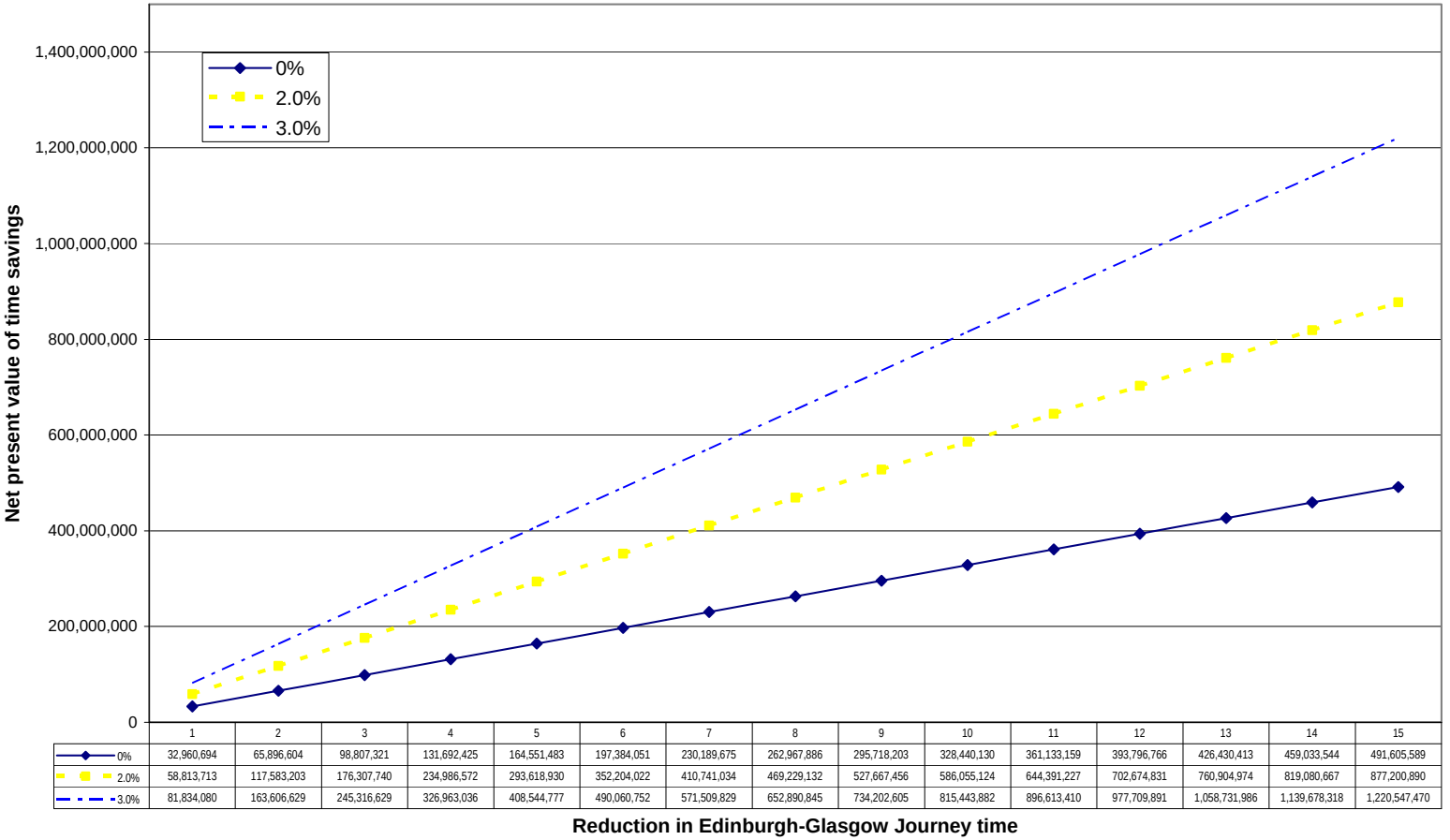
Economies of agglomeration describes the productivity benefits than some firms derive from a densification of economic activity e.g. proximity to other firms facilitates more sharing of knowledge or access to more suppliers and larger labour markets. In a cluster, each firms' productivity depends on the location decisions of other firms. Firms will take account of the productivity difference in their own location decision, but not the gains to other firms when they located in a cluster or city. Hence, the gains to society exceed the gains to the firm.

As the overview of the economy identified, Glasgow and Edinburgh are the two main drivers of economic activity in Scotland and would derive agglomeration benefits from any transport intervention that improved connections between them.

[53] Further details of the relationship between Transport and the Economy may be found in a recently published Scottish Government Economist Group discussion paper at: http://www.scotland.gov.uk/Topics/Economy/17858/10374.

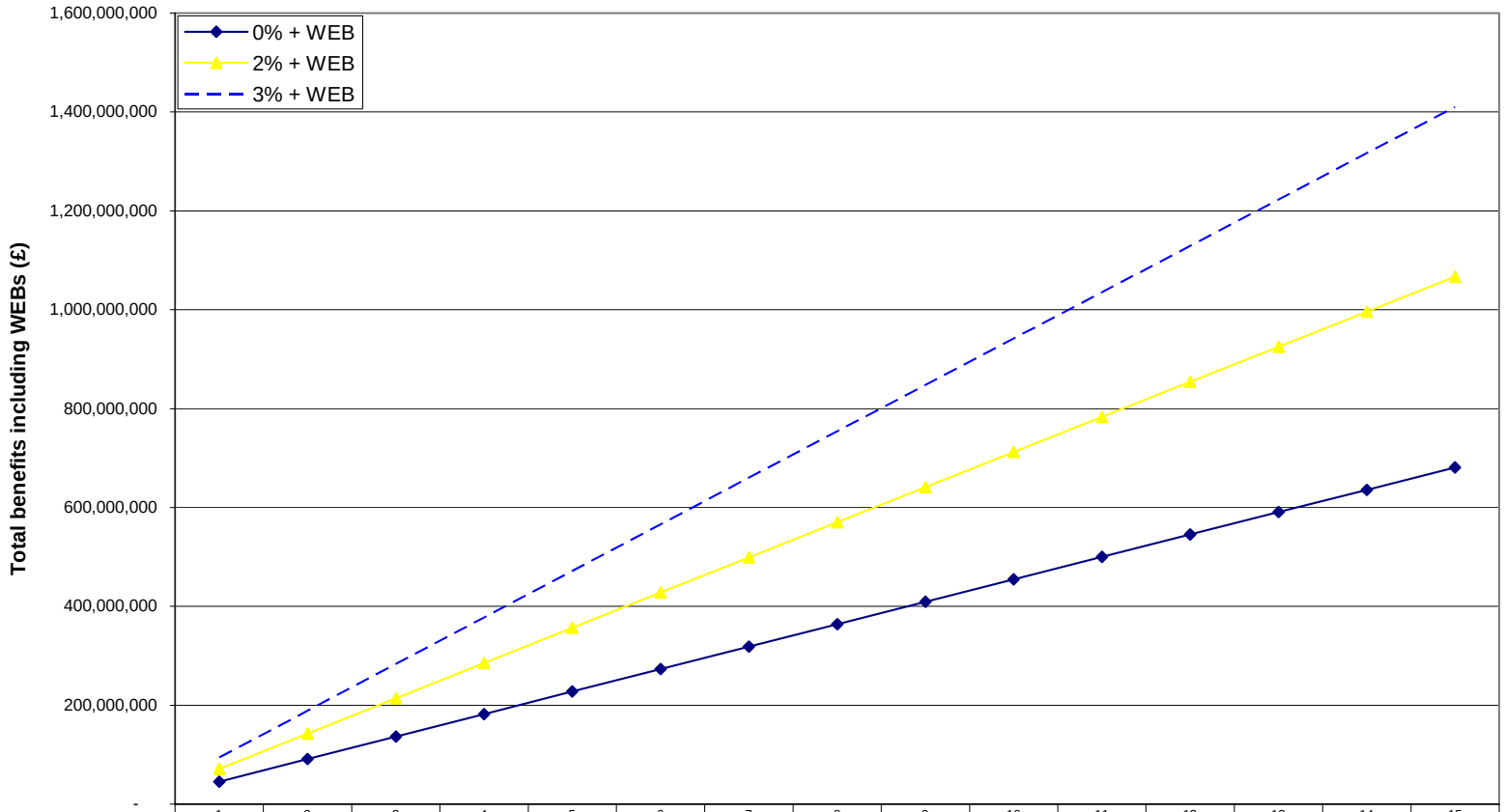
To illustrate the potential benefits of agglomeration, a methodology was developed and applied to the Edinburgh – Glasgow corridor. A five minute reduction in journey time is estimated to yield additional discounted economic benefits of approximately £60 million. A ten minute journey time saving is estimated to yield additional discounted economic benefits of approximately £125 million.

Figure 5.4.1 – **Journey Time Reduction Benefits**



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0%	32,960,694	65,896,604	98,807,321	131,692,425	164,551,483	197,384,051	230,189,675	262,967,886	295,718,203	328,440,130	361,133,159	393,796,766	426,430,413	459,033,544	491,605,589
2.0%	58,813,713	117,583,203	176,307,740	234,986,572	293,618,930	352,204,022	410,741,034	469,229,132	527,667,456	586,055,124	644,391,227	702,674,831	760,904,974	819,080,667	877,200,890
3.0%	81,834,080	163,606,629	245,316,629	326,963,036	408,544,777	490,060,752	571,509,829	652,890,845	734,202,605	815,443,882	896,613,410	977,709,891	1,058,731,986	1,139,678,318	1,220,547,470

***Figure 5.4.2* – Journey Time Total Benefits Including WEBs**



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0% + WEB	45,575,014	91,126,868	136,655,153	182,159,448	227,639,322	273,094,332	318,524,023	363,927,926	409,305,561	454,656,434	499,980,036	545,275,843	590,543,317	635,781,905	680,991,034
2% + WEB	71,428,033	142,813,467	214,155,571	285,453,595	356,706,770	427,914,303	499,075,382	570,189,172	641,254,815	712,271,428	783,238,104	854,153,907	925,017,878	995,829,027	1,066,586,336
3% + WEB	94,448,401	188,836,893	283,164,461	377,430,059	471,632,617	565,771,033	659,844,176	753,850,885	847,789,964	941,660,186	1,035,460,287	1,129,188,968	1,222,844,891	1,316,426,679	1,409,932,915

As such, using the 2 per cent growth scenario the additional agglomeration benefits raise the total benefits of a 5 minute reduction to around £350m, a 10 minute reduction to around £710m and a 15 minute reduction to around £1.1b. These results are broadly consistent with those calculated for agglomeration in the Eddington Transport review.

These benefits are based on patronage on the route, but there could also be further benefits to the Scottish economy in terms of image and attractiveness. The relative proximity of the two major cities and a fast connection between them may increase the attractiveness of both cities to potential inward investors.

Inward investment, the injection of money from an external source into a region in order to purchase capital goods, is anecdotally cited as being highly dependant on transport links. Whilst evidence suggests that a high quality transport infrastructure is a necessary but not sufficient condition in terms of attracting inward investment, the attractiveness of a region to business is dependant on a large number of factors including infrastructure (including transport) quality, factor cost and supply (including labour), communications, international links, stable political situation, entrepreneurial culture, technological development and nature of competition between firms.

Michael Porter's model of business competitiveness[54] highlights the interdependence of these conditions and stresses that it is the overall quality of the business environment that is important rather than a single factor. Whilst, the improvement of rail services between Edinburgh, Glasgow and the communities in between will, in addition to improving the transport criteria itself, improve the supply of labour, the evidence base for the direct effect of transport improvements on inward investment is somewhat mixed. A full discussion of these issues can be found in a recently published Scottish Government Economist Group discussion paper[55].

5.5 Airports

Overview

Aviation is an important economic activity both through the income and employment it creates at airports and with airlines, and as a facilitator of other economic activities. In terms of its facilitator role it;

- supports international tourism;
- supports international trade;
- influences where companies invest;
- is important for key growth sectors as many of the sectors on which the Scottish economy depends are particularly dependent on air services for competing in the global economy; and
- It supports business efficiency.

[54] Porter, M (1990), The competitive advantage of nations, Free Press, New York
[55] http://www.scotland.gov.uk/Topics/Economy/

Glasgow and Edinburgh Airports are the two largest airports in Scotland providing key links to destinations elsewhere in the UK and overseas.

Glasgow Airport

As Scotland's busiest airport, Glasgow airport is key to the continued success of the Glasgow and wider Scottish economy. BAA forecasts that passenger numbers at Glasgow airport will increase from 8.8 million per annum in 2006 to between 12 and 15 million by 2015, and further to between 17 and 24 million per annum by 2030, with more than half of these travelling direct to and from international destinations.

As well as being Scotland's busiest airport in terms of passenger numbers, Glasgow airport is the seventh busiest airport in Britain, serving more than 90 destinations worldwide. Over the last ten years, international traffic has grown steadily at 4.1 per cent per annum, with growth of nearly 26 per cent in international scheduled services last year alone. Figures from the Scottish Executive show that Emirates' daily service to Dubai generates around £10 million per annum for the Scottish economy.

Presently, passengers classed as 'foreign based', that is those whose homes are not in the UK, make up around 13 per cent of the total passenger base using Glasgow Airport. This figure is expected to rise to around 30 per cent by 2015 and 40 per cent by 2030, bringing in a greater number of tourists, and therefore providing a huge boost to the wider economy.

Around 6,300 tonnes of freight was carried by the airport in 2006, down from around 8,700 in 2005. The majority of air freight in the west passes through Glasgow Prestwick airport, which handled around 28,500 tonnes in 2006.

A report from the Fraser of Allander Institute in 2002 found that Glasgow Airport supported 15,700 jobs across Scotland. Direct employment at the airport is forecast to rise from 5,000 to 8,200 by 2015 and to 12,100 by 2030, with the remainder employed indirectly through supply chains and associated service-providers etc. This same report showed that the airport contributes more than £700 million per year to the Scottish economy.

BAA is committed to substantial extensive work on the terminal building itself, with a near £10 million three storey extension to the international side already opened in 2006. Around £55 million is the forecast cost of further work to increase terminal capacity and accommodate growth in international services, which is part of BAA's £290 million ten year investment programme.

The current public transport service from the city centre consists mainly of express bus services. Service frequency ranges from every ten minutes during the day to a half hourly service after 8pm, and journey time is 25 minutes at best, but longer at peak times. The Glasgow Airport Rail Link (GARL) project will provide a new direct rail link between Glasgow Central station and Glasgow International Airport and deliver a fast, frequent, and reliable modern service. It is expected to be operating by 2012.

Edinburgh Airport

Edinburgh Airport also plays a key role in the prosperity and success of Scotland's capital city. It is one of the fastest growing airports in the UK, serving over 70 domestic and short-haul destinations.

In 2006 Edinburgh Airport handled around 8.6 million passengers, with 73 per cent on domestic services and 27 per cent on international services. BAA forecasts that passenger numbers will increase to between 12 and 13.7 million per annum by 2013, and to as much as 26 million per annum by 2030. It is expected that half of these will be travelling to and from international destinations.

Foreign based passengers currently represent only 17 per cent of the total passenger base, but this number is forecast to rise to around 30 per cent by 2013 and to 40 per cent by 2030, creating extensive opportunities for the tourism industry, and facilitating knock on benefits for the wider economy.

Edinburgh Airport carries the most freight in Scotland, ahead of Glasgow Prestwick, and has the third busiest mail operation in the UK. In 2006 around 36,400 tonnes of freight was carried by the airport, up around 23 per cent on the previous year.

The 2002 Fraser of Allander Institute report found that Edinburgh Airport supported 7,200 jobs throughout Scotland, with 2,300 people directly employed at the airport. This number is forecast to increase to 5,700 by 2013, and to 9,000 by 2030, acting as a stimulant to the local economy. The report also found that the airport contributes £287 million to the Scottish economy every year. Considerable investment has also been made in Edinburgh Airport, including a new air traffic control tower that was opened in November 2005 at a cost of £11 million.

5.6 Environment

Scotland's Railways highlights the importance of a reduction in the harmful emissions in our environment and rail's contribution by "offering a world class service on increasingly fuel efficient trains, a service that is reliable, punctual and convenient". A Strategic Environmental Assessment (SEA) is currently being prepared for the Strategic Transport Projects Review (STPR) and will therefore link into this report.

For the purposes of this study, we have identified the environmental baseline of the Edinburgh to Glasgow transport corridor, as summarised below for each environmental feature:

Noise and Vibration:

Throughout the corridor, receptors within 50m of the rail line are considered to be the most sensitive to rail based noise and vibration therefore existing noise levels within 100m (50m either side) of the present Edinburgh to Glasgow rail links were identified as well as noise levels surrounding the major railway junctions along each route.

Within Edinburgh City, the highest existing noise levels occurred at the main junctions between the Haymarket and Edinburgh Waverley stations, while in Glasgow, background noise levels were also highest at main junctions however; in this case, tunnels under the city centre reduced the impact of rail noise on receptors.

Air Quality:

Glasgow City Council and Edinburgh City Council have both declared Air Quality Management Areas (AQMAs). In general, road traffic is the major source of all air pollution in urban areas, as the rail network is responsible for significantly lower quantities of all three pollutants considered within this assessment (NO_2 CO_2 and PM_{10}).

CO_2 emissions generated by road traffic across Scotland are significantly higher (around 6.5 million tonnes per year) than emissions generated by rail (around 79000 tonnes per year).

Water:

Various points along the rail network have been identified where flooding from surface water may occur. The Water Environment (Controlled Activities) (Scotland) Regulations 2005 (the CAR regulations), provides for the protection of Scotland's water and therefore any engineering developments carried out need to take be in accordance with this legislation.

Geology:

Within the corridor there are 23 designated geological SSSIs within the corridor, designated for their geological or pedological significance. The predominant underlying geology of the central belt is carboniferous sedimentary while Glasgow is predominantly underlain by sedimentary and igneous and Edinburgh by carboniferous limestone and sandstone.

Biodiversity:

Within the corridor there are 15 Natura 2000 sites (of international importance), 184 Sites of Special Scientific Interest (of national importance), 2 National Nature Reserves (of national importance) and numerous Local Nature Reserves (of local importance).

Agriculture and Soils:

The majority of the agricultural land in this corridor is classed as improved pasture, with some rough grazing and arable land. The prime agricultural soils (classes 1, 2 and 3.1) are predominantly to the east of the corridor; immediately to the east of Edinburgh and along the Forth Valley. A smaller extent of prime agricultural land is to be found within the Clyde Valley to the south west.

Landscape:

Within the corridor there are 23 Areas of Great Landscape Value, designated by local authorities as areas of local scenic importance. There are no National Scenic Areas within the corridor.

Cultural Heritage:

Within the corridor there are 2 World Heritage Sites (Glasgow and Edinburgh Old and New Towns) and 3 proposed (Forth Rail Bridge, New Lanark and Antonine Wall). There are 591 Scheduled Ancient Monuments, a high number of which are located close to the rail network.

Emissions from Road and Rail

In 2003 work was undertaken for the former Strategic Rail Authority which found that average carbon dioxide emissions per passenger kilometre for rail and bus services were similar and were around two thirds of those for car passengers per kilometre. The report also suggests that freight transported by rail produces around one eighth of the carbon dioxide emissions per tonne kilometre, compared to road based Heavy Goods Vehicles.

Emissions from Electric and Diesel Trains

A review of available data on emissions factors, fuel use and electricity consumption by passenger trains was undertaken to support the *Scotland's Railways* environmental assessment. There is no standardised single source of information on the comparative energy and/or carbon emissions of trains therefore is was not possible to present data for a large range of comparative diesel and electric trains. Therefore, it was agreed that the following two train types would provide a reasonable comparison:

- Class 377 electric train unit (4-car train); and
- Class 170 diesel train unit (3-car train).

The comparison suggests that an electric train operating similar routes would produce around 15 per cent fewer emissions of CO_2 than the equivalent diesel train. It is likely that the actual reduction would be slightly higher for a 3-car vs 3-car or 4-car vs 4-car scenario, which would allow a comparison per passenger to be made.

Given the expected increase in the level of renewable energy comprising the UK (and particularly the Scottish) electricity supply in response to Government targets, it is expected that the relative environmental performance of electric trains will improve in terms of their carbon emissions when compared with diesel trains. This is because the CO2 emissions associated with the generation of each Kilowatt hour (KWh) of electricity will decline as the percentage of the energy supply provided by renewable sources (which do not emit carbon dioxide) increases. Advances in train technology such as the use of regenerative braking, are also predicted to improve carbon emissions performances from electric vehicles when compared with the diesel fleet.

6 Demand

6.1 Introduction

This chapter contains information on the demand for travel using a variety of data sources, including:

- Transport Model for Scotland (TMfS);
- First ScotRail Train Passenger Demand Data; and
- Structure Plans.

It should be noted that the demand data presented within this chapter has been summated to a strategic level to simplify the reporting and to allow the key results of the analysis of demand to be clearly noted.

6.2 Transport Model for Scotland

To ascertain the existing and future conditions on the transport network use has been made of the Transport Model for Scotland (TMfS). TMfS is a strategic multi-modal model covering approximately 95 per cent of Scotland's population[56]. Although this model does not cover the whole of Scotland, it includes the majority of trips made on the principal road network and many of the public transport journeys on Scotland's coach and rail network.' The demand data that has been reported is based on the 2005 Base model to establish the current situation and make it as comparable as possible to the other information reported from actual passenger demand. The future year information has been taken from the main STPR analysis for the Glasgow to Edinburgh corridor and is based on future years of 2017 and 2022.

The extraction of information from the model includes matrix analysis and analysis of assigned networks. When taken together, the demand matrices indicate the total demand for travel within the model and the share of this demand that is accommodated on the public transport network.

The disaggregated zone system within TMfS has been aggregated up to form sectors that are more meaningful in establishing and reporting the demand to travel.

6.3 Analysis – TMfS

The information presented within the section is based on current demand (2005 base model). The peak demand is the sum of the 3-hour AM and 3-hour PM peak periods

In Table 6.3.1, the demand to travel between Glasgow City Centre and the sectors within the study area is shown. This is also shown in the figure below, which includes as the second number travel to the wider "Inner Glasgow" area. This is an area that encompasses the city centre and wider areas such as Glasgow University, Govan, Cathcart and Parkhead.

56 http://www.tmfs.org.uk/

Table 6.3.1 – Demand to Travel to and from Glasgow City Centre (2005)

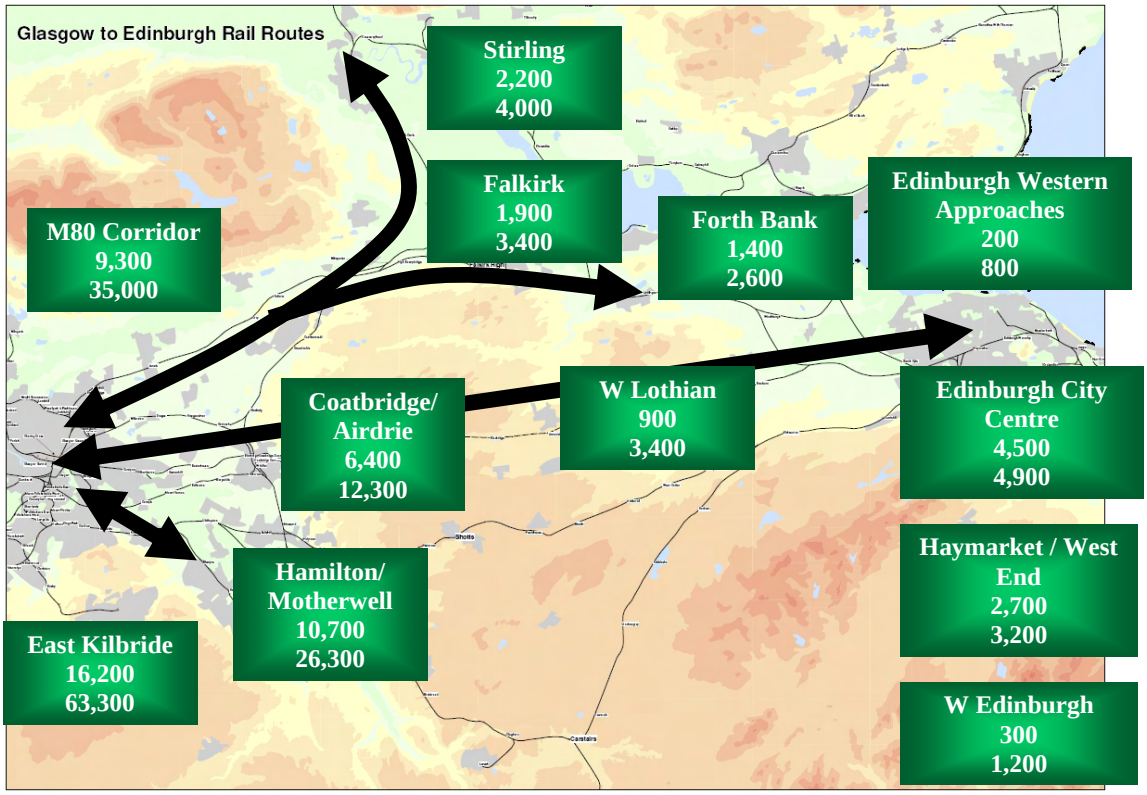
Glasgow City Centre	Peak Demand	% Public Transport	12hr Demand	% Public Transport
Edinburgh City Centre	4,473	96	5,864	94
Haymarket/West End	2,736	92	3,534	90
Edinburgh North	2,035	89	2,726	84
Edinburgh East	55	1	109	1
Edinburgh South	895	71	1,311	61
Edinburgh SW	188	7	319	4
Edinburgh West	338	22	611	12
Edinburgh Western Approaches[57]	228	14	433	20
Forth Bank[58]	1,426	76	1,871	72
Falkirk	1,874	84	2,042	80
Stirling & Dunblane	2,191	85	3,127	82
A80 Corridor[59]	9,253	57	13,165	57
West Lothian[60]	501	25	1,307	11
Motherwell	2,008	69	2,760	65

The key points from this table are:

- The A80 corridor sector has the highest demand from the study area;
- PT has a very high share of the city centre to city centre trips;
- PT has a high share of trips between Glasgow City Centre and (i) Haymarket/West End, (ii) Edinburgh North, (iii) Falkirk and (iv) Stirling; and
- Falkirk has only a 9 per cent increase between peak and 12-hour demand.

[57] Includes Edinburgh Airport and Heriot Watt University
[58] South Queensferry, Linlithgow, north of West Lothian, Polmont and Grangemouth
[59] Cumbernauld, Stepps, Denny and Moodiesburn
[60] Livingston, Bathgate, Armadale and Whitburn

Figure 6.3.1 – Peak Demand (AM + PM) to Travel to and from Glasgow City Centre / Inner Glasgow(2005)

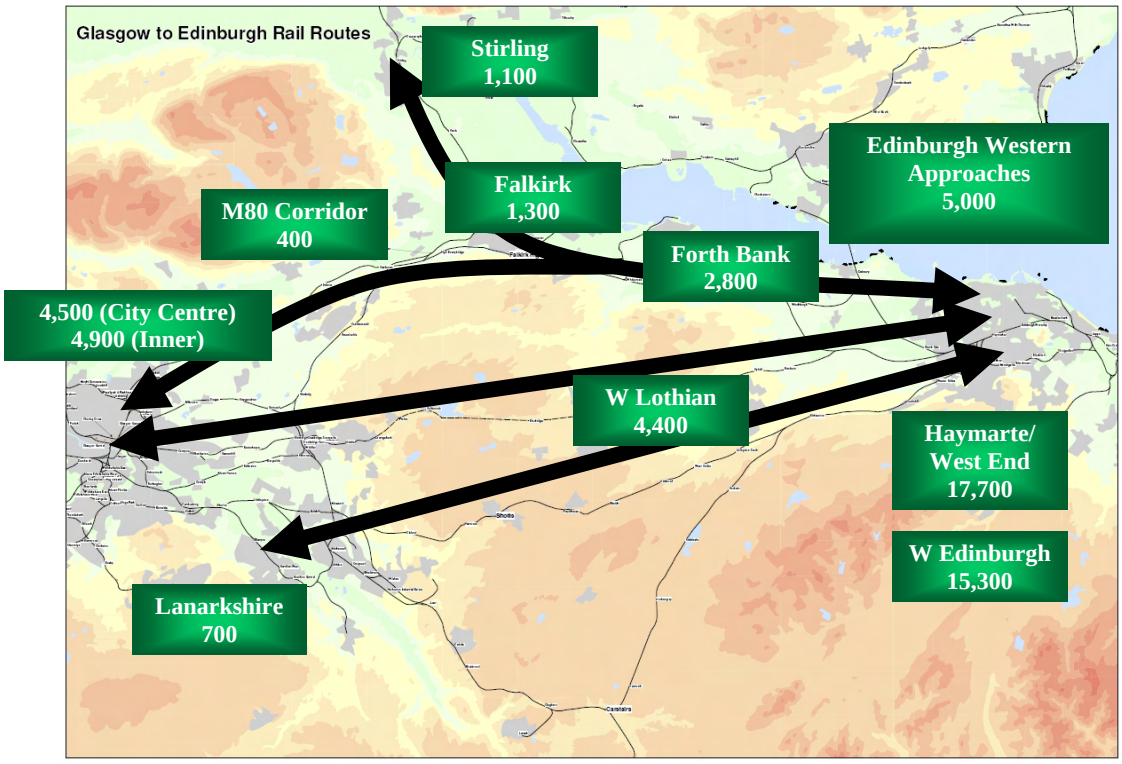


In the second table, the demand to travel between Edinburgh City Centre and the sectors within the study area is shown.

Table 6.3.2 – Demand to travel to and from Edinburgh City Centre

Edinburgh City Centre	Peak Demand	% Public Transport	12hr Demand	% Public Transport
Glasgow City Centre	4,473	96	5,864	94
Motherwell	150	82	206	75
West Lothian	4,412	78	5,931	69
A80 Corridor	374	47	549	40
Stirling & Dunblane	1,133	71	1,617	64
Falkirk	1,253	86	1,602	82
Forth Bank	2,754	78	3,802	69
Edinburgh Western Approachest	5,005	28	7,411	26
Haymarket/West End	17,665	29	32,352	29
Edinburgh West	15,274	53	23,760	54

Figure 6.3.2 – Peak Demand (AM + PM) to Travel to and from Edinburgh City Centre (2005)



The key points from this table are:

- High level of demand along the Edinburgh West – Haymarket – City Centre axis;
- Demand between the city centre and West Lothian is comparable to that between Glasgow and Edinburgh city centres; and
- Demand from the A80 corridor is low.

The table below shows some other key demand flows within the study area.

Table 6.3.3 – Other Key Demand Flows

Demand Movement	Peak Demand	% Public Transport	12hr Demand	% Public Transport
Forth Bank / Edinburgh Western Approaches	4,761	<1	7,170	<1
West Lothian / Edinburgh West	8,698	15	14,110	11
West Lothian / Edinburgh South	4,516	18	6,457	16
Stirling & Dunblane / Edinburgh West	1,223	7	1,550	6

The key points from this table are:

- Demand between Forth Bank and Edinburgh Western Approaches is higher than the city centre to city centre demand noted previously; and
- Demand between West Lothian and Edinburgh West is one of the highest sector-to-sector demands and has a comparatively low PT share.

Future growth in trips between Edinburgh and Glasgow and along the corridor linking them has been extracted from the main STPR study and is reported as follows.

Total trips between the corridor and Glasgow are forecast to increase by around 22 per cent by 2022. Trips between the corridor and Edinburgh are forecast to increase by around 18 per cent by 2022.

Trips between the centres of Glasgow and Edinburgh are forecast to increase by around 9 per cent by 2022.

In terms of modal split, 33 per cent of trips between Glasgow and Edinburgh were made by public transport as a whole in 2005. This is forecast to increase to 38 per cent by 2012 and to 39 per cent by 2022. For trips between the corridor and Glasgow, public transport as a whole accounts for 14 per cent of trips. This proportion is forecast to remain constant until 2012 and decline to 10 per cent of all trips by 2022. Between the corridor and Edinburgh, public transport as a whole accounts for 14 per cent of all trips and is forecast to increase to 19 per cent by 2012 then decrease to 16 per cent by 2022.

Within the corridor, public transport accounts for 15 per cent of all trips and this proportion is forecast to decrease steadily to 10 per cent by 2022. Trips between the corridor and other destinations have only a 4 per cent modal share by public transport and this is forecast to reduce to 3 per cent by 2022.

6.4 Train Passenger Demand Data

First Scotrail have supplied passenger survey data from boarding and alighting counts undertaken on the E&G service via Falkirk High in May 2007.

6.5 Analysis – TPDD

Table 6.5.1 –Direction: Edinburgh to Glasgow

Boarding at	AM 7am – 10am	% split of boarders AM	12-hour	% split of boarders 12-hour	% of 12-hour boarders occurring during AM peak
Edinburgh Waverley	976	39%	4617	53%	**21%**
Haymarket	558	22%	2304	26%	**24%**
Linlithgow	209	8%	415	5%	**50%**
Polmont	117	5%	246	3%	**48%**
Falkirk H	344	14%	586	7%	**59%**
Croy	257	10%	540	6%	**48%**
Lenzie	49	2%	56	<1%	**88%**
	2510	**100%**	**8764**	**100%**	

Table 6.5.2 –Direction: Glasgow to Edinburgh

Boarding at	AM 7am – 10am	% split of boarders AM	12-hour	% split of boarders 12-hour	% of 12-hour boarders occurring during AM peak
Glasgow Queen Street	1560	57%	6849	80%	**23%**
Lenzie	7	<1%	19	<1%	**37%**
Croy	254	9%	372	4%	**68%**
Falkirk H	349	13%	613	7%	**57%**
Polmont	245	9%	323	4%	**76%**
Linlithgow	319	12%	435	5%	**73%**
	2734	**100%**	**8611**	**100%**	

The tables above clearly demonstrate that the E&G service is providing a major commuter service during the peak with high boarding flows at the intermediate stations. Around 61 per cent of boardings in the Edinburgh to Glasgow direction in the AM peak are at Waverley and Haymarket with the remaining 39 per cent being supplied by the intermediate stations; a sizeable minority. Similarly, in the opposite direction around 57 per cent of boardings in the AM peak are at Glasgow Queen Street with the remaining 43 per cent being supplied by the intermediate stations; almost an equal split. However, when considering the 12-hour flow, Edinburgh Waverley and Haymarket account for 79 per cent of the boardings in the westbound direction and Glasgow Queen Street accounts for 80 per cent of the boardings in the eastbound direction. Overall, the proportion of journeys made on the line between Edinburgh (Waverley and Haymarket) and Glasgow Queen Street is 37 per cent with the remaining 63 per cent made up of trips from intermediate locations.

This data suggests that the E&G line is performing significantly different roles by time-of-day. In the peak hour, it provides commuter linkage between the city centres and from the intermediate stops to the respective city centres. Outwith the peak, the service provides for significant demand to travel between Glasgow City Centre and Edinburgh City Centre. This is a significant issue in terms of formulating the service options to best address the future demand on the route.

For E&G services, FSR data also reports that for the total trips on the line, the highest and lowest Origin-Destination pairings are:

- Edinburgh Waverley / Glasgow Queen Street 17 per cent;
- Edinburgh Waverley / Glasgow BR 15 per cent;
- Edinburgh Waverley / Linlithgow 9 per cent;
- Glasgow BR / Croy 6 per cent;
- Haymarket / Glasgow BR 5 per cent[61];
- Glasgow BR / Lenzie 5 per cent;
- Edinburgh Waverley / Polmont 4 per cent;
- Edinburgh Waverley / Falkirk H[62] 4 per cent;
- Glasgow BR / Bishopbriggs 4 per cent;
- Glasgow BR / Falkirk 4 per cent;
- Glasgow BR / Linlithgow 3 per cent; and
- Glasgow BR / Polmont 2 per cent

6.6 Airports

Various data sets are available for the airport in terms of travel demand. This section provides a summation of the most pertinent information and comments on the potential impact of this in terms of the study area demand.

Table 6.6.1 – Edinburgh Airport Passenger Breakdown

Traffic Type	Million passengers per annum (2003)
International Scheduled	1.1
International Low-Cost Carriers	0.5
International Charters	0.4
Domestic Scheduled	3.1
Domestic Low-Cost Carriers	2.3
Total	7.5

[61] Should be seen in context of EW / Glasgow BR as Edinburgh tickets often use Haymarket
[62] 2 per cent to/from Falkirk Grahamston and 2 per cent to/from Falkirk BR

In 2005 the airport handled 8.4 mppa. The average daily flow at the airport is 23,000 passengers but the high peak loading was 36,000 passengers per day.

Table 6.6.2 – Edinburgh Airport Key Passenger Catchments

Key Passenger Catchments	Percentage
City of Edinburgh	56
Fife	11
West Lothian	5
Stirling / Falkirk	5
Perth & Kinross	4
Dundee	4
Midlothian	2
East Lothian	2
Rest of UK	11

In terms of the study area, there are four results that are of significant importance. The high percentage from the City of Edinburgh confirms the importance of the airport to the immediate locality. The ability of public transport to effectively serve this market is likely to depend on the relative accessibility of the tram, bus and potential heavy rail connection. The 5 per cent of trips to/from West Lothian and 5 per cent of trips to/from Stirling/Falkirk are directly within the corridor and are of key importance. The 11 per cent forming the remainder encompasses around 5 per cent from the Strathclyde area including Glasgow, based on the 2005 CAA Passenger Survey, and nominal amounts from other areas.

It is also noted that trips across the Forth account for around 20 per cent of demand (accounting for the Highland and Grampian parts of 'Rest of UK'). This, together with the other key points above is of significant importance when formulating potential alternatives to EARL.

Table 6.6.3 – Edinburgh Airport Mode of Access (passenger)

Access mode to/from airport (passengers)	Percentage (2003/4)
Private Car	49%
Taxi	25%
Scheduled Bus	19%
Rental Car	6%
Hotel Shuttle Bus	1%

The table above demonstrates that private car is by far the most common mode of access to the airport, and if taken in combination with taxis, these account for around three quarters of all trips.

Table 6.6.4 – Edinburgh Airport Mode of Access (staff)

Access mode to/from airport (staff)	Percentage (2001)
Private Car	92%
Scheduled Bus	4%
Taxi	2%
Rail	1%
Other	1%

The overwhelming majority use private car with only 8 per cent using other modes such as bus or taxi.

Future growth of the airport is a key issue in terms of any surface access strategy. The Department for Transport (DfT) have published projections of airport growth across the UK. For Edinburgh, these are:

- 12.9 mppa (72 per cent increase on 2003) by 2015; and
- 21.2 mppa (183 per cent increase on 2003) by 2030.

Staff numbers at the time of survey were around 2,500. Similar to the passenger forecasts, the staff numbers are predicted to increase to around 5,500 by 2015 and 9,000 by 2030.

6.7 Future Land Use

Data from the three structure plans covering the study area has been considered. The following figures show the projected supply of new housing by area.

Figure 6.7.1 – Glasgow and Clyde Valley Structure Plan Housing Allocations[63]

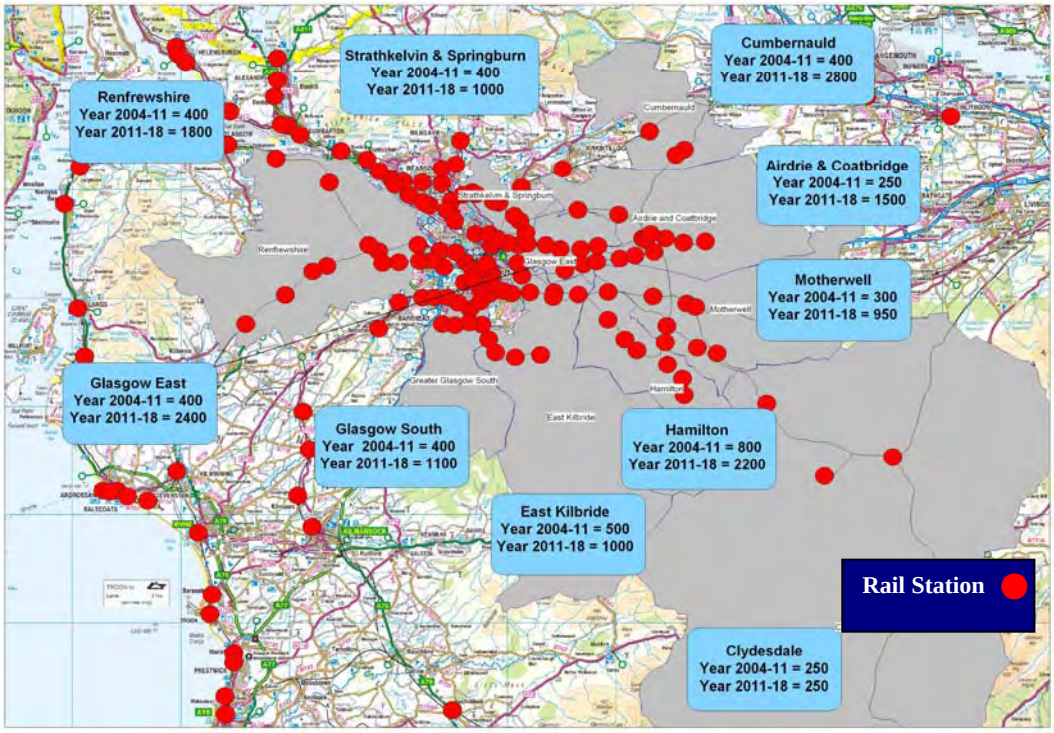
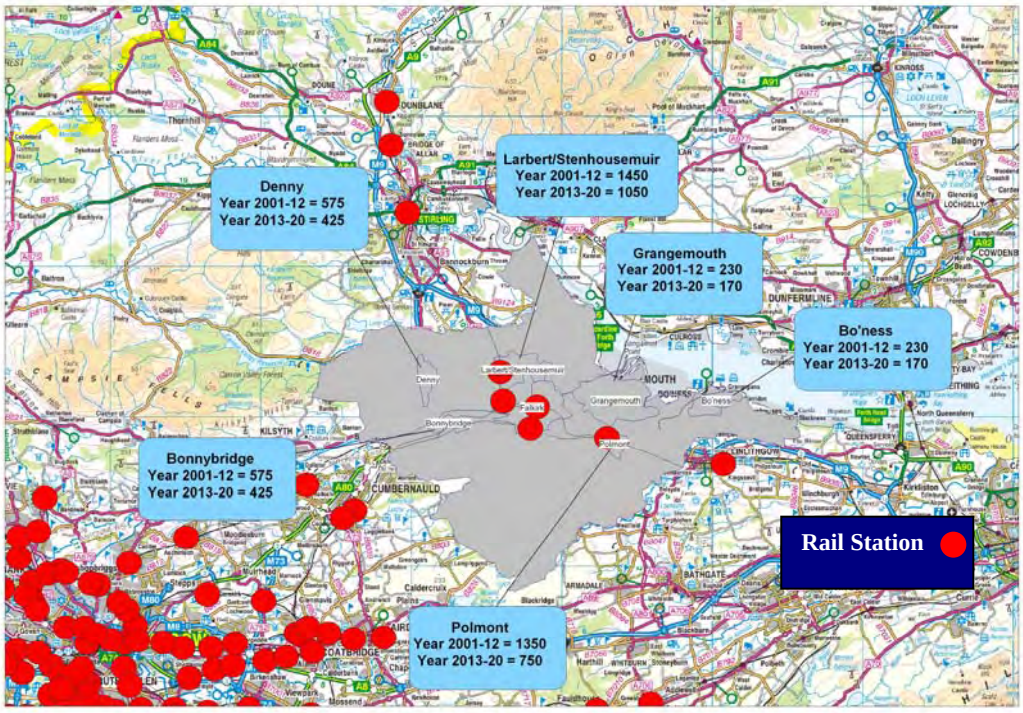
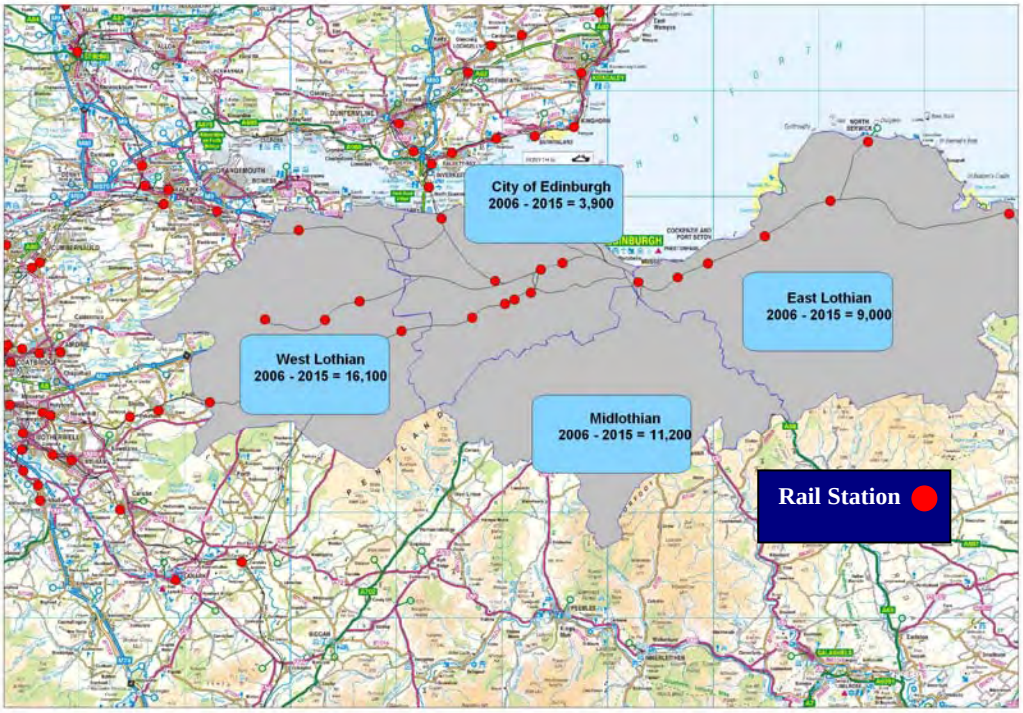


Figure 6.7.2 – Falkirk Structure Plan Housing Allocations



[63] Shows only current update of Structure Plan so Ravenscraig regeneration is additional

Figure 6.7.3 – Edinburgh and the Lothians Structure Plan Housing Allocations



The key points from these figures are:

- Major housing releases in West Lothian and Midlothian (SE Wedge);
- Significant housing concentration at Larbert/Stenhousemuir; and
- Large releases in North Lanarkshire (Cumbernauld area) and South Lanarkshire.

7 Issues, Constraints & Opportunities

Overview

This section considers the information generated and results of discussions with key stakeholders to provide a summation of the issues, constraints and opportunities that affect the rail routes between Edinburgh and Glasgow. This chapter forms the basis of the transport gap that the study is seeking to address through development of the key planning objectives outlined later in the report.

Whilst we are considering the constraints on each of the individual rail routes, all four routes share critical sections of the network, particularly on the Edinburgh approaches and to a lesser extent, the approach to Glasgow Central. Consequently the issue of approach constraints is dealt with first, and then generic and other constraints are listed.

7.1 Approach Constraints

The western approaches to Edinburgh and the approaches to Glasgow Queen Street and Glasgow Central in are of key importance in terms of considering how to modify and enhance services between the two cities.

Edinburgh Approaches

The linear nature of the approaches to Edinburgh from the western outskirts, through Haymarket and on to Edinburgh Waverley poses a significant constraint on the provision of rail services into and out of Edinburgh. In the east, the western approaches to Edinburgh Waverley currently have a theoretical capacity of 24 tph. Currently, during the inter peak period, there are 17 of these paths utilised by passenger services, comprising:

- 4 E&G;
- 2 Stirling/Dunblane;
- 2 Bathgate;
- 4 Fife;
- 1 Glasgow Central via Shotts;
- 1 Aberdeen;
- 1 Inverness/Perth;
- 1 Glasgow Central via Carstairs; and
- 1 Carlisle via Carstairs.

In addition, another path is used for empty rolling stock movements. This is an utilisation of 18/24 or 75 per cent. Given this is the inter peak situation, this is a high level of utilisation. Once peak services are added to this, the system can be seen to be operating close to capacity. This situation is further compounded by:

- A lack of balance between the north and south lines; and
- Restrictions on movement due to the layout of the west end throat at Edinburgh Waverley.

By 2008, it is anticipated that this will have an additional hourly service to Dundee and by 2010 there will be two additional services per hour associated with Airdire-Bathgate. The path capacity however will have been raised to 28 tph by this time. This will maintain the inter peak utilisation at 75 per cent.

Glasgow Approaches

The issue of approach capacity to Glasgow perhaps less severe than the issue in Edinburgh due to a number of factors, such as:

- Availability of two terminus stations; and
- Availability of two low level and two high level approach corridors.

However, each of these terminal stations and its associated approaches has operational issues. Glasgow Central is nearing capacity, and additional movements associated with GARL will largely use up remaining capacity. The south-eastern approaches to Glasgow Central are also heavily used by suburban services on the Argyle Line, which require to cross tracks to access the low level line through Rutherglen station. This means that junctions at Rutherglen East and Newton West act as key constraints.

At Glasgow Queen Street, the approaches have fewer crossing movements than those associated with Glasgow Central, but the approaches are only dual track rather than multiple track and the steep downhill gradient into Glasgow Queen Street means that this is subject to a 20mph speed limit. These factors contribute to placing a significant constraint on the movement of trains in and out of Glasgow Queen Street. These interact with the need to provide for movements at the Cowlairs Junction to further constrain operations. Within Glasgow Queen Street itself, the passenger circulation area is becoming congested and is of a smaller size relative to the number and arrangement of platforms than might be expected, but is clearly historical in design. Of the seven platforms within the high level station, only four are currently capable of taking 6-car trains (platforms 2, 5, 6 and 7).

7.2 Infrastructure/Service Constraints

- General level of demand for rail travel in the context of the current provision and overcrowding issues and future growth predictions[64];

[64] Scotland's Railways, Scottish Executive 2006

- [65]Growth on these and other routes will mean capacity at Glasgow Queen Street Station is likely to be a constraint beyond 2011;
- Between Edinburgh Waverley and Haymarket rail stations, the number of trains operated in the peak is at the capacity of this section of route;
- Congestion in the throat of Edinburgh Waverley means the line-speed of 40mph between Princes Street Gardens and Haymarket is rarely achieved;
- West of Haymarket the route is double track throughout without any loops resulting in faster trains being held up by stopping trains, imposing a further time penalty on the slower train;
- On the Edinburgh to Glasgow via Falkirk High route there are eleven locations where flat junctions with conflicting movements reduce capacity. The ruling line speed (100mph) is reduced at a number of locations with a consequential impact on journey times;
- The approach to Glasgow Queen Street (High Level) is on a steep gradient and partly in tunnel. This requires a slow approach to the station and impacts on the capacity from Cowlairs; and
- The approach to Glasgow Central is recognised in the RUS as being a major constraint on service enhancements to the city.

Opportunities

Table 7.1.1 below lists the interventions proposed in *Scotland's Railways* which could further enhance the important role that rail plays in contributing to the Scottish economy. These options will be considered as part of this study.

As well as problems and constraints, it is important in terms of STAG that we consider opportunities. From the outset of this study we have been aware of work being undertaken by Network Rail on the Edinburgh to Glasgow rail route via Falkirk High. This provided an opportunity for us to build on work previously done to ensure not only a joined-up approach, but to avoid un-necessary duplication of works.

The potential of schemes to integrate with other planned transport infrastructure is also considered to be of significance.

[65] Scotland's Railways, Scottish Executive 2006

Table 7.1.1 – Scotland's Railways Interventions

Timescale	Intervention
Short Term	Examine how best to reduce journey times between Edinburgh and Glasgow via Falkirk. Deliver the Stirling – Alloa – Kincardine project to reduce freight traffic on the eastern end of the Edinburgh – Glasgow route. Provide more frequent, faster journeys between Edinburgh and Glasgow via Shotts and Carstairs to improve links from Edinburgh to the south west of Glasgow and subsequently to Glasgow airport. Ensure better marketing of route options between Edinburgh and Glasgow to encourage passengers to use the service closest to their home instead of driving to stations on the Falkirk route to park and ride. Investigate options for developing capacity at Glasgow Central and Glasgow Queen Street stations including opportunities to enhance cross Glasgow connections and possibility of converting some routes to light rail operation through the STPR. Support measures to encourage passengers to travel outside the morning peak where possible. Investigate options for building on the current Edinburgh Waverley works to enhance passenger access and circulation space. Redevelopment of Haymarket Station increasing passenger circulating space and improving accessibility.
Medium Term	Increase capacity and reduce journey times by electrifying Edinburgh to Glasgow via Falkirk. Maximise Haymarket Station's role as a key interchange station including through integration with trams. Deliver chosen enhancements to improve capacity and connections across Glasgow. Deliver the Airdrie – Bathgate project creating a fourth route between Edinburgh and Glasgow. Deliver the Edinburgh Airport Rail Link.
Long Term	Consider options for further reducing journey times between Edinburgh and Glasgow including re-signalling, realignment, new infrastructure and high speed railway.

8 Planning Objectives

This study will examine all significant rail flows between Edinburgh and Glasgow, longer distance trips, tourism and business and leisure trips. The routes/locations to be considered as part of this study are as follows:-

- Edinburgh to Glasgow via Falkirk High;
- Edinburgh to Glasgow via Carstairs;
- Edinburgh to Glasgow via Shotts;
- Edinburgh to Glasgow via Airdrie – Bathgate; and
- Alternatives to the Edinburgh Airport Rail Link.

8.1 SMART Planning Objectives

Two key planning objectives were agreed at our stakeholder workshop. These Planning Objectives were reviewed at various stages throughout the study process and smartened in line with STAG.

Planning Objective 1: A programme of cost effective improvements to strengthen the connectivity between the centres of Edinburgh and Glasgow through:

- **Reducing rail journey times between the city centres of Edinburgh and Glasgow**: Within 5 years; target journey time to be 45mins or better; target service interval to be not longer than every 20 minutes by the fastest route. By 2022: Target journey time to be 35 minutes or better. Target service interval to be not longer than every 15 minutes by the fastest route.
- **Improving rail system capacity between Glasgow and Edinburgh** - Capacity to include train capacity, station capacity, route capacity and car park spaces. Measures to be number of seats, crowding standards (currently 10 mins standing time), passenger throughput at stations and car park utilisation (less than 90 per cent target).
- **Improving attractiveness of rail travel experience** - Indicators to include user satisfaction surveys and rail market share. Target 90 per cent NPS and an increase in rail market share.
- **Improving reliability of rail services between Edinburgh and Glasgow** - Indicators to be PPM[66] and right time arrival. Target 90 per cent right time arrival and 95 per cent PPM for E&G

PPM means public performance measure and is a combination of reliability and punctuality measures

Planning Objective 2: An effective linkage between the rail network and Edinburgh Airport.

- Indicators to include the proportion of journeys to and from the airport involving the use of rail. Before and after comparison of journeys to and from the airport. Target to be increasing the proportion against the baseline.

9 Packages & Appraisal

9.1 Introduction

Two workshops have taken place involving Transport Scotland, First ScotRail, Network Rail and Jacobs where a long list of potential intervention options was established. It is necessary to consider the interventions in terms of the project objectives but also to consider the way in which interventions could interact to provide service improvements. One of the most effective ways to achieve this is to 'package' individual options together to form a test scenario.

We have analysed the problems and opportunities associated with rail within the Edinburgh to Glasgow corridor as set out in previous chapters. We used this analysis to form SMART objectives for the work and through a combination of using previous relevant work and brainstorming fresh ideas we identified a wide range of options for achieving the objectives.

Changes within the rail industry involve complex interactions between infrastructure, rolling stock and timetables, and so we grouped options into packages primarily associated with timetable changes – the visible result from a customer perspective. We then appraised how well each package achieved the objectives set, and used this to make recommendations on a range of improvements.

9.2 Methodology

A number of key issues have been considered in determining the packages. Journey time can be reduced through stopping trains less often, using faster trains, increasing infrastructure capacity to allow more frequent services. Different packages have been developed around these different approaches to test the relative benefits and disbenefits of each.

It is important to recognise that each of the estimated journey times and capacity improvements proposed are the best estimates that can be achieved without undertaking much more detailed planning and analysis and has been carried out using the best information, knowledge and expertise in the time available. Further timetable development work is required to fully test the interactions with other services that operate over these corridors and amendment to the existing Franchise Agreement would be required to introduce any changes.

The packages have been developed to encompass a number of timeframes (short, medium and long term) for bringing infrastructure and services into operation, a scale of improvement in the service provided and a subsequent scale of intervention investment. It is noted that the packages form test scenarios in order to compare the relative performance of each against the planning objectives and the wider government objectives. In this context it should be recognised that the implemented strategy is likely to involve a refinement of the particular test scenario or scenarios to reflect more detailed timetabling, infrastructure and rolling stock assessments.

The infrastructure costs and additional operating costs have been based on current data available and infrastructure costs have been increased by the addition of optimism bias in accordance with standard guidance.

The assessment of the packages has involved two streams. Firstly, based on the derived train operations specified for a particular scenario, an assessment of the ability of the package to meet the planning objectives and government objectives has been made. This has been undertaken in discussion with the key stakeholders to minimise the potential for bias in subjective analysis. The information from this is reported in detail with the Project Summary Tables contained within the appendices. The second assessment stream has involved the use of transport modelling software to provide data on the change in patronage for a given test scenario. This data has then been combined with cost information to provide a net present value (NPV) and benefit cost ratio (BCR) for the package. Testing all of the packages within the same software was deemed to present difficulties as minor timetable alterations would be unlikely to produce a significant enough variation within the strategic level Transport Model for Scotland (TMfS). Similarly, the Network Modelling Framework (NMF), a standard UK level rail model, is not appropriate for tests that involve new infrastructure. Therefore, for the short term packages, the NMF was used. The NMF contains detailed timetable information and automatically produces the economic impact of interventions. For the medium and long-term packages, which involve new infrastructure, TMfS was used. The output from TMfS was used, applying standard methodological conventions, to produce the reported economic results. It should be noted that although the costs of each package are reported as a range, the Benefit Cost Ratios were calculated using the best estimate within that range.

This section provides an overview of each of the packages considered as part of the same study summarising the key service changes, the infrastructure requirements, the franchise and cost implications as well as the high level benefits to be achieved through implementation of same.

The packages are split into those that could be delivered in the:

- Short term;
- Medium term; and
- Long term.

Infrastructure options to be used in the medium term and long term packages are summarised in a table at the start of section 10.4 (medium term).

9.3 Short Term Packages (up to 2010)

The short term packages are split into two groups, A and B. The A packages assume no new infrastructure or rolling stock. The B packages assume no new infrastructure, but do require additional leased rolling stock and those costs are included in BCR. It should be noted that only B1 or B2 individually can be achieved with no new infrastructure.

Package A1

Overview

This package provides an improved journey time through a revision of stopping patterns on the existing route via Falkirk High.

Description

A1 uses the current 4 tph pattern on the E&G line via Falkirk High, but changes the inter-peak (0930 – 1530) stopping pattern, providing reduced end to end journey time through reducing the number of intermediate stops that are least used. This could provide a potential journey time on the route of 44 – 47 minutes, an improvement on the current 50 minutes. An additional semi-fast service from Glasgow Queen Street to Perth, calling at Stirling, Dumblane and Gleneagles is added within the constraints of existing rolling stock. This adds capacity on this section of the network and would also assist in moving passengers from the slow services to this new service – thus improving the timekeeping of slow services. The number of seats would be as at present.

The table below shows the change in inter-peak stopping level of service.

Table 9.3.1 – A1 E&G Change in Inter Peak Stopping Pattern

Station	Trains per hour to Glasgow (inter-peak)		Trains per hour to Edinburgh (inter-peak)	
	Current	Proposed	Current	Proposed
Croy	2	2	2	2
Falkirk High	4	**2**	4	**2**
Polmont	2	1	2	1
Linlithgow	2	1	2	1
Haymarket	4	4	4	4

The E&G train stopping pattern for this option is shown in the table below.

Table 9.3.2 – A1 E&G Revised Stopping Pattern

Station	XX:00	XX:15	XX:30	XX:45
Glasgow Queen Street	Yes	Yes	Yes	Yes
Croy	Yes		Yes	
Falkirk High	Yes		Yes	
Polmont				Yes
Linlithgow		Yes		
Haymarket	Yes	Yes	Yes	Yes
Edinburgh Waverley	Yes	Yes	Yes	Yes

Implications and Costs

The impact on existing local services would need to be examined in more detail. The service change would require an amendment to the existing Franchise Agreement. The package has no capital costs.

Risks and Uncertainties

A number of issues should be recognised, comprising:

- More detailed timetabling work is required to fully test the interaction with other services that operate over these corridors;
- The reduction in station calls could lead to adverse reaction;
- Potential for negative impact on trains other than the E&G;
- Additional Perth service is a performance risk; and
- SAK coal train timetabling is a risk between Carmuirs and Stirling.

Appraisal

The detailed Project Summary Tables (PSTs) are contained in Appendix C. This package has a BCR of 1.3 (minor benefit). However, this is inclusive of an additional service through Stirling and given the demand on this route, the E&G element alone of is likely to have a BCR that is at best marginal. Given that the package is based on a revised inter peak stopping pattern, this suggests that more passengers are being lost through reduced intermediate calls at Falkirk High, Polmont and Linlithgow, than are being attracted to the service through its reduced journey times combined with the benefit to existing passengers from shorter journey times.

Package A2

Overview

This package provides an improved journey time through a revision of stopping patterns on the existing route via Falkirk High

Description

A2 uses the current 4 tph pattern on the E&G line via Falkirk High, but changes the inter-peak (0930-1530) stopping pattern, providing reduced end to end journey time through introducing alternate express and stopping services.

The indicative journey times on the route are 42 minutes for fast services and 53 minutes for stopping services. Current rolling stock would be used. The number of seats would be unchanged.

This is achieved by splitting the Glasgow Queen Street to Edinburgh Waverley service into 2 tph 'stopping' (stopping at Croy, Falkirk High, Polmont, Linlithgow and Haymarket) and 2 tph 'fast' (stopping only at Haymarket).

Table 9.3.3 – A2 E&G Change in Inter Peak Stopping Pattern

Station	Trains per hour to Glasgow (inter-peak)		Trains per hour to Edinburgh (inter-peak)	
	Current	Proposed	Current	Proposed
Croy	2	2	2	2
Falkirk High	4	**2**	4	**2**
Polmont	2	2	2	2
Linlithgow	2	2	2	2
Haymarket	4	4	4	4

The E&G train stopping pattern for this option is shown in the table below.

Table 9.3.4 – A2 E&G Revised Stopping Pattern

Station	XX:00	XX:15	XX:30	XX:45
Glasgow Queen Street	Yes	Yes	Yes	Yes
Croy	Yes		Yes	
Falkirk High	Yes		Yes	
Polmont	Yes		Yes	
Linlithgow	Yes		Yes	
Haymarket	Yes	Yes	Yes	Yes
Edinburgh Waverley	Yes	Yes	Yes	Yes

An additional semi-fast service from Glasgow Queen Street to Perth, calling at Stirling, Dunblane and Gleneagles is operated within the constraints of the existing stock. This adds capacity on this section of the route and would also assist in moving passengers from the slow services to this new service – thus improving the timekeeping of the slow services.

Implications & Costs

The impact on existing local services would require to be examined in more detail. The service change would require an amendment to the existing Franchise Agreement. The package has no capital costs.

Risks and Uncertainties

A number of issues should be recognised, comprising:

- More detailed timetabling work is required; to fully test the interactions with other services that operate over these corridors. With this proposal there is much greater risk that due to the projected faster journey time, there may be an increased requirement for pathing time – either in the fast trains or those trains interacting with it en route;
- Stopping service may need 6-cars all day to meet demand, therefore increasing operating costs;
- The reduction in station calls at Falkirk High could lead to adverse reaction;
- Potential for negative impact on trains other than the E&G;
- Additional Perth service is a performance risk; and

- SAK coal train timetabling is a risk between Carmuirs and Stirling.

Appraisal

The detailed Project Summary Tables (PSTs) are contained in Appendix C. This package has a BCR of 2.7 (highly positive impact). This includes the additional semi-fast service to Perth but it is unlikely that the exclusion of this would reduce the BCR to such an extent that the E&G element alone is marginal or below one. Given the only station that has an inter peak reduction in calls is Falkirk High, it is likely that there is significantly less potential for a reduction in demand from intermediate stops than in A1. It is also likely that the reduction in headline journey time for the fast service is sufficient to act as an attraction to the service.

Package B1

Overview

This would supplement the existing Intercity services on the route to Edinburgh via Carstairs to provide an hourly service between Glasgow Central and Edinburgh Waverley. This package also has the ability to address North Lanarkshire to Edinburgh flows and reduces cross Glasgow transfers – thus freeing capacity on the existing E&G.

Description

The indicative journey time on this route is 65 minutes with stops at Motherwell and Haymarket. It requires two additional EMUs to be sourced.

The number of seats between Glasgow and Edinburgh would be increased by around 200 every second hour with the more frequent timetable, leading to a better spread of passenger loadings. It would also provide the option of an easier interchange in central Glasgow for passengers from the south of Glasgow, Renfrewshire and Ayrshire.

Implications and Costs

The impact on existing local services would require to be examined in more detail, particularly in light of the volume of freight traffic. The service change would require an amendment to the existing Franchise Agreement. The package has no capital costs and rolling stock would be met through additional leasing requirement. Also, the effect of the additional ten mile journey, when compared with the route via Shotts, would need to be considered further.

Risks and Uncertainties

A number of issues should be recognised, comprising:

- More detailed timetabling work is required;
- Potential capacity issues between Slateford and Edinburgh in the east and Uddingston and Glasgow in the west;
- Ability of intercity services to fit regular pattern;
- Assumes that EMU rolling stock will be available in timescale;
- Need to consider increased traffic across level crossings;
- Adverse impact on emissions;
- Only package B1 or B2 can be progressed in the short term;
- This option may require a review of the local services on this route; and
- Public demand for additional service stops.

Appraisal

The detailed Project Summary Tables (PSTs) are contained in Appendix C. This package has a BCR of 1.2 (minor benefit). The provision of a more regular timetable linking Glasgow city centre (south), people arriving at Glasgow Central and Motherwell with Edinburgh is shown to give a benefit. It is of note that the journey time of around 65 minutes is only 15 minutes longer than the current fast service from Glasgow Queen Street, which is competitive when including walk times to Glasgow Queen Street. The ability of the service to give a high BCR is limited by its frequency.

Package B2

Overview

This package would implement the 'Caledonian Express' semi-fast services from Glasgow Central to Edinburgh Waverley via Shotts. This package also has the ability to address North Lanarkshire to Edinburgh flows, reducing cross Glasgow transfers – thus freeing capacity on the existing E&G.

Description

This package is the preferred option that emerged from the Caledonian Express study published in 2006 (Option 3E). In addition to the existing hourly all-stops service, this provides an hourly semi-fast service, calling at only the key stations on the route.

The train stopping pattern assumed for this option is:

- Glasgow Central High Level – Uddingston – Shotts – West Calder – Livingston South – Haymarket – Edinburgh Waverley

It has been suggested that the final stopping pattern is kept under review in light of changing demand and developments around Holytown and Ravenscraig progress.

The indicative journey time on this route is 84 minutes for the existing stopping service and 67 minutes for the new semi-fast service. This assumes services using Class 158 or 170 DMU and requires additional rolling stock. The number of seats between Glasgow and Edinburgh would be increased by around 200 per hour.

Implications and Costs

The impact on existing local services would require to be examined in more detail. The service change would require an amendment to the existing Franchise Agreement. The package has minor capital costs and rolling stock would be met through additional leasing requirement.

Risks and Uncertainties

A number of issues should be recognised, comprising:

- More detailed timetabling work is required;

- Potential capacity issues between Slateford and Edinburgh in the east and Uddingston and Glasgow in the west;
- Possible conflicts on some paths during the day;
- Interaction with and impact on freight movements given the lack of loops to allow overtaking;
- Only package B1 or B2 can be progressed in the short term;
- Need to consider increased traffic across level crossings;
- Capacity of Haymarket East Junction; and
- Assumes that DMU rolling stock will be available in timescale.

Appraisal

The detailed Project Summary Tables (PSTs) are contained in Appendix C. This package has a BCR of 3.8 (highly positive impact). This is a high level of BCR and is likely to be a function of the service managing to combine the benefits of (i) a more regular timetable linking Glasgow city centre (south) and people arriving at Glasgow Central with Edinburgh with (ii) enhanced connectivity for key intermediate stations in North Lanarkshire and West Lothian. The high BCR indicates that this package has significant benefit.

9.4 Medium Term Packages (by 2014)

The medium term measures enable a step change to the service patterns and capacity to be delivered on the route but do require capital investment for infrastructure enhancement except where highlighted below. Additional rolling stock is required.

In order to inform this process, a menu of potential infrastructure interventions has been formed based on the options generated during workshop sessions and through discussion and debate.

The following table summaries the key infrastructure interventions, their indicative costs and comments on timescale for delivery. The costs quoted are inclusive of optimism bias and are described according to the following scale:

- A Under £10 million
- B £10 million to £20 million
- C £20 million to £40 million
- D £40 million to £70 million
- E £70 million to £100 million
- F £100 million to £150 million
- G £150 million to £200 million
- H £200 million to £250 million

Table 9.3.5 – Infrastructure Menu

Option	Description	Indicative Cost	Indicative Delivery Timescale
Garngad Chord	Provision of new chord from Cumbernauld line at Provanmill to Springburn line south of Barnhill Station. Allows Cumbernauld services to be routed away from Glasow Queen Street High Level	B	5 years
Bellgrove	Re-doubles junction and provides additional turnback platform	A	4 years
Greenhill Lower / Upper	Grade separation of lower and upper junctions at Greenhill	E / F	10 years
Polmont Station	Relocation of station to west to improve junction performance and provide enhanced opportunity for Park-&-Ride	A	4 years
Croy Turnback	Rebuilt on present site incorporating a turnback facility	C	5 years

Option	Description	Indicative Cost	Indicative Delivery Timescale
4-track Croy to Greenhill	Provision of 4-track line	F	10 years
4-track Bishopbriggs to Croy	Provision of 4-track line	G	10 years
Dalmeny Chord	Provision of new chord from around Humbie to new grade separated junction on Fife line north of Almond viaduct	G / H	7 years
Newbridge	Grade separation of junction and connection between north and south lines at Saughton	F	10 years
Saughton Junction	Alternative to Newbridge grade separation providing ladder junction to allow south lines access to north lines	B	3 years
Winchburgh	Provision of (i) improved flat junction or (ii) grade separation of junction.	(i) B (ii) D	(i) 3 years (ii) 5 years
Edinburgh Waverley North West	Improvements to the north-west quadrant of Edinburgh Waverley to allow for more efficient train operations.	E	5 years
Edinburgh Waverley South West	Improvements to the south-west quadrant of Edinburgh Waverley to allow for more efficient train operations.	E	5 years
Cowlairs Flyover	Grade separation of the Cowlairs North to Springburn movement so as not to impact on Glasow Queen Street High Level services. Associated with re-routing of North Suburban.	D	5 years
Newton West Junction	Replacement of single lead junction with double lead and associated works to Newton station to allow works.	C	4 years
Haymarket Platform 5	Provision of a new terminating platform to the south of the existing lines to mirror	B	4 years
4-track Greenhill to Polmont	Provision of 4-track line including new Falkirk High tunnel	H	10 years
GQS Platforms	Permit all platforms to accept 6-car trains (extension of platforms 1, 3 and 4).	D	6 years
Gogar Station	New station at Gogar. Interchange with tram. Note: included within cost of Dalmeny Chord.	A	3 years
Finnieston Turnback	East facing turnback at west end of Glasgow city centre to allow more trains to use low level without impacting on Partick/Hyndland section.	B	3 years

Option	Description	Indicative Cost	Indicative Delivery Timescale
125mph line speed	Upgrade of the E&G corridor to allow 125mph running	F	12 years
Minor Infrastructure and Signalling	Increase in line speeds and improved signalling headways on Shotts route.	C	5 years
Electrification (E&G core)	Electrification of Glasgow Queen Street to Edinburgh	G	6 years
Electrification (E&G Diversion Route 1)	Electrification of Edinburgh Western Approaches (north lines)	D	6 years
Electrification (E&G Diversion Route 2)	Electrification of Greenhill to Polmont via Falkirk Grahamston	D	6 years
Electrification (E&G Diversion Route 3)	Electrification of Greenhill to Springburn via Cumbernauld	E	6 years
Electrification (Carmuirs to	Electrification of Carmuirs to Dunblane and Stirling to Alloa	F	6 years
Electrification (Shotts)	Electrification of Holytown Junction to Midcalder Junction	E / F	6 years

Schematics of a number of these options are contained in Appendix B. In order to classify the overall package costs, we have adopted the following cost ranges for each of the packages:

- £10 million to £50 million;
- £50 million to £100 million;
- £100 million to £250 million;
- £250 million to £500 million;
- £500 million to £1 billion;
- £1 billion to £1.5 billion;
- £1.5 billion to £3 billion; and
- Over £3 billion

Package B3

Overview

This would combine packages B1 and B2 to provide two semi-fast trains per hour between Glasgow Central and Edinburgh Waverley using both the Shotts and Carstairs routes and supplementing the existing Intercity services. This package delivers an approximate half hourly service between Edinburgh Waverly and Glasgow Central with competitive journey times as a viable alternative to the existing E&G route for passengers on the south side of Glasgow. This then has a significant impact on passenger travel to and from Edinburgh from both Lanarkshire and south west Glasgow, Inverclyde and Ayrshire with connection between services at Glasgow Central becomes an attractive alternative to walking to Glasgow Queen Street Station. The combination of Packages B1 and B2 would require infrastructure enhancements.

Description

The indicative journey times are 65 minutes via Carstairs and 67 minutes via Shotts.

The number of seats between Glasgow and Edinburgh would be increased by an average of 300 per hour. It would also allow an easier interchange in central Glasgow for passengers from the south of Glasgow, Renfrewshire and Ayrshire. The stopping patterns are as per packages B1 and B2 and additional rolling stock would be required.

Implications and Costs

The pathing of two additional services rather than the one in either B1 or B2 will place significantly more strain on infrastructure. It will be necessary to relieve the approaches into Glasgow Central through an upgrade to Newton West Junction to allow greater flexibility in train movements and so avoid an adverse impact on the operation of Argyle Line services. In the east, there is concern that not all services may be able to be accommodated through the Haymarket to Edinburgh Waverley section and therefore an allowance has been made, in terms of infrastructure costs, to terminate some at a new platform 5 to the south side of Haymarket.

The infrastructure requirements for this package are estimated as:

- Newton West Junction; and
- Haymarket Platform 5.

The locations of these are shown in Figure 9.4.1. The infrastructure costs for implementing this package are estimated as being in the range of £10 million to £50 million.

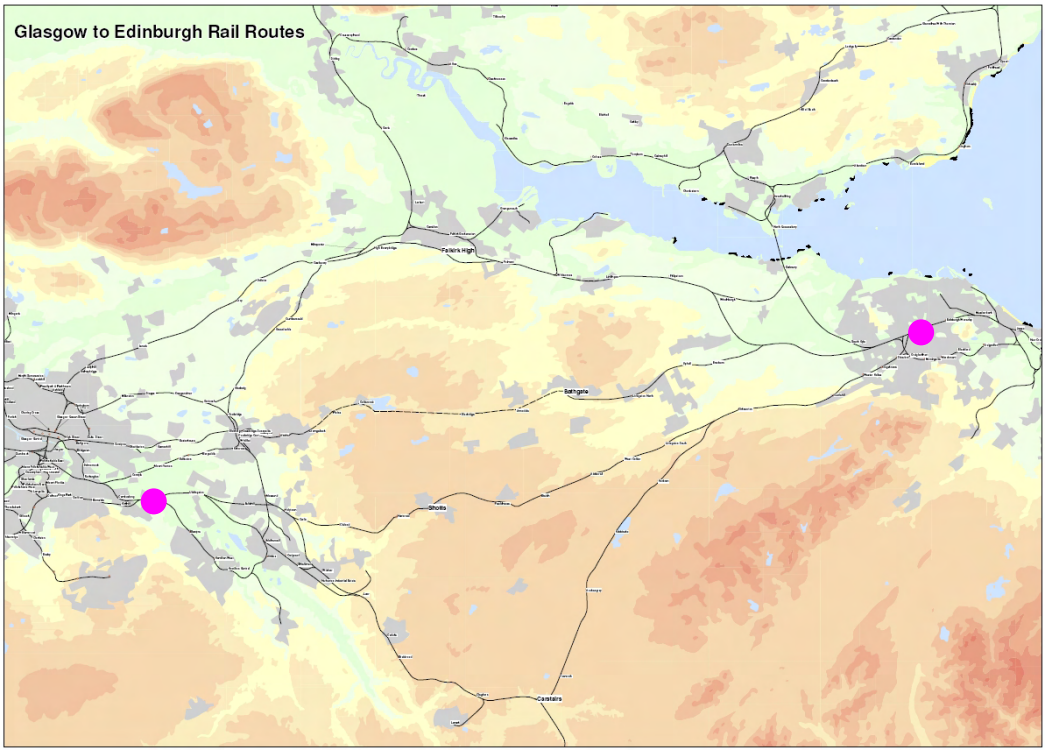
Risks and Uncertainties

A number of issues should be recognised, comprising:

- More detailed timetabling work is required;

- Possible conflicts on some paths during the day;
- Interaction with and impact on freight movements;
- Assumes that rolling stock will be available in timescale;
- Ability of intercity services to fit regular pattern;
- Conflict issue at Midcalder, although likely to be dealt with by Network Rail as an increase of scope to a planned renewal with funding via the Network Rail discretionary fund;
- Need to consider increased traffic across level crossings; and
- Public demand for additional service stops.

Figure 9.4.1 – B3 Infrastructure Upgrading



Appraisal

The detailed Project Summary Tables (PSTs) are contained in Appendix C. This package has a BCR of 1.8 (positive impact). The provision of a more regular timetable linking Glasgow city centre (south), people arriving at Glasgow Central and Motherwell with Edinburgh is shown to give a benefit. The improved linkages for North Lanarkshire and West Lothian are also noted. This package does provide a step change in linkage between Glasgow Central and Edinburgh Waverley. As would be anticipated, the BCR for this lies between the results for B1 and B2, but the additional infrastructure costs mean that it is at the lower end of this range. The infrastructure improvements would have some wider operational benefits for Argyle line services and potentially WCML services from better operational reliability in the Newton area. In addition, the construction of Platform 5 at Haymarket would give enhanced flexibility for services in the Edinburgh area.

Package C1

Overview

This package provides electrification of the E&G line together with feeder lines from Dunblane and Alloa.

Description

This package requires the electrification of the existing E&G line via Falkirk High, the diversionary route via Falkirk Grahamston, the Carmuirs to Dunblane section of route and the spur line to Alloa. The electrification of lines to Dunblane and Alloa is necessary to minimise the interaction between electric and diesel units so that train operating characteristics are as consistent as possible – over the common sections of the E&G route between Glasgow Queen Street and Greenhill and Polmont and Edinburgh Waverley.

For the purposes of this appraisal we have assumed the current stopping pattern would be retained with four trains per hour on the E&G. The rolling stock would be new electric sets. It is assumed that the equivalent new EMU stock would have at least the same seating capacity as the existing class 170 sets. The key issue is to note that this option does not therefore provide any additional seating capacity over the existing level and does not therefore address the problem of accommodating anticipated growth on the corridor.

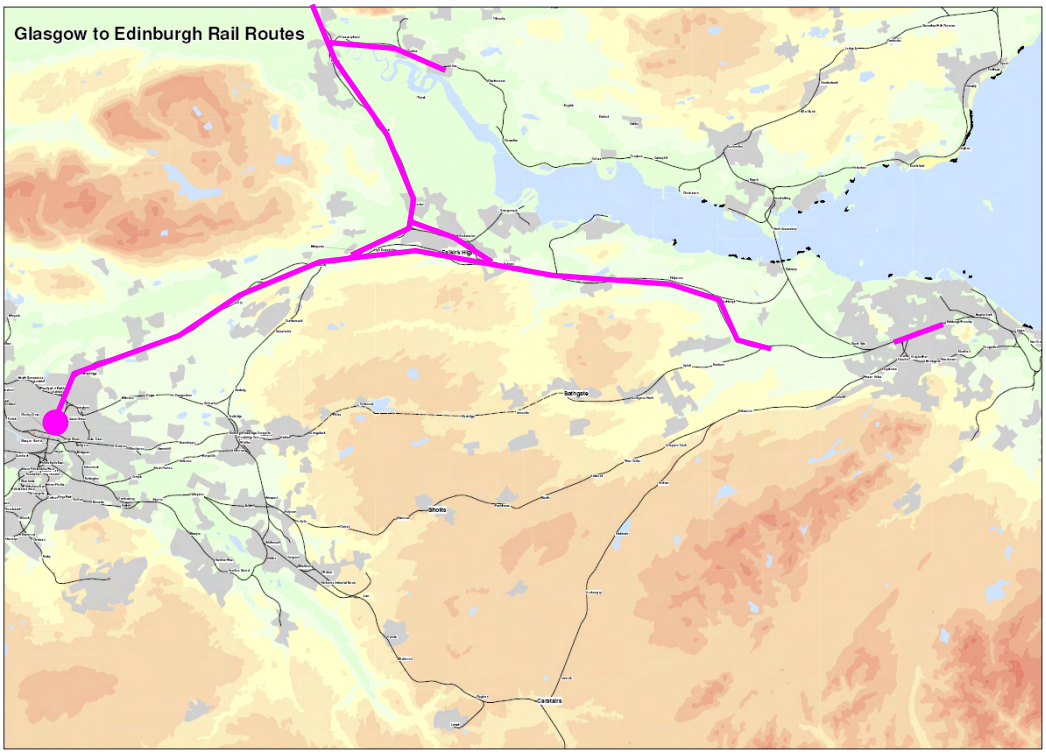
The indicative journey time for E&G services is 46 minutes, a reduction of around 4 minutes on the current situation. The indicative journey time for Dunblane/Glasgow services is 44 minutes, a reduction of around 5 minutes on the current situation. The indicative journey time for Dunblane/Edinburgh services is 59 minutes, a reduction of around 5 minutes on the current situation. Services to and from Alloa would have a similar journey time reduction as Dunblane. This package could also be combined with the timetable changes in either A1 or A2 above if desired.

Implications and Costs

- Electrification of the E&G (from west of Newbridge Junction) to Glagow;
- Electrification of Greenhill and Polmont to Dunblane and Alloa;
- Electrification of North lines at Haymarket; and
- Glasgow Queen Street 1 platform extension

The locations of these are shown in Figure 9.4.2. The infrastructure costs for implementing this package are estimated as being in the range of £250 million to £500 million.

Figure 9.4.2 – C1 Infrastructure Upgrading



The platform extension at Glasgow Queen Street may not be required depending on detailed analysis. New rolling stock would be required for these services, the leasing costs have been included.

Risks and Uncertainties

A number of issues should be recognised, comprising:

- No improved seating capacity on E&G route;
- Assumes that Bishopbriggs will be upgraded to 6-car platforms;
- Need to restructure AM peak movement from Dunblane to take account of DMU/EMU issues associated with Perth services.
- Reduction in available diversion routes for E&G as Cumbernauld and Dalmeny are not being electrified and these are the two most commonly used diversions today, although Airdrie-Bathgate would be available;
- Disruption and construction impact;
- Possible performance conflict with longer distance DMU services; and

- Benefit of strengthening of peak Dunblane to Glasgow and Edinburgh Service by electrification.

Appraisal

The detailed Project Summary Tables (PSTs) are contained in Appendix C. This package has a BCR of 1.3 (minor benefit). There are environmental benefits from providing an electrified service in terms of reduction in emissions. However, it should be noted that this package does not provide any additional seat capacity so during peak periods when travel demand is at its highest, overcrowding may be compounded by the attractiveness of a reduced journey time.

Package C2

Overview

This package provides a significant step change in the capability and capacity of the route and involves tackling the physical network constraints on the E&G line but continuing to use diesel units.

Description

This package develops the E&G line via Falkirk High by providing significant additional capacity and removing key constraint points. It would make it possible to run a 6 tph service pattern on a non-electrified line. In order to provide a robust assessment of the infrastructure required, it is assumed that the line to Cumbernauld would be electrified and these services would be diverted to Glasgow Queen Street Low Level via a new chord at Garngad. It has been assumed that these would be a diversion and extension of the current services to Springburn. This would link the existing Cumbernauld line at Provanmill with the Springburn line south of Barnhill. In addition, and for the same reasons, the North Suburban services would need to be diverted away from Glasgow Queen Street High Level. This has been linked with the replacement provision to Springburn by diverting these services to a new improved interchange at Bellgrove Station. The improvements to Bellgrove are required to avoid negative impacts from diverted services on the north electric services. A turnback facility would be provided at Greenhill to allow the Croy local services to be reversed without impacting on the performance of the E&G services. The proposed Greenhill turnback is costed for this package, being less expensive to provide than a Croy turnback. However, a Croy turnback would use less network capacity and lowering operating costs and is therefore potentially a better long term solution.

The remodelling of Polmont Station has been included to allow more efficient operation of Polmont Junction and the potential for increased Park-&-Ride opportunities.

In the east, it is not possible to accommodate the enhanced service frequency through Newbridge Junction. Grade separation of Newbridge would provide a solution to this, but this would exacerbate the issue of imbalance between the north and south lines into Edinburgh. In this respect, the ability to increase services in the future through the grade separation is likely to be artificially restricted. An alternative solution would be to provide the Dalmeny Chord which provides a new section of new line from east of Winchburgh Junction on the E&G line to the existing line between Edinburgh and Fife, close to Edinburgh Airport. This would allow services to bypass Newbridge and route onto Waverly in advance of approaches to the north lines, thereby improving the balance of services on the approaches. It also provides the capability to enhance linkage to Edinburgh Airport by including a new station at Gogar adjacent to Edinburgh Airport, where an interchange would be provided with tram services. Including the 6 tph on the E&G line, there would be a total of 12 tph from Glasgow Queen Street and 8 tph from Edinburgh Waverley as follows:

- E&G
    - 2 tph fast (GQS – Haymarket – Edinburgh Waverley);

  - 4 tph stopping (2 x GQS – Polmont – Linlithgow – Gogar – Haymarket – Edinburgh Waverley and 2 x GQS – Croy – Falkirk High – Edinburgh Park – Haymarket – Edinburgh Waverley);

- Stirling/Dunblane/Alloa
  - 2 tph fast (GQS – Stirling) going forward to Perth, Aberdeen and Inverness;
  - 2 tph stopping (GQS – Croy – Larbert – Stirling – Alloa/Bridge of Allan – Dunblane);
  - 2 tph stopping (Edinburgh Waverley – Haymarket – Edinburgh Park – Linlithgow – Polmont – Falkirk Grahamston – Larbert – Stirling – Bridge of Allan – Dunblane);
- Croy
  - 2 tph inner suburban (GQS – Bishopbriggs – Lenzie – Croy).

This package would probably create sufficient capacity to accommodate enhanced Edinburgh local services but it has not been possible to identify the additional paths for an increased local service to Edinburgh.

The indicative journey times are 42 minutes for ‘fast’ and 50 minutes for ‘stopping’ services between Glasgow and Edinburgh, with an additional 400 seats per hour between Edinburgh and Glasgow. This rises to 800 if 6-car sets are used on the two additional trains.

The indicative journey time for Dunblane/Glasgow services is 40 minutes, a reduction of around 9 minutes on the current situation.

The indicative journey time for Dunblane/Edinburgh services is 55 minutes, a reduction of around 9 minutes on the current situation.

Implications and Costs

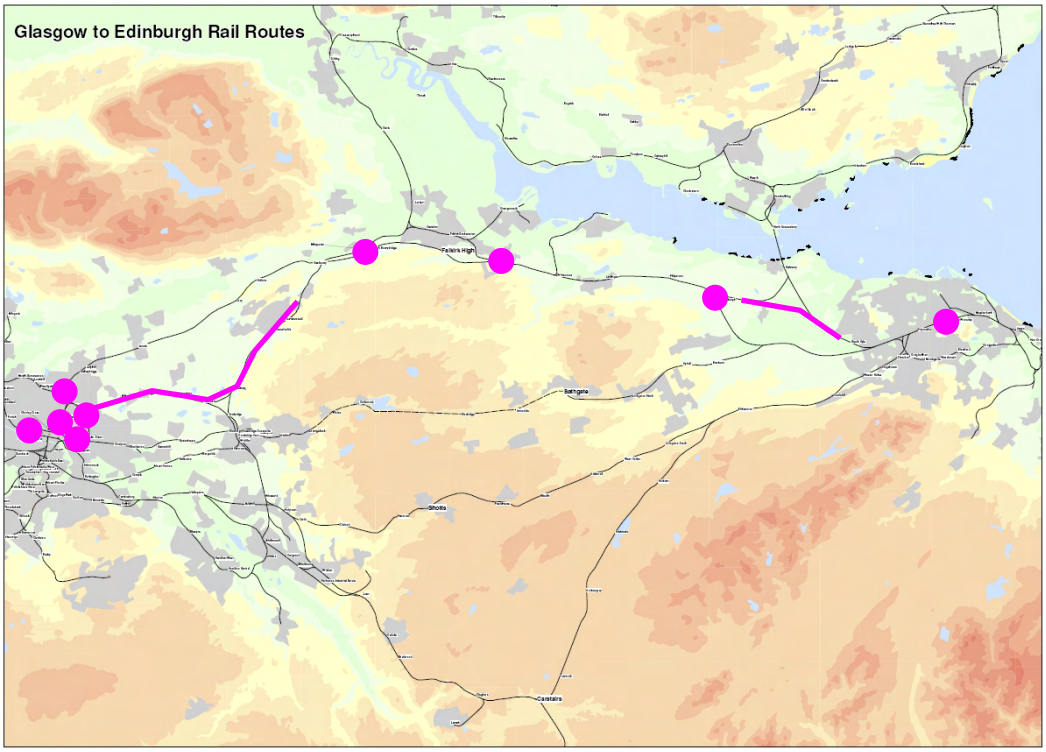
It appears feasible to provide the necessary infrastructure although seeking the necessary powers to construct the proposed new infrastructure the need for land purchase will extend the delivery period. Electrification will need detailed investigation as well as the impact of signaling changes. The infrastructure requirements for this package are estimated as:

- Finnieston turnback;
- GQS Platforms;
- Garngad Chord;
- Bellgrove;

- Cowlairs Flyover;
- Electrification to Cumbernauld;
- Greenhill turnback;
- Polmont Station;
- Winchburgh Grade Separation;
- Dalmeny Chord; and
- Edinburgh Waverley North West.

The locations of these are shown in Figure 9.4.3. The infrastructure costs for implementing this package are estimated as being in the range of £500 million to £1 billion. More detailed analysis of the interaction of services may remove the need for the Cowlairs Flyover. It may also be unnecessary to have grade separation at Winchburgh, however if this is the case then the flat junction solution would be required. If it proves to be possible to deliver this package with this reduced infrastructure, then the estimated infrastructure costs fall into the £250 million to £500 million range.

Figure 9.4.3 – C2 Infrastructure Upgrading



Risks and Uncertainties

A number of issues should be recognised, comprising:

- Provision of appropriate service for Springburn/Barnhill;
- Potential re-routing of North Suburban service;
- Relocation of Polmont Station;
- Disruption and Construction impact;
- Connections at Croy;
- DMU & EMU performance for residual longer distance DMU services; and
- Glasgow Queen Street to Cowlairs capacity.

Appraisal

The detailed Project Summary Tables (PSTs) are contained in Appendix C. This package has a BCR of 0.9 (minor negative impact), although if savings in infrastructure are achieved as noted above, then this would improve to 1.1(minor benefit). This indicates that the package is marginal at best, although there would be benefits to reliability through the improvement of key constraints.

Package D

Overview

This package involves the provision of an enhanced frequency electric train service on the Shotts line between Edinburgh and Glasgow.

Description

This package involves the development of the line via Shotts to provide enhanced and faster services by electrification. Although the route is 47 ¼ miles long, only 22 miles (47 per cent) are not currently electrified; the section from Holytown Junction to Midcalder Junction.

It has been assumed that the existing hourly all-stops service would be retained, however there would be opportunities to consider greater integration with existing Glasgow suburban electric services. Some infrastructure and signalling works would be required to ensure that the benefits from electrification were fully realised. A new platform at Haymarket station has been included within the costs for robustness as it may be necessary to terminate the stopping service at Haymarket due to pathing restrictions between Haymarket and Edinburgh Waverley, however this will require more detailed timetable modeling to be undertaken to clarify.

The new service would provide 2 tph between Glasgow Central and Edinburgh Waverley with service patterns of:

- Glasgow Central – Holytown – Shotts – Livingston South – Haymarket – Edinburgh Waverley; and
- Glasgow Central – Holytown – West Calder – Livingston South – Haymarket – Edinburgh Waverley.

The indicative journey time for these semi-fast services is around 55 minutes between Glasgow Central and Edinburgh Waverley, though it is noted that more detailed timetable planning is required to confirm this and map fully the interaction with Argyle Line and WCML services. An additional 400 seats per hour between Edinburgh and Glasgow would be provided. This rises to 800 if 6-car sets are used on the two additional trains.

Implications and Costs

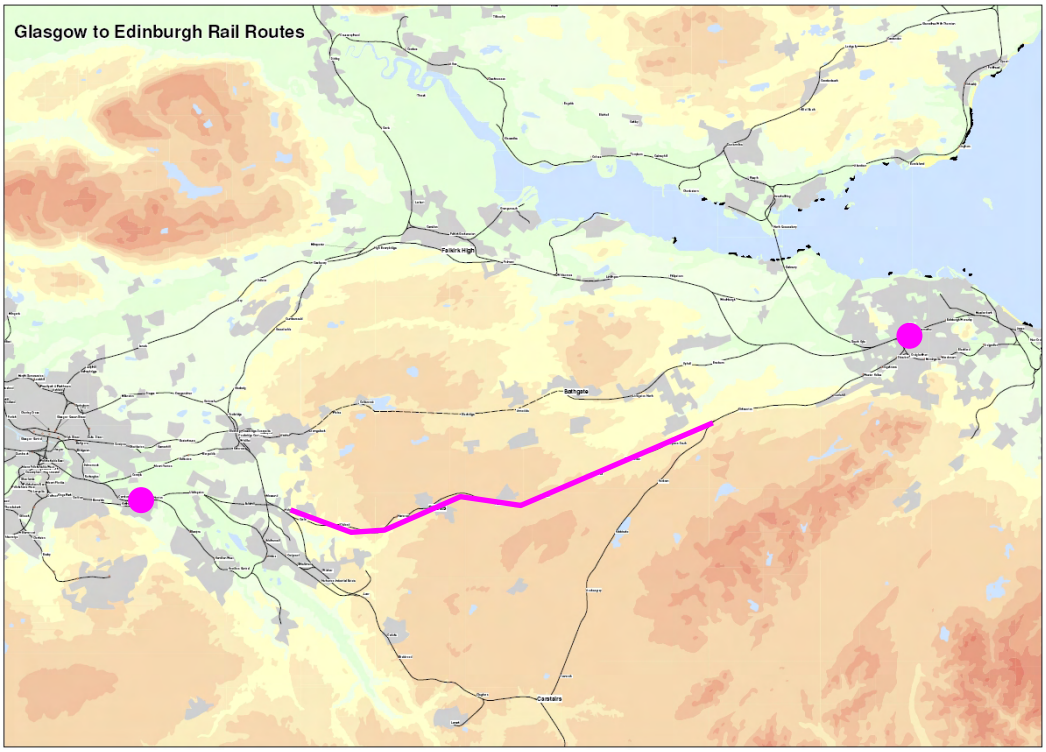
It is estimated that these services would require 4 new EMUs. The infrastructure requirements for this package are estimated as:

- Electrification;
- Major infrastructure/signaling;
- Newton West upgrade, line speed across the route, signalling headway improvements across the route; and

- Provision of Haymarket platform 5.

The locations of these are shown in Figure 9.4.4. The infrastructure costs for implementing this package are estimated as being in the range of £100 million to £250 million.

Figure 9.4.4 – D Infrastructure Upgrading



Risks and Uncertainties

A number of issues should be recognised, comprising:

- Potential to amalgamate with Whifflet electrification and combine all stops service, saving on operating costs and reducing conflicts;
- Interaction with and impact on freight movements given the lack of loops to allow overtaking; and
- Disruption and Construction impact.

Appraisal

The detailed Project Summary Tables (PSTs) are contained in Appendix C. This package has a BCR of 1.4 (positive impact). This would provide a step change in the connectivity of Glasgow Central and its rail services with Edinburgh as the indicative journey time compares favourably with the existing journey time using Glasgow Queen Street plus walk time. This offers benefits to journey time and reduced emissions over the B2 option on this route together with the lower operating costs of EMU compared with DMU.

9.5 Long Term Packages

This section provides a summary of the packages which are seen as long term interventions requiring significant infrastructure and funding and only implementable in the longer term horizon. Therefore, these options should be considered further as part of the Strategic Transport projects Review.

In packaging the options, we considered a number of key issues relating to major infrastructure.

Achieving a better balance between north and south lines on the western approach to Edinburgh would require a means to move services from the south lines (E&G and Bathgate), onto the north lines (Fife). While in theory this could be achieved through the provision of improved flat junctions, this would significantly impact on the capacity of the route in itself by requiring inbound services to cross outbound lines and vice versa. The EARL project would have allowed for some rebalancing of services by moving some E&G services onto the north lines. This could also be achieved by providing a section of line known as the Dalmeny Chord, which would link from around Humbie on the Winchburgh to Dalmeny section of line to around Turnhouse on the Fife line.

Further work to the west facing throat at Edinburgh Waverley would raise the theoretical capacity to 32 tph and it is likely that this would also allow a higher proportion of the theoretical paths to be used. The ability to use a greater proportion of the theoretical paths could also be enhanced through work to the east of Edinburgh Waverley to allow greater platform availability through marshalling trains at Abbeyhill or Craigentinny. Provision of additional siding capacity to the east of Edinburgh Waverley Station would enable the capacity of Edinburgh Waverley to be utilised more effectively as a 'through-train' only uses a platform for two to three minutes whereas a terminating train will tend to use a platform for a minimum of 5-6 minutes and sometimes significantly longer.

We have considered a major enhancement to the E&G line to provide a 125mph capable railway. The current E&G alignment geometry means that it cannot be upgraded to 125mph running. So much of the of the new infrastructure would be off the existing line that this would in essence be the construction of a new line. If that is the case, then it is considered that a more direct new alignment should be considered. However, 125mph running on the E&G could be achieved by using tilting train technology similar to that used on the WCML. The major benefit of this is the ability to reduce the infrastructure requirements and allow an upgrading mainly on the existing line of the route.

A number of strategic options have been considered to improve the capacity and speed of approach to Edinburgh. A tunnel from the west of Edinburgh to Edinburgh Waverley has not been taken forward within the packages. The cost of a single bore tunnel for EARL (1-track) was estimated at £80 million per km. A tunnel from west Edinburgh to Edinburgh Waverley would be around 8km long and would need to be twin bore. Using the figures from EARL, this would give a minimum cost of £1.3 billion for the tunnelling. However, the costs for EARL are on the basis of known ground conditions, no interface with foundations and limited risks to the built environment on the surface. Offsetting this to some degree are the one off costs of mobilisation and tunnelling machines..

At Edinburgh Waverley or nearby, there would be a need to construct a significantly large underground station complex. To do this while maintaining the operation of the current station and network would be a major challenge. Fire evacuation regulations are likely to mean that multiple access points would be required and these may require to be tunnelled.

Construction of the Channel Tunnel Rail Link (CTRL) Phase 2 that is due to open in late 2007 has an estimated cost of £3.3 billion. CTRL Phase 2 incorporates new surface stations at St Pancras, Ebbsfleet and Stratford together with 39km of twin track, 50 per cent of which is in tunnel. The station work at St Pancras includes the provision of a new underground 'Thameslink' facility. The cost breakdown for the project is:[67]

- St Pancras £800 million;
- Ebbsfleet £100 million;
- Stratford £210 million; and
- Other infrastructure £2.2 billion

It should be noted that the fitting out of the Thameslink station was subject to further grant funding of £65 million from DfT. Given these figures, the tunnelling estimate developed from the EARL figures appears to be reasonable, however ground conditions will be different and tunnelling conditions could be more severe in Edinburgh. The need to control settlement under a number of nationally important historical buildings is also noted. The provision of a large underground station complex in Edinburgh would be on a similar scale to the works undertaken at St Pancras, but with the majority of work being focussed underground rather than on surface refurbishment and construction. It is also important to note that the underground construction at St Pancras was carried out on a blockade basis and involved extensive 'cut-and-cover' techniques rather than actual underground construction.

The terrain and development currently in place around Edinburgh Waverley mean that a 'cut-and-cover' solution is unlikely to be a viable option. Therefore a tunnelled station would be necessary. Based on St Pancras and taking into account the various factors affecting construction, a lower bound cost of £1.5 billion – £2.0 billion should be considered. This means that a tunnelled solution for bypassing the western approaches to Edinburgh could have a lower bound cost of around £3 billion.

[67] Department for Transport and London and Continental Railways

Having considered a tunnel and dismissed this on cost grounds, the remaining longer term options comprise of (i) providing a double-deck approach along the existing E&G rail corridor, and (ii) upgrading of the Slateford corridor to provide off-line stations on loops and remove crossovers. Forming a double-deck section of track would be difficult to construct and given that much of this section is already raised above the surrounding ground level, the visual impact of this would be significant. A major upgrading of the Slateford corridor was considered, which would have required extensive demolition to achieve a 4-track approach, however we consider that a more practical option remains that would involve remodelling the existing stations, and in some cases moving these, to provide 4-track sections at the stations comprising of two high speed lines through the centre and two loop lines to the side to serve the stations and allow other services such as freight, to be overtaken.

Neither of these directly improves the capacity of the Haymarket to Edinburgh Waverley section, although an improvement to increase and better use the theoretical paths could work in tandem with these to provide better connectivity for an increased number of services.

Package C3

Overview

This package is an electrified version of Package C2 and provides for electrified services between Edinburgh and Glasgow, together with routes to Dunblane/Alloa. It also provides upgrading of key constraints.

Description

This package develops the E&G line via Falkirk High by providing significant additional capacity, removing key constraint points and electrifying the route. This package also provides the capacity to enhance linkage to Edinburgh airport by provision of a new station at Gogar, adjacent to Edinburgh airport where an interchange would be provided with the tram services.

This package would provide the ability to run six trains per hour on the E&G line as follows:

- E&G
    - 2 tph fast (GQS – Haymarket – Edinburgh Waverley);
    - 4 tph stopping (2 x GQS – Polmont – Linlithgow – Gogar – Haymarket – Edinburgh Waverley and 2 x GQS – Croy – Falkirk High – Edinburgh Park – Haymarket – Edinburgh Waverley);
- Stirling/Dunblane/Alloa
    - 2 tph fast (GQS – Stirling) going forward to Perth, Aberdeen and Inverness;
    - 2 tph stopping (GQS – Croy – Larbert – Stirling – Alloa/Bridge of Allan – Dunblane);
    - 2 tph stopping (Edinburgh Waverley – Haymarket – Edinburgh Park – Linlithgow – Polmont – Falkirk Grahamston – Larbert – Stirling – Bridge of Allan – Dunblane);
- Croy
    - 2 tph inner suburban (GQS – Bishopbriggs – Lenzie – Croy).

This package would probably create sufficient capacity to accommodate enhanced Edinburgh local services but it has not been possible to identify the additional paths for an increased local service to Edinburgh

The indicative journey times are 37 minutes and 47 minutes respectively for fast and stopping services between Glasgow and Edinburgh, with an additional 400 seats per hour between Edinburgh and Glasgow. This rises to 800 if 6-car sets are used on the two additional trains.

The indicative journey time for Dunblane/Glasgow services is 37 minutes, a reduction of around 12 minutes on the current situation.

The indicative journey time for Dunblane/Edinburgh services is 53 minutes, a reduction of around 11 minutes on the current situation.

The infrastructure requirements would be as per package C2 plus electrification of the E&G line via Falkirk, the Carmuirs to Dunblane section of the route and the Stirling to Alloa.

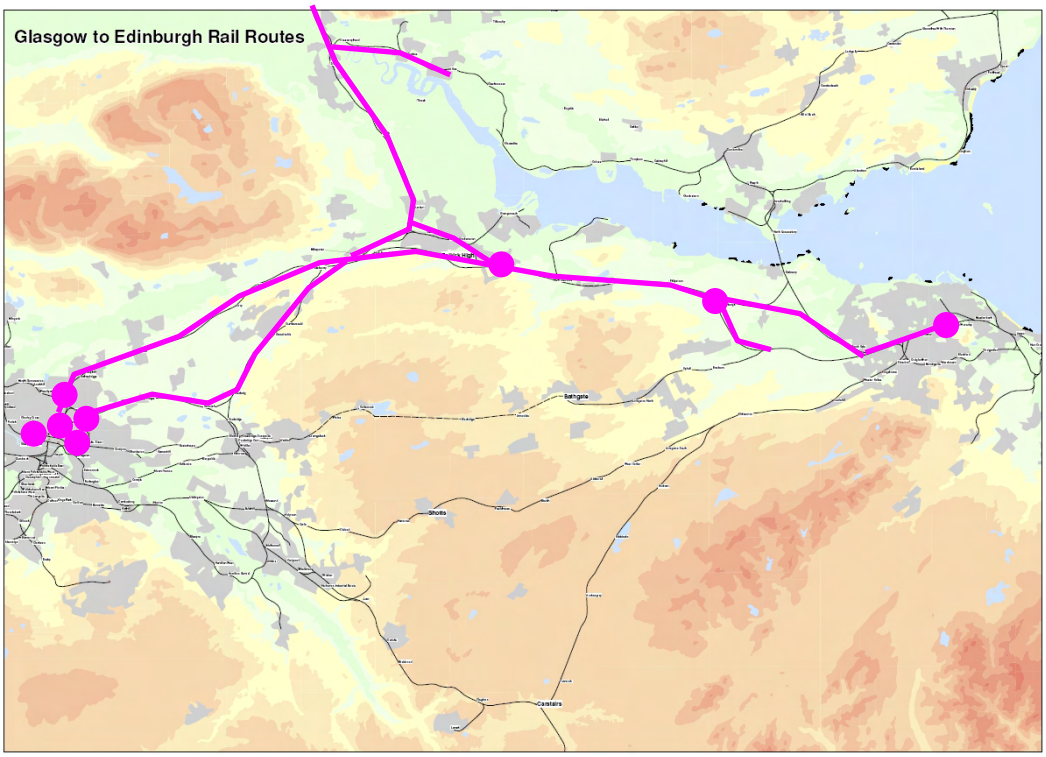
Implications and Costs

It appears feasible to provide the necessary infrastructure although the need for land purchase will extend the delivery period and electrification will need detailed investigation as well as the impact of signaling changes. The infrastructure requirements for this package are estimated as:

- Finnieston turnback;
- GQS Platforms;
- Garngad Chord;
- Bellgrove;
- Cowlairs Flyover;
- Electrification to Cumbernauld;
- Greenhill turnback;
- Polmont Station;
- Winchburgh Grade Separation;
- Dalmeny Chord;
- Edinburgh Waverley North West;
- Electrification of core E&G;
- Electrification of Diversion Route 1 (Haymarket);
- Electrification of Diversion Route 2 (Falkirk G'ston); and
- Extension of electrification to Dunblane/Alloa.

The locations of these are shown in Figure 9.4.5. The infrastructure costs for implementing this package are estimated as being in the range of £500 million to £1 billion.

Figure 9.4.5 – C3 Infrastructure Upgrading



Risks and Uncertainties

A number of issues should be recognised, comprising:

- Possibility of operating an additional local service from Falkirk to Edinburgh;
- Provision of appropriate service for Springburn/Barnhill;
- Potential re-routing of North Suburban service;
- Relocation of Polmont Station;
- Disruption and Construction impact;
- Connections at Croy;
- DMU and EMU performance for residual longer distance DMU services; and
- Glasgow Queen Street to Cowlairs Capacity.

Appraisal

The detailed Project Summary Tables (PSTs) are contained in Appendix C. This package has a BCR of 1.1(minor benefit), although if savings in infrastructure are achieved as noted above, then this would improve to 1.3 (minor benefit). By combining packages C1 and C2, this package provides the environmental benefit of reduced emissions by moving to electric traction and providing a significant improvement in seating capacity per hour.

Package E

Overview

This package would provide significant further step change in capacity and performance of the E&G line that would allow the 6tph service of other options to include four fast services with an operating speed of 125mph and may allow an 8tph E&G service to operate through major infrastructure and electrification. Express services would be operated using rolling stock with tilt capability. This would enable the best possible railway that can be provided within the confines of the existing route alignment.

This package considered providing 125mph capability on the existing route but the amount of major route realignment work required means this would effectively be a brand new railway. It is therefore proposed that the 125mph capability is achieved through the use of tilting trains operating at a higher speed on what would be substantially the existing track alignment.

Description

This package involves a major upgrade to the E&G line via Falkirk High to provide 4-track railway where practicable, increased line speed of 125mph where practicable and the provision of the Dalmeny Chord and associated new station at Gogar. As a minimum it could deliver the basic timetable as detailed in option C2/C3 with faster journey times on the express services, with an additional local service in the east, providing journey time savings on the Dunblane/Edinburgh services, and this is the timetable option that has been tested. In addition to the infrastructure required for C3, this package provides for the grade separation of the junctions at Greenhill, which would reduce conflicting movements, giving enhanced capacity and reliability. It would also provide 4-track railway between Bishopbriggs and Croy to allow separation of fast and stopping services. There is also an allowance made for general speed upgrading to allow 125mph tilting rolling stock to operate fast services.

This package would provide an end to end fast journey time of 34 minutes and the service pattern as tested is noted below. Using tilting rolling stock would allow up to 900 additional seats per hour between Edinburgh and Glasgow.

- E&G
    - 4 tph fast (GQS – Gogar – Haymarket – Edinburgh Waverley);
    - 2 tph stopping (GQS – Bishopbriggs – Lenzie – Croy – Falkirk High – Polmont – Linlithgow – Edinburgh Park – Haymarket – Edinburgh Waverley);
- Stirling/Dunblane/Alloa
    - 2 tph semi fast (GQS – Croy – Larbert – Stirling) and onward to Perth – Inverness – Aberdeen
    - 2 tph stopping (GQS – Bishopbriggs – Lenzie – Croy – Larbert – Stirling);

- 2 tph semi fast (Edinburgh Waverley – Haymarket – Gogar – Falkirk Grahamston – Camelon – Larbert – Stirling – Bridge of Allan – Dunblane)
- 2 tph stopping (Edinburgh Waverley – Haymarket – Edinburgh Park – Linlithgow – Polmont – Falkirk Grahamston)

Implications and Costs

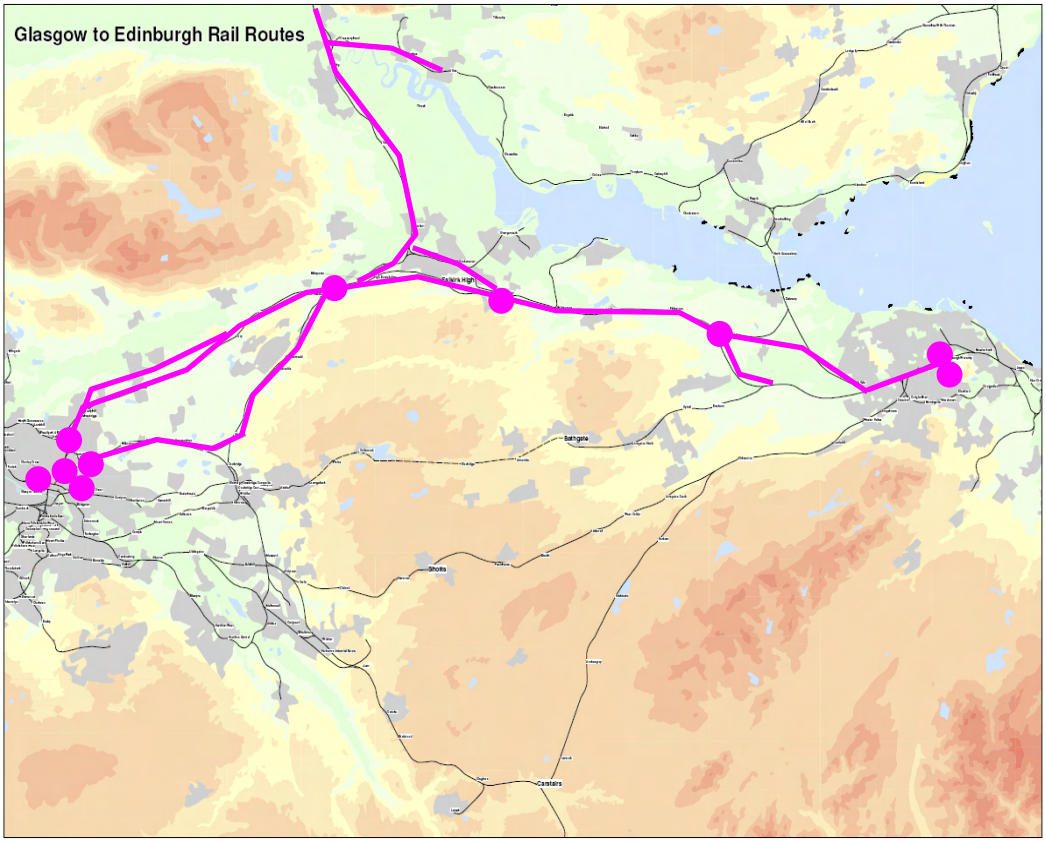
The infrastructure requirements for this package are estimated as:

- Finnieston turnback;
- GQS Platforms;
- Garngad Chord;
- Bellgrove;
- Cowlairs Flyover;
- Electrification to Cumbernauld;
- 4-track Bishopbriggs to Croy
- Greenhill Lower / Upper;
- Polmont Station;
- Winchburgh Grade Separation;
- Dalmeny Chord;
- Edinburgh Waverley North West;
- Edinburgh Waverley South West;
- Electrification of core E&G;
- Electrification of Diversion Route 1 (Haymarket);
- Electrification of Diversion Route 2 (Falkirk G'ston);
- Extension of electrification to Dunblane/Alloa; and
- 125mph line speed.

The locations of these are shown in Figure 9.4.6. The infrastructure costs for implementing this package are estimated as being in the range of £1 billion to £1.5 billion.

The diversion of North Suburban services may not be required depending on detailed analysis. This would remove the need for the Cowlairs Flyover. There may also be opportunities to achieve a reduction in the costs at Edinburgh Waverley by terminating some services at a new platform 5 at Haymarket, located to the south of the current platforms.

Figure 9.4.6 – E Infrastructure Upgrading



Risks and Uncertainties

A number of issues should be recognised, comprising:

- Provision of appropriate service for Springburn/Barnhill;
- Re-routing of North Suburban service;
- Relocation of Lenzie Station
- Detailed timetabling – Edinburgh Waverley and Glasgow Queen Street capacity constraints;
- Land impacts;
- Relocation of Polmont Station; and

- Disruption and Construction impact.

Appraisal

The detailed Project Summary Tables (PSTs) are contained in Appendix C. This package has a BCR of 0.9 (minor negative impact), although if savings in infrastructure are achieved as noted above, then this would improve to 0.94. However, it must be noted that the timetable tested within this package was an initial view of what could be achieved on this infrastructure. Given that the infrastructure provides for the release of major constraints and a significant increase in system capacity, it is considered that this package provides for a highly flexible solution that could support a more intense usage than has been tested to date. This should feed back into the main STPR project and form the basis for testing a rail plan across Central Scotland.

The difference in test service patterns between package C2/C3 and E is the inclusion of an additional 2 tph between Edinburgh Waverley and Falkirk Grahamston. The other major difference is the speeding up of services due to the higher running speeds provided by the infrastructure associated with package E. It is notable however that package E gives significant potential for service alteration, augmentation and revision that cannot fully be explored without a more significant timetabling exercise. There is even greater potential if the installation of Platform 0 at Haymarket is mirrored with a similar facility to the south; Platform 5.

Package F

Overview

This package would provide a high speed link between Glasgow Central and Edinburgh Waverley, making the best use of existing infrastructure and providing new links where necessary.

Description

This package involves a major upgrade to the Glasgow Central to Edinburgh Waverley route between Glasgow Central and Rutherglen 4-track railway. A grade separated bypass section would be provided from Rutherglen to west of Uddingston. Lesmahagow Junction at Motherwell would be grade separated. A new section of line would be provided from Law to Cobbinshaw to bypass Carstairs. The service pattern would be 4 tph between Glasgow Central and Edinburgh Waverley with all 4 trains stopping at Haymarket only and 2 tph stopping at Motherwell. The indicative journey time would be 35 minutes for Haymarket only and 40 minutes for Motherwell stopping services. It is assumed that a dedicated fleet of new EMUs would be required to run this service, similar to those being introduced for domestic services on CTRL.

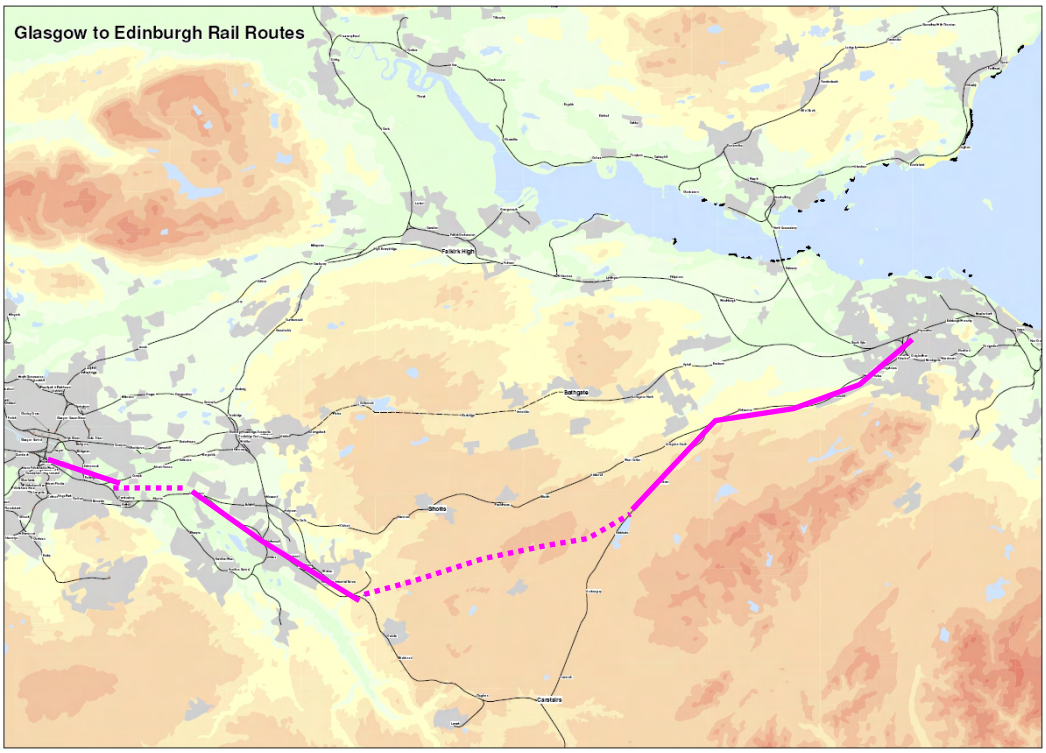
Implications and Costs

This package involves the delivery of significant infrastructure other than that considered within the specific menu of interventions listed earlier. The infrastructure requirements for this package are estimated as:

- WCML upgrading Glasgow Central to Law;
- Cambuslang/Newton Bypass Line;
- Law to Cobbinshaw Line; and
- Cobbinshaw to Haymarket Upgrade.

The locations of the new build elements are shown in Figure 9.4.7. The infrastructure costs for implementing this package are estimated as being in the range of £1.5 billion to £3 billion.

Figure 9.4.7 – F Infrastructure Upgrading



Risk and Uncertainties

There are significant risks and uncertainties relating to this package as it involves major new railway construction, the implementation of upgrading works over live railway, significant structural and ground engineering works and a significant environmental impact due to the new lines.

Appraisal

The detailed Project Summary Tables (PSTs) are contained in Appendix C. This package has a BCR of 0.4 (high negative impact). The high level of infrastructure cost and subsequent service delivery does not result in a level of patronage that is sufficient enough to deliver a BCR that is above 1. This package does not perform well in comparison to some other long term options.

Package G

Overview

This package would provide a new route alignment between Glasgow and Edinburgh.

Description

This package would provide a new route alignment between Glasgow and Edinburgh following the M8 corridor from Baillieston to Newbridge. In the west, two approaches to the city centre have been considered. The first would use Glasgow Central as the terminus with two upgraded fast tracks to Rutherglen and then a new grade separated alignment following the Whifflet line to Baillieston. A second option would provide a new underground station at George Square with a tunnel approach from High Street. A new high speed twin track alignment would be provided adjacent to the north electric line from High Street to Baillieston with a tunnel section under Garrowhill.

In the east, two approaches to the city centre have been considered. The first would provide a bridge over the city bypass and would run above the existing E&G line to Haymarket. It is envisaged that potential to switch from top to bottom deck would be required and a remodelling of Haymarket would be required to provide high level terminating platforms. The second option would join the existing suburban line through Slateford at the city bypass. The existing stations on the line would be located onto loops to allow high speed running on the existing tracks. A service pattern of 4 tph has been used with an indicative journey time for this service of 27 minutes. It is assumed that a dedicated fleet of new EMUs would be required to run this service, similar to those being introduced for domestic services on CTRL.

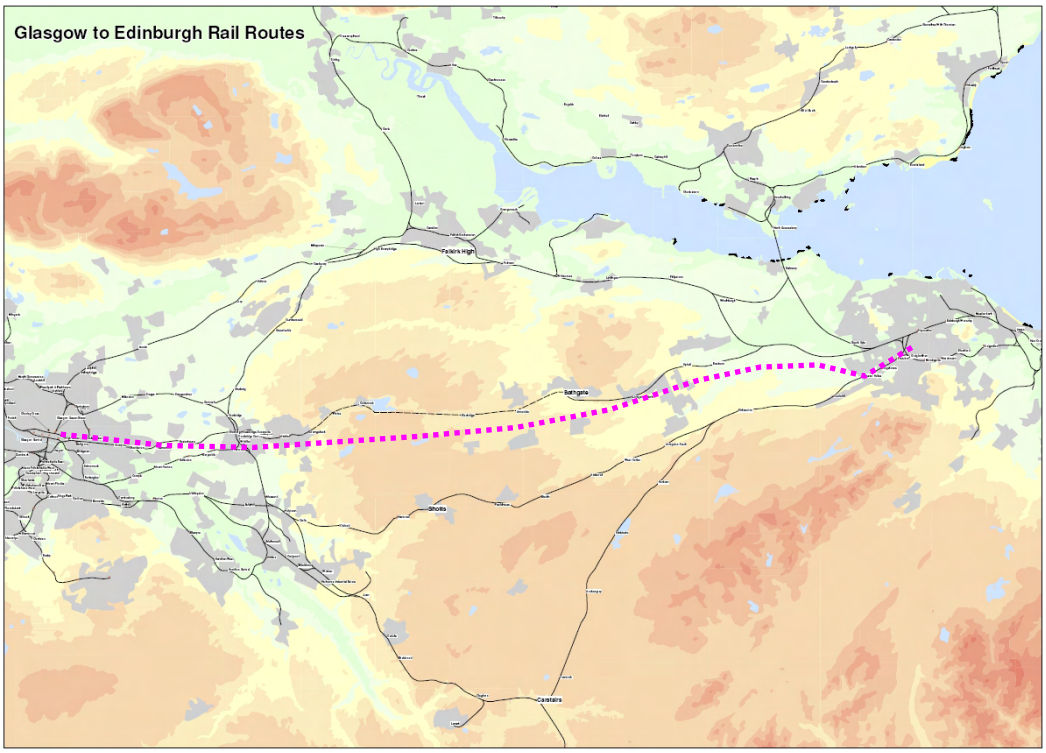
Implications and Costs

The infrastructure requirements for this package are estimated as:

- George Square Station and Approaches;
- George Square to High Street;
- High Street to Garrowhill;
- Garrowhill tunnel;
- Baillieston to City Bypass; and
- Slateford Approach.

The indicative location of the new line is shown in Figure 9.4.8. The infrastructure costs for implementing this package are estimated as being in the range of over £7 billion.

Figure 9.4.8 – G Infrastructure Upgrading



Risk and Uncertainties

There are significant risks and uncertainties relating to this package as it involves major new railway construction, underground construction, significant structural and ground engineering works and a significant environmental impact due to the new lines.

Appraisal

The detailed Project Summary Tables (PSTs) are contained in Appendix C. This package has a BCR of 0.3 (high negative impact). The high level of infrastructure cost and subsequent service delivery does not result in a level of patronage that is sufficient enough to deliver a BCR that is above 1. This package does not perform well in comparison to other long term options.

9.6 Sensitivity Tests

This section of the report details a number of sensitivity tests carried out on the core results:

- Agglomeration Impacts;
- Optimism Bias; and
- Combination of both of the above.

Fairly coarse analysis reported earlier in this paper calculated the extent of agglomeration impacts on the core Edinburgh Glasgow route to be around 20 per cent of travel time savings. This level is applied to the TMfS analysis of packages C to G. The figure related to a maximum journey time saving of 15 minutes. As an additional sensitivity for the two high speed options, F and G, additional agglomeration sensitivity was calculated at the level of 60 per cent of travel time savings. This level is considerably higher than the evidence indicates is the case but is included for comparison purposes.

The level of optimism bias for packages C to E is set at 44 per cent, the standard civil engineering level, to reflect that they involve existing infrastructure. The sensitivity reported here raises the level of optimism bias for these packages to 66 per cent, the non-standard civil engineering level. Packages F and G, reflecting the new build infrastructure, used an optimism bias level of 66 per cent. In the optimism bias sensitivity for F and G, the level of optimism bias is reduced to 44 per cent.

The key point to note is that the ranking of packages, in terms of the Benefit Cost ratio, is unaffected within these sensitivity tests. Additionally, the BCR for packages F and G remains significantly below 1 even with the high level of agglomeration impact and the reduced optimism bias levels

Table 9.6.1 – Sensitivity Testing

	Core		Agglomeration			Optimism Bias		Optimism Bias and Agglomeration		
			20% of time savings	60% of time savings		C1 to E – 66% F, G – 44%		20% / 60% Agglomeration; OB: C1 to E – 66% OB: F, G – 44%		
	BCR	**Ranking**	**BCR**	**BCR**	**Ranking**	**BCR**	**Ranking**	**BCR**	**BCR**	**Ranking**
C1	1.31	2	1.52	-	2	1.10	2	1.27	-	2
C2 High Cost	0.89		1.04	-		0.80		0.93	-	
C2 Low Cost	1.12	4	1.31	-	4	1.01	4	1.18	-	4
C3 High Cost	1.10		1.28			0.96		1.12	-	
C3 Low Cost	1.30	3	1.51		3	1.13	3	1.31	-	3
D	1.41	1	1.60	-	1	1.29	1	1.46	-	1
E High	0.87		1.01	-		0.76		0.88	-	
E Low	0.93	5	1.08	-	5	0.82	5	0.94	-	5
F	0.35	6	0.40	0.48	6	0.39	6	0.44	0.54	6
G	0.28	7	0.32	0.39	7	0.32	7	0.36	0.45	7

9.7 Complementary Packages

Package Y

This package considers significant alterations that could be made to the major stations that serve this study area and impact on the operation of services between Glasgow and Edinburgh. Some of the options are shown schematically in Appendix B. The elements of this package are:

- Relocation of Polmont station to improve train operations and provide additional Park-&-Ride capacity;
- Relocation of Lenzie station to better serve future balance of the town. Incorporation of major Park-&-Ride facility and loops for stopping services;
- Relocation of Linlithgow station to improve train operations, provide additional Park-&-Ride capacity and loops for stopping services;
- Provision of new Park-&-Ride station near Greenhill with platforms on both E&G line and Cumbernauld to Falkirk Grahamston line;
- Relocation of Croy station.

Relocation of Lenzie Station

The present Lenzie Station is located near to the centre of the town and is the main station for the Lenzie and Kirkintilloch conurbation. It has a 149-space Park-&-Ride facility and is served by 2 tph to/from Glasgow and 2 tph to/from Stirling/Dunblane. The Park-&-Ride facility is at capacity within the AM peak and there are limited opportunities to provide a significant extension to this facility and there is currently a significant problem with on-street parking. Trains stopping at Lenzie impact on the operation of the E&G line. There is an opportunity at Lenzie to move the station to either the east or west of its current position and provide 4-tracks.. There is an option for moving the station to the west and incorporates over 500 Park-&-Ride spaces. A relocation of the station to the east could be incorporated into the redevelopment of the Woodilee area, and would provide a significant 'walk to' catchment from the new development and would significantly enhance the access to/from Kirkintilloch, but it may be more difficult for other parts of the town to access a station here. Either site would also retain a significant walk catchment.

The relocation of Lenzie station would provide provision for four tracking to allow fast trains to overtake slow trains, will provide additional park and ride spaces and improve road links to Kirkintilloch. Therefore, this option should be considered further as a potential modification to the finalised package.

Provision of New Station at Greenhill

A significant amount of work has been undertaken to consider the potential for a Park-&-Ride at Allandale, near to Castlecary. This would provide a facility for southbound trips heading to Glasgow to park and access trains on the Cumbernauld line. The concept of this to intercept trips on the M80 is sound, but the location is significantly distant from the majority of trip origins (Falkirk/Stirling) to lie outwith the concept of short distance Park-&-Ride (such as Croy) and is not far enough in towards the destination (Glasgow) to match with the concept of longer distance Park-&-Ride (such as Shields Road or Hermiston Gait).

Provision of enhanced Park-&-Ride capacity at Croy and a relocated Lenzie are likely to give sufficient provision for trips to Glasgow, although this may offer a long term alternative depending on levels of traffic congestion. Demand for travel to the east is significantly less in terms of volume and therefore enhanced Park-&-Ride opportunities at Polmont and Linlithgow are likely to offer a better option for travel.

Relocation of Croy Station to Greenhill

The present Croy Station is located between Kilsyth and Cumbernauld. It has a 153-space Park-&-Ride facility and is served by 4 tph to/from Glasgow (E&G and Dunblane services) and 2 tph to/from Edinburgh. The concept of closing Croy would be to rationalise stations on the line, were the stations at Lenzie and Greenhill to be positioned and accessible so as to offer an acceptable alternative. However, Croy serves a significant local market for travel into Glasgow and it is unlikely that Lenzie would offer a good enough alternative.

Croy station should be maintained, but redesign to incorporate 4-track with platforms serving the slow lines should be considered.

Relocation of Polmont Station

The present Polmont Station is located between Polmont and Maddiston. It has a 101-space Park-&-Ride facility and is served by 2 tph to/from Glasgow and 4 tph to/from Edinburgh (E&G and Dunblane services). Trains stopping at Polmont impact on the operation of the E&G line. The Park-&-Ride facility at is at capacity within the AM peak and there are limited opportunities to provide a significant extension to this facility. In addition, the current station is located to the east of Polmont junction, meaning that any trains stopping here act as a block for all other services. There is an opportunity to realign the junction and provide a new station that could serve both the E&G line and the line to Falkirk Grahamston as a 4-platform station or to provide platforms only on the Falkirk Grahamston Line. The infrastructure changes include replacement goods line track and the slueing of existing 4x800m tracks. Impact on structures is low but land purchase is required. There is an option to provide around 500-spaces for Park-&-Ride. This is likely to reduce the number of houses within the walk catchment of the station, but would significantly increase the capacity of the Park-&-Ride to serve a wide area. In terms of train operations, this option would significantly improve the management of services at Polmont Junction.

The relocation of Polmont station will provide additional network capacity improving the operation of the junction and will also provide additional park and ride capacity. Therefore the relocation of Polmont station should be considered further as a potential modification to the finalised package.

Relocation of Linlithgow Station

The present Linlithgow Station is located towards the east side of the town. It has a 91-space Park-&-Ride facility and is served by 2 tph to/from Glasgow and 4 tph to/from Edinburgh (E&G and Dunblane services). Trains stopping at Linlithgow impact on the operation of the E&G line. There is an opportunity at Linlithgow to move the station further to the east and provide 4-tracks at the station to allow stopping services to be passed. This would also allow a significant extension to the Park-&-Ride facilities, but there would be a reduction in the number of houses within a reasonable walk catchment of the station.

The relocation of Linlithgow station should be considered further as a potential modification to the finalised package.

Package Z

This package encompasses a range of measures that can broadly be brought under a title of 'Customer Care'. Within the option generation phase, a number of interventions were identified to address the issues of quality and attractiveness. While not a package that on its own can deliver the planning objectives, this group of interventions was studied to consider which might add value and act as 'package enhancements' to the major infrastructure and operations packages being considered. The proposed interventions include:-

Smart Card Pilot on E&G - Passenger benefits include greater flexibility and ease of purchase, reduced queuing for ticket purchase;

Ticket Machines at all Intermediate Stations – Passenger benefits include increased flexibility, ease of ticket purchase, resultant reduction in queuing for ticket purchase, social inclusion (tickets can be bought via the internet and collected at the station avoiding travel to the station to make advance purchases);

Through Tickets from Edinburgh Airport – Passenger benefits include increased flexibility, ease of ticket purchase, promotion of integrated travel, adds to competitiveness with car.

Web-Integrated Travel Tickets – Passenger benefits include increased flexibility, ease of ticket purchase, promotion of integrated travel, adds to competitiveness with car/taxi, visitors to Scotland can purchase integrated airport ticket before arrival in the country.

On-train connectivity – Passenger benefits include improving on train services, better business class product, also of benefit to leisure customers, proactive use of on train time.

It is recommended that these options are considered further as part of the ongoing development of the franchise and future franchise specifications.

10 Conclusions

Having considered each of the packages separately in the previous section, we now conclude by considering the merits of the various options, and how they might be combined.

The tables below show the comparative journey time reductions and additional seating capacity provision for each of the packages. The third table illustrates performance of the packages against the planning objectives. This is followed by a summary of the results for each of the packages together with our conclusions.

Table 10.1.1 – Summary of Journey Time Improvements

Route	Package	Fastest Journey Time		
		Short Term (2010)	**Medium Term (2014)**	**Long Term (2022)**
E&G *(current 50 mins)*	**A1**	46 / 47 mins inter peak only		
	A2	42 mins inter peak only		
	C1		46 mins	
	C2		42 mins	
	C3		37 mins	
	E			34 mins
Shotts / Carstairs *(current 84 mins Shotts and 60 – 65 mins Carstairs)*	**B1**	65 mins		
	B2	67 mins		
	B3	67 mins (Shotts) 65 mins (Carstairs)		
	D		55 mins (Shotts - fast)	
Alternative Routes	**F**			35 mins
	G			27 mins

The table below shows comparative additional seating capacity and follows the colour convention as for table 10.1.1.

Table 10.1.2 – Summary of Additional Seating Capacity between Edinburgh and Glasgow per hour

Route	Package	Additional seats per hour per direction between Glasgow and Edinburgh[68]		
		Short Term (2010)	Medium Term (2014)	Long Term (2022)
E&G *(current seating around 800 interpeak and 1600 peak)*	**A1**	None		
	A2	None		
	C1		None	
	C2		400 (up to 800 if 6-car)	
	C3		400 (up to 800 if 6-car)	
	E			900
Shotts / Carstairs (*current seating around 150 interpeak and 300 peak Shotts only)*	**B1**	200		
	B2	200		
	B3	400		
	D		400 (up to 800 if 6-car)	
Alternative Routes	**F**			Minimum of 1,400 Possible 2,200
	G			Minimum of 1,400 Possible 2,200 +

[68] Based on an EMU having the same capacity as existing Class 170 DMU

The table below shows the performance of each of the packages against the Planning Objectives.

Table 10.1.3 – Summary of Performance Against the Planning Objectives

Package	Planning Objective 1a *Reducing rail journey times between the city centres of Edinburgh and Glasgow*	Planning Objective 1b *Improving rail system capacity between Edinburgh and Glasgow*	Planning Objective 1c *Improving attractiveness of rail travel experience*	Planning Objective 1d *Improving reliability of rail services between Edinburgh and Glasgow*	Planning Objective 2 *An effective linkage between the rail network and Edinburgh Airport*	NPV	BCR
A1	+	Neutral	+/-	Neutral	Neutral	<£10m	1.3
A2	++	Neutral	++/-	Neutral	Neutral	£25m to £50m	2.7
B1	+	+	+/Neutral	-	Neutral	£10m to £25m	1.2
B2	+	+	+/Neutral	-	Neutral	£150m to £200m	3.8
B3	+	+	++/Neutral	+	Neutral	£100m to£150m	1.8
C1	+	Neutral	++	+/-	Neutral	£50m to£100m	1.3
C2	++	++	++	++	++	-£50m to -£100m	0.9
D	+	++	++/Neutral	+/-	Neutral	£50m to £100m	1.4
C3	++	++	++	++	++	£50m to £100m	1.1
E	+++	+++	+++	+++	++	-£100m to -£150m	0.9
F	++	+++	+++	++	Neutral	-£1bn to -£1.5bn	0.4
G	+++	+++	+++	++	Neutral	-£3bn to -£4bn	0.3

Short Term Interventions (up to 2010)[69]

Package A1 – E&G Revised Stopping Pattern 1

This package offers improved end to end journey times on the Edinburgh to Glasgow via Falkirk High route, potentially reducing the current 50-minute end to end journey time to 46/47 minutes in the inter-peak. This is based on a revised inter-peak stopping pattern with reduced intermediate calls at Falkirk High, Polmont and Linlithgow. This package does not offer additional seating capacity and there are no changes to the peak services with this package.

Package A2 – E&G Revised Stopping Pattern 2

This package offers improved end to end journey times on the Edinburgh to Glasgow via Falkirk High route through a reduced frequency of calls at Falkirk High and a mix of 'fast' and 'stopping' services. For the 'fast' services, it is estimated that journey times could be reduced from 50 minutes to 42 minutes, while the 'stopping' services would have an increased journey time to 53 minutes (both journey times are in the inter-peak only). This implementation of this package may require strengthening of off-peak services. This option would not provide any additional seating capacity and there are no changes to the peak services with this package.

Package B1 – Hourly Services via Carstairs

This package would provide additional services between Glasgow Central and Edinburgh Waverley via Carstairs, which, when added to the existing Intercity services on this route, would give an hourly frequency. The indicative journey time on this route would be 65 minutes assuming stops at Motherwell and Haymarket and it would require rolling stock to be sourced. This package also has the ability to improve the rail option for North Lanarkshire to Edinburgh flows and reduces cross Glasgow transfers – thus freeing capacity on the existing E&G The number of seats would be increased by up to two hundred every second hour.

Package B2 – Caledonian Express[70]

This package offers an improved timetable, improved journey time and approximately two hundred additional seats per hour on the Edinburgh to Glasgow via Shotts route through the implementation of the 'Caledonian Express' semi-fast services, which would offer an hourly semi fast service in addition to the existing service on this route. These new services would provide an Edinburgh to Glasgow service taking around 67 minutes.

[69] For the short term measures, with the exception of Package B2 and B3, it is assumed that the packages do not require capital investment for infrastructure enhancement. It is also assumed that current rolling stock is sufficient for A1 and A2.

[70] It should be noted that either B1 or B2 could be delivered in the short term but not both. If both are to be implemented (see package B3), the infrastructure works required will extend the delivery timescale into the medium term horizon

Medium Term Interventions (2010 – 2014)

The medium term measures would require capital investment for infrastructure enhancement and additional rolling stock.

Package B3 – Caledonian Express + Hourly Services via Carstairs (B1+B2)

This combination would provide improved journey times, two Edinburgh to Glasgow trains per hour 'semi-fast', additional seating capacity on the Edinburgh to Glasgow via Carstairs and Shotts route as well as better connections at Glasgow Central Station. As with B1 this package also has the ability to improve the rail option for North Lanarkshire to Edinburgh flows and reduces cross Glasgow transfers – thus freeing capacity on the existing E&G. It would require some infrastructure changes and journey times would be as B1 and B2 but the combination of both packages would deliver up to four hundred additional seats per hour.

Package C1 – Electrification of E&G/Dunblane/Alloa

This package offers improved journey times on both the peak and off peak services on the Edinburgh to Glasgow via Falkirk High route through electrification of the route (and key diversionary routes). This package retains the current stopping and timetable pattern though other variants are possible. This package offers an indicative journey time reduction from 50 minutes to 46 minutes city to city with additional journey time benefits for passengers travelling from Glasgow and Edinburgh to Dunblane, Stirling and Alloa. However, there would be no increase in seating capacity with this package.

Package C2 – E&G Line Development (conflict removal)

This package offers a mix of 'fast' and 'stopping' services as well as additional capacity to allow six trains per hour on the Edinburgh to Glasgow via Falkirk High route. This would be achieved by tackling the physical network constraints on the E&G line through a range of infrastructure improvements and using existing rolling stock.

As with Package C1, journey time improvements would benefit not only city to city passengers but passengers travelling to and from Dunblane/Stirling and Alloa. The additional capacity would also allow an interchange at Gogar with the tram to allow access to Edinburgh Airport. 'Fast' services would see journey times reduce from 50 minutes to 42 minutes. Meanwhile, 'stopping' services would be able to retain the current journey time of 50 minutes end to end. This package would also provide four hundred additional seats per hour or eight hundred additional seats per hour if six-car sets are used.

Package D – Electrification of Shotts Line

This package offers improved journey times and enhanced frequency of services on the Edinburgh to Glasgow via Shotts line through revision of the stopping pattern and electrification of the remainder of the route that is currently not electrified, as well as other infrastructure enhancements along the route. This package would reduce journey times on the Shotts line from 84 minutes to 55 minutes with four hundred additional seats per hour being provided or eight hundred additional seats per hour if six-car sets are used.

Long Term Interventions (2014 – 2022)

Package C3 – E&G Line Development & Electrification

This package combines the benefits of C1 and C2 and would deliver six services per hour between Edinburgh and Glasgow on the E&G line. It offers improved journey times through a mix of 'fast' and 'stopping' services on the Edinburgh to Glasgow via Falkirk High route. It also provides additional seating capacity, allows for increased frequency of services and creates an improved interchange with the tram to allow access to Edinburgh Airport. These benefits would be achieved through electrification of the route and significant infrastructure enhancements. The indicative journey time could be reduced significantly from 50 minutes at present to 37 minutes for 'fast' services and to 47 minutes for 'stopping' services. Four hundred additional seats per hour could be provided, though this could be increased to eight hundred if six-car sets are used. A number of component parts of this package are deliverable within the medium term horizon and the full package could potentially be delivered by 2016.

Package E - E&G Major Upgrade and Tilting Trains

This package offers a step change in seating capacity, service frequency, journey time and overall performance of the Edinburgh to Glasgow via Falkirk High route and associated services through a programme of electrification and major infrastructure enhancements including increasing the linespeed to 125mph. The indicative journey time would reduce significantly from 50 minutes to 34 minutes with additional journey time savings and benefits on other routes. It would also provide additional seating capacity with an increase of nine hundred seats per hour. A total of six services per hour would be provided between Edinburgh and Glasgow.

Package F –New/Upgraded High Speed Route

This package provides a high speed link between Edinburgh Waverley and Glasgow Central providing improved journey time, increased service frequency and additional seating capacity through significant infrastructure enhancements to the existing route via Carstairs as well as major new railway construction. However, this route would be longer than the E&G route so journey times would remain slightly longer than Package E.

The fastest journey time from city centre to city centre would be significantly reduced from the current 50 minutes to 35 minutes for 'fast' services and reduced to 40 minutes for services stopping at Motherwell. Substantial additional seating capacity would be provided with 1,400 additional seats per hour, which could be increased to 2,200 additional seats per hour with longer trains.

Package G – New High Speed Route

This package provides a brand new dedicated high-speed route between Edinburgh and Glasgow offering a step change in journey time, service frequency and performance through major construction works. This could provide a journey time of 27 minutes between the two cities; the quickest journey time of all the options considered. Additional seating capacity of 1,400 to 2,200 per hour could also be provided. For the purposes of testing, it has been assumed that this route is high-speed conventional rail, but this could equally be any high-speed technology such as Maglev.

Complementary Packages

Two additional packages were developed for further consideration. These packages consist of a range of measures to improve the attractiveness and quality of the services on the Edinburgh to Glasgow routes. However, these packages have not been appraised against STAG and require further consideration.

Conclusions

The key conclusions of the study are:

- The short term packages do provide journey time improvements and additional benefits but they do not offer an improved link between the rail network and Edinburgh airport in the short term.

- In the short term, A2 has the biggest impact on reducing journey times but there may be difficulties in implementing it and it only provides benefits in the off-peak period.

- Package B2 performs well and would take some pressure from the E&G route. The BCR is high but it only benefits a relatively small proportion of the study area.

- B3 provides a step change in connectivity for Glasgow Central to Edinburgh. and could be seen as an intermediate step to achieving Package D, which has enhanced cross connectivity potential with the Glasgow suburban electrified network.

- For the E&G line, Package C3 represents the most cost-effective way of achieving the benefits set out within the planning objectives in the medium term. It offers additional seat capacity and services with the benefits of electrification and an improved link between the rail network and Edinburgh airport.

- For the long term, a bespoke new route is unlikely to offer better value for money than continued investment in the E&G route. However, the options put forward could be augmented by further service alterations and additions that have a wider impact across the study area and beyond. Packages E, F and G should therefore be referred back to the main STPR study with the analysis developed to date for further consideration.

11 Glossary

BCR	Benefit Cost Ratio
DMU	Diesel Multiple Unit. A diesel powered formation of vehicles either permanently or semi-permanently coupled together to form a train.
E&G	The rail line between Edinburgh and Glasgow via Falkirk High.
ECML	East Coast Main Line
EMU	Electric Multiple Unit. An electrically powered formation of vehicles either permanently or semi-permanently coupled together to form a train.
Gauge	A grading of rail routes based on the ability of the line and its structures to accept a given size of vehicle or container.
GQS	Glasgow Queen Street Station
GVA	Gross Value Added. A measure of the contribution to the economy of each individual producer.
Headway	The minimum time between trains on a route. This is principally governed by signalling.
Line Speed	The maximum operating speed of a given section of line.
NMF	Network Modelling Framework
NPV	Net Present Value
Route Availability	A grading of rail routes on the basis of the axle load that they are able to take. Highest loading from UK locomotives is RA8 (Class 67).
SPT	Strathclyde Partnership for Transport, the Regional Transport Partnership for the West of Scotland.
tph	trains per hour
TMfS	Transport Model for Scotland
WCML	West Coast Mainline. The route from Glasgow to London via Carlisle.

Appendix A – Study Approach

Appendix A

Study Approach

This study is being undertaken according to the principles of the Scottish Transport Appraisal Guidance (STAG) taking a problem-based and not solution-led approach. The problems on the Edinburgh to Glasgow rail routes are well known and have a clear evidence-base having been highlighted in the *Scottish Planning Assessment* (October 2005), *Scotland's Railways* (December 2006), *The Scotland Route Utilisation Strategy* (March 2007) and most recently, the *High Level Output Specification* (July 2007).

However, unlike most STAG appraisals, this study focuses on rail-based solutions only, as it forms one part of the wider STPR that will consider all modes.

The STAG methodology is as follows:

Stage 1 Establish geographic, social and economic context. Establish existing and future rail network. Identify problems, issues, constraints and opportunities.

Stage 2 Develop SMART Planning Objectives/commence Option Generation.

Stage 3 Undertake analysis of demand for travel and develop high level specification of options.

Stage 4 Initial sift of long list of options against Planning Objectives.

Stage 5 Generation of Core Packages based on previously sifted options.

Stage 6 Appraisal of packages against the planning objectives and impacts on the economy, environment, safety, integration and accessibility.

Stage 7 Conclusions

Stakeholder Involvement

A crucial element of this work was stakeholder involvement and in particular, working collaboratively with Network Rail and First ScotRail.

From the outset it was clear that some common interests existed, not least the desire to see the project move forward and a willingness to engage in making that happen. Thus a 'High level Steering Group' was established with representation at the most senior level from Transport Scotland, Network Rail and First ScotRail to drive the project and provide a strategic steer agreeable to all parties involved.

Core Project Group

A 'Core Project Group' was established responsible for delivery of key outputs including the final report. The Core Project Group was represented by Jacobs UK, Transport Scotland, Network Rail and First ScotRail, and met on a weekly basis to review project and report progress and to discuss and agree next steps.

Under the Core Project Group sat five sub-groups responsible for providing contributions across a variety of disciplines for appraisal of options and inclusion in the report itself. The sub-groups were as follows:-

Demand & Modelling Sub-Group

With representation from Jacobs UK and Transport Scotland Economics Division, this group were responsible for producing all demand to travel data from TMfS, undertaking a rail stations review using LENNON data and producing baseline information relating to agglomeration benefits. In addition, the group modelled each of the proposed options using NMF and TMfS to ascertain the impacts, both positive and negative of implementation.

Timetabling, Rolling Stock and Performance Group

This Sub-group was responsible for initial development of the train timetables for the short and medium term interventions. The group considered options for reducing the headline journey time from Edinburgh to Glasgow using existing infrastructure in the short term, and using enhanced infrastructure and additional rolling stock beyond that. The group was represented by Jacobs UK and Transport Scotland with significant intellectual input from First ScotRail and Network Rail in terms of timetable planning.

Infrastructure Sub-Group

Represented by Jacobs UK, Transport Scotland and Network Rail, the group's remit was to establish the infrastructure requirements and implications for each of the proposed packagess. This included assessing buildability, providing cost estimates and likely timescales for implementation.

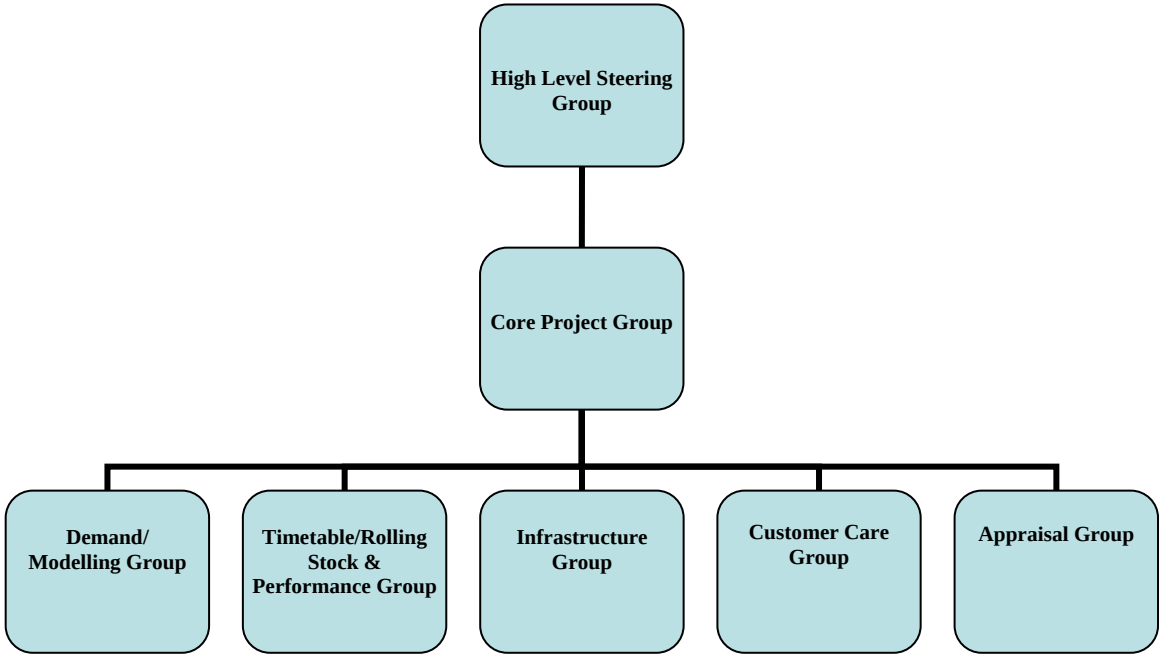
Customer Care Sub-Group

Responsible for the issue of 'attractiveness' and in particular, assessment of how the current rail service between the cities could be improved to be perceived as more attractive by new and existing passengers. This group was represented by Jacobs UK, Transport Scotland, First ScotRail and Network Rail.

Appraisal Sub-Group

The appraisal sub-group set the economic and environmental baseline and appraised each of the options against the five Government objectives in line with STAG guidelines. This group was represented by Transport Scotland and Jacobs UK.

Organisation Chart



1.1 Workshops

Throughout the course of the study, the High Level Steering Group were consulted by way of three workshop meetings in July and August and kept informed of progress via weekly progress emails. In addition, the Core Project Group met weekly to discuss progress and next steps, whilst the Sub-Groups provided ongoing contributions to the report writing and appraisal process.

This section provides an overview of the Workshops that were crucial to stakeholder involvement and the development of this report:-

Workshop 1 – Overview

Held on 19th July 2007 this workshop was a Project Scoping workshop consisting of Transport Scotland and their Consultants, Jacobs UK. First ScotRail and Network Rail were invited but unable to attend due to diary commitments. The purpose of the workshop was to discuss the geographic, social and economic context of the study area and to provisionally agree the scope and Planning Objectives. This included an overview of the existing and future rail network and an assessment of the main issues and constraints.

Workshop 1 – Outputs

The key issues and constraints were agreed as was the scope and timescale of the study. Provisional Planning Objectives were set and an initial Option Generation exercise was carried out.

Workshop 2 – Overview

Held on 30th July 2007 this was the first 'Key Stakeholder Workshop' and was attended by Transport Scotland, Network Rail, First ScotRail and Jacobs UK. The purpose of this workshop was to ensure key stakeholders were updated on the purpose and objectives of the project, to ensure the Planning Objectives were clearly understood by and agreeable to the stakeholders, and to explain the process, structure and method the project would be adopting. It was also an opportunity to make clear the roles and responsibilities required of each of the organisations but primarily to enable Transport Scotland and Jacobs to draw on the knowledge, expertise and perspectives of key stakeholders throughout the project.

Workshop 2 – Outputs

The stakeholders were updated as to the context and strategic importance of the project. The key issues and constraints were summarised along with an overview of overall demand to travel (across all modes) on the Edinburgh – Glasgow corridor. This was followed by a presentation from Network Rail on their 'World Class Railways Initiative' which specifically considers improvements on the Edinburgh to Glasgow via Falkirk rail route. It was agreed that the work done by Network Rail to date was useful and would feed into this study.

The provisional Planning Objectives were discussed and amended to produce Planning Objectives which were meaningful and agreeable to all in attendance. These Objectives were then smartened to include targets and specific measures. The original long list of options was discussed and amended building on the knowledge and expertise of those in attendance. This produced a final list of options for consideration –the list of options is attached at the end of this document. Finally, specific roles and responsibilities were discussed and it was agreed that Network Rail and First ScotRail would provide resources to contribute to each of the sub-groups.

Sub-Group Workshop – Overview

Held on Wednesday 1st August 2007, the purpose of this workshop was to gather together each of the sub-group members and to provide some background and context to the project.

Sub-Group Workshop – Outputs

Members of all sub-groups (Customer Care, Infrastructure, Timetabling, Demand/Modelling and Appraisal) had the opportunity to meet their group members including the Group Lead and Group Administrators. Groups then broke off into rooms to briefly discuss their main objectives and agree an initial meeting date. From thereon, each sub-group met regularly throughout the course of the study to pull together information for the study and appraisal processes.

Package Development and Appraisal

Each of the options was considered by the individual groups before being packaged into a range of measures offering short, medium and long term improvements to the rail network between the two cities. These Packages were then appraised against the planning objectives and the five Government Objectives using a seven point scale as explained in further detail in the report. The results include performance against objectives, benefit cost ratio and net present value. From this information, the conclusions in the report were drawn.

3.0 Long List of Options

No.	Category	Option Description	Timescale	Cost	Workshop comments	Sifted in/Out
		INFRASTRUCTURE				
1	A	Electrification of E&G			NR have completed GRIP1	
2	A	Electrification of Shotts				
3	A	Grade Separate Junctions				
		Greenhill Upper				
		Newbridge				
		Polmont				
		Winchburgh (with Dalmeny)				
		Rutherglen				
		Newton				
		Greenhill Chord Lower				
4	A	30mph into Queen Street			Allow 30mph running into Queen Street Station.	
5	A	Remove 90mph on viaducts and elsewhere			Remove speed restrictions and increase to 100mph	
6	A	Multiple track where possible			Increase available lines	
		Multiple track where possible				
		Bishopbriggs to Croy 4-track				
		Improved Passing Loops				
		Haymarket to Winchburgh via Dalmeny 4-tracking				
7	A	Improved capacity into Edinburgh Waverley throat				
8	A	Dalmeny Chord				
9	A	Carstairs and Garrongill realignments			New 150mph line? From X to Y (bypassing Carstairs)	
10	A	Higher Line Speeds				
		Upgrade Line Speed on E&G to 110mph				
		Upgrade Line Speed on E&G to 125mph				
		Upgrade Line Speed on E&G to 110mph				

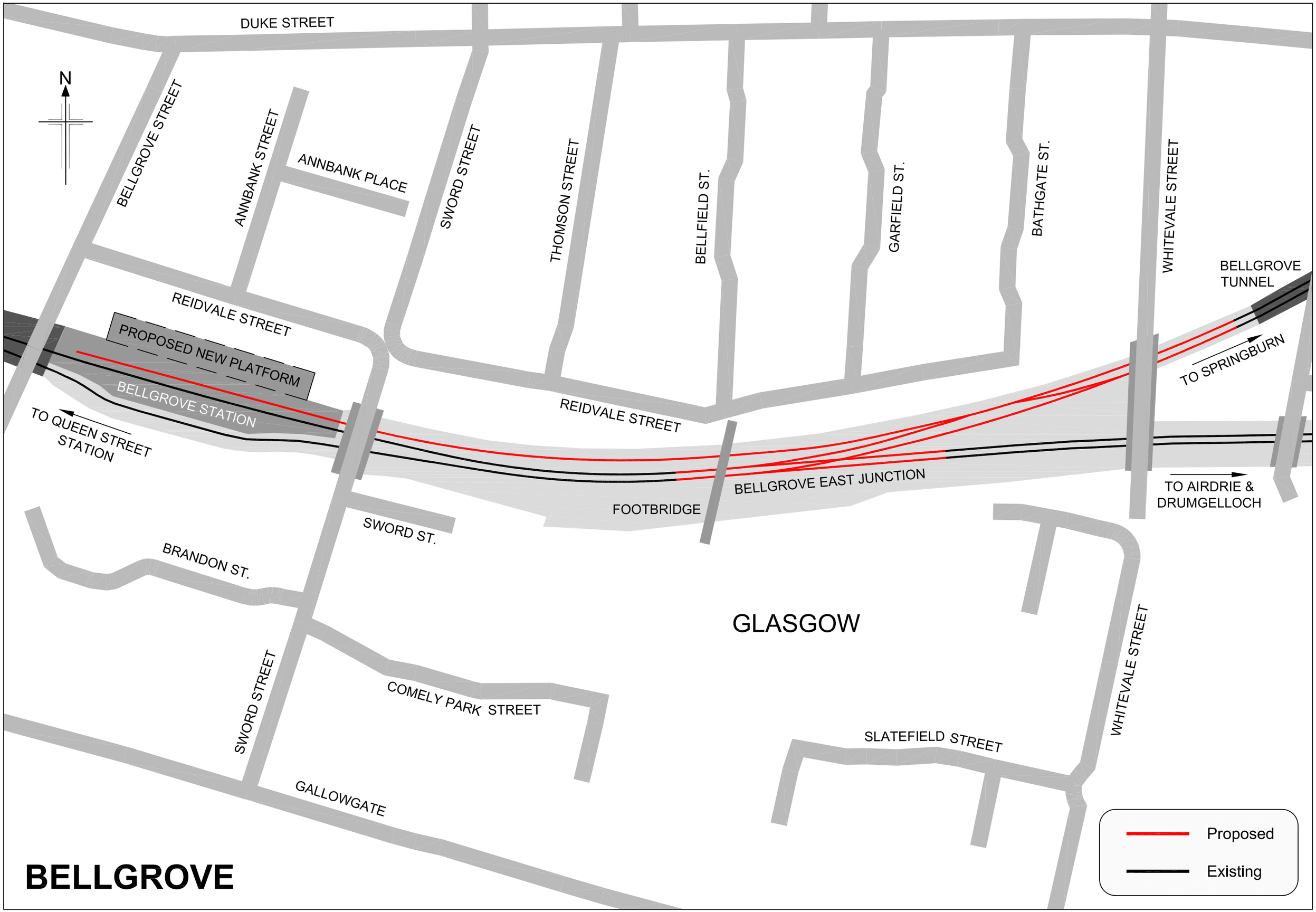
		100mph on new Airdrie to Bathgate route				
		125mph on new Airdrie - Bathgate route				
11	A	Build a new dedicated line				
		New High Speed Line				
		Maglev				
12	A	Gogar Interchange			Relocate South Gyle Station to Gogar to facilitate interchange with airport	
13	A	Queen Street to Glasgow Central Tunnel			Cross Glasgow Tunnel (Cowlairs to Shields) incorporating new Central Glasgow Station	
14	A	New Tunnel to Queen Street Station				
15	A	Bi-directional capability				
16	A	Rutherglen and Newton line speeds and capacity improvements				
17	A	Turnbacks				
		Croy				
		Polmont				
		Linlithgow				
18	A	Divert Cumbernauld service to low level (Garngad Curve)				
19	A	Finnieston turnback on to A-B line				
20	A	Introduce shared running to take local services into both cities e.g. tram/train				
		TIMETABLE/ROLLING STOCK				
21	B	Re-engine existing trains				
22	B	New Diesels, Class 172 or other			New diesel rolling stock	
23	B	Hourly service on Carstairs			Hourly service from Glasgow Central Station to carstairs	
24	B	Make use of coal paths after re-opening of SAK				
25	B	Utilise rolling stock to exploit line speeds			Make best use existing line speed wherever possible	
26	B	Longer trains				
27	B	Single hourly through service			One of existing 4 E&G to run non-stop between Edinburgh and Glasgow	
28	B	Review balance of Falkirk High and Falkirk			Better balance of services at both stations	

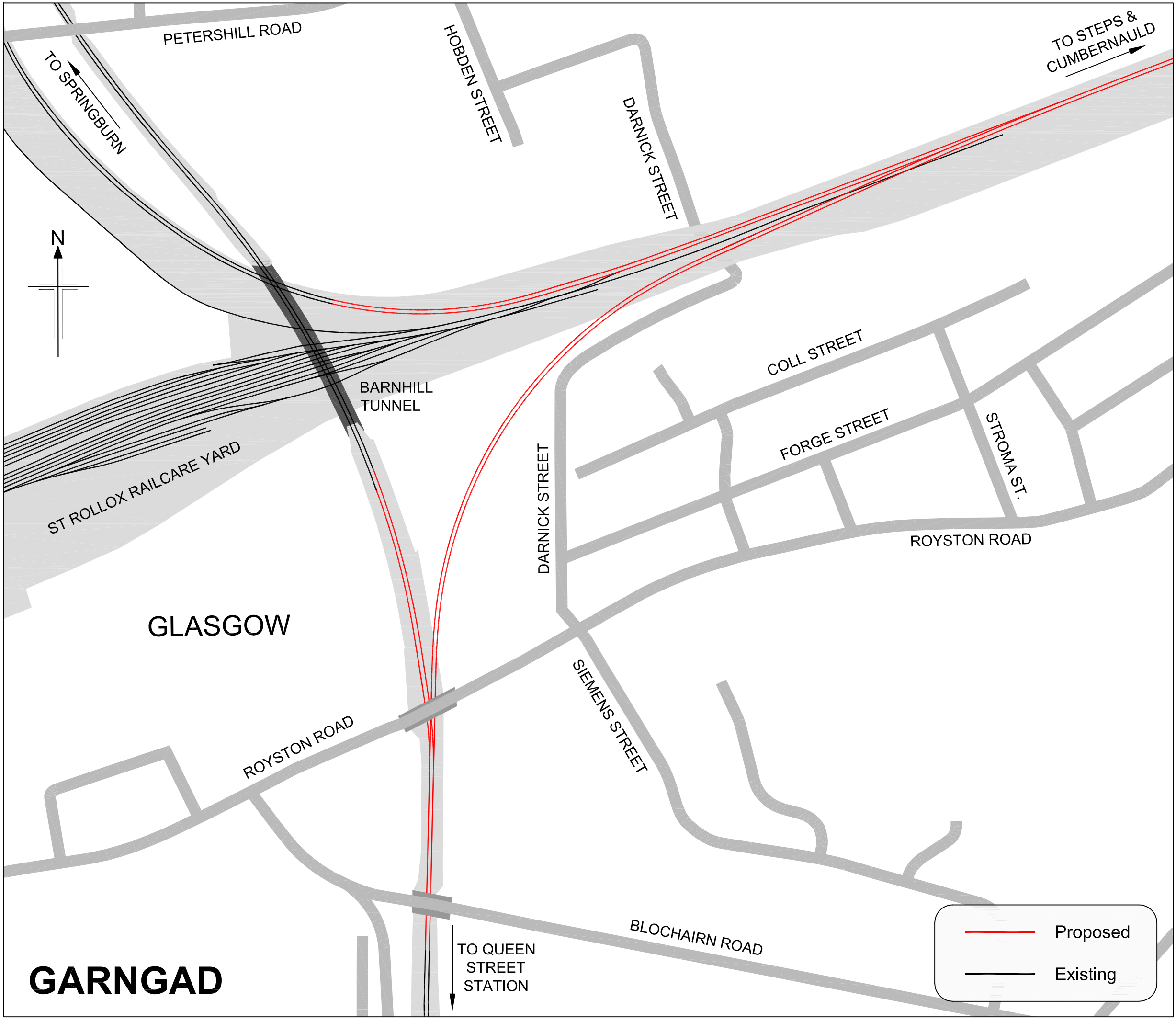
		Grahamston			to meet planning objectives	
29	B	Timetable recast (around primary route)			E&G route as primacy	
30	B	Move to 6tph clockface			Provide 6 trains per hour on E&G (clockface)	
31	B	6-car trains - fixed formation			Provide 6 car units with 2DVTs (rather than 2 coupled 3-cars)	
32	B	Improve connectivity with London services				
33	B	Move from 30 sec to 10 sec timetabling				
34	B	Stop at Edinburgh Park			Stop E&G services at Edinburgh Park	
35	B	Earlier and later trains			Earlier and later services than currently provided	
36	B	Rebalancing of north and south lines			Alter services and infrastructure to provide better balance between north and south routes	
37	B	Improve carriage layout			Ergonomics and design of carriage layout	
38	B	Reduce calls between Airdrie and Glasgow				
39	B	Improve cycle facilities on trains				
40	B	7-day Railway - (also infrastructure)				
41	B	Remove Croy/Lenzie to Glasgow morning peak - from E&G			Provide alternative capacity for Croy to Glasgow (other than E&G)	
42	B	Remove Linlithgow/Polmont to Edinburgh morning peak - from E&G				
43	B	Alternative services via Grahamston			Divert slower services via Grahamston to allow faster services to pass Falkirk High	
44	B	Fife services to Glasgow				
45	B	Implement Caledonian Express - move to timetabling				
46	B	Extend Alloa services to Fife				
47	B	GNER not stopping at Haymarket - consider GNER stopping pattern at Haymarket			Remove Haymarket call from GNER services	
48	B	Improved performance of non E&G services			To minimise impact on E&G running	
49	B	Separation of fast services from stopping services				
		by 93				
		by 94				
		by 95				

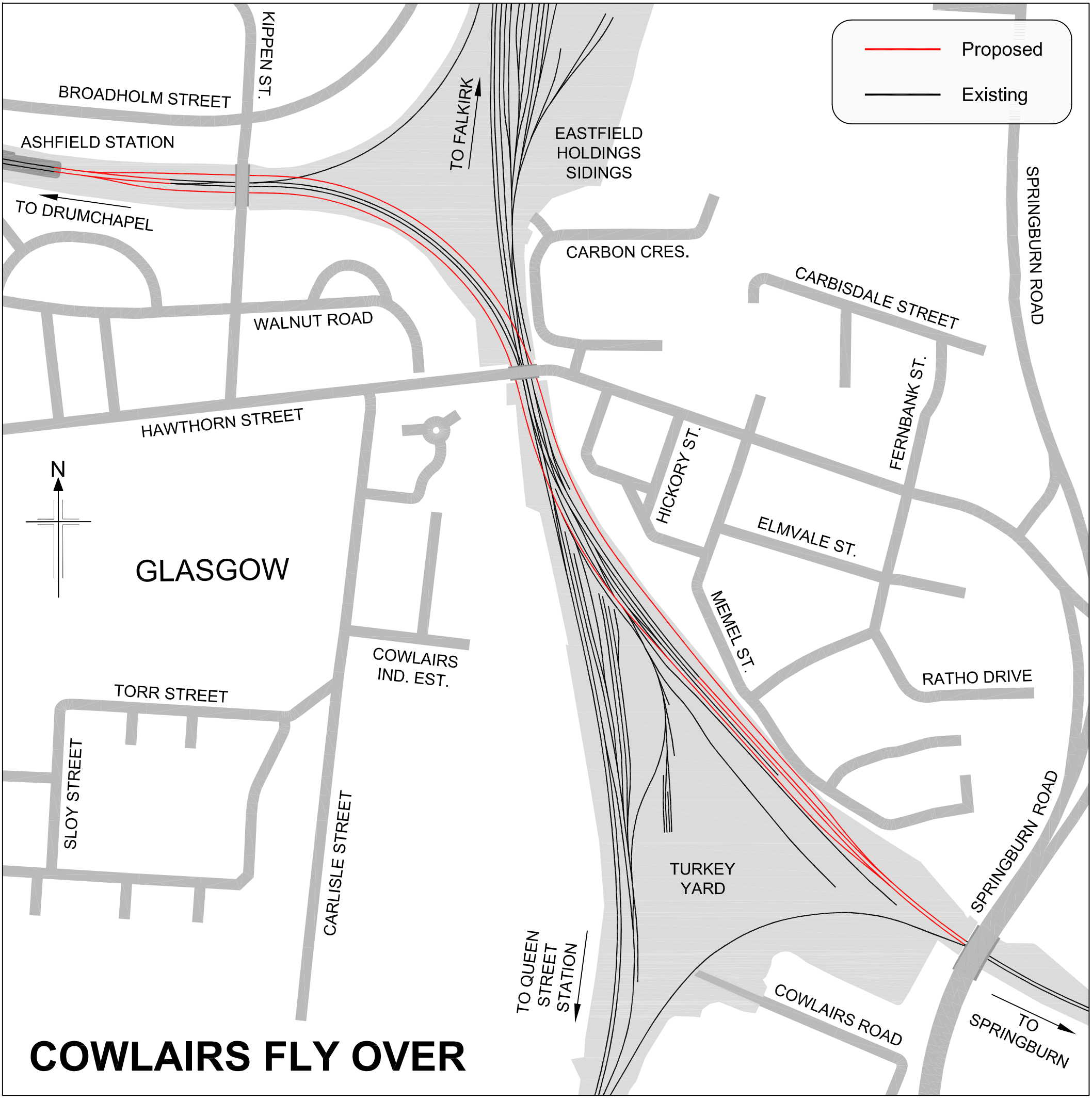
50	B	Stopping trains through Springburn			Divert stopping services to Queen Street Low Level	
51	B	Best use of diversionary routes				
		Make best use of existing (infrastructure also)				
		Identify and utilise new possible routes (infrastructure also)				
52	B	West Lothian to South Edinburgh services				
53	B	Edinburgh South Suburban to help facilitate movement from East Edinburgh				
54	B	Service pattern to review 20min headway fast Edinburgh to Glasgow and half hourly slow E-G				
		STATIONS				
55	C	Longer platforms e.g. Queen Street Station				
56	C	Relocate terminals of Edinburgh airport			Relocate to increase efficiency and capacity and improve connectivity	
57	C	Improved Motherwell Interchange				
58	C	Escalators from all exits at Waverley Station				
59	C	Improve passenger flow mechanisms at stations				
60	C	Pre-advice on seating at intermediate stations				
61	C	Extending canopies over length of stations			Canope to extend over full train length at platforms	
62	C	Make cylces available at stations				
63	C	Open new station at Winchburgh and others (move to section C)			Need to define station locations	
64	C	Review location of stations across the network				
65	C	Increase car park capacity				
66	C	New exit from Queen Street Station car park for cars				
67	C	Improve toilets waiting facilities at stations - stations				
		SIGNALLING				
68	D	Improvements to signalling				
69	D	ERTMS				
70	D	Review of junction margins			Improve junction margins to minimise impact on journey time	

71	D	Resignalling of route			Resignalling of routes	
72	D	Reduce number of signal boxes			To increase efficiency	
73	D	detailed signalling changes			Targetted upgrading of signalling hotspots (we should list specifics)	
74	D	Improvements to signalling headways at Queen Street				
		TRAIN OPERATIONS				
75	E	Selective door opening				
76	E	Reduce Station dwell times, door cycle times, driver operated door controls and improve passenger flow mechanisms				
77	E	Faster driving techniques e.g. breaking at stations				
78	E	Designated standing area for shorter journeys (reflected in fares)				
		MISC/ CUSTOMER SERVICE				
79	F	Review ticketing structure				
80	F	Smart card pilot				
81	F	Improve mobile phone coverage				
82	F	Improve onward connection opportunities at stations - buses				
83	F	Improved travel information				
84	F	Increase personal security				
85	F	Better promotion of services				
86	F	Re-branding to improve attractiveness (business focus etc)				
87	F	Bus service from Linlithgow to Edinburgh Airport				
88	F	Catering improvements on trains and at stations				

Appendix B – Infrastructure Schematics


DUKE STREET
N
BELLGROVE STREET
ANNBANK STREET
ANNBANK PLACE
SWORD STREET
THOMSON STREET
BELLFIELD ST.
GARFIELD ST.
BATHGATE ST.
WHITEVALE STREET
BELLGROVE TUNNEL
REIDVALE STREET
PROPOSED NEW PLATFORM
BELLGROVE STATION
TO QUEEN STREET STATION
REIDVALE STREET
TO SPRINGBURN
BELLGROVE EAST JUNCTION
TO AIRDRIE & DRUMGELLOCH
FOOTBRIDGE
SWORD ST.
BRANDON ST.
GLASGOW
SWORD STREET
COMELY PARK STREET
WHITEVALE STREET
SLATEFIELD STREET
GALLOWGATE
BELLGROVE
Proposed
Existing


PETERSHILL ROAD
TO SPRINGBURN
HOBDEN STREET
DARNICK STREET
TO STEPS & CUMBERNAULD
N
BARNHILL TUNNEL
ST ROLLOX RAILCARE YARD
COLL STREET
FORGE STREET
STROMA ST.
ROYSTON ROAD
DARNICK STREET
GLASGOW
SIEMENS STREET
ROYSTON ROAD
BLOCHAIRN ROAD
TO QUEEN STREET STATION
GARNGAD
Proposed
Existing



COWLAIRS FLY OVER

Proposed

Existing

A803

B8023

B802

TO EDINBURGH WAVERLEY

CROY

FORTH & CLYDE CANAL

B822

A807

KIRKINTILLOCH

B8048

B8048

ANTONINE'S WALL
(course of)

B757

LENZIE

B802

B819

B819

A803

B812

A80

M73

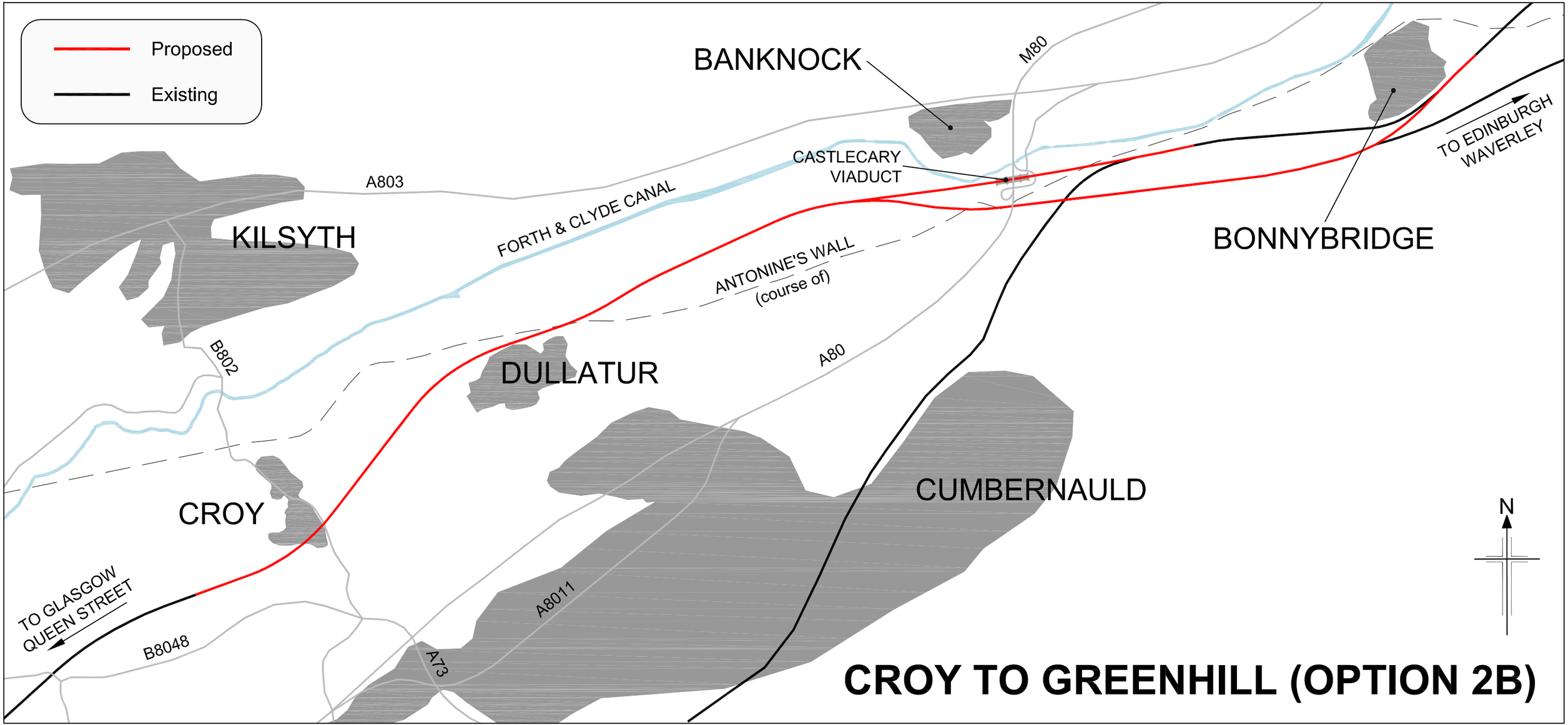
N

TO GLASOW QUEEN STREET

BISHOPBRIGGS

B757

BISHOPBRIGGS TO CROY (OPTION 2)


Proposed
Existing
BANKNOCK
M80
CASTLECARY
VIADUCT
TO EDINBURGH
WAVERLEY
A803
KILSYTH
FORTH & CLYDE CANAL
ANTONINE'S WALL
(course of)
BONNYBRIDGE
B802
DULLATUR
A80
CUMBERNAULD
CROY
N
TO GLASGOW
QUEEN STREET
B8048
A8011
A73
CROY TO GREENHILL (OPTION 2B)

Proposed

Existing

N

A89

RIVER ALMOND

EDINBURGH RD.

GLASGOW ROAD (A8)

NEWBRIDGE

TO LINLITHGOW & GLASGOW

B7030

TO EDINBURGH WAVERLEY

TO BATHGATE

CLIFTONHALL RD.

CLAYLANDS ROAD

M8

HARVEST ROAD

M8

NEWBRIDGE GRADE SEPARATED

Proposed

Existing

DALMENY

TO DALMENY JUNCTION

STANDINGSTANE ROAD

TO DALMENY JUNCTION

N

TO LINLITHGOW & GLASGOW

EDINBURGH AIRPORT

RIVER ALMOND

TO EDINBURGH WAVERLEY

TURNHOUSE GRADE SEPARATED

Proposed

Existing

EDINBURGH

TO EDINBURGH WAVERLEY

CARRICK KNOWE AVENUE

SAUGHTON RD. NORTH

WHITSON ROAD

STENHOUSE AV.

STEVENSON DRIVE

TO DALMENY

STENHOUSE DRIVE

TO BATHGATE

SAUGHTON RD.

CALDER ROAD

WATER OF LEITH

N

SAUGHTON FLAT JUNCTION

Proposed

Existing

EDINBURGH

TO EDINBURGH WAVERLEY

CARRICK KNOWE AVENUE

SAUGHTON RD. NORTH

WHITSON ROAD

STEVENSON DRIVE

STENHOUSE AV.

TO DALMENY

STENHOUSE DRIVE

TO BATHGATE

SAUGHTON RD.

CALDER ROAD

WATER OF LEITH

N

SAUGHTON GRADE SEPARATED JUNCTION

Appendix C – Project Summary Tables

Proposal Details	***Package A1:*** **E&G Revised Stopping Pattern 1**	**Short Term (no infrastructure)**

Estimated total Public Sector Funding Requirement:	***Capital Costs/grant*** ***Annual Revenue Support*** ***Present Value of Cost to Gvt***	None + 0 to £2 million < £25 million

		- - -	- -	-	*0*	+	++	+++
Summary Impact on Government's Objectives for Transport	**Accessibility and Social Inclusion**							
	Economy							
	Environment							
	Integration							
	Safety							

Package Description:

- 4 trains per hour on the E&G
- Reduced frequency for intermediate stations during inter-peak
- No change to rolling stock

Reduce frequency of station stops in the inter peak period (0930 hrs to 1530 hrs) – minimum possible stops.

Indicative journey times of between 46 and 47 minutes, compared with current 50 minutes.

No additional seats.

2 tph: GQS – Croy – F High – Haymarket – Waverley
1 tph: GQS – Linlithgow – Haymarket – Waverley
1 tph GQS – Polmont – Haymarket – Waverley

Planning Objectives	
Planning Objective 1: **Programme of cost effective improvements to strengthen the connectivity between Glasgow and Edinburgh through**:	
Planning Objective 1a: Reducing rail journey times between the city centres of Edinburgh and Glasgow. Planning Objective 1b: Improving rail system capacity to ensure planned demand growth is not inhibited. Planning Objective 1c: Improve rail travel experience for current users and improve attractiveness for new users (in addition to objectives 1a, 1b and 1d). Planning Objective 1d: Improving reliability of rail services between Glasgow and Edinburgh.	**1a: Minor positive –** achieves a small reduction in journey time for all E&G services. **1b: Neutral –** has no significant impact either positively or negatively. Does not provide new capacity but is designed to intervene only over a short term timeframe. **1c: Minor positive / minor negative –** for city centre to city centre journeys there are small improvements and this may attract new users. Some small negative impacts for intermediates due to change in calling pattern. **1d: Neutral –** no significant impact.
Planning Objective 2: **An effective linkage between the rail network and Edinburgh Airport**	
	2: Neutral – no significant impact.

Implementability Appraisal	
Technical:	Subject to detail timetabling exercise and performance modelling. Note: potential to impact on large number of other services. There are minor peak adjustments required. Potential line speed improvements (NR planned interventions). Connectivity at Croy needs to be considered in future more detailed timetabling exercise. Impact of additional Perth service should be considered.
Operational:	No significant longer term issues. Limited potential to increase capacity (short term solution)
Financial:	No capital costs. Impact step on annual subsidy is + 0 to £2 million
Public:	Not made public. It is noted that A1 has more potential for negative public response than A2.

Government's Objectives for Transport		
Objective:	**Assessment Summary:**	**Supporting Information:**
Environment:	Minor Benefit	Fewer stops and therefore less acceleration/deceleration.
Safety:	Neutral	No significant impact.
Economy:	Minor Benefit	Present Value of Benefits of £25 million to £50 million NPV <£10m BCR of 1.3.
Integration:	Neutral	No significant impact.
Accessibility & Social Inclusion:	Minor Negative Impact	Reduction in journey opportunities for intermediate stations.

Impact of proposal
The proposal does not perform as well as package A2 in delivering improvements within the short term. This package should therefore not be progressed further.

Proposal Details	***Package A2:*** **E&G Revised Stopping Pattern 2**	**Short Term (No infrastructure)**

Estimated total Public Sector Funding Requirement:	***Capital Costs/grant*** ***Annual Revenue Support*** ***Present Value of Cost to Gvt***	None + £2 million to £4 million <£25 million

		- - -	- -	-	0	+	++	+++
Summary Impact on Government's Objectives for Transport	**Accessibility and Social Inclusion**					■		
	Economy						■	
	Environment				■			
	Integration				■			
	Safety				■			

Package Description:

- 4 trains per hour on the E&G
- Reduced frequency for intermediate stations during inter-peak
- No change to rolling stock

Reduce frequency of station stops in the inter peak period (0930 hrs to 1530 hrs) for Falkirk High only.

Indicative journey times of 42 minutes (fast) and 53 minutes (stopping) compared with current 50 minutes.

No additional seats.

2 tph (stopping): GQS – Croy – F High – Polmont – Linlithgow – Haymarket – Waverley
2 tph (fast): GQS – Haymarket – Waverley

Planning Objectives	
Planning Objective 1: **Programme of cost effective improvements to strengthen the connectivity between Glasgow and Edinburgh through**:	
Planning Objective 1a: Reducing rail journey times between the city centres of Edinburgh and Glasgow. Planning Objective 1b: Improving rail system capacity to ensure planned demand growth is not inhibited. Planning Objective 1c: Improve rail travel experience for current users and improve attractiveness for new users (in addition to objectives 1a, 1b and 1d). Planning Objective 1d: Improving reliability of rail services between Glasgow and Edinburgh.	**1a: Positive –** 2 fast trains per hour will have a reduction in journey time. **1b: Neutral -** has no significant impact either positively or negatively. Does not provide new capacity but is designed to intervene only over a short term time frame. **1c: Positive / minor negative -** for city centre to city centre journeys there are improvements and this may attract new users. Some small negative impacts for intermediates due to change in calling pattern and journey time but opportunities here for new journeys due to these trains being 'all stops'. **1d: Neutral –** no significant impact.
Planning Objective 2: **An effective linkage between the rail network and Edinburgh Airport**	
	2: Neutral – no significant impact.

Implementability Appraisal	
Technical:	Subject to detail timetabling exercise and performance modelling. Note: potential to impact on large number of other services. There are minor peak adjustments required. Potential line speed improvements (NR planned interventions). Connectivity at Croy needs to be considered in future more detailed timetabling exercise. Impact of additional Perth service should be considered.
Operational:	No significant longer term issues. Limited potential to increase capacity (short term solution) Potential for 3-car sets to be overcrowded due to change in service offering.
Financial:	No capital costs. Impact on annual subsidy + £2 million to £4 million
Public:	Not made public. It is noted that A2 has less potential for negative public response than A1.

Government's Objectives for Transport		
Objective:	**Assessment Summary:**	**Supporting Information:**
Environment:	Neutral	No significant change in acceleration or deceleration of services.
Safety:	Neutral	No significant impact
Economy:	Moderate Benefit	Present Value of Benefits of £25 million to £50 million NPV £25m to £50m BCR of 2.7
Integration:	Neutral	No significant impact.
Accessibility & Social Inclusion:	Minor Benefit	Some new journey opportunities through intermediate station linkage.

Impact of proposal
The proposal performs well in terms of the journey time and attractiveness planning objectives and would provide a significant decrease in journey time for two of the four E&G services per hour. There would be a marginal increase in journey time for the two stopping services. The BCR is significantly positive although the benefits are slightly overestimated due to additional journey opportunities between Perth and Glasgow also being available. This package represents the better option for short term intervention on the E&G line.

Proposal Details	***Package B1:*** **Hourly Service Via Carstairs**	**Short Term (No Infrastructure)**
Estimated total Public Sector Funding Requirement:	***Capital Costs/grant***	None
	Annual Revenue Support	+ 0 to £2 million
	Present Value of Cost to Gvt	£50 million to £100 million

		- - -	- -	-	0	+	++	+++
Summary Impact on Government's Objectives for Transport	**Accessibility and Social Inclusion**							
	Economy							
	Environment							
	Integration							
	Safety							

Package Description:

Provision of hourly service between Glasgow Central and Waverley via Carstairs.
Stops at Motherwell and Haymarket.
Indicative journey time of 65 minutes.
Around 200 additional seats every 2-hours.
Timetable will fill in gaps in existing Intercity provision.

Planning Objectives	
Planning Objective 1: **Programme of cost effective improvements to strengthen the connectivity between Glasgow and Edinburgh through**:	
Planning Objective 1a: Reducing rail journey times between the city centres of Edinburgh and Glasgow. Planning Objective 1b: Improving rail system capacity to ensure planned demand growth is not inhibited. Planning Objective 1c: Improve rail travel experience for current users and improve attractiveness for new users (in addition to objectives 1a, 1b and 1d). Planning Objective 1d: Improving reliability of rail services between Glasgow and Edinburgh.	**1a: Minor positive** – for journeys with origin nearer to Glasgow Central this may offer some reduction in overall journey time **1b: Minor positive** – provides additional capacity between Glasgow and Edinburgh via Motherwell. **1c: Minor positive / Neutral** – some improvement for current users who would rather travel from Central or travel from Lanarkshire. Provides an improved service to attract new users. Note no improvement for users on E&G main line. **1d: Minor Negative –** puts additional services through busy sections of route with no infrastructure improvements.
Planning Objective 2: **An effective linkage between the rail network and Edinburgh Airport**	
	2: Neutral – no significant impact

Implementability Appraisal	
Technical:	Timetable interface with WCML / ECML and Argyle Line needs consideration. Need to consider increased train operations across level crossings. Requires two additional EMUs to be sourced from national stock. Uses existing spare path in west, but interaction issues in the east require more detailed consideration.
Operational:	Standard frequency timetable. Inter-operation with ECML services extending to Glasgow Central would require further resource planning. Assumes that EMU rolling stock will be available
Financial:	No capital costs Additional rolling stock leasing Impact on annual subsidy is + 0 to £2 million
Public:	Not made public. Response is likely to be positive.

Government's Objectives for Transport		
Objective:	**Assessment Summary:**	**Supporting Information:**
Environment:	Minor Benefit	No significant impact on flora or fauna. Small benefit from transfer of trips from road to electrified rail services, but number involved would be low.
Safety:	Minor Benefit	Small benefits in terms of reduced road collisions due to modal transfer.
Economy:	Minor Benefit	Present Value of Benefits of £50 million to £100 million NPV £10m to £25m BCR of 1.2
Integration:	Minor Benefit	Some benefits due to improved service connections at Glasgow Central.
Accessibility & Social Inclusion:	Minor Benefit	Connectivity improvements for Motherwell and thereby wider Lanarkshire area. Improved linkage to Edinburgh for areas in the south of Glasgow through interchange at Central.

Impact of proposal
The proposal gives minor benefits against the majority of the planning objectives and against the government objectives for transport. The package does provide an additional 200 seats approx every 2 hours equivalent for journeys between Glasgow and Edinburgh. Service frequency limits the ability of this option to have a more significant impact. This package performs less well than B2 as a short term intervention on the lines out of Glasgow Central. It could be taken forward as an addition to B2 through package B3.

Proposal Details	***Package B2:*** **Caledonian Express**	**Short Term**
Estimated total Public Sector Funding Requirement:	***Capital Costs/grant*** ***Annual Revenue Support*** ***Present Value of Cost to Gvt***	£10 million to £50 million + £2 million to £4 million £50 million to £100 million

Summary Impact on Government's Objectives for Transport		- - -	- -	-	0	+	++	+++
	Accessibility and Social Inclusion							
	Economy							
	Environment							
	Integration							
	Safety							

Package Description:

Implementation of Caledonian Express proposals on Shotts Line. Likely to require minor revision on Argyle Line timetable.

Service provided is additional hourly service between Glasgow Central and Waverley via Shotts, calling at Uddingston, Shotts, West Calder, Livingston South and Haymarket.

Indicative journey time for fast service of 67 minutes over current 84 minutes via this line.

Around 200 additional seats every hour.

Planning Objectives	
Planning Objective 1: **Programme of cost effective improvements to strengthen the connectivity between Glasgow and Edinburgh through**:	
Planning Objective 1a: Reducing rail journey times between the city centres of Edinburgh and Glasgow. Planning Objective 1b: Improving rail system capacity to ensure planned demand growth is not inhibited. Planning Objective 1c: Improve rail travel experience for current users and improve attractiveness for new users (in addition to objectives 1a, 1b and 1d). Planning Objective 1d: Improving reliability of rail services between Glasgow and Edinburgh.	**1a: Minor positive** – for journeys with origin nearer to Glasgow Central this may offer some reduction in overall journey time **1b: Minor positive** – provides additional capacity between Glasgow and Edinburgh via Shotts. **1c: Minor positive / Neutral** – some improvement for current users who would rather travel from Central or travel from Lanarkshire. Provides an improved service to attract new users. Note no improvement for users on E&G main line. **1d: Minor Negative –** puts additional services through busy sections of route with no infrastructure improvements.
Planning Objective 2: **An effective linkage between the rail network and Edinburgh Airport :**	
	2: Neutral – no significant impact

Implementability Appraisal	
Technical:	All works would use tried and tested techniques. Construction risks associated with track sluing and upgrade works. Earthworks required at Benhar for track sluing. Some statutory planning process may be required. Operational by Dec 2009. Timetable issue more significant than Package A1/A2. Kirknewton Level Crossing requires work and possibly other crossing in due course.
Operational:	Assumes DMUs will be available in timescale. Interaction with freight services will need further consideration
Financial:	Capital costs of £10 million to £50 million. Impact on annual subsidy is + £2 million to £4 million .
Public:	Proposals for Caledonian Express have been published.

Government's Objectives for Transport		
Objective:	**Assessment Summary:**	**Supporting Information:**
Environment:	Minor Benefit	No significant impact on flora or fauna. Slight limited increase in noise and vibration due to increased train numbers. Increased CO_2 emissions from rail offset by greater reduction in road traffic.
Safety:	Minor Benefit	Small benefits in terms of reduced road collisions due to modal transfer. Potential to improve some key stations in terms of personal security as part of package.
Economy:	Moderate Benefit	Present Value of Benefits of £200 million to £400 million. NPV £150m to £200m BCR of 3.8
Integration:	Minor Benefit	Some benefits due to improved service connections at Glasgow Central.
Accessibility & Social Inclusion:	Minor Benefit	Connectivity improvements for some intermediate locations and improved access to both cities.

Impact of proposal
The proposal has a high BCR in comparison to other options but this should be seen in the context of having a significant impact on a limited area. The provision of a significant improvement to journey time for both current and new passengers from key destinations into Glasgow and Edinburgh is of significance and it is likely to be this rather than a significant end-to-end market that is driving the results, it does however provide additional seats. This package should be taken forward for further consideration either on its own or as part of B3.

Proposal Details	***Package B3:***	**Caledonian Express + Carstairs Hourly**	**Medium Term**
Estimated total Public Sector Funding Requirement:		***Capital Costs/grant*** ***Annual Revenue Support*** ***Present Value of Cost to Gvt***	£10 million to £50 million + £2 million to £4 million £150 million to £200 million

Summary Impact on Government's Objectives for Transport	**Accessibility and Social Inclusion** **Economy** **Environment** **Integration** **Safety**	- - -	- -	-	*0*	+	++	+++

Package Description:

Packages B1 + B2

Implementation of Caledonian Express proposals on Shotts Line, and additional services on Carstairs route to have hourly service. Likely to require revision on Argyle Line timetable.

Services provided are:

- additional hourly service between Glasgow Central and Waverley via Shotts, calling at Uddingston, Shotts, West Calder, Livingston South and Haymarket; and
- hourly service between Glasgow Central and Waverley via Carstairs calling at Motherwell and Haymarket. Fills gaps in existing intercity provision.

Indicative journey times of 67 minutes via Shotts and 65 minutes via Carstairs.

Around 300 additional seats (average) every hour between Glasgow and Edinburgh.

Additional infrastructure is required to support this package, comprising:

- Newton West Junction; and
- Haymarket Platform 5

Planning Objectives	
Planning Objective 1: **Programme of cost effective improvements to strengthen the connectivity between Glasgow and Edinburgh through**:	
Planning Objective 1a: Reducing rail journey times between the city centres of Edinburgh and Glasgow. Planning Objective 1b: Improving rail system capacity to ensure planned demand growth is not inhibited. Planning Objective 1c: Improve rail travel experience for current users and improve attractiveness for new users (in addition to objectives 1a, 1b and 1d). Planning Objective 1d: Improving reliability of rail services between Glasgow and Edinburgh.	**1a: Minor positive** – for journeys with origin nearer to Glasgow Central this may offer some reduction in overall journey time **1b: Minor positive** – provides additional capacity between Glasgow and Edinburgh. **1c: Positive / Neutral** – improvement for current users who would rather travel from Central or travel from Lanarkshire. Provides an improved service to attract new users. Achieves 2 semi-fast trains between Central and Waverley per hour. Note no improvement for users on E&G main line. **1d: Minor positive –** provides infrastructure improvements that will be of benefit to other services and provide greater robustness in operations.
Planning Objective 2: **An effective linkage between the rail network and Edinburgh Airport :**	
	2: Neutral – no significant impact

Implementability Appraisal	
Technical:	All works would use tried and tested techniques. Construction risks associated with track sluing and upgrade works. Earthworks required at Benhar. Some statutory planning process may be required. Station works at Haymarket should be within existing railway limits. Requires additional EMUs and DMUs to be sourced from national stock. Potential conflicts at Midcalder Junction are assumed to be resolved in the intervening period through Network Rail operations. Kirknewton Level Crossing requires work and possibly other crossings in due course.
Operational:	Assumes EMUs/DMUs will be available in timescale. Interaction with freight services will need further consideration. Works to Haymarket and Newton West Junction will improve general operations.
Financial:	Capital costs of £10 million to £50 million. Impact on annual subsidy is + £2 million to £4 million.
Public:	Proposals for Caledonian Express have been published.

Government's Objectives for Transport		
Objective:	**Assessment Summary:**	**Supporting Information:**
Environment:	Minor Benefit	No significant impact on flora or fauna. Slight limited increase in noise and vibration due to increased train numbers. Increased CO_2 emissions from rail offset by greater reduction in road traffic.
Safety:	Minor Benefit	Small benefits in terms of reduced road collisions due to modal transfer. Potential to improve some key stations in terms of personal security as part of package.
Economy:	Minor Benefit	Present Value of Benefits of £200 million to £400 million. NPV £100m to £150m BCR of 1.8
Integration:	Minor Benefit	Some benefits due to improved service connections at Glasgow Central.
Accessibility & Social Inclusion:	Moderate Benefit	Connectivity improvements for some intermediate locations and improved access to both cities. Provision of two semi-fast services between Central and Waverley and additional seat capacity is of benefit.

Impact of proposal
The proposal performs similarly to B1 and B2 against the planning objectives, although the associated infrastructure will have benefits to reliability and there is a greater provision in seats between Glasgow and Edinburgh. There may be benefit in taking forward this package as a development of B2, particularly if there is a need to provide for relief capacity due to works on the E&G or to provide a general increase in seat capacity into and between the cities.

Proposal Details	***Package C1: Electrification of E&G/Dunblane/Alloa***	**Medium Term**
Estimated total Public Sector Funding Requirement:	***Capital Costs/grant***	£250 million to £500 million
	Annual Revenue Support	- £8 million to - £12 million
	Present Value of Cost to Gvt	£200 million to £400 million

		- - -	- -	-	0	+	++	+++
Summary Impact on Government's Objectives for Transport	**Accessibility and Social Inclusion**							
	Economy							
	Environment							
	Integration							
	Safety							

Package Description:

Electrification of existing E&G line from Queen Street to Newbridge via Falkirk High, electrification of diversion routes from Greenhill to Polmont via Falkirk Grahamston and Haymarket area, electrification of Carmuirs to Dunblane.

Existing services and frequencies.

Indicative journey time on E&G of 46 minutes, compared with current 50 minutes.

Indicative journey time on Dunblane to Glasgow and Dunblane to Edinburgh shortened by 5 minutes (indicative journey times of 44 minutes and 59 minutes respectively).

No additional seats

Additional infrastructure is required to support this package, comprising:

- Electrification of E&G and Diversion Routes 1 and 2;
- Electrification from Carmuirs to Dunblane/Alloa; and
- Extension of 1 no additional platform at Queen Street to accept 6-car trains.

Planning Objectives	
Planning Objective 1: **Programme of cost effective improvements to strengthen the connectivity between Glasgow and Edinburgh through**:	
Planning Objective 1a: Reducing rail journey times between the city centres of Edinburgh and Glasgow.	**1a: Minor Positive** – reduction in journey time achieved but may not be sub-45 minutes.
Planning Objective 1b: Improving rail system capacity to ensure planned demand growth is not inhibited.	**1b: Neutral** – this package does not provide any additional seating capacity or network capacity.
Planning Objective 1c: Improve rail travel experience for current users and improve attractiveness for new users (in addition to objectives 1a, 1b and 1d).	**1c: Positive** – new trains, faster journey time and general attractiveness of electrified services will have a positive impact.
Planning Objective 1d: Improving reliability of rail services between Glasgow and Edinburgh.	**1d: Minor Positive / Minor Negative** - some improvement on approaches to main cities but may mean express services catch up with stopping services on core route, so slight negative.
Planning Objective 2: **An effective linkage between the rail network and Edinburgh Airport :**	
	2: Neutral – no change to current situation

Implementability Appraisal	
Technical:	Electrification assessment has been carried out. Standard working techniques and construction.
Operational:	No significant issues have been identified.
Financial:	Capital costs of £250 million to £500 million. Impact on annual subsidy is - £8 million to - £12 million
Public:	This proposal has not been made public; however the upgrading is based on the existing route, which should minimise any negative public reaction.

Government's Objectives for Transport		
Objective:	**Assessment Summary:**	**Supporting Information:**
Environment:	Moderate Benefit / Minor Negative Impact	Benefits due to reduced emissions from electric rolling stock. Negative visual impact from overhead catenary system.
Safety:	Neutral	It is not considered that there will be significant impacts or benefits resulting from this package. Lack of additional capacity for modal shift is a limitation.
Economy:	Minor Benefit	Present Value of Benefits £200 million to £400 million NPV £50m to £100m BCR of 1.3
Integration:	Neutral	It is not considered the package makes a significant contribution towards improving integration.
Accessibility & Social Inclusion:	Minor Benefit	The improvements in journey time across the Glasgow/Edinburgh/Dunblane triangle would improve access to jobs and opportunities by rail but lack of additional capacity will limit this.

Impact of proposal
The proposal performs well in increasing the attractiveness of services by providing a faster and more reliable service. There are significant infrastructure requirements, although it is noted that Network Rail have undertaken work to investigate these. The package performs well in environmental terms but its ability to provide more benefit is limited by the lack of additional capacity to allow modal shift. This package could be taken forward but consideration should be given to augmenting it with other options to provide additional capacity or developing it as part of a programme to deliver C3.

Proposal Details	***Package C2: E&G Line Development (conflict Removal)***	**Medium Term**
Estimated total Public Sector Funding Requirement:	***Capital Costs/grant***	£500 million to £1 billion
	Annual Revenue Support	-£2 million to - £4 million
	Present Value of Cost to Gvt	£400 to £600 million

Summary Impact on Government's Objectives for Transport

	- - -	- -	-	0	+	++	+++
Accessibility						■	
Social Inclusion			■				
Economy			■		■		
Environment						■	
Integration					■		
Safety							

Package Description:

General upgrading of line speeds and removal of conflict issues. No major diversions from existing alignment except would include Garngad Chord and Dalmeny Chord. Dalmeny Chord would include a station at Gogar.

6 tph on E&G with Croy local service turnback at Greenhill.

Proposed Anniesland to Bellgrove shuttle in place of North Suburban. Garngad Chord with diversion of Cumbernauld to GQS low level.

From Glasgow Queen Street High Level

- 2 tph Bishopbriggs, Lenzie, Croy and turnback at Greenhill
- 4 tph Stirling to Glasgow
- ~1 tph Aberdeen as present
- ~1 tph Inverness as present
- 6 tph E&G – 2 fast, 2 via Edinburgh Park, 2 via Gogar.

Journey time on E&G 50 minutes for stopping services and 42 minutes for fast services.

Journey time on Dunblane to Glasgow and Dunblane to Edinburgh shortened by 9 minutes (indicative journey times of 40 minutes and 55 minutes respectively).

Around 400 additional seats every hour between Glasgow and Edinburgh (800 if 6-car trains). Additional 400 seats per hour between Glasgow and Stirling/Dunblane/Alloa and 400 inner suburban to Croy (both 800 if 6-car trains).

Additional infrastructure is required to support this package, comprising:

- Garngad Chord;
- Bellgrove;
- Polmont Station;
- Electrification to Cumbernauld;
- Dalmeny Chord;
- Winchburgh Grade Separation;
- Waverley North West;
- Cowlairs Flyover;
- GQS Platforms; and
- Finnieston turnback.

Planning Objectives	
Planning Objective 1: **Programme of cost effective improvements to strengthen the connectivity between Glasgow and Edinburgh through**:	
Planning Objective 1a: Reducing rail journey times between the city centres of Edinburgh and Glasgow.	**1a: Positive** – reduction in journey time for 2 tph to around 42 minutes.
Planning Objective 1b: Improving rail system capacity to ensure planned demand growth is not inhibited.	**1b: Positive** – provides additional 2 tph on E&G services, safeguards centre-to-centre capacity, provides linkage for intermediate stations, provides new services for suburban stations in the west, provides increased services between Stirling/Dunblane and Glasgow.
Planning Objective 1c: Improve rail travel experience for current users and improve attractiveness for new users (in addition to objectives 1a, 1b and 1d).	**1c: Positive** – new trains, faster journey times and general attractiveness of improved service frequency.
Planning Objective 1d: Improving reliability of rail services between Glasgow and Edinburgh.	**1d: Positive** – removal of some major constraints, some improvement on approaches to main cities.
Planning Objective 2: **An effective linkage between the rail network and Edinburgh Airport :**	
	2: Positive – interchange with tram via station at Gogar.

Implementability Appraisal	
Technical:	This package would involve the use of standard railway and construction techniques, but there are areas of risk. The works to upgrade and provide additional capacity will require to be undertaken while maintaining operations on the existing network. This is likely to require blockade closures (such as Christmas) and overnight working. The construction of the chord lines at Dalmeny and Garngad, and the construction adjacent to the existing alignment along the E&G may encounter ground condition issues. Interface with other parts of the rail network and road network is a particular issue.
Operational:	The provision of additional capacity and relief of key constraints will provide some longer term operational benefits to the general railway across central Scotland. No significant longer term operational issues have been identified.
Financial:	Capital costs of £500 million to £1 billion. Impact on annual subsidy is -£2 million to - £4 million.
Public:	This proposal has not been made public; however the upgrading is based on the existing route, which should minimise any negative public reaction.

Government's Objectives for Transport		
Objective:	**Assessment Summary:**	**Supporting Information:**
Environment:	Minor Benefit / Minor Negative Impact	Benefits due to increase in passenger numbers from modal shift, but negative impact from running more diesel trains.
Safety:	Minor Benefit	The modal transfer from road to rail resulting from this package would provide some benefits in terms of road accident reduction. Works to stations resulting from this would give benefit in terms of passenger security.
Economy:	Minor Negative Impact	Present Value of Benefits of £400 million to £600 million NPV -£50m to -£100m BCR of 0.9.
Integration:	Moderate Benefit	The provision of higher frequency services together with improved interchange between fast and stopping services. Interchange with tram at new Gogar station, Edinburgh Park and Haymarket for various services.
Accessibility & Social Inclusion:	Moderate Benefit	The improvements in journey time across the Glasgow/Edinburgh/Dunblane triangle in tandem with the provision of new services and capacity would improve access to jobs and opportunities by rail.

Impact of proposal
This proposal performs well against the planning objectives and in particular is the earliest delivering package that can provide an enhanced linkage to Edinburgh Airport. In terms of the government objectives, there are some negative environmental impacts from running more diesel trains, but this is offset by the ability to carry additional passengers and achieve modal shift. A key issue is the BCR of 0.9. This is marginal and there may be items of infrastructure that more detailed analysis may confirm can be omitted. In this scenario, the BCR would be 1.1 This package performs less well than C1 but does provide additional capacity. Consideration could be given to taking this forward as part of the delivery of C3, which has a better overall performance.

Proposal Details	***Package D:* Electrification of Shotts Line**	**Medium Term**

Estimated total Public Sector Funding Requirement:	***Capital Costs/grant***	£100 million to £250 million
	Annual Revenue Support	0 to - £2 million
	Present Value of Cost to Gvt	£100 million to £150 million

		- - -	- -	-	*0*	+	++	+++
Summary Impact on Government's Objectives for Transport	**Accessibility and Social Inclusion**							
	Economy							
	Environment							
	Integration							
	Safety							

Package Description:

Provision of an enhanced frequency electric train service on the Shotts line.

Existing hourly all stops service would be retained.

Service provided is additional 2tph between Glasgow Central and Waverley via Shotts, calling at Holytown, Shotts or West Calder, Livingston South and Haymarket.

Indicative journey time for fast service of 55 minutes over current 84 minutes via this line.

Around 400 additional seats every hour (800 if 6-car trains).

Additional infrastructure is required to support this package, comprising:

- Electrification of Holytown to Midcalder; and
- Minor infrastructure / signalling improvements.

Planning Objectives	
Planning Objective 1: **Programme of cost effective improvements to strengthen the connectivity between Glasgow and Edinburgh through**:	
Planning Objective 1a: Reducing rail journey times between the city centres of Edinburgh and Glasgow. Planning Objective 1b: Improving rail system capacity to ensure planned demand growth is not inhibited. Planning Objective 1c: Improve rail travel experience for current users and improve attractiveness for new users (in addition to objectives 1a, 1b and 1d). Planning Objective 1d: Improving reliability of rail services between Glasgow and Edinburgh.	**1a: Minor Positive** – for journeys with origin nearer to Glasgow Central this may offer some reduction in overall journey time **1b: Positive** – provides additional capacity between Glasgow and Edinburgh via Shotts. **1c: Positive / Neutral** – some improvement for current users who would rather travel from Central or travel from Lanarkshire. Provides an improved service to attract new users. Note no improvement for users on E&G main line. **1d: Minor Positive / Minor Negative –** some infrastructure upgrading but routes additional services through busy sections of route.
Planning Objective 2: **An effective linkage between the rail network and Edinburgh Airport :**	
	2: Neutral – no significant impact

Implementability Appraisal	
Technical:	All works would use tried and tested techniques. Construction risks associated with track sluing and upgrade works. Earthworks required at Benhar. Some statutory planning process may be required.
Operational:	EMU operation integration with Glasgow and Edinburgh services. Interaction with freight services will need further consideration.
Financial:	Capital costs of £100 million to £150 million. Impact on annual subsidy is 0 to - £2 million.
Public:	Proposals for Caledonian Express have been published.

Government's Objectives for Transport		
Objective:	**Assessment Summary:**	**Supporting Information:**
Environment:	Minor Benefit / Minor Negative Impact	No significant impact on flora or fauna. Slight limited increase in noise and vibration due to increased train numbers. Reduction in emissions. Negative visual impact from overhead catenary.
Safety:	Minor Benefit	Small benefits in terms of reduced road collisions due to modal transfer. Potential to improve some key stations in terms of personal security as part of package.
Economy:	Moderate Benefit	Present Value of Benefits of £150million to £200 million. NPV £50m to £100m BCR of 1.4
Integration:	Minor Benefit	Some benefits due to improved service connections at Glasgow Central and intermediate stations.
Accessibility & Social Inclusion:	Moderate Benefit	Connectivity improvements for some intermediate locations and improved access to both cities.

Impact of proposal
The proposal has a good BCR in comparison to other options but this should be seen in the context of having a significant impact on a limited area. The provision of a significant improvement to journey time for both current and new passengers from key destinations into Glasgow and Edinburgh is of significance and it is likely to be this rather than a significant end-to-end market that is driving the results, it does however provide additional seats. This package could be considered as an improvement to B2 or as part of a wider corridor intervention under STPR.

Proposal Details	***Package C3:***	**E&G Line Development & Electrification**	**Long Term**
Estimated total Public Sector Funding Requirement:		***Capital Costs/grant*** ***Annual Revenue Support*** ***Present Value of Cost to Gvt***	£500 million to £1 billion -£12 million to - £16 million £600 million to £800 million

Summary Impact on Government's Objectives for Transport		- - -	- -	-	0	+	++	+++
	Accessibility and Social Inclusion						■	
	Economy					■		
	Environment			■			■	
	Integration						■	
	Safety					■		

Package Description:

General upgrading of line speeds and removal of conflict issues. Step towards Package E. No major diversions from existing alignment except would include Garngad Chord and Dalmeny Chord. Dalmeny Chord would include a station at Gogar.

6 tph on E&G with Croy local service turnback at Greenhill.

Proposed Anniesland to Bellgrove shuttle in place of North Suburban. Garngad Chord with diversion of Cumbernauld to GQS low level.

From Glasgow Queen Street High Level

- 2 tph Bishopbriggs, Lenzie, Croy and turnback at Greenhill
- 4 tph Stirling to Glasgow
- ~1 tph Aberdeen as present
- ~1 tph Inverness as present
- 6 tph E&G – 2 fast, 2 via Edinburgh Park, 2 via Gogar.

Journey time on E&G 47 minutes for stopping services and 37 minutes for fast services.
Journey time on Dunblane to Glasgow and Dunblane to Edinburgh shortened by 12/11 minutes (indicative journey times of 37 minutes and 53 minutes respectively).

Around 400 additional seats every hour between Glasgow and Edinburgh (800 if 6-car trains). Additional 400 seats per hour between Glasgow and Stirling/Dunblane/Alloa and 400 inner suburban to Croy (both 800 if 6-car trains).

Additional infrastructure is required to support this package, comprising:

- Garngad Chord;
- Bellgrove;
- Polmont Station;
- Electrification to Cumbernauld;
- Dalmeny Chord;
- Winchburgh Grade Separation;
- Waverley North West;
- Cowlairs Flyover;
- GQS Platforms;
- Finnieston turnback;
- Electrification of E&G and Diversion Routes 1 and 2; and
- Electrification from Carmuirs to Dunblane/Alloa.

Planning Objectives	
Planning Objective 1: **Programme of cost effective improvements to strengthen the connectivity between Glasgow and Edinburgh through**:	
Planning Objective 1a: Reducing rail journey times between the city centres of Edinburgh and Glasgow. Planning Objective 1b: Improving rail system capacity to ensure planned demand growth is not inhibited. Planning Objective 1c: Improve rail travel experience for current users and improve attractiveness for new users (in addition to objectives 1a, 1b and 1d). Planning Objective 1d: Improving reliability of rail services between Glasgow and Edinburgh.	**1a: Positive** – reduction in journey time for 2 tph to 37 minutes and for stopping services to 47 minutes. **1b: Positive** – provides additional 2 tph on E&G services, safeguards centre-to-centre capacity, provides linkage for intermediate stations, provides new services for suburban stations in the west, provides increased services between Stirling/Dunblane and Glasgow. **1c: Positive** – new trains, faster journey times and general attractiveness of improved service frequency. **1d: Positive** – removal of some major constraints, some improvement on approaches to main cities.
Planning Objective 2: **An effective linkage between the rail network and Edinburgh Airport :**	
	2: Positive – interchange with tram via station at Gogar.

Implementability Appraisal	
Technical:	This package would involve the use of standard railway and construction techniques, but there are areas of risk. The works to upgrade and provide additional capacity will require to be undertaken while maintaining operations on the existing network. This is likely to require blockade closures (such as Christmas) and overnight working. The construction of the chord lines at Dalmeny and Garngad, and the construction adjacent to the existing alignment along the E&G may encounter ground condition issues. Interface with other parts of the rail network and road network is a particular issue. Electrification assessment has been carried out.
Operational:	The provision of additional capacity and relief of key constraints will provide some longer term operational benefits to the general railway across central Scotland. No significant longer term operational issues have been identified.
Financial:	Capital costs of £500 million to £1 billion Impact on annual subsidy is -£12 million to - £16 million.
Public:	This proposal has not been made public; however the upgrading is based on the existing route, which should minimise any negative public reaction.

Government's Objectives for Transport		
Objective:	**Assessment Summary:**	**Supporting Information:**
Environment:	Moderate Benefit / Minor Negative Impact	Benefits due to reduced emissions from electric rolling stock and increase in passenger numbers. Negative visual impact from overhead catenary system and increased noise/vibration from increase in train numbers.
Safety:	Minor Benefit	The modal transfer from road to rail resulting from this package would provide some benefits in terms of road accident reduction. Works to stations resulting from this would give benefit in terms of passenger security.
Economy:	Minor Benefit	Present Value of Benefits of £600 million to £800 million NPV £50m to £100m BCR of 1.1
Integration:	Moderate Benefit	The provision of higher frequency services together with improved interchange between fast and stopping services. Interchange with tram at new Gogar station, Edinburgh Park and Haymarket for various services.
Accessibility & Social Inclusion:	Moderate Benefit	The improvements in journey time across the Glasgow/Edinburgh/Dunblane triangle in tandem with the provision of new services and capacity would improve access to jobs and opportunities by rail.

Impact of proposal
This proposal performs well against the planning objectives and against the government objectives. It is of note that there are certain infrastructure items that more detailed analysis may confirm can be omitted. In this scenario, the BCR would be 1.3. This package achieves significant benefits in terms of delivering a sub-40 minute journey time for fast services, increases in seats, enhanced access to Edinburgh Airport and reductions in emissions both due to electric traction and modal shift from road. This package could be taken forward and consideration given to the delivery order of infrastructure and rolling stock delivery.

Proposal Details	***Package E:***	**E&G Major Upgrade and Tilting Train**	**Long Term**
Estimated total Public Sector Funding Requirement:		***Capital Costs/grant***	£1 billion to £1.5 billon
		Annual Revenue Support	- £16 million to -£20 million
		Present Value of Cost to Gvt	£800 to £1 billion

Summary Impact on Government's Objectives for Transport		- - -	- -	-	0	+	++	+++
	Accessibility and Social Inclusion							
	Economy							
	Environment							
	Integration							
	Safety							

Package Description:

"The best conventional railway we can have." Major infrastructure upgrade of existing E&G route.

Standard hourly timetable of:

- 4 tph fast E & G;
- 2 tph stopping E&G;
- 4 tph Stirling to Glasgow (2 semi-fast, 2 stopping);
- 2 tph Dunblane to Edinburgh; and
- 2 tph Falkirk Grahamston to Edinburgh

Indicative journey time of 34 minutes Queen Street to Waverley for fast services.

Journey time savings on other routes similar to C3.

Around 900 additional seats every hour between Glasgow and Edinburgh.

Additional infrastructure is required to support this package, comprising:

- Garngad Chord;
- Bellgrove;
- Greenhill Upper/Lower;
- Polmont Station;
- 4-track Bishopbriggs to Croy;
- Electrification to Cumbernauld;
- Dalmeny Chord;
- Winchburgh Grade Separation;
- Waverley North West;
- Waverley South West;
- Cowlairs Flyover;
- GQS Platforms;
- Finnieston turnback;
- Electrification of E&G and Diversion Routes 1 and 2; and
- Electrification from Carmuirs to Dunblane/Alloa; and
- 125mph line speed for tilt.

Planning Objectives	
Planning Objective 1: **Programme of cost effective improvements to strengthen the connectivity between Glasgow and Edinburgh through**:	
Planning Objective 1a: Reducing rail journey times between the city centres of Edinburgh and Glasgow. Planning Objective 1b: Improving rail system capacity to ensure planned demand growth is not inhibited. Planning Objective 1c: Improve rail travel experience for current users and improve attractiveness for new users (in addition to objectives 1a, 1b and 1d). Planning Objective 1d: Improving reliability of rail services between Glasgow and Edinburgh.	**1a: Strongly Positive** – the upgraded E&G line would provide an indicative journey time of 34-minutes between central Glasgow and Waverley (30-minutes to Haymarket). **1b: Strongly Positive –** provision of 6 additional services per hour on Glasgow/Edinburgh/Stirling triangle. Additional 900 seats per hour and capacity increases into both Glasgow and Edinburgh. Improvement to network capacity. **1c: Strongly Positive** – significant time saving benefits for centre-to-centre travel, better frequency for general services, enhanced seating capacity and clearer hierarchy of services. **1d: Strongly Positive** – physical separation of fast and slow services, grade separation of junctions, speed improvements and improved balance of services on Edinburgh Western approaches.
Planning Objective 2: **An effective linkage between the rail network and Edinburgh Airport :**	
	2: Positive – use of Dalmeny Chord diversion and interchange at Gogar.

Implementability Appraisal	
Technical:	This package would involve the use of standard railway and construction techniques, but there are a number of areas of risk. The works to upgrade and provide additional capacity will require to be undertaken while maintaining operations on the existing network. This is likely to require blockade closures (such as Christmas) and overnight working. The construction of the chord lines at Dalmeny and Garngad, and the construction adjacent to the existing alignment along the E&G may encounter ground condition issues. Interface with other parts of the rail network and road network is a particular issue.
Operational:	The provision of additional capacity and relief of key constraints will provide some longer term operational benefits to the general railway across central Scotland. No significant longer term operational issues have been identified.
Financial:	Capital Costs of £1 billion to £1.5 billion Impact on annual subsidy is - £16 million to -£20 million
Public:	This proposal has not been made public; however the majority of the upgrading is based on the existing route, which should minimise any negative public reaction.

Government's Objectives for Transport		
Objective:	**Assessment Summary:**	**Supporting Information:**
Environment:	Moderate Benefit / Moderate Negative Impact	Significant benefit in terms of emissions reduction due to modal shift. Visual impact, noise issues, severance and impact of the route improvements on flora and fauna will have a negative impact.
Safety:	Moderate Benefit	The modal transfer from road to rail resulting from this package would provide benefits in terms of road accident reduction. Works to stations resulting from this would give benefit in terms of passenger security.
Economy:	Minor Benefit	Present Value of Benefits of £800 million to £1 billion NPV -£100m to -£150m BCR of 0.9
Integration:	Major Benefit	The provision of higher frequency services together with improved interchange between fast and stopping services. Interchange with tram at new Gogar station, Edinburgh Park and Haymarket for various services.
Accessibility & Social Inclusion:	Major Benefit	This package would provide a step change in accessibility across and wide range of origins and destinations across central Scotland. Improvements to the E&G line have the ability to impact other services and areas.

Impact of proposal
This proposal represents a step change in rail system provision and the network utilisation within the test scenario is low compared with others. While the BCR is marginal, the ability to run various different service scenarios should be given more consideration. This option should be considered further by STPR.

Proposal Details	***Package F:***	***New/Upgrade High Speed*** **Route**	**Long Term**
Estimated total Public Sector Funding Requirement:		***Capital Costs/grant***	£1.5 billion to £3 billion
		Annual Revenue Support	-£4 million to - £8 million
		Present Value of Cost to Gvt	£1.5 billion to £2 billion

Summary Impact on Government's Objectives for Transport	- - -	- -	-	0	+	++	+++
Accessibility and Social Inclusion							
Economy							
Environment							
Integration							
Safety							

Package Description:

Glasgow Central to Rutherglen, upgrade existing route to provide 2 slow lines to the north and 2 fast lines to the south (fast to take Glasgow/Edinburgh and WCML).

East of Farmeloan Rd bridge, fast lines are raised to go across the top of the Whifflet line diverge. Services on the fast will not require to interact with Argyle Line.

New alignment from River Clyde bridge at Uddingston to bypass Cambuslang and Newton, which can also be used by WCML services.

Run on upgraded existing WCML through Uddingston to Motherwell. Stop 2 tph at Motherwell. Grade separate Hamilton to Bellshill movement by going below WCML.

Existing upgraded WCML to Law. New alignment from Law to near Cobbinshaw located north of Windfarm, south of Opencast. Join Edinburgh to Carstairs line near Cobbinshaw Reservoir.

4 tph frequency with indicative journey time of 35 mins (40 mins if stopping at Motherwell)

Around 1,400 minimum additional seats per hour
(could be increased to 2,200)

Additional infrastructure is required to support this package, comprising:

- WCML upgrading between Central and Law;
- Cambuslang/Newton bypass line;
- Law to Cobbinshaw line; and
- Cobbinshaw to Haymarket upgrade.

Planning Objectives	
Planning Objective 1: **Programme of cost effective improvements to strengthen the connectivity between Glasgow and Edinburgh through**:	
Planning Objective 1a: Reducing rail journey times between the city centres of Edinburgh and Glasgow. Planning Objective 1b: Improving rail system capacity to ensure planned demand growth is not inhibited. Planning Objective 1c: Improve rail travel experience for current users and improve attractiveness for new users (in addition to objectives 1a, 1b and 1d). Planning Objective 1d: Improving reliability of rail services between Glasgow and Edinburgh.	**1a: Positive –** provides 35 minutes for non-stopping services but journey time for stopping would be 40 minutes. All trains could be run non-stopping, but this would lose connectivity benefits in Lanarkshire. **1b: Strongly Positive –** the assessment assumes 450-seats per train, which is conservative for a 9-car set, giving carrying capacity of 1,800-seated per hour per direction. Although running on existing infrastructure for much of the journey, key infrastructure upgrading would have benefit beyond this service, such as WCML. **1c: Strongly Positive –** providing new route sections and connection to Glasgow Central would be a significant step change in the quality and attractiveness offered to both current rail users and new users. Connectivity at Motherwell would provide a Lanarkshire hub connection to Edinburgh and be attractive to new users. **1d: Positive –** new line sections and improvements to existing infrastructure would improve reliability, but does not provide infrastructure on E&G line and therefore impact on reliability on this line would be limited.
Planning Objective 2: **An effective linkage between the rail network and Edinburgh Airport :**	
	2: Neutral – this intervention would not provide any significant betterment to the linkage as interchange would occur via the tram at Haymarket.

Implementability Appraisal	
Technical:	This package would involve the use of standard railway and construction techniques, but there are a number of areas of risk. The points of interface with the current services will require careful design and construction as these may place pressure on existing infrastructure until complete. The new diversion section around Cambuslang and Newton is over an area with former mine working and therefore ground conditions will be an issue. Providing a grade separation at Motherwell is likely to require an underpass rather than overbridge and ground conditions are therefore an issue. The new line section from Law to Cobbinshaw is over moorland and ground conditions are likely to be poor. Assumes that additional paths into Central will be available by this timescale (divert Whifflet to low level/divert Shotts to low level/LRT for Cathcart circle).
Operational:	The provision of diversion facilities into Glasgow and at Motherwell will provide some longer term operational benefits to the general railway and in particular to WCML services. No significant longer term operational issues have been identified.
Financial:	Capital cost of £1.5 billion to £3 billion. Impact on annual subsidy is -£4 million to - £8 million.
Public:	This proposal has not been made public; however some general discussion has occurred in the public arena in respect of high speed new line connections between the two cities. It is unlikely that reliable and reportable public feedback could be given until detailed route alignment proposals were published.

Government's Objectives for Transport		
Objective:	**Assessment Summary:**	**Supporting Information:**
Environment:	Moderate Benefit / Moderate Negative Impact	Significant benefit in terms of emissions reduction due to modal shift. Visual impact, noise issues, severance and impact of the route on flora and fauna will have a negative impact.
Safety:	Moderate Benefit	The modal transfer from road to rail resulting from this package would provide benefits in terms of road accident reduction. Works to stations resulting from this would give benefit in terms of passenger security.
Economy:	Moderate Negative Impact	Present Value of Benefits of £600 million to £800 million NPV-£1bn to -£1.5bn BCR of 0.4
Integration:	Moderate Benefit	Provision of a high speed link from Glasgow Central would give significant benefit to integration with suburban rail services. Services would provide for integration with tram at Haymarket.
Accessibility & Social Inclusion:	Moderate Benefit	This package would provide a significant improvement in accessibility with connections to the suburban rail/bus network in Glasgow and the tram/bus network in Edinburgh meaning that the area of each city that is accessible by PT to the other in a given time will be significantly enhanced.

Impact of proposal
This proposal performs well against the planning objectives apart from enhancing access to Edinburgh Airport. In terms of the government objectives, the general performance is good but the BCR is low. This package should be referred to the main STPR study but it is noted that it does not perform as well as package E.

Proposal Details	**Package G: New High Speed Route**	**Long Term**
Estimated total Public Sector Funding Requirement:	***Capital Costs/grant***	Over £7 billion
	Annual Revenue Support	-£16 million to - £20 million
	Present Value of Cost to Gvt	£4 billion to £6 billion

Summary Impact on Government's Objectives for Transport

	- - -	- -	-	0	+	++	+++
Accessibility and Social Inclusion							
Economy							
Environment							
Integration							
Safety							

Package Description:

Totally bespoke route. Principle of route is to run along M8 corridor. Core section from Baillieston (s. of A8/M8), cross A8/M8 between Shawhead and Chapelhall. Run along n. side of M8 – note some demolition required at Bathgate/Livingston. Approach to Newbridge is between A-B and E&G lines.

West Approach Options:

(i) Glasgow Central High Level, as per west section of Package F but new line runs beside Whifflet line to Baillieston. Some demolition in Carmyle. Need additional paths into GC so some combination of divert Whifflet to low level/divert Shotts to low level/LRT for Cathcart circle.

(ii) George Square, new terminus station under George Square facing east. Tunnel to east of High Street then alongside Airdrie line to Garrowhill. Option to tunnel under Garrowhill or major property purchase to achieve alignment.

East Options:

(i) Cross M8 west of Newbridge and pick up alignment of Carstairs line to south of Heriot Watt University. Join existing line (upgraded to 125mph). Move Kingsknowe station to east or west with loops (fast lines through the middle). Close level crossing. Remodel Slateford area. Edinburgh bound, provide loop as station stop with ability to rejoin fast line or drop down to go under existing line and join eastbound suburban line. Outbound provide loop for station stop. Fast lines through the middle. Loops to be able to take freight train length. Relocation of Haymarket Station and/or bay platforms for Glasgow Central terminators

(ii) Align just to the north of M8 then pick up E&G alignment. Cross over top of City Bypass and run above E&G to Haymarket. New terminal station at street level at Haymarket.

Tested scenario comprises West (ii) and East (i)

4 tph frequency with indicative journey time of 27 minutes.

Around 1,400 minimum additional seats per hour
(could be increased to 2,200)

Planning Objectives	
Planning Objective 1: **Programme of cost effective improvements to strengthen the connectivity between Glasgow and Edinburgh through**:	
Planning Objective 1a: Reducing rail journey times between the city centres of Edinburgh and Glasgow. Planning Objective 1b: Improving rail system capacity to ensure planned demand growth is not inhibited. Planning Objective 1c: Improve rail travel experience for current users and improve attractiveness for new users (in addition to objectives 1a, 1b and 1d). Planning Objective 1d: Improving reliability of rail services between Glasgow and Edinburgh.	**1a: Strongly Positive –** the new high speed line would provide an indicative journey time of 27-minutes between central Glasgow and Waverley (23-minutes to Haymarket). **1b: Strongly Positive –** the assessment assumes 450-seats per train, which is conservative for a 9-car set, giving carrying capacity of 1,800-seated per hour per direction. **1c: Strongly Positive –** providing a new route and high speed service would be a significant step change in the quality and attractiveness offered to both current rail users and new users. **1d: Positive –** new line itself would have high reliability but does not provide infrastructure on E&G line and therefore impact on reliability on this line would be limited.
Planning Objective 2: **An effective linkage between the rail network and Edinburgh Airport**	
	2: Neutral – this intervention would not provide any significant betterment to the linkage as interchange would occur via the tram at Haymarket.

Implementability Appraisal	
Technical:	There are significant technical risks associated with this package. A Transport Works Act procedure would be require to be promoted. The approach to Glasgow would be more simple to deliver if Glasgow Central was the terminus, but this would still require significant construction of high speed line and major road crossing. A terminus at George Square would require major tunnelling and excavation. In the east, an approach through Slateford would largely use existing railway land to provide capacity to run high speed. An approach using double deck construction along the existing western approaches would be difficult to construct. While an alignment alongside the M8 is likely to minimise demolition, it is clear that some will be required, particularly in the Bathgate/Livingston area, although it is anticipated that either all or the vast majority would be employment rather than residential property.
Operational:	The provision of an entirely new network connection between Glasgow and Edinburgh removes the potential for operational issues to impact on much of the line. The need for the line to interface with other services on the approach to the main cities means that there is the potential for changes in these to impact on the operation of this service, but these would be minimised.
Financial:	Capital costs of over £7 billion Impact on annual subsidy is -£16 million to - £20 million.
Public:	This proposal has not been made public; however some general discussion has occurred in the public arena in respect of high speed new line connections between the two cities. It is unlikely that reliable and reportable public feedback could be given until detailed route alignment proposals were published.

Government's Objectives for Transport		
Objective:	**Assessment Summary:**	**Supporting Information:**
Environment:	Moderate Benefit / Major Negative Impact	Significant benefit in terms of emissions reduction due to modal shift. Visual impact, noise issues, severance and impact of the route on flora and fauna are likely to have a negative impact. New route through Central Scotland has significant implications.
Safety:	Moderate Benefit	The modal transfer from road to rail resulting from this package would provide some benefits in terms of road accident reduction. Works to stations resulting from this would give benefit in terms of passenger security.
Economy:	Moderate Negative Impact	Present Value of Benefits of £1 billion to £1.5 billion NPV -£3bn to -£4bn BCR of 0.3
Integration:	Minor Benefit	Provision of a new terminal in Glasgow would not give a seamless integration with existing heavy rail. Services would provide for integration with tram at Haymarket.
Accessibility & Social Inclusion:	Major Benefit	This package would provide a significant step change in accessibility with connections to the suburban rail/bus network in Glasgow and the tram/bus network in Edinburgh meaning that the area of each city that is accessible by PT to the other in a given time will be significantly enhanced

Impact of proposal
This proposal performs well against the planning objectives apart from enhancing access to Edinburgh Airport. In terms of the government objectives, the general performance is good but the BCR is low. This package should be referred to the main STPR study but it is noted that it does not perform as well as other long term options.