

Wednesbury to Brierley Hill



Strategic Case Appendix S1 – Options Assessment Report

Midland Metro Wednesbury to Brierley Hill
Extension

Black Country Access

WBHS Corridor Options Economic Assessment

Technical note - Draft v3.0

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1 Introduction

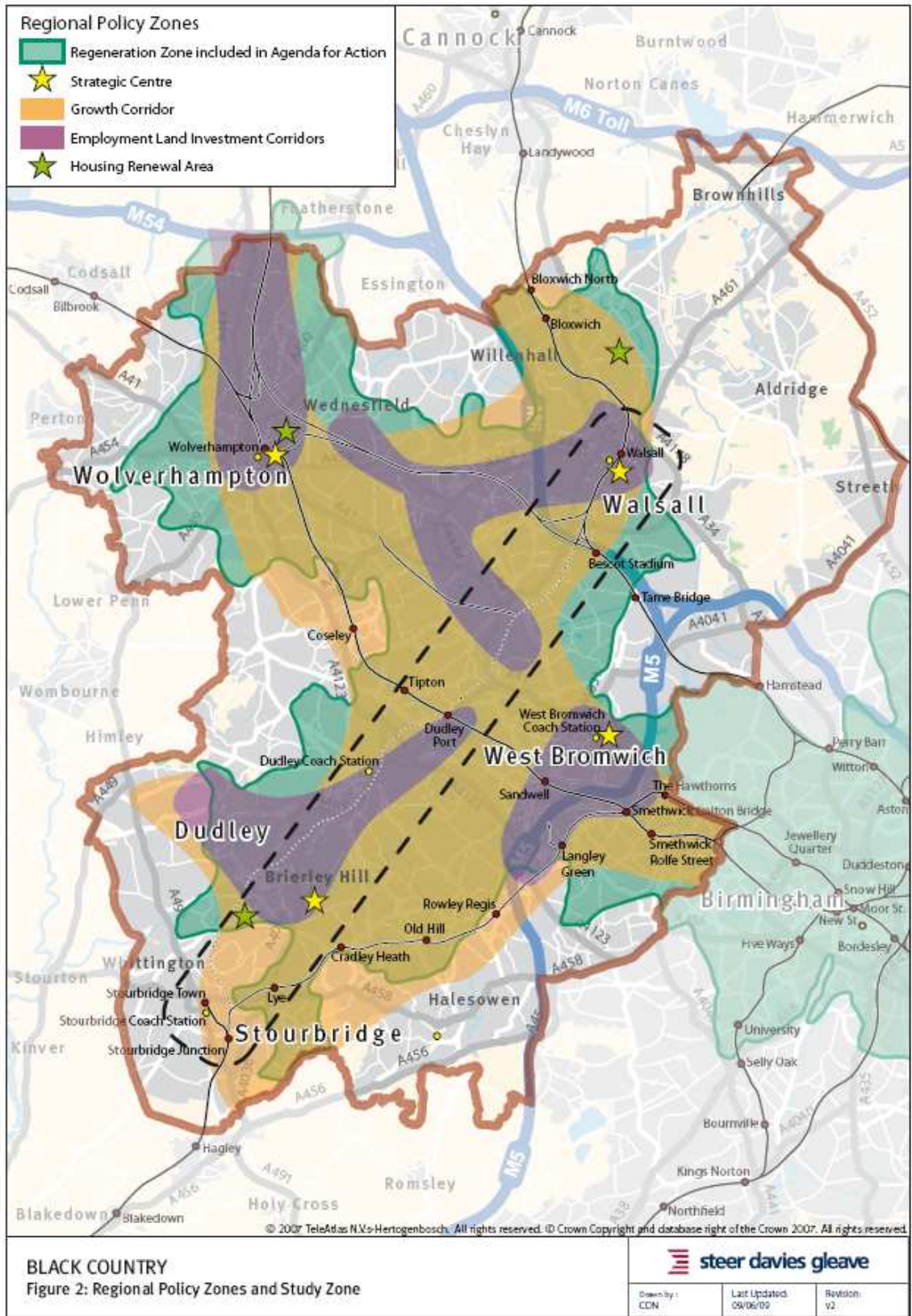
Context

- 1.1 The corridor option assessment process is intended to support the development of a public transport scheme for the Black Country Access corridor (encompassing Walsall, Brierley Hill and Stourbridge) that can complement the reinstatement of rail freight in the corridor. The establishment of a robust case for the identified preferred solution will be critical for successfully achieving funding for the delivery of the scheme.
- 1.2 At this stage of the process the objective is to identify a short list of options, each of which is plausible as a proposal, that provide a range of solutions to deliver the objectives agreed for the scheme. The consideration of the short list of options and the recommended schemes to be progressed for more detailed development and assessment is framed by the narrative articulated in the Strategic Case for transport investment in the Black Country Access corridor.
- 1.3 The Black Country Access corridor is shown in Figure 1.1.

Strategic Case

- 1.4 The Black Country and the West Midlands currently underperform in the UK. Low productivity from the Black Country contributes 80% of the Birmingham city region's output gap. The low productivity of the sub-region must be addressed in order for the Black Country, and the West Midlands, to achieve their aspirations. For the West Midlands region as a whole to achieve its growth and regeneration targets, the Black Country must be viewed as a priority.
- 1.5 Were the Black Country to realise the growth needed to close the output gap and regenerate the sub-region without additional public transport investment there will be an increase in congestion and the use of private cars. The implication of this is that it will not meet its economic goals and environmental commitments, as well as its responsibility to tackle climate change by reducing emissions.
- 1.6 With national policy outlined in DaSTS, the challenge of achieving both economic growth while reducing carbon emissions will require action in the Black Country beyond simple pro-growth economic policies - investments will need to be taken to reduce the sub-region's reliance on the private car. Within the Black Country, the highest return for investment is likely to be improving public transport connectivity within the Black Country Access corridor, notably for the strategic centre of Brierley Hill and to the regional centre, Birmingham.
- 1.7 In order to ensure that current and future investment in health, education and employment fully realises its potential, coupled with the wider regeneration aspirations of the Black Country, the provision of an integrated rapid passenger transport scheme along the corridor is considered to be of fundamental regional importance.

FIGURE 1.1 REGIONAL POLICY AND BLACK COUNTRY ACCESS CORRIDOR



1.8 Having established the case for the prioritisation of the corridor, objectives for the scheme were developed by Centro and their regional partners within the framework of national, regional and local policy, as well as the problems facing the Black Country. The five scheme objectives are:

- Support and promote the growth and competitiveness of the Black Country economy through improving connectivity, increasing capacity and unlocking development along the corridor by connecting the key economic centres with one another and to the wider region.
- Support and promote the sustainable growth of the Black Country, and contribute to tackling climate change, through reducing the carbon impact of transport and decoupling carbon emissions from economic growth.
- Promote equality of opportunity by enhancing access to jobs, and enabling greater participation in a range of leisure, retail and health activities through improving transport accessibility within the Black Country and to key economic and leisure centres in the Black Country and West Midlands.
- Contribute to achievement of local air quality targets and reduce traffic and congestion in and between key centres in the Black Country.
- Contribute to improving the overall safety, security and health in the Black Country and West Midlands, through reducing accidents and improving security on the public transport network.

1.9 The objectives for the scheme/corridor then informed the initial stage of identifying broad transport systems that are capable of meeting the objectives for the scheme and excluding those that would not.

Option Development

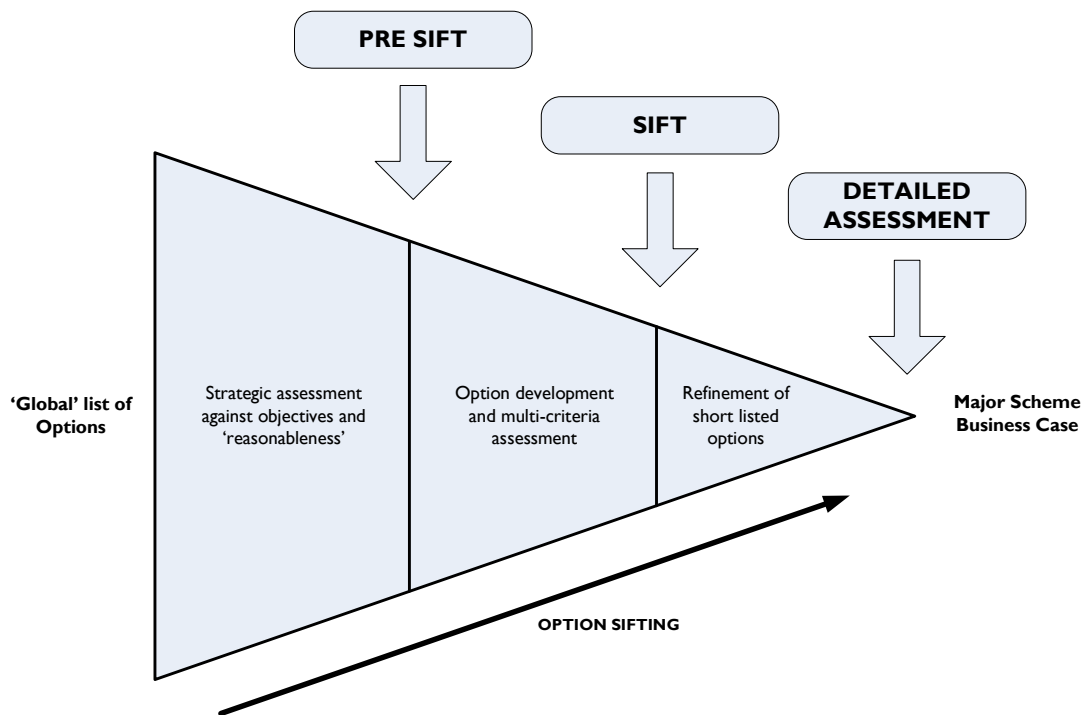
1.10 The long list of options that were developed included tram, tram-train, heavy rail, bus rapid transit (BRT) and bus priority. The options were developed to a sufficient level of detail so they could be assessed and sifted to make a short-list of options for further development and analysis. The option development process or sifting process consists of three steps, going from a 'global' list of options to a preferred option presented in the funding bid submission, e.g. DfT Major Scheme Business Case, as illustrated in Figure 1.2.

1.11 The short list of options that emerged from the sift were taken forward for more detailed assessment. Full details of this process are reported in *Black Country Access: Option Development for the WBHS Corridor* (September 2009).

1.12 The short listed options have since been developed further and detailed assessment has been undertaken to select those options to be taken forward. These options, subject to further refinement and analysis are proposed for consideration as part of the funding bid submission development. It is critical to avoid the premature rejection of options without sufficient information on which to base such a decision.

1.13 This technical note reports the results of the detailed assessment and provides a recommendation on the options to be taken forward.

FIGURE 1.2 OPTION SIFTING PROCESS



Options for Assessment

1.14 The options that have been identified for assessment cover:

- Heavy rail
- Tram-Train
- BRT
- On-highway Bus Priority

1.15 In each case the public transport options have been considered as incremental to a freight scheme (either full double-track or double-track with passing loops).

1.16 Table 1.1 below presents the details of the options and sub-options that were identified for assessment.

TABLE 1.1 OPTIONS FOR ASSESSMENT

Option Identifier	PT modelling code	Option Description
Freight		
FR_1	n/a	Walsall to Round Oak Freight Reinstatement (sections of single-track)
FR_2	n/a	Walsall to Round Oak Freight Reinstatement (full double track)
Tram Train		
TT_A	DS3_opt0	Wolverhampton / Birmingham (Line 1) to Stourbridge via Dudley town centre and Brierley Hill Tram - Train
TT_B	DS3_opt1	Wednesbury to Stourbridge Shuttle via Dudley town centre and Brierley Hill with Interchange at Wednesbury Tram-Train
TT_C	DS3_opt2	Wednesbury to Brierley Hill Shuttle via Dudley town centre with Interchange at Wednesbury Tram-Train
TT_D	DS3_opt3	Wolverhampton / Birmingham (Line 1) to Brierley Hill via Dudley town centre Tram-Train
TT_E	DS3_opt6	Wolverhampton / Birmingham (Line 1) to Brierley Hill via Dudley Tunnel Tram-Train (Dudley Town Centre via later intervention)
TT_F	n/a	Wolverhampton / Birmingham (Line 1) to Stourbridge Tram - Train (Incorporating Shared Busway Through Brierley Hill-Merry Hill-Waterfront)
BRT / Bus Priority		
BU_1	DS5_opt1	Wednesbury Bus Station to Stourbridge town centre (Bus Station) and Stourbridge Junction via Dudley town centre and Brierley Hill (rail corridor)
BU_2	DS5_opt2	Walsall to Stourbridge town centre (Bus Station) and Stourbridge Junction via Wednesbury Bus Station, Dudley town centre and Brierley Hill (rail corridor)
BU_3	DS5_opt3	Wednesbury Bus Station to Stourbridge Junction and Stourbridge town centre (Bus Station) via Dudley town centre and Brierley Hill (highway corridor)
BU_4	DS5_opt4	Walsall to Stourbridge Junction and Stourbridge town centre (Bus Station) via Wednesbury Bus Station, Dudley town centre and Brierley Hill (highway corridor)
BU_5	DS5_opt1.1	Wednesbury Bus Station to Brierley Hill via Dudley town centre (rail corridor)

WBHS Corridor Options Economic Assessment

Option Identifier	PT modelling code	Option Description
BU_6	DS5_opt3.1	Wednesbury Bus Station to Brierley Hill via Dudley town centre (highway corridor)
Heavy Rail		
HR_1	DS4_opt2	Walsall to Stourbridge 2 train paths per hour
HR_2	DS4_opt1	Walsall to Stourbridge 4 train paths per hour
HR_3	DS4_opt4	Wednesbury to Stourbridge 2 train paths per hour
HR_4	DS4_opt3	Wednesbury to Stourbridge 4 train paths per hour
HR_5	DS4_opt4.1	Wednesbury to Brierley Hill 2 train paths per hour
HR_6	DS4_opt3.1	Wednesbury to Brierley Hill 4 train paths per hour

1.17 Centro has previously obtained statutory powers for a tram scheme, in the March 2005 Transport and Works Act Statutory Instrument 2005 No. 927 The Midland Metro (Wednesbury to Brierley Hill and Miscellaneous Amendments) Order 2005.

1.18 An assessment of this tram scheme has also been undertaken to compare to the options outlined above.

2 Scheme Costs

Introduction

- 2.1 Cost estimates for each of the options have been developed and profiled from 2010 until the final appraisal year, 2078. The heavy rail, tram-train and tram costs have been provided by Centro. Steer Davies Gleave compiled costs for the BRT and Bus options.

Capital Costs

- 2.2 The capital costs for each option were profiled over a 10 year period, from 2010, reflecting the GRIP process. The direct construction duration is anticipated to span 4 years, concluding in the scheme opening year, with the following phasing (as advised by Centro):

- 2016: 15%
- 2017: 35%
- 2018: 35%
- 2019: 15% (opening year)

- 2.3 The tram-train and tram vehicle capital costs were treated with separate phasing, as advised by Centro and is set out below:

- 2017: 25%
- 2018: 35%
- 2019: 40% (opening year)

- 2.4 The BRT/Bus vehicle capital costs were treated with the following phasing:

- 2019: 50% (opening year)
- 2020: 30%
- 2021: 10%
- 2022: 10%

Freight Capital Costs

- 2.5 Freight costs have been produced for a full double-tracking option and an option with some single track sections. These sections occur where the corridor width is insufficient for double-track freight and a third 'track' for public transport. This is the case at:

- West Coast Main Line/Dudley Port overbridges
- Parkhead Viaduct
- [TBC]

TABLE 2.1 ESTIMATED CAPITAL COSTS FOR FREIGHT OPTIONS (£M 2009)

	Sections of single track	Full double track
	FR_1	FR_2
Infrastructure Costs	86.0	89.4
Risk & Contingency	9.0	9.0
Total	95.0	98.4

Public Transport Capital Costs

2.6 The incremental capital costs for the public transport options are presented below.

TABLE 2-2 ESTIMATED CAPITAL COSTS FOR TRAM-TRAIN OPTIONS (£M 2009)

	Line 1 to S/bridge	Shuttle Wed-S/b	Shuttle Wed-BH	Line 1 to BH	Line 1 to BH (via Dudley tunnel)
	TT_A	TT_B	TT_C	TT_D	TT_E
Infrastructure Costs	162.8	147.9	109.8	127.1	112.5
Vehicle Costs	69.0	39.0	36.0	56.0	53.0
Risk & Contingency	13.5	13.2	8.7	8.9	9.7
Total	245.3	200.1	154.5	192.0	175.2

2.7 Option TT_F was not considered as part of the assessment at this stage.

TABLE 2-3 ESTIMATED CAPITAL COSTS FOR BRT/BUS OPTIONS (£M 2009)

	Wed-S/b (Rail corridor)	Walsall-S/b (Rail corridor)	Wed-S/b (HW corridor)	Walsall-S/b (HW corridor)	Wed-BH (Rail Corridor)	Wed-BH (HW Corridor)
	BU_1	BU_2	BU_3	BU_4	BU_5	BU_6
Infrastructure Costs	150.5	183.7	82.3	115.5	117.0	62.5
Vehicle Costs	5.1	7.0	6.4	8.6	3.5	4.8
Risk & Contingency	31.1	38.2	17.7	24.8	24.1	13.5
Total	186.7	221.9	106.4	149.0	144.6	80.8

2.8 At this time no additional costs for rail freight related adjustments has been included within the costs for the BRT option, e.g. slewing tracks. Initial estimates suggest this will add c£3m to the capital cost.

TABLE 2-4 ESTIMATED CAPITAL COSTS FOR HEAVY RAIL OPTIONS (£M 2009)

	Walsall-S/b (2 tph)	Walsall-S/b (4 tph)	Wed-S/b (2 tph)	Wed-S/b (4 tph)	Wed-BH (2 tph)	Wed-BH (4tph)
	HR_1	HR_2	HR_3	HR_4	HR_5	HR_6
Infrastructure Costs	61.3	61.3	64.7	64.7	32.6	32.6
Risk & Contingency	4.2	4.2	4.4	4.4	2.3	2.3
Total	65.5	65.5	69.1	69.1	34.9	34.9

2.9 As heavy rail vehicles are assumed to be leased there are no vehicle costs included for these options. The vehicle costs form part of the operations and maintenance costs.

TABLE 2.5 ESTIMATED CAPITAL COSTS FOR TRAM OPTION (£M 2009) - TBA

Renewals

2.10 Renewal cost estimates were provided along with their expenditure cycle in order to enable a profile to be produced for the 60 year appraisal period. The renewals encompass items such as track, signalling, structures, stops and overhead line equipment (OLE) as appropriate for each option. For the tram-train, BRT and bus based options the replacement of vehicle fleets was included in the renewal values. For the heavy rail options, rolling stock is assumed to be leased.

Freight Renewal Costs

2.11 The estimated renewal costs for the freight options are presented below for the duration of the 60 year appraisal.

TABLE 2.5 RENEWAL COSTS FOR FREIGHT OPTIONS (£M 2009)

	Sections of single track	Full double track
	FR_1	FR_2
Trackwork	22.25	24.59
Signalling	12.60	10.08
Structures	27.00	27.00
Total	61.85	61.67

Public Transport Renewal Costs

2.12 The incremental renewal costs vary between options due to the mode and the specification.

2.13 For the tram-train options, track, signalling, stations and OLE renewals were taken into account.

TABLE 2-6 RENEWAL COSTS FOR TRAM-TRAIN OPTIONS (£M 2009)

	Line 1 to S/bridge	Shuttle Wed-S/b	Shuttle Wed-BH	Line 1 to BH	Line 1 to BH (via Dudley tunnel)
	TT_A	TT_B	TT_C	TT_D	TT_E
Trackwork	43	43	30	30	30
Signalling	14	14	13.6	13.6	13.6
Stations	21	21	18	18	18
OHLE	52	52	38	38	40
Total	130	130	109.6	109.6	101.6

2.14 For the BRT/Bus options, busway infrastructure, stops, signalling and vehicle renewals were all calculated.

TABLE 2-7 RENEWAL COSTS FOR BRT/BUS OPTIONS (£M 2009)

	Wed-S/b (Rail corridor)	Walsall- S/b (Rail corridor)	Wed-S/b (HW corridor)	Walsall- S/b (HW corridor)	Wed-BH (Rail Corridor)	Wed-BH (HW Corridor)
	BU_1	BU_2	BU_3	BU_4	BU_5	BU_6
Busway	10.5	12.9	3.1	5.6	7.5	1.5
Signalling	9.2	15.5	12.4	18.8	6.6	11.5
Vehicle	15.4	21.1	19.2	25.9	10.6	14.4
Stops	31.3	37.9	16.5	23.1	27.4	12.8
Total	66.3	87.4	51.2	73.4	52.1	40.1

2.15 For the heavy rail options, track, signalling and station renewals were considered. OLE renewals were not relevant, as the line would be assumed to not be electrified.

2.16 All the renewal costs were assumed the same as for the Heavy Rail options.

TABLE 2-8 RENEWAL COSTS FOR HEAVY RAIL OPTIONS (£M 2009)

	Walsall-S/b (2 tph)	Walsall-S/b (4 tph)	Wed-S/b (2 tph)	Wed-S/b (4 tph)	Wed-BH (2 tph)	Wed-BH (4tph)
	HR_1	HR_2	HR_3	HR_4	HR_5	HR_6
Track	9.0	9.0	9.0	9.0	8.0	8.0
Signalling	1.7	1.7	1.7	1.7	1.7	1.7
Station	10.0	10.0	10.0	10.0	8.5	8.5
Total	20.7	20.7	20.7	20.7	18.2	18.2

TABLE 2.10 RENEWAL COSTS FOR TRAM OPTION (£M 2009) - TBA

Operating & Maintenance

2.17 Operating and maintenance costs were estimated as a per annum figure. This was applied for each of the years in the 60 year appraisal period between 2019 and 2078.

2.18 There is no operating cost considered for the freight options.

Public Transport Operating and Maintenance Costs

2.19 For each of the public transport options an annual operating cost was estimated.

TABLE 2-9 OPERATING AND MAINTENANCE COSTS FOR TRAM-TRAIN OPTIONS (£M 2009)

	Line 1 to S/bridge	Shuttle Wed-S/b	Shuttle Wed-BH	Line 1 to BH	Line 1 to BH (via Dudley tunnel)
	TT_A	TT_B	TT_C	TT_D	TT_E
Operating & Maintenance Costs	4.8	3.0	2.1	3.8	3.8

TABLE 2-10 OPERATING AND MAINTENANCE COSTS FOR BRT/BUS OPTIONS (£M 2009)

	Wed-S/b (Rail corridor)	Walsall-S/b (Rail corridor)	Wed-S/b (HW corridor)	Walsall-S/b (HW corridor)	Wed-BH (Rail Corridor)	Wed-BH (HW Corridor)
	BU_1	BU_2	BU_3	BU_4	BU_5	BU_6
Operating & Maintenance Costs	3.8	5.3	4.7	6.2	2.8	3.5

TABLE 2-11 OPERATING AND MAINTENANCE COSTS FOR HEAVY RAIL OPTIONS (£M 2009)

	Walsall-S/b (2 tph)	Walsall-S/b (4 tph)	Wed-S/b (2 tph)	Wed-S/b (4 tph)	Wed-BH (2 tph)	Wed-BH (4tph)
	HR_1	HR_2	HR_3	HR_4	HR_5	HR_6
Operating & Maintenance Costs	2.6	5.1	1.8	3.5	1.5	3.0

TABLE 2.14 OPERATING AND MAINTENANCE COSTS FOR TRAM OPTION (£M
2009) - TBA

3 Scheme Benefit Forecasting

Introduction

- 3.1 The quantified transport benefits of the freight options and the incremental benefits of the public transport options have been forecast.

Freight

- 3.2 For the freight options these benefits relate to the improvement in performance on the rail network resulting from the transfer of some freight services from the existing routes to the reinstated Round Oak to Walsall route. Additionally, the increase in overall network capacity provided by the options enable a higher level of future freight demand to be accommodated on the rail network, rather than on the highway network.
- 3.3 The performance benefits (improvements in average delay minutes) were forecast in RailSys. The benefits of avoiding highway freight movements is captured by Sensitive Lorry Miles (SLMs). Network Rail advised on the value per freight train.
- 3.4 Full details of the freight scheme benefit forecasting can be found in the report: *Black Country Access: Economic Assessment of Freight Scheme* (January 2010).

Public Transport

- 3.5 Public Transport demand and benefit modelling was undertaken by Centro for the rail and tram-train options. Steer Davies Gleave used an approach consistent with Centro to forecast the benefits for the BRT and bus options.

Public Transport Modelling Approach

- 3.6 The approach used to model the different public transport options was similar to that used for modelling the Birmingham City Centre Extension for Midland Metro. In summary the approach is as follows:
- Using the 2016 and 2026 Do Minimum networks as a starting point, the network coding for different options is carried out. This provides 2016 and 2026 Do Something networks.
 - PRISM matrix inputs are used to determine the transfer from non-PT modes on to the scheme option being tested. However, due to the large number of options being considered forecast year PRISM matrices were available for only some of the Do Something options for this modelling exercise. Therefore some of the Do Something options use the same input matrices. E.g. Heavy Rail - Walsall to Stourbridge 4 trains per hour and Heavy Rail - Walsall to Stourbridge 2 trains per hour use the same input trip matrices.
 - Each option model is then run for the 2016 and 2026 forecast years and for the AM and IP periods by loading the relevant matrices on to coded networks in VISUM. Results from assigned networks are then analysed and the outputs are compared with the Do Minimum model outputs. Particular focus is given to the annual patronage and line loadings on the options being considered. More

detailed outputs (generalised time skims, demand matrices) from the Do Something option are fed into TUBA along with outputs from the Do Minimum model to determine PT user time saving benefits.

Model Results

- 3.7 Table 3.1 below presents the annual patronage forecasts for the options. Due to through running or interchange between the options and Line 1, the results used to forecast the scheme benefits include additional demand generated on Midland Metro Line 1.
- 3.8 The results are presented as absolute patronage levels in the 2016 and 2026 modelled forecast years. Also for each option the incremental demand over and above the Do Minimum patronage in 2016 and 2026 is presented in the middle two columns. The net additional demand between the Do Minimum scenario and each of the Do Something scenarios is a combination of incremental demand on the new service (Tram-train, Heavy Rail or BRT) and on Metro Line 1. Finally, and for information, the new patronage without the Metro Line 1 demand is presented in the last two columns. The net incremental demand includes the passengers interchanging between Metro Line 1 and the new service.
- 3.9 There is some discrepancy in a few scenarios (e.g. DS4_opt4) when individual service demand is significantly lower than the net additional demand. This is because identical matrix inputs have been used in sets of model runs where a limited number of PRISM model runs were available. Hence there is inconsistency between the network assumptions and the demand inputs for some scenarios. This results in discrepancies between individual service loadings and the net incremental demand.
- 3.10 As the tram-train option TT_D (DS3_opt3) is identical to the TWA tram scheme in modelling terms, the benefits generated by this option have been used to assess the tram scheme.

TABLE 3.1 ANNUAL PATRONAGE FORECASTS

		Patronage (millions)		Compared to DM		New Demand	
		2016	2026	2016	2026	2016	2026
DM	DM	7.76	9.29	-	-	-	-
TT	DS3_opt0	13.93	15.84	6.18	6.55	5.91	6.71
	DS3_opt1	10.78	12.70	3.03	3.41	2.72	3.07
	DS3_opt2	10.06	11.92	2.30	2.63	2.02	2.32
	DS3_opt3	13.01	15.38	5.25	6.10	5.21	6.07
	DS3_opt6	11.51	13.74	3.76	4.45	3.66	4.32
HR	DS4_opt1	9.81	11.47	2.06	2.18	1.43	1.72
	DS4_opt2	9.23	10.78	1.47	1.49	0.79	0.95
	DS4_opt3	9.06	10.55	1.30	1.27	0.61	0.72
	DS4_opt4	8.80	10.25	1.04	0.97	0.35	0.41
	DS4_opt1.1	9.47	11.06	1.71	1.78	1.05	1.28
	DS4_opt2.1	9.03	10.54	1.27	1.25	0.58	0.71
	DS4_opt3.1	8.84	10.31	1.08	1.03	0.39	0.47
BRT/ Bus	DS5_opt1	12.51	14.16	4.75	4.88	3.42	3.86
	DS5_opt2	13.67	15.47	5.91	6.18	4.57	5.15
	DS5_opt3	10.36	12.26	2.61	2.97	1.83	2.03
	DS5_opt4	11.54	13.59	3.78	4.30	2.94	3.30
	DS5_opt1.1	11.31	12.83	3.55	3.54	2.27	2.56
	DS5_opt2.1	12.48	14.13	4.72	4.84	3.41	3.85
	DS5_opt3.1	9.72	11.55	1.97	2.27	1.20	1.33
	DS5_opt4.1	10.89	12.87	3.13	3.58	2.30	2.58

Tram-Train results

- 3.11 The best tram-train option, in terms of annual patronage figures, is the Stourbridge Junction to Line 1 through running option (DS3_Opt0) with nearly 6.2 million additional passengers travelling on the metro system annually in 2016. Further analysis of the additional 6 million passengers in this option demonstrates that:
- 2 million passengers travel entirely on the BCA corridor between Wednesbury and Stourbridge Junction using the new tram-train service;
 - 2 million passengers travel on Metro Line 1 corridor taking benefit of the increased frequency on Line 1 due to the through running tram-trains; and
 - Nearly 2 million passenger travel between the BCA corridor and Line 1 corridor taking benefit of the connectivity between the two corridors due introduction of the new tram-train service.
- 3.12 The second best option, in terms of patronage, is also the through running option which terminates at Brierley Hill/Merry Hill (DS3_Opt3) with nearly 5.1 million additional annual patronage on the metro system in 2016.
- 3.13 The shuttle option with tram-trains running between Wednesbury and Stourbridge Junction (DS3_Opt1) is forecasted to carry an additional 3 million passengers per annum in 2016. Of these, 2 million passengers are travelling entirely on the BCA corridor with an additional 1 million interchanging onto Line 1. This is in line with the results obtained from the equivalent through running option (DS3_Opt0) where the number of passengers travelling entirely on the BCA corridor is forecasted to be nearly 2 million per annum and the number of passenger travelling between BCA corridor and Line 1 corridor is forecasted around 2 million. Hence the introduction of an interchange penalty at Wednesbury in the case of shuttle running is seen to bring the inter-corridor passenger movement down from 2 million to 1 million per annum.
- 3.14 Termination of the tram-train shuttle service at Brierley Hill/Merry Hill (DS3_Opt2) is forecasted to give 2.3 million additional patronage in 2016.
- 3.15 In option DS3_Opt6 the tram-train skips Dudley town centre by travelling through Dudley Tunnel. As a results it is seen to carry fewer passengers (0.9-1.4 million) per annum as compared to their corresponding street running through Dudley options. This is primarily due to passengers interchanging at Dudley Bus station in the street running options which increases their patronage forecasts. Note that the Do Minimum model network coding, which is also used in all these options, assumes the bus network as it existed in 2005 with a focus on Dudley. The recent reorganisation of the bus network with increased focus on Merry Hill has not been modelled in these tests. An anticipated effect of updating the network coding to reflect these recent changes would be that the impact of skipping Dudley centre would be less pronounced than that shown by this study.

Heavy Rail results

- 3.16 The heavy rail options results shown in Table 3.1 above include additional patronage on Metro Line 1 due to increased interchange at Wednesbury between the heavy rail passengers and metro passengers. The total number of interchanging passengers is in the range of 0.5-0.7 million per annum. Therefore the total annual patronage on the heavy rail line could be calculated by deducting the interchanging passengers from the incremental demand over DM scenario shown in Table 3.1. The reason for presenting combined heavy rail and metro demand in Table 3.1 is to keep the results comparable with the tram-train options.
- 3.17 Heavy rail options generally perform poorly when compared to the tram-train options with the best option (DS5_Opt1 - Walsall to Stourbridge 4tph) forecasted to attract only 2 million additional annual patronage in 2016. The heavy rail options are confined to the rail corridor and so do not penetrate Dudley town centre or the centres of Brierley Hill and Merry Hill. This limited catchment and the lower frequency of the train service (relative to tram-train options) between these stations lowers the attractiveness of the heavy rail service.

BRT/Bus Priority results

- 3.18 The BRT/bus options results show that the rail corridor based BRT option performs best in terms of attracting patronage. The Wednesbury-Stourbridge rail corridor BRT option (DS5_Opt1) is forecasted to carry nearly 4.8 million annual patronage in 2016. The extended option of this BRT route to Walsall through Darlaston (DS5_Opt2) is forecasted to attract nearly 6 million annual patronage in 2016. The key attractiveness of the rail based BRT options is the direct linkage between key centres of the Black Country - Wednesbury, Dudley, Merry Hill, Brierley Hill and Stourbridge. In addition, running on segregated alignment for the majority of its route allows faster run times between these centres as compared to the on highway bus options. Therefore the road based (highway corridor) bus options (DS5_Opt3 and DS5_Opt4) are forecasted to attract nearly 2 - 2.2 million fewer passengers per annum in 2016 as compared to the rail based BRT options.
- 3.19 The segregated BRT route to Brierley Hill (DS5_Opt1.1) is forecasted to carry 1.2 million less passengers per annum as compared to the option running to Stourbridge (DS5_Opt1). For on highway bus route to Brierley Hill (DS5_Opt3.1) patronage levels are approximately 0.7 million passengers per annum less in 2016 than the option to Stourbridge. This is because the road based BRT route from Brierley Hill to Stourbridge town goes through Lye and therefore is much longer than the route for rail corridor based BRT route.
- 3.20 In comparison to the equivalent tram-train shuttle option between Wednesbury and Stourbridge (DS3_Opt 1) the rail corridor based BRT option (DS5_Opt1) is seen to be performing much better in terms of attracting patronage (3.03m vs. 4.75m). Even though the tram-train option and the BRT option share the same route and stops for the majority of their alignment, have the same frequency and the tram-train is marginally faster, the BRT outperforms equivalent tram-train option in the sections of the route where its alignment differs from tram-train, particularly between:

- **Brierley Hill and Stourbridge:** Where the tram-train route comes out of Brierley Hill and re-joins the rail corridor to go to Stourbridge Junction, the BRT route heads straight to Stourbridge town centre and then follows the People Parry Mover alignment to Stourbridge junction. This enables the BRT route to connect Brierley Hill/Merry Hill centres directly to Stourbridge centre. Other centres further north (Dudley and Wednesbury) are also directly connected to Stourbridge.
- **Wednesbury Centre and Wednesbury Parkway:** The tram-train route starts from Wednesbury Great Western Station and follows the rail alignment in a southbound direction. Whereas the BRT route starts from Wednesbury bus station and links it to Wednesbury Parkway station thereby providing a direct link between passengers interchanging at the bus station to the BRT and Line 1 metro routes.

- 3.21 These two sections result in BRT being forecasted as performing better than the equivalent tram-train option, in terms of patronage. Figures 3.1 and 3.2 show the southbound tram-train and BRT station by station boarding and alighting figures respectively. Note that the two stations before Great Bridge on the left side and two stations after Brettell Lane on the right are different for tram-train and BRT as their alignment is different in these sections. They have been overlaid on the same chart to demonstrate the difference in demand patterns between the two routes.
- 3.22 It can be seen from Figure 3.1 that BRT attracts more passengers at Dudley town centre stops (Dudley bus station, Flood Street) and at Merry Hill and Brierley Hill stops than the tram-train does. The majority of these increased passengers are seen to alight at Stourbridge town centre's bus station in Figure 3.2. The BRT route also attracts more passengers at the Stourbridge bus station heading towards Stourbridge Junction stop, essentially replacing the People Parry Mover service demand.

FIGURE 3.1 TRAM-TRAIN VS BRT - SOUTHBOUND BOARDINGS

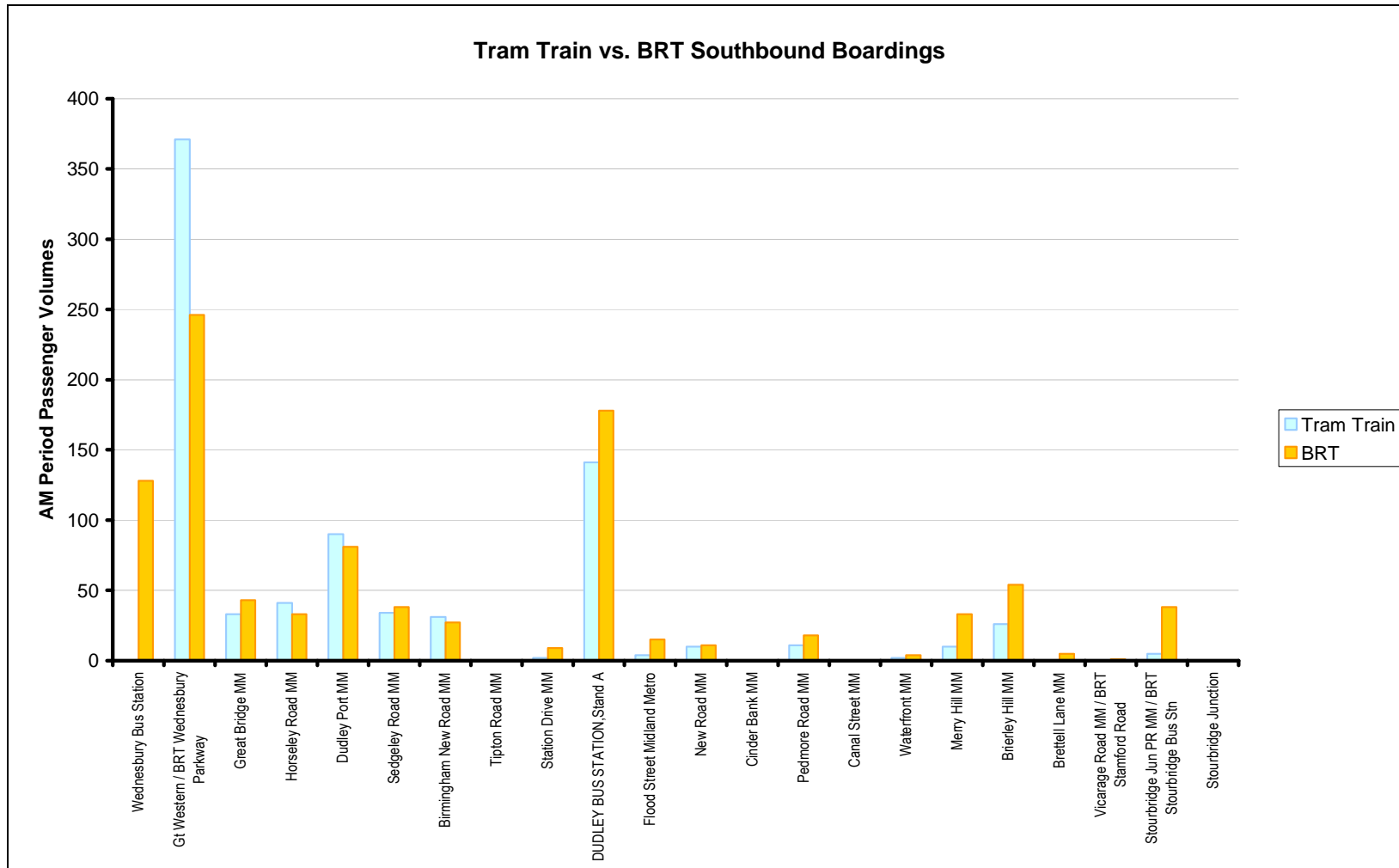
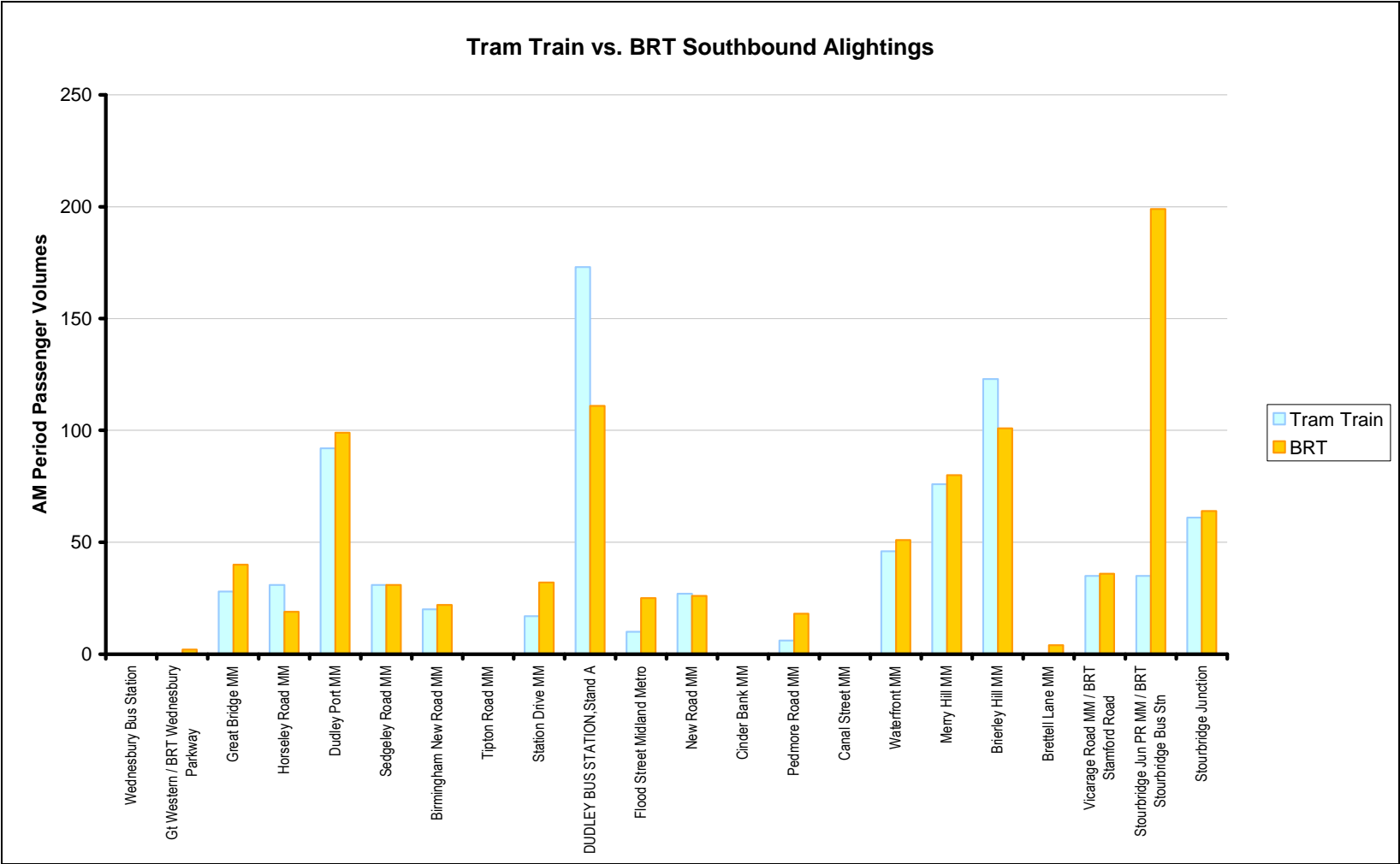


FIGURE 3.2 TRAM-TRAIN VS BRT - SOUTHBOUND ALIGHTINGS



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- 3.23 Table 3.2 shows the passenger boarding numbers along key sections of the route for each of the modes considered. As can be seen, the busiest section of the route by boarders is Wednesbury to Brierley Hill.
- 3.24 Between Walsall and Wednesbury, the BRT attracts more boarders than the on highway bus. This is likely to be due to the faster journey times on the rest of the route (and hence the greater overall attraction of the option). The heavy rail attracts the least boarders and the tram-train options do not run on this section.
- 3.25 Between Wednesbury and Brierley Hill, the tram-train attracts by far the most boarders due to faster connectivity than BRT and on highway bus. Again, heavy rail attracts the least due to its poor connectivity to key centres.
- 3.26 The Brierley Hill to Stourbridge section attracts the least boarders, as can be seen in Figure 3.2 there are more alightings in this section during the am peak. However, the difference between the BRT/bus and tram-train/heavy rail is likely to be the routing, as neither the tram-train nor the heavy rail would provide access to Stourbridge Town Centre.

TABLE 3.2 RUN TIMES AND PASSENGER BOARDINGS BY ROUTE SECTION (2026 AM PERIOD 0700-0900)

Options	Walsall - Wednesbury		Wednesbury - Brierley Hill		Brierley Hill - Stourbridge Jn/Town Centre	
	Run Time	Passengers Boarding	Run Time	Passengers Boarding	Run Time	Passengers Boarding
Tram-Train (DS3_Opt1)	N/A	N/A	20 min	923	7 min	38
Heavy Rail (DS4_Opt1)	6 min	196	16 min	103	10 min	16
BRT (DS5_Opt2)	17 min	564	24 min	576	12 min	130
BRT (DS5_Opt4)	17 min	449	33 min	249	15 min	136

4 Economic Appraisal

Introduction

- 4.1 This chapter presents the results of the economic assessment undertaken for the options presented in the previous chapters. It has been undertaken in line with DfT guidance.

Approach to Appraisal

- 4.2 The main assumptions employed in the appraisal are:

- Scheme opening year 2019
- Costs and benefits rebased and discounted to 2002 prices and values
- Real revenue growth
- Forecast years 2016 and 2026
- Demand and benefits interpolated between forecast years with no growth beyond 2026
- WebTAG values of time
- WebTAG value of time growth

- 4.3 Standards such as real growth, optimism bias, discount rate and appraisal period were kept constant for each option, to allow easy and accurate comparison of the schemes and to allow compliance with DfT standards.

Do Minimum

- 4.4 The freight costs were treated separately to the public transport options, in order to create a Do Minimum scenario, upon which, incremental cost of each option can be based. In the case of the freight options, the Do Minimum scenario is no development and therefore zero costs and benefits.

Treatment of Costs

- 4.5 For the economic appraisal the costs have been treated as follows:

- Real cost inflation
- Construction cost profile
 - 2016:15%
 - 2017:35%
 - 2018:35%
 - 2019:15%
- Market price adjustment (20.9%) applied to financial items
- Optimism Bias of 66% on capital costs & renewals

I Optimism Bias of 6% on vehicles

Treatment of Benefits

- 4.6 TUBA was used to forecast the journey time saving benefits.
- 4.7 As the associated highway benefits have not been modelled at this stage of the process, a global 25% uplift was applied and included within the time savings benefits.

Appraisal results

- 4.8 The economic results for the options are presented below by mode.

Freight

- 4.9 Table 4.1 summarises the economic results for the freight options that form the basis of the freight case. The same level of benefits has been assumed for both the double track and single track schemes. The results demonstrate that the greatest component of the benefits derives from the SLMs. The single-track freight scheme (FR_1) achieves a slightly higher Benefit:Cost Ratio (BCR) of 1.5:1 due to the lower costs. This indicates a medium Value for Money scheme.

TABLE 4.1 ECONOMIC APPRAISAL RESULTS FOR FREIGHT OPTIONS

ELEMENT	£000, PV	
	Sections of single track FR_1	Full double track FR_2
COSTS		
Non-Vehicle Capex	94,807	98,156
Non-Vehicle Renewals	21,478	20,358
Opex	20,524	25,654
Indirect Tax	48,760	48,760
Costs Total	185,569	192,928
BENEFITS		
Reliability Benefits	18,680	18,680
SLMs	234,845	234,845
Benefits Total	253,526	253,526
ECONOMIC RESULTS		
PV Benefits	211,524	207,513
PV Costs	143,567	146,916
NPV	67,956	60,598
BCR	1.5:1	1.4:1

Tram-Train Options

4.10 Table 4.2 summarises the economic results for the tram-train options.

TABLE 4.2 ECONOMIC APPRAISAL RESULTS FOR TRAM-TRAIN OPTIONS

	£000, PV				
	Line 1 to S/bridge	Shuttle Wed-S/b	Shuttle Wed-BH	Line 1 to BH	Line 1 to BH (via Dudley tunnel)
ELEMENT	TT_A	TT_B	TT_C	TT_D	TT_E
COSTS					
Non-Vehicle Capex	176,233	161,245	118,695	136,095	121,517
Vehicle Capex	42,641	24,102	22,248	34,607	32,753
Non-Vehicle Renewals	42,284	42,284	34,689	34,689	31,905
Vehicle Renewals	14,924	8,435	7,787	12,113	11,464
Opex	81,735	51,856	36,515	65,710	64,547
Indirect Tax	24,165	12,524	9,652	22,339	16,282
Total Costs	381,983	300,447	229,585	305,552	278,468
BENEFITS					
Time Savings	242,104	125,786	109,030	217,149	188,592
Revenue	142,495	73,853	56,917	131,725	96,009
Total Benefits	384,598	199,639	165,947	348,874	284,601
ECONOMIC RESULTS					
PV Benefits	245,655	97,063	86,957	236,363	176,685
PV Costs	243,039	197,871	150,595	193,041	170,553
NPV	2,616	-100,808	-63,639	43,322	6,133
BCR	1.0:1	0.5:1	0.6:1	1.2:1	1.0:1
Operating Ratio	1.7:1	1.4:1	1.6:1	2.0:1	1.5:1

4.11 The best performing options are the three options that include through running to Line 1 (TT_A, TT_D and TT_E) all with a BCR of 1:1 or above. The shuttle options (TT_B and TT_C) generate far lower patronage and therefore far lower benefits, but, due to the required infrastructure, with similar capital costs. Option TT_D, which runs from Brierley Hill to Line 1 produces the highest BCR at 1.2:1.

4.12 Option TT_E does not include street running through Dudley town centre as the rest of the options do. Although this option would be less costly than running through Dudley town centre, the reduced connectivity results in lower benefits and so performs worse than its street running counterpart (TT_D).

WBHS Corridor Options Economic Assessment

- 4.13 By comparing TT_A and TT_D, it is possible to assess the value of extending the route from Brierley Hill to Stourbridge. As can be seen, the Stourbridge to Line 1 option (TT_A) achieves higher benefits than the Brierley Hill to Line 1 option (TT_D). However, the additional cost of extending the line outweighs these additional benefits, producing a lower BCR.
- 4.14 From the above results, option TT_D has the best economic case for being taken forward for further consideration.

BRT/Bus Options

- 4.15 Table 4.3 summarises the economic results for the BRT/Bus options. As previously noted, no additional costs for rail freight related adjustments has been included within the costs for the BRT option (e.g. slewing tracks). Initial estimates suggest this will add c£3m to the capital cost. This additional cost has not been included within this economic assessment.

TABLE 4.3 ECONOMIC APPRAISAL RESULTS FOR BRT/BUS OPTIONS

ELEMENT	£000, PV					
	Wed-S/b (Rail corridor)	Walsall- S/b (Rail corridor)	Wed-S/b (HW corridor)	Walsall- S/b (HW corridor)	Wed-BH (Rail Corridor)	Wed-BH (HW Corridor)
	BU_1	BU_2	BU_3	BU_4	BU_5	BU_6
COSTS						
Non-Vehicle Capex	181,086	221,316	99,873	140,167	140,723	75,968
Vehicle Capex	3,001	4,126	3,751	5,063	2,063	2,813
Non-Vehicle Renewals	18,182	23,761	11,569	17,147	14,811	9,316
Vehicle Renewals	3,561	4,896	4,451	6,009	2,448	3,338
Opex	65,289	91,275	79,524	106,026	46,939	60,241
Indirect Tax	18,031	22,829	10,913	15,787	13,133	8,312
Total Costs	289,150	368,203	210,081	290,200	220,118	159,987
BENEFITS						
Time Savings	167,191	191,322	123,263	149,394	130,772	115,614
Revenue	106,324	134,616	64,352	93,093	77,443	49,011
Total Benefits	273,515	325,939	187,616	242,487	208,215	164,625
ECONOMIC RESULTS						
PV Benefits	186,483	206,006	92,072	113,305	144,016	91,730
PV Costs	202,118	248,271	114,537	161,018	155,919	87,092
NPV	-15,635	-42,264	-22,465	-47,713	-11,903	4,638
BCR	0.9:1	0.8:1	0.8:1	0.7:1	0.9:1	1.1:1

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Operating Ratio	1.6:1	1.5:1	0.8:1	0.9:1	1.6:1	0.8:1
4.16	Only the on highway bus option between Wednesbury and Brierley Hill (BU_6) achieves a BCR over 1:1. The rest of the options perform similarly in BCR terms, however the segregated BRT options (BU_1, BU_2 and BU_3) achieve much higher benefits than their on highway bus counterparts due to the shorter journey times.					
4.17	The segregated nature of the BRT options (BU_1, BU_3 and BU_5) mean they achieve similar benefits when compared to the tram-train shuttle options and the slightly lower capital costs mean that they perform better than the shuttle options. However, the through-running to Line 1 options achieve significantly more benefits for less additional cost.					
4.18	When comparing the segregated BRT option to Stourbridge and Brierley Hill (BU_1 and BU_5), the incremental BCR is the same as the overall BCR for the option. This indicates that the additional section from Brierley Hill to Stourbridge performs as strongly as the rest of the route.					
4.19	In contrast, for the on-highway bus option the section between Brierley Hill and Stourbridge performs more poorly than the rest of the route. Hence the increased BCR from the original option. The strong performance of the BRT option is due to its direct routeing to Stourbridge town centre. The on-highway bus option stops at Stourbridge Junction before proceeding to the town centre.					
4.20	From the economic results options BU_5 (BRT from Wednesbury to Brierley Hill) and BU_6 (on highway bus from Wednesbury to Brierley Hill) appear to have the best case for further development.					

Heavy Rail Options

- 4.21 Table 4.4 summaries the economic results for the heavy rail options.
- 4.22 The heavy rail options represent the lowest cost options due to the relatively small amount of infrastructure required incremental to the freight scheme. Due to this, even though the benefits achieved by these options are very low when compared to the other public transport options, most of the options achieve BCRs over 1:1.
- 4.23 However, none of the operating ratios exceed 1:1 suggesting that a heavy rail option would be likely to operate at a loss and require external revenue support.
- 4.24 For completeness, services that operate between Wednesbury and Brierley Hill were included in the assessment. From the economic results it can be seen that the option that operates 2tph between Wednesbury and Brierley produces the best BCR of all the public transport options at 1.5:1. However, it is not considered practical to operate a train over this short distance, especially as the trains would need to run to these locations to begin service. In reality a train service from Walsall to Stourbridge would be the most viable solution.
- 4.25 Taking the feasibility issues and economic performance into account, option HR_1 (2tp from Walsall to Stourbridge) is the best performing heavy rail option.

TABLE 4.4 ECONOMIC APPRAISAL RESULTS FOR HEAVY RAIL OPTIONS

ELEMENT	£000, PV					
	Walsall-S/b (2 tph)	Walsall-S/b (4 tph)	Wed-S/b (2 tph)	Wed-S/b (4 tph)	Wed-BH (2 tph)	Wed-BH (4tph)
	HR_1	HR_2	HR_3	HR_4	HR_5	HR_6
COSTS						
Non-Vehicle Capex	65,035	65,035	68,659	68,659	34,756	34,756
Non-Vehicle Renewals	6,807	6,807	6,807	6,807	5,987	5,987
Opex (including vehicles)	44,023	88,046	30,255	60,527	28,220	56,440
Indirect Tax	6,371	9,285	4,157	5,426	3,546	4,409
Total Costs	122,236	169,173	109,878	141,420	72,508	101,592
BENEFITS						
Time Savings	102,006	118,877	83,525	85,687	72,520	73,839
Revenue	37,569	54,750	24,511	31,998	20,908	26,001
Total Benefits	139,575	173,626	108,036	117,685	93,428	99,840
ECONOMIC RESULTS						
PV Benefits	88,745	78,773	70,974	50,350	59,221	37,413
PV Costs	71,406	74,320	72,816	74,086	38,301	39,165
NPV	17,339	4,453	-1,842	-23,735	20,919	-1,752
BCR	1.2:1	1.1:1	1.0:1	0.7:1	1.5:1	1.0:1
Operating Ratio	0.9:1	0.6:1	0.8:1	0.5:1	0.7:1	0.5:1

Tram Option

4.26 To be completed.

5 Recommendations

Context

- 5.1 The options development and assessment process is a staged approach leading to the establishment of a preferred scheme for which funding will be sought. At this stage of the process the objective is to identify a short list of options, each of which is plausible as a proposal, that provide a range of solutions to the objectives set for the scheme. It is critical to avoid the premature rejection of options without sufficient information on which to base such a decision.
- 5.2 The recommended options have emerged from a robust, consistent and transparent approach employing the currently available information. They, and the preceding process, therefore provide a sound platform for the continued development of the project and the subsequent compelling and compliant funding bid to central government.
- 5.3 In addition to the economic assessment set out within this technical note, the options have also been assessed against deliverability criteria and the DaSTS objectives. The results of this assessment can be seen in Appendix A. The recommendations presented in this note are based on both the reported economic performance and wider strategic and deliverability issues.
- 5.4 In developing these options there are a number of issues that have been identified from the initial findings that will be addressed. These are discussed below.

Issues

The value of connecting to Stourbridge

- 5.5 By considering the range of options assessed within this note, it is possible to infer the value (in transport economic terms) of the connection to Stourbridge. The analysis shows that directly linking centres such as Dudley and Brierley Hill to Stourbridge town centre rather than Stourbridge Junction provides significant benefits. This can be seen with the BRT options.
- 5.6 However, more analysis is required to see whether these benefits compensate for the additional cost of extending the options. It is also recommended that the BRT alignment for the section is considered for the on highway option and the engineering feasibility of running the tram-train option to Stourbridge town centre is re-examined.

Fit with the freight scheme

- 5.7 All the options have been developed as an increment to the freight scheme. However, as noted previously the different characteristics of the options mean different levels of interdependency. The tram-train and heavy rail options are dependent on the freight scheme and the BRT and bus options much less so.
- 5.8 The BRT option does not allow for a full double track freight option to be delivered. The space required for the two-way busway means that circa 30% of the freight scheme would need to be bi-direction single track.

- 5.9 This issue will need to be kept in mind while developing the options further, notably in relation to the deliverability implications of the options.

Conclusions

- 5.10 The tram-train options provide the quickest journey times between key centres and as such achieve the greatest patronages. Those options that include through-running on to Line 1 also provide a direct connection to regional strategic centres, particularly Birmingham and Wolverhampton resulting in higher benefits than the shuttle options for comparatively little additional capital cost. Failure to connect to Dudley town centre also reduced the level of benefits.
- 5.11 Due to the segregated nature of the BRT option it also achieves considerable journey time savings, but not as great as for tram-train. This level of segregation also means that the capital costs are only slightly lower than the tram-train option.
- 5.12 The on highway bus options have the slowest journey times, but do connect all the key centres and could be implemented wholly independently of the freight scheme. While being a lower cost option than the tram-train and BRT options it is less likely to support the realisation of the strategic objectives for the BCA corridor.
- 5.13 The heavy rail options achieve BCRs above 1:1 but as they are confined to the rail corridor they do not penetrate the important local centres of Dudley, Brierley Hill, Merry Hill and Stourbridge town centre. Although capital cost is the lowest of the public transport options due to the relatively small amount of infrastructure required incremental to the freight scheme, the patronage levels are also low due to its poor connectivity.
- 5.14 The original tram scheme (to be completed)

Recommendation

- 5.15 As noted previously, all the options were developed to address the issues identified in the Strategic Case and the objectives set for the scheme. The different characteristics of the options mean that they meet these objectives through different means and to differing extents leading to trade-offs.
- 5.16 It is recommended that four options are progressed for further development and assessment, one from each of the specified modes. This range of options enables the identified trade-offs to be examined in detail and the best overall scheme selected for a funding bid to central government.
- 5.17 The recommended options represent the best performing options for each mode in both economic and strategic terms:
- Tram-Train - Wolverhampton / Birmingham (Line 1) - Brierley Hill
 - BRT - Wednesbury to Brierley Hill via Dudley and Merry Hill (rail-corridor)
 - Bus Priority - Wednesbury to Brierley Hill via Dudley and Merry Hill (non-rail corridor)

■ Heavy Rail - Walsall to Stourbridge 2 trains per hour

5.18 As part of the further development and assessment stage, more detailed option modelling and assessment will be undertaken. This process will seek to strengthen the forecast economic performance of the options. As part of this process, extending the options to Stourbridge will also be considered.

APPENDIX

A

OPTION PERFORMANCE AGAINST DASTS OBJECTIVES AND DELIVERABILITY CRITERIA

CONTROL SHEET

Project/Proposal Name Black Country Access
Document Title WBHS Corridor Options Economic Assessment
Client Contract/Project No.
SDG Project/Proposal No. 22017111

ISSUE HISTORY

Issue No.	Date	Details
1.0	15/01/10	Work in Progress
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