TRANS-PENNINE TUNNEL STUDY PLUS

REPONSES TO DFT'S COMMENTS – TECHNICAL NOTE

MARCH 2019

Project:	Trans-Pennine Tunnel Study Plus
Subject:	Responses to DfT Comments
Author:	[redacted]
Reviewed:	[redacted]

1 INTRODUCTION

1.1.1 This note has been prepared as part of the Trans-Pennine Tunnel Strategic Study Plus (TPTS+). The study was commissioned on the understanding that a suitable variant of the Highways England Trans-Pennine Regional Transport Model (TPS RTM), referred to as vRTM, would be made available to the study team to appraise options.

1.1.2 However, vRTM was not made available and the study team has progressed with the TPS RTM with a number of adjustments to the forecast year models (these changes are documented in a separate note).

1.1.3 The suitability of the Base Year TPS RTM has also been questioned as part of the project assurance process, particularly how well the observed volumes and journey times are reproduced by the model. These metrics will provide assurance as to whether TPS RTM provides an acceptable level of assurance for the traffic forecasting and economic appraisal process.

1.1.4 This note has been therefore produced as an additional piece of work to set out key metrics relating to the model performance across the Pennines. Following on from this Introduction, it contains the following sections:

- Section 2 – Base Year Model Review
- Section 3 – Demand Responses by Hierarchy
- Section 4 – Flow Difference Between Optimised Package & Do Minimum
- Section 5 – Select Link Analysis by User Class
- Section 6 – Sector Plan as Percentage Changes
- Section 7 – Economic Geography
- Section 8 – SATURN Assignment Stats

1.1.5 Section 2 shows the level of error in the model relating to modelled flow volumes and journey times. This variance becomes less relevant for forecasting and appraisal because:

- The observed and modelled journey time profile for the A628 is generally consistent except in the Mottram area;
- The RIS scheme at Mottram is included in the forecast year models and therefore the level of error in the base year model is less relevant as through traffic bypasses this section of network; and
- The most significant flow differences relate to local traffic and not the through traffic that is forecast to divert to the TPTS scheme.

1.1.6 The level of error can be contextualised if the model is assumed to overestimate traffic by 400 vehicles in the peak hour and that the TUBA appraisal attributes a travel time saving of 20 minutes

to each of these. This is an extreme test and a simple calculation to monetise this sensitivity provides a value of £0.1bn, as below:

- 400 hourly flow;
- x 0.33 (20 minute) time saving;
- x 10 hours per factor;
- x 250 annualisation factor;
- x 30 appraisal period factor (allowing for discounting over 60 years); and
- x £10 average value of time.

1.1.7 This level of variance in benefits will not materially impact on the overall appraisal which has a value of around £5bn.

1.1.8 The remaining sections of the document provide detail of the model forecasts to assist DfT with its assurance process.

2 BASE YEAR MODEL REVIEW

2.1.1 This section provides a high-level summary of the review of the TPS RTM base year model in terms of flow and journey time validation, more specifically on the routes that are within the influence areas of the TPTS+ studies.

2.1.2 All the figures for this section have been extracted from the RTM reporting kindly supplied by Highways England.

2.2 Mini-Screenline Validation

2.2.1 The following figures, (Figure **2.1**, Figure **2.2** and **Figure 2.3**) show how well the screenlines perform across the modelled area for the three modelled time periods.

Figure 2.1 TPS RTM Mini-Screenline Validation - AM peak

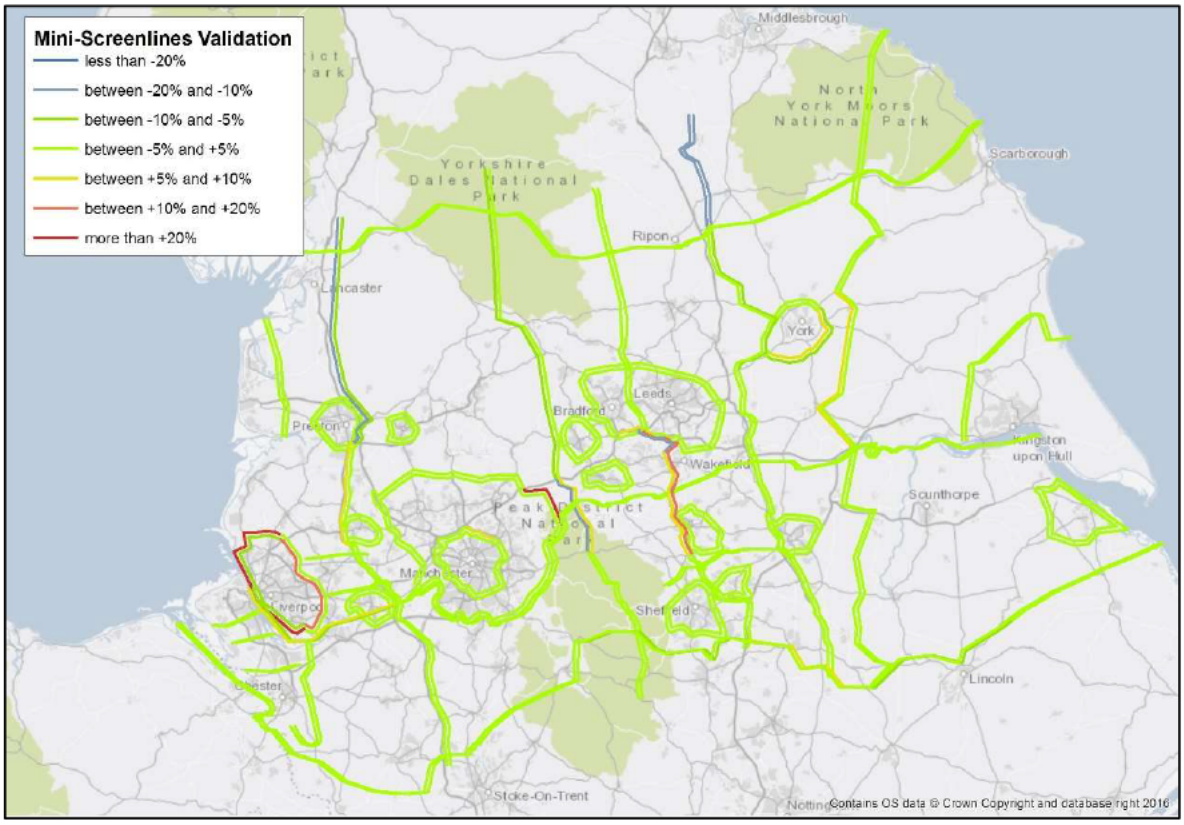


Figure 2.2 TPS RTM Mini-Screenline Validation - Inter-Peak

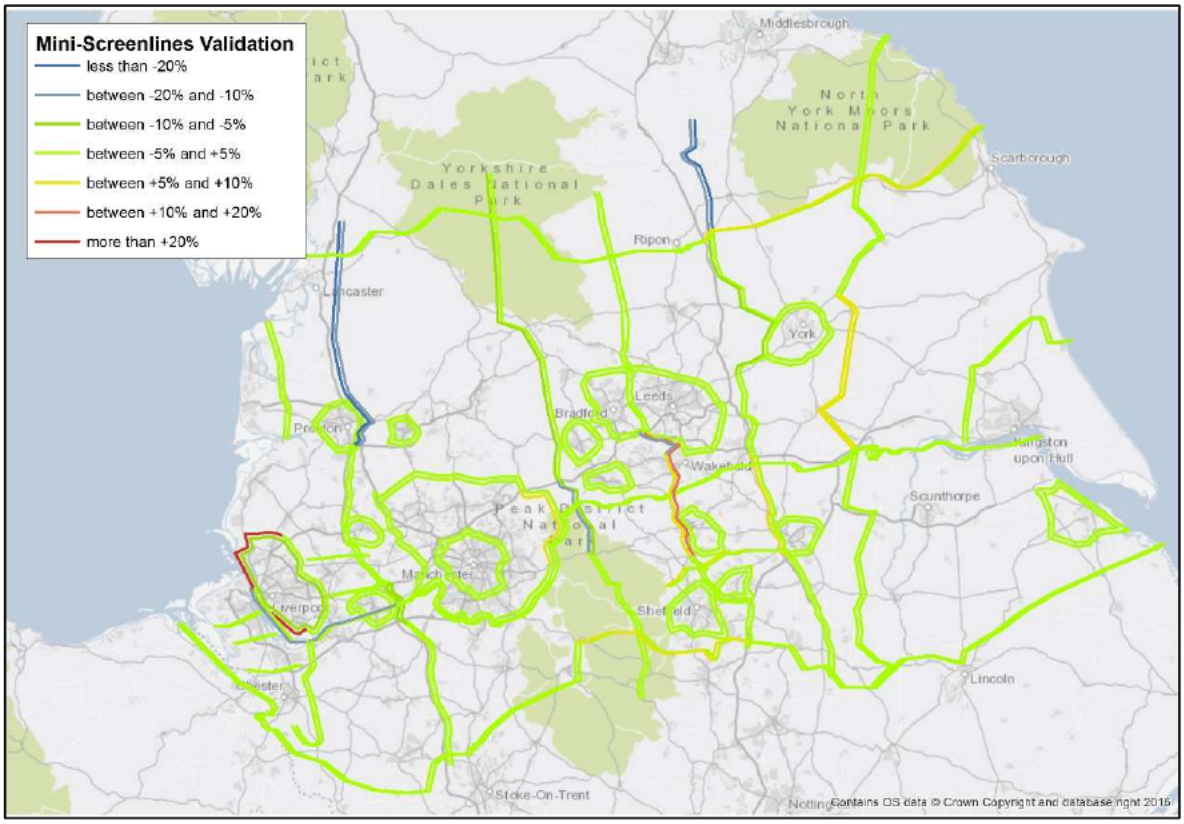
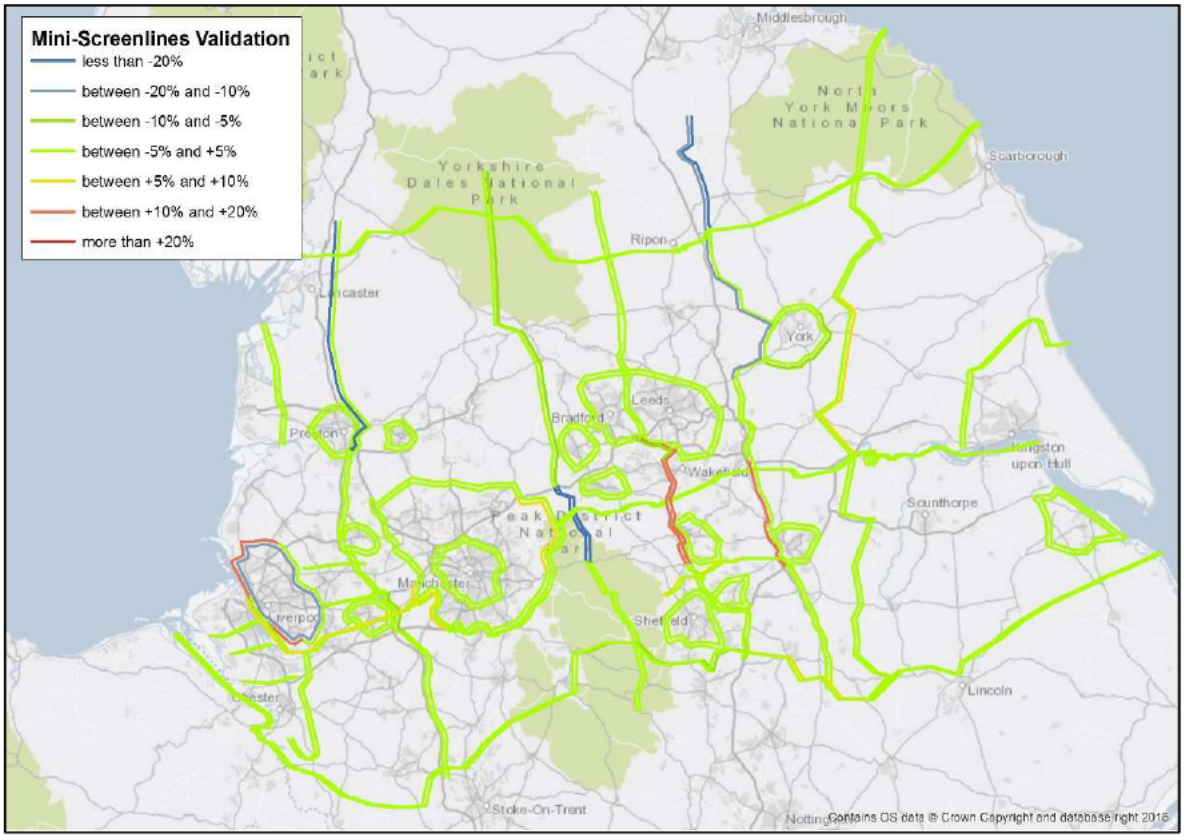


Figure 2.3 TPS RTM Mini-Screenline Validation - PM Peak



2.2.2 It can be seen from the mini-screenline validation figures that:

- The M60 cordons surrounding Manchester are generally within an acceptable criterion (less than 5% difference between modelled flow and observed counts);
- Cordons surrounding Sheffield and Leeds also show good validation with difference are within the acceptable criterion (less than 5% difference between modelled flows and observed counts);
- There is however an underestimate of total flows across the M62/A628, across all three modelled periods. This would potentially result in under-reporting of the TPTS impacts in terms of demand crossing the Pennines when the TPTS is built; and
- There is an overestimate of total flows across the mini-screenline west of the M1 between Barnsley and Wakefield. However, the overestimate of demand for this mini-screenline seems to suggest being a result of excessive localised trips that access onto the M1 (further evidence provided in the subsequent section) and therefore would not have significant impacts on the TPTS.

2.3 SRN link Count Validation

2.3.1 The following figures, (**Figure 2.4**, **Figure 2.5** and **Figure 2.6**) illustrate flow validation at individual link levels, particularly on the SRN networks.

Figure 2.4 SRN Link Validation - AM Peak

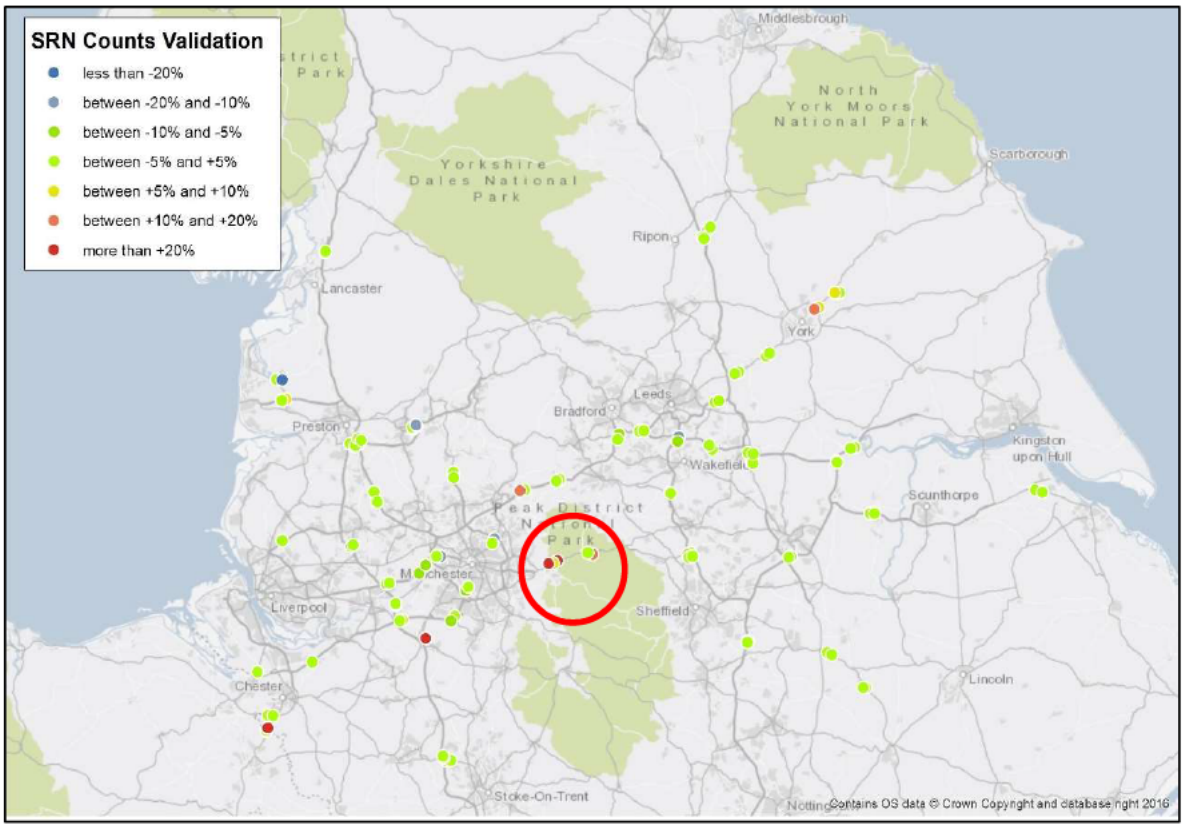


Figure 2.5 SRN Link Validation - Inter-Peak

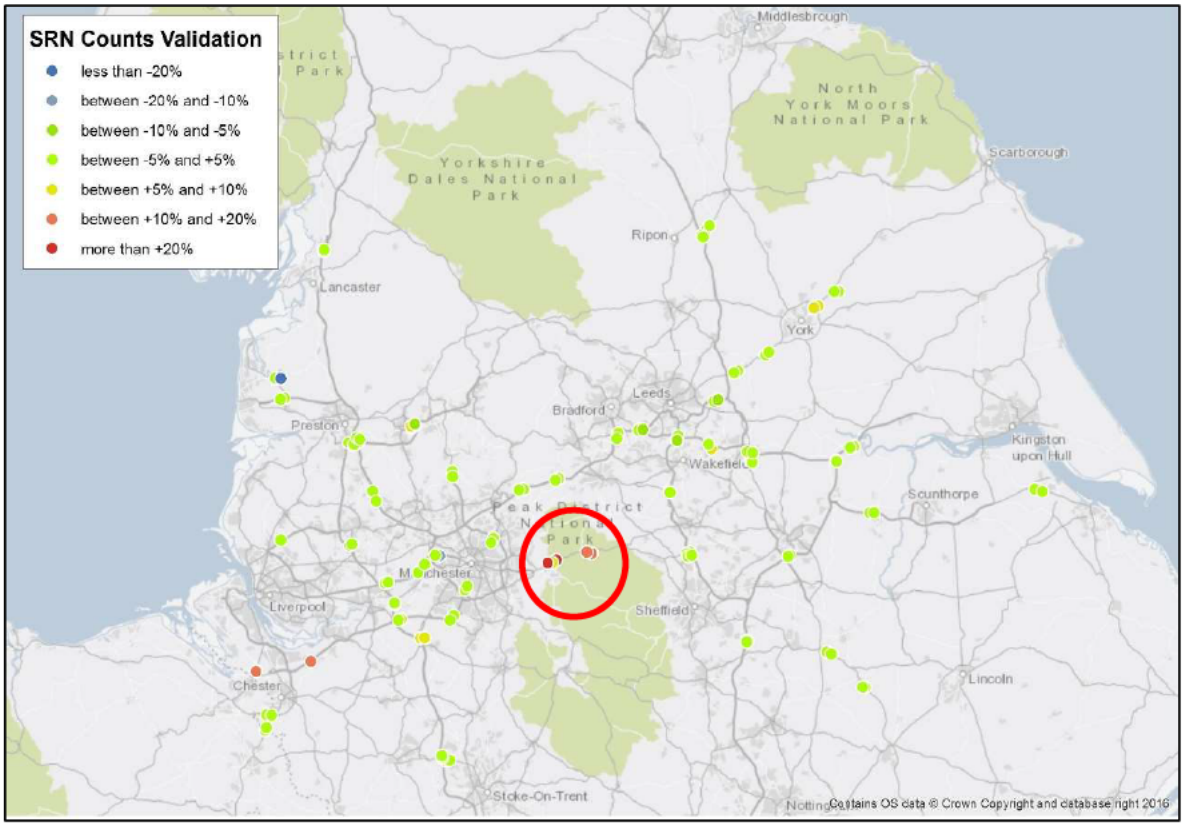
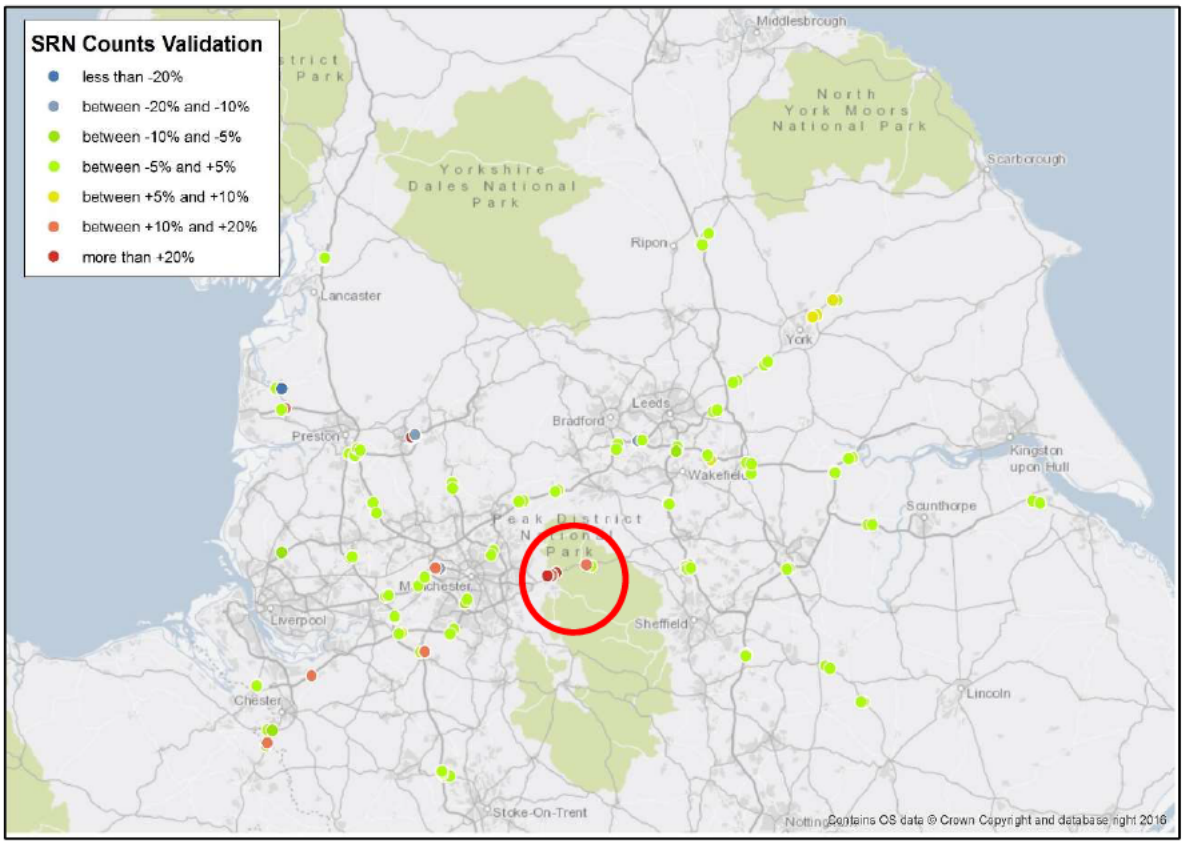


Figure 2.6 SRN Link Validation - PM Peak



2.3.2 It can be seen from the SRN link validation that:

- The SRN link modelled flows are generally within 10% of the observed counts;
- There is an exception of SRN links along the A628 Trans-Pennine routes where modelled flows are higher than the observed counts.

2.3.3 It should be noted that along the A628 Trans-Pennine routes whilst eastbound modelled flows are within the acceptable criterion, westbound traffic showing average 80% higher (300-400veh) compared to observed counts.

2.3.4 Analysis of the flow validation on the A628 shows that the overestimate of the westbound traffic on A628 was on two sections: a) from M1 J37 Barnsley and b) near Mottram. A628 both directions near Woodhead (A6024) are however within the acceptable criterion. That suggests the overestimate of modelled flows on A628 are primarily associated with localised trips near Mottram and near M1 (as mentioned in the mini-screenline section) and therefore not likely to affect the demand crossing the Pennines.

2.4 Journey Time Validation

2.4.1 Figures 2.7 to 2.9 below provide high-level summary of the journey time validation that was extracted from the TPS RTM LMVR.

Figure 2.7 Journey Time Validation - AM Peak

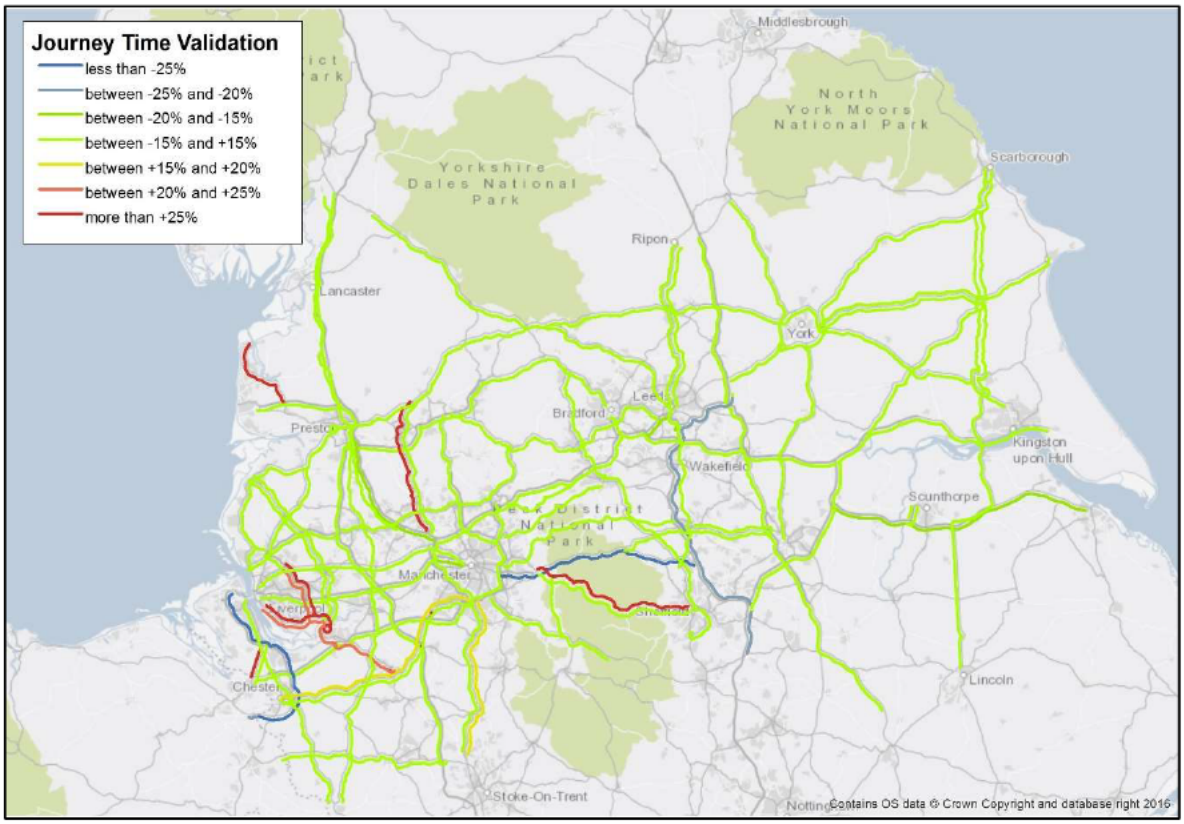


Figure 2.8 Journey Time Validation - Inter-Peak

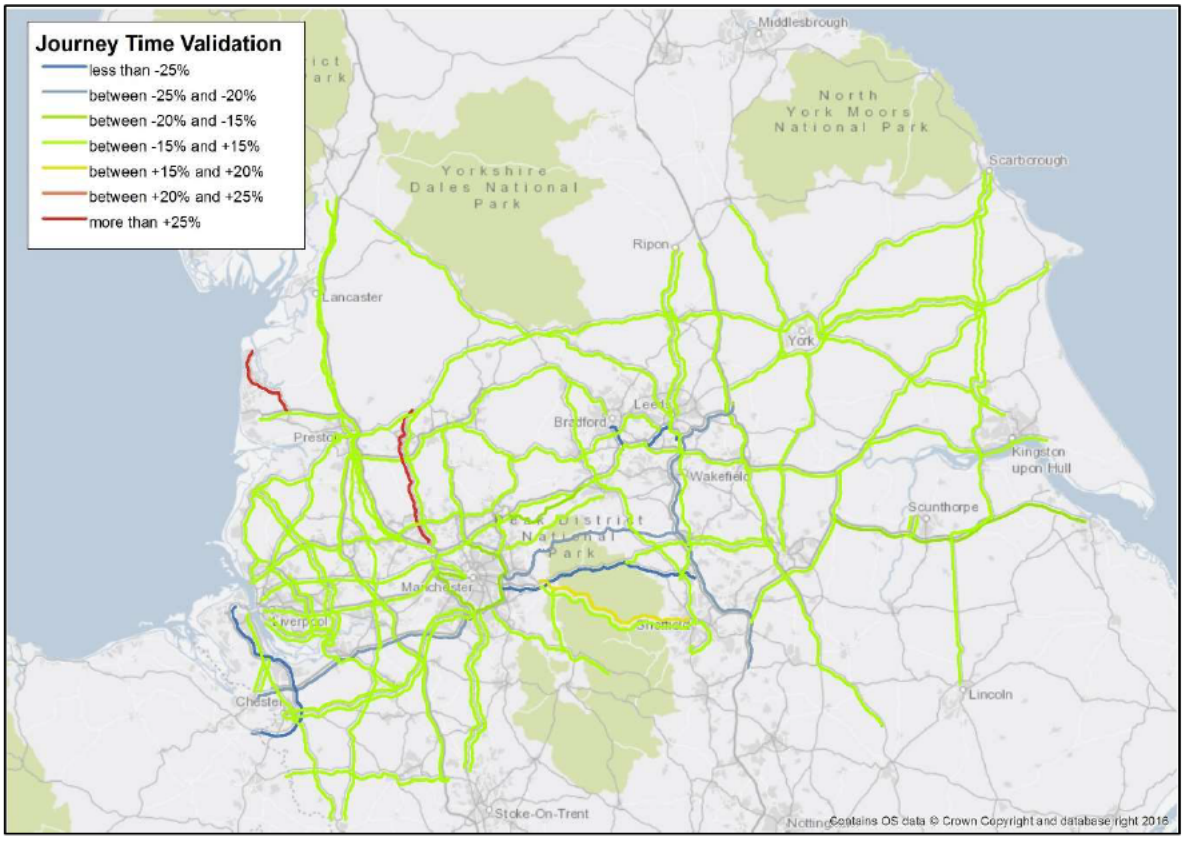
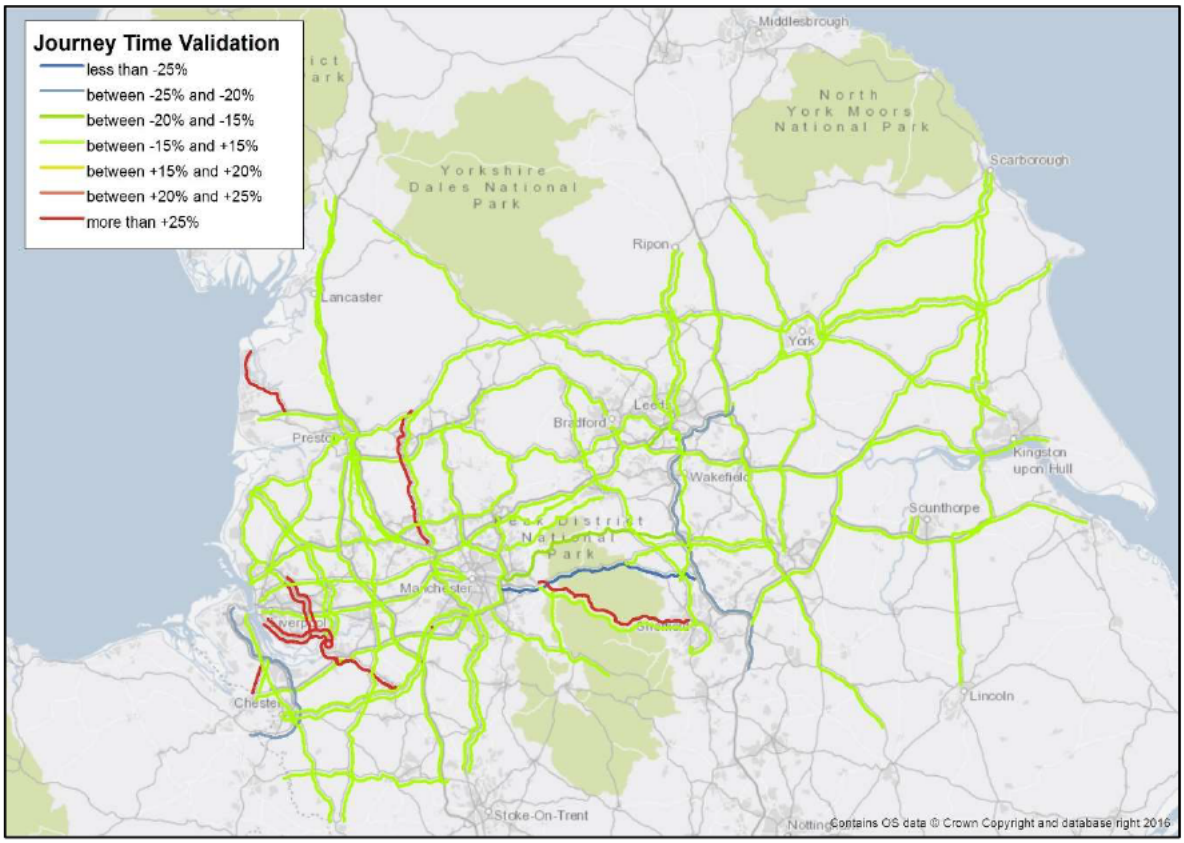


Figure 2.9 Journey Time Validation - PM Peak



2.4.2 It can be seen from the journey time validation figures that:

- M62 between Manchester and Leeds: modelled speeds are within acceptable range of the observed data. That would suggest accurate representation of time savings due to rerouting with the TPTS intervention is in place; however, it is noted that
- M67/A628/A616 Trans-Pennine routes: modelled speeds are faster than observed speeds for the westbound direction (more than 25% different, or 8-11 minutes faster), primarily due to the faster speed on A628 between Woodhead and Mottram in the model compared to observed data;
- M1 southbound between Sheffield and Leeds: modelled speeds are faster than observed speeds (overall difference is between 9-12% faster); and
- A57 Snake Pass westbound: modelled speeds are slower than the observed speeds in the AM and PM peaks (between 15-20min slower).

2.4.3 The delay along the key section across the M67/A628/A616 (primarily on A628 between Woodhead and Mottram) is underrepresented in the model. This section carries the highest volume of traffic across the Pennines with the exception of the M62. The model is likely to underestimate the journey time savings of the scheme and therefore underestimate the transfer of traffic to the scheme and the associated user benefits. However, the forecast year networks contain RIS1 improvements in the Do Minimum scenario these interventions would improve journey times and therefore the level of error in the base may be offset.

2.4.4 The opposite effect is evident on the A57 Snake Pass. However, this links carries lower volumes of traffic (150-200veh) crossing the Pennines so its impact on the user benefits is likely to be relatively modest. In addition, the analysis from the Base year model shows that the majority of the modelled delays is at junction between Mottram Moor and Wooley lane, which will be offset in the forecast year with the Mottram bypass included.

2.4.5 JT validation plots extracted from the LMVR for the M67/A628 and A57 are provided in Figure 2.10 and 2.11 below.

Figure 2.10 Journey Time Validation – M67/A628

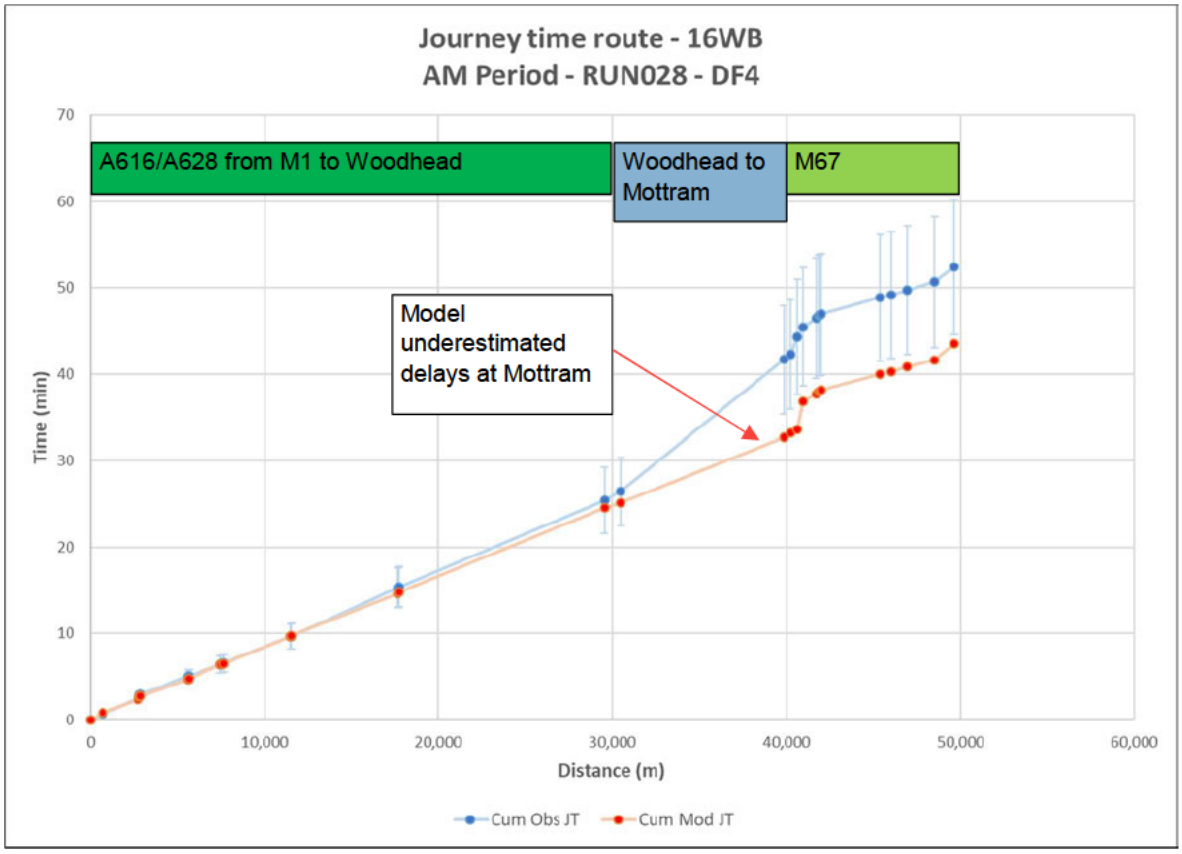
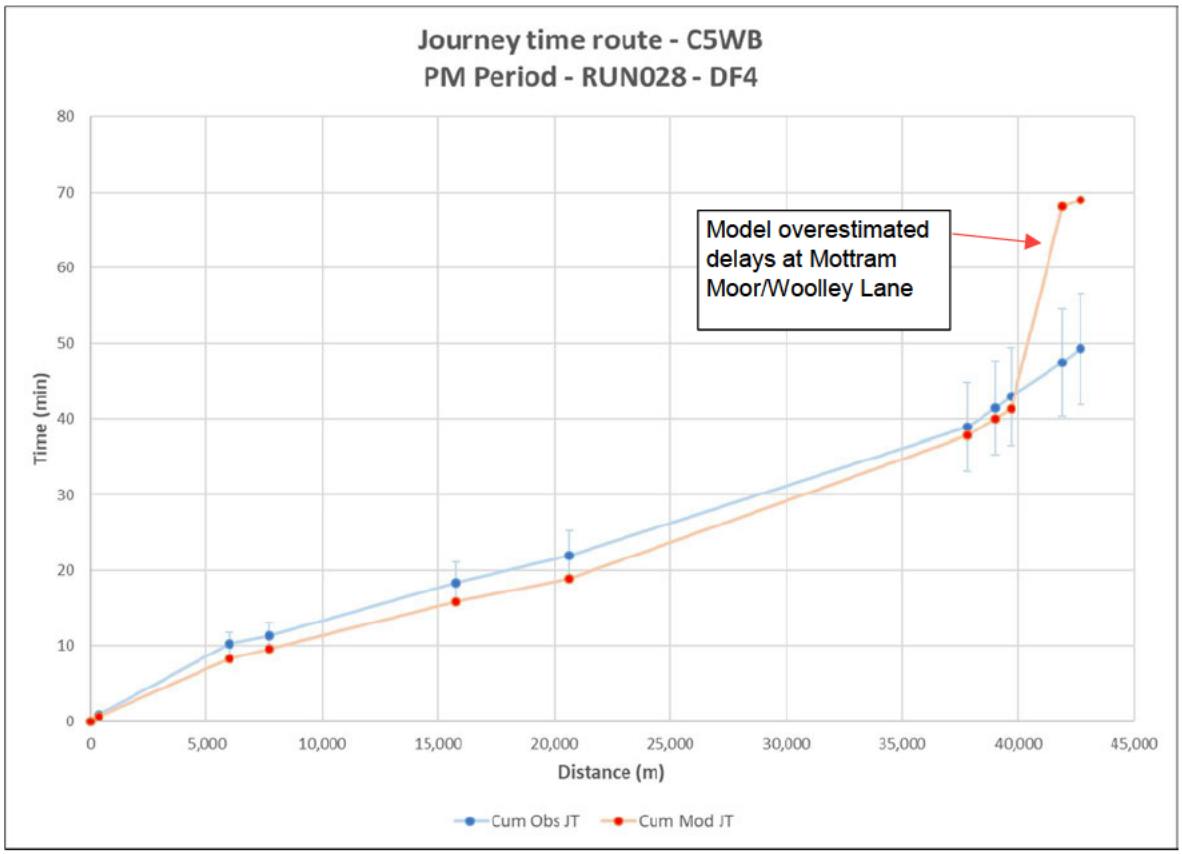


Figure 2.11 Journey Time Validation – A57



2.5 Base year Model Conclusion

2.5.1 The review of the base year TPS RTM model shows that overall the base model validation is within the acceptable criteria for both flow and journey time.

2.5.2 The two exceptions of the TPS RTM model within the vicinity of the TPTS are the flow and journey time validation on the A628 section between Woodhead and Mottram westbound direction, where modelled flows are between 300-400veh higher than the observed counts and modelled time is between 8-11 minutes faster than observed speed; and journey time validation on A57 westbound at direction, at junction Mottram Moor and Woolley lane, where modelled time is between 15-20min slower than the observed data.

2.5.3 However, the RIS1 scheme, i.e. Mottram bypass, that is included in the forecast network would improve journey time along these sections and therefore the level of errors maybe offset. Furthermore, the higher modelled flows on A628 near Mottram suggested to be localised trips, and low flow volume on the A57 would not likely to make significant impacts on the demand crossing the Pennines.

2.5.4 M62 between Manchester and Leeds carries significant amount of traffic and the impacts of the TPS would result in significant reduction of traffic on the motorways. The flow and journey time validation on the M62 are deemed acceptable and therefore would represent accurately the impacts of the TPTS on travel time savings.

2.5.5 With these above, it is considered that the base year model is deemed to be acceptable for the purpose of the TPTS+ studies at this stage.

3 DEMAND RESPONSES BY HIERARCHY

3.1.1 This section provides a high-level summary of the change in demand by hierarchy in response to change in travel costs.

3.1.2 The RTM VDM model is an incremental PA model which pivots from the base year model and includes the following choice responses in order of hierarchy:

- Macro time of day choice: represent travel choice between different time periods of a day;
- Mode choice: represent choice between car and public transport; and
- Destination choice: choice between different destinations.

3.1.3 It is generally anticipated that:

- As the highway cost increases at a larger step compared to PT cost increase, the mode choice response would result in reduction in car trips and increase in PT trips;
- Increase in travel costs during peak hour would normally be larger than during inter-peak and off-peak period, the time choice response would result in reduction in car demand during AM and PM peak period and transfer trips toward inter-peak and off-peak period;
- The effect of destination choice is more evident at sector level as trips would switch to destinations that offer lower costs of travel.

3.1.4 The following sections provide in more detail the impacts of the VDM on demand responses.

3.2 Impact of VDM on Matrix Totals by Mode and Time Period

3.2.1 The impacts of VDM on change in demand in response to change in costs with respect to mode choice and time choice is presented in **Table 3.1** and **Table 3.2**. for the Do-Minimum and the Optimised package respectively. The results are presented by trip purpose and by time period.

Table 3.1 Impact of VDM on Demand Responses – Do-Minimum

Period	Highway				PT			
	Business	Commute	Other	Total	Business	Commute	Other	Total
Reference Demand								
AM Peak	1,266,425	7,115,329	7,967,726	**16,349,481**	147,552	748,961	215,273	**1,111,786**
Inter-Peak	2,322,985	6,913,195	20,066,673	**29,302,852**	103,255	98,972	352,932	**555,159**
PM Peak	1,283,365	7,200,327	11,199,745	**19,683,437**	137,878	775,738	235,340	**1,148,956**
Off-Peak	1,042,930	4,438,938	10,333,761	**15,815,629**	62,131	213,881	117,939	**393,950**
Total	**5,915,705**	**25,667,788**	**49,567,906**	**81,151,399**	**450,816**	**1,837,552**	**921,484**	**3,209,851**
Post-VDM demand								
AM Peak	1,255,744	7,071,401	7,958,372	**16,285,517**	155,315	808,883	232,739	**1,196,938**
Inter-Peak	2,309,851	6,880,404	20,038,639	**29,228,895**	108,826	106,890	382,061	**597,777**
PM Peak	1,271,592	7,152,423	11,172,966	**19,596,981**	145,308	837,803	255,151	**1,238,262**
Off-Peak	1,056,520	4,429,909	10,364,233	**15,850,663**	66,033	230,993	127,876	**424,901**
Total	**5,893,707**	**25,534,137**	**49,534,211**	**80,962,056**	**475,482**	**1,984,568**	**997,828**	**3,457,878**
Change								
AM Peak	-10,682	-43,928	-9,354	**-63,964**	7,763	59,922	17,466	**85,152**
Inter-Peak	-13,133	-32,790	-28,034	**-73,958**	5,570	7,918	29,129	**42,618**
PM Peak	-11,773	-47,904	-26,779	**-86,456**	7,430	62,064	19,811	**89,306**
Off-Peak	13,591	-9,029	30,473	**35,034**	3,902	17,112	9,937	**30,951**
Total	**-21,997**	**-133,651**	**-33,695**	**-189,343**	**24,666**	**147,017**	**76,344**	**248,027**
%Change								
AM Peak	-0.8%	-0.6%	-0.1%	**-0.4%**	5.3%	8.0%	8.1%	**7.7%**
Inter-Peak	-0.6%	-0.5%	-0.1%	**-0.3%**	5.4%	8.0%	8.3%	**7.7%**
PM Peak	-0.9%	-0.7%	-0.2%	**-0.4%**	5.4%	8.0%	8.4%	**7.8%**
Off-Peak	1.3%	-0.2%	0.3%	**0.2%**	6.3%	8.0%	8.4%	**7.9%**
Total	**-0.4%**	**-0.5%**	**-0.1%**	**-0.2%**	**5.5%**	**8.0%**	**8.3%**	**7.7%**

Table 3.2 Impact of VDM on Demand Responses – Optimised Package

Period	Highway				PT			
	Business	Commute	Other	Total	Business	Commute	Other	Total
Reference Demand								
AM Peak	1,266,425	7,115,329	7,967,726	**16,349,481**	147,552	748,961	215,273	**1,111,786**
Inter-Peak	2,322,985	6,913,195	20,066,673	**29,302,852**	103,255	98,972	352,932	**555,159**
PM Peak	1,283,365	7,200,327	11,199,745	**19,683,437**	137,878	775,738	235,340	**1,148,956**
Off-Peak	1,042,930	4,438,938	10,333,761	**15,815,629**	62,131	213,881	117,939	**393,950**
Total	**5,915,705**	**25,667,788**	**49,567,906**	**81,151,399**	**450,816**	**1,837,552**	**921,484**	**3,209,851**
Post-VDM demand								
AM Peak	1,256,297	7,072,013	7,959,302	**16,287,612**	155,114	808,731	232,683	**1,196,529**
Inter-Peak	2,309,793	6,880,032	20,037,318	**29,227,143**	108,681	106,870	381,973	**597,524**
PM Peak	1,271,711	7,152,965	11,174,691	**19,599,367**	145,123	837,645	255,095	**1,237,863**
Off-Peak	1,056,459	4,429,467	10,363,037	**15,848,963**	65,944	230,949	127,846	**424,740**
Total	**5,894,261**	**25,534,476**	**49,534,348**	**80,963,085**	**474,863**	**1,984,195**	**997,598**	**3,456,656**
Change								
AM Peak	-10,128	-43,316	-8,425	**-61,869**	7,562	59,770	17,410	**84,743**
Inter-Peak	-13,191	-33,163	-29,356	**-75,710**	5,426	7,898	29,041	**42,365**
PM Peak	-11,654	-47,362	-25,054	**-84,070**	7,245	61,907	19,755	**88,907**
Off-Peak	13,529	-9,471	29,276	**33,335**	3,814	17,068	9,907	**30,790**
Total	**-21,444**	**-133,312**	**-33,558**	**-188,314**	**24,047**	**146,643**	**76,114**	**246,805**
%Change								
AM Peak	-0.8%	-0.6%	-0.1%	**-0.4%**	5.1%	8.0%	8.1%	**7.6%**
Inter-Peak	-0.6%	-0.5%	-0.1%	**-0.3%**	5.3%	8.0%	8.2%	**7.6%**
PM Peak	-0.9%	-0.7%	-0.2%	**-0.4%**	5.3%	8.0%	8.4%	**7.7%**
Off-Peak	1.3%	-0.2%	0.3%	**0.2%**	6.1%	8.0%	8.4%	**7.8%**
Total	**-0.4%**	**-0.5%**	**-0.1%**	**-0.2%**	**5.3%**	**8.0%**	**8.3%**	**7.7%**

3.2.2 It should be noted that special trip generators (e.g. airport trips), LGV and HGV trips are assumed not to be subject to VDM impacts and therefore are not reported here.

3.2.3 It is also noted that the reduction in car trips does not equal to the increase in PT trips due to the car unit being vehicle as opposed to the person trips in PT.

3.2.4 The results from the Tables3.1 and 3.2 demonstrate that:

- Mode choice responses resulted in transferring trips from highway to PT across all the purposes and time periods. This is a result of larger increase in highway congestion compared to the increase in PT costs in the forecast years.
- Time choice responses resulted in transferring highway trips from peak to off-peak periods. This is a result of larger increase in travel costs during the peak hours compared to cost change during the off-peak period. It is also noted that the reduction in the highway trips in the AM and PM peak are larger than that in the inter-peak (0.4% reduction in the AM and PM compared to 0.3% reduction in the inter-peak). It is deemed plausible given the larger increase in travel costs in the AM and PM peak compared to the inter-peak.
- Impacts of VDM on the demand responses for the Do-Minimum and the Optimised package are considered plausible, with increase in demand in the Optimised package from the Do-Minimum during the AM and PM periods, and reduction in demand in the optimised package compared to the Do-Minimum during the inter-peak and off-peak periods. The reduction in demand during the inter-peak and off-peak periods are expected to be the effects of time choice modelling within the VDM.

3.3 Impact of TPTS to Do-Minimum Demand

3.3.1 Table 3.3 provides summary of change demand total as a result of TPTS interventions.

Table 3.3 Impact of TPTS on Demand Responses

Period	Highway				PT			
	Business	Commute	Other	Total	Business	Commute	Other	Total
Reference Demand								
AM Peak	1,255,744	7,071,401	7,958,372	**16,285,517**	155,315	808,883	232,739	**1,196,938**
Inter-Peak	2,309,851	6,880,404	20,038,639	**29,228,895**	108,826	106,890	382,061	**597,777**
PM Peak	1,271,592	7,152,423	11,172,966	**19,596,981**	145,308	837,803	255,151	**1,238,262**
Off-Peak	1,056,520	4,429,909	10,364,233	**15,850,663**	66,033	230,993	127,876	**424,901**
Total	**5,893,707**	**25,534,137**	**49,534,211**	**80,962,056**	**475,482**	**1,984,568**	**997,828**	**3,457,878**
Post-VDM demand								
AM Peak	1,256,297	7,072,013	7,959,302	**16,287,612**	155,114	808,731	232,683	**1,196,529**
Inter-Peak	2,309,793	6,880,032	20,037,318	**29,227,143**	108,681	106,870	381,973	**597,524**
PM Peak	1,271,711	7,152,965	11,174,691	**19,599,367**	145,123	837,645	255,095	**1,237,863**
Off-Peak	1,056,459	4,429,467	10,363,037	**15,848,963**	65,944	230,949	127,846	**424,740**
Total	**5,894,261**	**25,534,476**	**49,534,348**	**80,963,085**	**474,863**	**1,984,195**	**997,598**	**3,456,656**
Change								
AM Peak	554	612	929	**2,095**	-201	-152	-56	**-409**
Inter-Peak	-58	-373	-1,322	**-1,752**	-145	-20	-88	**-253**
PM Peak	119	542	1,725	**2,386**	-185	-158	-56	**-399**
Off-Peak	-61	-442	-1,196	**-1,700**	-88	-43	-30	**-161**
Total	**554**	**339**	**137**	**1,029**	**-619**	**-373**	**-230**	**-1,222**
%Change								
AM Peak	0.0%	0.0%	0.0%	**0.0%**	-0.1%	0.0%	0.0%	**0.0%**
Inter-Peak	0.0%	0.0%	0.0%	**0.0%**	-0.1%	0.0%	0.0%	**0.0%**
PM Peak	0.0%	0.0%	0.0%	**0.0%**	-0.1%	0.0%	0.0%	**0.0%**
Off-Peak	0.0%	0.0%	0.0%	**0.0%**	-0.1%	0.0%	0.0%	**0.0%**
Total	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**-0.1%**	**0.0%**	**0.0%**	**0.0%**

3.3.2 As can be seen from Table 3.3 that with the TPTS in place:

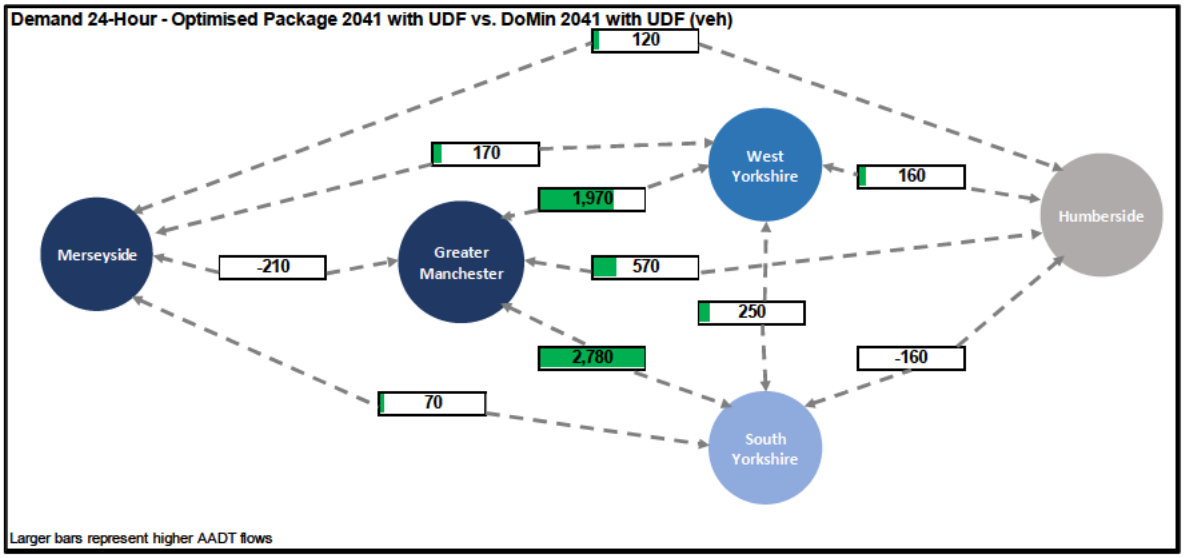
- Mode choice response would result in trips that transferred to the PT in the Do-Minimum has now switched back to cars due to reduction in car travel costs in the Do-Something compared to the Do-Minimum; and
- Time choice responses would result in transferring trips from the inter-peak and off-peak back to the AM and PM peak periods due to reduction in cost change during the peak periods in the Do-Something compared to the Do-Minimum, i.e. increase in AM and PM peak demand in the Do-Something against Do-Minimum.

3.3.3 Overall, it is concluded that the change in demand in response to change in travel costs in the Do-Minimum and Do-Something are considered plausible.

3.4 Impacts of Destination choice on TPTS demand

3.4.1 Figure 3.1 below provides a summary on the impacts of the TPTS interventions on destination choice responses. The Figure shows the change in demand across major conurbation areas in the Do-Something against the Do-minimum.

Figure 3.1 Impacts of TPTS on Destination Choice Responses



3.4.2 It can be seen that, with the TPTS in place, the destination choice responses would result in more trips to be travelling across the Pennines (for example, between Manchester and Leeds, Manchester to Sheffield, etc.) instead of staying entirely within Manchester, Leeds or Sheffield areas.

3.4.3 It is to conclude that the destination choice response as a result of the TPTS interventions are deemed plausible.

3.5 Effects of 'Fitting-On' Factors

3.5.1 It is noted that prior to the SATURN assignments, a set of 'Fitting-On' factors have been applied to the output OD demand produced from VDM (as shown in **Table 3.1/3.2**) to create a post-VDM matrix to be assigned onto the highway network.

3.5.2 The 'Fitting On' factors are essentially adjustment factors at individual OD cell levels, by time period and by user class that have been calculated during the development of the base year demand model. These have been created to address the issue with the inconsistency between the PA and OD format.

3.5.3 The application of the 'Fitting-On' factors has resulted in a reduction of the slightly counter-intuitive matrix totals in the post-VDM demand matrices that have been used for SATURN assignments compared to the OD demand outputs from the VDM.

3.5.4 An example of this is shown in the demand matrix totals produced from the VDM process. This shows that the matrix totals for the Optimised Package shows a slight increase from the Do-Minimum scenario. The matrix totals for the post-Fitting-On factor application results in smaller matrix totals for the optimised packages compared to the Do-Minimum.

3.5.5 Following discussions with Highways England, it was agreed that the overall change in demand was not large and therefore would not be an issue.

3.6 Impact of VDM on Trip-Length Distribution (TLD)

3.6.1 This section provides a high-level summary of the impacts of VDM on the Trip-Length Distribution of car trips by each purpose: Business, Commuting, and Other, as shown in Figure 3.2, 3.2 and 3.4.

3.6.2 Freight (LGV and HGV) are considered not subject to the VDM responses and therefore not reported here.

Figure 3.2 Impacts of VDM on TLD - Business

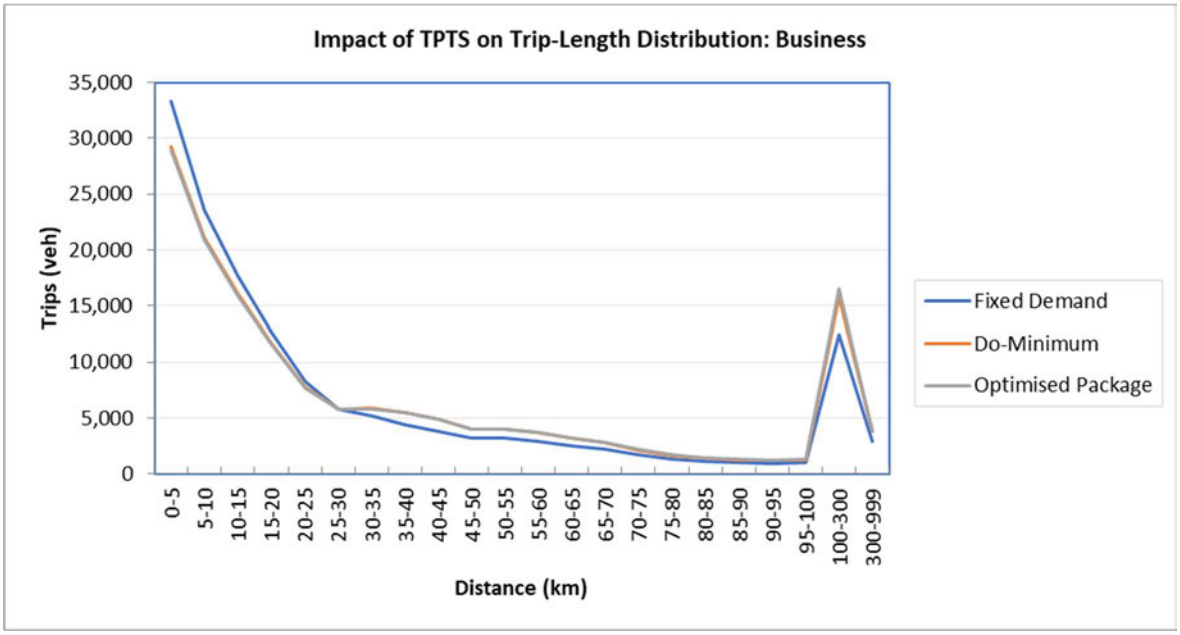


Figure 3.3 Impacts of VDM on TLD - Commute

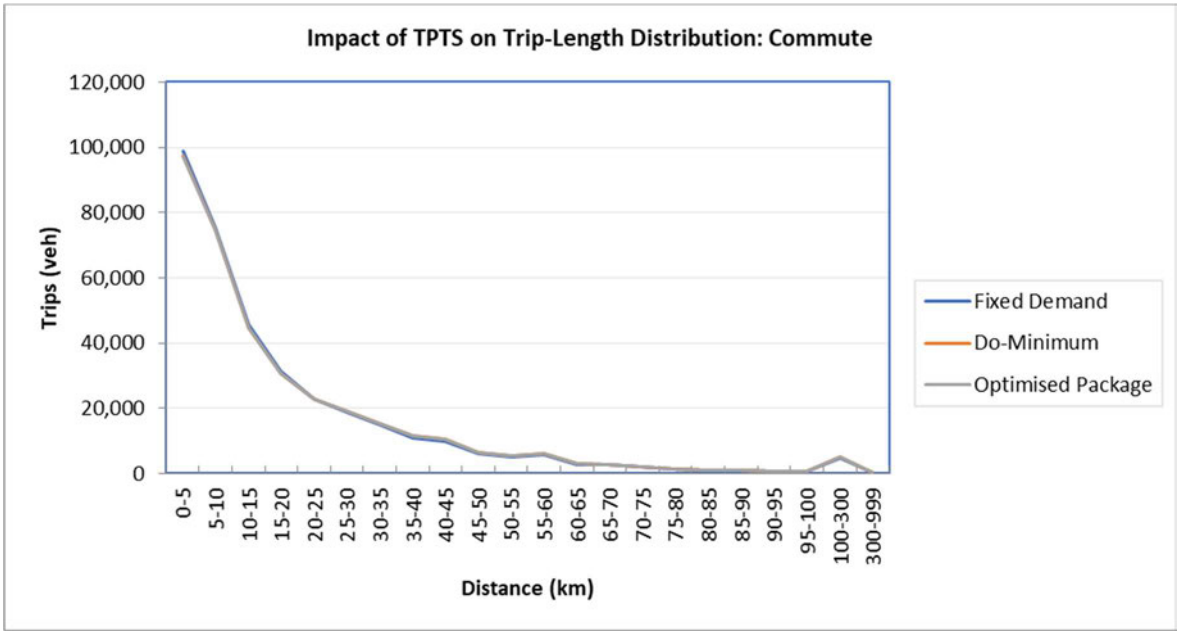
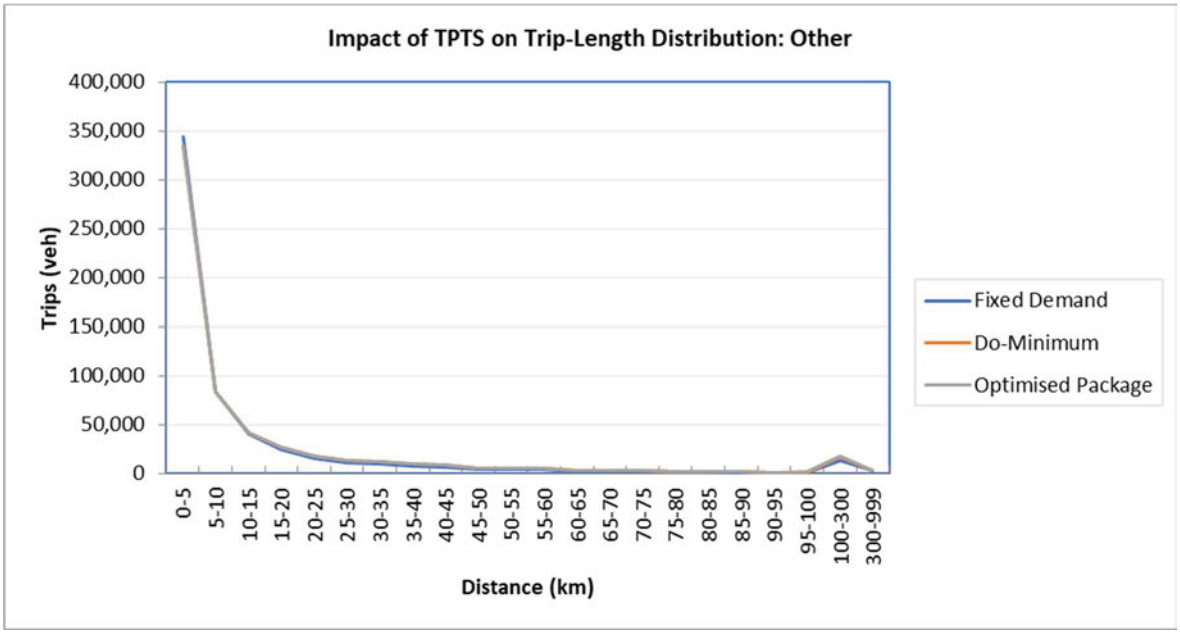


Figure 3.4 Impacts of VDM on TLD - Other



3.6.3 The figures show that:

- The VDM results in change in the TLD for all three purposes, with the strongest response for the business trips.
- Comparing the Fixed demand and Do-Minimum, business trips show a reduction in the short distance and a significant increase in long distance trips. This is anticipated as whilst urban areas would suffer from increase in congestion, number of RIS1 and LA highway interventions in the future would result in reduction in long distance travel costs and as a result suppress short distance trips and induce long distance trips (primarily a result of mode choice and destination choice).
- The change in TLD between the Do-Minimum and the Optimised Package also shows an increase in long distance business trips, but at a smaller magnitude compared to the change between the Fixed Demand and the Do-Minimum.
- The increase in long distance business trips is consistent with the increase in business trips on the TPTS as shown in the flow difference plots and this explains significant TUBA benefits associated with business trips.
- The Commute and Other trip purposes do not show significant change in the TLD compared to the change in Business trips. This is expected as majority of Commuting and Other trips are normally associated with short distance trips or intra-region trips and therefore not affected significantly.

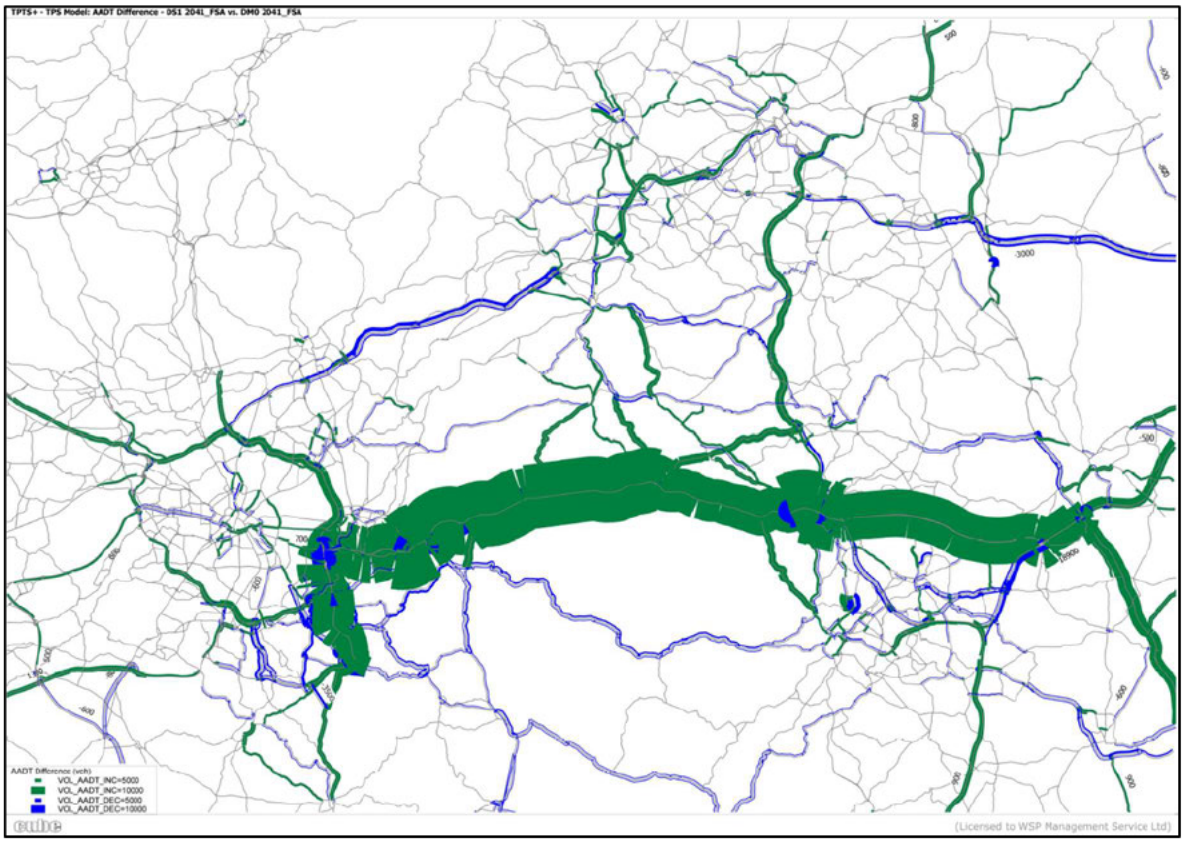
4 FLOW DIFFERENCE - OPTIMISED PACKAGE VS. DO-MINIMUM

4.1.1 This chapter provide flow difference plots between the Optimised Package and the Do-Minimum, at AADT level, by user classes (Business, Commuting, Other, Freight) and by total flows.

4.2 Flow Difference Plots – Total Flow

4.2.1 The following figures (4.1 and 4.2) illustrate the impacts of the TPS in terms of flow difference on the network, with Figure 4.1 provides a zoomed in view focused on the Manchester and Sheffield areas and Figure 4.2 provides a wider view the impacts of the TPTS.

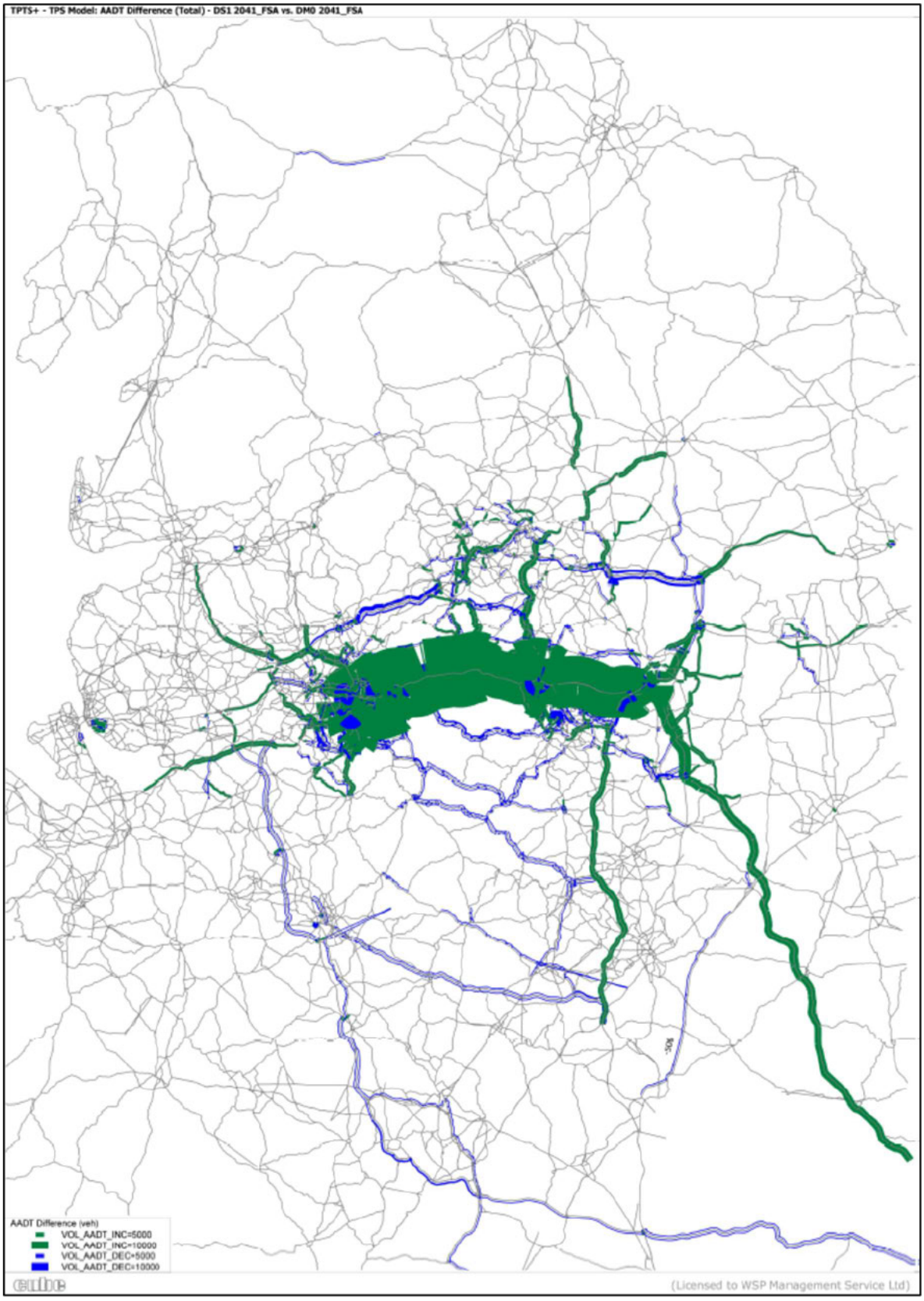
Figure 4.1 Flow Difference Plot - Zoomed in to Manchester/Sheffield areas



4.2.2 It can be seen, the TPTS intervention would result in significant traffic rerouting on the network, in particular:

- Reduction of traffic on M62 between Manchester and Leeds;
- Increase of traffic on M60 toward the M67 to the TPTS; and
- Increase in traffic on M1 between Wakefield and Leeds (TPTS provide faster travel to the M1 toward Leeds).
- Reduction of traffic on M6 compensated by increase on traffic on M1 and A1 toward the south as a result of TPTS+ M1-M18 link connecting M1 and M18 providing faster travel time to the A1 to travel south compared to currently on M6.

Figure 4.2 Flow Difference Plot - Wider Plot



4.3

4.4 Flow difference by User Classes

4.4.1 The subsequent figures show the impacts of the TPTS interventions in terms of change in traffic on the network, by each of the three car user classes (Business, Commuting, Other).

Figure 4.3 Flow Difference Plot - Business

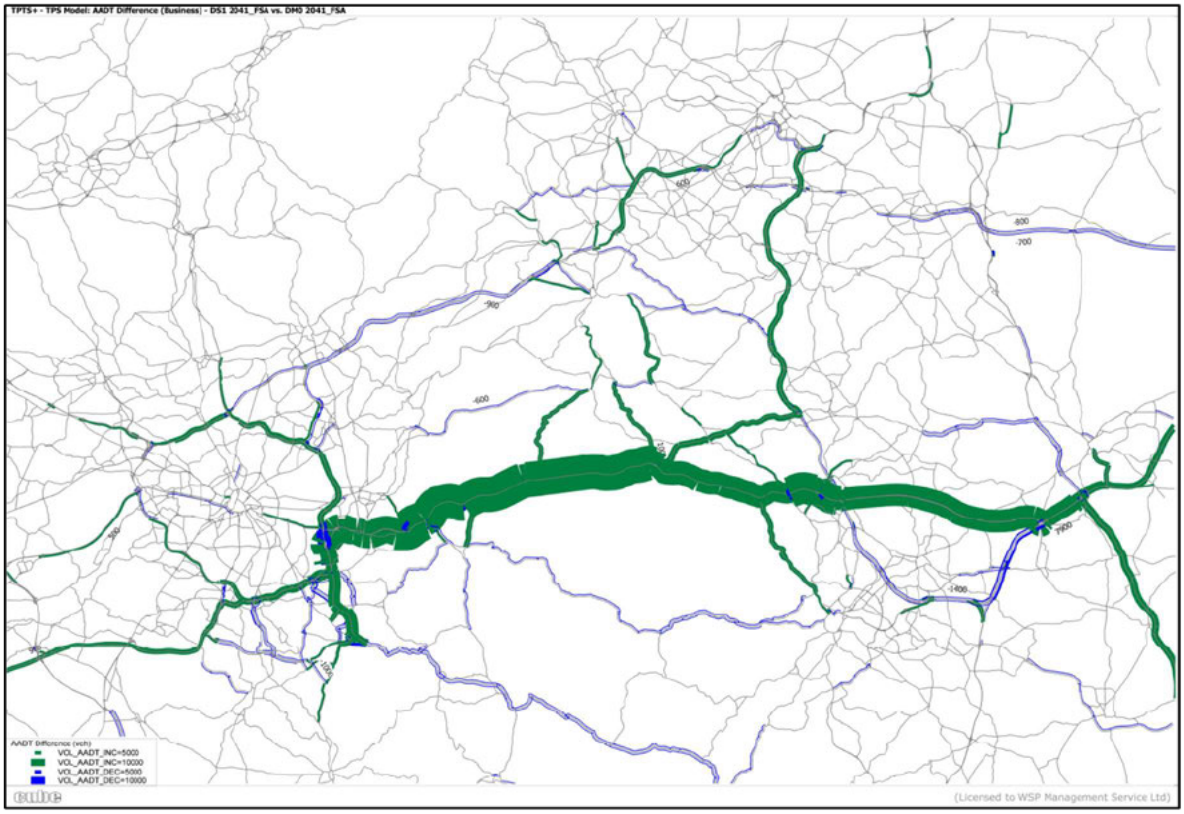


Figure 4.4 Flow Difference Plot - Commute

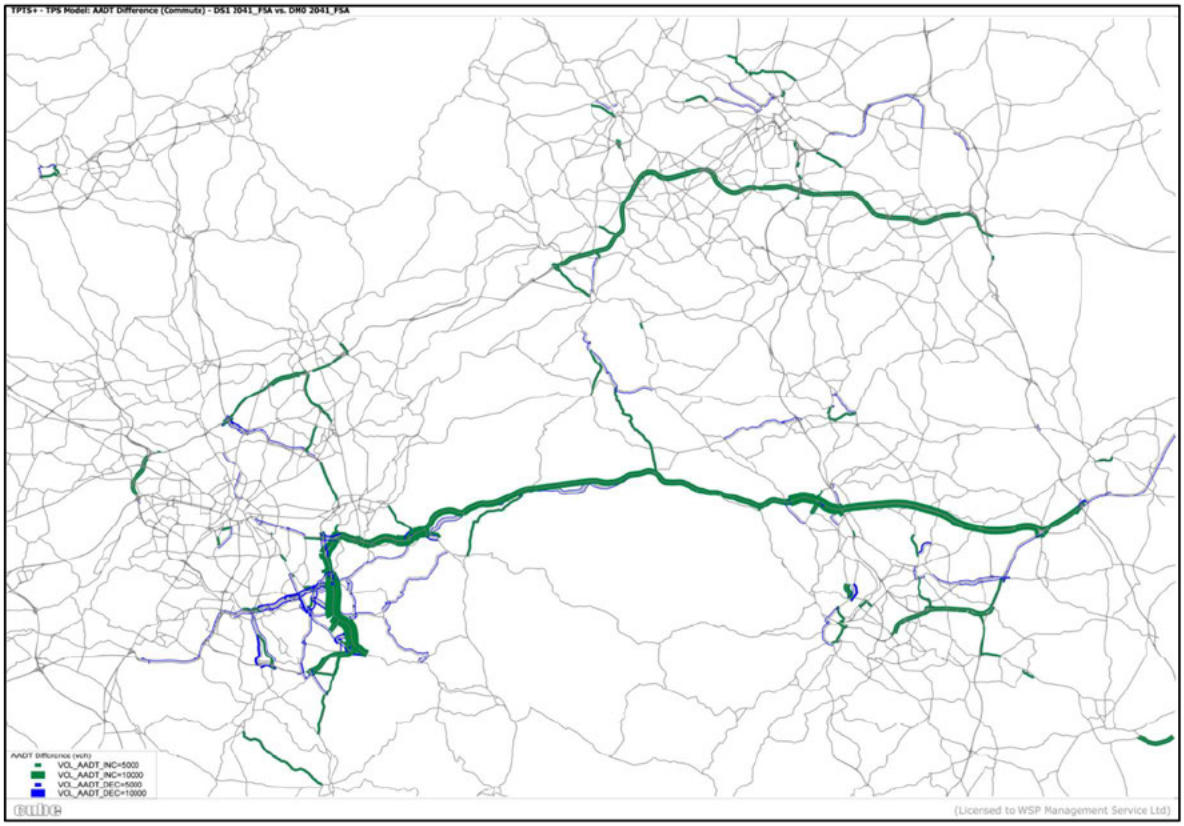
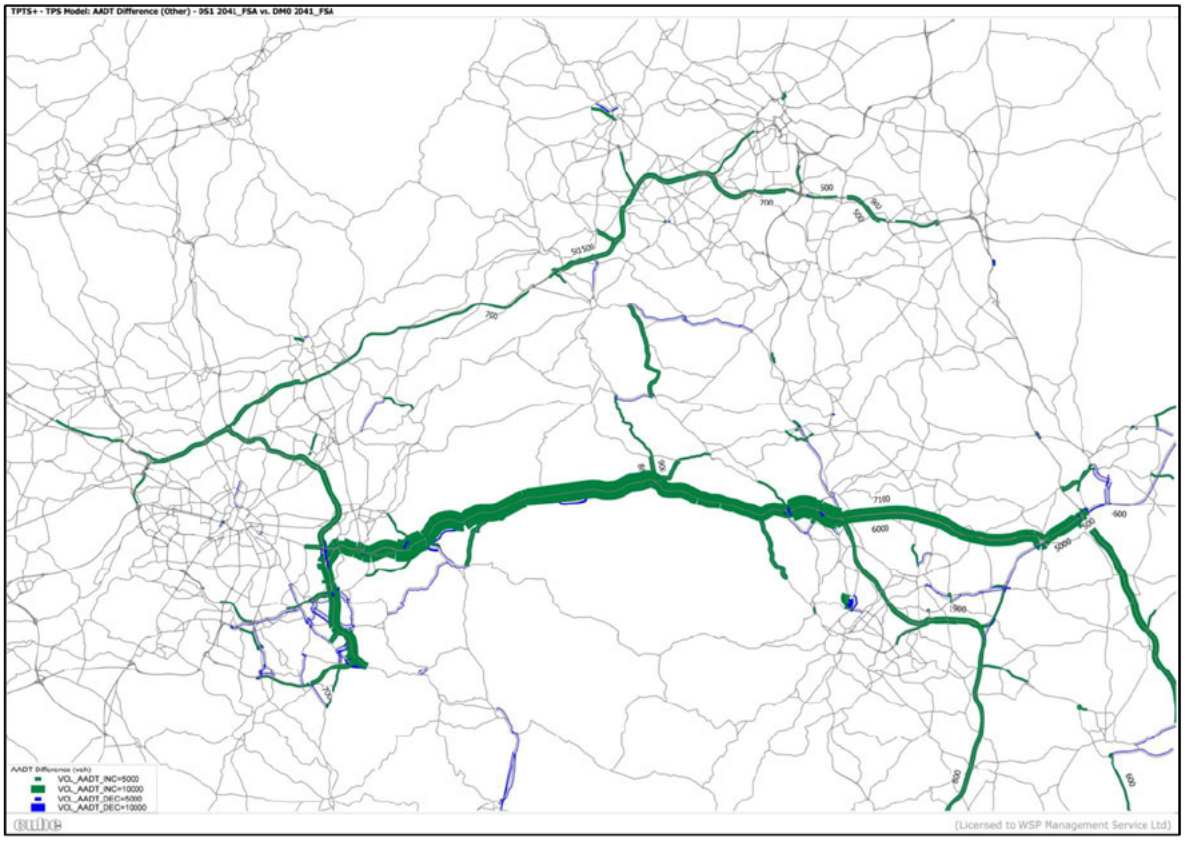


Figure 4.5 Flow Difference Plot - Other



4.4.2 It is noted that the freight (LGV and HGV) are not subject to VDM and only subject to route choice and therefore not reported here.

4.4.3 It can be seen from the figures that:

- The Optimised Package generates the largest increase in Business, followed by Other trips and finally Commute trips on the TPTS link.
- Additional Business and Other trips as a result of the TPTS are not only between Manchester to Sheffield but are also to areas towards the south of the country.
- For Commute trips, the impact of the TPTS optimised package appears to be between Manchester and Sheffield only. This result is plausible given that the average travel time of commute trips in England is about 30 minutes, therefore it is not expected that there would be a wider increase in commute trips beyond Manchester and Sheffield.
- Trips to Leeds and Hull also increase as a result of the M1-M18 link that provides faster travel time and shorter distance between the M1 and M18.
- The increase of business and Other trips on the TPTS link is also attributed by routeing effects that attract trips to use the M1/A1 to the south as opposed to travelling on M6.

Figure 4.6 Flow Difference Plot - Business – Wider Plot

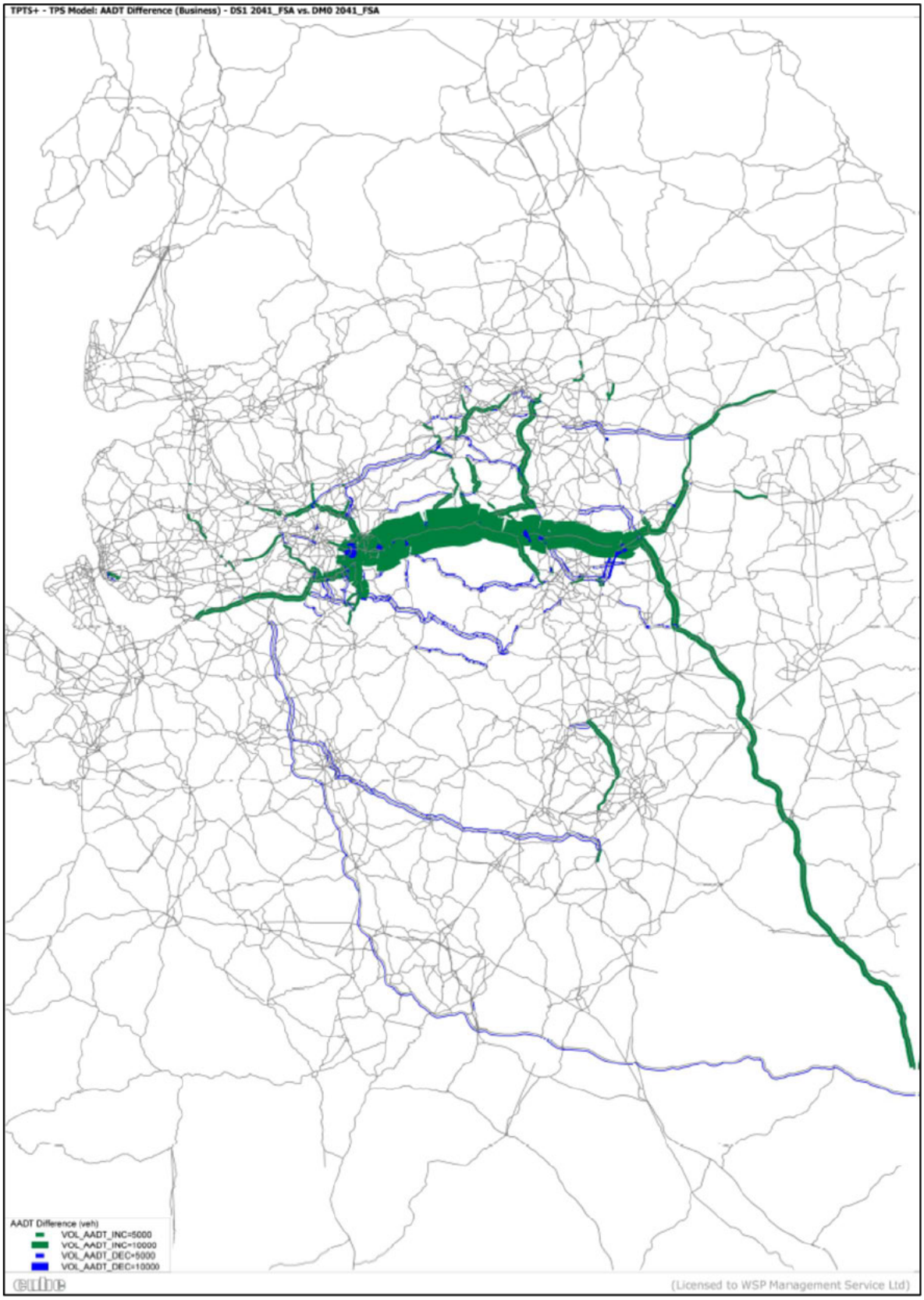


Figure 4.7 Flow Difference Plot - Commute – Wider Plot

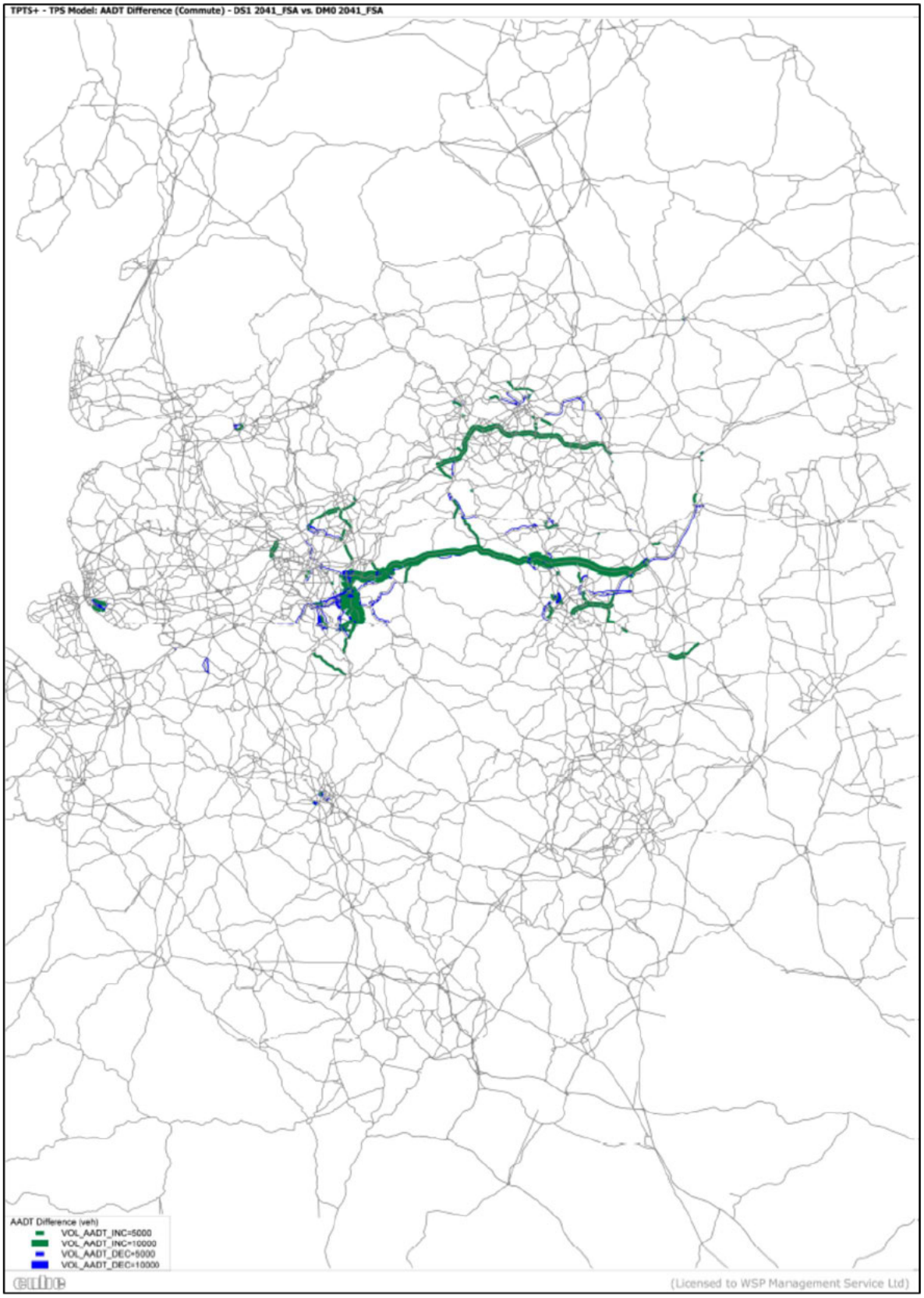
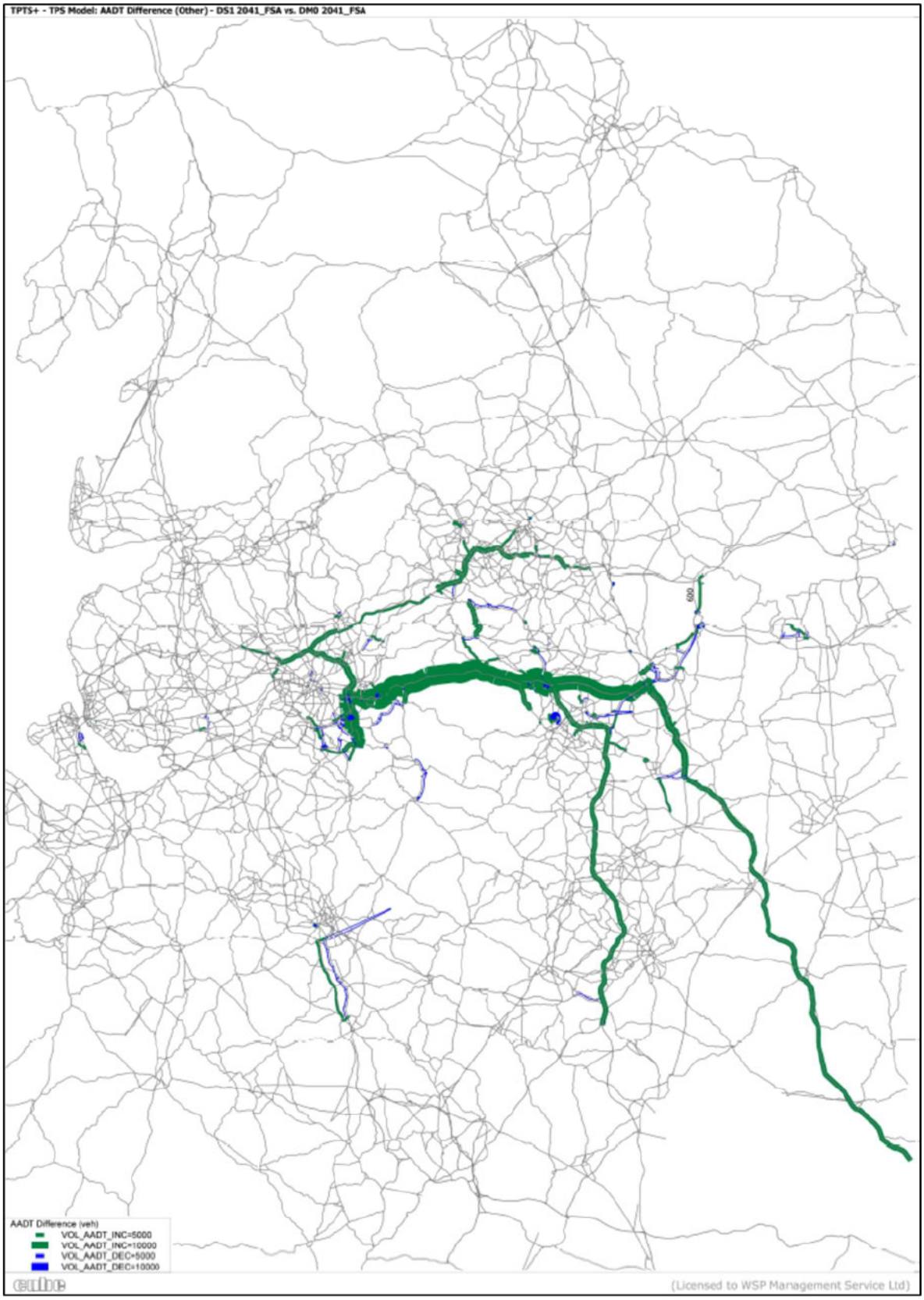


Figure 4.8 Flow Difference Plot - Other – Wider Plot



5 SELECT LINK ANALYSIS BY USER CLASS

5.1.1 The following figures show the result from the 'Select Link analysis' process that was carried out on the TPTS link to understand the origin/destination of traffic that travel on the TPTS link. Within the figures, blue represents westbound traffic and green represents eastbound traffic.

Figure 5.1 Select Link Analysis on TPTS - Total Flow

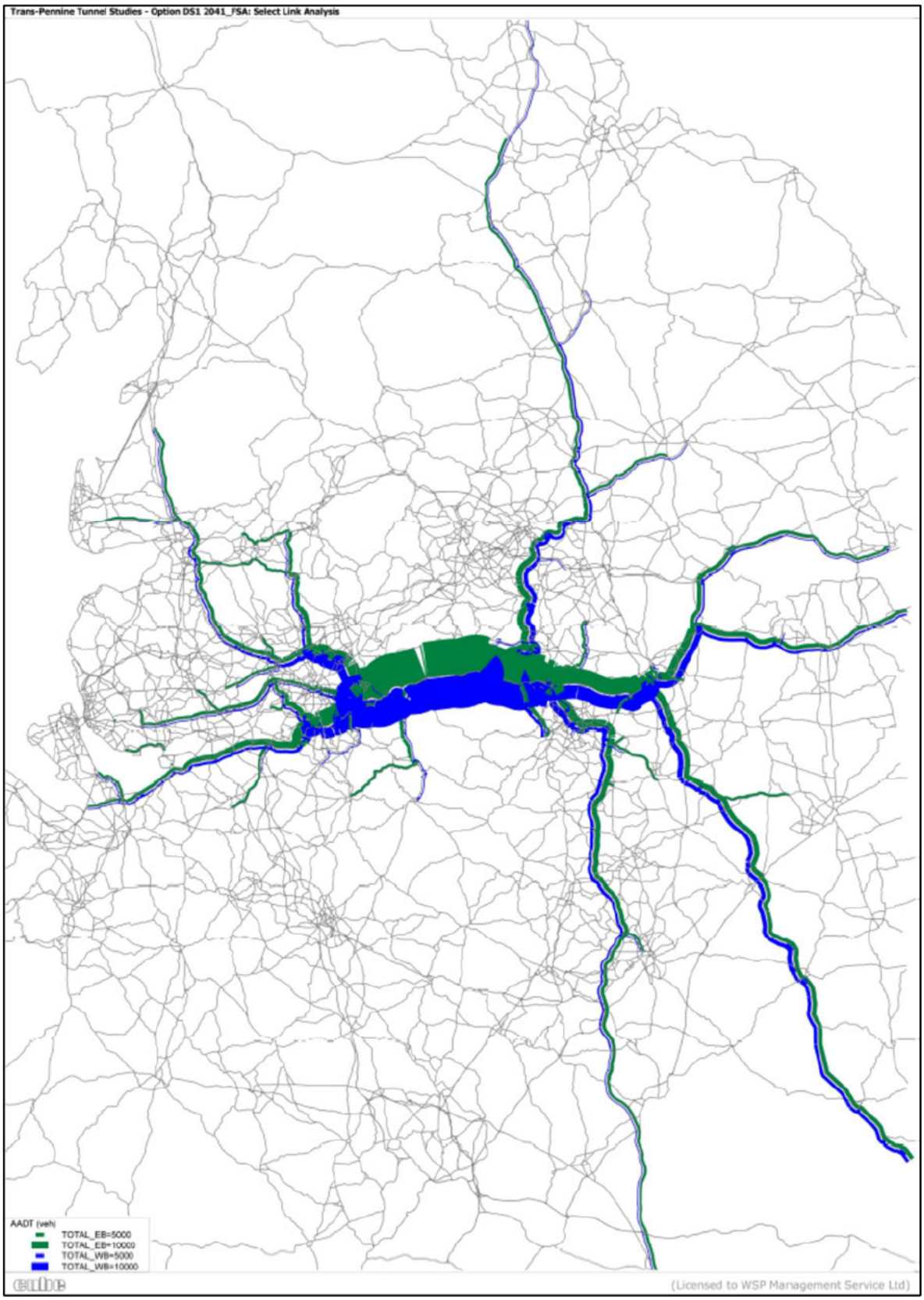


Figure 5.2 Select Link Analysis on TPTS - Business

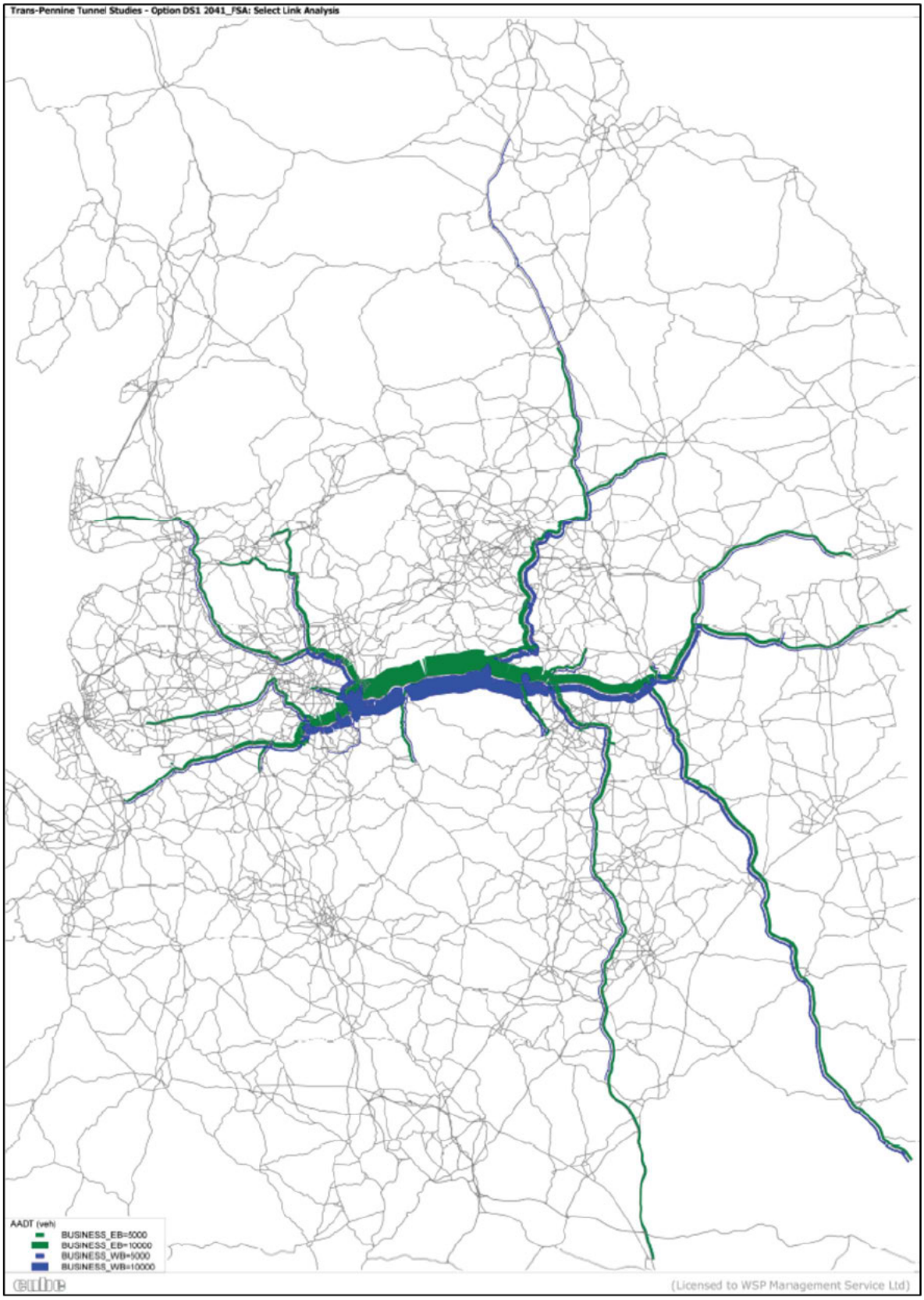


Figure 5.3 Select Link Analysis on TPTS - Commute

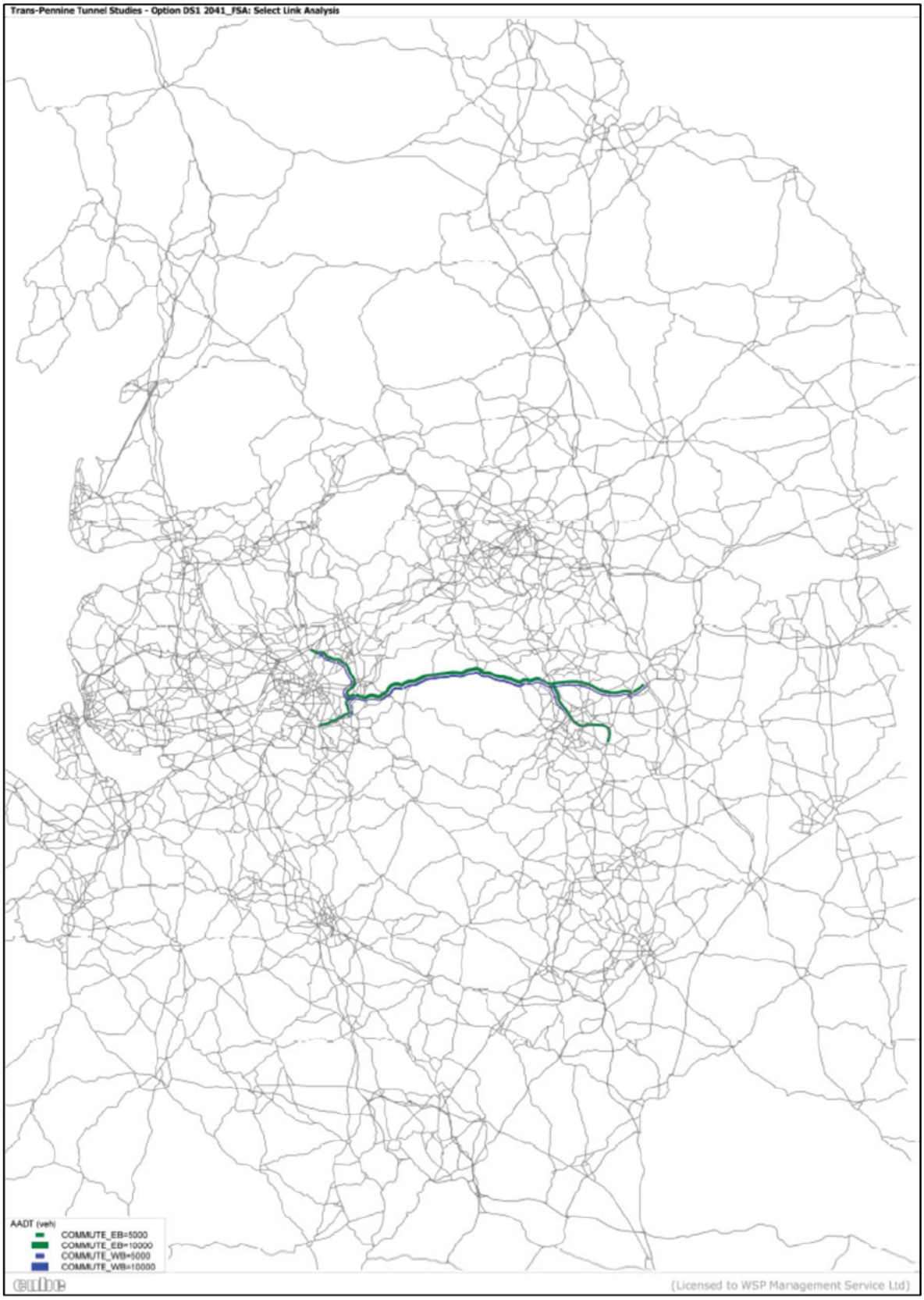


Figure 5.4 Select Link Analysis on TPTS - Other

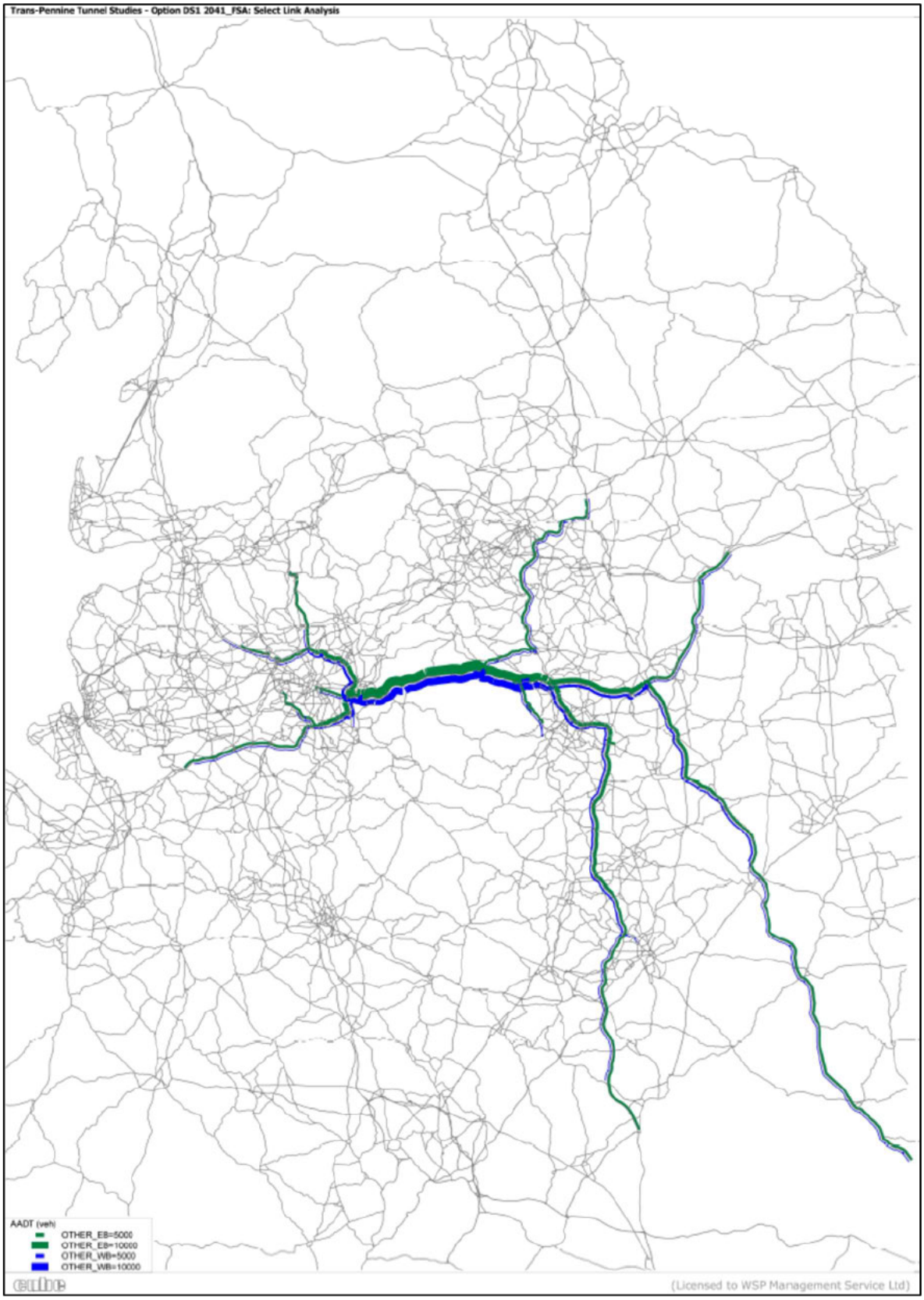
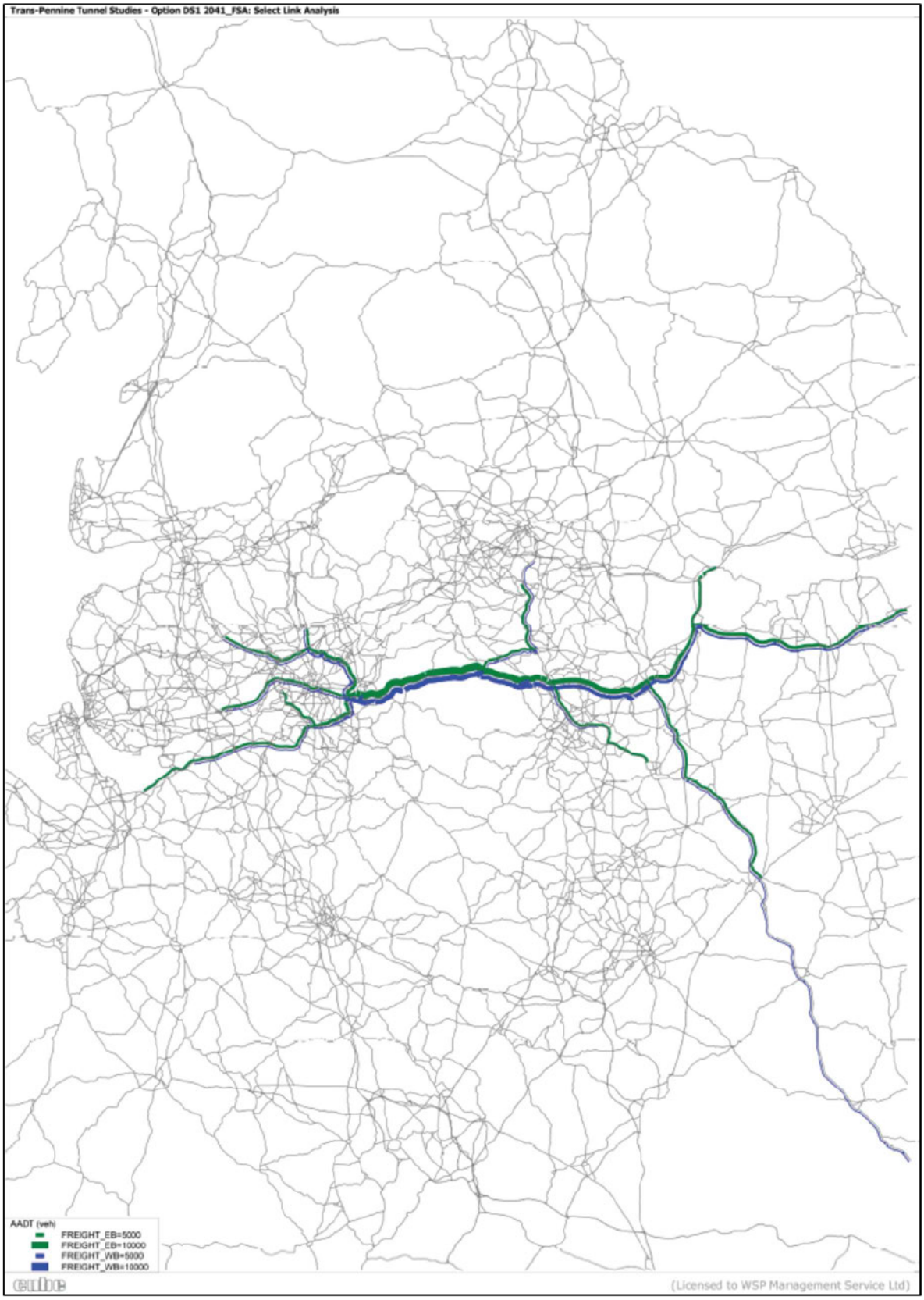


Figure 5.5 Select Link Analysis on TPTS - Freight



5.1.2 Please note that Freight includes LGV and HGV in the Select Link analysis plots.

5.1.3 It can be seen from the Select Link Analysis that:

- The results indicate that a significant volume of business trips is forecast to use the TPTS, including trips between Manchester and Sheffield and also long-distance trips.
- There is a modest number of commuting trips, and these are primarily between Manchester and Sheffield. This result is plausible given the average commuting time is about 30 minutes across the country.
- 'Other' trips share similar patterns with business trips on the TPTS, with a smaller volume compared to Business trips.
- The results are consistent with a high proportion of TUBA user benefits for Business.

5.1.4 Table 5.1 below provides summary of the traffic volume by user classes and proportion of each user class toward the total traffic volume.

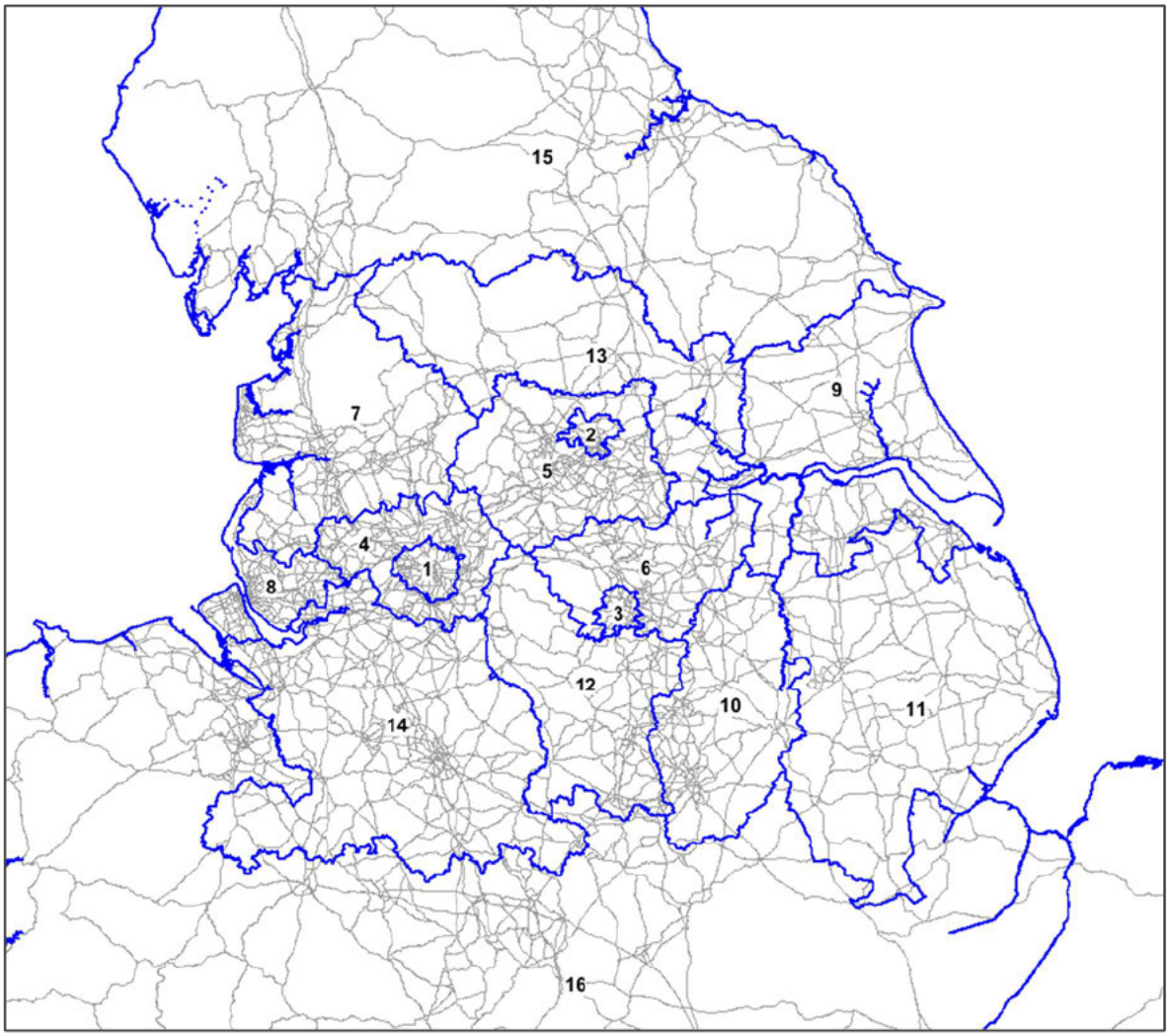
Table 5.1 Traffic Volume on TPTS Link (veh)

Purpose	Eastbound		Westbound		Total	
	Volume	%	Volume	%	Volume	%
Business	23,004	54%	19,862	54%	42,867	54%
Commute	2,327	5%	2,166	6%	4,493	6%
Other	10,505	25%	8,676	24%	19,181	24%
Freight	6,764	16%	5,996	16%	12,759	16%
Total	**42,600**	**100%**	**36,700**	**100%**	**79,301**	**100%**

6 DEMAND CHANGES AT SECTORAL LEVEL

6.1.1 This section provides a summary of change in demand between the Optimised Package and the Do-Minimum at 16x16sector system. The sector plan can be seen in Figure 6.1 below.

Figure 6.1 Sector Plan



6.1.2 Description of each sector is provided in Table 6.1 below

Table 6.1 Sector Description

Sector	Sector
Manchester urban area	1
Leeds urban area	2
Sheffield urban area	3
Manchester (outside M60 ring road)	4
West Yorkshire (outside Leeds)	5
South Yorkshire (outside Sheffield)	6
Lancashire	7
Merseyside	8
Humberside	9
Nottinghamshire	10
Lincolnshire	11
Derbyshire	12
North Yorkshire	13
Cheshire, Shropshire, etc	14
North	15
South	16

6.1.3 Table 6.2 below provide summary of highway demand changes between the Optimised package and the Do-Minimum as produced from the forecast 2041 VDM model, converted to 24-hour format.

6.1.4 The table shows that:

- Overall reduction in highway demand in the Optimised package compared to the Do-Minimum. It was noted that the reduction was a result of the application of the 'Fitting-On' factor that has been mentioned in section 3.5 of this document.
- Reduction in demand that travel entirely within Manchester, Leeds and Sheffield areas compensated by increase in demand between conurbation areas such as between Manchester to Leeds, Manchester to Sheffield/Derbyshire areas. The change in demand is deemed plausible given the TPTS improvements between Manchester and Sheffield.

Table 6.2 Change in demand at Sector Level

Change in Travel Time, Distance at Sub-corridor level																		
Sub-Corridor	Analysis																	
Time Period	24-Hour																	
'DoMin' Sheet	DM041_U	DoMin 2041 with UDF																
'DoSom' Sheet	DS141_U	Optimised Package 2041 with UDF																
User Class	All																	
Type	Demand	(veh)																
	DoMin 2041 with UDF																	
DM041_UDF	Sector	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total
Manchester urban area	1	1,009,366	2,927	1,036	410,889	9,921	1,313	34,014	33,869	1,889	733	166	5,432	1,618	58,145	3,687	12,182	1,587,188
Leeds urban area	2	2,975	536,205	2,382	6,423	240,984	10,678	2,853	2,935	9,012	1,949	948	1,853	21,896	2,132	5,135	6,914	866,274
Sheffield urban area	3	489	2,991	618,819	1,815	7,706	151,356	300	381	4,931	6,686	1,078	41,162	1,467	1,132	2,016	4,955	847,283
Manchester (outside M60 ring road)	4	398,370	6,697	1,874	2,366,673	31,334	3,678	132,674	71,817	5,882	1,710	588	20,582	4,498	132,402	8,181	30,831	3,217,789
West Yorkshire (outside Leeds)	5	8,737	265,758	8,977	31,022	2,683,485	81,702	21,618	5,999	22,480	8,135	4,307	6,146	80,414	5,794	19,625	19,717	3,273,914
South Yorkshire (outside Sheffield)	6	666	10,665	146,000	2,754	73,676	1,295,179	1,302	733	23,331	37,091	4,847	26,630	8,615	2,016	5,848	11,600	1,650,962
Lancashire	7	29,881	2,180	561	138,834	18,835	2,150	2,166,596	73,112	1,951	684	253	1,329	10,137	22,321	28,383	15,251	2,512,467
Merseyside	8	28,520	2,916	420	67,083	7,851	958	66,690	1,697,991	2,279	556	152	1,104	1,500	149,319	3,231	36,318	2,066,889
Humberside	9	1,717	8,169	4,682	4,683	20,144	28,887	1,878	2,180	1,458,547	6,145	40,992	1,951	29,218	2,210	16,858	8,365	1,636,627
Nottinghamshire	10	623	2,656	6,739	1,607	7,282	41,240	427	387	6,200	1,462,729	31,288	129,158	1,844	6,568	3,600	78,342	1,780,687
Lincolnshire	11	50	1,123	1,011	347	3,469	5,382	117	117	42,592	31,152	794,707	3,327	856	797	1,197	81,055	967,298
Derbyshire	12	6,263	2,979	43,382	34,007	7,268	35,470	1,707	1,783	3,384	131,055	3,611	1,331,443	1,804	41,676	3,725	89,956	1,739,614
North Yorkshire	13	1,679	20,312	1,333	4,996	81,824	9,406	12,117	1,706	33,319	1,930	1,004	1,026	617,990	1,690	39,753	4,473	834,668
Cheshire, Shropshire, etc	14	58,437	2,703	947	131,099	8,188	2,726	25,384	170,735	2,805	6,703	812	42,666	2,047	2,745,239	5,731	261,354	3,467,674
North	15	3,795	4,004	1,715	10,813	18,292	6,165	32,179	3,433	18,011	3,510	1,623	2,170	39,527	5,623	14,120,526	24,000	14,296,388
South	16	8,920	8,773	4,191	29,552	20,554	18,571	13,850	31,069	9,180	82,628	87,314	97,662	4,254	252,454	25,176	58,524,729	58,218,878
	Total	1,680,480	881,068	844,088	3,242,698	3,240,812	1,884,861	2,613,706	2,098,248	1,646,782	1,783,386	973,680	1,713,637	827,686	3,429,618	14,292,873	59,210,044	99,962,288
	Optimised Package 2041 with UDF																	
DS141_UDF	Sector	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total
Manchester urban area	1	1,006,300	3,153	1,594	408,715	10,580	2,400	33,517	33,375	2,375	1,266	319	6,057	1,730	58,331	3,749	12,834	1,586,296
Leeds urban area	2	3,160	535,544	2,332	6,781	240,946	10,524	2,917	3,103	9,115	1,944	961	1,844	21,881	2,274	5,125	6,866	866,319
Sheffield urban area	3	764	2,944	616,704	2,324	7,789	151,000	424	518	4,947	6,999	1,146	41,283	1,466	1,276	2,003	4,965	846,561
Manchester (outside M60 ring road)	4	396,572	7,068	2,490	2,362,606	32,533	5,712	131,914	71,471	6,776	2,420	866	22,018	4,775	132,746	8,286	31,430	3,219,881
West Yorkshire (outside Leeds)	5	9,185	265,632	9,039	32,010	2,679,563	81,973	21,762	6,235	22,862	8,394	4,504	6,336	80,499	6,241	19,569	20,014	3,273,818
South Yorkshire (outside Sheffield)	6	1,154	10,450	145,517	4,047	73,936	1,292,142	1,688	1,047	22,843	37,311	4,836	26,975	8,501	2,583	5,781	11,534	1,650,345
Lancashire	7	29,423	2,260	732	138,086	19,132	3,056	2,165,110	73,013	2,091	969	380	1,438	10,183	22,382	28,370	15,665	2,512,289
Merseyside	8	28,035	3,166	554	66,817	8,370	1,391	66,653	1,697,226	2,556	647	218	1,111	1,616	149,078	3,252	36,328	2,067,017
Humberside	9	2,110	8,269	4,706	5,555	20,499	28,249	1,989	2,336	1,456,272	5,957	40,787	1,916	29,286	2,600	16,889	8,222	1,636,840
Nottinghamshire	10	995	2,639	7,112	2,146	7,524	41,371	568	439	6,012	1,461,185	31,105	129,126	1,812	6,662	3,575	78,283	1,780,668
Lincolnshire	11	94	1,140	1,089	518	3,650	5,390	161	164	42,429	31,005	793,759	3,345	849	852	1,187	81,087	966,719
Derbyshire	12	7,037	2,966	43,495	37,539	7,501	35,954	1,810	1,801	3,314	131,077	3,628	1,327,945	1,824	41,470	3,747	89,926	1,741,634
North Yorkshire	13	1,777	20,291	1,322	5,307	81,909	9,268	12,158	1,791	33,314	1,892	995	1,022	617,443	1,821	39,722	4,424	834,465
Cheshire, Shropshire, etc	14	58,553	2,894	1,080	131,365	8,844	3,378	25,517	170,495	3,306	6,837	902	42,452	2,248	2,742,658	5,811	261,430	3,467,772
North	15	3,836	3,999	1,706	10,944	18,281	6,108	32,168	3,445	18,077	3,485	1,610	2,167	39,512	5,681	14,120,428	23,955	14,296,402
South	16	9,281	8,714	4,179	30,195	20,796	18,412	14,155	31,108	9,033	82,590	87,327	97,628	4,234	252,566	25,203	58,522,857	58,218,278
	Total	1,558,277	881,131	843,660	3,244,866	3,241,864	1,898,328	2,612,612	2,097,588	1,646,322	1,783,977	973,343	1,712,682	827,867	3,429,221	14,292,898	59,208,820	99,951,172
	Change																	
Difference (min)	Sector	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total
Manchester urban area	1	-3,067	226	558	-2,174	659	1,087	-498	-494	486	534	153	625	112	186	62	652	-888
Leeds urban area	2	185	-661	-50	358	-38	-154	64	168	103	-5	13	-8	-15	142	-10	-48	46
Sheffield urban area	3	275	-48	-2,115	509	84	-356	124	138	17	313	68	121	-1	145	-13	9	-731
Manchester (outside M60 ring road)	4	-1,799	371	616	-4,067	1,200	2,034	-760	-346	894	710	277	1,436	277	343	105	600	1,882
West Yorkshire (outside Leeds)	5	448	-125	61	988	-3,923	271	144	237	382	259	197	191	85	447	-56	297	96
South Yorkshire (outside Sheffield)	6	488	-215	-482	1,293	261	-3,038	387	314	-489	220	-10	345	-114	568	-67	-66	-867
Lancashire	7	-458	80	171	-748	298	905	-1,486	-99	140	285	127	109	46	61	-13	414	-165
Merseyside	8	-485	250	134	-266	519	432	-37	-765	277	90	66	7	115	-242	22	10	127
Humberside	9	392	100	24	872	355	-638	111	156	-2,275	-188	-205	-35	67	389	31	-144	-887
Nottinghamshire	10	372	-17	374	539	242	132	142	52	-187	-1,543	-183	-31	-32	93	-25	-60	-131
Lincolnshire	11	44	18	79	171	181	8	43	47	-163	-147	-948	18	-7	55	-10	32	-580
Derbyshire	12	775	-13	112	3,532	233	483	103	18	-70	22	18	-3,498	20	-206	22	-30	1,621
North Yorkshire	13	98	-21	-11	311	85	-139	41	84	-5	-38	-9	-4	-547	131	-31	-49	-103
Cheshire, Shropshire, etc	14	116	192	134	266	657	652	133	-240	500	134	90	-214	201	-2,581	80	76	186
North	15	41	-5	-9	131	-12	-58	-10	12	66	-25	-13	-3	-15	58	-98	-45	14
South	16	361	-59	-12	643	242	-159	305	38	-147	-38	12	-33	-20	113	27	-1,872	-889
	Total	-2,213	78	-418	2,368	1,042	1,486	-1,184	-676	-470	682	-347	-876	172	-288	26	-224	-1,087
%Difference	Sector	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total
Manchester urban area	1	0%	8%	54%	-1%	7%	83%	-1%	-1%	26%	73%	92%	11%	7%	0%	2%	5%	0%
Leeds urban area	2	6%	0%	-2%	6%	0%	-1%	2%	6%	1%	0%	1%	0%	0%	7%	0%	-1%	0%
Sheffield urban area	3	56%	-2%	0%	28%	1%	0%	41%	36%	0%	5%	6%	0%	0%	13%	-1%	0%	0%
Manchester (outside M60 ring road)	4	0%	6%	33%	0%	4%	55%	-1%	0%	15%	42%	47%	7%	6%	0%	1%	2%	0%
West Yorkshire (outside Leeds)	5	5%	0%	1%	3%	0%	0%	1%	4%	2%	3%	5%	3%	0%	8%	0%	2%	0%
South Yorkshire (outside Sheffield)	6	73%	-2%	0%	47%	0%	0%	30%	43%	-2%	1%	0%	1%	-1%	28%	-1%	-1%	0%
Lancashire	7	-2%	4%	30%	-1%	2%	42%	0%	0%	7%	42%	50%	8%	0%	0%	0%	3%	0%
Merseyside	8	-2%	9%	32%	0%	7%	45%	0%	0%	12%	16%	43%	1%	8%	0%	1%	0%	0%
Humberside	9	23%	1%	1%	19%	2%	-2%	6%	7%	0%	-3%	-1%	-2%	0%	18%	0%	-2%	0%
Nottinghamshire	10	60%	-1%	6%	34%	3%	0%	33%	14%	-3%	0%	-1%	0%	-2%	1%	-1%	0%	0%
Lincolnshire	11	87%	2%	8%	49%	5%	0%	37%	40%	0%	0%	0%	1%	-1%	7%	-1%	0%	0%
Derbyshire	12	12%	0%	0%	10%	3%	1%	6%	1%	-2%	0%	0%	0%	1%	0%	1%	0%	0%
North Yorkshire	13	6%	0%	-1%	6%	0%	-1%	0%	5%	0%	-2%	-1%	0%	0%	8%	0%	-1%	0%
Cheshire, Shropshire, etc	14	0%	7%	14%	0%	8%	24%	1%	0%	18%	2%	11%	-1%	10%	0%	1%	0%	0%
North	15	1%	0%	-1%	1%	0%	-1%	0%	0%	0%	-1%	-1%	0%	0%	1%	0%	0%	0%
South	16	4%	-1%	0%	2%	1%	-1%	2%	0%	-2%	0%	0%	0%	0%	0%	0%	0%	0%
	Total	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

7 ECONOMIC GEOGRAPHY

7.1.1 This section provides spatial distribution of TUBA and WITA level 2 benefits (at Local Authority level) in order to help understand the areas that would benefit from the TPTS interventions.

Figure 7.1 TUBA User Benefits by LAD – Origin Totals

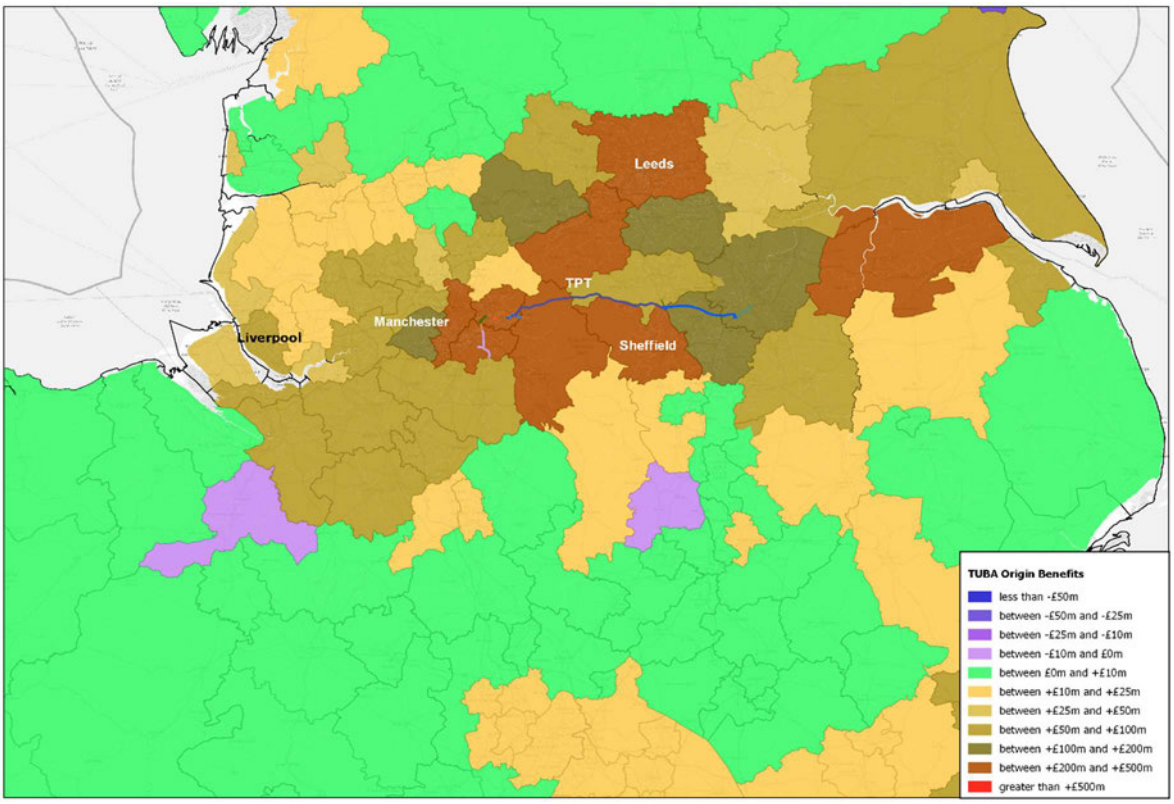
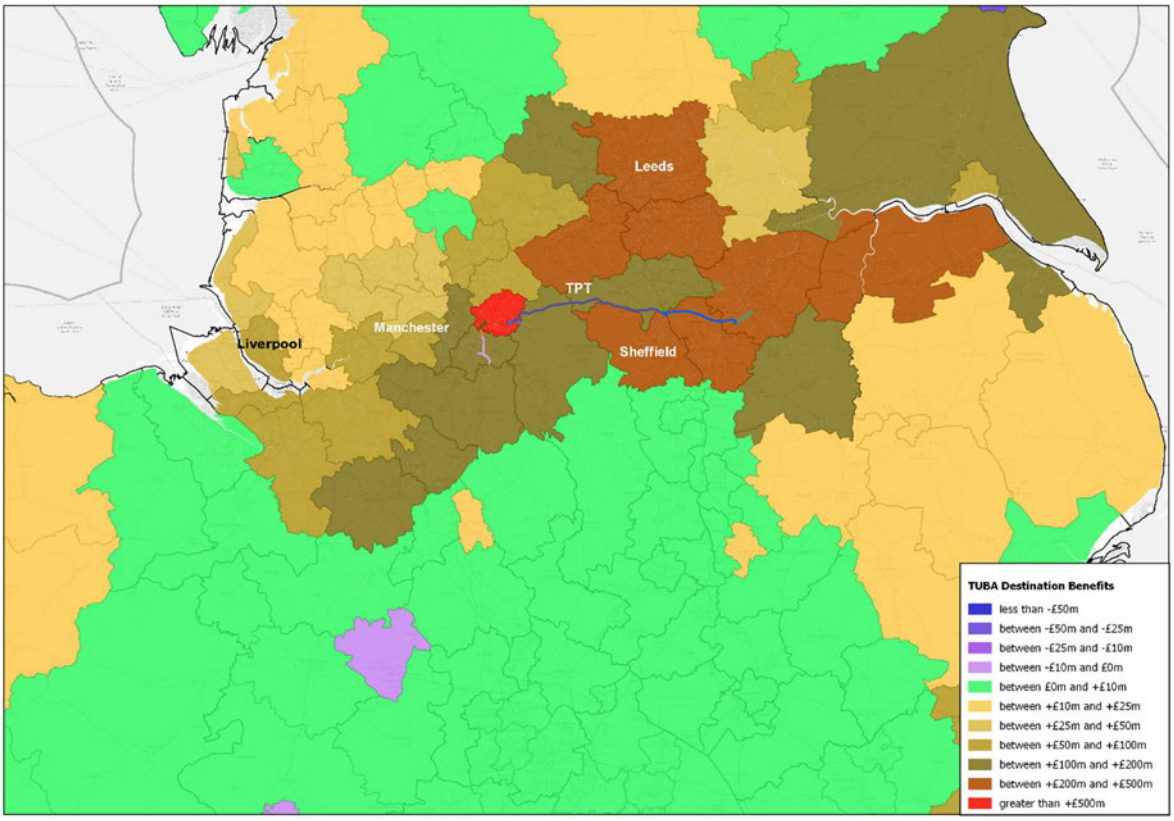


Figure 7.2 TUBA User Benefits by LAD – Destination Totals

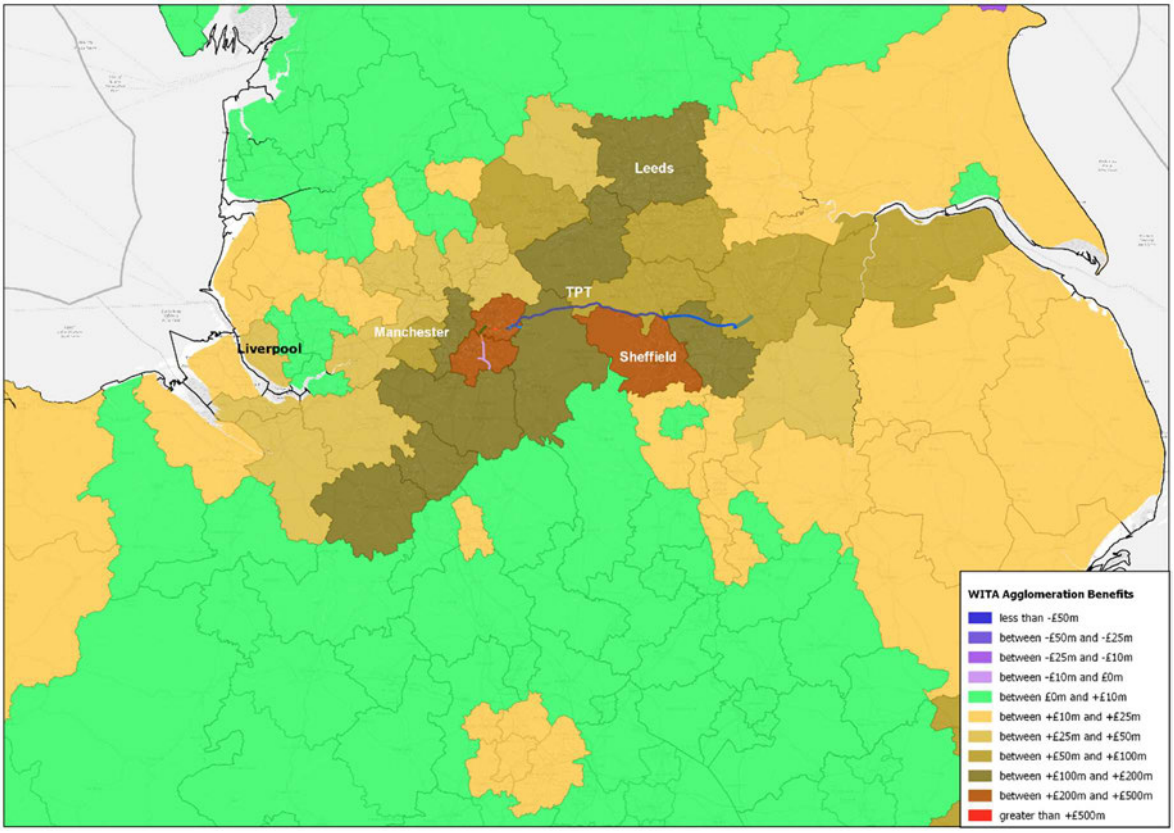


7.1.2 It can be seen from the Figures 7.1 and 7.2 that**:**

- The results illustrate in general that it shows plausible spatial distribution of the TUBA benefits.
- The major benefits are accrued in areas within the vicinity of the TPTS, for example: Tameside, Stockport, High Peak and Sheffield.
- Kirklees and Leeds also benefit from the TPTS because of reduced travel time on the M62.
- Doncaster and North Lincolnshire also benefit from the TPTS, primarily due to the M1-M18 link improvement that reduces travel time for trips to or from these areas.

7.1.3 Table 7.3 below provide spatial distribution of WITA level 2 agglomeration benefits.

Figure 7.3 WITA Agglomeration Benefits by LAD



7.1.4 Similar to the TUBA benefits, WITA shows plausible agglomeration benefits, primarily to LADS around Manchester and Sheffield, and extending to Kirklees and Leeds.

7.1.5 From the flow difference plots above, it is expected that the majority of the agglomeration benefits are associated with business trips and not much is associated with commuting trips.

8 SATURN ASSIGNMENT STATS

8.1.1 This section provides a summary of the SATURN assignment in terms of the flow in the next hours. The summary has been produced for the Do-Minimum and the Optimised Package and provided in **Table 8.1** and **Table 8.2** below.

8.1.2 Table 8.3 provide the difference between the optimised package and the Do-minimum in terms of the network statistics.

Table 8.1 SATURN Assignment Summary – Do-Minimum 2041

Summary	TP_DM0_2041_TS1_delays			TP_DM0_2041_TS2_delays			TP_DM0_2041_TS3_delays		
	This Period	Next period	Total	This Period	Next period	Total	This Period	Next period	Total
Matrix Total Summary									
Business			385,156			404,452			402,575
Commuting			2,650,111			1,008,969			2,494,167
Other			2,634,678			3,349,695			3,758,417
LGV			856,046			785,257			831,477
HGV			341,974			353,746			249,026
Total			**6,867,965**			**5,902,119**			**7,735,661**
Network Statistics									
Total travel time (veh.hrs)									
Car	1,226,909	27,675	1,254,584	757,159	8,686	765,845	1,348,490	30,144	1,378,634
LGV	191,515	4,284	195,799	150,634	1,327	151,961	181,787	4,103	185,890
HGV	248,300	7,590	255,889	239,057	2,769	241,826	179,656	4,488	184,143
Total travel distance (veh.kms)									
Car	91,363,681	1,219,275	92,582,956	57,520,175	413,619	57,933,794	98,744,545	1,215,310	99,959,855
LGV	14,315,164	205,339	14,520,503	11,938,176	67,022	12,005,198	13,546,318	192,031	13,738,349
HGV	18,776,082	421,671	19,197,754	19,548,336	174,912	19,723,248	13,561,647	252,978	13,814,626
Average speed (kph)									
Car	74.5	44.1	73.8	76.0	47.6	75.6	73.2	40.3	72.5
LGV	74.7	47.9	74.2	79.3	50.5	79.0	74.5	46.8	73.9
HGV	75.6	55.6	75.0	81.8	63.2	81.6	75.5	56.4	75.0

Table 8.2 SATURN Assignment Summary – Optimised Package 2041

Summary	TP_DS1_2041_TS1_delays			TP_DS1_2041_TS2_delays			TP_DS1_2041_TS3_delays		
	This Period	Next period	Total	This Period	Next period	Total	This Period	Next period	Total
Matrix Total Summary									
Business			385,136			404,256			402,270
Commuting			2,650,139			1,008,917			2,494,446
Other			2,634,819			3,349,552			3,758,792
LGV			856,046			785,257			831,477
HGV			341,974			353,746			249,026
Total			**6,868,113**			**5,901,728**			**7,736,010**
Network Statistics									
Total travel time (veh.hrs)									
Car	1,229,276	26,667	1,255,943	758,955	8,023	766,977	1,350,823	29,591	1,380,414
LGV	191,450	4,059	195,509	150,484	1,221	151,704	181,613	3,938	185,551
HGV	248,156	6,997	255,153	238,678	2,384	241,063	179,315	4,222	183,537
Total travel distance (veh.kms)									
Car	91,671,200	1,179,804	92,851,003	57,812,676	393,319	58,205,996	99,043,889	1,210,378	100,254,267
LGV	14,327,308	194,152	14,521,459	11,945,176	62,025	12,007,201	13,552,476	185,994	13,738,470
HGV	18,803,215	388,005	19,191,219	19,566,084	153,218	19,719,303	13,571,006	241,809	13,812,815
Average speed (kph)									
Car	74.6	44.2	73.9	76.2	49.0	75.9	73.3	40.9	72.6
LGV	74.8	47.8	74.3	79.4	50.8	79.1	74.6	47.2	74.0
HGV	75.8	55.5	75.2	82.0	64.3	81.8	75.7	57.3	75.3

Table 8.3 SATURN Assignment Summary – Difference

Summary	TP_DS1_2041_TS1_delays			TP_DS1_2041_TS2_delays			TP_DS1_2041_TS3_delays		
	This Period	Next period	Total	This Period	Next period	Total	This Period	Next period	Total
Matrix Total Summary									
Business			-20			-196			-304
Commuting			27			-52			279
Other			141			-143			374
LGV			0			0			0
HGV			0			0			0
Total			**148**			**-391**			**349**
Network Statistics									
Total travel time (veh.hrs)									
Car	2,367	-1,008	1,359	1,796	-663	1,133	2,333	-553	1,780
LGV	-65	-225	-290	-151	-106	-257	-175	-165	-339
HGV	-144	-593	-736	-379	-385	-763	-341	-266	-606
Total travel distance (veh.kms)									
Car	307,519	-39,471	268,048	292,501	-20,299	272,202	299,344	-4,932	294,412
LGV	12,144	-11,187	957	6,999	-4,997	2,003	6,158	-6,037	121
HGV	27,133	-33,666	-6,535	17,748	-21,694	-3,944	9,359	-11,169	-1,811
Average speed (kph)									
Car	0.1	0.1	0.1	0.2	1.4	0.3	0.1	0.6	0.1
LGV	0.1	-0.1	0.1	0.1	0.3	0.1	0.1	0.4	0.1
HGV	0.2	-0.1	0.2	0.2	1.1	0.2	0.2	0.9	0.3

8.1.3 It can be seen from the tables that:

- Total vehicle travel time and travel distance in the next periods is between 1-2% of that during the modelled periods;
- Whilst the total vehicle distance and time travelled increase in the Do-Something (the TPTS interventions would result in increase in long distance car trips compared to the Do-Minimum, thus longer travel distance and travel time on the network), the total number of vehicle time and distance in the next period reduces in the Do-Something compared to the Do-minimum. That indicates that TPTS interventions is forecast to produce congestion relief on the network, reducing number of vehicle queuing on the network.

8.1.4 The statistics suggest that the modelling outputs show plausible results in terms of reduction in congestion on the network as a result of the TPTS interventions.

9 CONCLUSION

9.1.1 This Technical Note has been prepared in response to DfT's comments to assist reviewing of the modelling outputs of the TPTS interventions.

9.1.2 The findings of the key elements in the note illustrates that:

9.1.3 The base year model, whilst showing number of weakness in term of flow and journey time validation on the routes crossing the Pennines, it deemed acceptable for the purpose of the TPTS modelling and appraisal

9.1.4 The impacts of VDM process on demand change by hierarchy shows plausible responses to the change in travel costs in the respective Do-minimum and Do-Something from the base year model, in terms of mode choice response, time choice response, destination responses and change in trip-length distribution.

9.1.5 The impact of the TPTS interventions on the flow on the network show plausible changes in flows, particularly change in flows within the vicinity of the TPTS interventions. The increase in business trips as a result of the TPTS interventions is deemed plausible and that explain the significant proportion of business TUBA benefits.