



Burnley / Pendle Growth Corridor

Lancashire County Council

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1. Introduction

1.1 Background

This technical note documents the methodology of the local junction modelling undertaken as part of the Burnley / Pendle Growth Corridor Junction Improvements scheme.

It has been produced at the request of the independent assurer as part of the development of the Strategic Outline Business Case for the Burnley / Pendle Growth Corridor, and to support the business case submission

Following discussions at the progress meeting on 27th August at County Hall, this technical note includes detail on the setup, forecasting and validation of each junction model produced.

In addition to this, a section on alternate demand responses has been included, justifying the use of local junction modelling software and demonstrating the appropriateness of this with respect to potential strategic alternatives.

As a result, this note has been designed to provide the required evidence that a robust approach has been applied to the junction modelling and address comments above highlighted by the independent assurer.

1.2 Report Contents

This remainder of this report is structured as follows:

- Chapter 2 – Overview of Scheme;
- Chapter 3 – Model Setup;
- Chapter 4 – Forecasting; and
- Chapter 5 – Alternate Demand Responses.

2. Overview of Scheme

The *Burnley / Pendle Growth Corridor Strategy* (Jacobs, June 2014) identified a number of potential options which were expected to deliver benefits to the Burnley / Pendle Growth Corridor.

In order to deliver these options, LCC identified eighteen schemes across the corridor, of which sixteen are highway improvements and two are rail station facility improvements.

The scheme locations are shown in Figure 2-A.

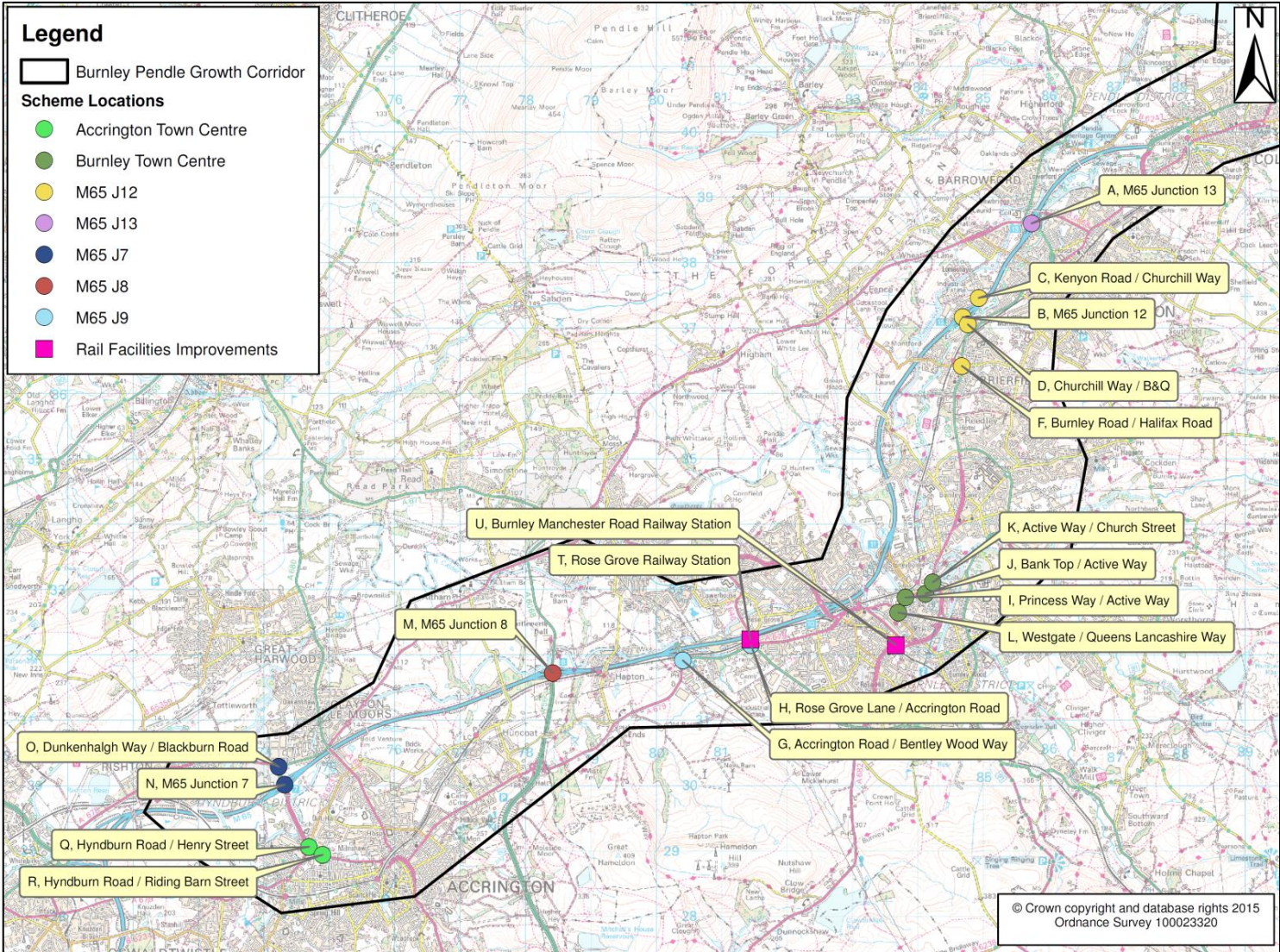


Figure 2-A: Scheme Locations

Detail on the improvements proposed by each scheme is shown in Table 2-A.

Reference	Scheme	Intervention/Benefits Stream	Package name
A	M65 Junction 13	Signalisation of roundabout.	M65 Junction 13
B	M65 Junction 12	Signalisation of roundabout.	M65 Junction 12
C	Kenyon Road/Churchill Way	Signalisation of T junction.	
D	Churchill Way / B&Q	Alteration of junction layout.	
F	Burnley Road / Halifax Road	Signal technology upgrade include improvements for pedestrians.	
G	Accrington Road / Bentley Wood Way	Alteration of junction layout.	M65 Junction 9
H	Rose Grove Lane / Accrington Road	Alteration of junction layout and signal technology upgrade. Provision of a 48 space car park adjacent to Rose Grove station.	
T	Rose Grove Railway Station	Passenger facilities improvements.	
I	Princess Way / Active Way	Signalisation of roundabout.	Burnley Town Centre
J	Bank Top / Active Way	Signal technology upgrade.	
K	Active Way / Church Street	Alteration of junction layout & signal technology upgrade.	
L	Westgate / Queens Lancashire Way	Signalisation of roundabout.	
M	M65 Junction 8	Signalisation of roundabout.	M65 Junction 8
N	M65 Junction 7	Signalisation of roundabout.	M65 Junction 7
O	Dunkenhalgh Way / Blackburn Road	Alteration of junction layout & signal equipment.	
Q	Hyndburn Road / Henry Street	Alteration of junction layout & signal equipment.	Accrington Town Centre
R	Hyndburn Road / Riding Barn Street	Signal technology upgrade.	
U	Manchester Road Railway Station	Increase in station car park capacity.	Rail Facilities Improvements

Table 2-A: Scheme Details

3. Model Setup

Of the sixteen junctions identified, it was a requirement to build local junction models for the Do Nothing (DN) and Do Something (DS) scenarios in the base year (2015) and future year (2030).

The junction modelling outputs informed delay calculations on which benefits were calculated over the appraisal period, as reported within the Economic Case of the Strategic Outline Business Case.

LCC were responsible for the development and build of each junction model, with Jacobs providing assistance at various stages in terms of assignment and matrix building (for example production of matrices for inter-peak hour models, low growth scenarios and intermediate years where required.)

In all cases model setup was undertaken or checked by the same BPGC junction design engineer to avoid error and to ensure current and proposed layouts and operation are accurately reflected in the models. Data inputs & parameter selection were in line with standard practice. Furthermore, observations and liaison with traffic engineers with supplementary local knowledge was undertaken to ensure the base models (DN 2015) were reflective of week on week average conditions.

No data led validation process using measured journey times or measured queues was undertaken, however as highlighted above, the methodology applied in developing the base models is a standard one, and as detailed in the following sections.

3.1 Turning Count Data

Manual classified turning counts were commissioned by LCC in 2014 and 2015 in order to provide a true representation of the traffic flows at each junction, specifically for the junction scheme design and business case development.

These directly fed into the junction model input in the current year and also were the basis on which future year matrices were produced.

The total flows of traffic through the junction as a rolling hourly total column by 15 minute time period was calculated in order to determine the peak hour in the AM and PM time periods.

Although some information was collected in 2014 no growth factors were applied to this data as the effect was considered negligible and would therefore have little bearing on the modelling results.

The data has been examined in Turning Count and Link Flow Studio (TCLF) in order to highlight anomalies in the data that may require further checking to determine whether genuine or erroneous. Anomalies are also highlighted by a graphical representation between the traffic which departs from one junction and arrives at the next where surveyed junctions are in close proximity. Opposite movements have also been compared, where the pattern of traffic volumes on different movements in the AM peak period is often expected to be opposite in the PM peak period, and vice versa. As per best practice, if any errors are found a recount would be required either from the video recordings or on-site as appropriate. In the context of the surveys undertaken as part of the Burnley / Pendle Growth Corridor, no recounts were required.

The table below shows the details of the data collected and is considered to be 'neutral', or representative, avoiding main and local holiday periods, local school holidays and half terms, and other abnormal traffic.

It is acknowledged that one MCC site was undertaken in December for junction F. Whilst not considered 'neutral' by WebTAG, this data has been deemed appropriate for use based on local knowledge of the area. It is also acknowledged that the proposed interventions at this junctions are relatively minor, with only a signal technology upgrade proposed, and therefore the data is appropriate for this application.

Date	Junction	Time Periods Surveyed		
03/06/2014	A	07:30-09:30	16:00-18:00	
	B & D	07:30-09:30	16:00-18:00	
	C	07:30-09:30	16:00-18:00	
02/12/2014	F	07:30-09:30	16:00-18:00	
27/03/2014	G	07:00-10:00	15:00-18:00	
	H	07:00-10:00	15:00-18:00	
03/06/2014	I	07:30-09:30	11:00-13:00	16:00-18:00
	J	07:30-09:30	16:00-18:00	
	K	07:30-09:30	16:00-18:00	
	L	07:30-09:30	11:00-13:00	16:00-18:00
	M	07:00-19:00		
	N	07:00-19:00		
	O	07:30-09:30	16:00-18:00	
05/03/2015	Q	07:30-09:30	16:00-18:00	
	R	07:30-09:30	16:00-18:00	

Table 3-A: Time Periods Surveyed

3.2 Junction Modelling Software Selection

The selection of junction modelling software was based upon professional judgement and some initial testing of junction arrangements in both Linsig and Arcady.

Arcady version 6 or Linsig version 3 was used to model each junction with details for software selection outlined in further detail later in this note. For each junction assessed there is a current layout DN model and a DS model, reflecting the proposed improvements.

Geometric parameters were measured from existing drawings or a design based on topographical surveys with traffic flow inputs taken directly from the traffic count information, as explained above.

A number of situations existed at M65 junctions where unequal lane usage occurs, in particular when there is a specific lane destination, specifically junctions 7, 8, 12 and 13. In these situations Arcady could not easily replicate the queuing situations and it was therefore deemed inappropriate to use Arcady. Instead the priority roundabout modelling functionality within Linsig was utilised.

A summary of the software selection, by junction and scenario, is shown in Table 3-B.

Junction	DN Model Software	DS Model Software
A	Linsig	Linsig
B	Linsig	Linsig
C	Arcady	Linsig
D	Arcady	Arcady
F	Linsig	Linsig
G	Linsig	Linsig
H	Arcady	Arcady
I	Arcady	Linsig
J	Linsig	Linsig
K	Linsig	Linsig
L	Arcady	Linsig
M	Linsig	Linsig
N	Linsig	Linsig
O	Linsig	Linsig
Q	Linsig	Linsig
R	Linsig	Linsig

Table 3-B: Software Selection by Junction & Scenario

3.3 Linsig Specific Parameters

Geometric and signal timing information was based on information derived from LCC's traffic signal database, including site record drawings or sketch or detail designs based on recent topographical surveys.

The give way parameters at unsignalised nodes and for gap accepting situations used the standard values as recommended by JCT, the Linsig developer.

Saturation flows were either input by entering geometric information such as lane widths, if these were known, through existing site records or measured from detail design drawing based on topographical surveys. If an outline design was only available a typical saturation flow of 1900 pcu's per hour was used. This is considered a conservative estimate for many lanes without high turning flows.

Intergreens and staging operations were based on existing TR2500 information if it was an existing site, otherwise as detailed in DfT guidance "General Principles of Traffic Control by Light Signals".

PCU O-D matrix information was taken directly from the traffic count information as explained above.

For straightforward junctions the normal optimisation process was used, based on either observed cycle times or a cycle time that would typically balance needs of pedestrians and vehicles.

However modelling signalised roundabouts required an iterative approach, which again was based on the recommendations of JCT, the Linsig developer. This uses the Linsig timing dials to run the entry arm up to 90% of saturation and adjust the offset so that any internal queuing is contained in the physical space available.

3.4 Scenarios Modelled

For each model there is a 2015 scenario and future year 2030 scenario each with an AM peak hour model and PM hour model.

A number of junctions were also identified for analysis of the average inter-peak hour (average hourly traffic between 1000 and 1600) based on the potential for disbenefit in the IP period as a result of signalling a previously uncontrolled junction.

In addition to this, selected junctions were also identified for further testing, including intermediate year modelling or a low growth scenario. The identification of junctions for intermediate year testing was based upon the benefits profile and between opening and design year and junctions identified for a low growth scenario were based on delay per vehicle calculations (discussed in section 4.1) and the individuals scheme BCR's in the Core scenario.

Table 3-C summaries the scenarios modelled for each junction, which have been agreed with the independent assurer.

Junction	Core Scenario			Additional Testing	
	AM	IP	PM	Low Growth	Intermediate Year
A	✓	✓	✓		
B	✓	✓	✓		✓
C	✓	✓	✓	✓	✓
D	✓		✓	✓	
F	✓		✓		
G	✓		✓		
H	✓		✓		✓
I	✓	✓	✓		
J & K	✓		✓	✓	
L	✓	✓	✓		✓
M	✓	✓	✓		✓
N	✓	✓	✓		✓
O	✓		✓		
Q	✓		✓	✓	✓
R	✓		✓	✓	

Table 3-C: Summary of Scenarios Modelled

3.5 Summary of Model Builds

A brief summary of any junction specific issues or notes are highlighted, by package, in this section.

3.5.1 M65 Junction 13

3.5.1.1 Junction A

The current configuration of the motorway junction consists of two roundabouts with a nearby priority junction that could affect the queuing at peak times. This motorway junction roundabout and slip roads are operated and maintained by LCC.

An initial test of Arcady software did not provide an accurate representation of the current conditions at this junction. Arcady software assumes equal queueing across all lanes and does not allow for specific lane destination assignment. As a result, uneven queueing across lanes, which is observed in the current situation, cannot be easily reflected within this software. The alternative Linsig model does allow for specific lane destinations and the resultant uneven queueing, thereby better aligning with current conditions. Hence, Linsig models were developed for both the DN and DS scenarios. This situation was found to occur at the M65 Junctions 7, 8 12 and 13.

The DS modelling methodology followed the process as described above so that a realistic operation could be predicted.

Saturation capacity increases as a result of upgrading from fixed time to MOVA operation were not incorporated into the DS Linsig model in order to develop a conservative estimate of the future capacity.

3.5.2 M65 Junction 12

3.5.2.1 Junction B

This motorway junction roundabout and slip roads are operated and maintained by LCC.

As per junction A, the initial Arcady model was not replicating the existing uneven queueing across entry lanes accurately and therefore a Linsig model was developed for both the DN and DS scenarios.

The impacts and effect of changes on the nearby B&Q junction (junction C) were carefully considered although it was deemed unnecessary to develop a network model.

Saturation capacity increases as a result of upgrading from fixed time to MOVA operation were not incorporated into the DS Linsig model in order to develop a conservative estimate of the future capacity.

3.5.2.2 Junction C

The DN scenarios incorporating the existing mini roundabout was modelled using Arcady with the proposed DS signalled T junction using modelled Linsig.

The impact of the all red pedestrian stage was considered and modelled accordingly.

Saturation capacity increases as a result of upgrading from fixed time to MOVA operation were not incorporated into the DS Linsig model in order to develop a conservative estimate of the future capacity.

3.5.2.3 Junction D

Given the proposed intervention is solely the improvements of the existing roundabout layout and no signalisation was required, it was deemed appropriate to model both the DN and DS scenarios using Arcady.

3.5.2.4 Junction F

The proposed intervention at this junction maintains the existing layout however an upgrade of the signal controls from fixed time to MOVA operated control is proposed.

It is acknowledged that MOVA operated control is inherently difficult to model accurately within Arcady, however evidence sourced from the "Modelling MOVA Control" technical note (tec, September 2003) suggest a saturation capacity increase of 2.78% as a result of moving from fixed time to MOVA operated control.

Both the DN and DS scenario were modelling using Linsig, with the DS scenario incorporating a 2.78% increase in saturation capacity.

3.5.3 M65 Junction 9

3.5.3.1 Junction G

Both the DN and DS scenarios were modelled in Linsig. There was careful consideration to make sure that the modelled staging and phasing could be practically delivered within the physical layout design.

Saturation capacity increases as a result of upgrading from fixed time to MOVA operation were not incorporated into the DS Linsig model in order to develop a conservative estimate of the future capacity.

3.5.3.2 Junction H

Both the DN and DS scenarios were modelled using Arcady.

3.5.4 Burnley Town Centre

3.5.4.1 Junction I

The DN scenario was modelled using Arcady, with the DS scenario modelled using Linsig in order to inform the signalised roundabout design and operation.

Saturation capacity increases as a result of upgrading from fixed time to MOVA operation were not incorporated into the DS Linsig model in order to develop a conservative estimate of the future capacity.

3.5.4.2 Junctions J & K

An operational study on both junctions was commissioned in 2014 by LCC and which Jacobs undertook. The study included Linsig modelling to investigate potential options for improvement.

The recommendations and analysis in the report has been incorporated into the Linsig DN and DS scenarios with consideration given to linked coordination and signal operational changes.

3.5.4.3 Junction L

The DN scenario was modelled using Arcady in order to reflect the current operation of the junction. It should be noted that the current roundabout is not of the typical design and engineering experience potentially leads to the model being unrepresentative of the queuing that can now take place.

Arcady's algorithms are based on research for a range of typical roundabouts to give an average prediction. However because this junction is of a non-typical roundabout design a note of caution should be applied to the Arcady results. Furthermore there is often unequal lane usage which, as noted previously, gives problems with Arcady modelling the junction accurately. Engineering judgment at these situations then needs to be applied and the judgment using local knowledge is that the Arcady DN model is underrepresenting delay. This has been balanced against the DS Linsig model of the proposals which predicts a junction operation that would be satisfactory in 2030 peak hours, with no reason to suspect a problem with Linsig modelling outputs.

A Linsig model was developed for the DS model.

Saturation capacity increases as a result of upgrading from fixed time to MOVA operation were not incorporated into the DS Linsig model in order to develop a conservative estimate of the future capacity.

3.5.5 M65 Junction 8

3.5.5.1 Junction M

This motorway junction roundabout and slip roads are operated and maintained by Highways England. Highways England have provided a letter of support confirming agreement to the principle of both schemes subject to detailed design / review in due course.

As per junction A, the initial Arcady model was not replicating the existing uneven queueing across entry lanes accurately and therefore a Linsig model was developed for both the DN and DS scenarios.

Saturation capacity increases as a result of upgrading from fixed time to MOVA operation were not incorporated into the DS Linsig model in order to develop a conservative estimate of the future capacity.

3.5.6 M65 Junction 7

3.5.6.1 Junction N

This motorway junction roundabout is operated and maintained by LCC, however the slip roads are operated and maintained by Highways England. Highways England have provided a letter of support confirming agreement to the principle of both schemes subject to detailed design / review in due course.

As per junction A, the initial Arcady model was not replicating the existing uneven queueing across entry lanes accurately and therefore a Linsig model was developed for both the DN and DS scenarios.

Saturation capacity increases as a result of upgrading from fixed time to MOVA operation were not incorporated into the DS Linsig model in order to develop a conservative estimate of the future capacity.

3.5.6.2 Junction O

Linsig was used to model both the DN and DS scenarios.

Saturation capacity increases as a result of upgrading from fixed time to MOVA operation were not incorporated into the DS Linsig model in order to develop a conservative estimate of the future capacity.

3.5.7 Accrington Town Centre

3.5.7.1 Junction Q

An operational study on this junction was commissioned in 2014 by LCC and which Jacobs undertook. The study included Linsig modelling to investigate potential options for improvement. It should be noted that the current situation experiences significant queueing and delay at peak times which is reflected in the DN model.

Both the DN and DS scenarios have been modelled using Linsig.

Saturation capacity increases as a result of upgrading from fixed time to MOVA operation were not incorporated into the DS Linsig model in order to develop a conservative estimate of the future capacity.

3.5.7.2 Junction R

Similar to junction F, the proposed intervention at this junction maintains the existing layout however an upgrade of the signal controls from fixed time to MOVA operated control is proposed.

It is acknowledged that MOVA operated control is inherently difficult to model accurately within Arcady, however evidence sourced from the "Modelling MOVA Control" technical note (tec, September 2003) suggest a saturation capacity increase of 2.78% as a result of moving from fixed time to MOVA operated control.

Both the DN and DS scenario were modelling using Linsig, with the DS scenario incorporating a 2.78% increase in saturation capacity.

4. Forecasting

In order to forecast the future year growth, factors were obtained using the industry standard TEMPRO database (NTEM Version 6.2).

This was interrogated in order to extract growth factors from 2014/5 to 2030 for a selection of locations in all districts along the BPGC route.

- The TEMPRO selection criteria were:
 - Data Selections;
 - Dataset version 6.2 showing trip ends by time period; and
- Area definitions were set to represent the individual identified locations along the corridor; and
 - Trip End Selections; and
 - All journey purposes were included; and
 - Car Driver was the only transport mode selected.
- Trip End Type;
 - Origin/Destination for weekday AM and PM time periods.

The resultant origin/destination data was then run through the National Traffic Model growth factor process using the latest AF09 dataset; with the area types and road types selected to best represent each location to provide suitable and final growth factors.

Location	2024		2030	
	AM	PM	AM	PM
M65 J7	1.1084	1.1095	1.2397	1.2526
M65 J8	1.0849	1.0859	1.1920	1.1968
M65 J9	1.0849	1.0859	1.1920	1.1968
Rose Grove	1.0849	1.0859	1.1589	1.1616
Burnley Town centre	1.0849	1.0859	1.1730	1.1757
M65 J12	1.1131	1.1177	1.2509	1.2568
A682 Brierfield	1.1131	1.1177	1.2054	1.1236
M65 J13	1.1039	1.1070	1.2124	1.2181

Table 4-A: Summary of AM & PM 2014/15 - 2030 Growth Factors

4.1 Delay per Vehicle

In order to establish that the modelled delay in both the base year and forecast year are of a reasonable order, a delay per vehicle calculation was carried out on each junction in the DN scenario.

It was not considered necessary to undertake this for the DS scenario as the total junction delay was expected to decrease as a result of increased capacity, and therefore the delay per vehicle would also decrease, as demand remains constant.

Table 4-B below summarises the findings of the analysis.

Those entries highlighted as “N/A” as due to the fact that an IP model does not exist for that junctions, as noted in Table 3-C. Those entries highlighted in red are those that have a delay per vehicle value of greater than 02:30.

This is a threshold against which it is considered that the delay per vehicle is higher than expected and further investigation into the modelling is required in order to establish that the level of delay is reasonable and that any rerouting is likely to occur.

Junction	Base Year			Forecast Year		
	AM	IP	PM	AM	IP	PM
A	00:00:14	00:00:02	00:00:05	00:00:59	00:00:03	00:00:30
B	00:00:03	00:00:02	00:00:05	00:00:46	00:00:02	00:01:02
C	00:04:37	00:00:07	00:00:40	00:08:10	00:00:08	00:02:15
D	00:00:17	N/A	00:00:09	00:02:32	N/A	00:00:42
E	00:00:05	N/A	00:00:04	00:00:07	N/A	00:00:05
F	00:00:34	N/A	00:00:24	00:02:04	N/A	00:00:30
G	00:00:06	N/A	00:00:05	00:00:11	N/A	00:00:06
H	00:01:02	N/A	00:01:18	00:03:21	N/A	00:04:50
I	00:00:17	00:00:07	00:00:14	00:01:53	00:00:13	00:01:20
L	00:00:08	00:00:06	00:00:06	00:00:31	00:00:08	00:00:09
M	00:00:08	00:00:02	00:00:07	00:01:21	00:00:03	00:00:41
N	00:00:07	00:00:03	00:00:05	00:01:05	00:00:04	00:00:38
O	00:00:52	N/A	00:00:42	00:03:15	N/A	00:01:16
Q	00:03:00	N/A	00:02:21	00:04:11	N/A	00:06:48
R	00:00:22	N/A	00:00:25	00:00:27	N/A	00:00:54

Table 4-B: Delay per Vehicle Summary

5. Alternate Demand Responses

By definition, local junction models do not consider a number of potential demand responses from a change in demand.

As local junction models calculate delay on the basis of a fixed demand matrix this can lead to the overestimation of the potential transport benefits, commonly due to excessive delay in the Do Nothing scenario.

This section on alternate demand responses evidences the appropriateness of local junction modelling software results with respect to alternative routes and potential reassignment, mode choice alternatives, and potential peak spreading.

5.1 Potential Demand Responses

With an increase in travel demand and delays, a number of demand responses are commonly expected, namely:

- Rerouting;
- Peak Spreading; and
- Mode Shift.

5.1.1 Rerouting

The rerouting demand response is potentially common as a result of increased delay at a junction, and usually is the most sensitive response to additional delay build-up.

In order to demonstrate the appropriateness of the local junction modelling with respect to this point, a series of journey time analyses have been undertaken at the location of each package of improvements using the Google API data. This journey time analysis reflects congested travel time at present conditions.

5.1.1.1 M65 Junction 13

Figure 5-A illustrates that for northbound trips from Nelson, there are a number of alternative routes that are only marginally slower in terms of journey times in comparison to the main route using the M65 J13. These alternative routes however are significantly more urban in nature in comparison to the M65.

When the average delay per vehicle is considered, as set out in section 4.1, the maximum average time saving forecast to be delivered by the improvements is approximately 1 minute (in the AM peak period in the forecast year). Were there to be no intervention at this junction and this delay were to materialise, the journey time would effectively be the same as the alternative route. Hence, is it anticipated very limited rerouting is likely to occur.

For journeys southbound from Nelson it is likely these vehicles would use the M65 J12 to join the M65.

Considering the evidence set out above, these alternative routes are not considered to be viable options and therefore the use of a local junction model is deemed appropriate.

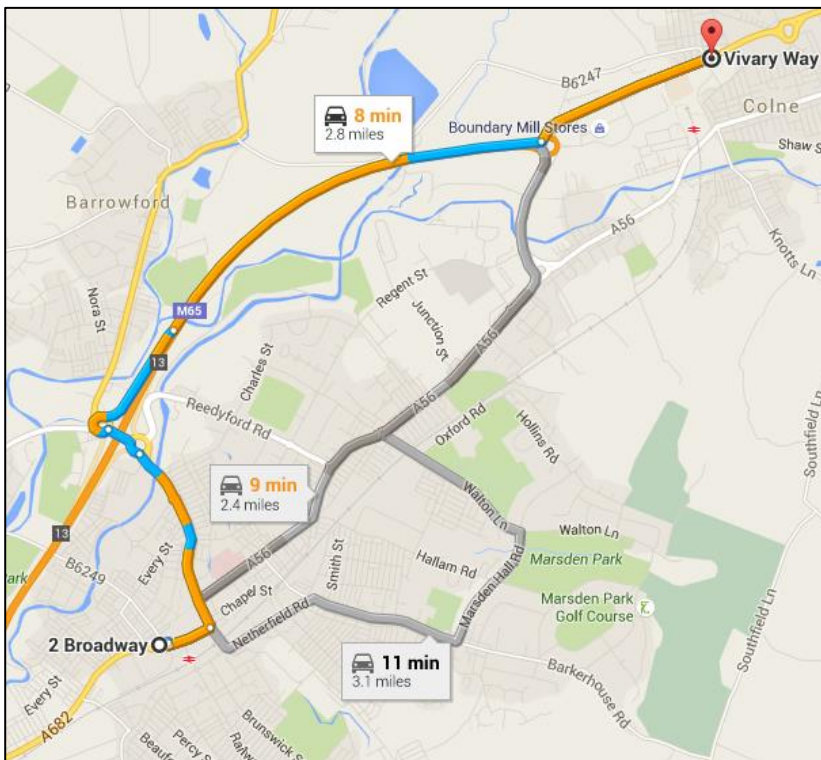


Figure 5-A: M65 J13 Potential Routes NB

5.1.1.2 M65 Junction 12

Figure 5-B and Figure 5-C demonstrate that for both northbound and southbound trips from Brierfield the alternative routing options avoiding the M65 J12 are significantly longer than the equivalent journey time using J13. Based on this, it is reasonable to assume that limited strategic rerouting will occur for those trips using junction 12.

Lomeshaye Industrial Estate, to the north of the M65 J12, was identified as a key development site in the Burnley / Pendle Growth Corridor. The primary access to this site is through the M65 J12 and therefore the majority of movements in or out of this site will require the use of the M65 J12.

When the average delay per vehicle is considered, as set out in section 4.1 the maximum average time saving that could be delivered by the improvements is approximately 8 minutes at junction C (in the AM peak period in the forecast year). Given the location of junction C, within Lomeshaye Industrial Estate, there are no rerouting opportunities through this junction when attempting to access the estate. Furthermore, the route through junction D on Churchill Way has a maximum average delay of approximately 2.5 minutes (in the AM peak period in the forecast year). If this delay were to materialise, routing through this junction would still be quicker than the alternative routes identified in Figure 5-B.

Considering the evidence set out above, these alternative routes are not considered to be viable options and therefore the use of a local junction model is deemed appropriate.

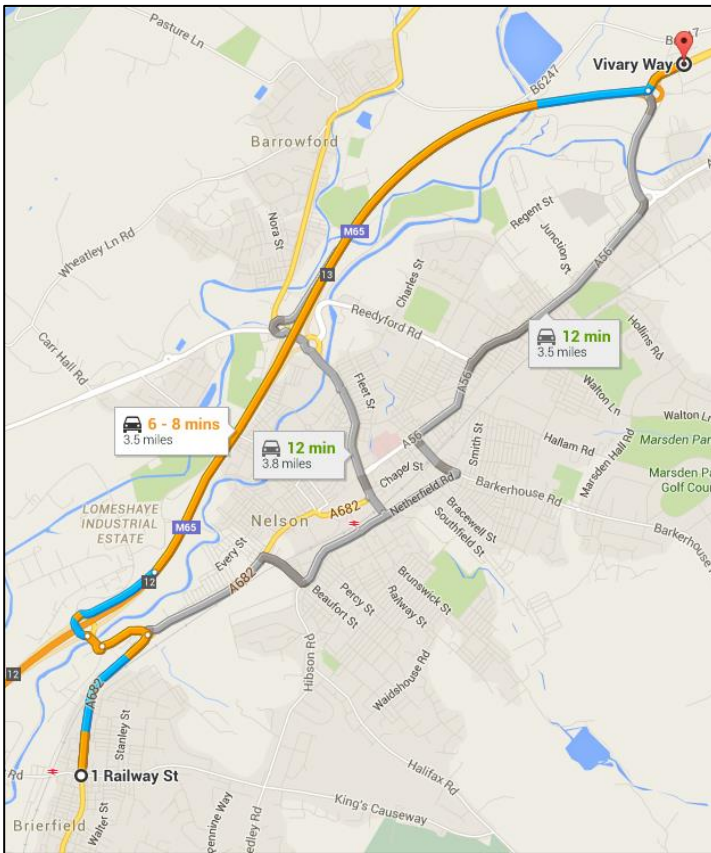


Figure 5-B: M65 J12 Potential Routes NB

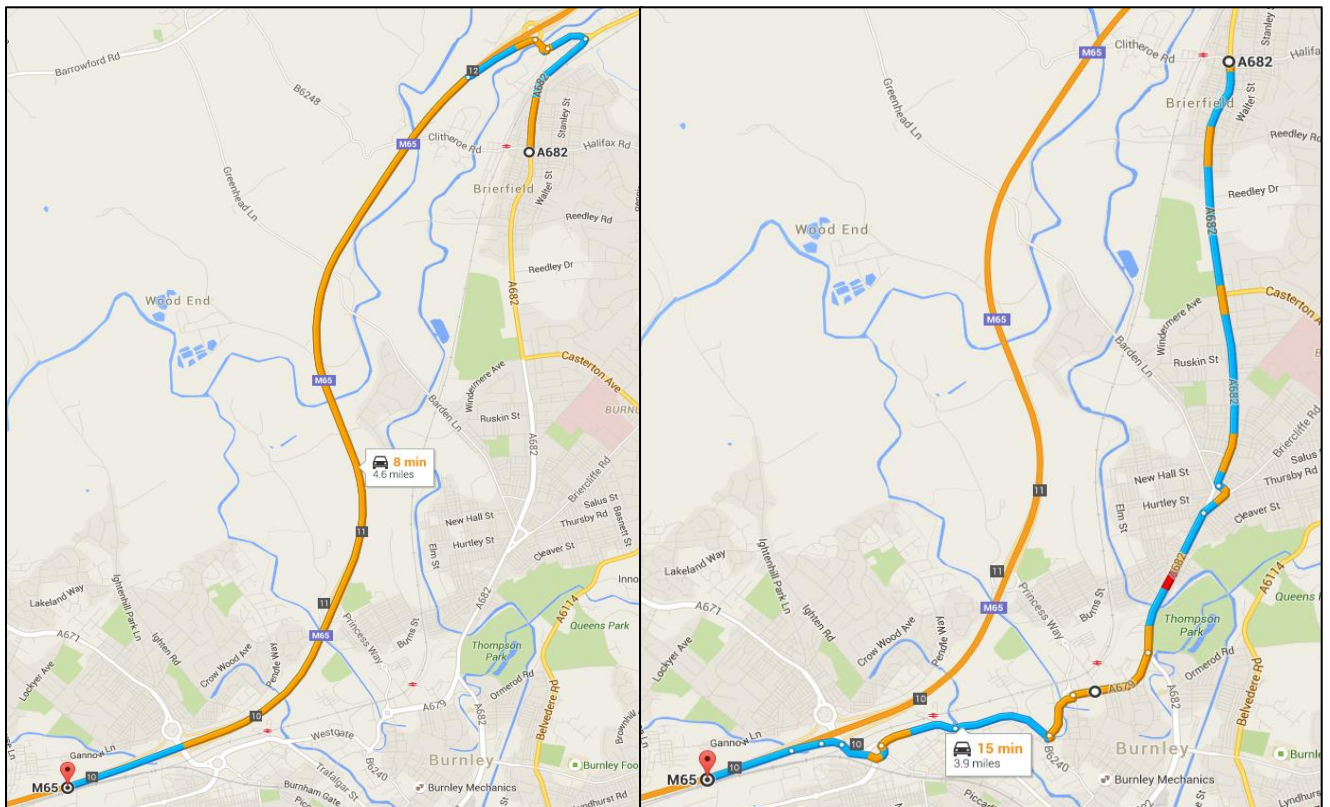


Figure 5-C: M65 J12 Potential Routes SB

5.1.1.3 M65 Junction 9

The M65 Junction 9 package consists of improvements to both the Rose Grove junction and the M65 J9. It should be noted that the M65 J9 is a limited movement junction and therefore any traffic entering the M65 eastbound, or exiting the M65 westbound is likely to use the M65 J10.

Figure 5-D demonstrates that for northbound and southbound trips between the south of Burnley and north of the M65 (Padiham) any alternative routes to the Rose Grove junctions require a significantly more urban route and are likely to take at least 3 minutes longer with additional distance travelled of at least 0.7 miles. Based on this is, it is reasonable to assume that there will be limited strategic rerouting for these trips.

Figure 5-E and demonstrates that for trips from the south of Burnley travelling west, both the M65 J10 and the M65 J9 are options for routing, with an equal journey time expected for both. The maximum average delay at Junction G is approximately 11 seconds and therefore a change in delay of this magnitude is very unlikely to prompt a rerouting demand response. Figure 5-F demonstrates that for most journeys originating in Burnley they are likely to use the M65 J10, rather than the M65 J9.

Considering the evidence set out above on alternative routes, the use of a local junction model is considered appropriate.

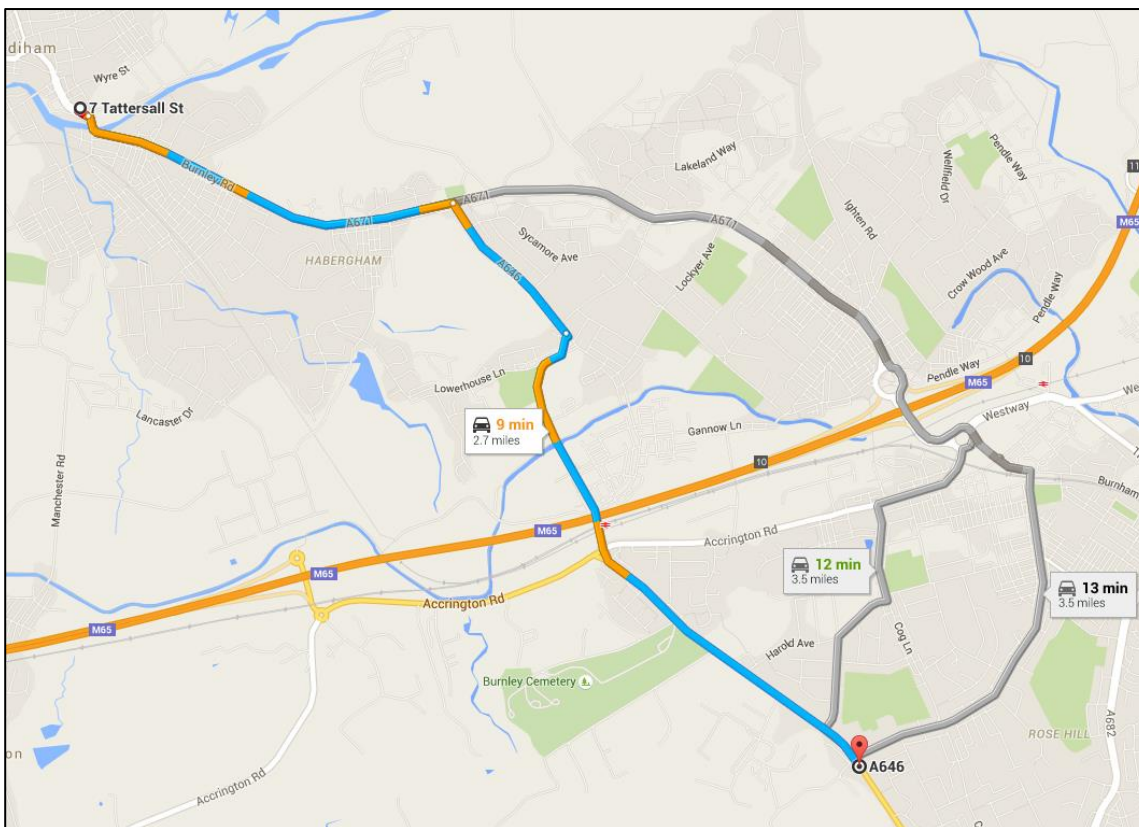


Figure 5-D: M65 J9 Potential Routes NB/SB

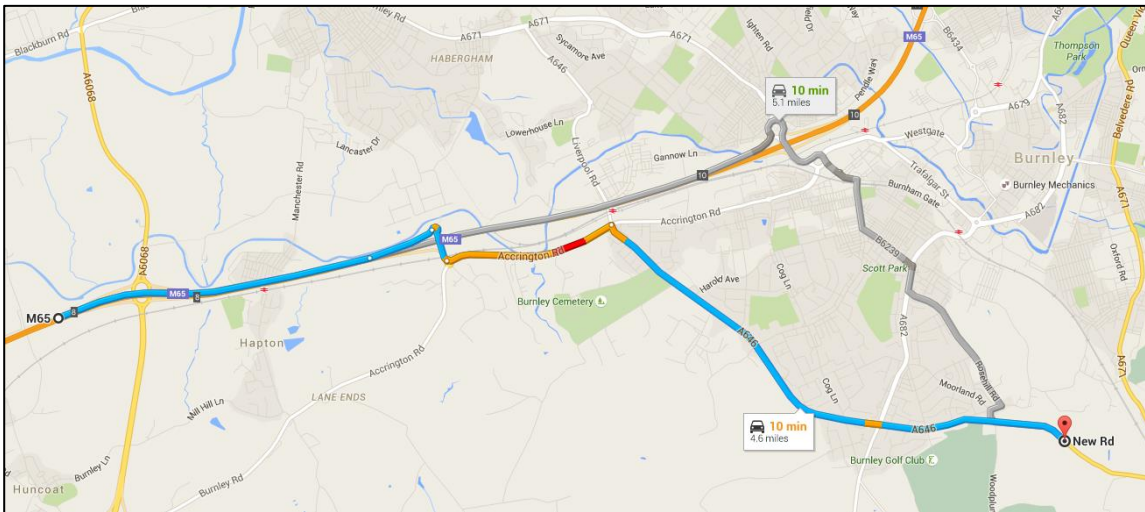


Figure 5-E: M65 J9 Potential Routes EB/WB (1)

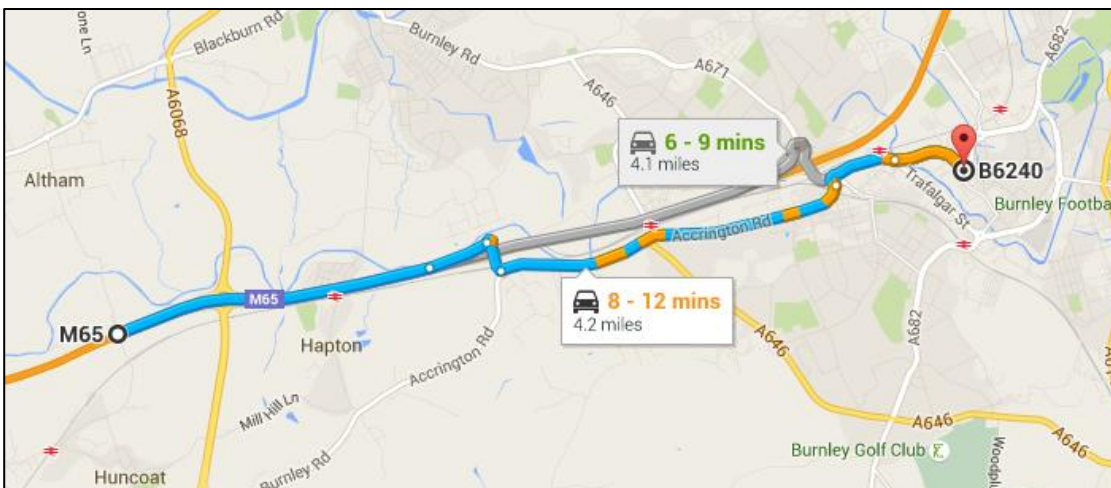


Figure 5-F: M65 J9 Potential Routes EB/WB (2)

5.1.1.4 Burnley Town Centre

The Burnley Town Centre package consists of improvements at four junctions along the A679 between Queens Lancashire Way and Church Street.

Figure 5-G and Figure 5-H illustrate that there is only one potential route for rerouting through Burnley Town Centre. However the alternative route along the A682 is 0.5 miles longer with a number of major junctions, primarily the roundabout at Burnley Manchester Road station, and is likely to deter any significant rerouting.

The maximum average time saving that could be delivered by the improvements is approximately 2 minutes at junction I (see section 4.1). Without the intervention it is expected that the journey times on alternative routes would be similar in the forecast year and as such it would not be a sufficient change in journey time to prompt a rerouting demand response.

Considering the evidence set out above on alternative routes, the use of a local junction model is considered appropriate.

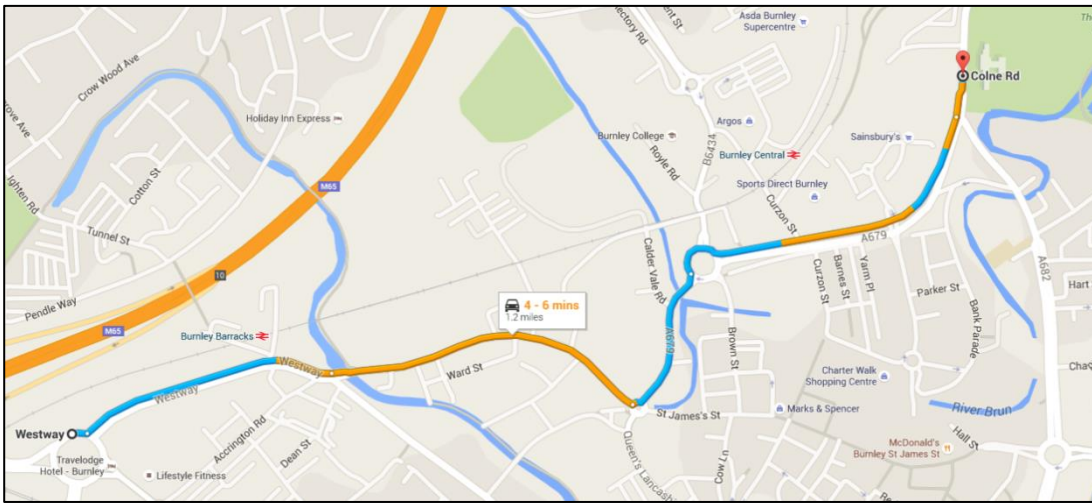


Figure 5-G: Burnley Town Centre Main Route

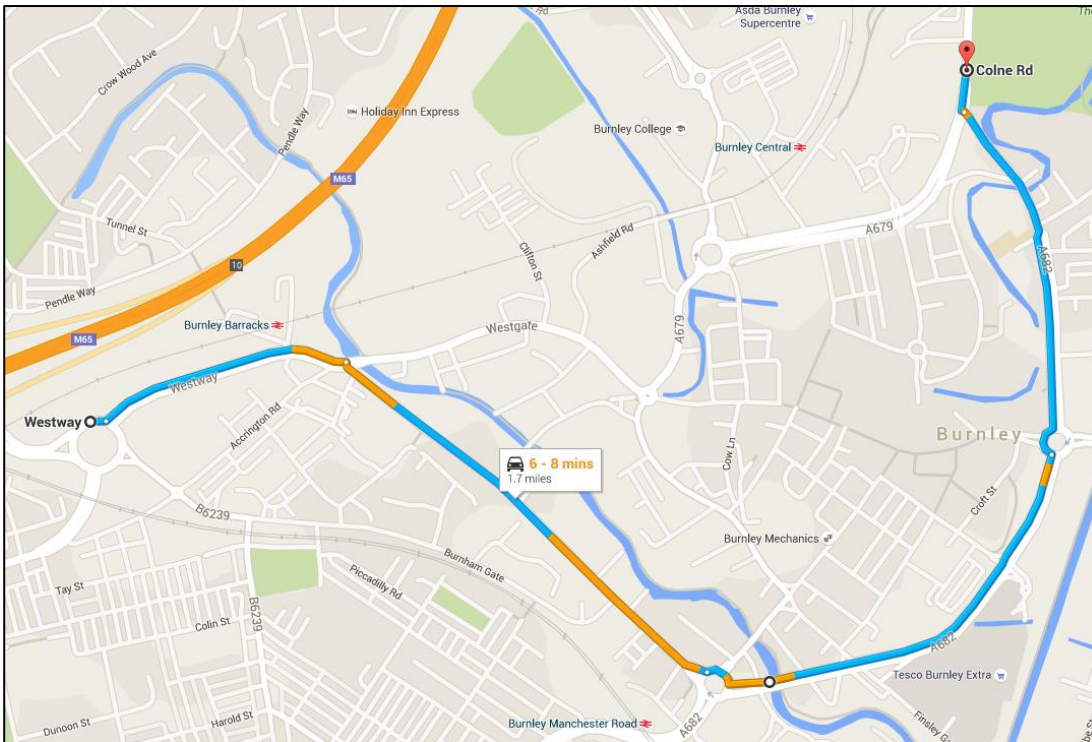


Figure 5-H: Burnley Town Centre Alternative Route

5.1.1.5 M65 Junction 8

Figure 5-I illustrates that there are a number of alternative routes of similar length passing through the M65 J8, however those routes avoiding the junction take significantly longer in terms of journey time.

For movements using the M65 east or westbound, there are no viable alternative routes.

Considering the evidence set out above on alternative routes, the use of a local junction model is considered appropriate.

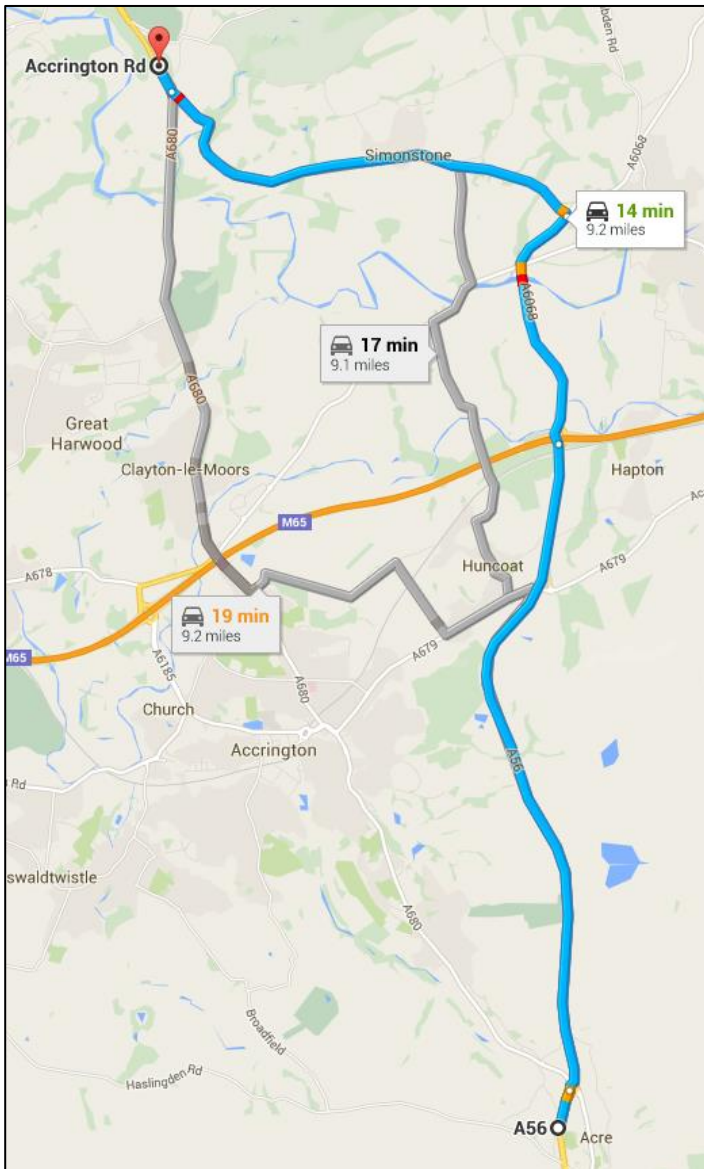


Figure 5-I: M65 Junction 8 Routes

5.1.1.6 M65 Junction 7

Figure 5-J illustrates that there is only one viable alternative route to using the M65 J7 which is of similar length and journey time.

This route is significantly more urban. Of note, the alternative route uses the Hare & Hounds junction, which was identified as a problem area in the original BPGC strategy, and subject to a significant level of delay in peak time periods.

When the average delay per vehicle is considered, as set out in section 4.1, the maximum average time saving that could be delivered by the improvements is approximately 3.25 minutes at junction O (in the AM peak period in the forecast year). If there were no intervention and this delay were to materialise it is expected that the journey times on alternative routes would be similar in the forecast year, due to the increase in demand, and subsequently delay, on alternative routes.

For movements using the M65 east or westbound, there are no viable alternative routes.

Considering the evidence set out above on alternative routes, the use of a local junction model is considered appropriate.

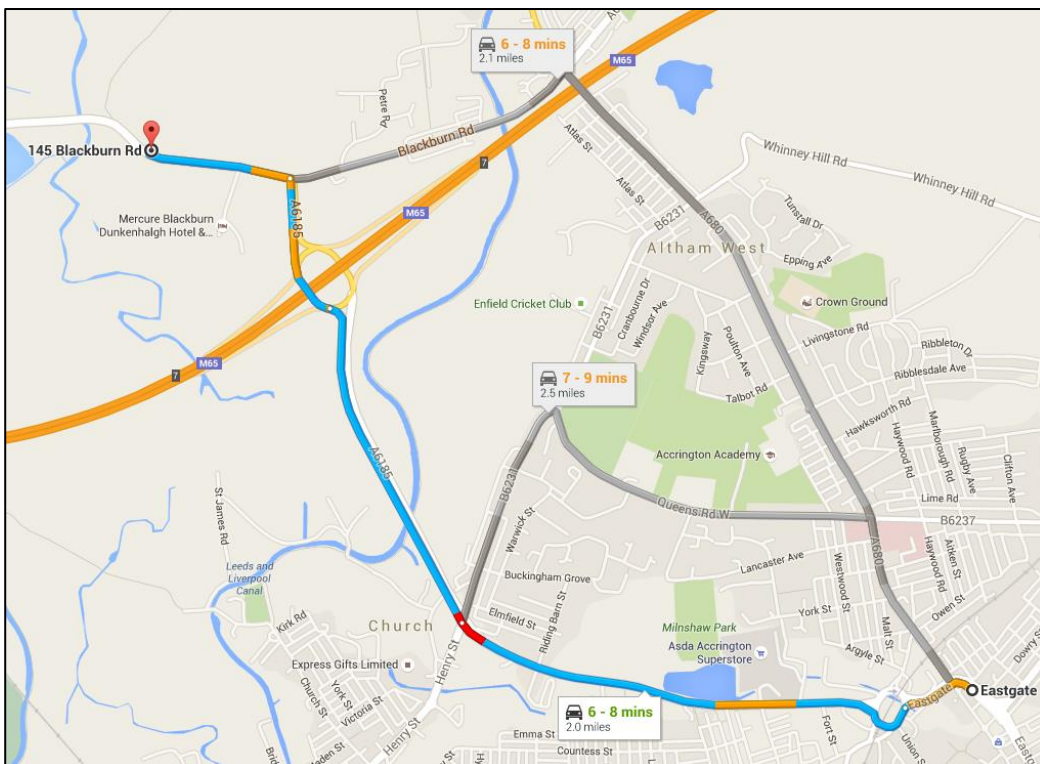


Figure 5-J: M65 Junction 7 Routes

5.1.1.7 Accrington Town Centre

Figure 5-K, Figure 5-L and Figure 5-M demonstrate that the alternative route are in the region of 2-3 minutes longer than the main route in terms of journey time. Both alternative routes are also approximately 0.6 miles longer. Considering the maximum delay per vehicle levels are of a similar value it is reasonable to assume no strategic rerouting would take place at these junctions.

Considering the evidence set out above on alternative routes, the use of a local junction model is considered appropriate.

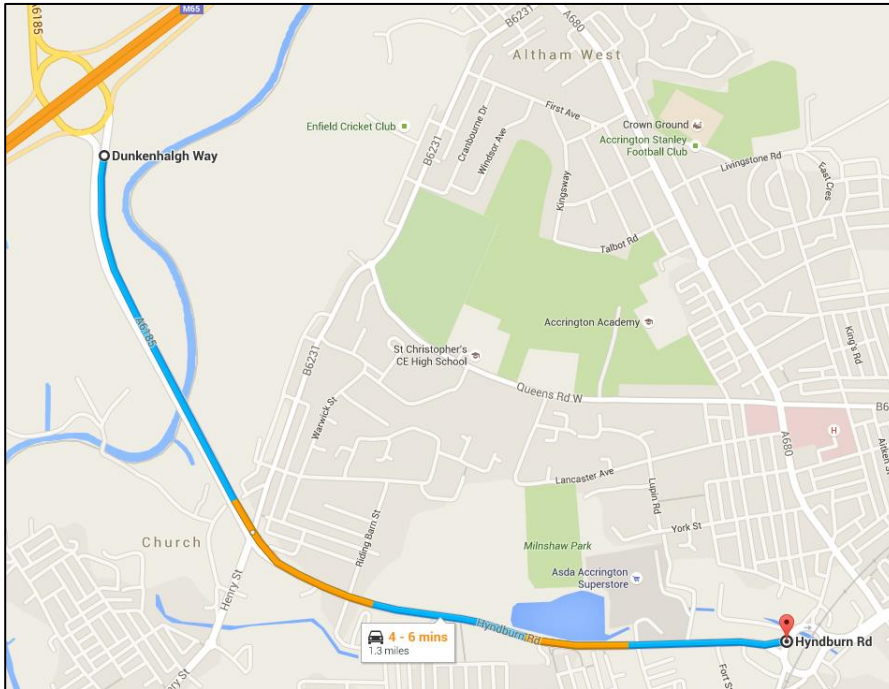


Figure 5-K: Accrington Town Centre Main Route

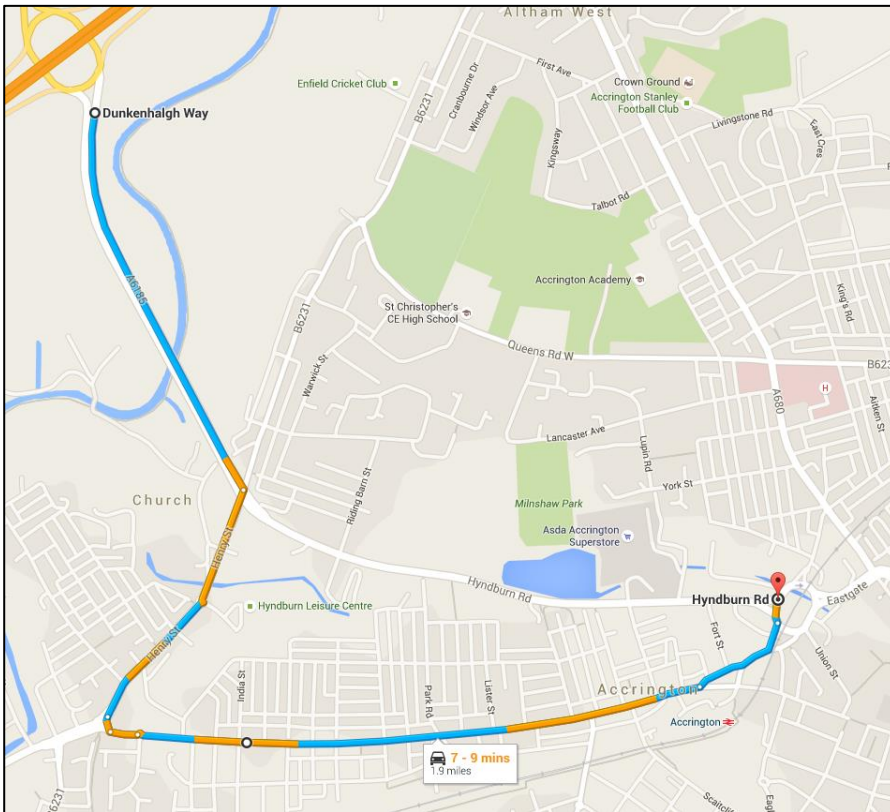


Figure 5-L: Accrington Town Centre Alternative Route (1)

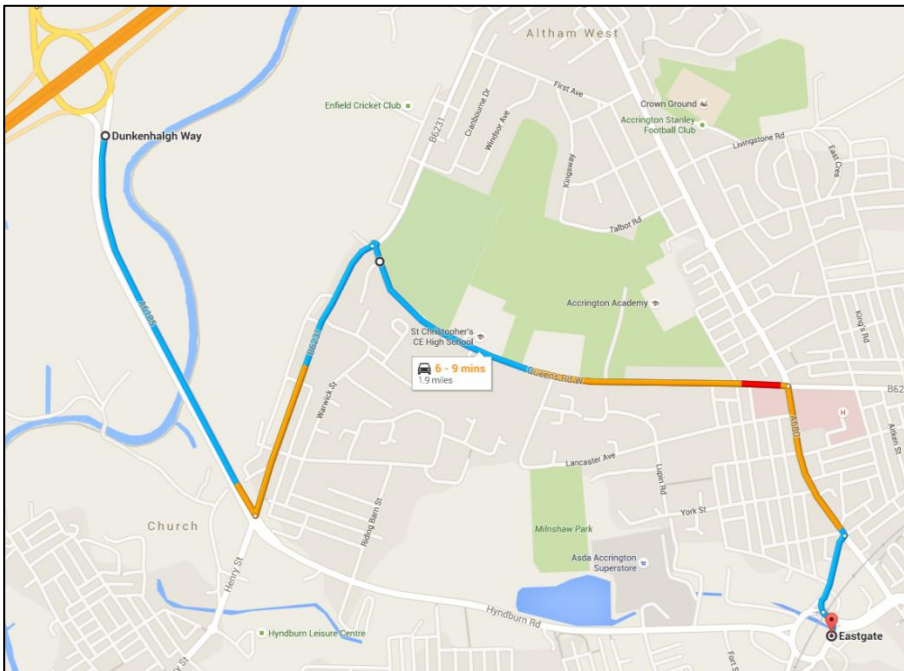


Figure 5-M: Accrington Town Centre Alternative Route (2)

5.1.2 Peak Spreading

A potential peak spreading demand response could emerge when the peak period extend beyond the peak hour. This demand response is noticeable where a junction or network is operating at, or near, full capacity for the full peak hour.

This has been investigated through analysis of a series of traffic flow profiles in the vicinity of a number of the junction improvements. In summary, the effect of peak spreading as a demand response is expected to be negligible.

Figure 5-N and Figure 5-O demonstrate that there is capacity within the peak hour to allow for additional traffic through these sites, without likely prompting significant levels of peak-spreading beyond the modelled time periods.

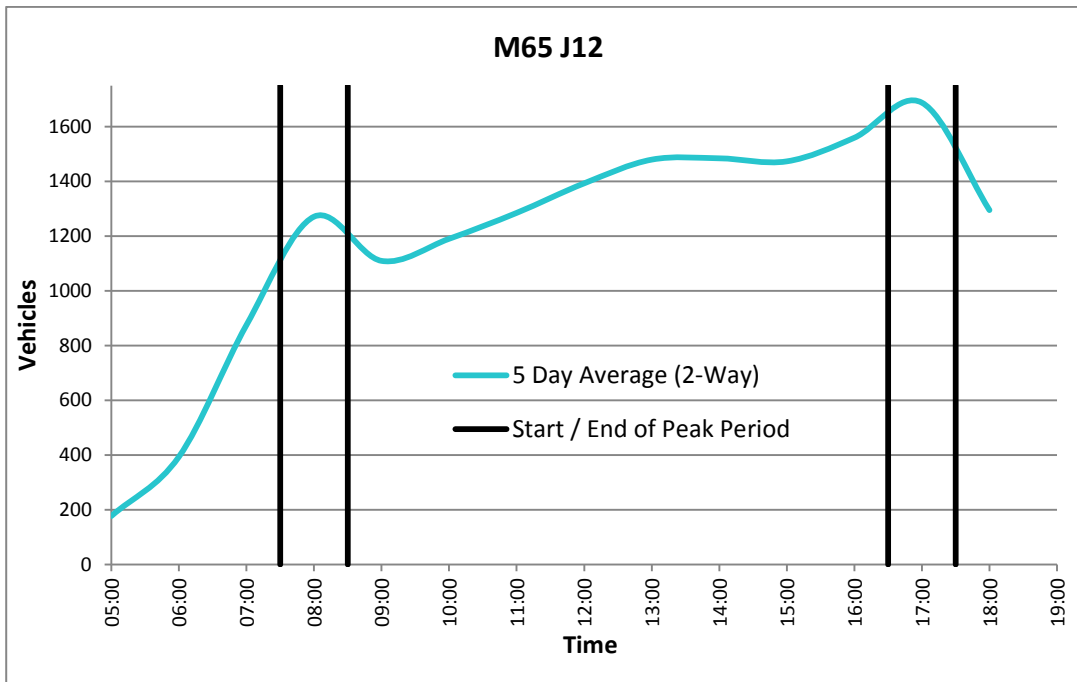


Figure 5-N: Flow Profile - M65 J12

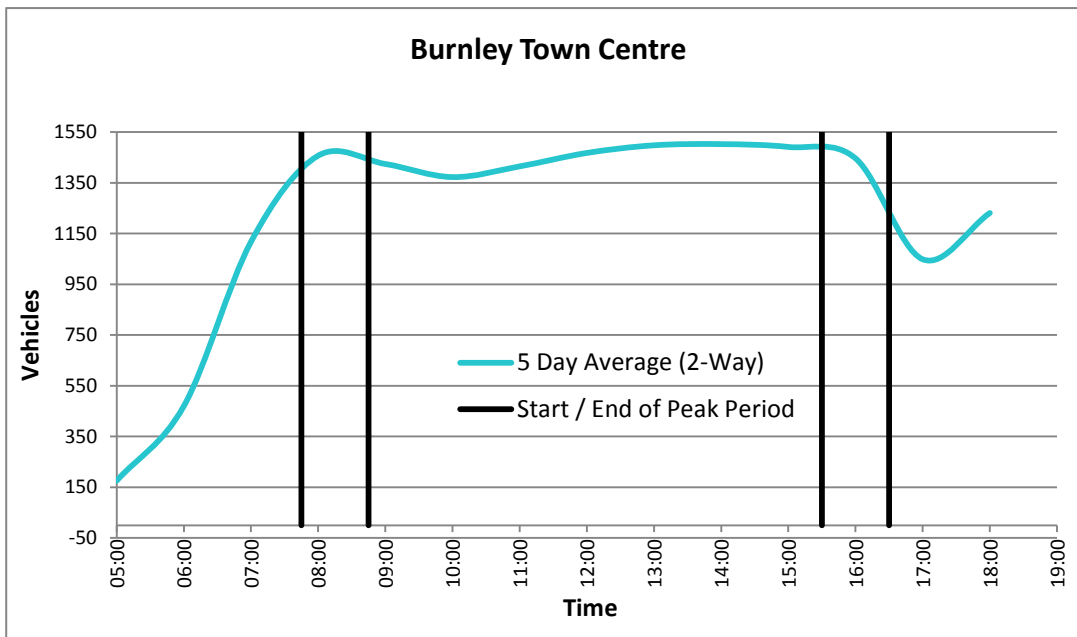


Figure 5-O: Flow Profile – Burnley Town Centre

5.1.3 Mode Shift

The mode shift demand response is as a potential result of car drivers choosing alternative modes of transport to undertake their journey due to excessive delay on the highway network in the forecast years without any intervention. Analysis of this response has been informed by WebTAG guidance and local understanding of the connectivity and route options provided by local public transport operators.

5.1.3.1 Modal Shift Significance Test

WebTAG Unit M2 “*Variable Demand Modelling*” (DfT, January 2014) sets out criteria for evaluating the potential significance of mode shift between public transport and car modes.

Specifically, the modal impact may be considered significant if:

- The car share is below 75%, the cost change between modes is more than one minute; or
- The car share is between 75% and 85%, the cost change is more than two minutes; or
- The car share is above 85%, the cost change is more than four minutes.

The guidance goes on to state that if a significant modal impact is not demonstrated this is sufficient evidence for not requiring a mode choice model.

In order to determine if there is likely to be significant modal impact, census journey to work data has been interrogated for the three districts of Burnley, Pendle and Hyndburn.

Table 5-A below shows the percentage split between each mode for those people of working age, in employment and not working from home.

District	Public Transport	Driver or Passenger in a car or van	Total
Burnley	12%	88%	100%
Hyndburn	7%	93%	100%
Pendle	7%	93%	100%

Table 5-A: 2011 Census Journey to Work Mode Shares

It is clear from the table above that driver of passenger in a car or van represents the most significant percentage of mode share in the three districts with between 88% and 93% of mode share. The percentage of car or van as a mode share being so high is representative that the public transport network in the area is not a convenient alternative. Based upon these results, and the guidance set out above, if the cost change can be demonstrated to be less than or equal to 4 minutes, the effect of modal shift can be considered insignificant.

Using the average delay per vehicle analysis set out in section 4.1, the increase in average delay per vehicle between the forecast year and base year is summarised in Table 5-B below. With the exception of Junction Q (highlighted in red in Table 5-B) the change in average delay is under 4 minutes for all junctions, notably, the change is generally less than 2 minutes, with only five occurrences between 2 and 4 minutes (highlighted in amber in Table 5-B). Therefore, by WebTAG definition, the modal impact is considered insignificant as the car mode share is greater than 85% but the cost change is less than 4 minutes.

Junction	Increase in Average Delay per Vehicle		
	AM	IP	PM
A	00:00:45	00:00:01	00:00:25
B	00:00:43	00:00:00	00:00:57
C	00:03:33	00:00:01	00:01:35
D	00:02:15	N/A	00:00:33
E	00:00:02	N/A	00:00:01
F	00:01:30	N/A	00:00:06
G	00:00:05	N/A	00:00:01
H	00:02:19	N/A	00:03:32
I	00:01:36	00:00:06	00:01:06
L	00:00:23	00:00:02	00:00:03
M	00:01:13	00:00:01	00:00:34
N	00:00:58	00:00:01	00:00:33
O	00:02:23	N/A	00:00:34
Q	00:01:11	N/A	00:04:27
R	00:00:05	N/A	00:00:29

Table 5-B: Increase in Average Delay per Vehicle

This represents a priori evidence for determining the mode choice alternatives as being limited, thereby reinforcing the robustness of the economic assessment approach and the use of local junction models.

However, further analysis has also been undertaken in terms of specific junctions and movements, to further demonstrate this point, with respect to the local public transport networks and conditions on the ground.

5.1.3.2 Bus Network

In addition to the modal shift significance test, analysis into the connectivity and accessibility of the bus network has been undertaken.

A plot illustrating the bus network across the BPGC has been sourced from the *“Burnley / Pendle Growth Corridor Strategy Stage 1 Data Collection and Problem Identification Report”* (Jacobs, June 2014) and is included in Appendix A.

This plot demonstrates that whilst network coverage to the east and west is relatively widespread the majority of buses only operate a 30 or 60 minute frequency.

It is also notable that all routes use local A-roads, with no services utilising the M65 as an express route through the corridor. Notably there are only a number of strategic routes operating within the corridor, thereby limiting strategic connectivity into the study area. Namely, these services are:

- The 152 between Burnley and Preston; and
- The X43 between Nelson and Manchester.
-

These constraints on strategic connectivity of the bus network is expected to limit the effect of mode shift as a demand response, in addition to theoretical considerations detailed in WebTAG.

5.1.3.3 Rail Network

In addition to the modal shift significance test, analysis of the connectivity and accessibility of the rail network has also been undertaken.

Figure 5-P below illustrates the wider rail network within Lancashire. The BPGC is served by 3 rail services:

- Blackpool North and York
- Blackpool South and Colne; and
- Blackburn to Manchester (via Burnley Manchester Road).

All three services operate on an hourly frequency along the line, with both the Blackpool North to York service and Blackburn to Manchester service only calling at three stations within the BPGC study area; Blackburn, Accrington, Rose Grove and Burnley Manchester Road. The Blackpool South to Colne service calls at all stations within the BPGC study area.

As per the bus network, strategic connectivity by rail to and from the study area is limited with only one direct service per hour links the BPGC with Manchester. Other opportunities for wider connectivity are available if passengers are willing to interchange in Blackburn. For passengers between the Preston to Colne branch line and Manchester an interchange is required at Burnley or Rose Grove limiting strategic connectivity and changes.

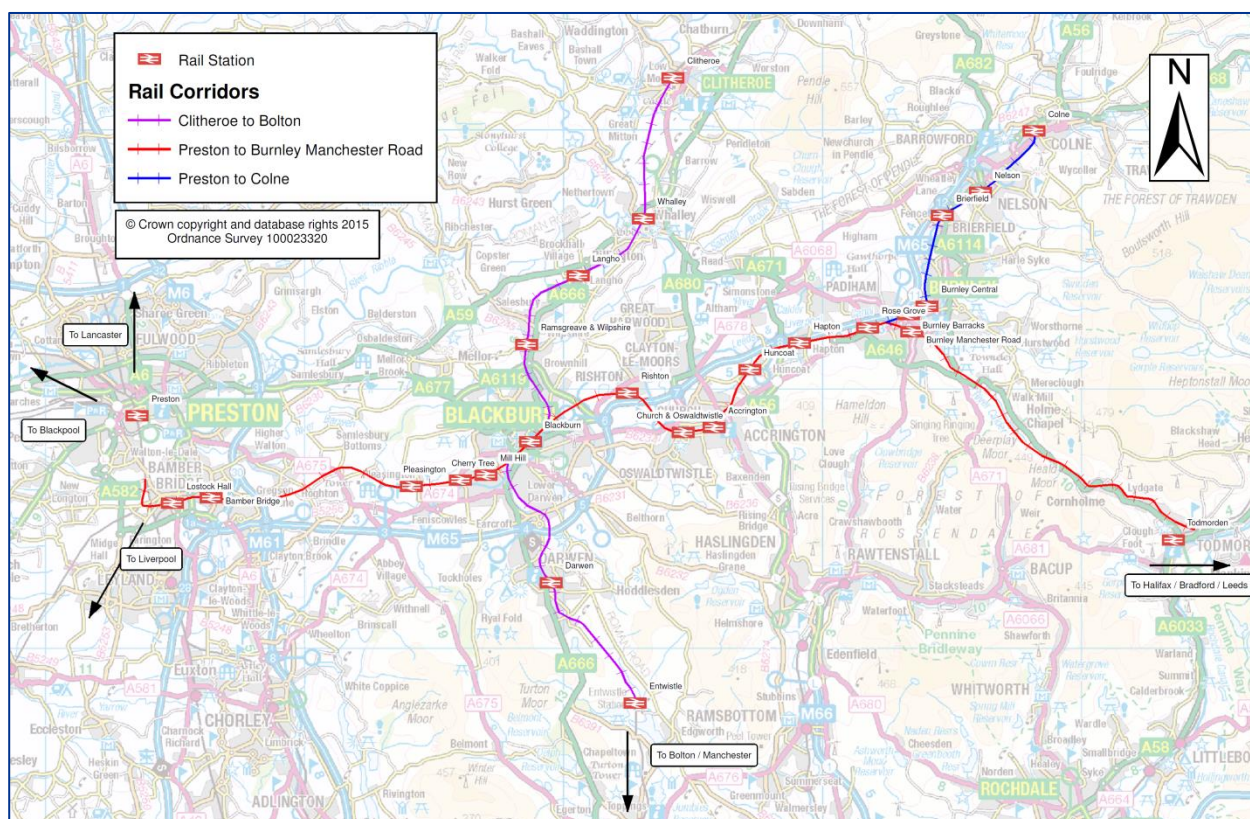


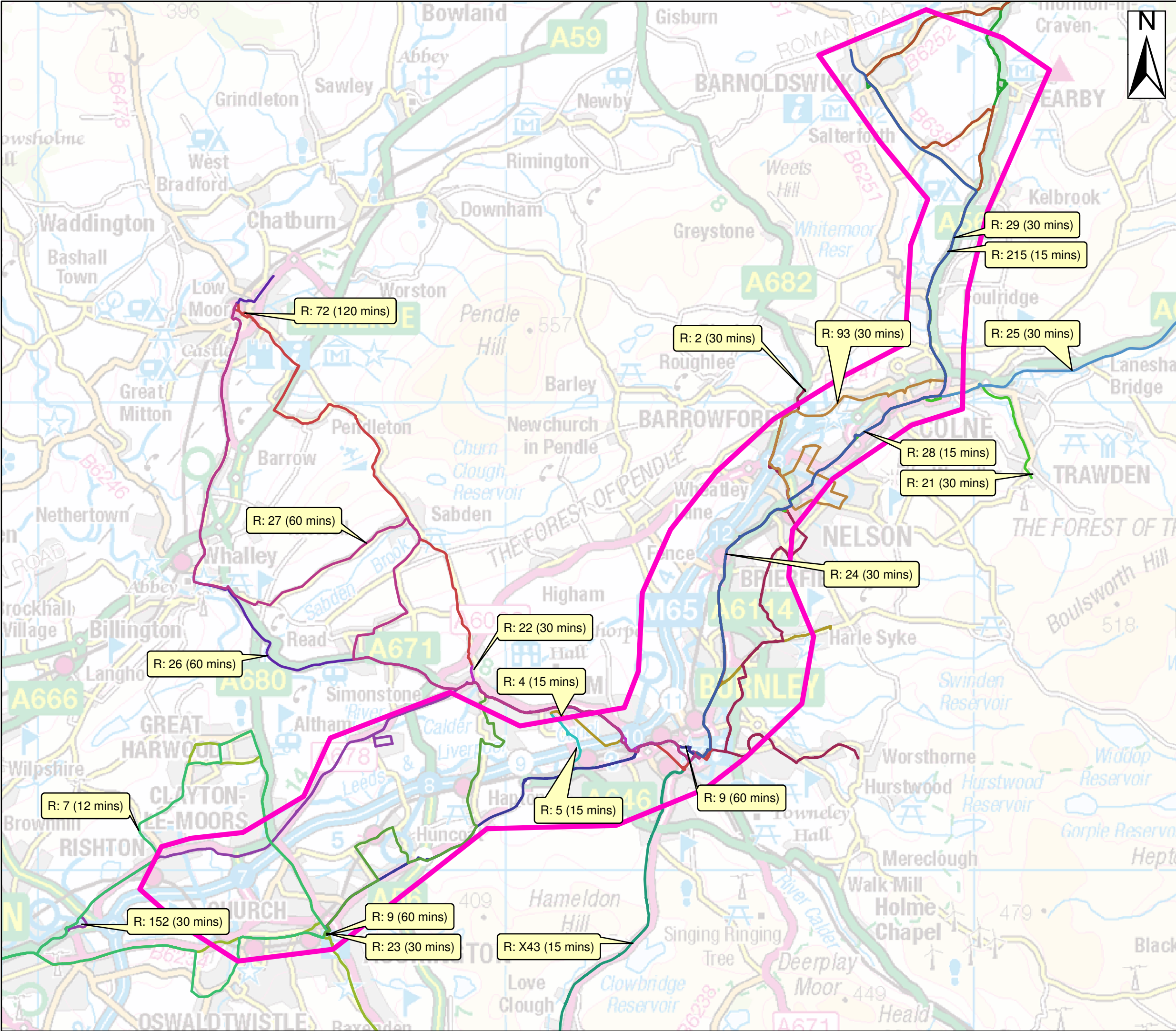
Figure 5-P: BPGC Rail Network

In addition to the connectivity issues the “East Lancashire Rail Connectivity Study Stage 1 Data Collection and Problem Identification Report” (Jacobs, December 2014) highlighted significant reliability issues on both the Blackpool north to York service and the Blackpool South to Colne service.


5.1.3.4 Summary

Based upon the evidence set out in sections 5.1.3.1, 0 and 5.1.3.3 above, it has been demonstrated that the modal impact can be considered insignificant. Therefore the likely impact of mode shift, whilst not considered in local junction modelling as a demand response, can be considered negligible and the use of local junction models is deemed appropriate















Appendix A.



Legend

 Burnley / Pendle Growth Corridor

Route

-  R:152 - Burnley - Preston (via Blackburn)
-  R:2 - Higherford - Worsthorne (via Nelson & Burnley)
-  R:21 - Burnley - Trawden
-  R:215 - Skipton - Burnley
-  R:22 - Burnley - Padiham
-  R:23 - Burnley - Accrington
-  R:24 - Colne - Burnley
-  R:25 - Colne - Keithley
-  R:26 - Burnley - Clitheroe
-  R:27 - Burnley - Clitheroe (via Sabden)
-  R:28 - Burnley - Skipton (via Earby & Barnoldswick)
-  R:29 - Burnley - Skipton (via Barnoldswick)
-  R:4 - Harle Syke - Rosegrove (via Burnley)
-  R:5 - Harle Syke - Rosegrove (via Burnley)
-  R:7 - Blackburn - Accrington
-  R:72 - Nelson - Clitheroe (via Burnley)
-  R:9 - Burnley - Accrington
-  R:93 - Colne - Nelson
-  R:X41 - Blackburn - Manchester (via Harwood & Accrington)
-  R:X43 - Nelson - Manchester via Burnley

Note: Times stated in brackets are the peak hour frequencies of services.

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Project

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Corridor Strategy**

Drawing Title

Daily Bus Routes

Drawing Status

Scale	NOT TO SCALE	DO NOT SCALE
Jacobs No.		
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