THE CITY OF BRADFORD METROPOLITAN DISTRICT COUNCIL
(HARROGATE ROAD/NEW LINE JUNCTION IMPROVEMENTS) (SIDE ROADS)
ORDER 2017
THE CITY OF BRADFORD METROPOLITAN DISTRICT COUNCIL
(HARROAGTE ROAD/NEW LINE JUNCTION IMPROVEMENT SCHEME)
COMPULSORY PURCHASE ORDER 2017

THE HIGHWAYS ACT 1980
-and-
THE ACQUISITION OF LAND ACT 1981
THE HIGHWAYS (INQUIRIES PROCEDURE) RULES 1994
COMPULSORY PURCHASE (INQUIRIES PROCEDURE) RULES 2007

National Transport Casework Team (REFERENCE: NATTRAN/YH/LAO/149)
In the matter of
a highway improvement scheme involving highway alterations to improve and widen the A658 Harrogate Road from a point 70 metres north east of its junction with Carr Bottom Road, south westwards to a point 25 metres south west of its junction with Stanley Street and the A657 New Line from a point 45 metres north west of its junction with Haigh Hall Road, south eastwards to its junction with Elder Street, Bradford and a new 60 metres long one-way link road between Harrogate Road and New Line, Bradford in the County of West Yorkshire

Proof of Evidence dated 11th October 2018
of


# Andrew John Bradshaw

Director, Fore Consulting Limited
MSci (Hons), MSc, MCIHT


(Document Reference: P08/AB/Transport Modelling)

presented as evidence in chief on behalf of
The City of Bradford Metropolitan District Council
to
Local Public Inquiry – 6th November 2018

# Contents

## Appendices

# 1 Personal Details

1.1 My name is Andrew John Bradshaw and I hold the position of Director of Fore Consulting Limited (Fore), which is a consultancy specialising in transport planning. I have a First Class Master in Science (MSci) in Physics from the University of Nottingham. I also have a Master of Science (MSc) in Transport Planning Practice from the Institute of Transport Studies at the University of Leeds, for which I was awarded a Distinction. I am a member of the Chartered Institution of Highways and Transportation (CIHT).

1.2 I have over 15 years' experience in transport planning and modelling with a specialism in traffic microsimulation modelling, particularly using Aimsun software, which has been used to inform the design of, and inform the business case for, the A658 Harrogate Road / A657 New Line Improvement Scheme (referred to hereon as "the scheme").

1.3 For the purposes of this inquiry, I confirm that I am familiar with the site and the surrounding highway network.

# 2 Scope of Evidence

2.1 My evidence covers transport planning and traffic modelling maters in relation to the scheme and is structured as follows:

- Section 3 explains why I have been asked by the Council to present evidence to the Inquiry.
- Section 4 summarises existing conditions on the highway network and explains why the scheme is required in transport planning terms.
- Section 5 summarises the microsimulation traffic modelling work that has been undertaken to assess options for improving the A658 Harrogate Road / A657 New Line junction.
- Section 6 summarises the microsimulation traffic modelling work that has been undertaken to assess for preferred option for the A658 Harrogate Road / A657 New Line junction.
- Section 7 summarises the economic assessment work that has been undertaken by the Council to support the outline business case for the scheme.
- Section 8 provides a detailed response to an objection that is relevant to my evidence.
- Section 9 summarises and concludes my evidence.
- Section 10 presents my expert declaration.

# 3 My Appointment

3.1 I am appointed by City of Metropolitan District Council (**"the Council"**) to present evidence on behalf of the Council in relation to transport planning and traffic modelling matters relating to the scheme. In particular, Fore were appointed by the Council to undertake Aimsun microsimulation modelling of potential options and to help refine the scheme design. The modelling was also used by the Council to support the scheme through Gateway 1 (now known as Outline Business Case)(see Core Document 21.1.22) of the West Yorkshire Transport Fund (see Core Document 21.1.19).

# 4 Existing Situation

## Existing Traffic Flows

4.1 Turning count traffic surveys covering key junctions in the study area were undertaken, as set out in Table 1. Turning counts were collected at a total of eight junctions. The turning counts were collected in fifteen-minute intervals and were classified by vehicle type. The count data covers the time periods 07:00 to 10:00 and 15:00 to 19:00 during the weekday and 10:00 to 14:00 for Saturday.

**Table 1: Traffic Survey Locations**

| Location | Type | Date |
|---|---|---|
| A658 Harrogate Road / A657 New Line | CTC | 23/03/2017 |
| A658 Harrogate Road / Stockhill Road | | |
| A658 Harrogate Road / Carr Bottom Road | | |
| A657 New Line / Elder Street | | |
| A657 New Line / Asda Access | | |
| A658 Harrogate Road / Farmfoods Access | | |
| A658 Harrogate Road (North) / Sainsburys / A658 Harrogate Road (South) | | |
| The Grove / A657 New Line (East) / A657 New Line (West) | | |
| A657 New Line (West) | ATC | 23/03/2017 - 05/04/2017 |
| A658 Harrogate Road (South) | | |
| A657 New Line (East) | | 02/06/2017 - 15/06/2017 |

4.2 The traffic surveys provide a comprehensive picture of traffic flows through the Harrogate Road / New Line junction and also traffic associated with side road junctions and accesses in the vicinity of the junction. The surveys were undertaken during typical traffic conditions and are therefore considered to be fit for purpose. These surveys have been used to inform the traffic modelling set out later in my evidence.

4.3 In addition to turning counts, queue length surveys were also undertaken at Harrogate Road / New Line junction on Thursday 23 March 2017 at the same time as the classified turning count traffic survey. The queue length surveys are summarised in the box and whisker plots[1] presented on Graph 1 to Graph 3 and show that the junction is currently operating with queuing on all arms. In the AM peak hour (08:00 to 09:00), queues extend to a maximum of 39 vehicles (approximately 234m) on the A658 Harrogate Road (North) and 29 vehicles (approximately 174m) on A657 New Line (West) approaches to the junction.

4.4 In the PM peak hour (17:00 to 18:00), the queuing is even more extensive, with substantial queues on each arm of the junction with maximum queues as follows:

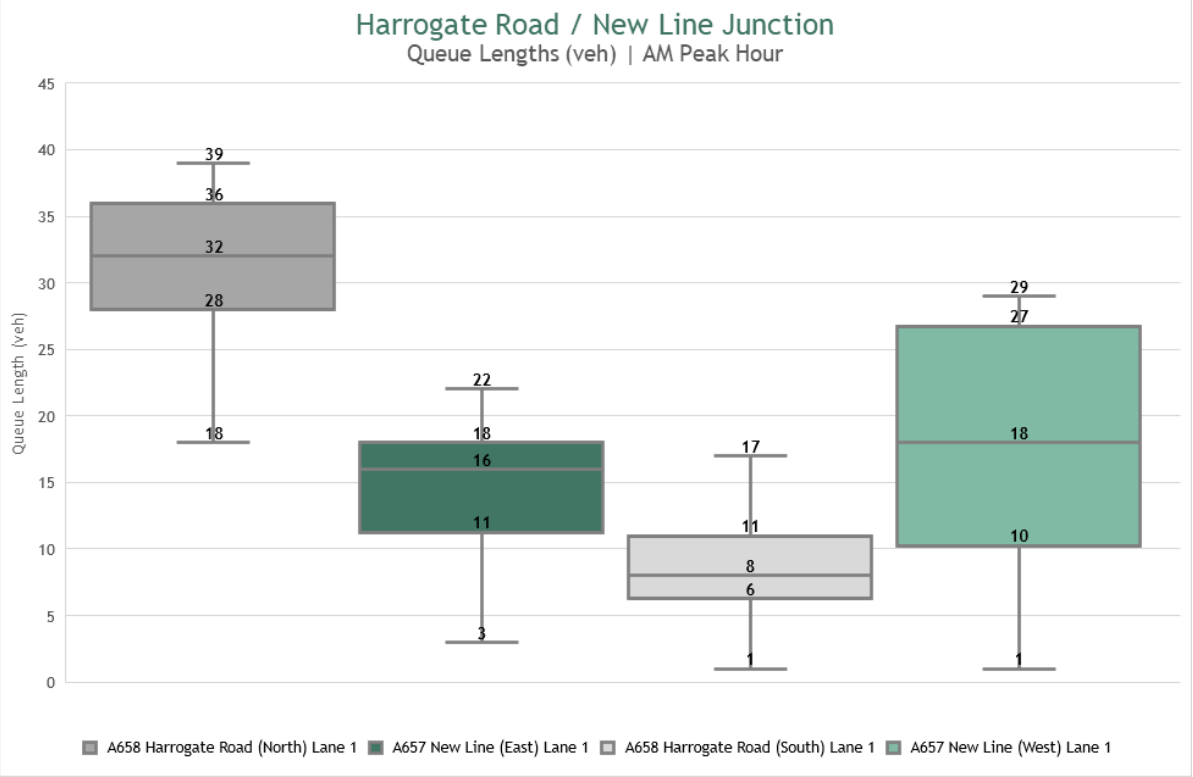
- A658 Harrogate Road (North) – 55 vehicles (330m)
- A657 New Line (East) – 34 vehicles (204m)
- A658 Harrogate Road (South) – 65 vehicles (390m)
- A657 New Line (East) – 28 vehicles (168m)

[1] The box and whisker plots show the variation in queues recorded. The box shows the 25th and 75th percentile queue lengths, with the line through the box showing the median queue length. The "whiskers" show the minimum and maximum queue lengths observed.

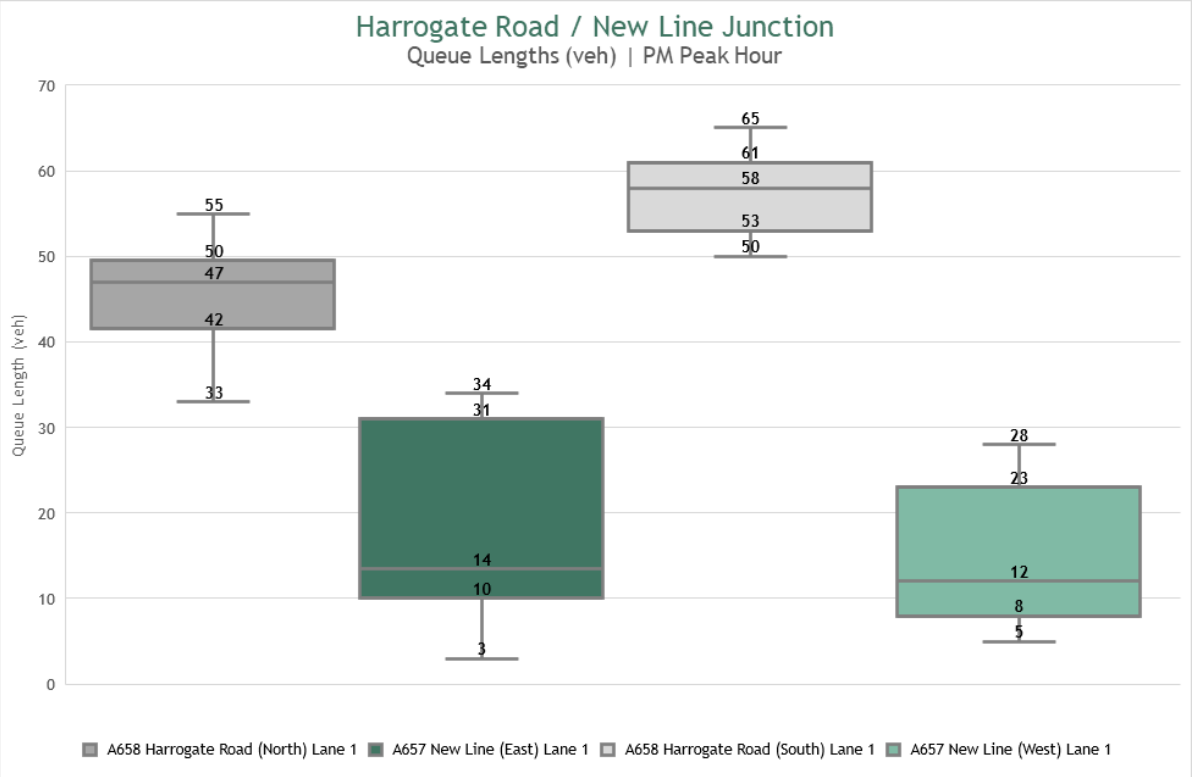
4.5 Queues are also present on a Saturday, with maximum queues on each arm of the junction as follows:

- A658 Harrogate Road (North) – 33 vehicles (198m)
- A657 New Line (East) – 40 vehicles (240m)
- A658 Harrogate Road (South) – 25 vehicles (150m)
- A657 New Line (East) – 30 vehicles (180m)

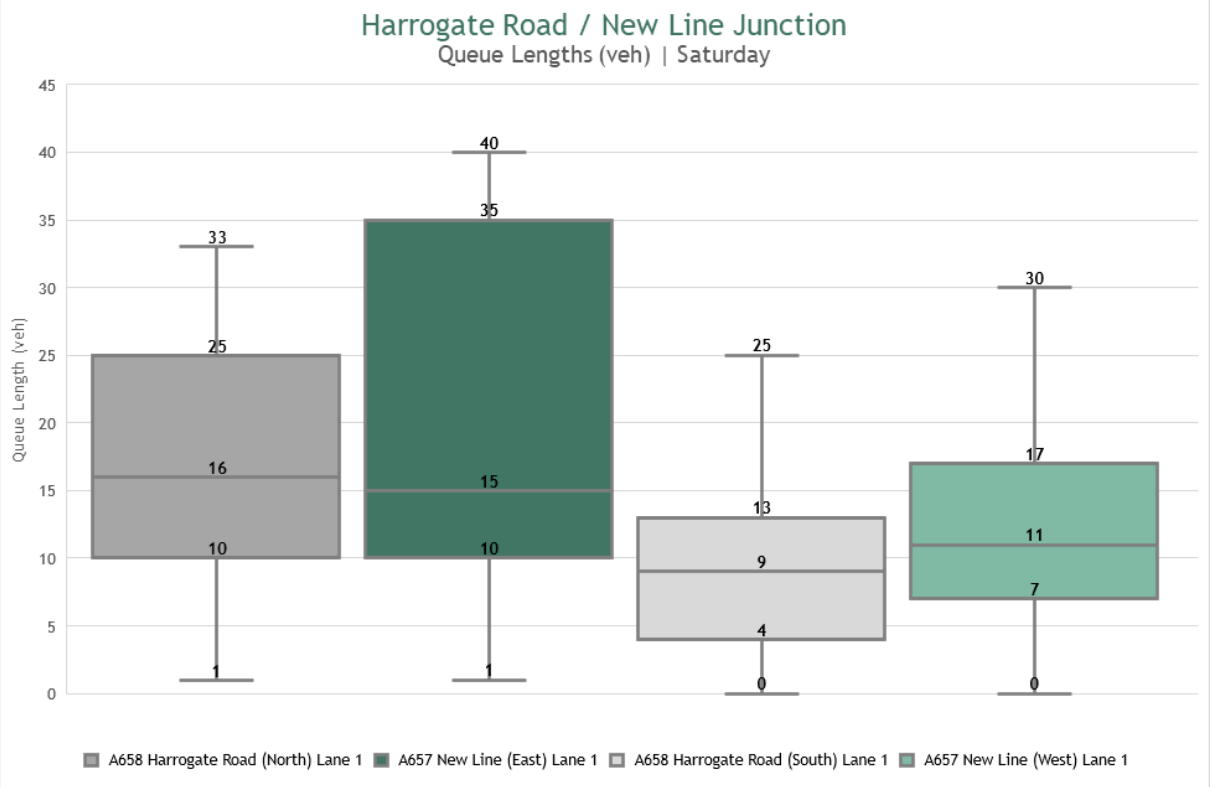
**Graph 1: Queue Length Summary | AM Peak Hour (0800 to 0900)**



**Graph 2: Queue Length Summary | PM Peak Hour (1700 to 1800)**

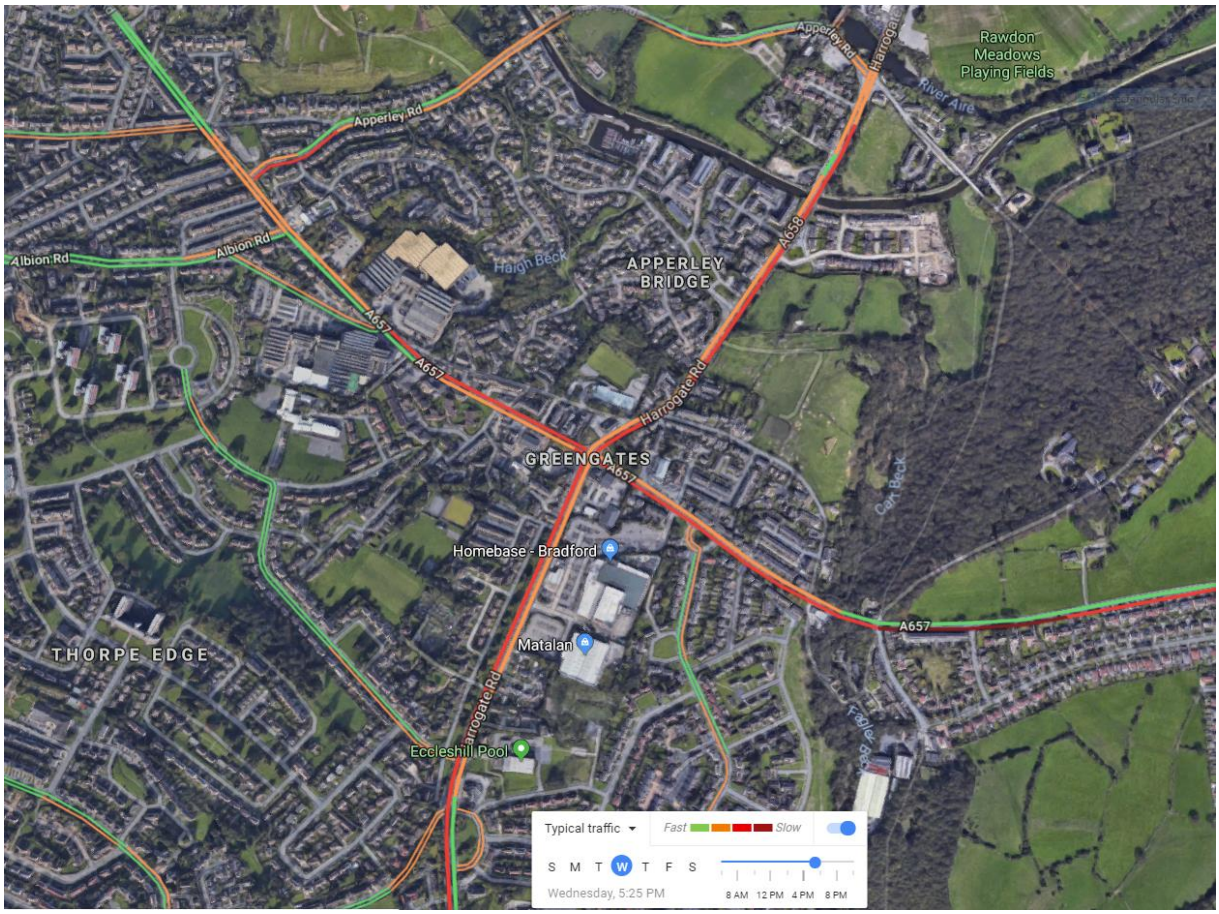



**Graph 3: Queue Length Summary | Saturday (1000 to 1400)**



4.6 The level of queuing surveyed is evident of a junction that is operating in excess of capacity during the peak hours. Further evidence of traffic conditions in the peak hours can be seen using the "Traffic" feature on Google Maps, a screenshot of which is presented in Screenshot 1, below. This shows typical traffic speeds on a Wednesday at 17:25 using different colours. In my experience, the extent of the red colouration typically corresponds to actual queues on-street and demonstrates significant queuing on all approaches to the junction in the PM peak hour, consistent with the queue length surveys, but suggesting an even greater extent of queuing.

**Screenshot 1: Google Traffic | 'Typical Traffic' | Wednesday | 17:25**



## Summary

4.7 Queue length surveys for the junction show that the junction is subject to queueing at peak times and also on a Saturday, suggesting that the junction is currently operating at, or over, capacity and resulting in significant delay for current users. There is, therefore, no capacity to accommodate future growth at the junction (either background traffic growth or that associated with committed and new development) and this will result in further deterioration of conditions in the future.

# 5 Options Testing Traffic Modelling

## Fore Commission

5.1 Fore were originally commissioned by CBMDC in 2014 to assess the performance of a range of options for improving the A658 Harrogate Road / A657 New Line junction using an Aimsun microsimulation traffic model.

## Benefits of Microsimulation

5.2 Microsimulation models use a comprehensive suite of car-following, lane-changing, merging and gap-acceptance models to model individual vehicles on a geometrically accurate representation of the highway network. The models implicitly take into account the effects of factors such as adjacent junctions, bus stops and pedestrian crossings, as well as junction geometry and gradient, and are ideally placed to model more complex junction arrangements. In particular, microsimulation models are able to model the effects of queues from one junction or merge blocking back through other junctions. For these reasons, I considered that microsimulation is the best and most appropriate method to assess the impacts of the scheme.

5.3 Furthermore, microsimulation models are able to provide statistics relating to the operation of the whole network and can therefore be used to determine the network performance statistics that are required for economic analysis.

## Base Year Model

5.4 The development, calibration and validation of the base year model is set out in the Fore report titled "*A658 Harrogate Road / A657 New Line Aimsun Model Validation Report*" and dated 11 June 2014 (see Core Document 21.1.60).

5.5 The network has been developed to show the extent of queuing from the A658 Harrogate Road/A657 New Line junction. Key elements of the local highway infrastructure have been modelled to accurately represent behaviour of traffic in close proximity to the junction. The extent of the model is shown in Screenshot 2.

**Screenshot 2: Extent of the Harrogate Road/New Line Aimsun Model (2013)**

5.6 The model has been developed to replicate typical conditions in the year 2013 during the following time periods:

- AM peak period: 0700 to 0900
- PM peak period: 1600 to 1800

These periods were chosen to best represent peak traffic flows on the highway network during a school term-time weekday. No Saturday modelling was undertaken at this stage as data was not available for this time period and it was considered that the AM and PM peak hours represented a worse-case in terms of traffic flows.

5.7 The model considers the following vehicle types:

- Light vehicles – comprising cars and light vans with a gross vehicle weight of less than 3.5t;
- Light goods vehicles (LGVs)
- Heavy goods vehicles (HGVs) – comprising vehicles (except buses) with a gross vehicle weight greater than 3.5t;
- Buses – comprising all public service buses.

The proportions of each vehicle type in the model were derived from traffic survey data and therefore accurately reflect what was observed on site.

5.8 The model was fully calibrated and validated in accordance with best practice guidance. It accurately reflected observed traffic flows and journey times and produced queues that were broadly consistent with observed queue lengths. As such, I consider that the model was suitable for the assessment of different options for the A658 Harrogate Road / A657 New Line junction.

## Options Assessment

5.9 The assessment of the options is set out in detail in the Fore report titled "*Harrogate Road/New Line Junction Options Aimsun Modelling Report*", dated 10 June 2014 (see Core Document 21.1.59). The following options were tested, as requested by the Council:

- Option 5 – Major Cross Roads with Lanes Extended;
- Option 8 – P-Loop; and
- Option 9 – P-Loop with Extended Lanes.

5.10 Network-wide statistics have been outputted from the model and these show the overall impact of the scheme. For simplicity, I have presented the average delay (expressed in units of seconds per kilometre) for each of the options assessed in Table 2.

**Table 2: Aimsun Modelling Results: Network Statistics**

| Scenario | Average Network Delay (s / km) | |
|---|---|---|
| | AM Peak (0700 to 0900) | PM Peak (1600 to 1800) |
| 2013 Base Year | | |
| Base | 95 | 114 |
| Option 5 – Major Cross Roads with Lanes Extended | 40 | 40 |
| Option 8 – P-Loop | 68 | 68 |
| Option 9 – P-Loop with Extended Lanes | 41 | 43 |

5.11 The above table shows that all options assessed would provide benefits over the base scenario, although further analysis in the report shows that Option 8 would not resolve queuing completely and the junction would still operate at, or over, capacity. This option would not therefore accommodate future traffic growth on the network.

5.12 Options 5 and 9 both provide similar levels of benefit, although Option 5 would provide slightly greater benefits overall. However, Option 9 minimises the overall impact on third party land owners and was therefore taken forward as a preferred option for further development by the Council.

# 6 Preferred Scheme Traffic Modelling

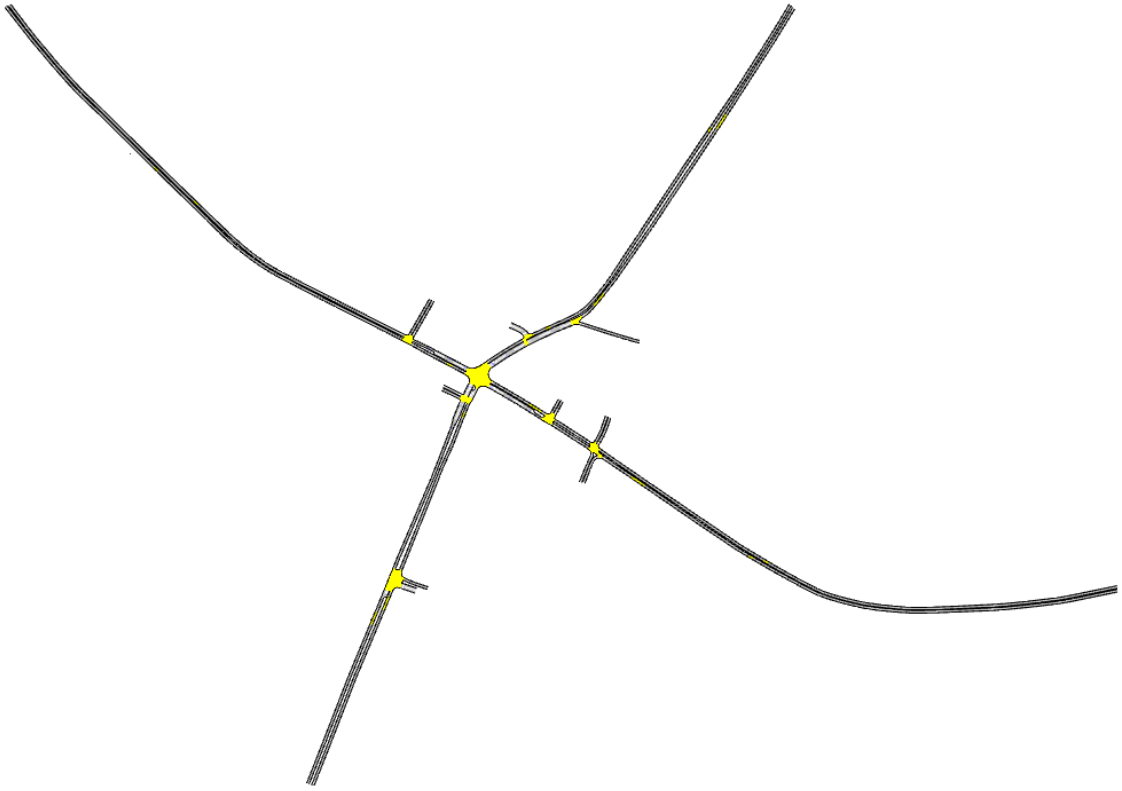
6.1 Fore were subsequently appointed in 2017 by the Council to develop an updated Aimsun microsimulation model in order to provide a robust assessment of the preferred scheme.

## Summary of Modelling Approach

6.2 The development, calibration and validation of the revised model are set out in detail in the "Harrogate Road Model Validation Report", (see Core Document 21.1.38). I have summarised the key features of the model below.

6.3 A screenshot of the Aimsun model is shown in Screenshot 1. The roads shown illustrate the extent of the modelled network, which comprises the A658 Harrogate Road / A657 New Line junction as well as accesses to local retail developments. Harrogate Road and New Line are extended in each direction in order to capture the full extent of any queueing from the junction but do not necessarily reflect the full level of network detail along their lengths.

**Screenshot 3: Extent of the Model**



## Modelled Year, Time Periods and Vehicle Types

6.4 The model has been developed to be representative of typical conditions in the year 2017 during the following time periods:

- Weekday AM peak period: 07:00 to 10:00
- Weekday PM peak period: 15:00 to 19:00
- Saturday peak period: 10:00 to 14:00

6.5 These peak periods were chosen as these capture the peak traffic flows on the highway network. These extended modelled periods include the shoulders of the peak hour, enabling the build-up and decay of queues to be better represented.

6.6 The model considers the following vehicle types:

- Cars – comprising private cars and taxis;
- Light goods vehicles (LGVs) – with a gross vehicle weight of less than 3.5t;
- Heavy goods vehicles (HGVs) – with a gross vehicle weight greater than 3.5t;
- Buses – comprising all public service buses.

The proportions of each vehicle type in the model were derived from the traffic survey data set out in section 4.1 and therefore accurately reflect what was observed on site.

## Traffic Flow Verification

6.7 Modelled traffic flows have been compared to observed turn and section traffic flows from the classified turning count traffic surveys to verify that the model is correctly reproducing the inputted traffic flows. WebTAG sets out acceptability guidelines[2] for the calibration and validation of section flows and turning movements.

6.8 The results of the traffic flow verification for the Weekday AM, PM and Saturday peak periods are set out in detailed in the Model Validation Report, which shows that the traffic flows within the model are represented to a very high level of accuracy with all section and turning flows being replicated well within the acceptability guidelines set out in WebTAG.

[2] TAG Unit M3.1, Table 2

## Traffic Flow Validation

6.9 Modelled traffic flows have been compared to observed traffic flows from automatic traffic count (ATC) data to validate the model. This data is independent of the data used to calibrate the model and spans the full three hour modelled AM and PM peak periods. The validation is set out in detail in the model validation report (see Core Document 21.1.38).

6.10 The tables demonstrate that the WebTAG criteria are met for the AM and PM peak periods. However, in the Saturday peak the GEH falls short at 71%. It should be noted the only sections to not validate were New Line East. Due to damage to the survey equipment and subsequent roadworks in the area, the ATC data for this approach was collected two months after the rest of the data used in the validation of the model. The modelled data is higher than the observed ATC and it is possible that the observed ATC data is atypically low due to seasonal factors. Notwithstanding this, it is clear that the modelled traffic flows on a Saturday represent a robust scenario for the purposes of scheme testing since the traffic flows used in the model are higher than those observed from the ATC surveys.

## Queue Length Validation

6.11 Queues in the model have been compared to the queue length surveys set out above in order the validate queuing behaviour in the model. The comparison is set out in detail in the model validation report (see Core Document 21.1.38) and confirms that the model accurately replicates existing queues.

6.12 Having regard to the above, I conclude that the model is a robust and suitable tool for assessing the impacts of the proposed scheme.

## Future Year Modelling – Do Minimum

6.13 Scenarios that reflect what traffic conditions at the junction would be like without the proposed scheme (the "Do Minimum" scenarios) have been created for the 2021 Opening Year and 2029 Assessment Year. These are created by keeping the junction the same as in the base scenario but applying traffic growth in line with the guidance set out in WebTAG.

6.14 Background traffic growth was applied by factoring the traffic demand matrices in the model using National Transport Model (NTM) locally-adjusted growth factors derived using TEMPro. The factors used are summarised in Table 3. The table confirms that traffic levels are likely to increase by approximately 6% by 2021 and 18% by 2029, relative to the 2017 base year.

**Table 3: NTM / TEMPRo Growth Factors (2017 to 2021)**

| Base Year | Future Year | NTM Local Growth Factor Bradford 09 and 027 | | |
|---|---|---|---|---|
| | | AM Peak | PM Peak | SAT Peak |
| 2017 | 2021 | 1.063 | 1.061 | 1.060 |
| 2017 | 2029 | 1.182 | 1.181 | 1.185 |

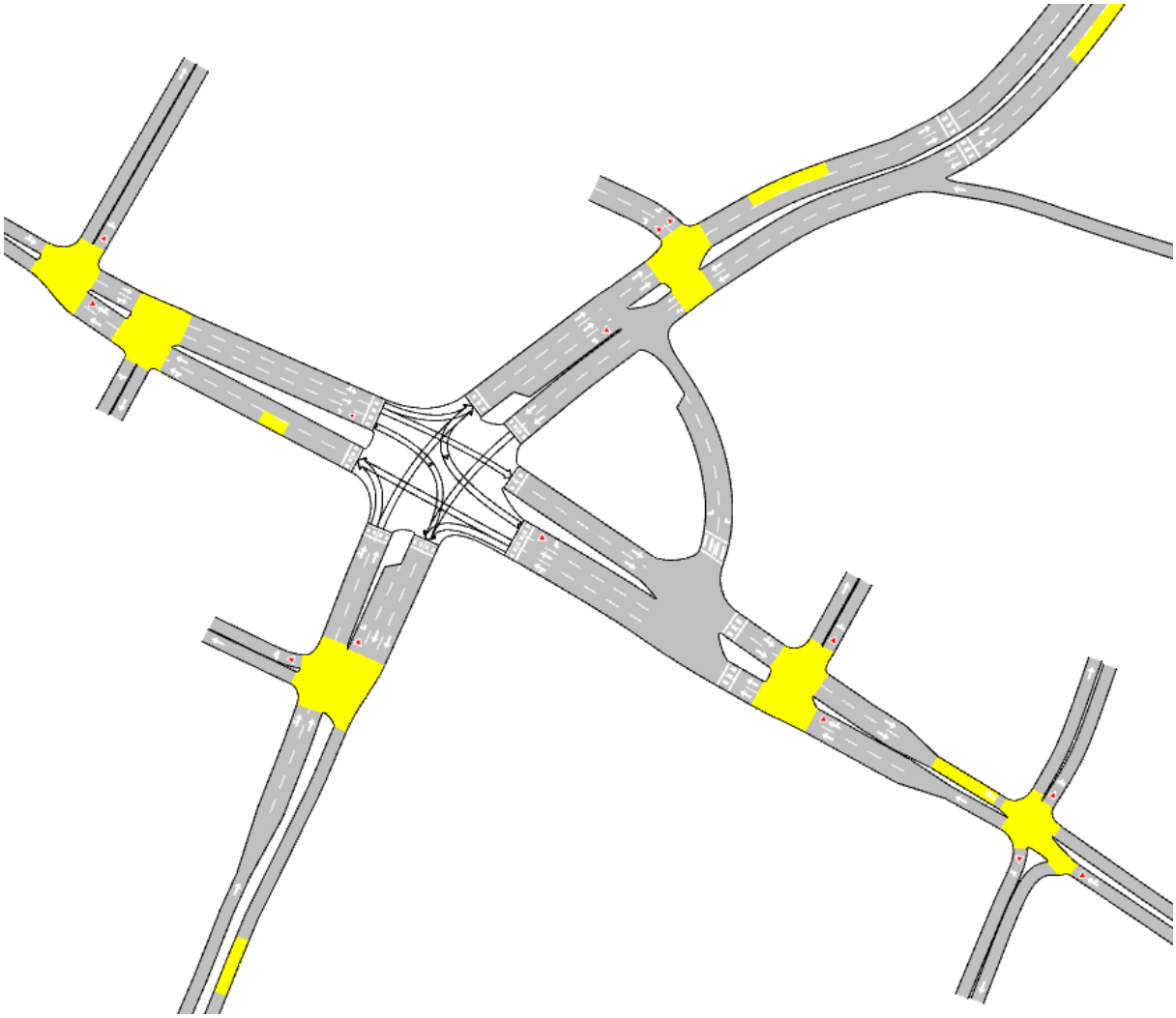
6.15 In addition to background traffic growth, further additional traffic associated with committed developments in the vicinity will also use the junction and this has been included within the model.

6.16 Future traffic flows through the junction are therefore forecast to increase significantly.

## Future Year Modelling – Do Something

6.17 The "Do Something" scenario has been developed by coding the proposed scheme into the future year Do Minimum models, as shown in Screenshot 4, below. By comparing the outputs from this model to those from the equivalent Do Minimum model, the impact of the scheme can be determined.

**Screenshot 4: 2021 Future Year Do Something Network Coding**



## Aimsun Model Results

6.18 Network-wide statistics have been outputted from the model. These show the overall impact of the scheme and are used in economic appraisal. For simplicity and consistency with the results from the options assessment, I have presented the average network delay time for the scenarios in Table 4, below. However, it should be noted that these values can not be directly compared with those for the options presented in Table 2, since there are differences in the networks, traffic demands, modelled time periods and assessment years.

**Table 4: Aimsun Modelling Results: Network Statistics**

| Scenario | Network Delay (s/km) | | |
|---|---|---|---|
| | AM Peak Period (0700 to 1000) | PM Peak (1600 to 1900) | Saturday Peak (1000 to 1400) |
| 2017 Base Year | | | |
| Base | 54 | 173 | 96 |
| 2021 Opening Year | | | |
| Do Minimum | 102 | 234 | 159 |
| Do Something | 40 (-61%) | 53 (-77%) | 42 (-74%) |
| 2029 Assessment Year | | | |
| Do Minimum | 312 | 287 | 247 |
| Do Something | 116 (-63%) | 77 (-73%) | 55 (-78%) |

6.19 The above table shows that without the proposed scheme in place, and with the forecast increases in traffic, delay on the network will increase significantly by 2021 compared to the 2017 baseline. The modelled increases in delay are 89%, 35% and 66% in the AM, PM and Saturday peak periods, respectively. By 2029, delay will be even greater compared to the 2017 baseline, with increases of 478%, 66% and 157%, respectively. Improvements to

the junction are therefore needed in order to accommodate the forecast increases in traffic.

6.20 With the proposed scheme in place, the delay is forecast to reduce significantly compared to the equivalent Do Minimum scenario, with reductions of up to 77% in 2021 and 78% in 2029. Moreover, it can be seen that conditions on the network in the 2029 Do Something scenario will be better than the current situation in both the PM and Saturday peak periods.

6.21 To provide a more tangible statistic on what these means for each individual user of the junction, I have also calculated what the average travel time per vehicle would be in each of the scenarios and this is set out in Table 5.

**Table 5: Aimsun Modelling Results: Network Statistics – Average Travel Time per Vehicle**

| Scenario | Average Travel Time per Vehicle (s) | | |
|---|---|---|---|
| | AM Peak Period (0700 to 1000) | PM Peak (1600 to 1900) | Saturday Peak (1000 to 1400) |
| 2017 Base Year | | | |
| Base | 138 | 165 | 169 |
| 2021 Opening Year | | | |
| Do Minimum | 165 | 308 | 236 |
| Do Something | 122 (-26%) | 121 (-61%) | 107 (-55%) |
| 2029 Assessment Year | | | |
| Do Minimum | 424 | 366 | 311 |
| Do Something | 127 (-70%) | 143 (-61%) | 116 (-63%) |

6.22 The above table shows that the average travel time will increase significantly due to the forecast growth in traffic, with average journey times through the junction increasing by 286s (nearly five minutes) in the 2029 AM peak period compared to the 2017 baseline. The equivalent increases for the PM and Saturday peak periods are 201s (just over three minutes) and 142s (just over two minutes), respectively.

6.23 I consider such increases in journey time at a single junction to be unacceptable and, as such, an improvement scheme is required to address the capacity issues at the junction and facilitate the forecast increase in traffic flows.

6.24 The table also shows how average journey time per vehicle will change with the proposed scheme, with journey times reducing significantly by up to 70% and still remaining below current travel times by 2029.

## Travel Time Statistics

6.25 To analyse the impact of the junction improvement scheme on the travel time associated with each movement through the junction, the travel time OD statistics for each arm of the Harrogate Road / New Line junction have been extracted from the model. The difference in travel times between 2021 Opening Year Do Minimum scenario and the 2021 Opening Year Do Something scenario are presented for the AM, PM and Saturday peak periods in Table 6 to Table 8. Similar results for the 2029 future year are presented in Table 9 to Table 11.

**Table 6: 2021 AM Travel Time Differences**

| Travel Time (s) | Harrogate Road North | New Line East | Harrogate Road South | New Line West |
|---|---|---|---|---|
| Harrogate Road North | N/A | -76 | -79 | -150 |
| New Line East | -237 | N/A | -166 | -170 |
| Harrogate Road South | -256 | -412 | N/A | -256 |
| New Line West | -481 | -351 | -618 | N/A |

**Table 7: 2021 PM Travel Time Differences**

| Travel Time (s) | Harrogate Road North | New Line East | Harrogate Road South | New Line West |
|---|---|---|---|---|
| Harrogate Road North | N/A | -211 | -221 | -349 |
| New Line East | -178 | N/A | -122 | -139 |
| Harrogate Road South | -255 | -447 | N/A | -241 |
| New Line West | -286 | -271 | -400 | N/A |

**Table 8: 2021 SAT Travel Time Differences**

| Travel Time (s) | Harrogate Road North | New Line East | Harrogate Road South | New Line West |
|---|---|---|---|---|
| Harrogate Road North | N/A | 0 | -12 | -3 |
| New Line East | -121 | N/A | -93 | -81 |
| Harrogate Road South | -117 | -183 | N/A | -111 |
| New Line West | -530 | -532 | -683 | N/A |

**Table 9: 2029 AM Travel Time Differences**

| Travel Time (s) | Harrogate Road North | New Line East | Harrogate Road South | New Line West |
|---|---|---|---|---|
| Harrogate Road North | N/A | -208 | -210 | -269 |
| New Line East | -387 | N/A | -306 | -308 |
| Harrogate Road South | -318 | -517 | N/A | -307 |
| New Line West | -563 | -432 | -693 | N/A |

**Table 10: 2029 PM Travel Time Differences**

| Travel Time (s) | Harrogate Road North | New Line East | Harrogate Road South | New Line West |
|---|---|---|---|---|
| Harrogate Road North | N/A | -232 | -225 | -298 |
| New Line East | -241 | N/A | -172 | -186 |
| Harrogate Road South | -295 | -532 | N/A | -276 |
| New Line West | -397 | -385 | -500 | N/A |

**Table 11: SAT Travel Time Differences**

| Travel Time (s) | Harrogate Road North | New Line East | Harrogate Road South | New Line West |
|---|---|---|---|---|
| Harrogate Road North | N/A | -17 | -31 | -17 |
| New Line East | -177 | N/A | -172 | -151 |
| Harrogate Road South | -351 | -492 | N/A | -332 |
| New Line West | -648 | -669 | -891 | N/A |

6.26 The travel time analysis indicates that the junction improvement scheme would provide significant journey time benefits for all movements through the junction. In the 2021 Opening Year, improvements in travel time are achieved for all movements through the junction, with the largest improvements being on the New Line (West) approach with benefits of up to 683 seconds (over 11 minutes) in the SAT peak. In the 2029 Future Year 2029, travel time benefits are increased along each route with the New Line (West) approach again receiving the largest improvements across the three peak periods.

## Minor Roads and Accesses

6.27 Due to the significant layout changes being proposed as part of the Harrogate Road / New Line junction improvements it is important to assess and consider the impacts upon minor roads and car park accesses. Table 12 sets out the statistics that have been used to consider the level of congestion experienced at these minor junctions and the impact of the scheme.

**Table 12: Individual Arm Statistics Description**

| Statistic | Units | Description |
|---|---|---|
| Flow | veh/h | This shows the actual traffic flow on each arm of the junction |
| Delay | s | This shows the delay experienced by each vehicle on each arm of the junction and is calculated as the difference between the actual travel time and free-flow travel time |
| Mean Queue | veh | This shows the time-averaged queue. |
| Max Queue | veh | This shows the maximum length of queue observed on each arm |

6.28 Statistics for Stockhill Road, the Farmfoods car park, the New Line Retail Park and the Asda car park are presented in Table 13 to Table 24. The statistics are presented as average totals over each peak period respectively.

## Stockhill Road

**Table 13: Stockhill Road AM Peak Statistics**

| Statistic | 2017 Base | 2021 Do Min | 2021 Do Something | 2029 Do Min | 2029 Do Something |
|---|---|---|---|---|---|
| Flow | 108 | 137 | 132 | 146 | 149 |
| Delay | 11 | 129 | 5 | 225 | 7 |
| Mean Queue | 0 | 4 | 0 | 10 | 0 |
| Max Queue | 5 | 25 | 1 | 35 | 5 |

**Table 14: Stockhill Road PM Peak Statistics**

| Statistic | 2017 Base | 2021 Do Min | 2021 Do Something | 2029 Do Min | 2029 Do Something |
|---|---|---|---|---|---|
| Flow | 177 | 185 | 185 | 209 | 210 |
| Delay | 22 | 60 | 6 | 114 | 8 |
| Mean Queue | 1 | 2 | 0 | 6 | 0 |
| Max Queue | 14 | 15 | 5 | 21 | 6 |

**Table 15: Stockhill Road SAT Peak Statistics**

| Statistic | 2017 Base | 2021 Do Min | 2021 Do Something | 2029 Do Min | 2029 Do Something |
|---|---|---|---|---|---|
| Flow | 170 | 185 | 188 | 210 | 218 |
| Delay | 6 | 7 | 4 | 8 | 5 |
| Mean Queue | 0 | 0 | 0 | 0 | 0 |
| Max Queue | 5 | 4 | 4 | 5 | 5 |

## Farmfoods Access

**Table 16: Farmfoods Car Park AM Peak Statistics**

| Statistic | 2017 Base | 2021 Do Min | 2021 Do Something | 2029 Do Min | 2029 Do Something |
|---|---|---|---|---|---|
| Flow | 6 | 10 | 9 | 9 | 9 |
| Delay | 5 | 32 | 14 | 33 | 18 |
| Mean Queue | 0 | 0 | 0 | 0 | 0 |
| Max Queue | 1 | 3 | 2 | 3 | 2 |

**Table 17: Farmfoods Car Park PM Peak Statistics**

| Statistic | 2017 Base | 2021 Do Min | 2021 Do Something | 2029 Do Min | 2029 Do Something |
|---|---|---|---|---|---|
| Flow | 23 | 25 | 25 | 28 | 26 |
| Delay | 40 | 28 | 13 | 31 | 19 |
| Mean Queue | 0 | 0 | 0 | 0 | 0 |
| Max Queue | 6 | 5 | 3 | 5 | 4 |

**Table 18: Farmfoods Car Park SAT Peak Statistics**

| Statistic | 2017 Base | 2021 Do Min | 2021 Do Something | 2029 Do Min | 2029 Do Something |
|---|---|---|---|---|---|
| Flow | 21 | 26 | 28 | 32 | 31 |
| Delay | 19 | 28 | 11 | 21 | 16 |
| Mean Queue | 0 | 0 | 0 | 0 | 0 |
| Max Queue | 4 | 4 | 4 | 5 | 5 |

## Asda Car Park Access

**Table 19: Asda Car Park AM Peak Statistics**

| Statistic | 2017 Base | 2021 Do Min | 2021 Do Something | 2029 Do Min | 2029 Do Something |
|---|---|---|---|---|---|
| Flow | 38 | 38 | 39 | 43 | 43 |
| Delay | 48 | 117 | 10 | 175 | 13 |
| Mean Queue | 0 | 1 | 0 | 2 | 0 |
| Max Queue | 10 | 9 | 4 | 13 | 5 |

**Table 20: Asda Car Park PM Peak Statistics**

| Statistic | 2017 Base | 2021 Do Min | 2021 Do Something | 2029 Do Min | 2029 Do Something |
|---|---|---|---|---|---|
| Flow | 45 | 52 | 51 | 53 | 60 |
| Delay | 76 | 62 | 12 | 85 | 18 |
| Mean Queue | 1 | 1 | 0 | 1 | 0 |
| Max Queue | 16 | 9 | 5 | 13 | 6 |

**Table 21: Asda Car Park SAT Peak Statistics**

| Statistic | 2017 Base | 2021 Do Min | 2021 Do Something | 2029 Do Min | 2029 Do Something |
|---|---|---|---|---|---|
| Flow | 38 | 44 | 44 | 49 | 47 |
| Delay | 40 | 56 | 11 | 58 | 14 |
| Mean Queue | 0 | 1 | 0 | 1 | 0 |
| Max Queue | 7 | 10 | 4 | 7 | 5 |

## New Line Retail Park Access

**Table 22: New Line Retail Park AM Peak Statistics**

| Statistic | 2017 Base | 2021 Do Min | 2021 Do Something | 2029 Do Min | 2029 Do Something |
|---|---|---|---|---|---|
| Flow | 5 | 4 | 5 | 6 | 5 |
| Delay | 1 | 3 | 1 | 4 | 1 |
| Mean Queue | 0 | 0 | 0 | 0 | 0 |
| Max Queue | 1 | 1 | 1 | 1 | 0 |

**Table 23: New Line Retail Park PM Peak Statistics**

| Statistic | 2017 Base | 2021 Do Min | 2021 Do Something | 2029 Do Min | 2029 Do Something |
|---|---|---|---|---|---|
| Flow | 15 | 17 | 15 | 18 | 18 |
| Delay | 0 | 6 | 1 | 3 | 1 |
| Mean Queue | 0 | 0 | 0 | 0 | 0 |
| Max Queue | 2 | 2 | 2 | 2 | 1 |

**Table 24: New Line Retail Park SAT Peak Statistics**

| Statistic | 2017 Base | 2021 Do Min | 2021 Do Something | 2029 Do Min | 2029 Do Something |
|---|---|---|---|---|---|
| Flow | 28 | 27 | 29 | 31 | 33 |
| Delay | 1 | 4 | 1 | 7 | 1 |
| Mean Queue | 0 | 0 | 0 | 0 | 0 |
| Max Queue | 2 | 4 | 2 | 3 | 2 |

6.29 The individual access and side-road statistics indicate that with the improvement scheme in place there are, in general, benefits to existing access junctions. For each peak period there is either a reduction or no impact in queueing and delay time with the improvement scheme in place compared with the Do minimum scenario in both 2021 and 2029.

## Summary

6.30 In summary, the traffic modelling shows that without the scheme, journey times through the junction will continue to increase, with drivers being subject to severe congestion. The scheme is shown to deliver significant journey time benefits of up to eleven minutes in some cases. Overall, the scheme is also shown to provide benefits for vehicles emerging from existing accesses in the vicinity of the scheme with either a reduction or no impact in queueing and delay time.

# 7 Economic Appraisal

## Introduction

7.1 The original Aimsun microsimulation modelling was used to undertake an economic appraisal of the scheme. This was required for the Economic Case of the Gateway 1 Submission the West Yorkshire Transport Fund (**"WYTF"**) and determines whether the scheme would represent good value for money and therefore whether it should be funded by the public purse.

7.2 The Gateway 1 Submission, now known as the Outline Business Case (see Core Document 21.1.22), has been independently peer reviewed in accordance with the West Yorkshire Combined Authority (**"WYCA"**) Assurance Framework (see Core Document 21.1.61). This led to the scheme receiving Development Approval (Gateway 1) in November 2014. The scheme appraisal has therefore been undertaken in accordance with the appropriate guidance.

## Findings from the Economic Case

7.3 The options testing Aimsun modelling has been used by the Council to calculate the ratio of benefits to cost (BCR), which is used to determine the value for money associated with the scheme. The derivation of the BCR is set out in the Economic Case of the Gateway 1 Submission (see Core Document 21.1.22). Based on the central levels of traffic growth assumed, the economic analysis shows that the scheme would result in a BCR of 11.62. In accordance with the Value for Money Framework published by the DfT[3], the scheme falls into the "very high" value for money category, which is for schemes where the BCR is greater than or equal to 4.

[3] Value for Money Framework, Department for Transport, July 2017, relevant extracts presented in Appendix A

7.4 In accordance with WebTAG guidance, the Council has also undertaken sensitivity tests with lower and higher levels of traffic growth, which provide a BCR of 8.51 and 11.46, respectively. Therefore, regardless of the growth scenario, the scheme would still fall well within the "very high" value for money category.

# 8 Response to Objections

## Objection from Ladbrokes Coral Group plc

8.1 An objection letter has been received by Secretary of State for Transport[4] by Ladbrokes Coral Group plc which relates to plot 913 Harrogate Road. A copy of the letter is presented in Appendix B. The letter raises two points that are relevant to my evidence, as follows:

*"1. The acquisition and demolition of the above premises is solely to facilitate a new access into the Farmfoods store to the rear. There is already an existing access from Harrogate Road into the Farmfoods property and we fail to see how it is in the public interest to adopt CPO powers to acquire and demolish the Coral shop premises (thereby extinguishing our business) to be benefit of another existing commercial occupier.*

*2. It appears that an arbitrary decision has been made to acquire/demolish the above property along with No 911 rather than adopt other options to facilitate the scheme."*

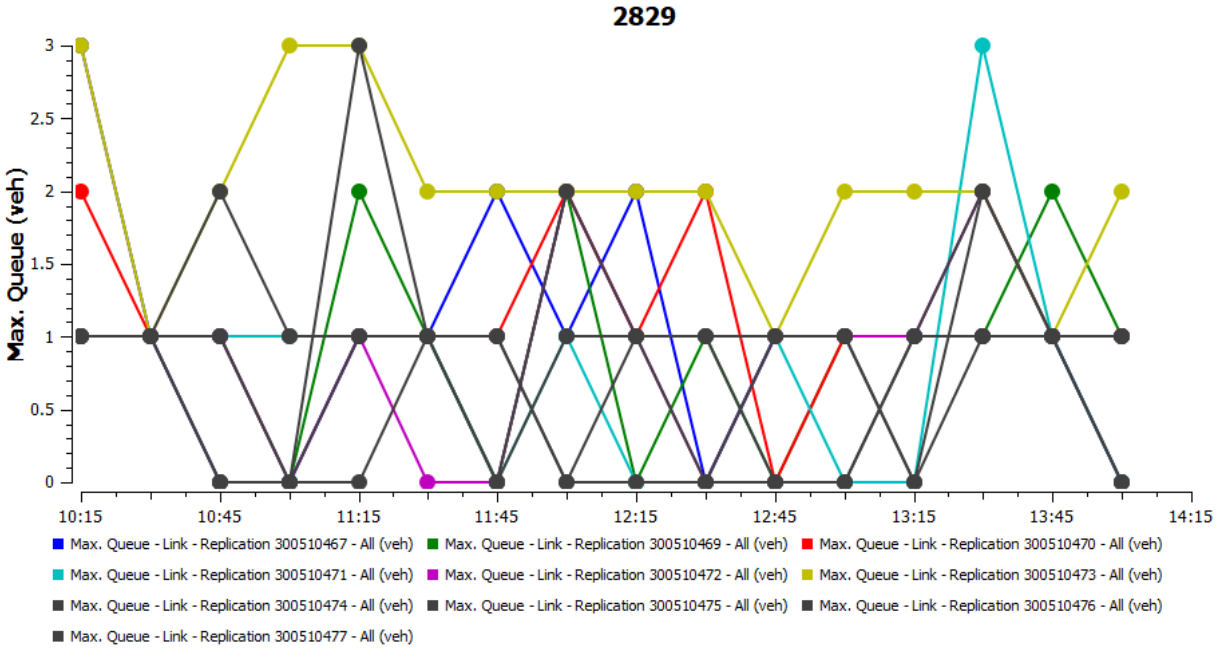
8.2 There are a number of engineering reasons regarding the position of the Farmfoods access which are covered in evidence by others who explain why the access can not remain in its current position. I will therefore confine my evidence in relation to this objection to the traffic modelling considerations that inform the location of the access.

8.3 It is important for the safe and efficient operation of the junction that vehicles waiting to turn right into the Farmfoods access can be accommodated within the right turning lane provided and do not block back into the junction. I have outputted the queue length of vehicles from ten model runs from the Aimsun simulation of the junction in the 2029

[4] Letter dated 22 February 2018 from Ladbrokes Coral Group plc to Secretary of State for Transport.

Saturday peak period, which represents the busiest period for use of the Farm Foods access. The queue length results are shown graphically in Screenshot 5.

**Screenshot 5: Queuing on the Right Turn Lane to the Farmfoods Access**




8.4 The outputs show that a maximum of three vehicles would queue at the access at any time. Assuming that all three vehicles were cars, these would form a queue length of approximately 18m, which could be accommodated in the available right turning space of approximately 30m. This suggests that the right turn lane could be shortened slightly, which may eliminate the impact on plot 913. However, if you consider that one of those vehicles could be an HGV (for example, a 16.5m long articulated HGV making deliveries to the store), this would increase the length of the three vehicle queue to some 28.5m, which could only just be accommodated in the available storage space.

8.5 Having regard to the above, I consider that the outputs from the Aimsun modelling support the proposed location of the Farmfoods access, which seeks to minimise the prospect of right turning vehicles blocking back into the junction and thus affecting the safe and efficient operation of the junction.

# 9 Summary and Conclusions

## Existing Situation

9.1 Queue length surveys for the junction show that the junction is subject to queueing at peak times and also on a Saturday, suggesting that the junction is currently operating at, or over, capacity which results in significant delay for current users. There is, therefore, no capacity to accommodate future growth at the junction (either background traffic growth or that associated with committed and new development) and this will result in further deterioration in conditions in the future.

## Options Testing Traffic Modelling

9.2 In order to develop and appraise potential solutions to the existing capacity issues at the A658 Harrogate Road / A657 New Line junction, an Aimsun microsimulation model of the junction was developed. This was used to test three options and informed the selection of the current option as the preferred option.

## Preferred Option Traffic Modelling

9.3 An updated version of the model was prepared to assess the preferred solution based on updated traffic count data. Traffic modelling using this model shows that without the scheme, journey times through the junction will continue to increase, with drivers being subject to severe congestion. The scheme is shown to deliver significant journey time benefits of up to eleven minutes in some cases. Overall, the scheme is also shown to provide benefits for vehicles emerging from existing accesses in the vicinity of the scheme with either a reduction or no impact in queueing and delay time.

## Economic Appraisal

9.4 The Aimsun microsimulation modelling has been used to undertake an economic appraisal of the scheme. Based on the central levels of traffic growth assumed, the economic analysis shows that the scheme would provide very high value for money with a BCR of 11.62, demonstrating that the scheme is in the public interest.

## Response to Objections

9.5 I have identified the Objection by Ladbrokes Coral Group plc to be relevant to my evidence and have provided a detailed response to this from a traffic modelling perspective. In particular, I demonstrate that the access to the Farmfoods store needs to be relocated, as proposed, in order to provide sufficient storage space on the right turn to accommodate likely levels of queuing.

## Conclusion

9.6 In summary, I am of the view that I have advanced a compelling case to justify the Orders being confirmed in the public interest to ensure that the Council, acting on its behalf, will be able to use compulsory purchase powers, should the use of such powers be required as a last resort, to acquire for the purposes of the Orders, all the land and rights needed to promote, deliver and facilitate the proper construction to improve and widen the the A658 Harrogate Road from a point 70 metres north east of its junction with Carr Bottom Road, south westwards to a point 25 metres south west of its junction with Stanley Street and the A657 New Line from a point 45 metres north west of its junction with Haigh Hall Road, south eastwards to its junction with Elder Street, Bradford and a new 60 metres long one-way link road between Harrogate Road and New Line, Bradford in the County of West Yorkshire.

# 10 Expert Declaration

10.1 I confirm that my duty to the Inquiry as an expert witness overrides any duty to those instructing or paying me, that I have understood this duty and complied with it in giving my evidence impartially and objectively and that I will continue to comply with that duty.

10.2 I confirm that my expert evidence includes all facts which I regard as being relevant to the opinions I have expressed and that attention has been drawn to any matter that would affect the validity of those opinions.

10.3 I am not instructed under any conditional fee arrangement and have no conflict of interest.

10.4 I confirm that I have made clear which facts and matters referred to in this proof of evidence are within my own knowledge and which are not. Those that are within my own knowledge I confirm to be true. The opinions I have expressed represent my true and complete professional opinions on the matters to which they refer.

# Appendix A

Extracts from the DfT's Value for Money Framework

# Appendix B

Copy of Ladbrokes Coral Group plc Objection dated 22 February 2018

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