



17th March 2014

Mr. Steve Kirkham
Development Management
Environmental Services
Barnsley Metropolitan Borough Council
PO Box 601
Barnsley
S70 9FA

Our Reference: AS/VN30177

Dear Steve

Proposed Foodstore – Stairfoot Business Park, Barnsley

Following our meeting with you and your Highways colleagues on 12th March 2014 I have the pleasure of submitting for your attention details of the proposed highway mitigation scheme associated with planning application 2014/0075.

I provide below a summary of the proposed mitigation and enclose for your information a plan of the proposals and a technical report prepared by AECOM, which demonstrates the benefits of the scheme, highlighting that it mitigates any negative impacts associated with the current development proposals.

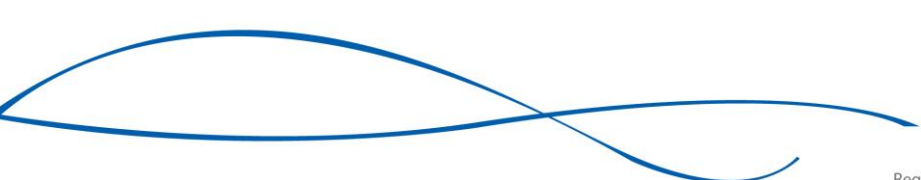
The need for mitigation

A detailed traffic impact assessment of the development proposals formed part of the Transport Assessment report (Vectos, January 2014) which was submitted with the planning application. This traffic impact assessment used a methodology that was agreed in advance with the Highway Authority and on the recommendation of the Council consisted of a VISSIM model of the stairfoot roundabout junction.

The results of these assessments presented by AECOM are provided in the Transport Assessment. The report confirmed that, following the development of the site as a foodstore, there will be increases in journey times on the approach arms of McDonalds, Wombwell Lane, Bleachcroft Way and Hunningley Lane, particularly during the weekday evening peak period.

The report concluded that mitigation would be required, particularly at the following locations:

- The Bleachcroft Way approach, for people leaving the store;



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- The interaction between Wombwell Lane and right turning traffic on the gyratory; and
- Improvements to the circulatory carriageway.

The Proposed Mitigation Scheme

As you are aware, a mitigation scheme has been developed by Vectos and AECOM for the Stairfoot Roundabout, with the proposals being assessed by AECOM using the VISSIM model. The results of this assessment, which show all negative impacts being mitigated satisfactorily, have been presented and discussed with the Highway Authority.

I attach Vectos Plan No. VN30177-107 Rev D which shows the mitigation proposals. It incorporates:

- Widening at the Bleachcroft Way egress onto the gyratory to increase the capacity for customers leaving the proposed foodstore;
- Conversion of the westbound bus lane on the gyratory to allow three lanes of general traffic, significantly increasing the capacity back around the gyratory to Wombwell Lane (and reconstructing a new bus stop and layby);
- Widening the circulatory carriageway on the Stairfoot Roundabout to provide 3 lanes of circulatory traffic between Doncaster Road (east) and Hunningley Lane to increase the capacity at this bottleneck; and
- Conversion of the Doncaster Road (east) bus lane to allow three lanes of general traffic and the closure of the internal bus lane on the central island.

As we discussed, it should be remembered that the improvements currently proposed on Bleachcroft Way and forming part of Vectos Plan No. VN30177-107 Rev D do not precisely reflect the layout that was modelled by AECOM (as shown at Figure 1 of their report). Within the model, Bleachcroft Way incorporated 2 lanes at the stop line and a longer second lane. However, with the VISSIM model demonstrating that this level of improvement was not required, the improvement has been scaled back as shown to provide 3 lanes at the stop line but a shorter flare length.

Benefits of the Mitigation Scheme

The benefits of the mitigation scheme are explained in detail in the AECOM Technical Report dated 17th December 2013, which I attach. This is the last in a series of technical reports prepared by AECOM, with the other reports forming Appendix I to the Transport Assessment. This report details the difference between the 'base case' (allowing for a fully operational permitted development on the site) and the 'with development scenario' allowing for the benefits of the mitigation measures.

Tables 8 to 10 in the attached AECOM report provide the information which demonstrates the benefits of the mitigation scheme. They highlight how journey times through the network will change as a result of the development and mitigation proposals.

Whilst there is not predicted to be any material impact during the weekday morning peak period, Table 8 shows how journey time savings will be made when compared to the base and even the existing situation, particularly on Grange Lane and Doncaster Road (east). For example, a vehicle passing from Doncaster

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Road (east) to Doncaster Road (west) would save 127 seconds in the development scenario including the mitigation measures compared to the base scenario. Importantly, they would still save 106 seconds when comparing the development scenario including the mitigation measures against the existing situation. The proposed mitigation would therefore bring significant improvements to the operation of the Stairfoot Roundabout during the weekday morning peak period, allowing for the additional Sainsbury's development traffic.

Table 9 provides identical information for the weekday evening peak hour, which the Transport Assessment concluded would suffer from worsened traffic conditions as a result of the development proposals. Table 9 demonstrates that when compared to the base scenario, the with development scenario including the mitigation measures would again lead to significant improvements in journey times, particularly on Grange Lane, Doncaster Road (east), Wombwell Lane and Hunningley Lane. Similarly to the weekday morning peak period, benefits in terms of journey time savings are predicted when compared to the existing situation on the majority of arms.

Table 10 provides the various Saturday scenarios results. This demonstrates that every link on the network would operate better allowing for the development and mitigation measures when compared to the base scenario. When compared to the existing situation, all of the arms apart from Bleachcroft Way and Hunningley Lane would experience less delay, and only very small increases in delay (less than 10 seconds per car) would be experienced on these two roads.

Overall, it can be concluded that the proposed mitigation measures will bring significant benefits to the operation of the local highway network and are sufficient to remove any negative impacts that would result from the development proposals. This conclusion is accepted by your highways colleagues.

Impact on Buses

As you know, the proposals include the removal of public transport infrastructure and it is of course therefore important that the proposals are acceptable to the SYPTE and local bus operators. At our meeting last week, you will recall that we discussed the benefits that the proposed mitigation scheme will have upon bus journey times with Matthew Reynolds from SYPTE.

Table 11 in AECOM's report shows the benefits that would be gained following the introduction of the mitigation measures in relation to journey time savings. This demonstrates that bus journey times will either stay the same ie. a very small increase or decrease in journey time which will be imperceptible to passengers and operators, or that there will be very significant benefits in journey time savings. For example, significant time savings are predicted on bus journeys between Wombwell Lane and Doncaster Road (west) and between Doncaster Road (west) and Doncaster Road (east).

Conclusion

As you are aware, we have been working very closely with your highway colleagues and AECOM to assess and develop a suitable mitigation scheme for the Stairfoot Roundabout junction. The scheme which is attached, has been demonstrated to mitigate fully the conversion of the existing B&Q DIY store to form a Sainsbury's foodstore, without impacting negatively upon the operation of the highway network or the operation of buses.

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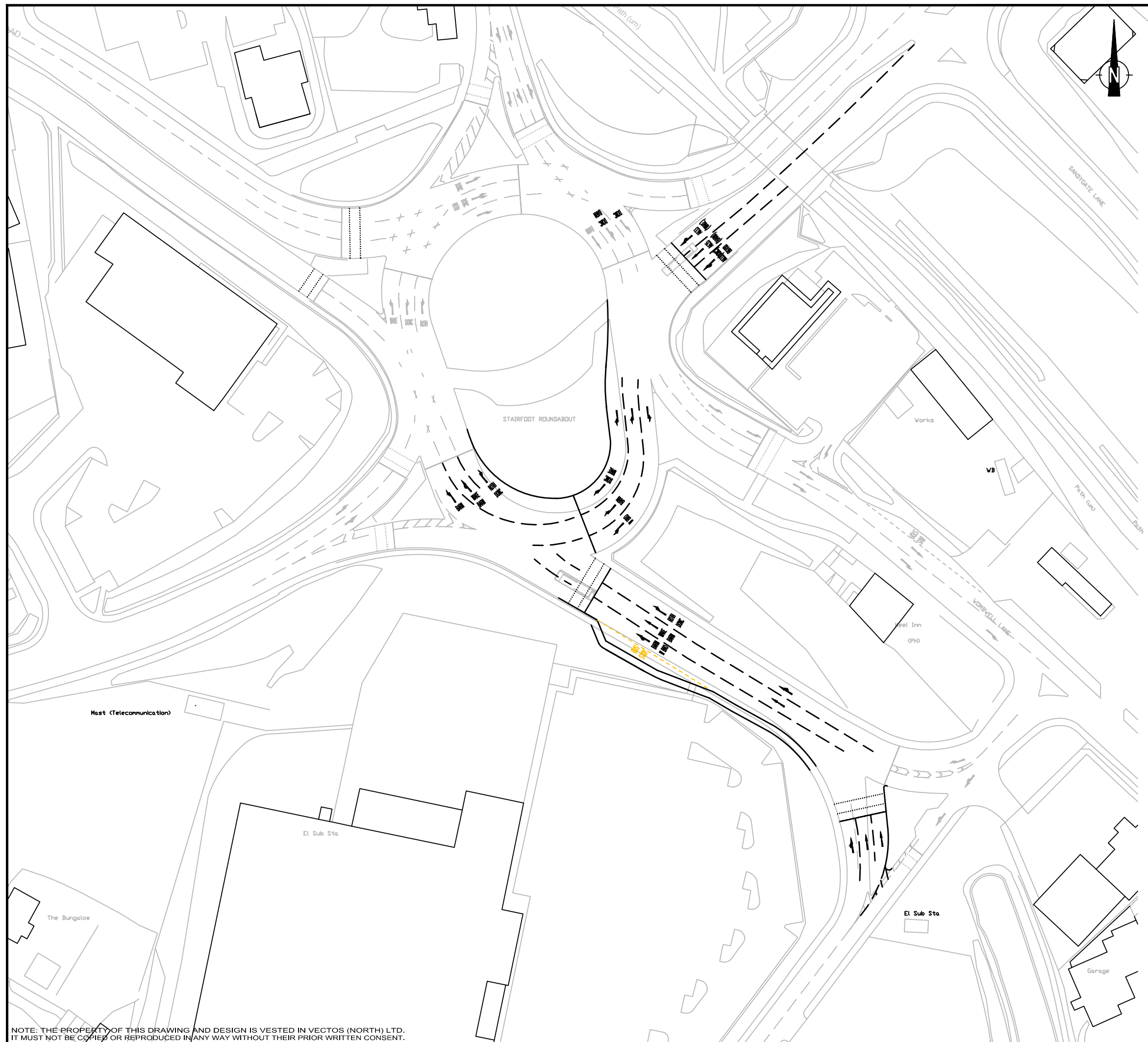
I trust the above is satisfactory. However, should you require any further information please do not hesitate to contact me.

Yours sincerely

A handwritten signature in black ink, reading 'Adam Smith' with a long, sweeping horizontal line extending from the end of the name.

Adam Smith
Associate Director
for **Vectos (North) Limited**
0161 228 1008
adam.smith@vectos.co.uk

Enc.



1. This is not a construction drawing and is intended for illustrative purposes only.
2. White lining is indicative only.

D	Layout Amendments	HF	AS	14.01.14
C	Layout Amendments	HS	AS	13.09.13
B	Layout Amendments	HS	AS	09.12.13
A	Layout Amendments	HS	AS	09.12.13
REV.	DETAILS	DRAWN	CHECKED	DATE

Sainsbury's Supermarkets Ltd

Proposed Sainsbury's Store,
Barnsley

Proposed Roundabout Improvements

1:1000 at A3

DRAWN:	HS	CHECKED:	AS	DATE:	11.12.13
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DRAWING NUMBER: VN30177-107	REVISION: D
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Project:	Stairfoot roundabout VISSIM assessment	Job No:	60309648
Subject:	Base Case + Development + Mitigation VISSIM modelling methodology		
Prepared by:	Ben Midgley	Date:	12th December 2013
Approved by:	Michael Banham	Date:	17th December 2013

1 Introduction

This note forms a continuation of *Base Case and Base Case + Development VISSIM modelling technical note* and details the methodology adopted for the construction of Base Case + Development + Mitigation model scenarios. Mitigation measures were discussed at a meeting between AECOM, Barnsley MBC and Vectos on 4th December 2013 allowing Vectos to generate and provide the chosen proposed design on 9th December 2013. This proposed design is provided in **Figure 1**.

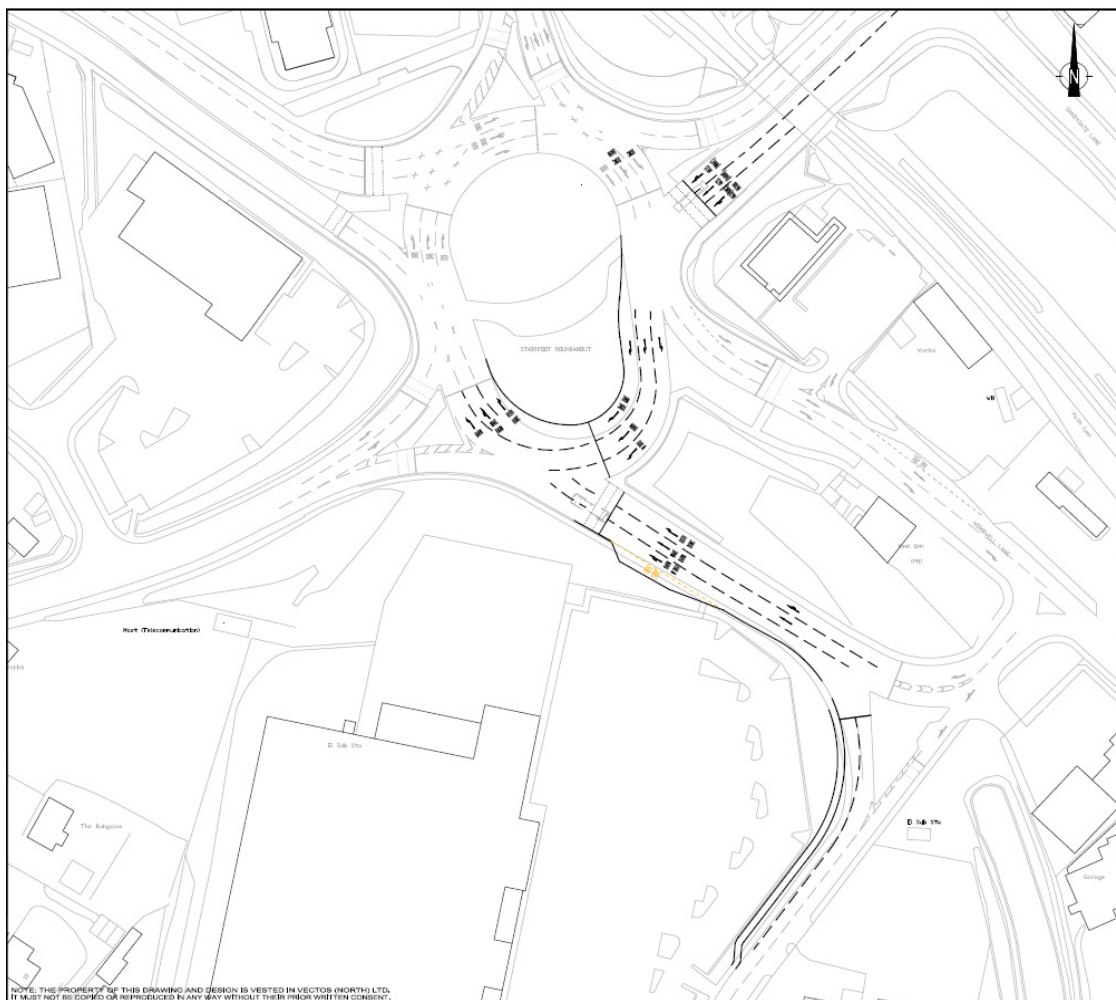


Figure 1: Proposed mitigation measures design

The key amendments to the existing road network involve the conversion of bus priority lanes on Doncaster Road (E) and Bleachcroft Way to general traffic lanes, thus allowing increased general traffic capacity on these approaches. In order to accommodate the amendment to the Doncaster Road (E)

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approach, the gyratory between this approach and the Bleachcroft Way approach has been widened from two to three lanes and the bus lane through the centre of the roundabout has been removed. Carriageway widening has also taken place on the Bleachcroft Way site egress to accommodate increased flow and on the Bleachcroft Way approach to the gyratory to allow provision of a bus lay by.

2 Base Case + Development + Mitigation modelling

2.1 Changes from Base Case + Development Model

Mitigation measures illustrated in **Figure 1** were coded into each of the three peak hours modelled separately so as to maintain consistency throughout modelling for any one peak. The link and connector structure was initially amended to ensure that movements on approach to and around the gyratory aligned with those provided in the proposed design. Routing decisions were adjusted to ensure that OD movements used the desired approach and circulatory lanes (as of **Figure 1**), with redistribution across lanes wherever possible (for a single OD movement) to ensure appropriate approach lane usage. Signal coding was amended to remove bus priority from the network and re-proportion two stage junctions where amendments allowed for green time to be distributed more effectively. Public transport was considered to certify that suitable bus routes were retained and any priority decisions disturbed as a result of mitigation measures were amended appropriately.

Once each of the models were updated to reflect the proposed design, it was necessary to make specific amendments to individual models to ensure that calibration to saturation flows was maintained, that approach lane usage was appropriate and to ensure signal timings provided the most efficient operation of an individual junctions. These amendments were minor and guarantee the models reflect proposed network operation as accurately as possible.

2.2 Model outputs

Outputs were obtained for each of the three peak hours to ensure calibration to turning counts and saturation flows was maintained where possible, and to assess the impact of mitigation measures on the Base Case + Development models, in terms of queue lengths and journey times around the network.

2.2.1 Turning counts

Table 1 below provides the number of movements around the network that fall within each GEH category, when comparing model input to model output. Full turning movement details are provided in **Appendix A**.

Table 1: GEH distributions for three Base Case + Development + Mitigation models

Number of movements within each GEH category						
AM						
Total	GEH<1	GEH<2	GEH<3	GEH<4	GEH<5	GEH>5
48	35	6	5	1	1	0
	73%	13%	10%	2%	2%	0%
PM						
Total	GEH<1	GEH<2	GEH<3	GEH<4	GEH<5	GEH>5
48	47	1	0	0	0	0
	98%	2%	0%	0%	0%	0%
Saturday						
Total	GEH<1	GEH<2	GEH<3	GEH<4	GEH<5	GEH>5
48	41	8	6	0	0	0
	85%	8%	6%	0%	0%	0%

All peaks calibrate well in terms of turning movements with the PM and Saturday shows particularly good calibration.

2.2.2 Signal timings

As with turning movements, signal timing model inputs were compared with outputs to ensure models were performing as desired. Outputs are provided in **Table 2**, **Table 3** and **Table 4** below.

Table 2: AM comparison of average green time per cycle

Average green time per cycle	AM		
	Input	Output	Difference
Doncaster Road (W)	00:00:13	00:00:13	00:00:00
Circulatory @ DR (W)	00:00:49	00:00:49	00:00:00
Doncaster Road bus	-	-	-
Hunningley Lane	00:00:13	00:00:11	00:00:02
Circulatory @ HL	00:00:49	00:00:47	00:00:02
Bleachcroft Way bus	-	-	-
Bleachcroft Way @ gyratory	00:00:21	00:00:19	00:00:02
Circulatory @ BW	00:00:41	00:00:39	00:00:02
Doncaster Road (E)	00:00:19	00:00:19	00:00:00
Circulatory @ DR (E)	00:00:43	00:00:43	00:00:00
Grange Lane	00:00:16	00:00:16	00:00:00
Circulatory @ GL	00:00:46	00:00:46	00:00:00
Bleachcroft Way (RT)	00:00:50	00:00:50	00:00:00
Bleachcroft Way B&Q (LT)	00:00:12	00:00:12	00:00:00
Wombwell Lane LT	00:00:54	00:00:58	00:00:04
Circulatory at WL	00:00:08	00:00:08	00:00:00
Wombwell Lane (N) @ Tesco	00:00:50	00:00:49	00:00:01
Wombwell Lane (S) @ Tesco	00:00:40	00:00:40	00:00:00
Tesco RT	00:00:09	00:00:09	00:00:00
Tesco LT	00:00:19	00:00:19	00:00:00

Table 3: PM comparison of average green time per cycle

Average green time per cycle	PM		
	Input	Output	Difference
Doncaster Road (W)	00:00:19	00:00:19	00:00:00
Circulatory @ DR (W)	00:00:43	00:00:43	00:00:00
Doncaster Road bus	-	-	-
Hunningley Lane	00:00:13	00:00:11	00:00:02
Circulatory @ HL	00:00:49	00:00:47	00:00:02
Bleachcroft Way bus	-	-	-
Bleachcroft Way @ gyratory	00:00:28	00:00:26	00:00:02
Circulatory @ BW	00:00:34	00:00:32	00:00:02

Doncaster Road (E)	00:00:14	00:00:14	00:00:00
Circulatory @ DR (E)	00:00:48	00:00:48	00:00:00
Grange Lane	00:00:16	00:00:16	00:00:00
Circulatory @ GL	00:00:46	00:00:46	00:00:00
Bleachcroft Way (RT)	00:00:50	00:00:50	00:00:00
Bleachcroft Way B&Q (LT)	00:00:12	00:00:12	00:00:00
Wombwell Lane LT	00:00:50*	00:00:50	00:00:00
Circulatory at WL	00:00:12*	00:00:12	00:00:00
Wombwell Lane (N) @ Tesco	00:01:18	00:01:18	00:00:00
Wombwell Lane (S) @ Tesco	00:00:54	00:00:55	00:00:01
Tesco RT	00:00:08	00:00:08	00:00:00
Tesco LT	00:00:30	00:00:30	00:00:00

* The circulatory right turn movement at Wombwell Lane was redistributed two extra seconds of green time from the Base modelling assessment, made possible by the reduced friction and thus queuing on Wombwell Lane northbound which was reduced by two seconds.

Table 4: Saturday comparison of average green time per cycle

Average green time per cycle	Saturday		
	Input	Output	Difference
Doncaster Road (W)	00:00:14	00:00:14	00:00:00
Circulatory @ DR (W)	00:00:48	00:00:48	00:00:00
Doncaster Road bus	-	-	-
Hunningley Lane	00:00:14	00:00:12	00:00:02
Circulatory @ HL	00:00:48	00:00:46	00:00:02
Bleachcroft Way bus	-	-	-
Bleachcroft Way @ gyratory	00:00:25	00:00:23	00:00:02
Circulatory @ BW	00:00:37	00:00:35	00:00:02
Doncaster Road (E)	00:00:18	00:00:18	00:00:00
Circulatory @ DR (E)	00:00:43	00:00:43	00:00:00
Grange Lane	00:00:16	00:00:16	00:00:00
Circulatory @ GL	00:00:46	00:00:46	00:00:00
Bleachcroft Way (RT)	00:00:50	00:00:51	00:00:01
Bleachcroft Way B&Q (LT)	00:00:12	00:00:12	00:00:00
Wombwell Lane LT	00:00:42*	00:00:43	00:00:01
Circulatory at WL	00:00:18*	00:00:18	00:00:00
Wombwell Lane (N) @ Tesco	00:01:09	00:01:09	00:00:00
Wombwell Lane (S) @ Tesco	00:00:52	00:00:53	00:00:01
Tesco RT	00:00:08	00:00:08	00:00:00
Tesco LT	00:00:24	00:00:24	00:00:00

* As with PM modelling, the circulatory right turn movement at Wombwell Lane was redistributed three additional seconds with Wombwell Lane northbound green time reducing by the same amount when compared against the Base scenario.

The above tables demonstrate that there are no significant inconsistencies between modelled input and modelled output, thus calibration to signal timings is achieved. Bus priority is removed as a consequence of mitigation measures at the junction, hence no recordings are provided for these stages.

2.2.3 Saturation flows

Base Case + Development + Mitigation saturation flows were compared with Observed recordings to ensure the models calibrate to Existing conditions. Differences between Observed values and Base Case recordings are included in the tables below to allow consistency checks between Base Case and 'mitigation' saturation flows.

Table 5: AM comparison of modelled and observed saturation flows

Approach lane	VISSIM Sat Flow Average	Observed	Base Case + Development + Mitigation / Observed diff		Base Case / Observed diff	
			No.	%	No.	No.
Doncaster Road (W) N/S	1790	1965	-175	-8.88%	-174	-8.87%
Doncaster Road (W) O/S	1773	1694	79	4.64%	91	5.35%
Hunningley Lane N/S	2022	1870	152	8.14%	147	7.87%
Hunningley Lane O/S	1992	1997	-5	-0.23%	-11	-0.54%
Bleachcroft Way N/S	1734	1747	-13	-0.75%	168	9.61%
Bleachcroft Way O/S	#DIV/0!	1883	-	-	-123	-6.53%
Doncaster Road (E) O/S	2079	1895	184	9.69%	-30	-1.57%
Doncaster Road (E) N/S	2037	1867	170	9.10%	88	4.71%
Grange Lane	1560	1750	-190	-10.86%	-201	-11.49%
Wombwell Lane	1528	1510	18	1.21%	10	0.63%

Table 6: PM comparison of modelled and observed saturation flows

Approach lane	VISSIM Sat Flow Average	Observed	Base Case + Development + Mitigation / Observed diff		Base Case / Observed diff	
			No.	%	No.	%
Doncaster Road (W) N/S	1864	2002	-138	-6.90%	-150	-7.50%
Doncaster Road (W) O/S	1824	2116	-292	-13.82%	-261	-12.34%
Hunningley Lane N/S	1783	1920	-137	-7.15%	-141	-7.36%
Hunningley Lane O/S	1779	1945	-166	-8.51%	-183	-9.40%
Bleachcroft Way N/S	1856	1875	-19	-1.00%	99	5.27%
Bleachcroft Way O/S	1931	1873	58	3.09%	-108	-5.78%
Doncaster Road (E) O/S	1766	1761	5	0.27%	-177	-10.03%
Doncaster Road (E) N/S	1757	1866	-109	-5.82%	-276	-14.79%
Grange Lane	1784	1928	-144	-7.45%	-86	-4.45%

Wombwell Lane	1544	1497	47	3.14%	14	0.91%
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Table 7: Saturday comparison of modelled and observed saturation flows

Approach lane	VISSIM Sat Flow Average	Observed	Base Case + Development + Mitigation / Observed diff		Base Case / Observed diff	
			No.	%	No.	%
Doncaster Road (W) N/S	1824	1775	31	1.75%	39	2.18%
Doncaster Road (W) O/S	1799	1767	53	2.98%	59	3.34%
Hunningley Lane N/S	1800	1735	48	2.76%	56	3.23%
Hunningley Lane O/S	1955	1937	38	1.99%	39	2.01%
Bleachcroft Way N/S	1923	1833	176	9.61%	178	9.71%
Bleachcroft Way O/S	1930	1736	218	12.56%	169	9.71%
Doncaster Road (E) O/S	1702	1660	15	0.90%	26	1.57%
Doncaster Road (E) N/S	1702	1694	30	1.75%	1	0.07%
Grange Lane	1839	1964	-134	-6.84%	-112	-5.71%
Wombwell Lane	1556	1430	87	6.07%	118	8.27%

Table 5, Table 6 &

Table 7 above demonstrate that consistency between saturation flow values when comparing Mitigation to Base Case. Although this is not as close as between previous modelling scenarios, due to fundamental link and connector structure amendments in the model on both the Doncaster Road (E) and Bleachcroft Way approaches, the saturation flow calibration still shows a good correlation.

2.2.4 Queue lengths

Base Case + Development + Mitigation queue lengths were compared with Base Case queue lengths for each of the three peak hours, allowing assessment of the impact of mitigation measures on the network. The figures below demonstrate these comparisons, with numerical values provided in **Appendix B**.



Figure 2: AM Mitigation and Base Case queue length comparison

Figure 2 illustrates the fact that queue lengths are significantly reduced by mitigation measures, most noticeably on Doncaster Road (E) in the AM peak. Reductions are noticed elsewhere, with the site exit proving the only approach arm to experience slightly larger queues under the mitigation scenario.

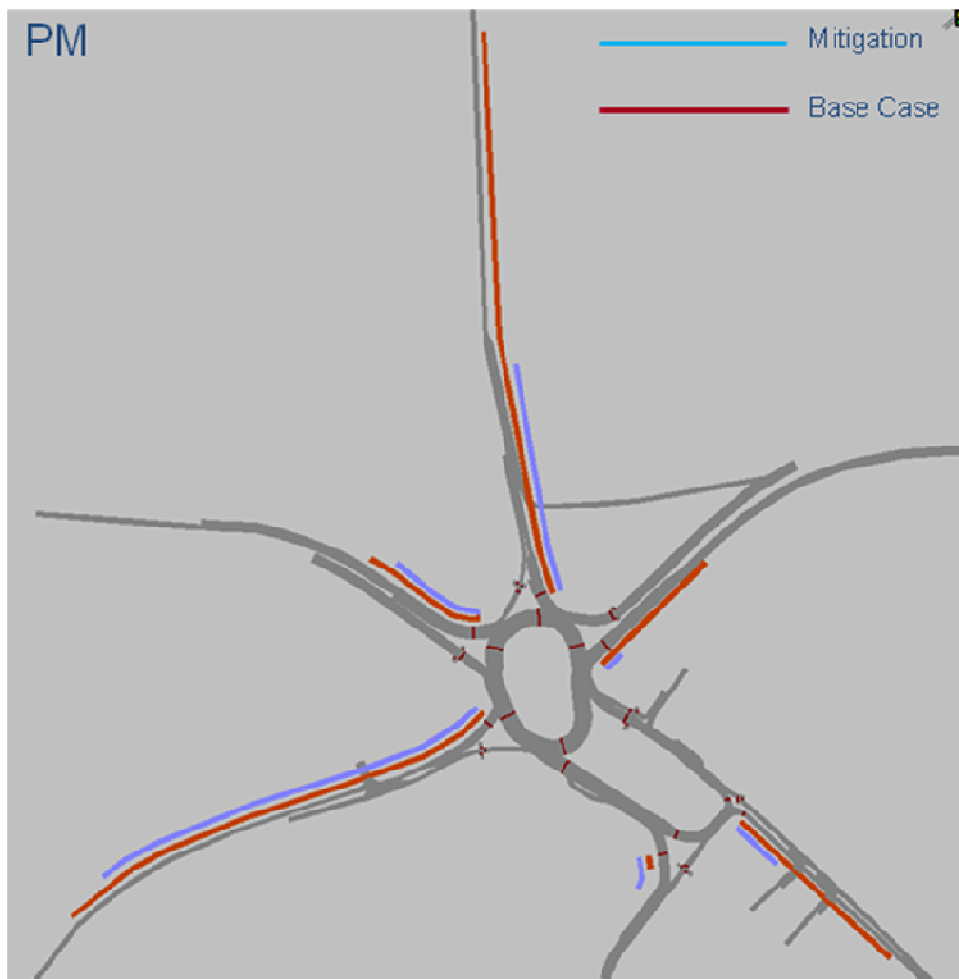


Figure 3: PM Mitigation and Base Case queue length comparison

Figure 3 again demonstrates reduced queue lengths on all approaches bar the site exit, with significant improvements noticed on Doncaster Road (E), Wombwell Lane and Grange Lane.



Figure 4: Saturday Mitigation and Base Case queue length comparison

The Saturday peak is that which experiences the largest reductions in queue lengths, with significant improvements again noticed on Doncaster Road (E), Wombwell Lane and Grange Lane. The site exit also experiences reduced queuing when compared with Base Case modelling.

2.2.5 Journey times

Whilst journey times were not validated against during Existing Case modelling, they have been output to allow comparison between scenarios throughout modelling stages. Whilst these journey times do not validate against any observed recorded data, the differences between models is useful to determine increased delay as a result of model amendments. The comparisons found in **Table 8**, **Table 9** & **Table 10** below are made between the Mitigation Case models and both Existing and Base Case models.

Table 8: AM journey time comparison

From	To	Existing Case	Base Case	Base Case + Development + Mitigation	Existing / Mitigation diff	Base / Mitigation diff
Grange Ln	Doncaster Rd (E)	05:21	05:49	05:09	-12	-40
	McDonalds	05:07	05:38	04:48	-19	-50
	Wombwell Ln	05:32	05:54	05:10	-22	-44
	Bleachcroft Way	06:12	06:40	06:11	0	-29
	Hunningley Ln	05:45	06:05	05:08	-38	-58
	Doncaster Rd (W)	05:52	06:18	05:22	-30	-56
Doncaster Rd (E)	McDonalds	02:38	02:47	01:15	-83	-93
	Wombwell Ln	02:52	03:05	01:24	-88	-101
	Bleachcroft Way	03:54	04:08	02:22	-92	-105
	Hunningley Ln	03:04	03:19	01:23	-101	-117
	Doncaster Rd (W)	03:24	03:45	01:38	-106	-127
	Grange Ln	03:26	03:51	02:00	-86	-111
McDonalds	Wombwell Ln	00:17	00:17	00:19	2	1
	Bleachcroft Way	00:49	00:49	00:54	5	5
	Hunningley Ln	01:48	01:46	01:54	6	8
	Doncaster Rd (W)	02:02	02:00	02:08	6	8
	Grange Ln	02:15	02:13	02:26	11	13
	Doncaster Rd (E)	02:14	02:06	02:18	3	12
Wombwell Ln	Bleachcroft Way	00:48	00:55	00:49	1	-6
	Hunningley Ln	01:27	01:39	01:29	2	-10
	Doncaster Rd (W)	01:49	01:59	01:51	2	-8
	Grange Ln	02:09	02:20	02:07	-2	-13
	Doncaster Rd (E)	02:20	02:22	01:51	-29	-30
	McDonalds	02:28	02:22	02:09	-19	-13
Bleachcroft Way	Hunningley Ln	01:23	01:26	01:26	2	0
	Doncaster Rd (W)	01:32	01:31	01:29	-2	-2
	Grange Ln	01:51	01:55	01:53	2	-2
	Doncaster Rd (E)	02:01	02:04	01:57	-5	-7
	McDonalds	00:00	00:00	00:00	0	0
	Wombwell Ln	02:45	02:54	02:37	-8	-16

Hunningley Ln	Doncaster Rd (W)	01:33	01:39	01:20	-14	-19
	Grange Ln	01:38	01:43	01:23	-15	-19
	Doncaster Rd (E)	01:43	01:47	01:27	-16	-20
	McDonalds	02:13	02:17	01:59	-14	-18
	Wombwell Ln	02:24	02:28	02:09	-15	-18
	Bleachcroft Way	02:45	02:55	02:48	3	-7
Doncaster Rd (W)	Grange Ln	01:13	01:12	01:11	-2	-1
	Doncaster Rd (E)	01:20	01:19	01:16	-4	-2
	McDonalds	01:42	01:45	01:24	-18	-21
	Wombwell Ln	01:58	01:58	01:45	-12	-13
	Bleachcroft Way	01:51	02:02	02:10	19	8
	Hunningley Ln	01:56	02:00	01:34	-22	-26

The above table demonstrates that the majority of movements throughout the network experience at least slight journey time reductions, with more significant reductions noticed on Doncaster Road (E) due to the removal of bus lane.

Table 9: PM journey time comparison

From	To	Existing Case	Base Case	Base Case + Development + Mitigation	Existing / Mitigation diff	Base / Mitigation diff
Grange Ln	Doncaster Rd (E)	03:09	04:57	02:51	-18	-126
	McDonalds	03:03	04:52	02:43	-20	-129
	Wombwell Ln	03:12	05:04	02:52	-20	-132
	Bleachcroft Way	04:15	06:06	04:03	-12	-124
	Hunningley Ln	03:28	05:19	02:53	-35	-146
	Doncaster Rd (W)	03:42	05:37	03:06	-36	-150
Doncaster Rd (E)	McDonalds	02:01	02:14	01:25	-36	-49
	Wombwell Ln	02:05	02:27	01:37	-27	-50
	Bleachcroft Way	02:43	03:18	02:34	-9	-43
	Hunningley Ln	02:12	02:40	01:36	-36	-64
	Doncaster Rd (W)	02:57	03:21	01:48	-69	-94
	Grange Ln	03:53	04:14	02:12	-101	-122
McDonalds	Wombwell Ln	00:19	00:19	00:22	3	3
	Bleachcroft Way	00:50	01:06	01:16	26	10
	Hunningley Ln	01:41	02:01	01:57	16	-4
	Doncaster Rd (W)	01:53	02:12	02:25	32	14
	Grange Ln	02:10	02:35	02:47	37	12
	Doncaster Rd (E)	02:33	03:07	02:42	9	-25
Wombwell Ln	Bleachcroft Way	00:45	01:25	00:54	9	-31
	Hunningley Ln	01:16	02:03	01:26	10	-37
	Doncaster Rd (W)	01:32	02:26	01:42	10	-44

	Grange Ln	01:52	02:55	02:04	12	-52
	Doncaster Rd (E)	02:04	03:11	01:58	-6	-73
	McDonalds	02:34	03:37	02:26	-8	-71
Bleachcroft Way	Hunningley Ln	01:21	01:24	01:26	6	3
	Doncaster Rd (W)	01:27	01:33	01:34	7	1
	Grange Ln	01:43	02:02	01:57	14	-6
	Doncaster Rd (E)	02:05	02:15	02:06	1	-9
	McDonalds	00:00	00:00	02:31	151	151
	Wombwell Ln	02:42	02:58	02:46	4	-12
	Doncaster Rd (W)	04:02	04:25	03:47	-15	-38
Hunningley Ln	Grange Ln	04:10	04:33	04:05	-5	-28
	Doncaster Rd (E)	04:15	04:40	04:16	1	-24
	McDonalds	04:33	04:58	04:48	15	-10
	Wombwell Ln	05:01	05:25	04:58	-3	-27
	Bleachcroft Way	05:50	06:09	05:42	-8	-28
	Doncaster Rd (W)	01:19	01:17	01:11	-8	-6
Doncaster Rd (W)	Grange Ln	01:23	01:23	01:16	-6	-7
	McDonalds	01:51	02:00	01:43	-8	-17
	Wombwell Ln	02:14	02:25	02:06	-8	-19
	Bleachcroft Way	02:15	02:48	02:42	26	-6
	Hunningley Ln	02:10	02:22	01:52	-18	-29
	Doncaster Rd (E)	01:23	01:23	01:16	-6	-7

As with AM modelling, the PM Mitigation scenario is found to reduce journey times on all approaches, with significant impacts aligning with queue length reductions on Doncaster Road (E), Grange Lane and Wombwell Lane. Comparisons with Existing Case modelling demonstrate less significant but similar reductions in journey times from all approaches.

Table 10: Saturday journey time comparison

From	To	Existing Case	Base Case	Base Case + Development + Mitigation	Existing / Mitigation diff	Base / Mitigation diff
Grange Ln	Doncaster Rd (E)	00:00	00:00	00:00	0	0
	McDonalds	04:03	04:55	02:51	-72	-124
	Wombwell Ln	04:16	05:08	03:05	-71	-124
	Bleachcroft Way	05:46	06:23	03:40	-126	-164
	Hunningley Ln	04:26	05:16	02:57	-89	-139
	Doncaster Rd (W)	04:33	06:01	03:17	-76	-164
Doncaster Rd (E)	McDonalds	01:42	02:13	01:08	-34	-65
	Wombwell Ln	02:13	02:17	01:24	-49	-53
	Bleachcroft Way	03:20	03:16	01:54	-86	-81
	Hunningley Ln	02:37	02:43	01:37	-60	-66
	Doncaster Rd (W)	03:00	04:40	01:50	-71	-170
	Grange Ln	03:15	05:55	02:01	-75	-234

McDonalds	Wombwell Ln	00:43	00:39	00:32	-11	-7
	Bleachcroft Way	01:48	01:45	01:02	-46	-43
	Hunningley Ln	03:38	03:21	02:00	-99	-82
	Doncaster Rd (W)	03:30	03:08	02:15	-76	-54
	Grange Ln	03:38	03:40	02:21	-77	-79
	Doncaster Rd (E)	03:40	03:47	02:42	-58	-64
Wombwell Ln	Bleachcroft Way	01:06	02:28	01:10	4	-79
	Hunningley Ln	01:51	03:21	01:39	-12	-102
	Doncaster Rd (W)	02:09	03:43	01:56	-13	-107
	Grange Ln	02:12	03:53	02:05	-7	-108
	Doncaster Rd (E)	02:31	04:06	02:17	-14	-109
	McDonalds	03:08	04:46	02:53	-14	-113
Bleachcroft Way	Hunningley Ln	01:27	01:59	01:29	2	-30
	Doncaster Rd (W)	01:36	02:11	01:35	-2	-36
	Grange Ln	01:47	02:28	01:53	6	-35
	Doncaster Rd (E)	02:07	02:44	02:15	8	-29
	McDonalds	02:44	02:56	02:53	9	-3
	Wombwell Ln	03:00	03:38	03:04	4	-34
Hunningley Ln	Doncaster Rd (W)	01:17	01:35	01:18	2	-17
	Grange Ln	01:20	01:39	01:22	1	-17
	Doncaster Rd (E)	01:29	01:48	01:38	9	-10
	McDonalds	02:07	02:15	02:12	5	-3
	Wombwell Ln	02:26	02:42	02:29	2	-13
	Bleachcroft Way	03:51	03:41	02:54	-57	-47
Doncaster Rd (W)	Grange Ln	01:29	01:35	01:16	-13	-19
	Doncaster Rd (E)	01:35	01:41	01:22	-13	-19
	McDonalds	02:27	02:26	01:55	-33	-32
	Wombwell Ln	03:14	03:07	02:40	-34	-27
	Bleachcroft Way	04:04	04:01	02:54	-70	-67
	Hunningley Ln	03:01	03:02	02:15	-46	-47

The Saturday Mitigation model is comparable to the PM model in that significant reductions in journey time are seen on Doncaster Road (E), Grange Lane and Wombwell Lane, whilst less significant reductions are seen on all other approaches. Comparison with the Existing Case models demonstrates that whilst Hunningley Lane and Bleachcroft Way journey times are unchanged, the remainder of movements undergo journey time reductions in line with those when comparing with Base Case.

2.2.6 Bus journey times

Table 11: Bus journey time comparisons

AM	Direction	Base	Base + Dev + Mitigation	Absolute Difference
Bus journey times	Northbound	03:30	03:20	-10
	Southbound	06:15	06:19	4
	Eastbound	01:32	01:32	0
	Westbound	04:02	02:12	-110
PM				
Bus journey times	Northbound	04:40	03:27	-73
	Southbound	06:19	06:22	3
	Eastbound	02:03	01:49	-14
	Westbound	03:38	02:25	-73
Saturday				
Bus journey times	Northbound	07:26	03:26	-240
	Southbound	07:01	06:59	-2
	Eastbound	02:35	02:05	-30
	Westbound	03:36	02:13	-84

Table 11 highlights the fact that bus journey times will significantly reduce under the proposed mitigation when compared to the Base case scenario. The existing roundabout layout has short sections of bus lane which, given the high levels of congestion shown in the Base model, buses are not able to reach without waiting in significant queues. By increasing the capacity of the roundabout the delay to all vehicles on the arms previously with bus priority is reduced. Furthermore, by removing the bus priority stages at the junction the traffic signal coordination of the roundabout is improved which reduces blocking back of the internal arms and reduces congestion also. The highest reductions in journey time are shown on the northbound movement from Wombwell Lane to Doncaster Road (W) where long queues in the Base model have been removed by the inclusion of the mitigation measures.

3 Conclusions

All mitigation models demonstrate good calibration against turning movements, saturation flow recordings and input signal timings. This provides confidence that the models are appropriate and provide a robust assessment of the measures proposed.

The mitigation proposed offsets all development traffic and provide a considerable improvement to the operation of the Starfoot Roundabout. The mitigation measures significantly improves journey times on Wombwell Lane during its congested periods in the PM and Saturday peak periods and also reduces congestions on Doncaster Road East in all peaks. Aside from these obvious benefits, through the inclusion of new infrastructure, there are also benefits to the general operation of the roundabout due to the overall increase in capacity and the associated reduction in blocking of the internal links. This sees journey times reduced on Grange Lane, Hunningley Lane and Doncaster Road (W).

This note concludes that when comparing Mitigation modelling with Base Case modelling in terms of queue lengths and journey times significant reduction are seen throughout the network. This includes reductions in bus journey times for the Northbound and Westbound movements throughout all peak periods assessed.

Appendix A: Base Case + Development + Mitigation modelled input and output turning count comparison

Table 12: AM turning count comparison

Stairfoot roundabout (all vehicles)					
From	To	Model input	Model output	Input / Output difference	GEH
Grange Ln	Doncaster Rd (E)	13	11	2	0.6
	McDonalds	10	9	1	0.3
	Wombwell Ln	291	258	33	2.0
	Bleachcroft Way	74	42	32	4.2
	Hunningley Ln	252	228	25	1.6
	Doncaster Rd (W)	44	37	7	1.1
Doncaster Rd (E)	McDonalds	10	11	-1	0.2
	Wombwell Ln	75	71	4	0.5
	Bleachcroft Way	52	43	9	1.3
	Hunningley Ln	140	137	3	0.3
	Doncaster Rd (W)	472	478	-6	0.3
	Grange Ln	264	264	0	0.0
McDonalds	Wombwell Ln	9	8	1	0.2
	Bleachcroft Way	3	3	0	0.0
	Hunningley Ln	7	8	-1	0.2
	Doncaster Rd (W)	9	9	0	0.0
	Grange Ln	3	4	-1	0.4
	Doncaster Rd (E)	2	2	0	0.3
Wombwell Ln	Bleachcroft Way	133	104	29	2.7
	Hunningley Ln	117	108	9	0.9
	Doncaster Rd (W)	321	327	-6	0.3
	Grange Ln	280	267	13	0.8
	Doncaster Rd (E)	33	30	3	0.5
	McDonalds	3	3	0	0.2
Bleachcroft Way	Hunningley Ln	48	32	16	2.5
	Doncaster Rd (W)	60	53	8	1.0
	Grange Ln	69	54	15	2.0
	Doncaster Rd (E)	24	15	10	2.2
	McDonalds	0	0	0	0.0
	Wombwell Ln	35	27	8	1.4
Hunningley Ln	Doncaster Rd (W)	32	33	-1	0.2
	Grange Ln	305	308	-3	0.2

	Doncaster Rd (E)	126	123	4	0.3
	McDonalds	5	5	0	0.1
	Wombwell Ln	127	122	5	0.5
	Bleachcroft Way	49	30	19	3.0
Doncaster Rd (W)	Grange Ln	57	58	-1	0.1
	Doncaster Rd (E)	260	261	-1	0.1
	McDonalds	10	11	-1	0.4
	Wombwell Ln	279	291	-12	0.7
	Bleachcroft Way	59	39	20	2.9
	Hunningley Ln	36	32	4	0.6
Retail park junction (all vehicles)					
From	To	Model input	Model output	Input / Output difference	GEH
Wombwell Lane (N)	Wombwell Lane (S)	619	607	12	0.5
	Retail park	171	172	-1	0.0
Wombwell Lane (S)	Wombwell Ln (N)	727	714	13	0.5
	Retail park	87	88	-1	0.1
Retail park egress	Wombwell Lane (N)	135	130	5	0.4
	Wombwell Lane (S)	72	73	-1	0.2

Table 13: PM turning count comparison

Stairfoot roundabout (all vehicles)					
From	To	Model input	Model output	Input / Output difference	GEH
Grange Ln	Doncaster Rd (E)	3	3	0	0.2
	McDonalds	27	26	1	0.3
	Wombwell Ln	240	241	-1	0.1
	Bleachcroft Way	60	66	-6	0.7
	Hunningley Ln	291	298	-7	0.4
	Doncaster Rd (W)	30	33	-3	0.5
Doncaster Rd (E)	McDonalds	12	12	0	0.1
	Wombwell Ln	70	71	-1	0.1
	Bleachcroft Way	56	56	0	0.0
	Hunningley Ln	83	85	-2	0.2
	Doncaster Rd (W)	246	250	-4	0.2
	Grange Ln	206	202	4	0.3
McDonalds	Wombwell Ln	27	24	3	0.5
	Bleachcroft Way	6	7	-1	0.4
	Hunningley Ln	14	13	1	0.2
	Doncaster Rd (W)	10	12	-2	0.5
	Grange Ln	14	15	-1	0.2
	Doncaster Rd (E)	10	10	0	0.0
Wombwell Ln	Bleachcroft Way	190	183	7	0.5
	Hunningley Ln	170	162	8	0.6
	Doncaster Rd (W)	250	256	-6	0.4
	Grange Ln	209	197	12	0.8
	Doncaster Rd (E)	63	62	2	0.2
	McDonalds	14	14	0	0.1
Bleachcroft Way	Hunningley Ln	91	91	0	0.0
	Doncaster Rd (W)	117	112	5	0.4
	Grange Ln	130	128	2	0.2
	Doncaster Rd (E)	82	81	1	0.2
	McDonalds	8	7	1	0.5
	Wombwell Ln	98	100	-2	0.2
Hunningley Ln	Doncaster Rd (W)	27	25	2	0.4
	Grange Ln	283	271	12	0.7
	Doncaster Rd (E)	147	140	7	0.6
	McDonalds	12	12	0	0.1
	Wombwell Ln	137	116	21	1.8

Doncaster Rd (W)	Bleachcroft Way	56	53	3	0.5
	Grange Ln	46	44	2	0.3
	Doncaster Rd (E)	425	412	13	0.6
	McDonalds	18	16	2	0.4
	Wombwell Ln	437	439	-2	0.1
	Bleachcroft Way	87	82	5	0.6
	Hunningley Ln	54	56	-2	0.2
Retail park junction (all vehicles)					
From	To	Model input	Model output	Input / Output difference	GEH
Wombwell Lane (N)	Wombwell Lane (S)	591	596	-5	0.2
	Retail park	393	395	-2	0.1
Wombwell Lane (S)	Wombwell Ln (N)	503	512	-9	0.4
	Retail park	166	165	1	0.1
Retail park egress	Wombwell Lane (N)	368	357	11	0.6
	Wombwell Lane (S)	161	159	2	0.1

Table 14: Saturday turning count comparison

Stairfoot roundabout (all vehicles)					
From	To	Model input	Model output	Input / Output difference	GEH
Grange Ln	Doncaster Rd (E)	0	0	0	0.0
	McDonalds	28	26	2	0.3
	Wombwell Ln	282	278	4	0.2
	Bleachcroft Way	114	117	-3	0.3
	Hunningley Ln	179	176	3	0.2
	Doncaster Rd (W)	17	14	3	0.8
Doncaster Rd (E)	McDonalds	22	22	0	0.1
	Wombwell Ln	132	136	-4	0.3
	Bleachcroft Way	90	95	-5	0.5
	Hunningley Ln	73	77	-4	0.5
	Doncaster Rd (W)	270	285	-15	0.9
	Grange Ln	185	185	0	0.0
McDonalds	Wombwell Ln	23	22	1	0.1
	Bleachcroft Way	6	6	0	0.1
	Hunningley Ln	9	9	0	0.1
	Doncaster Rd (W)	14	16	-2	0.4
	Grange Ln	16	16	0	0.1
	Doncaster Rd (E)	10	10	0	0.1
Wombwell Ln	Bleachcroft Way	147	142	5	0.4
	Hunningley Ln	228	216	12	0.8
	Doncaster Rd (W)	294	296	-2	0.1
	Grange Ln	158	152	6	0.5
	Doncaster Rd (E)	53	54	-1	0.1
	McDonalds	16	16	1	0.1
Bleachcroft Way	Hunningley Ln	77	78	-1	0.1
	Doncaster Rd (W)	121	116	5	0.5
	Grange Ln	140	137	3	0.3
	Doncaster Rd (E)	72	73	-1	0.1
	McDonalds	7	8	-1	0.2
	Wombwell Ln	101	99	3	0.3
Hunningley Ln	Doncaster Rd (W)	48	50	-2	0.3
	Grange Ln	211	212	-1	0.1
	Doncaster Rd (E)	105	110	-5	0.5
	McDonalds	17	29	-12	2.5
	Wombwell Ln	164	148	16	1.3
	Bleachcroft Way	60	60	0	0.0

Doncaster Rd (W)	Grange Ln	59	58	1	0.1
	Doncaster Rd (E)	286	292	-6	0.3
	McDonalds	12	13	-1	0.3
	Wombwell Ln	334	354	-20	1.1
	Bleachcroft Way	104	99	5	0.5
	Hunningley Ln	32	34	-2	0.3
Retail park junction (all vehicles)					
From	To	Model input	Model output	Input / Output difference	GEH
Wombwell Lane (N)	Wombwell Lane (S)	525	524	1	0.0
	Retail park	524	521	3	0.1
Wombwell Lane (S)	Wombwell Ln (N)	380	440	-60	3.0
	Retail park	101	116	-15	1.4
Retail park egress	Wombwell Lane (N)	471	421	50	2.4
	Wombwell Lane (S)	215	194	21	1.4

Appendix B: Base Case + Development + Mitigation average hourly queue length comparisons
Table 15: AM queue length comparison on approaches to Stairfoot roundabout

Stairfoot roundabout			
Queue counter location	Base Case queue (m)	Base Case + Development + Mitigation queue (m)	Base Case / Mitigation difference
Doncaster Road (E) approach	203	18	-185
Wombwell Lane NB LT to Bleachcroft Way	36	22	-15
Bleachcroft Way LT	3	5	2
Bleachcroft Way approach	68	58	-10
Hunningley Lane approach	78	50	-29
Doncaster Road (W) approach	38	31	-7
Grange Lane approach	431	393	-37

Table 16: PM queue length comparison on approaches to Stairfoot roundabout

Stairfoot roundabout			
Queue counter location	Base Case queue (m)	Base Case + Development + Mitigation queue (m)	Base Case / Mitigation difference
Doncaster Road (E) approach	104	14	-90
Wombwell Lane NB LT to Bleachcroft Way	144	38	-106
Bleachcroft Way LT	9	23	14
Bleachcroft Way approach	120	90	-30
Hunningley Lane approach	334	296	-38
Doncaster Road (W) approach	92	69	-23
Grange Lane approach	406	165	-241

Table 17: Saturday queue length comparison on approaches to Stairfoot roundabout

Stairfoot roundabout			
Queue counter location	Base Case queue (m)	Base Case + Development + Mitigation queue (m)	Base Case / Mitigation difference
Doncaster Road (E) approach	218	19	-198
Wombwell Lane NB LT to Bleachcroft Way	405	70	-335
Bleachcroft Way LT	44	20	-24
Bleachcroft Way approach	207	33	-174
Hunningley Lane approach	75	51	-25
Doncaster Road (W) approach	128	80	-49
Grange Lane approach	430	180	-249