Lincoln Eastern Bypass

Alternative VDM Specification

October 2016

Produced By

Lincolnshire COUNTY COUNCIL
HIGHWAYS ALLIANCE

Document Control Sheet

Project Title	Lincoln Eastern Bypass
Report Title	Alternative VDM Specification
Revision	1.0
Status	Draft
Control Date	18th October 2016

Record of Issue

Issue	Status	Author	Date	Check	Date	Authorised	Date
1 0	Draft	AA	18/10/16	PS	18/10/16	PR	18/10/16

Distribution

Organisation	Contact	Copies
Lincolnshire County Council	Lee Rowley	Electronic
Department for Transport	Robert Fox	Electronic

This Report is presented to Lincolnshire County Council in respect of Lincoln Eastern Bypass and may not be used or relied on by any other person or by the client in relation to any other matters not covered specifically by the scope of this Report.

Notwithstanding anything to the contrary contained in the Report, Mouchel Limited working as Lincolnshire County Council Highways Alliance is obliged to exercise reasonable skill, care and diligence in the performance of the services required by Lincolnshire County Council and Mouchel Limited shall not be liable except to the extent that it has failed to exercise reasonable skill, care and diligence, and this report shall be read and construed accordingly.

This Lincolnshire County Council Highways Alliance Report has been prepared by Mouchel Limited. No individual is personally liable in connection with the preparation of this Report. By receiving this Report and acting on it, the client or any other person accepts that no individual is personally liable whether in contract, tort, for breach of statutory duty or otherwise.

Contents

Tables & Figures

1 Introduction

1.1 Introduction

Lincoln Eastern Bypass (LEB) is proposed as a 7.5km single carriageway road linking the existing A158 Northern Relief Road to the A15 Sleaford Road to the south, running through an area of predominantly arable farmland to the east of the city and the villages of Canwick and Bracebridge Heath, and to the west of the outlying villages of North Greetwell, Cherry Willingham, Washingborough and Branston.

The road is a key element of the Lincoln Integrated Transport Strategy (LITS) designed to provide much needed relief to the congested historic core of Lincoln and to permit a range of complementary policies, also identified in LITS, on traffic management and sustainable modes to be introduced to the city, thereby improving traffic and environmental conditions for a wide range of road users.

1.2 Background

Mouchel has been commissioned under the Lincolnshire County Council (LCC) Technical Services Partnership to produce an updated set of models, forecasting and appraisal work in support of the Best and Final Offer Business Case for the Lincoln Eastern Bypass (LEB).

The original modelling and appraisal was prepared by Jacobs to support the first Major Scheme Business Case (MSBC) submission for the scheme at Programme Entry stage. However a subsequent assessment by the Department for Transport (DfT) highlighted a number of substantive issues relating to the quality and suitability of the modelling work.

Mouchel addressed these issues to the satisfaction of the DfT and the scheme gained Funding Approval following submissions in 2011.

The Final Funding submission has been made in October 2016. As part of this exercise the VDM model has been updated. During the submission of the bid DfT have made comment on a specific method employed and have requested an additional test to verify outcomes. This note reports that process.

1.3 Structure

This report describes the methods employed in the economic evaluation of the project. The topics covered are detailed below:

- Chapter 2 – Specifies the nature of the issue;
- Chapter 3 – Details the remedial actions;
- Chapter 4 – Reports the forecast outcomes; and
- Chapter 5 – Provides an economic assessment.

2 2015 Model

2.1 Background

As part of the Final Funding Submission (FFS) an early request of DfT was to evaluate the level of growth apparent in the model by way of a review of traffic conditions in the present year (then 2015).

This was duly undertaken by means of a forecast from 2006 to the present year. This was treated as an effective forecast from 2006 to 2015 and was undertaken using TEMRPO 6.2 land use changes over the period, with specific developments plugged into the growth to accurately reflect travel demand. At the same time the level of trip making over the period was reduced to accord with changes in NTS trip rates since 2006.

This resulted in a 2015 present year model which was compared against both traffic flows and journey time data. The former data was available for 3 screenlines considered relevant to the LEB. The latter data was available for all routes

The results of the exercise established that whilst the Present Year Comparison was not WebTAG compliant the performance of the screenlines, particularly the Witham Screenline was sufficiently close to observation (in the order of 3.5% higher than counts) such that the primary flows within the model was considered by the consultants to be fit for purpose.

The consultants were unable to test a wider verification of the traffic resulting in a present year validation due to the limited availability of traffic data at that stage[1].

On this basis the 2015 demand was used in the VDM model pivot to derive 2018 and 2033 forecasts.

2.2 Travel Demand Scenarios

On discussion of early documents submitted as part of the FFS the DfT queried this approach. Their perspective was that the demand in 2015 was too high and may lead to an over estimation of benefits as the level of growth from 2015 to 2018 and 2033 would include the excessive demand implied from 2006 to 2015.

This perspective was taken based on the differences between strategic and local counts. The strategic counts showed an increase of around 5% whereas the local counts showed a static or minimal decline in traffic over the intervening 9 years. Figure 2-1 presents the locations of the DfT counts within the study area. Figure 2-2 presents the AADT graphs for sites with AADT flow over 5,000 vehicles. Figure 2-3

[1] LCC are currently commencing a wide area data collection to assist with the new Lincoln Model Development, employing up to date OD data.

presents the location of the monitoring count sites managed by LCC. The AADT data collected between 2006 and 2015 is presented in Figure 2-4.

Figure 2-1: DfT AADF Count Sites

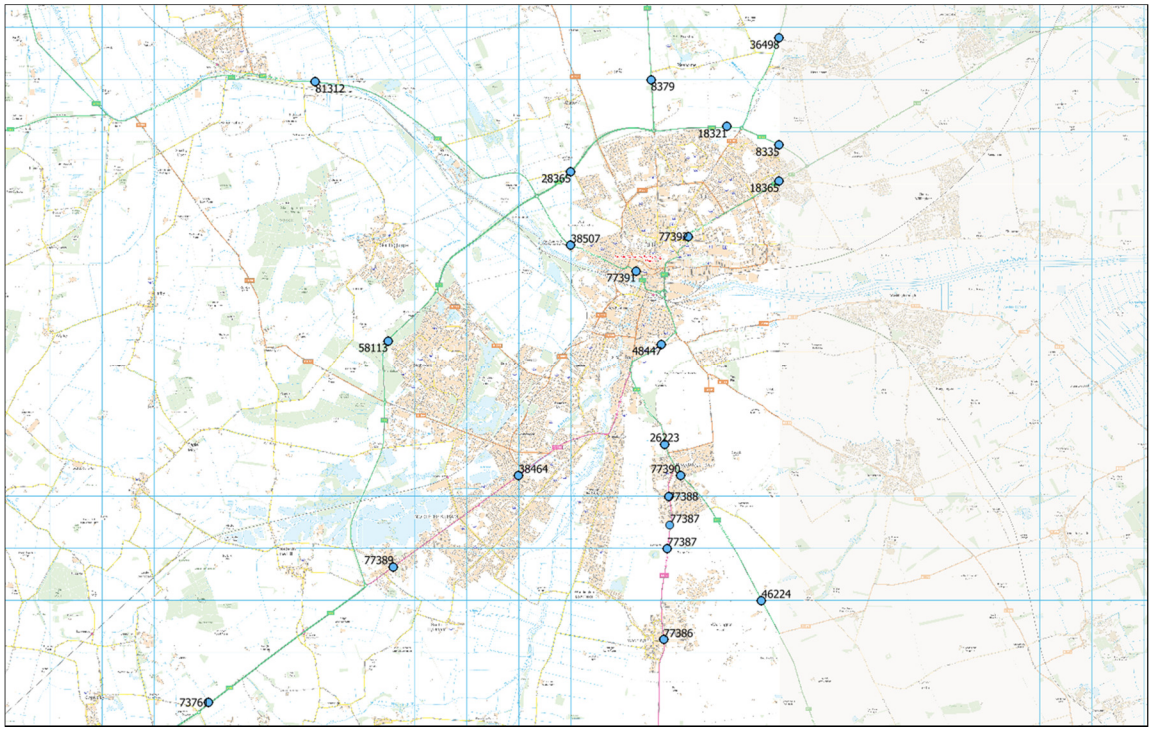


Figure 2-2: AADF Flows for selected sites (>5,000veh)

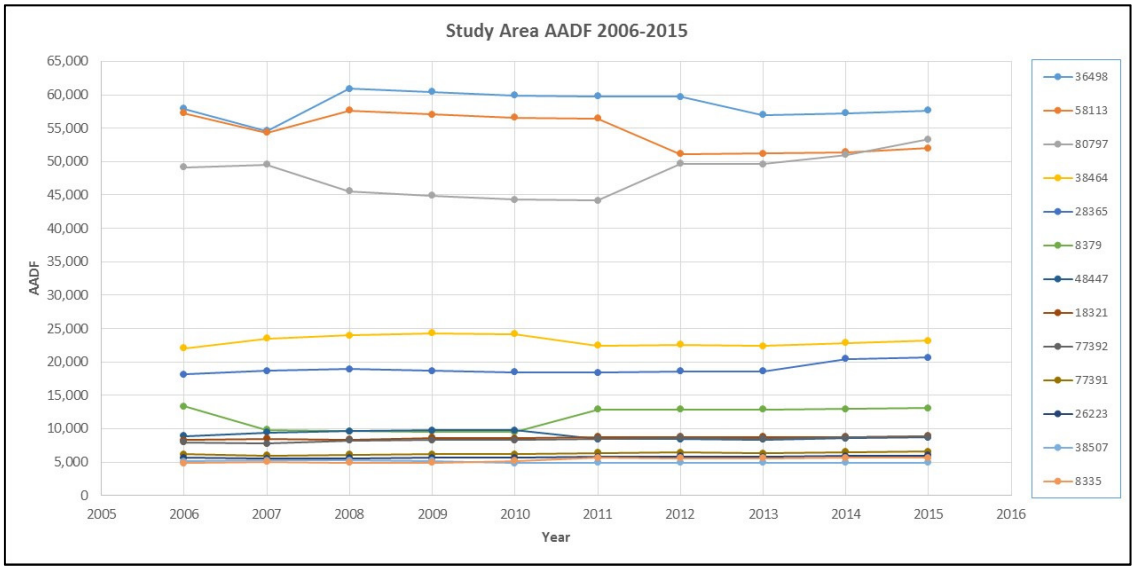


Figure 2-3: LCC Monitoring Counts

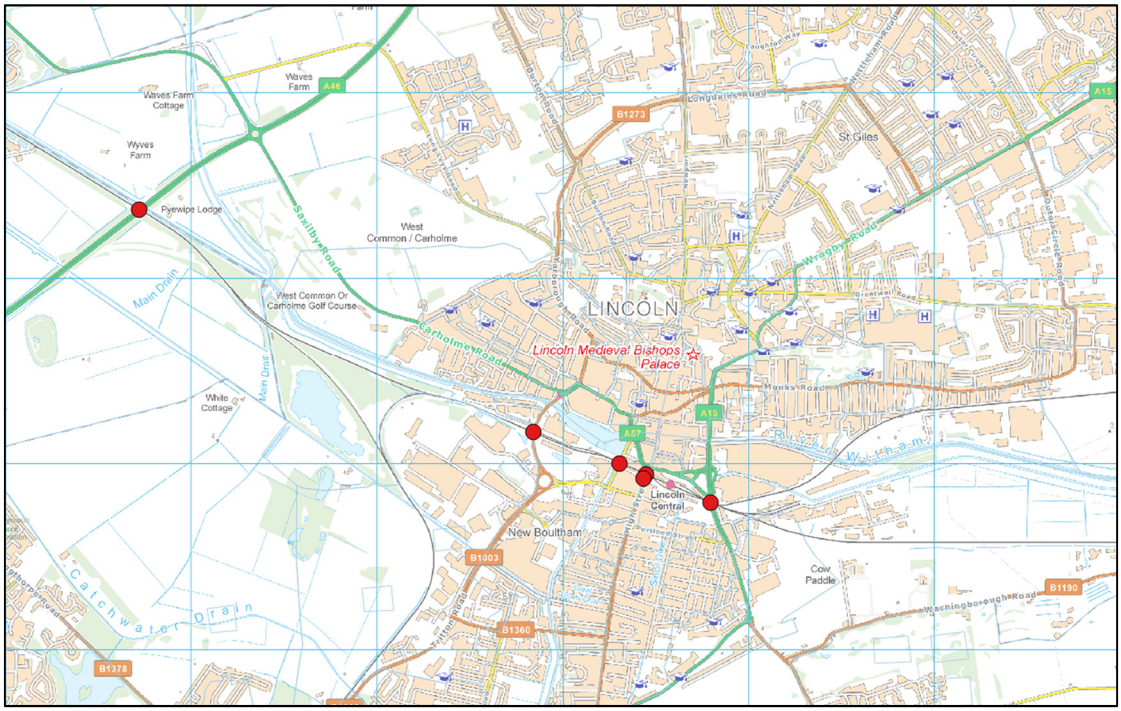
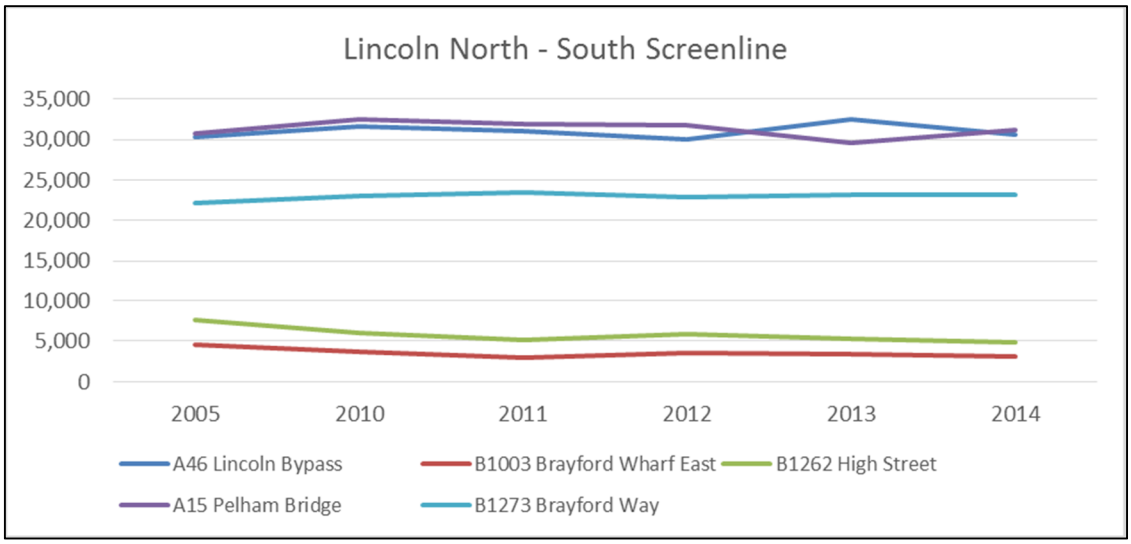


Figure 2-4: LCC Observed AADT Flows – 2005-2014 – River screenline



2.3 Agreed Actions

Following a teleconference on 12th October it was decided to make adjustments to a version of the core scenario to evaluate the impact of the DfT concerns. The adjustments and resultant outcomes are reported in the remainder of this note.

3 Remedial Actions

3.1 DfT Request

DfT considered the growth from 2006 to 2015 as flat/negligible and therefore requested the impact of a reduced quantum of traffic for 2015 to be tested as part of the VDM pivoting. The impact of effective zero growth would be propagated into reduced reference matrices for 2018 and 2033. DfT expects this would reduce the NPV and resultant BCR of the LEB.

3.2 Interpretation within Traffic Modelling

The 2015 traffic model contains a number of developments which have been opened since 2006. Of the more significant sites these include

- Bunkers Hill
- Carholme Road; and
- Teal Park

Of these sites Bunkers Hill is most directly relevant to LEB, being located to the west of the northernmost section (without a direct connection).

The sum total of trips associated with these developments was estimated to be 1533 daily based on TRICS data. These developments have been distributed across the modelled area based on adherence to appropriate trip length distributions by land use. The overall matrix total had been constrained to TEMPRO.

The approach to replicating the 2006 traffic volumes for 2015 involved scaling back the 2015 matrices to reflect the 2006 total traffic volumes by detailed assignment user class. Hence the factors used to derive this adjustment are indicated below

Table 3-1: 2006 and 2015 matrix totals and adjusting factors to 2006

User Class	2006 AM	2015 AM	Factor AM	2006 IP	2015 IP	Factor IP	2006 PM	2015 PM	Factor PM
Commute	26,646	27,577	**0.966**	6,424	6,640	**0.967**	21,662	22,496	**0.963**
Other	17,176	19,014	**0.903**	32,402	36,331	**0.892**	21,581	23,660	**0.912**
Business	5,534	5,662	**0.977**	4,800	4,930	**0.974**	5,343	5,496	**0.972**
LGV	7,849	9,048	**0.867**	7,330	8,452	**0.867**	7,523	8,673	**0.867**
HGV	2,758	2,563	**1.076**	3,948	3,667	**1.077**	1,999	1,859	**1.075**

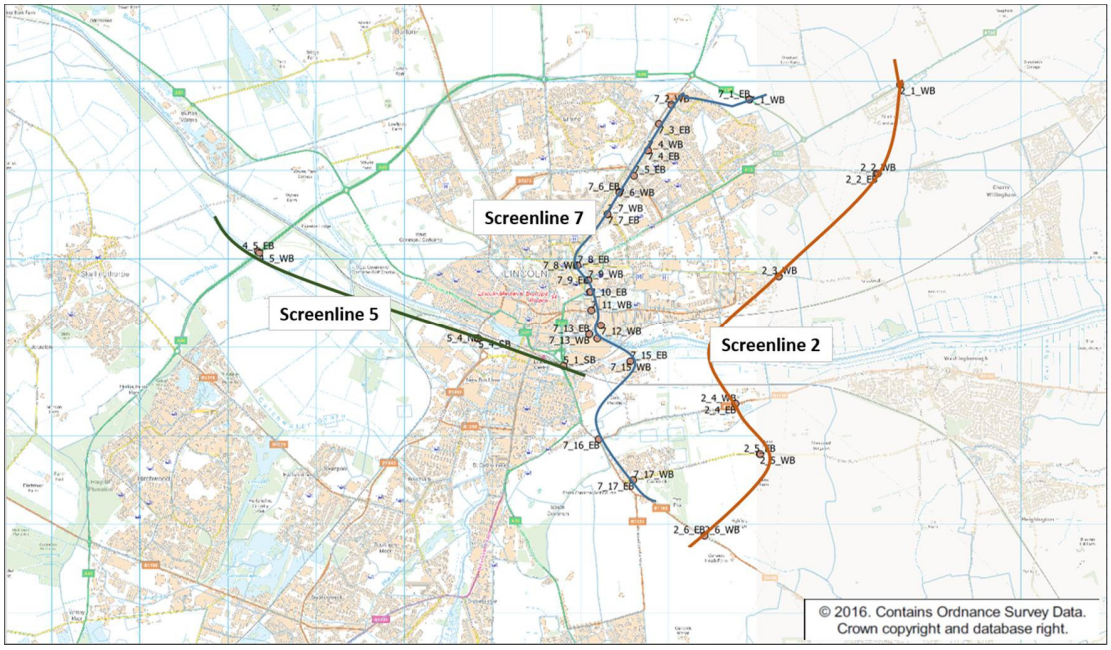
By applying these factors the 2015 matrix adhered to the 2006 traffic volume, but with specific developments relevant to the 2015 network also included.

3.3 2006/15 Comparison

The 2006/15 assignment comparison was run with the time and distance parameters shown in Table 4.2 (Unchanged from earlier work – future values also included)..

The resultant model outputs are shown below. The screenlines used for comparison are demonstrated in Figure 3.1. These show flow patterns of direct relevance to LEB.

Figure 3-1: Screenline Locations



WebTAG flow and GEH criteria for the links and screenlines are specified as follows:

- Model within 100 vehicles for counts <700;
- Model within 15% for counts >700 & <2700;
- Flows within 400 for flows >2700;
- GEH < 5 for flows; and
- Screenline model within 5% of counts.

Additionally a Screenline GEH target of 4 is included as well as the flow criteria target although this is not relied upon for any conclusions.

The results of the exercise are shown below. Flow volumes are similar to the earlier PYV and demonstrate the variable flow levels even with a reduced level of growth in the model. Irrespective of the flow outcome the lower growth 2015 scenario leads to lower costs than the previous model and results in lower growth matrices in the future years.

Table 3-2: AM Peak Hour Flow Comparison

Screen-Line 2	2015 Model	2006 Observed	2015 Observed	Growth 2006-15	2015 Flow Criteria	2015 GEH Criteria
2_1_EB	443	481	446	-7%	Pass	Pass
2_2_EB	219	259	240	-7%	Pass	Pass
2_3_EB	133	123	114	-7%	Pass	Pass
2_4_EB	127	124	127	2%	Pass	Pass
2_5_EB	52	97	103	6%	Pass	Fail
2_6_EB	300	296	298	1%	Pass	Pass
2_7_EB	600	514	428	-17%	Fail	Fail
Total	1874	1894	1756	-7%	1%	2.8
Screen-Line 2	**2015 Model**	**2006 Observed**	**2015 Observed**	**Growth 06-15**	**2015 Flow Criteria**	**2015 GEH Criteria**
2_1_WB	689	612	513	-16%	Fail	Fail
2_2_WB	429	506	424	-16%	Pass	Pass
2_3_WB	480	563	472	-16%	Pass	Pass
2_4_WB	427	443	372	-16%	Pass	Pass
2_5_WB	192	307	207	-33%	Pass	Pass
2_6_WB	714	712	647	-9%	Pass	Pass
2_7_WB	480	580	486	-16%	Pass	Pass
Total	3411	3723	3121	-16%	9%	5.1
Screen-Line 5	**2015 Model**	**2006 Observed**	**2015 Observed**	**Growth 2006-15**	**2015 Flow Criteria**	**2015 GEH Criteria**
5_1_NB	1975	1994	1997	0%	Pass	Pass
5_3_NB	847	600	571	-5%	Fail	Fail
5_4_NB	1086	862	821	-5%	Pass	Fail
4_5_NB	1687	1962	1868	-5%	Pass	Fail
Total	5595	5418	5257	-3%	-3%	2.4
Screen-Line 5	**2015 Model**	**2006 Observed**	**2015 Observed**	**Growth 2006-15**	**2015 Flow Criteria**	**2015 GEH Criteria**
5_1_SB	1146	1216	1218	0%	Pass	Pass
5_3_SB	459	500	476	-5%	Pass	Pass
5_4_SB	994	1046	996	-5%	Pass	Pass
4_5_SB	1263	1428	1360	-5%	Pass	Pass
Total	3862	4190	4050	-3%	8%	5.2

Screen-Line 7	2015 Model	2006 Observed	2015 Observed	Growth 06-15	2015 Flow Criteria	2015 GEH
7_1_EB	671	820	729	-11%	Pass	Pass
7_2_EB	107	133	145	9%	Pass	Pass
7_3_EB	223	301	291	-3%	Pass	Pass
7_4_EB	35	56	31	-44%	Pass	Pass
7_5_EB	728	565	676	20%	Pass	Pass
7_6_EB	81	99	9	-91%	Pass	Fail
7_7_EB	439	512	141	-73%	Fail	Fail
7_8_EB	92	77	425	451%	Pass	Fail
7_9_EB	764	972	523	-46%	Fail	Fail
7_10_EB	0	0	0	0%	Pass	Pass
7_11_EB	462	467	309	-34%	Fail	Fail
7_12_EB	23	155	176	14%	Pass	Fail
7_13_EB	75	26	22	-15%	Pass	Fail
7_14_EB	75	53	56	5%	Pass	Pass
7_15_EB	315	319	317	-1%	Pass	Pass
7_16_EB	127	125	148	18%	Pass	Pass
7_17_EB	52	64	102	59%	Pass	Fail
Total	4269	4744	4100	-14%	-4%	2.6

Screen-Line 7	2015 Model	2006 Observed	2015 Observed	Growth 06-15	2015 Flow Criteria	2015 GEH
7_1_WB	638	675	563	-17%	Pass	Pass
7_2_WB	171	194	215	11%	Pass	Pass
7_3_WB	251	182	315	73%	Pass	Pass
7_4_WB	99	63	50	-21%	Pass	Fail
7_5_WB	312	808	358	-56%	Pass	Pass
7_6_WB	49	35	22	-38%	Pass	Pass
7_7_WB	236	219	74	-66%	Fail	Fail
7_8_WB	264	224	212	-5%	Pass	Pass
7_9_WB	983	625	625	0%	Fail	Fail
7_10_WB	176	106	155	47%	Pass	Pass
7_11_WB	461	349	378	8%	Pass	Pass
7_12_WB	194	351	199	-43%	Pass	Pass
7_13_WB	175	147	127	-14%	Pass	Pass
7_14_WB	51	178	44	-75%	Pass	Pass
7_15_WB	100	122	94	-23%	Pass	Pass
7_16_WB	427	448	376	-16%	Pass	Pass
7_17_WB	192	110	158	43%	Pass	Pass
Total	4779	4836	3966	-18%	-17%	12.3

Table 3-3: Inter-peak Flow Comparison

Screen-Line 2	2015 Model	2006 Observed	2015 Observed	Growth 06-15	2015 Flow Criteria	2015 GEH Criteria
2_1_EB	544	558	584	5%	Pass	Pass
2_2_EB	170	143	150	5%	Pass	Pass
2_3_EB	195	211	221	5%	Pass	Pass
2_4_EB	162	163	191	17%	Pass	Pass
2_5_EB	103	159	155	-2%	Pass	Pass
2_6_EB	340	387	399	3%	Pass	Pass
2_7_EB	363	308	320	4%	Pass	Pass
Total	1877	1929	2020	5%	3%	3.2
Screen-Line 2	2015 Model	2006 Observed	2015 Observed	Growth 06-15	2015 Flow Criteria	2015 GEH Criteria
2_1_WB	512	540	553	2%	Pass	Pass
2_2_WB	162	122	125	2%	Pass	Pass
2_3_WB	175	199	204	3%	Pass	Pass
2_4_WB	220	223	236	6%	Pass	Pass
2_5_WB	79	94	85	-10%	Pass	Pass
2_6_WB	322	371	384	3%	Pass	Pass
2_7_WB	377	294	301	2%	Pass	Pass
Total	1847	1843	1887	2%	0%	0.9
Screen-Line 5	2015 Model	2006 Observed	2015 Observed	Growth 2006-15	2015 Flow Criteria	2015 GEH Criteria
5_1_NB	1179	1202	1204	0%	Pass	Pass
5_3_NB	539	600	571	-5%	Pass	Pass
5_4_NB	750	845	805	-5%	Pass	Pass
4_5_NB	975	1080	1028	-5%	Pass	Pass
Total	3443	3727	3608	-3%	8%	4.7
Screen-Line 5	2015 Model	2006 Observed	2015 Observed	Growth 2006-15	2015 Flow Criteria	2015 GEH Criteria
5_1_SB	1277	1341	1343	0%	Pass	Pass
5_3_SB	426	380	362	-5%	Pass	Pass
5_4_SB	754	899	856	-5%	Pass	Fail
4_5_SB	1055	1100	1047	-5%	Pass	Pass
Total	3512	3720	3608	-3%	6%	3.5
Screen-Line 7	2015 Model	2006 Observed	2015 Observed	Growth 06-15	2015 Flow Criteria	2015 GEH
7_1_EB	634	644	584	-9%	Pass	Pass
7_2_EB	98	130	170	31%	Pass	Fail
7_3_EB	158	262	269	3%	Pass	Fail
7_4_EB	41	18	30	67%	Pass	Pass
7_5_EB	455	511	479	-6%	Pass	Pass

7_6_EB	23	23	12	-46%	Pass	Pass
7_7_EB	297	344	100	-71%	Fail	Fail
7_8_EB	87	96	274	186%	Pass	Fail
7_9_EB	695	890	579	-35%	Fail	Pass
7_10_EB	0	0	0	0%	Pass	Pass
7_11_EB	329	417	326	-22%	Pass	Pass
7_12_EB	79	182	99	-46%	Pass	Pass
7_13_EB	86	12	10	-17%	Pass	Fail
7_14_EB	33	51	32	-37%	Pass	Pass
7_15_EB	184	231	206	-11%	Pass	Pass
7_16_EB	162	175	237	35%	Pass	Fail
7_17_EB	103	124	161	30%	Pass	Fail
Total	3464	4110	3570	-13%	3%	1.8
Screen-Line 7	2015 Model	2006 Observed	2015 Observed	Growth 06-15	2015 Flow Criteria	2015 GEH
7_1_WB	678	700	547	-22%	Fail	Fail
7_2_WB	118	140	142	1%	Pass	Pass
7_3_WB	276	351	388	11%	Pass	Fail
7_4_WB	62	25	36	45%	Pass	Pass
7_5_WB	294	526	321	-39%	Pass	Pass
7_6_WB	39	23	12	-49%	Pass	Fail
7_7_WB	120	157	116	-26%	Pass	Pass
7_8_WB	127	114	202	77%	Pass	Fail
7_9_WB	902	1104	628	-43%	Fail	Fail
7_10_WB	169	67	81	20%	Pass	Fail
7_11_WB	461	480	348	-27%	Fail	Fail
7_12_WB	168	224	212	-5%	Pass	Pass
7_13_WB	150	141	122	-13%	Pass	Pass
7_14_WB	34	56	53	-5%	Pass	Pass
7_15_WB	108	214	170	-21%	Pass	Fail
7_16_WB	220	236	293	24%	Pass	Pass
7_17_WB	79	95	88	-8%	Pass	Pass
Total	4005	4653	3758	-19%	-6%	4.0

Table 3-4: PM Peak hour Flow Comparison

Screen-Line 2	2015 Model	2006 Observed	2015 Observed	Growth 06-15	2015 Flow Criteria	2015 GEH Criteria
2_1_EB	757	776	625	-19%	Fail	Fail
2_2_EB	324	229	184	-20%	Fail	Fail
2_3_EB	436	506	407	-20%	Pass	Pass
2_4_EB	374	295	277	-6%	Pass	Fail
2_5_EB	102	343	256	-25%	Pass	Fail
2_6_EB	634	681	635	-7%	Pass	Pass
2_7_EB	672	555	341	-39%	Fail	Fail
Total	3299	3385	2725	-20%	3%	10.5
Screen-Line 2	2015 Model	2006 Observed	2015 Observed	Growth 06-15	2015 Flow Criteria	2015 GEH Criteria
2_1_WB	533	542	504	-7%	Pass	Pass
2_2_WB	123	108	100	-7%	Pass	Pass
2_3_WB	126	127	118	-7%	Pass	Pass
2_4_WB	218	272	190	-30%	Pass	Pass
2_5_WB	122	88	77	-13%	Pass	Pass
2_6_WB	313	349	392	12%	Pass	Pass
2_7_WB	499	388	361	-7%	Fail	Fail
Total	1934	1874	1742	-7%	-3%	4.5
Screen-Line 5	2015 Model	2006 Observed	2015 Observed	Growth 2006-15	2015 Flow Criteria	2015 GEH Criteria
5_1_NB	1253	1146	1148	0%	Pass	Pass
5_3_NB	516	600	573	-5%	Pass	Pass
5_4_NB	1033	1027	978	-5%	Pass	Pass
4_5_NB	1485	1786	1700	-5%	Pass	Fail
Total	4287	4559	4399	-4%	6%	4.1
Screen-Line 5	2015 Model	2006 Observed	2015 Observed	Growth 2006-15	2015 Flow Criteria	2015 GEH Criteria
5_1_SB	1702	1774	1777	0%	Pass	Pass
5_3_SB	503	480	457	-5%	Pass	Pass
5_4_SB	927	1077	1025	-5%	Pass	Pass
4_5_SB	1682	1873	1783	-5%	Pass	Pass
Total	4814	5204	5042	-3%	8%	5.5
Screen-Line 7	2015 Model	2006 Observed	2015 Observed	Growth 06-15	2015 Flow Criteria	2015 GEH
7_1_EB	645	745	636	-15%	Pass	Pass
7_2_EB	206	183	281	54%	Pass	Pass
7_3_EB	200	339	273	-20%	Pass	Pass

7_4_EB	26	51	37	-28%	Pass	Pass
7_5_EB	678	823	492	-40%	Fail	Fail
7_6_EB	51	176	25	-86%	Pass	Pass
7_7_EB	344	399	107	-73%	Fail	Fail
7_8_EB	51	58	298	413%	Pass	Fail
7_9_EB	909	929	649	-30%	Fail	Fail
7_10_EB	0	0	0	0%	Pass	Pass
7_11_EB	416	392	371	-5%	Pass	Pass
7_12_EB	57	181	125	-31%	Pass	Fail
7_13_EB	87	5	4	-20%	Pass	Fail
7_14_EB	21	102	14	-87%	Pass	Pass
7_15_EB	106	100	114	14%	Pass	Pass
7_16_EB	374	312	284	-9%	Pass	Pass
7_17_EB	102	245	260	6%	Pass	Fail
Total	4273	5040	3968	-21%	-7%	4.8
Screen-Line 7	2015 Model	2006 Observed	2015 Observed	Growth 06-15	2015 Flow Criteria	2015 GEH
7_1_WB	699	895	597	-33%	Fail	Pass
7_2_WB	249	210	157	-25%	Pass	Fail
7_3_WB	272	377	404	7%	Pass	Fail
7_4_WB	113	21	40	90%	Pass	Fail
7_5_WB	256	574	358	-38%	Pass	Fail
7_6_WB	32	0	11	0%	Pass	Pass
7_7_WB	279	282	325	15%	Pass	Pass
7_8_WB	203	186	299	61%	Pass	Fail
7_9_WB	1138	1277	592	-54%	Fail	Fail
7_10_WB	149	193	193	0%	Pass	Pass
7_11_WB	466	461	304	-34%	Fail	Fail
7_12_WB	190	296	355	20%	Pass	Fail
7_13_WB	151	119	94	-21%	Pass	Fail
7_14_WB	52	64	118	84%	Pass	Fail
7_15_WB	143	212	234	11%	Pass	Fail
7_16_WB	218	308	213	-31%	Pass	Pass
7_17_WB	122	88	80	-10%	Pass	Pass
Total	4732	5563	4373	-21%	-8%	5.3

The journey time comparison is included below. The majority of routes are within 15% of travel time. The routes which have the greatest discrepancy are not directly relevant to the LEB corridor or traffic relief resultant from the LEB.

Figure 3-2: Journey Time Routes

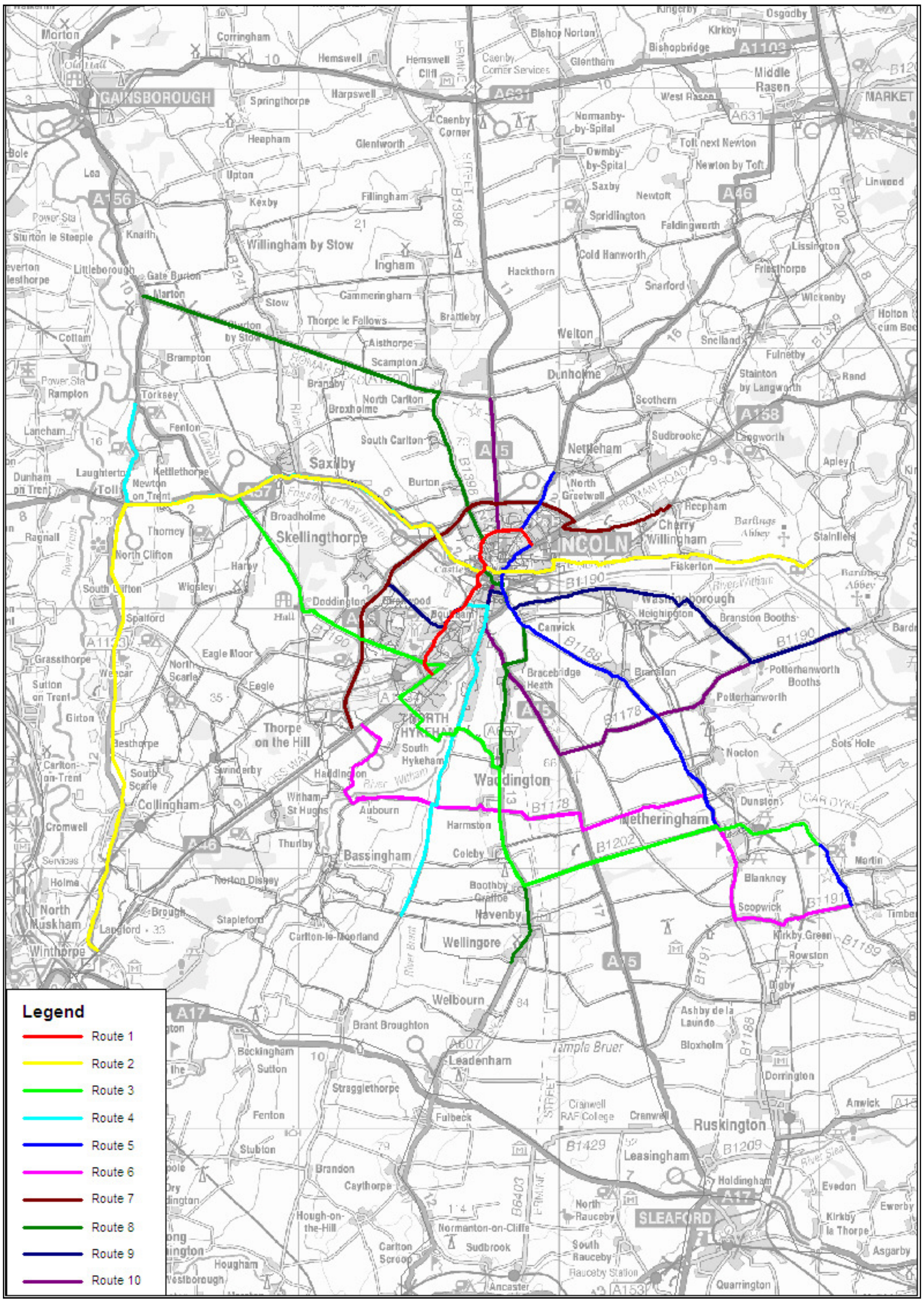


Table 3-5: Journey Times By Time Period

Route	Direction	Model			Observed			% Difference			Difference (minutes)		
		AM	IP	PM	AM	IP	PM	AM	IP	PM	AM	IP	PM
1	NB	20.4	17.2	22.0	22.0	18.0	22.0	-7%	-4%	0%	-1.6	-0.8	0.0
1	SB	21.6	15.5	19.9	22.0	18.0	19.0	-2%	-14%	5%	-0.4	-2.5	0.9
2	NB	51.6	49.9	56.3	55.0	55.0	55.0	-6%	-9%	2%	-3.4	-5.1	1.3
2	SB	55.5	47.2	54.9	55.0	55.0	55.0	1%	-14%	0%	0.5	-7.8	-0.1
3	NB	54.3	41.5	52.5	50.0	45.0	50.0	9%	-8%	5%	4.3	-3.5	2.5
3	SB	53.3	43.1	54.3	47.5	50.0	55.0	12%	-14%	-1%	5.8	-6.9	-0.7
4	NB	52.4	41.5	53.0	45.0	45.0	50.0	16%	-8%	6%	7.4	-3.5	3.0
4	SB	44.8	39.7	50.7	45.0	45.0	50.0	0%	-12%	1%	-0.2	-5.3	0.7
5	NB	36.9	29.9	36.9	37.5	35.0	35.0	-2%	-15%	6%	-0.6	-5.1	1.9
5	SB	34.2	31.4	39.7	35.0	35.0	40.0	-2%	-10%	-1%	-0.8	-3.6	-0.3
6	NB	33.2	25.2	33.4	30.0	35.0	30.0	11%	-28%	11%	3.2	-9.8	3.4
6	SB	27.2	25.0	29.2	30.0	30.0	30.0	-9%	-17%	-3%	-2.8	-5.0	-0.8
7	NB	18.0	15.5	20.2	22.0	20.0	26.0	-18%	-23%	-22%	-4.0	-4.5	-5.8
7	SB	19.0	16.0	17.4	28.5	20.0	22.0	-33%	-20%	-21%	-9.5	-4.0	-4.6
8	NB	47.1	41.8	49.0	50.0	45.0	50.0	-6%	-7%	-2%	-2.9	-3.2	-1.0
8	SB	48.6	43.8	52.0	47.5	45.0	50.0	2%	-3%	4%	1.1	-1.2	2.0

4 Forecast Application

4.1 Future Year Matrices

2018 and 2033 matrix totals are included below. The totals are in the order of 6% or so lower.

Table 4-1: 2018 and 2033 matrix totals

Category		2006	2015	2018	2033	% Difference		
						2006->2015	2015->2018	2018->2033
AM Peak								
1	Commute	26,646	26,640	27,163	28,669	-0.03%	1.96%	5.55%
2	Other	17,176	17,170	17,903	20,523	-0.04%	4.27%	14.63%
3	Emp Bus.	5,534	5,533	5,638	5,936	-0.02%	1.90%	5.29%
4	LGV	7,849	7,844	8,512	11,845	-0.06%	8.52%	39.16%
5	HGV	2,758	2,758	2,810	3,092	-0.01%	1.88%	10.06%
Total		**59,963**	**59,944**	**62,026**	**70,066**	**-0.03%**	**3.47%**	**12.96%**
Development Trips			551	1,041	4,426	-	-	-
Background Trips			59,393	60,985	65,640	-	2.68%	7.63%
Inter Peak								
1	Commute	6,424	6,421	6,539	6,848	-0.05%	1.84%	4.72%
2	Other	32,402	32,407	33,627	38,566	0.02%	3.76%	14.69%
3	Emp Bus.	4,800	4,802	4,892	5,152	0.04%	1.87%	5.32%
4	LGV	7,330	7,328	7,945	11,055	-0.03%	8.42%	39.16%
5	HGV	3,948	3,949	4,024	4,435	0.01%	1.89%	10.22%
Total		**54,904**	**54,906**	**57,026**	**66,056**	**0.00%**	**3.86%**	**15.83%**
Development Trips			384	742	2,938	-	-	-
Background Trips			54,522	56,284	63,118	-	3.23%	12.14%
PM Peak								
1	Commute	21,662	21,665	22,141	23,546	0.01%	2.19%	6.35%
2	Other	21,581	21,578	22,355	25,172	-0.01%	3.60%	12.60%
3	Emp Bus.	5,343	5,342	5,449	5,767	-0.02%	2.00%	5.83%
4	LGV	7,523	7,519	8,158	11,353	-0.05%	8.50%	39.16%
5	HGV	1,999	1,999	2,036	2,239	-0.02%	1.88%	9.94%
Total		**58,108**	**58,103**	**60,139**	**68,076**	**-0.01%**	**3.50%**	**13.20%**
Development Trips		0	598	1,002	4,313	-	-	-
Background Trips			57,505	59,137	63,763	-	2.84%	7.82%
Daily								
1	Commute	184,343	184,314	188,031	198,633	-0.02%	2.02%	5.64%
2	Other	328,292	328,299	340,805	389,437	0.00%	3.81%	14.27%
3	Emp Bus.	63,703	63,709	64,927	68,459	0.01%	1.91%	5.44%
4	LGV	93,634	93,595	101,514	141,264	-0.04%	8.46%	39.16%
5	HGV	40,039	40,040	40,796	44,936	0.00%	1.89%	10.15%
Total		**710,011**	**709,958**	**736,073**	**842,730**	**-0.01%**	**3.68%**	**14.49%**

Category	2006	2015	2018	2033	% Difference		
					2006->2015	2015->2018	2018->2033
Development Trips		5,920	10,911	45,118	-	-	-
Background Trips		704,037	725,161	797,612	-	3.00%	9.99%

The cost parameters used in the assignment are indicated below. As the value of time increases the relative cost per km decreases.

Assignment networks are demonstrated in Appendix A.

Table 4-2: GC Parameters

	2015 Parameters		2018 Parameters		2033 Parameters	
	Time	**Distance**	**Time**	**Distance**	**Time**	**Distance**
User Class	pence per minute	pence per km	pence per minute	pence per km	pence per minute	pence per km
UC1 - commute	13.54	6.51	14.32	6.00	18.94	5.57
UC2 - other	18.25	6.51	19.20	6.00	24.75	5.57
UC3 - employers business	45.76	12.91	48.40	12.46	64.15	11.94
LGV	20.96	13.56	22.21	13.15	29.67	13.42
HGV	21.25	46.25	22.51	46.82	30.07	55.44

The VDM model was run and output DM and to convergence and output results evaluated from an operational and economic perspective.

4.2 Operational Results

The LEB forecast volumes are indicated below. AADT flows are around 8.5% lower than the VDM core.

Table 4-3: AADT Flows – LEB Sections

Section	Forecast Two Way AADT Flows		
	2018	2033	Growth over Forecast Period
Section 1a	16,546	18,969	15%
Section 1b	15,926	18,658	17%
Section 2	19,409	22,318	15%
Section 3	13,841	17,095	24%
Section 4	14,823	18,223	23%

Flow volumes are presented in Appendix B.

Traffic relief is shown below. 2006 and 2015 flow volumes demonstrate similar magnitude in line with the test objectives. The screenline flows are somewhat reduced in comparison with the core, by around 6%.

Table 4-4: Traffic Relief Statistics

Part of Cordon	2006	2015	2018 DM	2018 DS	2033 DM	2033 DS
AADT Flows						
A46	31,558	31,329	34,307	32,405	36,305	34,087
City Centre - Brayford Way	21,090	21,546	25,289	21,531	29,987	24,750
City Centre - Wigford Way	13,166	13,201	12,814	11,871	13,259	13,665
City Centre - A15 Broadgate	38,785	39,248	38,720	28,883	38,527	32,511
LEB Section 2				20,781		25,122
SUM	104,599	105,324	111,130	115,471	118,078	130,135
Flow Change						
A46		-1%	10%	-6%	12%	-6%
City Centre - Brayford Way		2%	17%	-15%	39%	-17%
City Centre - Wigford Way		0%	-3%	-7%	12%	3%
City Centre - A15 Broadgate		1%	-1%	-25%	33%	-16%
LEB Section 2		-	-	-	-	-
SUM		1%	6%	4%	2%	10%

5 Economic Evaluation

5.1 Introduction

The VfM appraisal was conducted in the same manner as the previous analysis using the unmodified 2015 pivot. This includes common aspects in respect of

- Annualisation factors;
- Appraisal period;
- Scheme costs;
- Time slices;
- User classes; and
- Sectorisations

For the detail associated with these elements the reader is referenced to the "Economic Appraisal Report" dated October 2016.

5.2 Sensitivity Test Results

The TUBA summary is included below.

Table 5-1: TUBA Results Summary Table

Cost and Benefits	Core Scenario
Economic Efficiency	
Consumer User (Commute)	61,520
Consumer User (Other)	271,968
Business User and Provider	342,666
Indirect Tax Revenue	13,881
Carbon Benefits	-4,583
Present Value of Benefits (PVB)	**685,452**
Investment Costs	79,789
Present Value of Costs (PVC)	**79,789**
Net Present Value (NPV)	605,663
BCR	**8.591**
AM Peak – 2016	1,210
AM Peak - 2031	1,390
PM Peak – 2016	2,713

Cost and Benefits	Core Scenario
PM Peak – 2031	2,276
Inter Peak – 2016	5,764
Inter Peak - 2031	7,398
Off Peak – 2016	1,230
Off Peak - 2031	1,446
Weekend – 2016	1,226
Weekend – 2031	1,436

The result demonstrates that the lower growth reduces the NPV by around 14%.

Detailed TEE, PA and AMCB tables are included in Appendix C.

The reduced benefit is evident across all time periods with the exception of 2033 PM where the benefit contribution is slightly raised. This is evidenced in a number of the lower growth tests and indicates that lower flow volumes lead to reduced impedance for traffic which wishes to use LEB, leading to slightly raised benefit. Being 2033 this is heavily discounted into the PVB figure.

Table 5-2: Comparative Economic Performance (Traffic) - Sensitivity Tests

Cost and Benefits	Core Fixed	Core VDM	Core High	Core Low	TEMPRO 7	VOT Update	Revised Pivot
Economic Efficiency							
Consumer User (Commute)	128,404	62,709	62,235	66,320	63,097	91,281	61,520
Consumer User (Other)	543,649	316,237	301,974	283,168	311,790	253,202	271,968
Business User and Provider	717,929	398,213	369,059	325,006	396,987	289,106	342,666
Indirect Tax Revenue	-36,817	12,582	11,793	18,793	14,057	10,471	13,881
Carbon Benefits	14,139	-3,797	-3,568	-6,543	-4,426	-3,492	-4,583
Present Value of Benefits (PVB)	**1,367,304**	***785,944***	***741,493***	***686,744***	***781,505***	***640,568***	**685,452**
Present Value of Costs (PVC)	***79,789***	***79,789***	***79,789***	***79,789***	***79,789***	***79,789***	***79,789***
Net Present Value (NPV)	***1,287,515***	***706,155***	***661,704***	***606,955***	***701,716***	***560,779***	***605,663***
BCR	***17.14***	***9.85***	***9.29***	***8.61***	***9.79***	***8.03***	***8.59***
AM Peak – 2018	2,148	1,467	1,849	1,430	1,400	1,329	1,210
AM Peak – 2033	3,010	1,527	1,515	1,366	1,496	1,409	1,390
PM Peak – 2018	5,137	2,915	2,694	2,713	3,054	2,570	2,713
PM Peak – 2033	4,954	2,029	1,574	2,393	2,158	1,735	2,276
Inter Peak – 2018	16,226	7,812	9,057	6,966	7,574	6,218	5,764
Inter Peak – 2033	15,337	8,904	8,141	7,096	8,780	7,303	7,398
Off Peak – 2018	3,135	1,624	1,857	1,487	1,573	1,172	1,230
Off Peak – 2033	2,744	1,651	1,602	1,397	1,636	1,203	1,446
Weekend – 2018	3,133	1,620	1,852	1,486	1,569	1,236	1,226
Weekend - 2033	2,724	1,640	1,589	1,389	1,625	1,272	1,436

6 Conclusions

This report covers the economic assessment of the LEB route. The core test is provided by way of comparison with earlier works. Within the core test the following elements are included:

- Base model recalibration;
- Projection of model to 2015;
- Design revisions of LEB since 2011;
- Enhancements to modelling resultant from outcome of public inquiries;
- Updated development assumptions;
- Updated scheme costs; and
- Update to original VOT.

Sensitivity tests are conducted in a number of areas which are of interest to the DfT, including:

- Variable Demand;
- High and Low Growth;
- TEMPRO 7; and
- Forthcoming Values of Time

On the basis of the analysis conducted to date the LEB has been demonstrated to provide a robust economic performance under all scenarios which suggests continued high Value for Money irrespective of the circumstance.

Appendix A – Modelled Highway Networks

Figure A1 – Do-Minimum Network

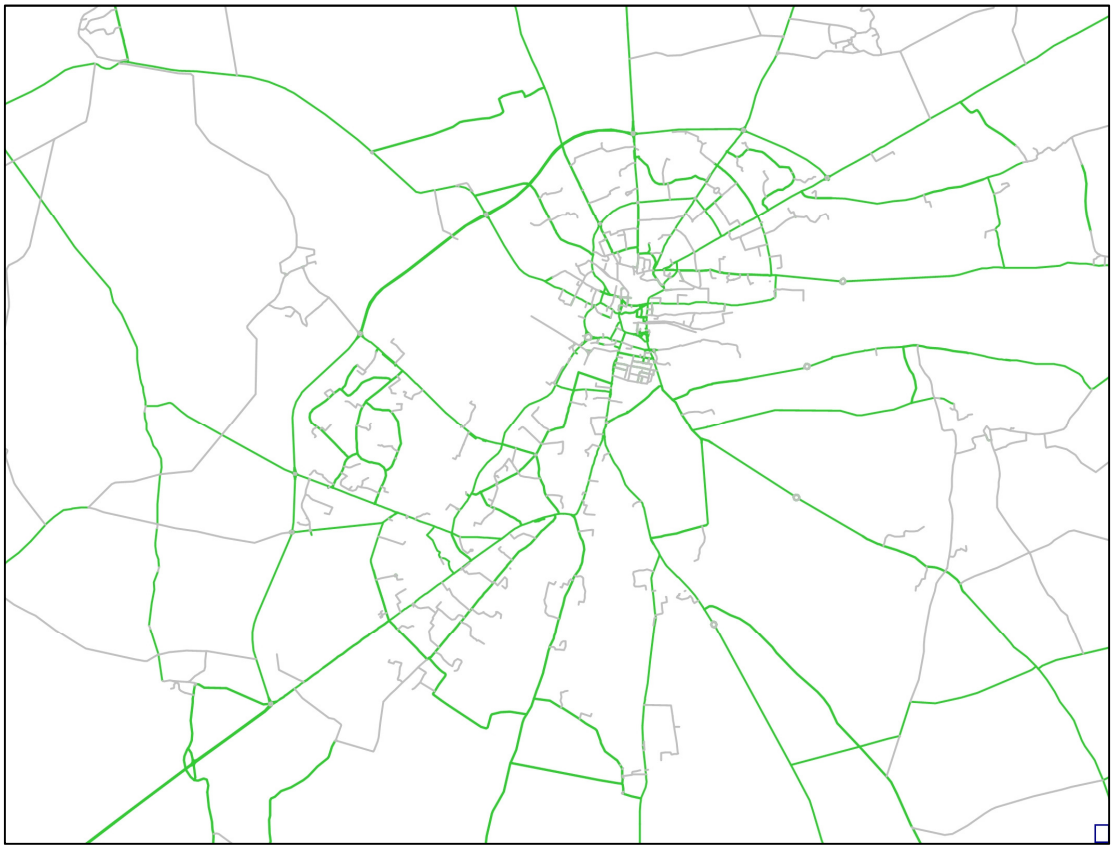
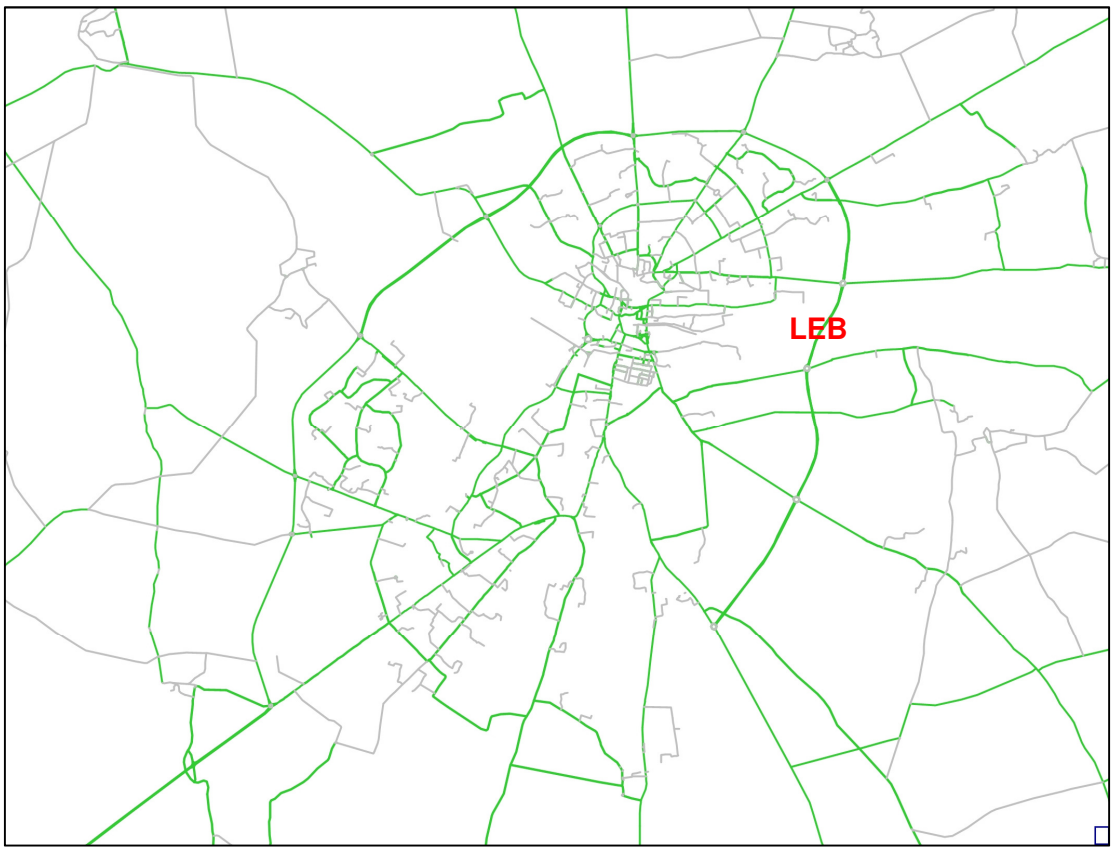


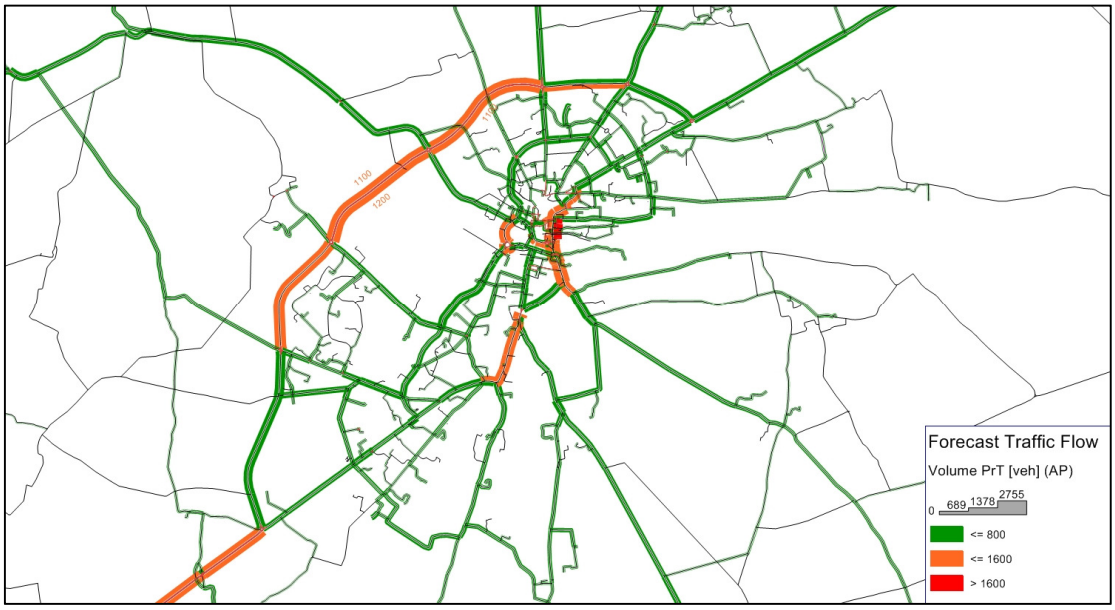
Figure A2 – Do-Something Network



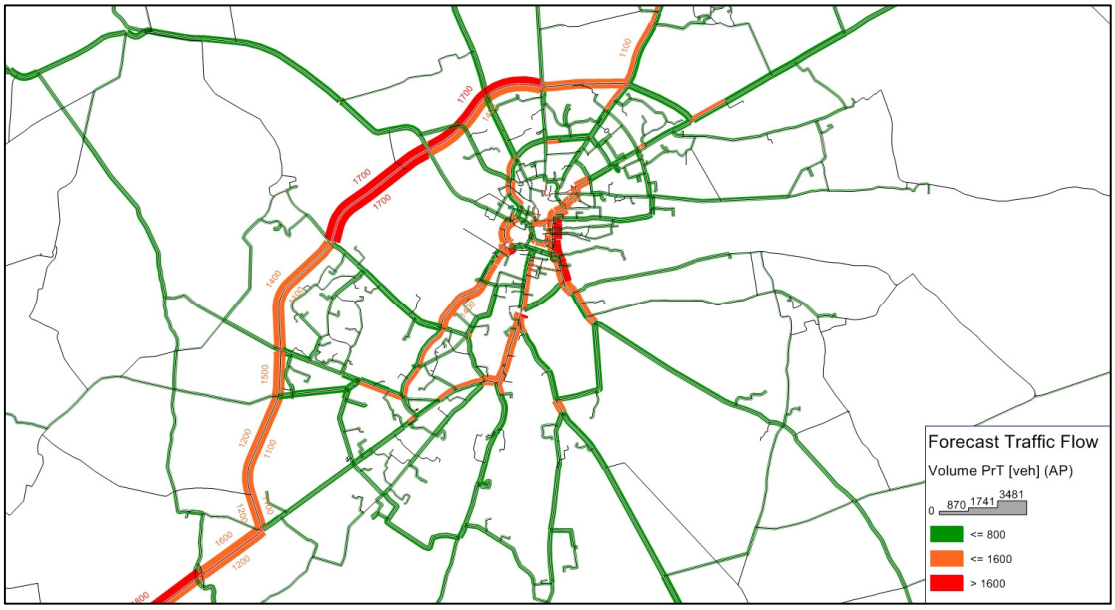
Appendix B – Peak Hour Flows

DM 2018 AM

DM 2018 IP



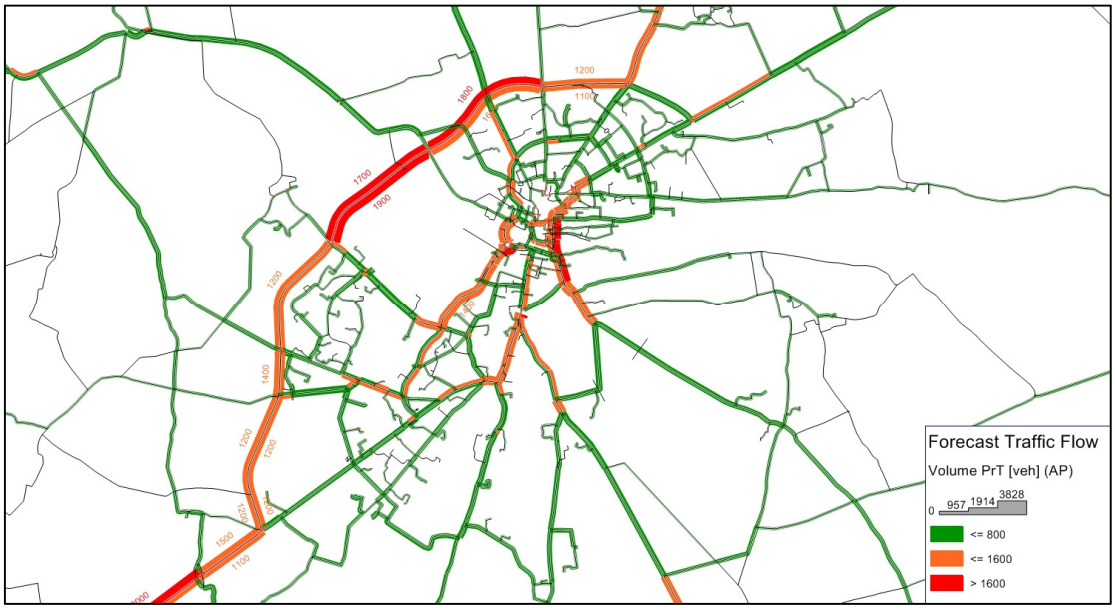
DM 2018 PM



DM 2033 AM

DM 2033 IP

DM 2033 PM



DS 2018 AM

.

DS 2018 IP

DS 2018 PM

DS 2033 AM

DS 2033 IP

DS 2033 PM

Appendix C – Economic Appraisal Tables

Lincolnshire COUNTY COUNCIL HIGHWAYS ALLIANCE

Alternative VDM Test – Economic Evaluation Outputs
Economic Efficiency of the Transport System (TEE)

Non-business: Commuting	**ALL MODES**		**ROAD**	**BUS/COACH**	**RAIL**	**OTHER**
User benefits	**TOTAL**		**Private Cars/LGVs**	**Passengers**	**Passengers**	
Travel Time	63,649		63,649	0	0	0
Vehicle operating costs	-2,129		-2,129	0	0	0
User charges	0		0	0	0	0
During Construction & Maintenance	0		0	0	0	0
NET NON-BUSINESS BENEFITS: COMMUTING	**61,520**	*(1a)*	**61,520**	**0**	**0**	**0**

Non-business: Other	**ALL MODES**		**ROAD**	**BUS/COACH**	**RAIL**	**OTHER**
User benefits	**TOTAL**		**Private Cars/LGVs**	**Passengers**	**Passengers**	
Travel time	275,051		275,051	0	0	0
Vehicle operating costs	-3,083		-3,083	0	0	0
User charges	0		0	0	0	0
During Construction & Maintenance	0		0	0	0	0
NET NON-BUSINESS BENEFITS: OTHER	**271,968**	*(1b)*	**271,968**	**0**	**0**	**0**

Business			**ROAD**		**BUS/COACH**	**RAIL**		**OTHER**
User benefits	**TOTAL**		**Good Vehicles**	**Business Cars/LGVs**	**Passengers**	**Freight**	**Passengers**	
Travel time	314,009		138,700	175,309	0	0	0	0
Vehicle operating costs	28,657		17,306	11,351	0	0	0	0
User charges	0		0	0	0	0	0	0
During Construction & Maintenance	0		0	0	0	0	0	0
Subtotal	**342,666**	*(2)*	**156,006**	**186,660**	**0**	**0**	**0**	**0**
Private sector provider impacts						**Freight**	**Passengers**	

Revenue	0						
Operating costs	0						
Investment costs	0						
Grant/subsidy	0						
Subtotal	**0**	*(3)*		**0**	**0**	**0**	**0**
Other business impacts							
Developer contributions	0	*(4)*					
NET BUSINESS IMPACT	**342,666**	*(5) = (2) + (3) + (4)*					
TOTAL							
Present Value of Transport Economic Efficiency Benefits (TEE)	**676,154**	*(6) = (1a) + (1b) + (5)*					

Notes: Benefits appear as positive numbers, while costs appear as negative numbers.
All entries are discounted present values, in 2010 prices and values (£,000s)

Public Accounts for the Appraisal of Major Highway Schemes

	ROAD INFRASTRUCTURE TOTAL	
Local Government Funding		
Operating Costs	0	
Investment Costs	33,574	
Developer and Other Contributions	0	
NET IMPACT	**33,574**	*(7)*
Central Government Funding: Transport		

Operating costs	0	
Investment Costs	46,215	
Developer and Other Contributions	0	
NET IMPACT	**46,215**	*(8)*
Central Government Funding: Non-Transport		
Indirect Tax Revenues	-13,881	
TOTALS	**-13,881**	*(9)*
Broad Transport Budget	**79,789**	*(10) = (7) + (8)*
Wider Public Finances	**-13,881**	*(11) = (9)*

Analysis of Monetised Costs and Benefits

Noise		*(12)*
Local Air Quality		*(13)*
Greenhouse Gases	-4,583	*(14)*
Journey Ambience		*(15)*
Accidents		*(16)*
Economic Efficiency: Consumer Users (Commuting)	61,520	*(1a)*
Economic Efficiency: Consumer Users (Other)	271,968	*(1b)*
Economic Efficiency: Business Users and Providers	342,666	*(5)*

Wider Public Finances (Indirect Taxation Revenues)	13,881	*- (11) - sign changed from PA table, as PA table represents costs, not benefits*
Option Values		*(17)*
Present Value of Benefits (see notes) **(PVB)**	**685,452**	*(PVB) = (12) + (13) + (14) + (15) + (16) + (1a) + (1b) + (5) + (17) - (11)*
Broad Transport Budget	79,789	*(10)*
Present Value of Costs (see notes) **(PVC)**	**79,789**	*(PVC) = (10)*
OVERALL IMPACTS		
Net Present Value (NPV)	**605,663**	*NPV = PVB - PVC*
Benefit to Cost Ratio (BCR)	**8.591**	*BCR = PVB/PVC*

Note : This table includes costs and benefits which are regularly or occasionally presented in monetised form in transport appraisals, together with some where monetisation is in prospect. There may also be other significant costs and benefits, some of which cannot be presented in monetised form. Where this is the case, the analysis presented above does NOT provide a good measure of value for money and should not be used as the sole basis for decisions.

TUBA Benefit Summary

Transport Efficiency	
Consumer User (Commute)	61,520
Consumer User (Other)	271,968
Business User and Provider	342,666
Indirect Tax Revenue	13,881

Greenhouse Gas	-4,583
Accident Benefits	0
Delays during Construction	
Reliability Benefits	
Wider Impact Benefits	
Present Value of Benefits (PVB)	**685,452**

Broad Transport Budget

Investment Costs	79,789
Operating Costs	0
Present Value of Costs (PVC)	**79,789**

Overall Impacts

Net Present Value (NPV)	**605,663**
Benefit to Cost Ratio (BCR)	**8.591**

Number of warnings	

Personal Business (WITA)	186,660

User Benefits and Charges by Modelled Year and Time Period

Period	Time	VoC	Ind. Tax	Total
AM peak - 2018	1,114	63	33	1,210
AM peak - 2033	1,309	71	10	1,390
PM peak - 2018	2,500	89	124	2,713
PM peak - 2033	2,089	175	12	2,276

Inter-peak - 2018	5,325	126	313	5,764
Inter-peak - 2033	6,937	332	129	7,398
Off-peak - 2018	1,159	-32	103	1,230
Off-peak - 2033	1,377	15	54	1,446
Weekend - 2018	1,160	-29	95	1,226
Weekend - 2033	1,372	14	50	1,436
AM peak - Total	65,219	3,013	602	68,834
PM peak - Total	109,484	6,793	1,252	117,529
Inter-peak - Total	341,265	12,727	6,862	360,854
Off-peak - Total	68,494	474	2,683	71,651
Weekend - Total	68,247	438	2,482	71,167