

- 1. The Lincolnshire County Council (A15 Lincoln Eastern Bypass)
(Classified Road) (Side Roads) Order 2014**
- 2. The Lincolnshire County Council (A15 Lincoln Eastern Bypass)
Compulsory Purchase Order 2014**
- 3. Application In Relation To Proposed Compulsory Purchase Of
Land Held By The Canal & River Trust**

Department for Transport Reference: NATTRAN/EM/LAO/0084

Response to Objector's Proof

Mr P Moore

Response from Lincolnshire County Council to letter/proof of evidence from Mr Paul Moore

1 Issues Raised by Mr Moore

1.1.1 Mr Moore helpfully summarises his concerns. His summary points 1 through 5 (page 1) set the scene for his critique of the work undertaken. The following issues are distilled from the remainder of his points.

- 1. Match between the traffic model and observed counts is (in)sufficiently close having significant impacts on the assessment of local traffic issues such as assessing rat-running, traffic relief to individual roads and junction performance;**
- 2. Hawthorn Road 2015 OD data supports or possibly conflicts with other traffic data and existing modelling;**
- 3. Modelling may not be sufficiently accurate to draw robust conclusions as to the level of traffic relief provided to Hawthorn Road west of the LEB and to some roads in the Carlton estate and may overstate the level of traffic relief afforded by the LEB. Flow increases occurring after the opening of the LEB may impact on the performance of the local network and particularly alternative routes to Hawthorn Road;**
- 4. High level of queueing on Greetwell Road E roundabout entry arm with queues of over 300 vehicles and significant delays of up to 30 minutes;**
- 5. Suggestion of Side Road Orders being conditional on an improvement scheme for Wickes Roundabout**
- 6. Modelling of Kennel Lane/A158 junction and whether delays and the variability of delays have been modelled sufficiently robustly at this junction. Modelling of the Hawthorn Road/Bunkers Hill junction.**
- 7. Review of speed surveys in the area**

2 Response from LCC

2.1 Summary

2.1.1 Mr Moore has raised a number of issues which focus on close levels of detail within the model, which may be appropriate for micro-level analyses of individual junction operations, but are not particularly relevant to the determination of the effectiveness of a strategic traffic scheme, primarily the establishment of safe and efficient alternative routes. The LEB seeks to relieve a number of key routes within the city and the traffic modelling demonstrates that the scheme is effective in doing so. The side road order is a key component of delivering the scheme. Alternative routes should be evaluated in their entirety rather than as individual movement components.

2.1.2 Whilst Mr Moore does not wish to question the strategic case for the LEB it is not possible to maintain this stance at the same time as questioning the effectiveness of

the modelling based on micro levels of detail. The modelling must be either appropriate or inappropriate for the strategic case. If the former is the case then Mr Moore's comments must be inappropriate. Given that the business case has recently been reviewed and accepted by experienced DfT case officers following a period of detailed scrutiny we would suggest that Mr Moore's comments on the modelling are inappropriate and do not assist in addressing the issue before the Inquiry. Whilst Mr Moore does make a number of relevant points in respect of the level of proximity between some surveyed and modelled flows these are only in the context of specific local detail as opposed to overall scheme assessment. The accuracy of isolated individual turn flows over relatively lightly trafficked roads should not compromise a strategic case for investment in the event that the issues are not materially important to the case before the Inquiry. No traffic model can profess exact replication of reality. Models seek to simplify and to distill the issues into those most critical to the scheme in question.

- 2.1.3 As part of their modelling exercise the County Council has recognised some modest historic weaknesses in original 2006 data and has sought to examine that weakness to see if an issue exists. This examination has been undertaken through the application of survey data to modify the traffic patterns in a "Sensitivity Test" to gauge the impact on the business case in the event that the traffic patterns were revised to account for the latest observations. Application of the sensitivity test demonstrates a greater similarity with established traffic flow observations and, most importantly, does not result in differing conclusions in respect of the economic or operational performance of the scheme. Mr Moore has had access to this information and has chosen not to reference it in any meaningful way.
- 2.1.4 The modelling has been approached in a robust and pragmatic manner and the results are supportive of the partial closure of Hawthorn Road to maintain the effectiveness of the LEB scheme. The majority of Mr Moore's comments are irrelevant given the strategic position and, whilst a smaller number are technically correct, they do not take account of the Sensitivity test, which demonstrates the outcome to be immaterial to the performance of the network. All identified issues remain surmountable. Alternative routes remain reasonably convenient.

2.2 Comparison of Observed and Modelled Flows

- 2.2.1 Mr Moore has placed a particular emphasis on the comparison of junction turn flows. Whilst this demonstrates an interest in detail it is not necessarily the most appropriate form of analysis in the circumstances. Proximity of modelled and surveyed flows are required to be demonstrably close at key points on the network, highlighting broad movements. These key locations are known as screenlines. Flows at a screenline level should be within close tolerances. Flows at a link level are generally acceptable with a lower tolerance and those at a turn level are acceptable at an even lower tolerance again. In a strategic model where broad movements are considered, calibration and validation at the latter level is not commonly required. Higher tolerances of difference are permitted for lower flows and the GEH statistic commonly used in traffic modelling seeks to incorporate this. The current model has passed the stipulations required by the DfT in assessment of highway schemes.
- 2.2.2 It should be noted that the Greater Lincoln Traffic Model is a regional model which covers the whole of Lincoln plus a considerable outlying area. It has been attuned to

reflect an appropriate level of detail to forecast the impacts of the LEB. With models of this nature a stronger emphasis is placed on the comparison of observed and surveyed link flows in the validation process. There is therefore generally less confidence in turn flows in comparison to link flows whilst forecasting strategic traffic impacts. The detailed junction evaluations are commonly cross checked in terms of sensible growth patterns in future, based on both modelled information, knowledge of how the network currently operates and future anticipated traffic growth.

2.2.3 Mr Moore’s analysis compares the AM peak hour 2015 surveyed flows with 2018 Do-Minimum modelled flows for the same period. The comparisons detailed in the following paragraphs therefore consider the same time periods.

2.2.4 Mr Moore’s analysis focuses on the 2018 Do-Minimum AM peak hour from the Core Scenario model. However a Sensitivity Test has also been undertaken which focussed on flows in the immediate vicinity of Hawthorn Road. This test is detailed in the Model Sensitivity Note (CD85), submitted as part of Mr Smith’s original evidence. Due to some uncertainty surrounding specific traffic flow data from 2006 the base model flows in this location were calibrated against surveyed data for 2015 and a Sensitivity Test was then undertaken to determine the implications of this. Modelled outputs from this Sensitivity Test have been used to demonstrate that irrespective of the detail of base flows the impact of the LEB remains consistent in future years.

2.2.5 Mr Moore suggests the Outer Circle Road / Greetwell Road double mini-roundabout junction to be problematic. Table 1 below compares the observed and modelled links flows on the entry arms to the junction, including the link road between the adjacent roundabouts.

Table 1 – Outer Circle Road / Greetwell Road Junction Flows

Approach	Survey	Model	GEH
Greetwell Road (W)	309	286	1.3
Outer Circle Road	1098	637	15.6
Internal Arm Westbound	530	518	0.5
Greetwell Road (E)	639	561	3.2
Allenby Road	311	382	3.8
Internal Arm Eastbound	769	628	5.3

2.2.6 The above table indicates that 4 out of 6 arms of the junction have GEH values within the acceptable limit of 5 whilst an additional arm is just over 15. This is considered tolerable when considering the size and the good validation of the overall model. At this location the Outer Circle Road under estimates the flow somewhat. Nevertheless the E-W Screenline (within Screenline 5) referenced in the LMVR demonstrates that the strategic flow is appropriately validated and the A15 Canwick Road southbound has a GEH of around 5. This demonstrates that the major potential market for LEB travel is reasonably accurate.

2.2.7 Another junction of interest to Mr Moore is the Outer Circle Road / Carlton Boulevard traffic signals. It is recognised that this junction is a location where discrepancies occur between observed and modelled flows. However it is considered that the wider model validates well and discrepancies of this nature at isolated locations are

tolerable in a model of this scale. The implications for the operation and assessment of the LEB are not significant.

- 2.2.8 Mr Moore has raised particular concern regarding the right turn from Hawthorn Road (W) in to St Augustine Road. In the AM peak hour this movement was observed to be 255 pcus in comparison to 65 pcus in the 2018 Do-Minimum Core Scenario model. This turn movement was addressed in the Sensitivity Test Base model which was taken through to forecasting and economic assessment. The corresponding right turn movement in the 2018 Do-Minimum Sensitivity Test is 272 pcus, therefore much closer to the observed movement. From an operational perspective this junction does not present any capacity issues.
- 2.2.9 With regard to link flows Mr Moore has raised the issue of westbound flow on Hawthorn Road being much higher in the model in comparison to the survey. Upon comparison of relevant survey data it became apparent that there were inconsistencies between the 2006 data originally used to validate the model and more recent surveys at this location. Full details of the conflicting count data were included in the Model Sensitivity Note.
- 2.2.10 The conclusion of that note was that the presence or absence of specific traffic counts for Hawthorn Road is immaterial to the LEB flows and economic assessments. With the sensitivity test, as with the Core model, the forecast flows on Hawthorn Road are forecast to decrease considerably to the west of the proposed bypass whilst no material differences are forecast to the east.
- 2.2.11 The Sensitivity Test used the 2015 surveys to calibrate the Hawthorn Road flow at this location. A comparison between the observed and modelled westbound flow on Hawthorn Road, to the east of St Augustine Road, is presented in Table 2 below.

Table 2 – Hawthorn Road Westbound Flows

Link	Direction	Survey	Core Scenario		Sensitivity Test	
			Model	GEH	Model	GEH
Hawthorn Road	Westbound	258	436	9.6	345	5.0

- 2.2.12 It can be seen that in the Sensitivity Test the modelled flow has reduced to 345 resulting in an acceptable GEH of 5.0. It should be noted that the modelled flow is at the year 2018 thus a slight increase compared to the 2015 survey should be expected. The operational assessment of adjacent junctions of interest is unaffected.
- 2.2.13 Traffic flows through the Carlton Estate have also been questioned, particularly on St Augustine Road and Carlton Boulevard. It should be noted that these links have never been used as a calibration and validation point due to their localised nature in comparison to the surrounding strategic links. A comparison of the observed and modelled link flows on St Augustine Road and Carlton Boulevard is presented in Table 3 below. Modelled results for both the Core Scenario and Sensitivity Test are shown.

Table 3 – Flows on St Augustine Road and Carlton Boulevard

Link	Direction	Survey	Core Scenario		Sensitivity Test	
			Model	GEH	Model	GEH
St Augustine Road	Northbound	149	63	8.3	91	5.3
St Augustine Road	Southbound	390	111	17.6	316	3.9
Carlton Boulevard	Eastbound	212	89	10.0	116	7.5
Carlton Boulevard	Westbound	601	405	8.7	399	9.0

2.2.14 It can be seen from the above that the Sensitivity Test results in considerable improvements in GEH values when compared with the Core Scenario. Notably all GEH values are below 10. DfT guidance recommends that GEH values between 5 and 10 may warrant investigation; however, as these links are not calibration or validation points the values are considered acceptable.

2.2.15 The most notable improvement in GEH value is on the St Augustine Road southbound link with the GEH falling from 17.6 to 3.9. This can be attributed to the additional trips turning right from Hawthorn Road (W) to St Augustine Road in the Sensitivity Test as described previously. At the other end of the link the Outer Circle Road is relieved by the LEB and operational assessment indicates no problem for the signalised junction with Carlton Boulevard as spare capacity is reallocated by an optimisation of green time.

2.2.16 At the A158 / Wragby Road / Bunkers Hill junction Mr Moore asserts that modelled flows are ‘significantly lower than observed values on two critical arms’. A comparison of the observed and surveyed entry flows to this junction, and the resulting GEH values, is presented in Table 4 below.

Table 4 – A158 / Wragby Road / Bunkers Hill Junction Flows

Link	Survey	Model	GEH
Bunkers Hill	451	492	1.9
A158 Bypass	808	697	4.0
A158 Wragby Road E	775	675	3.7

2.2.17 It can be seen from the above that all entry arms have a GEH value of less than five. The modelled flows are therefore considered acceptable. Further, comparison with a single count on one day isn’t necessarily the best way to conclude that a model is fit or otherwise for purpose.

2.3 Conflicts of Origin-Destination Data

2.3.1 Mr Moore presents a comparison of the 2015 surveyed Origin-Destination (OD) data with the 2006 Core Scenario Base Model. It is recognised that the Core Scenario model does under-represent some of the observed traffic patterns. LCC do not consider this to be significant to the assessment of the LEB case.

2.3.2 Within the Sensitivity Test it was sought to address a number of these travel patterns. The most appropriate comparison of O-D data is with the 2018 Do-Minimum

Sensitivity Test data. This is presented in Table 5 below and includes 2015 OD surveyed values versus 2018 DM Sensitivity model in brackets ().

Table 5 – Origin-Destination Data Comparison

Point to Point flow values	Kennel Lane	Station Road Fiskerton	Croft Lane Cherry Willingham	Carlton Boulevard	Hawthorn Road at Wragby Road	Unmatched	Total
Kennel Lane	19 (N/A)	13 (39)	76 (114)	33 (0)	11 (0)	46 (123)	209 (276)
Station Road Fiskerton	8 (27)	29 (N/A)	6 (0)	5 (0)	3 (0)	30 (2)	81 (29)
Croft Lane Cherry Willingham	24 (22)	9 (0)	77 (N/A)	27 (0)	47 (71)	26 (68)	210 (161)
Carlton Boulevard	97 (0)	8 (0)	28 (4)	42 (N/A)	21 (4)	18 (118)	214 (126)
Hawthorn Road at Wragby Road	14 (0)	8 (0)	68 (49)	251 (138)	68 (N/A)	52 (197)	461 (426)
Unmatched	73 (51)	92 (0)	185 (154)	304 (326)	153 (271)		
Total	235 (100)	159 (39)	440 (321)	662 (464)	303 (384)		

2.3.3 It should be noted that comparisons between journeys entering and exiting the cordon at the same point are not applicable, as these kind of trips do not occur in the model. Modelled trips have one origin and one destination with no intermediate points therefore 'U-turning trips' do not occur in the same way. This kind of trip is effectively two separate trips in the model and thus is not directly comparable with observed trips of this type.

2.3.4 The above table indicates a reasonable level of fit, with a similar distribution of high and low values, particularly when compared with the analysis undertaken in Mr Moore's evidence. Whilst differences do exist they are much less pronounced than Mr Moore suggests. The closer fit reflects the outcome of the sensitivity test, which still supports the economic impact of LEB and the consequential effects on the highway network.

2.4 Modelling Accuracy and Traffic Relief

2.4.1 Mr Moore's evidence raises concerns about a number of locations where changes in traffic flow are forecast to occur between the Do-Minimum and Do-Something scenarios. The locations identified are considered in detail in the following paragraphs.

2.4.2 The northbound traffic flow on Kennel Lane is forecast to increase from 183 pcus to 311 pcus in the 2018 AM peak hour. The increase in traffic flows at this location can

be attributed to trips that were previously using Hawthorn Road westbound diverting to Wragby Road via Kennel Lane to continue their journeys to areas North and West of Lincoln.

- 2.4.3 As described previously the Core Scenario has a high flow on Hawthorn Road westbound in the AM peak, when compared with recent survey data. The Sensitivity Test addressed this inconsistency and is likely to provide a better indication of the amount of traffic that would divert from Hawthorn Road to Kennel Lane. In the 2018 AM Do-Something Sensitivity Test the forecast flow on Kennel Lane northbound is 188 pcus.
- 2.4.4 Notwithstanding the above, the Kennel Lane junction has been modelled with the forecast Core Scenario Do-Something traffic flows which indicates that the junction will operate within capacity. This assessment can be considered a 'worst case' assessment due to the likely slight over estimation in trips diverting to Kennel Lane northbound in this scenario. A test of this junction using sensitivity flows would improve the capacity assessment of the junction.
- 2.4.5 Within his evidence Mr Moore has asked for clarification on the reasons for the decrease in southbound flows on Kennel Lane. This decrease in flow can be attributed to trips originating from zones to the north of Lincoln which use Kennel Lane to access Reepham, Cherry Willingham and Fiskerton in the Do-Minimum. In the Do-Something these trips divert to the LEB, at its northern junction with the A158, and travel to the villages via the off-slip onto Hawthorn Road East and the roundabout at Greetwell Road. Consequently Kennel Lane flows reduce due to diversion of local destined southbound traffic onto LEB.
- 2.4.6 Mr Moore raises concerns about delays on the westbound approach to the A158 / Wragby Road / LEB roundabout leading to trips diverting to the LEB southbound via Kennel Lane and Hawthorn Road. The capacity of this junction has been assessed with the LEB in place. Full details were included in Paul Smith's Proof of Evidence. The assessment indicates that the junction is forecast to operate within capacity with minimal queueing and delay. Additionally this is the case at the junction in the VISUM model. No trips access the LEB southbound via Kennel Lane and Hawthorn Road westbound in any of the modelled scenarios.
- 2.4.7 With regards to traffic flows on Croft Lane Mr Moore raises concerns about the impact of the increase in northbound flows impacting on the operation of the priority junction with Hawthorn Road. The traffic surveys undertaken in March 2015 indicate that this junction is currently lightly trafficked with minimal queueing occurring on the Croft Lane arm.
- 2.4.8 The capacity of this junction has been assessed using the PICADY modelling software. The assessment considers the 2033 Design Year, with the LEB in place, in order to represent a 'worst case' scenario. Assessments have also been undertaken for both the Core Model and Sensitivity Test to account for the variability in traffic flows, predominantly on Hawthorn Road, between the two scenarios. In addition the 2015 surveyed flows have also been modelled in order to ensure the model reflects current conditions. The results are presented in Table 6 below.

Table 6 – Hawthorn Road / Croft Lane Capacity Assessment Results

Movement	AM		PM	
	Max RFC	Max Queue	Max RFC	Max Queue
2015 Surveyed				
Croft Lane Left Turn	0.235	0	0.221	0
Croft Lane Right Turn	0.321	1	0.370	1
Hawthorn Road Right Turn	0.323	1	0.345	1
2033 Do-Something Core Scenario				
Croft Lane Left Turn	0.426	1	0.005	0
Croft Lane Right Turn	0.650	2	0.568	1
Hawthorn Road Right Turn	0.417	1	0.341	1
2033 Do-Something Sensitivity Test				
Croft Lane Left Turn	0.401	1	0.005	0
Croft Lane Right Turn	0.528	1	0.566	1
Hawthorn Road Right Turn	0.416	1	0.310	0

2.4.9 The above table indicates that the junction is forecast to operate well within capacity upon the introduction of the LEB. The forecast assessments has been undertaken at the 2033 Design Year which provides a ‘worst case’ assessment. It is evident that the additional traffic flows on Croft Lane will not have a detrimental impact on the operation of the junction.

2.5 Queueing at Greetwell Road Double Mini Roundabouts.

2.5.1 Mr Moore has undertaken an operational analysis of the double mini roundabout at the junction of Greetwell Road and Outer Circle Road using a bespoke model he created which treats the junction in isolation. The analysis was undertaken for the AM peak hour only. The County Council does not accept that this approach provides a basis for concluding that Greetwell Road does not represent a reasonable convenient alternative route. Such an approach is not supported by DfT advice and would be inadequate to support any applications made to the department.

2.5.2 Mr Moore’s model is not validated against observed data and hence its predictions must be treated with caution. In contrast, the County Council’s model has been extensively validated and has been accepted by DfT as providing an appropriate basis for assessing the Scheme.

2.5.3 A key aspect of Mr Moore’s modelling approach is that it deals only with the junction in isolation with no opportunity for traffic to reassign onto other routes if delays become a deterrent. As a consequence, the delays forecast by Mr Moore’s model are likely to be over-estimated and this is confirmed by comparison with professionally collected survey data (see below). In contrast, the County Council’s model allows for junction delays to be taken into account for driver route choice and so traffic can reassign elsewhere if junction delays become large. In this way, it provides a more appropriate basis for assessing all of the alternative routes available following the implementation of the scheme.

2.5.4 While the County Council does not accept that the Greetwell Road/Outer Circle Road junction should be assessed in isolation (for the reasons given above), it has considered Mr Moore’s analysis in some detail and conducted a similar exercise

using industry standard software, in order to assist understanding of the issues. This exercise and the results are described below.

- 2.5.5 Mr Moore's capacity assessment of this double mini-roundabout predicts that with the AM peak hour traffic flows from the March 2015 survey, commissioned by LCC, a maximum queue of 81 vehicles will occur on the Greetwell Road East approach. This compares to a maximum observed queue of 21 vehicles and an average of 17 vehicles. Where a predicted output from a model differs greatly from an observed value, it would be normal practice to assume that the model may need to be refined to provide closer correlation with the observed value. In this case, Mr Moore takes a different approach and provides the following explanation:
- 2.5.6 *"I believe this queue survey to be inaccurate as to achieve a queue of only 21 with the counted entry and circulatory flows would have required an unfeasibly high value for the roundabout entry capacity parameters for the Greetwell Road (E) roundabout entry. Queue surveys are always difficult to conduct accurately and in this case an intermediate gap in the queue may have been mistaken for the end of the queue. During the HRAG surveys the queue on this arm of the junction was observed to regularly contain gaps as traffic dawdled to move up the queue or were affected by poor sightlines."*
- 2.5.7 The traffic counts and queue length surveys were undertaken by an experienced independent traffic survey company who are professionally obliged to report the survey results in an honest and unbiased way. It is highly unlikely that they would mistake a queue in the order of 80 vehicles for one in the order of 20 vehicles. Whilst gaps in queues do occur it is not accepted that these gaps were consistently mistaken for the end of the queue throughout the surveyed period. However, it is agreed, as Mr Moore states, that queue surveys are always difficult to conduct accurately and a more likely explanation for the discrepancy with the HRAG survey results is that the inexperienced HRAG team may well have interpreted slow moving traffic approaching the junction as queuing traffic.
- 2.5.8 In addition, journey time surveys which included Greetwell Road were commissioned by LCC and were conducted by the same survey company using the moving observer method. The data was collected during the AM, PM and Inter Peak periods and included five runs in each direction during each of these time periods. From the data supplied by the survey company, it is not possible to separately identify the delay at each junction, however, the recorded time for each section of the route include any delays experienced at junctions. The results of these surveys are shown in Table 7 below.

Table 7 – Journey Time Survey Results – Kennel Lane/High Street, Reepham to Greetwell Road/Allenby Road Junction

Peak	Run	Finish Time	Journey Time	Average
AM Peak	Run 1	08:21:27	00:12:53	00:08:24
	Run 2	08:35:21	00:06:48	
	Run 3	08:43:32	00:07:27	
	Run 4	08:51:45	08:03:00	
	Run 4	09:05:42	00:06:48	
Inter-Peak	Run 1	10:13:34	00:06:57	00:07:00
	Run 2	10:28:22	00:07:15	
	Run 3	10:42:34	00:06:36	
	Run 4	10:57:19	00:07:18	
	Run 5	11:11:19	00:06:54	
PM Peak	Run 1	17:14:01	00:07:15	00:06:55
	Run 2	17:28:52	00:06:54	
	Run 3	17:42:37	00:06:42	
	Run 4	17:43:58	00:06:48	
	Run 5	17:56:28	00:06:57	

NB "Finish Time" is the actual time that the survey vehicle crossed the stop line at the Greetwell Road/Outer Circle Road junction

- 2.5.9 It can be seen that through most of the periods surveyed, there is little variation in journey time on the section of route approaching the Outer Circle junction. If the Inter peak and PM peak times are taken as representing relatively free flow conditions, then three runs in the AM peak had additional delays of less than one minute. Only the earliest run which arrived at the Outer Circle Road at 08.21 showed a significantly longer delay, in the order of 5 to 6 minutes longer than at other times. This indicates that while longer queues and delays may occur at some times in a typical AM peak period, these issues are short lived and for the majority of the day, including the majority of the AM peak period, delays and queues are small.
- 2.5.10 Due to the considerable inconsistency between the 2015 observed and modelled queue in Mr Moore's model it is not accepted that the Mr Moore's model can be considered to be validated and provides an accurate basis to assess the forecast scenario. As such it is considered that Mr Moore's forecast Do-Something queue of over 300 vehicles at this location is an over estimation.
- 2.5.11 In order to provide a comparison, modelling of this junction, and in particular the Greetwell Road East approach, has been undertaken using ARCADY. Using a similar methodology as Mr Moore the intercept value of the Greetwell Road east approach has been adjusted in order to replicate observed queuing. This represents the more correct approach, having been calibrated to the levels of queueing observed in the March 2015 surveys commissioned by LCC. The results are presented in Table 8 along with the surveyed queue values. It can be seen that the modelled queues represent a close fit compared to the surveyed queues.

2.5.12 This ARCADY model has been used to assess the forecast traffic flows as per Mr Moore's analysis and in addition, the junction has been assessed using equivalent traffic forecasts for Objector's Alternative No 1. The results are presented in Table 8 and it can be seen that in the scenario with the Scheme, the Greetwell Road approach is forecast to operate with an RFC of 1.273 and with Objector's Alternative No 1 the equivalent value would be 1.150.

2.5.13 The ARCADY results demonstrate that in both of the 2018 cases presented the results have exceeded an RFC of 1.0. ARCADY results exceeding RFC 0.85 indicate capacity issues and, for ratios exceeding unity, the precise level of queueing is largely immaterial, the same conclusion can be drawn. This particular arm is oversaturated and there is no realistic difference between an ARCADY predicted queue of 205 and one of 124. These results are in part due to traffic volume but also in part to the difficulties involved in the assessment of double mini-roundabouts. In the same way as Mr Moore, the County Council has addressed the issue from a single arm perspective which overcomes the difficulty of limited internal stacking, however the general conclusion is that a more macro-level of analysis is appropriate under the current objectives, which is to test the safe and reasonable alternative routes to Hawthorn Road. Dr Billington presents this analysis in his evidence

Table 8 – Greetwell Road / Allenby Road Capacity Assessment Results

Approach	AM				
	Max RFC	Max Queue		Average Queue	
		Model	Survey	Model	Survey
2015 Surveyed					
Greetwell Road E	0.987	21	21	16.5	17.5
2018 Do-Something					
Greetwell Road E	1.273	220	-	139	-
2018 Do-Something Sensitivity Test					
Greetwell Road E	1.253	205		130	
2018 Objector's Alternative 1					
Greetwell Road E	1.150	124		80	

2.5.14 Moreover, as previously stated, the above analysis suggesting queues of several hundred vehicles under future year conditions are considered to be excessively pessimistic from a demand perspective. In the event of traffic demand being so high, it is likely that drivers would readjust their behaviour due to an excess of demand in this vicinity and spare capacity elsewhere. A proportion of travellers would choose alternative times of travel, alternative modes and ultimately alternative destinations for travel, reducing the level of delay. The assessment of such variation is not possible with the use of an ARCADY model.

2.5.15 All of the analysis undertaken by Mr Moore and LCC, and the interpretation above, is limited to the AM peak hour period which represents in the order of 10 or 11% of the total daily traffic in the study area. Even if excessive delays were to occur at this junction on a regular basis, approximately 90% of traffic movements through the day would find the routes which include the Greetwell Road/Outer Circle Road to be available for use without any or any excessive delay at most times. For example, as shown the response to Mr Walton's questions, journeys made for retail-related purposes are predominantly made outside of the AM peak hour. The route remains therefore for the reasons given by Dr Billington as part of the network providing the

reasonably convenient alternatives to the current users of Hawthorn Road following its partial closure.

- 2.5.16 The junction is recognised by LCC as already being a sensitive interchange and it is accepted that LCC as the Highway Authority has a Statutory Duty under The Traffic Management Act 2004 to ensure that the junction operates at an acceptable level regardless of the construction of the LEB.
- 2.5.17 Some limited enhancement to existing mini-roundabout configuration, in terms of increased stopline capacity on the Greetwell Road E arm, would improve the 2018 DS operation to above that of the 2015 survey analysis (RfC 0.807 with a maximum queue of 4 vehicles). Although outside the remit of the LEB scheme, this assessment provides confidence that the efficient operation of this junction can be maintained into the future in advance of significant new development in the surrounding area.
- 2.5.18 Beyond this limited improvement, a masterplan proposal for the full build-out of the NEQ development (submitted as part of the recent Phase 1 planning application for 500 houses) has indicated a signalised layout for the junction. In order to assess the implications of this, the layout has been tested for 2018 Do Something flows, using LINSIG, and the maximum Degree of Saturation (DoS), where a figure below 90% indicates efficient operation, is reported in the PM peak on Outer Circle Road with DoS 75% and a queue of 8 vehicles. The Greetwell Road East arm has a maximum DoS of 69% and queue of 9 vehicles in the AM peak. This layout is demonstrably effective in maintaining the traffic flow at this location.
- 2.5.19 In summary, the County Council does not accept that Mr Moore's approach, albeit limited to the AM peak hour, to assessing the Greetwell Road/Outer Circle Road is appropriate in determining whether the routes which pass through it are reasonably convenient. In addition, any future issues which may result from the Scheme would most likely be matched by similar issues resulting from Objector's Alternative 1. Further, the County Council has a responsibility to maintain an acceptable level of operation on its network and although the junction is outside of the Scheme an appropriate solution for this junction has been identified and tested, should this be considered necessary in the future.

2.6 *Improvements to Wickes Roundabout*

- 2.6.1 The Side Roads Order cannot be conditional on improvement elsewhere. Analysis of the Wickes Roundabout (Greetwell Road/Allenby Road Junction) has indicated that there are feasible options for addressing the specified location and that traffic progression can be maintained. Therefore there is no need for any conditionality, even if it were allowed.

2.7 *Modelling of Bunkers Hill / Hawthorn Road and Wragby Road / Kennel Lane Priority Junctions*

- 2.7.1 Mr Moore raises concerns regarding the modelling of the Bunkers Hill / Hawthorn Road junction. As the modelled flows on Hawthorn Road are higher than those observed in the 2015 surveys he raises the issue that the model may not accurately reflect the relief at this junction due to the introduction of the LEB.
- 2.7.2 As previously described it has been identified that there are inconsistencies between the 2006 traffic data available at Hawthorn Road and more recent surveys. The

Sensitivity Test has lower flows on Hawthorn Road westbound. The junction has been modelled with the Sensitivity Test forecast traffic flows. The results indicate a similar pattern to the Core Scenario test with the junction forecast to be over capacity in the Do-Minimum. The junction performance improves in the Do-Something and is forecast to operate well within capacity whereas with Hawthorn Road still in place, as per the Alternatives, the junction will fail.

- 2.7.3 Mr Moore also raises concerns about queueing on Bunkers Hill southbound having the potential to block back to the Hawthorn Road junction, thus effecting capacity. The introduction of the LEB is forecast to result in a significant reduction in traffic flows on Bunkers Hill and Wragby Road, to the west of the scheme. For example, in the 2033 AM peak hour, queues on the Wragby Road East approach to the traffic signal junction with Outer Circle Road are forecast to reduce from 54 pcus to 14 pcus. It is therefore anticipated that the reduction in flows on this link will result in reducing queueing and blocking back, thus improving the operation of the Bunkers Hill / Hawthorn Road junction.
- 2.7.4 Mr Moore questions the impact of platooning on the performance of the Wragby Road / Kennel Lane interchange. The crossing is almost 3km upstream of the subject junction with 5 intervening junctions. It is considered that over this length of route and assuming an average travel speed of 50kph (from standstill to national speed limit) vehicles will have around 3 and a half minutes or so to accelerate and adjust their headways to a more standardised profile and therefore the impact of a sporadic crossing closure would be minimised.
- 2.7.5 Furthermore, and dependent upon the direction of train travel, closures of crossings in Cherry Willingham and Reepham will temporarily reduce the demand for turns out of Kennel Lane as eastbound trains through the villages will require early closure of the respective crossings. The platooning effect of arrivals at the Kennel Lane stopline will coincide with reduced movement for westbound traffic on the A158 as the A158 crossing is subsequently closed.
- 2.7.6 In any case the closures are sporadic events and should not impact on the strategic capacity of the movement.

2.8 Speed Surveys

- 2.8.1 It is generally agreed that speed reduction in dense residential areas is beneficial and that closure of access roads is not the only tool available to achieve this.

2.9 Conclusions

- 2.9.1 Mr Moore has focussed on several areas of detail within the model primarily related to perceived conflicts between observed data and also the match between observed data and model outputs. This has been used as a pretext to cast doubt onto the conclusions of operational assessments of key junctions and the traffic relief that is afforded by the LEB scheme.
- 2.9.2 The explanations provided within our response cover a number of issues. Firstly the level of “validation” at several sites is addressed. This level of local detail is not usually considered in traffic models focussed on schemes such as the LEB.

Validation of the LEB model has in fact been carried out at other sites across the city and the locations considered by Mr Moore are in fact minor movements in terms of their impact on the strategic modelled case. The validation across the majority of sites highlighted is not unreasonable given the close level of detail being considered.

- 2.9.3 The discrepancy in surveys highlighted by Mr Moore was noted by the model development team and led to the analysis of an alternative sensitivity test based on updated observed data. In the sensitivity test the flows match the recent observed data much more closely whilst the conclusions on operational effectiveness of the LEB remain constant.
- 2.9.4 In respect of flow patterns the queries of Mr Moore have all been answered and the operational performance of relevant junctions has been found to be acceptable. The modelling supports the assessment of reasonably convenient alternative routes established in the evidence from Dr Billington.
- 2.9.5 Mr Moore has estimated the consequences of LEB on the Greetwell Road mini roundabouts. Based on the quoted model queue figures this does not appear to be convincing analysis and the level of queueing quoted in forecast scenarios would seem to be improbable, particularly given alternative choices. In any event the junction is outside of the scope of the Inquiry and the capacity effects of LEB, NEQ and any other traffic will be dealt with as part of the statutory duties of the highway authority. It has been demonstrated that a limited improvement to the existing mini-roundabout layout would maintain efficient operation of the junction prior to any development in the surrounding area. An indicative signalised improvement scheme for this junction proposed as part of the NEQ Masterplan results in no significant over capacity issues once the full development has been delivered.
- 2.9.6 The operational characteristics of Bunkers Hill / Hawthorn Road and Kennel Lane / Wragby Road have been addressed. It would not be standard practice to assess the extent to which the level crossing on the A158 may generate platooning sufficient to cause issues for the Kennel Lane egress due to the minimal impact such a matter will have on the day to day operations of the junction.

3 Response to Questions and Rebuttal

- 3.1.1 Responses to questions to Mr Moore and Mr Moore's rebuttal of Mr Smith's proof of evidence will be provided separately.