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1.1 Introduction

1.1.1 This technical note provides supplementary modelling evidence in support of the published Local Plan Transport Highway Impact Assessment (THIA)[1].

1.1.2 Findings from the October 2019 THIA modelling addendum[2], suggest that the junction of A132/Church End Lane (W3) in north Wickford will likely remain over-capacity at the end of the Local Plan period, despite provision of potential mitigation in the form of a mini-roundabout to help manage the impact of traffic growth. At the same time, a mini-roundabout layout would disadvantage northbound flows along the A132, and as such, would unlikely be supported by Essex County Council (ECC) if mainline flows are impeded.

1.1.3 Prior to consideration of a mini-roundabout as a potential mitigation measure, other proposals for the A132/Church End Lane junction were considered unviable. The proximity of St. Mary's Church to the junction restricts the space available to provide a right-turn lane from the A132 to Church End Lane. Restricting turning movements at the junction was believed likely to move the same junction capacity issues south along the A132 to the junction with Harold Gardens, and would lead to undesirable levels of traffic rerouting through residential areas.

1.1.4 Whilst proposals for a grade-separated junction on the A127 at Pound Lane / Cranfield Park Road may further mitigate traffic growth along the A132 corridor through Wickford, the scheme is subject to a full business case appraisal to determine its viability. It is therefore important to be able to demonstrate that the road network across Basildon, Billericay and Wickford can reasonably accommodate future growth without the A127 junction included as Local Plan mitigation.

1.1.5 Whilst THIA modelling has indicated that provision of a mini-roundabout at Junction W3 should result in a nil-detriment impact of Local Plan development trips across the junction as a whole, concern remains around the acceptability of the proposed mitigation in terms of its impact on the A132, as well as the limited capacity benefits it practically affords. ECC and BBC are therefore looking to better understand the future situation with/without the proposed mitigation at Junction W3 so as to determine the scope for sustainable transport links in the short-medium term, before a large-scale infrastructure measure – such as the proposed new A127 junction, could potentially be implemented.

1.2 Caveats around local junction modelling

1.2.1 It is important to acknowledge that the accuracy of junction model outputs reduces once a junction exceeds capacity. This is because the model uses fixed demand matrices that are unresponsive to delay calculated at the junction once flow exceeds practical capacity.

1.2.2 Local junction models are based on empirical data, defined geometry parameters and fixed capacity calculations. It is not always possible to account for nuanced driver behaviour at junctions, particularly

[1] 'Basildon Local Plan Part 1 - Draft Local Plan Transport & Highway Impact Assessment': Essex Highways, July 2017 (EV074_BC)
'Basildon Local Plan Part 2 – Publication Local Plan Transport & Highway Impact Assessment': Essex Highways, March 2018 (EV069_BC)
'Basildon Local Plan Part 2 Transport & Highway Impact Assessment (March 2018) Addendum': Essex Highways, August 2018 (EV075_BC)

[2] 'Basildon Local Plan: Publication Local Plan Transport & Highway Impact Assessment – Pound Lane/Cranfield Park Road Junction Addendum', Essex Highways, October 2019

those operating over-capacity. This might include major movements voluntarily giving way to minor movements under congested conditions (for example).

1.2.3 For this reason, results at Junction W3 should be treated as indicative of a 'worst-case scenario' rather than a true reflection of future performance. This is explored further in the following sections.

2.1 2014 junction modelling

2.1.1 Base year 2014 junction capacity analysis shows Junction W3 to be operating significantly over-capacity in the PM peak with a Ratio-of-Flow-to-Capacity (RFC) of 1.34. Indicatively, this equates to a delay of over 7 minutes along Church End Lane and just under 2 minutes on the A132 southbound approach.

2.1.2 These delays have been compared against Teletrac data for 2014. Specifically, analysis of average PM peak hour vehicle speeds as a percentage of free-flow speeds through Junction W3. This analysis has been mapped to provide a visual indicator of congestion on the approaches to the junction.

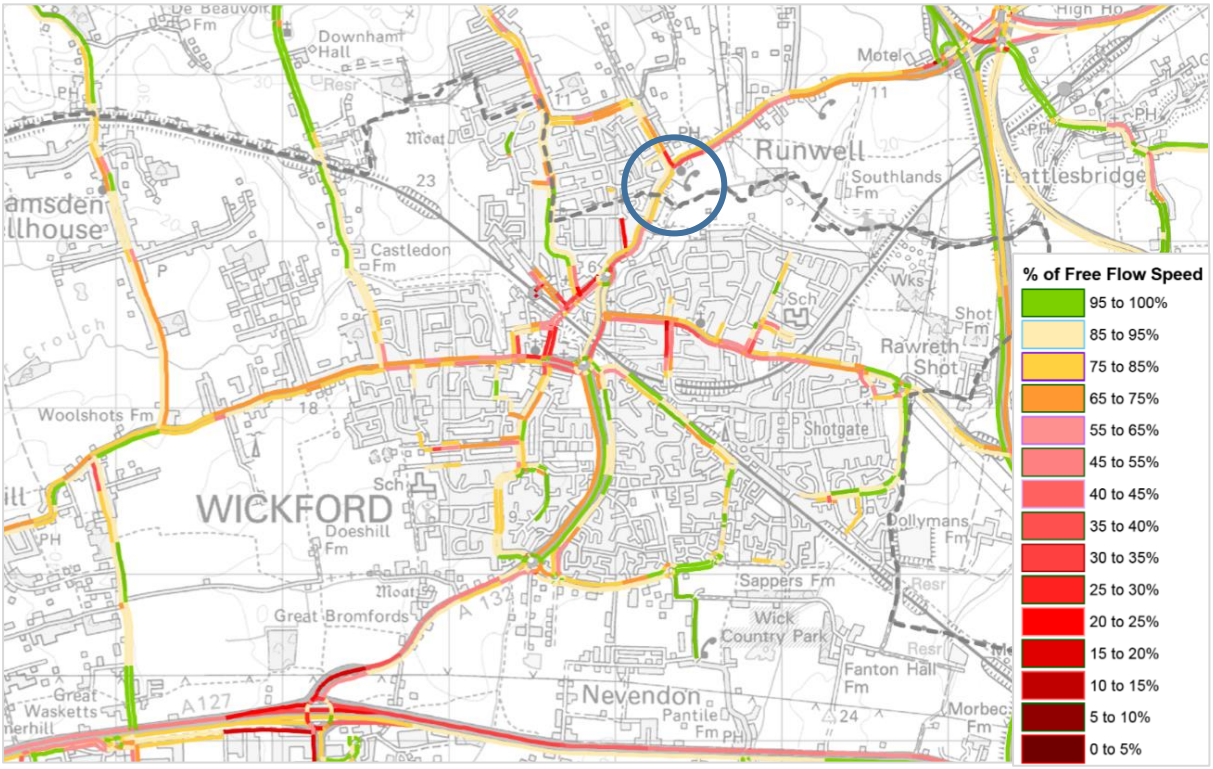

Figure 1 – Neutral month comparison of average PM peak hour vehicle speeds vs free flow speeds. Junction W3 circled.

2.1.3 With reference to Figure 1 above, average PM peak hour speeds along the A132 southbound (for example) are shown to be around 25% of free-flow in the immediate vicinity of the junction. This increases to 50-75% of free-flow speeds 100m away from the junction. Assuming a free-flow speed of 30mph, this equates to a typical journey time delay on the A132 southbound approach to the junction of around 20 seconds, with similar delays apparent along Church End Lane.

2.1.4 There is an argument, therefore, to suggest that the modelled base year delay calculated at Junction W3 could be overstated. Although not possible to quantify robustly, the inference from the base year comparison of delay at Junction W3, is that the forecast year delay modelled at the junction for the

various scenarios in the THIA might reasonably be considered an 'upper-limit', if not an over-estimate of what might be expected.

2.2 Excess peak hour demand

2.2.1 The junction modelling presented in the THIA is acknowledged to be a worst-case scenario as the forecast flows used in the matrix development do not account for variable demand elements such as route choice, peak spreading and mode-shift, all of which would be expected to occur in response to peak hour network congestion.

2.2.2 To consider the potential impact of variable demand at Junction W3, capacity outputs from the AM and PM peak junction models were reviewed for the following scenarios:

- Scenario 2 - 2034 Final Growth Scenario – No mitigation
- Scenario 3b – 2034 Final Growth Scenario - With mini-roundabout layout

2.2.3 Model outputs from the Junctions 9 modelling package provide approach arm RFC values for each quarter-hour period of the assessed peak. The junction modelling undertaken for the THIA studies assumes a peaked demand profile (see Figure 2 in paragraph 5.1.4 as an illustration) with higher peak flows in the latter quarter-hour periods. RFC values for the busiest quarter-hour period are then stated in the THIA reports as a robust 'worst-case' assessment of peak hour conditions.

2.2.4 Table 1 below highlights the modelled vehicle demand in Passenger Car Units (PCUs) and capacity for each approach arm of Junction W3 per quarter-hour period of the AM and PM peak hour. Flows are based on Scenario 2, representing a 2034 forecast year with full Local Plan development and background growth but with no mitigation at the junction. The difference between demand and capacity accumulated across the four quarter hour periods can be used to gauge the extent of spare peak hour capacity on each approach arm, with negative values representing the volume of excess peak hour demand modelled at the junction.

Scenario 2 AM	08:00-08:15		08:15-08:30		08:30-08:45		08:45-09:00	
Arm	Demand (PCU)	Capacity (PCU)	Demand (PCU)	Capacity (PCU)	Demand (PCU)	Capacity (PCU)	Demand (PCU)	Capacity (PCU)
A132 Runwell Rd North	250	251	306	232	306	232	250	251
A132 Runwell Rd South	235	∞	288	∞	288	∞	235	∞
Church End Lane	58	121	71	2	71	0	58	0

Scenario 2 PM	17:00-17:15		17:15-17:30		17:30-17:45		17:45-18:00	
Arm	Demand (PCU)	Capacity (PCU)	Demand (PCU)	Capacity (PCU)	Demand (PCU)	Capacity (PCU)	Demand (PCU)	Capacity (PCU)
A132 Runwell Rd North	286	236	351	210	351	210	286	236
A132 Runwell Rd South	284	∞	348	∞	348	∞	284	∞
Church End Lane	59	29	73	0	73	0	59	0

Scenario 2 AM	
Arm	Spare Peak Hour Capacity (PCU)
A132 Runwell Rd North	-145
A132 Runwell Rd South	-
Church End Lane	-135

Scenario 2 PM	
Arm	Spare Peak Hour Capacity (PCU)
A132 Runwell Rd North	-383
A132 Runwell Rd South	-
Church End Lane	-234

Table 1 – Volume of excess peak hour demand predicted at Junction W3 in Scenario 2 (existing layout)

2.2.5 A review of outputs shown in Table 1 suggests that, without mitigation in 2034, approximately 150 vehicles on both the A132 northern approach arm and Church End Lane cannot be accommodated in the AM Peak and will not get through the junction. These values rise to approximately 400 and 250 vehicles respectively in the PM Peak.

2.2.6 Table 2 below highlights the modelled vehicle demand and capacity for each approach arm of Junction W3 per quarter-hour period of the AM and PM peak hour. Flows are based on Scenario 3b, representing a 2034 forecast year with full Local Plan development and background growth, and the redesign of the junction as a mini-roundabout to help reduce the RFC value of the worst performing junction arm (Church End Lane).

Scenario 3b AM	08:00-08:15		08:15-08:30		08:30-08:45		08:45-09:00	
Arm	Demand (PCU)	Capacity (PCU)	Demand (PCU)	Capacity (PCU)	Demand (PCU)	Capacity (PCU)	Demand (PCU)	Capacity (PCU)
A132 Runwell Rd North	209	248	250	246	306	245	306	245
A132 Runwell Rd South	197	214	235	168	288	209	288	209
Church End Lane	49	112	58	102	71	101	71	101

Scenario 3b PM	17:00-17:15		17:15-17:30		17:30-17:45		17:45-18:00	
Arm	Demand (PCU)	Capacity (PCU)	Demand (PCU)	Capacity (PCU)	Demand (PCU)	Capacity (PCU)	Demand (PCU)	Capacity (PCU)
A132 Runwell Rd North	240	246	286	244	351	242	351	242
A132 Runwell Rd South	238	212	284	210	348	210	348	210
Church End Lane	50	102	59	100	73	99	73	99

Scenario 3b AM		
Arm	Pre/Post Peak Demand (PCU)*	Spare Peak Hour Capacity (PCU)
A132 Runwell Rd North	41	-127
A132 Runwell Rd South	38	-246
Church End Lane	10	157

Scenario 3b PM		
Arm	Pre/Post Peak Demand (PCU)*	Spare Peak Hour Capacity (PCU)
A132 Runwell Rd North	47	-299
A132 Runwell Rd South	46	-423
Church End Lane	10	137

* Junctions 9 roundabout modelling in the THIA assumes a peaked demand profile with a small proportion of demand allocated before and after the peak hour. This demand has been factored into the calculation of spare peak hour capacity.

Table 2 – Volume of excess peak hour demand predicted at Junction W3 in Scenario 3b (mini-roundabout layout)

2.2.7 A review of outputs shown in Table 2 suggests that, with a revised mini-roundabout layout at Junction W3, approximately 125 vehicles on the A132 northern approach arm and 250 vehicles on the A132 southern approach arm cannot be accommodated in the AM Peak. These values rise to approximately 300 and 425 vehicles respectively in the PM Peak.

2.2.8 The redesign of the junction does provide spare peak hour capacity on the Church End Lane approach arm and reduces the level of excess peak hour demand modelled on the A132 northern approach arm. As shown in Table 3 below, this is reflected in a significant improvement in the RFC value modelled on Church End Lane. However, a high level of excess peak hour demand is modelled on the A132 southern approach arm as a result of the change in junction layout. This generates a larger volume of excess peak hour demand modelled at the junction overall.

AM PEAK	Existing Layout (Scenario 2)	With Mitigation (Scenario 3b)
Arm	RFC	RFC
A132 Runwell Rd North	1.32	1.25
A132 Runwell Rd South	-	1.38
Church End Lane	2.00+	0.7

PM PEAK	Existing Layout (Scenario 2)	With Mitigation (Scenario 3b)
Arm	RFC	RFC
A132 Runwell Rd North	1.67	1.45
A132 Runwell Rd South	-	1.66
Church End Lane	2.00+	0.73

Table 3 – Peak hour RFC values modelled at Junction W3 with/without mitigation

3.1 Variable Demand: Route choice

3.1.1 The THIA junction modelling considers junctions in isolation, and whilst forecast development trips are assigned to a wider modelled network before being incorporated into junction demand matrices, the impact of forecast congestion at junctions on the reassignment of background traffic and Local Plan trips is not specifically modelled.

3.1.2 It is not possible to quantify the likely extent of route reassignment away from over-capacity junctions without use of a detailed assignment model. A sensitivity test using a manual reassignment of trips between routes in Wickford would prove challenging in this instance, given the difficulty in judging future journey times along competing routes, and estimating the quantum of local background traffic that would be considered 'in-scope' to transfer to alternative routes.

3.1.3 Nevertheless, there would be an expectation that a proportion of the 'excess' vehicle demand modelled at Junction W3 would alter their route choice to avoid potential delays at the junction in the future.

3.2 Variable Demand: Peak spreading

3.2.1 The THIA junction modelling analysis does not consider the impact of peak spreading and assumes a typical peaked demand profile in the AM and PM capacity appraisals. Figure 2 below provides an illustration of a junction operating over-capacity with no demand responsivity to congested conditions experienced.

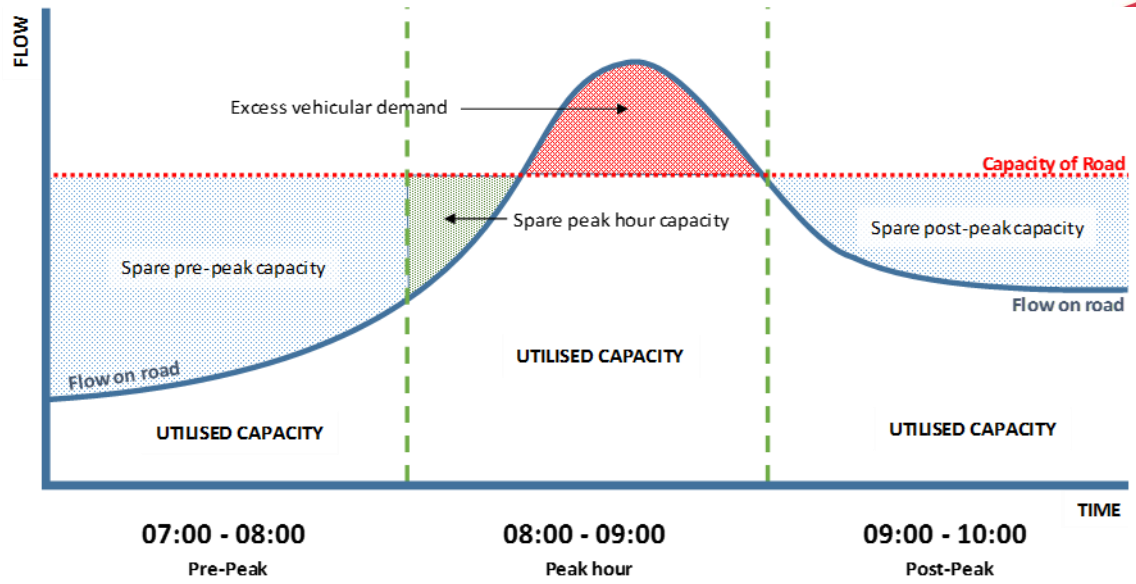

Figure 2 - Illustration of capacity at a congested junction across a three-hour peak period

3.2.2 In reality, it might be expected that people will vary their time of travel to avoid the peak hour extents of network congestion. Figure 3 illustrates the impact of peak spreading at a typical junction, with the graph showing a flatter peak period demand profile.

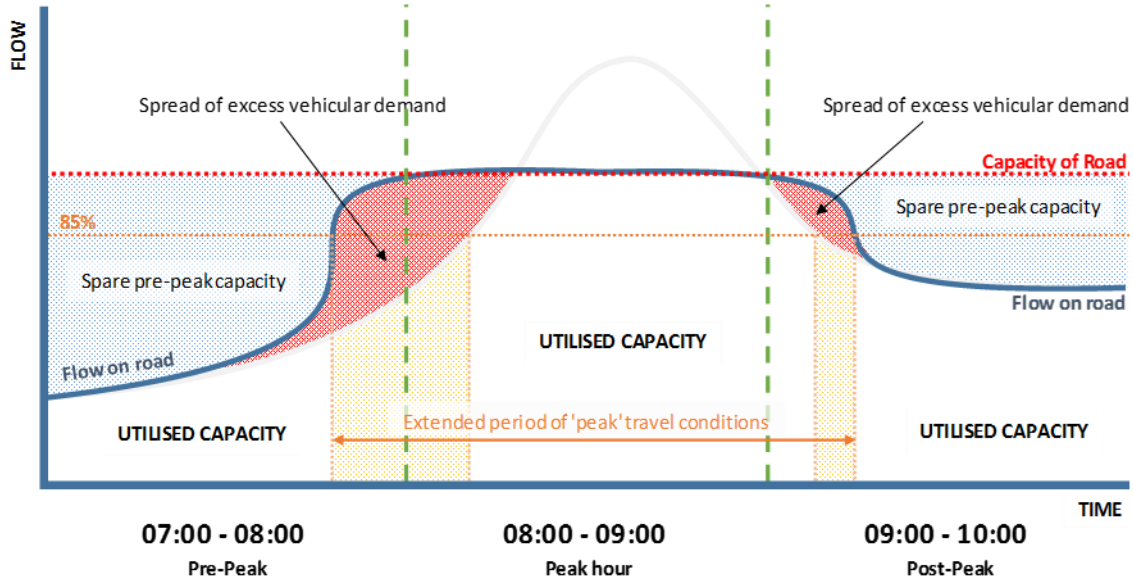

Figure 3 - Illustration of the impact of peak spreading

3.2.3 Peak spreading is the process of transferring excess peak hour demand to the peak shoulders (pre/post peak hour). This results in a lengthened period of time across the peak hour and peak shoulders where 'typical' peak travel conditions are experienced, with moderate levels of congestion and delay at junctions.

3.2.4 Where there is little spare peak period capacity at a junction, either before or after peak spreading, it is likely that 'typical peak travel' conditions will be spread over a greater proportion of the peak period. Tolerance of extended peak travel conditions is subjective, and the need for capacity improvements or sustainable mitigation will be dependent on tolerance limits.

3.2.5 In order to gain a better understanding of peak spreading at Junction W3 in Wickford, it would be possible to collect additional traffic count data in the future and undertake further analysis. This would help better understand the vehicle demand profile at the junction over a three-hour period across both the AM and PM peaks. The profile could then be updated to a forecast year with traffic growth applied proportionally across the three-hour period. Spare peak hour and peak shoulder capacity could then be evaluated to determine the extent to which excess peak hour demand could be accommodated across a wider peak period.

3.3 Variable Demand: Mode-shift

3.3.1 The THIA junction modelling does not directly consider the impact of mode-shift – the transfer of trips to alternative modes of transport, on future network capacity. Instead, an RFC value of 1.15 has been used in the THIA as a threshold for the consideration of infrastructure mitigation at specific junctions. Junctions modelled with maximum approach arm RFCs of between 1.00 and 1.15 are shown to be over-capacity but with excess peak hour demand that could potentially be accommodated through peak spreading and mode-shift to sustainable alternatives.

3.3.2 At the time of the junction capacity modelling for the THIA, location-specific sustainable mitigation had not been identified from which to evaluate the impact on traffic flows through assessed junctions in Basildon, Wickford and Billericay. It was also acknowledged that mode shift to sustainable measures could not be modelled robustly without more detailed demand modelling that fell outside the strategic scope of the Local Plan modelling.

3.3.3 A separate study has since been commissioned to look at 'aspirational' peak hour car trip reductions at assessed junctions in Basildon, Wickford and Billericay, through mode-shift to walking, cycling and public transport modes. This is detailed in the Task 5 technical note: 'Basildon Local Plan Examination Support – Assessing implications of mode-shift on junction capacity mitigation modelling', Essex Highways, January 2020.

3.3.4 Findings suggest that there is reasoned justification for lowering Local Plan development car trip rates given the prevalence of existing bus and rail services in the vicinity of proposed development sites. With a higher level of public transport usage modelled, sensitivity testing demonstrated the potential for a peak hour reduction in Local Plan development traffic at Junction W3 of 19% in both the AM and PM peaks. This would, however, be dependent on there being available capacity on the existing public transport network to accommodate growth in demand from new developments.

3.3.5 Background traffic was not discounted as part of the sensitivity testing. Therefore, the overall reduction in vehicle demand at Junction W3 was modelled as 60 vehicles (2.5%) in the AM peak and 88 vehicles (3.2%) in the PM peak. This was shown to have little overall impact on the future capacity of the junction. However, these values might reasonably be increased with further investment in bus, walking and cycling infrastructure in the area, targeting mode shift amongst existing residents.

4.1 Summary & Next Steps

4.1.1 Table 4 below summarises the excess peak hour demand modelled at Junction W3 in 2034 with full background and Local Plan development – both with and without proposed mitigation. The modelled peak hour reduction in vehicle flow as a result of limited mode-shift amongst Local Plan development trips is also stated.

AM PEAK	Existing Layout (Scenario 2)	With Mitigation (Scenario 3b)	Limited mode-shift reduction
Arm	Excess Peak Hour Demand (PCU)	Excess Peak Hour Demand (PCU)	Peak Hour Demand (PCU)
A132 Runwell Rd North	145	127	-4
A132 Runwell Rd South	-	246	-33
Church End Lane	135	0	-23

PM PEAK	Existing Layout (Scenario 2)	With Mitigation (Scenario 3b)	Limited mode-shift reduction
Arm	Excess Peak Hour Demand (PCU)	Excess Peak Hour Demand (PCU)	Peak Hour Demand (PCU)
A132 Runwell Rd North	383	299	-87
A132 Runwell Rd South	-	423	-1
Church End Lane	234	0	0

Table 4 – Summary of excess peak hour demand alongside limited mode-shift reduction in vehicle flow

4.1.2 Current mitigation proposed at the junction in the form of a mini-roundabout has been shown in the THIA reporting to negate the impact of Local Plan development across the junction as a whole. However, it should be noted that the revised junction layout disadvantages flows along the A132 from the south in order to improve access to/from Church End Lane. As a consequence, the junction is modelled to remain over capacity with excess peak hour demand, both with and without a mini-roundabout layout. This brings into question the practicality of implementing the proposed mitigation and places greater emphasis on the need to consider the impact of improved sustainable transport links on flows through the junction.

4.1.3 Outline modelling, in the absence of more detailed sustainable demand modelling, suggests that the provision of further bus, rail, walking and cycling infrastructure and/or services would likely result in a modest reduction in development trips through Junction W3. However, there would seem to be scope for a further reduction in traffic flow at the junction through mode-shift amongst existing local (background) trips. To quantify this would require a more detailed appraisal of proposed sustainable transport measures in and around Wickford.

4.1.4 The importance placed on new sustainable transport links to encourage mode shift and reduce traffic flows at the Church End Lane / A132 Runwell Road junction, will likely be shaped by the extent to which the wider peak periods can accommodate excess demand from the peak hours, and the tolerance levels considered acceptable by the public and local authorities, for extended periods of congestion at the junction.

4.1.5 There would be an expectation that alongside peak spreading, a proportion of excess peak hour demand at Junction W3 would re-route away from the A132 to avoid congestion. Whilst neither re-routing or peak spreading is desirable, the extent to which excess modelled demand shown in Table 4 would take the form of peak hour queuing at the junction, would be expected to be smaller than the junction capacity modelling suggests.

4.1.6 With the use of updated turning movement survey data at Junction W3, it would be possible to determine the vehicle demand profile at the junction over a three-hour period across both the AM and PM peaks. Junction capacity assessments could then be undertaken to evaluate the extent to which the excess peak hour demand modelled at the junction (as shown in Table 4 above) can be accommodated across the wider peak periods.