A47 North Tuddenham to Easton Junction & Sideroad Strategy

PCF STAGE NO. 3

HE551489-GTY-HGN-000-RP-CH-30001
February 2020
P01

Notice

Highways England Programme Leader:	Peter Havlicek
Highways England Project Manager:	James Powis
Galliford Try Sweco Delivery Integration Partner:	Joe Goldie
PCF STAGE NO Supplier:	SWECO UK LTD

Document control

Client	HIGHWAYS ENGLAND
Project	A47 North Tuddenham to Easton
Document title	Junction & Sideroad Strategy
Job no.	HE551489
Document reference	HE551489-GTY-HGN-000-RP-CH-30001

Revision history

Job number: HE551489			Document ref: HE551489-GTY-HGN-000-RP-CH-30001			
Revision	Purpose description	Originator	Checked	Approved	Authorised	Date
P01	FOR INFORMATION	RE/SO	JMc	XC	BA	Feb 2020

Prepared for:

Galliford Try
Cowley Business Park
Cowley
Uxbridge
Middlesex
UB8 2AL

Prepared by:

Sweco UK Ltd
Grove House
Mansion Gate Dr
Leeds
LS7 4DN

Table of contents

Appendices

Figures

Tables

1. Scheme Introduction

1.1. Background

The A47 is an important connection linking the cities of Norwich and Peterborough, the towns of Wisbech, Kings Lynn, Dereham, Great Yarmouth and Lowestoft and a succession of villages in what is a largely rural area.

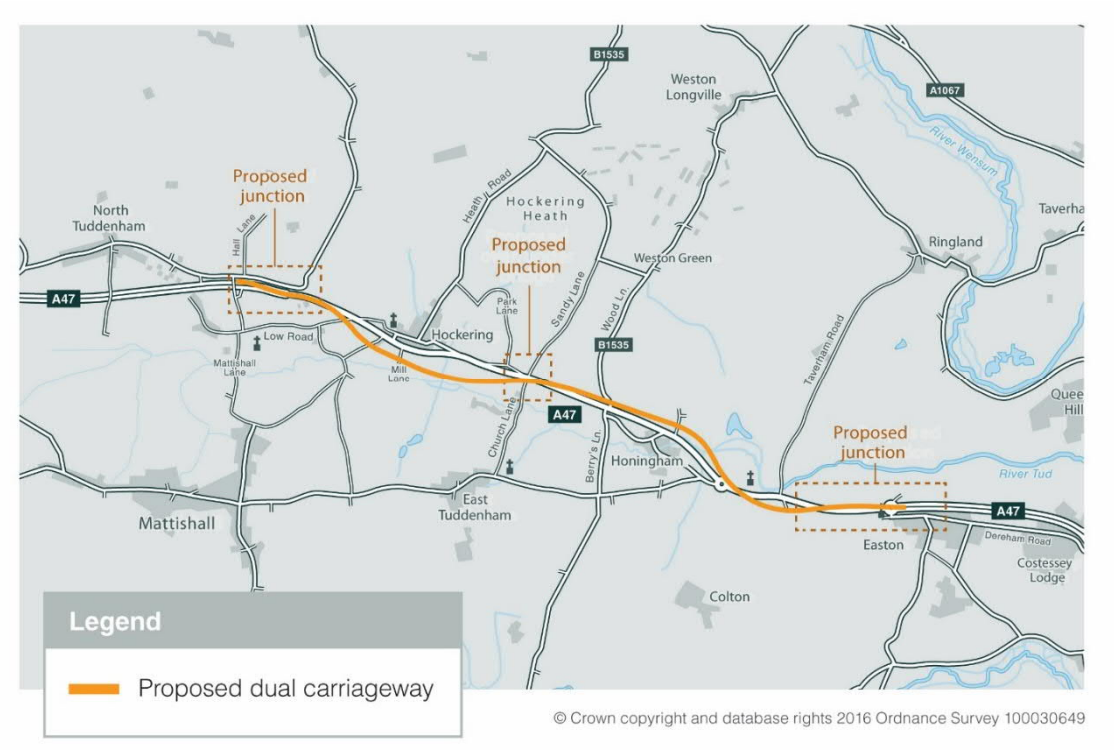
As part of a £15.1 billion investment to improve journeys on England's major A roads and motorways, the Government announced a package of 6 schemes on the 115 mile stretch of the A47 between Peterborough and Great Yarmouth. Together, the proposals will relieve congestion and improve the reliability of journey times for drivers.

This scheme aims to improve the section of the A47 between North Tuddenham and Easton, which is currently single carriageway. This single carriageway section acts as a bottleneck, resulting in congestion, longer journey times and contributes to a poor safety record.

The proposed scheme will relieve congestion, reduce journey times, encourage economic growth and improve our customers' safety and experience.

Following initial public consultation, a preferred route (the PRA alignment) was published for further development before statutory consultation; see Figure 1-1.

Figure 1-1 : A47 North Tuddenham to Easton Preferred Route



1.2. Purpose of Report

1.2.1. Assess the Stage 2 Traffic Figures and provide a technical recommendation on the Junction layout for the 3 proposed junction locations announced at PRA.

1.2.2. Assess the Stage 2 Traffic Figures and provide a technical recommendation on the Sideroad layout for the scheme to maintain connectivity.

1.2.3. Assess the Stage 2 Traffic Figures with allowance made for the inclusion of the Norwich Western Link scheme which announced Preferred Route Alignment in July 2019 and provide a technical recommendation on the Junction Layouts.

1.2.4. Assess the Stage 2 Traffic Figures with allowance made for the inclusion of the Norwich Western Link scheme which announced Preferred Route Alignment in July 2019 and provide a technical recommendation on the Sideroad Layouts.

1.2.5. Assess the mainline geometry design to ensure compliance with the scheme high level requirements.

1.2.6. Identify proposed lay-by locations to ensure consistency of provision on the network and replace those lost from the single lane A47 section of carriageway

1.2.7. Provide a junction and sideroad recommendation based on technical expertise, in line with current design standards and the HE Scheme Objectives.

2. Junction Strategy

2.1. High Level Strategy

The PRA alignment, shown in Figure 1-1, outlines three proposed junction locations at:

- Fox Lane
- Sandy Lane/Church Lane
- Easton (at site of existing roundabout)

The Stage 2 Design contained several assumptions which are detailed below:

- The mainline geometry was designed for at-grade roundabouts
- The junction at Fox Lane remained in its current form
- No allowance made for lay-by provision on the proposed A47 mainline
- The existing roundabout linking the single carriageway A47 to the dual carriageway A47 and intersection with Dereham Road and Church Lane will be removed as part of the scheme.

Appendix A should be referred to for a layout plan showing the overall scheme layout including the mainline layout and junction form.

2.2. A47 Cross Section

2.2.1. Existing Cross Section

The existing A47 cross section varies between 7-7.5m of single carriageway (3.5 - 3.7m per lane) with 0.5m hard strips on both sides.

There is a total of 41 direct accesses along the existing A47 route. This is made up of a mixture of simple T junctions and ghost island junction layouts as well as private accesses for residential properties and businesses. There are also a number of field accesses for various landowners.

2.2.2. Proposed Cross Section

The proposed cross section will be a D2AP comprising of a 7.3m wide carriageway with 1.0m hard strips. Both the central reserve, and verges on either side of the carriageway, will be a minimum of 2.5m wide. Widening for visibility will be provided where required in accordance with CD 109 Highway Link Design.

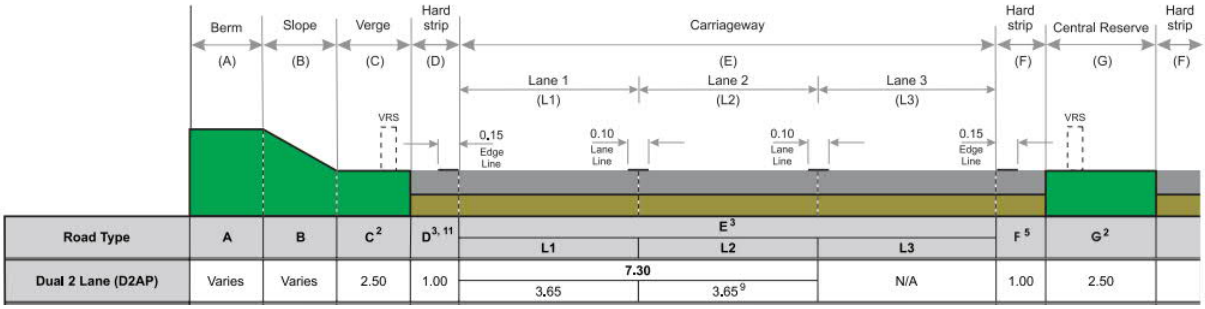


Figure 2-1 : Proposed D2AP Carriageway cross-section

It is proposed to remove any direct access from sideroads / access roads onto the A47 mainline and further details with respect to the management of the sideroad network is provided in the sideroad strategy section of this report.

2.3. Junction Form

The following junction forms have been assessed for the proposed scheme:

- At-Grade Roundabouts (DMRB CD 116)
- Compact Grade Separated Junction (DMRB CD 122)
- Fully Grade Separated Junction (DMRB CD 122)

The assessment on which junction form was appropriate was determined using the latest traffic figures, accounting for the updated forecast year, changes to the demand model, inclusion of supplementary local road surveys and the proposed Norwich Western Link scheme

Traffic levels are the determining factor in the identification of the junction type which is suitable for a scheme. The sub-sections below provide details with respect to the various junction types assessed and the traffic levels associated with each junction type.

2.4. Roundabout

Two roundabouts were proposed during PCF Stage 2 and initially designed as the preferred option. The inscribed circle diameter (ICD) was increased to 100m diameter (the maximum recommended in DMRB CD 116) to assess the predicted traffic flows.

The Ratio of Flow to Capacity (RFC) and maximum queue length from ARCADY are the two primary measures of junction-arm performance for a roundabout.

An RFC value below 0.85 for a particular arm would indicate that that arm would operate within capacity for the roundabout.

A Saturn model with design year of 2036 was developed to examine the functionality of the roundabout; results for the design year are shown on tables 2-1 and 2-2 below.

2.4.1. Wood Lane Junction

The results of the model, shown in Table 2-1 below, indicate that in the PM peak hour, the Wood Lane junction (A47/Wood Lane) would have three of the four arms operating over the target capacity of 85% and with delays of up to 151 seconds on the Wood Lane arm.

Junction at A47/Wood Lane

2036DS	V/C (Delay in seconds per vehicle during peak hour)	
Approach Arm	**AM**	**PM**
A47 west	75% (3s)	**92% (6s)**
Wood Lane	**103% (135s)**	**102% (151s)**
A47 east	54% (3s)	66% (3s)
Berry's Lane	23% (10s)	**100% (96s)**

Table 2-1: AM/PM Peak Volume to Capacity Ratio

2.4.2. Norwich Road Junction

The Norwich Road junction (A47/Norwich Road) model highlights that in the AM peak hour two of the four arms were running over capacity and with the A47 west arm running close to the capacity at 81%, with 85% considered capacity.

Junction at A47/Norwich Road

2036DS	V/C (Delay in seconds per vehicle during peak hour)	
Approach Arm	**AM**	**PM**
A47 west	81% (6s)	77% (7s)
New Road	**101% (132s)**	82% (51s)
A47 east	53% (5s)	75% (12s)
Norwich Road	**98% (67s)**	**104% (181s)**

Table 2-2: AM/PM Peak Volume to Capacity Ratio

Roundabouts operate optimally when traffic volumes are distributed relatively evenly across each arm on the roundabout. Given the high traffic volumes on the mainline, it is to be expected that the two minor arms of the roundabout are hindered and push them over the capacity threshold.

A brief summary of the most onerous peak flows is shown below for both junctions.

The turning flows can be found in Appendix C.

Total Vehicles - A47/Wood Lane

DS 2036 PM

			TO			
			A	B	C	D
			Wood Lane	A47	Berry's Lane	A47
FROM	A	Wood Lane	0	105	32	1
	B	A47	203	0	0	**1932**
	C	Berry's Lane	58	121	0	40
	D	A47	71	**2130**	75	0

Table 2-3: Peak flows for proposed roundabout at A47/Wood Lane

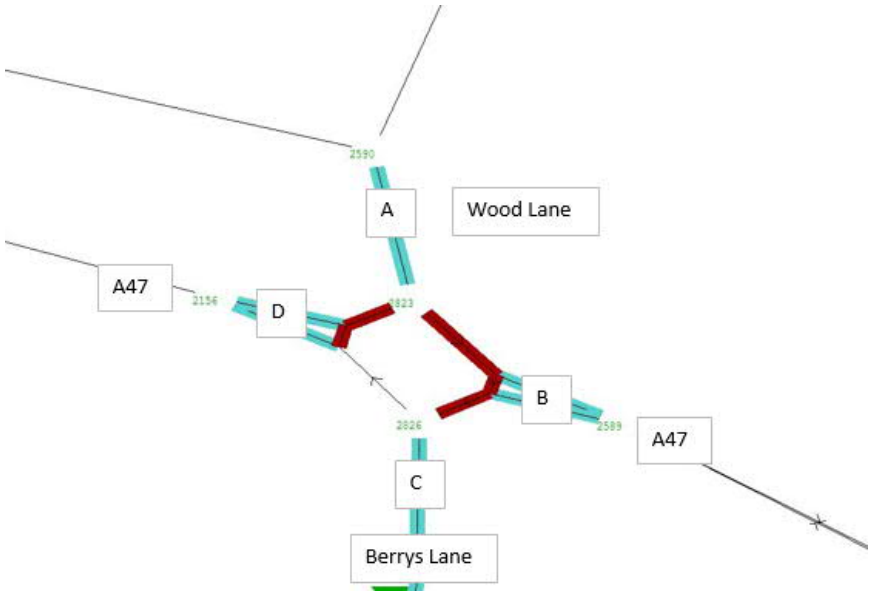


Figure 2-2: A47/Wood Lane Peak Flow Schematic

The turning movements shown above highlight that the majority of traffic, in the order of 2000 vehicles, is straight through traffic. This prevents vehicles from both Wood Lane and Berry's Lane joining the A47, resulting in the excessive delays shown on these arms.

Total Vehicles - A47/Norwich Road

DS 2036 AM

			TO			
			A	B	C	D
			New link to Taverham Road	A47	Norwich Road	A47
FROM	A	New link to Taverham Road	0	13	78	72
	B	A47	4	0	114	**1472**
	C	Norwich Road	105	246	0	0
	D	A47	56	**1917**	0	0

Table 2-4: Peak flows for proposed roundabout at A47/Norwich Road

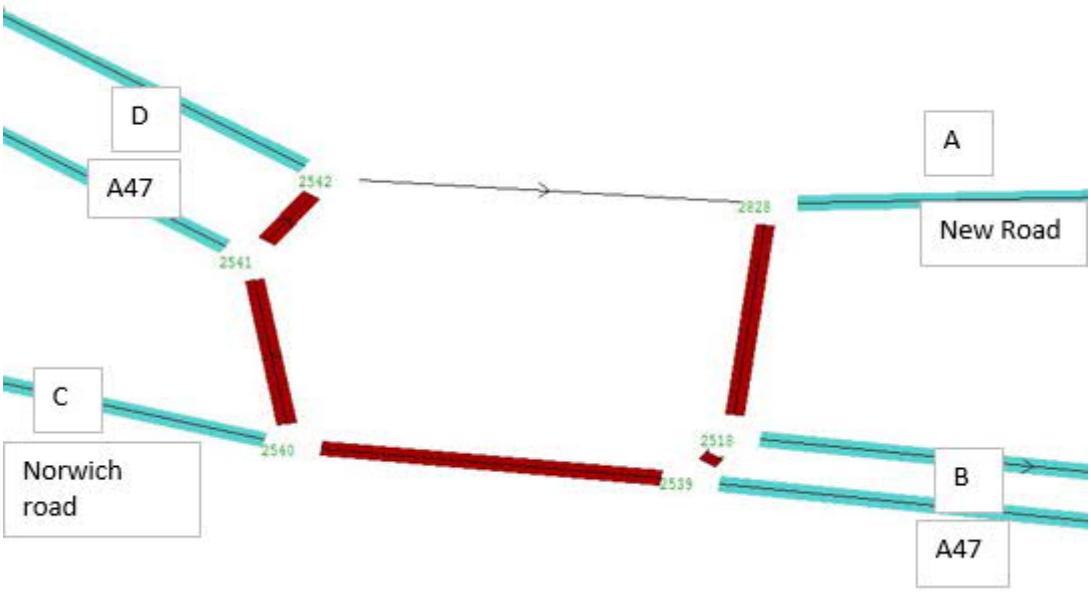


Figure 2-3 : A47/Norwich Road Peak Flow Schematic

Similar to the Wood Lane junction, the A47/Norwich Road turning movements outlined above highlight that the majority of traffic, in the order of 1500 - 2000 vehicles, is straight through traffic. This prevents vehicles from both the new link to Taverham Road and Norwich Road joining the A47, hence the excessive delays on these arms.

Given the results of the traffic modelling and the turning counts it was determined that at-grade roundabout junctions were not suitable for this scheme and alternative options should be investigated.

2.5. Compact Grade Separation

2.5.1. Wood Lane Junction

An updated Saturn model with revised design year of 2037 was developed to examine the functionality of the two compact grade separation junctions. The mainline traffic figure in the vicinity of the Wood Lane junction is in the order of 45,000 Annual Average Daily Traffic (AADT) at design year (2037).

The sideroad AADT is in the order of 4,000 AADT (This is taken from the slip road figures)

CD 122 Clause 2.2.1 states, 'Compact grade separated junctions should not be used on dual and single carriageway roads when mainline flows are above 30,000 AADT.'

From the traffic figures available the AADT on the mainline will be close to 50% higher than the recommendations set out in the DMRB.

Based on the AADT figures above it is recommended that a full grade separation layout should be developed for the Wood Lane junction.

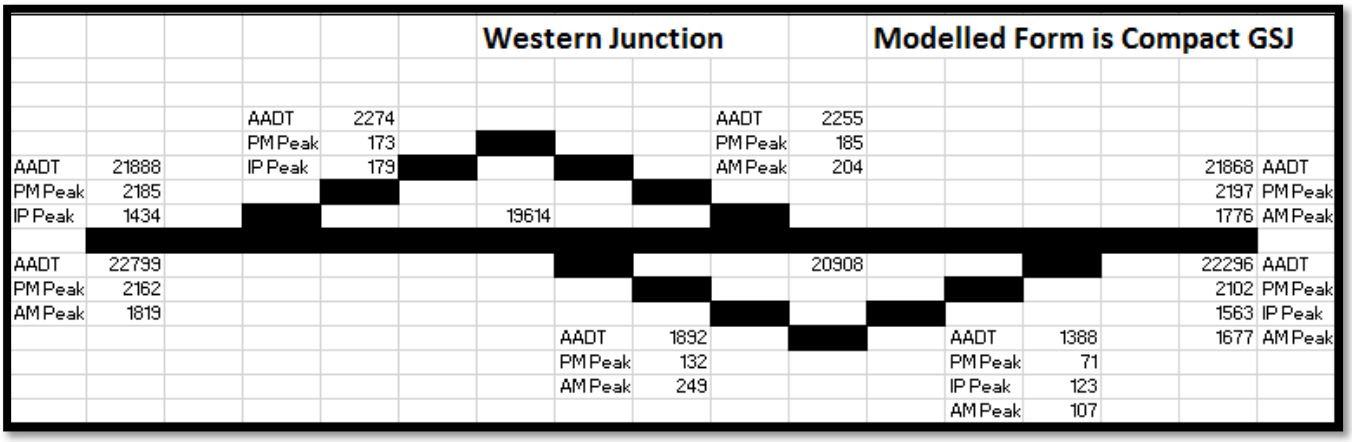


Figure 2-4: Stage 2 Traffic Figures at design year 2037 – Wood Lane Junction Compact Grade Separation

2.5.2. Norwich Road Junction

The mainline traffic in the vicinity of the Norwich Road junction in is the order of 44,000 to 48,000 AADT at design year (2037).

The sideroad AADT is in the order of 3,000 to 7000 AADT (This is taken from the slip road figures)

CD 122 Clause 2.2.1 states, 'Compact grade separated junctions should not be used on dual and single carriageway roads when mainline flows are above 30,000 AADT.'

From traffic figures available the AADT on the mainline will be between 50 to 60% higher than the recommendations set out in the DMRB.

Based on the AADT figures above it is recommended that a full grade separation layout should be developed for the Norwich Road junction.

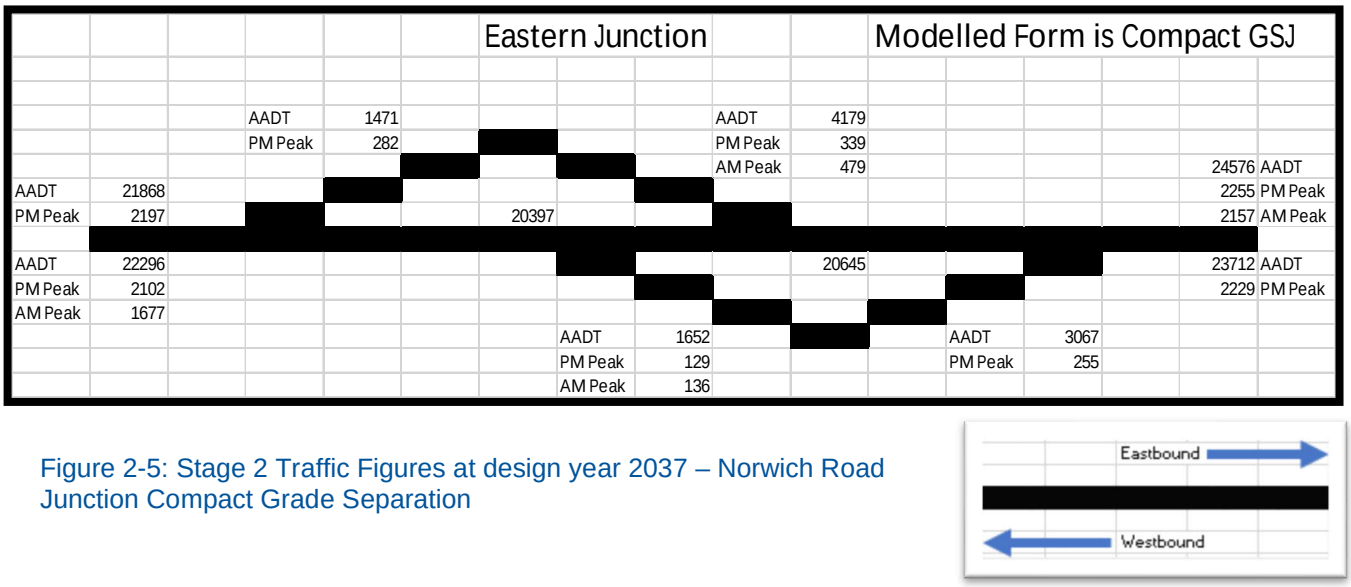


Figure 2-5: Stage 2 Traffic Figures at design year 2037 – Norwich Road Junction Compact Grade Separation

2.6. Full Grade Separation

Given the predicted traffic figures it is recommended that full grade separation will be required for both junction types.

A Stage 3 traffic model based on new opening year (2025) and design year (2040) was developed to examine the two fully grade separated junctions (FGSJ). The results for the design year of 2040 are shown below.

2.6.1. Wood Lane Junction

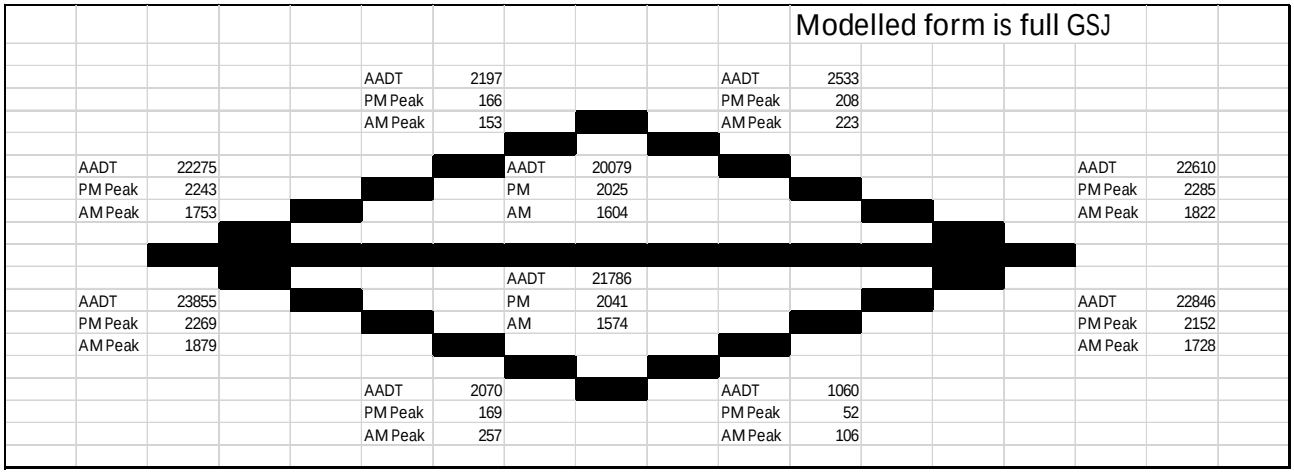


Figure 2-6: Stage 3 Traffic Figures at design year 2040 – Wood Lane Junction Full Grade Separation

The AADT modelled within the vicinity of the junction is in the order of 45,000. This figure further justifies the proposal to proceed with FGSJ given the limiting figure of the compact layout is 30,000.

The finalised layout of the junction slip roads and connector roads will be determined based on the requirements of CD 122 and the anticipated traffic volumes. This is covered within Section 3 of this report.

2.6.2. Norwich Road Junction

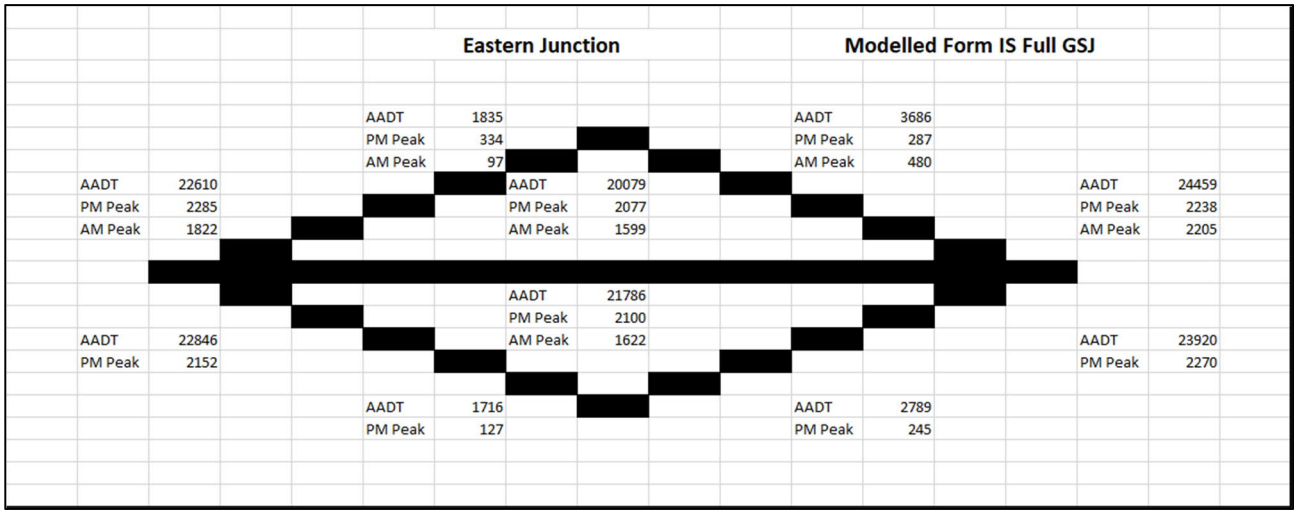


Figure 2-7: Stage 3 Traffic Figures at design year 2040 – Norwich Road Junction Full Grade Separation

The AADT in the vicinity of the junction is in the order of 45,000-48,000. This figure further justifies the proposal to proceed with FGSJ given the limiting figure of the compact layout is 30,000.

The finalised layout of the junction slip roads and connector roads will be determined based on the requirements of CD 122 and the anticipated traffic volumes. This is discussed within Section 3 of this report.

3. Junction Slip Road Design

3.1. Slip Road Configuration

In selecting the appropriate slip road configuration, the peak traffic flows are to be considered in accordance with Clause 3.8 of CD 122 which states that the mainline maximum vehicles per hour per lane shall be taken as 1,600 for all-purpose roads.

Adjustment factors as necessary shall then be applied to the peak flows in accordance with Clause 3.9 of CD 122.

CD 122 Clause 3.9 states**, '***Where there is an uphill gradient and a presence of HGVs the hourly design flows for the mainline and merges shall be adjusted in accordance with Table 3.9a and 3.9b*.'

Table 3.9a Adjustment factors for uphill gradients and for the presence of large goods vehicles on the mainline

% HGVs on mainline	Mainline gradient	
	<2%	≥2%
5	none	1.10
10	none	1.15
15	none	1.20
20	1.05	1.25

Table 3-1: CD 122 Adjustment factors for uphill gradients on mainline

Table 3.9b Adjustment factors for uphill gradients and for the presence of large goods vehicles on merge connector roads

% HGVs on merge connector	Merge connector gradient		
	<2%	2% to 4%	>4%
5	-	1.15	1.30
10	-	1.20	1.35
15	1.05	1.25	1.40
20	1.10	1.30	1.45

Adjustments are not made to diverge flows.

Table 3-2: CD 122 Adjustment factors for uphill gradients on merge connector roads

CD 122 Clause 3.10 states, *'The mainline gradient used to calculate the adjusted hourly design flows shall be the average gradient over a distance 0.5 km either side of the merge or diverge nose tip.'*

CD 122 Clause 3.11 states, '*The merge connector road gradient used to calculate the adjusted hourly design flows shall be the average of the 0.5 km section before the nose tip.'*

Based on an initial alignment review the following tables outline the mainline and merge connector gradients to be used when determining the adjustment factor

	Wood Lane Junction EB Diverge	**Wood Lane Junction WB Merge**	**Wood Lane Junction EB Merge**	**Wood Lane Junction WB Diverge**
Gradient	+1.15%	-0.96%	-1.51%	+1.59%
HGV %	5-7%.	3-4%	5-7%.	3-4%
	Norwich Road Junction EB Diverge	**Norwich Road Junction WB Merge**	**Norwich Road Junction EB Merge**	**Norwich Road Junction WB Diverge**
Gradient	+0.91%	-1.01%	-0.24%	+0.11%
HGV %	5-7%.	3-4%	5-7%.	3-4%

Table 3-3: Mainline Gradients and HGV %

	Merges only	
	Wood Lane Junction	**Norwich Road Junction**
Eastbound Merge	-1.10	+0.33
HGV %	>1%	3%
Westbound Merge	+1.53	+0.19
HGV %	3%	>1%

Table 3-4: Merge Slip Road Gradients & HGV %

Positive values represent uphill gradients and require adjustments to be made in line with Clause 3.9 of CD 122.

Based on the values above the following table outlines the factors to be adopted for each of the slip lanes.

	Wood Lane Junction EB Diverge	Wood Lane Junction WB Merge	Wood Lane Junction EB Merge	Wood Lane Junction WB Diverge
Factor	No factor required gradient <2%	No factor required downhill gradient	No factor required downhill gradient	No factor required gradient <2%
	Norwich Road Junction EB Diverge	**Norwich Road Junction WB Merge**	**Norwich Road Junction EB Merge**	**Norwich Road Junction WB Diverge**
Factor	No factor required gradient <2%	No factor required downhill gradient	No factor required downhill gradient	No factor required gradient <2%

Table 3-5: Mainline factors to be applied

	Merges only	
	Wood Lane Junction	**Norwich Road Junction**
Eastbound Merge Factor	No factor required downhill gradient	No factor required gradient <2%
Westbound Merge Factor	No factor required gradient <2%	No factor required gradient <2%

Table 3-6: Merge factors to be applied

No factors are required based on the proposed design.

The peak hour flows will be used in conjunction with CD 122 Figures 3.12a and 3.26a for merge and diverge lanes respectively to determine the suitable slip lane layout. See Appendix D for Merge and Diverge figures with peak flows and slip lane layout selection shown.

Wood Lane Junction

Eastbound				Westbound			
Diverge		**Merge**		**Diverge**		**Merge**	
Mainline	**Slip Lane**	**Mainline**	**Slip Lane**	**Mainline**	**Slip Lane**	**Mainline**	**Slip Lane**
2243	166	2285	223	2152	106	2269	257
CD 122 Figure 3.30a		**CD 122 Figure 3.14a**		**CD 122 Figure 3.30a**		**CD 122 Figure 3.14a**	
Type A		Type A		Type A		Type A	

Table 3-7: Wood Lane junction slip lane layout

It should be noted that the peak hour flow for the mainline does not always match the corresponding peak hour for the slip lane. The most onerous combination has therefore been adopted.

As can be seen from the table above the slip lane layout recommended is a Type A layout for both the merge and diverge lanes in both directions. A diagram of the proposed layout form is shown below in Figures 3-1 and 3-2.

Norwich Road Junction

East Bound				West Bound			
Diverge		**Merge**		**Diverge**		**Merge**	
Mainline	**Slip Lane**	**Mainline**	**Slip Lane**	**Mainline**	**Slip Lane**	**Mainline**	**Slip Lane**
2285	334	2238	480	2270	245	2152	156
CD 122 Figure 3.30a		**CD 122 Figure 3.14a**		**CD 122 Figure 3.30a**		**CD 122 Figure 3.14a**	
Type A		Type A		Type A		Type A	

Table 3-8: Norwich Road junction slip lane layout

Note the peak hour for the mainline does not always match the corresponding peak hour for the slip lane. The most onerous combination has therefore been adopted.

As can be seen from the table above the slip lane layout recommended is a Type A layout for both the merge and diverge lanes in both directions. A diagram of the proposed layout form is shown below.

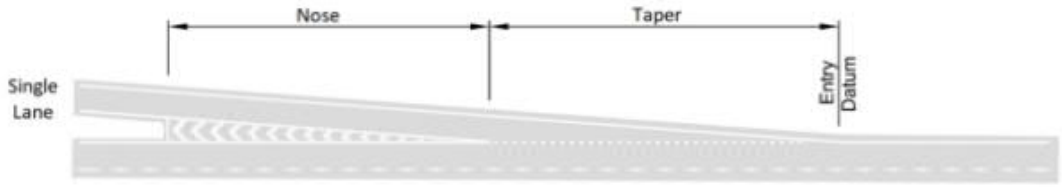


Figure 3-1 : Type A – Taper Merge Layout

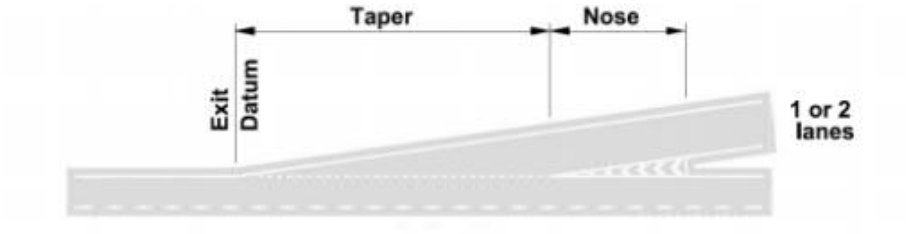


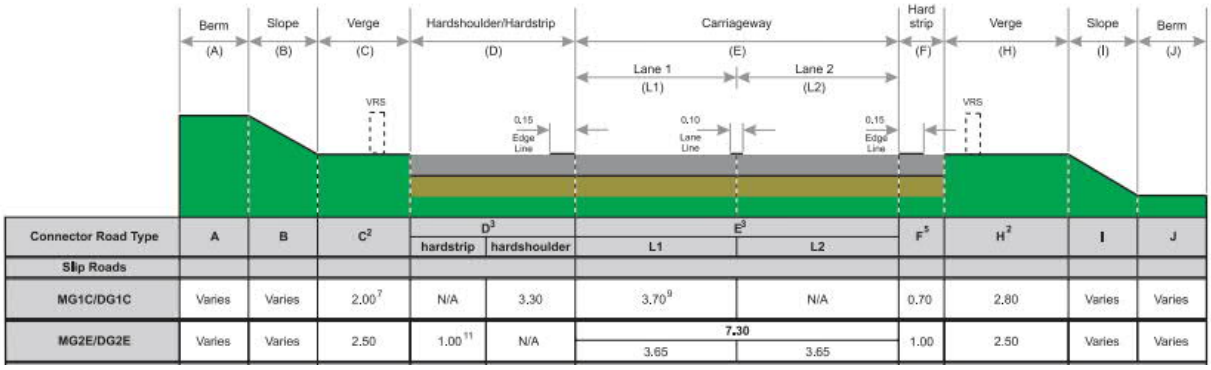
Figure 3-2: Type A – Taper Diverge Layout

3.2. Connector Road Configuration

In accordance with Chapter 5 of CD 122 and Figure 3-3 below. The cross section of all merges and diverges for both the Wood Lane and Norwich Road junctions will be a MG1C/DG1C layout as they are below the threshold of 800 vph in the peak hour. The cross-section of the merges and diverges are shown in Figure 3-4 below.

	Adjusted connector road flow (vph)			
	0-800	**801-1200**	**1201-2400**	**2401-3200**
Merge (rural)	MG1C		MG2E	
Merge (urban)	MG1D		MG2F	
Diverge (rural)	DG1C	DG2E		
Diverge (urban)	DG1D	DG2F		
Interchange link/loop (rural)	IL1C or IL2C (see clause 5.3)		IL2C	
Interchange link/loop (urban)	IL1D or IL2D (see clause 5.3)		IL2D	

Figure 3-3: Cross-sections for connector roads to/from mainline all-purpose roads



Connector Road Type	A	B	C[2]	D[3]		E[3]		F[5]	H[2]	I	J
				hardstrip	hardshoulder	L1	L2				
Slip Roads											
MG1C/DG1C	Varies	Varies	2.00[7]	N/A	3.30	3.70[9]	N/A	0.70	2.80	Varies	Varies
MG2E/DG2E	Varies	Varies	2.50	1.00[11]	N/A	7.30		1.00	2.50	Varies	Varies
						3.65	3.65				

Figure 3-4: Cross-sections for connector roads

The connector roads between the northern and southern roundabouts of both the Wood Lane and Norwich Road junctions have been developed as single lane layouts.

Forecast traffic flows for the design year (2040) have been taken from the SATURN model and have then been used in the detailed junction ARCADY analysis. The results of this assessment suggest that the connector roads for both junctions with a single lane layout are predicted to operate within capacity.

The Ratio of Flow to Capacity (RFC) values are all predicted to be below 50% which indicates both connector roads would perform with only a low level of queuing anticipated.

4. Lay-by Provision

4.1. High Level Strategy

CD 169 outlines the requirements and defines geometric standards that must be met when positioning lay-bys on dual carriageway schemes. These are outlined below.

4.1.1. Frequency

The recommended spacing of lay-bys is outlined in CD 169 and Table 4-1 below. This indicates that the recommended spacing of lay-bys should be 2.5km for dual carriageways. However, local factors should also be taken into consideration when assessing the frequency of lay-bys. This includes factors such as proximity to junctions along the scheme and alternative rest areas in towns and villages.

Carriageway Type	Two-way Annual Average Daily Traffic (AADT) Vehicle Flow	Recommended Spacing
Dual Carriageway	All levels	2.5km
Single Carriageway	>8,000	Between 2km and 5km
	2,500 – 8,000	Between 5km and 8km
	1,200 – 2,500	Between 8km and 12km

Table 4-1: Recommended spacing of lay-bys in both directions

The proposed scheme is approximately 8.5km in length, based on the recommended spacing in Table 4-1 this would indicate that 3 lay-by locations should be provided in each direction.

However, when taking into consideration the location of both existing junctions to be retained and the proposed junctions on the scheme, which are located at approximate Chainage 0m (Fox Lane junction which provides access to Hockering), Chainage 4900m (Wood Lane junction which provides access to Hockering and Honingham) and Chainage 7550m (Norwich Road junction which provides access to Easton), it has been determined that the most appropriate and beneficial location for a lay-by would be between the Fox Lane and Wood Lane junctions.

4.1.2. Lay-by positioning

There are a number of geometric specifications in CD 169 as to where lay-bys should be positioned; and these are outlined below.

Clause 3.8 of CD 169 states *'Lay-bys shall not be sited between a junction advance direction sign and the junction diverge.'*

Clause 3.13 of CD 169 states *'On dual carriageway roads, lay-bys on opposing carriageways shall not be located opposite each other,'*

4.1.2.1. Horizontally

Clause 3.2 of CD 169 states *'lay-bys shall not be sited on the outside of a right-hand curve with a radius of less than the appropriate value for the design speed of the road.*'

Clause 3.2.1 of CD 169 states *'lay-bys should not be sited on the inside of a left-hand curve with a radius less than the appropriate value for the design speed of the road.'*

Design speed (km/h)	120	100	85	70	60	50
Minimum curve radius (m)	2,040	1,440	1,020	720	510	360

Table 4-2: Minimum radius where the lay-by is sited on a curve

Clause 3.7 of CD 169 states *'The separation between a lay-by and an at-grade junction or access (excluding field accesses) on the same side of the road, both upstream and downstream, shall be at least 3.75V metres where V is the design speed in kph. The separation distance between a lay-by and a junction or access is required to reduce the possibility of road users confusing the downstream junction or access with the lay-by entrance and to reduce the likelihood of late manoeuvres where a junction or access is upstream of the lay-by.*'

Document CD 122 [Ref 6.N] provides the separation requirements between a lay-by and a grade separated junction and states, *'For all-purpose roads, the minimum length between a full grade separated junction and an at-grade junction, service area and lay-by shall be 1 km for rural roads.'*

4.1.2.2. Vertically

Clauses 3.10 and 3.11 of CD 169 state *'Lay-bys shall not be located on gradients in excess of the desirable maximum gradients in accordance with CD 109'* and *'Lay-bys shall not be sited on crests with a value less than the desirable minimum value in accordance with CD 109.'*

4.1.3. Eastbound and westbound positioning

Based on the requirements outlined above the proposed alignment was reviewed. When the horizontal and vertical alignment, and the proximity to housing and junctions, were considered, the most appropriate location for a lay-by to be positioned on either side of the carriageway is between Chainage 2490m to 2790m.

This location meets the following requirements set out in CD 169:

- On a low gradient (less than 4%)
- On a 10,000m radius curve (greater than 2040m)
- Located more than 1km from the nearest grade separated junction

However, this location does not meet the requirement of Clause 3.13, as lay-bys are proposed opposite each other in both carriageways. Given the other requirements and constraints it is considered that having lay-bys opposite each other is the only solution available whilst still providing lay-by provision on both directions. As a result of this a Departure from Standard will be sought to have lay-bys positioned opposite each other.

4.2. Police Observation Platforms

4.2.1. The provision of Police observation platforms has not been considered at this time and are subject to consultation with the Norfolk Constabulary Police force during design development.

5. Sideroad Strategy

5.1. High Level Strategy

The development of the scheme sideroad network was based on:

- creating a parallel local link road network between North Tuddenham and Easton by utilising the existing A47 carriageway or constructing new single carriageway roads
- connecting severed roads or accesses either with new connector roads or utilising the existing local road network.

The main aims of the parallel route are to:

- allow local road traffic to travel between the various villages without the need to use the proposed A47. This also improves the efficiency of the proposed trunk road
- provide a reasonable parallel route for trunk road traffic in case of emergency (the roads through the villages are very narrow)
- provide a route for pedestrians and cyclists to use, away from the proposed A47.

Appendix A should be referred to for a layout plan showing the scheme layout including the proposed sideroad network and tie-in to the wider existing network.

5.2. PRA Alignment

The proposed scheme removes all direct access to the A47 mainline, therefore, any existing roads or tracks severed by the proposed A47 have to be reconnected via the local road network.

The local roads connecting to the existing A47 are generally narrow; either single lane or two-way with no centreline road marking. The exception is at the existing roundabout east of Honingham, at Norwich Road which is a wide single carriageway.

5.3. Severance of existing local roads

The proposed alignment crosses the following existing roads from west to east;

1. Existing A47 west of Hockering
2. Low Road south of the existing Low Road A47 Junction

3. Mattishall Lane south of the existing Mattishall Lane A47 Junction
4. Mill Lane south of the existing Mill Lane A47 Junction
5. Access Track to Reclamation Yard
6. Church Lane south of the existing Church Lane A47 Junction
7. Existing A47 between Church Lane and Wood Lane
8. Wood Lane North of the existing Wood Lane A47 Junction
9. Hall Farm Access Road
10. Existing A47 near St Andrew's Church
11. Blind Lane south of the existing Blind Lane A47 Junction
12. The existing A47 between Blind Lane and Easton
13. Proposed A47 tie-in removing the existing roundabout at Easton

5.4. Sideroad Strategy

5.4.1. Existing A47 west of Hockering

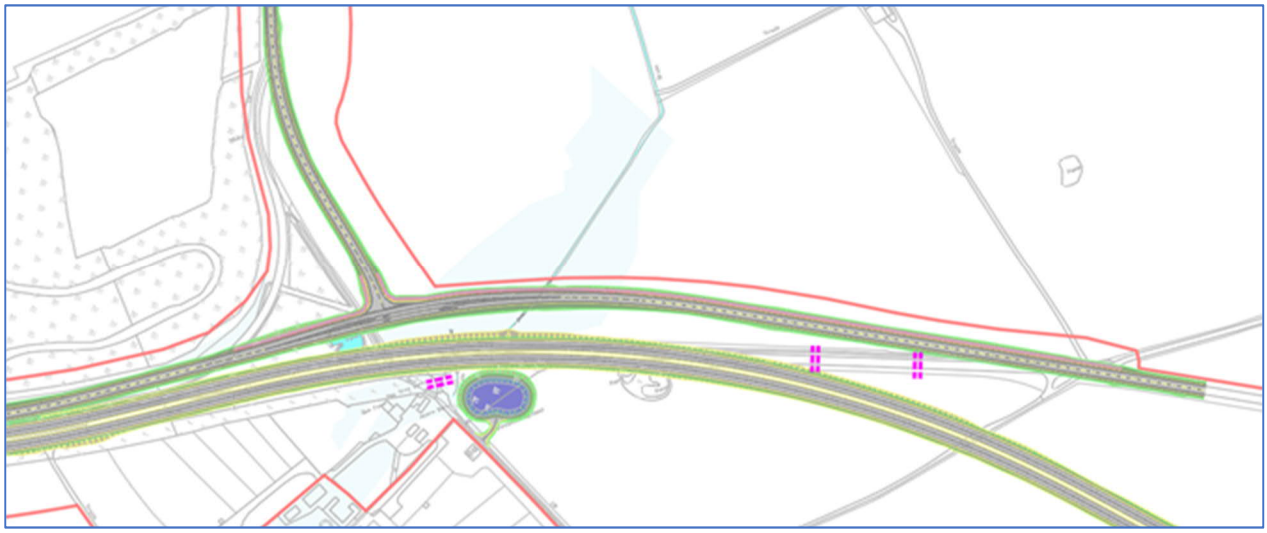


Figure 5-1 : Existing A47 west of Hockering

The existing A47 west of Hockering will be severed as part of the Works. There is an existing access to Oak Farm on the south side of the existing A47 which will also be severed. Access to this farm is still available from the existing Oak Farm access road to the south of the property.

Severance of the existing A47 would cut off Hockering from North Tuddenham and the existing A47 Fox Lane junction. In addition, it would not be possible to connect villages and properties to the south of the proposed A47 by diverting via the Fox Lane (see Low Road and Mattishall Road).

It is proposed to provide a new connection between Fox Lane junction and Hockering using the existing A47, a new connector road and the existing Lyng Road single carriageway. This would create a two-lane single carriageway road that could also be used to get to Etling Green and Dereham without accessing the A47. A revised road layout utilising a priority T-junction is proposed to connect the existing Lyng Road to the new link.

5.4.2. Low Road south of the existing Low Road A47 Junction

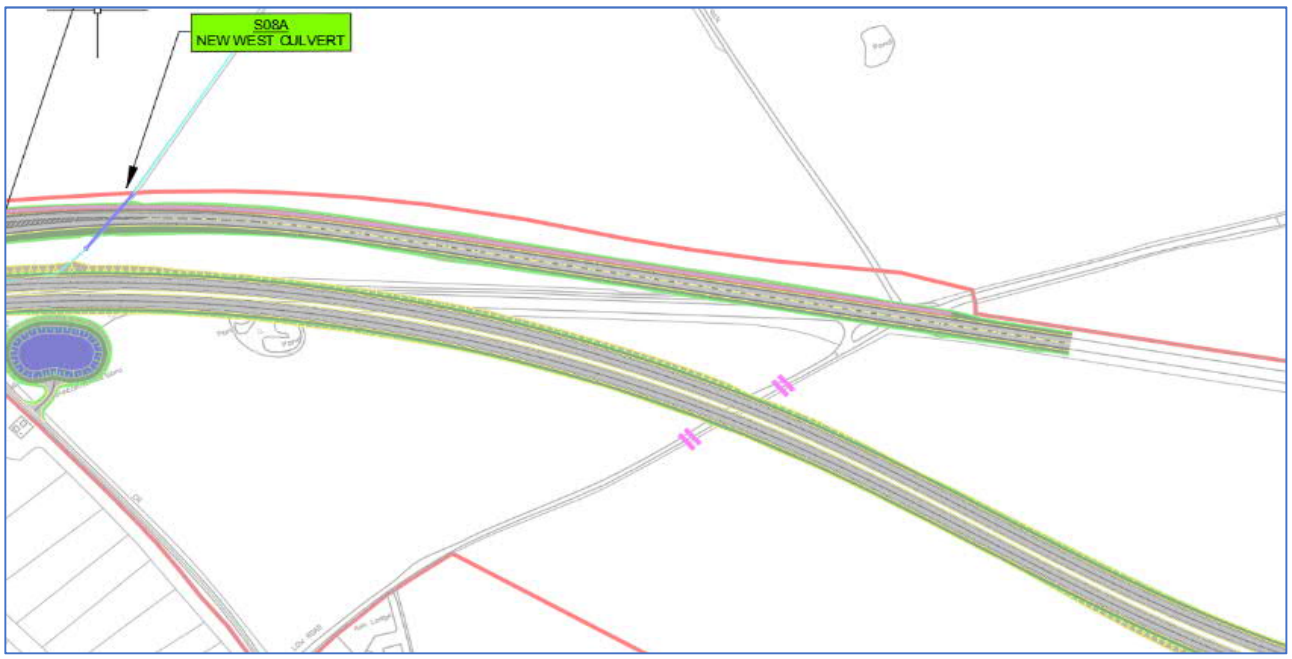


Figure 5-2 : Low Road, south of existing A47

The severance of Low Road affects several farms and residential properties to the west of the proposed A47 by increasing the distance to Hockering.

The only alternative route is via the Fox Lane junction and the proposed local link road to the north of the proposed A47; a diversion of up to 3.1 km.

5.4.3. Mattishall Lane south of the existing Mattishall Lane A47 junction

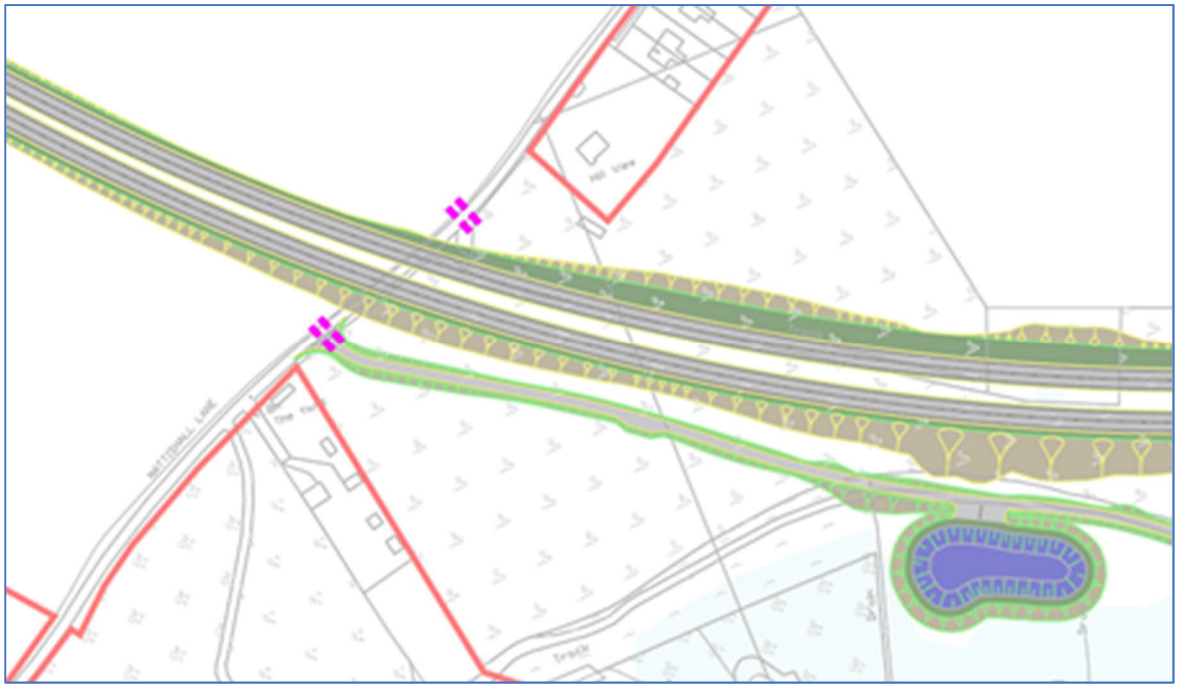


Figure 5-3 : Mattishall Lane

The severance of Mattishall Lane has no impact in terms of access for properties east of the proposed A47 mainline. There are seven residential properties located on the Hockering side of the proposed route and will therefore maintain access to the existing A47.

However, feedback received indicates there is demand, to travel between Hockering and Mattishall, in particular to the doctor's surgery and a nursery in Mattishall. For those travelling between Hockering and Mattishall, the route would be via the proposed local link road to the north of the proposed A47, onto Fox Lane and then Mattishall Lane. This is an increase of approximately 3.5 km when compared to the current route.

5.4.4. Mill Lane

Figure 5-4: Mill Lane

The Proposed A47 severs access from Mill Lane to a timber yard to the south. Access to the timber yard will be taken from the basin access track that connects to Mattishall Lane to the west.

5.4.5. Access Track to Reclamation Yard

Figure 5-5: Access track to Reclamation Yard

The proposed A47 severs an existing access track which serves a number of properties and a reclamation yard. Access to the properties will remain unaffected from the existing A47. Access to a number of out buildings within the reclamation yard however will no longer be feasible from the existing A47, an alternative route may be investigated from Church Lane which would run parallel to the proposed A47 scheme.

5.4.6. Church Lane south of the existing Church Lane A47 junction

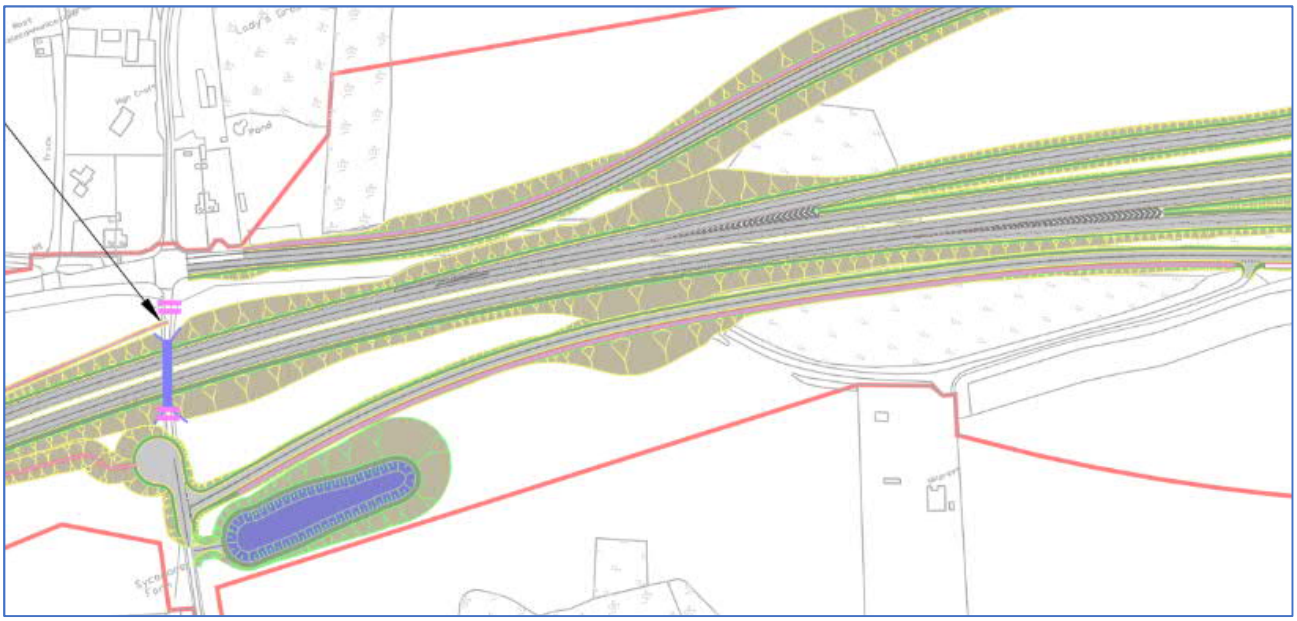


Figure 5-6: Church Lane south of the existing Church Lane A47 junction

The severance of Church Lane affects a number of residential and commercial properties near the River Tud. It also creates severance between Hockering and East Tuddenham, although the demand between these two villages is not known.

Utilising the existing road network would mean travelling to the proposed Wood Lane junction then heading south on Berry's Lane and west on Mattishall Road, an increase of approximately 3.0km over the current route. It is therefore suggested that a short link be provided linking Church Lane to the Wood Lane Junction is provided. This link will incorporate a section of the existing A47 which is required to maintain access to Hill Crest house. The length of the new build will be in the order of 600m.

5.4.7. The Existing A47 between Church Lane and Wood Lane

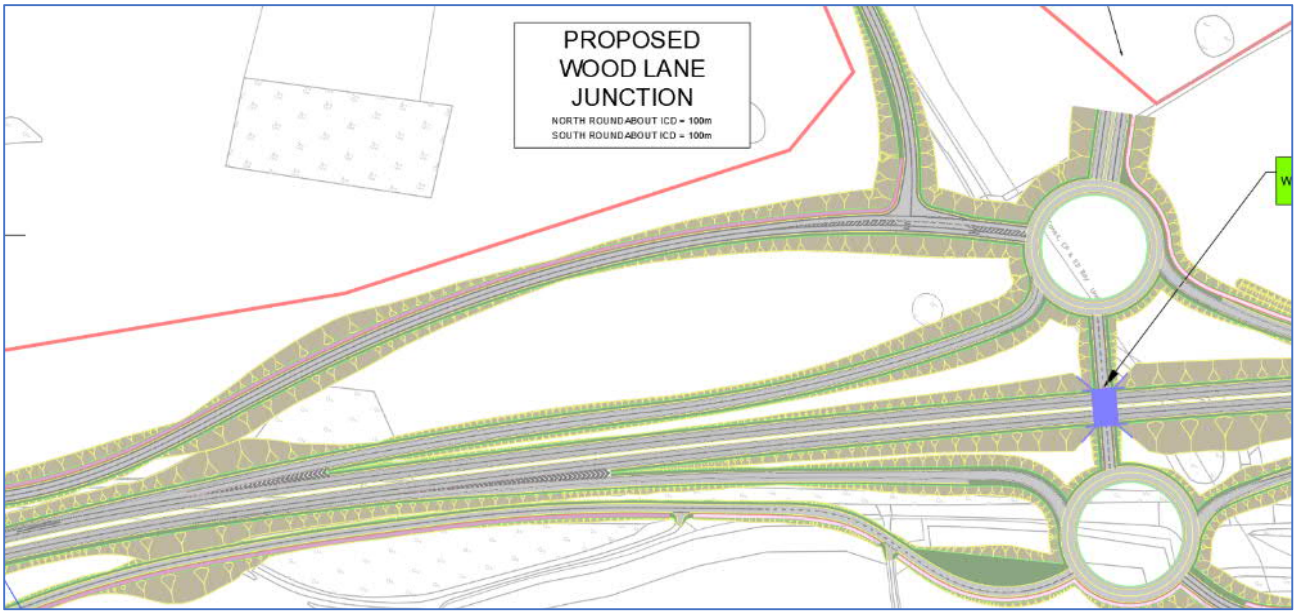


Figure 5-7 : Existing A47 between Church Lane and Wood Lane

Severing the existing A47 near Church Lane would cause Hockering to Honingham links to be severed. It is proposed to provide a new connection between the existing A47 at Church Lane junction and the proposed Wood Lane junction.

Access to the properties and land to the south of the A47 would be achieved via the new connection discussed above in section 5.4.6.

5.4.8. Wood Lane north of the existing Wood Lane A47 Junction

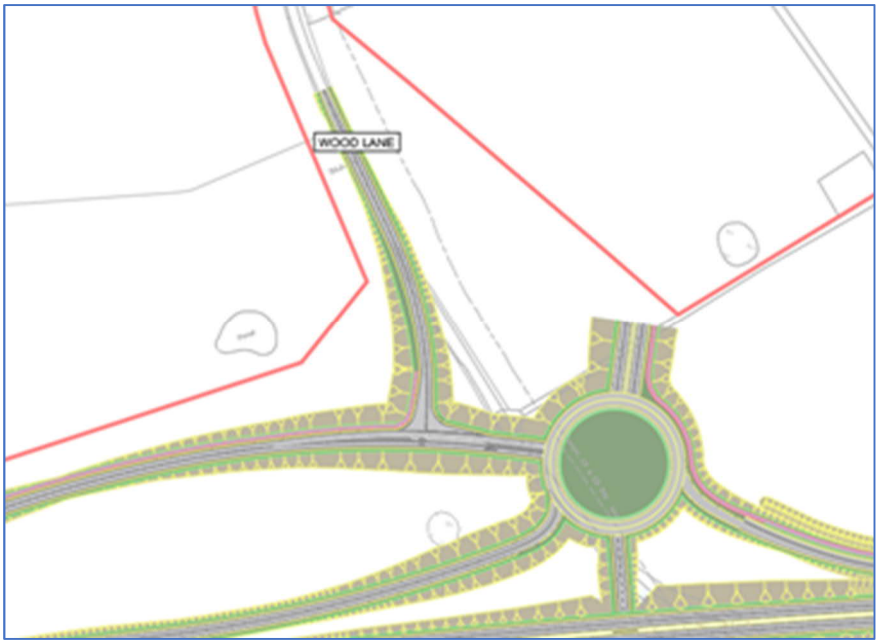


Figure 5-8 : Wood Lane north of the existing Wood Lane A47 Junction

The existing Wood Lane where it connects to the existing A47 will be severed by the proposed Wood Lane junction and new A47 mainline. To maintain connectivity of this sideroad it is proposed to realign Wood Lane slightly to the west and will tie into the proposed link between Church Lane and the new Wood Lane junction northern roundabout.

5.4.9. Hall Farm Access Road

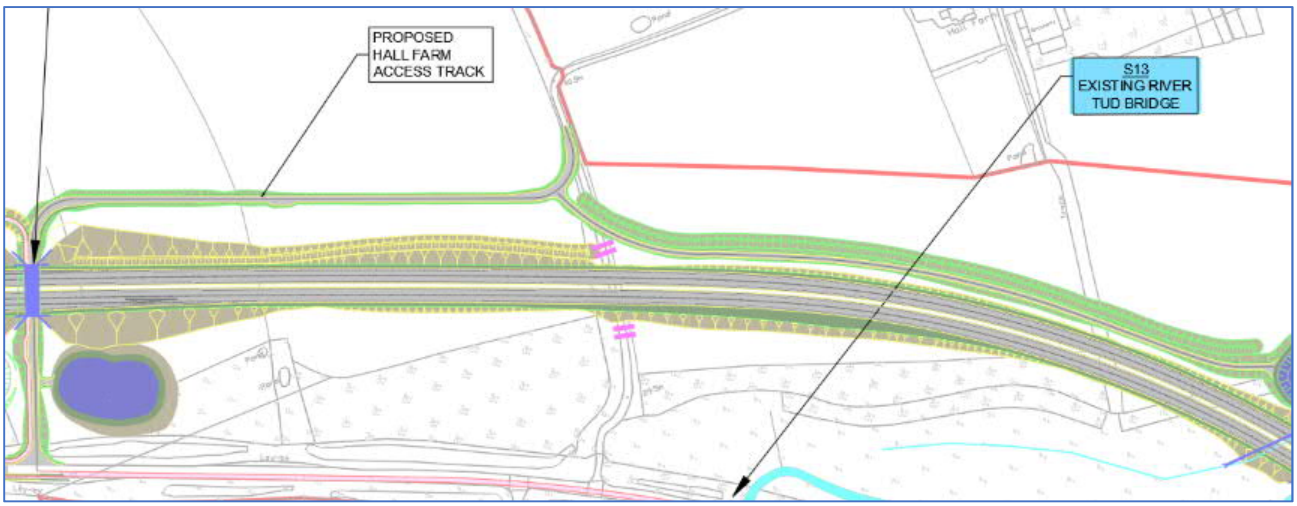


Figure 5-9 : Hall Farm Access

A new access will be required for Hall Farm. This will either be via a new link to Wood Lane, north of the proposed A47 or via a new link which will connect to the existing A47 and cross the proposed A47 via an underpass. The layout of this link will be determined through the development of the overall junction layout.

5.4.10. The existing A47 near St Andrew's Church

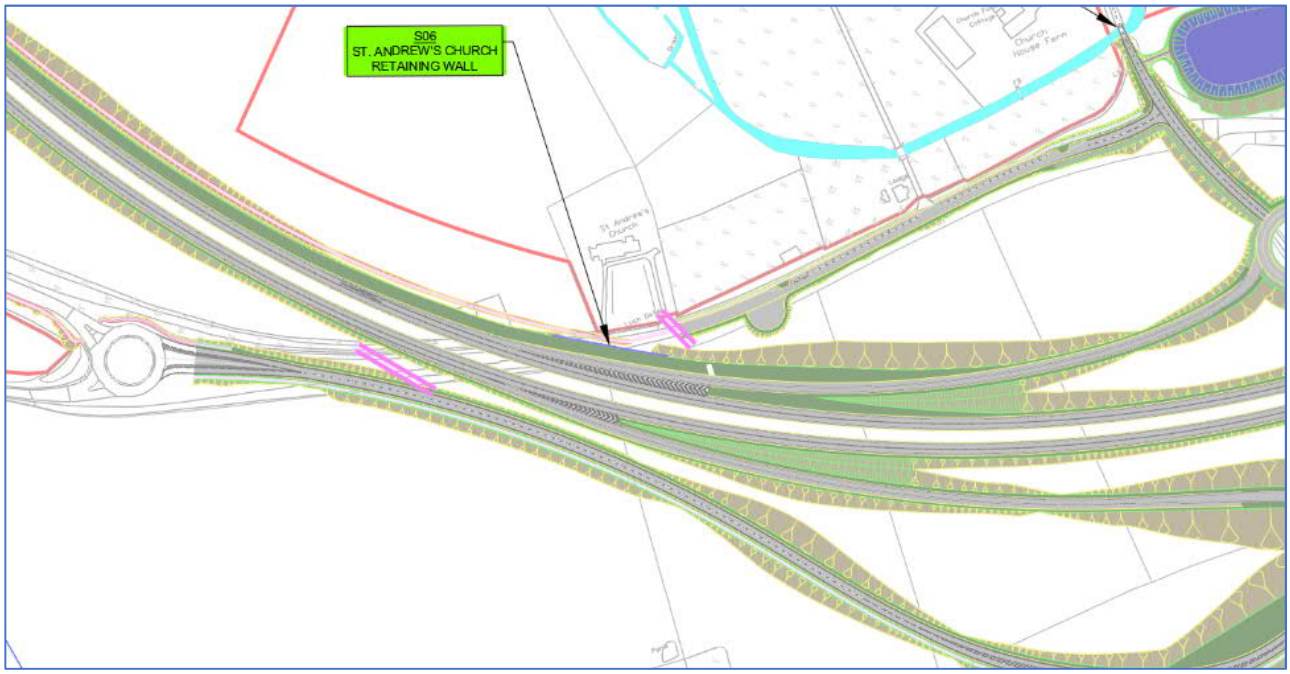


Figure 5-10 : Existing A47 at St. Andrews Church

The proposed A47 severs the existing A47 immediately west of St Andrews Church.

It is proposed to provide a new connection between the existing roundabout on the A47 to the east of Honingham and a new proposed junction located at Blind Lane. This will provide connectivity for Honingham and surrounding communities to the east.

A short connection is proposed between the existing A47 at St Andrews Church, to the proposed junction.

5.4.11. Blind Lane south of the existing Blind Lane A47 Junction

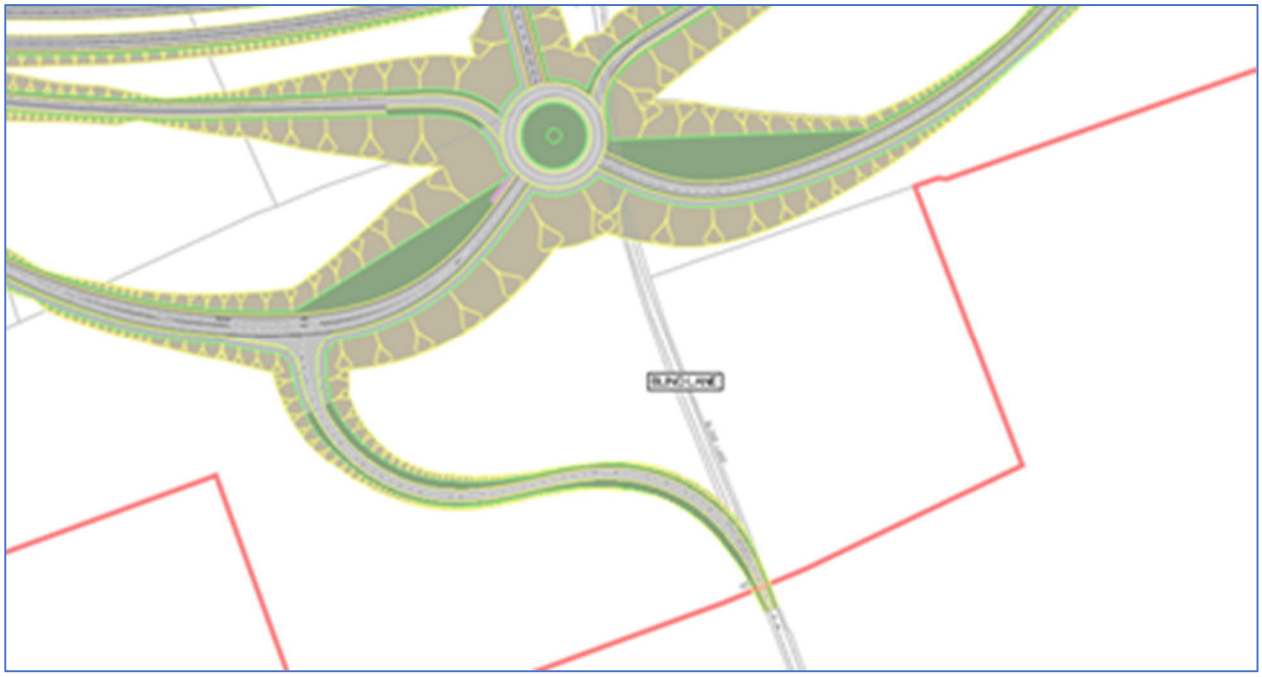


Figure 5-11: Blind Lane and existing A47 Junction

The existing junction of Blind Lane and the A47 will be severed by the proposed Norwich Road junction and new A47 mainline.

In order to maintain the connectivity of Blind Lane with the local sideroad network it is proposed to reroute Blind Lane to the west of the Norwich Road junction southern roundabout and connect to the realigned Norwich Road east of Honingham.

5.4.12. The existing A47 between Blind Lane and Easton

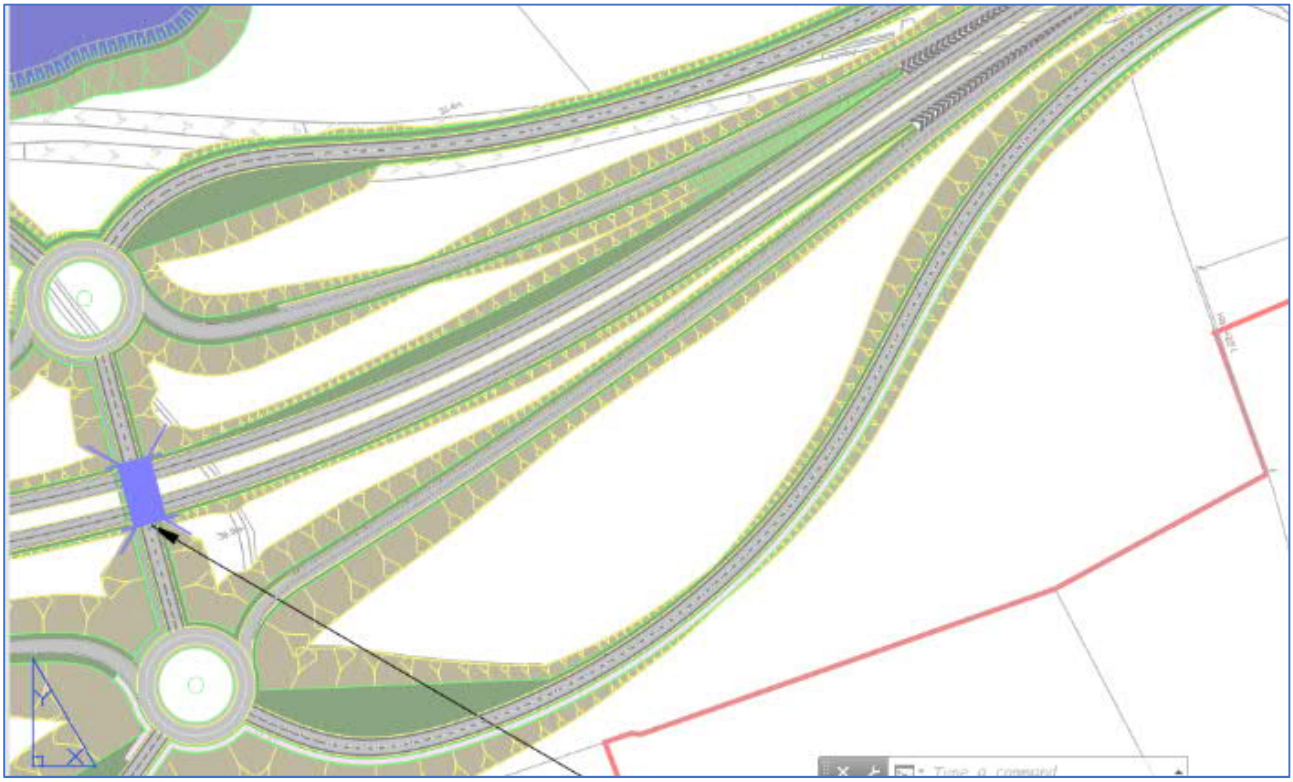


Figure 5-12: Existing A47 between Blind Lane and Easton

The proposed A47 severs the existing A47 between Blind Lane and the roundabout at the intersection of Church Lane and Dereham Road. To maintain connectivity links shall be provided to the proposed Norwich Road junction. A new link would be provided from the proposed roundabout at Taverham Road to tie in with Church Lane. An additional link is proposed from Blind Lane and will tie in with Dereham Road south of the existing roundabout at the intersection of Church Lane and Dereham Road. This would lead to an additional journey length of up to 2.5km for road users moving between Dereham Road and Church Lane.

5.4.13. Existing roundabout at intersection of Church Lane and Dereham Road

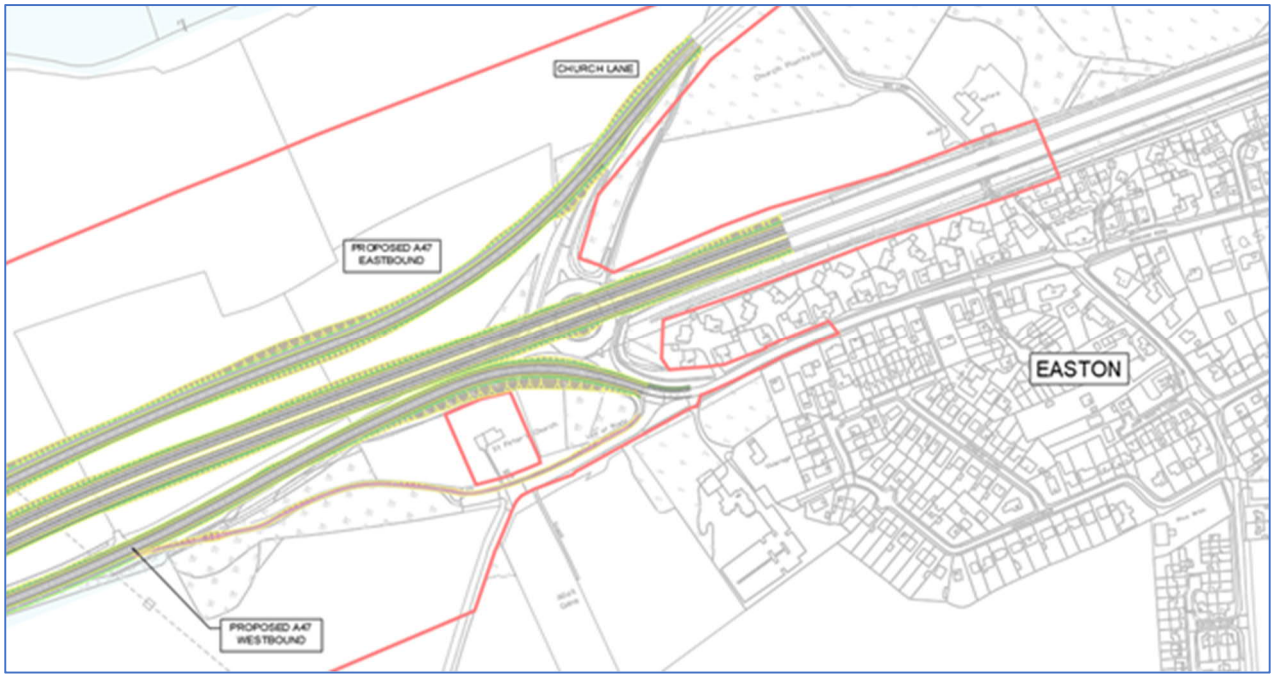


Figure 5-13: Existing roundabout at intersection of Church Lane and Dereham Road

As part of the strategy to provide a route with no direct access onto it, it is proposed to remove the existing roundabout at the intersection of Church Lane and Dereham Road. This will sever the link between Church Lane and Dereham Road. As discussed above in section 5.4.12 the two new links either side of the proposed A47 Dual Carriageway and connecting into Norwich Road junction will maintain connectivity, with an additional journey length of approximately 2.5km.

5.5. Design Speed and Cross Section Assessment

5.5.1. Design Speed

The development of the re-aligned sideroads has been based on a design speed assessment undertaken in accordance with CD 109 Highway Link Design. The project team are also engaging with Norfolk County Council regarding the proposed sideroad design speeds. These discussions will help influence the development of the design going forward to ensure an appropriate design speed is adopted.

For each of the proposed sideroad connections, as detailed in Section 5.4 above, a design speed assessment has been carried out.

Values for the Alignment Constraint (Ac) and Layout Constraint (Lc) have been established using a desk-based study of the existing sideroads. These can be found in Appendix E.

These parameters have then been used to determine the theoretical design speeds using Figure 5-14 from CD 109, as shown below.

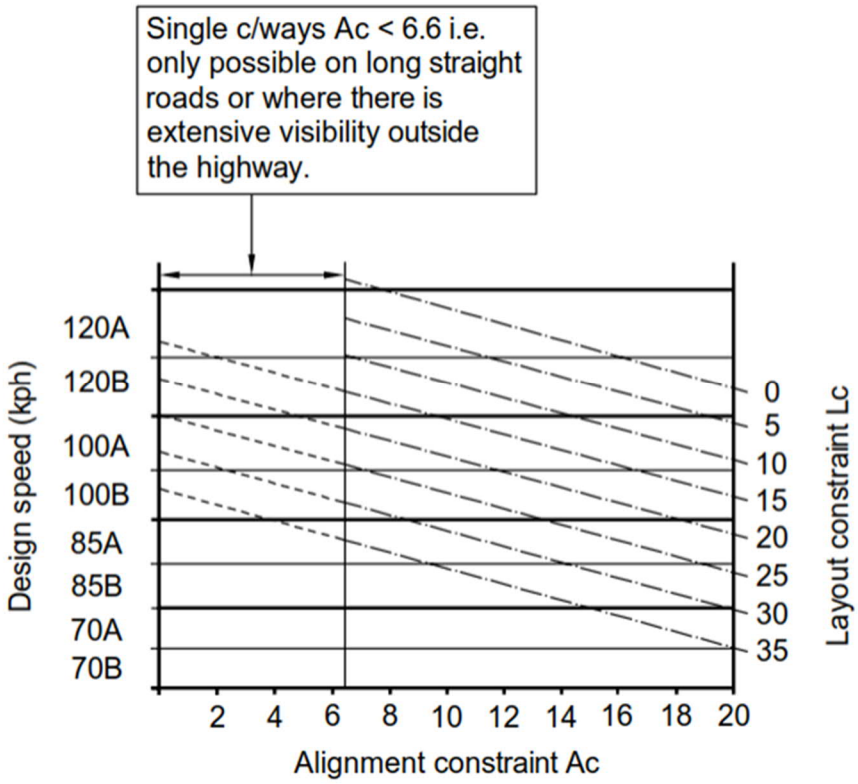
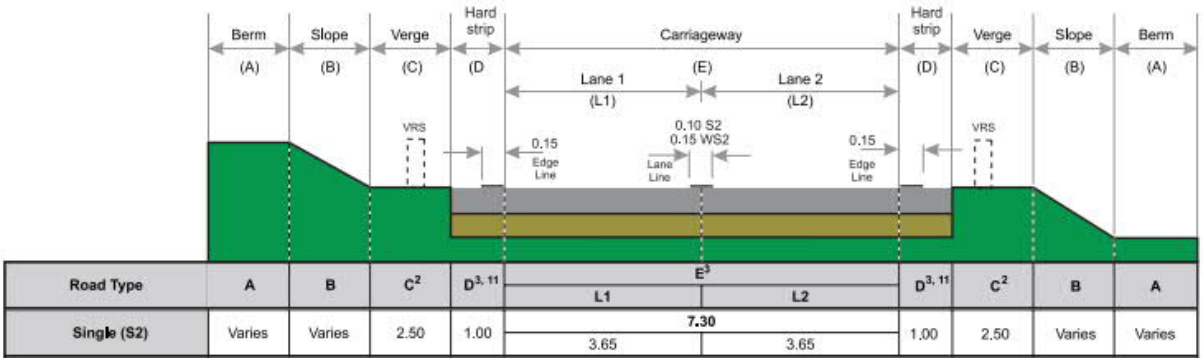


Figure 5-14: Selection of Design Speed (Rural Roads)

The theoretical design speeds determined using the method outlined above are however not necessarily appropriate for the roads in question. Other factors have therefore been taken into consideration in determining an appropriate design speed for each proposed section of road.

5.5.2. Cross Section

CD 127 outlines the permitted cross sections available for use when developing the scheme. The cross section for rural single carriageways is highlighted below. This consists of a 7.3m carriageway with 1.0m hard strips and 2.5m verges.



Road Type	A	B	C[2]	D[3, 11]	E[3]		D[3, 11]	C[2]	B	A
					L1	L2				
Single (S2)	Varies	Varies	2.50	1.00	7.30		1.00	2.50	Varies	Varies
					3.65	3.65				

Figure 5-15: Proposed S2 single carriageway cross-section

As the existing road network does not always meet the cross section outlined above, the standard S2 single carriageway may not necessarily be appropriate for the roads in question. Other factors have therefore been taken into consideration in determining an appropriate cross section of road.

Table 5-1 below, therefore sets out both the theoretical and actual proposed design speed and the adopted cross sections with justifications for their selection detailed in the following paragraphs.

A47 Tuddenham - Sideroad Strategy					
Location	**Design Speed as per CD 109 (kph) (See Appendix E)**	**Existing Road Width (m)**	**Adopted Design Speed (kph)**	**Adopted Road Cross-Section (CD 127)**	**Justification**
Re-aligned A47 west of Hockering	85A	7.5m Carriageway 1m Verges	85A	S2	A design speed of 85kph has been adopted for this section of road that will tie-in and utilise a section of the existing A47, west of Hockering. This existing section of A47 is currently a single carriageway, Class A road with a speed limit of 60mph. It is proposed to reduce the speed limit to 50mph, with the proposed realigned road therefore designed to meet this standard. This reduction in speed limit will encourage road users to use the new A47 Dual Carriageway and allow the new sideroad network to be used by local traffic.
Fox Lane northern tie-in	85A	6m Carriageway 0.5m Verges	85A	S2	This road is currently a national speed limit road at 60mph. The physical nature of the existing road makes this speed achievable for the road user. As the new layout of the road will tie-in to the existing A47 west of Hockering link via a T-junction, it is proposed that the speed limit is reduced to 50mph and a design speed of 85kph is adopted. As the T-junction will require road users to give way to vehicles on the existing A47 west of Hockering - which shall become the primary route - encouraging a slower approach to the junction would improve safety. Appropriate signage will be provided to warn road users to slow down on approach to this T-junction.

Link to Existing A47 (Hockering)	85A	7.5m Carriageway 1m Verge	85	S2	A design speed of 85kph has been adopted for this section of road that will tie-in and utilise a section of the existing A47, which bypasses Hockering. This existing section of A47 is currently a single carriageway, Class A road with a speed limit of 60mph. It is proposed to reduce the speed limit to 50mph, with the proposed realigned road therefore designed to meet this standard. This reduction in the speed limit will encourage road users to use the new A47 Dual Carriageway and allow the new sideroad network to be used by local traffic.
Link to Church Lane (Honingh-am)	85A	3m Carriageway Variable Verge widths	70	6.0m wide cross-section	It is proposed that the link road from the new Wood Lane junction to Church Lane is designed with a design speed of 70kph and has a width of 6 metres. As the existing Church Lane is only 3 metres wide, it is felt it is appropriate for the new link road to have a reduced 6 metre wide cross section from the standard 7.3 metre wide cross section in order to help maintain the current approach drivers have when using Church Lane. It is proposed that a T-junction shall form the connection between the new link and Church Lane, this will ensure motorists have reduced their speeds accordingly when turning onto the existing road. Appropriate signage shall also be provided to warn motorists of the change in cross section.
Wood Lane B1535	85A	7m Carriageway 0.5m Verge	85A	S2	The current speed limit of this Class B single carriageway road is 60mph. The current layout of the road would make it difficult for the driver to have sufficient forward visibility to be aware that a junction is upcoming. It is therefore proposed that the speed limit is reduced to 50mph and the road is designed to a design speed of 85kph. This reduced speed, along with appropriate signage, will provide a safer approach to the new Wood Lane junction.

Berry's Lane	85A	4.5m Carriageway Variable verge widths	50	S2	This road is currently a national speed limit single track road and does not offer sufficient road width to allow vehicles to pass without pulling into the verge. It is proposed that the new section of Berry's Lane is designed to a design speed of 50kph and widened to an S2 single carriageway standard. This section of Berry's Lane will also incorporate a T-Junction that connects a link to Dereham Road which carries traffic to and from Honingham. A lower speed limit of 30mph has been adopted to encourage safer driving in close proximity to the junction. The existing road south of the tie-in is straighter than the proposed new road which may encourage motorists to increase their speed. To mitigate this appropriate signage to warn road users will be provided.
Dereham Road (Link to Honingham from Berry's Lane)	85A	5m Carriageway Variable verge widths	50	S2	This proposed road will tie into Dereham Road and will provide road users with a route between Honingham and Wood Lane junction. Currently the 30mph speed limit for travelling through Honingham doesn't come into effect until closer to the village. To avoid road users travelling at speed along the new link road between Wood Lane junction and Honingham, a design speed of 50kph and proposed speed limit of 30mph has been adopted commencing where road users exit the roundabout.
Link to Norwich Road (east of Honingham)	85A	7.5m Carriageway 2m Verges	85	S2	This road will provide a link from the new Norwich Road junction to the existing Norwich Road east of Honingham. It is proposed that a design speed of 85kph and a speed limit of 50mph will be adopted. This reduction in speed limit will encourage road users to use the new A47 Dual Carriageway and allow the new sideroad network to be used by local traffic.

Link to Taverham Road	85A	5m Carriageway Variable verge widths	50	6.0m wide cross-section	The existing Taverham Road has national speed limit restrictions and a narrow cross section. It is proposed that a design speed of 50kph is adopted along with a cross section in line with the existing sideroad. It is also proposed to have a reduced speed limit of 30mph between the Norwich Road junction northern roundabout and the tie-in to existing in order to reduce vehicle speeds approaching and leaving the new junction. The reduced speed limit will also improve the safety for road users turning into and out of the T-junction providing access to St. Andrews church. Appropriate signage will be provided to warn road users of a narrowing of the road at the tie-in.
Link to Blind Lane	85A	3.5m Carriageway Verge Variable verge widths	50	6.0m wide cross-section	Blind Lane is currently an unclassified road where national speed limit restrictions apply. A design speed of 50kph and speed limit of 30mph is proposed for this link road. This short section of road terminates with a T-junction connecting to Dereham Road. It is proposed that the link road will have a 6 metre width to allow sufficient space for vehicles to pass each other upon entry and exit from the junction. Thereafter, the road will taper down to match existing. Appropriate signage will also be provided to ensure road users are sufficiently warned of the road narrowing south of the tie-in.
Link to Church Lane (Easton)	85A	6m Carriageway Variable verge widths	85	S2	This road will provide a link from the new Norwich Road junction to the existing Church Lane that currently connects to the existing roundabout at Easton. It is proposed that a design speed of 85kph and a reduced speed limit of 50mph will be implemented on this new link to encourage improved road safety and driver behaviour.

Link to Dereham Road (Easton)	85A	7m Carriageway 2m Verges	85	S2	This road will provide a link from the new Norwich Road junction northern roundabout to the village of Easton, utilising a small section of the existing A47. It is proposed that a design speed of 85kph and a speed limit of 50mph are adopted to encourage safer driving along the link. A 30mph speed limit currently comes in to effect on the approach to Easton, the reduced speed limit on the new link will therefore reduce vehicle speeds on the approach to the 30mph speed limit. Appropriate signage will also be provided to warn road users to reduce their speed on approach to the village.

Table 5-1: Sideroad Design Speed and Cross-Section Strategy

5.6. Sideroad Junction Strategy

Within the sideroad network there are 20 at-grade priority junction arrangements proposed.

The locations of these junctions include junctions between adjoining sideroads and access tracks, direct accesses serving local properties, and direct accesses serving drainage basins, and which are given as follows;

Sideroads:

- Re-aligned A47 west of Hockering / Fox Lane northern Tie-in
- Link to Existing A47 (Hockering) / B1135 Wood Lane
- Link to Dereham Road (Honingham) / Berry's Lane
- Link to Dereham Road (Honingham) / Access to existing A47 from Dereham Road (Honingham)
- Link to Existing A47 Norwich Road Roundabout / Blind Lane
- Taverham Road / Access to St Andrew's Church

Access Tracks:

- Existing A47 / Hall Farm Access Track
- Blind Lane / Berry Hall Cottages Access
- Blind Lane / Berry Hall Access
- Blind Lane / Merrywood House Access
- Link to Church Lane (Honingham) / Berry Hall Cottages Access
- Link to Church Lane (Honingham) / Hillcrest Access
- Mattishall Lane / Timber Yard Access

Drainage Basin Accesses:

- Newgate House Access Track Drainage Basin Access
- Church Lane Drainage Basin Access
- Berry's Lane Drainage Basin Access
- Hall Farm Access Track Drainage Basin Access 1

- Hall Farm Access Track Drainage Basin Access 2
- Existing A47 (Hockering) Drainage Basin Access
- Taverham Road Drainage Basin Access

For all access tracks to properties and drainage basins, the junction type was chosen to be the form of a simple rural at-grade priority junction with this design decision based on assumed low demand by local road users or occasional use by maintenance vehicles.

The appropriate junction type for junctions between adjoining sideroads was determined using the process given in Chapter 2 of CD 123 Geometric design of at-grade priority and signal-controlled junctions. This process is based on the 2-way AADT figures for both the major and minor road used in conjunction with Figure 5-16 as shown below.

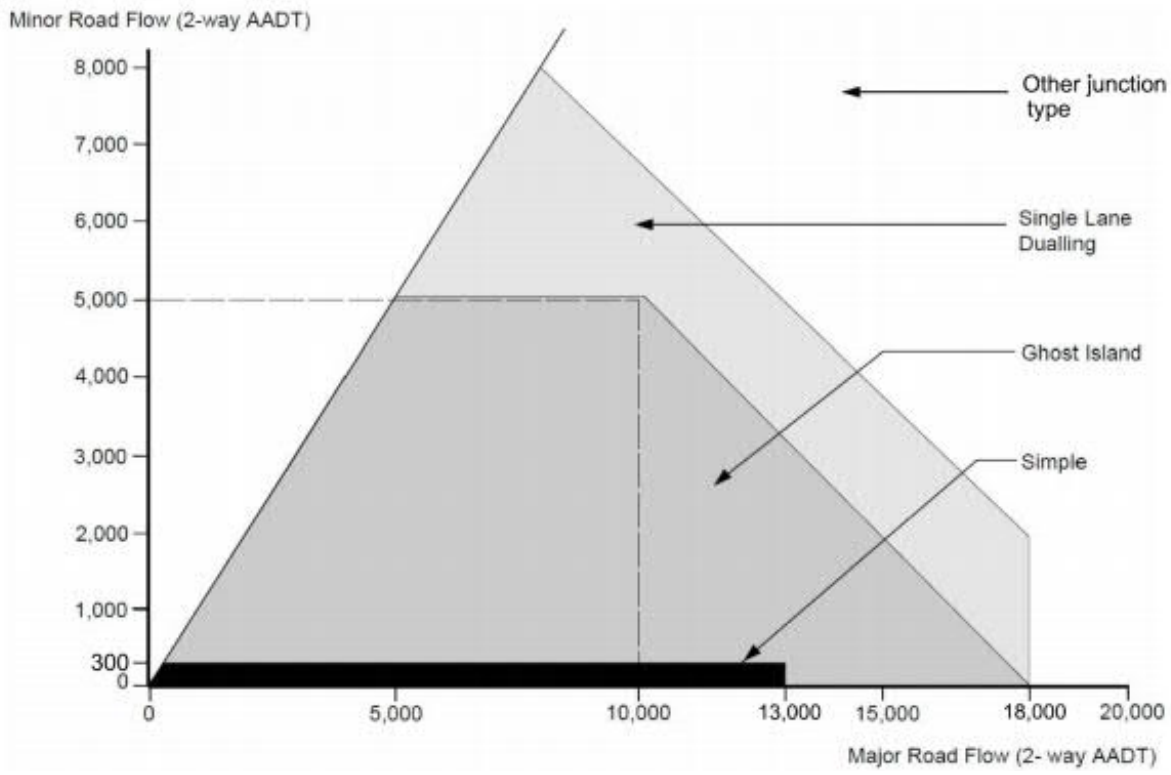


Figure 5-16: CD 123. Approximate priority junction provision on single carriageway roads based on flows only.

The AADT figures and subsequent application of Figure 5-16 to determine the appropriate junction type for each of the sideroad junctions is given below.

5.6.1. Fox Lane Junction

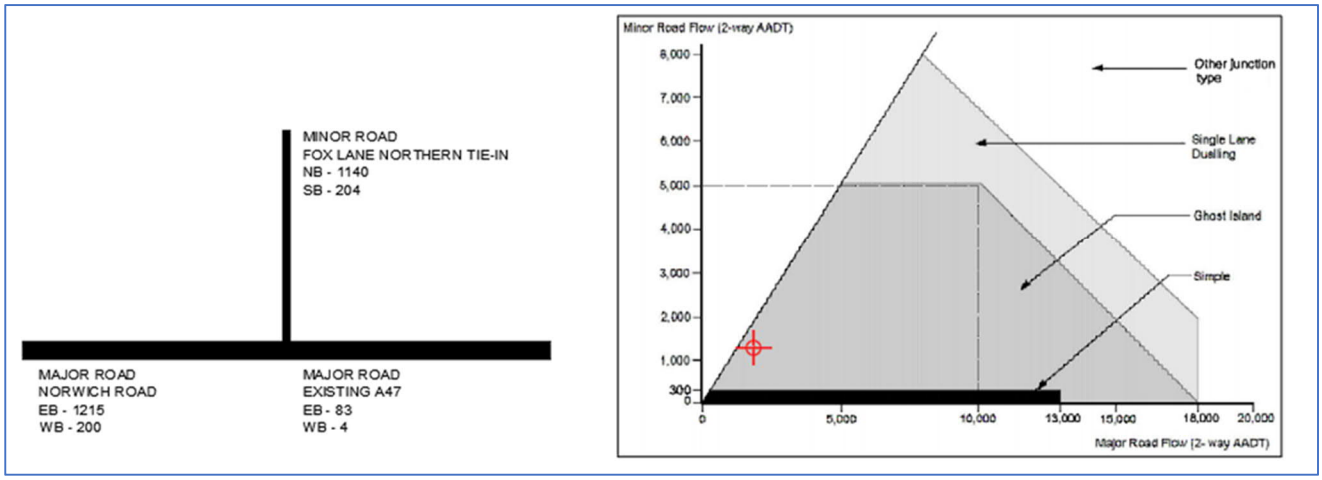


Figure 5-17: Fox Lane junction priority junction provision

Resultant junction type – Ghost Island

5.6.2. B1135 Wood Lane junction with Church Lane to Wood Lane link

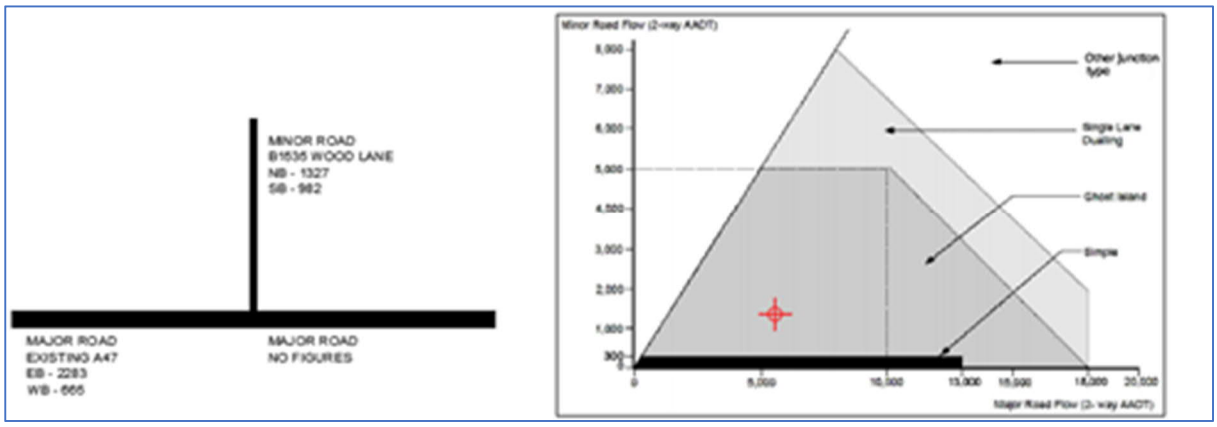


Figure 5-18: B1135 Wood Lane junction priority junction provision

Resultant junction type – Ghost Island

5.6.3. Berry's Lane junction with realigned Dereham Road

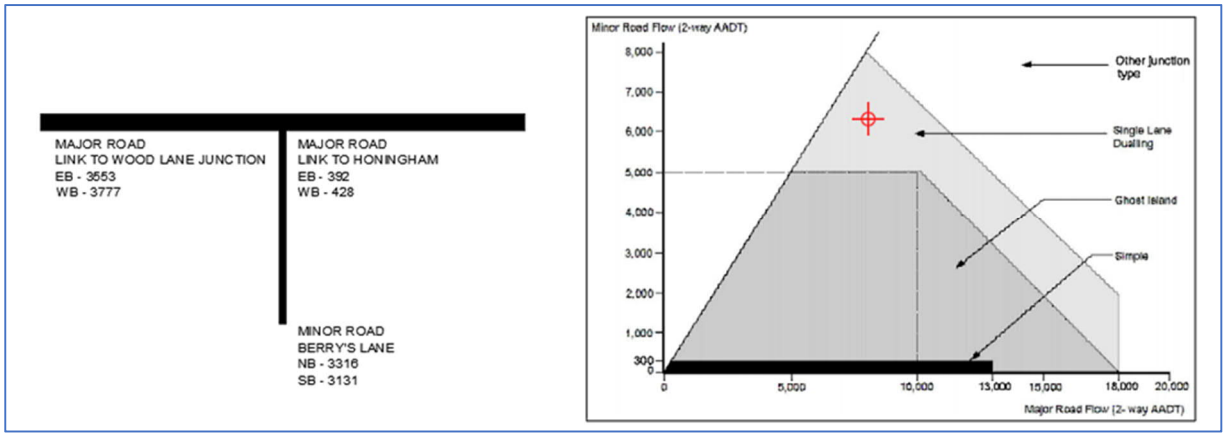


Figure 5-19: Berry's Lane junction priority junction provision

Resultant junction type – Single Lane Dualling

5.6.4. Hall Farm Access Track junction with realigned Dereham Road

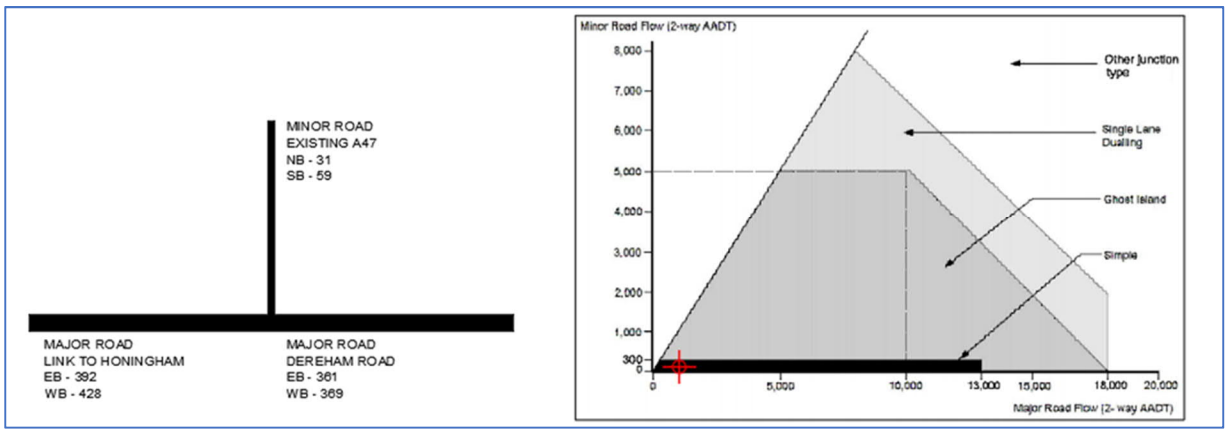


Figure 5-20: Hall Farm Access Track priority junction provision

Resultant junction type – Simple Junction

5.6.5. Blind Lane junction with realigned Norwich Road

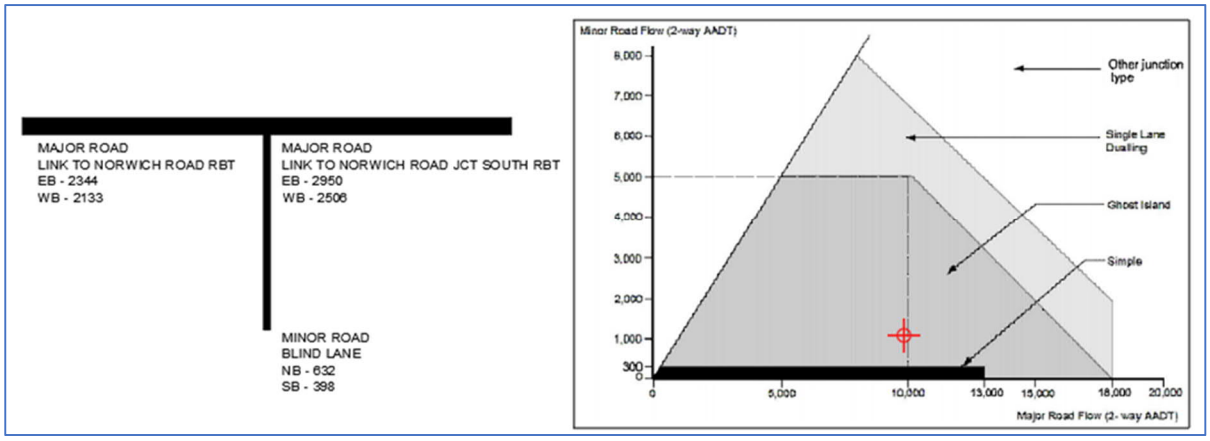


Figure 5-21: Blind Lane priority junction provision

Resultant junction type – Ghost Island

5.6.6. Access to St. Andrew's Church

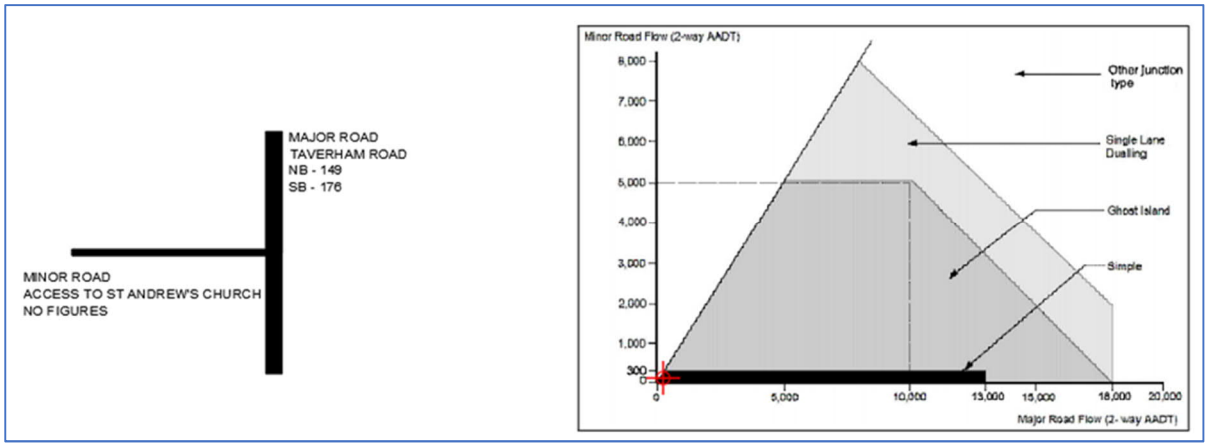


Figure 5-22 : Access to St. Andrew's Church priority junction provision

Resultant junction type – Simple Junction as the major road AADT figures are very low and the Access to St Andrew's Church is a stopped-up road with local access only.

In summary, the following junctions were developed using a simple priority junction layout:

- Link to Dereham Road (Honingham) / Access to existing A47 from Dereham Road (Honingham)
- Taverham Road / Access to St Andrew's Church

The following junctions were developed using a ghost island layout:

- Re-aligned A47 West of Hockering / Fox Lane Northern Tie-in

- Link to Existing A47 (Hockering) / B1135 Wood Lane
- Link to Existing A47 Norwich Road Roundabout / Blind Lane

The following junctions were developed using a Single Lane Dualling layout

- Link to Dereham Road (Honingham) / Berry's Lane

5.6.7. Junction Design

Simple priority junctions were designed in accordance with the design principles outlined in Chapter 5 of CD 123 *Geometric design of at-grade priority and signal-controlled junctions*. Corner radii tapers have been adopted in accordance with clause 5.6.2 of CD 123 where provision for articulated vehicle manoeuvres is required. At junctions where it is anticipated that articulated vehicle manoeuvres shall only form a small percentage of the total number of vehicles that will use the junction, bellmouth radii have been provided in accordance with clauses 5.2 and 5.6.1 of CD 123.

Ghost island and single lane dualling junctions were designed in accordance with the design principles outlined in Chapter 6 of CD 123 *Geometric design of at-grade priority and signal-controlled junctions*, in particular the geometrical general layout given in Figures 5-23 and 5-24 below.

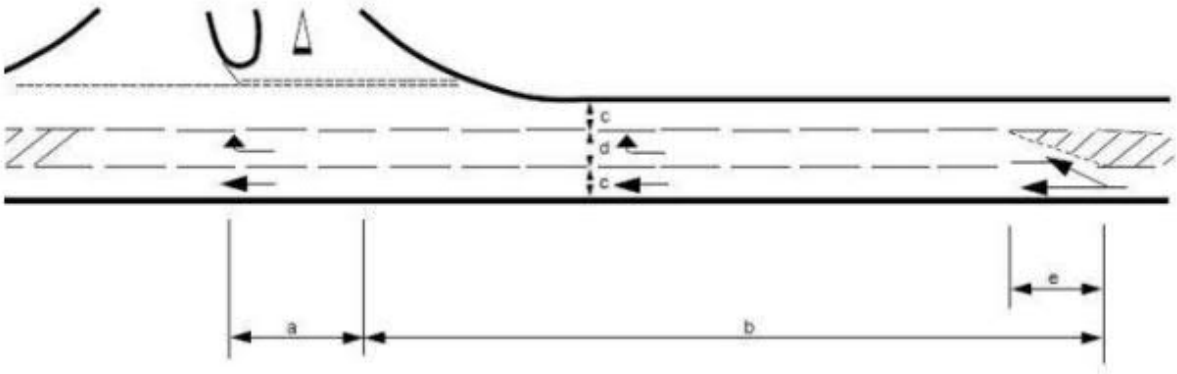


Figure 5-23 : Major / minor priority junction with a ghost island on single carriageway

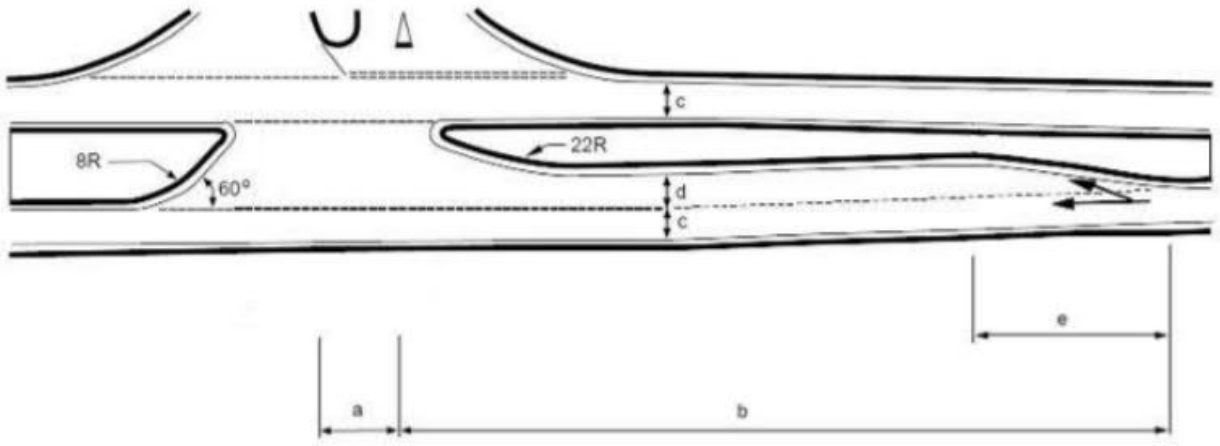


Figure 5-24 : Major / minor priority junction with single lane dualling

On the major road, the development of the ghost island tapers and lengths of turning lane are based on the design speed of the road and are provided in accordance with standard. No additional length has been provided for stacking of vehicles wishing to turn right into the minor road. The turning lane and through lane widths of the ghost island layout are taken as 3.50m and 3.65m in accordance with CD 123 Clause 6.8 and Clause 6.10.1 respectively.

On the minor road, the junction layout was designed in accordance with Clause 5.6.3 and therefore making no allowance for diverge or merge tapers. Physical traffic islands have not been provided on the minor road of any of the ghost island junction locations.

6. Direct Access

6.1. Direct Access Provision

At present there are 41 direct accesses onto the single carriageway A47 between the Fox Lane junction and the roundabout at the intersection of Dereham Road and Church Lane.

The 41 direct accesses are made up from 23 on the eastbound side and 18 on the westbound side. These accesses include at-grade priority junctions, in the form of simple T-junctions as well as ghost island junctions, serving various sideroads along the route. In addition, there are also accesses for both private single dwelling properties and field accesses.

There will be no direct access permitted onto the new A47 Dual Carriageway. The existing accesses that cannot be rerouted as part of the sideroad strategy will therefore either be stopped up or relocated onto the existing sideroad network and away from the new A47 Dual Carriageway.

The strategy for how each existing access will be dealt with has not been finalised and will therefore be developed in further detail at the next design stage.

7. Norwich Western Link

7.1. Scheme Background

The Norwich Western Link (NWL) scheme promoted by Norfolk County Council (NCC) formally announced Preferred Route (PRA) in July 2019.

The proposed 3.9mile dual carriageway road links from the roundabout at the western end of Broadland Northway and connects to the A47 via a new proposed junction at Wood Lane (B1535).

Together with the proposed dualling of the A47 between North Tuddenham and Easton, the Norwich Western Link would create a fully dual carriageway orbital route around the city.

The Norwich Western Link would provide a higher standard route between the western end of Broadland Northway and the A47, and significantly improve travel between these two major roads.

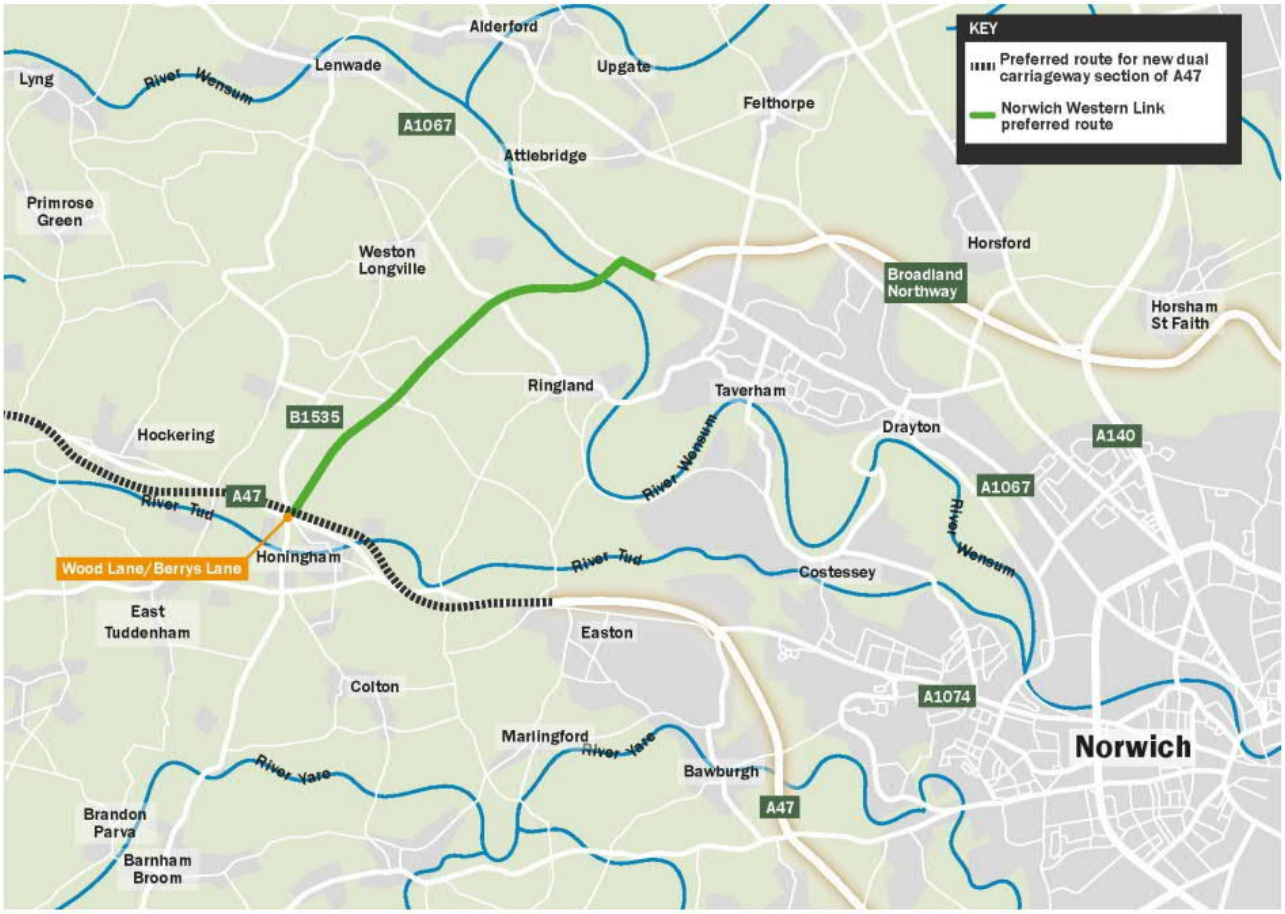


Figure 7-1: Norwich Western Link (NWL) Preferred Route Alignment

7.2. NWL Impact on Junction Design

A revised traffic model was generated based on the inclusion of the NWL the results of which are shown below. A full review of the figures further confirm that full grade separated junctions are required. The traffic figures below outline the impacts on the flows in the vicinity of the junctions.

7.2.1. Traffic Figures

The high-level traffic figures outlined below highlight the main changes in the AADTs when the NWL is considered

Two Way AADT - DS2040 (Approx. values)

Location Description	With NWL	Without NWL	Difference
To the west of Wood Lane junction	53094	46131	6963
Between the two junctions	42779	45456	-2677
To the east of Norwich Road junction	44337	48379	-4042
NWL	28427		

Table 7-1: Sideroad Design Speed and Cross-Section Strategy

As can be seen from the table above, when the NWL is in place, the model is predicted to have an approximate increase of 7,000 AADT to the west of the Wood Lane junction.

This increase is in line with expectations as the proposed NWL scheme is beneficial to longer distance trips between the west and north of Norwich. The reduction of AADT to the east of the Wood Lane junction is also plausible, as the west – north trips (in both directions) that would previously have continued travelling along the A47 and through the Norwich Road junction would now be using the NWL instead.

The direct impacts on the junction layouts are highlighted within the following sections.

7.2.2. Wood Lane Junction

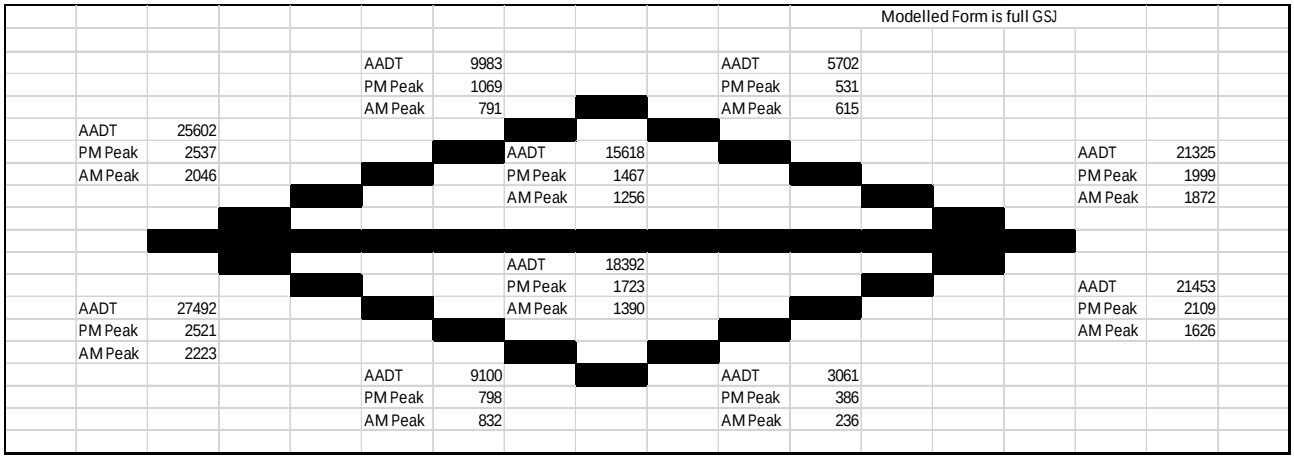


Figure 7-2 : Stage 3 Traffic Figures at design year 2040– Wood Lane Junction Full Grade Separation including NWL

The AADT in the vicinity of the junction is in the order of 41,000-53,000. There is an increase of approximately 8000 vehicles on the western side of the junction and a decrease of 2000 vehicles to the east. This is a direct impact of the inclusion of the NWL.

The layout of the junction slip roads and connector roads will be determined based on the CD 122 requirements and traffic volumes which is discussed within Section 7.3 of this report.

7.2.3. Norwich Road Junction

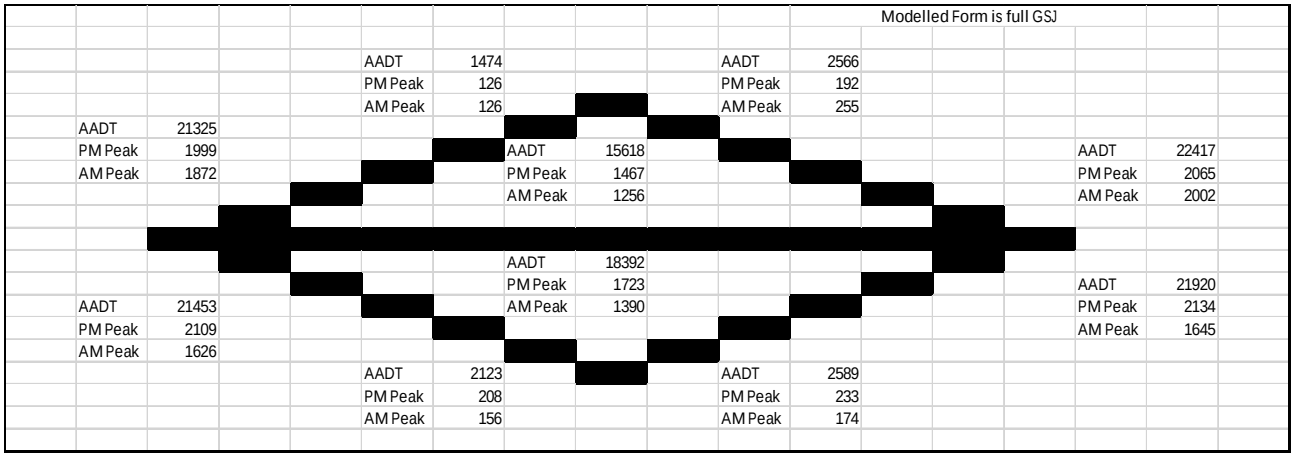


Figure 7-3 : Stage 3 Traffic Figures at design year 2040 – Norwich Road Junction Full Grade Separation including NWL

The AADT in the vicinity of the junction is in the order of 43,000-44,000. Although there is a decrease in the traffic in the vicinity of the junction the overall volume still justifies a full grade separated layout.

The finalised layout of the junction slip roads and connector roads will be determined based on the CD 122 requirements and traffic volumes which is discussed within Section 7.3 of this report.

7.3. Slip Road Configuration

In selecting the appropriate slip road configuration, the peak traffic volumes are to be considered along with adjustment factors in accordance with Clause 3.9 of CD 122.

CD 122 states:

Clause 3.9 *Where there is an uphill gradient and a presence of HGVs the hourly design flows for the mainline and merges shall be adjusted in accordance with Table 3.9a and 3.9b*.

Table 3.9a Adjustment factors for uphill gradients and for the presence of large goods vehicles on the mainline

% HGVs on mainline	Mainline gradient	
	<2%	≥2%
5	none	1.10
10	none	1.15
15	none	1.20
20	1.05	1.25

Table 7-2: CD 122 Adjustment factors for uphill gradients on mainline

Table 3.9b Adjustment factors for uphill gradients and for the presence of large goods vehicles on merge connector roads

% HGVs on merge connector	Merge connector gradient		
	<2%	2% to 4%	>4%
5	-	1.15	1.30
10	-	1.20	1.35
15	1.05	1.25	1.40
20	1.10	1.30	1.45

Table 7-3: CD 122 Adjustment factors for uphill gradients on merge connector roads

Clause 3.10 *The mainline gradient used to calculate the adjusted hourly design flows shall be the average gradient over a distance 0.5 km either side of the merge or diverge nose tip.*

Clause 3.11 *The merge connector road gradient used to calculate the adjusted hourly design flows shall be the average of the 0.5 km section before the nose tip.*

Based on an initial alignment review the following table outlines the mainline and merge connector gradients to be used when determining the adjustment factor

Mainline Gradients & HGV%

	Wood Lane Junction EB Diverge	Wood Lane Junction WB Merge	Wood Lane Junction EB Merge	Wood Lane Junction WB Diverge
Gradient	+1.15%	-0.96%	-1.51%	+1.59%
HGV %	5-7%.	3%	5-7%.	3%
	Norwich Road Junction EB Diverge	**Norwich Road Junction WB Merge**	**Norwich Road Junction EB Merge**	**Norwich Road Junction WB Diverge**
Gradient	+0.91%	-1.01%	-0.24%	+0.11%
HGV %	5-7%.	3%	5-7%.	3%

Table 7-4: Mainline Gradients and HGV %

Merge Slip Road Gradients

	Merges only	
	Wood Lane Junction	**Norwich Road Junction**
Eastbound Merge	-1.10	0.33
HGV %	1%	3%
Westbound Merge	+1.55	0.19
HGV %	2%	>1%

Table 7-5: Merge Slip Road Gradients & HGV %

Positive values are uphill gradients and require adjustments to be made in line with Clause 3.9 of CD 122

Based on the values above the following table outlines the factors to be adopted for each of the slip lanes.

Mainline Factors

	Wood Lane Junction EB Diverge	Wood Lane Junction WB Merge	Wood Lane Junction EB Merge	Wood Lane Junction WB Diverge
Factor	No factor required gradient <2%	No factor required downhill gradient	No factor required downhill gradient	No factor required gradient <2%
	Norwich Road Junction EB Diverge	**Norwich Road Junction WB Merge**	**Norwich Road Junction EB Merge**	**Norwich Road Junction WB Diverge**
Factor	No factor required gradient <2%	No factor required downhill gradient	No factor required downhill gradient	No factor required gradient <2%

Table 7-6: Mainline factors to be applied

Merge Factors

	Merges only	
	Wood Lane Junction	**Norwich Road Junction**
Eastbound Merge Factor	No factor required downhill gradient	No factor required gradient <2%
Westbound Merge Factor	No factor required gradient <2%	No factor required gradient <2%

Table 7-7: Merge factors to be applied

No factors are required based on the proposed design. The Peak hour flows will be used in conjunction with CD 122 Figure 3.12a for merge lanes and Figure 3.26a for diverge lanes to determine the suitable slip lane layout.

Wood Lane Junction

East Bound				West Bound			
Diverge		Merge		Diverge		Merge	
Mainline	Slip Lane	Mainline	Slip Lane	Mainline	Slip Lane	Mainline	Slip Lane
2537	1069	1999	615	2109	386	2521	832
CD 122 Figure 3.30e		CD 122 Figure 3.14a		CD 122 Figure 3.30a		CD 122 Figure 3.14e	
Type C		Type A		Type A		Type D	

Table 7-8: Wood Lane junction slip lane layout

Note the peak hour for the mainline does not always match the corresponding peak hour for the slip lane. The most onerous combination has therefore been adopted.

As can be seen from the table above the slip lane layout recommended is a Type A layout for both the eastbound merge and westbound diverge, a Type C layout for the eastbound diverge and a Type D layout for the westbound merge. A diagram of the proposed layout forms is shown below.

In accordance with Chapter 5 of CD 122 and Figure 7-4 below, the cross section of the east bound diverge slip will be a DG2E as it is over the threshold of 800 vph in the peak hour. The remainder shall be a MG1C/DG1C cross section. The cross-sections can be seen in Figure 3-4 in Section 3.

	Adjusted connector road flow (vph)			
	0-800	801-1200	1201-2400	2401-3200
Merge (rural)	MG1C		MG2E	
Merge (urban)	MG1D		MG2F	
Diverge (rural)	DG1C	DG2E		
Diverge (urban)	DG1D	DG2F		
Interchange link/loop (rural)	IL1C or IL2C (see clause 5.3)		IL2C	
Interchange link/loop (urban)	IL1D or IL2D (see clause 5.3)		IL2D	

Figure 7-4: Cross-sections for connector roads to/from mainline all-purpose roads

Norwich Road Junction

East Bound				West Bound			
Diverge		**Merge**		**Diverge**		**Merge**	
Mainline	**Slip Lane**	**Mainline**	**Slip Lane**	**Mainline**	**Slip Lane**	**Mainline**	**Slip Lane**
1999	126	2065	255	2134	233	2109	208
CD 122 Figure 3.30a		**CD 122 Figure 3.14a**		**CD 122 Figure 3.30a**		**CD 122 Figure 3.14a**	
Type A		Type A		Type A		Type A	

Table 7-9: Norwich Road junction slip lane layout

Note the peak hour flow for the mainline does not always match the corresponding peak hour flow for the slip lane. The most onerous combination has therefore been adopted.

As can be seen from the table above the slip lane layout recommended is a Type A layout for both the Merge and Diverge lanes in both directions. A diagram of the proposed layout forms is shown below.

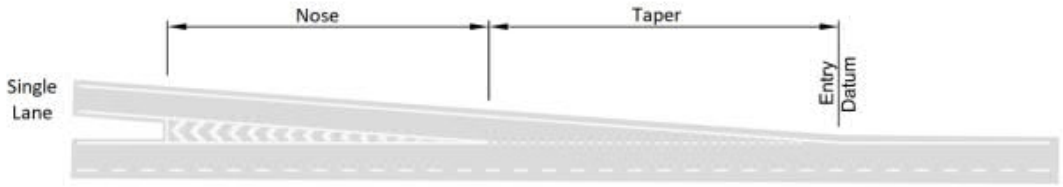


Figure 7-5: Type A – Taper Merge Layout

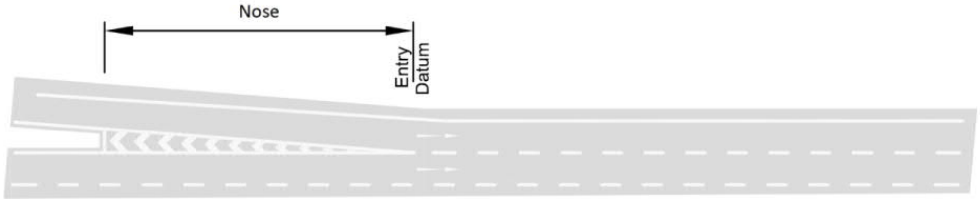


Figure 7-6: Type D – Lain Gain Layout

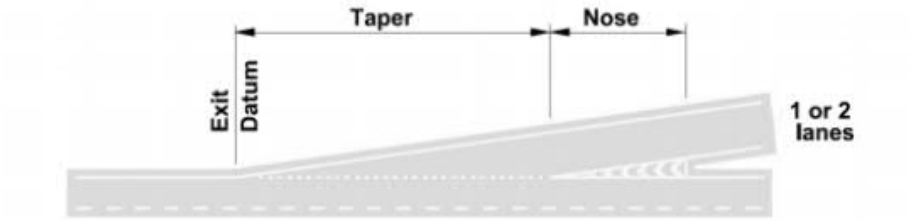


Figure 7-7: Type A – Taper Diverge Layout

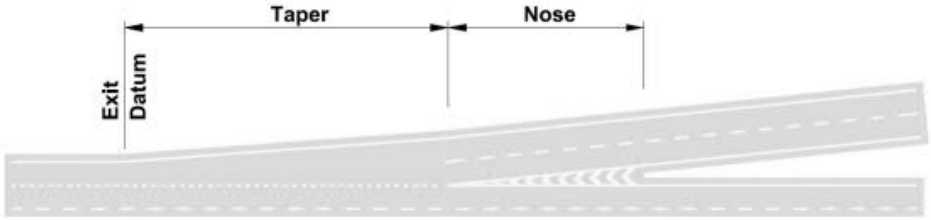


Figure 7-8: Type C – Lane Drop Layout

7.4. Connector Road

The connector road between the northern and southern roundabouts of Wood Lane junction has been assessed for the additional traffic flows through the junction when the Norwich Western Link is included.

Forecast traffic flows for the design year (2040) have been taken from the SATURN model and have then been used in the detailed junction ARCADY analysis. The results of this assessment suggest that the connector road modelled as a single 2 lane layout is predicted to operate within capacity.

The ratio of flow to capacity (RFC) values are all predicted to be below 50% which indicates both connector roads would perform with only a low level of queuing anticipated.

7.5. Scheme Layout with inclusion of NWL

Appendix B should be referred to for a layout plan showing how the Norwich Western Link is incorporated into the scheme and the effect this ha on the Wood Lane junction and sideroad network.

8. Results of Junction Analysis

8.1. Overview

Traffic flows were taken from the forecast assignment models and used in detailed junction model assessments using ARCADY (JUNCTION 9) for all roundabouts within the two full grade separated junctions. The traffic flows used in the junction models can be found in Appendix C.

The results of the assessment of junction operation for both the AM and PM peak flows are discussed in more detail below. The Ratio of Flow to Capacity (RFC) and maximum queue length from ARCADY are the two primary measures of junction-arm performance for a roundabout.

An RFC value below 0.85 for a particular arm would indicate that that arm would operate within capacity for the roundabout.

It should be noted that the analysis undertaken at this stage is based on:

- a preliminary design of Wood Lane junction and
- a May 2019 version of WebTAG economic parameters for the forecast models.

As such the analysis and results may change once the scheme design has been finalised as well as the latest WebTAG economic parameters having been applied; this will be revisited during the next stage design development.

8.2. Junction Capacity Assessments

8.2.1. A47/Wood Lane Junction – Northern Roundabout

The assessment of the junction capacity indicate that the northern roundabout is predicted to operate within capacity during both peaks in both scenarios. It is worth noting that the EB diverge link under 2040 DS with NWL has a two-lane approach (rather than one-lane approach as in the 2040 DS without NWL scenario) in order to accommodate the additional NWL related traffic.

ARM	2040 DS with NWL				2040 DS without NWL			
	AM		PM		AM		PM	
	RFC	Max Q (PCU)	RFC	Max Q (PCU)	RFC	Max Q (PCU)	RFC	Max Q (PCU)
NWL	0.68	2.2	0.61	1.6	-	-	-	-
EB Merge	-	-	-	-	-	-	-	-
Roundabout Link Road	0.30	0.4	0.48	0.9	0.10	0.1	0.06	0.1
EB Diverge	0.38	0.7	0.58	1.4	0.08	0.1	0.08	0.1
A47 Link Rd	0.25	0.3	0.50	1.0	0.35	0.5	0.26	0.4

Table 8-1: A47/Wood Lane Junction – Northern Roundabout

8.2.2. A47/Wood Lane Junction – Southern Roundabout

The assessment of the junction capacity indicate that the southern roundabout is also predicted to operate within capacity with all modelled arms' RFCs being relatively higher under the with NWL scenario due to the presence of NWL related traffic. The link to Church Lane in East Tuddenham was not assessed because it is a minor road and as such it was not included in the assignment model and therefore no modelled traffic flow data was available.

ARM	2040 DS with NWL				2040 DS without NWL			
	AM		PM		AM		PM	
	RFC	Max Q (PCU)	RFC	Max Q (PCU)	RFC	Max Q (PCU)	RFC	Max Q (PCU)
Roundabout Link Road	0.66	2.0	0.66	2.0	0.23	0.3	0.16	0.2
WB Diverge	0.16	0.2	0.28	0.4	0.06	0.1	0.03	0.0
Berry's Lane	0.25	0.3	0.38	0.6	0.06	0.1	0.07	0.1
Link to Church Lane	-	-	-	-	-	-	-	-
WB Merge	-	-	-	-	-	-	-	-

Table 8-2: A47/Wood Lane Junction – Southern Roundabout

8.2.3. A47/Norwich Road Junction – Northern Roundabout

The assessment of the junction capacity indicate that the northern roundabout is predicted to operate within capacity in both scenarios. The results are broadly unchanged between the two scenarios, apart from the Link to existing A47 and Church Lane. The increased RFC

on this link under without NWL scenario is mainly due to the diversion of North – West directional traffic from NWL into Ringland Road which meets the new junction via Church Lane at Easton.

ARM	2040 DS with NWL				2040 DS without NWL			
	AM		PM		AM		PM	
	RFC	Max Q (PCU)	RFC	Max Q (PCU)	RFC	Max Q (PCU)	RFC	Max Q (PCU)
EB Diverge	0.07	0.1	0.07	0.1	0.06	0.1	0.21	0.3
Link to Church Farm / Taverham Rd	0.01	0.0	0.01	0.0	0.01	0.0	0.02	0.0
Link to existing A47 and Church Lane	0.01	0.0	0.00	0.0	0.27	0.4	0.14	0.2
EB Merge	-	-	-	-	-	-	-	-
Underbridge Link Rd	0.17	0.2	0.13	0.2	0.27	0.4	0.28	0.4

Table 8-3: A47/Norwich Road Junction – Northern Roundabout

8.2.4. A47/Norwich Road Junction – Southern Roundabout

The assessment of the junction capacity indicate that the southern roundabout is also predicted to operate below capacity with very little difference between the two scenarios.

ARM	2040 DS with NWL				2040 DS without NWL			
	AM		PM		AM		PM	
	RFC	Max Q (PCU)	RFC	Max Q (PCU)	RFC	Max Q (PCU)	RFC	Max Q (PCU)
Underbridge Link Rd	0.09	0.1	0.09	0.1	0.17	0.2	0.15	0.2
WB Diverge	0.10	0.1	0.14	0.2	0.11	0.1	0.15	0.2
Link to existing A47 and Dereham Rd, Easton	0.10	0.1	0.17	0.2	0.09	0.1	0.16	0.2
Link to Honingham	0.18	0.2	0.13	0.2	0.26	0.4	0.23	0.3
WB Merge	-	-	-	-	-	-	-	-

Table 8-4: A47/Norwich Road Junction – Southern Roundabout

8.3. Impact on existing A47 / Fox Lane Junction

Based on the ARCADY analysis above, the scheme is unlikely to cause any significant delay in its vicinity although it is likely to increase the pressure on adjacent junctions. This is expected due to additional traffic on the A47 with the implementation of the schemes. According to the traffic forecast, the existing A47 / Fox Lane junction to the west of the scheme is expected to carry a mainline AADT of 49,100 with the NWL included and 43,100 without the NWL respectively. Although this junction is still predicted to operate without any excessive delay from the traffic impact perspective, its mainline traffic figures are far beyond the limiting figure of 30,000 recommended for a compact layout.

	24hour AADT	
Link	**2040 DS With NWL**	**2040 DS Without NWL**
A47 Mainline – Two Way	49,100	43,100
WB Merge	200	300
WB Diverge	4,200	3,400
Fox Lane – Two Way	4,300	3,600

Table 8-5: AADT figures for design year 2040 at the existing Fox Lane Junction with and without NWL

9. Operational Safety Review

9.1. Proposed A47 Mainline

Currently, the A47 between North Tuddenham and Easton is a 7.9km long section of single carriageway road, linking existing sections of dual carriageway. Users of the road experience significant congestion in its current configuration due to traffic build-up and other reasons; for example, flooding when heavy rain falls.

There are a high number of 'reportable' (as per the definition contained within Section 170 of the Road Traffic act 1988) road traffic collisions recorded within the single carriageway section, with clear cluster hotspots in close proximity to at-grade junctions where sideroads currently allow traffic to leave/join the mainline.

Upgrading the section to dual carriageway will involve the closure of 41 direct access sideroad junctions, where vehicular traffic of all types (motorcycles, cars, goods vehicles, plant, agricultural vehicles and machinery), can currently either leave or join the mainline. By closing these junctions there will be an anticipated significant reduction in reportable road traffic collisions on the A47 within the scheme.

The dualling of the carriageway between North Tuddenham and Easton will be approximately 8.5 kilometres in length and will consist of two lanes in each direction separated by a central reserve with a vehicle restraint system, providing a safer environment for road users and road workers. The scheme includes the construction of two full grade separated junctions on the mainline with merge and diverge entry and exit slip roads providing connection to the local road network.

Congestion and collision rates are anticipated to drop significantly on the A47 following implementation of this scheme.

Consideration shall be given to the inclusion of removable sections of the central reserve barrier on the mainline to provide crossover points within it. This will accommodate vehicular traffic being moved to opposing carriageways in the event of a spontaneous major or critical incident on the road where traffic management of this nature is required. Demountable sections of barrier would also provide contingencies for maintenance and repair operations. As part of this process, dialogue with Norfolk Constabulary and Highways England Operation's Team will be sought.

The construction of the central reserve raises several considerations from a safety viewpoint with comparisons of safety benefits outlined in Table 9-1 below.

Hardened Central Reserve	Non-Hardened Central reserve
Additional run off area available, which provides road users with an area to regain control of an errant vehicle.	
If a vehicle leaves the offside lane and encroaches onto this area, the hardened surface would reduce the risk of loss of control/overturning in comparison to a soft central reserve. A hardened surface would also then reduce the likelihood of loose material being dragged onto the carriageway causing a hazard to other road users.	Reduction in the quantity of materials imported and exported from site. Likelihood of loose material being dragged onto the carriageway causing a hazard to other road users.
Reduction in maintenance activities, such as grass cutting and rodding of drainage pipes on balanced sections of carriageway.	Reduced area requiring work during construction and therefore reduction in the length of the overall programme.
Increased forward visibility where sightlines cross into the central reserve compared to a non-hardened solution if grass cutting is performed inconsistently.	A reduction of the flow to the surface water drainage system due to the increased permeable area.
Removes the need for central reserve drainage on a balanced carriageway and removes drainage conflicts with a potential RCB.	
Emergency Crossing Points (ECPs) can be incorporated into the general central reserve hardening.	
The hardened central reserve provides a suitable foundation for a potential RCB.	
The hardened surface can reduce the collection of detritus, growth of vegetation and accumulation of soil and organic matter.	'Low grow' types of grass can be used that will grow to a maximum of around 20 centimetres, however weeds can still grow and may require cutting/ weed killer treatment. A non-hardened surface will result in a progressively increased

	surface level when compared to hardened surfaces.

Table 9-1: Comparison of benefits of hardened and non-hardened central reserve

9.2. Grade Separated Junctions

There are two proposed full grade separated junctions with slip roads within the scheme, both being of 'dumbbell' configuration;

- 'Eastern Junction' referred to as the 'Norwich Road Junction' (located where the A47 currently joins the Norwich Southern Bypass at Blind Lane and Taverham Road).

- 'Western Junction' referred to as the 'Wood Lane Junction' (located where the A47 currently passes the staggered junction at Berry's Lane and Wood Lane);

There are currently two different options for the Wood Lane Junction, one which includes the Norwich Western Link Road, a northern connector road proposed by Norfolk County Council, and one without it.

The maximum permitted speed limit for motor vehicles on a standard dual carriageway is 70 miles per hour, with further restrictions imposed dependent on classification, size and category of vehicles[1]. The scheme mainline is designed to a speed of 120 kph, with a maximum vehicular speed limit of 70 mph.

Consideration should be given to ensuring that all signage, particularly on the approach to junctions, and within junction parameters is clear and simple to understand in order to avoid 'information overload' for drivers.

The UK has what is commonly described as an 'ageing population'. According to the 2011 population census, 16.4% of the UK population are aged over 65, and in Norfolk that figure sits at 21.6%. Elderly drivers are recognised (amongst others) as being a vulnerable road user group. Where drivers of motor vehicles leave the A47 dual carriageway via the exit slip roads they may be travelling at dual carriageway speeds, faced with a multi-lane slip road layout and a significant number of route options ahead denoted by signage. It is recommended that any signage information be kept clear and concise for ease of understanding. This is particularly relevant for those who are visitors to the area and not familiar with the layout.

[1] DVSA 2019 Highway Code

For example, drivers travelling east on the A47 intending to take the exit slip road at Wood Lane junction with the NWL will be faced with a two-lane slip road, with four exit options from the roundabout ahead of them.

Drivers travelling west on the A47 at the same junction intending to travel to Honingham will encounter four exit options from the roundabout, then upon turning south on Dereham Road towards Honingham will immediately be faced with more signage for the staggered junction at Berry's Lane.

At the exits from the roundabouts onto the local road network, the geometry should reflect the nature of the local road, its width and achieved visibility, which will be significantly different to the trunk road drivers may have just used. It should encourage much slower speeds onto the adjoining local link. Note that whilst this design approach may require departures from standards it is in the interests of road user's safety rather than going against them.

The Norwich Road junction presents similar signage and driver information challenges. Where a roundabout is designed to have multiple lanes on the circulatory carriageway these should be clearly marked to encourage proper lane discipline in drivers and to make full use of the carriageway.

9.3. Sideroad Junctions

At sideroad junctions, the entry and exit radii should be designed to constrain vehicle speeds, with the size of the junction again reflecting the nature of the sideroad.

Due consideration shall also be made for the appropriate design vehicle at all junction locations and the junction design shall be in accordance with CD 123 Clause 5.2

9.4. Carriageway Tie-ins

Links should be designed to reflect the class of road to which they will join and the wider network they connect to, such that drivers are aware from the outset of the standard of highway they may expect and adjust their behaviour accordingly. Drivers moving from a modern S2 7.3m wide carriageway to older sections of road will be particularly at risk as they may be travelling at inappropriately high speeds for the type of link they will encounter. The project team are in engagement with Norfolk County Council regarding carriageway tie-ins and how new sideroads connect to the wider network. These discussions will help influence the development of the design going forward to ensure an appropriate cross-section and tie-in layout is adopted. Where there is a change in cross-section at a tie-in

location, any necessary mitigation measures shall be provided, including advanced warning signage on either side of the tie-in location.

Appropriate signage shall be provided to ensure warning of the tie-ins for both directions at all locations, particularly where there is a difference in the carriageway width.

9.5. Walking, Cycling and Horse Riding (WCHR)

There is currently no data available in relation to the demand for pedestrians, cyclists, horse riders to use or cross the A47 within the scheme, however it must be considered that non-motorised road users are permitted within the law to use roads of this category.

It follows that whilst not advised to do so on safety grounds, pedestrians, pedal cyclists, mobility scooters and powered wheelchairs are entitled to use the road and police reports nationally show that usage of this nature occur on dual carriageway roads with varying regularity.

In addition, trunk roads are designed to carry high volumes of motor traffic at high speed. As such their alignments, both horizontal and vertical, are usually the most direct. It should not be surprising then that WCHR, particularly those who are commuting or otherwise making a utilitarian journey, choose to use these roads in preference, to using more circuitous back roads where traffic flows can be expected to be lower.

The current design proposals provide a mixture of shared footway/cycleway, footpath and cycleway routes with crossing points, that link the villages and existing footways on and off line across the old A47 alignment and the new proposed dual carriageway.

High-quality segregated facilities should be provided for the routes that are proposed to run along the new alignment to reduce the likelihood of WCHR and vehicular traffic interaction. The proposed signage and markings delineation should provide clear, unambiguous and safe wayfinding guidance to ensure efficient, safe and easy to understand navigation through the routes and reduce risk of interaction between users.

Safe crossing locations and facilities are required at the recognised crossing points; design document CD143 and CD195 outline the requirements for providing suitable road crossing infrastructure for various locations (roundabouts, side-roads, etc.) and speeds of roads.

Where proposed new footways or cycleways run immediately adjacent to the new A47 alignment in the verge, appropriate vehicle restraint systems should be provided where necessary to reduce the risk of errant vehicles ending at the bottom of the embankments and in conflict with non-motorised users.

9.6. Special Interest Groups

The land adjoining the scheme comprises largely of agricultural farmland with both arable and dairy farm sites and also some small business premises.

Modern day farm businesses usually generate considerable movement of agricultural machinery, heavy plant and goods vehicles. For example, during crop harvests there is likely to be movement of slow-moving vehicles such as combine harvesters, fleets of agricultural tractors with trailers and large goods vehicles transporting goods from fields to farm storage sites or directly on to wholesalers or crop treatment locations.

Farms and businesses will require deliveries and collections, movement of milk tankers and other functions requiring vehicular movement.

It is likely that the scheme will be used for the movement of such vehicles on the mainline, but additionally it is anticipated that due to side-road closures there will be some displacement of these types of vehicles from the local minor road network.

To add an example and further context to the strategic importance of the A47, in 2018 there was a proposal to construct the world's largest windfarm in the North Sea adjacent to Norfolk and it was considered that the A47 would be a primary route for the movement of materials and wind mill component parts (blades, tower sections).

Police escort groups with experience of previous similar operations throughout the UK highlight that some of the component parts may be upwards of 40 metres in length and require Special Types General Order (STGO) abnormal load movement orders.

It is recommended that a line of contact is established with Norfolk Constabulary Roads Policing Unit in order that the police can be kept informed about the project development details, and also in order to glean understanding from them of any local issues (such as that mentioned above) that would assist to enhance the design and development of the scheme.

The Highways England Traffic Officer Service do not currently run routine patrol operations on the A47 within Norfolk.

9.7. Additional Factors

The River Tud is a tributary of the River Wensum and passes to the south of Hockering, and through Honingham where it crosses the current A47. Under the A47 dual carriageway proposals the river will pass below the new mainline.

The carriageway of the A47 is currently exposed to the risk of flooding with a number of recent instances of severe flooding on the route resulting in road closures and diversionary

routes being set up. It may be necessary to incorporate culverts where roads are on embankment and in flood areas in order to maintain existing flow paths.

9.8. Road traffic collision data

Accurate and up to date Stats 19 collision data has been provided for the A47 Trunk Road by Highways England in December 2019. This data covers the period 2014 to 2018 inclusive.

For the purposes of this road safety review a collision data analysis was carried out based on the five-year data 2014 to 2018 inclusive for the area of the A47 covering the scheme extends between the points E:605633, N:313670 and E:613527, N:311025 a distance of 8.5km (5.3 miles).

Traffic flow data for this period was obtained through WebTRIS counters 6342/1 and 6342/2 located west of the A47 junction with B1535 Wood Lane at the vicinity of Honingham. The collision and casualty rates are calculated per Hundred Million vehicle Miles (HMvM).

(Note; collision data does not include a record of all collisions that have occurred. For example, collisions which have involved no injuries (damage only), and where all legal obligations are complied with will not be recorded).

Table 9-2: Collision Numbers

	Number of Collisions				
Year	Fatal	Serious	Slight	KSI	Total
2014	0	0	7	0	7
2015	0	0	10	0	10
2016	0	1	10	1	11
2017	0	3	14	3	17
2018	0	5	13	5	18
5 years	0	9	54	9	63
Average	0	1.8	10.8	1.8	12.6

Table 9-3: Collision Rates

	Collision Rates HMvM				
Year	Fatal	Serious	Slight	KSI	Total
2014	0	0	15.11	0	15.11
2015	0	0	21.14	0	21.14
2016	0	2.04	20.39	2.04	22.43
2017	0	5.97	27.88	5.97	33.86
2018	0	10.40	27.04	10.40	37.45
5 years	0	3.73	22.41	3.73	26.14
Average	0	3.73	22.41	3.73	26.14

Table 9-4: Casualties Numbers

	Number of Casualties				
Year	Fatal	Serious	Slight	KSI	Total
2014	0	0	10	0	10
2015	0	0	18	0	18
2016	0	1	17	1	18
2017	0	4	22	4	26
2018	0	6	19	6	25
5 years	0	11	86	11	97
Average	0	2.2	17.2	2.2	19.4

Table 9-5: Casualties Rates

	Casualty Rates HMvM				
Year	Fatal	Serious	Slight	KSI	Total
2014	0	0	21.59	0	21.59
2015	0	0	38.05	0	38.05
2016	0	2.04	34.66	2.04	36.70
2017	0	7.97	43.81	7.97	51.78
2018	0	12.48	39.53	12.48	52.01
5 years	0	4.56	35.69	4.56	40.25
Average	0	4.56	35.69	4.56	40.25

The analysis shows that both the collision and casualty rates for the area over the last five years are approximately two times higher than the Highways England Strategic A Roads rates of 16.14/HMvM collisions and 24.96/HMvM casualties derived from the Reported Road Casualties on the Strategic Network 2017.

The data highlights significant hotspot clusters of reported injury collisions at the following locations;

- A47 near to Hockering Nursery (7 collisions in 5 years - 2 serious injury and 5 slight injury).
- A47/Church Lane junction (4 slight injury collisions in 5 years).
- A47/Berry's Lane/Wood Lane staggered junction (8 collisions in 5 years - 2 serious injury and 6 slight injury). This is the proposed location of the 'Western Junction' which is proposed to be a full grade separation with merge and diverge slip road layouts.
- A47/Norwich Road junction (3 slight injury collisions in 5 years). This is the proposed location of the 'Eastern Junction' which is also proposed to be a full grade separation with merge and diverge slip road layouts.

- A47/Taverham Rd/ Blind Lane staggered junction (7 injury collisions in 5 years – 2 serious injury and 5 slight injury).

- A47/ Norwich Southern Bypass vicinity (8 collisions in 5 years – 1 serious injury and 7 slight injury collisions).

Of the above cluster locations 40 collisions occurred in the proximities of five junctions. Another 6 collisions occurred near junctions and accesses that did not fall into a cluster location, summing up to 46 out of the total 63 collisions (73%).

9.9. Recommendations

As part of the Preliminary Road Safety Review, the following recommendations are made.

- Sections of the existing A47 be used to create a parallel link road, with consideration that it may provide an alternative route for road users other than those on the dual carriageway.

- Local link roads be developed to assist local traffic and businesses and to minimise the adverse impact on accessing the properties and land between the existing A47 and the new proposed route.

- The use of sections of the existing A47 be highlighted with the emergency services as a possible diversion route when the mainline is blocked.

- Directional and information signage at the Wood Lane and Norwich Road full grade separated junctions is simple, clear and precise without information overload for drivers who are faced with multiple route and lane options.

- Clear and effective wayfinding signage is provided for non-motorised users, particularly at Wood Lane and Norwich Road full grade separated junctions taking into account desire lines where possible, but whilst maintaining safety as the imperative.

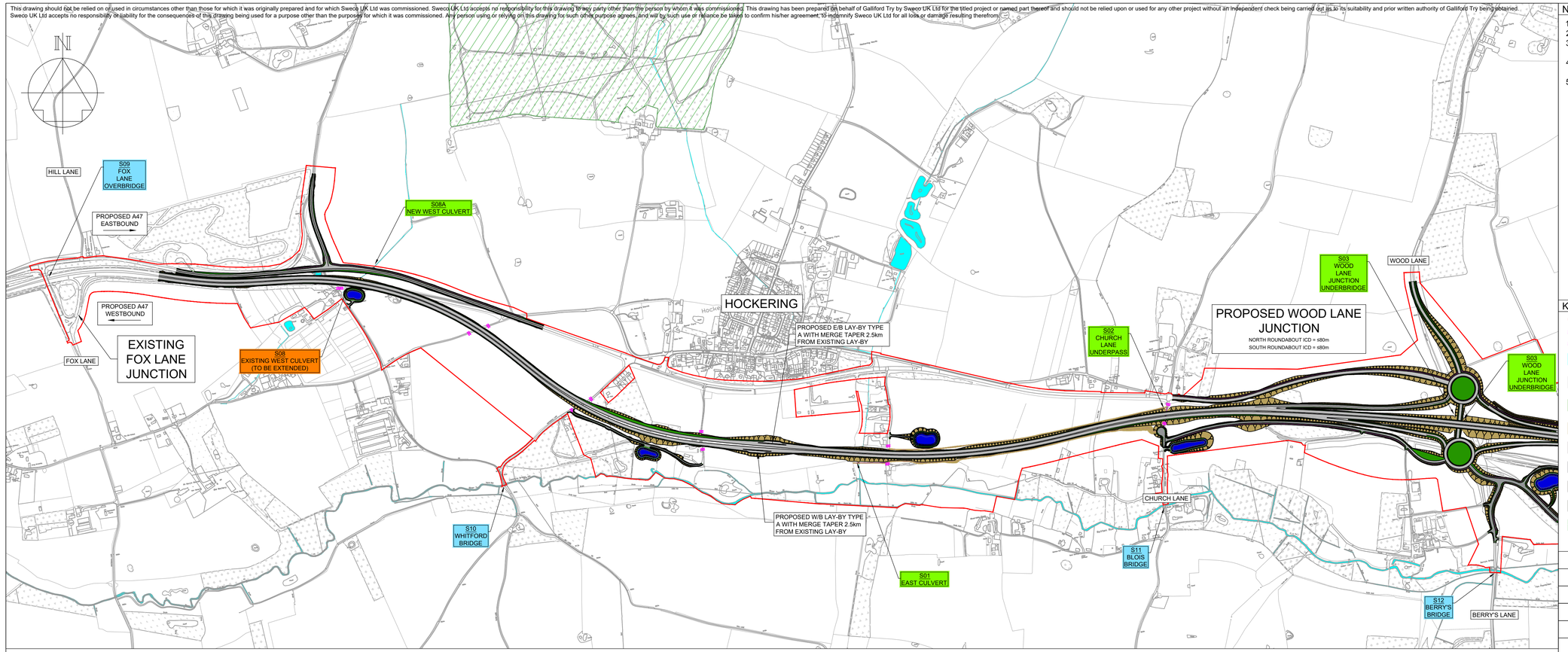
- Appropriate infrastructure is provided for walkers, cyclists and horse-riders, separating them both from motor vehicles and each other.

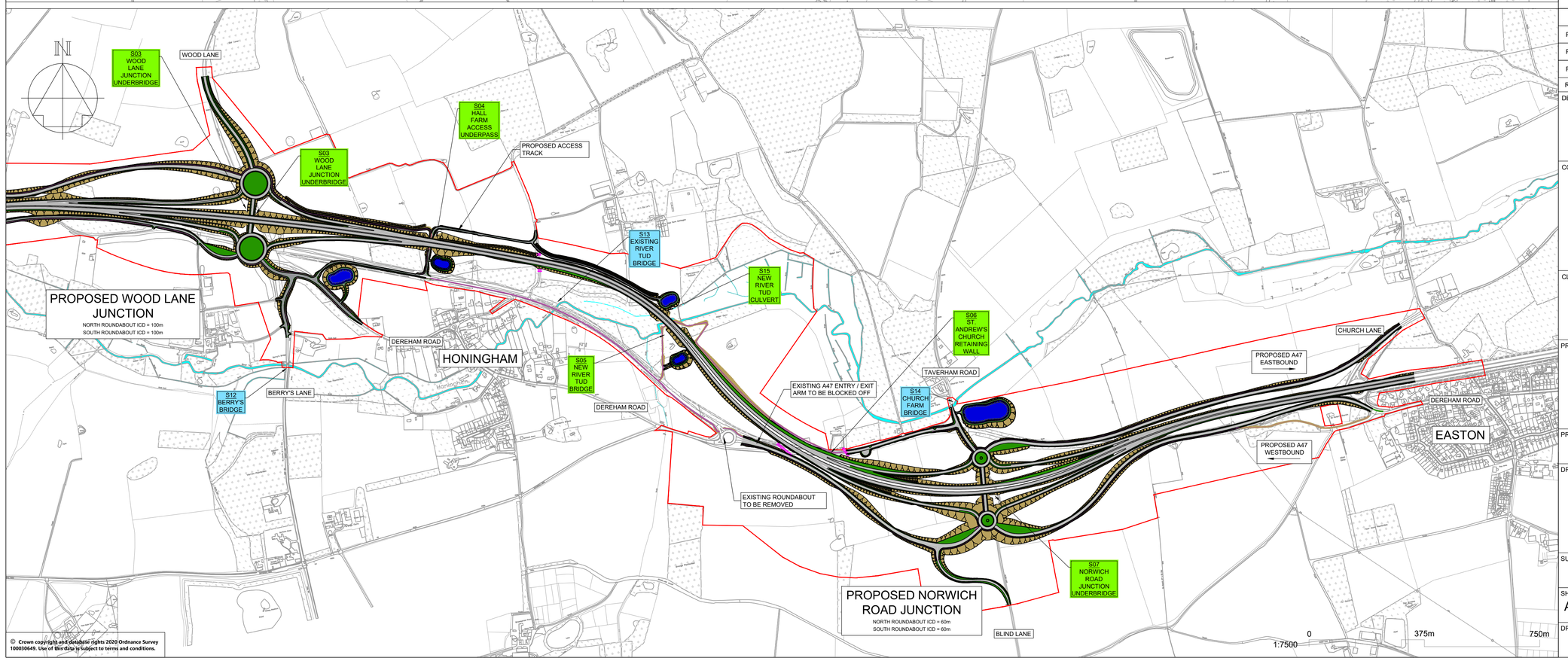
- Cross-over points are incorporated into the central reserve design to allow emergency services, vehicle recovery units and maintenance teams with a contingency to deal with traffic flow at critical scenes.

- A point of contact be established with Norfolk Constabulary Roads Policing Unit (to represent all emergency services) for the exchange of information and advice.

Appendix A. Junction & Sideroads Without NWL Plan Layout

File Ref: HE551489-GTY-HGN-000-DR-CH-30029





NOTES

1. DESIGNED IN ACCORDANCE WITH DMRB.
2. MAINLINE DESIGNED TO 120kph.
3. JUNCTIONS ARE DESIGNED IN ACCORDANCE WITH THE RELEVANT DMRB VOLUME 6 CD 116, CD 122 AND CD 123.
4. STRUCTURES ARE DESIGNED IN ACCORDANCE WITH THE RELEVANT DMRB STANDARDS.
5. LAY-BYS ARE DESIGNED IN ACCORDANCE WITH THE RELEVANT DMRB VOLUME 6 CD 169.

KEY TO SYMBOLS

- ENVIRONMENTAL SCOPING BOUNDARY
- ROUTE SEVERED
- RIVER TUD / WATERCOURSES
- PAVED AREAS
- VERGE
- EARTHWORKS
- PROPOSED DRAINAGE BASIN
- SXX — EXISTING STRUCTURE (NO CHANGE)
- SXX — EXISTING STRUCTURE (MODIFIED)
- SXX — NEW STRUCTURE
- SSSI - HOCKERING WOOD

REV	DATE	REVISION NOTE	ORG	CHK'D	APP'D
P01	14/11/19	DESIGN FIX A	BR	BR	BR
P02	19/11/19	DESIGN FIX A UPDATE	BR	BR	BR
P03	14/02/20	SUITABLE FOR INFORMATION	JM	JM	JM

DESIGNER

SWECO

CONTRACTOR

GallifordTry

CLIENT

highways england

PROJECT TITLE

A47 NORTH TUDDENHAM TO EASTON

PROJECT STAGE

PCF STAGE 3

DRAWING TITLE

JUNCTION AND SIDEROADS CONCEPT WITHOUT NORWICH WESTERN LINK

SUITABILITY

SUITABLE FOR INFORMATION

SHEET SIZE	SCALE	STATUS	REVISION
A1	1:7500	S2	P03

DRAWING NUMBER

HE551489-GTY-HGN-000-DR-CH-30029

Appendix B. Junction & Sideroads With NWL Plan Layout

File Ref: HE551489-GTY-HGN-000-DR-CH-30030

HILL LANE
S09 FOX LANE OVERBRIDGE
PROPOSED A47 EASTBOUND
PROPOSED A47 WESTBOUND
FOX LANE
EXISTING FOX LANE JUNCTION
S08A NEW WEST CULVERT
S08 EXISTING WEST CULVERT (TO BE EXTENDED)
HOCKERING
PROPOSED E/B LAY-BY TYPE A WITH MERGE TAPER 2.5km FROM EXISTING LAY-BY
PROPOSED W/B LAY-BY TYPE A WITH MERGE TAPER 2.5km FROM EXISTING LAY-BY
S10 WHITFORD BRIDGE
S01 EAST CULVERT
S02 CHURCH LANE UNDERPASS
PROPOSED WOOD LANE JUNCTION
NORTH ROUNDABOUT ICD = ≤80m
SOUTH ROUNDABOUT ICD = ≤80m
PROPOSED NORWICH WESTERN LINK CONNECTION
S03 WOOD LANE JUNCTION UNDERBRIDGE
WOOD LANE
S03 WOOD LANE JUNCTION UNDERBRIDGE
CHURCH LANE
S11 BLOIS BRIDGE
S12 BERRY'S BRIDGE
BERRY'S LANE

S03 WOOD LANE JUNCTION UNDERBRIDGE
WOOD LANE
PROPOSED NORWICH WESTERN LINK CONNECTION
S04 HALL FARM ACCESS UNDERPASS
PROPOSED ACCESS TRACK
S03 WOOD LANE JUNCTION UNDERBRIDGE
PROPOSED WOOD LANE JUNCTION
NORTH ROUNDABOUT ICD = 100m
SOUTH ROUNDABOUT ICD = 100m
S13 EXISTING RIVER TUD BRIDGE
S15 NEW RIVER TUD CULVERT
S06 ST. ANDREW'S CHURCH RETAINING WALL
CHURCH LANE
PROPOSED A47 EASTBOUND
TAVERHAM ROAD
DEREHAM ROAD
HONINGHAM
S05 NEW RIVER TUD BRIDGE
S12 BERRY'S BRIDGE
BERRY'S LANE
DEREHAM ROAD
EXISTING A47 ENTRY / EXIT ARM TO BE BLOCKED OFF
S14 CHURCH FARM BRIDGE
DEREHAM ROAD
EASTON
PROPOSED A47 WESTBOUND
EXISTING ROUNDABOUT TO BE REMOVED
S07 NORWICH ROAD JUNCTION UNDERBRIDGE
PROPOSED NORWICH ROAD JUNCTION
NORTH ROUNDABOUT ICD = 60m
SOUTH ROUNDABOUT ICD = 60m
BLIND LANE

1:7500 0 375m 750m

NOTES

1. DESIGNED IN ACCORDANCE WITH DMRB.
2. MAINLINE DESIGNED TO 120kph.
3. JUNCTIONS ARE DESIGNED IN ACCORDANCE WITH THE RELEVANT DMRB VOLUME 6 CD 116, CD 122 AND CD 123
4. STRUCTURES ARE DESIGNED IN ACCORDANCE WITH THE RELEVANT DMRB STANDARDS.
5. LAY-BYS ARE DESIGNED IN ACCORDANCE WITH THE RELEVANT DMRB VOLUME 6 CD169.

KEY TO SYMBOLS

- ENVIRONMENTAL SCOPING BOUNDARY
- ROUTE SEVERED
- RIVER TUD / WATERCOURSES
- PAVED AREAS
- VERGE
- EARTHWORKS
- PROPOSED DRAINAGE BASIN
- SXX EXISTING STRUCTURE (NO CHANGE)
- SXX EXISTING STRUCTURE (MODIFIED)
- SXX NEW STRUCTURE
- SSSI - HOCKERING WOOD

REV	DATE	REVISION NOTE	ORG	CHK'D	APP'D
P01	19/11/19	DESIGN FIX A	BR	BR	BR
P02	14/02/20	SUITABLE FOR INFORMATION	JM	JM	JM

DESIGNER
SWECO

CONTRACTOR
GallifordTry

CLIENT
highways england

PROJECT TITLE
A47 NORTH TUDDENHAM TO EASTON

PROJECT STAGE
PCF STAGE 3

DRAWING TITLE
JUNCTION AND SIDEROADS CONCEPT WITH NORWICH WESTERN LINK

SUITABILITY
SUITABLE FOR INFORMATION

SHEET SIZE	SCALE	STATUS	REVISION
A1	1:7500	S2	P02

DRAWING NUMBER
HE551489-GTY-HGN-000-DR-CH-30030

Appendix C. Stage 2 Design and Revised Design Traffic Flows

Stage 2 Design (2036) Traffic Flows – A47/Wood Lane Roundabout

Arm	Name
A	Wood Lane
B	A47 East
C	Berry's Lane
D	A47 West

AM Peak Total Flows (Veh)	A	B	C	D	Total
A	0	136	66	51	**253**
B	164	0	0	1393	**1556**
C	71	0	0	39	**109**
D	85	1849	88	0	**2022**
Total	**319**	**1985**	**154**	**1482**	**3940**
PM Peak Total Flows (Veh)	A	B	C	D	**Total**
A	0	105	32	1	**138**
B	203	0	0	1932	**2134**
C	58	121	0	40	**219**
D	71	2130	75	0	**2276**
Total	**332**	**2355**	**107**	**1973**	**4767**

Stage 2 Design (2036) Traffic Flows – A47/Norwich Road Roundabout

Arm	Name
A	New Link to Taverham Road
B	A47 East
C	Norwich Road
D	A47 West

AM Peak Total Flows (Veh)	A	B	C	D	Total
A	0	13	78	72	**163**
B	4	0	114	1472	**1591**
C	105	246	0	0	**352**
D	56	1917	0	0	**1973**
Total	**166**	**2177**	**192**	**1544**	**4079**
PM Peak Total Flows (Veh)	A	B	C	D	**Total**
A	0	10	89	86	**185**
B	10	0	212	2046	**2268**
C	61	89	0	1	**150**
D	349	1999	0	0	**2348**
Total	**420**	**2098**	**301**	**2133**	**4952**

Revised Design (2040) – A47/Wood Lane Junction – Northern Roundabout With NWL Scenario

Arm	Name
A	Eastbound Merge
B	Roundabout Link Road
C	Eastbound Diverge
D	A47 Link Road/ Wood Lane B1535
E	Norwich Western Link

AM Peak Total Flows (Veh)	A	B	C	D	E	**Total**
A	0	0	0	0	0	**0**
B	0	0	0	162	344	**506**
C	0	26	0	0	743	**769**
D	216	55	0	0	0	**271**
E	410	1019	0	0	0	**1429**
Total	**626**	**1100**	**0**	**162**	**1087**	**2975**
PM Peak Total Flows (Veh)	A	B	C	D	E	**Total**
A	0	0	0	0	0	**0**
B	0	0	0	230	575	**805**
C	0	21	0	0	1048	**1069**
D	326	58	0	0	34	**418**
E	221	1022	0	1	0	**1244**
Total	**547**	**1101**	**0**	**232**	**1657**	**3536**

Revised Design (2040) – A47/Wood Lane Junction – Southern Roundabout With NWL Scenario

Arm	Name
A	Westbound Merge
B	Roundabout Link Road
C	Westbound Diverge
D	Berry's Lane

AM Peak Total Flows (Veh)	A	B	C	D	Total
A	0	0	0	0	**0**
B	795	0	0	308	**1103**
C	0	227	0	0	**227**
D	25	287	0	0	**313**
Total	**821**	**514**	**0**	**308**	**1643**
PM Peak Total Flows (Veh)	A	B	C	D	**Total**
A	0	0	0	0	**0**
B	776	0	0	328	**1104**
C	0	392	0	0	**392**
D	25	417	0	0	**442**
Total	**801**	**809**	**0**	**328**	**1938**

Revised Design (2040) – A47/Norwich Road Junction – Northern Roundabout With NWL Scenario

Arm	Name
A	EB Merge
B	Underbridge Link Road
C	EB Diverge
D	Link to Church Farm
E	Link to existing A47 and Church Lane

AM Peak Total Flows (Veh)	A	B	C	D	E	**Total**
A	0	0	0	0	0	**0**
B	246	0	0	8	1	**255**
C	0	122	0	3	0	**125**
D	10	4	0	0	0	**14**
E	2	10	0	0	0	**12**
Total	**258**	**135**	**0**	**11**	**1**	**406**
PM Peak Total Flows (Veh)	A	B	C	D	E	**Total**
A	0	0	0	0	0	**0**
B	180	0	0	14	2	**196**
C	0	124	0	2	0	**126**
D	11	7	0	0	0	**18**
E	0	1	0	0	0	**1**
Total	**190**	**132**	**0**	**16**	**3**	**341**

Revised Design (2040) – A47/Norwich Road Junction – Southern Roundabout With NWL Scenario

Arm	Name
A	WB Merge
B	Underbridge Link Road
C	WB Diverge
D	Link to existing A47 and Dereham Road. Easton
E	Link to Honingham

AM Peak Total Flows (Veh)	A	B	C	D	E	**Total**
A	0	0	0	0	0	**0**
B	1	0	0	124	13	**138**
C	0	6	0	51	113	**170**
D	121	3	0	0	8	**131**
E	28	246	0	13	0	**287**
Total	**150**	**255**	**0**	**187**	**134**	**726**
PM Peak Total Flows (Veh)	A	B	C	D	E	**Total**
A	0	0	0	0	0	**0**
B	3	0	0	115	16	**134**
C	0	11	0	10	210	**231**
D	174	25	0	0	16	**216**
E	33	160	0	12	0	**205**
Total	**211**	**197**	**0**	**136**	**243**	**786**

Revised Design (2040) – A47/Wood Lane Junction – Northern Roundabout Without NWL Scenario

Arm	Name
A	Eastbound Merge
B	Roundabout Link Road
C	Eastbound Diverge
D	A47 Link Road/ Wood Lane B1535
E	Norwich Western Link (not modelled)

AM Peak Total Flows (Veh)	A	B	C	D	E	**Total**
A	0	0	0	0	-	**0**
B	0	0	0	161	-	**161**
C	0	50	0	101	-	**151**
D	222	335	0	0	-	**557**
E	-	-	-	-	-	**-**
Total	**222**	**385**	**0**	**262**	-	**869**
PM Peak Total Flows (Veh)	A	B	C	D	E	**Total**
A	0	0	0	0	-	**0**
B	0	0	0	95	-	**95**
C	0	74	0	82	-	**156**
D	204	201	0	0	-	**405**
E	-	-	-	-	-	**-**
Total	**204**	**275**	**0**	**177**	-	**656**

Revised Design (2040) – A47/Wood Lane Junction – Southern Roundabout Without NWL Scenario

Arm	Name
A	Westbound Merge
B	Roundabout Link Road
C	Westbound Diverge
D	Berry's Lane

AM Peak Total Flows (Veh)	A	B	C	D	**Total**
A	0	0	0	0	**0**
B	219	0	0	166	**385**
C	0	107	0	0	**107**
D	36	53	0	0	**88**
Total	**255**	**160**	**0**	**166**	**581**
PM Peak Total Flows (Veh)	A	B	C	D	**Total**
A	0	0	0	0	**0**
B	102	0	0	172	**274**
C	0	52	0	0	**52**
D	71	42	0	0	**113**
Total	**174**	**95**	**0**	**172**	**440**

Revised Design (2040) – A47/Norwich Road Junction – Northern Roundabout Without NWL Scenario

Arm	Name
A	EB Merge
B	Underbridge Link Road
C	EB Diverge
D	Link to Church Farm
E	Link to existing A47 and Church Lane

AM Peak Total Flows (Veh)	A	B	C	D	E	**Total**
A	0	0	0	0	0	**0**
B	274	0	0	8	129	**411**
C	0	54	0	3	41	**98**
D	10	4	0	0	0	**14**
E	199	199	0	0	0	**399**
Total	**483**	**257**	**0**	**12**	**170**	**921**
PM Peak Total Flows (Veh)	A	B	C	D	E	**Total**
A	0	0	0	0	0	**0**
B	203	0	0	35	183	**421**
C	0	76	0	27	235	**338**
D	11	7	0	0	0	**18**
E	72	135	0	0	0	**207**
Total	**286**	**218**	**0**	**63**	**418**	**984**

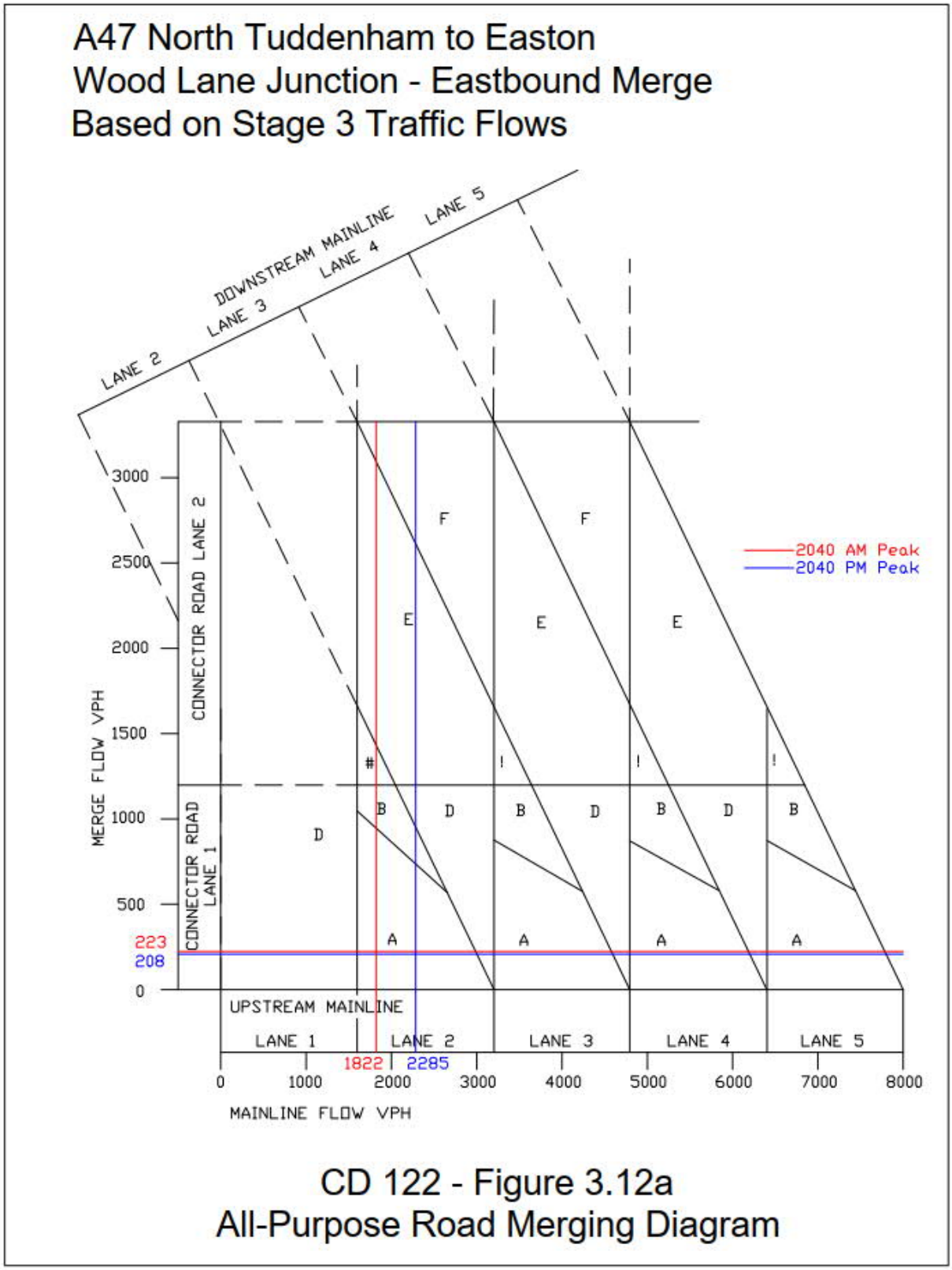
Revised Design (2040) – A47/Norwich Road Junction – Southern Roundabout Without NWL Scenario

Arm	Name
A	WB Merge
B	Underbridge Link Road
C	WB Diverge
D	Link to existing A47 and Dereham Road. Easton
E	Link to Honingham

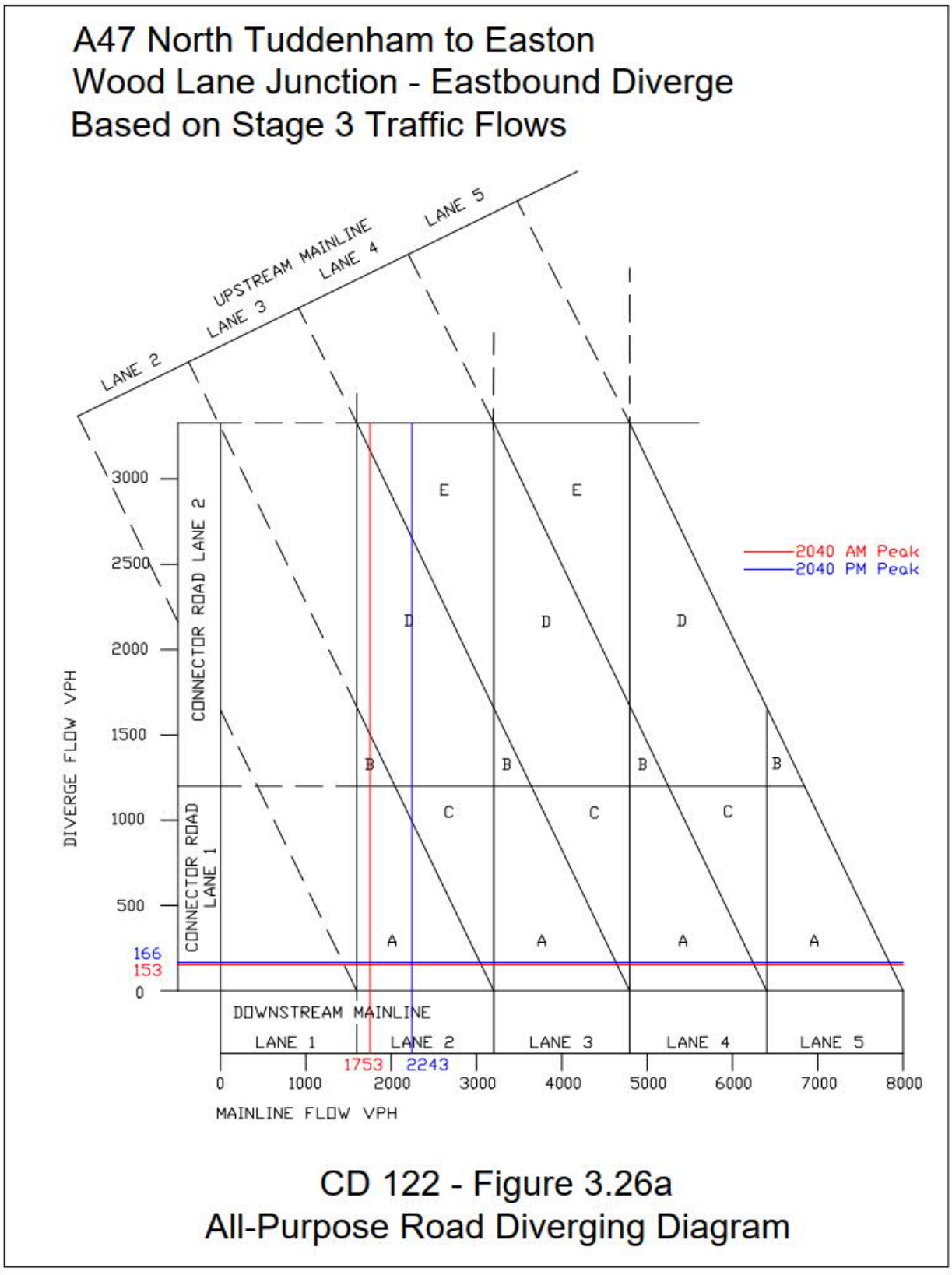
AM Peak Total Flows (Veh)	A	B	C	D	E	**Total**
A	0	0	0	0	0	**0**
B	57	0	0	119	81	**257**
C	0	8	0	48	125	**181**
D	77	27	0	0	9	**113**
E	24	377	0	13	0	**414**
Total	**158**	**412**	**0**	**180**	**215**	**965**
PM Peak Total Flows (Veh)	A	B	C	D	E	**Total**
A	0	0	0	0	0	**0**
B	21	0	0	103	94	**218**
C	0	14	0	10	222	**246**
D	81	89	0	0	17	**187**
E	29	320	0	13	0	**361**
Total	**130**	**423**	**0**	**126**	**334**	**1013**

Appendix D. Merge / Diverge Diagrams

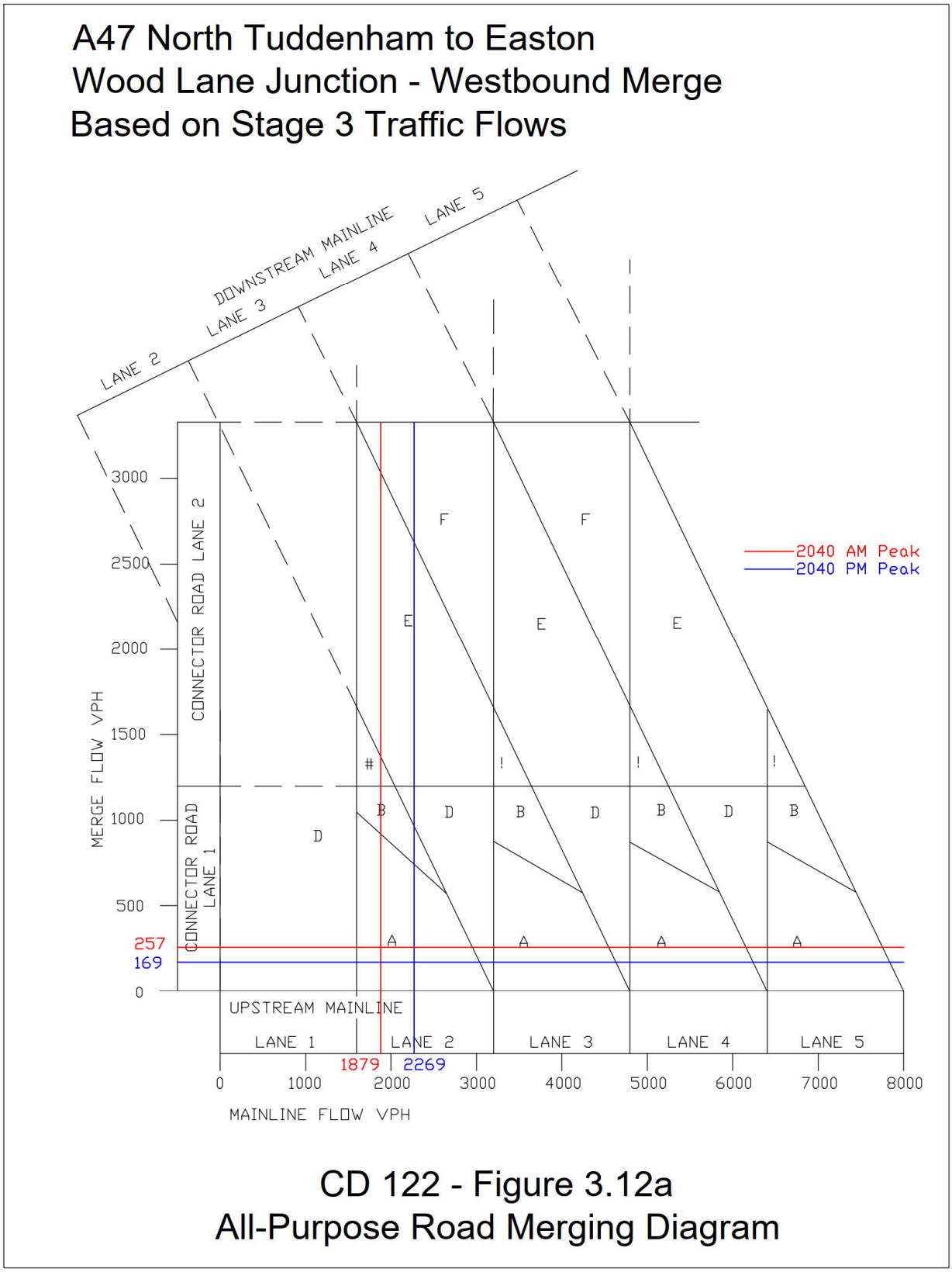
Diagrams for the Merge / Diverge Layouts Without NWL



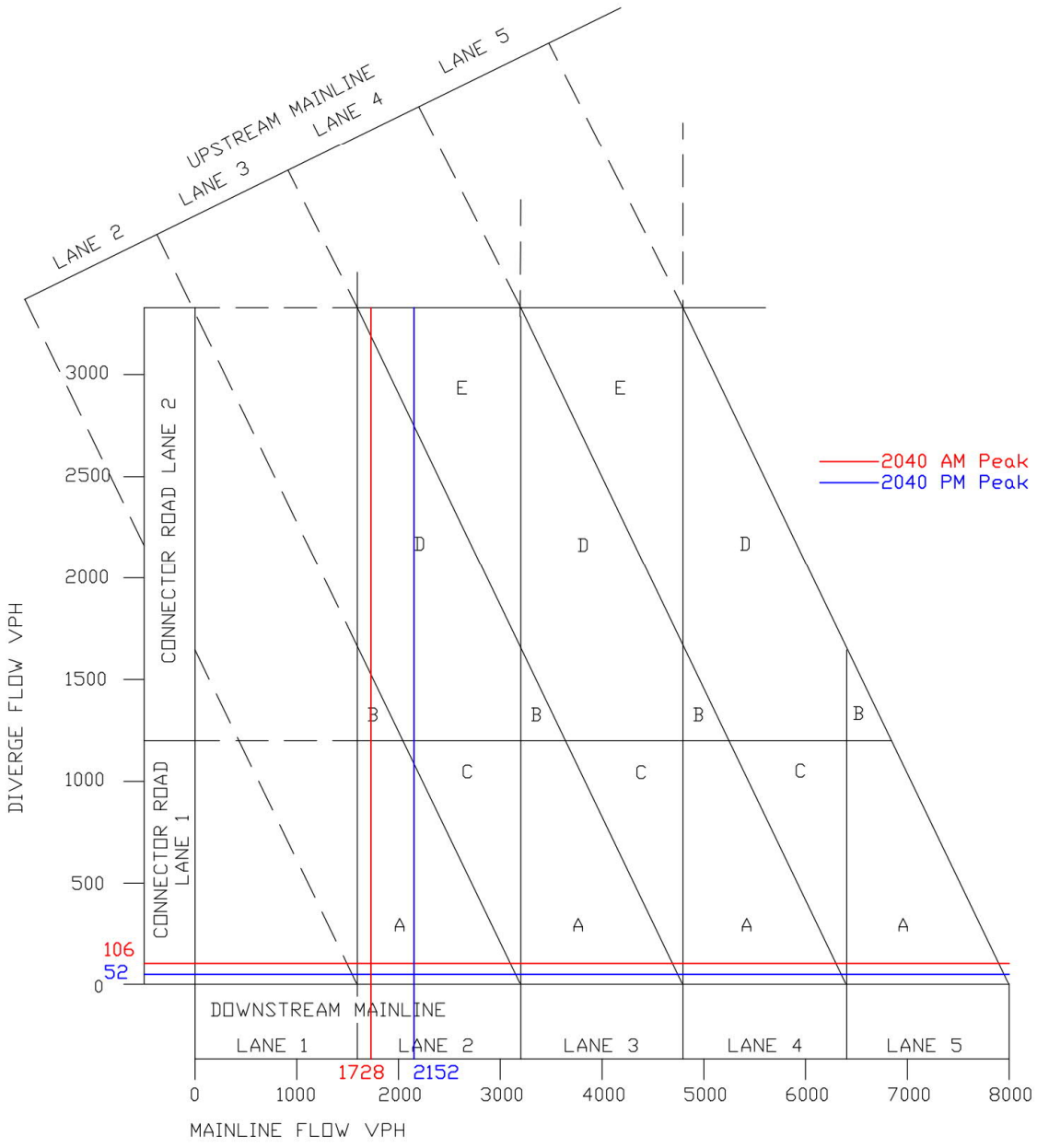
CD 122 - Figure 3.12a
All-Purpose Road Merging Diagram



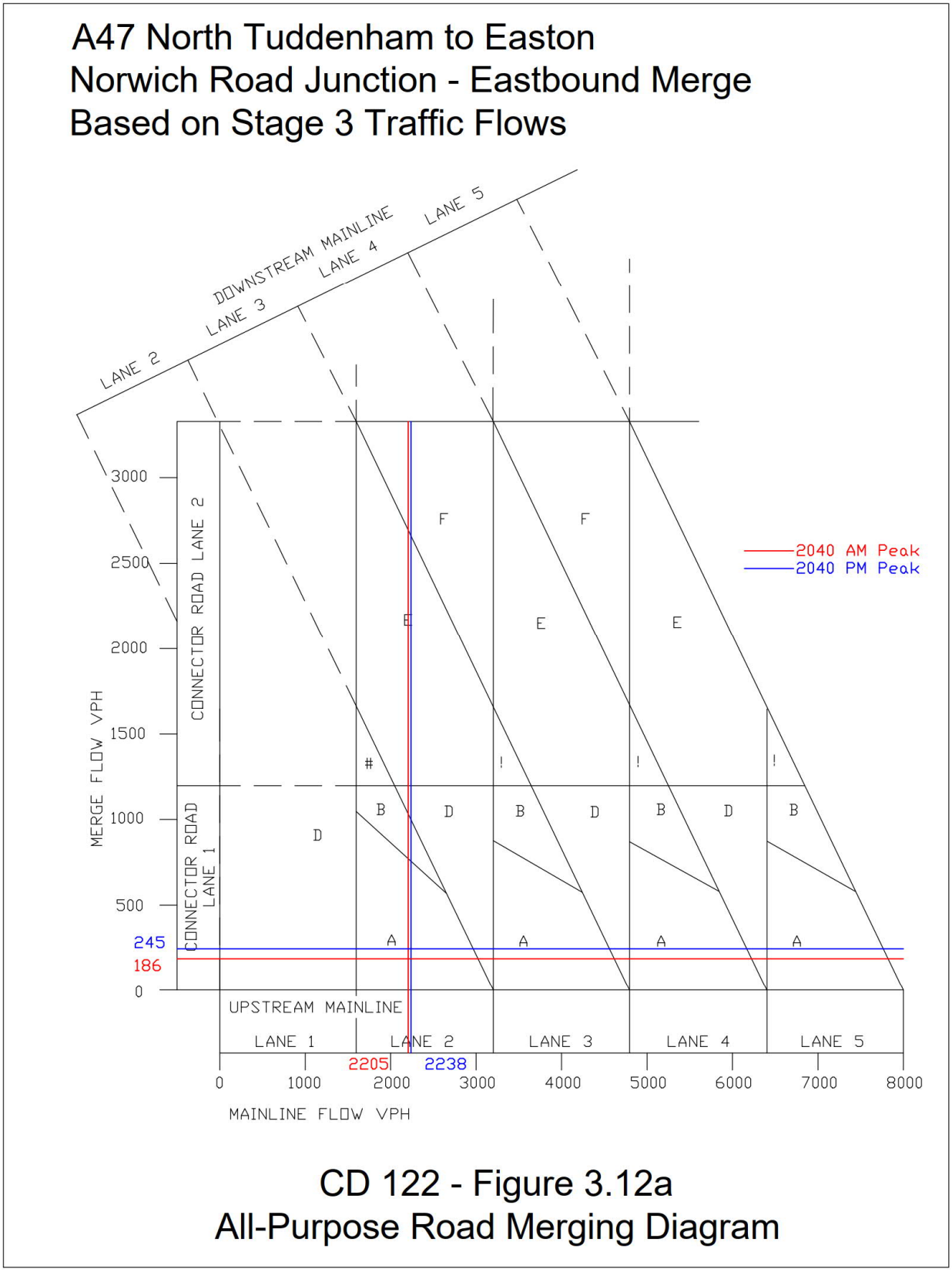
CD 122 - Figure 3.26a
All-Purpose Road Diverging Diagram

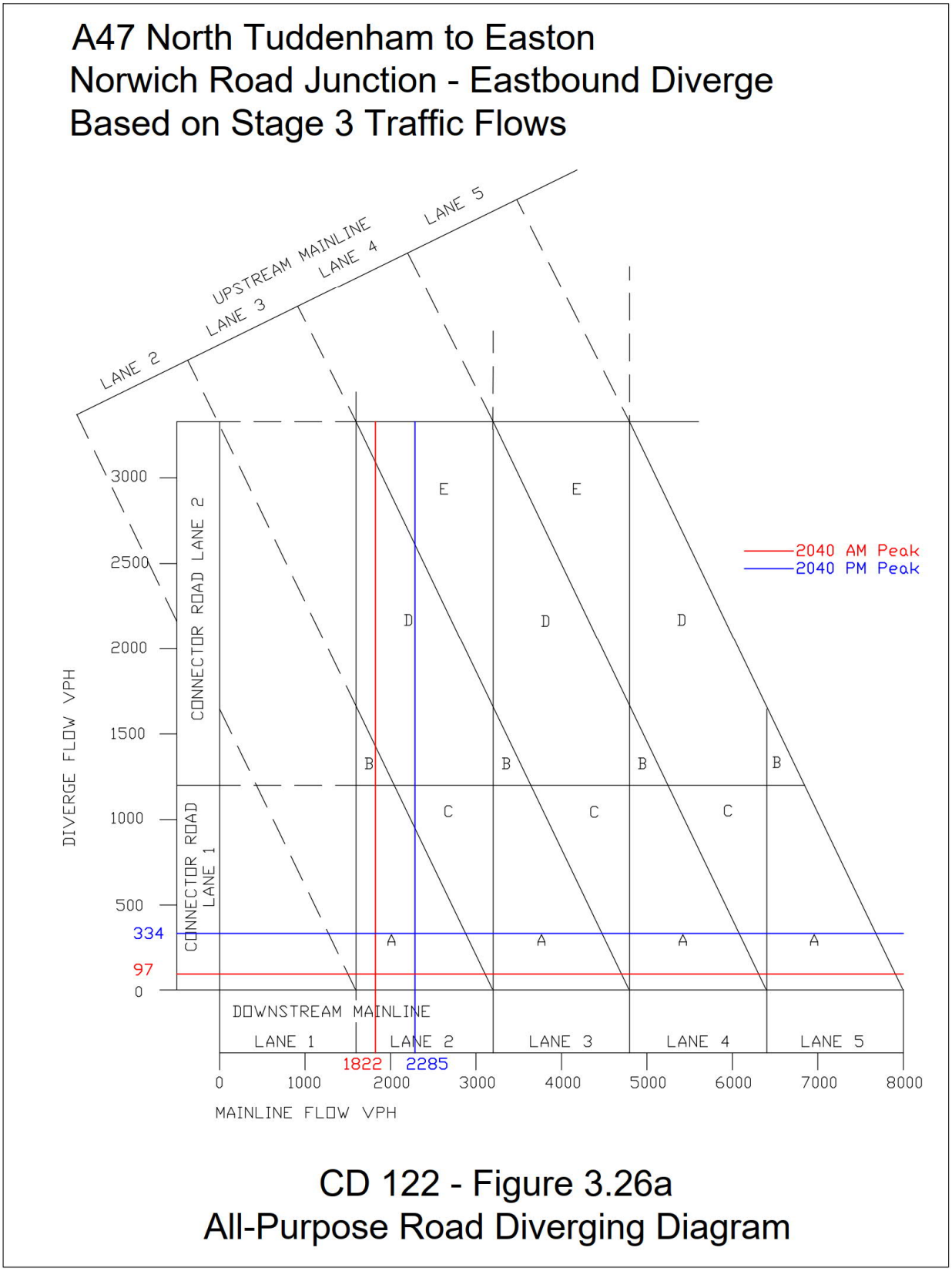

A47 North Tuddenham to Easton
Wood Lane Junction - Westbound Merge
Based on Stage 3 Traffic Flows
DOWNSTREAM MAINLINE
LANE 2
LANE 3
LANE 4
LANE 5
CONNECTOR ROAD LANE 2
CONNECTOR ROAD LANE 1
MERGE FLOW VPH
3000
2500
2000
1500
1000
500
257
169
0
2040 AM Peak
2040 PM Peak
F
E
D
B
A
#
!
UPSTREAM MAINLINE
LANE 1
LANE 2
LANE 3
LANE 4
LANE 5
1879
2269
0
1000
2000
3000
4000
5000
6000
7000
8000
MAINLINE FLOW VPH
CD 122 - Figure 3.12a
All-Purpose Road Merging Diagram

A47 North Tuddenham to Easton
Wood Lane Junction - Westbound Diverge
Based on Stage 3 Traffic Flows



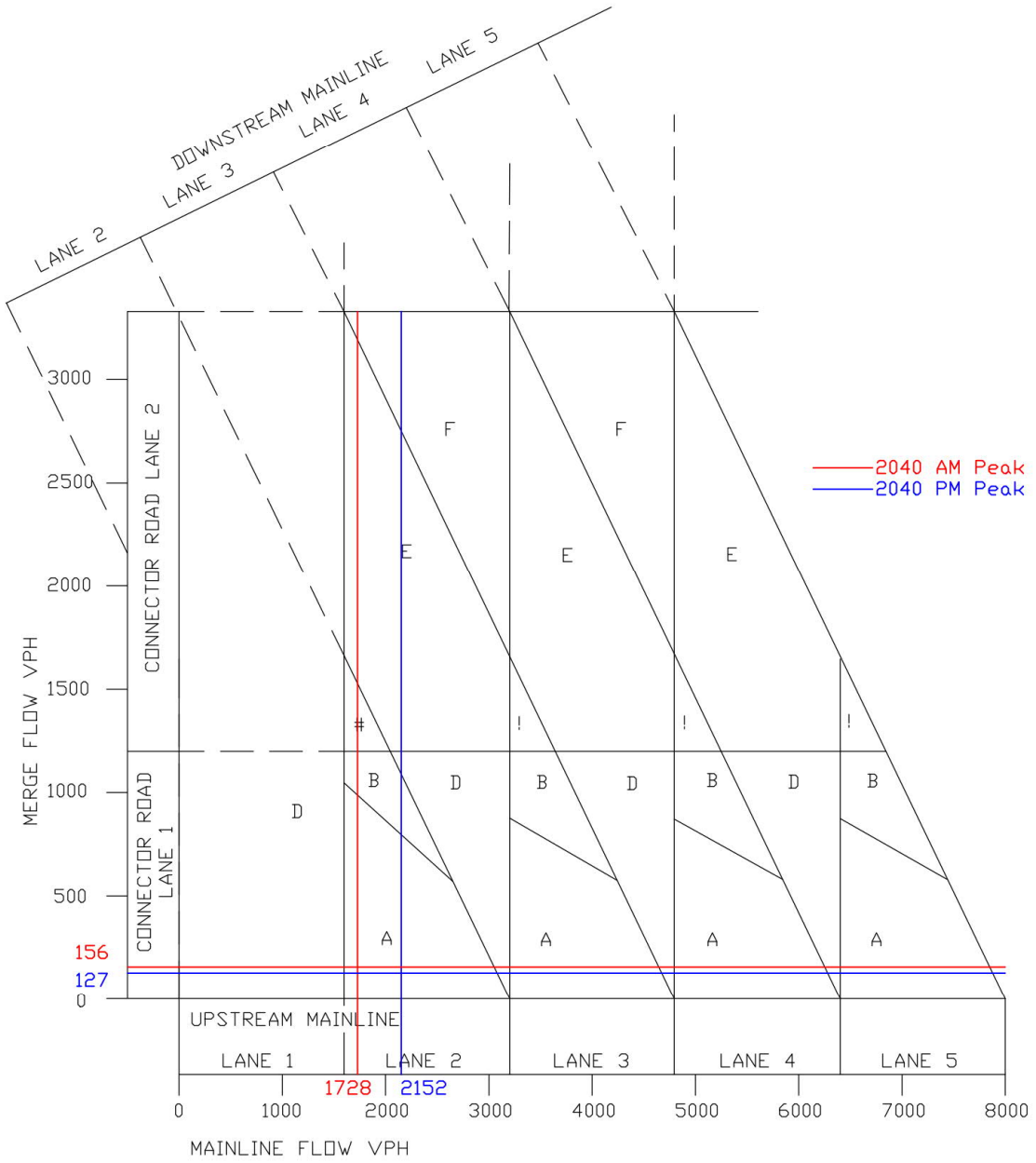
CD 122 - Figure 3.26a
All-Purpose Road Diverging Diagram


A47 North Tuddenham to Easton
Norwich Road Junction - Eastbound Merge
Based on Stage 3 Traffic Flows
DOWNSTREAM MAINLINE
LANE 2
LANE 3
LANE 4
LANE 5
CONNECTOR ROAD LANE 2
CONNECTOR ROAD LANE 1
MERGE FLOW VPH
3000
2500
2000
1500
1000
500
245
186
0
F
E
D
B
A
#
!
2040 AM Peak
2040 PM Peak
UPSTREAM MAINLINE
LANE 1
LANE 2
LANE 3
LANE 4
LANE 5
2205
2238
0
1000
2000
3000
4000
5000
6000
7000
8000
MAINLINE FLOW VPH
CD 122 - Figure 3.12a
All-Purpose Road Merging Diagram

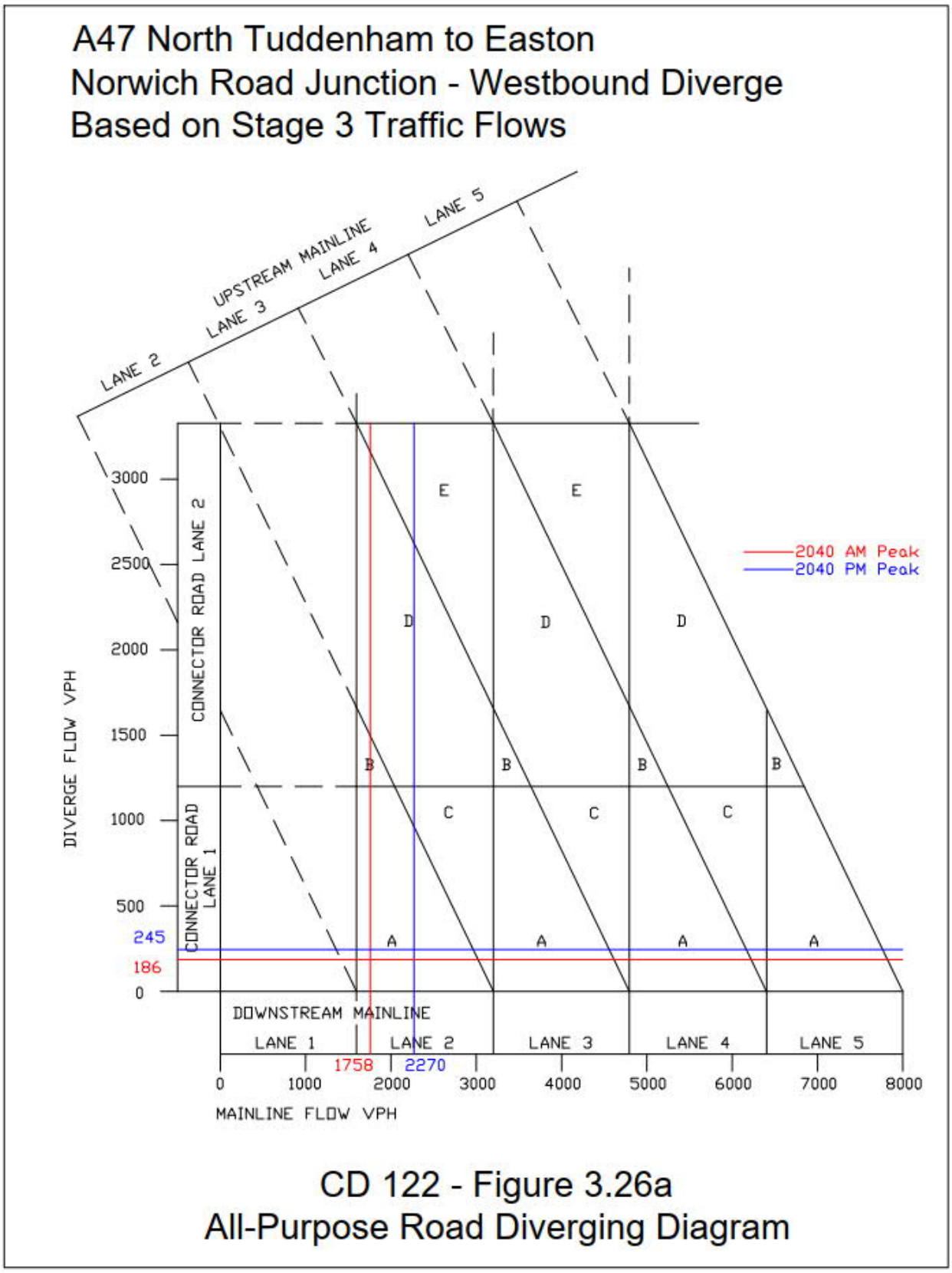


CD 122 - Figure 3.26a
All-Purpose Road Diverging Diagram

A47 North Tuddenham to Easton
Norwich Road Junction - Westbound Merge
Based on Stage 3 Traffic Flows

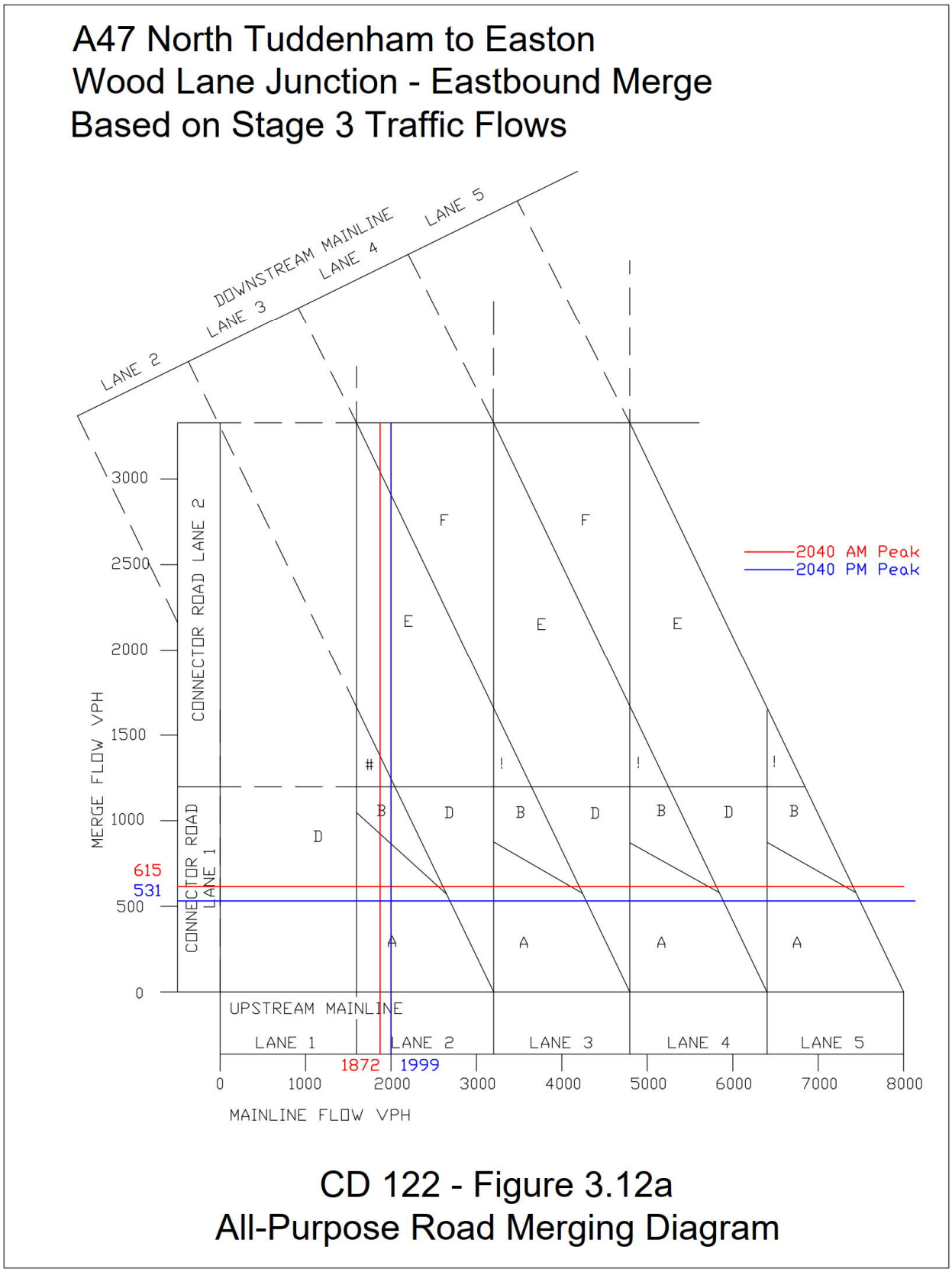


CD 122 - Figure 3.12a
All-Purpose Road Merging Diagram



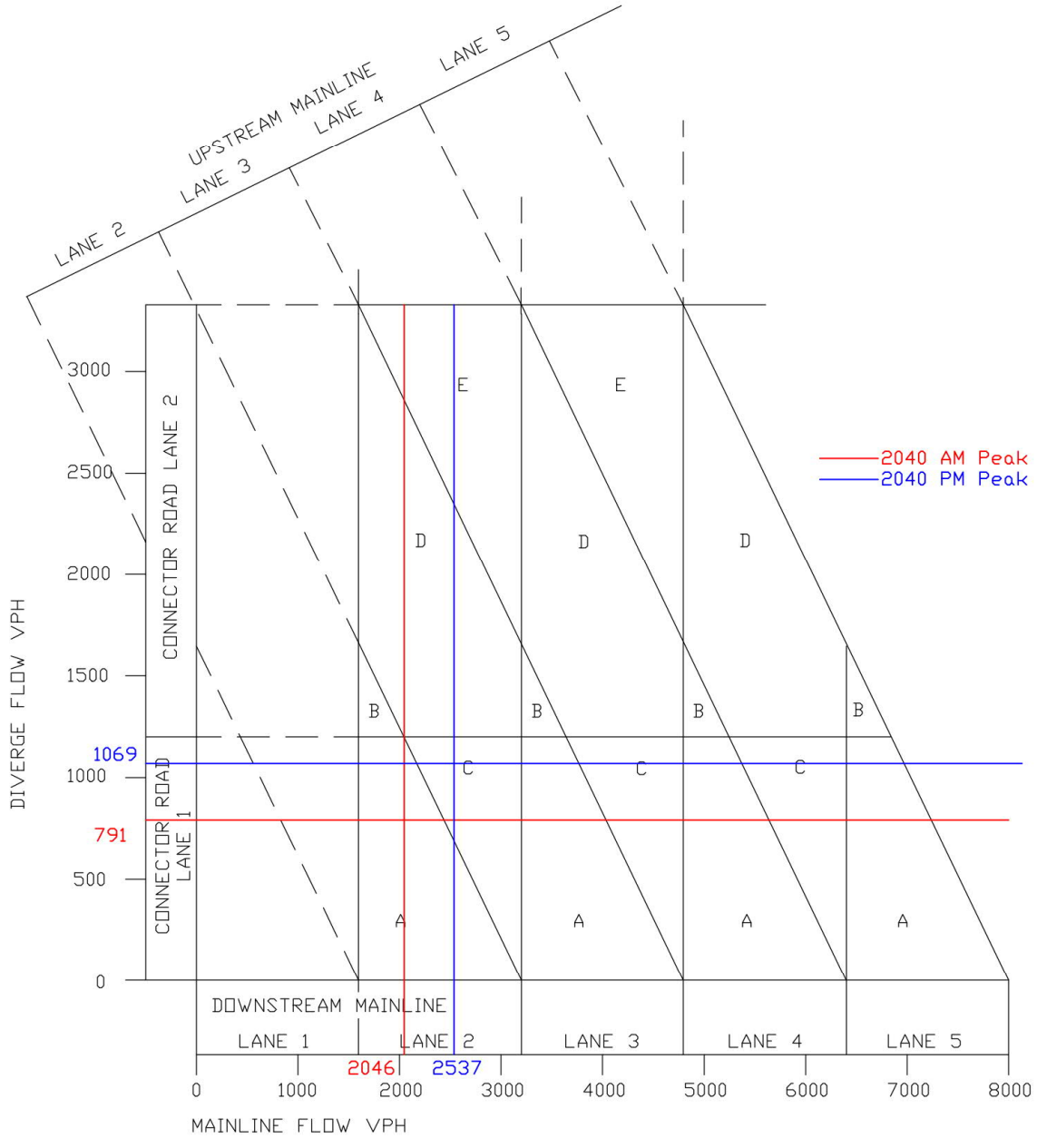
CD 122 - Figure 3.26a
All-Purpose Road Diverging Diagram

Diagrams for the Merge / Diverge Layouts With NWL



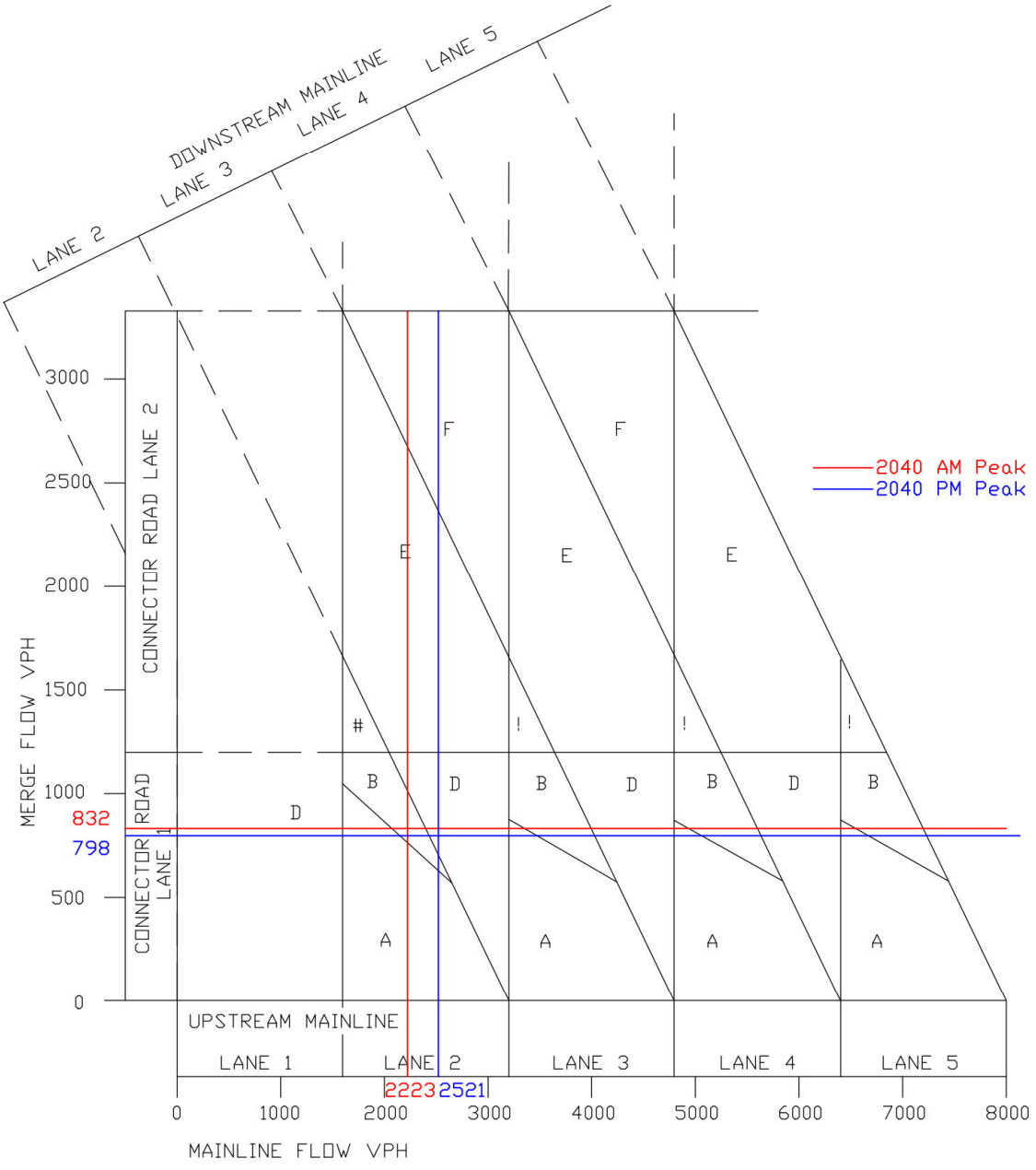
CD 122 - Figure 3.12a
All-Purpose Road Merging Diagram

A47 North Tuddenham to Easton
Wood Lane Junction - Eastbound Diverge
Based on Stage 3 Traffic Flows

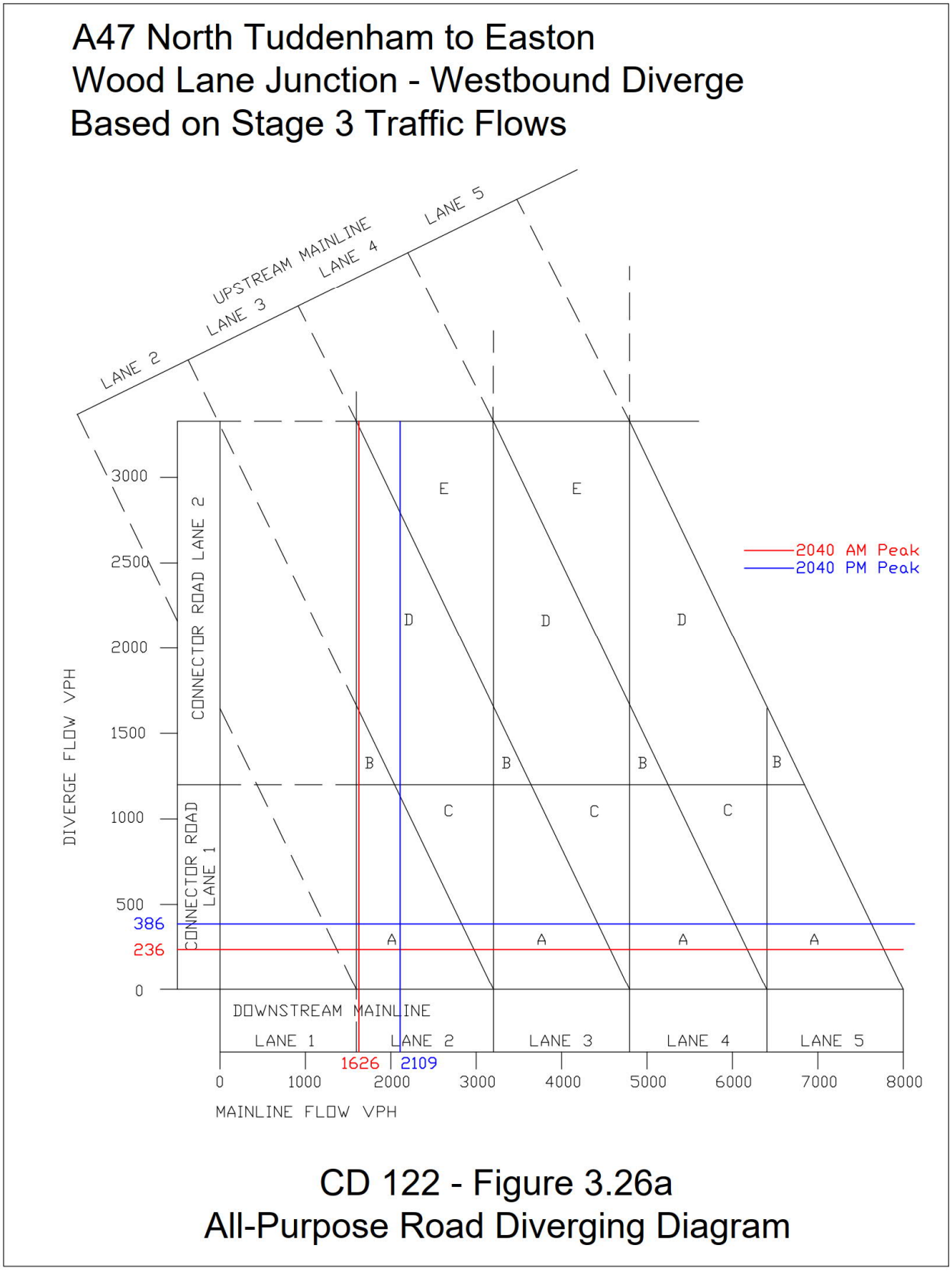


CD 122 - Figure 3.26a
All-Purpose Road Diverging Diagram

A47 North Tuddenham to Easton
Wood Lane Junction - Westbound Merge
Based on Stage 3 Traffic Flows

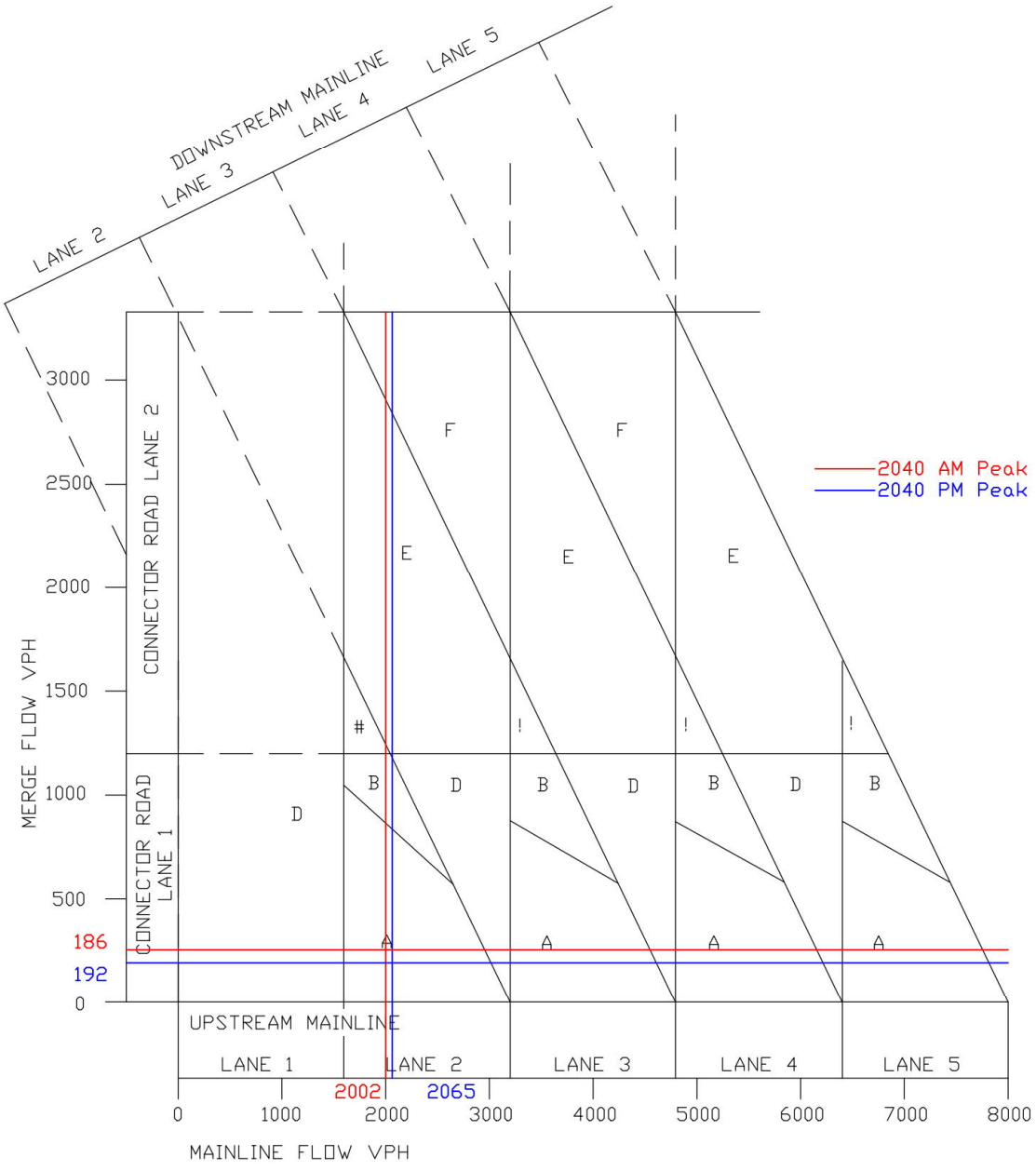


CD 122 - Figure 3.12a
All-Purpose Road Merging Diagram

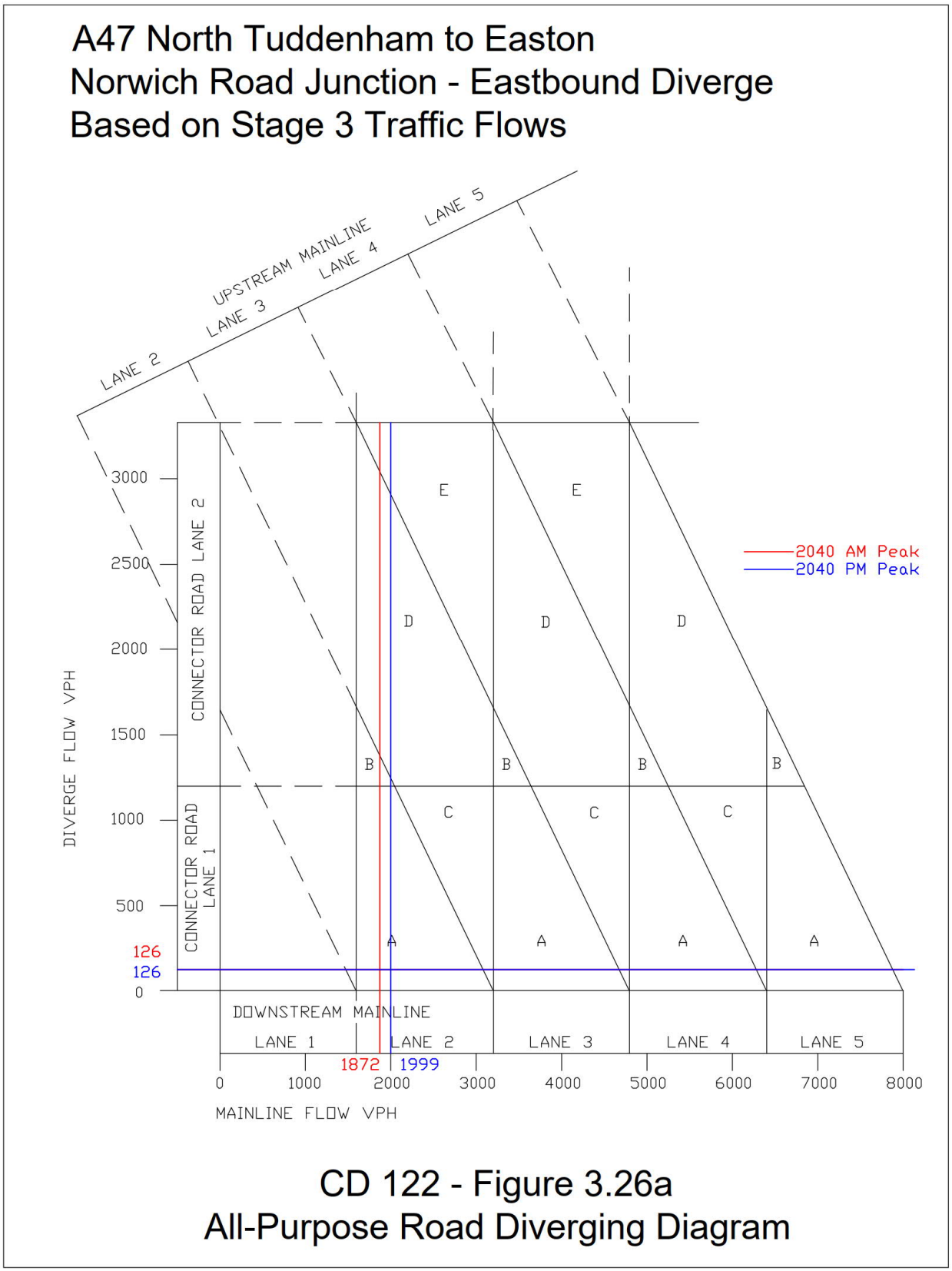


CD 122 - Figure 3.26a
All-Purpose Road Diverging Diagram

A47 North Tuddenham to Easton
Norwich Road Junction - Eastbound Merge
Based on Stage 3 Traffic Flows

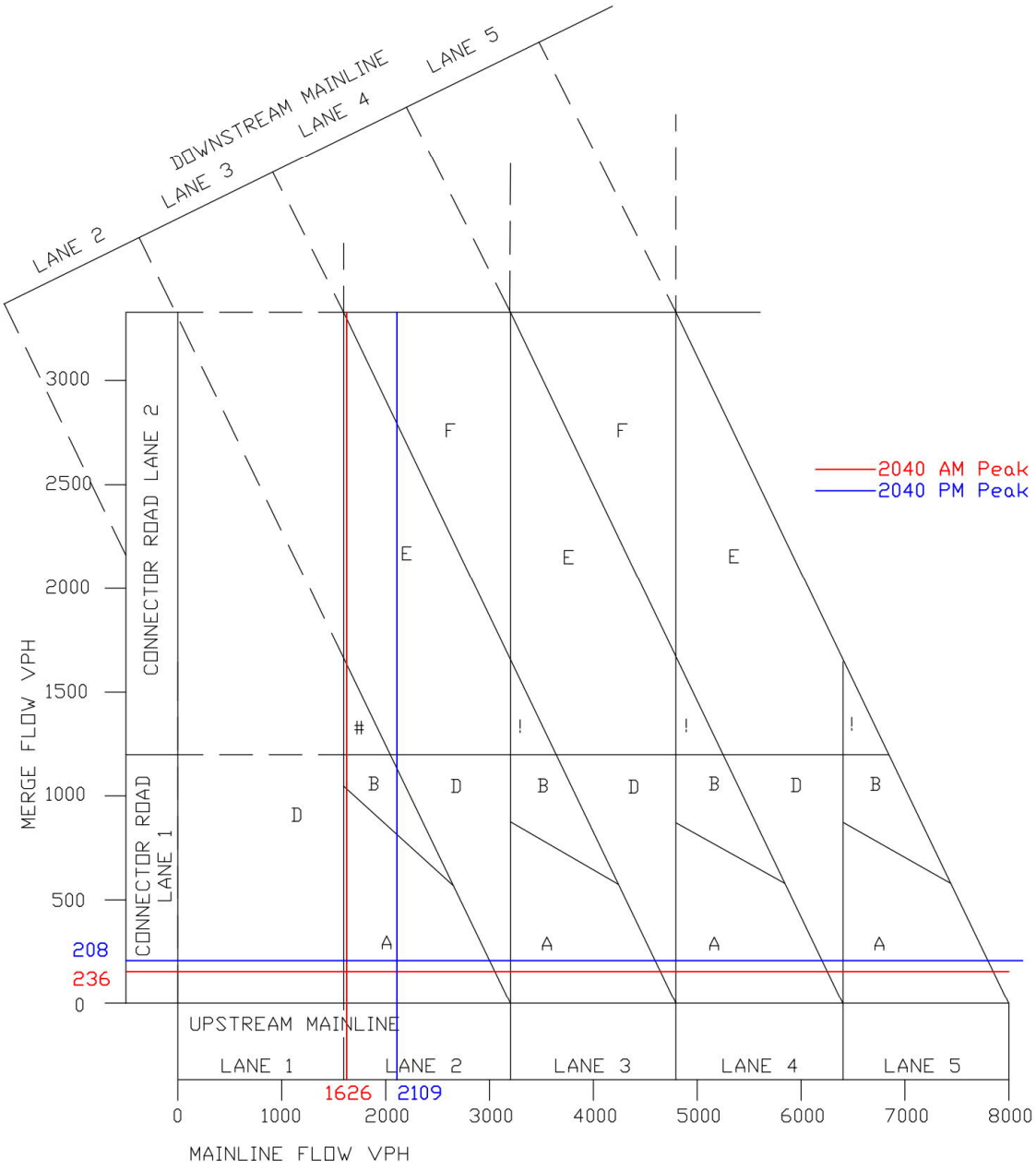


CD 122 - Figure 3.12a
All-Purpose Road Merging Diagram

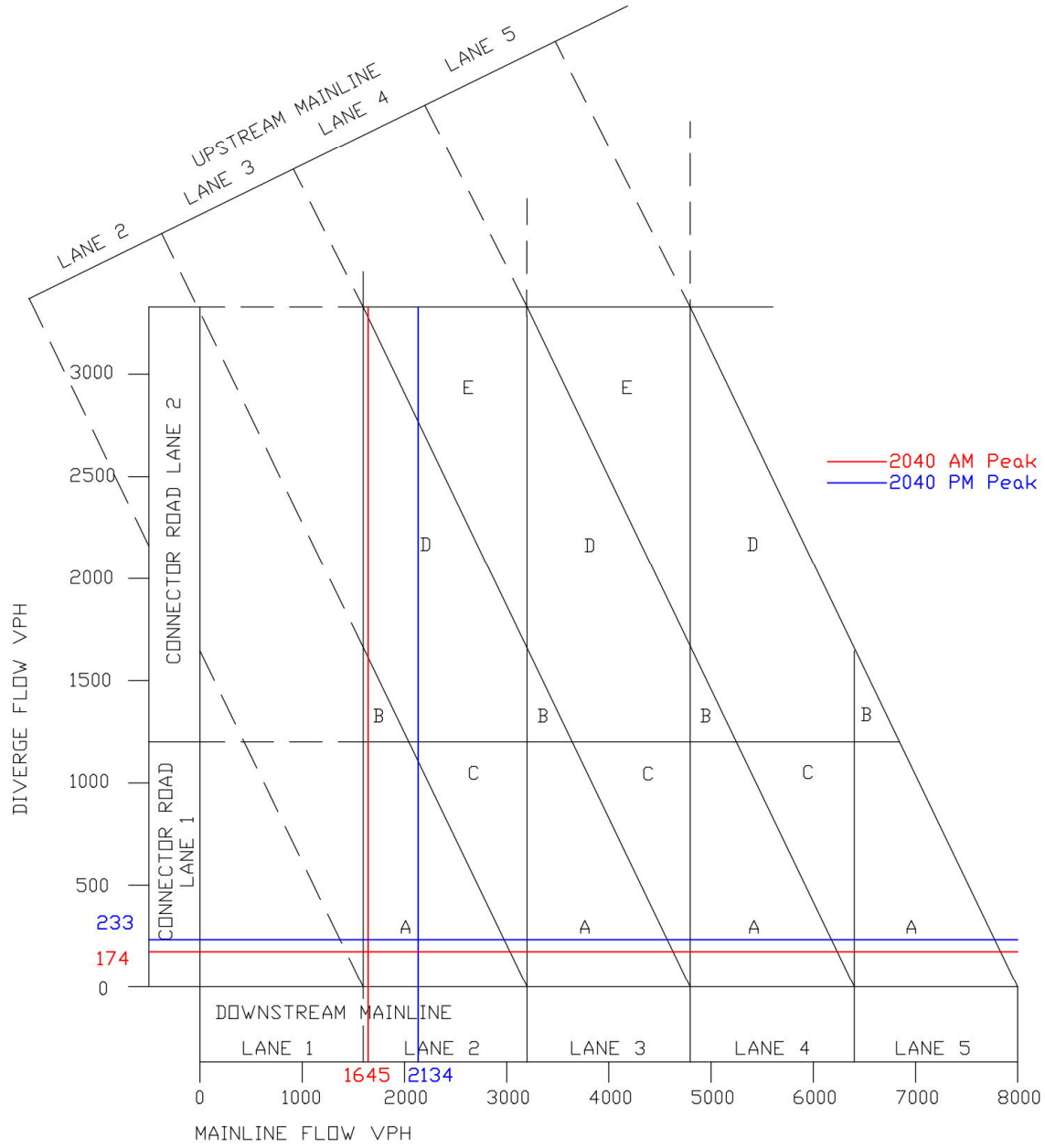


CD 122 - Figure 3.26a
All-Purpose Road Diverging Diagram

A47 North Tuddenham to Easton
Norwich Road Junction - Westbound Merge
Based on Stage 3 Traffic Flows



CD 122 - Figure 3.12a
All-Purpose Road Merging Diagram



CD 122 - Figure 3.26a
All-Purpose Road Diverging Diagram

Appendix E. Sideroad Design Speed Calculations

Location	Bendiness	Road Width (m)	Verge Width (m)	VISI	Alignment Constraint	Layout Constraint	Design Speed	Comments
Existing A47 West of Hockering	31.75085	7.5	1.00	263	9.0	28 - Low (3 per km)	85A	
Fox lane northern tie-in	53.061	6	0.50	223	10.6	30 - Low (2.5 per km)	85A	
Existing A47 Bypassing Hockering	30.501	7.5	1.00	265	8.9	28 - Medium (6 per km)	85A	
Link to Church Lane	96.219	3	0.00	166	13.5	30 - low (1.5 per km)	85A	
Wood Lane B1535	45.074	7	0.50	233	10.1	30 - low (2 per km)	85A	
Berry Lane	21.187	4.5	0.10	258	8.6	30 - low (1.5 per km)	85A	
Dereham Road (Link to Honingham from Berrys Lane)	37.450	5	0.10	235	9.8	-	85A	Road ties into existing 30mph speed limit entering Honningham
Existing A47 Junction (Tie-in to Norwhich Road)	40.985	7.5	2.00	274	9.3	28 - Low (3.5 per km)	85A	
Taverham Road	36.542	4	0.10	236	9.7	30 - Low (3 per km)	85A	
Blind Lane	60.67755	3.5	0.00	203	11.3	30 - Low (2.5 per km)	85A	
Chruch Lane (Link from new Norwhich Road junction to Ringland Road)	81.7474	6	0.25	184	12.6	30 - Low (5 per km)	85A	
Dereham Road (Link from new Norwich Road Junction to Easton)	15.966	7	2.00	316	7.4	-	85A	Road ties into existing 30mph speed limit entering Easton

Alignment Constraint Ac: This measures the degree of constraint imparted by the road alignment, and measured by:

Single Carriageways: Ac = 12 - VISI/60 + 2B/45

Where:

B = Bendiness Degrees/km (refer to drawing XXXX)

VISI = Harmonic Mean Visibility m (see Annex A).

From Annex a TD9/93

Log10 VISI = 2.46 + VW/25 - B/400

3. For existing roads, an empirical relationship has been derived which provides estimates of VISI given in bendiness and verge width (applicable up to VISI = 720m) i.e.

$$\text{Log}_{10}\,\text{VISI} = 2.46 + \text{VW}/25 - \text{B}/400$$

where:

VW = Average verge width (averaged for both sides of the road)

B = Bendiness (Degree per km - minimum Length of about 2 km)

4.4 Where an existing single carriageway contains sharp bends, frequent double white line sections, narrow verges, etc.

VISI = 100 - 200m

although the empirical formula shown in 3 above can be used if Bendiness is available.