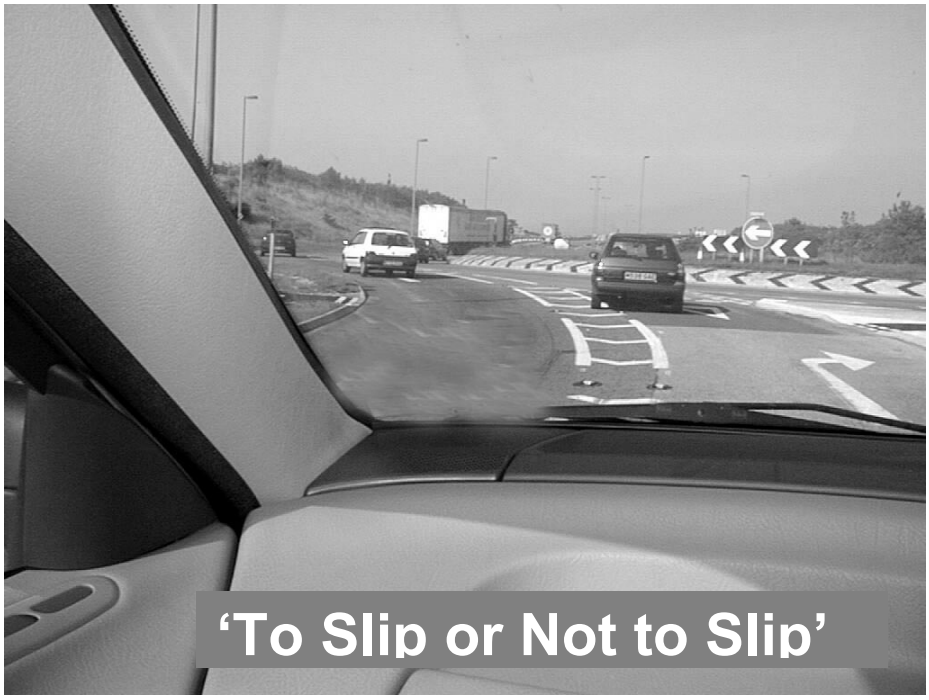
JCT Symposium – September 2000



by

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'To Slip or not to Slip'

The title refers to the provision of free left turn lanes on signal controlled roundabout approaches. For example, at the M25, Junction 28, the removal of an existing free left-turn lane on the M25 southbound off-slip approach markedly improved the capacity at the roundabout. This paper introduces two further cases, Case 1 and 2, where such inclusions, or proposed inclusions also reduced the potential capacity availability at the junction. To 'balance the discussion', Case 3 presents an example where the provision of of a free left turn slip was an obvious and advantageous design solution

1.0 CASE STUDY 1: M6 JUNCTION 3 – REMOVE THE SLIPS!

(Acknowledgements: Warwickshire County Council)

Figure 2.1 shows the location and proposed 'Option A improvement ' layout at the M6, Junction 3. My involvement with the scheme was to evaluate various proposed Options using the Transyt computer program and advise whether further modifications were desirable and/or necessary.

The free left turn approach lanes shown on approach Arms B and E (A444 approaches) already exist at this site. The additional free left slip proposed on approach Arm A was a new proposal for the Option A improvement.

Traffic Flow Data The junction evaluation exercise was for year 2015 flows:-

2015 AM PEAK M6, Junction 3

	A	B	C	D	E	Totals		
A	0	400	0	299	527	1226	A	M6 from Birmingham
B	514	0	636	229	**1699**	3078	B	A444 from Nuneaton
C	0	503	0	397	510	1410	C	M6 from Coventry
D	208	161	279	0	171	819	D	B4113 from Bedford
E	303	915	300	244	0	1762	E	A444 from Coventry
Totals	1025	1979	1215	1169	2907	8295		

2015 PM PEAK M6, Junction 3

	A	B	C	D	E	Totals		
A	0	448	0	82	470	1000	A	M6 from Birmingham
B	317	0	381	152	907	1757	B	A444 from Nuneaton
C	0	777	0	275	394	1446	C	M6 from Coventry
D	139	509	264	0	186	1098	D	B4113 from Bedford
E	361	**1825**	617	160	0	2963	E	A444 from Coventry
Totals	817	3559	1262	669	1957	8264		

Note that although Option A proposes free left turn lanes on approaches A, B and E , these left turn movements are not the major origin – destination movements. The major movements are:-

i) Am peak: A very predominant North to South movement along the A444 (B to E)
ii) Pm peak: An almost reciprocal South to North movement along the A444 (E to B)

A careful study of the peak hour origin-destination movements can give a useful early indication as to the likelihood or not of capacity benefits if left-turn slips are provided. However, to confirm and quantify such likely benefits, full Lane/Flow diagrams need to be constructed and studied.

Compare Peak hour Lane/Flow Diagrams Figures 2.2 and 2.3 (Option A) with Figure 2.4 and 2.5 (a new improved proposal, Option C)..

Generally, provision of free left turn lanes are not advisable if:-

- On the approaches, provision of a free left turn may hamper the ability for approach traffic to equally distribute itself between the available lanes, and in so doing, sometimes seriously restrict the available entry capacity.

- On the exits, provision of a nearside free left turn lane may restrict the ahead exit capacity off the gyratory.

To illustrate the above, compare Lane/Flow Diagrams 2.3 & 2.4 (Option A) with Figures 2.4 and 2.5 (A new Option C that excludes the free left turns, and in so-doing, is better able to distribute the traffic more evenly across the available approach and gyratory Arms).

Note:-

The Webster & Cobb relationships: Y=(q1 + q2) / S and Y = (C-L)/L were applied to derive the following ***'critical cumulative lane flow values*** *', (i.e. q1+q2)' at entry junctions:-*

{ note q1 = maximum approach lane flow, q2 = maximum gyratory lane flow, at a junction, C = cycle time, assume 60 seconds, and L = sum of the 'effective' lost times, assume 8 seconds at this site}

Degree of saturation (1900 pcu/hr)	*Saturation Flow (2000 pcu/hr)*	*Saturation Flow (pcu/hr)*
90%	*1482*	*1560*
95%	*1564*	*1650*

Using the (q1+q2) < = 1500 pcu/hr criteria described above, the Option A peak hour Lane/Flow diagrams (Figures 2.2 and 2.3) indicate potential capacity problems at the M6(S) and B4133 junctions in the am peak (Figure 2.2) and in particular, at the M6(N)and A444(S) junctions in the pm peak (Figure 2.3). The Transyt results for the pm peak, ***(see*** *Figure 2.6a)* illustrate this pm capacity restriction dramatically, with a predicted 144% degree of saturation and mean max queue of 154 vehicle predicted at the preceding A444(S) junction. The cause of the latter is a modelling necessity to restrict the ahead flow into the gyratory due to a capacity restriction at the M6(N) junction.

In Summary – Option A

The most obvious solution for Option A is to seek means of reducing the critical lane entry flow volumes at the affected junctions. Removal of the free left turn lanes, in particular, on the A444(S) approach *(i.e. Node E)*, offers an immediate way forward.

New Option C

Option C evolved during the design process as a result of the above evaluations. The prime objective was to more evenly distribute the traffic between all available approach and gyratory lanes, and thus reduce the 'critical cumulative lane flow' at each entry. The proposed new layout and road markings are illustrated in Figure 2.7.

The principal new features are:-

- Removal of all the free left turn lanes
- Provision of longer / as long as possible three to two lane merges at the A444 (N) and A444(S) exits
- New lane markings and gyratory spiral routes to attain more equal use of the approach and gyratory lanes - these to be supported by road signs on the approaches.

  The assembled am and pm peak period Lane/Flow diagrams for proposed new Option C are given in Figures 2.4 and 2.5. When compared with the Option A lane/Flow Diagrams (Figures 2.2 and 2.3) and pm peak hour Transyt results (Figure 2.6b), these immediately illustrate the advantages of removing the free left turn lanes. Traffic can now more equally distribute between the lanes on the approaches and on the gyratory. In so doing, the principal objective of reducing critical lane traffic volumes , and therefore increasing junction capacity, is achieved.

2.0 Case Study 2: M3, Junction 4 Blackwater Valley, Surrey – No Slip Please!

(Acknowledgements:- Highway Agency Scheme, Consultants Mott MacDonald, Stillwell Bell, Cornwall County Council)

The site location , final junction layout and am peak flows for the Southern Roundabout are illustrated in Figures 3.1 , 3.2 & 3.4. The am peak Lane/Flow diagram for same is shown in Figure 3.3, and a summary of the Transyt Results, in Figure 3.5. My involvement with the scheme was to evaluate a number of proposed options for the Southern Roundabout and advise on possible improvements for the northern roundabout. The Case Study today concerns the Southern roundabout, where my Client asked me to draft a response to the following:-

'Query by member of the public re provision of a new free-left-turn filter lane on M3 eastbound off-slip at Southern Round about

the response:-

'An extensive review of the operation of this roundabout has recently been completed. As previously promised, your suggestion that a free left-turn slip be provided for left-turning traffic from the M3 off-slip approach was given full consideration. The review is now nearing completion and clearly indicates that signal control is likely to offer the optimum solution for all users of this busy roundabout.

However, whether left as a traditional but improved roundabout or signal controlled, it would not have proved possible to provide this suggested free left-turn slip without seriously compromising other traffic. This is because of the two lane restriction under the over-bridge between the southern and northern roundabouts. Had a free left turn slip been provided, this would have necessitated the high volume of traffic approaching from the Frimley/Farnborough direction having to merge from 2 or three lanes into a single off-side lane. Such a design was clearly unfeasible and would have cause serious block-back into the roundabout.

Once again thank you for your design suggestion. I trust that under the new traffic control regime, a primary object of which was to relieve congestion on the M3 off-slip, you will find egress to the left considerably improved. '

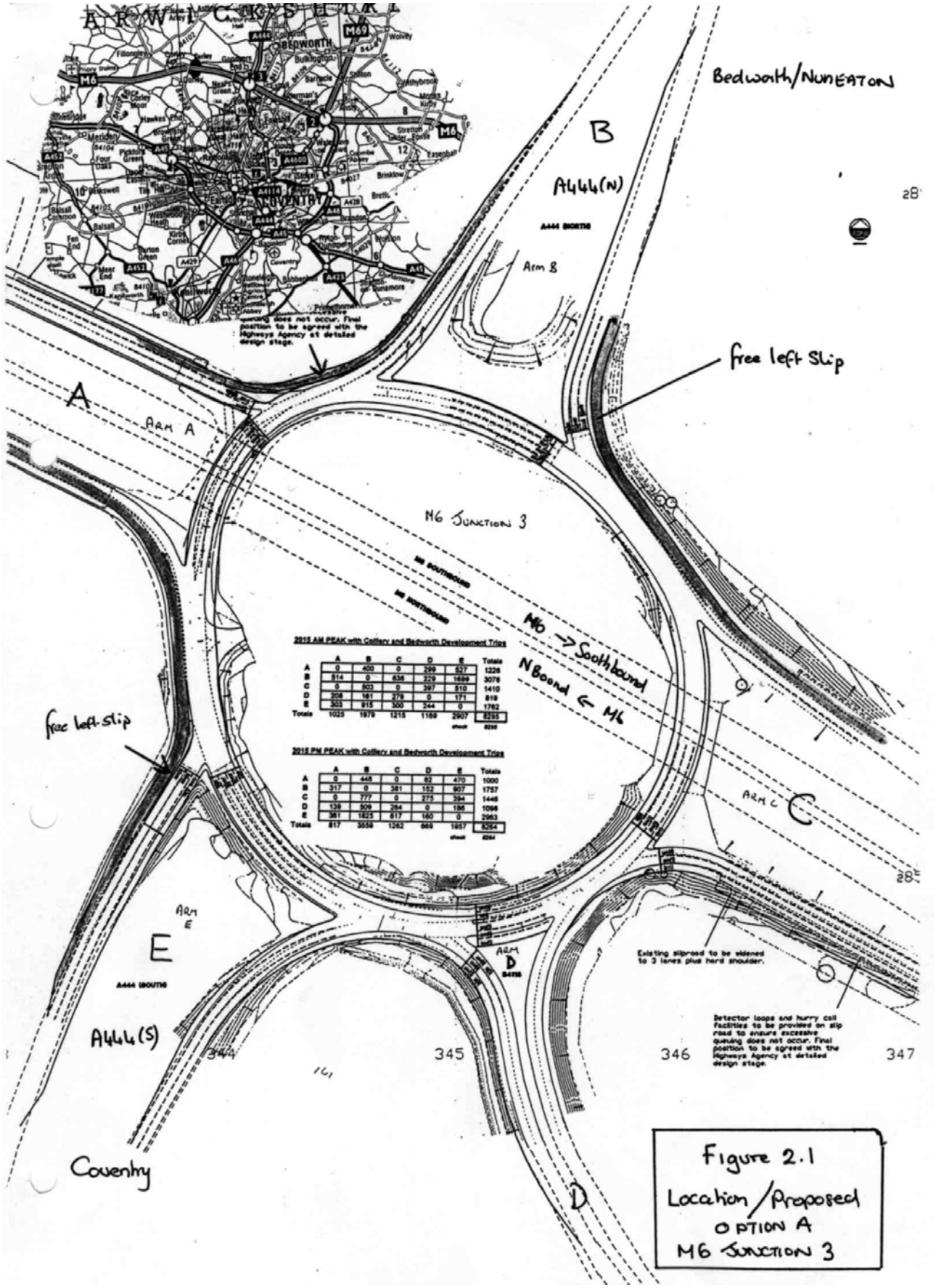
Another point of Interest ……..

Note that the business park exit is to be left as giveway – there was a time at design process when parties were unhappy that this exit was to be left as giveway, this despite my assurance that the upstream intergreens would provide sufficient gaps. However, to reassure the client, I suggested implementation of call/cancel queue loops on the business park approach that could extend one of the upstream intergreens from 5 to 9 seconds if necessary. Issue resolved!

3.0 Case Study 3: M40 Junction 9, Wendlebury – Slip?, Yes Please!

(Acknowledgements: Highway Agency Scheme, Consultants Kennedy & Donkin)

Figure 4.1 illustrates proposed improvements at M40, Junction 9. The left-turn slip from the A34 already exists and is a correct and obvious design choice. This becomes evident when examining the peak hour origin-destination flow matrices.


Bedworth/Nuneaton
B
A466(N)
Arm B
Free left Slip
A
Arm A
M6 Junction 3
M6 Southbound
NBound M6
Free left slip
Arm C
C
Arm E
E
A444 (South)
A466(S)
Arm D
D
Existing sliproad to be widened to 3 lanes plus hard shoulder.
Detector loops and hurry call facilities to be provided on slip road to ensure excessive queuing does not occur. Final position to be agreed with the Highways Agency at detailed design stage.
344
345
346
347
Coventry
2015 AM PEAK with Colliery and Bedworth Development Trips
2015 PM PEAK with Colliery and Bedworth Development Trips
Figure 2.1
Location / Proposed
OPTION A
M6 Junction 3

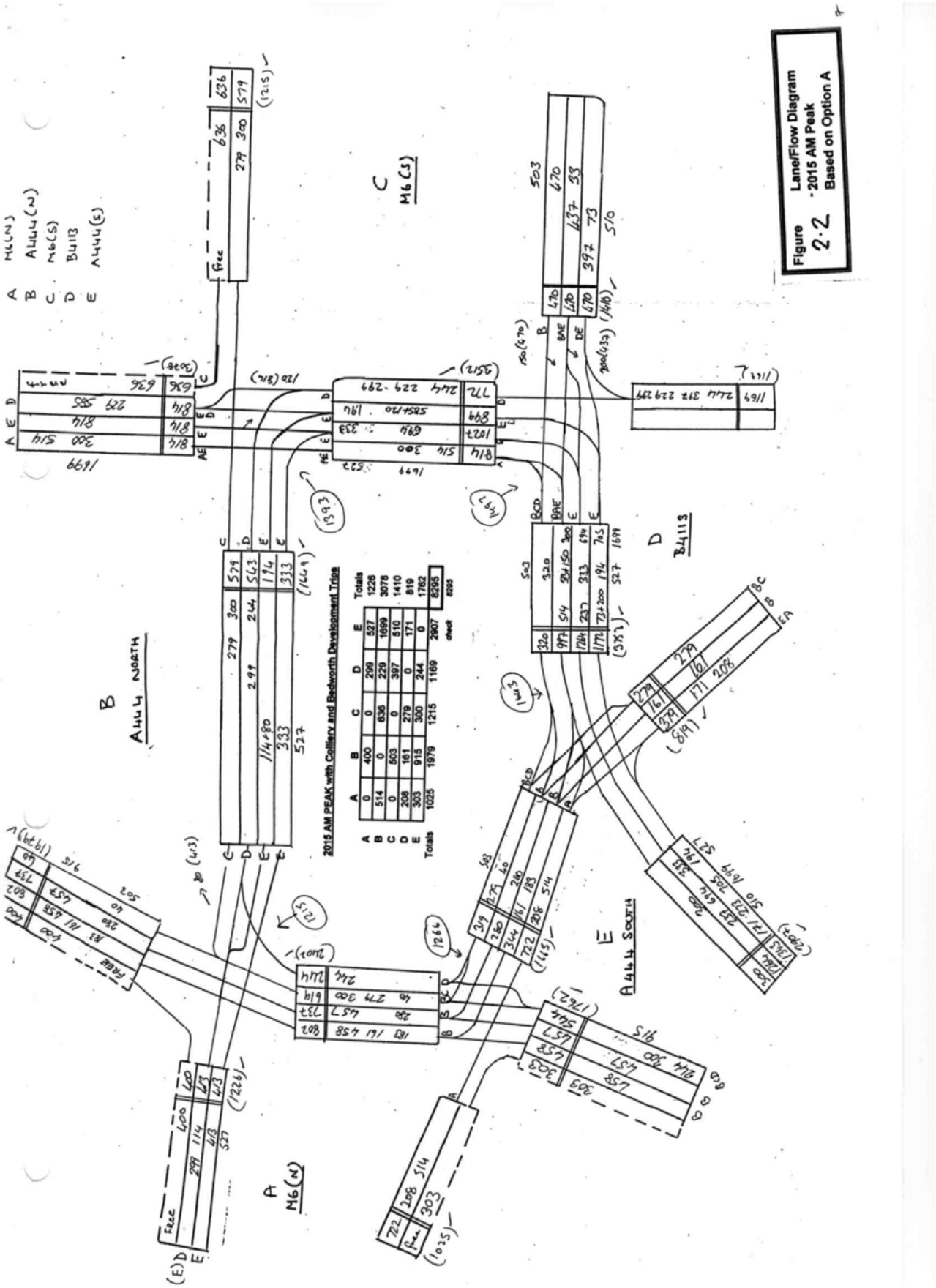


Figure 2·2 Lane/Flow Diagram ·2015 AM Peak Based on Option A
A M6(N)
B A444 (N)
C M6(S)
D B4113
E A444(S)
2015 AM PEAK with Colliery and Bedworth Development Trips
Totals
A444 NORTH
M6(S)
B4113
A444 South
M6(N)

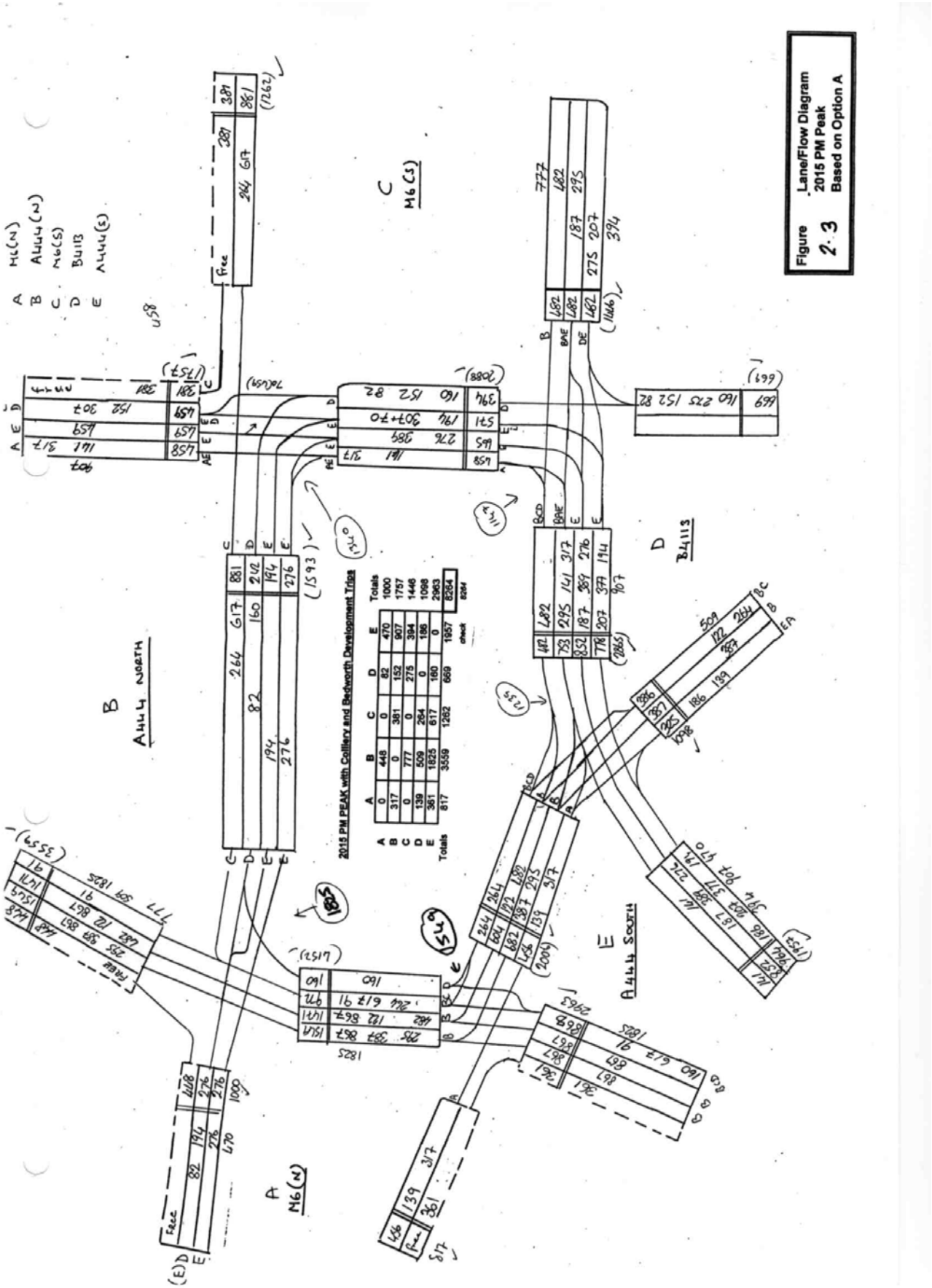


Figure 2.3 Lane/Flow Diagram 2015 PM Peak Based on Option A
A M6(N)
B A444 (N)
C M6(S)
D B4113
E A444 (S)
A M6(N)
B A444 NORTH
C M6 (S)
D B4113
E A444 South
2015 PM PEAK with Colliery and Bedworth Development Trips

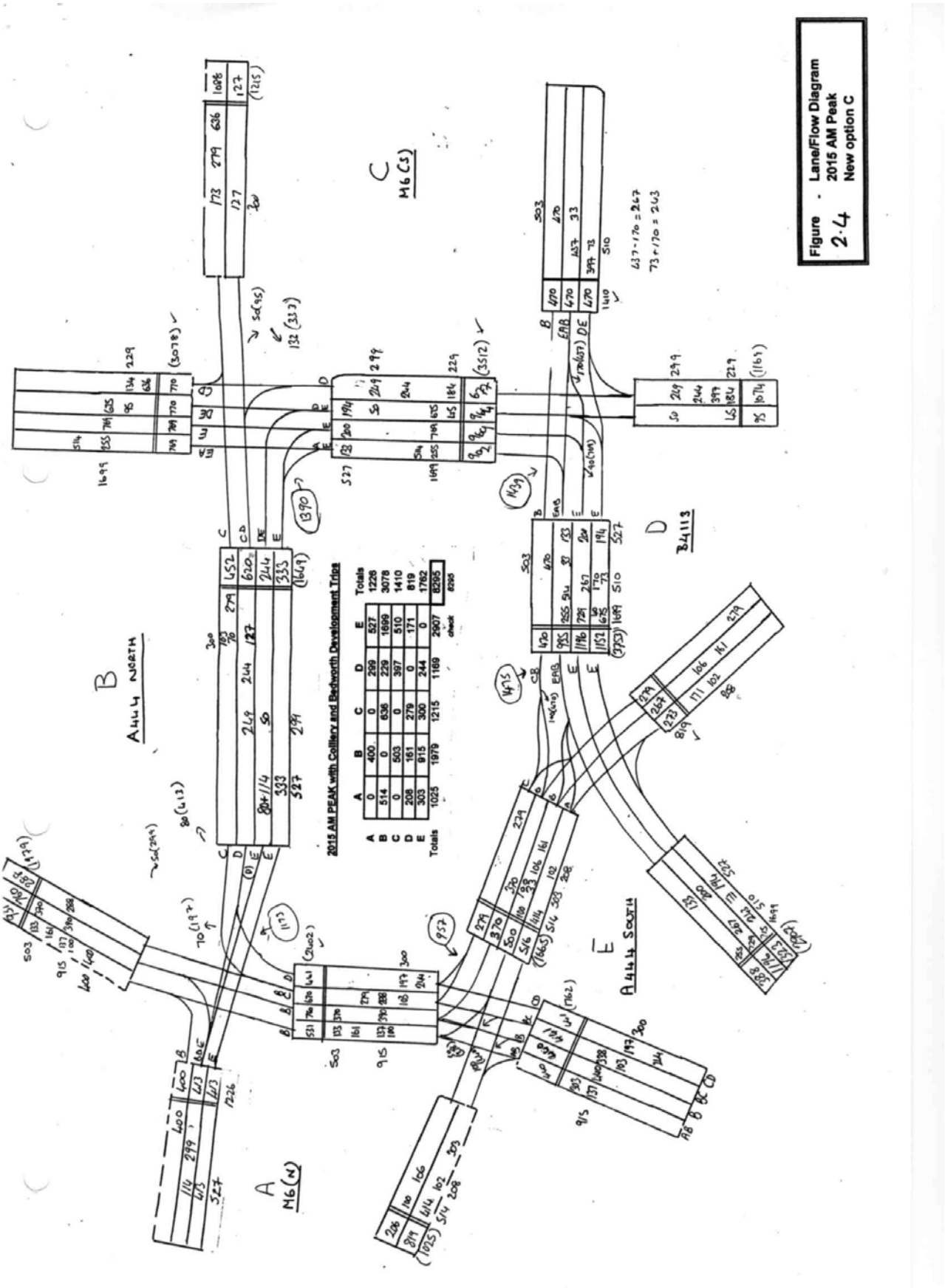


Figure 2.4 Lane/Flow Diagram 2015 AM Peak New option C
2015 AM PEAK with Colliery and Bedworth Development Trips
A M6 (N)
B A444 NORTH
C M6 (S)
D B4113
E A444 South

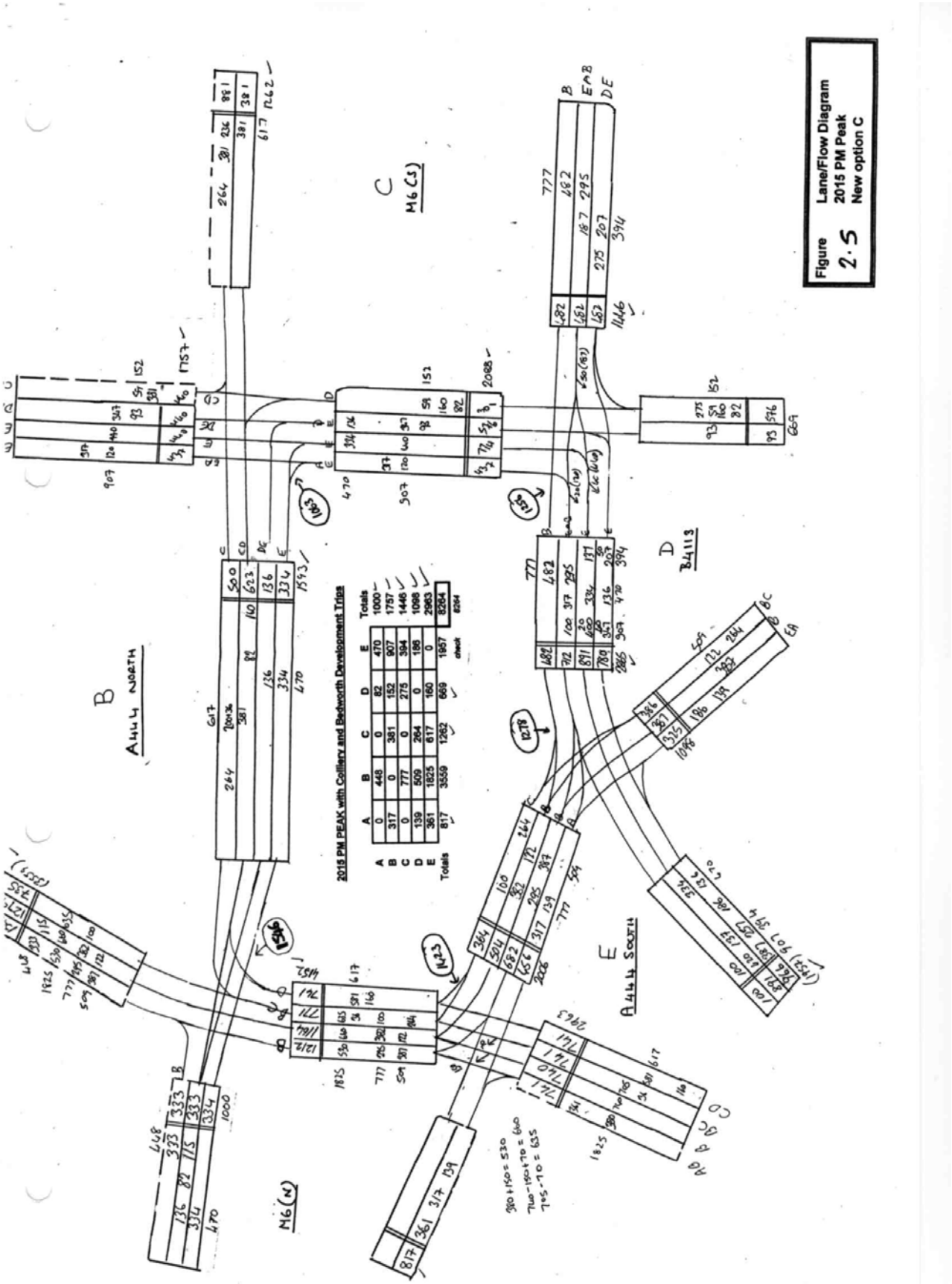
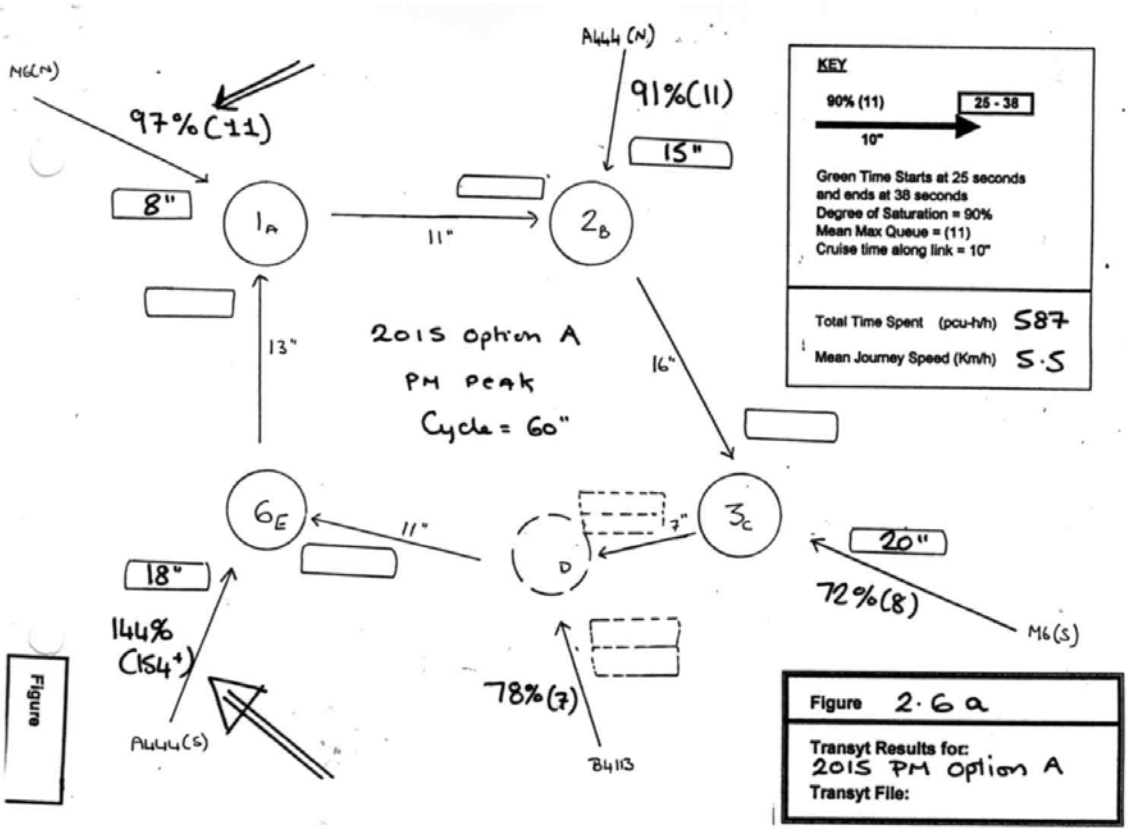


Figure 2.5 Lane/Flow Diagram 2015 PM Peak New option C
2015 PM PEAK with Colliery and Bedworth Development Trips
A444 NORTH
A444 SOUTH
B4113
M6 (S)
M6 (N)
A
B
C
D
E
Totals



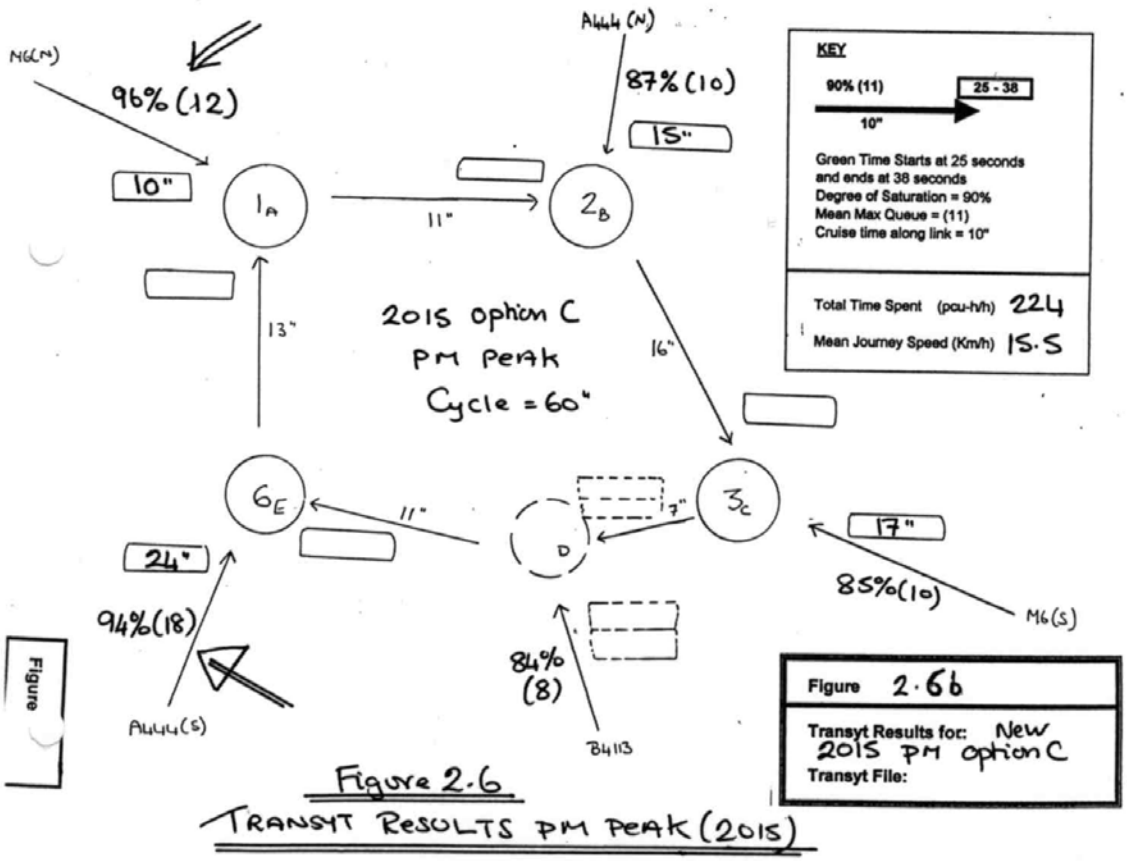


Figure 2.6
TRANSYT RESULTS PM PEAK (2015)

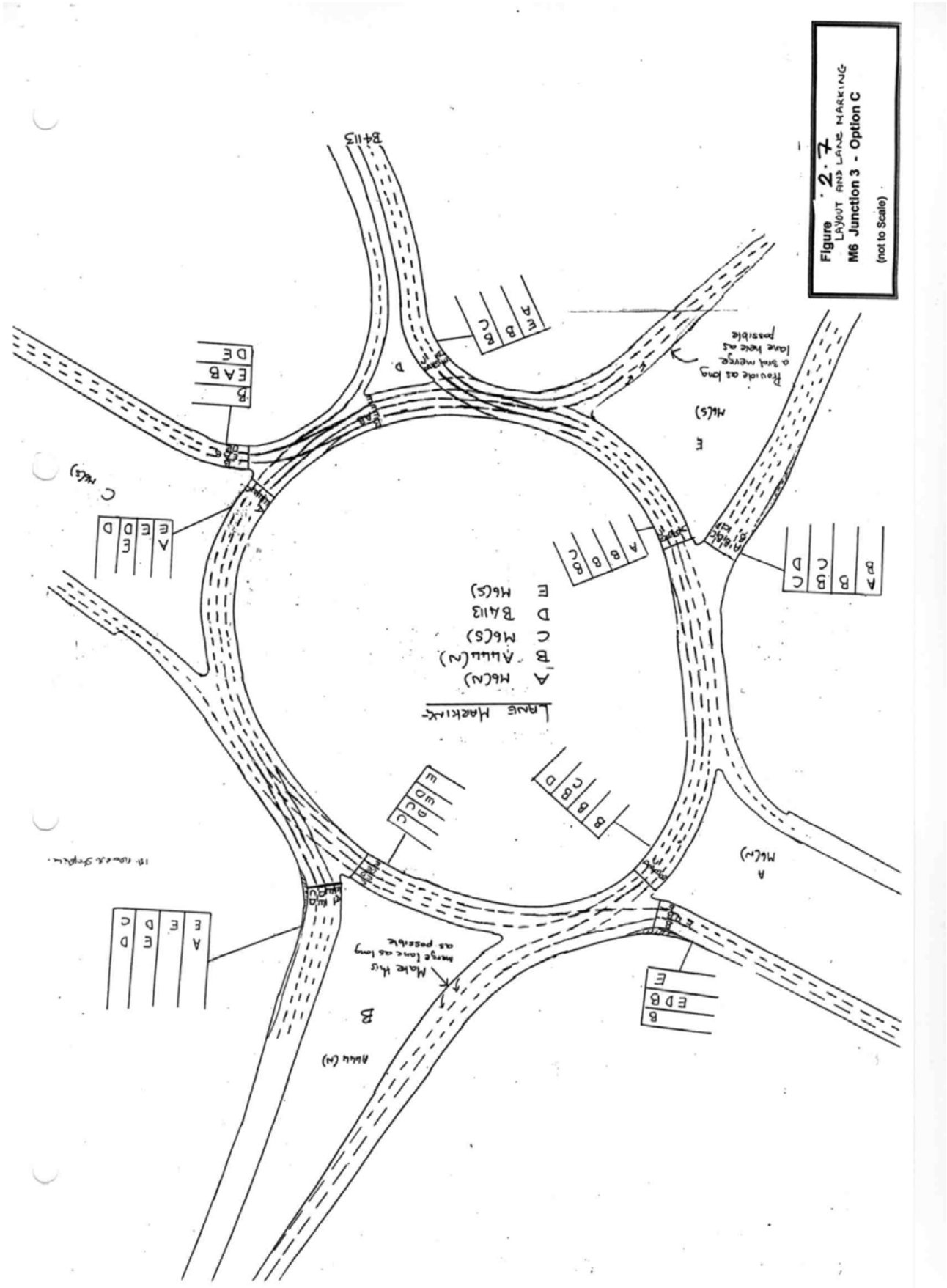


Figure 2.7
LAYOUT AND LANE MARKING
M6 Junction 3 - Option C
(not to Scale)

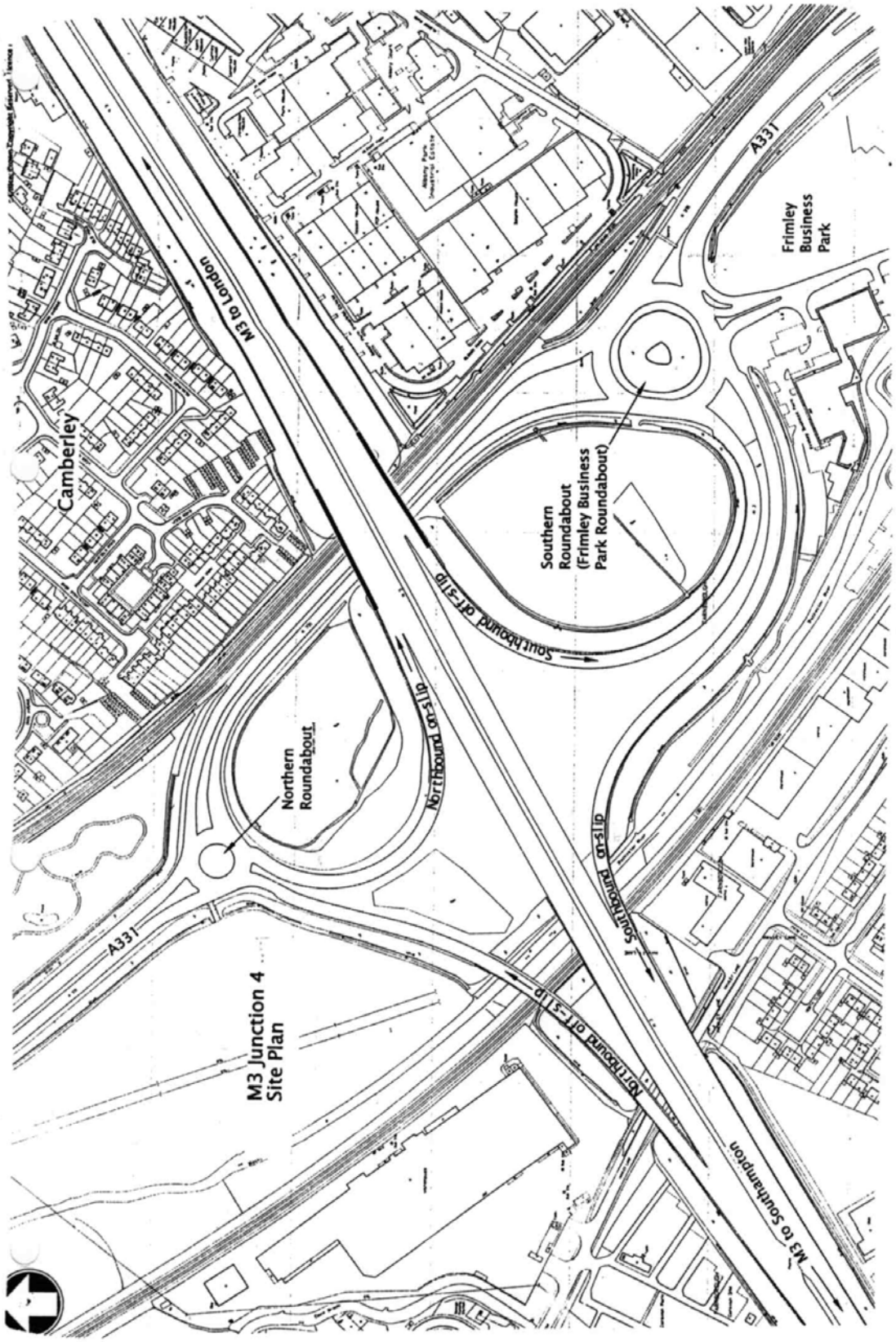


Figure 3.1 M3 Junction 4

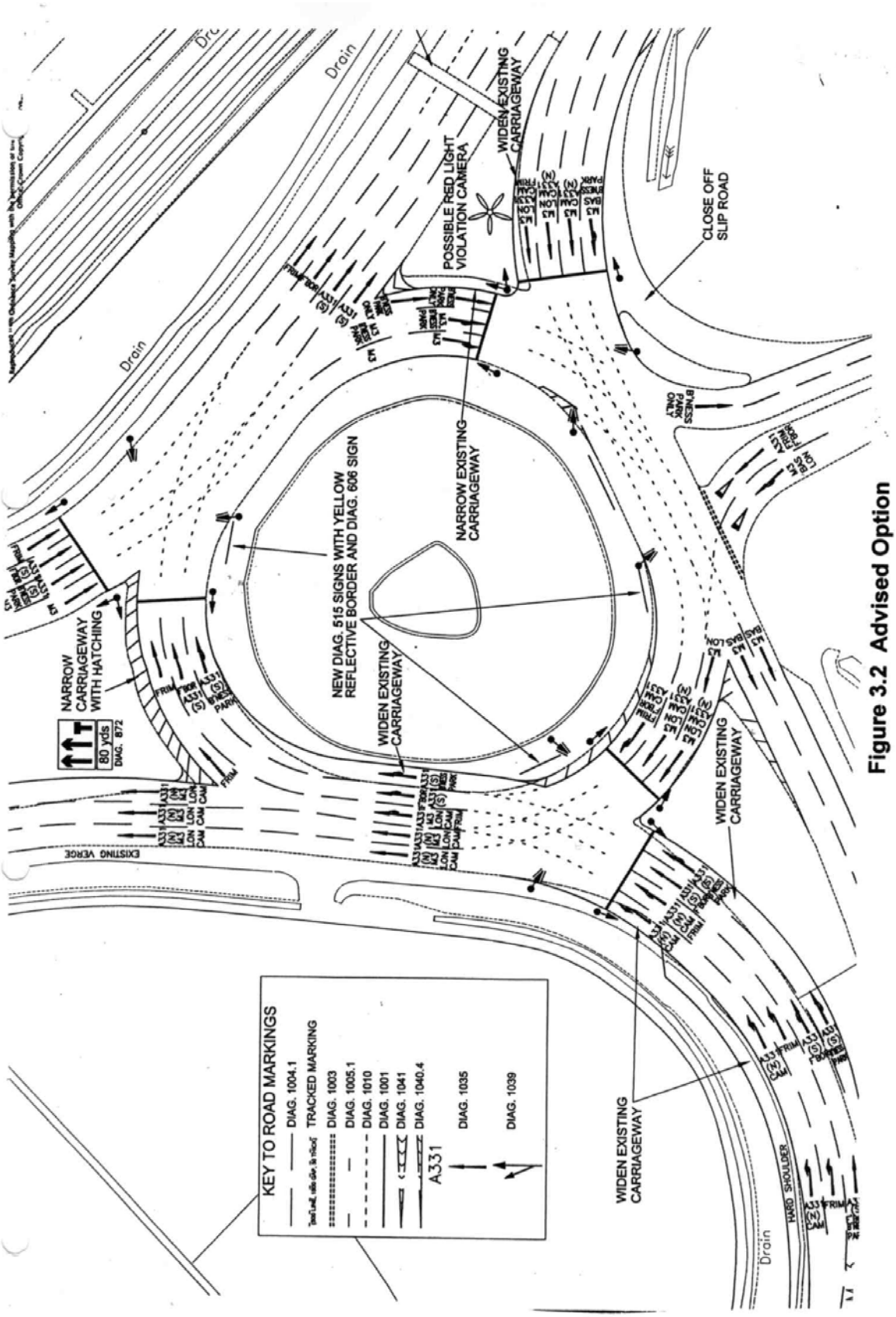


Figure 3.2 Advised Option

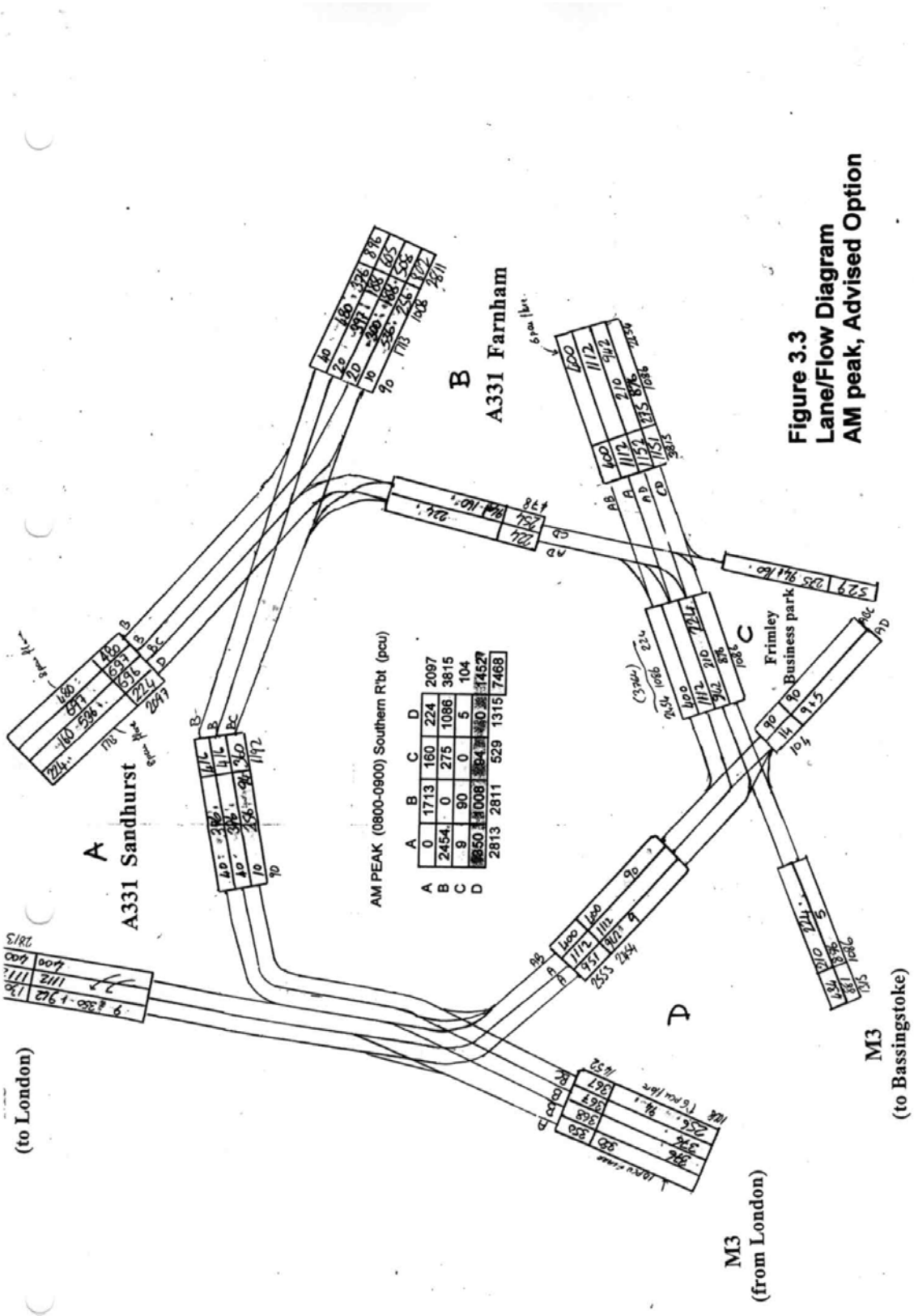


Figure 3.3
Lane/Flow Diagram
AM peak, Advised Option

AM Peak (0800–0900) Southern R'bt (pcu)

	A	B	C	D	
A	0	1713	160	224	2097
B	2454	0	275	1086	3815
C	9	90	0	5	104
D	350	1008	94	0	1452
	2813	2811	529	1315	7468

Count On Us Traffic Data 24/3/98

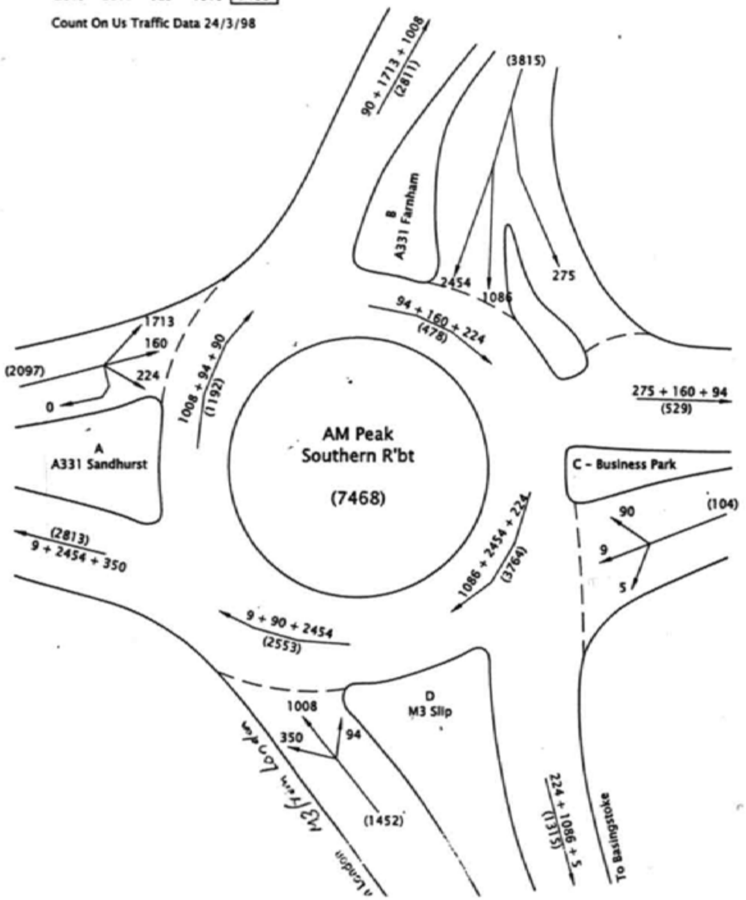


Figure 3.4 Distribution of AM Peak Flows

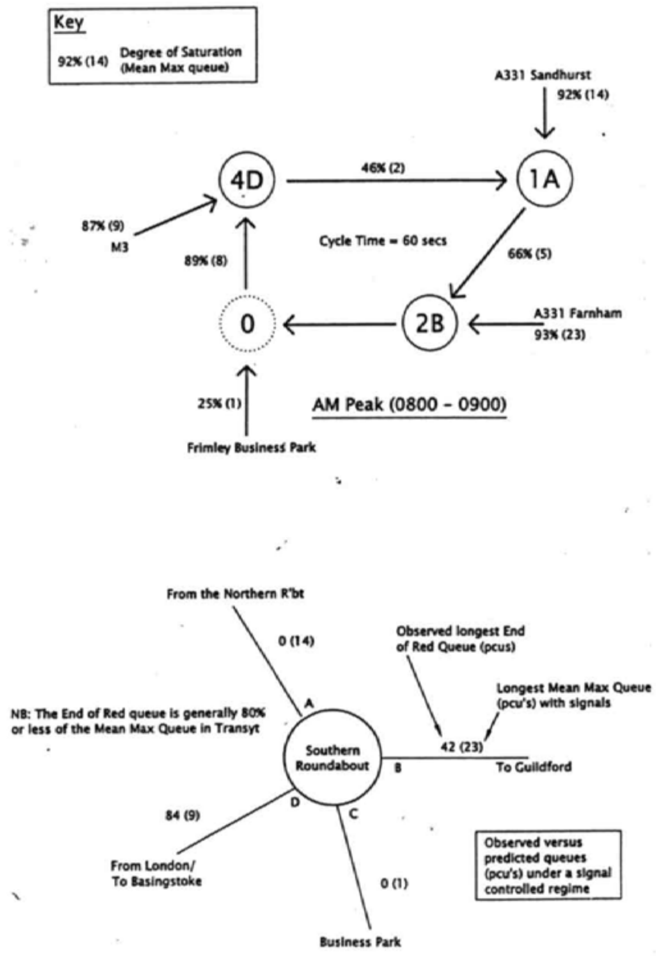


Figure 3.5 Transyt Results for AM Peak, Advised Option

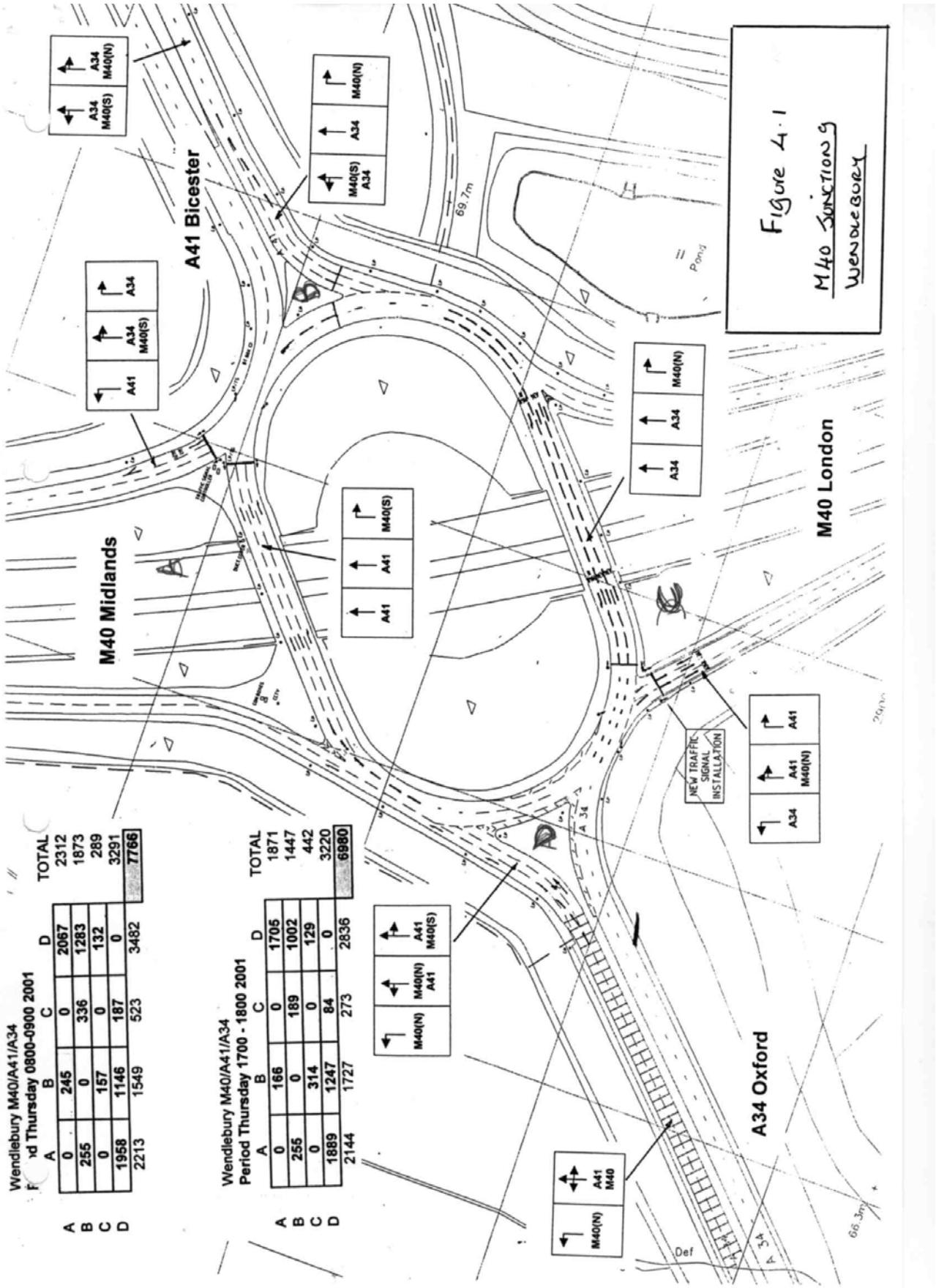


Figure 4.1
M40 Junctions 9
Wendlebury
A41 Bicester
M40 Midlands
M40 London
A34 Oxford
NEW TRAFFIC SIGNAL INSTALLATION
69.7m
Pond
Wendlebury M40/A41/A34
Period Thursday 0800-0900 2001
A B C D TOTAL
A 0 245 0 2067 2312
B 255 0 336 1283 1873
C 0 157 0 132 289
D 1958 1146 187 0 3291
2213 1549 523 3482 7766
Wendlebury M40/A41/A34
Period Thursday 1700 - 1800 2001
A B C D TOTAL
A 0 166 0 1705 1871
B 255 0 189 1002 1447
C 0 314 0 129 442
D 1889 1247 84 0 3220
2144 1727 273 2836 6980