

M40 J4 / A404 Handy Cross Roundabout Economy Study

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Executive Summary

Having investigated the various aspects of the brief it is apparent that the existing operation of Handy Cross Roundabout is not being maximised and is operating under capacity with poor lane utilisation & discipline. There are 2 fundamental reasons for this:

- a) The existing signal co-ordination around the junction is poor, as described in chapter 4.1.
- b) There are various maintenance issues (see chapter 4.2) associated with the very poor condition of the carriageway surface and road markings, together with the lack of visual contrast between these two features.

To address the poor signal co-ordination, the existing signals should be optimised, as described in chapter 4.1, and subsequent minor on-street adjustments should be carried out as required. From the TRANSYT modelling which has been undertaken, signal optimisation is predicted to deliver VHD savings of 112,295 hours in the opening year which, assuming a cost estimate of £10,000, equates to a journey time benefit of £1,374,488 in the opening year. The PAR contained in Appendix E for signal optimisation confirms the BCR as 6130 and a VM score of 10.

The following is recommended to address the identified maintenance issues:

- Undertake appropriate remedial measures to rectify areas on the circulatory carriageway and roundabout approaches where the existing high-friction surfacing (HFS) has delaminated.
- On the circulatory carriageway and roundabout approaches, provide a black-coloured road surface which meets DMRB Vol. 7 requirements to improve the current poor contrast between the buff-coloured HFS and the road markings.
- With the exception of the A404 southbound exit from the roundabout (see below), re-mark the existing road marking layout as shown on drawing no. 3/004973/DR/000/001 in Appendix A.
- Amend the existing lane loss layout on the A404 southbound by removing all existing lane markings and studs between lanes 2 and 3 where the width of lane 3 is less than 2.5m. If necessary, re-mark the TSRGD Diagram 1014 deflection arrows in accordance with TSM Chapter 5.
- Undertake appropriate maintenance to address a number of gullies on the inner circle of the south eastern quadrant of the circulatory carriageway that were observed as being full of standing water and whose grating/frame was too low in relation to the adjacent carriageway. In addition, consider providing a concrete apron at the back of the existing kerb in relation to the identified overrun issue.

The above improvement and maintenance measures should be implemented at the earliest opportunity and then the junction should be monitored, through HAIL & Watchman enquiries, to determine what, if any, residual problems exist. Should any residual problems exist, these should only be investigated following a sufficient monitoring period. The issues described in chapters 4.8 and 5 could also be investigated in more detail at this time.

1.0 Introduction

1.1 Background

Under the Area 3 Managing Agent Contractor contract (MAC) for the Highways Agency (HA), EnterpriseMouchel has been tasked to undertake an economy study at M40 J4 / A404 Handy Cross Roundabout, due to concerns that signs and road markings on the circulatory carriageway and its approaches are inconsistent.

A number of HAIL enquiries have been received highlighting poor lane utilisation on the south eastern quadrant of the circulatory carriageway, affecting the operational performance of the existing traffic signals. In addition to the above, the existing lane loss layout on the A404 southbound exit from the roundabout has been reported as being confusing, hazardous, raising safety issues, and not to current standard.

1.2 Brief

To investigate the issues described above, the brief for this study is as follows:

- Undertake a site visit to observe lane utilisation, the use of the Burroughs Grove Hill and A404 southbound exits with the Route Steward.
- Review the existing layout to understand the site constraints, and review existing studies and schemes to identify additional recommendations that could be implemented.
- Obtain and review collision records to assist with supporting proposals (see Appendix C).
- Review the feasibility of two improvement measures: the closure of the exit to Burroughs Grove Hill, except for buses; the provision of a 2-to-1 merge on Burroughs Grove Hill on the immediate exit from Handy Cross roundabout, adjacent to the existing splitter island.
- Model the existing operation of the junction using the TRANSYT (TRL computer program for determining and studying optimum fixed time, co-ordinated, traffic signal timings) modelling tool to establish the base situation from which revised situations or layouts can be measured.
- Review the existing lane loss layout on the A404 southbound exit from the roundabout, against Design Manual for Roads and Bridges(DMRB) & Traffic Signs Manual (TSM), and make recommendations for improvement as appropriate.
- Assess the benefits of identified schemes and prepare an associated business case using Project Appraisal Report (PAR).

Further to a meeting with the Area 3 Network Review Manager on 19/01/12, a further requirement of the brief was to acknowledge the Handy Cross Hub development proposal within the study given the proximity of this development and its likely significant impact on traffic flows at the junction.

2.0 Existing Site Description & HAIL Enquiries

2.1 Site Description

Handy Cross Roundabout is a large seven-arm signalised roundabout linking the M40 at Junction 4 with the A404 and three local roads. The junction is a signalised roundabout forming a grade separated junction with four slip roads providing access to and from the M40 Motorway in both directions. It is used by approximately 100,000 vehicles per day.

The M40 connects Birmingham and Oxford (via the A34) with London and the Handy Cross junction is the main route for traffic accessing the centre of High Wycombe, with its hotel and retail complexes, residential areas, schools and sports centre.

In May 2007, a Major Junction Improvement was opened to traffic at the M40 J4/A404 Handy Cross Roundabout on the southern outskirts of High Wycombe in Buckinghamshire, at a cost (2002 prices) of £13.5m. The scheme included a new 5 lane cross-link through the gyratory to assist traffic movements between the M40 and the A404(S) Marlow Bypass, and a new dedicated left turn slip lane between A404(S) Marlow Bypass and M40 towards Oxford. Approaches to the junction from the M40 were widened from 4 to 5 lanes, and signalised pedestrian crossings installed around the western side of the junction.

The Split Cycle Offset Optimisation Technique (SCOOT) method of signal control formed part of the above scheme. However, upon going live 'on the street', it is understood that SCOOT soon resulted in gridlock and an alternative Cableless Linking Facility (CLF) method of control was implemented.

The Post Opening Project Evaluation (POPE) One Year After Study, issued in June 2009, noted that the scheme was still awaiting full implementation of SCOOT and some final changes to lane designations and road markings. Therefore, the POPE One Year After Study was not able to fully evaluate the impacts of the scheme. It is understood that the Enterprisemouchel (EM) Area 3 Traffic Signals Manager has proposals to introduce SCOOT across the junction as soon as practical and subject to funding.

The roundabout circulatory carriageway and the A404 to the south of the junction are part of the HA Area 3 Network. The M40 slip roads at the junction are the responsibility of UK Highways under the HA M40 DBFO contract and the remaining arms of the junction are the responsibility of Buckinghamshire CC (BCC).

2.2 Summary of HAIL Enquiries

Details for a total of 23 HAIL enquiries between July 2009 and March 2011 in relation to the junction were obtained and examined (see Appendix B). Of these 23 enquiries, 9 were general and did not identify a specific problem. Of the remaining 14 enquiries, 11 referred to lane utilisation generally in the area of the A404 southbound exit from the roundabout and 3 referred to worn road markings.

3.0 Traffic Analysis

3.1 Traffic Survey

A traffic survey was commissioned and undertaken on Thursday 20th October 2011 between the hours of 07:00 & 19:00. The survey produced a classified Origin-Destination (O/D) spreadsheet by 7 classes of vehicle. No traffic incidents were recorded by the surveyors during the survey period which may have affected the survey results.

In addition, a video record was obtained of the following 3 approaches as part of the above survey; M40 EB, M40 WB & A404 NB, during the same period, to record queues. These images indicated the following:

- The A404 northbound approach queued extensively in the AM & PM peak periods; however the current flared lanes on the immediate approach to the roundabout were not being used to full capacity (see Section 4.6).
- The M40 westbound approach coped adequately in the AM and started well at 17:00 but by 18:00 the queue was more than 100 vehicles, across 3 lanes.
- The M40 eastbound approach performed well with queues of only up to 5 vehicles per lane observed at the end of the peak times.

The spreadsheet data was then analysed to find the busiest / peak hours and converted to Passenger Car Units (PCU) using the standard factors for each vehicle class, then presented as an O/D matrix of all movements.

To reflect Demand Flows, the observed queues were added and factored in proportion to the stop line flows matrix (Refer to Table 3.1).

That matrix was then assigned to each lane at each stop-line based on signed destinations and some common sense decisions, as the Traffic Survey had not captured actual lane flows.

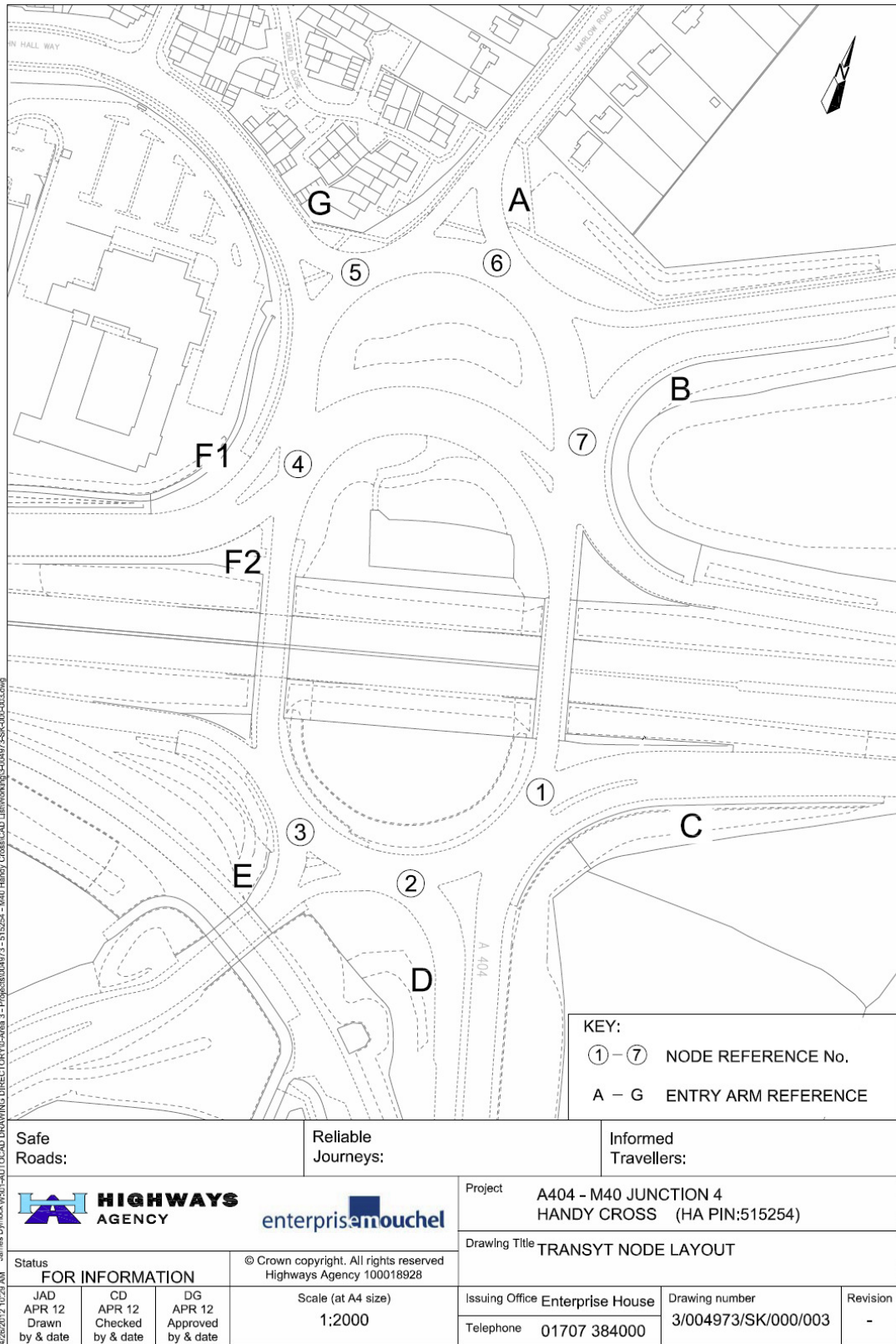


Figure 3.1 – Node & Arm Referencing

3.2 Traffic Modelling

A TRANSYT geometric model was developed from the 2011 junction layout and the derived lane flows entered, although exact replication of this complex junction signal staging, with phase delays at staggered stop lines is not entirely possible within the limitations of TRANSYT 12. Traffic growth of 1% was applied from 2011 to 2012 in line with Road Transport Forecasts 2009, produced by the Department for Transport.

Saturation Flows were based on TRL Roadnote Report 67 as no site measurements were available.

Copies of the controller specifications were obtained, allowing the 'actual' signal timing data to be extracted for inclusion in the TRANSYT model for the existing scenario. Those specifications included the Special Conditioning that had been included in the original controller logic in an attempt to deal with anticipated gyratory 'gridlock' and queues developing on HA approach roads. As SCOOT is not currently implemented, the junction operates CLF Plan 0 in the AM period, CLF Plan 1 in the off-peak and CLF Plan 2 in the PM period, but changes to CLF Plan 3 if queuing is detected on any of the HA approaches. In consequence the controller should be operating CLF Plan 3 during most of each peak period as there is a queue on the A404 northbound throughout both peaks. The TRANSYT output files contained in Appendix D for the AM & PM peak and Inter Peak base (2012) model have been derived from the relevant CLF plans. A TRANSYT Link-Node Diagram is also included in Appendix D.

These existing CLF plans are dated 2012 but show Controller PROM variant as 0, which indicates that they are as installed in 2007, when the major junction improvement was completed.

Finally the lane Saturation Flows were 'adjusted' to try and replicate the degree of queuing recorded on the video, the main 'adjustments' being links 701/702 A404 (Marlow Hill from Wycombe) and 111/121 (Eastside overbridge). That final TRANSYT model had to be accepted as 'validated' within the constraints of the data available, and was then available for Option Testing.

AM 0800-0900 Demand Flows

| | | TO | | | | | | | |
|------------------|--------|-----|------|------|------|-----|-----|------|-------|
| | | A | B | C | D | E | F | G | Total |
| F R O M | A | 0 | 52 | 113 | 345 | 213 | 16 | 97 | 836 |
| | B | 66 | 0 | 309 | 582 | 13 | 79 | 91 | 1140 |
| | C | 119 | 258 | 0 | 757 | 112 | 3 | 656 | 1905 |
| | D | 516 | 229 | 337 | 0 | 2 | 53 | 139 | 1276 |
| | E | 155 | 52 | 500 | 79 | 0 | 87 | 224 | 1097 |
| | F1 | 23 | 318 | 1 | 0 | 0 | 0 | 210 | 552 |
| | F2 | 0 | 0 | 7 | 809 | 29 | 0 | 0 | 845 |
| | G | 31 | 131 | 314 | 156 | 134 | 83 | 0 | 849 |
| | Totals | 910 | 1039 | 1581 | 2728 | 503 | 322 | 1417 | |

PM 1700-1800

| | | TO | | | | | | | |
|------------------|--------|-----|------|------|------|-----|-----|------|-------|
| | | A | B | C | D | E | F | G | Total |
| F R O M | A | 0 | 49 | 172 | 287 | 188 | 16 | 98 | 810 |
| | B | 70 | 0 | 406 | 581 | 12 | 234 | 59 | 1362 |
| | C | 139 | 357 | 0 | 718 | 118 | 4 | 598 | 1934 |
| | D | 449 | 314 | 619 | 0 | 3 | 77 | 80 | 1542 |
| | E | 113 | 29 | 363 | 45 | 0 | 78 | 174 | 802 |
| | F1 | 19 | 252 | 0 | 0 | 0 | 0 | 126 | 397 |
| | F2 | 0 | 0 | 6 | 649 | 26 | 0 | 0 | 681 |
| | G | 48 | 203 | 514 | 214 | 233 | 198 | 0 | 1410 |
| | Totals | 838 | 1204 | 2080 | 2494 | 580 | 607 | 1135 | |

Table 3.1 – O/D Demand Flow Matrix AM & PM peak hour (PCU/hr)

4.0 Site Observations & Discussion

A site inspection was carried out on Tuesday 3rd January 2012 to investigate the specific issues referred to in the brief and to identify potential improvements to address them. Other, more general, issues considered relevant to the brief have been investigated and possible remedial measures to these issues are discussed.

For ease of reference, and with the exception of chapters 4.1, 4.2 & 4.8 below, the junction has been described in this chapter using the node and entry arm referencing as shown in Figure 3.1. Please also refer to drawing no. 3/004973/DR/000/001 in Appendix A which shows the existing lane destination markings and signs on the roundabout and its approaches.

4.1 Optimisation to improve existing poor signal co-ordination

From an examination of the Controller Forms, it would appear that the junction has been operating the same CLF plans throughout the working day since the major improvement opened in 2007. The controller logic reacts to both internal queuing and external queuing, but may not be able to react consistently when both occur at the same time. The video survey indicates occasions, particularly in the PM peak, when some internal links are 'empty' and traffic is queuing on that approach, but the current signal coordination would not accommodate more traffic released into the system without causing internal gridlock. This indicates that the existing signal coordination at the junction is poor on certain links.

Having established the 2012 AM and PM peak base models within TRANSYT (see Appendix D), a function of the software is to optimise the performance and timings of the network under investigation.

The results from optimising the whole network are summarised in Table 4.1 below. Please note that these results are expressed in terms of Performance Index (PI), a value of the combination of delays and stops which TRANSYT optimises to derive timings that reduce the PI to a minimum value:

| | Existing Scenario (2012) | | Optimised Scenario (2012) | |
|-------------------|--------------------------|------|---------------------------|------|
| | AM | PM | AM | PM |
| Performance Index | 5522 | 6539 | 2381 | 3033 |

Table 4.1 – Performance Index of 2012 Existing & Optimised Scenarios

It can be seen that the PI for the Optimised Scenario indicates improvements in both peaks with a more significant improvement in the PM peak compared to the Existing Scenario. The TRANSYT output files for the Existing and Proposed Scenarios are contained in Appendix D.

Looking at the predicted performance of individual links in the optimised scenario, the following is evident, see Table 4.2 and 4.3:

| | 2012 AM Peak | | | |
|--------------------------|-------------------------|-------------------------------|--------------------------|--------------------------------|
| Approach / Link | Existing Green Time (s) | Existing Mean Max Queue (PCU) | Optimised Green Time (s) | Optimised Mean Max Queue (PCU) |
| Arm C | 12 | 33 | 14 | 21 |
| Arm F1/F2 | 11 | 26 | 10 | 17 |
| Arm D | 14 | 25 | 15 | 22 |
| Link between Nodes 1 & 7 | 37 | 18 | 35 | 20 |
| Link between Nodes 7 & 4 | 16 | 16 | 13 | 14 |

Table 4.2 – 2012 AM Peak Existing & Optimised Green Times & Queues

| | 2012 PM Peak | | | |
|--------------------------|-------------------------|-------------------------------|--------------------------|--------------------------------|
| Approach / Link | Existing Green Time (s) | Existing Mean Max Queue (PCU) | Optimised Green Time (s) | Optimised Mean Max Queue (PCU) |
| Arm C | 12 | 57 | 14 | 24 |
| Arm F1/F2 | 9 | 12 | 9 | 12 |
| Arm D | 12 | 183 | 15 | 55 |
| Link between Nodes 1 & 7 | 37 | 22 | 35 | 18 |
| Link between Nodes 7 & 4 | 10 | 86 | 14 | 20 |

Table 4.3 – 2012 PM Peak Existing & Optimised Green Times & Queues

With one exception, all optimised queues are equal or less than the existing queues with a particular improvement shown on the A404 PM northbound approach (183 PCU queue reduced to 55 PCU queue). The optimised queue on the internal link over the M40 eastern bridge is expected to increase marginally from 18 PCU to 20 PCU, however, this is regarded as tolerable given the available length of this link.

Vehicle Hour Delay (VHD) benefits arising from optimisation were assessed for the AM peak, PM peak, Inter-peak and Saturday/Sunday daytime on the 3 approaches which are the responsibility of the HA, namely M40 westbound, M40 eastbound & A404 northbound. These benefits were then calculated in

accordance with paragraph. 5.4 of PAR v6.2 User Notes and are summarised in Appendix E. Any potential night-time benefits were considered to be negligible and were therefore not investigated further.

With reference to the Economics Worksheet in the Conception PAR, provided in Appendix F, the total time saved in the opening year (2012) is 112,295 hours. Using the 2012 value of time per average vehicle per hour of £12.24, this equates to a journey time benefit in the opening year of £1,374,488. It can also be seen from the PAR in Appendix F that the BCR of this option is 6130 and the VM score is 10.

It would be a relatively straightforward and inexpensive process to test the optimisation 'on street' by creating CLF Plans 4 & 5 with the optimised timings and observing the effects. Assuming the predicted improvements materialise on site, and making an allowance for any minor on-street adjustments, the controller EPROM could be updated accordingly.

4.2 Maintenance Issues

This chapter primarily highlights maintenance and contrast issues in relation to the poor condition of anti skid surfacing and road markings at the junction. These issues are considered to be very relevant to the study brief in that they are a factor associated with poor lane discipline and utilisation as well as the operational performance of the traffic signals.

Figures 4.1 and 4.2 below show the very poor condition of the carriageway surface and lane markings on the link between nodes 1 and 7. Firstly, as there is very little contrast provided between the buff-coloured anti-skid surfacing and the road markings, conspicuity of the markings is poor. In addition, the anti-skid surfacing is badly delaminating from the bituminous surface below and the lane markings are particularly worn and not recognisable within the wheel tracks.

Furthermore, the lane destination markings on this link extend to 4 lines of text on lanes 1 & 2 and 5 lines on lane 3 (see Appendix A). It is felt that this amount of text on the road surface is too much for drivers to reasonably assimilate.

When all of these features are combined, drivers are presented with a largely illegible and confusing layout at a point where lane clarity, by destination, should be a primary objective.



**Figure 4.1 – Poor condition of existing anti-skid surfacing and road markings
(view looking south)**



**Figure 4.2 - Poor condition of existing anti-skid surfacing and road markings
(view looking north)**

Two further examples of this are provided in Figures 4.3 and 4.4 below. Figure 4.3, taken on the circulatory between nodes 3 and 4, shows the extent of delamination of the anti skid surfacing from the bituminous carriageway below. Figure 4.4, taken on the circulatory between nodes 6 and 7, principally shows the poor road marking condition and in particular the destination markings which are illegible.



Figure 4.3 – Delamination of anti skid surfacing on circulatory carriageway



Figure 4.4 – Very poor condition of road markings on circulatory carriageway

On the Arm B approach to the roundabout (see Figure 4.5), the anti skid has worn through to reveal a previous road marking layout applied on the carriageway below. Again, this results in a road marking layout which is illegible to approaching drivers.



Figure 4.5 – ‘Wear’ of anti skid revealing previously applied road markings

Between nodes 1 and 2 on the roundabout central island, there is evidence of vehicles over-running the kerb. A Heavy Goods Vehicle (HGV) in lane 3 at this stop line was observed to overrun the kerb whilst continuing around the roundabout. This overrun problem would appear to be due to a narrow lane width for HGV’s of approximately 3.0m at the node 1 stop line, continuing downstream on a radius around the central island generally at the above lane width.

These overrun issues are possibly contributing to either the failure of or the blockage of some gully runs within the central island. A number of gullies were observed as being full of standing water and the cover level of some gullies had sunk. As well as undertaking appropriate remedial drainage works, the provision of a concrete apron immediately behind the existing kerb could be considered in relation to the identified overrun issue.

4.3 Link between Nodes 1 & 7

4.3.1 Existing sign and road marking provision

Sign Refs ES14 & ES15 on drawing no. 3/004973/DR/000/001 in Appendix A are a pair of lane destination signs (TSRGD Diagram 2019), located approximately 90m back from the stop line at Node 1. Given the proximity of Node 7, these signs are located as far as reasonably possible in advance of the above stop line, however there are no lane destination markings (TSRGD Diagram 1035) adjacent to these signs to reinforce the lane requirements of the approach signing or act as a supplementary warning.

In addition, the existing signing provision on this link is to a lesser standard when compared to the corresponding internal link between Nodes 4 and 3. From drawing no. 3/004973/DR/000/001 in Appendix A it can be seen that the corresponding link opposite has a pair of Diagram 2019 signs (Ref ES03 & ES04) adjacent to the stop line and gantry-mounted signs (Ref Gantry 1) immediately south of the over bridge.

4.3.2 Observed contraventions of existing lane assignment

As can be seen from the drawing in Appendix A, lanes 1 and 2 at the stop line on this link are each marked with 'Ahead Only' markings to TSRGD Diagram 1036.2, although the current poor condition of these markings means that they are quite inconspicuous.

The drawing in Appendix A shows that ahead movements from lane 3 at this stop line are also permitted, however 'Ahead Only' markings are not present in this lane as all traffic wishing to turn right and remain on the circulatory carriageway is also currently required to use lane 3.

From a detailed analysis of the October 2011 traffic survey, the 'desire' line flows at this stop line by movement are:-

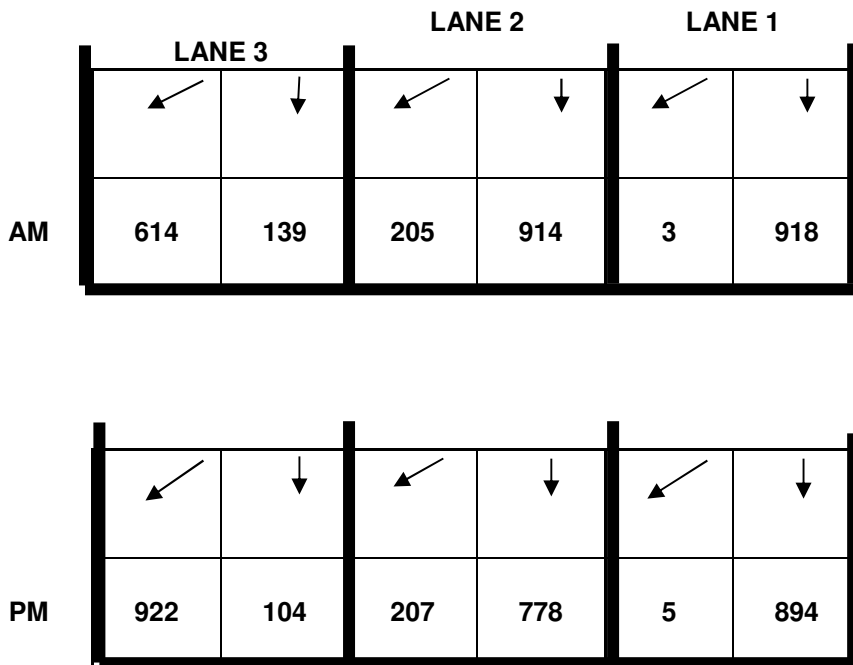


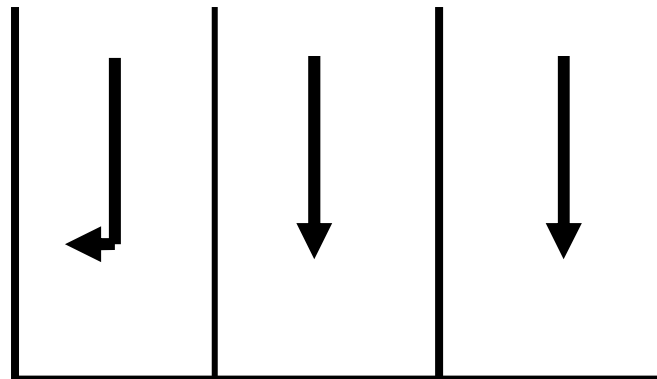
Figure 4.1 – AM & PM peak hour desire line flows (PCU)

It can be seen that 139 PCU use lane 3 to travel ahead on the A404 southbound in the AM peak hour, while 205 PCU contravened the 'Ahead Only' markings and turned right from lane 2. An example of this is shown in Figure 4.6 below where a bus can be seen turning right from lane 2 to exit via the Burroughs Grove Hill/Wycombe Road arm. This is the conflict reported frequently in the HAIL enquiries summarised in Appendix B.



Figure 4.6 – Bus disobeying ‘Ahead Only’ markings & turning right from lane 2

This conflict could be resolved by revising the lane assignments as follows:

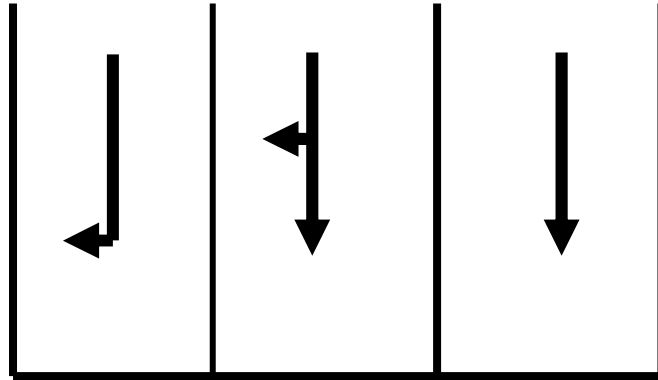


Whilst it is felt that during the AM peak the flows referred to in Figure 4.1 could be accommodated by the revised markings, it is considered that the PM peak flows would exceed the practical capacity of a single lane under signal control (assumed to be <1000 pcu/hr), which is considered likely to have an adverse affect on upstream stop lines.

This is a possible reason why the video survey shows right turning traffic in lane 2 and even lane 1 on occasions. In addition, the current layout requires Marlow Bottom traffic to move from lane 3 at Node 1 to lane 1 at Node 2 which is a particularly challenging manoeuvre given the short link length, the alignment and the uneven queue that develops at Node 2.

Due to the above concerns regarding the likely performance of this revised arrangement in the PM peak, it is not considered to be a viable measure to take forward and is not discussed further.

An alternative lane layout to target the observed conflict could be as follows:



In order for this arrangement to operate satisfactorily within the available link length of 140m, it would be necessary to increase the green time by 2 seconds at the expense of Arm C which would get 2 seconds less. As a result, queues on Arm C are predicted to increase by 1 vehicle per cycle per lane (3 lane approach, 60 cycles per hour) which would generate a negative VHD benefit in net terms.

Due to the negative VHD savings which this arrangement would generate, it is not considered to be a viable measure to take forward and is not discussed further.

4.4 Arm E

Figures 4.7 and 4.8 below show the general arrangement of Arm E, namely the entry (Figure 4.7) which is a 2 lane approach that flares abruptly to 3 lanes at the stop line, and the wide single lane exit from the roundabout (Figure 4.8).



Figure 4.7 – Arm E entry to roundabout



Figure 4.8 – Arm E exit from roundabout (view looking west)



Figure 4.9 – Arm E exit from roundabout (view looking east)

Two measures on this arm were stipulated in the brief for investigation, namely:

- The closure of the exit into Burroughs Grove Hill (Arm E), except for buses;
- The provision of a 2-to-1 merge on Burroughs Grove Hill on the immediate exit from the roundabout, adjacent to the existing splitter island.

In both cases, it is understood that the background to these measures is primarily to improve the problems with poor lane discipline and utilisation on the south-eastern part of the circulatory carriageway.

4.4.1 *Closure of exit into Arm E, except for buses*

There are a number of concerns with this measure, as described below:

- From the traffic survey, there were 497 and 568 PCU which exited Handy Cross roundabout into this arm in the AM and PM peak respectively. By closing this exit from the roundabout to all traffic except buses, traffic would be diverted onto the A404 southbound exit (Arm D) towards Marlow. It is therefore reasonable to assume that this displaced traffic would access Marlow via the A404/A4155 Westhorpe interchange. This would exacerbate an existing peak period congestion problem at the Westhorpe interchange where queuing regularly extends back onto the A404 northbound mainline from the northbound exit slip.
- The provision of signing alone to prevent all traffic from entering Arm E, except for buses, may not be a sufficient means of enforcement and it may be that physical measures such as a 'rising bollard' would need to be provided. Assuming that measures would need to be provided at the roundabout splitter island to enforce this restriction, in the event of an unauthorised vehicle needing to reverse back from the splitter island/restriction there is concern regarding this type of manoeuvre occurring in very close proximity to the circulatory carriageway and the associated risk of reversing traffic, stationary traffic and thus collisions.
- The signing of any closure or restriction at Arm E will add a further dimension, complexity, and hierarchy to the signing requirements at Handy Cross roundabout and potentially lead to more confusion to the existing signing and marking regime.
- There is an existing Harvester restaurant (The Blacksmiths Arms) approximately ¼ mile south of Handy Cross Roundabout on Burroughs Hill / Wycombe Road and 3 nearby farm properties (Red House Cottage, Green Hill Cottage, and Wymers Lodge) on Burroughs Hill / Wycombe Road. It is considered that all of these properties/businesses would be severely inconvenienced by introducing this measure and, in the case of the Harvester; it is considered that they would have a legitimate case for compensation.

Due to the above concerns, it is not considered to be a viable measure to take forward and is not discussed further.

4.4.2 *Provision of a 2-to-1 merge on immediate exit from roundabout*

Another measure stated in the brief for investigation on this arm is for the provision of a 2-to-1 merge on the immediate exit from the roundabout, adjacent to the existing splitter island. As can be seen in Fig. 4.8, although the existing layout on the exit from the roundabout is a wide single lane the existing carriageway width is insufficient for it to be re-marked as two lanes and therefore carriageway widening would be required.

It is considered that widening on the offside would mean that the approach would need to be reduced to a single lane entry and thus would reduce the capacity of this approach. Furthermore, there is concern that widening on the offside could result in opposing flows being too close to each other on a tight radius which could increase the likelihood of side-swipe collisions (see Figure 4.8).

Widening on the nearside to achieve a 2-lane exit would therefore appear to be the more preferable and practical option; however, the proximity of the adjacent underbridge (see Figure 4.9) suggests that the cost of widening at this location could well be prohibitively expensive.

In addition, TD 16/07 paragraph 7.63 states that *“the (roundabout) exit width should be reduced in such a way as to avoid exiting vehicles encroaching onto the opposing lane at the end of the splitter island. Normally the width would reduce at a taper of 1:15 to 1:20”*.

To comply with paragraph 7.63 of TD 16/07, assuming a lane width of 3.65m, an approximate taper length of between 55 and 73m would be required. As it is estimated that only approximately one third of this recommended lane reduction distance could be provided in this case, a departure from standard is likely to be required. This is unlikely to be approved given the scale by which the above TD 16/07 recommendations cannot be met.

Due to the issues described above, the provision of a 2-to-1 merge on the immediate exit from the roundabout is not considered to be a viable measure to take forward and is not discussed further.

4.5 Arm D exit from roundabout

The southbound A404 exit from the roundabout is marked as 3 lanes which merge into 2 lanes approximately 215m south of the roundabout splitter island. Under this arrangement, the offside lane is lost. However, as can be seen from Figures 4.10 and 4.11, the lane markings in between lanes 2 and 3 continue up to the point where the lane width in lane 3 is zero. In the 5-year collision period examined in Appendix C, there have been 2 collisions which are possibly linked to this layout (Accident No's 39 & 53).



Figure 4.10 – A404 southbound looking away from Handy Cross Junction



Figure 4.11 – A404 southbound looking back towards Handy Cross Junction

It is considered that either TD 16/07 paragraph 7.63 or TD 50/04 paragraph 2.31 is applicable in assessing this lane loss layout.

In the case of the former, the details of which are as described in chapter 4.4 previously, the lane loss would need to be provided over a taper length of between 55 and 73m.

In the case of TD 50/04, paragraph 2.31 states “the number of straight ahead entry and exit lanes for a traffic stream should be balanced in order to reduce conflict caused by traffic merging or diverging within the junction intervisibility zone. Where it is necessary to reduce the number of lanes on the exit arm this should be carried out beyond the junction intervisibility zone, over a distance of 100 metres for a single lane reduction, measured from the limit of the junction intervisibility zone, as indicated in Figure 4.12. The lane reduction may be carried out on either the nearside or offside dependent upon traffic conditions.”

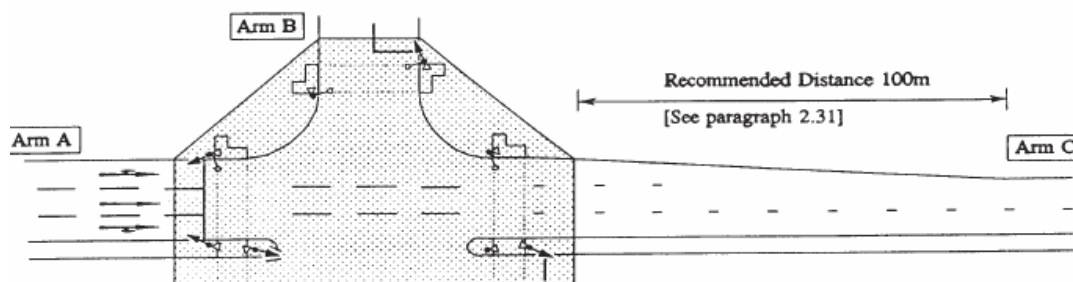


Figure 4.12 Lane Continuity through junction indivisibility zone

As can be seen from Figures 4.10 & 4.11, the existing lane loss layout does not resemble either of the recommended layouts referred to above and may have contributed to 2 injury collisions which are recorded over the 5-year collision period investigated. The layout should be amended by removing all existing lane markings and studs between lanes 2 and 3 where the width of lane 3 is less than 2.5m and the deflection arrows (TSRGD Diagram 1014) should, if necessary, be remarked in accordance with TSM Chapter 5.

4.6 Arm D entry to roundabout

The video survey has confirmed extensive queuing on this approach during both peak periods. It is not possible to confirm the exact extent of the queue from the survey but anecdotal evidence suggests it can be up to 1 mile in length.

The signal optimisation (see Chapter 4.1) is predicted to reduce the existing queuing on this approach, with a particular improvement predicted in the PM peak (183 PCU queue reduced to 55 PCU queue).

In addition, it was observed that lane 1 is very lightly used (only 1 vehicle per cycle) as it is signed for Marlow Bottom but lane 3 was very slow to access during the red stage of the signals, and frequently discharge started while still not full (see Figure 4.13). The under-utilisation of lane 3 is due to the layout of the existing lane markings where lane 3 is introduced and it is considered that a marginal capacity improvement of 2 PCU's per cycle during peak periods could be realised through a locally revised lane alignment.



Figure 4.13 – Underutilisation of lane 3 on A404 Northbound approach to roundabout

4.7 Arm G

The exit into Arm G from the circulatory carriageway is only marked as a single lane and the traffic survey has confirmed a high exit flow into this arm, particularly in the AM peak hour (1417 PCU). The corresponding entry flow from this arm in the PM peak of 1410 PCU is catered for by the provision of 3 lanes on the approach to the stop line.

As a result of the single lane exit, it was observed that drivers wishing to take Arm G off the circulatory would lead to a slow-moving procession of vehicles in lane 1 across the western M40 overbridge and back to the next stop line at Node 3, often when the other adjacent lanes on the circulatory were free-flowing.

Consequently, and given that carriageway widening would be required in order to increase its capacity, this exit is regarded as a capacity constraint on the junction. It is noted that Arm G is the responsibility of BCC, and not the HA.

4.8 General road marking strategy at junction

An issue has been identified which is applicable to the whole junction and its approaches which is considered to be outside the scope of this study but is highlighted for further consideration.

It concerns the method of lane assignment which, with the exception of the existing Ahead Only markings, is currently shown through the use of route numbers and destinations rather than lane arrows. It is recognised that the marked route numbers and destinations on the carriageway are provided to supplement and hopefully be consistent with the existing lane destination signs, however, due to the similarity with some of the route numbers and destinations (e.g. M40, A404, A4010, Marlow, Marlow Bottom), it is possible that adopting this approach could be leading to more confusion than by using just lane arrows. Furthermore, as noted in 4.2, there are instances where the amount of text on the carriageway could be leading to driver confusion.

For the purpose of this study, the convention of using route numbers and destinations, rather than arrows, on the carriageway has been maintained, however, a review of the current strategy for lane assignment across the whole junction should be considered as part of future stakeholder consultation (see Chapter 5).

5.0 Previous Road Marking and Traffic Sign Review

A report was produced by Enterprisemouchel in November 2008 which reviewed the existing road markings and directional signing on the approaches and circulatory carriageway of the Handy Cross junction. This review was carried out against TSRGD 2002, Local Transport Note 1/94 and the Traffic Signs Manual.

A site visit was undertaken and a number of suggestions made for improvement across the junction, including those approaches which are the responsibility of UK Highways and BCC.

Generally, it is felt that there is merit in a lot of the suggested improvements although appraising the benefits of them, in isolation as a LNMS through PAR, may not result in a viable scheme. Furthermore, in order to meaningfully take forward these proposals it would be necessary to:

- Fully review them in relation to the Handy Cross Hub development proposals (see Chapter 6);
- Undertake a thorough consultation exercise on a complete set of proposals, including the potential use of lane arrows rather than route numbers and destinations, with the Area 3 Asset Manager, UK Highways & BCC. This could take the form of a stakeholder workshop involving all interested parties to raise and resolve all relevant issues.

It is considered that this process is outside the scope of this study and should therefore form part of a future study.

6.0 Handy Cross Hub Development

Figure 6.1 below shows a plan of the proposed Handy Cross Hub Development, located in very close proximity to the Handy Cross roundabout in between the A404 Marlow Hill and the M40.

Handy Cross Hub is the name given to the whole Sports Centre Site which includes both the proposed High Wycombe Regional Coachway Park & Ride and the proposed Business Park. Since the concept of improved coach connections in the Thames Valley was first identified by Central Government in 2002, Buckinghamshire County Council and Wycombe District Council have had an aspiration to develop a regional Coachway Park and Ride facility at Handy Cross, High Wycombe.

The coachway and park & ride facility will offer the following facilities:

- High quality interchange for regional and long-distance coaches
- Re-location of the existing local Park & Ride service, accessed off A4010 John Hall Way, to the new site to allow for the integration of facilities
- Interchange facilities for local bus services with links for cycling and walking
- Prioritised access /egress point for buses and coaches into the site to allow for quick and easy pick ups/drop offs
- High quality waiting facilities for passengers
- 8 bays for Coaches, local bus services and Park & Ride buses
- **550** space car park with specific spaces for disabled drivers, electric vehicles and bicycles
- Real Time Passenger Information
- Refreshment facilities

It was anticipated that the scheme could have been constructed as early as 2011/12, however Buckinghamshire CC has been informed that its Transportation funding has been cut significantly as part of the Government's spending cuts. The issue for the Coachway is that the 'Integrated Block' part of the Transportation budget has been hit hardest and this is where the development work for the Coachway is funded, the scheme is currently on 'hold'.

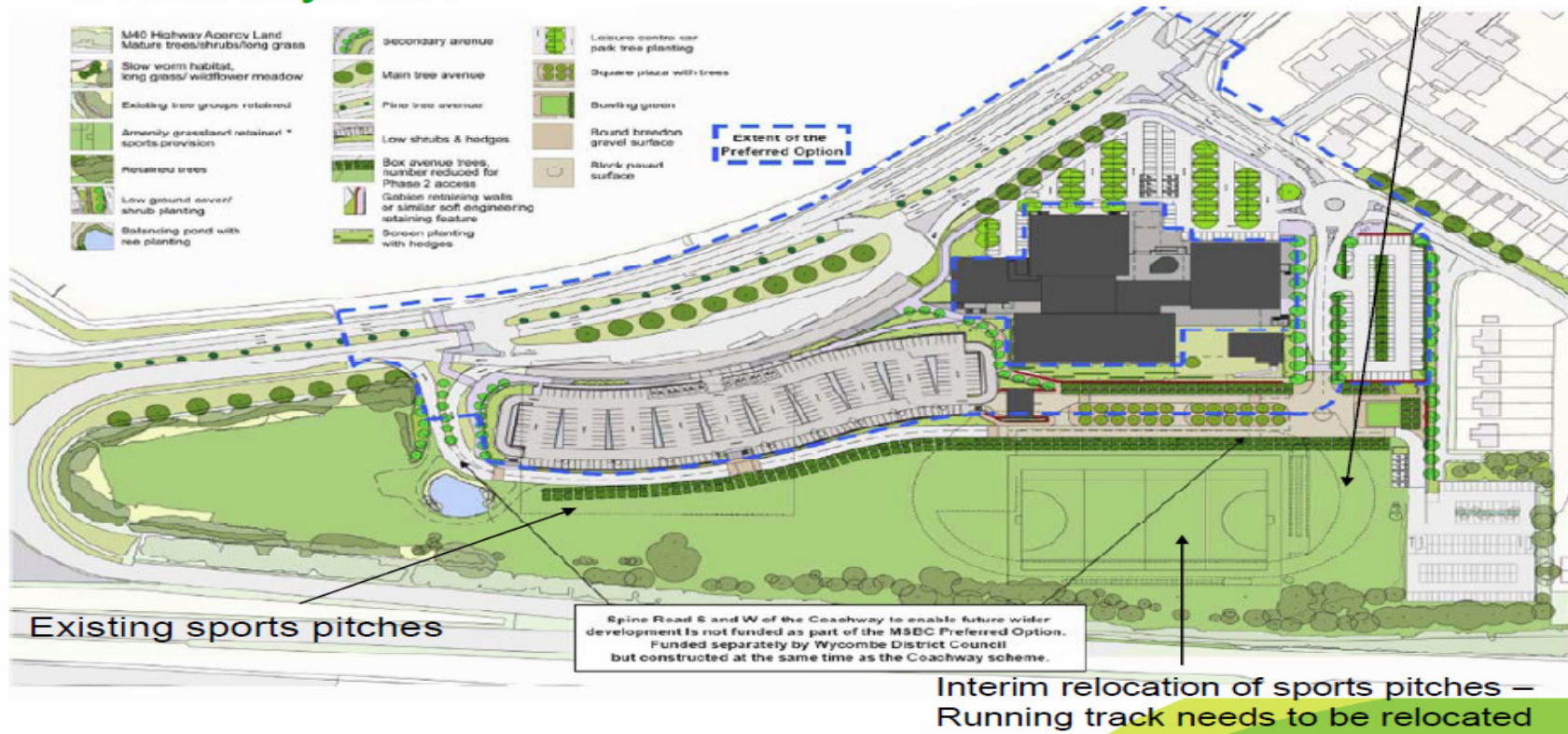
The development would require the provision of 2 new signaled junctions on the A404 Marlow Hill to prioritise access/egress for buses and coaches as well as enhancements to the existing Sports Centre access road junction.

Clearly, a development of this nature will significantly alter the traffic distribution at the Handy Cross junction and the progress of the development will need to be monitored closely as the scheme progresses in an attempt to minimize the potential impact on the busy roundabout and to ensure the Signal Control Strategy of the junction is modified at the correct time.

Buckinghamshire County Council

Coachway/P&R

Existing running track



Interim relocation of sports pitches –
Running track needs to be relocated

Figure 6.1: plan of the proposed Handy Cross Hub Development

7.0 Conclusion

Having investigated the various aspects of the brief it is apparent that the existing operation of Handy Cross Roundabout is not being maximised and is resulting in poor lane utilisation & discipline. There are 2 fundamental reasons for this:

- c) The existing signal co-ordination around the junction is poor, as described in chapter 4.1.
- d) There are various maintenance issues (see chapter 4.2) associated with the very poor condition of the carriageway surface and road markings, together with the lack of visual contrast between these two features.

From the TRANSYT modelling undertaken, the existing signal co-ordination could be significantly improved by optimising the current operation through the implementation of new CLF plans for the AM & PM peak and subsequent minor on-street adjustments. By optimising the existing signals, at an estimated cost of only £10,000, VHD savings of 112,295 hours are predicted in the opening year which equates to a journey time benefit of £1,374,488 in the opening year. The PAR contained in Appendix E for signal optimisation confirms the BCR as 6130 and a VM score of 10.

To address the maintenance issues described in chapter 4.2, the specific items described in Chapter 8 should be undertaken at the earliest opportunity. Included within these items is a compliant solution to the existing hazardous lane loss layout on the A404 southbound exit from the roundabout.

The above improvement and maintenance measures should be implemented at the earliest opportunity and then the junction should be monitored, through HAIL & Watchman enquiries, to determine what, if any, residual problems exist. Should any residual problems exist, these should only be investigated following a sufficient monitoring period. The issues described in chapters 4.8 and 5 could also be investigated in more detail at this time.

8.0 Recommendation

The following recommendations are made in respect of Handy Cross Roundabout:

Recommended maintenance measures

- Undertake appropriate remedial measures to rectify areas on the circulatory carriageway and roundabout approaches where the existing high-friction surfacing (HFS) has delaminated.
- On the circulatory carriageway and roundabout approaches, provide a black-coloured road surface which meets DMRB Vol. 7 requirements to improve the current poor contrast between the buff-coloured HFS and the road markings.
- With the exception of the existing lane loss layout on the A404 southbound exit from the roundabout (see below), re-mark the existing road marking layout as shown on drawing no. 3/004973/DR/000/001, in Appendix A.
- Amend the existing lane loss layout on the A404 southbound by removing all existing lane markings and studs between lanes 2 and 3 where the width of lane 3 is less than 2.5m. If necessary, re-mark the TSRGD Diagram 1014 deflection arrows in accordance with TSM Chapter 5.
- Undertake appropriate maintenance to address a number of gullies on the inner circle of the south eastern quadrant of the circulatory carriageway that were observed as being full of standing water and whose grating/frame was too low in relation to the adjacent carriageway. In addition, consider providing a concrete apron at the back of the existing kerb in relation to the identified overrun issue.

Recommended improvement measures

- Optimise the existing signal operation, as described in chapter 4.1, and subsequently undertake minor on-street adjustments as required.

Appendices

Appendix A: Drawing of Existing Signs & Road Markings (Drawing No. 3/004973/DR/000/001)

Appendix B: HAIL enquiries from July 2009

| Client Ref. | Enquiry Description |
|--------------------|---|
| 1- 13085367 | A404 Handy Cross Rbt - issues with lane markings.I write concerning what I believe to be a dangerous roundabout - Handy Cross. the roundabout over junction 4 of the M40. I am copying [REDACTED] the Chairman of the Marlow Bottom Residents Association. and Steve Baker. my MP. into this e-mail.Handy Cross is a large roundabout with 6 exits. The problem lies between the turning to the M40 London bound and the A404 southbound (Marlow bypass). Between those junctions there are 3 lanes. Lanes 1 and 2 are marked "ahead only" both on the road (paint is a bit faded now) and on the large signs to the side of the road. Lane 3 is marked both for straight ahead (down the A404 southbound) and for turning right. for those who want to continue further round the roundabout. The problem lies in that drivers in lane 2 increasingly assume that all traffic in lane 3 is going to turn right and therefore they also turn right directly from lane 2. If somebody in lane 3 wants to straight on down the A404. then the driver turning from lane 2 cuts across the lane in front of them and there is either a near miss or an accident occurs. as happened to me 90 minutes ago.Furthermore. even if drivers in lane 3 plan to turn right. those who want to exit to Marlow Bottom down Burrows Grove Hill need to turn into lane 1 of the next section in order to exit Handy Cross successfully. Unfortunately. drivers turning from lane 2 often aim for lane 2 (the lane for the M40 northbound) of the next section and again. either a near miss occurs. or an accident occurs at this point. This really is a most dangerous section of this roundabout and the lanes or the lane markings need to be changed. Drivers in lane 2 must be left in no doubt that they cannot turn right to continue round the roundabout from this lane. If this is not possible then I suggest a physical separation of traffic at this point via deformable plastic bollards - lanes 1 and 2 ahead only and lane 3 right turn only. |
| 13131126; 13130890 | M40 J4 Handy Cross - Lane marking issues.I am writing concerning the above road junction. locally known as the Handycross Roundabout. I transit the roundabout twice daily and. without fail. cars nearly collide with me due to extremely faint road markings that look as if they haven't been repainted for some time. The main problem is when approaching the start of the A404(M). There are three lanes. The middle lane states ahead only yet it is so worn that cars try and turn right in this lane. thus cutting up cars in the correct lane trying to turn right. I would urge that you repainted this as a matter of urgency before a serious collision happens. I have drawn this matter to the attention of Bucks Highways who state that this falls within your remit. Additionally. you may wish to be aware that this topic has been raised by many members of a local parents website and the local media are becoming interested. |
| obj 4 8837116 | A404 Handy cross. not scheme related unhappy with confusing la-out and being cut up by other drivers. referred to the network intelligence team. |
| 8884803 | M40 handy cross general complaint regarding signals and design passed to dorking for guidance. |
| CEO 360/10 | Subject:M40 J4 handy cross CEO 360-10 Steve Baker MPFollow Up Flag: Follow upFlag Status: OrangeAttachments: CEO 360 10 S BAKER MP.pdfDear RichardPlease see attached.We spoke yesterday morning about this. Just to cover ourselves and what you can answer. can you check:What signage is there for the A404. for motorists. needing to turn right to Marlow Bottom?Does the tailback at the lights prevent access (vehicles blocking the carriageway. I assume) and therefore the only way is to use the middle lane. not the right-hand lane. contrary to the signage?Why is there no sign simply pointing M40 West. instead of causing confusion by indicating the A404 across all three lanes?Can you confirm what the signage on the M40 bridge gantry says - does it counter what the motorist has just come from ie Marlow or Reading? Therefore. traffic coming off the M40 northbound only has to turn left onto the A404. if heading for Marlow and Reading. If the gantry is situated before the M40 southbound slip. is it necessary to have Marlow signed on the gantry at all?I do not know these roads. AT ALL. Im afraid and can only ride on the back of what Miss Pearman has said. If necessary. we could discuss again - you have made me aware that it doesnt look as though its anyones specific responsibility. Let me know if there is anything else I may not have covered in the above that you think relevant to answer this CEO.Many thanks.Mary |
| 1- 13054056 | A404 Handy Cross - lane layoutCaller is asking if someone can look at the lane set up approaching the A404 .she says that the lanes make you cross in front of other vehicles and could be dangerous. also there is a green light out on the traffic lights .Can someone call her please and she can talk these through properlypj 18/08/10 Forwarded to M40 DBFO.....PhilipPlease forward the above HAIL onto Area 3 as they are responsible for the traffic lights and road layout at J4.Please close out in respect of M40 DBFO.Mary thanksRegards [REDACTED] FONetwork/Liaison Manager01295 2709200772 635200.....AA Fwd Area 3 21/08/10 |
| 1- 13053754 | RE: High Wycombe to Marlow Bottom local traffic Please advice on correct lane procedures here... I am constantly getting traffic in the middle lane from High Wycombe to Marlow A404 (signed Ahead only on the road very faintly and a straight up arrow on the overhead gantry) changing lane to the right and moving into the Marlow Bottom local traffic lane and thinking they are following the correct procedure. This used to be the correct route round the roundabout but changed about 2 years ago. Now when approaching the Marlow Bottom filter lane we are guided through the inside lane round the roundabout. Nearly every time I go from High Wycombe to Marlow Bottom someone pulls in front of me from the middle lane and toots me as if I am in the wrong. Its very frustrating and I feel its an accident waiting to happen. I know a lot of locals have complained to one of our local councillors about this. Can anything be done to highlight the AHEAD ONLY road markings which most drivers obviously do not see..... Holding reply sent to customer. fwd to Area 3. IR. 18/08/2010 |
| 3- 13039016 | A404/M40 Junction 4 Handy crossCustomer is stating that the slip road was showing a sign for congestion at the A404 but when he got there this was not the case Advised that traffic england did not show this sign he states that are systems are at fault. He also states that the light sequencing at the Denham R/VB at junction 1 is not working as it should he states this needs to be corrected.fwded to DBFO M40 KP 09.07.10 |
| 1- 13069216 | A404 - condition of slip roadsDear Highways AgencyI would like to draw your attention to the very bad road surface condition of the exit slip road from the A404 north bound at the Cox Green Maidenhead.The Anti Slip coating has worn away in places and left very big patches of very slippery tarmac. this is not so bad when the surface is dry.However when it is wet like today it is extremely treacherous even at low speed it is only a matter of time before a vehicle loses traction.I would also like to bring to your attention the entry slip road to the A404 south bound towards the M4 from Cox Green Maidenhead.On this part of the slip road whenever it rains a very large puddle forms just at the point where it merges with the main A404. this is caused by very bad drainage and the large amount of rain water running off the surrounding fields.As we are coming into winter this of course will freeze causing a large area of ice on a bend joining a dual carriageway.I hope you will take the above points into consideration and if I can be of any assistance please do not hesitate to contact me.Regards [REDACTED] |
| 1- 13007127 | A404 Handycross enquiry. caller requesting details on markings and arrangement in place on date of accident. |
| 1- 13037297 | M4 Junction 4 Handy Cross - traffic signal queryCaller travels by motorcycle on the North bound A404 to where it joins the Handy cross round about.He is requesting a slight change in the sequencing of the traffic lights that control the West bound traffic using the M40 exit slip at J4. Specifically the traffic lights at the stop line between the South and North bound entrance & exit of the A404 on to the M40 J round about on the south side of the roundabout . The caller would like the above lights or those that control the traffic that enters the roundabout from the northbound A404 to be altered to give the west bound traffic time to clear before the lights on the A404 N/B change to green. He has experienced a number of "near misses as he enters the roundabout and west bound traffic either jumps the lights or is still on the roundabout. The problem is worse when there are hold ups on the wycombe road which is the next clockwise exit off the roundabout. |
| 13123618 | M40 Junction 4 handy cross behavior concernAre you still responsible for the traffic flow on this roundabout? It has reverted to almost as bad as just post the improvements to the junction in 2007. In the afternoons. between 5.30 and 6.00. the slip road coming off the M40 northbound to go on to High Wycombe has been severely congested. In the mornings. coming out of Marlow Road (not Marlow Hill) it is sometimes not possible to get onto the roundabout due to traffic already backed up on the roundabout. We know the roundabout can work better than it is at the moment because we have enjoyed much better travel through it up until about 4 months ago. Several times over the last couple of weeks we havent even bothered with doing the little u-turn that many people do. going off to Marlow Bottom and turning around in the truck lay-by. it has just easier to go on to Stokenchurch and drive back to Wycombe. Hardly eco-friendly. but easier. |
| 13134238 | M40 Jct 4 Customer wants lane markings diagram for Handy Cross JctDear Sir / Madam.Do you have an official diagram showing the lane markings on Handy Cross that I can see or have a copy of? |
| 4667650 | Caller is concerned about road markings on the Handy Cross roundabout which is located at J4 of the M40 and joins with the A404.Caller states that when he is travelling Southbound on the M40 and exits the roundabout to go south on the A404 for Marlow Bottom. there is confusion amongst drivers regarding what lane is for a particular direction |

| | |
|-------------|--|
| 1- 13001599 | A404 Handy cross enquiry redirected from both MP and DBFO. 07/04/2010 called customer. closed to hail and need to speak with [REDACTED] in monday.15/04/2010 CH confirmed configuration of closure. customer called CLOSED. |
| 2- 13084589 | A404 Handy Cross Rbt - issues with congestionAre there any projects on the horizon to reduce the congestion at Handy cross roundabout. J4 on the M40 ?----- Vessey-Thank you for your email to the Highways AgencyI am sorry to have to inform you that there are currently no plans to make any further alterations to the Handy Cross junction on the M40.I trust this helps you with your enquiry. if you have any future enquiries regarding Highways Agency related issues please visit our website where information on all Highways Agency policies and procedures can be found: http://www.highways.gov.uk . Alternatively you can contact us via email or on our 24 hour Information Line on 0300 123 5000. Kind Regards [REDACTED] |
| 1- 8872306 | A404 Handy cross general observation FIO. CLOSED [REDACTED] |
| 1- 13018001 | M40 Handy Cross - request for junction designCaller would like some information / details of the design brief. with regards to the allocation of lanes on the M40 J.4 Handy Cross roundabout .Caller wants this information with regards to an RTC that his wife had and third party insurance are contesting the circumstances so this may go to court. |
| 13115444 | M40 junction 4 handy cross safty observationsTo whom it may concernThe road markings on the Handy Cross roundabout at M40 J4 need renovation. Two areas in particular need attention. One area is at the north end of the roundabout just before the A404 north exit. where the lanes were remarked at some point to create a "spiralling out" effect. It appears that at the time, the prior lane markings were not removed but merely covered with anti-skid surfacing. The latter is now worn, and the prior markings are now as prominent as the later ones - leading to a very ambiguous situation. The second area is on the east side of the roundabout where the middle lanes "ahead only" marking is now faint, increasing the likelihood of drivers attempting a right turn from that lane and causing collisions. (Id like to see further measures there in addition to repainting that marking; right turns from that lane are not uncommon.)No doubt you have plenty of things to deal with but I wanted you to be fully aware of the situation. |
| 2- 13064396 | A404 Handy Cross - issues about layout of the junction. [REDACTED] would like her comments on the Handy Cross works forwarded. Caller states that she has had 10 near misses from people not knowing where to turn off for Marlow Bottom. Caller states that Marlow Bottom should be signed. [REDACTED] commented on an article in her local paper, which stated that the roundabout continues to operate safely. Mrs Glover strongly disagrees with this quote. |
| 2- 13099499 | M40 Junction 4 Handy cross concernSubject: Dangerous Road Layout at Handycross Hi. please may I draw your attention to the problems at Handycross. Particularly at the exit onto the A404 southbound. On a daily/hourly basis drivers have to deal with the misuse of the lanes, the associated danger it creates and the subsequent abuse that it causes when near collisions are caused by the combined poor layout and signage at that exit. I accept that it partly seems that some drivers still insist on using it as per the layout before the changes ... without considering that the centre lane now can go directly down the a404 as (what is too all intense and purposes) the fast lane of the A404 however it happens to regularly for it simply to be down to obstinant locals. Ive also noted that some of the traffic that originated in the middle lane actually (which should be A404 Southbound only) continues even further around to exit the roundabout at the A40 northbound orworse the ASDA exit???! I also recall a collision between a bus and a people carrier shortly after it fully reopened that when I passed it, it looked like it had been caused by this very problem .. and now cant help butwonder how many accidents have occurred since then. I believe it is the responsibility of Transport for Bucks to ensure that our roads are safe and as such to allow a junction to continue to operate in such a dangerous state as seems to have been the case for many years is ultimately irresponsible. I would be interested to hear your view [REDACTED] |
| 0- 8897079 | M40 Handy Cross. Called hail and spoke at length with "john" who confirmed this should have been sent for the attention of MP first. he requested i put a closure notice in to confirm this. |
| 13139851 | A404 Handycross Rbt - faded lane marking concernsThe caller is concerned that the road markings are fading and as a result drivers are not following the instructions.One example given is the two "ahead only" markings which have nearly disappeared and consequently the caller believes there is a serious risk of an accident.Could someone call the customer to discuss this issue please. |

Appendix C: Collision Analysis & Plots

C.1 Collision Caveat

The personal injury / statistical collision data referred to within this report has been sourced from the Area 3 Operational Data. This data has not yet been validated by the Department for Transport (DfT), and cannot be assumed to be a complete data set as it may be found to be incomplete or contain inaccuracies at a later date. However, the requirement for up-to-date information for operational purposes was a considerable factor in the decision to use this data. The data was sourced from seven Local Authorities (Berkshire, Buckinghamshire, Dorset, Hampshire, Oxfordshire, Surrey and Wiltshire), which cover the Area 3 Trunk Road Network and is considered sufficiently robust to be used in this context.

C.2 General

In the 5-year study period from the 1st July 2006 to the 30th June 2011 inclusive, a total of 58 Personal Injury Collisions (PICs) were recorded within the scope of the study area. The 58 collisions resulted in a total of 78 casualties, an average of 1.3 casualties per collision. The accident plots (Drawing No's 3/004973/DR/2600/001 to /003) contained in this Appendix show the location and further details of these 58 collisions.

| | Jul 06/ Jun 07 | Jul 07/ Jun 08 | Jul 08/ Jun09 | Jul 09/ Jun10 | Jul 10/ Jun 11 | Total 5 years | | |
|---|-------------------|-------------------|------------------|------------------|-------------------|------------------|-------------------------|----------------------------|
| Fatal Collisions | 0 | 0 | 1 | 0 | 0 | 1 | | |
| Serious Collisions | 0 | 1 | 0 | 0 | 1 | 2 | | |
| Slight Collisions | 10 | 16 | 10 | 13 | 6 | 55 | | |
| Total No. of Collisions | 10 | 17 | 11 | 13 | 7 | 58 | | |
| | Jul 06/ Jun 07 | Jul 07/ Jun 08 | Jul 08/ Jun09 | Jul 09/ Jun10 | Jul 10/ Jun 11 | Total 5-years | Area 3 Average* † | National Average** ‡ |
| Severity ratio | 0% | 5.9% | 9.1% | 0% | 14.3% | 5.2% | 18% | 16% |
| Collisions occurring on a wet road surface | 1 10% | 2 11.8% | 4 36.4% | 6 46.2% | 1 14.3% | 14 24.1% | 28% | 31% |
| Dark collisions: street lighting present | 2 20% | 7 41.2% | 2 18.2% | 2 15.4% | 3 42.9% | 16 27.6% | 9% | 7% |
| Dark collisions: no street lighting | 0 0% | 1 5.9% | 1 9.1% | 1 7.7% | 0 0% | 3 5.2% | 22% | 18% |

† Figures are from Area 3 Managing Agent Contractor (MAC) Route Safety Plans 2011 (*RSP - 2011*)

* The averages are for 'A-Class Roads' only ‡ Figures are from Road Casualties Great Britain: 2010 (*RCGB - 2010*)

** The averages are for 'Non Built-up Roads' only

Table C.1: Collision summary within study area for the latest 5-years to 2011

The collision trends, seen in Table 3.1 above, indicate that the collisions increased in 2007/08 and in 2009/10 and reduced number of collisions in 2008/09 and in 2010/11. The increase in collisions in 2007/08 may be attributed to the major scheme that was opened to traffic in March and May 2007 where the layout of the road was altered. There has been one fatal collision (2008) and two serious collisions, one occurring in 2008 and one in 2011.

A review of the fatal and serious collisions shows that;

- The 2008 fatal collision occurred in July with rain and wet conditions in daylight conditions. This collision was on the eastbound slip road merge from the Handy Cross roundabout to the M40 where the driver of the car left the nearside carriageway, hit a tree and received fatal injuries. The primary causation was losing control on a left hand bend.
- The 2008 serious collision occurred in dry, fine and dark lit conditions in February. The collision was on the Handy Cross roundabout at the automatic traffic signals travelling south. A motorcycle hit the rear of a car and the rider fell off receiving serious injuries. The primary causation was a shunt from failing to look properly.
- The 2011 serious collision occurred in May in dry, fine and dark lit conditions. The collision was on the eastbound slip road merge from the Handy Cross roundabout to the M40 where a car left the carriageway to the near side and hit a tree where the driver and passenger received serious injuries. The primary causation was losing control on a left hand bend.

C.3 Collisions Breakdown

C.3.1 Time/day/date

Collisions were broken down by time/day/month and the highest collision frequencies were identified. The AM collision peak was between 08:00-08:59 hrs and 09:00-09:59 hrs both with 5 collisions. The PM collision peak was between 16:00-16:59 hrs with 8 collisions.

The daily collision frequencies shows Tuesday had the highest collision rate with 12 collisions (18 were drivers over 25 yrs, 2 were female under 25 yrs and 1 was male over 59 yrs), followed by Monday having 10 collisions (12 were drivers over 25 yrs, 2 were female under 25 yrs). There is a local market in High Wycombe on a Tuesday, Friday and Saturday.

The highest monthly collision frequency was during the month of June having 10 collisions.

C.3.2 Wet collisions

A total of 14 collisions occurred while the road surface was wet, giving a wet collision ratio of 24.1%, which is below both the Area 3 and the National Averages.

C.3.3 Dark unlit collisions

A total of 3 collisions occurred in the dark with no street lighting present, giving a dark unlit ratio of 5.2%, which is below both the National Average and the Area 3 Average.

Dark with street lighting present and lit had 16 collisions, 2 of which were serious, giving a dark lit ratio of 27.6% which is above both the National Average and the Area 3 Average, 3 of which occurred in wet conditions.

C.3.4 Skidding

There were 16 collisions (involving 25 vehicles) where at least one vehicle skidded. Out of these 25 vehicles, 16 vehicles skidded; and 2 vehicles overturned.

C.3.5 Single vehicles

There were 15 collisions where only one vehicle was involved.

- 7 occurred in dark conditions (5 lit & 2 unlit),
- 7 occurred in wet road conditions,
- 11 were the result of a loss of control,
- 2 were the result of pedestrians in a hurry or failing to look,
- 1 was the result of alcohol impairment
- 1 was the result of a tyre blow out.

C.3.6 Vehicles Leaving the Carriageway

There were 17 collisions involving 21 vehicles where at least one vehicle left the carriageway.

- 8 left via the nearside
- 9 left via the off side.

Out of these 17 collisions

- 11 were the result of a loss of control,
- 1 was impaired by alcohol,
- 1 was the result of a lane change,
- 1 was swerving,
- 1 due to excess speed,
- 1 had a tyre blow out,
- 1 was a stolen vehicle driven over a 'stinger' device.

C.3.7 Object Hit

There were 19 collisions where at least one vehicle hit an object

- 8 hit barriers (3 nearside and 5 offside),
- 1 hit a lamp post,
- 1 hit a sign,
- 1 hit a bollard,
- 2 hit a kerb

- 7 hit a tree.

C.3.8 Breakdown of Collision Types

Table C.2 below shows a breakdown of the different collision types with a summary of the collision types split into different sectors.

| Collision Types | Collision Occurrences | Collision Percentage |
|--|-----------------------|----------------------|
| Shunt | 15 | 26% |
| Loss of Control | 11 | 19% |
| Change of Lane | 10 | 17% |
| Failed to look properly | 4 | 7% |
| Swerved | 2 | 3% |
| Sudden Braking | 2 | 3% |
| Excess Speed | 2 | 3% |
| Unknown | 2 | 3% |
| Junction overshoot | 1 | 2% |
| Illegal turn or direction of travel | 1 | 2% |
| Impaired by alcohol | 1 | 2% |
| Inexperienced of driving on left | 1 | 2% |
| Stolen Vehicle | 1 | 2% |
| Tyre Blow out | 1 | 2% |
| Disobeyed automatic traffic signal | 1 | 2% |
| Poor Turn or Manoeuvre | 1 | 2% |
| Careless, reckless or in a hurry (ped) | 1 | 2% |
| Failed to look properly (ped) | 1 | 2% |
| TOTAL | 58 | 100% |

Table C.2: Breakdown of collision types

C.4 Collisions per Sector

The Interchange has been broken down into 11 sectors in order to further analyse the incidents (See Figure 3.1).

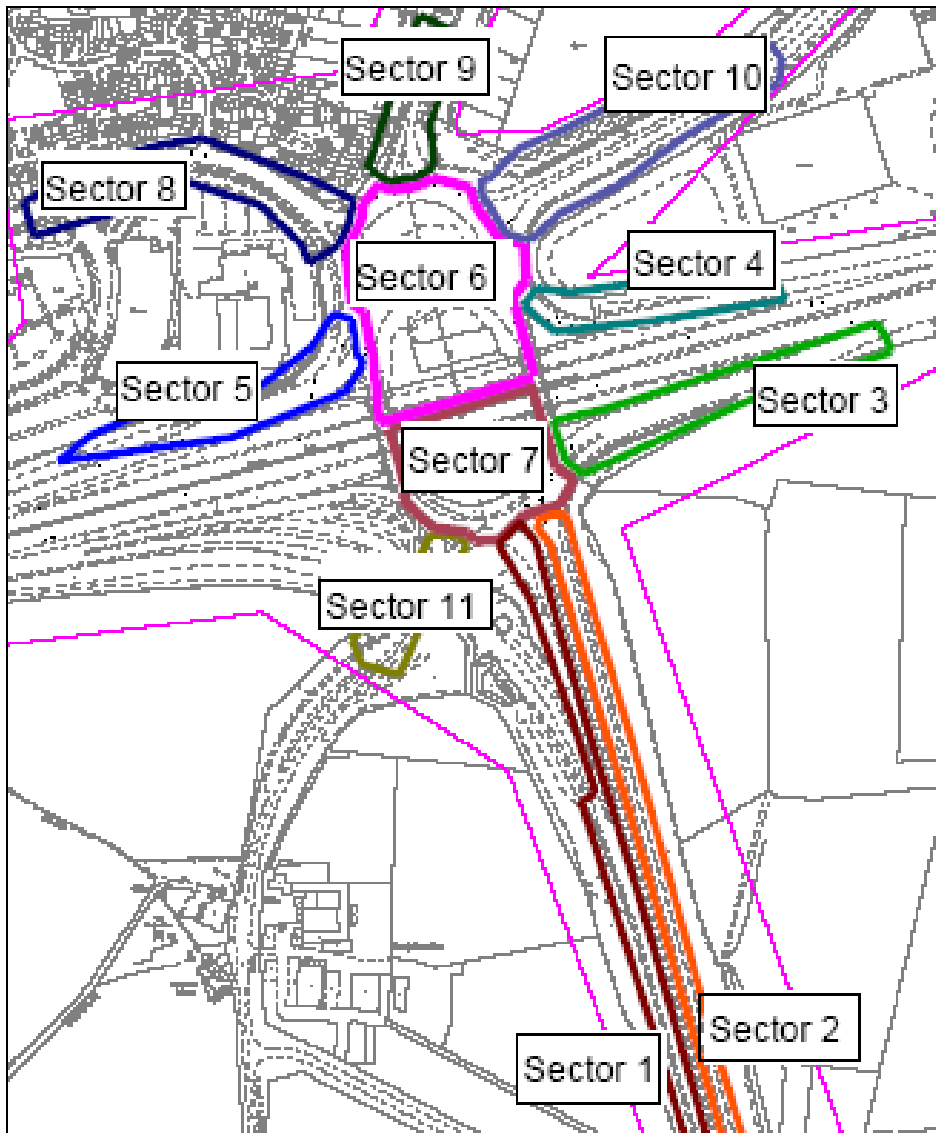


Figure C.1: Collisions per Sector

C.4.1 A404 Northbound to M40 Westbound (unreferenced sector)

There have been no collisions within this sector.

C.4.2 Interchange slip road to M40 Westbound Merge (unreferenced sector)

There have been no collisions within this sector.

C.4.3 Sector 1 - A404 Northbound to Interchange Give Way Lines

There are 4 collisions within this sector as follows;

| No. | Severity | Lighting Condition | Weather Condition | Road Surface | Primary Causation |
|-----|----------|--------------------|-------------------|--------------|---------------------------------|
| 19 | Slight | Daylight | Fine | Dry | Shunt (queue at traffic lights) |
| 37 | Slight | Daylight | Fine | Dry | Shunt (heavy traffic) |
| 55 | Slight | Dark: Unlit | Fine | Wet | Loss of Control (distracted) |
| 58 | Slight | Daylight | Rain | Wet | Shunt (heavy traffic) |

Table C.3: Sector 1

C.4.4 Sector 2 – Give Way Lines at Interchange to A404 Southbound

There were 5 collisions within this sector as follows;

| No. | Severity | Lighting Condition | Weather Condition | Road Surface | Primary Causation |
|-----|----------|--------------------|-------------------|--------------|-------------------------------------|
| 39 | Slight | Daylight | Fine | Dry | Pedestrian failed to look properly |
| 46 | Slight | Dark: Lit | Fine | Dry | Shunt (queuing traffic) |
| 52 | Slight | Dark: Unlit | Fine | Dry | Tyre Blow-out |
| 53 | Slight | Daylight | Fine | Dry | Excess Speed |
| 57 | Slight | Dark: Lit | Fine | Dry | Loss of control (defective vehicle) |

Table C.4: Sector 2

C.4.5 Sector 3 - M40 Westbound Diverge to Interchange Give Way Lines

There was 1 collision within this sector as follows;

| No. | Severity | Lighting Condition | Weather Condition | Road Surface | Primary Causation |
|-----|----------|--------------------|-------------------|--------------|------------------------------|
| 5 | Slight | Dark: Lit | Fine | Dry | Loss of Control (in a hurry) |

Table C.5: Sector 3

C.4.6 Sector 4 – Give Way Lines at Interchange to M40 Eastbound Merge (from direction can not be ascertained)

There were 9 collisions within this sector as follows;

| No. | Severity | Lighting Condition | Weather Condition | Road Surface | Primary Causation |
|-----|----------|--------------------|-------------------|--------------|---------------------------------------|
| 35 | Slight | Daylight | Other | Wet | Loss of Control (travelling too fast) |
| 40 | Fatal | Daylight | Rain | Wet | Loss of Control (unfamiliar with |
| 44 | Serious | Dark: Lit | Fine | Dry | Loss of Control (travelling too fast) |
| 45 | Slight | Daylight | Rain | Wet | Loss of Control (travelling too fast) |
| 47 | Slight | Dark: Lit | Fine | Dry | Loss of Control (travelling too fast) |
| 48 | Slight | Dark: Lit | Rain | Wet | Loss of Control (deposit on road) |
| 50 | Slight | Daylight | Other | Wet | Illegal turn or direction of travel |
| 51 | Slight | Daylight | Rain | Wet | Loss of Control (Slippery Road) |
| 54 | Slight | Daylight | Rain | Wet | Loss of Control (Slippery Road) |

Table C.6: Sector 4

C.4.7 Sector 5 - M40 Eastbound Diverge to Interchange Give Way Lines

There were 4 collisions within this sector as follows;

| No. | Severity | Lighting Condition | Weather Condition | Road Surface | Primary Causation |
|-----|----------|--------------------|-------------------|--------------|---------------------------------|
| 2 | Slight | Dark: Lit | Fine | Dry | Shunt (failed to look properly) |
| 6 | Slight | Dark: Lit | Fine | Dry | Stolen Vehicle |
| 7 | Slight | Daylight | Fine | Dry | Shunt (failed to look properly) |
| 9 | Slight | Daylight | Fine | Dry | Shunt (travelling too fast) |

Table C.7: Sector 5

C.4.8 Sector 6 - Interchange from Give Way Lines (North section – taken from M40 Centre Line)

There were 13 collisions within this sector as follows;

| No. | Severity | Lighting Condition | Weather Condition | Road Surface | Primary Causation |
|-----|----------|--------------------|-------------------|--------------|---|
| 10 | Slight | Daylight | Fine | Dry | Change of Lane |
| 11 | Slight | Daylight | Fine | Dry | Change of Lane |
| 12 | Slight | Dark: Lit | Fine | Wet | Change of Lane |
| 13 | Slight | Daylight | Fine | Wet | Shunt (aggressive driving) |
| 14 | Slight | Daylight | Fine | Dry | Change of Lane |
| 17 | Slight | Daylight | Unknown | Dry | Change of Lane |
| 20 | Slight | Daylight | Fine | Dry | Swerved (failed to look when exiting onto roundabout) |
| 21 | Slight | Dark: Lit | Fine | Dry | Sudden Braking |

| | | | | | |
|----|---------|-----------|------|-----|------------------------------------|
| 25 | Serious | Dark: Lit | Fine | Dry | Shunt (failed to look properly) |
| 28 | Slight | Daylight | Fine | Dry | Disobeyed automatic traffic signal |
| 29 | Slight | Daylight | Fine | Dry | Shunt (failed to look properly) |
| 32 | Slight | Daylight | Fine | Dry | Change of Lane |
| 33 | Slight | Dark: Lit | Fine | Dry | Unknown |

Table C.8: Sector 6

C.4.9 Sector 7 - Interchange from Give Way Lines (South section – taken from M40 Centre Line)

There were 11 collisions within this sector as follows;

| No. | Severity | Lighting Condition | Weather Condition | Road Surface | Primary Causation |
|-----|----------|--------------------|-------------------|--------------|---------------------------------|
| 16 | Slight | Daylight | Fine | Dry | Shunt (failed to look properly) |
| 18 | Slight | Daylight | Fine | Dry | Change of Lane |
| 22 | Slight | Daylight | Fine | Dry | Impaired by Alcohol |
| 24 | Slight | Daylight | Fine | Dry | Unknown |
| 26 | Slight | Dark: Lit | Fine | Dry | Junction Overshoot |
| 34 | Slight | Daylight | Fine | Dry | Excess Speed |
| 36 | Slight | Daylight | Fine | Dry | Swerved |
| 38 | Slight | Dark: Lit | Fine | Wet | Failed to look properly |
| 41 | Slight | Daylight | Fine | Dry | Change of Lane |
| 42 | Slight | Daylight | Fine | Dry | Poor turn or manoeuvre |
| 43 | Slight | Daylight | Fine | Dry | Change of Lane |

Table C.9: Sector 7

C.4.10 Sector 8 - North West of Interchange Give Way Lines – John Hall Way (both directions)

There were 4 collisions within this sector as follows;

| No. | Severity | Lighting Condition | Weather Condition | Road Surface | Primary Causation |
|-----|----------|--------------------|-------------------|--------------|---|
| 1 | Slight | Daylight | Other | Dry | Pedestrian Careless, reckless of in a hurry |
| 3 | Slight | Daylight | Fine | Dry | Failed to look properly (Heavy Traffic) |
| 4 | Slight | Daylight | Fine | Dry | Failed to look properly (entering roundabout) |
| 8 | Slight | Dark: Lit | Fine | Dry | Inexperienced driving on left |

Table C.10: Sector 8

C.4.11 Sector 9 - North of Interchange Give Way Lines – Marlow Road (both directions)

There was 1 collision within this sector as follows;

| No. | Severity | Lighting Condition | Weather Condition | Road Surface | Primary Causation |
|-----|----------|--------------------|-------------------|--------------|-------------------------|
| 15 | Slight | Daylight | Fine | Dry | Failed to look properly |

Table C.11: Sector 9

C.4.12 Sector 10 - North East of Interchange Give Way Lines – A404 continuation (both directions)

There were 5 collisions within this sector as follows;

| No. | Severity | Lighting Condition | Weather Condition | Road Surface | Primary Causation |
|-----|----------|--------------------|-------------------|--------------|-----------------------------------|
| 27 | Slight | Dark: Lit | Fine | Dry | Shunt (travelling too fast) |
| 30 | Slight | Daylight | Fine | Dry | Shunt (Queuing traffic at lights) |
| 31 | Slight | Dark: Unlit | Rain | Wet | Change of Lane |
| 49 | Slight | Daylight | Fine | Dry | Shunt (queuing traffic) |
| 56 | Slight | Daylight | Other | Wet | Sudden Braking |

Table C.12: Sector 10

C.4.13 Sector 11 - South West of Interchange Give Way Lines – Wycombe Road (both directions)

There was 1 collision within this sector as follows;

| No. | Severity | Lighting Condition | Weather Condition | Road Surface | Primary Causation |
|-----|----------|--------------------|-------------------|--------------|---------------------------------|
| 11 | Slight | Daylight | Fine | Dry | Shunt (failed to look properly) |

Table C.13: Sector 11

C.5 Statistically Significant Results

The Highways Agency Operational Folder Blank Calculating Tables (2007-2009) were completed for this interchange to ascertain if any of the categories are at or above the intervention level (National Statistic Figure) and therefore statistically significant;

| Category | Intervention Level | Actual Level | RAG Status |
|---------------------------------------|--------------------|--------------|------------|
| Involved at least 1 pedestrian injury | 2.2% | 5.2% | Amber |
| Only involved 1 vehicle | 24% | 26% | Amber |
| Dry road conditions | 66% | 76% | Amber |
| At or within 20m or a junction | 43% | 66% | Red |
| At a roundabout | 18% | 59% | Red |
| Two-wheeled motor vehicle | 4.7% | 5.0% | Amber |
| Male drivers/riders all ages | 68% | 73% | Amber |
| Female drivers/riders under 25yrs old | 6.2% | 6.7% | Amber |
| Waiting to go ahead | 9.8% | 11% | Amber |
| Stopping | 12% | 15% | Amber |
| Overtaking a moving vehicle | 2.8% | 3.4% | Amber |
| Going ahead on a bend | 5.6% | 6.7% | Amber |
| Changing lane (left or right) | 5.6% | 8.4% | Amber |

Table 3.14: Intervention Levels

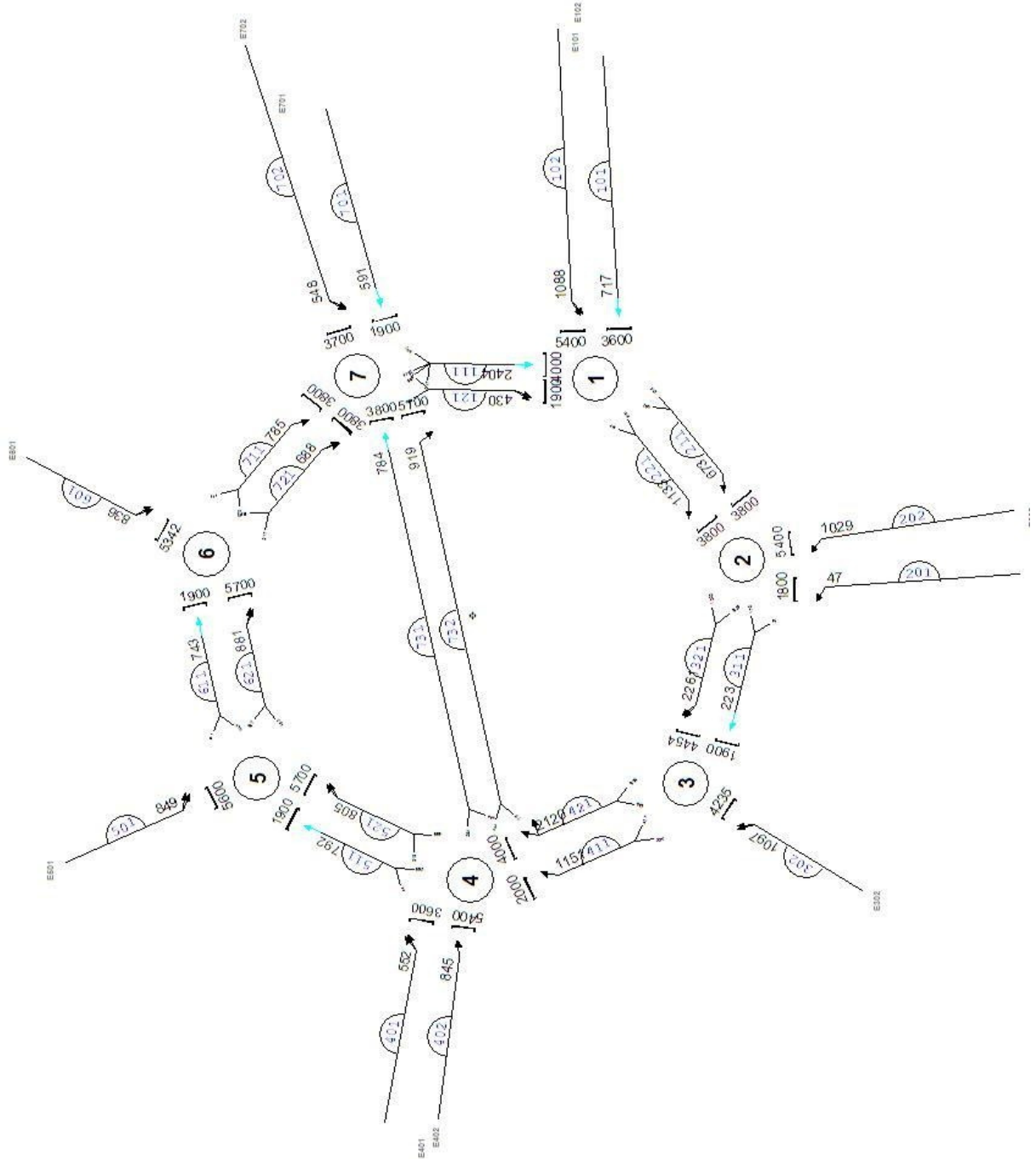
C.5.1 Collision Conclusion

The following collision problems have been identified:

- High collision rate
- High rate of collisions involving single vehicles
- High collision rate in dark lit conditions
- High collision rates at slip road junctions
- High collision rate involving vehicles leaving the carriageway

Within this study area there is a high rate of collisions involving, shunts (26% of which 87% occur at or on the approach to the interchange), loss of control (19%) and change of lane (17%).

Appendix D: TRANSYT Link Node Diagram & Output



TRANSYT LINK-NODE DIAGRAM

TRANSYT Output: AM Peak Existing

TRANSYT Output: PM Peak Existing

TRANSYT Output: Inter Peak Existing

TRANSYT Output: AM Peak Optimised

TRANSYT Output: PM Peak Optimised

TRANSYT Output: Inter Peak Optimised

Appendix E: VHD Calculation

| Road | Links | Uniform + Oversaturated Delay (PCU Hr/Hr) | | | | | | | | | | | | | | |
|--------|-------|---|-------------|------|------|--------------|---------------|---------------|------|------|-------------|---------------|-------------|-------|------|--------------|
| | | FLOW | VEH | AM | %HGV | VehHr/Hr | FLOW | VEH | OP | %HGV | Veh/Hr | FLOW | VEH | PM | %HGV | VehHr/Hr |
| M40 WB | 101 | 757 | 737 | 62.4 | 2.66 | 60.8 | 469 | 448 | 20.5 | 4.8 | 19.6 | 718 | 699 | 42.7 | 1.50 | 42.1 |
| | 102 | 1148 | 1118 | 22.0 | 2.66 | 21.4 | 712 | 679 | 7.7 | 4.8 | 7.3 | 1214 | 1183 | 44.7 | 1.50 | 44.0 |
| A404NB | 201 | 55 | 53 | 0.4 | 3.34 | 0.4 | 34 | 33 | 0.2 | 3.4 | 0.2 | 80 | 77 | 0.5 | 2.90 | 0.5 |
| | 202 | 1255 | 1214 | 12.4 | 3.34 | 12.0 | 778 | 753 | 4.8 | 3.4 | 4.6 | 1462 | 1415 | 168.5 | 2.90 | 163.8 |
| M40EB | 401 | 552 | 529 | 21.2 | 4.36 | 20.3 | 342 | 328 | 4.1 | 4.4 | 3.9 | 397 | 380 | 9.2 | 4.27 | 8.8 |
| | 402 | 845 | 810 | 7.2 | 4.36 | 6.9 | 524 | 502 | 2.4 | 4.4 | 2.3 | 681 | 653 | 6.2 | 4.27 | 5.9 |
| | | 4612 | 4462 | | | 121.8 | 2859.4 | 2742.4 | | | 38.0 | 4552.0 | 4407 | | | 265.1 |

Allow TRANSYT to Optimise Timings on same traffic flows

| Road | Links | Uniform + Oversaturated Delay (PCU Hr/Hr) | | | | | | | | | | | | | | |
|--------|-------|---|-------------|------|------|-------------|-------------|-------------|-----|------|-------------|---------------|-------------|------|------|-------------|
| | | FLOW | VEH | AM | %HGV | VehHr/Hr | FLOW | VEH | OP | %HGV | Veh/Hr | FLOW | VEH | PM | %HGV | VehHr/Hr |
| M40 WB | 101 | 757 | 737 | 15.6 | 2.66 | 15.2 | 469 | 448 | 4.7 | 4.8 | 4.5 | 718 | 699 | 10.1 | 1.49 | 10.0 |
| | 102 | 1148 | 1118 | 9.8 | 2.66 | 9.5 | 712 | 679 | 5.4 | 4.8 | 5.2 | 1214 | 1183 | 12.0 | 1.49 | 11.8 |
| A404NB | 201 | 55 | 53 | 0.4 | 3.34 | 0.4 | 34 | 33 | 0.2 | 3.4 | 0.2 | 80 | 77 | 0.5 | 2.90 | 0.5 |
| | 202 | 1255 | 1214 | 10.1 | 3.34 | 9.8 | 778 | 753 | 4.8 | 3.4 | 4.6 | 1462 | 1415 | 40.1 | 2.90 | 39.0 |
| M40EB | 401 | 552 | 529 | 47.5 | 4.36 | 45.5 | 342 | 328 | 5.5 | 4.4 | 5.3 | 397 | 380 | 9.2 | 4.27 | 8.8 |
| | 402 | 845 | 810 | 8.6 | 4.36 | 8.2 | 524 | 502 | 4.4 | 4.4 | 4.2 | 681 | 653 | 6.2 | 4.27 | 5.9 |
| | | 4612 | 4462 | | | 88.7 | 2859 | 2742 | | | 24.0 | 4552.0 | 4407 | | | 76.0 |

Appendix F: PAR