

Wokingham Borough Council

WOKINGHAM STRATEGIC TRANSPORT MODEL 4 (WSTM4)

Highway Model Outputs



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CONTENTS

116

1	INTRODUCTION	1
2	VISUM MODELLING OUTPUTS	2
2.1	INTRODUCTION	2
2.2	ACTUAL AND DEMAND FLOW	2
2.3	VOLUME OVER CAPACITY	4
2.4	DELAY	6
2.5	LEVEL OF SERVICE	7
3	COMPARISON OF VISUM WITH OUTPUTS FROM OTHER SOFTWARE	10
3.1	JUNCTIONS 9	10
4	SUMMARY	13

TABLES

Table 1 – Junction Level of Service interpretation

FIGURES

Figure 1 – VISUM link actual flow, vehicles	2
Figure 2 – VISUM link demand flow, vehicles	3
Figure 3 – VISUM actual flow turning volumes, vehicles	3
Figure 4 – VISUM demand flow turning volumes, vehicles	4
Figure 5 – VISUM link VoC, %	4
Figure 6 – VISUM links coloured by VoC category, %	5
Figure 7 – VISUM turning VoC, %	5
Figure 8 – VISUM total delay time, seconds	6

7

Figure 9 – VISUM turning delay, seconds	7
Figure 10 – VISUM node LoS	8
Figure 11 – VISUM LoS with turn indicators	8
Figure 12 – VISUM turn LoS	9
Figure 13 – Lower Earley Way/ Rushey Way/ Mill Lane roundabout comparison	11
Figure 14 – A329 Wokingham Road/ Mill Lane priority junction comparison	12

1 INTRODUCTION

- 1.1.1. In 2008 WSP was appointed as the Highways and Transport Term consultant for Wokingham Borough Council (WBC). This included the use and on-going maintenance of the Wokingham Strategic Transport Model (WSTM) to support transport policies and scheme development.
- 1.1.2. Since this appointment WSP has completed three model updates as follows:
 - WSTM2 Update of Highway model forecast scenarios in SATURN to include details of Strategic Development Locations and mitigation measures;
 - WSTM3 Update to a 2010 model base year with the Highway model in SATURN, Public Transport model in VISUM and Variable Demand Model in DIADEM; and
 - WSTM4 Update to a 2015 base year with Highway model, Public Transport model and Variable Demand Model all developed in VISUM.
- 1.1.3. The WSTM3 has been used for wider strategic testing, localised testing, plan policy evaluation and scheme appraisal. This has included:
 - Park and Ride Strategy Action Plan;
 - Wokingham Town Centre Parking Strategy;
 - Wokingham LSTF programme evaluation along the A329 corridor;
 - Public consultation on locally significant schemes for Arborfield Relief Road, North Wokingham Distributor Road, South Wokingham Relief Road;
 - DfT LSTF funding (£2.75m) and funding from the Local Pinch Point Fund for:
 - A329 Coppid Beech Junction Improvement (£1.859m of £2.655m total scheme cost); and
 - Station Link Road (£2.650m of £3.786m total scheme cost).
 - Section 106 contributions from developers:
 - Hatch Farm Dairies development to Winnersh Relief Road Phase 1;
 - South of the M4 J10 development to Eastern Relief Road (ERR) east of Shinfield; and
 - Initial assessment of the viability for a Third Thames Crossing to support transport objectives of Wokingham and Reading Borough Councils.
 - Corridor studies in the borough to study a selection of highway options which have been identified to provide the strategic infrastructure that is needed to accommodate future development in the borough. The highway schemes that have been considered are: Arborfield Cross Relief Road, Full Northern Distributor Road and Ashridge Interchange, South Wokingham Distributor Road; and
 - Transport Assessments to inform Planning Applications for a range of the infrastructure schemes in the borough including ACRR, WRR Phase 2, SWDR, NWDR and others.
- 1.1.4. The WSTM3 has been considered a powerful tool in aiding decision making and shaping transport planning policies and strategies in the borough, has gained significant planning "weight" and is well understood by WBC planning officers.
- 1.1.5. As part of the WSTM4 model update the software platform for the Highway model and Variable Demand Model was changed to VISUM. This enabled all of the sub-models to be run in one suite of programmes. Further benefits to using VISUM include improved data management and visual display compared to SATURN.
- 1.1.6. The updated WSTM4 model will serve as a robust and up to date basis:
 - for scheme and development assessments in Wokingham borough considered as part of the 2026-2036 Local Plan;
 - in negotiations with the adjacent authorities, the Highways England and Network Rail; and
 - for assessing car parks management and re-development proposals in the borough.
- 1.1.7. To ensure a smooth transition between the models and the software platforms and to confirm the robustness of model outputs, this document sets out the modelling outputs available in VISUM, and compares them to outputs from other software, including SATURN and Junctions 9.



2 VISUM MODELLING OUTPUTS

2.1 INTRODUCTION

- 2.1.1. VISUM generally provides the same set of outputs WBC planning officers are used to seeing in SATURN, including:
 - Actual and demand flow;
 - Volume over Capacity (VoC); and
 - Delay.
- 2.1.2. In addition, Level of Service (LoS) is commonly used in VISUM.
- 2.1.3. Each of these outputs is described in turn below.

2.2 ACTUAL AND DEMAND FLOW

- 2.2.1. Similarly to SATURN, VISUM displays link actual and demand flows. It should however be noted that SATURN link flows are in pcu (passenger car units), whereas VISUM link flows are in vehicles.
- 2.2.2. Figure 1 and Figure 2 show example plots of link actual and demand flow in Wokingham Town Centre extracted from the WSTM4.



Figure 1 – VISUM link actual flow, vehicles



Figure 2 – VISUM link demand flow, vehicles

2.2.3. As with SATURN, VISUM also displays the actual and demand turning volumes at individual nodes. Figure 3 and Figure 4 show example plots of the actual and demand turning volumes at a node, along with the junction geometry at that node.



Figure 3 – VISUM actual flow turning volumes, vehicles

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Figure 4 – VISUM demand flow turning volumes, vehicles

- 2.2.4. Link and junction names can be included in the outputs.
- 2.2.5. Similarly to SATURN, actual and demand flow turning matrices can be extracted for expanded junctions (junctions modelled by more than one node, for example motorway junctions).

2.3 VOLUME OVER CAPACITY

2.3.1. Both VISUM and SATURN display link VoC as a percentage. Figure 5 shows an example plot of link VoC in Wokingham Town Centre extracted from the WSTM4.



Figure 5 – VISUM link VoC, %

2.3.2. As previously mentioned, VISUM benefits from improved visualisation compared to SATURN, which allows more graphical outputs to be produced. Figure 6 shows an example plot of the links in Wokingham coloured

by VoC category. Links with VoC less than 85% are coloured green, links with VoC between 85% - 95% are coloured orange and links with VoC greater than 95% are coloured red.



Figure 6 – VISUM links coloured by VoC category, %

2.3.3. Similarly to SATURN, VISUM also displays the VoC for each turning movement at a node. Figure 7 shows an example plot of the turning VoC at a node, and the junction geometry at that node.



Figure 7 – VISUM turning VoC, %



2.3.4. Whilst SATURN considers the impact of delays and queuing at the downstream junction on link capacity, VISUM calculates link VoC independently of whether congestion at the downstream junction reduces capacity along the approach link. Therefore WSP does not recommend using link VoC as a measure of congestion on the approaches to junctions. We instead recommend using delays and LoS as a measure of congestion on the approaches to junctions, which are discussed in detail below.

2.4 DELAY

2.4.1. Similarly to SATURN, VISUM calculates the total delay time per vehicle, which includes the delay along the link and the weighted delay at the downstream node. Figure 8 shows an example plot of the total delay time in Wokingham Town Centre extracted from the WSTM4. The values are in seconds.



Figure 8 – VISUM total delay time, seconds

2.4.2. As with SATURN, VISUM also displays the delay experienced by vehicles making each individual turn at a node. Figure 9 shows an example plot of the turning delays at a node, along with the junction geometry at that node.



Figure 9 – VISUM turning delay, seconds

2.5 LEVEL OF SERVICE

2.5.1. In VISUM Level of Service (LoS) is commonly used to describe how well a junction or a turn is performing. LoS is related to the mean delay experienced per vehicle, as set out in Table 1.

	Mean delay/ vehicle					
LOS	Un-signalised junction	Signalised junction				
A	0 – 10 sec	0 – 10 sec				
В	10 – 15 sec	10 – 20 sec				
С	15 – 25 sec	20 – 35 sec				
D	25 – 35 sec	35 – 55 sec				
E	35 – 50 sec	55 – 80 sec				
F	50 + sec	80 + sec				

Table 1 – Junction Level of Service interpretation

- 2.5.2. Table 1 shows that the LoS thresholds differ for un-signalised and signalised junctions. One reason for this is that delay at a signalised junction is more 'acceptable' because drivers expect to be delayed at traffic lights.
- 2.5.3. If the volume exceeds the capacity for a particular turn, LoS F will be allocated to that turn regardless of the delay.
- 2.5.4. VISUM calculates the LoS for each individual turning movement, as well as an overall node LoS. The overall node LoS is based on the mean delay experienced across all turning movements, which may disguise some congestion issues. Therefore it is considered a more robust approach to assess junction performance based on the maximum turn LoS at a node.
- 2.5.5. Figure 10 shows an example of the junctions in Wokingham Town Centre categorised by maximum turn LoS. The approaches to the junctions which the turns originate from have also been highlighted. The junctions and junction approaches allocated LoS C are coloured green, LoS D is shown in yellow, LoS E is shown in orange, and LoS F is shown in red. Junctions and junction approaches which experience turn LoS A or B are shown in black.



Figure 10 – VISUM node LoS

2.5.6. It is possible to add turn indicators to the figure to show the individual turns experiencing congestion, however the graphic parameters cannot be edited. This means that the colour cannot be classified by LoS, as shown in Figure 11 below. Instead multiple figures showing each LoS category in turn could be provided.



Figure 11 – VISUM LoS with turn indicators

2.5.7. Figure 12 shows an example plot of the LoS for individual turns at a node, and the junction geometry at that node.

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Figure 12 – VISUM turn LoS

3 COMPARISON OF VISUM WITH OUTPUTS FROM OTHER SOFTWARE

3.1 JUNCTIONS 9

- 3.1.1. To confirm the robustness of the VISUM model outputs, WSP has assessed two junctions in both VISUM and Junctions 9 to see if similar results are produced. Junctions 9 is a software package for predicting capacities, queues and delays at roundabouts and priority intersections, and is a valuable tool for assessing junction performance.
- 3.1.2. The comparison has been undertaken for the following two junctions:
 - Lower Earley Way/ Rushey Way/ Mill Lane roundabout; and
 - A329 Wokingham Road/ Mill Lane priority junction.
- 3.1.3. The demand flow, VoC, delay and LoS for each turning movement was extracted from example VISUM models.
- 3.1.4. The VISUM demand flows were then fed into the Junctions 9 models, and the resulting ratio of demand flow to capacity (RFC), delay and LoS were extracted.
- 3.1.5. The results for each junction are presented in Figure 13 and Figure 14 below. The VISUM VoC has been converted to RFC to maintain consistency with Junctions 9.
- 3.1.6. Figure 13 shows that VISUM and Junctions 9 produce very similar RFC for the approaches to the Lower Earley Way/ Rushey Way/ Mill Lane roundabout. The LoS produced by each software programme is also reasonably similar. Although VISUM underestimates the delay experienced on the Rushey Way approach in the AM peak and the Lower Earley Way West approach in the PM peak compared to Junctions 9, the LoS for these approaches identify that they experience congestion.
- 3.1.7. Queue lengths are available in VISUM, however as shown in Figure 13 VISUM produces queue lengths of zero across all arms and time periods. Queue lengths in VISUM are not representative of the real life observations and therefore we recommend that these are not used. This is similar to Saturn outputs.
- 3.1.8. Figure 14 shows the RFC and delay results for the A329 Wokingham Road/ Mill Lane priority junction. Again VISUM underestimates the delay experienced by vehicles at the junction compared to Junctions 9, in particular for vehicles turning right out of Mill Lane, and predicts queue lengths of zero across all approaches and time periods.
- 3.1.9. The differences between VISUM and Junctions 9 results can partly be explained by the different levels of detail included in the models. Junctions 9 is a localised junction modelling software which considers the specific measurements at individual junctions, whereas VISUM is a strategic modelling software which assumes default junction geometries over a large network. This enables Junctions 9 to calculate more accurate capacities at junctions, and produce more realistic RFC and delay results.,
- 3.1.10. The observed differences reiterate the strategic nature of VISUM, and reinforce that as with SATURN modelling, the findings of the strategic assessment need to be used in conjunction with results from more detailed, local junction assessments to identify additional specific impacts on the network.



Junctions 9									
		А	М		PM				
Arm	Queue (pcu)	Delay (s)	RFC	LOS	Queue (pcu)	Delay (s)	RFC	LOS	
А	3.5	10.18	0.78	В	12.7	30.31	0.94	D	
В	6.5	25.95	0.87	D	2.3	11.19	0.70	В	
С	0.8	5.39	0.44	А	43.6	114.92	1.05	F	
D	20.3	67.68	0.99	F	1	7.65	0.49	А	

VISUM									
	AM				PM				
Arm	Queue (pcu)	Delay (s)	RFC	LOS	Queue (pcu)	Delay (s)	RFC	LOS	
А	0	12.18	0.82	В	0	31.1	0.99	D	
В	0	15.1	0.78	С	0	8.98	0.65	А	
С	0	5.52	0.43	А	0	42.99	1.02	E	
D	0	26.24	0.93	D	0	7.41	0.47	A	

Figure 13 – Lower Earley Way/ Rushey Way/ Mill Lane roundabout comparison



Junctions 9									
		A	М		PM				
Stream	Queue (pcu)	Delay (s)	RFC	LOS	Queue (pcu)	Delay (s)	RFC	LOS	
B-C	0.3	12.12	0.21	В	0.1	9.79	0.06	А	
B-A	1.1	41.17	0.53	E	1	39.75	0.52	E	
C-B	0.2	10.13	0.12	В	0.2	8.6	0.16	А	

VISUM									
		A	М		PM				
Stream	Queue (pcu)	Delay (s)	RFC	LOS	Queue (pcu)	Delay (s)	RFC	LOS	
B-C	0	8.04	0.06	А	0	7.82	0.02	А	
B-A	0	9.73	0.11	Α	0	9.95	0.11	А	
C-B	0	8.07	0.04	Α	0	8.08	0.06	A	

Figure 14 – A329 Wokingham Road/ Mill Lane priority junction comparison

4 SUMMARY

- 4.1.1. WSP has recently developed the WSTM4, which consists of Highway, Public Transport and Variable Demand Models all developed in VISUM.
- 4.1.2. The updated WSTM4 model will serve as a robust and up to date basis:
 - for scheme and development assessments in Wokingham borough considered as part of the 2026-2036 Local Plan;
 - in negotiations with the adjacent authorities, the Highways England and Network Rail; and
 - for assessing car parks management and re-development proposals in the borough.
- 4.1.3. Highway model outputs available in VISUM include actual and demand flow, VoC and delay. These are generally consistent with the outputs usually extracted from SATURN, with the added benefit of improved visualisation.
- 4.1.4. Since VISUM does not take into account the impact of delays and queuing when calculating link VoC, it is recommended that this parameter is not used as a measure of congestion on the approaches to junctions.
- 4.1.5. VISUM also calculates LoS for junctions and turning movements within junctions. LoS describes how well a junction or turn is performing, and is related to the mean delay experienced per vehicle. This will provide an additional insight into impact analysis using the WSTM4.
- 4.1.6. Similar to SATURN queue lengths in VISUM are not representative of the real life observations and therefore we recommend that these are not used.
- 4.1.7. The following two junctions have been assessed in VISUM and Junctions 9 to understand whether similar results are produced in each software programme:
 - Lower Earley Way/ Rushey Way/ Mill Lane roundabout; and
 - A329 Wokingham Road/ Mill Lane priority junction.
- 4.1.8. Generally VISUM and Junctions 9 produce similar RFC results, although VISUM underestimates the delay experienced on some approaches. This is due to the different levels of detail included in each software programme, thus reiterating the strategic nature of the model and the advice that findings of the strategic assessment should not in any way reduce the need for undertaking detailed, local junction assessments.



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