Project:	**Highways England Spatial Planning Arrangement**	Job No: **60600479 DM014.006**
Subject:	**South Caldecotte, Audit of Revised VISSIM model**	
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Executive Summary

This technical note describes a modelling audit of the revised Kelly's Kitchen Roundabout (A5) base Vissim models, provided by BWB to support the planning application of the proposed South Caldecotte development in Milton Keynes. The audit was carried out based on WebTAG guidance and best practices recommended in Transport for London (TfL) Modelling Guidelines which is recognised as the most comprehensive Vissim modelling guidance in the industry.

AECOM has previously undertaken two reviews of the original base models (reference 'South Caldecotte VISSIM Model Review_v10' – dated 2nd November 2018, and 'Revised South Caldecotte VISSIM review_v8' – dated 26th April 2019) and AECOM's comments on the previous base models have been considered within this review. It is understood that revised forecast models will be built once the base models are agreed.

The note draws attention to the elements coded and the vehicle data used in the model along with the calibration and validation results. Elements that have been audited are:

- Link and Connectors coding;
- Vehicle Inputs and routes;
- Turning Count data and Journey times;
- Signal Operation;
- Priority Rules & Conflict areas;
- Reduced Speed Areas & Speed Distributions;
- Network Operation & Routing;
- Driving Behaviour;
- Calibration Results; and
- Validation Results.

Issues/Errors that were found in the models have been classified into three levels:

- **MINOR –** The issues found are likely to produce minimal changes in the results.
- **MEDIUM –** The issues found could have a medium impact on the results.
- **SIGNIFICANT –** The issues are considered as an error and are likely to have a large/ significant impact on the results.

The following table shows a summary of assessment on the status of the issues identified during the previous audits:

Issue Identified in Previous Audit	Level of Issue	Resolved?	Comments
Traffic Composition not including LGVs	Minor	Yes	Minor coding issue have been observed and documented in this technical note.
General Coding Errors (Overlapping vehicles)	Minor	No	No changes have been made as the impact is minor.
Conflict Areas coding errors and Inconsistencies	Medium	Yes	
Desired Speed Decision coding errors	Minor	Yes	
Reduced Speed Areas coding errors	Minor	Yes	
Link-Connector coding errors	No Impact	Yes	
Vehicle Inputs	Minor	Yes	Minor coding issue have been observed and documented in this technical note.
Signal Coding and Detector errors	Significant	Yes	
Driving Behaviours	Minor	Yes	
Model Calibration and Latent Demand reporting issues	Significant	Yes	
Saturation Flow Calibration not provided	Medium	Yes	
Journey Time Validation criteria Misinterpretation	Significant	Yes	
Evidence supporting calibration of MOVA	Medium	Yes	Video footage is analysed and reported to extract minimum and maximum signal green times.
Consistency issues between AM and PM Peak models	Significant	Yes	

There are a few **MINOR** issues in Vehicle Inputs and Compositions raised in this Technical Note and addressing those might not have any impact on the operation and the overall results of the AM and PM peak models. However, it is recommended that these are considered further by the modellers and addressed to provide consistency and as much accuracy as possible.

Based on the overall findings from the model audit, there is a significant improvement from the previous submission. However, there are still a few concerns with the model journey time validation results for the AM and PM peaks. These concerns may impact on the testing of the proposed development in the forecast models. Route D-A, which is not validated in both peaks, is considered a key route as the proposed development site access is along this route. AECOM recommends that the journey time route D-A be validated in the base VISSIM models before the forecast year modelling which might also improve the journey time validation results passing the required WebTAG criteria. The issues are considered as **MEDIUM**.

1 Introduction

This Technical Note (TN05) provides a summary of the auditing work conducted of the base Vissim models developed for the A5 Kelly's Kitchen Roundabout by BWB. The Vissim models have been prepared to support the planning application of a proposed employment development at South Caldecotte in Milton Keynes. This Technical Note should be read alongside Technical Note 03 ('South Caldecotte VISSIM Model Review_v10') and Technical Note 04 ('Revised South Caldecotte VISSIM review_v8'), which documents the review of the previous base and forecast models and Technical Note 02 ('TN02_Review of South Caldecotte TA_v7'), which documents the review of the Transport Assessment (TA) associated with the proposed development, which the Vissim model has been used to inform.

The models/information received by AECOM include:

- The Base year 2017 AM/PM peak models; and
- Local Model Validation Report (LMVR), file reference 'SCD-BWB-GEN-XX-RP-TR-003_LMVR-S2-P5'.

2 2017 Base Model Review

2.1 Traffic Data

The traffic inputs and routes in the models (vehicle inputs and vehicle static routes) were checked against the MCTC survey data provided. There were a few inconsistencies found in the previous audit as the MCTC survey data did not match with the vehicle inputs. The first point of Section 2014 in the LMVR now states *"The video footage was observed and it was noted that 68 and 92 vehicles during the morning and evening peak hours respectively, entered the roundabout from the service road link as opposed to the A4146. Therefore these have been subtracted from the total vehicle input along the A4146"*. Considering this and checking the consistencies, it has been found that the traffic data now matches well with the Vissim Inputs. Comments have been made on Vehicle Inputs in Vissim in Section 2.3 of this Technical Note.

2.2 Traffic Composition

The vehicle compositions are coded in the Vissim AM and PM models. The Lights are coded with vehicle types of Cars (90%) and LGVs (10%) whereas the Heavies are coded with vehicle types of MGVs (58%) and HGVs (42%). These compositions are the same in the AM and PM models. The compositions of the AM model match with the survey data provided, but PM model vehicle compositions have a different proportion of Heavy vehicles when compared with the survey data. This change might not have any significant impact on the model results but AECOM recommends that the traffic compositions are coded as per survey data for consistency in the PM Peak.

The impact of this issue is likely to be **MINOR.**

2.3 Vehicle Inputs

Vehicle Input no. 9 (Name A on Link 18) has been coded with vehicle compositions of "Lights" in both the AM and PM Vissim models. This should have been coded with vehicle compositions of "Heavies" as the numbers in Vehicle Inputs match with the Heavies in the Survey data. These vehicles will simulate with the characteristics of Cars and LGVs instead of MGVs and HGVs. It should be noted that the Lights have already been coded separately for Vehicle Input no. 1 on the same link. Considering that the Vehicle Input no 9 does not have a very high number of vehicles, this correction might have a very negligible impact on the calibration

and validation results. However, AECOM recommends that this correction should be made to the models in both AM and PM Peaks.
The impact of this issue is likely to be **MINOR.**

2.4 Signal Controllers

Section 3.2 of the LMVR shows the signal information obtained from the video footage for AM and PM peaks. The signal controller coding in AM and PM models was reviewed by comparing the VAPs of all the controllers against the Min and Max values of green times tabulated in the LMVR. There are minor differences between the VAPs and the tabular numbers. Section 3.3 of the LMVR reports that there were minor tweaks made to the Min and Max values in a few of the signal controllers which was aimed to calibrate and validate the Vissim models. Considering that the junction operates under MOVA and also considering the variable nature of the Vissim model, the signal coding is acceptable as the signals are reactive to the traffic demand.

2.5 Additional Model Elements Review

The other network coding elements in the AM and PM models were reviewed and found to be consistent in both the scenarios. The review suggests that the network elements are coded to replicate the ground conditions reasonably well and are considered acceptable without any further changes. The list of the elements reviewed are as follows:

- Links and Connectors Network coding;
- Link and Driving Behaviour coding;
- Desired Speed Decisions coding;
- Reduced Speed Areas coding;
- Conflict Areas coding;
- Signal Detectors coding; and
- Signal Heads coding.

3 Calibration and Validation Results

3.1 Turning Count Calibration

AECOM had identified a few inconsistencies in the observed flow values within the calibration table during the previous audit. The observed traffic flows in the turning count calibration table were compared with the actual survey data and the Vissim Inputs and no inconsistencies have been identified. Also, no issues have been found while replicating the calibration results for the AM and PM peaks. Since there are no major or significant issues identified in the coding of the models, the calibration results are not expected to change if the recommended minor corrections are applied.

The AM traffic flow calibration table (for all the junctions) shows that only 2 out of 47 turns have GEH value more than 3 but both of these turns have a GEH value less than 5. The PM traffic flow calibration table shows that 3 out of 47 turns have a GEH value more than 3 and only 1 turn has a GEH value more than 5.

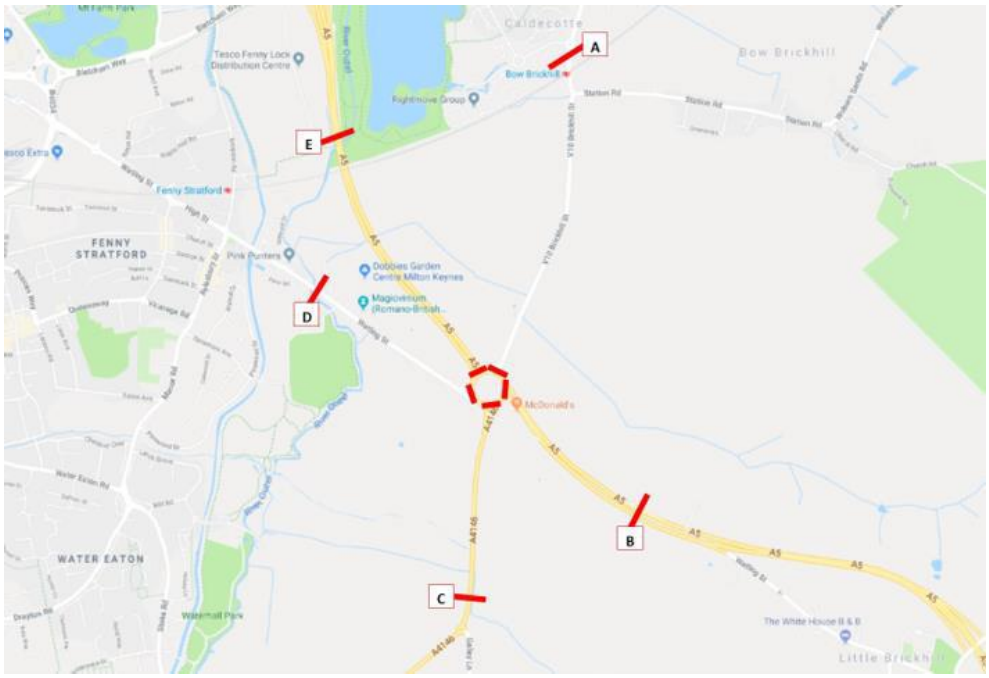
The error log review highlighted some latent demand issues in the PM peak. There are some vehicles that cannot access the network due to the extent of the queue on the A4146 (vehicle input no.5). The observed latent demand may be related with the length of the link in the model as it has been observed from Google Maps that the queue may extend pass the length of the modelled link. The latent demand should be justified in the validation report.

However, as per the DfT Transport Analysis Guidance TAG Unit 3.1 Section 3.2.8., the GEH calibration is acceptable for this network for both AM and PM peaks as the GEH values are less than 5 for more than 85% of the turns.

3.2 Journey Time Validation

AECOM had identified a few inconsistencies in the coding elements during the previous audit. The adjustments to those elements were expected to change the model journey time results. The journey time results have now been reviewed, have been replicated and there were no issues identified in the model results. The figure below shows the start and end points of journey time routes.

Figure 1: Start and End points of journey time routes



The tables below show the model validation results for AM and PM Peak.

Table 1: AM Journey Time Validation Results

Route	Survey Journey Time (s)	VISSIM Journey Time (s)	Difference	Difference (%)	Fast/Slow (in model)
A-B	143	161	-17	-11.9%	Slow
A-C	237	226	+11	+4.6%	Fast
A-D	232	246	-14	-6.0%	Slow
B-A	338	308	+30	+8.9%	Fast
B-C	186	163	+23	+12.4%	Fast
B-D	179	173	+6	+3.4%	Fast
B-E	193	196	-3	-1.6%	Slow
C-A	302	340	-38	-12.6%	Slow
C-B	229	225	+3	+1.3%	Fast
C-D	180	196	-16	-8.9%	Slow
C-E	203	217	-14	-6.9%	Slow
D-A	155	224	-69	-44.6%	Slow
D-B	124	122	+2	+1.6%	Fast
D-C	151	188	-37	-24.5%	Slow
D-E	109	114	-5	-4.6%	Slow
E-B	95	105	-10	-10.5%	Slow
E-C	133	172	-39	-29.3%	Slow
E-D	168	190	-22	-13.1%	Slow

Table 2: PM Journey Time Validation Results

Route	Survey Journey Time (s)	VISSIM Journey Time (s)	Difference	Difference (%)	Fast/Slow (in model)
A-B	239	259	-19	-7.9%	Slow
A-C	299	313	-14	-4.7%	Slow
A-D	338	311	+27	+8.0%	Fast
B-A	190	204	-14	-7.4%	Slow
B-C	110	108	+2	+1.8%	Fast
B-D	135	102	+34	+25.1%	Fast
B-E	106	120	-13	-12.2%	Slow
C-A	404	368	+36	+8.9%	Fast
C-B	372	300	+71	+19.1%	Fast
C-D	306	266	+40	+13.1%	Fast
C-E	328	285	+43	+13.1%	Fast
D-A	244	207	+37	+15.1%	Fast
D-B	150	139	+11	+7.3%	Fast
D-C	207	195	+12	+5.8%	Fast
D-E	130	128	+2	+1.5%	Fast
E-B	198	217	-19	-9.6%	Slow
E-C	240	273	-33	-13.7%	Slow
E-D	258	267	-9	-3.5%	Slow

As seen in the table above, the AM Peak model journey time results show that there are 3 out of 18 routes failing to validate with the 15% criteria, 1 of which (Route D-A) also fails the 60 seconds criteria. All the routes failing to validate are slower in the model compared to the surveyed journey time data.

Similar to the AM Peak, the PM Peak model journey time results also show that 3 out of 18 routes fail to validate with the 15% criteria and Route C-B fails to validate with the 60 seconds criteria. However, all the routes failing to validate are faster in the model compared to the surveyed journey time data.

Considering the WebTAG unit M3.1 recommendation, it is recommended that the modelled journey times should be within 15% of the surveyed times for the 85% of the routes in the AM and PM peak models. Since, both, AM and PM Peaks have 3 out of total 18 routes (17% of the total routes) failing to validate the required WebTAG criteria, the required threshold of 85% is not passed.

The routes which fail the validation criteria in AM model are D-A, D-C and E-C whereas those for the PM model are B-D, C-B and D-A. Out of these routes, Route D-A is along the link (Brickhill Street) on which the proposed development site access is planned. Route D-A is slower in the model by 69 seconds during the AM Peak, whereas it is faster by 37 seconds in the model during the PM Peak. Overall, in general, the journey time routes in the model are slower than the surveyed data which suggests that the AM model is more congested than in reality and it might not predict the correct impact of the development in forecast year models. Contrary to the AM Peak model, PM Peak model journey time routes are faster than the surveyed data which suggests that the PM model is underrepresenting the congestion in reality.

Overall, based on the journey time validation results, AECOM has concerns that the model operation in both peaks (AM and PM) might not provide a robust basis to assess the impact of the proposed development in the forecast scenarios.

Considering that the WebTAG criteria of journey time validation of the routes is not met in both the AM and PM peaks, further analysis has been undertaken to identify the non-validated routes and estimate any possible impact on the forecast result analysis.

Route D-A, which is not validated in both AM and PM, is considered a key route as the proposed development site access is along this route. Based on these concerns it is not recommended to accept the AM and PM Peak base models until this route is within the required validation criteria as the models may not provide a robust basis to develop the forecast scenarios and assess the impact of the proposed development growth/ network changes in the area.

AECOM recommends that the journey time route D-A be validated in the base VISSIM models before the forecast year modelling as this route is along the proposed development site. The validation of this route might also improve the overall journey time validation results meeting the criteria.

The impact of this issue is likely to be **MEDIUM.**

3.3 Saturation Flow Calibration

The Saturation Flow Calibration Summary shows a good match between the model and measured saturation flow. All the Vissim saturation flow values are found to be within 10% difference of the measured values (RR67). Further improvements in the model are considered to be minor which would have no potential impact to the saturation flow results of the models and therefore these are acceptable.

3.4 Signal Timing Calibration

MOVA has been replicated with VisVAP coding and PC MOVA software has not been used. Although it is generally known that PC MOVA can replicate MOVA controllers in the closest way, VisVAP coding can also give a reasonable representation of the signal operation. The model operation is considered a reasonable representation of signal operation compared with the MOVA setting files provided.

During the previous audits, it was identified that there was no documentation of the survey analysis from the videos for the Min and Max times used in the VAP coding and there were gaps in reporting of the calibration and validation of the base signal operation. As also documented in Section 2.4 of this Technical note, the modelled average stage length is based on the green times estimated from the video footage as it has been reported that MOVA logs were not available for the day of the surveys. The tabular information of the Min and Max green times from the video footage is also reported in the LMVR for both AM and PM peaks.

The review suggests that there were minor tweaks made to the signal green times which are considered to be acceptable considering the variable nature of Vissim software and MOVA operation. Also, considering there are no major or significant issues in the coding of the models, the signal timing calibration is acceptable.

4 Conclusions

AECOM has undertaken an audit of the South Caldecotte Vissim base models, as part of a wider review of the potential impact of the proposed South Caldecotte development on the strategic road network.

The majority of the coding concerns raised during the previous audits have been addressed. A few minor coding errors have been identified in the current Technical Note regarding the data and inputs. It is recommended that these are addressed for consistency and accuracy. However, it should be noted that the issues identified in coding are very minor and addressing those would unlikely have any significant impact on the overall model results in both AM and PM peaks.

The calibration and validation results have been reviewed and checked for consistency. AECOM were able to replicate the results without any issues. The junction turning counts calibration table shows reasonably a good match between the observed and modelled turning counts with majority of the turns having GEH of 5. The saturation flow calibration also shows that all the lanes calibrate well with the measured RR67 Saturation flow.

The journey time validation results show that both AM and PM peaks have 3 out of 18 routes (17% of the total routes) not matching the WebTAG validation criteria of 15%. Overall, the AM Peak model is slower and the PM Peak model is faster than observed journey times, which suggests that the congestion is not represented accurately in the models. Considering the significance of Brickhill Street along Route D-A, where the proposed development site access is planned, AECOM has concerns in accepting the journey time validation results for AM and PM Peak as the route fails the validation in both peaks. AECOM recommends that the journey time route D-A be validated in the base VISSIM models before the forecast year modelling is undertaken.

Overall, based on the evidence provided in this note AECOM has identified a few concerns with the model validation results. The validation results suggest that the modelled capacity and operation of the A5 Kelly's Kitchen Roundabout is not sufficiently accurate to be a reliable basis for testing the proposed development. It is recommended that the concerns raised within this technical note are addressed and that revised base and forecast models are presented for review to support the development going forward.