OXFORDSHIRE COUNTY COUNCIL

Bicester Transport Modelling

Bicester Peripheral Route Quantitative Assessment Report

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1 Introduction

BACKGROUND

1.1 WYG have been commissioned by Oxfordshire County Council to complete a quantitative assessment of the five options for peripheral route improvements at Bicester.

1.2 In February 2013, WYG reported on a Bicester movement study, which concluded that improvements to the peripheral routes should remain an integral part of the transport plans for the town. These improvements would connect major development sites with strategic links and the existing urban area, as well as enable the delivery of sustainable links within the town.

1.3 An initial qualitative assessment included within the movement study considered six potential route corridors and concluded that new links to the south-east of the town would provide the largest economic and social impact benefits, while options to the west would have the fewest environmental constraints. Three of the route options which were expected to perform the best have been taken forward within this commission and a re-examination of the need for new highway infrastructure undertaken. This study also considers the potential impacts of more localised improvement works and modal shift measures to ensure that a robust range of future transport strategy options has been examined.

1.4 The assessment of route options was carried out using the Bicester Town Transport Model, a strategic town wide transport model. This model was constructed and validated for a 2007 base year which was prior to large scale redevelopment of Bicester Town Centre. As such, revalidation of the model to a new base year of 2013 is anticipated to be completed in 2014. The revalidated model will be to WebTAG Variable Demand Model Guidance.

1.5 The 2007 model had to be used in conjunction with the strategic Central Oxfordshire Transport Model to incorporate variable demand. As such, the existing SATURN transport model is not WebTAG compliant when used in isolation from the strategic Central Oxfordshire Transport Model. However, in the interim period, this model can be used for a comparative review of strategic options and to identify a preferred option which can then be taken forward for further testing within an updated model.

1.6 The economic appraisal of the options considered was carried out using TUBA, assuming a scheme opening year of 2017 and a 60 year appraisal period.

FORMAT OF REPORT

1.7 This report provides an overview of the development context against which the assessment has been carried out and summary details of the modelling and economic appraisal undertaken.

1.8 The remainder of this report is laid out as follows:

- **Section 2** provides a summary of the future development context against which the peripheral route options have been assessed and creation of a reference case model;
- **Sections 3-7** provide further details with regards to the main options;
- **Section 8** provides and compares details of the model results;
- **Section 9** details the economic assessments and results; and
- **Section 10** provides an overall summary and conclusions

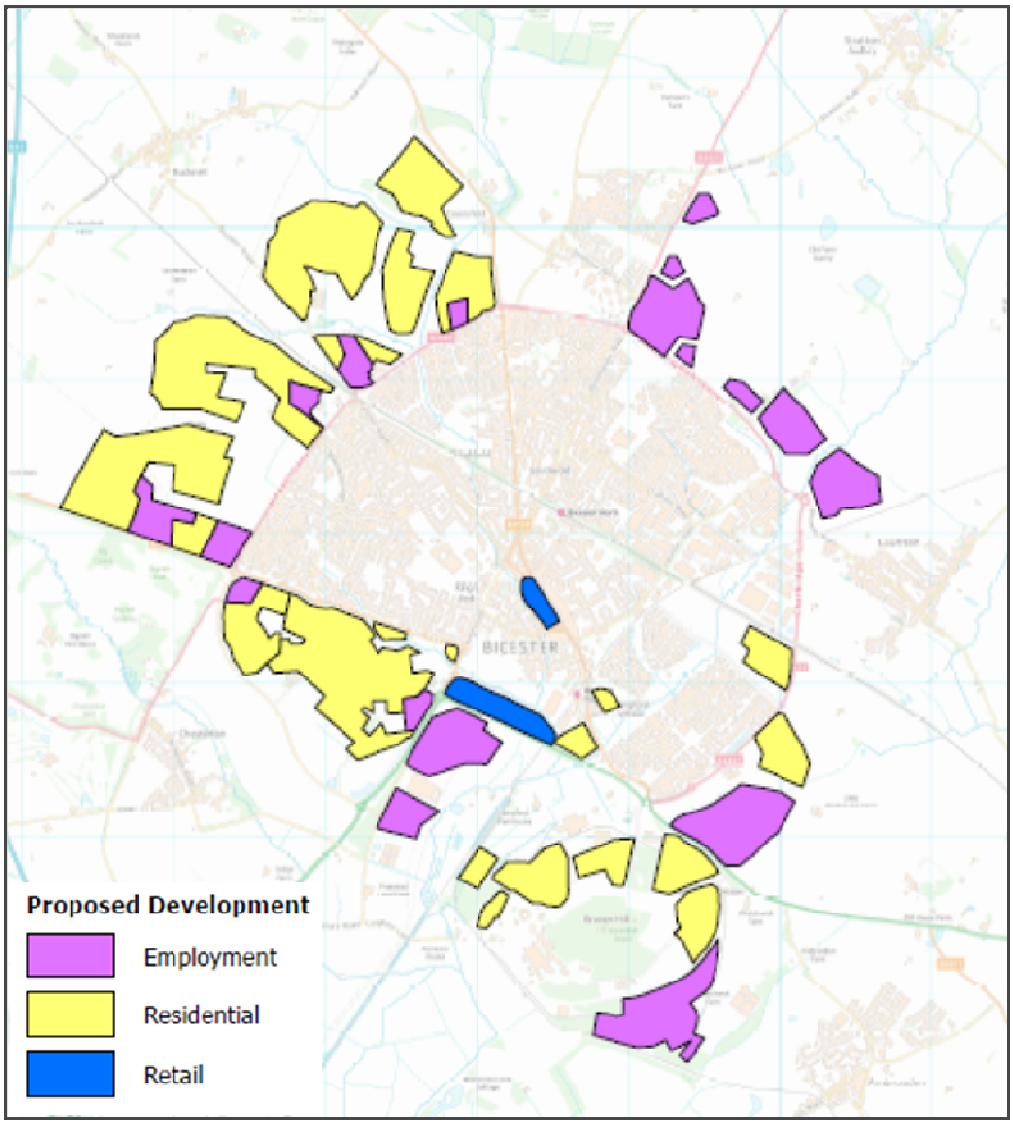
2 Reference Case Development

DEVELOPMENT CONTEXT

2.1 Bicester has been identified as the main location for housing growth within the emerging Cherwell Local Plan.

2.2 The aim of current planning and transport planning policy in Bicester is to deliver jobs-led growth supported by housing, with up to 20,000 new jobs and 10,500 new homes by 2040.

2.3 A plan detailing the general extent of future development considered is provided below:



2.4 These levels of growth and development predicted for the town are expected to have significant future traffic and travel implications, with increases in traffic levels to, from and within the town. In particular the development of large residential and employment sites on the periphery of Bicester will result in changes in demands for trips between the outskirts of the town and the town centre.

2.5 The transport network needs to play its part in making the town an attractive location for businesses by enabling access to the strategic transport system and to ease movements between homes and the main employment areas. The priority is to tackle the challenges identified in the movement study by:

i) Delivering highway infrastructure which effectively reduces the predicted transport congestion in Bicester

ii) Delivering highway capacity improvements to peripheral routes to make these attractive to employment and longer distance traffic and thereby enabling the improvement of internal sustainable movements within the town

iii) Proactively accommodating the proposed strategic rail initiatives

iv) Strengthening the town's sustainable transport network to ensure good links to local employment opportunities and amenities within the town.

2.6 Delivering peripheral route highway improvements is seen as critical to unlocking the overall transport strategy. However, this commission also considers the relative merits of alternative strategic approaches by examining the predicted impact of simply improving the capacity of existing links and junctions in the town rather than providing a new link road, and also maximising use of sustainable transport modes within the town.

2.7 In order to carry out any assessment work a reference case needs to be constructed initially. This reference case provides a base line from which all options can be compared. For this assessment the reference case is that of "All Proposed Growth" (APG) which seeks to maximise the use of the existing highway transport network.

2.8 The following sections detail the construction of the reference case hereby referred to as Option 1 APG.

2.9 The Bicester SATURN model was created in 2007 as part of assessing the impact of different levels of housing and employment growth associated with the South East Plan and Structure Plan. The model was developed to enable the appraisal of transport schemes in the Bicester area. The Bicester model was then built into the Central Oxfordshire Transport Model which is a multi-modal strategic model, covering a large part of the county. This was to provide any variable demand forecasting and to allow the model to be WebTAG compliant.

2.10 Matrices were created in the SATURN model for the morning peak, average inter-peak and evening peak periods, using information from roadside interview surveys, journey time surveys, junction counts and a number of household surveys.

2.11 A review of the Bicester model was carried out by Halcrow in early 2013 to determine whether the model was still suitable for use as a 2012 model prior to the town centre changes in Bicester (Technical Note Reference GOXFCC100 11th May 2013). This review looked at the AM and PM peak models using traffic counts only (no journey time surveys were available).

2.12 The report concluded that:

"The validation checks show that the model nearly validates to the criteria set out in DMRB. The most significant issue is the overestimation of modelled flows on the B430. However, the Bicester SATURN model is generally just used for the assessment of traffic impacts within the town/urban fringe. When scheme/developments are expected to have a more strategic impact (i.e. effecting changes on the M40, or to the area surrounding Bicester) then the Central Oxfordshire Transport Model is the most appropriate assessment tool. When considering the validation of the model within the town itself, the DMRB criteria are met."

2.13 As such, it was deemed suitable that the model be taken forward for this section of work with the caveat that the model will be updated at a later date to a WebTAG compliant validated base and forecast models for assessment of the preferred option.

2.14 In order for the model to satisfactorily represent a 2012 base network, the following changes were also included:

- Vendee Drive (the south west link road); and

- M40 Junction 9 phase 1.

2.15 The inclusion of these network changes reduced the overall link validation from 86%/84% to 77%/78% within 5.0 GEH for the AM and PM peaks respectively. This would be expected however as the network changes would lead to rerouting particularly in the case of the introduction of Vendee Drive. The reduction in model validation would be unlikely to materially affect the analysis of the peripheral routes as all routes would be compared against the same reference case. Given that a revised 2013 validated base model will be constructed in the near future, revalidation to 2012 was not considered by OCC to be cost or time efficient at this stage. Therefore, this revised 2012 base model has been taken forward for analysis of the peripheral route options.

2.16 To update the 2012 network to the Option 1 – APG reference case model, the following changes to the network were requested by OCC:

- Town centre access improvements;
- Changes implemented as part of the town centre redevelopment;
- Traffic calming and 30mph speed limit on Middleton Stoney Road;
- Changes at the Pingle Drive junction, A41 / Oxford Road (ESSO) junction and along the A41 corridor as part of the mitigation measures from Tesco's move and Bicester Village phase 4;
- Park & ride entrance / exit at the junction of Vendee Drive and the A41;
- A4095 / B4100 junction alterations as part of NW Bicester exemplar site;
- Alterations to the A41 / London Road (Rodney House) junction as part of Graven Hill mitigation; and
- M40 Junction 9 phase 2.

2.17 Additionally, accesses to the following new development zones were included:

- North West Bicester (BICESTER 1);
- Graven Hill (BICESTER 2);

- South West Bicester phase 2 (BICESTER 3);
- Bicester Business Park (BICESTER 4);
- Town centre redevelopment phase 2 (BICESTER 6);
- RAF Bicester (BICESTER 8);
- Bicester Gateway (BICESTER 10);
- North East Bicester Business Park (BICESTER 11) including the care home and business park adjacent to this site with existing planning permission; and
- South East Bicester (BICESTER 12).

2.18 Where available, plans for the network changes coded are included in **Appendix A**. Coding has been carried out to be consistent with that used in the existing network.

2.19 In addition the town is expected to undergo further changes as a result of a significantly improved rail offer, including improvements in service as a result of East–West Rail and the Evergreen 3 rail project, cumulatively providing an increase in service frequency and regularity to major destinations including Oxford, Birmingham and London.

2.20 The rail improvements proposed will result in a marked improvement in the levels of connectivity between Bicester and adjacent major local centres such as Oxford; however these improvements are also expected to result in specific local impacts including the need to more regularly close the London Road level crossing.

2.21 For the peripheral routes testing, the assumption has been made by OCC that the London Road crossing will be closed permanently to through traffic at points immediately north and south of the current rail level crossing. The roads to the immediate north and south will be retained and turning areas provided providing access to developments and side roads to either side of the level crossing. Network Rail have confirmed to Oxfordshire County Council that this is their preferred option at the time of writing this report.

MATRIX DEVELOPMENT

2.22 WebTAG guidance recommends that an uncertainty log is developed in order to determine a 'core' scenario for forecasting and that a range of sensitivity tests and/or alternative scenarios will also be developed to account for future uncertainty. For this stage of the assessment of the peripheral routes, only the core scenario will be used. The uncertainty log will then be used in conjunction with the revised 2013 base model as detailed above in order to create robust forecasts for the preferred option.

2.23 In the uncertainty log, land use developments are categorised based on the WebTAG criteria given in the following table:

Table 1: **WebTAG Unit 3.15.5: The Treatment of Uncertainty in Model Forecasting**

Probability of the Input	**Status**
Near certain: The outcome will happen or there is a high probability that it will happen.	- Intent announced by proponent to regulatory agencies. - Approved development proposals. - Projects under construction.
More than likely: The outcome is likely to happen but there is some uncertainty.	- Submission of planning or consent application imminent. - Development application within the consent process.
Reasonably foreseeable: The outcome may happen, but there is significant uncertainty.	- Identified within a development plan. - Not directly associated with the transport strategy/ scheme, but may occur if the strategy/scheme is implemented. - Development conditional upon the transport strategy/scheme proceeding. - Or, a committed policy goal, subject to tests (e.g. of deliverability) whose outcomes are subject to significant uncertainty.
Hypothetical: There is considerable uncertainty whether the outcome will ever happen.	- Conjecture based upon currently available information. - Discussed on a conceptual basis. - One of a number of possible inputs in an initial consultation process. - Or, a policy aspiration.

2.24 The land use developments that were to be included in the reference case scenario matrices are those categorised as near certain and more than likely. The uncertainty log developed is given in **Appendix B**.

2.25 As discussed above, the reference case is that of All Proposed Growth. As such, a future year has not been explicitly defined but it has been assumed that all developments that fall within the core scenario are 100% built out.

2.26 Trip rates for each development have been used to convert the development size into a predicted number of vehicle trip ends for use in the AM and PM peak hour matrices. Where data was available, trip rates from the relevant Transport Assessments have been used. Where not available, trip rates have been taken from the TRICS database.

2.27 For the North West Bicester development, residential trip rates were supplied by the consultant working on behalf of the developer. These rates, when applied to the number of dwellings, were set at a level to generate the number of trips for both the dwellings, the employment, the retail and the schools planned for the development. This trip rate was agreed between the consultant and OCC as the 85th percentile vehicle trips to be used for this assessment.

2.28 Trip ends have been converted to origin and destination distributions based on the existing pattern of trips in the matrix from a combination of nearby zones/zones with similar demographic characteristics as defined as part of the Bicester Movement Study carried out in 2012/2013.

2.29 Generally, the methodology often adopted for future year forecasting involves adding committed development to growthed future year matrices and then applying a constraint factor in order to reduce the overall matrix total growth to that predicted by the National Trip End Model (NTEM) forecasts via the TEMPro (Trip End Model Presentation Program). However, this is not possible in this case due to the scale of development predicted within and around Bicester in the APG scenario and due to the moderate size of the modelled network area. Although the predicted growth is included in the TEMPro forecasts, it is assumed to be spread over a much larger area of the county rather than focused on Bicester as set out in the Local Plan. The process of constraining to a Bicester area TEMPro factor would therefore result in a significant reduction in traffic in a large number of zones that do not have any predicted committed development occurring in them. This particularly affects the cordon zones which correspond to the M40 if the reduction is applied on a pro rata basis as these zones have the highest number of trips. This reduction is not considered realistic and as such, an alternative methodology for matrix building has been used where the matrices consist of the base 2012 traffic plus all of the predicted committed development trips. This is considered a robust estimate of the core growth traffic for the Bicester area modelling.

3 Option 1: All Proposed Growth (APG)

3.1 The core growth APG matrix as detailed above was assigned to the Option 1 APG networks for the AM and PM peak hour periods using the SATURN suite of programs.

3.2 **Figures 1 and 2** show bandwidth plots of the traffic flows from the Option 1 APG models for the AM and PM peak hour models respectively. All flows are in PCU's.

3.3 **Figures 3 and 4** give difference plots between Option 1 APG and the 2012 base models where a positive number is an increase with the Option 1 APG model.

3.4 As can be seen from **Figures 3 and 4**, there is a general increase in traffic in the Option 1 APG models as would be expected. The negative values that correspond to decreases in traffic on certain links in the Option 1 APG models are due to rerouting of traffic caused by newly available alternative routes or increase in capacity restraint on certain links such as the closure of the London Road level crossing or the provision of the north-western link associated with the NW Bicester development. Where links are pale grey and no numbers are presented, this is due to a change in the modelled network which Saturn cannot compare directly rather than a lack of flows on these links.

4 Option 2: Optimisation of Sustainable Transport (OST)

4.1 Option 2 looks to test the implications of other affects on travel demand. When the North West Bicester development site was announced as an eco-development the Department for Communities and Local Government provided Cherwell District Council with funding for demonstration eco-projects within the existing town. One of these was a travel behaviour demonstration project which aimed to increase the number of trips made by sustainable modes within the town from the current 31% to 40% by concentrating on shorter distance trips.

4.2 The network is to be that constructed to accommodate the APG scenario above but with no proposed peripheral route.

4.3 The matrix has been altered to proxy for the modal shift measures. Initially, a cordon was taken around Bicester using the A4095, A4421, A41 and B4030 as the boundary but including trips on these routes. This allowed all trips with a trip end point within Bicester or travelling through the central area to be isolated from those with neither trip end within Bicester.

4.4 Trips from this cordoned matrix that were more than 4km were then taken out as these are assumed to have too great a travel distance to be affected by the travel behaviour project based on 4.0km being used as an assumed reasonable average cycle trip distance.

4.5 Based on the data supplied by OCC that sustainable modes account for 31% of the shorter distance trips, the remaining car trips in the matrix were assumed to be the other 69%. (As the model is a highway model, public transport trips are not included directly but are modelled as bus routes and frequencies with no details of patronage. As such, no public transport matrices were available to further refine the above assumptions.)

4.6 The target of increasing the current shorter distance trips from 31% to 40% requires a corresponding decrease of 9% of the total trips applied to the existing light vehicle trips which is equivalent to applying a factor of 60/69 to the <4km cordon matrix detailed above. This resulted in a net reduction in trips from 7344 by 957 to 6386 in AM peak light vehicle matrix and from 8036 by 1048 to 6988 in the PM peak matrix for the <4km cordon trips. All trips greater than 4km or outside of the cordoned light vehicle matrix have been retained.

4.7 All heavy vehicle trips have been retained as these would be unlikely to be affected by the travel behaviour projects due to the nature of the trips themselves.

4.8 The resultant Optimisation of Sustainable Transport matrices (OST) were assigned to the Option 1 network to produce the Option 2 OST Scenario.

4.9 **Figures 5 and 6** show bandwidth plots of the traffic flows from the Option 2 OST models for the AM and PM peak hour models respectively. All flows are in PCU's.

4.10 **Figures 7 and 8** give difference plots between Option 2 OST and the Option 1 APG models where a positive number is an increase with the Option 2 OST model.

4.11 As can be seen from **Figures 7 and 8**, there is a general reduction in traffic in Bicester with optimisation of sustainable transport matrix alterations.

4.12 Please note that this modelling does not take any account of how achievable it would be to produce this modal shift. The matrices created for Option 2 are *not* carried through to the options 3 to 5.

5 Option 3 – Peripheral Route 1b

5.1 Option 3 is based on Option 1 APB but includes route 1b from the Strategic Highway Corridor Options: Initial Sifting Report (Feb 2013). This route consists of a north west route running from the Vendee Drive junction with the A4095, around the outskirts of the NW Bicester development site but within the red line boundary to the B4100 and across to the north of Caversfield to join with the A4421 Buckingham Road. The Route 1b corridor is shown on **Figure 9**. The alignment of this route is indicative only and further assessment of the alignment with regards to developments in the area would need to be carried out were the option to be taken forward.

5.2 New links for this route were coded as 40mph single carriageway between its junction with Vendee Drive and the B4100 and a 50mph speed limit between the B4100 and the A4421.

5.3 The new link joins the Vendee Drive/Middleton Stoney Road roundabout as a new approach/exit to the existing roundabout. New roundabout junctions were included where the new link intersects with Bucknell Road and the B4100. The existing three arm priority junction of the A4421 with Bicester Road was realigned and recoded as a four arm roundabout for the northern most junction of the new link.

5.4 The existing A4095 between Vendee Drive and the B4100 and the new link coded as part of the NW Bicester development infrastructure were reduced to a 30mph speed limit.

5.5 The APG matrix was assigned to the Option 3 Route 1b network. **Figures 10 and 11** show bandwidth plots of the traffic flows from the Option 3 R1b models for the AM and PM peak hour models respectively. All flows are in PCU's.

5.6 **Figures 12 and 13** give difference plots between Option 3 R1b and the Option 1 APG models where a positive number is an increase with the Option 3 R1b model.

5.7 The large number of 'blue' reductions in link flow are due to traffic rerouting onto the new link. As stated earlier, these links do not show flows on a difference plot as SATURN is unable to produce the flows on 'grey' links that have different node numbers between models. The positive flows on the new links are shown in **Figures 10 and 11**.

6 Option 4 – Peripheral Route 2c

6.1 Option 4 is based on Option 1 APB but includes route 1b from the Strategic Highway Corridor Options: Initial Sifting Report (Feb 2013). This route consists of a new link running from the A41 junction with Vendee Drive east towards Graven Hill and then skirts southwards and round Graven Hill making use of the development site's proposed road to then link back in with the A41 at its junction with the new link road up to the A4421 included as part of the Option 1 All Proposed Growth scenario. The Route 2c corridor is shown on **Figure 14**.

6.2 New links for this route were coded as 40mph single carriageway.

6.3 The new route joins at Wendlebury Road/Vendee Drive as a new approach to the existing 3 arm priority junction to the east of the A41/Vendee Drive roundabout. New roundabout junctions were included to the south and west of Graven Hill as access points to the development. The north-eastern end of the new route ties into the access for Graven Hill onto the A41.

6.4 The junction of the A41 with Vendee Drive was upgraded to incorporate the additional links required for Route 2c.

6.5 The APG matrix was assigned to the Option 4 Route 2c network. **Figures 15 and 16** show bandwidth plots of the traffic flows from the Option 4 R2c models for the AM and PM peak hour models respectively. All flows are in PCU's.

6.6 **Figures 17 and 18** give difference plots between Option 4 R2c and the Option 1 APG models where a positive number is an increase with the Option 4 R2c model.

6.7 The 'blue' reductions in link flow are most significantly on the A41 between its junctions with Vendee Drive and the B4100 London Road due to traffic rerouting onto the new link where a reduction of approximately 1400 and 1500 PCUs (two-way) is seen for the AM and PM peak periods respectively. As stated earlier, these links do not show flows on a difference plot as SATURN is unable to produce the flows on 'grey' links that have different node numbers between models. The positive flows on the new links are shown in **Figures 15 and 16**.

7 Option 5 – Peripheral Route 3

7.1 Option 5 is based on Option 4 Route 2c. However, the south-eastern tie in to the existing network is further to the southeast on the A41 at the junction with Wendlebury Road as shown in the Strategic Highway Corridor Options: Initial Sifting Report (Feb 2013). This route retains the link skirting to the south of the Graven Hill development to link back in with the A41 at its junction with the new link road up to the A4421 included as part of the Option 1 All Proposed Growth scenario. The Route 3 corridor is shown on **Figure 19**.

7.2 New links for this route were coded as 40mph single carriageway.

7.3 The new route joins at the A41/Wendlebury Road with a revised junction layout consisting of a 5 arm roundabout. New roundabout junctions were included to the south and west of Graven Hill as access points to the development. The north-eastern end of the new route ties into the access for Graven Hill onto the A41.

7.4 The APG matrix was assigned to the Option 5 Route 3 network. **Figures 20 and 21** show bandwidth plots of the traffic flows from the Option 5 R3 models for the AM and PM peak hour models respectively. All flows are in PCU's.

7.5 **Figures 22 and 23** give difference plots between Option 5 R3 and the Option 1 APG models where a positive number is an increase with the Option 5 R3 model.

7.6 Again, the 'blue' reductions in link flow are most significantly on the A41 between its junctions with Vendee Drive and the B4100 London Road due to traffic rerouting onto the new link. A reduction of approximately 1500 PCUs (two-way) is seen in each peak period. As stated earlier, these links do not show flows on a difference plot as SATURN is unable to produce the flows on 'grey' links that have different node numbers between models. The positive flows on the new links are shown in **Figures 20 and 21**.

8 Model Comparisons

8.1 The following tables give the summary network statistics for each option by peak period.

Table 2: **AM Peak Model Network Summary Statistics**

Option:	2012	1	2	3	4	5
Total Travel Time (PCU Hrs)	3,078	4,127	4,067	4,087	4,019	4,026
Total Travel Distance (PCU Kms)	237,614	268,176	267,005	268,244	267,059	266,974
Average Speed (Kph)	77.2	65.0	65.7	65.6	66.5	66.3
Over Capacity Queues PCU (Hrs)	278	575	553	558	506	526

Table 3: **PM Peak Model Network Summary Statistics**

Option:	2012	1	2	3	4	5
Total Travel Time (PCU Hrs)	3,164	4,358	4,275	4,300	4,269	4,255
Total Travel Distance (PCU Kms)	243,940	274,467	273,081	274,396	273,238	273,507
Average Speed (Kph)	77.0	63.0	63.9	63.8	64.0	64.3
Over Capacity Queues PCU (Hrs)	188	675	635	641	613	615

8.2 As can be seen from the tables above, Option 1 is the worst performing option in terms of both over capacity queuing, average speed and travel time. This is a significant increase over the 2012 levels.

8.3 Of the Options, Route 2c (Option 4) for the AM peak performs best in these same three areas. For the PM peak Route 2c (Option 4) performs best for over capacity queues but Route 3 (Option 5) performs better for average speed and total travel time.

8.4 Option 2 has the lowest total travel distance. This is as expected as there are fewer vehicle trips in the matrices.

8.5 The following tables give link flows in PCUs on key links across the network for each Option:

Table 4: **AM Peak Modelled Option Link Demand Flows (PCUs)**

Link	Anode	Bnode	Option:	1	2	3	4	5
A41 Between M40 and Wendlebury Road	10195	22215	NEB	1496	1497	1489	1608	1511
	40297	10190	SWB	1322	1338	1288	1481	1490
Vendee Drive	22101	22087	NWB	304	292	354	341	334
	22087	22101	SEB	520	532	544	1352	863
Middleton Stoney Road (East of Vendee Drive)	30025	30470	EB	444	448	372	372	298
	30470	30025	WB	334	306	345	399	355
NW Bicester Development Link Road	30703	30705	NEB	530	521	306	527	464
	30705	30703	SWB	495	498	206	588	551
A4095 (West of Banbury Road)	30370	30020	EB	1023	978	1056	1008	981
	30020	30370	WB	565	548	235	629	594
A4095 (West of A4421)	30295	30015	EB	1191	1193	1198	1183	1143
	30015	30295	WB	797	800	555	800	794
A4421 Skirmingdish Lane	22245	22256	SEB	1429	1436	1521	1392	1424
	22256	22245	WB	905	889	894	833	837
A4421 Wretchwick Way	30255	30270	NEB	460	450	451	638	576
	30270	30255	SWB	443	429	417	425	390
A41 (East of Oxford Road)	22205	90405	EB	1938	1900	1900	1332	1147
	90405	22206	WB	1650	1630	1630	854	901
Kings End	30030	30460	NB	1228	1200	1105	1263	1300
	30460	30030	SB	1014	1006	1025	1009	1019
Field Street	30040	30045	NB	1396	1329	1272	1328	1367
	30045	30040	SB	1174	1117	1145	1055	1060
Banbury Road (North of Field Street)	30045	30200	NB	330	310	328	329	321
	30200	30045	SB	373	343	312	359	352
Buckingham Road (North of Field Street)	30045	30591	NB	1060	1012	930	990	1039
	30591	30045	SB	794	766	819	688	700
Route 1b North West Link (South of Bucknell Rd)	23000	23001	NEB	NA	NA	357	NA	NA
	23001	23000	SWB	NA	NA	355	NA	NA
Route 2c (South of Graven Hill)	23102	23103	EB	NA	NA	NA	707	NA
	23103	23102	WB	NA	NA	NA	627	NA
Route 3 (South of Graven Hill)	23102	23103	EB	NA	NA	NA	NA	1022
	23103	23102	WB	NA	NA	NA	NA	689

Table 5: **PM Peak Modelled Option Link Flows (PCUs)**

Link	Anode	Bnode	Option:	1	2	3	4	5
A41 Between M40 and Wendlebury Road	10195	22215	NEB	1570	1607	1560	1651	1696
	40297	10190	SWB	1296	1313	1289	1303	1310
Vendee Drive	22101	22087	NWB	743	735	800	909	897
	22087	22101	SEB	433	423	499	463	400
Middleton Stoney Road (East of Vendee Drive)	30025	30470	EB	389	338	429	381	365
	30470	30025	WB	365	346	425	349	309
NW Bicester Development Link Road	30703	30705	NEB	571	550	326	594	571
	30705	30703	SWB	571	550	284	546	511
A4095 (West of Banbury Road)	30370	30020	EB	761	729	588	724	714
	30020	30370	WB	711	675	580	677	644
A4095 (West of A4421)	30295	30015	EB	408	410	314	349	369
	30015	30295	WB	1389	1357	1561	1334	1343
A4421 Skirmingdish Lane	22245	22256	SEB	1088	1072	1068	1000	1022
	22256	22245	WB	1609	1528	1633	1576	1600
A4421 Wretchwick Way	30255	30270	NEB	687	660	656	596	608
	30270	30255	SWB	762	760	741	677	631
A41 (East of Oxford Road)	22205	90405	EB	1767	1741	1754	887	962
	90405	22206	WB	1733	1698	1685	1091	1061
Kings End	30030	30460	NB	1157	1125	1084	1226	1181
	30460	30030	SB	1099	1078	1082	1094	1094
Field Street	30040	30045	NB	1286	1250	1215	1254	1252
	30045	30040	SB	1159	1119	1127	1190	1196
Banbury Road (North of Field Street)	30045	30200	NB	848	760	621	783	778
	30200	30045	SB	440	420	438	443	442
Buckingham Road (North of Field Street)	30045	30591	NB	755	747	809	741	744
	30591	30045	SB	1035	956	904	1017	1025
North West Link (Route 1b)	23000	23001	NEB	NA	NA	335	NA	NA
	23001	23000	SWB	NA	NA	379	NA	NA
Route 2c (South of Graven Hill)	23102	23103	EB	NA	NA	NA	741	NA
	23103	23102	WB	NA	NA	NA	532	NA
Route 3 (South of Graven Hill)	23102	23103	EB	NA	NA	NA	NA	708
	23103	23102	WB	NA	NA	NA	NA	582

8.6 Options 4 and 5 show significant reductions on the A41 (East of Oxford Road). Option 3 sees the largest reduction on Kings End northbound although the southbound flows on this link remains largely static in all options.

8.7 Field Street remains largely unchanged in all options. This is likely due to the vehicles using this link having a trip end near to the link limiting the routing alternatives.

8.8 Volume over capacity (V/C) ratios are given in **Figures 24 to 33** for each Option in the AM and PM peak periods. Only the links where the V/C's are in excess of 90% are shown.

8.9 The number of links and junctions over 90% V/C are given in the following tables:

Table 6: **Number of Modelled Links and Junctions over 90% V/C (AM Peak)**

Option	Link	Junction
2012	12	17
1	44	83
2	39	75
3	42	76
4	36	72
5	38	75

Table 7: **Number of Modelled Links and Junctions over 90% V/C (PM Peak)**

Option	Link	Junction
2012	15	19
1	59	102
2	56	92
3	50	92
4	49	84
5	48	83

8.10 As can be seen from the above tables, Option 4 has the least amount of links or junctions over 90% V/C in the AM peak. In the PM peak, Option 5 has the least number of Links and junction over 90%.

9 Economic Assessment

9.1 In accordance with WebTAG guidance on the Transport Economic Efficiency Sub-Objectives (TAG Unit 3.5.2), the Transport User Benefit Appraisal program, TUBA, (version 1.9) has been used to estimate the benefits derived from a scheme in terms of time and vehicle operating cost savings. TUBA assesses the whole life costs and benefits of transport schemes using matrices of costs, in terms of distance and time, and trips from the transport model. The program calculates user benefits and changes in revenues and produces indicators of a project worth.

TUBA Inputs

9.2 There are three main inputs to the TUBA process:

- Economic parameters
- Scheme specific control data
- Matrix data from the traffic model

Economic Parameters

9.3 In accordance with WebTAG guidance, the standard TUBA economics file has been used. This file provides details of tax rates, Values Of Time (VOT) and Vehicle Operating Cost (VOC) parameters and growth forecasts for VOT and VOC.

Scheme Specific Control Data

9.4 The control data file used by TUBA is scheme specific and defines the appraisal period, sets out the scheme costs, provides details of model specific data (e.g. time slices and user classes) and defines the annualisation factors (i.e. to convert model time periods to their annual equivalent).

9.5 For the purposes of the TUBA assessment the current year has been taken as 2013 and, with an opening year of 2017, the horizon year is 2076, thus providing a 60 year assessment period in accordance with WebTAG guidance (TAG Unit 3.5.2). A second year of 2031 is also defined within TUBA for assessment. However, as only one modelled 'year' scenario is available from the SATURN model but TUBA requires a minimum of two modelled years, the same model outputs have been used for both of the scheme appraisal years (2017 and 2031) input to

TUBA. This means there is an assumption that all growth and infrastructure occurs, and is complete, by the first assessment year of 2017 and stays the same until 2031.

9.6 The time periods from the transport model were:

- 0800 – 0900 (AM peak); and
- 1700 – 1800 (PM peak).

9.7 A simplistic approach for the calculation of annualisation factors has been taken where the factors are assumed to be the number of weekdays in a year (253) for each peak period.

9.8 The total annual hours assessed therefore are 506 (out of an annual total of 8760 hours). This is not considered to be a robust assessment and further assessment should be made to refine these factors post model revalidation based on survey data.

9.9 The following vehicle mode types have been used in the TUBA assessment:

- Cars
- Light Goods Vehicles (LGV)
- Medium Goods Vehicles (OGV1); and
- Heavy Goods (OGV2)

9.10 Although only 2 vehicle classes were available from the model (Lights and Heavies), it was deemed appropriate to split the model outputs into the four classes for assessment with TUBA. As such the Lights vehicle class is assumed to consist of 90% car and 10% light goods vehicles and the heavies vehicle class is assumed to consist of 60% OGV1 and 40% OGV2. This allows TUBA to take account of different vehicle type impacts in the assessment. Separate vehicle matrices for each class or factors derived from count information as a minimum should be used for the post model revalidation economic assessments.

9.11 All scheme costs have been entered as Factor Costs to allow TUBA to convert to Market Prices.

9.12 All scheme costs have been assumed to occur in 2016.

9.13 The Retail Price Index (RPI) value of 246.8 has been used in all assessments. This is equivalent to the December 2012 figure which was the latest available at the time of carrying out the assessments.

9.14 All costs have been assumed to be attributable to TUBA Mode 1 (i.e. Private Mode).

9.15 Costs for construction were not available for input to the TUBA assessments. Therefore, a generic figure of £1,000 has been assumed for all options as a proxy for real values. As such, the resultant Present Value Costs (PVC) from the TUBA assessment should not be used. Further as the Benefit Cost Ratio (BCR) uses the PVC in its calculation, the BCR should also be disregarded in the assessment. Only the Present Value Benefits should be used for analysis of the results and as only one modelled year is available for input to the TUBA, the PVB should only be used to provide a ranking of the options compared to the reference case.

Matrix Data from the Transport Model

9.16 Forecast flows from the Bicester Options models, as detailed in the previous sections have been used in the economic assessments.

9.17 Trip Matrices have been skimmed from the SATURN assignments for each vehicle type (Lights and Heavies) for both the "All Proposed Growth" and the "Optimisation of Sustainable Transport" Matrices.

9.18 Each Option has then been skimmed to produce time and distance matrices by origin destination pair. In accordance with TUBA guidance, a factor of 0.00028 has been used to convert the time matrices from seconds to hours and a factor of 0.001 has been used to convert the distance matrices from metres to kilometres.

9.19 The following TUBA assessments have been carried out with Option 1 being taken as the reference case for all assessments:

- Option 1 versus Option 2
- Option 1 versus Option 3
- Option 1 versus Option 4
- Option 1 versus Option 5

9.20 Checks have been carried out to ensure the correct matrices have been input into the TUBA assessment process.

TUBA Error / Warning Message Analysis

9.21 TUBA outputs error and warning messages generated during the assessment. These were checked and are summarised below.

9.22 Errors: No scheme related errors have been recorded. The "Table FUEL_COST_CHANGES" error was present but this relates to data being specified in the economics parameters file for horizon years post 2076 and can therefore be ignored.

9.23 Warnings: A large number of warnings were generated for each of the TUBA assessments. This is expected in TUBA and is not a cause for concern as long as they can be justified. The warnings were checked and summarised below:

- Ratio of travel times higher than the limit (none serious)
- Speeds less than limit
- Speeds greater than limit

9.24 The warnings have been analysed and are due to changes in routing with the reduction in traffic in Option 2 or with the introduction of new links for options 3 to 5 which affect travel time through the availability of alternative routes. They are therefore not considered a cause for concern.

TUBA Results

9.25 Again, it should be noted that the Benefit Cost Ratio cannot be used directly as no costs for construction have been supplied. Furthermore, as only one modelled year is available, the Present Value Benefits (PVB) can only be used as an indicator as to whether the scheme to be tested is an improvement over the reference case and *the absolute value should not be used*.

9.26 Option 1 versus Option 2: Option 2 shows a positive PVB and can be considered an improvement in terms of travel time for vehicular journeys when compared to Option 1.

9.27 Option 1 versus Option 3: Option 3 shows a positive PVB and can be considered an improvement in terms of travel time for vehicular journeys when compared to Option 1. The quantity of the PVB indicates less of a positive benefit than that shown by Option 2 versus Option 1.

9.28 Option 1 versus Option 4: Option 4 shows a positive PVB and can be considered an improvement in terms of travel time for vehicular journeys when compared to Option 1. The quantity of the PVB indicates more of a positive benefit than that shown by Option 2 or Option 3 versus Option 1.

9.29 Option 1 versus Option 5: Option 5 shows a positive PVB and can be considered an improvement in terms of travel time for vehicular journeys when compared to Option 1. The quantity of the PVB indicates more of a positive benefit than that shown by Options 2, 3 or 4 versus Option 1.

Order of Ranking

9.30 In summary, the options increase in benefit compared to Option 1 in the following order:

- Option 2 (OST)
- Option 3 (Route 1b)
- Option 4 (Route 2c)
- Option 5 (Route 3)

Least benefit

Most benefit

10 Conclusions

10.1 The inclusion of the predicted growth for the Bicester area in Option 1 results in significant increases in over capacity queuing, average speed and total travel time from the 2012 base.

10.2 Of the Options, Route 2c (Option 4) for the AM peak performs best in these same three areas. For the PM peak Route 2c (Option 4) performs best for over capacity queues but Route 3 (Option 5) performs better for average speed and total travel time.

10.3 Option 2 has the lowest total travel distance. This is as expected as there are fewer vehicle trips in the matrices.

10.4 As can be seen from the above tables, Option 4 has the least amount of links or junctions over 90% V/C in the AM peak. In the PM peak, Option 5 has the least number of Links and junction over 90%.

10.5 Of the known over capacity roads in the area, Options 4 and 5 show significant reductions on the A41 (East of Oxford Road). Option 3 sees the largest reduction on Kings End northbound although the southbound flows on this link remains largely static in all options. Field Street remains largely unchanged in all options. This is likely due to the vehicles using this link having a trip end near to the link limiting the routing alternatives.

10.6 The Benefit Cost Ratio and the Present Value Costs produced by TUBA cannot be used directly in the assessment due to a lack of cost information and the lack of additional forecast year models. For the same reasons, the Present Value Benefit from TUBA can only be used to rank the options in order of benefit.

10.7 TUBA indicates that the options increase in benefit compared to Option 1 in the following order:

- Option 2 (OST)
- Option 3 (Route 1b)
- Option 4 (Route 2c)
- Option 5 (Route 3)

Least benefit

Most benefit

Appendix A – Option 1 APG Reference Case Network Plans

Appendix B – Uncertainty Log

Input	Uncertainty	Comments
393 house/2,900sqm employment development at NW Bicester exemplar	Near certain	Site approved and S106 signed. Expecting to implement by the end of 2013.
4,607 house/25.5Ha employment development at NW Bicester Masterplan	Near certain	Site accepted by central government for eco-development. Is in the emerging Local Plan as BICESTER 1. Masterplan to be submitted for SPD in Spring 2014.
Additional 1,000 houses on NW Bicester Masterplan	More than likely	This is additional housing numbers than Cherwell District Council have previously discussed but can be fitted within the red line boundary of the Masterplan site
1,900 house/104,000 sqm employment development at Graven Hill	Near certain	BICESTER 2 in the proposed Local Plan. Approved subject to S106
1,631 house development at SW Bicester	Near certain	Under construction.
720 house development at SW Bicester	More than likely	Site identified in emerging Local Plan as BICESTER 3. Application going to Planning Committee imminently
Additional 100 houses at SW Bicester	More than likely	Currently being considered
46,200 sqm employment development at Bicester Business Park, including relocation of Tesco store	More than likely	Outline permission granted in 2010. Identified in the proposed Local Plan as BICESTER 4.
Town centre redevelopment phase 1	Certain	Has just opened, including superstore, cinema and smaller retail units
Town centre redevelopment phase 2	Reasonably foreseeable	Proposed in the emerging Local Plan as BICESTER 6. CDC considering now that phase 1 is open.
RAF Bicester	Near certain	In the Local Plan as BICESTER 8. Plans being drawn up.
19,800 sqm employment at Bicester Gateway	More than likely	Identified in the proposed Local Plan submission as BICESTER 10.
26,400 sqm employment	More than	Identified in the proposed Local Plan submission

development at NE Bicester Business Park	likely	document as BICESTER 11.
800 houses / 64,812 sqm employment development at SE Bicester	More than likely	Identified in the emerging Local Plan as BICESTER 12.
Bicester Village phase 4	Near certain	Approval subject to S106
Caversfield, Fringford Lane	Near Certain	200 dwellings
RAF Bicester (new houses in Caversfield)	Certain	Under construction