Position Statement

Date	May 2012
Subject	Highways Agency Response to the South Gloucestershire Core Strategy

1 Introduction

1.1 This statement sets out the Highways Agency's (HA) position with regards to the South Gloucestershire Core Strategy proposals in respect of the Cribbs / Patchway New Neighbourhood (CPNN), East of Harry Stoke New Neighbourhood (EHSNN) and North Yate New Neighbourhood (NYNN). The HA has focused on these developments as they are the largest strategic sites in the Core Strategy and hence are likely to generate the highest levels of demand and potential impact on the strategic road network (SRN).

1.2 The HA is responsible for managing the safe and efficient operation of England's strategic road network (SRN). In the case of this written statement, the HA's principal interest is in the operation of the M5 between junction 18 (J18) and junction 15 (J15); the M4 between junction 20 (J20) and junction 18 (J18) and also the M32. The HA also has a wider role to work co-operatively, with partners, within the framework of the Government's policies to deliver sustainable economic development. Patterns of growth should be managed so that significant development is focused in locations which are or can be made sustainable.

1.3 In order to reach an informed decision on the implications of the Core Strategy for the strategic road network (SRN) the HA have been guided by the following policy documentation:

- National Planning Policy Framework
- Circular 02/2007; and the
- Guidance on Transport Assessments

1.4 In reaching a view, the HA favours a sequential approach where:

- New developments are located in areas that encourage the development of sustainable communities (reduce the need to travel)
- Road performance can be improved through better network management (such as the Managed Motorways scheme that is scheduled for completion in 2013); and where
- Smarter journey choices can be made through the provision of high quality walking, cycling and public transport provision.

1.5 Only after these considerations have been taken into account, will the HA then determine the requirement for capacity improvements.

1.6 In preparing this submission, the HA has worked collaboratively with South Gloucestershire Council (SGC) and has undertaken traffic modelling assessments to inform its understanding of the implications of the proposed allocations set out in the Core Strategy and specifically those identified in paragraph 1.1.

1.7 The HA is now working towards agreeing a Statement of Common Ground with SGC which will be presented in advance of highway matters being discussed at the forthcoming EiP.

2 Location of Development

2.1 It is the HA's view that the significant housing, community and employment growth proposals of the emerging Core Strategy, are provided for in sustainable locations and that the plan is likely to move towards the development of more sustainable communities. Therefore, the HA is broadly supportive of the approach which SGC has taken to managing the pattern of future development.

2.2 It has previously been recognised that there is an imbalance in the location of employment and housing in the greater Bristol urban area and the Core Strategy goes some way to re-balancing this by provision of a significant amount of housing close to jobs in the northern Bristol area.

2.3 The Post-Submission changes to the Core Strategy provides for 34,000m2 of comparison retail floor space at The Mall, which is in close proximity to the M5. The HA is not convinced that this proposal is a demonstrably sustainable pattern for such a significant level of retail growth or that a significant expansion of a current out of centre retail location accords with Government policy set out in the town centre first policy in the NPPF.

2.4 Whilst it is not the HA's role to determine what levels of retail growth are appropriate, the HA does have an interest in the impact of the level of growth particularly where there is likely to be an impact on the SRN. In this respect the HA looks to the Inspector for assurance through the Hearing process that both the scale and location of this aspect of retail growth is the most appropriate in the circumstances and that the opportunity cost of this impact is acceptable.

2.5 The HA interest in this is most sharply felt in relation to impacts on network capacity and performance including safety. Development at The Mall will absorb capacity in the network and the HA would like to be sure that such a loss of capacity meets a defined and evidenced based need. Simply, the HA would like to be assured that the Inspector is convinced that both the scale and location of comparison retail growth at the Mall should be provided for.

2.6 The HA notes the NPPF policy regarding: the vitality of existing town centres (para 23); the requirement to objectively meet needs (para 17); and that patterns of growth should be managed to make use of sustainable locations (para 17).

3 Transport Evidence Base Assessment

3.1 SGC has completed a multi modal traffic modelling exercise using the Greater Bristol Transport Strategy (GBATS) v3 model in order to underpin and support the development of the Core Strategy highway and transport evidence base for the North Fringe of the Bristol Urban Area. The modelling work has been undertaken at a necessarily strategic level and is considered proportionate in terms of assessing future weekday morning and evening peak period travel demand in the North Fringe. The model has been fully calibrated and validated to a 2011 base year and is therefore considered fit for purpose.

3.2 Although the plan period for the Core Strategy is 2026, SGC have undertaken forecast year assessments to 2031. The effect of which is that the actual Core Strategy impacts at 2026 can be expected to be lower than those predicted in the model at 2031. This is considered acceptable by the HA.

3.3 Two forecast year assessments were undertaken by SGC which included a reference case which assumed that the Cribbs / Patchway (CPNN) and East of Harry Stoke (EHSNN) new neighbourhoods were not developed (and the accompanying transport package not provided) and a Do Something which assumed that both neighbourhoods are developed together with an appropriate transport package.

Reference Case

3.4 The purpose of the 2031 Reference case assessment was to act as a comparator with the Do Something enabling the impact of the new neighbourhoods in the North Fringe to be isolated. The Reference Case comprised of the following development:-

- Recently completed sites
- Sites with permission (under construction and near certain)
- Local Plan Allocations which were reasonably foreseeable to be constructed
- Core Strategy Allocations at North Yate and Thornbury Housing Opportunity Area
- Background traffic growth from developments outside South Gloucestershire

Reference case network changes included:

- Recent highway improvements
- Greater Bristol Bus Network improvements
- A38 Cribbs Causeway Distributor Road (part of the Charlton Hayes development); and the
- M4/M5 Managed Motorways scheme

Do Something

3.5 The Do Something case included all of the above plus the provision of 8,450 dwellings and 4,825 jobs at CPNN and EHSNN together with a package of transport improvements defined in policy CS7 of the Core Strategy document including:-

- Additional bus routes linking CPNN and EHSNN
- A new rail link between Henbury and Bristol Temple Meads with a new station at Filton
- A new rail station at Ashley Hill
- Increased frequency on the Bristol Metro rail network including increased services to the North Fringe
- Stoke Gifford Transport Link
- North Fringe to Hengrove Rapid Transit Route
- Increased capacity for traffic at key junctions on the local road network and SRN

3.6 The HA welcomes the provision of a comprehensive public transport package allied to the CPNN and EHSNN as it offers the potential to provide a step change in travel behaviour in the North Fringe.

3.7 Despite the above improvements, the Do Something assessment revealed that further mitigation was required to the SRN in order to safeguard the operational performance of M5 J16 and M5 J17 and was hence re-run with a series of highway improvements which are discussed in paragraph 3.15.

3.8 In order to assess the impact on the SRN in more detail, the HA undertook micro-simulation modelling assessments using a calibrated and validated PARAMICS model in accordance with the Design Manual for Roads and Bridges. The model assessments include the junctions identified in paragraph 1.1 above and for the forecast years identified in paragraph 2.3.

3.9 Demand data was taken from the GBATS v3 strategic model as the outputs from one model can be used as inputs to another. This also ensured that there was a level of compatibility between the two models and is standard industry procedure.

3.10 The benefits of a micro-simulation model assessment to the HA is that it provides more detail on the operation of junctions and better reflects lane utilisation and driver behaviour. In particular the HA wished to consider whether the proposals created queuing on slip roads which would block back onto the motorway mainline.

3.11 The outcomes of the weekday AM and PM peak microsimulation modelling exercise are outlined in the following section.

4 Outcomes

Introduction

4.1 Base Year, 2031 Reference Case and Do Something PARAMICS runs were undertaken. The impact of consented/committed schemes, small local plan allocations and background traffic growth was established by identifying the differences in operational impacts between the Base Year and the 2031 Reference Case.

4.2 The impact of the CPNN and EHSNN developments was established by identifying the differences in operational impacts between the 2031 Reference Case and 2031 Do Something model assessments. It should be noted that the NYNN was included in the Reference Case and therefore a different mode of assessment was required. This is discussed later.

4.3 Operational impacts were measured from a combination of the following:-

- Queuing on slip roads (PARAMICS model output)
- Journey times on the network (PARAMICS model output);
- Overall network performance (PARAMICS model output); and
- Volume / Capacity Ratios (SATURN strategic model output) – a proxy for 'network stress' where:

  < 85% = within capacity

  85% to 100% = at or slightly above theoretical capacity giving rise to some flow instability

  >100% = significantly over capacity leading to frequent flow breakdown

4.4 The outcomes of the modelling exercise are shown at Appendix A.

Base Year comparison with 2031 Reference Case

4.5 The results show that mean speeds will deteriorate across the network. Part of this reason can be attributed to the inclusion of the managed motorways scheme (MMS) in the reference case where it is assumed that it will be in operation between Junction 19 and 20 of the M4, and between Junctions 15 and 17 of the M5.

4.6 The MMS automatically adjusts speed limits in response to congestion levels and allows for hard-shoulder running on the approaches to the main junctions as follows:

- M5 southbound approach to J15
- M5 southbound approach to J17
- M5 northbound approach to J16
- M4 eastbound approach to J19
- M4 westbound approach to J20

4.7 The MMS provides three "alert" levels, dependent on traffic flows and speeds, which then display reduced speed limits to traffic via overhead gantries. The three levels are;

- Congestion level 1 – traffic levels are reaching congested levels and a 60mph speed limit is set for the congested section
- Congestion level 2 – traffic levels are high enough to justify a 50mph speed limit
- High Occupancy – a flow breakdown has been detected and a 40mph speed limit is set.

4.8 The PARAMICS model indicates that by 2031, the MMS will be operating at the high occupancy level for some or all of the peak periods which will have a consequential impact on journey times.

4.9 Another factor is that the demand data from the SATURN model (input into the PARAMICS model) is indicating a 29% increase in highway trips between 2011 and 2031 arising partly from a 16% increase in the number of houses and a 15% increase in the number of jobs. Dialogue with SGC has indicated that the increase between 2026 and 2031 is around 4%.

4.10 The modelling has also identified that without mitigation queuing would block back onto the mainline at the M5 J16 northbound off slip in the morning peak and also at M32 J1 in the evening peak. The M5 J16 southbound off slip would also be under a significant amount of network stress.

4.11 In addition the network stress on the M4 J19 off slips where it meets the M32 is also likely to be at / or over capacity

4.12 In summary, the '2031 Reference Case' modelling suggests that the benefits of the Managed Motorway scheme are likely to be eroded by the traffic growth experienced between 2011 and 2031 in the morning and evening peak periods.

2031 Reference Case comparison with 2031 Do Something

4.13 An initial Do Something test using the GBATS v3 model was run by SGC with CPNN and EHSNN included and the CS7 transport package. The results indicated that without mitigation at M5 junction 16 and 17, queuing would block back onto the mainline motorway even allowing for a significant increase in public transport trips arising from the sustainable transport measures identified in paragraph 2.5 which are supported by the HA.

4.14 A revised Do Something test was re-run containing the following mitigation at M5 J16 and J17:-

- M5 J17 Nearside widening of southbound off slip
- M5 J17 Nearside and offside widening of northbound off slip
- M5 J17 Northbound on slip widening including improvements to the circulatory carriageway
- M5 J16 Southbound off slip widening to 5 lanes including the widening of the A38 southbound from 3 to 4 lanes and then from 4 to 5 lanes at the Aztec Roundabout.
- M5 J16 northbound off slip widening from 2 to 3 lanes
- M5 J16 northbound on slip widening and lengthening and improvements to the circulatory carriageway

4.15 The mitigation package was found to address the slip road queuing at M5 J16 identified in the reference case. Queuing on all other slip roads at J16 and J17 were contained within the length of the slip road. Overall the package broadly returns the operation of the network to that experienced in the reference case which is shown in Appendix A.

4.16 The HA have undertaken a high level initial feasibility assessment of the proposed measures and have found that there no significant buildability concerns have been identified at this stage which might render these as undeliverable. However departures from standards are likely to be required and the responsibility for identifying circumstances where such departures may be appropriate will rest with third parties. A clear and adequate justification for not adopting the full standard will need to be submitted to the HA when seeking approval for each proposed departure. Planning considerations would not override this requirement.

4.17 In addition, the measures identified are likely to incur significant traffic management costs given the complexity of movements in the area. Major services are also located in the vicinity which will increase scheme costs. Initial observations suggest that third party land take requirements will be minimal or not required. However, this can only be confirmed with certainty with more detailed optioneering which is beyond the remit of this response at this stage of the planning process.

4.18 The HA has also identified that further mitigation may need to be provided at M32 Junction 1 in the form of a tiger tail southbound off slip diverge which would provide two opportunities to diverge separated by a ghost island. This could be provided within the existing highway boundary and it is recommended that this be considered in conjunction with improvements to the capacity of the A4174 and the A4174/ Hanbrook signalised junction in particular.

4.19 Whilst proposed improvements at the A4174 /Hanbrook signalised junction were not modelled in PARAMICS they are known to be a local bottleneck affecting the operation of the SRN. In this regard, the HA welcomes the inclusion of improvements to the Avon Ring Road as identified in policy CS7 and in particular those that provide knock on benefits to the operation of M32 J1 and ultimately M4 J19.

4.20 As a sensitivity test, the inclusion of the southbound tiger tail diverge was undertaken. The improvement was found to benefit the operation of both the southbound and northbound off slips at M32 J1 through a reallocation of green time to the slips. Modelling also suggested that these measures would also present downstream benefits in reducing the level of weaving movements between M4 J19 and M32 J1. Queues on the slip roads at M32 J1 were also found to be within acceptable limits with the inclusion of the tiger tail diverge

4.21 Whilst the results from the Do Something tests appear to show that the CPNN and EHSNN only result in a marginal deterioration of performance at M32 J1 and M4 J19, the results are highly dependent on the provision of the Stoke Gifford Link and provision of public transport measures as identified in paragraph 2.5. On this basis, the HA would need to give careful scrutiny at the planning application stage to the phasing of CPNN and EHSNN to determine whether mitigation was required at these junctions.

North Yate

4.22 The North Yate New Neighbourhood (NYNN) would be provided to the north of Yate and unlike the CPNN and EHSNN is not located adjacent to the SRN. Given its proximity and the need to isolate the impacts of the CPNN and EHSNN, SGC elected to include this development in the Reference Case.

4.23 Multi modal modelling suggests that the NYNN accounts for between 1% and 2% of flows on the SRN for the junctions identified in paragraph 1.2 and hence the impact is likely to be relatively minor compared to the CPNN and EHSTNN developments.

4.24 The HA's view is that the inclusion of NYNN is unlikely to generate additional mitigation at the junctions identified in paragraph 1.2 beyond those already identified (in paragraphs 3.14 to 3.19).

4.25 A PARAMICS assessment of M5 J14 and M4 J18 has not been conducted but the mitigation package (if required) is likely to be less extensive than that identified for M5 J16 and J17. This will need to be decided at the detailed planning application stage.

5 Conclusions and Recommendations

5.1 This written statement has provided a view on the HA's current position on the transport and highway aspects of the Core Strategy and how the various allocations will impact on the SRN. Our comments are set out below.

5.2 The HA is not convinced that the proposal for identification of Cribbs Causeway as an emergent centre is appropriate and that such a significant level of additional comparison retail floor space at The Mall is supported by evidence of need and the relative assessment of impacts of alternative locations for retail growth. The HA would welcome the inspectors view on this matter and contends that there is an opportunity cost associated with providing road capacity to retail which could be used to accommodate other or later growth.

5.3 The HA has not assessed the weekend impact of the Cribbs Causeway retail elements and would expect the developer to fully assess the impacts on the SRN and identify appropriate mitigation. In this respect if the Inspector finds that the level and location of retail growth at Cribbs/The Mall is acceptable then the Core Strategy should recognise that its transport impacts (on the SRN) outside week-day peak hours will need to be assessed and where assessment demonstrates, mitigation provided which is not set out in the Core Strategy.

5.4 Notwithstanding the above, the HA is able to offer in principle support to the allocations at CPNN and EHSNN subject to a comprehensive package of mitigation being provided which fully addresses the impact on the SRN. The mitigation package (discussed above) includes public transport and walking and cycling interventions together with improvements to the SRN at M5 J16 and M5 J17. Depending on the phasing arrangements there may also be a need to provide mitigation at M32 J1. In providing this in principle support, the HA wishes to make the following observations:-

- The mitigation package is contingent on a number of significant public transport, walking and cycling interventions being in place. Without these measures, the highway mitigation identified is unlikely to be sufficient to mitigate the impact of the CPNN and EHSNN on the SRN.

- A level of modal shift has been assumed in the provision of the sustainable measures identified above and will need to be closely monitored. If the modal shift is not or cannot be achieved then further travel demand, smarter choices and 'hard mitigation' measures may need to be identified and considered.

- The assumptions underpinning the analysis have been at a necessary strategic level given the absence of detailed information on the development composition and layout. As part of a more detailed planning application, developers will need to enter into discussions with the HA on the evidence base underpinning their analysis. It should not be assumed that the assumptions underpinning this Core Strategy analysis can be used in a TA supporting a planning application. For example different sets of parameters may need to be used for aspects such as trip generation, distribution and modelling methodologies.

- The highway mitigation identified at M5 J16, M5 J17 and M32 J1 will need to be considered alongside adjacent local road improvements in order to realise the full operational benefits to the SRN

- As developments come forward, each developer will be expected to mitigate the specific aspects of their development. This will need to take into account the phasing of other developments

- Some of the mitigation identified may require departures from design standards. Each departure will need to be assessed on its own merits and approved by the HA. Planning considerations do not override this requirement

- The HA would wish to be part of any early engagement in the production of an area wide masterplan for CPNN and EHSNN ensuring that the developments are comprehensively planned and take full account of phasing requirements

5.5 The HA is able to offer in principle support to the allocation at the NYNN on the basis that its impact on the SRN network (identified in paragraph 1.2) is unlikely to add an additional burden to the network beyond that already identified for the CPNN and EHSNN and for which a potential mitigation package has been identified in paragraphs 4.14 to 4.19. In providing this in principle support, the HA wishes to make the following observations:-

- Modelling has not been conducted at M5 J14 or M4 J18 and a mitigation package may be required for these junctions.

- The scale of impact at these junctions is unlikely to be at the same scale as CPNN or EHSNN and therefore it could be reasonably assumed that the mitigation package required will be less extensive.

- If NYNN was to be developed without CPNN and/or EHSNN then the impact on the junctions identified in paragraph 1.2 would need to be assessed in that context.

Distribution

Name/ Signed Andrew Roberts

Table 1 Queuing on slip roads blocking back to the main line (PARAMICS)

Queue Location		AM PEAK			PM PEAK		
		Base*	2031 Reference Case	2031 Do Something	Base*	2031 Reference Case	2031 Do Something
1	M5 J16 SB offslip	OK	OK	OK	OK	OK	OK
2	M5 J16 NB offslip	OK	Yes	OK	Yes	OK	OK
3	M5 J17 SB offslip	OK	OK	OK	OK	OK	OK
4	M5 J17 NB offslip	OK	OK	OK	OK	OK	OK
5	M4 J19 EB offslip	OK	OK	OK	OK	OK	OK
6	M4 J19 WB offslip	OK	OK	OK	Yes	OK	OK
7	M32 J1 SB offslip	OK	OK	OK	Yes	Yes	OK
8	M32 J1 NB off slip	OK	OK	OK	OK	Yes	OK

*** Excludes Managed Motorways**

Table 2 - Journey times section by section (PARAMICS)

Route	Description	AM PEAK			PM PEAK		
		Base*	2031 Reference Case	2031 Do Something	Base*	2031 Reference Case	2031 Do Something
Route 1	M4 J19 to M4 J20	164	343	507	166	481	456
Route 2	M4 J20 to M4 J19	167	254	225	215	192	191
Route 3	M5 J15 to M5 J16	58	62	94	58	63	73
Route 4	M5 J16 to M5 J15	41	47	49	42	49	49
Route 5	M5 J16 to M5 J17	115	170	154	117	161	236
Route 6	M5 J17 to M5 J16	115	516	360	178	431	419
Route 7	M5 J17 to M5 J18	159	168	168	162	169	166
Route 8	M5 J18 to M5 J17	170	446	311	163	340	352
Route 9	M5 J18 to M5 J19	108	117	115	113	123	122
Route 10	M5 J19 to M5 J18	116	237	176	111	123	124
Route 11	M32 J1 to M4J19	38	60	153	44	164	194
Route 12	M4 J19 to M32 J1	46	54	92	93	52	54

*** Excludes Managed Motorways**

Table 3: Overall Network Performance in Paramics

Parameters	Base* AM	2031 AM Reference Case	2031 AM Do Something	Base* PM	2031PM Reference Case	2031 PM Do Something
Mean Delay across the whole network(secs)	373.08	674.37	652.06	382.88	636.12	631.63
Mean Speed across the network (mph)	48.93	26.10	26.53	47.79	27.72	27.43

*** Excludes Managed Motorways**

Table 4: SATURN Result Comparison of Performance - Base Year , 2031 Reference Case and 2031 Do Something Scenario

Location	Description	AM PEAK									PM PEAK								
		Flow in Vehicle			Speed in MPH			Stress (Vol/Capacity)			Flow in Vehicle			Speed in MPH			Stress (Vol/Capacity)		
		Base* AM	2031 AM Reference Case	2031 AM Do Something	Base* AM	2031 AM Reference Case	2031 AM Do Something	Base* AM	2031 AM Reference Case	2031 AM Do Something	Base* PM	2031 AM Reference Case	2031 AM Do Something	Base* PM	2031 AM Reference Case	2031 AM Do Something	Base* PM	2031 AM Reference Case	2031 AM Do Something
M5 J15/M4 J20	M4 EB within J20	1409	2821	2565	69	42	44	34	66	61	1754	2331	2279	67	46	46	41	54	53
	M4 WB within J20	1416	2121	1989	67	47	48	35	51	48	1936	2690	2556	65	44	45	43	62	59
	M5 NB within J15	1456	2256	2341	69	46	45	36	55	56	2086	2692	2769	65	43	43	47	63	65
	M5 SB within J15	2161	3002	3178	60	40	39	55	73	77	1782	2612	2689	65	44	43	40	61	63
	M4 J20 EB to M5 J15	1522	1670	1929	52	52	48	42	43	49	706	958	987	57	58	58	17	24	25
	M4 WB J20 to M5 J15 SB	1789	2818	3173	56	46	44	46	58	68	1684	2012	2258	56	48	47	44	37	41
	M5 J16 NB to M4 J20 WB	173	360	376	62	39	39	5	11	12	513	637	737	62	39	39	12	15	18
	M5 NB between J15 and J16	1081	1809	1805	67	47	47	28	45	45	1414	2271	2271	66	45	45	33	54	54
	M5 NB distributor to M5 NB between J16 and J15	374	447	536	46	36	35	18	24	28	672	420	498	43	36	36	32	22	26
	M5 Slip to M4 EB	1281	1441	1333	59	30	32	34	78	73	1483	1242	1224	58	37	37	37	63	62
	M5 J15 SB to M5 J16	672	809	1064	47	26	21	33	65	87	278	398	431	51	28	27	13	30	33
	M5 J15 SB On Slip	3399	3179	3835	64	49	49	51	34	40	2345	2391	2468	70	50	50	35	25	26
	M4 J20 WB to M5 SB	3399	2247	1982	23	38	43	88	73	62	2345	1993	2037	47	42	41	60	61	65
Betn M4 J19 and J20	M4 junction 20 to 19	4424	6032	6109	54	48	48	67	77	78	5239	6189	6241	46	48	48	76	77	78
	M4 Junction 19 to 20	4010	6334	6419	57	48	48	63	82	83	5184	6147	6191	46	49	49	76	76	77
M5 J16	M5 NB Mainline within J16	2130	3758	3776	68	43	43	36	70	71	2973	4542	4556	66	39	39	44	79	80
	M5 SB Mainline within J16	2932	4441	4096	66	49	55	46	72	66	3005	4208	4296	67	54	52	45	66	69
	M5 J16 NB offslip	1937	1814	1722	20	14	20	87	95	62	1315	1138	996	23	28	20	69	55	32
	M5 J16 SB onslip	675	1185	1261	61	38	30	18	80	89	1386	1408	1634	59	31	16	36	88	98
	M5 J16 NB onslip	819	930	1461	62	40	23	20	59	91	1573	1360	1638	60	29	14	37	83	99
	M5 J16 SB offslip	1956	2490	3613	59	50	49	50	27	39	845	914	1175	65	50	50	20	10	12
Betn M5 J16 and J17	M5 junction 17 to 16	3608	5626	5356	61	49	49	62	73	70	4390	5615	5929	56	49	49	71	70	74
	M5 Junction 16 to 17	4068	5572	5498	56	49	49	89	72	71	4288	5680	5552	57	49	49	80	71	69
M5 J17	M5 NB Mainline within J17	3290	4309	4259	63	50	50	51	71	70	2893	3883	3759	67	56	57	43	62	61
	M5 SB Mainline within J17	2419	3832	3840	68	54	55	39	65	65	2795	3920	4072	67	56	55	42	62	64
	M5 J17 NB offslip	1163	1103	1353	64	65	64	29	28	34	690	999	1247	65	65	64	17	25	31
	M5 J17 SB offslip	1189	1794	1516	64	50	50	31	29	24	1595	1695	1857	63	50	50	39	27	30
	M5 J17 NB onslip	777	1263	1239	63	59	59	20	41	40	1394	1797	1793	61	54	54	33	54	54
	M5 J17 SB onslip	668	911	1011	61	58	58	16	28	31	1181	1335	1318	60	55	56	28	41	40
M32 J1	Anon Ring Road (West) EB	959	1326	1595	6	5	4	44	60	72	2247	2526	2622	4	4	3	75	84	87
	Anon Ring Road (West) WB	1927	1892	1856	28	25	25	55	55	54	950	1301	1518	28	25	25	27	37	43
	M32 J1 NB On Slip	715	1253	1510	60	57	54	25	40	48	1541	1930	1909	55	50	50	46	56	56
	M32 J1 SB Off Slip	1783	1923	1736	11	14	16	96	91	83	1287	1447	1427	9	11	12	93	84	83
	Anon Ring Road (East) EB	2047	2391	1952	37	32	38	63	72	59	2891	2878	2717	28	27	29	84	85	80
	Anon Ring Road (East) WB	1827	2308	2278	26	22	22	59	72	70	1625	2046	1926	29	25	26	49	62	58
	M32 J1 SB On Slip	1191	1458	1599	38	33	31	58	71	75	1012	1537	1407	41	32	35	48	75	67
	M32 J1 NB Off Slip	1309	1436	1308	23	23	24	62	69	61	1236	1629	1575	25	24	24	46	62	60
	M32 NB within junction 1	2433	2801	2531	60	56	59	52	58	53	2542	2440	2415	59	61	61	53	50	49
	M32 SB within junction 1	2171	2273	2447	64	63	62	47	49	53	2373	2724	2686	63	59	60	49	56	55
Betn M4 J20 and M32 J1	M32 J1 to M4 J19	3147	4053	4041	62	55	55	60	77	76	4084	4370	4324	56	53	53	73	80	79
	M4 J19 to M32 J1	3954	4196	4183	57	54	56	57	60	60	3660	4171	4114	61	57	58	52	58	57
M4 J19	M4 J19 NB On Slip	2193	2981	2964	51	23	24	67	96	95	2739	3088	3045	45	23	25	77	95	94
	M4 J19 SB Off Slip	2222	2962	2914	33	22	23	78	96	95	2520	3019	3027	31	24	24	84	93	94
	M4 J19 SB On Slip	954	1073	1077	60	59	59	39	44	45	1344	1279	1276	58	59	59	55	51	51
	M4 J19 NB Off Slip	1732	1328	1319	43	9	10	69	103	102	1139	1159	1091	46	29	31	45	87	82
	M4 NB within Junction 19	954	1072	1077	10	6	6	66	87	88	1344	1282	1278	7	3	3	92	101	101
	M4 SB within Junction 19	2222	2906	2895	28	27	27	56	63	63	2520	3012	3022	27	27	27	60	62	62

Table 1 Queuing on slip roads blocking back to the main line (PARAMICS)

Queue Location		AM PEAK			PM PEAK		
		Base*	2031 Reference Case	2031 Do Something	Base*	2031 Reference Case	2031 Do Something
1	M5 J16 SB offslip	OK	OK	OK	OK	OK	OK
2	M5 J16 NB offslip	OK	Yes	OK	Yes	OK	OK
3	M5 J17 SB offslip	OK	OK	OK	OK	OK	OK
4	M5 J17 NB offslip	OK	OK	OK	OK	OK	OK
5	M4 J19 EB offslip	OK	OK	OK	OK	OK	OK
6	M4 J19 WB offslip	OK	OK	OK	Yes	OK	OK
7	M32 J1 SB offslip	OK	OK	OK	Yes	Yes	OK
8	M32 J1 NB off slip	OK	OK	OK	OK	Yes	OK

*** Excludes Managed Motorways**

Table 2 - Journey times section by section (PARAMICS)

Route	Description	AM PEAK			PM PEAK		
		Base*	2031 Reference Case	2031 Do Something	Base*	2031 Reference Case	2031 Do Something
Route 1	M4 J19 to M4 J20	164	343	507	166	481	456
Route 2	M4 J20 to M4 J19	167	254	225	215	192	191
Route 3	M5 J15 to M5 J16	58	62	94	58	63	73
Route 4	M5 J16 to M5 J15	41	47	49	42	49	49
Route 5	M5 J16 to M5 J17	115	170	154	117	161	236
Route 6	M5 J17 to M5 J16	115	516	360	178	431	419
Route 7	M5 J17 to M5 J18	159	168	168	162	169	166
Route 8	M5 J18 to M5 J17	170	446	311	163	340	352
Route 9	M5 J18 to M5 J19	108	117	115	113	123	122
Route 10	M5 J19 to M5 J18	116	237	176	111	123	124
Route 11	M32 J1 to M4J19	38	60	153	44	164	194
Route 12	M4 J19 to M32 J1	46	54	92	93	52	54

*** Excludes Managed Motorways**

Table 3: Overall Network Performance in Paramics

Parameters	Base* AM	2031 AM Reference Case	2031 AM Do Something	Base* PM	2031PM Reference Case	2031 PM Do Something
Mean Delay across the whole network(secs)	373.08	674.37	652.06	382.88	636.12	631.63
Mean Speed across the network (mph)	48.93	26.10	26.53	47.79	27.72	27.43

*** Excludes Managed Motorways**

Table 4: SATURN Result Comparison of Performance - Base Year , 2031 Reference Case and 2031 Do Something Scenario

Location	Description	AM PEAK									PM PEAK								
		Flow in Vehicle			Speed in MPH			Stress (Vol/Capacity)			Flow in Vehicle			Speed in MPH			Stress (Vol/Capacity)		
		Base* AM	2031 AM Reference Case	2031 AM Do Something	Base* AM	2031 AM Reference Case	2031 AM Do Something	Base* AM	2031 AM Reference Case	2031 AM Do Something	Base* PM	2031 AM Reference Case	2031 AM Do Something	Base* PM	2031 AM Reference Case	2031 AM Do Something	Base* PM	2031 AM Reference Case	2031 AM Do Something
M5 J15/M4 J20	M4 EB within J20	1409	2821	2565	69	42	44	34	66	61	1754	2331	2279	67	46	46	41	54	53
	M4 WB within J20	1416	2121	1989	67	47	48	35	51	48	1936	2690	2556	65	44	45	43	62	59
	M5 NB within J15	1456	2256	2341	69	46	45	36	55	56	2086	2692	2769	65	43	43	47	63	65
	M5 SB within J15	2161	3002	3178	60	40	39	55	73	77	1782	2612	2689	65	44	43	40	61	63
	M4 J20 EB to M5 J15	1522	1670	1929	52	52	48	42	43	49	706	958	987	57	58	58	17	24	25
	M4 WB J20 to M5 J15 SB	1789	2818	3173	56	46	44	46	58	68	1684	2012	2258	56	48	47	44	37	41
	M5 J16 NB to M4 J20 WB	173	360	376	62	39	39	5	11	12	513	637	737	62	39	39	12	15	18
	M5 NB between J15 and J16	1081	1809	1805	67	47	47	28	45	45	1414	2271	2271	66	45	45	33	54	54
	M5 NB distributor to M5 NB between J16 and J15	374	447	536	46	36	35	18	24	28	672	420	498	43	36	36	32	22	26
	M5 Slip to M4 EB	1281	1441	1333	59	30	32	34	78	73	1483	1242	1224	58	37	37	37	63	62
	M5 J15 SB to M5 J16	672	809	1064	47	26	21	33	65	87	278	398	431	51	28	27	13	30	33
	M5 J15 SB On Slip	3399	3179	3835	64	49	49	51	34	40	2345	2391	2468	70	50	50	35	25	26
	M4 J20 WB to M5 SB	3399	2247	1982	23	38	43	88	73	62	2345	1993	2037	47	42	41	60	61	65
Betn M4 J19 and J20	M4 junction 20 to 19	4424	6032	6109	54	48	48	67	77	78	5239	6189	6241	46	48	48	76	77	78
	M4 Junction 19 to 20	4010	6334	6419	57	48	48	63	82	83	5184	6147	6191	46	49	49	76	76	77
M5 J16	M5 NB Mainline within J16	2130	3758	3776	68	43	43	36	70	71	2973	4542	4556	66	39	39	44	79	80
	M5 SB Mainline within J16	2932	4441	4096	66	49	55	46	72	66	3005	4208	4296	67	54	52	45	66	69
	M5 J16 NB offslip	1937	1814	1722	20	14	20	87	95	62	1315	1138	996	23	28	20	69	55	32
	M5 J16 SB onslip	675	1185	1261	61	38	30	18	80	89	1386	1408	1634	59	31	16	36	88	98
	M5 J16 NB onslip	819	930	1461	62	40	23	20	59	91	1573	1360	1638	60	29	14	37	83	99
	M5 J16 SB offslip	1956	2490	3613	59	50	49	50	27	39	845	914	1175	65	50	50	20	10	12
Betn M5 J16 and J17	M5 junction 17 to 16	3608	5626	5356	61	49	49	62	73	70	4390	5615	5929	56	49	49	71	70	74
	M5 Junction 16 to 17	4068	5572	5498	56	49	49	89	72	71	4288	5680	5552	57	49	49	80	71	69
M5 J17	M5 NB Mainline within J17	3290	4309	4259	63	50	50	51	71	70	2893	3883	3759	67	56	57	43	62	61
	M5 SB Mainline within J17	2419	3832	3840	68	54	55	39	65	65	2795	3920	4072	67	56	55	42	62	64
	M5 J17 NB offslip	1163	1103	1353	64	65	64	29	28	34	690	999	1247	65	65	64	17	25	31
	M5 J17 SB offslip	1189	1794	1516	64	50	50	31	29	24	1595	1695	1857	63	50	50	39	27	30
	M5 J17 NB onslip	777	1263	1239	63	59	59	20	41	40	1394	1797	1793	61	54	54	33	54	54
	M5 J17 SB onslip	668	911	1011	61	58	58	16	28	31	1181	1335	1318	60	55	56	28	41	40
M32 J1	Anon Ring Road (West) EB	959	1326	1595	6	5	4	44	60	72	2247	2526	2622	4	4	3	75	84	87
	Anon Ring Road (West) WB	1927	1892	1856	28	25	25	55	55	54	950	1301	1518	28	25	25	27	37	43
	M32 J1 NB On Slip	715	1253	1510	60	57	54	25	40	48	1541	1930	1909	55	50	50	46	56	56
	M32 J1 SB Off Slip	1783	1923	1736	11	14	16	96	91	83	1287	1447	1427	9	11	12	93	84	83
	Anon Ring Road (East) EB	2047	2391	1952	37	32	38	63	72	59	2891	2878	2717	28	27	29	84	85	80
	Anon Ring Road (East) WB	1827	2308	2278	26	22	22	59	72	70	1625	2046	1926	29	25	26	49	62	58
	M32 J1 SB On Slip	1191	1458	1599	38	33	31	58	71	75	1012	1537	1407	41	32	35	48	75	67
	M32 J1 NB Off Slip	1309	1436	1308	23	23	24	62	69	61	1236	1629	1575	25	24	24	46	62	60
	M32 NB within Junction 1	2433	2801	2531	60	56	59	52	58	53	2542	2440	2415	59	61	61	53	50	49
	M32 SB within Junction 1	2171	2273	2447	64	63	62	47	49	53	2373	2724	2686	63	59	60	49	56	55
Betn M4 J20 and M32 J1	M32 J1 to M4 J19	3147	4053	4041	62	55	55	60	77	76	4084	4370	4324	56	53	53	73	80	79
	M4 J19 to M32 J1	3954	4196	4183	57	54	56	57	60	60	3660	4171	4114	61	57	58	52	58	57
M4 J19	M4 j19 NB On Slip	2193	2981	2964	51	23	24	67	96	95	2739	3088	3045	45	23	25	77	95	94
	M4 J19 SB Off Slip	2222	2962	2914	33	22	23	78	96	95	2520	3019	3027	31	24	24	84	93	94
	M4 J19 SB On Slip	954	1073	1077	60	59	59	39	44	45	1344	1279	1276	58	59	59	55	51	51
	M4 J19 NB Off Slip	1732	1328	1319	43	9	10	69	103	102	1139	1159	1091	46	29	31	45	87	82
	M4 NB within Junction 19	954	1072	1077	10	6	6	66	87	88	1344	1282	1278	7	3	3	92	101	101
	M4 SB within Junction 19	2222	2906	2895	28	27	27	56	63	63	2520	3012	3022	27	27	27	60	62	62