HIGHWAYS AGENCY

A303 Stonehenge Improvement Scheme Review

Partial Solutions Options Analysis

February 2008

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1 Introduction

The post-2004 Public Inquiry review of the A303 Stonehenge Improvement was carried out in two stages. Stage 1 was completed in January 2006 with publication of the *A303 Stonehenge Improvement, Scheme Review – Stage 1 Report*. Stage 2 involved further assessments of the options for improvement and included a public consultation, culminating in the *A303 Stonehenge Improvement, Scheme Review – Stage 2 Report*.

The review included options for 'Partial Solutions' on the A303 in the vicinity of Stonehenge. In order to understand more fully the effects of the Partial Solutions on the operation of the A303 and the local road network, it was clear that a more detailed analysis based on up-to-date traffic information was needed. Fresh traffic surveys were carried out in the autumn of 2006 and a new traffic model has been produced, to provide the basis for further and more robust analytical work.

The first step was to model today's (2006) traffic flows and then to apply growth factors to assess the future traffic consequences of leaving the existing road network largely as it is (the Do-Minimum situation). Following this, the consequences of closing the A303/A344 junction were analysed as the starting point for a Partial Solution. That work was completed in September 2007, and was described in the *A303 Stonehenge Improvement Scheme Review - Partial Solutions - A303/A344 Junction Closure* report.

In that report, it was concluded that implementation of the A303 / A344 junction closure would aggravate the congestion problems that will arise along this section of the A303 (including at Longbarrow Crossroads) as traffic continues to grow in the future. This report presents the further analysis of options that may alleviate these problems, making use of the latest traffic data and modelling.

The work described herein has been limited to traffic and economic analyses. In the event that any of the options described in this report are considered worthy of further development, then it would also be necessary to undertake environmental assessment. However, environmental assessment would not detract from the results of the traffic and economic analyses which capture the degree of any operational benefit which may be derived from the various options.

The analyses in this report are made on the same basis as those in the preceding *A303 Stonehenge Improvement Scheme Review - Partial Solutions - A303/A344 Junction Closure* report (September 2007). In particular:

- The analyses rely wholly on the new traffic model developed using the autumn 2006 traffic data
- A Scheme Opening Year of 2012 and a Design Year of 2027 (fifteen years after opening) have been adopted, instead of the equivalent years previously adopted for the Stonehenge Improvement Review (2008 and 2023) which are now unachievable
- The methodologies underlying the SATURN and VISSIM models are as described in Section 2 of the preceding September 2007 report
- The Stonehenge Visitor Centre is assumed to remain at its present location.

2 A303/A344 Junction Closure - Option 1 (Baseline Scheme)

2.1 Baselines for Comparison

Closure of the A303 / A344 junction would enable the UK Government to meet its commitment (made in 1986 when Stonehenge was inscribed on the World Heritage list) to close the A344 where it crosses The Avenue on its approach to Stonehenge. The proposed junction closure is thus designated herein as Option 1, and is the scheme that was assessed in the September 2007 report *A303 Stonehenge Improvement Scheme Review - Partial Solutions - A303/A344 Junction Closure.*

The objective of this follow-on report is to evaluate (in traffic and economic terms) the potential for further options to alleviate congestion problems that would remain with Option 1. For that reason, the baseline for comparing the traffic effects of further options assumes Option 1 as the starting point. The traffic data presented in this report therefore identify the extent to which the further options described mitigate the congestion problems remaining with Option 1, and make no comparisons with existing conditions beyond those already made for Option 1 itself in the September 2007 report.

Because the further mitigation options build on Option 1, the assessed Benefit Cost Ratios (BCRs) represent the total effect of the mitigation options, including Option 1. The BCRs are thus based on a comparison with the Do-Minimum case (i.e. the existing conditions).

The traffic and economic data presented herein for Option 1 are taken from the September 2007 report.

2.2 Option 1 - Summary

The September 2007 report identified that implementing Option 1 (closing the A303/A344 junction) would result in additional traffic transferring to the A360 / A303 (via Longbarrow Crossroads), with some also transferring to The Packway. The following effects would arise:

- The single carriageway section of the A303 past Stonehenge would be under greater stress, with more frequent breakdowns in the smooth flow of traffic and a higher incidence of congestion and queuing traffic.
- Longbarrow Crossroads would experience greater levels of congestion, particularly on the A303 West and the A360 North approaches to the roundabout, with the junction reaching capacity two or three years ahead of when it would reach capacity in the Do-Minimum scenario.
- At Airman's Corner, the main traffic movement would become that between the A360 West and the A360 South. This would mean that the junction layout should be modified for safety reasons to accommodate the changed turning priorities.
- The closure of the A344 would make little difference to the operation of Countess Roundabout.

Figure 2.1 shows the predicted AADT traffic volumes that would result from Option 1.

This report evaluates options aimed at mitigating the congestion that would remain with the implementation of Option 1.

The economic assessment of Option 1 over a 60 year period between 2010 and 2069 demonstrated the following costs and benefits:

- Increased travel time and vehicle operating costs, with user disbenefits of between **-**£23.2m (low growth) and **-**£22.0m (high growth)

- Accident benefits between £10.0m (low growth) and £12.5m (high growth)
- A Net Present Value of **-**£13.3m (low growth) and **-**£9.9m (high growth).

A summary of the economic assessment for Option 1 is given in Table 2.1 below:

Table 2.1 - A344 Junction Closure: Summary of Economic Assessment (Including Accident Benefits)

A344 Junction Closure (Do-Something)		**Low Growth (£000)**	**High Growth (£000)**
Consumer User Benefits		-10,842	-10,141
Business User Benefits		-12,364	-11,892
Private Sector Provider Impacts		0	0
Other Business Impacts		0	0
Accident Benefits		9,993	12,530
Carbon Benefits		-72	-24
Net present Value of Benefits (PVB)		-13,285	-9,527
Local Government Funding		0	0
Central Government Funding	- Investment Costs	565	565
	- Indirect Tax Revenues	-590	-206
Net present Value of Costs (PVC)		-25	359
Net present Value (NPV)		-13,260	-9,886
Benefit to Cost Ratio (BCR)		531.40	-26.54
Appraisal Period		2010-2069	2010-2069

NOTES: 1. Values from TUBA and COBA discounted to 2002 prices.
2. The large BCR at low growth results from the fact that both PVB and PVC are negative, and is therefore meaningless.

3 Scheme Descriptions: Options 2, 3 and 4

3.1 Introduction

The options described in this section are possible measures for mitigating the effects of congestion on the A303 remaining with the closure of the A303 / A344 junction. This includes the Winterbourne Stoke Bypass, which formed the western section of the A303 Stonehenge Improvement, and which has been assessed to determine whether, in the light of the 2006 traffic survey data, it might be economically justifiable as a stand-alone scheme. (If that was the case, then there may at some future date be a possibility that it could be promoted independently of the section through the World Heritage Site).

The options considered in the report have the following components.

Scheme component:	Closure of A303 / A344 junction	At-grade improvements of Longbarrow Roundabout (shown in Fig 3.1)	Winterbourne Stoke Bypass (shown in Fig 3.2)	At-grade improvements of Countess Roundabout (shown in Fig 3.3)
Option 1	✓			
Option 2	✓	✓		
Option 3	✓	✓	✓	
Option 4	✓	✓		✓

Details of Option 1 are given in the report *A303 Stonehenge Improvement Scheme Review - Partial Solutions - A303/A344 Junction Closure*. Options 2, 3 and 4 are described below.

3.2 Option 2: At-Grade Improvements: Longbarrow Roundabout

This option incorporates the closure of the A303/A344 junction and the improvement of Longbarrow Roundabout shown in Figure 3.1.

The improvement at Longbarrow Roundabout would comprise an additional lane for the traffic movement from A303 westbound to the A360 northbound and from the A360 southbound to the A303 eastbound. This could be achieved within the existing highway boundary. (Where the widening of the existing carriageway would result in the earthworks being extended into the existing toe ditch, this would need to be replaced with a filter drain.)

3.3 Option 3: Winterbourne Stoke Bypass

This option incorporates the closure of the A303/A344 junction, the at-grade improvement of Longbarrow Roundabout shown in Figure 3.1, and the Winterbourne Stoke Bypass shown in Figure 3.2. The bypass would be to the same dual 2-lane standard (and would follow the same alignment) as the route included in the Published Scheme for the A303 Stonehenge Improvement, which was the subject of a Public Inquiry in 2004. The changes from the scheme presented at the Public Inquiry are:

- The bypass terminates at its eastern end at a new roundabout on the A303 approximately 700 metres west of Longbarrow Roundabout.
- Much of the landscape mitigation fill between the River Till valley and eastern end of the bypass is omitted. The reason is that without the excavated material from the Stonehenge tunnel, the landscaping could only be carried out if significant quantities

of fill material were to be imported at a substantial cost. While this issue would need to be re-visited if a stand-alone bypass was to be pursued, for the purposes of undertaking a preliminary economic assessment, the costs have been minimised to see whether such a scheme could potentially produce positive benefits and a strong economic case.

3.4 Option 4: At-Grade Improvements: Longbarrow/Countess Roundabouts

This option incorporates the closure of the A303/A344 junction, the at-grade improvement of Longbarrow Roundabout shown in Figure 3.1, and the at-grade improvement of Countess Roundabout shown in Figure 3.3.

The works at Longbarrow Roundabout are as described above. The works at Countess Roundabout would comprise an additional circulatory lane on the roundabout as well as an additional lane on all entries to and exits from the roundabout. Traffic signals would also be provided on all arms with the aim of increasing the capacity of the roundabout. The proposed work would be entirely within the existing highway boundary. Whilst roundabout signalisation does not in itself always guarantee an overall improvement in capacity, the associated circulatory widening and entry improvements would provide an increase in the capacity of Countess Roundabout.

4 Option 2 - Traffic and Economic Assessment

4.1 Traffic Network

Table 4.1 (which can be found after Section 7) compares Option 1 and Option 2 link flows in the 2012 Opening Year at selected locations. It is noticeable that, in 2012, the only significant impact of the at-grade improvements at Longbarrow roundabout occurs in the morning peak hour, with southbound traffic on the A360 approach from Airman's Corner increasing by 180-230vph in the low and high growth scenarios respectively. However, to the east of Longbarrow roundabout the eastbound flow on the A303 increases by only 40-70vph. This is because the eastbound flow from the A303 West through Longbarrow roundabout is decreased with Option 2, whilst traffic making the right turn from the southern A360 arm is also reduced. Indeed, network analysis shows that traffic from the A36 making use of the B390/A360 route via Shrewton increases marginally with the improvement of the Longbarrow junction, with this traffic diverting from the A303.

The increase in traffic on the southbound A360 approach to Longbarrow roundabout results in a modest reduction in eastbound traffic using The Packway in the morning peak hour when compared with Option 1, and also a similar reduction in traffic on the southbound A345 approach to Countess. However, the Longbarrow roundabout improvements result in little or no change to flows along The Packway in the inter-peak hour or the evening peak such that, in daily terms, the overall change in traffic on The Packway is likely to be minimal.

Table 4.2 (which again can be found after Section 7) shows similar comparisons for the 2027 Design Year. The impact in the morning peak hour is similar to that in 2012, with the improvements to the northern A360 arm at Longbarrow roundabout attracting significant additional southbound traffic. This increase is about 250-260vph in both the low and high growth scenarios, although the corresponding net eastbound increase on the A303 immediately east of Longbarrow is again much lower for reasons described above. Eastbound traffic on The Packway is again reduced in 2027 in the morning peak hour. However, as in 2012, the flows along The Packway in the inter-peak hour and evening peak hour are virtually unaltered from those with Option 1.

Not unexpectedly, the impact of the Longbarrow improvement is virtually negligible in the inter-peak hour, even in 2027, because the unimproved junction is still capable of operating satisfactorily in this period. In the evening peak hour, however, the improvement attracts additional traffic on the southbound A360 approach in the high growth scenario, although there is little change with the low growth scenario. It is noticeable that the volume of traffic exiting towards Airman's corner shows little difference in the evening peak hour with either Options 1 and 2, as indeed is the case with the westbound traffic using The Packway. This suggests that the at-grade improvement at Longbarrow has little impact on westbound routing via either the A303 or The Packway in this period.

Figure 4.1 shows the predicted AADT traffic volumes that would result from the closure of the A303/A344 junction coupled with at-grade improvements to Longbarrow roundabout.

4.2 Traffic Impacts at Selected Junctions

4.2.1 Introduction

To better understand the potential traffic impacts at selected junctions, the predicted change in flows from the SATURN model has been entered into the VISSIM model. This section presents and discusses the results of this analysis, comparing the results of Options 1 and 2.

4.2.2 Impacts in 2012: Opening Year

2012 AM Peak

In the AM peak, the improvements to Longbarrow Crossroads attract more traffic to access the junction from A360 North, via Airman's Corner, as shown in Table 4.3 below.

Table 4.3 - Entry Flows and Queue Lengths - 2012 AM Peak

Location		Closure of A344: Option 1				Option 2			
		Low Growth		High Growth		Low Growth		High Growth	
		Flow (vph)	Queue (m)	Flow (vph)	Queue (m)	Flow (vph)	Queue (m)	Flow (vph)	Queue (m)
Airman's Corner	B3086 North	45	2	40	2	65	2	75	3
	A344 East	4	0	4	0	6	0	5	0
	A360 South, left turn	178	0	244	0	200	0	282	0
	A360 South, right turn	61	13	64	13	69	17	82	17
	A360 West	410	0	403	0	560	0	590	0
Longbarrow Crossroads	A360 North	395	120	359	199	598	47	634	73
	A303 East	972	52	1093	69	962	52	1094	66
	A360 South	410	20	488	25	395	21	467	26
	A303 West	1104	70	1134	157	1054	45	1082	62
Countess Roundabout	A345 North	825	53	916	52	834	47	880	52
	A303 East	1041	48	1160	71	999	44	1133	60
	A345 South	595	42	615	80	594	43	621	66
	A303 West	1359	111	1389	173	1417	126	1447	187

At Longbarrow Crossroads, queues on the A360 North arm decrease from 120m to 47m with low growth, and from 199m to 73m with high growth, despite the increase in flow, because of the increased capacity on that arm. There is no discernible benefit to westbound A303 traffic from the additional right-turn lane on the A303 East arm because the southbound circulating traffic has increased. The eastbound flow from the A303 West reduces slightly because some traffic re-routes to the B390/A360 via Longbarrow to take advantage of the increased capacity there, resulting in a corresponding small decrease in queues on the A303 West.

Flows on the A360 West at Airman's Corner increase by up to 46% in high growth, but there is sufficient capacity as this movement is virtually unopposed, and no effect on queues.

At Countess Roundabout, there is a small increase in flow on A303 West, with only a marginal increase in queue length.

2012 PM Peak

In the PM peak, there are no significant changes in flows at any of the junctions, as shown in Table 4.4 below, although queues reduce substantially at Longbarrow.

Table 4.4 - Entry Flows and Queue Lengths - 2012 PM Peak

Location		Closure of A344: Option 1				Option 2			
		Low Growth		High Growth		Low Growth		High Growth	
		Flow (vph)	Queue (m)	Flow (vph)	Queue (m)	Flow (vph)	Queue (m)	Flow (vph)	Queue (m)
Airman's Corner	B3086 North	171	11	218	14	180	7	239	8
	A344 East	38	0	54	0	50	0	71	0
	A360 South, left turn	533	0	555	0	553	0	581	0
	A360 South, right turn	56	3	115	19	70	12	122	22
	A360 West	184	0	279	0	182	0	296	0
Longbarrow Crossroads	A360 North	372	28	517	67	392	22	565	36
	A303 East	1410	46	1475	73	1378	37	1445	52
	A360 South	493	57	476	79	496	33	477	43
	A303 West	841	124	808	302	842	107	842	196
Countess Roundabout	A345 North	614	24	676	31	634	26	686	28
	A303 East	1610	71	1685	94	1577	74	1680	100
	A345 South	668	161	661	216	692	104	660	200
	A303 West	1110	80	1168	108	1088	84	1197	126

At Longbarrow Crossroads, there is a very small increase in flow on A360 North, with again a reduction in queue lengths due to the increased junction capacity. On all other arms the queues reduce even though the flows remain reasonably static, because of the increased capacity across the whole roundabout.

At Countess Roundabout, the reduction in queue length on A345 South from 161m to 104m in low growth, despite a small increase in flow, is due to less right-turning traffic from both A345 North and A303 East leading to less conflict within the circulating carriageway.

4.2.3 Impacts in 2027: Design Year

2027 AM Peak

By 2027 (see Table 4.5 below), AM Peak flows on the A360 North at Longbarrow have increased to 659 vph in low growth and 782 vph in high growth. The queues in 2027 have reached 82m in low growth and 353m in high growth, but this is a large reduction from Option 1, where queues reached 976m in high growth, reaching back to Airman's Corner.

Table 4.5 - Entry Flows and Queue Lengths - 2027 AM Peak

Location		Closure of A344: Option 1				Option 2			
		Low Growth		High Growth		Low Growth		High Growth	
		Flow (vph)	Queue (m)	Flow (vph)	Queue (m)	Flow (vph)	Queue (m)	Flow (vph)	Queue (m)
Airman's Corner	B3086 North	46	2	26	10	91	3	234	6
	A344 East	3	0	2	0	5	0	6	0
	A360 South, left turn	243	0	247	0	313	0	423	0
	A360 South, right turn	72	16	28	79	118	40	77	24
	A360 West	402	0	472	77	597	0	635	0
Longbarrow Crossroads	A360 North	359	256	339	976	659	82	782	353
	A303 East	1106	58	1247	65	1095	61	1210	78
	A360 South	483	32	605	53	457	28	558	65
	A303 West	1116	161	987	654	1097	70	942	283
Countess Roundabout	A345 North	892	54	871	190	838	49	847	200
	A303 East	1197	69	1447	107	1169	58	1429	81
	A345 South	607	76	640	271	616	56	689	165
	A303 West	1419	201	1300	515	1480	173	1369	805

Queues on the A303 West also reduce from 161m to 70m in low growth and from 654m to 283m in high growth, due to longer gap times in right turning traffic from the east.

At Countess roundabout the change in traffic patterns results in less right-turning traffic, giving greater capacity from the A345 South and North. However, under high growth, more traffic from the A303 West, together with a small increase in traffic from A345 South, causes greater queues on the A303 West, from 515m to 805m.

Airman's Corner copes with the increased traffic southbound to Longbarrow, as this is a virtually unopposed movement. However by 2027 there is also a small increase in northbound traffic wishing to turn right, and this is subject to greater delays caused by southbound traffic, resulting in a small increase in queuing under low growth. With high growth the flow from A360 South increases, with a corresponding decrease in queue length. This is because with Option 1, the queue back from Longbarrow on A360 southbound occasionally blocked back through Airman's Corner, causing disruption to northbound traffic wishing to turn right. With the increased capacity at Longbarrow in Option 2 this no longer happens.

2027 PM Peak

In a similar way to 2012, the flows in the PM peak do not change significantly between Options 1 and 2 in 2027 (see Table 4.6 below), but there is a noticeable reduction in queues at Longbarrow on A360 North and A303 West due to the increase in capacity with Option 2.

Table 4.6 - Flows Entry flows and Queue Lengths - 2027 PM Peak

Location		Closure of A344: Option 1				Option 2			
		Low Growth		High Growth		Low Growth		High Growth	
		Flow (vph)	Queue (m)	Flow (vph)	Queue (m)	Flow (vph)	Queue (m)	Flow (vph)	Queue (m)
Airman's Corner	B3086 North	248	8	216	12	273	8	330	9
	A344 East	42	0	51	0	54	0	69	0
	A360 South, left turn	465	0	521	0	519	0	593	0
	A360 South, right turn	77	17	140	21	87	17	171	35
	A360 West	189	0	318	4	186	0	405	0
Longbarrow Crossroads	A360 North	459	48	566	78	495	32	770	47
	A303 East	1408	72	1490	168	1421	49	1469	61
	A360 South	479	85	526	154	480	43	491	49
	A303 West	927	199	909	475	911	190	917	522
Countess Roundabout	A345 North	575	24	770	36	603	25	756	36
	A303 East	1738	136	1635	203	1733	133	1649	176
	A345 South	655	309	606	459	665	309	681	459
	A303 West	1201	135	1199	177	1153	133	1219	264

At Airman's Corner there is little change. Under high growth the increased eastbound right-turning traffic results in marginally increased queues for the A360 South right turn.

At Countess roundabout in high growth, redistribution of traffic again gives slightly easier access to the roundabout to eastbound traffic from the A303, with an accompanying small reduction in queue length. However this is offset by an increase in queue from A303 West, which has more difficulty accessing the roundabout.

4.3 Summary of Traffic Impacts

In summary, at-grade improvements to Longbarrow roundabout coupled with the closure of the A303/A344 junction would have the following traffic impacts:

- The improvement to the southbound A360 approach to Longbarrow roundabout would attract significant additional southbound traffic during the morning peak hour in both 2012 and 2027. The increase (high growth) by 2027 is around 260vph. However, the corresponding eastbound traffic increase on the A303 immediately east of Longbarrow is much lower. This is because the eastbound flow from the A303 West through Longbarrow roundabout is decreased with Option 2, whilst traffic making the right turn from the southern A360 arm is also reduced.
- The improvements at Longbarrow would reduce eastbound traffic using The Packway in the morning peak hour in both 2012 and 2027, although the westbound flow would remain unaltered from that predicted with Option 1. Furthermore, the Longbarrow roundabout improvements result in little or no change to flows along The Packway in the inter-peak hour or the evening peak such that, in daily terms, the overall change in traffic on The Packway is likely to be minimal.

- In overall terms, the operational benefits of the increased capacity at Longbarrow would be relatively localised, being limited by the capacity constraint still imposed by the single carriageway section of the A303 between Longbarrow and Stonehenge Bottom.

4.4 Economic Assessment

The economic assessment has been undertaken using TUBA (Transport Users Benefit Appraisal). TUBA completes a matrix-based appraisal, taking trip, time and distance matrices from the SATURN model and disaggregating them by vehicle type, purpose and person type. The scheme costs are input as appropriate. TUBA does not calculate benefits due to changes in accident costs and therefore COBA has been used for this purpose. The results of the economic appraisal using TUBA are shown in Table 4.7, the accident benefits from COBA are shown in Table 4.8, and the combined assessment results for Option 2 are shown in Table 4.9.

It is evident from Table 4.7 that, under low growth conditions, the journey time and vehicle operating cost disbenefits caused by the closure of the A303/A344 junction still outweigh the benefits of improvements to Longbarrow Crossroads resulting in a negative PVB, and thus a negative NPV. However, under high growth conditions, particularly in 2027, the Do-Minimum network experiences significant congestion. Therefore, the additional network capacity provided by improvements to Longbarrow Crossroads offsets the disbenefits caused by the A303/A344 junction closure. The outcome is the provision of marginal benefits and a positive NPV. The total budget estimate (i.e. the total cost at 2006 Q2 prices of construction, land, planning and supervision, with allowance for optimism bias and VAT, where applicable) for Option 2 is some £2.6m.

Table 4.7 - Summary of Economic Assessment (Without accident benefits)

Option 2 (Do-Something)		**Low Growth (£000)**	**High Growth (£000)**
Consumer User Benefits		-6477	-485
Business User Benefits		-5314	2075
Private Sector Provider Impacts		0	0
Other Business Impacts		0	0
Accident Benefits		n/a	n/a
Carbon Benefits		-157	-172
Net present Value of Benefits (PVB)		-11,948	1,418
Local Government Funding		0	0
Central Government Funding	- Indirect Tax Revenues	-1200	-1228
	- Investment Costs	2292	2292
Net present Value of Costs (PVC)		1,092	1,064
Net present Value (NPV)		-13.040	354
Benefit to Cost Ratio (BCR)		-10.94	1.33
Appraisal Period		2010-2069	2010-2069

NOTE: Values discounted to 2002 prices.

The case for closing the A303/A344 junction at Stonehenge Bottom is not based on improving journey times. On the contrary, closing the junction could increase traffic problems elsewhere, particularly at Longbarrow Crossroads. The case for closure is based on the aim of improving the setting of Stonehenge, and on the need to address the poor safety record of the junction, which has worsened in recent years.

It is evident from Table 4.8 below that accident savings, both in quantity and monetary value, are a likely outcome of implementing Option 2. However, the benefits are largely a consequence of closing the A303/A344 junction, with the improvements to Longbarrow

Crossroads providing slight disbenefits. COBA calculates the number of accidents at junctions based on a formula, which includes accident coefficients at specific junction types and a function of traffic flow. There were 18 accidents at Longbarrow Crossroads between 2002 and 2006. This accident history is used as a base to calculate future accident rates for both the Do-Minimum scenario and, as the junction has not been reclassified, the Do-Something scenario. In consequence, the difference between accident rates for the Do-Minimum and the Do-Something is primarily due to a change in the traffic flow, which is calculated using the inflow from adjoining links. Therefore, the increase in trips through the junction increases the likelihood of accidents occurring, thus increasing the accident cost and reducing the overall accident benefits of Option 2 relative to Option 1.

Table 4.8 - Summary of Accident Benefits

		Number of Accidents (over 60 years across the whole network)			Costs (£'000)
		Links	Junctions	Total	
Low Growth	Do-Minimum	32,042	1,692	33,733	2,000,582
	Do-Something	31,977	1,607	33,584	1,992,066
	Benefits	64	85	149	8,515
High Growth	Do-Minimum	39,656	2,249	41,905	2,463,636
	Do-Something	39,613	2,134	41,747	2,453,904
	Benefits	43	115	158	9,732

The accident benefits are combined with the TUBA assessment results to form an overall assessment in Table 4.9. Under low growth conditions, while the accident benefits bring some improvement in the overall PVB, they are not sufficient to outweigh the traffic disbenefits, and the total PVB remains negative. However, under high growth conditions, the accident benefits further enhance the traffic benefits to provide a positive NPV.

Table 4.9 - Summary of Economic Assessment (Including Accident Benefits)

Option 2 (Do-Something)		**Low Growth (£000)**	**High Growth (£000)**
Consumer User Benefits		-6477	-485
Business User Benefits		-5314	2075
Private Sector Provider Impacts		0	0
Other Business Impacts		0	0
Accident Benefits		8,515	9,732
Carbon Benefits		-157	-172
Net present Value of Benefits (PVB)		-3,433	11,150
Local Government Funding		0	0
Central Government Funding	- Indirect Tax Revenues	-1200	-1228
	- Investment Costs	2292	2292
Net present Value of Costs (PVC)		1,092	1,064
Net present Value (NPV)		-4,525	10,086
Benefit to Cost Ratio (BCR)		-3.14	10.48
Appraisal Period		2010-2069	2010-2069

NOTE: Values from TUBA and COBA discounted to 2002 prices.

Table 4.10 shows that Option 2 provides an improved economic outcome compared to Option 1, and also, for high growth only, compared to the Do-Minimum. These improvements are particularly marked at high growth because of improved journey times resulting from the congestion relief provided by the increased capacity of Longbarrow Crossroads.

Table 4.10 - Comparison of Economic Benefits: Option 1 v Option 2

	Option 1 LG (£000)	Option 1 HG (£000)	Option 2 LG (£000)	Option 2 HG (£000)
Net present Value of Benefits (PVB)	-13,285	-9,527	-3,433	11,150
Net present Value of Costs (PVC)	-25	359	1,092	1,064
Net present Value (NPV)	-13,260	-9,886	-4,525	10,086
Benefit to Cost Ratio (BCR)	531.40	-26.54	-3.14	10.48

Notes:
1. Values from TUBA and COBA discounted to 2002 prices.
2. The large BCR for Option 1 at low growth results from the fact that both PVB and PVC are negative, and is therefore meaningless.
3. LG = Low Growth, HG = High Growth

5 Option 3 - Traffic and Economic Assessment

5.1 Traffic Network

Table 5.1 (which can be found after Section 7) compares link flows in the 2012 Opening Year at selected locations with Option 1, the closure of the A303/A344 junction only. The most noticeable impact of constructing the Winterbourne Stoke bypass is the overall increase in traffic using the A303 immediately west of the Longbarrow junction. In the morning peak hour the eastbound flow approaching Longbarrow roundabout increases by around 100vph with both the low and high growth scenario. Whilst southbound traffic on the A360 from Airman's corner also increases relative to Option 1 in the morning peak hour, this increase is lower than Option 2. In consequence, the improvement to the A303 route resulting from the bypass can be seen to encourage diversion from the A360. Indeed, as will be described below, the net impact of the Winterbourne Stoke bypass reduces the two-way AADT volume of traffic using the A360 north of Longbarrow roundabout. The reason for this is a significant reduction in the right turn from the A303 East, which more than compensates for a residual increase in southbound traffic using the A360 North arm when compared with Option 1.

In the evening peak hour the westbound flow on the A303 immediately west of Longbarrow increases by around 260vph in both the low and high growth scenarios. There is no material change in the corresponding westbound flows on The Packway with Options 3 and 1, showing that this diversion is associated with traffic previously continuing northbound on the A360, or turning right from the A303 onto the northbound A360 at Longbarrow roundabout.

Table 5.2 (which can be found after Section 7) shows the corresponding comparisons for the 2027 Design Year. As can be seen from these figures, the patterns exhibited by the traffic flow changes are similar to those described above for 2012.

Figure 5.1 shows the predicted two-way AADT traffic volumes for Option 3. The predicted AADT flow range for the A303 West at Longbarrow roundabout is 33400-37400 in 2027. This compares with 30900-32700 under Option 1. Similarly, the AADT figures for the A360 to the south of Airman's Corner are 10700-13200 with Option 3, showing a small reduction from the 10800-13500 forecast range in 2027 with Option 1. Examination of the directional turning AADT volumes at Longbarrow roundabout with Options 1 and 3 shows that, with the roundabout improvements and construction of the bypass, the overall AADT flow to the junction increases by 1500 vehicles under low growth and around 2000 vehicles under high growth. Key changes in directional flows and turning volumes at Longbarrow roundabout with Option 3 are as follows:

- In the 2027 low growth scenario the two-way increase of 2500 AADT on the A303 West is predominantly associated with a westbound increase of 1800 vehicles. This is nearly all associated with the westbound movement from the A303 East, with corresponding reductions in the left and right turning volumes to the A360 South and North of 220 vehicles and 920 vehicles AADT respectively. The southbound increase on the A360 North is around 600 vehicles AADT, but the reduction in the northbound flow results in a net two-way decrease of 100-200 vehicles AADT.
- The 1500 vehicle AADT inflow increase to Longbarrow under low growth in 2027 is essentially shared by similar increases on the A303 West, A360 North and A303 East approaches. However, the inflow on the A360 South falls, due a reduction in the right turn to the A303 East.
- In the 2027 high growth scenario the two-way increase of 4700 vehicles AADT on the A303 West is associated with a westbound increase of 2600 vehicles and an eastbound increase of 2100 vehicles. The westbound increase is nearly all associated with the westbound movement from the A303 East, with corresponding reductions in the left and

right turning volumes to the A360 South and North of 900 and 1400 vehicles AADT respectively. In fact, the predicted inflow increase on the A303 East with Option 3 is negligible, such that the increase on the A303 to the west of Longbarrow roundabout is nearly all due to reductions in traffic making the left and right turns onto the A360. The southbound increase on the A360 North is around 400 AADT, but the reduction in the northbound flow results in a net two-way decrease of 300-400 vehicles AADT.

- The increased eastbound traffic on the A303 West (2100 AADT) nearly all continues to the A303 East. However, the net increase in the eastbound flow on the A303 immediately east of Longbarrow roundabout is 'dampened' by corresponding reductions in the left turn from the A360 North (400 AADT) and the right turn from the A360 South (550 AADT).

5.2 Summary of Traffic Impacts

In summary, the provision of the Winterbourne Stoke Bypass plus at-grade improvements to Longbarrow roundabout coupled with the closure of the A303/A344 junction would have the following traffic impacts:

- Traffic usage of the A303 west of Longbarrow increases with the provision of the Winterbourne Stoke bypass in all time periods in both 2012 and 2027.
- There is some corresponding reduction in traffic levels using the A360 to the north of the A303.
- The predicted AADT flow range for the A303 West at Longbarrow roundabout is 33400-37400 in 2027. This compares with 30900-32700 under Option 1. Similarly, the AADT figures for the A360 to the south of Airman's Corner are 10700-13200 with Option 3, showing a small reduction from the 10800-13500 forecast range in 2027 with Option 1. Analysis of predicted AADT turning movement changes at the roundabout shows an overall increase in junction inflow of 1500-2000 AADT under Option 3, with increases on the A303 West largely caused by corresponding decreases in the turning movements to and from the A360. Whilst southbound traffic on the A360 North approach to Longbarrow roundabout is increased with Option 3, the reduction in northbound traffic yields a net decrease in the two-way volume on this arm.
- Directional flows of traffic using The Packway in 2012 and 2027 are not materially different from those obtained with Option 1, and as such remain higher than previously reported flows in the Do-Minimum.

5.3 Economic Assessment

As previously, the economic assessment has been undertaken using TUBA, with COBA used to calculate changes in accident costs. The results of the economic appraisal using TUBA are shown in Table 5.3, the accident benefits from COBA are shown in Table 5.4, and the combined assessment results for Option 3 are shown in Table 5.5.

It is evident from Table 5.3 that the construction of the Winterbourne Stoke Bypass provides positive traffic-related benefits compared to the Do-Minimum. However, the total budget estimate of constructing the bypass is some £87.7m, outweighing the benefits and resulting in a negative NPV.

Table 5.3 - Option 3: Summary of Economic Assessment (Without accident costs)

Option 3 (Do-Something		Low Growth (£000	High Growth (£000)
Consumer User Benefits		581	9,492
Business User Benefits		14,274	15,950
Private Sector Provider Impacts		0	0
Other Business Impacts		0	0
Accident Benefits		n/a	n/a
Carbon Benefits		-1,626	-1,581
Net present Value of Benefits (PVB)		13,229	23,861
Local Government Funding		0	0
Central Government Funding	- Indirect Tax Revenues	-11,853	-11,576
	- Investment Costs	70,956	70,956
Net present Value of Costs (PVC)		59,103	59,380
Net present Value (NPV)		-45,874	-35,519
Benefit to Cost Ratio (BCR)		0.22	0.40
Appraisal Period		2010-2069	2010-2069

NOTE: Values discounted to 2002 prices.

It is evident from Table 5.4 below that considerable accident benefits are likely to occur as a result of transferring traffic away from the existing road through Winterbourne Stoke. There were 17 accidents on the single carriageway section of the A303 between Berwick Down and its junction with the B3083 west of Winterbourne Stoke between 2002 and 2006. During the same period there were 11 accidents on the A303 between Winterbourne Stoke and Longbarrow Crossroads. Both links experience significant traffic relief following the construction of the proposed bypass with a consequent reduction in accidents.

COBA uses default accident rates to calculate the number of accidents likely to occur on new links, such as the Winterbourne Stoke Bypass. The outcome is that fewer accidents are likely to occur on the Do-Something network, including the bypass, than currently occur on the existing network, thus creating significant accident savings.

Approximately a quarter of the accident benefits for both low and high growth are attributed to savings made by closing the A303/A344 junction.

Table 5.4 - Option 3: Summary of Accident Benefits

		Number of Accidents (over 60 years across the whole network)			Costs (£000)
		Links	Junctions	Total	
Low Growth	Do-Minimum	32,042	1,692	33,733	2,000,582
	Do-Something	31,703	1,495	33,197	1,963,233
	Benefits	339	197	536	37,349
High Growth	Do-Minimum	39,656	2,249	41,905	2,463,636
	Do-Something	39,286	1,983	41,269	2,419,148
	Benefits	369	267	636	44,488

The accident benefits are combined with the TUBA assessment results to form an overall assessment in Table 5.5. While the accident benefits bring about a large improvement to the overall PVB for low traffic growth, they are not sufficient to offset the cost of construction. However, in the high traffic growth scenario the accident benefits increase the PVB to a value marginally greater than the PVC, resulting in a positive NPV.

Table 5.5 - Option 3: Summary of Economic Assessment (Including Accident Benefits)

Option 3 (Do-Something)		Low Growth (£000)	High Growth (£000)
Consumer User Benefits		581	9,492
Business User Benefits		14,274	15,950
Private Sector Provider Impacts		0	0
Other Business Impacts		0	0
Accident Benefits		37,349	44,488
Carbon Benefits		-1,626	-1,581
Net present Value of Benefits (PVB)		50,578	68,349
Local Government Funding		0	0
Central Government Funding	- Indirect Tax Revenues	-11,853	-11,576
	- Investment Costs	70,956	70,956
Net present Value of Costs (PVC)		59,103	59,380
Net present Value (NPV)		-8,525	8,969
Benefit to Cost Ratio (BCR)		0.86	1.15
Appraisal Period		2010-2069	2010-2069

NOTE: Values from TUBA and COBA discounted to 2002 prices.

From Table 5.6 below, it can be seen that the costs and benefits largely attributable to the Winterbourne Stoke Bypass alone improve the NPV in both the low and high growth scenarios when compared with Option 1, albeit marginally so with low growth. However, the BCRs at both low and high growth are relatively low and are not sufficient to generate a strong business case for the pursuit of a bypass independently of an improvement scheme that would secure the upgrading of the A303 over the entire length between Amesbury and Berwick Down. Without such a scheme, the section of single carriageway between Longbarrow and Stonehenge Bottom would remain a bottleneck, militating against the business case for other major local improvements on this part of the network.

Table 5.6 - Comparison of Economic Benefits: Options 1, 2 and 3

	Option 1 LG (£000)	Option 1 HG (£000)	Option 2 LG (£000)	Option 2 HG (£000)	Option 3 LG (£000)	Option 3 HG (£000)
Net present Value of Benefits (PVB)	-13,285	-9,527	-3,433	11,150	50,578	68,349
Net present Value of Costs (PVC)	-25	359	1,092	1,064	59,103	59,380
Net present Value (NPV)	-13,260	-9,886	-4,525	10,086	-8,525	8,969
Benefit to Cost Ratio (BCR)	531.40	-26.54	-3.14	10.48	0.86	1.15

NOTES: 1. Values from TUBA and COBA discounted to 2002 prices.
2. The large BCR for Option 1 at low growth results from the fact that both PVB and PVC are negative, and is therefore meaningless.
3. LG = Low Growth, HG = High Growth

6 Option 4 - Traffic and Economic Assessment

6.1 Traffic Network

As with previous options, Table 6.1 (which can be found after Section 7) compares link flows in the 2012 Opening Year at selected locations with Option 1, the closure of the A303/A344 junction only. Table 6.2 (also to be found after Section 7) provides similar comparisons in the 2027 Design Year.

Whilst Option 4 includes at-grade improvements at both Longbarrow and Countess roundabouts, it is evident from Table 6.1 that the only significant impact in 2012 is on traffic using Longbarrow. As with Option 2, this is generally confined to the morning peak hour. For brevity, a full synopsis of the flow impacts resulting from the Longbarrow improvement in 2012 is not repeated here, as changes arising have already been fully described in discussing the traffic network effects of Option 2. The additional point to note, in the context of Option 4, is that there are no material link flow changes in the vicinity of Countess roundabout in any time period in 2012.

Examination of Table 6.2 shows that the proposed at-grade improvements and signalisation at Countess roundabout has a much greater traffic network impact in 2027, particularly in the morning peak hour. For Option 4, link flow comparisons have also been made on Tisbury Road, immediately north of the A303 Folly Bottom. This is because examination of the SATURN model outputs showed that the southbound Tisbury Road approach to the roundabout on the north side of the Folly Bottom interchange was highly capacity 'critical' during the morning peak hour in the 2027 high growth scenario, with over-capacity operating conditions and long delays predicted in both the Do-Minimum and Option 1 scenarios.

In the morning peak hour the at-grade improvements at Countess roundabout lead to an increase of southbound traffic using the A345 North approach to the junction, particularly in the high growth scenario. This increase arises from congestion on Tisbury Road, where southbound traffic levels fall as a result of diversion to the A345. This diversion to the A345, albeit small, is sufficient to substantially ease morning peak hour operating conditions on Tisbury Road in 2027. The impacts of the Longbarrow improvements are similar to those previously described for Option 2, with southbound traffic on the A360 North approach increasing by around 240vph under the low growth scenario and 200vph under the high growth scenario. As with Option 2, the corresponding eastbound flow changes on the A303 just east of Longbarrow roundabout are lower than those suggested by the transfers to the A360, due to associated reductions in traffic arrivals on the A303 West and the A360 South approaches.

In the inter-peak hour in 2027 there are no noticeable link flow changes arising from the at-grade improvements at the two roundabouts. This is not unexpected as the unimproved junctions do not reveal operational problems in this period in the SATURN model. However, it is important to note that, with limited potential for traffic growth in the peak hours in 2027, actual growth in usage of the A303 will generally be catered for in the inter-peak period, with peak spreading increasing the duration of 'peak' conditions.

In the evening peak hour the significant change in the vicinity of the Longbarrow junction is confined to the high growth scenario, with A360 southbound traffic arriving from Airman's Corner rising by around 170vph. At Countess, the northbound flow on the A345 just north of the A303 also increases by about 120vph in the high growth scenario. This is not a result of any diversion from Tisbury Road, but instead reflects the improved capacity available at Countess roundabout. Increased northbound traffic usage of the A345 also results in a small increase in westbound traffic using The Packway.

Figure 6.1 shows the predicted AADT traffic volumes that would result from the closure of the A303/A344 junction coupled with at-grade improvements to Longbarrow roundabout and Countess roundabout.

6.2 Traffic Impacts at Selected Junctions

6.2.1 Introduction

As described in Section 4.2 for Option 2, to understand better the potential traffic impacts of the proposed junction improvements, the data from the SATURN model has been entered into the VISSIM model. This section presents and discusses the results of this analysis for Option 4 in the assumed opening year of 2012 and design year of 2027. Because the results for Option 2 have already been compared to Option 1 in Section 4.2, isolating the effects of the Longbarrow Crossroads improvement, the Option 4 results are here compared to Option 2, to isolate the effects of the Countess roundabout improvement.

6.2.2 Impacts in 2012: Opening Year

2012 AM Peak

In the AM peak, the improvement of Countess Roundabout makes little difference to the flows at any of the three junctions shown in Table 6.3 below.

Table 6.3 - Entry Flows and Queue Lengths - 2012 AM Peak

Location		Option 2				Option 4			
		Low Growth		High Growth		Low Growth		High Growth	
		Flow (vph)	Queue (m)	Flow (vph)	Queue (m)	Flow (vph)	Queue (m)	Flow (vph)	Queue (m)
Airman's Corner	B3086 North	65	2	75	3	65	2	74	2
	A344 East	6	0	5	0	3	0	3	0
	A360 South, left turn	200	0	282	0	205	0	290	0
	A360 South, right turn	69	17	82	17	70	15	82	19
	A360 West	560	0	590	0	558	0	592	0
Longbarrow Crossroads	A360 North	598	47	634	73	593	50	630	68
	A303 East	962	52	1094	66	1038	58	1106	67
	A360 South	395	21	467	26	393	22	465	27
	A303 West	1054	45	1082	62	1050	45	1102	68
Countess Roundabout	A345 North	834	47	880	52	831	39	917	35
	A303 East	999	44	1133	60	985	44	1115	46
	A345 South	594	43	621	66	534	39	560	41
	A303 West	1417	126	1447	187	1414	60	1457	61

At Countess Roundabout itself there is a decrease of 60 vehicles/hour on A345 South approach, in both low and high growth. This indicates an increase on Stonehenge Road, presumably by traffic wishing to avoid the signals, as there is a net gain on the A303 westbound at Longbarrow.

There is however a reduction in queue length on every arm in high growth, showing that the junction is operating more efficiently.

2012 PM Peak

In the PM peak in 2012, there is again little change to flows at any of the three junctions shown in Table 6.4 below.

Table 6.4 - Entry Flows and Queue Lengths - 2012 PM Peak

Location		Option 2				Option 4			
		Low Growth		High Growth		Low Growth		High Growth	
		Flow (vph)	Queue (m)	Flow (vph)	Queue (m)	Flow (vph)	Queue (m)	Flow (vph)	Queue (m)
Airman's Corner	B3086 North	180	7	239	8	211	7	239	8
	A344 East	50	0	71	0	50	0	71	0
	A360 South, left turn	553	0	581	0	573	0	586	0
	A360 South, right turn	70	12	122	22	82	15	120	21
	A360 West	182	0	296	0	182	0	294	0
Longbarrow Crossroads	A360 North	392	22	565	36	426	23	565	35
	A303 East	1378	37	1445	52	1426	41	1466	51
	A360 South	496	33	477	43	489	39	481	44
	A303 West	842	107	842	196	841	129	850	246
Countess Roundabout	A345 North	634	26	686	28	581	24	661	25
	A303 East	1577	74	1680	100	1604	52	1763	57
	A345 South	692	104	660	200	621	39	581	40
	A303 West	1088	84	1197	126	1085	57	1199	63

There is a small flow increase on the A303 East at Countess, with a corresponding decrease on the A345 South. As with the AM Peak however, there is a reduction in queue length on every arm.

6.2.3 Impacts in 2027: Design Year

2027 AM Peak

In 2027 AM peak there is a more significant effect than in 2012 at Countess Roundabout (see Table 6.5 below).

Table 6.5 - Entry Flows and Queue Lengths - 2027 AM Peak

Location		Option 2				Option 4			
		Low Growth		High Growth		Low Growth		High Growth	
		Flow (vph)	Queue (m)	Flow (vph)	Queue (m)	Flow (vph)	Queue (m)	Flow (vph)	Queue (m)
Airman's Corner	B3086 North	91	3	234	6	70	3	168	5
	A344 East	5	0	6	0	3	0	3	0
	A360 South, left turn	313	0	423	0	317	0	395	0
	A360 South, right turn	118	40	77	24	123	40	85	34
	A360 West	597	0	635	0	603	0	640	1
Longbarrow Crossroads	A360 North	659	82	782	353	647	70	749	233
	A303 East	1095	61	1210	78	1152	66	1256	68
	A360 South	457	28	558	65	467	29	584	56
	A303 West	1097	70	942	283	1094	80	982	189
Countess Roundabout	A345 North	838	49	847	200	939	34	1049	35
	A303 East	1169	58	1429	81	1150	51	1301	55
	A345 South	616	56	689	165	555	41	573	48
	A303 West	1480	173	1369	805	1483	61	1571	73

At low growth there is an increase in flow on the A345 North entry from 838 to 939 vehicles/hour, but a decrease of 60 vehicles/hour on the A345 South, again indicating the likely use of Stonehenge Road as a rat-run to the A303. At high growth the increase on the A345 North doubles to 200 vehicles/hour, with an increase of 200 vehicles also on A303 West, but a decrease of 120 vehicles on A345 South. The two arms with significant increases at high growth are both partly due to a release of traffic that was previously queuing here in Option 2, in addition to traffic rerouting to take advantage of the greater capacity at Countess.

There is a reduction in queuing on all arms, particularly from A303 West, with the reductions being significant at high growth.

2027 PM Peak

The PM peak in 2027 shows the most significant impact of the improvements to Countess Roundabout (see Table 6.6 below).

Table 6.6 - Entry flows and Queue Lengths - 2027 PM Peak

Location		Option 2				Option 4			
		Low Growth		High Growth		Low Growth		High Growth	
		Flow (vph)	Queue (m)	Flow (vph)	Queue (m)	Flow (vph)	Queue (m)	Flow (vph)	Queue (m)
Airman's Corner	B3086 North	273	8	330	9	278	7	333	12
	A344 East	54	0	69	0	54	0	69	0
	A360 South, left turn	519	0	593	0	520	0	562	0
	A360 South, right turn	87	17	171	35	97	18	187	59
	A360 West	186	0	405	0	189	0	391	0
Longbarrow Crossroads	A360 North	495	32	770	47	503	33	761	44
	A303 East	1421	49	1469	61	1441	51	1365	54
	A360 South	480	43	491	49	481	43	510	39
	A303 West	911	190	917	522	915	185	960	358
Countess Roundabout	A345 North	603	25	756	36	583	24	730	30
	A303 East	1733	133	1649	176	1862	66	2008	76
	A345 South	665	309	681	459	655	41	711	50
	A303 West	1153	133	1219	264	1155	65	1285	71

On the A303 East at Countess there is a significant increase in the flow able to enter the junction, from 1733 to 1862 vehicles/hour at low growth, and from 1649 to 2008 vehicles/hour at high growth. This leads to an increase in turning traffic at Countess, as there is no corresponding increase at Longbarrow. Again there is a significant reduction in queues on the entry arms at both low and high growth.

6.3 Summary of Traffic Impacts

In summary, at-grade improvements to the Longbarrow and Countess junctions coupled with the closure of the A303/A344 junction would have the following traffic impacts:

- As with Option 2, the improvement to the northern A360 approach to Longbarrow roundabout would attract additional southbound traffic during the morning peak hour in both 2012 and 2027. However, the corresponding eastbound traffic increases on the A303 immediately east of Longbarrow are much lower due to associated reductions in traffic arrivals on the A303 West and the A360 South approaches
- The improvement of Countess roundabout has a significant network impact in the morning peak hour in 2027 under high growth assumptions. The SATURN model reveals significant southbound congestion on Tisbury Road to the north of Folly Bottom at this time as a result of operational problems at the roundabout on the north side of the interchange. This is due in part to the level of anticipated development in this area of Amesbury. The improvement to the capacity of the southbound A345 approach to Countess roundabout would be instrumental in reducing the overall level of congestion in the 2027 high growth scenario by affording relief to Tisbury Road.
- Apart from a reduction in eastbound traffic in the morning peak hour, Option 4 has little effect on the traffic flows along The Packway forecast with the A303/A344 junction

closure, though there is a reduction in eastbound traffic in the morning peak and, by 2027, an increase in the westbound flow under high growth.

- As with Option 2, in overall terms any operational benefits of the improvement at Longbarrow and Countess would be relatively localised, being limited by the capacity constraint still imposed by the single carriageway section of the A303 between Longbarrow and Stonehenge Bottom.

6.4 Economic Assessment

As previously, the economic assessment has been undertaken using TUBA, with COBA used to calculate changes in accident costs. The results of the economic appraisal using TUBA are shown in Table 6.7, the accident benefits from COBA are shown in Table 6.8, and the combined assessment results for Option 4 are shown in Table 6.9.

It is evident from Table 6.7 that a large disparity exists between the PVB for low and high growth. Under high growth conditions, by 2027, the Do-Minimum network will experience significant congestion at Folly Bottom during the morning peak. Improvements to Countess Roundabout will attract some traffic away from Folly Bottom, thus providing significant journey time benefits compared to the Do-Minimum. Under low growth conditions Folly Bottom is less stressed, so road users will not experience the same level of delay and improvements at Countess Roundabout do not provide user benefits.

The total budget estimate is some £5.6m, with a resulting negative Net Present Value at low growth, and positive NPV at high growth.

Table 6.7 - Option 4: Summary of Economic Assessment (Without accident benefits)

Option 4 (Do-Something)		**Low Growth (£000)**	**High Growth (£000**
Consumer User Benefits		-7,012	18,875
Business User Benefits		-6,485	23,854
Private Sector Provider Impacts		0	0
Other Business Impacts		0	0
Accident Benefits		n/a	n/a
Carbon Benefits		-120	-353
Net present Value of Benefits (PVB)		-13,617	42,376
Local Government Funding		0	0
Central Government Funding	- Indirect Tax Revenues	-893	-2,415
	- Investment Costs	4,803	4,803
Net present Value of Costs (PVC)		3,910	2,388
Net present Value (NPV)		-17,527	39,988
Benefit to Cost Ratio (BCR)		-3.482	17.75
Appraisal Period		2010-2069	2010-2069

NOTE: Values discounted to 2002 prices.

It is evident from Table 6.8 that accident benefits are achieved due to the proposed improvements at Countess Roundabout. However, it is possible that these benefits are inflated due to recent relatively high accident numbers at Countess Roundabout. There were 36 accidents at the roundabout during the five-year period between 2002 and 2006 creating an accident rate in COBA higher than would be expected for a 'typical' junction of this nature. Thus the employment of lower 'default' rates for the proposed signalised improvement, albeit for a different junction type, straightaway reduces the likely number of accidents before consideration of changes in traffic flow.

In the absence of 'actual' data for a hypothetical scenario, the COBA default rates provide the best source of accident rates and it may well be that the proposed improvements to Countess Roundabout might reduce the frequency of accidents to a level that reflects a 'typical' signalised junction.

Table 6.8 - Option 4: Summary of Accident Benefits

		Number of Accidents (over 60 years across the whole network)			Costs (£'000)
		Links	Junctions	Total	
Low Growth	Do-Minimum	32,042	1,692	33,733	2,000,582
	Do-Something	31,873	1,326	33,198	1,977,833
	Benefits	169	366	535	22,749
High Growth	Do-Minimum	39,656	2,249	41,905	2,463,636
	Do-Something	39,477	1,747	41,224	2,434,462
	Benefits	179	502	681	29,175

The accident benefits are combined with the TUBA assessment results to form an overall assessment in Table 6.9. The accident benefits have created a positive PVB, NPV and BCR for low growth. For high growth the accident benefits have further increased the positive PVB, NPV and BCR. The wide range in NPV between low and high growth demonstrates that the economic benefits of Option 4 are highly dependent on the extent of future traffic growth, and it is probably worth noting that the potential for high growth in the future may be restricted by other capacity constraints on the network, particularly the section of A303 single carriageway between Longbarrow and Stonehenge Bottom.

Table 6.9 - Option 4: Summary of Economic Assessment (Including Accident Costs)

Option 4 (Do-Something)		**Low Growth (£000)**	**High Growth (£000)**
Consumer User Benefits		-7,012	18,875
Business User Benefits		-6,485	23,854
Private Sector Provider Impacts		0	0
Other Business Impacts		0	0
Accident Benefits		22,749	29,175
Carbon Benefits		-120	-353
Net present Value of Benefits (PVB)		9,132	71,551
Local Government Funding		0	0
Central Government Funding	- Indirect Tax Revenues	-893	-2,415
	- Investment Costs	4,803	4,803
Net present Value of Costs (PVC)		3,910	2,388
Net present Value (NPV)		5,222	69,163
Benefit to Cost Ratio (BCR)		2.34	29.96
Appraisal Period		2010-2069	2010-2069

NOTE: Values from TUBA and COBA discounted to 2002 prices.

It is evident from Table 6.10 that at-grade improvements to Longbarrow roundabout (Option 2) provide user benefits under the low growth scenario when compared to Option 1. However, additional at-grade improvements to Countess Roundabout (Option 4) provide user benefits when compared to Option 1 and the Do-Minimum scenario. With high traffic growth, improvements to Longbarrow roundabout alone provide benefits when compared to both the Do-Minimum and Option 1 scenarios, but these benefits are significantly increased by the addition of improvements to Countess Roundabout.

Table 6.10 - Comparison of Economic Benefits: Options 1, 2 and 4

	Option 1 LG (£000)	Option 1 HG (£000)	Option 2 LG (£000)	Option 2 HG (£000)	Option 4 LG (£000)	Option 4 HG (£000)
Net present Value of Benefits (PVB)	-13,285	-9,527	-3,433	11,150	9,132	71,551
Net present Value of Costs (PVC)	-25	359	1,092	1,064	3,910	2,388
Net present Value (NPV)	-13,260	-9,886	-4,525	10,086	5,222	69,163
Benefit to Cost Ratio (BCR)	531.40	-26.54	-3.14	10.48	2.34	29.96

NOTES: 1. Values from TUBA and COBA discounted to 2002 prices.
2. The large BCR for Option 1 at low growth results from the fact that both PVB and PVC are negative, and is therefore meaningless.
3. LG = Low Growth, HG = High Growth

7 Conclusions

This report has considered the traffic and economic impacts of three Partial Solution Options for the A303 in the vicinity of Stonehenge. These comprise the implementation of further highway works in addition to the closure of the A303/A344 junction, in order to mitigate previously identified adverse network impacts remaining with the latter. The assessment of the A303/A344 junction closure in isolation (referred to herein as Option 1) is described in the '*A303 Stonehenge Improvement Scheme Review - Partial Solutions - A303/A344 Junction Closure'* report, completed in September 2007. In that report it was concluded that implementation of the closure of the A303 / A344 junction would aggravate the congestion problems that will arise along this section of the A303 (including at Longbarrow Crossroads), as traffic continues to grow in the future.

Option 2 considers the implementation of an at-grade improvement scheme at Longbarrow roundabout, in addition to the A303/A344 junction closure. This proposes capacity improvements on the A360 southbound and A303 westbound approaches to the junction. Traffic analyses undertaken reveal the following:

- The improvement to the southbound A360 approach to Longbarrow roundabout would attract significant additional southbound traffic during the morning peak hour in both 2012 and 2027. However, the corresponding eastbound traffic increase on the A303 immediately east of Longbarrow is much lower. This is because the eastbound flow from the A303 West through Longbarrow roundabout is decreased with Option 2, whilst traffic making the right turn from the southern A360 arm is also reduced.
- The improvements at Longbarrow would reduce eastbound traffic using The Packway in the morning peak hour in both 2012 and 2027, although the westbound flow would remain unaltered from that predicted for Option 1. Furthermore, the Longbarrow roundabout improvements result in little or no change to flows along The Packway in the inter-peak hour or the evening peak such that, in daily terms, the overall change in traffic on The Packway is likely to be minimal.
- In overall terms, the operational benefits of the increased capacity at Longbarrow would be relatively localised, being limited by the capacity constraint still imposed by the single carriageway section of the A303 between Longbarrow and Stonehenge Bottom.

Economic analysis of Option 2 shows that the inclusion of the Longbarrow improvement would yield an NPV of -£4.5m and £10.1m under low and high traffic growth assumptions respectively. This compares with -£13.3m and -£9.9m for Option 1. In consequence, the inclusion of the Longbarrow scheme produces positive benefits at both low and high growth, sufficient to overcome the potential disbenefit of the A303/A44 junction closure under high growth.

Option 3 considers the construction of the Winterbourne Stoke bypass in addition to Option 2. The reason for including this Option was to review the traffic effects and economics case for the bypass as a stand-alone scheme, in addition to the closure of the A303/A344 junction. The main traffic effects of the bypass were found to be:

- Traffic on the A303 west of Longbarrow increases with the provision of the Winterbourne Stoke bypass in all time periods in both 2012 and 2027.
- There is a corresponding reduction in traffic levels using the A360 to the north of the A303.

Economic analysis of Option 3 shows that, despite positive user benefits and accident savings, the scheme would yield an NPV of -£8.5m and £9.0m under low and high traffic growth assumptions respectively (again, compared with -£13.3m and -£9.9m for Option 1). BCRs of between 0.86 and 1.15 are not sufficient to provide a strong economic case for providing a dual

carriageway bypass of Winterbourne Stoke as a stand-alone scheme. The section of single carriageway between Longbarrow and Stonehenge Bottom would also remain a bottleneck, militating against the business case for other major local improvements on this part of the network.

Option 4 considers the implementation of at-grade improvement schemes at both Longbarrow roundabout and Countess roundabout, in addition to the A303/A344 junction closure. The improvement scheme at Countess includes entry and exit improvements on all the roundabout arms, coupled with full signalisation. Not unexpectedly, the traffic effects at Longbarrow roundabout are similar to Option 2. The effects at Countess are not significant in 2012, but become so in the 2027 high growth scenario. By 2027, under high growth, the SATURN model reveals significant southbound congestion on Tisbury Road to the north of Folly Bottom in the morning peak hour, due in part to the level of anticipated development in this area of Amesbury. The improvement to the southbound A345 approach at Countess would be instrumental in reducing the overall level of congestion in the 2027 high growth scenario, with traffic diverting from Tisbury Road to the A345.

The effect at Folly Bottom of the Countess roundabout improvement in 2027 has a significant impact on the economic forecasts. The PVB under low growth is £9.1m, yet with high growth it is £71.6m. This is attributable to the relief of congestion at Folly Bottom, which does not occur in the Do-Minimum with low growth. The resulting NPV for Option 4 is £5.2m (low growth) and £69.2m (high growth), so the economics are highly dependent on the anticipated local growth scenario around Amesbury by 2027. The comparative NPV figures for Option 1 are -£13.3m and -£9.9m, and for Option 2 are -£4.5m and £10.1m.

In summary, the disbenefits of closing the A303/A344 junction at low growth are almost offset by improvements to Longbarrow Crossroads (Option 2). However, additional at-grade improvements to Countess Roundabout (Option 4) provide user benefits under low growth when compared to Option 1 and the Do-Minimum scenario. With high traffic growth, improvements to Longbarrow roundabout alone provide benefits when compared to both the Do-Minimum and Option 1 scenarios, but these benefits are significantly increased by the addition of improvements to Countess Roundabout. It should be noted that the potential for high growth in the future may be restricted by other capacity constraints on the network, particularly the section of A303 single carriageway between Longbarrow and Stonehenge Bottom. Notwithstanding this, Option 4 provides a BCR of 2.34 even with low traffic growth assumptions.

Table 4.1 Modelled SATURN Link Flows: Comparison of Option 2 with Option 1 - 2012 OPENING Year

		A360, North of A303		The Packway, East of Rollestone		A303, East of Longbarrow Roundabout		A345, North of Countess Roundabout	
AM Peak		Southbound	Northbound	Eastbound	Westbound	Westbound	Eastbound	Southbound	Northbound
2006		386	204	345	196	821	1063	746	494
Option 1	Low	427	281	459	190	1140	1447	917	558
	High	407	377	584	220	1253	1460	986	606
Option 2	Low	603	291	426	208	1129	1489	885	557
	High	638	398	511	241	1240	1530	925	602
Inter Peak		Southbound	Northbound	Eastbound	Westbound	Westbound	Eastbound	Southbound	Northbound
2006		172	185	108	120	826	808	576	400
Option 1	Low	304	312	142	169	1115	1027	513	429
	High	340	348	163	195	1249	1170	566	480
Option 2	Low	304	312	142	169	1117	1028	513	429
	High	347	349	163	195	1254	1171	566	480
PM Peak		Southbound	Northbound	Eastbound	Westbound	Westbound	Eastbound	Southbound	Northbound
2006		165	247	203	290	1031	979	685	567
Option 1	Low	368	611	224	448	1483	1186	659	743
	High	504	644	286	553	1500	1318	691	758
Option 2	Low	374	612	223	449	1491	1186	659	743
	High	534	642	283	555	1500	1328	687	758

Note:

Because VISSIM has been validated using turning movements, whereas SATURN uses link counts, the flows in the two models will not necessarily be exactly the same on each link but should be of the same order of magnitude. The greater accuracy is required in the VISSIM model to test more robustly the effect of traffic changes at Countess Roundabout, Longbarrow Crossroads and the junction at Airman's Corner.

Table 4.2 Modelled SATURN Link Flows: Comparison of Option 2 with Option 1 - 2027 DESIGN Year

		A360, North of A303		The Packway, East of Rollestone		A303, East of Longbarrow Roundabout		A345, North of Countess Roundabout	
AM Peak		Southbound	Northbound	Eastbound	Westbound	Westbound	Eastbound	Southbound	Northbound
2006		386	204	345	196	821	1063	746	494
Option 1	Low	415	392	580	218	1293	1504	961	580
	High	561	509	683	293	1466	1449	1015	664
Option 2	Low	663	459	537	248	1274	1562	886	539
	High	823	544	581	410	1416	1515	971	652
Inter Peak		Southbound	Northbound	Eastbound	Westbound	Westbound	Eastbound	Southbound	Northbound
2006		172	185	108	120	826	808	576	400
Option 1	Low	329	334	156	194	1300	1171	544	504
	High	430	404	209	286	1476	1419	634	653
Option 2	Low	333	334	156	194	1303	1171	544	504
	High	447	411	206	292	1477	1421	625	651
PM Peak		Southbound	Northbound	Eastbound	Westbound	Westbound	Eastbound	Southbound	Northbound
2006		165	247	203	290	1031	979	685	567
Option 1	Low	446	537	231	541	1500	1277	617	864
	High	550	620	372	661	1500	1399	820	954
Option 2	Low	460	543	228	546	1500	1279	612	864
	High	727	648	383	683	1500	1438	759	944

Note:

Because VISSIM has been validated using turning movements, whereas SATURN uses link counts, the flows in the two models will not necessarily be exactly the same on each link but should be of the same order of magnitude. The greater accuracy is required in the VISSIM model to test more robustly the effect of traffic changes at Countess Roundabout, Longbarrow Crossroads and the junction at Airman's Corner.

Table 5.1 Modelled SATURN Link Flows: Comparison of Option 3 with Option 1 - 2012 OPENING Year

		A303, West of Longbarrow Roundabout		A360, North of A303		The Packway, East of Rollestone		A303, East of Longbarrow Roundabout		Winterbourne Stoke Bypass	
AM Peak		Eastbound	Westbound	Southbound	Northbound	Eastbound	Westbound	Westbound	Eastbound	Eastbound	Westbound
2006		1003	694	386	204	345	196	821	1063	-	-
Option 1	Low	1238	894	427	281	459	190	1140	1447	-	-
	High	1275	922	407	377	584	220	1253	1460	-	-
Option 3	Low	1347	946	504	280	428	206	1160	1498	1270	919
	High	1379	1044	586	330	516	239	1272	1528	1304	1018
Inter Peak		Eastbound	Westbound	Southbound	Northbound	Eastbound	Westbound	Westbound	Eastbound	Eastbound	Westbound
2006		833	832	172	185	108	120	826	808	-	-
Option 1	Low	909	986	304	312	142	169	1115	1027	-	-
	High	1018	1102	340	348	163	195	1249	1170	-	-
Option 3	Low	924	1073	312	302	139	167	1177	1040	885	1034
	High	1061	1204	347	338	156	191	1324	1194	1017	1160
PM Peak		Eastbound	Westbound	Southbound	Northbound	Eastbound	Westbound	Westbound	Eastbound	Eastbound	Westbound
2006		782	930	165	247	203	290	1031	979	-	-
Option 1	Low	968	1085	368	611	224	448	1483	1186	-	-
	High	1003	1079	504	644	286	553	1500	1318	-	-
Option 3	Low	997	1343	419	404	222	498	1500	1205	963	1278
	High	1117	1339	491	419	282	598	1500	1372	1080	1290

Note:

Because VISSIM has been validated using turning movements, whereas SATURN uses link counts, the flows in the two models will not necessarily be exactly the same on each link but should be of the same order of magnitude. The greater accuracy is required in the VISSIM model to test more robustly the effect of traffic changes at Countess Roundabout, Longbarrow Crossroads and the junction at Airman's Corner.

Table 5.2 Modelled SATURN Link Flows: Comparison of Option 3 with Option 1 - 2027 DESIGN Year

		A303, West of Longbarrow Roundabout		A360, North of A303		The Packway, East of Rollestone		A303, East of Longbarrow Roundabout		Winterbourne Stoke Bypass	
AM Peak		Eastbound	Westbound	Southbound	Northbound	Eastbound	Westbound	Westbound	Eastbound	Eastbound	Westbound
2006		1003	694	386	204	345	196	821	1063	-	-
Option 1	Low	1261	953	415	392	580	218	1293	1504	-	-
	High	1151	994	561	509	683	293	1466	1449	-	-
Option 3	Low	1380	1119	599	359	540	243	1315	1560	1309	1093
	High	1376	1198	635	400	689	435	1420	1562	1333	1178
Inter Peak		Eastbound	Westbound	Southbound	Southbound	Eastbound	Westbound	Westbound	Eastbound	Eastbound	Westbound
2006		833	832	172	185	108	120	826	808	-	-
Option 1	Low	1009	1156	329	334	156	194	1300	1171	-	-
	High	1196	1206	430	404	209	286	1476	1419	-	-
Option 3	Low	1045	1265	327	321	148	190	1386	1189	1005	1227
	High	1296	1372	461	405	213	324	1499	1462	1249	1304
PM Peak		Eastbound	Westbound	Southbound	Southbound	Eastbound	Westbound	Westbound	Eastbound	Eastbound	Westbound
2006		782	930	165	247	203	290	1031	979	-	-
Option 1	Low	1055	1198	446	537	231	541	1500	1277	-	-
	High	1130	1167	550	620	372	661	1500	1399	-	-
Option 3	Low	1074	1391	466	369	230	569	1500	1300	1045	1297
	High	1320	1386	555	469	389	703	1500	1478	1288	1306

Note:

Because VISSIM has been validated using turning movements, whereas SATURN uses link counts, the flows in the two models will not necessarily be exactly the same on each link but should be of the same order of magnitude. The greater accuracy is required in the VISSIM model to test more robustly the effect of traffic changes at Countess Roundabout, Longbarrow Crossroads and the junction at Airman's Corner.

Table 6.1 Modelled SATURN Link Flows: Comparison of Option 4 with Option 1 - 2012 OPENING Year

		Tisbury Road, North of A303 Folly Bottom		A360, North of A303		The Packway, East of Rollestone		A303, East of Longbarrow Roundabout		A345, North of Countess Roundabout	
AM Peak		Southbound	Northbound	Southbound	Northbound	Eastbound	Westbound	Westbound	Eastbound	Southbound	Northbound
2006		523	245	386	204	345	196	821	1063	746	494
Option 1	Low	594	224	427	281	459	190	1140	1447	917	558
	High	732	256	407	377	584	220	1253	1460	986	606
Option 4	Low	591	238	602	293	426	208	1127	1482	882	528
	High	670	266	640	404	514	239	1239	1528	962	573
Inter Peak		Southbound	Northbound	Southbound	Northbound	Eastbound	Westbound	Westbound	Eastbound	Southbound	Northbound
2006		250	172	172	185	108	120	826	808	576	400
Option 1	Low	267	198	304	312	142	169	1115	1027	513	429
	High	315	236	340	348	163	195	1249	1170	566	480
Option 4	Low	269	199	304	312	142	169	1114	1028	510	427
	High	319	237	348	351	163	195	1250	1167	560	474
PM Peak		Southbound	Northbound	Southbound	Northbound	Eastbound	Westbound	Westbound	Eastbound	Southbound	Northbound
2006		318	458	165	247	203	290	1031	979	685	567
Option 1	Low	278	517	368	611	224	448	1483	1186	659	743
	High	282	558	504	644	286	553	1500	1318	691	758
Option 4	Low	306	542	401	615	225	474	1479	1181	592	711
	High	304	580	533	642	284	556	1500	1320	653	758

Note:

Because VISSIM has been validated using turning movements, whereas SATURN uses link counts, the flows in the two models will not necessarily be exactly the same on each link but should be of the same order of magnitude. The greater accuracy is required in the VISSIM model to test more robustly the effect of traffic changes at Countess Roundabout, Longbarrow Crossroads and the junction at Airman's Corner.

Table 6.2 Modelled SATURN Link Flows: Comparison of Option 4 with Option 1 - 2027 DESIGN Year

		Tisbury Road, North of A303 Folly Bottom		A360, North of A303		The Packway, East of Rollestone		A303, East of Longbarrow Roundabout		A345, North of Countess Roundabout	
AM Peak		Southbound	Northbound	Southbound	Northbound	Eastbound	Westbound	Westbound	Eastbound	Southbound	Northbound
2006		523	245	386	204	345	196	821	1063	746	494
Option 1	Low	732	244	415	392	580	218	1293	1504	961	580
	High	781	320	561	509	683	293	1466	1449	1015	664
Option 4	Low	638	257	652	466	549	225	1293	1552	1000	514
	High	702	308	763	528	597	370	1422	1521	1111	597
Inter Peak		Southbound	Northbound	Southbound	Northbound	Eastbound	Westbound	Westbound	Eastbound	Southbound	Northbound
2006		250	172	172	185	108	120	826	808	576	400
Option 1	Low	313	220	329	334	156	194	1300	1171	544	504
	High	416	307	430	404	209	286	1476	1419	634	653
Option 4	Low	327	220	333	335	156	194	1298	1168	529	501
	High	414	300	439	413	206	304	1470	1414	610	655
PM Peak		Southbound	Northbound	Southbound	Northbound	Eastbound	Westbound	Westbound	Eastbound	Southbound	Northbound
2006		318	458	165	247	203	290	1031	979	685	567
Option 1	Low	312	608	446	537	231	541	1500	1277	617	864
	High	386	612	550	620	372	661	1500	1399	820	954
Option 4	Low	332	611	467	551	235	552	1500	1264	584	884
	High	407	617	716	634	385	739	1500	1434	722	1073

Note:

Because VISSIM has been validated using turning movements, whereas SATURN uses link counts, the flows in the two models will not necessarily be exactly the same on each link but should be of the same order of magnitude. The greater accuracy is required in the VISSIM model to test more robustly the effect of traffic changes at Countess Roundabout, Longbarrow Crossroads and the junction at Airman's Corner.

Glossary of Acronyms

AADT	Annual Average Daily Traffic
AM	Morning, 00:00hrs to 12:00hrs
ATC	Automatic Traffic Count
BCR	Benefit Cost Ratio
COBA	Cost Benefit Analysis (software)
DIADEM	Dynamic Integrated Assignment and Demand Modelling
DMRB	Design Manual for Roads and Bridges
ECI	Early Contractor Involvement
EXCEL	Microsoft spreadsheet software
NPV	Net Present Value
NRTF	National Road Traffic Figures
OAT	Option Assessment Table
PM	Afternoon 12:00hrs to 24:00hrs
PVB	Present Value of Benefits
PVC	Present Value of Costs
Q2	Second Quarter of the financial year
SAR	Scheme Assessment Report
SATURN	Simulation and Assignment of Traffic to Urban Road Networks (software)
TEMPRO	Trip End Model Presentation Program (software)
TRICS	Trip Rate Information Computer System (software)
TUBA	Transport Users Benefit Appraisal
UNESCO	the United Nations Educational, Scientific and Cultural Organisation
VISSIM	Software for detailed modelling of urban traffic flows
Vph	Vehicles per hour
WCC	Wiltshire County Council
WHC	World Heritage Site

Figures