A12 Four Villages Study

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Executive Summary

Executive Summary

General

This report is written in response to a brief entitled ‘Four Villages Bypass Study’ issued by Suffolk County Council (SCC) in December 2013 dealing with improvements to the A12, which connects Lowestoft and East Suffolk to the strategic road network. AECOM understand that there have been previous proposals to improve the section of A12 between the Wickham Market bypass and the Saxmundham bypass. In addition to improving the route as a strategic link, these improvements would bring traffic relief to the villages of Marlesford, Little Glemham, Stratford St Andrew and Farnham. AECOM are aware that Suffolk County Council’s view is that the traffic impacts from the proposed Sizewell C development will be of such severity that there is an associated case for the provision of a bypass to these villages as part of the development. The scale of investment required is such that the provision of a continuous bypass may not be achievable as mitigation for the development impacts. A partnership approach to funding and staged delivery may be necessary.

AECOM have been instructed that Suffolk County Council wishes to explore options for delivery of a bypass by staged improvements either as a single or dual carriageway. The aim of this report is to provide a summary of environmental assessments of the possible routes, for single and dual carriageway options, and to produce estimates of cost for construction of the improvements. This will enable a preliminary comparison of the deliverability of all of the A12 improvement options.

Route Options

For the bypass options AECOM have considered, in accordance with the brief, the following routes.

- Route SB1 (Pink Route) approximately 1.95km, single carriageway, bypassing the villages of Farnham and Stratford St Andrew.
- Route SB2 with Link1 and 2 (Green Route) 2.26km dual carriageway, bypassing to the north the villages of Farnham and Stratford St Andrew.
- Route SB5 with Link 1 (Blue Route) 3.5km dual carriageway and X.XKm Single carriageway bypassing to the south the villages of Farnham and Stratford St Andrew.
- Route SB4 (Red Route) 2.85km dual carriageway, bypassing the village of Little Glemham.
- Route LB3 (Orange Route) 5.6km dual carriageway, bypassing to the south the village of Marlesford and the village of Little Glemham.

SCC also requested analysis of a two stage construction of SB1 (Pink Route). These two proposed routes are detailed as the North and South stages of the route.

- Route SB1 North (Pink Route), approximately 1.05 km in length and includes a roundabout on the A12.
- Route SB1 South (Pink Route); approximately 0.9km in length.

In October 2014 SCC extended the research to provide a more detailed assessment of the SB5 (Blue Route as a single carriageway.

- SB5 single carriageway (Blue Route)

The results of this are also discussed.

Scheme Development and Construction Programme

An estimated construction programme has been defined based on previous AECOM design and construction work. The programme shows the approximate years in which the design and construction will take place but the durations of these may alter depending on extent of the further work. Table 1 shows a summary of the construction programme for each scheme.

Table 1: Summary of Construction Programmes

Activity	SB1 S	SB1 A12 North S	SB1 A12 South S	SB2 D	SB4 D	SB5 S	SB5 D	LB3 D
Carry out Preliminary Design and consultation	2014	2014	2014	2014	2014	2014	2014	2014
Announce Preferred Route	2015	2015	2015	2015	2015	2015	2015	2015
Carry out Detailed Design	2016	2016	2021	2016	2016	2016	2016	2015/ 2016
Public Inquiry	2016	2016	2021	2016	2016	2016	2016	2016
Order Publication Period and CPO	2017	2017	2022	2017	2017	2017	2017	2017
Award of Tender	2018	2018	2023	2018	2018	2018	2018	2018
Construction Period	2018/2019	2018/2019	2023/2024	2018-2020	2018-2020	2018-2019	2018-2020	2018-2020
Open to Traffic	2020	2020	2024	2020	2020	2020	2020	2020

S = Single Carriageway D = Dual Carriageway

Construction Cost Estimates

The following costs taken from the reporting are as follows:

Table 2: Construction Cost Estimate Summary and Road Areas

Route (Road Area)		Net Total (inc Opt Bias, Contingency, Inflation etc.)
SB1 – Pink Route 21,262m2	Whole Scheme	£18,651,620
	A12 North including roundabout	£12,402,134
	A12 South	£6,800,452
SB2 – Green Route (Single Carriageway) 27,156m2		£ 25,915,017
SB2 – Green Route (Dual Carriageway) Including Link 1 and Link 2 51,210m2		£ 44,057,647
SB4 – Red Route (Single Carriageway) 28,040m2		£ 16,245,913
SB4 – Red Route (Dual Carriageway) 52,706m2		£ 25,650,099
SB5 – Blue Route (Single Carriageway) 34,234m2		£ 26,517,383
SB5 – Blue Route (Dual Carriageway) Including Link 1 68,463m2		£ 46,318,936
LB3 – Orange Route (Single Carriageway) 69,006m2		£ 55,683,518
LB3 – Orange Route (Dual Carriageway) 116,538m2		£ 92,404,852

Traffic Assessment (Journey Times, Accident Benefits and CO2 Benefits)

A traffic and economic assessment has been undertaken for the A12 between Wickham Market and the A1094. Carbon emissions have also been estimated as part of this assessment.

Following a traffic assessment it has been concluded that the predicted volumes of traffic, for the design year of 2031, using the proposed design scheme will be 20,992 per day. This figure is an increase of 35% in comparison to the usage in 2012, excluding construction traffic from Sizewell C.

Table 3, below, provides a breakdown of the travel time savings for each of the scheme options and including single and dual carriageway alternatives. These have been calculated for each of the three model years and are the average time savings allowing for differing travel times between different hours of the day and days of the year. For the shorter single carriageway bypasses the time savings are about 0.5 minutes in 2031 whereas for the longer dual carriageway sections the time savings are slightly under 2 minutes. For the single carriageway options time savings are about 25% of existing route travel times which increases to around 40% for the dual carriageway options. As it can be seen, route LB3 is the most beneficial in reducing travelling times throughout the forecasted years, in comparison to all other proposed routes.

Table 3: Average Travel Time Savings per Vehicle (SINGLE Carriageway Options) (minutes)

	2020		2024		2031	
Option	**Single**	**Dual**	**Single**	**Dual**	**Single**	**Dual**
SB1	0.42	n/a	0.45	n/a	0.49	n/a
SB1 (North)*	0.27	n/a	0.29	n/a	0.31	n/a
SB1 (South)*	n/a	n/a	0.16	n/a	0.17	n/a
SB2	0.59	1.11	0.61	1.16	0.65	1.21
SB4	0.83	1.43	0.86	1.49	0.90	1.56
SB5	0.56	0.99	0.59	1.04	0.63	1.09
LB3	0.81	1.66	0.85	1.75	0.91	1.84

Sixty year discounted accident benefits in 2010 prices range from £6.5 million for the SB1 single carriageway scheme to £28.8 million for the LB3 dual carriageway option. The number of accidents saved over the 60 year period ranges from 76 for the SB1 single carriageway scheme to 279 for the LB3 dual carriageway option. The table below provides a breakdown of the accident costs and benefits for each scheme.

Table 4: A12 Accident Costs and Benefits (SINGLE Carriageway Options)

	SB1	SB1 (A12 North)	SB1 (A12 South)	SB2	SB4	SB5	LB3
Benefit Summary (£000s)							
Total Without-Scheme Accident Costs	17,946	9,894	7,678	20,550	22,363	24,641	33,660
Total With-Scheme Accident Costs	11,407	6,041	5,164	13,149	12,928	16,811	22,633
Total Accident Benefits Saved by Scheme	**6,539**	**3,852**	**2,514**	**7,401**	**9,435**	**7,830**	**11,028**
Accident Summary							
Total Without-Scheme Accidents	208.9	115.1	93.5	239.2	260.3	286.8	391.8
Total With-Scheme Accidents	132.8	70.3	62.9	153.0	150.5	195.7	263.4
Total Accidents Saved by Scheme	**76.1**	**44.8**	**30.6**	**86.1**	**109.8**	**91.1**	**128.3**
Casualty Summary							
Total Without-Scheme Casualties (Fatal)	8.1	4.4	3.6	9.2	10.1	11.1	15.1
(Serious)	46.3	25.5	20.7	53.0	57.7	63.6	86.8
(Slight)	282.3	155.7	126.3	323.3	351.8	387.7	529.6
Total With-Scheme Casualties (Fatal)	5.1	2.7	2.4	5.9	5.8	7.6	10.2
(Serious)	29.4	15.6	13.9	33.9	33.4	43.4	58.4
(Slight)	179.5	95.1	85.0	206.9	203.4	264.5	356.1

Total Casualties Saved by Scheme (Fatal)	**2.9**	**1.7**	**1.2**	**3.3**	**4.2**	**3.5**	**5.0**
(Serious)	**16.9**	**9.9**	**6.8**	**19.1**	**24.3**	**20.2**	**28.4**
(Slight)	**102.9**	**60.6**	**41.4**	**116.4**	**148.4**	**123.2**	**173.5**

Carbon emission data has been determined using the TUBA economic assessment software. Traded and untraded emissions data are available on a yearly basis in terms of tonnes and monetary costs. The monetary costs and benefits generally indicate a cost in terms of additional greenhouse gases with two options, SB4 single carriageway and SB1 (A12 North) showing a reduction in greenhouse gas emissions due to their shorter length compared to the existing A12.

Environmental Assessment

Air Quality

All the proposed road scheme options are predicted to lead to an overall improvement in air quality as the assessment scores are negative (excluding and including traffic from Sizewell C). The largest change in air quality is predicted to be an improvement in both Nitrogen Dioxide NO_2 and Particulate Matter PM_{10} concentrations of large magnitude as a result of the proposed SB1 (Pink Route North and South) and SB5 (Blue Route) schemes.

SB1 (Pink Route), SB2 (Green Route), and SB5 (Blue Route) schemes are likely to remove exceedances on the A12 between Stratford St Andrew and Farnham, while the SB1 North scheme will not improve air quality at receptors located within the Stratford Air Quality Management Area (AQMA) which, in terms of air quality, are the most impacted receptors due to Sizewell C construction traffic movements. All the proposed bypass scheme options, except SB4 (Red Route) single carriageway, are predicted to result in an increase in NO_x and carbon emissions in 2035 relative to Do-Minimum in the same year. The positive Total Net Present Value for all the bypass options indicates a net beneficial impact (i.e. air quality improvement) over the lifetime of the schemes. The table below summarises the overall air quality findings.

Table 5: Overall Evaluation of Local Air Quality Significance

Key Criteria Questions	Yes / No					
	SB1 – Pink Route	SB1 North – Pink Route	SB2 – Green Route	SB4 – Red Route	SB5 – Blue Route	LB3 – Orange Route
Is there a risk that environmental standards will be breached?	No	Yes	No	No	No	No
Will there be a large change in environmental conditions?	Yes	Yes	Yes	Yes	Yes	Yes
Will the effect continue for a long time?	N/A	N/A	N/A	N/A	N/A	N/A
Will people be affected?	No	No	No	No	No	No
Is there a risk that designated sites, areas, or features will be affected?	No	No	No	No	No	No
Will it be difficult to avoid, or reduce or repair or compensate for the effect?	N/A	N/A	N/A	N/A	N/A	N/A

Noise

A Stage 1 noise assessment, following the principles of the Design Manual for Roads and Bridges (DMRB) assessment methodology has been carried out, in order to establish whether the assessment should proceed to either the Simple or Detailed Assessment. This considers the increases in noise levels at Noise Sensitive Receptors (NSRs) associated with the proposed scheme options.

At this stage only noise impacts relating to the operational use of the proposed development is considered. The table below summarises the noise assessment findings. The split pink route was not included as one of the options and therefore only a qualitative assessment is given.

Table 6: Noise Assessment Summary

Route	Qualitative Impacts	Assessment	Potential Mitigation	Residual Effects With Mitigation
SB1	This scheme will bring both beneficial and adverse noise impacts during the day but no adverse night impacts are expected	Adverse	Acoustic Noise Barrier	Insignificant
SB2	This scheme will bring both beneficial and adverse noise impacts during the day including adverse night impacts at one property	Adverse	Substantial Mitigation Requirements are likely	Adverse / Insignificant
SB4	This scheme will bring both beneficial and adverse noise impacts during the day but no adverse night impacts are expected. The single carriageway option is recommended for Detailed Assessment	Adverse	Acoustic Noise Barrier	Insignificant
SB5	This scheme will bring both beneficial and adverse noise impacts during the day but no adverse night impacts are expected.	Adverse	Substantial Mitigation Requirements are likely	Adverse / Insignificant
LB3	This scheme will bring both beneficial and adverse noise impacts during the day but no adverse night impacts are expected. The single carriageway option is recommended for Detailed Assessment	Adverse	Acoustic Noise Barrier	Insignificant

The Northern Section of the Pink Route will move traffic further away from those properties in the village of Farnham which will be bypassed due to this option. However, properties along Low Road may be adversely affected as traffic is moved closer as a result of this route.

Comparing all the route options shown in Table 6 the single carriageway option for the SB4 and LB3 routes are recommended for detailed noise assessment.

Biodiversity

The area surrounding the route options is dominated by the River Ore floodplain to the west surrounding route options LB3 (Orange Route) and SB4 (Red Route) and the River Alde floodplain to the east through which SB1 (Pink Route), SB2 (Green Route) and SB5 (Blue Route) pass.

The Biodiversity study carried out by AECOM set out to assess and evaluate the potential effects of the proposed route options. By identifying a study area, notable habitats and species could be identified as being adversely effected by a particular route. This study area could then identify which route would be the least damaging to the natural environment capital within the area. There were several survey limitations when the ecological walkover scoping survey was conducted by AECOM with full detail represented in the report. These included that the survey was only carried out on publically accessible land. Another limitation that should be highlighted is that dedicated species surveys have not been carried out in this assessment, this would be carried out in subsequent protected species survey.

For all the proposed routes Slight Adverse effects would be caused due to hydrologically linked drainage systems to internationally designated sites. The proposed routes are at a large distance from these sites so it is considered unlikely that they would be adversely impacted. Due to the bisecting of the largely arable land to construct the different routes, habitat fragmentation will occur in close proximity to the road. In many of the cases the road bisects multiple tributaries which support a number of species and groups including water voles, otters and Great Crested Newts (GCN). Valued fauna is also likely to be effected. The proposed routes also cut through hedgerows and field margins which support species rich flora and nesting habitats for birds and foraging communities. Mitigation measures are especially crucial for SB2 (Green Route) where at least six hedgerows will be directly affected by the route. The other routes also bisect hedgerows to a lesser degree. The agricultural landscape of the proposed bypass is dotted with small pockets of plantation woodlands and two County Wildlife Sites (CWS) woodlands that are also classed as Ancient; Great Wood and Foxburrow Wood. LB3 (Orange Route) and SB4 (Red Route) are adjacent to Great Wood with directs impact on the woodland classed as Moderately Adverse prior to mitigation. SB5 (Blue Routes) run adjacent to Foxburrow Wood, located approximately 10m from the working corridor of the route.

Many of the routes go through woodland that has non-native invasive species. The construction of the new road could lead to enhancement of these areas with specific woodland management. Similarly, the watercourses present along the proposed routes offer poor passage for fish and other species. By extending existing culverts, a sympathetic design to reduce fragmentation could be introduced.

Mitigation measures to limit damage to the environmental capital within the various route options has been explored in the full report. A table summarising the environmental effects of the proposed routes and proposed mitigation measures can be seen in Table 7.

Table 7: Biodiversity Summary

Route	Summary Assessment Score	Comments	Mitigation	Residual Effects with Mitigation
SB4 (Red Route)	Slight Adverse	Presence of GCN to be considered. Possible loss of habitats and fragmentation of woodland. Proximity of ponds to construction works.	Screening from the road via habitat replacement. Construction mitigation to prevent run off into connected drainage ditches and rivers. Consideration for bridge crossings to minimise habitat loss and fragmentation. Culvert designs to be suitable for safe passage for otter, water vole and bats. Pre-construction surveys of the chosen route would be required, revealing the connections between GCN meta populations and enable the design of suitable underpasses and replacement breeding and terrestrial habitat. Avoid the area via road alignment design to prevent habitat loss.	Slight Adverse
LB3 (Orange Route)	Slight to Moderate Adverse	Effects on a number of species and groups including GCN and water vole, fragmentation of habitats and bisecting of small tributaries along route.	Construction mitigation to prevent run off into connected drainage ditches and rivers. Consideration for bridge crossings to minimise habitat loss and fragmentation. Culvert designs to be suitable for safe passage for otter, water vole and bats. Pre-construction surveys and a Natural England Conservation Licence would be required. GCN surveys and licence likely required	Slight Adverse
SB1 (Pink Route)	Moderate Adverse	Potential to affect many species at the River Alde and its associated flood plain. Loss of habitat at Butchers Hole and Benhall Lodge Park Woodland.	Construction mitigation to prevent run off into connected drainage ditches and rivers. Consideration for bridge crossings to minimise habitat loss and fragmentation. Culvert designs to be suitable for safe passage for otter, water vole and bats. Pre-construction surveys of the chosen route would be required, revealing the connections between GCN meta populations and enable the design of suitable underpasses and replacement breeding and terrestrial habitat. There would be limited areas available upstream or downstream of the new road for flood replacement areas for a 1:50	Slight Adverse

			years flood zone.	

Route	Summary Assessment Score	Comments	Mitigation	Residual Effects with Mitigation
SB2 (Green Route)	Moderate Adverse	Potential to effect many species at the River Alde and downstream. Possible fragmentation of ponds, hedgerows and woodland. Loss of habitat at Butchers Hole and Benhall Lodge Park Woodland.	Construction mitigation to prevent run off into connected drainage ditches and rivers. Consideration for bridge crossings to minimise habitat loss and fragmentation. Culvert designs to be suitable for safe passage for otter, water vole and bats. Pre-construction surveys and a Natural England Conservation Licence would be required. Replacement of hedgerow habitat.	Slight Adverse
SB5 (Blue Route) Dual	Moderate to Large Adverse	Potential to affect GCN terrestrial habitat. Water vole may be moderately adversely affected due to closure of tributaries. Possible direct loss of Ancient Woodland.	Construction mitigation to prevent run off into connected drainage ditches and rivers. Consideration for bridge crossings to minimise habitat loss and fragmentation. Culvert designs to be suitable for safe passage for otter, watervole and bats. Pre-construction surveys of the chosen route would be required, revealing the connections between GCN meta populations and enable the design of suitable underpasses and replacement breeding and terrestrial habitat. Ancient woodland is not replaceable. Impacts upon this habitat, including indirect impacts should be avoided. Screening from the road via habitat replacement.	Slight Adverse

SB5 (Blue Route) Single	Moderate Adverse	Potential to affect GCN terrestrial habitat. Water vole may be moderately adversely affected due to closure of tributaries. Possible direct loss of Ancient Woodland.	Construction mitigation to prevent run off into connected drainage ditches and rivers. Consideration for bridge crossings to minimise habitat loss and fragmentation. Culvert designs to be suitable for safe passage for otter, water vole and bats. Pre-construction surveys of the chosen route would be required, revealing the connections between GCN meta populations and enable the design of suitable underpasses and replacement breeding and terrestrial habitat. Ancient woodland is not replaceable. Impacts upon this habitat, including indirect impacts should be avoided. Screening from the road via habitat replacement. Existing arable land is fragmented thus lessening the potential impact.	Slight Adverse

Landscape

All of the proposed options have the potential to affect nationally and locally important designations, landscape character and visual amenity. SB1 (Pink Route) is considered to result in the largest residual effect on landscape character and visual amenity, due to the severance of the landscape pattern and proximity to Stratford St Andrew and Farnham. Route options LB3 (Orange Route), SB2 (Green Route) and SB5 (Blue Route) will all result in Moderate Adverse residual effects on the landscape and visual amenity due to the fragmentation of the landscape and loss of features. SB4 (Red Route) is considered to have the least effect on the landscape and visual amenity, with Slight Adverse residual effects due to the limited fragmentation of the landscape and limited loss of features. Landscape effects would be similar on these routes, varying from Moderate Adverse to Slight to Large Adverse on each.

Table 8: Landscape and visual appraisal summary

Route	Assessment	Mitigation	Residual Effects With Mitigation
LB3			
Landscape Character	Large Adverse	Reinstatement of boundary planting, structure screen planting	Moderate Adverse
Visual Amenity	Slight-Very Large Adverse		Slight- Large Adverse
SB1			
Landscape Character	Large Adverse	As above	Large Adverse
Visual Amenity	Slight- Large Adverse		Slight- Large Adverse
SB2			
Landscape Character	Large Adverse	As above	Moderate Adverse
Visual Amenity	Moderate to Large Adverse		Moderate to Large Adverse
SB4			
Landscape Character	Moderate Adverse	As above	Slight Adverse

Visual Amenity	Slight-Very Large Adverse		Slight-Large Adverse
SB5			
Landscape Character	Moderate Adverse	As above	Moderate Adverse
Visual Amenity	Slight- Large Adverse		Slight- Large Adverse

Heritage

The archaeological and cultural heritage assessment has collated baseline data within a study area of approximately 300 m from the proposed bypass, as required by guidance in DMRB. Data was collected from Suffolk Historic Environment Record, The English Heritage Archives Services and historic maps. Ninety-three archaeological sites were identified within the study area. The different route options will have various effects to heritage assets. Overall the SB5 (Blue Route) single will potentially have less of an impact on heritage assets as the broader field patterns and scale would better accommodate landscape mitigation measures.

Table 9: Heritage Assessment Summary

Route	Qualitative Impacts	Assessment	Mitigation	Residual Effects With Mitigation
LB3	Flint scatter (70). Part or complete loss of asset	Slight Adverse	Simple Assessment followed by additional evaluation if required.	Slight Adverse
	Glemham Park (33). Partial loss of asset and effects on the setting of the asset	Moderate Adverse	Topographic and photographic recording, use of screening	Slight Adverse
	Little Glemham. Reduction of traffic	Slight Beneficial	N/A	Slight Beneficial

Route	Qualitative Impacts	Assessment	Mitigation	Residual Effects With Mitigation
SB1	Old field system (87). Part or complete loss of asset	Slight Adverse	Simple Assessment followed by additional evaluation if required.	Slight Adverse
	Pillbox (88). Effects on the setting of the asset	Slight Adverse	Photographic recording, use of screening	Slight Adverse
	Benhall Lodge Park medieval settlement (BNL 020). Partial loss of asset and effects on the setting of the asset	Slight Adverse	Simple Assessment followed by additional evaluation if required.	Slight Adverse
	Stratford St Andrew. Reduction of traffic	Slight Beneficial	N/A	Slight Beneficial
SB2	Pottery sherds (61). Part or complete loss of asset	Slight Adverse	Simple Assessment followed by additional evaluation if required.	Slight Adverse
	Benhall Lodge Park medieval settlement (BNL 020). Partial loss of asset and effects on the setting of the asset	Slight Adverse	Simple Assessment followed by additional evaluation if required.	Slight Adverse
	Stratford St Andrew. Reduction of traffic	Slight Beneficial	N/A	Slight Beneficial

Route	Qualitative Impacts	Assessment	Mitigation	Residual Effects With Mitigation
SB4	Glemham Park (33). Partial loss of asset and effects on the setting of the asset	Moderate Adverse	Topographic and photographic recording, use of screening	Slight Adverse
	Marlesford Conservation Area (91). Reduction of traffic in the Conservation Area	Slight Beneficial	N/A	Slight Beneficial
SB5	Old field system (87). Part or complete loss of asset	Slight Adverse	Simple Assessment followed by additional evaluation if required.	Slight Adverse
	Flint scatter (66). Part or complete loss of asset	Slight Adverse	Simple Assessment followed by additional evaluation if required.	Slight Adverse
	Lithic scatter (67). Part or complete loss of asset	Slight Adverse	Simple Assessment followed by additional evaluation if required.	Slight Adverse
	Farnham Manor (11). Effects on the setting of the asset	Slight Adverse	Photographic recording, use of screening	Slight Adverse
	Farnham. Reduction of traffic	Slight Beneficial	N/A	Slight Beneficial
	Stratford St Andrew. Reduction of traffic	Slight Beneficial	N/A	Slight Beneficial

Route	Qualitative Impacts	Assessment	Mitigation	Residual Effects With Mitigation
SB5 single	Old field system (87). Part or complete loss of asset	Slight Adverse	Simple Assessment followed by additional evaluation if required.	Slight Adverse
	Flint scatter (66). Part or complete loss of asset	Slight Adverse	Simple Assessment followed by additional evaluation if required.	Slight Adverse
	Lithic scatter (67). Part or complete loss of asset	Slight Adverse	Simple Assessment followed by additional evaluation if required.	Slight Adverse
	Farnham Manor (11). Effects on the setting of the asset	Slight Adverse	Photographic recording, use of screening	Slight Adverse
	Farnham. Reduction of traffic	Slight Beneficial	N/A	Slight Beneficial
	Stratford St Andrew. Reduction of traffic	Slight Beneficial	N/A	Slight Beneficial

Water Environment

Impacts associated with all routes are considered to be of low significance. The magnitude of impact of all schemes examined with mitigation in place will be either minor or negligible

Mitigation measures: Noise Barriers

It has been put forward by SCC that mitigation measures regarding the noise due to the proposed scheme developments is a significant issue. Following this raised concern; noise barrier preliminary estimates were conducted.

The proposed routes of the Four Villages bypass will affect the noise levels experienced at properties in the vicinity of the routes. The large quantity of vehicles on the routes will generate a continuous stream of noise from the engine and tyres of the vehicles. Adverse or beneficial effects on present noise levels are dependent on the proximity of the property location to the proposed route. AECOM are proposing to mitigate these effects by the construction of three metre high timber fencing, commonly known as noise or acoustic barriers. A preliminary estimate on where noise barriers may need to be constructed and the extent of the noise barriers is detailed below. The estimates have followed guidance set out by guidance from the DMRB, HA 66/95.[1]

It is important to note that after 300m, the noise attenuation experienced with respect to the noise barrier is negligible in the rural location that the proposed routes are in. This is because soft ground such as countryside absorbs sound waves, attenuating the noise over a distance

Table 10 details the estimate lengths of the noise barriers for the proposed routes. A three metre high timber fence has been assumed and further topography data would be required to progress the design further.

[1] DMRB, Volume 10, Section 5: Environmental Barriers, HA 66/95.

Table 10: Summary table of length of noise barriers

Route Option	No. of noise barriers
SB1(Pink Route)	**1No. x 400m**
SB1 North (Pink Route)	**1No. X 100m***
SB1 South (Pink Route)	**1No. x 400m**
SB2 (Green Route)	**2No. x 400m**
SB4 (Red Route)	**1No. X 100m***
SB5 (Blue Route)	**4No. x 400m**
LB3 (Orange Route)	**3No. x 400m**

*Estimate

Conclusions

From the foregoing tabulated and reported information there will clearly need to be further work towards the assessment and design of a suitable improvement scheme in appropriate stages for the A12 Four Villages route. In order to address the most problematic part of the route, between Stratford St Andrew and Farnham three possible options have been identified, two of them examined for both dual carriageway and single carriageway scenarios.

On a cost basis, looking first at single carriageway options, the SB1 (Pink Route) has advantages over the SB2 (Green Route) and the SB5 (Blue Route). Time savings for the three routes are similar although accident savings are slightly better for the latter two. Additional greenhouse gases would be similar for all three. Noise would be reduced to acceptable levels by suitable mitigation on all three schemes between Stratford St Andrew and Farnham. It can be seen that with the exception of the split SB1 North section and SB4 (Red Route) there is a need for the installation of noise barriers to protect properties affected by the proposed routes. For Air Quality it is predicted that no environmental standards would be breached and that few people would be affected by the changes for any of the routes.

Landscape effects would be similar on these routes, varying from Moderate Adverse to Slight to Large Adverse on each. Regarding biodiversity, from the tabular presentation and descriptions in the reporting, all of the route options would have slight adverse effects causing habitat loss of small amounts of woodland and hedgerows and small amounts of agricultural land. Heritage effects would be slightly better for Route SB5 single as the broader field patterns and scale would better accommodate landscape mitigation measures

For the dual carriageway versions of the SB2 (Green Route) and SB5 (Blue Route) there is a marked difference in costs compared with the single carriageway schemes.

Turning to the other two schemes, LB3 (Orange Route) and SB4 (Red Route) the latter has some clear advantages. The relatively low cost of the single carriageway version of SB4 (Red Route) together with its relatively good accident rate and journey time saving make it worthy of consideration should further testing be required. However SB4 would only provide a bypass of Little Glemham. The Orange Route, whilst providing good bypass facilities of both Marlesford and Little Glemham and the best accident rate and journey time savings of all the routes, would be significantly more costly to construct than Route SB4

From the ecological walkover scoping survey, an assessment of the proposed routes has been carried out. SB4 (Red Route) has the least adverse effect on the environment with the environmental assessment deeming only Slight Adverse impact on the study area. All the routes will lead to fragmentation of habitats, with mitigation measures detailed to reduce the impact. The least favourable scheme option is SB5 (Blue Route) dual carriageway which may lead to the risk of directly impacting the Ancient Woodland of Foxburrow Wood. This can lead to irreparable damage if mitigation measures are not correctly adhered too. However the single carriageway option if SB5 Blue route does not impact on Fox Burrow wood due to its reduced width and siting.

On Environmental grounds the provision of Route SB1 or SB1 North would have a far greater adverse impact on local settlements than the provision of Route SB5 single carriageway.

Much work has been undertaken in the assesment of the individual schemes and their appraisal. Although journey times would be significantly reduced with the dual carriageway options there would need to be further assessment to establish cost/benefit ratios over a specified period in order to make a firm decision.

It is therefore suggested that a cost/benefit ratio analysis be undertaken alongside design refinement including mitigation measures, accurate costing analysis and traffic forecast and a detailed environmental assessment for the chosen preferred route. Once a preferred route has been decided, it is proposed that the following further investigations need to take place – detailed in section 9. The results of these may change the design and construction period specified in section 3.

- Liaison with Environment Agency;
- Further Investigation with Statutory Undertakers to C3 stage;
- A cost benefit analysis of the chosen route and
- Scheme delivery through Detailed Design and Construction stages.

Further Investigative Study – Preliminary Preferred Route

Following further instructions from SCC in October 2014 two schemes were further analysed, SB1 Pink Route and SB5 Blue Route, assuming either would be progressed as a single carriageway road constructed to HA S2 standards. The analysis encompassed a comparison of the Environmental and Cost issues associated with each route.

For the purposes of this comparison the SB1 Pink Route North, SB1 Pink Route Full Scheme and SB5 schemes were examined.

Net Benefits: Environmental and Cost Comparison

- All the routes present improvements in Air Quality and Noise for the villages of Stratford St Andrew and Farnham as the traffic is directed away from the villages. The SB5 route shows the highest net improvement in air quality and a smaller number of properties who will experience deterioration in air quality.

- Similarly SB5 was found to provide twice as many beneficial impacts compared to the SB1 route option with respect to Noise.

- In terms of Landscape all the preferred route options have the potential to affect nationally and locally important designations and landscape character; with the SB5 route potentially having less of an impact as the broader field patterns and scale would better accommodate landscape mitigation measures

- All options have various sitings in the general area of Special Landscape Value as shown in the Local Plan. On balance SB1 will have a far greater effect on Community Visual Impact with SB1 North slightly lesser so. It has been demonstrated that SB5 will have a localised Community Visual Impact affecting only a few properties south of the existing A12.

- Community Severance will be greater on Routes SB1 and SB1 North, due to their proximity to the villages. Route SB5 would entail some local severance but this would be ameliorated by the provision of connecting roads and underpass works.

- The SB1 and SB5 routes were found to have beneficial effects on the villages (Stratford St Andrew and Farnham) Heritage assets but the SB1 North is likely to have a lower risk for previously unrecorded archaeological remains to be located as it is shorter route. Looking at the broader historic landscape it is considered that a new road on the Pink Route would be forming a wall (as it is mostly higher than existing ground level) that separates the settlement core (around the church) from the river – this settlement is one of many clearly sited on the Alde valley, and the name suggests it is at the point that a major Roman road (presumably a predecessor of the A12 route) crossed the river. Conversely the Blue Route should have a (more minor) impact on the setting of Farnham Church.

- Impacts of all options on the Surface Water environment are that they cross the River Alde, however whilst sub-option SB5 (single) crosses the river in a perpendicular manner, sub-option SB1 crosses more acutely. As such SB1 crosses more ditches that ultimately enter the river and crosses more of the rivers flood plain. The River Alde is a WFD watercourse and with more ditch crossings associated with SB1 in the vicinity of this watercourse the potential for detrimental impacts on the WFD watercourse is increased. As such from a Surface Water environment perspective SB5 (single) would be the preferred option.

- Similarly as SB1 extends further within the flood plain of the River Alde (the main river crossed by both of the preferred options) it would be associated with potentially more Flood Risk effects. Hence from a broad flood risk perspective, SB5 would be the preferred option (note that flood risk should be considered in detail and to the requirements of the National Planning Policy Framework (NPPF) published on the 27 March 2012 (Department for Communities & Local Government, 2012).

- From the aspect of Biodiversity, it is the case that all route options will lead to habitat loss and fragmentation. The magnitude of fragmentation of ‘Suffolk Biodiversity Partnership Priority Habitats’ is greater for Route SB1 (North and complete routes) in comparison with SB5. This is because route SB1 will fragment and reduce the connectivity of floodplain grazing marsh and associated ditch networks, which are a coherent and integrated habitat matrix. This habitat and multiple associated floral and faunal species including water vole, otter and a range of invertebrates are listed on the Suffolk Biodiversity Action Plan. The Blue Route SB5 adds to the fragmentation of woodland and pond habitats within a largely arable landscape. It is determined that impacts associated with fragmentation attributable to route SB5 could be addressed with more practicable and likely more successful mitigation than those associated with route SB1.

The Way Forward

AECOM have considered the next actions which would be necessary
These include the following;

- Carry out full topographical survey of the SB5 (currently all schemes are designed using EMAP and LIDAR backgrounds).
- Conduct soil surveys (geological survey was based on information extracted from British Geological Survey website and historical data).
- Carry outstructural design based on geotechnical work.
- Develop a full construction cost estimate.
- Carry out land referencing.
- Conduct C2 and C3 Statutory Undertakers research.
- Carry out Preliminary Design and Consultation.
- Announce Preferred Route.
- Carry out Detailed Design.
- Public Inquiry.
- Order Publication Period and CPO.
- Award of tender.
- Construction Period.
- Open to Traffic.

1 Introduction

1 Introduction

1.1 General

AECOM understands that improving the A12, which connects Lowestoft and East Suffolk to the strategic road network, is important for the future growth of this part of Suffolk. There is a long standing proposal to improve the section between the Wickham Market by pass and the Saxmundham bypass. In addition to improving the route as a strategic link, this improvement would bring traffic relief to the villages of Marlesford, Little Glemham, Stratford St Andrew and Farnham.

Suffolk County Council's view is that the traffic impacts from the proposed Sizewell C development will be of such severity that there is a compelling case for the provision of a bypass to these villages as part of the development. The scale of investment required is such that the provision of the full bypass may not be achievable as mitigation for the development impacts. A partnership approach to funding and staged delivery may be necessary.

Suffolk County Council (SCC) wants to explore options for delivery of a bypass by staged improvements either as a single or dual carriageway. Five bypass route options are to be investigated and evaluated for both a single and/or dual carriageway. In this report the evaluation of both carriageway options will cover:

- A high level environmental assessment of the routes, identifying any route location that are environmentally high risk and/or high impact;
- Construction cost estimate for delivering a single or dual carriageway improvements; and
- Forecast traffic figures including an assessment of the journey times, accidents and CO2 benefits.

1.2 Local Road Network

The four Suffolk villages of Farnham, Stratford St Andrew, Little Glemham and Marlesford, on the A12 Woodbridge to Lowestoft route are historic villages which provide local centres for an attractive rural hinterland. The towns of Wickham Market to the south and the village of Benhall to the north both have dual carriageway bypasses, while north of Saxmundham the A12 continues as a single carriageway route through a series of villages. It is the most easterly main route in England. To the west there is a fine network of minor rural roads, with only the A140 providing any significant north-south route other than the main M11 corridor between London and Cambridge. To the north of Lowestoft the A12 continues as a national trunk road to Great Yarmouth, which is also served by the A11 from south of Cambridge to Norwich and the A47.

The A12 is a multi-purpose route. It provides the strategic link between Ipswich and the south with the towns of Great Yarmouth and Lowestoft, and with a series of smaller market and coastal towns and villages to the north. It is a key commuter route, allowing those working in Woodbridge and Ipswich to live in the rural hinterland. It is a vital link in serving the tourist and leisure activities of the region, and of the Norfolk Broads area further north. It also provides an important road link between the communities and businesses in its corridor.

It is proposed that a third power station, Sizewell C will be constructed near the current Sizewell B power station close to Leiston, Suffolk. The main access route to Sizewell C, pre and post construction will be from the A12 between Woodbridge and Lowestoft. SCC predict that the proposed development will have a severe impact on the flow of traffic through the Suffolk villages of Farnham, Stratford St Andrew, Little Glemham and Marlesford and believe a bypass will help alleviate this problem.

AECOM is currently undertaking an additional study, on behalf of SCC, examining the local road network north of the mentioned four villages and encompassing the B1122 and other routes.

1.3 This Document

This report has been written to provide the technical background for SCC to evaluate and decide on which bypass route option should be taken forward for a more detailed study.

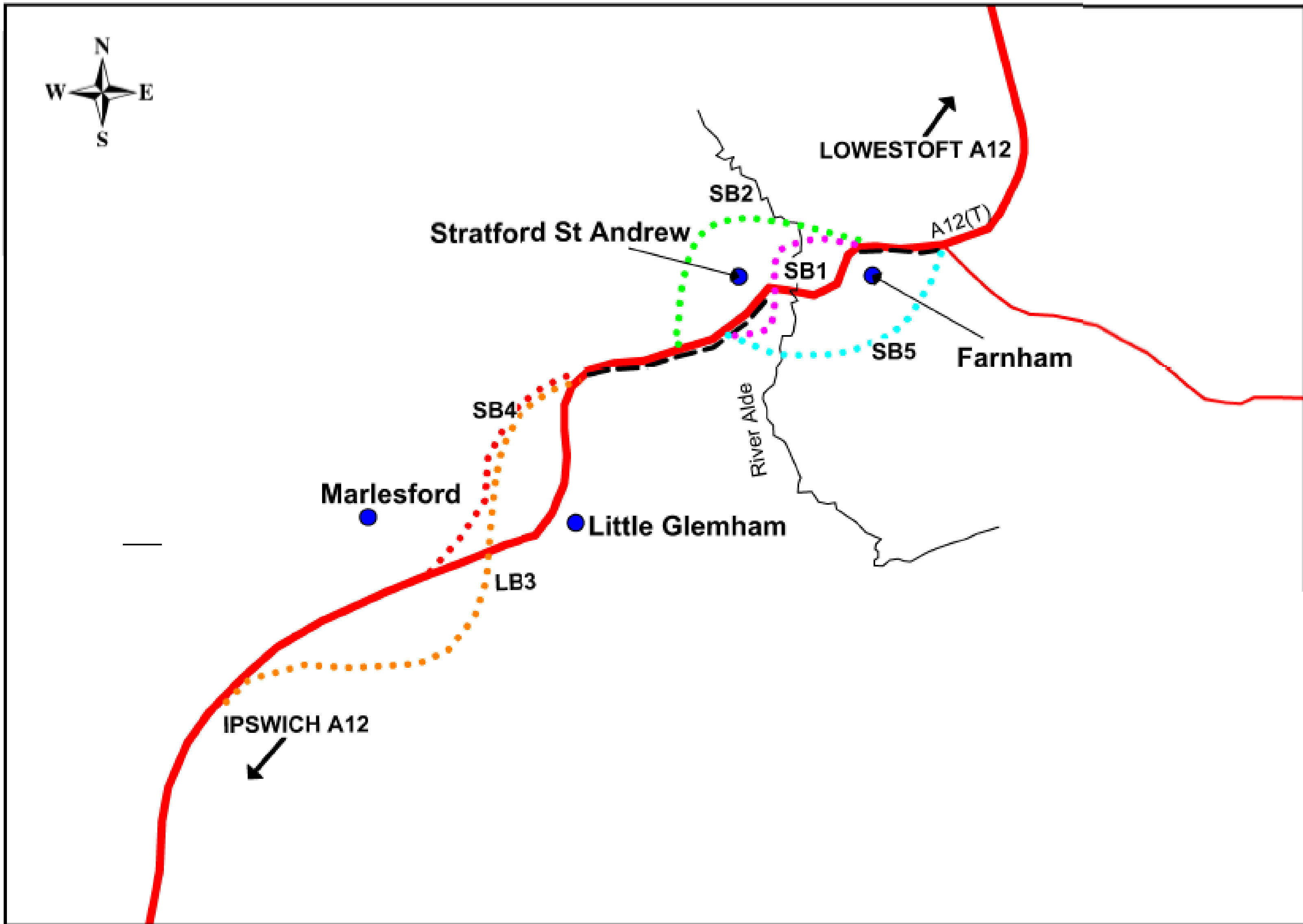
It is a self-contained document, covering all the work, but makes reference tosome more detailed technical supporting documents available in the appendices.

The report is structured as five further Chapters, describing the Study work as follows:

- Chapter 2 examines the Route Options, Ground Conditions and Structures;
- Chapter 3 outline the Scheme Development and Construction Programme;
- Chapter 4 describes the Environmental Analyses contributing to the Study;
- Chapter 5 describes the Noise Barrier proposals for the study;
- Chapter 6 describes the Traffic Analyses contributing to the Study;
- Chapter 7 summarises the Construction Cost Estimates for the Route Options;
- Chapter 8 AECOM’s Summary and Conclusions;

- Chapter 9 presents a detail of the Next Steps required to further develop and construct the schemes;
- Chapter 10 describes Further investigative Study for Preliminary Preferred Route.

2 Route Options



Legend

- SB1. Pink Bypass of Farnham and Stratford St. Andrew
- SB2. Green Northern Bypass of Farnham and Stratford St. Andrew
- LB3. Orange route to the south of Marlesford and the north of Little Glenham
- SB4. Red Bypass of Little Glenham
- SB5. Blue Southern Bypass of Stratford St. Andrew and Farnham
- A12 Improvements

Suffolk County Council

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A12 FOUR VILLAGES AND SIZEWELL

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2 Route Options

2.1 Introduction

In accordance with the brief, AECOM have prepared a study scope and programme evaluating the following routes

- Route SB1 (Pink)
- Route SB2 (Green) with Link1 and 2
- Route SB4 (Red)
- Route SB5 (Blue) with Link 1
- Route LB3 (Orange)

The evaluation was undertaken based on:

- A thorough review of the past information, A12 Four Villages Study – both to take advantage of the previous experience and identification of problems, and also to assess the schemes;
- A multi-disciplinary approach to technical analyses, covering environmental, traffic and wider economic and social issues;
- Summary of preliminary findings and recommendations for the way forward.

Since the original report was issued to SCC, AECOM have been instructed to also evaluate the concept of constructing SB1 (Pink Route) in two sections; A12 North and A12 South.

2.2 Route SB1

2.2.1 Location

Route SB1 (Pink Route) is approximately 1.95km, bypassing the villages of Farnham and Stratford St Andrew.

The route departs the A12, east of Stratford Plantation, and continues north east through the flood plain crossing the A12 at Great Glemham Road junction where a roundabout has been proposed. The route continues north east, crossing the River Alde and joining the A12 to Lowestoft.

A site walkover of the proposed route took place on the 12th March 2014 by AECOM staff. Observations from this site visit were as follows:

- A number of drains were sited along the flood plain;
- A weir is present at the existing Stratford Bridge; An Environment Agency gauging station exists adjacent to the Stratford Bridge abutments;

- The A12 junction with Great Glemham road is surrounded by a number of building/residences of which: The Riverside Centre, The Rosemary building were identified as likely to be primarily affected by future works for this route;
- BT overhead and underground cables present along the A12 and Great Glemham Road.

2.2.2 Carriageway Layout

The carriageway has been designed following guidance from the Design Manual of Roads and Bridges (DMRB, 2013). The Pink Route has been designed as a 1.95km single carriageway comprising of 7.3m width carriageways with one metre strips on either side. Side roads have been widened to a minimum of 6.1m.

The proposed route has been designed to cross a flood plain in order to divert the existing traffic on the A12 to Lowestoft from the villages of Stratford St Andrew and Farnham. The area around the flood plain is crossed by numerous existing drains and the River Alde. Culverts and a new river bridge are to be provided where these are crossed by the Pink Route.

Road closures and diversions, of existing roads, have been accounted for within the proposals at:

- Access onto the Pink Route has been provided for the side road located south of the A12 as a diversion was not feasible.
- North West side road has been diverted but still retains its current access onto the A12. No access has been provided onto the Pink Route.

The route also crosses tracks and footpaths. The current design proposals have not accounted for the closure and/or diversion of any tracks in any detail. Therefore further investigation and design should be undertaken to determine: the affected tracks and suitable design measures for these. However, the existing definitive footpaths have been noted and an allowance in the cost estimates has been made for stopping up and/or diversions.

The designed route resembles an elongated S shape with a roundabout in its centre to allow access to and from the two villages of Stratford St Andrews and Farnham.

- The roundabout has been designed to accommodate the existing A12 and Great Glemham Road.
- Side road over bridge allowing access to and from Farnham. The Ramblers side road has been realigned with an 8% gradient to accommodate the over-bridge.

Following recommendations provided in the DMRB, headlight screening, extending approximately 120m would be proposed. The screens will reduce the glare from the headlights on motorists accessing the A12 from Chapel Cottage side road.

The existing levels of the site vary from the levels proposed. Based on the current design proposals there appears to be a deficit in fill material which would require additional material to be brought on site. Additionally, where the low gradient levels are found drainage retention areas have been proposed. For the Pink Route two drainage retention areas are proposed. Existing drainage system will also be utilised following further investigation.

AECOM have been requested by SCC to evaluate the possibility of constructing the SB1 (Pink Route) in two stages. The two stages have been referred to as SBI (A12 North) and SB1 (A12 South) and are detailed below. The two sections have been split at the proposed roundabout crossing the A12 at Great Glemham Road. Therefore the same location, carriageway layout and structures remain unaltered.

- SB1 (A12 North) - the North Route is approximately 1.05 km in length and comprises a roundabout at the current A12 junction with Great Glemham Road.
- SB1 (A12 South) - the South Route is approximately 0.9km length and covers the proposed route south of the roundabout (take off from the A12 at Stratford Plantation and A12 junction with Great Glemham Road).

2.2.3 Structures

The structures present along each route have been assessed for feasibility and cost. Table 2.2.1 below details:

The number of structures present on the route;

- A high level description of the structure with preliminary measure. These measurements have been included in the study as an indication and should not be taken as exact;
- The obstacles i.e. road or river being crossed by the route requiring a structure.

The structures for the proposed route have been designed with a 7metre road to road clearance. Additionally it has been assumed that the widths for the drains/watercourses present on the site are one metre.

Table 2.2.1 Summary of structures on SB1 (Pink Route)

No	Structure Name	Obstacle	Structure Description
1	SB1 RIVER BRIDGE	River Alde (7m wide)	New single carriageway structure over existing River Alde Width over=30m, Span= 13m Single span steel composite deck Full height abutments. Piled foundations.
2	SB1 OVERBRIDGE	Minor Road	New single carriageway structure over existing track Width over=16.70m, Span=5.0m Single span steel composite deck

No	Structure Name	Obstacle	Structure Description
			Full height abutments. Piled foundations
3	SB1 CULVERT	Watercourse (1m wide)	New culvert to carry watercourse below single carriageway Length=27.16m, Internal Dia=1.5m
4	SB1 CULVERT	Watercourse (1m wide)	New culvert to carry watercourse below single carriageway Length=24.82m, Internal Dia=1.5m
5	SB1 CULVERT	Watercourse (1m wide)	New culvert to carry watercourse below single carriageway Length=21.93m, Internal Dia=1.5m
6	SB1 CULVERT	Watercourse (1m wide)	New culvert to carry watercourse below single carriageway Length=19.85m, Internal Dia=1.5m
7	SB1 CULVERT	Watercourse (1m wide)	New culvert to carry watercourse below single carriageway Length=18.32m, Internal Dia=1.5m
8	SB1 CULVERT	Watercourse (1m wide)	New culvert to carry watercourse below single carriageway Length=24.79m, Internal Dia=1.5m
9	SB1 CULVERT	Watercourse (1m wide)	New culvert to carry watercourse below single carriageway Length=40.44m, Internal Dia=1.5m
10	SB1 CULVERT	Watercourse (1m wide)	New culvert to carry watercourse below single carriageway Length=44.51m, Internal Dia=1.5m

2.3 Route SB2 (Green) with Link 1 and Link 2

2.3.1 Location

The Green Route is a 3.5km dual carriageway, bypassing to the north the villages of Farnham and Stratford St Andrew. The 3.5km route comprises the 0.9km Link 1 route and 0.6km Link 2 route.

The Green Route departs A12 to the north, through open farmlands and crosses Mill Lane and Low Road. A roundabout has been designed in the fields after the crossing with Low Road. The Green Route continues east through the flood plain crossing drains and the River Alde. Several culverts and a river bridge have been proposed at these locations. The route continues east to then re-join the A12 at the junctions with the A1094, Friday Street via Link 2..

A site walkover of the proposed route took place on the 12th March 2014 by AECOM staff. Observations from this site visit were as follows:

- A number of drains along the flood plain;
- Predominantly, the route passes agricultural land with few houses affected
- Widening of the A12 adjacent to Glemham Hall Park would be required for proposed Link 1 route.
- A disused pit is located on the north verge of Link 1.

2.3.2 Carriageway Layout

The carriageway has been designed following guidance from the Design Manual of Roads and Bridges (DMRB, 2013). The Green Route has been designed as a single or dual carriageway.

- 3.5km dual carriageway – the carriageway width measures 7.3m with one metre strips and 2.5 metre verge. At locations where straight roads are used, the central reservation has been designed as 2.5m.
- 2.7km single carriageway – the carriageway widths measure 7.3m with 3.5m verges.

The side roads for both options have been designed for a minimum of 6.1m.

The proposed route has been designed to cross open farmland and the flood plain in order to divert traffic on the existing A12 from the villages of Stratford St Andrew and Farnham.

2.3.3 Dual Carriageway

It is proposed that the Green Route departs the A12 to the north through fields where it crosses two roads. The road closure and diversions proposed are as follows:

- The old A12, towards the village of Stratford St Andrew, has been closed and access into the village is via Low Road.
- Chapel Cottages side road has been closed and access diverted.
- Mill Lane has been closed and access diverted to Low Road.
- Access onto the A12 has been proposed for properties such as Benhallstock Cottages.
- Park Road has been closed and access diverted to a side road approximately 500m to the west.

The route also crosses tracks and footpaths. The design proposals have not accounted for the closure and/or diversion of any tracks. However, the existing definitive footpaths have been noted and an allowance in the cost estimates has been made for stopping up and/or diversions.

A roundabout has been proposed to allow access to and from the village of Stratford St Andrew. From the roundabout the Green Route continues east through the flood plain crossing a drain, where a culvert would be provided and going on to cross the River Alde. The River Alde would be diverted in order to accommodate the embankment and a river bridge has also been proposed at this location. A drain has been closed and diverted into an existing drain on the A12 - a culvert has been proposed at this location.

The central reserve has been widened to improve visibility as the road curves to the east towards the A12. Additionally a side road over-bridge has been proposed to allow access to and from Farnham village to Benhall Park Lodge. From the over-bridge the route continues south east to re-join the A12 towards Lowestoft at Link 2.

Following recommendations provided in the DMRB, headlight screening has been proposed.. The screens will reduce the glare from the headlights on motorists accessing the A12 from Benhallstock cottages.

The existing levels of the site vary from the levels proposed. Based on the current design proposals there appears to be a surplus in cut material therefore material not used on site can be reused elsewhere. Additionally, where the low gradient levels are found, drainage retention areas have been proposed. For the current route two drainage retention areas are proposed. Where the route is an improvement or widening of the A12 it is assumed that the existing drainage system will be utilised following further investigation.

2.3.4 Single Carriageway

The proposed design for the single carriageway is similar to that for the dual, mentioned above. The Green Route departs A12 and heads north, through open farmlands crossing Chapel Cottages side road and Mill Lane with a roundabout at the crossing with Low Road. The size of the roundabout will be smaller compared to that proposed for the dual carriageway option. The Green Route continues east crossing the River Alde and drains. It is proposed that the road is designed to avoid diverting the River Alde and the drain. The road continues south east to re-join the A12 to Lowestoft. The road closure and diversions proposed are as follows:

- The old A12, towards the Stratford St Andrew village, has been closed and access into the village is via Low Road.
- Chapel Cottages side road has been closed and access diverted.
- Mill Lane has been closed and access diverted to Low Road.

The single carriageway Green Route option, compared to the dual, will:

- Reduce the amount of non-highway land required for construction;
- Reduce the overall design and construction costs.

The road levels for the single carriageway are assumed to be the same as those for the dual carriageway, but this might change during detailed design. The number of structures required for the both single and dual also remain the same.

2.3.5 Structures

The structures present along each route have been assessed for feasibility and cost. Table 2.3.1 below details:

- The number of structures present on the route;
- A high level description of the structure with preliminary measure – these measurements have been included in the study as an indication and should not be taken as exact;
- The obstacles i.e. road or river that the structure is being proposed for;

The structures for the proposed route have been designed with a 7 metre road to road clearance. Additionally it has been assumed that the widths for the drains/watercourses present on the site are one metre.

Table 2.3.1 Summary of Structures on SB2 (Green Route)

No	Structure Name	Obstacle	Structure Description
1	SB2 River Bridge	River Alde (5m wide)	New dual carriageway structure over existing River Alde Width over=41.9m, Span= 11m Single span steel composite deck Full height abutments. Piled foundations.
2	SB2 Over bridge	Minor Road	New dual carriageway structure over existing track Width over=55.4m, Span=6m Single span steel composite deck Full height abutments. Piled foundations
3	Link 1 Culvert Crossing	Watercourse (1m wide)	New culvert to carry watercourse below dual carriageway Length=47.00m, Internal Dia=1.5m
4	SB2 Culvert Crossing	Watercourse (1m wide)	New culvert to carry watercourse below dual carriageway Length=50.57m, Internal Dia=1.5m
5	SB2 Culvert Crossing	Watercourse (1m wide)	New culvert to carry watercourse below dual carriageway Length=45.6m, Internal Dia=1.5m

2.4 Route SB4 (Red)

2.4.1 Location

The SB4 (Red Route) is a 2.85km dual carriageway, bypassing the village of Little Glemham.

The route departs the A12 north of Milestones Farm and heads north east crossing Keepers Lane. The route continues north from Keepers Lane through the fields where it re-joins the A12 at Glemham Park.

A site walkover of the proposed route took place on the 12th March 2014 by AECOM staff. Observations from this site visit were as follows:

- Disused pit area adjacent to the A12, opposite Milestones;
- Overhead cables.
- The route crosses a footpath.
- Possible widening of the A12, at Glemham Hall entrance and Glemham Park – tie in Red Route with the A12.

2.4.2 Carriageway Layout

The carriageway has been designed following guidance from the Design Manual of Roads and Bridges (DMRB, 2013). The Red Route is designed as a single or dual carriageway.

- 2.85km dual carriageway – the carriageway widths measure 7.3m with one metre strips and 2.5 metre verge. At locations where straight roads are used, the central reservation has been designed as 2.5m.
- 2.2km single carriageway – the carriageway widths measure 7.3m with one metre strips.

The side roads for both options have been designed for a minimum of 6.1m.

The route has been designed to cross open farmland in order to divert traffic on the existing A12 from the village of Little Glemham. Where the route crosses a drain a culvert has been proposed.

The site visits revealed a disused pit opposite Milestones. Due to the extent of the pit the Red Route has been designed to start east of the pit thus reducing the amount of fill that might be required.

2.4.3 Dual Carriageway

The proposed design commences with improvements on the A12 and the construction of a single carriageway slip road. The slip road leads to a roundabout which links the existing A12 with the Red Route and allows access to and from the village of Little Glemham. Various options were possible in order to link the existing A12 to the Red Route - the roundabout was chosen and designed as it provided better visibility, buildability and safety compared to other junction options. On re-joining the A12 to

Lowestoft the Red Route has been designed to cross the entrance of Glemham Hall and Park.

Road closures and diversions, of existing roads, have been accounted for with proposals at:

- Keepers Lane has been closed, access to the A12 has been diverted and no access onto the Red Route is possible.
- Agricultural underpass, incorporating a drainage channel, has been designed to allow agricultural vehicles access to and from Little Glemham.

The route also crosses tracks and footpaths. The design proposals have not accounted for the closure and/or diversion of any tracks in any detail. Therefore further investigation and design should be undertaken to determine: the affected tracks and suitable design measures for these. However, the existing definitive footpaths have been noted and an allowance in the cost estimates has been made for stopping up and/or diversions.

The existing levels of the site vary from the levels proposed. Based on the current design proposals there appears to be proportional quantities of fill and cut therefore additional fill may not be required for the construction of the Red Route. Additionally, where low gradient levels are found drainage retention areas have been proposed. For the current route two drainage retention areas are proposed. The proposed location of one of the drainage retention areas is in Glemham Park. Where the route is an improvement or widening of the A12 it is assumed that the existing drainage system will be utilised following further investigation.

2.4.4 Single Carriageway

The proposed design for the single carriageway is similar to that for the dual, mentioned above. The Red Route departs the A12 north of Milestones Farm and heads north east through the farmland. The design of a new side road, from the existing A12 onto the Red Route, has been proposed to allow access to and from the village of Little Glemham. A roundabout has not been proposed as it was not deemed a feasible option. The Red Route continues north east and crossed Keepers Lane which has been closed and access diverted. From Keepers Lane the route heads north until it re-joins the A12 to Lowestoft at Glemham Park. The single carriageway Red Route option, compared to the dual, will:

- Reduce the amount of non-highway land required for construction;
- Reduce the impact of the Red Route on the Glemham Hall and Glemham Park;
- Reduce the Overall Design and Construction Costs.

The road levels for the single carriageway are assumed to be the same as those for the dual carriageway, but this might change during detailed design. The number of structures required for the both single and dual also remain the same.

2.4.5 Structures

The structures present along each route have been assessed for feasibility and cost for a single or dual carriageway option. Table 2.4.1 below details:

- The number of structures present on the route;
- A high level description of the structure with preliminary measure – these measurements have been included in the study as an indication and should not be taken as exact;
- The obstacles i.e. road or river that the structure is being proposed for.

The structures for the proposed route have been designed with a 7 metre road to road clearance. Additionally it has been assumed that the widths for the drains/watercourses present on the site are one metre.

Table 2.4.1 Summary of structures on SB4 (Red Route)

No	Structure Name	Obstacle	Structure Description
1	SB4 Underpass	Agricultural Track and Watercourse	New dual carriageway structure over existing watercourse and track. Width over=40.6m. Span=5m. Single span steel composite deck. Full height abutments. Piled foundation.
2	Link 1 Culvert Crossing	Watercourse (1m wide)	New culvert to carry watercourse below dual carriageway Length=42.40m, Internal Dia=1.5m

2.5 Route SB5 (Blue Route) with Link 1

2.5.1 Location

The Blue Route is a 3.4km dual carriageway bypassing to the south the villages of Farnham and Stratford St Andrew. The 3.45km route comprises the 1.1km Link 1 route common in both the Blue and Green Route.

The Blue Route departs the A12 via Link 1 and heads east through the flood plain where it crosses a number of drains and the River Alde. The route continues north to re-join the A12 to Lowestoft at the current junction with the A1094, Friday Street where a roundabout is proposed.

A site walkover of the proposed route took place on the 12th March 2014 by AECOM staff. Observations from this site visit were as follows:

- The route crosses flood plains and the River Alde.
- Widening of the A12 at the location of the proposed Link 1 would be adjacent to Glemham Hall Park.
- A disused pit is located on the north verge of Link 1.
- Predominantly, the route passes agricultural.
- The route is likely to clip both Pond Wood and Foxburrow Wood.

2.5.2 Carriageway Layout

The carriageway has been designed following guidance from the Design Manual of Roads and Bridges (DMRB, 2013). The Blue Route has been designed as a single or dual carriageway.

- 3.45km dual carriageway - the carriageway widths for the Blue Route have been designed to measure 7.3m with one metre strips and 2.5m verge. At locations where straight roads are used, the central reservation has been designed as 2.5m.
- 2.4km single carriageway - the carriageway widths for the Blue Route have been designed to measure 7.3m with 3.5m verges.

The side roads for both options have been designed for a minimum of 6.1m.

2.5.3 Dual Carriageway

It is proposed that the carriageway will start with a roundabout to join the new road to the existing A12 and allow local access to the old A12, the new road will continue along the existing A12 for Link 1 but will widen from a single carriageway to dual. This will continue 1.1km until the route departs from the main line into an east direction to form the Blue Route.

The proposed route has been designed to cross the flood plain in order to divert traffic on the existing A12 from the villages of Stratford St Andrew and Farnham. The Blue Route heads east from Link 1 through the flood plain crossing drains and the River Alde – culverts and a River Bridge have been proposed at these locations. Additionally in order to protect the River Alde a diversion of the river under the structure has been proposed. The route continues north to re-join the A12 with a roundabout.

Following recommendations provided in the DMRB, widening on low radius curves has been employed to give adequate visibility - central reservation and fence lines positioned to allow for increased visibility. Additionally woodland known as Pond Wood may need to be cleared to reduce visibility concerns, approximately half.

The existing levels of the site vary from the levels proposed. Based on the current design proposals there appears to be a deficit in fill material which would require additional fill material to be brought on site for the proposed route. Additionally, where the low gradient levels are found, drainage retention areas have been proposed. For the current route two drainage retention areas are proposed. Where the route is an improvement or widening of the A12 it is assumed that the existing drainage system will be utilised following further investigation.

2.5.4 Single Carriageway

The proposed design for the single carriageway route has a slightly different alignment than the dual, described above. The single carriageway Blue Route departs from the existing A12 via a new five arm roundabout near Park Gate Farm and heads east through the flood plain, crossing drains and the River Alde where several minor culverts and a main River Alde Bridge have been proposed. Where possible, local roads have been maintained or diverted. An example of this is the access road to Pond Barn Cottages where it is proposed that a side road overbridge will be provided. An agricultural underpass and local connections will be necessary to minimise severance at Farnham Hall. The bypass route continues north to re-join the A12 with a roundabout at the existing junction of the A1094. The size of the roundabout will be similar compared to that proposed for the dual carriageway option. The roundabout will have two single lane arms and one dual carriageway connection to the A12.

By building structures to allow the A12 to pass over existing roads wherever possible, disruption to the surrounding area has been minimised. An example of this is an access road to Pond Barn and Cottages, where it is proposed that a side road overbridge will be located. In some cases, however, it is necessary to divert routes which would be intercepted by the new path of the A12. Terminated roads include a private/ farm road for Park Gate Farm and a private/ footpath road to Foxburrow Wood.

The route also crosses tracks and footpaths. The design proposals have not accounted for the closure and/or diversion of any tracks. However, the existing definitive footpaths have been noted and an allowance in the cost estimates has been made for stopping up and/or diversions. Woodland located to the west of the proposed bypass, which would need to be cleared to provide adequate visibility for the dual carriage option, approximately a third, is less affected by the single carriageway bypass.

The existing levels of the site vary from the levels proposed. Based on the current design proposals there appears to be a deficit in fill material which would require additional fill material to be brought on site for the proposed route. Additionally, where the low gradient levels are found, drainage retention areas have been proposed. For the current route two drainage retention areas are proposed. Where the route is an improvement of the A12 it is assumed that the existing drainage system will be utilised following further investigation.

2.5.5 Structures

The structures present along each route have been assessed for feasibility and cost. Table 2.5.1 below details:

- The number of structures present on the route;
- A high level description of the structure with preliminary measure – these measurements have been included in the study as an indication and should not be taken as exact;
- The obstacles i.e. road or river that the structure is being proposed for.

The structures for the proposed route have been designed with a 7 metre road to road clearance. Additionally it has been assumed that the widths for the drains/watercourses present on the site are one metre.

Table 2.5.1 Summary of structures on SB5 (Blue Route)

No	Structure Name	Obstacle	Structure Description
8	SB5 River Bridge	River Alde (River diversion, 7.25m wide)	New dual carriageway structure over existing River Alde Width over=26.10m, Span= 13.25m Single span steel composite deck Full height abutments. Piled foundations.
1	SB5 Over Bridge	Minor Road	New structure for existing track over new dual carriageway Width over=8.1m, Span= 100m Two span steel composite deck Full height abutments. Piled foundations
2	Link 1 Culvert Crossing	Watercourse (1m wide)	New culvert to carry watercourse below dual carriageway Length=49.00m, Internal Dia=1.5m
3	SB5 Culvert Crossing	Watercourse (1m wide)	New culvert to carry watercourse below dual carriageway Length=53.90m, Internal Dia=1.5m
4	SB5 Culvert Crossing	Watercourse (1m wide)	New culvert to carry watercourse below dual carriageway Length=42.40m, Internal Dia=1.5m

2.6 Route LB3 (Orange Route)

2.6.1 Location

The Orange Route is a 5.55km dual carriageway, bypassing to the south the villages of Marlesford and Little Glemham.

The route departs the in the east direction through open farmland where it crosses the River Ore. The route continues north crossing the A12 where an over-bridge has been proposed, and continues in the north east direction to re-join the A12 at Glemham Park.

A site walkover of the proposed route took place on the 12th March 2014 by AECOM staff. Observations from this site visit were as follows:

- Predominantly, the route passes agricultural land with few houses affected;
- The route crosses several public footpaths;
- Possible widening of the A12 - tie in Orange Route to the A12- would be adjacent to Glemham Hall and Park;
- The existing B1078 bridge structure at the end of the Wickham Market bypass would require widening in order to accommodate the tie in of the Orange Route with the A12.

2.6.2 Carriageway Layout

The carriageway has been designed following guidance from the Design Manual of Roads and Bridges (DMRB, 2013). The Orange Route has been designed as a single or dual carriageway.

- 5.6km dual carriageway - the carriageway widths for the Orange Route have been designed to measure 7.3m with one metre strips and 2.5m verge. At locations where straight roads are used, the central reservation has been designed as 2.5m.
- 4.8km single carriageway - the carriageway widths for the Orange Route have been designed to measure 7.3m with 3.5m verges.

The side roads for both options have been designed for a minimum of 6.1m.

2.6.3 Dual Carriageway

The Orange Route departs the A12 in the east direction through the fields crossing drains and the River Ore – culverts and a River Bridge have been proposed at these locations. Where possible, roads have been maintained or diverted. The existing accesses onto the A12, for the B1078 and side roads have been maintained. Additionally where the Orange Route crosses the A12 an over-bridge has been proposed allowing access to and from the village of Marlesford from the A12. The Orange Route continues north till it re-joins the A12 to Lowestoft where it tapers from dual to single carriageway. An agricultural underpass, incorporating a drainage channel, has been proposed to allow agricultural vehicles access to and from the village of Farnham.

The route also crosses tracks and footpaths. The design proposals have not accounted for the closure and/or diversion of any tracks. However, the existing definitive footpaths have been noted and an allowance in the cost estimates has been made for stopping up and/or diversions.

Following recommendations provided in the DMRB, widening on low radius curves has been employed to give adequate visibility - central reservation and fence lines positioned to allow for increased visibility. The existing levels of the site vary from the levels proposed. Based on the current design proposals there appears to be a deficit in fill material which would require additional fill material to be brought on site for the proposed route. Additionally, where the low gradient levels are found drainage retention areas have been proposed. For the current route two drainage retention areas are proposed. Where the route is an improvement or widening of the A12 it is assumed that the existing drainage system will be utilised following further investigation.

2.6.4 Single Carriageway

The proposed design for the single carriageway is similar to that for the dual, mentioned above. The Orange Route departs A12, in the east direction, as a dual carriageway and tapers to a single carriageway. This route crosses drains and the River Ore where several culverts and a river bridge have been proposed at these locations. Where possible, roads have been maintained or diverted. The existing accesses onto the A12 for the B1078 and side roads have been maintained. Additionally where the Orange Route crosses the A12 an over-bridge has been proposed allowing access to and from the village of Marlesford. The A12 west of Glemham Hall has been closed with a proposed access onto the Orange Route via Nursery Plantation side road. The Orange Route continues north till it re-joins the A12 to Lowestoft.

The road levels for the single carriageway are assumed to be the same as those for the dual carriageway; however this might change during detailed design. The number of structures and drainage retention areas required for the both single and dual also remain the same.

2.6.5 Structures

The structures present along each route have been assessed for feasibility and cost. Table 2.6.1 below details:

- The number of structures present on the route;
- A high level description of the structure with preliminary measure – these measurements have been included in the study as an indication and should not be taken as exact;
- The obstacles i.e. road or river that the structure is being proposed for;

The structures for the proposed route have been designed with a 7 metre road to road clearance. Additionally it has been assumed that the widths for the drains/watercourses present on the site are one metre.

Table 2.6.1 Summary of structures on LB3 (Orange Route)

No	Structure Name	Obstacle	Structure Description
1	LB3 existing Bridge Abutment Wall	A12	Reinforced concrete wall in front of existing abutments
2	LB3 Over bridge	Minor Road	New dual carriageway structure over existing track Width over=27.8m, Span=6.00m Single span steel composite deck Full height abutments. Piled foundations
3	LB3 River Bridge	River Ore (4m wide)	New dual carriageway structure over River Ore Width over=57.6m, Span= 10m Single span steel composite deck Full height abutments. Piled foundations.
4	LB3 A12 Over bridge	Existing A12	New dual carriageway structure over existing A12 Width over=26.1m, Span=14.3m. Single span steel composite bridge. Full height abutments. Piled foundations
5	LB3 Underpass	Agricultural Track and Watercourse	New dual carriageway structure over existing watercourse and track. Width over=52.2m. Span=5m. Single span steel composite deck. Full height abutments. Piled foundation.
6	LINK 1 Culvert Crossing	Watercourse (1m wide)	New culvert to carry watercourse below dual carriageway Length=42.40m, Internal Dia=1.5m

2.7 Soil Conditions

The geotechnical information related to the proposed bypass options have been reviewed and analysed. The findings have been summarised below, with detailed report provided in Appendix 1.

The proposed routes are located along the villages of Marlesford, Little Glemham, Stratford St. Andrew and Farnham.

The landscape is predominantly agricultural with few residential settlements - mostly partitioned into open grazing fields. Some changes in elevation and steep dips were observed in some areas.

The geological survey undertaken for this site was based on information: extracted from the British Geological Survey (BGS) website and historical data - no indication of any significant changes in the use, and soil conditions over the years (1883- Feb. 2014) has been observed.

A high level interpretation of the ground conditions, based on the available information, has been carried out and might differ if a detailed ground investigation is undertaken. Table 2.7.1 below summarises the geological findings of the area.

Table 2.7.1 Summary of soil conditions

Depth	Strata	Villages	Note
0-0.5m	Topsoil	Present through all villages	Expected to be stripped off prior to construction.
0.5-3.5m	Lowestoft Formation (cohesive or non-cohesive)	Present in all villages – predominantly between the villages of little Glemham and Stratford St Andrew	The Cohesive Lowestoft Formation appears to be approximately 2m in thickness, and the non-cohesive has an average thickness of 4m.
3.5-12.5m	Crag Group	Present in Little Glemham and south of Stratford St Andrew and Farnham	A suite of shallow-water marine and estuarine sands and gravels, locally with bands of silts and clays weakly cement rock
12.5-17.5m	London Clay	Present through Little Glemham and south of Stratford St Andrew and Farnham	A marine formation, usually stiff to very stiff silty clay or a clayey silt in the basement beds, which is usually bluish grey but becomes brown when weathered.
17.5- not proved	Lambeth Group	Present between Little Glemham and south of Stratford St Andrew and Farnham	Mixed silty sandy clay or silty sand

From Table 2.7.1 it can be seen that the solid geology of the site consists mainly of the Crag Group Formation and the Red Crag Formation to the south of the villages of Stratford St. Andrew and Farnham.

The ground investigation undertaken also identified possible hazards present on the site - summarized below:

- The Environment Agency has identified the area in close proximity to the River Alde as a flood risk.
- Alluvial deposits are expected at the area around the river. Cohesive alluvial deposits are known for their instability issues and remediation may be needed.
- A thin area of head deposits is observed near the middle of the project. Due to the way head is formed it is possible that there may be slickenside shear plane present, these can be a hazard for earthworks.
- Low risk of contamination based on the current usage – agricultural and residential settlements – within the area. Nevertheless it is recommended that a detailed contaminated land assessment be undertaken prior to any works.
- Groundwater levels were not identified for the study area.

Following the results of the investigation and observations for the site it is recommended that the following should be undertaken prior to any work:

- A detailed ground investigation.
- A site topographical survey.
- An Envirocheck report – to gain more detailed information.

2.8 Statutory Undertakers

A statutory undertaker investigation, for the proposed Four Villages bypasses, was conducted on the 12th February 2014. The undertakers that responded affected by the scheme are as follows:

- BT Openreach
- Essex and Suffolk Water
- Ericsson Plant
- UK Power Networks

The mitigation measures have been allowed for in the estimated design costs for the proposed bypasses.

3 Scheme Development and Construction Programme

3 Scheme Development and Construction Programme

3.1 Development and Construction Programme

A programme of works, from design to construction, has been defined for the proposed route options based on previous AECOM design and construction work. The programme shows the approximate years in which the design and construction will take place but the durations of these may alter depending on extent of the further work. The following Tables illustrate the programme for each route option.

Table 3.1 SB1 Construction Programme

Activity	2014	2015	2016	2017	2018	2019	2020	2021	2022
Carry out Preliminary Design and consultation	■								
Announce Preferred Route		■							
Carry out Detailed Design			■						
Public Inquiry			■						
Order Publication Period and CPO				■					
Award of Tender					■				
Construction Period					■	■	■		
Open to Traffic							■		

3.2 SB1 Split A12 North Development and Construction Programme

A construction program estimate has been put together to show the approximate durations of the time it would take to fully design and construct each scheme. Table 3.2 below shows the construction programme for SB1 A12 North scheme.

Table 3.2 SB1 Split A12 North Construction Programme

Activity	2014	2015	2016	2017	2018	2019	2020	2021	2022
Carry out Preliminary Design and consultation									
Announce Preferred Route									
Carry out Detailed Design									
Public Inquiry									
Order Publication Period and CPO									
Award of Tender									
Construction Period									
Open to Traffic									

3.3 SB1 Split A12 South Development and Construction Programme

A construction program estimate has been put together to show the approximate durations of the time it would take to fully design and construct each scheme. Table 3.3 below shows the construction programme for SB1 A12 South scheme.

Table 3.3 SB1 Split A12 South Construction Programme

Activity	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Carry out Preliminary Design and consultation											
Announce Preferred Route											
Carry out Detailed Design											
Public Inquiry											
Order Publication Period and CPO											
Award of Tender											
Construction Period											
Open to Traffic											

3.4 SB2 Development and Construction Programme

A construction program estimate has been put together to show the approximate durations of the time it would take to fully design and construct each scheme. Table 3.4 below shows the construction programme for the SB2 scheme.

Table 3.4 SB2 Construction Programme

Activity	2014	2015	2016	2017	2018	2019	2020	2021	2022
Carry out Preliminary Design and consultation									
Announce Preferred Route									
Carry out Detailed Design									
Public Inquiry									
Order Publication Period and CPO									
Award of Tender									
Construction Period									
Open to Traffic									

3.5 SB4 Development and Construction Programme

A construction program estimate has been put together to show the approximate durations of the time it would take to fully design and construct each scheme. Table 3.5 below shows the construction programme for the SB4 scheme.

Table 3.5 SB4 Construction Programme

Activity	2014	2015	2016	2017	2018	2019	2020	2021	2022
Carry out Preliminary Design and consultation									
Announce Preferred Route									
Carry out Detailed Design									
Public Inquiry									
Order Publication Period and CPO									
Award of Tender									
Construction Period									
Open to Traffic									

3.6 SB5 Scheme Development and Construction Programme

A construction program estimate has been put together to show the approximate durations of the time it would take to fully design and construct each scheme. Table 3.6 below shows the construction programme for the SB5 scheme.

Table 3.6 SB5 Construction Programme

Activity	2014	2015	2016	2017	2018	2019	2020	2021	2022
Carry out Preliminary Design and consultation									
Announce Preferred Route									
Carry out Detailed Design									
Public Inquiry									
Order Publication Period and CPO									
Award of Tender									
Construction Period									
Open to Traffic									

3.7 LB3 Construction Programme

A construction program estimate has been put together to show the approximate durations of the time it would take to fully design and construct each scheme. Table 3.7 below shows the construction programme for the LB3 scheme.

Table 3.7 LB3 Construction Programme

Activity	2014	2015	2016	2017	2018	2019	2020	2021	2022
Carry out Preliminary Design and consultation									
Announce Preferred Route									
Carry out Detailed Design									
Public Inquiry									
Order Publication Period and CPO									
Award of Tender									
Construction Period									
Open to Traffic									

4 Environmental Assessments

4 Environmental Assessments

4.1 Air Quality

4.1.1 Introduction

The aim of the air quality option appraisal is to consider the potential effects on local air quality of the proposed bypass routes, considering the existing traffic movement and the additional road traffic movements likely to be generated by Sizewell C

The proposed bypass route sections considered, detailed in Chapter 2, have been combined to give seventeen possible routes for the proposed bypass scheme, each of which have been assessed in the air quality assessment.

A WebTag assessment has also been carried out, to assess the impact of the seventeen options on local air quality by quantifying the change in exposure at properties alongside the roads affected by the proposed bypass routes along with a regional assessment and economic valuation of air pollution and the change associated with each bypass option.

In addition, a high level qualitative dust assessment has been carried in order to consider possible air quality effects during the construction phase of the bypass options.

4.1.2 Regulatory / Planning Policy Framework

4.1.2.1 European Air Quality Directives

The Air Quality Framework Directive (96/62/EC)[2] on ambient air quality assessment and management defines the European Union policy framework for twelve air pollutants known to have a harmful effect on human health and the environment. The mandatory limit values for the pollutants were set through a series of Daughter Directives.

- Directive 1999/30/EC (the 1st Daughter Directive)[3] sets limit values (values not to be exceeded) for sulphur dioxide, nitrogen dioxide (NO2) and oxides of nitrogen (NO_x), particulate matter (PM_{10}) and lead in ambient air.
- Directive 2000/69/EC (the 2nd Daughter Directive)[4] establishes limit values for concentrations of benzene and carbon monoxide in ambient air.
- Directive 2002/3/EC (the 3rd Daughter Directive)[5] establishes long-term objectives, target values, an alert threshold and an information threshold for concentrations of ozone in ambient air.

[2] Air Quality Framework Directive (96/62/EC)
[3] Council Directive 1999/30/EC relating to limit values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in ambient air.
[4] Council Directive 2000/69/EC relating to limit values for benzene and carbon monoxide in ambient air
[5] Directive 2002/3/ EC of the European Parliament and of the Council of 12 February 2002 relating to ozone in ambient air

- Directive 2004/107/EC (the 4th Daughter Directive)[6] establishes a target value for the concentration of arsenic, cadmium, nickel and benzo(a)pyrene in ambient air so as to avoid, prevent or reduce harmful effects of arsenic, cadmium, nickel and polycyclic aromatic hydrocarbons on human health and the environment as a whole.
- Directive 2008/50/EC consolidates existing air quality legislation apart from the 4th Daughter Directive and provides a new regulatory framework for $PM_{2.5}$. It makes provision under Article 22 for Member States to postpone attainment deadlines and allow an exemption from the obligation to limit values for certain pollutants, subject to strict conditions and assessment by the European Commission.

4.1.2.2 UK Air Quality Strategy

The UK Air Quality Strategy (AQS) identifies nine ambient air pollutants that have the potential to cause harm to human health. These pollutants are associated with local air quality, with the exception of ozone, which is a regional pollutant. The Air Quality (England) Regulations set objectives for the seven pollutants that are associated with local air quality. These objectives aim to reduce the health impacts of the pollutants to negligible levels. Unlike the EU limit values, the objectives outlined in the UK AQS are not mandatory.

The Air Quality Standards Regulations 2010 came into force on 11th June 2010[7], replacing the previous Air Quality Standards Regulations 2007. The 2010 regulations transposed into national legislation the requirements of Directive 2008/50/EC[8] and Directive 2004/107/EC.

Air quality objectives and limit values are reported in Appendix 2.1.

4.1.2.3 Local Air Quality Management

The provisions of Part IV of the Environment Act 1995[9] establish a national framework for air quality management, which requires all local authorities in England, Scotland and Wales to conduct local air quality reviews. Section 82(1) of the Act requires these reviews to include an assessment of the current air quality in the area and the predicted air quality in future years. Should the reviews indicate that the objectives prescribed in the UK Air Quality Strategy and the Air Quality (England) Regulations[10],[11], will not be met, the local authority is required to designate an Air Quality Management Area (AQMA). Action must then be taken at a local level to ensure that air quality in the area improves. This process is known as ‘local air quality management’.

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[6] Council Directive 2004/107/EC relating to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air.
[7] The Air Quality Standards Regulations (2010). SI 2010 No. 1001.
[8] Council Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe.
[9] UK Government, Environment Act 1995, http://www.legislation.gov.uk/ukpga/1995/25/contents.
[10] Defra (2000). The Air Quality (England) Regulations, 2000 (SI 2000/928).
[11] Defra (2002). The Air Quality (England) (Amendment) Regulations, 2002 (SI 2002/3043).

4.1.2.4 National Planning Policy

The recently published National Planning Policy framework[12] states the following with regard to air quality:

"Planning policies should sustain compliance with and contribute towards EU limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and the cumulative effects on air quality from individual sites in local areas. Planning decisions should ensure that any new development in Air Quality Management Areas is consistent with the local air quality action plan."

4.1.2.5 Local Planning Policy

In December 2011 (SCC) adopted its Supplementary Guidance (SG) for Air Quality Management and New Development[13]. The principal aims of this SG on air quality are to:

- Maintain and where possible improve air quality;
- Ensure a consistent approach to local air quality management and new development across the county by:
    1. Identifying circumstances where an air quality assessment would be required to accompany an application;
    2. Providing guidance on the requirements of the air quality assessment; and
    3. Providing guidance on mitigation and offsetting of impacts.

(SCC) is preparing a new District Local Plan which sets out the planning policies, proposal and actions for the future development to 2027. The adopted Supplementary Planning Guidance (SPG) will be replaced by the Supplementary Planning Documents under the Suffolk Coastal District Local Plan. The "Section 106 guidance for developers" provides information on air quality:

"*The Local Authorities will seek to mitigate impacts from new developments that are detrimental to air quality and are in or adjacent to an AQMA or have a quantifiable impact on air quality in an AQMA by seeking contributions for measures to offset pollution effects."*

4.1.2.6 Greenhouse Gases

The UK Government is committed to reducing emissions of greenhouse gases responsible for climate change. Under the Kyoto Protocol, the Government has set a legally binding

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[12] Department for Communities and Local Government (2012), National Planning Policy Framework. March 2012. Page 29.
[13] Air Quality Management and New Development, 2011. Available http://www.suffolk.gov.uk/business/planning-and-design-advice/supplementary-guidance-air-quality-management-and-new-development-2011

target to reduce emissions of greenhouse gases to on average 12.5% below 1990 levels between 2008 and 2012. The European Union has set targets and policies that extend beyond the original ambition of the Kyoto Protocol. The European Climate Change Programme (ECCP)[14] outlines a climate change strategy to help prevent temperatures from increasing to more than 2°C above pre-industrial levels. The ECCP's strategy which was agreed by the Council of Ministers in Spring 2007 sets three targets to be reached by 2020:

- Greenhouse gas emissions: Cut by 20% from 1990 levels (or by 30% in the event of an adequate international agreement).
- Energy from renewable sources: Increase to 20% of all energy.
- Energy efficiency: Improve by 20%.

To achieve these targets, different policy measures have been adopted, in particular the EU Emissions Trading Scheme and various regulations and standards such as the Renewables Directive and Energy Performance in Buildings Directive.

The UK adopted the Climate Change Act[15] in November 2008, which sets a target for the UK to reduce carbon emissions to 80% below 1990 levels by 2050 and established the concept of carbon budgets. To drive progress towards this target, the Act introduces five year "carbon budgets", which define the emissions pathway to the 2050 target by limiting the total greenhouse gas emissions allowed in each five year period, beginning in 2008. The first three carbon budgets were announced in April 2009, covering the periods 2008-12, 2013-17 and 2018-22. It requires emissions reductions of just over 22%, 28% and 34% respectively below 1990 levels, and are in line with the recommendations of the Committee on Climate Change. Each sector must play its part in taking action to achieve these budgets.

It is therefore important that the impacts of proposed transport interventions on greenhouse gas emissions are included in the cost benefit analysis.

4.1.2.7 Standard and Key Policies

The following documents have been used in this chapter in order to assess the effects of the proposed development and to determine the significance of any impacts on local sensitive receptors:

- Highways Agency, Design Manual for Roads and Bridges, Volume 11 Section 3, Part 1: Air Quality, HA 207/07 and associated Interim Advice Notes (IAN 170/12, 174/13);
- Highways Agency, Approach to Evaluating Significant Air Quality Effects[16];

[14] European Commission, European Climate Change Programme. Available from http://ec.europa.eu/clima/policies/eccp/index_en.htm
[15] The Climate Change Act 2008 (c27).
[16] Highways Agency, Design Manual for Roads and Bridges, Volume 11 Section 3, Part 1: Air Quality

- Highways Agency, Design Manual for Roads and Bridges, Volume 11 Section 3, Part 3: Disruption due to construction;
- The policy and technical guidance notes, LAQM.PG(09)[17] and LAQM.TG(09)[18], issued by the Government to assist local authorities in their Local Air Quality Management responsibilities;
- The UK Air Quality Strategy;
- Department for Communities and Local Government (2012), National Planning Policy Framework;
- Building Research Establishment (BRE) publications, 'Control of Dust from Construction and Demolition Activities' and 'Controlling Particles, Vapour and Noise Pollution from Construction Sites';
- Suffolk Coastal District Council's Local Air Quality Review and Assessment Reports

4.1.3 Baseline Conditions

4.1.3.1 Pollutant of Concern

Nitrogen dioxide

The Government and Devolved Administrations adopted two Air Quality Objectives for NO_2 to be achieved by the end of 2005. These are:

- An annual mean concentration of 40 µg/m^3; and
- A one-hour mean concentration of 200 µg/m^3, not to be exceeded more than eighteen times per year.

In practice, meeting the annual mean objective was anticipated to be considerably more challenging than attaining the one-hour objective. The EU First Daughter Directive also sets limit values for NO_2 to be achieved by 1st January 2010, which have been incorporated into UK legislation. The Directive includes a one-hour limit value of 200 µg/m^3, not to be exceeded more than eighteen times per year and an annual mean limit value of 40 µg/m^3.

NO_2 and nitric oxide (NO) are collectively known as oxides of nitrogen, or NO_x. All combustion processes produce NO_x emissions, predominantly in the form of NO, which then undergoes conversion in the atmosphere to NO_2, mainly as a result of its reaction with ozone (O_3). It is NO_2 that has been most strongly associated with adverse effects upon human health. NO_2 can irritate the lungs and lower resistance to respiratory infections such as influenza. Continued or frequent exposure to concentrations that are typically much higher than those normally found in the ambient air. This may cause increased incidence of acute respiratory illness in children.

[17] Defra, (2009) Local Air Quality Management, Policy Guidance. LAQM.PG(09).
[18] Defra, (2009) Local Air Quality Management, Technical Guidance. LAQM.TG(09).

Updated total NO_x emissions estimates for 2011 showed that road transport accounted for the largest proportion (33%) of total UK NO_x emissions. Energy industries remained the second largest contributor. Road transport emissions have declined significantly since peaking in 1990 as a consequence of various policy measures, with total emissions reducing by 64% between 1990 and 2011. Further reductions are expected in future years.

Emissions from industrial sources have also declined significantly, due to the fitting of low NO_x burners, and the increased use of natural gas plant. Industrial sources generally make a small contribution to ground level NO_2 levels, although breaches of the hourly NO_2 objective may occur under rare meteorological conditions due to emissions from these sources.

The annual mean objective of 40 µg/m^3 is currently widely exceeded at roadside sites throughout the UK, with exceedences also reported at urban background locations in major conurbations. The number of exceedences of the 1-hour objective show considerable year-to-year variation, driven by meteorological conditions, which give rise to winter episodes of poor dispersion and summer oxidant episodes.

4.1.3.2 Particulate Matter

The Government and the Devolved Administrations adopted two Air Quality Objectives for PM_{10} to be achieved by the end of 2004:

- An annual mean concentration of 40 µg/m^3 (gravimetric); and
- A 24-hour mean concentration of 50 µg/m^3 (gravimetric) to be exceeded no more than 35 times per year.

Particulate matter is composed of a wide range of materials arising from a variety of sources, and is typically assessed as total suspended particulates, or as a mass size fraction. The European air quality standards have adopted the PM_{10} standard for the assessment of fine particulate matter. This expresses particulate levels as the total mass size fraction at or below an aerodynamic diameter of 10 µm. Particles of this size are able to penetrate beyond the nose and throat deep into the respiratory system reaching the bronchi and lungs.

Extensive scientific research has provided evidence of associations between exposure to fine particulate matter (PM) and increased morbidity and mortality. Numerous studies have associated particulate pollution with acute changes in lung function and respiratory illness, resulting in increased hospital admissions for respiratory disease and heart disease and the aggravation of chronic conditions such as bronchitis and asthma.

Adverse effects on the cardiovascular and respiratory systems have been causally linked with both short-term and long-term exposures to PM. Two collaborative projects undertaken in ninety cities in the United States and twenty-nine European cities reported links between daily mortality and PM concentration on the same day or several preceding days. Increases in total mortality of 0.27% per 10 µg/m^3 increase in PM_{10} and 0.6% per 10 µg/m^3 increase in

PM_{10} were determined for the US and European city studies, respectively[19],[20]. Long-term exposure to PM has been implicated in observed increases in all-cause, cardiopulmonary and lung cancer mortality[21],[22].

There is some concern that fine particles from diesel exhaust may have a carcinogenic effect. This may be due to air-stream entrained particles carrying adsorbed carcinogens into the respiratory system. The effects of particulate matter exposure on human health are complex and masked by other factors such as weather and lifestyle. Importantly, however, there is broad agreement in the scientific community that there is no threshold exposure level below which the adverse effects of PM exposure are no longer discernible[23].

In the UK, commercial, residential, agriculture and fishing, stationary and mobile combustion are the major sources of particulate emissions in 2011 (24%). Total UK PM_{10} emissions have fallen by more than 60% between 1980 and 2011 to around 113 kilo-tonnes. Revised figures indicate that after commercial, residential, agriculture and fishing, stationary and mobile combustion sources, road transport (21%) and industrial processes emissions (14%) remain the principal sources of PM_{10} in 2011.

Emissions of PM_{10} have decreased considerably in the past thirty years. PM_{10} emissions from road transport peaked during the early 1990s and have since fallen by around 46% (1993 to 2011). The energy and industry sectors have seen a decrease of 86%, for the same period. The reduction is mainly due to the decline in coal use and also the result of legislative and technical control of emissions from both road traffic and industrial sources. Energy Industries accounted for 7% of total PM_{10} emissions in 2011, compared with 27% in 1990.

4.1.3.3 Construction Dust

Dust is defined as all particulate matter up to 75 µm in diameter and comprising both suspended and deposited dust, whereas PM_{10} is a mass fraction of airborne particles of diameter of 10 microns or less. The health impacts associated with dust include eye, nose and throat irritation in addition to the nuisance caused by deposition on cars, windows and property. Dust and PM_{10} emissions arise from a number of sources, so both construction activities and emissions from vehicles associated with the construction site need to be considered.

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[19] Dominici F, Burnett R (2003). Risk models for particulate air pollution. J Toxicol Env Health Part A. 66: 1883–1889.
[20] Katsouyanni K., Touloumi G., Samoli E., et al (2001). Confounding and effect modification in the short-term effects of ambient particles on total mortality: results from 29 European cities within the APHEA-II project. Epidemiology 12: 521–531.
[21] Krewski D, Burnett RT, Goldberg MS, Hoover K, Siemiatiycki J, Jerrett M, Abrahamowicz M, White WH (2000). Reanalysis of the Harvard Six Cities Study and the American Cancer Society Study of Particulate Air Pollution and Mortality. Cambridge, MA: Health Effects Institute.
[22] Hoek G, Brunekreef B, Goldbohm S, Fischer P, van den Brandt PA. (2002). Association between mortality and indicators of traffic-related air pollution in the Netherlands: a cohort study. Lancet 360:1203–1209.
[23] WHO (2003). Health Aspects of Air Pollution with Particulate Matter, Ozone and Nitrogen Dioxide.

Literature suggests that the most sensitive vegetation species appear to be affected by dust deposition at levels above 1000 mg/m^2/day that is five times greater than the level (200 mg/m^2/day) at which most dust deposition may start to cause a perceptible nuisance to humans so vegetation is much less sensitive to dust than human activities. Most species appear to be unaffected by dust until deposition rates are at levels considerably higher than 1000 mg/m^2/day. Without mitigation, some construction activities can generate considerable levels of fugitive dust, although this is highly dependent on the nature of the ground and geology, time of year construction occurs in, length of time specific construction activity (e.g. boring) occurs for and prevailing meteorology during this activity.

4.1.4 Summary of Local Air Quality Management in Suffolk Coastal District Council

In 2006, the Suffolk Coast District Council declared an AQMA for NO_2 due to monitored exceedences of the annual mean NO_2 objective at a number of properties near Woodbridge Junction (Lime Kiln Quay Road, Thoroughfare and St. John’s Street in Woodbridge). A second AQMA has since been declared in 2009 for a single property in the Port of Felixstowe.

The first round of review and assessment was completed in 2001 and no AQMA were declared.

The 2005 Air Quality Action Plan and Progress Report confirmed the potential risk that Suffolk Coastal District Council may exceed the air quality objectives for NO_2, SO_2 and PM_{10}. Further investigation in the form of a Detailed Assessment found that an AQMA was required due to exceedences of the annual mean NO_2 objective at Lime Kiln Quay Road/The Thoroughfare/St John’s Street junction, Woodbridge. The area was subsequently declared an AQMA in 2006.

The Fourth round of the Updating and Screening Assessment confirmed that concentrations continued to exceed the annual mean objective at Woodbridge and that Ferry Lane, Felixstowe required a Detailed Assessment due to NO_2 exceedences. The Detailed Assessment showed that the container handling and HGV activities at the port was the cause of the high NO_2 concentrations. An Action Plan was produced in 2011 for the Felixstowe AQMA which included thirteen recommended measures to reduce NO_2 concentrations. The 2011 diffusion tube monitoring in the Felixstowe AQMA have shown that concentrations of NO_2 have decreased below the 40 $\mu g/m^3$ AQS objective level.

An Action Plan Progress Report for the Woodbridge Junction AQMA was included in the 2012 Updating and Screening Assessment. This report shows that measures to reduce traffic congestion have been successful at the junction with some reductions in concentrations. However, the area remains above the AQS objective and further work is required to reduce concentrations.

The 2012 automatic NO_X analyser and diffusion tube results recorded within the Woodbridge AQMA confirm that the annual mean NO_2 objective continues to be exceeded.

NO_2 concentrations recorded at the Felixstowe AQMA diffusion tube locations show a further reduction in NO_2 concentrations in 2012. A Detailed Assessment was also undertaken for Stratford St. Andrew area in 2012. The Detailed Assessment confirmed that an AQMA was required due to exceedence of the NO_2 AQS objective. The Detailed Assessment report has been taken to Suffolk Coastal's Cabinet who have recommended declaration of an AQMA to cover the four houses situated at Long Row, Main Road, Stratford St Andrew.

Further information on local air quality management and Review and Assessment undertaken by Suffolk Coastal District Council can be found on the Council's website[24].

4.1.4.1 Air Quality Monitoring in Suffolk Coastal District Council

Suffolk Coastal District Council (SCDC) operate a number of air quality monitoring sites using both automatic (i.e. continuous monitoring) and non-automatic (i.e. diffusion tubes) measurement methods.

Table 4.1.1 presents the monitored NO_2 concentrations at the SCDC continuous monitoring site at Woodbridge. The Woodbridge monitoring station is located approximately 8 km south of the proposed bypass options. Due to the distance from the proposed bypass routes and given the monitor's kerbside location within an AQMA, the concentrations monitored at this location are not considered representative of NO_2 concentrations in the vicinity of the bypass route.

Table 4.1.1: Air quality continuous monitoring station results

Site ID	Grid Reference		Site Type	In AQMA	Monitored Annual NO_2 Mean Concentration ($\mu g/m^3$), Number Hourly Exceedences in Parenthesis		
	X	Y			2011	2012	2013
Woodbridge Junction	627590	249260	Kerbside	Yes	**42** (0)	**44** (1)	**42** (0)

Notes: Exceedences of air quality objectives / EU limit values are shown in bold

In addition to the Woodbridge continuous monitoring, SCDC also monitor NO_2 concentrations at thirty-nine locations using diffusion tubes. Most of the diffusion tubes are located between 8 km and 25 km from the bypass routes and so are not considered representative of the study area and have not been considered further. In 2011 and 2012, additional diffusion tubes were put in place along the A12 to inform the planning application for the Sizewell C power station. These tubes are located at Little Glemham, Farnham and

[24] Air Pollution in Suffolk Coastal District Council available from http://www.suffolkcoastal.gov.uk/yourdistrict/envprotection/airquality/reports/ Accessed 19/02/2014.

Stratford St. Andrew (Appendix 2.1, Air Quality Figure 3.1.1) and their results are shown in Table 4.1.2.

NO_2 concentrations measured at the roadside diffusion tubes on the A12 are considered to be representative of the highest concentrations near the A12.

Table 4.1.2: Annual Mean Results of Diffusion Tubes Monitoring

Site ID	Grid Reference		Site Type	In AQMA	Monitored Annual NO_2 Mean Concentration ($\mu g/m^3$), Number Hourly Exceedences in Parenthesis		
	X	Y			2011	2012	2013[b]
Little Glemham 1	634200	225880	Roadside	No	17	14	14
Farnham 1	636270	260130	Roadside	No	29	26	29
Farnham 2	636270	260110	Roadside	No	33	31	31
Stratford St. Andrew 1 (STA1)	635740	259990	Roadside	No	**43**	**42**	**40**
Stratford St. Andrew 2 (STA2)	635740	260010	Roadside	No	N/A	26	26
Stratford St. Andrew 4 (STA4)	635870	260110	Roadside	No	N/A	24	16
Stratford St. Andrew 5 (STA5)	635720	259990	Roadside	No	N/A	18	N/A
Stratford St. Andrew 6 (STA6)	635790	260040	Roadside	No	N/A	N/A	23
Stratford St. Andrew 7 (STA7)	635720	259970	Roadside	No	N/A	N/A	34

Notes: Exceedences of air quality objectives / EU limit values are shown in bold; b) Bias adjusted using the National Bias Adjustment Factor (0.8).

The results in Table 4.1.2 indicate that the annual mean air quality objective / EU limit value (40 $\mu g/m^3$) was not exceeded at eight of the nine roadside diffusion tubes but did exceed the objective at Stratford St. Andrew 1 between 2011 and 2013.

4.1.4.2 Background Concentrations

A large number of small sources of air pollutants exist, which individually may not be significant, but collectively, over a large area, need to be considered in the modelling process. The emissions from these sources form part of the background air quality in the vicinity of the proposed bypass scheme. Defra have produced mapped background concentrations covering the whole of the UK for use by local authorities in the completion of their Review & Assessment (R&A) reports in the absence of local background monitoring or where insufficient background monitoring data is available. The maps provide background pollutant concentrations for each 1 km by 1 km grid square within the UK.

Table 4.1.3 shows the comparison of the closest urban background tube, number 21, which is located in Felixstowe with the grid square closest to that tube (629500, 234500). Diffusion tube 21 at Felixstowe is located more than 22 km to the south of the bypass routes, therefore, this monitoring location is not considered to be representative of the background concentration in the study area however it does allow the mapped Defra concentrations to be compared with monitored NO_2 concentrations. The urban background diffusion tube shows similar concentrations when compared to the mapped background concentrations.

Roadside diffusion tubes located at Little Glemham, Farnham and Stratford St. Andrew are not suitable as source of background concentrations in the study area, due to their close proximity to the A12. The use of the results from roadside sites as background concentration in the air quality assessment, would lead to a double count of the road contributions.

Table 4.1.4 shows the average mapped background concentrations for grid squares located alongside the bypass routes. Background NO_2 concentrations have been calculated without the influence of local road sources in accordance with Defra guidance[25] and using the updated Defra source apportionment adjustment calculator. Concentrations for both NO_2 and PM_{10} are significantly below annual mean objectives.

[25] Defra 2012. Local Air Quality Management Note on Projecting NO2 Concentrations. April 2012.

Table 4.1.3: Annual Mean Diffusion Tube Results Versus Mapped Background Concentrations

Diffusion Tube	Grid Reference		Monitored Annual NO_2 Mean Concentration ($\mu g/m^3$)		DEFRA NO_2 Mapped Background Concentration ($\mu g/m^3$)	
	X	Y	2012	2013	2012	2013
Felixstowe 21	629250	234430	22.0	21.0	21.6	21.2

Table 4.1.4: Mapped Background Concentrations

Road Section	2013		2024		2035	
	NO_2 ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)
Four Villages Background	9.7	16.0	7.2	14.9	7.1	14.8

4.1.5 Assessment Methodology

The proposed bypass has the potential to impact on air quality during its operational and construction phases. The main impacts during the construction phase will be airborne dust generated during demolition and construction activities. These impacts have been assessed qualitatively.

The main impacts during the operational phase are likely to be associated with road traffic. The effect on local air quality due to change in road traffic associated with the proposed bypass options have been predicted in accordance with the Design Manual for Roads and Bridges (DMRB), which provides a methodology to be followed when assessing the effects of a road scheme/s on local and regional air quality.

A Transport Analysis Guidance (WebTAG) assessment has also been undertaken to estimate the overall change in human exposure to pollution and emissions of regional air pollutants (including carbon) as a result of the scheme.

In assessing the potential impact of road traffic emissions the following scenarios have been assessed:

- Baseline scenario, 2013, which describes the current local road network in 2013;

- Do-Minimum scenario (DM) excluding Sizewell C, which describes the local road network excluding the Sizewell C traffic in place in 2024 (Sizewell peak construction year) and 2035;
- Do-Something scenario (DS) excluding Sizewell C with the proposed bypass schemes, which describes the local road network and the proposed bypass schemes excluding the Sizewell C traffic in 2024 (Sizewell peak construction year) and 2035;
- Do-Minimum scenario (DM) including Sizewell C, which describes the local road network including the Sizewell C traffic in place in 2024 (Sizewell peak construction year) and 2035;
- Do-Something scenario (DS) including Sizewell C with the proposed schemes, which describes the local road network and the proposed bypass schemes including the Sizewell C traffic in 2024 (Sizewell peak construction year) and 2035.

The following route options have been considered in this air quality assessment:

- Option 1: Existing route with SB1 (single carriageway) only;
- Option 2: LB3, Link1, SB2, Link2 dual throughout;
- Option 3: LB3, Link1,SB5 dual throughout;
- Option 4: LB3, single carriageway to chainage 5000.00, existing to end;
- Option 5: LB3, dual carriageway, Link 1 dual, SB1 single, existing to end;
- Option 6: LB3, single carriageway, existing road, SB1 single, existing road end;
- Option 7: SB4, Link1, SB2, Link2 dual throughout;
- Option 8: SB4, Link1,SB5 dual throughout;
- Option 9: SB4, single carriageway to chainage 5000.00, existing to end;
- Option 10: SB4, dual carriageway, Link 1 dual, SB1 single, existing to end;
- Option 11: SB4, single carriageway, existing road, SB1 single, existing to end;
- Option 12: LB3, existing road, SB5- single carriageway only;
- Option 13: SB4, existing road, SB5- single carriageway only;
- Option 14: LB3, single carriageway, existing road, SB2 single carriageway, existing road to 8500.00;
- Option 15: SB4, single carriageway, existing road, SB5 single carriageway;
- Option 16: Existing route with SB5 (single carriageway) only; and
- Option 17: Existing with northern section of SB1 (single carriageway) only.

4.1.5.1 Construction Phase

A qualitative assessment has been undertaken to assess the potential impacts of airborne dust and emissions generated during the construction phases of the scheme. The assessment has been conducted in accordance with the Design Manual for Roads and Bridges (DMRB) Volume 11 Section 3 Part 3, Disruption due to Construction[26].

According to the DMRB guidance, the impacts that may arise due to construction activities may affect people in residential properties or place of work, people visiting shopping centre or community facilities, pedestrian and travellers. When materials are transported from the highway construction site, the construction access routes should also be assessed.

Possible impacts can be:

- Dust deposition resulting in the soiling of surfaces;
- Visible dust plumes, which are evidence of dust emissions;
- Elevated PM_{10} concentrations as a result of dust-generating activities on site; and
- An increase in the concentrations of airborne particles and nitrogen dioxide resulting from exhaust emissions of diesel-powered vehicles and equipment used on site.

4.1.5.2 Operational Phase

DMRB 'Scoping' Level Assessment

The assessment of the operational phase of the development has been undertaken following the approach outlined in DMRB Volume 11 Environmental Assessment Section 3 Part 1 Air Quality (HA 207/07), Chapter 3[27]. As such, the following tasks have been undertaken:

4.1.5.3 Local Air Quality

Initially, traffic datasets for the Do-Minimum and Do-Something scenarios for each proposed link were compiled and the 'affected' road links identified. Paragraph 3.12 of the DMRB defines affected roads, with regard to local air quality, as those meeting one or more of the following criteria:

- Changes in Annual Average Daily Traffic (AADT) of 1,000 vehicles or more;
- Changes in Heavy Duty Vehicle flows of more than 200 AADT;
- Daily average speed changes of 10 kph or more; or
- Peak hour speed changes of 20 kph or more.

For those road links which meet one or more of the above criteria the DMRB assessment methodology requires that:

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[26] DMRB, http://www.dft.gov.uk/ha/standards/dmrb/vol11/section3.htm

[27] Highways Agency, Design Manual for Roads and Bridges. Volume 11 Section 3, Part 1: Air Quality, HA 207/07. May 2007.

- Existing sensitive receptors within 200 metres of the affected road links be identified.
- Selection of receptor locations where the impacts of the proposed scheme are expected to be greatest. Consideration was given to the proximity of properties to the proposed schemes.
- Calculation of pollutant concentrations associated with road traffic emissions at each receptor location using the DMRB Screening Method for future Do-Minimum and Do-Something scenarios to assess the potential impact of the road scheme on local air quality.

Additional scenarios have been modelled for the pollutant NO_2 in accordance with the Highways Agency's Interim Advice Note (IAN 170/12)[28], which provides supplementary advice to users of DMRB, using the spreadsheet tool provided[29]. This additional scenario takes into account the slower decline in vehicle NO_x emissions than was originally forecast in the DMRB model. These additional scenarios are named as:

- Projected base year 2024, which assesses the local road network in 2013 using 2024 vehicle emission factors and 2024 background concentrations; and
- Projected base year 2035, which assesses the local road network in 2013 using 2035 vehicle emission factors and 2035 background concentrations. Due to limitations of the Highway's Agency DMRB Screening Method worksheet, the assessment has been applied to the nearest possible year, i.e. year 2025.

These are then used to calculate a gap factor, as described in IAN 170/12, which is then applied to the results from the DMRB screening method.

4.1.5.4 Regional Air Quality

Again, traffic datasets for the Do-Minimum and Do-Something scenarios were compiled and the 'affected' road links identified. Paragraph 3.20 of the DMRB defines affected roads, with regard to regional air quality, as those meeting one or more of the following criteria:

- A change of more than 10% in AADT;
- A change of more than 10% to the number of heavy duty vehicles; or
- A change in daily average speed of more than 20 kph.

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[28] Highways Agency, Interim Advice Note 170/12 Rev 1, Updated Air Quality Advice on the assessment of Future NO_x and NO_2 projections for users of DMRB Volume 11, Section 3, Part 1 'Air Quality', June 2013. Available from http://www.dft.gov.uk/ha/standards/ians/index.htm

[29] Highways Agency, Long Term Gap Analysis Calculator, 2012 (version 1.0). Available from http://www.dft.gov.uk/ha/standards/ians/index.htm

As traffic data was available for affected roads, calculations have been made of the change in total emissions that will result from the project using the regional tab of the DMRB Screening Method.

4.1.5.5 WebTag Assessment

The WebTag assessment at plan level, as prescribed in TAG Unit 3.3.3 'The Local Air Quality Sub-objective 2013 ', provides guidance on assessing the impact of transport options on local air quality by quantifying the change in exposure at properties alongside the roads affected by the proposed scheme. This quantification includes all significant changes in exposure on existing routes, new routes or on the local network at relevant properties as defined in LAQM.TG(03), including residential flats and houses, hospitals, schools and churches.

The steps used to carry out the assessment are detailed below:

- NO_2 and PM_{10} concentrations are determined for the assessment years for all routes affected, for the DM and DS scenarios using the DMRB screening methodology at 20 m, 70 m, 115 m and 175 m from the road centre;
- The number of properties in the study area are counted and categorised into either of the following bands:
- Road centre to 50 m from road centre;
- 50 m – 100 m from road centre;
- 100 m – 150 m from road centre; or
- 150 m – 200 m from road centre.
- The above step is repeated for each affected route for both DM and DS. For each of the four bands, the pollutant concentration is then multiplied by the number of properties in that band and the results summed to give a total score for all routes, for each assessment year. Two separate scores, one for NO_2 and another for PM_{10} are calculated;
- The total score for the DM scenario is deducted from the DS score to give an overall impact score, with a negative score indicating reduced exposure to pollution, hence an improvement in air quality, and a positive score indicating higher exposure to pollutants thus a worsening in air quality;

The WebTAG results are presented quantitatively according to the 'Environment – Local Air Quality – Plan Level' worksheets, and qualitatively in reference to the UK Air Quality Strategy Objectives.

In addition to the assessment of direct impacts on air quality this assessment also includes:

- A Social and Distributional Impact (SDI) analysis which looks at the index of social deprivation in an area and allows the social impacts of the scheme to be assessed, both in absolute terms and how they distribute across different social groups;
- An economic evaluation of air pollution which calculates the impacts of the scheme on air quality in monetary terms considering the economic values associated with the changes. The valuation is calculated based on the change in NO_x emissions and PM_{10} concentrations. Economic valuations for NO_2 concentration are currently not published by the Inter Departmental Group on Costs and Benefits (Air Quality) (IGCB (AQ)) and, therefore, values for NO_x emissions have been used as a proxy. The resultant values reflect the cost of health impacts associated with exposure to air pollution.

4.1.6 Assessment of Local Air Quality

4.1.6.1 Sensitive Receptors

In accordance with guidance set out in the DMRB methodology (Section 5.2), only properties and ecologically designated sites within 200 metres of roads affected by a development need to be assessed. No sensitive ecologically sites have been identified within 200 metres of the proposed scheme or those affected by the proposed scheme and, as such, designated ecological sites were not considered in the assessment.

Seven receptors were selected across the study area, at locations considered likely to experience the greatest change in air quality as a result of the proposed bypass schemes. Affected road links within 200 m of the receptors were identified and the shortest distance from the receptor to the centre of the affected road link(s) was measured. Receptor 4 is located 200 m further from the proposed bypass schemes and it has been selected in order to assess the effect of SB1(Pink Route), SB2(Green Route) and SB5(Blue Route) on the local air quality of Stratford Saint Andrew. Receptor 5 has been selected in order to assess the effect of LB3 (Orange Route) and SB4 (Red Route), whereas Receptor 7 has been considered to assess the effect of LB3 (Orange Route). The location of affected roads and the receptors considered in this assessment are detailed in Table 4.1.5. All the proposed bypass routes are outside the AQMA's, but beneficial effects on properties located along the A12 is expected with all of the routes diverting traffic around Stratford St. Andrew. Receptor 1 which represents Long Row, Main Road, Stratford St Andrew should show this benefit and is where the 2012 Detailed Assessment identified exceedences for the AQS objective.

Table 4.1.5: Sensitive receptors

Receptor ID	Grid Reference		Details	Roads within 200m
	X	Y		
1	635852	260099	Residential	A12 SB1 – Pink Route
2	635627	260529	Residential	SB2 – Green Route
3	636847	259808	Residential	SB5 – Blue Route
4	636292	260172	Residential	A12
5 Orange	633965	258209	Residential	A12 LB3 – Orange Route
5 Red	633965	258209	Residential	A12
6 Orange	633821	258360	Residential	A12 LB3 – Orange Route
6 Red	633821	258360	Residential	A12 SB4 – Red Route
7	632797	257789	Residential	A12

4.1.6.2 Traffic Data

The traffic data used in the assessment is presented in the Appendix 2.1.

Conversion NO_x to NO_2

The proportion of NO_2 in NO_x varies greatly with location and time according to a number of factors including the amount of ozone available and the distance from the emission source.

AQEG[30] reported that urban NO_x concentrations had declined since the early 1990s as a result of decreasing road traffic emissions. Decreases in NO_2 were not as distinct, resulting in an increase in the NO_2/NO_x ratio. The magnitude of the increase was inconsistent with the increase expected solely as a consequence of reduced NO_x concentrations. The findings were supported by monitoring data from a number of locations in London and the Automatic Urban Rural Network (AURN) monitoring data from across the UK.

[30] Air Quality Expert Group; Nitrogen Dioxide in the United Kingdom; 2004

The observations prompted research into the NO_2/NO_x relationship and an updated version of the relationship was published[31]. More recently a spreadsheet[32] has been produced, which provides a revised methodology for converting NO_x to NO_2 for any given year. The most recent version of this methodology, updated in 2012, has been used for the purpose of this assessment for all scenarios. The 'All UK traffic' mix was used in the calculation as this offers the best representation of local traffic conditions and hence the NO_2/NO_x relationship for Suffolk Coastal.

4.1.7 Significance Criteria

4.1.7.1 Local Air Quality Impact

The Interim Advice Note (IAN 174/13)[33] updated advice for evaluating local air quality effects. The methodology is reported in Appendix 2.1.

The methodology proposed in IAN 174/13 only applies to those receptors exceeding the air quality thresholds; therefore an analysis has been carried out using the Highways Agency method[34] to evaluate the significance of local air quality effects arising from road schemes.

The Highways Agency proposed that local air quality assessments are evaluated based on five indicators:

- Effect on "hot-spots": Change in absolute concentrations of pollutants;
- Change in exposure: Change in number of receptors (human or ecological as appropriate) already exposed to air quality over objectives, i.e. removal and creation of exceedences;
- Change in exposure: Number of properties where air quality is improved/worsened;
- Triggering in statutory duties: Concentrations pushed over national air quality objectives in a new location; and
- Change in timescales to achieve air quality thresholds.

Table A3.1.8 in Appendix 2.1 sets out the methodology proposed by the Highways Agency to evaluate the significance of a scheme against the air quality indicators described above. This approach seeks to describe the significance of air quality impacts taking into consideration of the sensitivity, extent, magnitude and duration of an impact.

[31] Deriving NO_2 from NO_x for Air Quality Assessments of Roads –Updated to 2006, Air Quality Consultants.
[32] NO_X from NO_2 Calculator, 2012. Available from http://laqm.defra.gov.uk/tools-monitoring-data/no-calculator.html
[33] IAN 174/13, Updated advice for evaluating significant local air quality effects for users of DMRB Volume 11, Section 3, Part 1 'Air Quality (HA207/07), June 13.
[34] Review of the Highways Agency's Approach to Evaluating Significant Air Quality Effects Version 1.1, Highway Agency, September 2012.

4.1.7.2 Regional Assessment

There are no significance criteria for assessing effects of regional emissions. These effects will be put into context based on national and regional emissions. Potential mitigation measures will be described where necessary.

4.1.7.3 Construction Dust Impact

A ‘Stage 2’ assessment has been undertaken to identify the factors and effects associated with the disruption due to construction activities.

Below are described the steps required for the assessment:

- Estimate number of sensitive receptors within 100 m of each option route, in particular residential properties, schools, hospitals, aged persons homes or libraries;
- Identify ecological receptors within 100m of a route option, which might need to be protected from adverse impacts;
- Note any likely significant differences in the magnitude of disruption between routes. For example, large earthwork activities, tunnelling or bridgeworks.

An assessment of the borrow and surplus material requirements may also be carried out, if sufficient data are available.

4.1.8 Assumptions and Degree of Certainty

The assumptions that have been used in this air quality assessment are:

- Traffic flow on the A12 has been assumed to be the same along all route and bypass options;
- In the Do-Something scenarios only 5% of traffic has been assumed to be local traffic;
- National speed limits have been used for the proposed bypass routes, 60 mph for a single carriageway and 70 mph for a dual carriageway.

4.1.9 Predicted Effects

4.1.9.1 Model Verification

The model results have been verified and adjusted as shown in Appendix 2.1.

In addition to the systematic errors the model is still likely to predict concentrations slightly different to actual ambient values. This is termed random error and must also be considered. It is possible to account for the degree of random error, according to guidance provided by Environmental Protection United Kingdom (EPUK).

‘Stock U Values’, figures provided by EPUK, allow the standard deviation of the model (SDM) to be calculated. The Stock U Value for NO_2 is between 0.1 and 0.2 for an annual mean (it is higher for shorter averaging periods). The SDM can be calculated according to:

- SDM = U x Co

Where Co is the air quality objective (40 µg/m^3 for the NO_2 UK annual mean objective).

Therefore:

- SDM = 0.1 x 40 = 4 µg/m^3

This calculation quantifies the uncertainty in the identification of areas where an exceedence of the air quality objective can be considered possible. This region, therefore, extends between 36 µg/m^3 to 44 µg/m^3 at 1 standard deviation from the objective.

Table 4.1.6: Probability of exceedence of annual mean NO_2 objective

Probability of Exceedence	Uncertainty	Concentration Range ($\mu g/m^3$)
Very likely	> Mean + 2 SD	>48
Likely	Mean + 1 SD – Mean +2 SD	44 – 48
Probable	Mean - Mean + 1 SD	40 – 44
Possible	Mean - Mean – 1 SD	36 – 40
Unlikely	Mean - 1 SD – Mean - 2 SD	32 – 36
Very Unlikely	< Mean – 2 SD	< 32

The terminology given in Table 4.1.6 is used in conjunction with the modelling uncertainty concentrations and can be directly compared to the results presented in the results sections.

4.1.9.2 Local Air Quality Assessment Results

4.1.9.2.1. 2024 Excluding Sizewell C Traffic

Concentrations of NO_2 and PM_{10} at sensitive receptors, where the impacts of the proposed bypass schemes are deemed likely to be greatest, excluding the Sizewell C traffic, are given in Table 4.1.7 to 4.1.9 below. As required by the Highways Agency, two sets of results are reported for the pollutant NO_2 to show the adjustments made to project future concentrations. Modelled results and changes in concentrations between the Do-Something and Do-Minimum scenarios are reported to 1 decimal place, as stated in the Interim Advice Note 174/13[35].

[35] Interim Advice Note 174/13, Updated advice for evaluating significant local air quality effects for users of DMRB Volume 11, Section 3, Part 1 'Air Quality (HA207/07), June 13

Table 4.1.7: Predicted annual mean NO_2 concentrations at sensitive receptors – 2024 excluding Sizewell C traffic

Receptor	Predicted Annual Mean NO_2 Concentration (µg/m^3) Defra's Technical Guidance				RATIO A LAQM.TG(09) Projected Base Year / Modelled 2013 Base Year	RATIO B Alternative Projection Between 2013 and 2024	GAP FACTOR Ratio B /Ratio A	2024 DM x Gap Factor	2024 DS x Gap Factor
	2013 Base Year	Projected Base Year 2024	2024 DM	2024 DS					
1	39.1	31.7	32.5	17.5	0.81	0.92	1.14	37.1	19.9
2	9.7	7.2	7.2	19.1	0.74	0.92	1.24	9.0	23.8
3	9.7	7.2	7.2	9.9	0.74	0.92	1.24	9.0	12.3
4	28.7	23.0	23.5	8.2	0.80	0.92	1.15	27.1	9.4
5 Orange	26.7	21.3	21.8	11.2	0.80	0.92	1.16	25.2	13.0
5 Red	26.7	21.3	23.5	8.2	0.80	0.92	1.16	27.3	9.5
6 Orange	10.4	7.7	7.8	13.2	0.74	0.92	1.24	9.6	16.4
6 Red	10.4	7.7	7.8	8.5	0.74	0.92	1.24	9.6	10.6

7	27.3	22.3	22.4	8.1	0.82	0.92	1.13	25.3	9.2

Table 4.1.8: Predicted Improvement/Deterioration in Air Quality Excluding – 2024 Sizewell C Traffic

Receptor	Defra's Technical Guidance Predicted Annual Mean NO_2 Concentration (µg/m^3)			Highways Agency Long Term NO_2 Trend Projections (µg/m^3)		
	Impact			Impact		
	DS-DM	Improvement / Deterioration in Air Quality	Magnitude	DS-DM	Improvement / Deterioration in Air Quality	Magnitude
1	-15.0	Improvement	Large	-17.2	Improvement	Large
2	11.9	Deterioration	Large	14.8	Deterioration	Large
3	2.7	Deterioration	Medium	3.3	Deterioration	Medium
4	-15.3	Improvement	Large	-17.7	Improvement	Large
5 Orange	-10.6	Improvement	Large	-12.2	Improvement	Large
5 Red	-15.3	Improvement	Large	-17.8	Improvement	Large
6 Orange	5.4	Deterioration	Large	6.8	Deterioration	Large
6 Red	0.7	Deterioration	Small	1.0	Deterioration	Small
7	-14.3	Improvement	Large	-16.1	Improvement	Large

The results in Table 4.1.7 and Table 4.1.8 indicate that the UK annual mean NO_2 objective of 40 µg/m^3 is likely to be achieved at all seven receptors in the base year 2013 and future year 2024 with or without each of the bypass options. The maximum NO_2 concentration is predicted to occur at Receptor 1 in the Do-Minimum scenario with a predicted annual average NO_2 concentration of 37.1 µg/m^3. Receptor 1 is predicted to experience an improvement of large magnitude in terms of local air quality in accordance with IAN(174/13), as a result of the SB1(Pink Route).

Receptor 5 is predicted to experience the largest beneficial change in air quality as a result of the proposed SB4(Red Route) scheme, with a decrease in annual mean NO_2 concentrations of 17.8 µg/m^3 based on the Highway Agency's calculation methodology or 15.3 µg/m^3 based on Defra's Technical Guidance methodology. The modelling predicts that all receptors located along the A12, except those located near the proposed bypass routes, are predicted to experience an improvement in air quality. Receptor 2 is predicted to experience the largest adverse impact as a result of the proposed SB2(Green Route) scheme, with an increase in annual mean NO_2 concentration of 14.8 µg/m^3 based on Highway Agency methodology and 11.9 µg/m^3 based on Defra's Technical Guidance methodology.

The following conclusions can be made in accordance to the Highways Agency's air quality indicator:

- Receptor 1, 4, 5 and 7 will experience an improvement of more than 5% (2 µg/m^3) of the NO_2 annual mean objective as result of proposed schemes;
- Receptor 2, 3 and 6 Orange will experience a deterioration of more than 5% (2 µg/m^3) of the NO_2 annual mean objective;
- No receptor is expected to experience an improvement of between 2.5% and 5% (1-2 µg/m^3) of the UK annual mean NO_2 objective;
- Receptor 6 Red will experience deterioration in air quality of between 2.5% and 5% (1-2 µg/m^3) of the NO_2 annual mean objective;
- No receptor will experience an improvements and deteriorations of between 1% and 2.5% (0.4 – 1 µg/m^3) of the UK annual mean NO_2 objective;
- No receptor will experience changes (both improvements and deteriorations) of less than 1% (0.4 µg/m^3) of the UK annual mean NO_2 objective;

The adverse impacts predicted for the proposed routes are of a large magnitude, however they can be considered to be insignificant given that the proposed routes are unlikely to create any exceedences of the UK annual mean NO_2 objective. All the proposed routes are predicted to have a beneficial effect on receptors located along the A12 and an adverse effect on receptors located close to the relevant bypass scheme.

Table 4.1.9: Predicted annual mean PM_{10} concentrations at sensitive receptors – 2024 Excluding Sizewell Traffic

Receptor	Predicted Annual Mean PM_{10} Concentration (µg/m^3)			Impact		
	2013	2024 DM	2024 DS	DS- DM	Improvement / Deterioration in Air Quality	Magnitude
1	22.5 (7)	20.9 (5)	17.2 (1)	-3.7 (-4)	Improvement	Medium
2	16.0 (0)	14.9 (0)	17.5 (1)	2.6 (1)	Deterioration	Medium
3	16.0 (0)	14.9 (0)	15.7 (0)	0.8 (0)	Deterioration	Small
4	20.0 (3)	18.5 (2)	15.1 (0)	-3.4 (-2)	Improvement	Medium
5 Orange	19.5 (3)	18.1 (1)	16.1 (0)	-2.0 (-1)	Improvement	Medium
5 Red	19.5 (3)	18.1 (1)	15.1 (0)	-3.0 (-1)	Improvement	Medium
6 Orange	16.1 (0)	15.0 (0)	16.8 (1)	1.8 (1)	Deterioration	Small
6 Red	16.1 (0)	15.0 (0)	15.3 (0)	0.3 (0)	Deterioration	Imperceptib le
7	19.3 (3)	18.0 (1)	15.0 (0)	-3.0 (-1)	Improvement	Medium

The results in Table 4.1.9 indicate that the UK annual mean PM_{10} objective of 40 µg/m^3 is likely to be achieved at all seven receptors in the base year 2013 and future year 2024 with or without the proposed bypass schemes. The maximum PM_{10} concentration is predicted to occur at Receptor 1 in the Do-Minimum with a predicted annual average PM_{10}

concentration of 20.9 $\mu g/m^3$. Receptor 1 is predicted to experience an improvement of medium magnitude in terms of local air quality in accordance with IAN(174/13), as a result of the SB1 (Pink Route).

Receptor 4 is predicted to experience the largest beneficial change in air quality as a result of the proposed SB1 (Pink Route), SB2 (Green Route) and SB5 (Blue Route) schemes, with a decrease in annual mean PM_{10} concentrations of 3.4 $\mu g/m^3$. The modelling predicts that all receptors located along the A12, except those located near the proposed bypass routes, are predicted to experience an improvement in air quality. Receptor 2 is predicted to experience the largest adverse impact as a result of the proposed SB2 (Green Route) scheme, with an increase in annual mean PM_{10} concentration of 2.6 $\mu g/m^3$.

The following conclusions can be made in accordance to the Highways Agency's air quality indicator:

- Receptor 1, 4, 5 and 7 will experience an improvement of more than 5% (2 $\mu g/m^3$) of the PM_{10} annual mean objective as result of proposed schemes;
- Receptor 2 will experience a deterioration of more than 5% (2 $\mu g/m^3$) of the PM_{10} annual mean objective;
- No receptor is expected to experience an improvement of between 2.5% and 5% (1-2 $\mu g/m^3$) of the UK annual mean NO_2 objective;
- Receptor 3, 6 Orange will experience deterioration in air quality of between 2.5% and 5% (1-2 $\mu g/m^3$) of the PM_{10} annual mean objective;
- No receptor will experience an improvements and deteriorations of between 1% and 2.5% (0.4 – 1 $\mu g/m^3$) of the UK annual mean NO_2 objective;
- Receptor 6 Red will experience a deteriorations of less than 1% (0.4 $\mu g/m^3$) of the UK annual mean PM_{10} objective;
- No receptor will experience an improvement of less than 1% (0.4 $\mu g/m^3$) of the UK annual mean PM_{10} objective.

The adverse impacts predicted for the proposed routes are of a small and medium magnitude, however, they can be considered to be insignificant given that the scheme is unlikely to create any exceedences of the UK annual mean PM_{10} objective. All the proposed routes are predicted to have a beneficial effect on receptors located along the A12 and an adverse effect on receptors located close to the proposed route.

4.1.9.2.2. 2024 Including Sizewell C Traffic

Concentrations of NO_2 and PM_{10} at sensitive receptors, where the impacts of the proposed bypass schemes including the Sizewell C traffic are deemed likely to be greatest, are given in Table 4.1.10 to Table 4.1.12 below. As required by the Highways Agency, two sets of results are reported for the pollutant NO_2 to show the adjustments made to project future concentrations. Modelled results and changes in concentrations between the Do-Something and Do-Minimum scenarios are reported to 1 decimal place, as stated in the Interim Advice Note 174/13[36].

[36] Interim Advice Note 174/13, Updated advice for evaluating significant local air quality effects for users of DMRB Volume 11, Section 3, Part 1 'Air Quality (HA207/07), June 13

Table 4.1.10: Predicted annual man NO_2 concentrations at sensitive receptors – 2024 including Sizewell C Traffic

Receptor	Predicted Annual Mean NO_2 Concentration ($\mu g/m^3$) Defra's Technical Guidance				RATIO A LAQM.TG(09) Projected Base Year / Modelled 2013 Base Year	RATIO B Alternative Projection Between 2013 and 2024	GAP FACTOR Ratio B /Ratio A	2024 DM x Gap Factor	2024 DS x Gap Factor
	2013 Base Year	Projected Base Year 2024	2024 DM	2024 DS					
1	39.1	31.7	**41.2**	21.3	0.81	0.92	1.14	**47.0**	24.3
2	9.7	7.2	7.2	24.0	0.74	0.92	1.24	9.0	29.8
3	9.7	7.2	7.2	10.7	0.74	0.92	1.24	9.0	13.3
4	28.7	23.0	29.7	8.2	0.80	0.92	1.15	34.2	9.5
5 Orange	26.7	21.3	27.4	12.3	0.80	0.92	1.16	31.7	14.2
5 Red	26.7	21.3	27.4	8.1	0.80	0.92	1.16	31.7	9.4
6 Orange	10.4	7.7	8.0	15.1	0.74	0.92	1.24	9.9	18.7

6 Red	10.4	7.7	8.0	9.0	0.74	0.92	1.24	9.9	11.1
7	27.3	22.3	27.9	8.2	0.82	0.92	1.13	31.5	9.2

Table 4.1.11: Predicted improvement/deterioration in NO_2 – 2024 Including Sizewell C Traffic

Receptor	Defra's Technical Guidance Predicted Annual Mean NO_2 Concentration ($\mu g/m^3$)			Highways Agency Long Term NO_2 Trend Projections ($\mu g/m^3$)		
	Impact			Impact		
	DS-DM	Improvement / Deterioration in Air Quality	Magnitude	DS-DM	Improvement / Deterioration in Air Quality	Magnitude
1	-19.9	Improvement	Large	-22.7	Improvement	Large
2	16.8	Deterioration	Large	20.8	Deterioration	Large
3	3.5	Deterioration	Medium	4.3	Deterioration	Large
4	-21.5	Improvement	Large	-24.7	Improvement	Large
5 Orange	-15.1	Improvement	Large	-17.5	Improvement	Large
5 Red	-19.3	Improvement	Large	-22.3	Improvement	Large
6 Orange	7.1	Deterioration	Large	8.8	Deterioration	Large
6 Red	1.0	Deterioration	Small	1.2	Deterioration	Small
7	-19.7	Improvement	Large	-22.3	Improvement	Large

The results in Table 4.1.10 and Table 4.1.11 indicate that the UK annual mean NO_2 objective of 40 µg/m^3 is likely to be achieved at all seven receptors in the base year 2013 and future year 2024 with or without the proposed bypass, except at Receptor 1 in the 2024 Do-Minimum scenario, with a predicted NO_2 annual mean concentration of 47.0 µg/m^3 based on the Highway Agency's calculation methodology or 41.2 µg/m^3 based on Defra's Technical Guidance methodology.

The maximum NO_2 concentration is predicted to occur at Receptor 1 in the Do-Minimum. Receptor 1 is predicted to experience an improvement of large magnitude (-22.7 µg/m^3) in terms of local air quality in accordance with IAN(174/13), as a result of the SB1 (Pink Route). Predicted NO_2 concentration at this receptor in the Do-Something scenario is well below the annual mean objective.

Receptor 4 located along the A12 is predicted to experience the largest beneficial change in air quality as a result of the proposed SB1 (Pink Route), SB2 (Green Route), and SB5(Blue Route) schemes, with a decrease in annual mean NO_2 concentrations of 24.7 µg/m^3 based on the Highway Agency's calculation methodology or 21.5 µg/m^3 based on Defra's Technical Guidance methodology. The modelling predicts that all receptors located close to the A12, except those located near the proposed bypass schemes, are predicted to experience an improvement in air quality. Receptor 2 is predicted to experience the largest adverse impact as a result of the proposed SB2 (Green Route) scheme, with an increase in annual mean NO_2 concentration of 20.8 µg/m^3 based on Highway Agency methodology and 16.8 µg/m^3 based on Defra's Technical Guidance methodology.

The following conclusions can be made in accordance to the Highways Agency's air quality indicator:

- Receptor 1, 4, 5 and 7 will experience an improvement of more than 5% (2 µg/m^3) of the NO_2 annual mean objective as a result of the proposed bypass ;
- Receptor 2, 3 and 6 Orange will experience a deterioration of more than 5% (2 µg/m^3) of the NO_2 annual mean objective;
- No receptor is expected to experience an improvement of between 2.5% and 5% (1-2 µg/m^3) of the UK annual mean NO_2 objective;
- Receptor 6 Red will experience deterioration in air quality of between 2.5% and 5% (1-2 µg/m^3) of the NO_2 annual mean objective;
- No receptor will experience an improvements and deteriorations of between 1% and 2.5% (0.4 – 1 µg/m^3) of the UK annual mean NO_2 objective;
- No receptor will experience changes (both improvements and deteriorations) of less than 1% (0.4 µg/m^3) of the UK annual mean NO_2 objective;

The adverse impacts predicted at properties near the proposed bypass routes are of a large magnitude, however, the adverse impacts are smaller than the beneficial impacts that would occur at properties near the A12. The bypass would remove an exceedence of the NO_2 objective in Stratford St Andrew that would occur with the Sizewell C traffic in 2024. This is a significant benefit of the scheme.

Table 4.1 12: Predicted improvement/deterioration in PM_{10} – 2024 Including Sizewell C Traffic

Receptor	Predicted Annual Mean PM_{10} Concentration ($\mu g/m^3$) – Number Daily Exceedences in Parenthesis			Impact		
	2013	2024 DM	2024 DS	DS- DM	Improvement / Deterioration in Air Quality	Magnitude
1	22.5 (7)	22.1 (6)	17.6 (1)	-4.5 (-5)	Improvement	Large
2	16.0 (0)	14.9 (0)	18.0 (1)	3.1 (1)	Deterioration	Medium
3	16.0 (0)	14.9 (0)	15.8 (0)	0.9 (0)	Deterioration	Small
4	20.0 (3)	19.3 (3)	15.1 (0)	-4.2 (-3)	Improvement	Large
5 Orange	19.5 (3)	18.8 (2)	16.2 (0)	-2.6 (-2)	Improvement	Medium
5 Red	19.5 (3)	18.8 (2)	15.0 (0)	-3.8 (-2)	Improvement	Medium
6 Orange	19.5 (3)	15.0 (0)	17.0 (1)	2.0 (1)	Deterioration	Medium
6 Red	16.1 (0)	15.0 (0)	15.3 (0)	0.3 (0)	Deterioration	Imperceptible

7	16.1 (0)	18.6 (2)	15.0 (0)	-3.6 (-2)	Improvement	Medium

The results in Table 4.1.12 indicate that the UK annual mean PM_{10} objective of 40 µg/m^3 is likely to be achieved at all seven receptors in the base year 2013 and future year 2024 with or without the proposed schemes. The maximum PM_{10} concentration is predicted to occur at Receptor 1 in the Do-Minimum with a predicted annual average PM_{10} concentration of 22.1 µg/m^3. Receptor 1 is predicted to experience an improvement of large magnitude (4.5 µg/m^3) in terms of local air quality in accordance with IAN(174/13), as a result of the SB1 (Pink Route).

Receptor 4 is predicted to experience the largest beneficial change in air quality as a result of the proposed SB1 (Pink Route), SB2 (Green Route) and SB5 (Blue Route) schemes, with a decrease in annual mean PM_{10} concentrations of 4.2 µg/m^3. The modelling predicts that all receptors located along the A12, except those located near the proposed road schemes, are predicted to experience an improvement in air quality. Receptor 2 is predicted to experience the largest adverse impact as a result of the proposed SB2 (Green Route) scheme, with an increase in annual mean PM_{10} concentration of 3.1 µg/m^3.

The following conclusions can be made in accordance to the Highways Agency's air quality indicator:

- Receptor 1, 4, 5 and 7 will experience an improvement of more than 5% (2 µg/m^3) of the PM_{10} annual mean objective as result of proposed schemes;
- Receptor 2 and 6 Orange will experience a deterioration of more than 5% (2 µg/m^3) of the PM_{10} annual mean objective;
- No receptor is expected to experience an improvement or deterioration of between 2.5% and 5% (1-2 µg/m^3) of the UK annual mean NO_2 objective;
- Receptor 3 will experience a deterioration of between 1% and 2.5% (0.4 – 1 µg/m^3) of the UK annual mean NO_2 objective;
- No receptor will experience an improvements of between 1% and 2.5% (0.4 – 1 µg/m^3) of the UK annual mean NO_2 objective;
- Receptor 6 Red will experience a deteriorations of less than 1% (0.4 µg/m^3) of the UK annual mean PM_{10} objective;
- No receptor will experience an improvement of less than 1% (0.4 µg/m^3) of the UK annual mean PM_{10} objective.

The adverse impacts predicted for the proposed bypass schemes are of a small and medium magnitude, however, they can be considered to be insignificant given that the proposed schemes are unlikely to create any exceedences of the UK annual mean PM_{10} objective. All the proposed schemes are predicted to have a beneficial effect on receptors located along the A12 and an adverse effect on receptors located close to the relevant bypass scheme.

4.1.10 WebTAG

4.1.10.1 Local Air Quality Assessment Results

A local air quality assessment was carried out to determine the overall assessment score which indicates firstly whether the schemes will create an increase or a decrease in exposure to air quality and secondly the number of properties that will experience a deterioration or an improvement in their exposure to air quality as a result of the proposed schemes. The NO_2 and PM_{10} results for each of the seventeen proposed options are presented in Table 4.1.13 and Table 4.1.14, which exclude and include Sizewell C traffic respectively. An example of the WebTag distance bands is presented in the Appendix 2.1, Figure A3.1.3.

All the proposed road scheme options are predicted to lead to an overall improvement in air quality as the assessment scores are negative (excluding and including traffic from Sizewell C). The number of properties which will experience an improvement, no change and deterioration vary with options.

The best option, which leads to the lowest assessment score, is Option 12 (LB3, existing road, SB5- single carriageway only). Based on this route option, 155 properties will experience an improvement in air quality; while fifty-one properties experience deterioration and a further six properties experiencing no change in air quality. It should be noted however, that whilst a relatively large number of properties are likely to be affected by the proposed routes, the overall assessment scores indicate that the magnitude of potential effects on air quality are likely to be small at these properties.

The option which leads to the highest assessment score (worst option for local air quality), is Option 17 (Existing route with SB1 North (single carriageway) only). Based on this route option 55 properties will experience an improvement in air quality, 28 will experience deterioration in air quality and 128 will experience no change in air quality.

Table 4.1.13: WebTAG Assessment Scores – 2024 Excluding Sizewell C Traffic

Road options	PM_{10}				NO_2			
	Improvement	No change	Deterioration	Net total assessment for PM_{10}, all routes	Improvement	No change	Deterioration	Net total assessment for NO_2, all routes
Option 1	69	92	36	-173	69	92	36	-913
Option 2	155	0	78	-262	155	0	78	-1533
Option 3	155	3	54	-321	155	3	54	-1736
Option 4	86	75	34	-139	86	75	34	-758
Option 5	155	3	73	-306	155	3	73	-1660
Option 6	155	6	70	-312	155	6	70	-1672
Option 7	132	26	55	-229	132	26	55	-1346
Option 8	132	29	31	-288	132	29	31	-1549
Option 9	63	101	11	-103	63	101	11	-565
Option 10	132	29	50	-273	132	29	50	-1473
Option 11	132	32	47	-276	132	32	47	-1479
Option 12	155	6	51	-328	155	6	51	-1751
Option 13	132	32	28	-290	132	32	28	-1553
Option 14	155	6	72	-295	155	6	72	-1588
Option 15	132	32	28	-292	132	32	28	-1558

Option 16	69	92	17	-190	69	92	17	-993
Option 17	55	128	28	-90	55	128	28	-477

Table 4.1.14: WebTAG assessment scores – 2024 Including Sizewell C Traffic

Road Section	PM_{10}				NO_2			
	Improvement	No change	Deterioration	Net total assessment for PM_{10}, all routes	Improvement	No change	Deterioration	Net total assessment for NO_2, all routes
Option 1	69	92	36	-203	69	92	36	-1230
Option 2	155	0	78	-305	158	0	75	-2127
Option 3	155	3	54	-377	158	3	51	-2385
Option 4	86	75	34	-163	155	6	34	-1055
Option 5	155	3	73	-360	158	3	70	-2276
Option 6	155	6	70	-366	155	6	70	-2285
Option 7	132	26	55	-274	135	26	52	-1860
Option 8	132	29	31	-337	135	29	28	-2118
Option 9	63	101	11	-120	63	101	11	-783
Option 10	132	29	50	-321	135	29	47	-2009
Option 11	132	32	47	-324	132	32	47	-2013
Option 12	155	6	51	-384	155	6	51	-2396
Option 13	132	32	28	-339	132	32	28	-2119

Option 14	155	6	72	-347	155	6	72	-2178
Option 15	132	32	28	-342	132	32	28	-2124
Option 16	69	92	17	-222	69	92	17	-1341
Option 17	55	128	28	-105	55	128	28	-649

Regional Air Quality Assessment Results for the regional air quality assessment are reported in Table 4.1.15.

Table 4.1 15: Regional pollutant emissions (T/yr) – Excluding Sizewell C Traffic

Scheme Option	NO_x T/y							PM_{10} T/y							Carbon T/y						
	2013	2024		2035		Change		2013	2024		2035		Change		2013	2024		2035		Change	
		DM	DS	DM	DS	2024	2035		DM	DS	DM	DS	2024	2035		DM	DS	DM	DS	2024	2035
Option 1	18.9	18.4	18.9	21.3	21.9	0.5	0.6	0.5	0.6	0.6	0.7	0.7	0.0	0.0	2287	2510	2583	2934	3019	73	85
Option 2	18.9	18.4	26.9	21.3	31.2	8.5	9.9	0.5	0.6	1.3	0.7	1.6	0.7	0.9	2287	2510	3571	2934	4185	1061	1251
Option 3	18.9	18.4	27.2	21.3	31.6	8.8	10.3	0.5	0.6	1.3	0.7	1.6	0.7	0.9	2287	2510	3611	2934	4232	1101	1298
Option 4	18.9	18.4	20.3	21.3	23.6	1.9	2.3	0.5	0.6	0.7	0.7	0.9	0.1	0.2	2287	2510	2765	2934	3232	254	298
Option 5	18.9	18.4	23.9	21.3	27.8	5.5	6.5	0.5	0.6	1.1	0.7	1.3	0.5	0.6	2287	2510	3198	2934	3746	688	812
Option 6	18.9	18.4	20.9	21.3	24.2	2.5	2.9	0.5	0.6	0.8	0.7	0.9	0.2	0.2	2287	2510	2837	2934	3317	327	383
Option 7	18.9	18.4	23.7	21.3	27.5	5.3	6.2	0.5	0.6	1.1	0.7	1.3	0.5	0.6	2287	2510	3167	2934	3710	657	776
Option 8	18.9	18.4	22.8	21.3	26.4	4.4	5.1	0.5	0.6	1.0	0.7	1.2	0.4	0.5	2287	2510	3046	2934	3568	536	634
Option 9	18.9	18.4	18.3	21.3	21.3	-0.1	0.0	0.5	0.6	0.6	0.7	0.7	0.0	0.0	2287	2510	2503	2934	2926	-7	-8
Option 10	18.9	18.4	20.7	21.3	24.1	2.3	2.8	0.5	0.6	0.9	0.7	1.0	0.3	0.3	2287	2510	2794	2934	3271	284	337
Option 11	18.9	18.4	18.9	21.3	21.9	0.5	0.6	0.5	0.6	0.7	0.7	0.8	0.1	0.1	2287	2510	2576	2934	3011	65	78
Option 12	18.9	18.4	21.8	21.3	25.2	3.4	3.9	0.5	0.6	0.8	0.7	1.0	0.2	0.3	2287	2510	2957	2934	3457	447	523
Option 13	18.9	18.4	20.8	21.3	24.1	2.4	2.8	0.5	0.6	0.8	0.7	1.0	0.2	0.3	2287	2510	2806	2934	3283	296	349
Option 14	18.9	18.4	22.4	21.3	26.0	4.0	4.7	0.5	0.6	0.8	0.7	1.0	0.2	0.3	2287	2510	3045	2934	3559	534	625
Option 15	18.9	18.4	19.8	21.3	23.0	1.4	1.7	0.5	0.6	0.7	0.7	0.8	0.1	0.1	2287	2510	2696	2934	3151	185	217
Option 16	18.9	18.4	20.7	21.3	24.0	2.3	2.7	0.5	0.6	0.7	0.7	0.8	0.1	0.1	2287	2510	2825	2934	3301	314	367
Option 17	18.9	18.4	18.5	21.3	21.4	0.1	0.1	0.5	0.6	0.6	0.7	0.7	0.0	0.0	2287	2510	2520	2934	2945	10	12

The results in Table 4.1.15 indicate that all the route options, except Option 9 (SB4, single carriageway to chainage 5000.00, existing to end), are predicted to result in an increase in NO_x and carbon emissions in 2035 relative to Do-Minimum in the same year. Table 4.1.15 shows a slight increase in PM_{10} emissions, except for Option 1 (Existing route with SB1 - single carriageway only),Option 9 and Option 17. The increase in regional emissions is mainly due to the increase in road length.

The only option which shows no change in NO_x and PM_{10} emissions and a small decrease in carbon emissions is Option 9 (SB4, single carriageway to chainage 5000.00, existing to end). This is due to the small change in road length and relative change in HDV/LDV ratios on the existing A12. Option 17 is the option with the second lowest regional emissions.

Option 3 (LB3, Link1, SB5 Dual throughout) is the route option with the biggest increase in regional emissions due to the large increase in road length and average speed.

4.1.10.2 Economic Evaluation of Air Pollution

A monetary valuation of changes in air quality has been carried out for all of the seventeen options for the excluding Sizewell C traffic scenario.

Table 4.1.16: Monetary valuation estimation of changes in air quality

Scheme Options	Quantitative Assessment		Summary Assessment		
	Net Total Route Assessment (opening year) for PM_{10}	Change in NOx emissions over 60 year appraisal period (tonnes)	Net Present Value of change in PM_{10} concentrations (£)	Net Present Value of change in NOx emissions (£)	Total Net Present Value of Change in Air Quality (£)
Option 1	-173	39	901,647	-20,338	881,309
Option 2	-262	588	774,418	-308,701	465,717
Option 3	-321	609	952,387	-319,565	632,822
Option 4	-139	134	411,503	-70,411	341,091
Option 5	-306	385	907,888	-202,118	705,770
Option 6	-312	173	888,218	-90,750	797,468

Option 7	-229	368	676,354	-193,098	483,256
Option 8	-288	305	854,323	-159,916	694,407
Option 9	-103	-1	305,095	656	305,751
Option 10	-273	165	809,824	-86,515	723,309
Option 11	-276	38	819,639	-19,682	799,957
Option 12	-328	234	974,623	-122,777	851,846
Option 13	-290	165	859,343	-86,486	772,857
Option 14	-295	278	875,344	-145,902	729,442
Option 15	-292	99	868,215	-51,846	816,369
Option 16	-190	162	950,223	-84,841	865,382
Option 17	-90	6	652,998	-3,214	649,784

The positive Total Net Present Value presented in Table 4.1.16 for all the bypass options indicates a net beneficial impact (i.e. air quality improvement) over the lifetime of the scheme, despite the negative Net Present Value of the change in NO_x emissions, except for the Option 9 which shows a positive Net Present Value of the change in NO_x emissions. Option 1 and Option 16 are the most beneficial and Option 9 the least beneficial in terms of monetisation.

4.1.10.3 Social and Distributional Impacts of Air Quality

In terms of social distributional impacts, the study area covers three Lower Super Output Areas (E01030202, E01030176, and E01030212). In the latest Index of Multiple Deprivation (IMD), area E01030202 was ranked 27,467 out of 32,482 in England, where 1 was the most deprived and 32,482 the least; area E01030176 was ranked 15,975 out of 32,482; and area E01030212 was ranked 18,899 out of 32,482. The overall area affected is, therefore, less deprived than the average.

4.1.11 Construction Dust Assessment

The construction phase of the proposed scheme will lead to the generation of dust and PM_{10} within the boundaries of the construction areas. Whilst the majority of this dust will be contained within the boundaries, some will be transported in the air to sites outside the construction areas, possibly giving rise to adverse impacts. The main impact is likely to be nuisance caused by the deposition of dust on properties, vehicles and street furniture.

Dust sensitive receptors have been identified within 100m of the proposed routes in accordance with the methodology outlined in the DMRB guidance. A summary of the receptors and sensitivity within 100 m from each proposed route is reported in Table 4.1.17. The likely earthworks area is also reported in this table.

Table 4.1.17: Number of sensitive receptors and sensitivity

Route	Sensitive Receptors within 100 m from Route		Approximate Earthworks Area (m^2)	More Details
	Number	Details		
SB1- Pink Route	10	Residential properties and farm	19,000	The majority of this route is in the flood plain
SB2 – Green Route (single carriage way)	13	Residential properties and farm	25,000	Side road over-bridge River bridge
SB2 – Green Route (dual carriageway)	16	Residential properties and farm	93,000	Side road over-bridge River bridge
SB4 – Red Route (single carriageway)	3	Residential properties and farm	17,000	Underpass
SB4 – Red Route (dual carriageway)	3	Residential properties and farm	48,000	Underpass
SB5 – Blue Route (single carriageway)	3	Residential properties and farm	24,000	Roundabout Side road over-bridge River bridge
SB5 – Blue Route (dual carriageway)	3	Residential properties and farm	96,000	Roundabout Side road over-bridge River bridge
LB3 – Orange	6	Residential	49,000	25% of the route is within

Route (single carriageway)		properties		the flood Underpass Over bridge
LB3 – Orange Route (dual carriageway)	7	Residential properties	183,000	25% of the route is within the flood Underpass over-bridge
Link 1	1	Farm	47,000	
Link 2	3	Residential	14,000	

4.1.12 Opportunity for Mitigation and Enhancement

4.1.12.1 Construction Phase

It is possible to mitigate adverse impacts during the construction period, and it will be necessary to balance the severity of an impact with its duration. Should effective mitigation measures be enforced and implemented within a Dust Management Plan and/or CEMP then the residual impact of the construction phase will be of negligible significance with respect to all the construction activities.

4.1.12.2 Operational Phase

No mitigation measures are proposed during the operational phase.

4.1.13 Residual Impacts

4.1.13.1 Construction Phase

Construction impacts are likely to arise from constructions activities in the form of dust and particulate matter emissions. With appropriate mitigation measures, the significance of these impacts can be reduced to be of negligible significance.

4.1.13.2 Operational Phase

The main findings of this local air quality assessment are:

- The proposed bypass schemes are not located within an AQMA, however NO_2 concentrations monitored at Stratford St Andrew 1 which is 2m from the A12 indicates an exceedence of the UK air quality objectives / EU Limit ;
- Exceedence of NO_2 air quality objective / EU Limit Value were predicted at Receptor 1 in the Do-Minimum scenario including Sizewell C traffic;
- The proposed bypass schemes are estimated to reduce traffic along the existing A12 and they are expected to improve air quality overall;

- The largest change in air quality is predicted to be an improvement in both NO_2 and PM_{10} concentrations of large magnitude at Receptor 4 as a result of the proposed SB1(Pink Route), SB2(Green Route), and SB5 (Blue Route) schemes, while the largest negative impacts are of a large magnitude at Receptor 2. In both cases concentrations of PM_{10} and NO_2 remain well below the AQS objective levels;
- SB1 (Pink Route), SB2 (Green Route), and SB5(Blue Route) schemes are likely to remove exceedances on the A12 between Stratford St Andrew and Farnham;
- All the proposed road scheme options are predicted to lead to an overall improvement in air quality as the assessment scores are negative (excluding and including traffic from Sizewell C);
- All the proposed bypass scheme options, except Option 9 (SB4, single carriageway to chainage 5000.00, existing to end), are predicted to result in an increase in NO_x and carbon emissions in 2035 relative to Do-Minimum in the same year;
- The positive Total Net Present Value for all the bypass options indicates a net beneficial impact (i.e. air quality improvement) over the lifetime of the schemes.
- The significance of the proposed bypass routes is considered significant overall (Table 4.1.18), due to the large beneficial change in NO_2 and PM_{10} concentrations near the A12.

Table 4.1.18: Overall evaluation of local air quality significance

Key Criteria Questions	Yes / No					
	SB1 – Pink Route	SB1 North – Pink Route	SB2 – Green Route	SB4 – Red Route	SB5 – Blue Route	LB3 – Orange Route
Is there a risk that environmental standards will be breached?	No	Yes	No	No	No	No
Will there be a large change in environmental conditions?	Yes	Yes	Yes	Yes	Yes	Yes
Will the effect continue for a long time?	N/A	N/A	N/A	N/A	N/A	N/A
Will many people be affected?	No	No	No	No	No	No

Is there a risk that designated sites, areas, or features will be affected?	No	No	No	No	No	No
Will it be difficult to avoid, or reduce or repair or compensate for the effect?	N/A	N/A	N/A	N/A	N/A	N/A

4.1.14 Summary Table

Table 4.1.19: Air quality assessment summary table

Route	Net total assessment, all routes		Total Net Present Value of Change in Air Quality (£)	Qualitative Impacts
	NO_2	PM_{10}		
Option 1	-913	-173	881,309	Improved local air quality along the A12 due to new route away from sensitive receptors and the removal of an exceedence of the NO_2 objective in Stratford St Andrew which would occur with Sizewell construction traffic. Adverse effect on receptors located near the proposed routes. No exceedences of the air quality objectives at sensitive receptors with each route option.
Option 2	-1533	-262	465,717	
Option 3	-1736	-321	632,822	
Option 4	-758	-139	341,091	
Option 5	-1660	-306	705,770	
Option 6	-1672	-312	797,468	
Option 7	-1346	-229	483,256	
Option 8	-1549	-288	694,407	
Option 9	-565	-103	305,751	
Option 10	-1473	-273	723,309	
Option 11	-1479	-276	799,957	
Option 12	-1751	-328	851,846	
Option 13	-1553	-290	772,857	
Option 14	-1588	-295	729,442	
Option 15	-1558	-292	816,369	
Option 16	-993	-190	865,382	

Option 17	-477	-90	649,784	

Assessment is for without Sizewell C traffic

4.2 Noise

4.2.1 Introduction

The following chapter considers the potential noise and vibration impacts of the proposed options to the A12. The proposed scheme options under consideration would pass close to the villages of Marlesford, Little Glemham, Stratford St Andrew and Farnham.
The objective of this DMRB Scoping Assessment is:

- to gather sufficient data to establish the likely noise and vibration impact on sensitive receptors in the vicinity associated with the various options being considered and
- to establish whether the assessment should proceed to either the Simple or Detailed Assessment (as defined in the DMRB) by considering the increases in noise levels at selected Noise Sensitive Receptors (NSRs) associated with the proposed scheme.

At this stage only noise and vibration impacts relating to the operational use of the proposed development is considered. Noise and vibration impacts relating to the construction of the proposed scheme will be dealt with at later stages of the assessment.

To assist in the decision process, the various options have been ranked according to the number of residential properties where there are adverse or beneficial impacts which would meet the criteria used in DMRB for proceeding to the Simple or Detailed Assessment. A WebTag assessment is also included which assesses the monetary evaluation of each option by considering the long term impact on annoyance.

4.2.2 Regulatory / Planning Policy Framework

National Planning Policy

The National Planning Policy Framework (NPPF) was published on the 27 March 2012 (Department for Communities & Local Government, 2012), coming into immediate effect and replacing the majority of previous Planning Policy Guidance notes (PPGs) and Planning Policy Statements (PPSs). The relevant paragraphs from the NPPF relating to noise are set out below.
The relevant paragraphs from the NPPF relating to noise are:
Paragraph 109: The planning system should contribute to and enhance the natural and local environment by:

- preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability.

Paragraph 123: Planning policies and decisions should aim to:

- avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development;
- mitigate and reduce to a minimum other adverse impacts on health and quality of life arising from noise from new development, including through the use of conditions;
- recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established ; and
- identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.

Paragraph 143: In preparing Local Plans, local planning authorities should:

- set out environmental criteria, in line with the policies in this Framework, against which planning applications will be assessed so as to ensure that permitted operations do not have unacceptable adverse impacts on the natural and historic environment or human health, including from noise, dust, visual intrusion, traffic, tip and quarry-slope stability, differential settlement of quarry backfill, mining subsidence, increased flood risk, impacts on the flow and quantity of surface and groundwater and migration of contamination from the site; and take into account the cumulative effects of multiple impacts from individual sites and/or a number of sites in a locality; and
- when developing noise limits, recognise that some noisy short term activities, which may otherwise be regarded as unacceptable, are unavoidable to facilitate minerals extraction.

Paragraph 144: When determining planning applications, local planning authorities should:

- ensure that any unavoidable noise, dust and particle emissions and any blasting vibrations are controlled, mitigated or removed at source , and establish appropriate noise limits for extraction in proximity to noise sensitive properties.

The NPPF replaces the following noise specific documents:

- Planning Policy Guidance 24: Planning and Noise (3 October 1994);
- Minerals Policy Statement 2: Controlling and Mitigating the Environmental Effects of Minerals Extraction In England (23 May 2005); and
- Planning Policy Statement 23: Planning and Pollution Control (3 November 2004).

Noise Policy Statement for England (NPSE) March 2010

The Noise Policy Vision is to “promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development”, and its aims are that “Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:

- avoid significant adverse impacts on health and quality of life;
- mitigate and minimise adverse impacts on health and quality of life; and
- where possible, contribute to the improvement of health and quality of life."

Local Planning Policy

Suffolk County Council Local Planning Validation Requirements
The document outlines the information required to assess environmental consequences expected to arise from proposed developments.

> *"Noise Impact Assessment*
>
> *The assessment should identify properties and premises that are likely to be sensitive to noise, and provide information on proposed noise levels through the different stages of the work, the predicted or actual noise emissions from specific plant, the length of time plant will be in use, (i.e. 'on time'), and the methods to be employed to control noise, where operations are proposed outside of normal operating hours. A sample of noise calculations should be provided for a typical scenario within the site. Special consideration should be given to the impact of background noise on new schools and to acoustic design options where relevant."*

Standards and Key Policies

- Design Manual for Roads and Bridges (DMRB) HD 213/11 (Revision 1) (The Highways Agency et al., 2011);
- Calculation of Road Traffic Noise (CRTN) (Department of Transport, 1988); and
- Transport Appraisal Guidance (TAG) Unit 3.3.2 'The Noise Sub-objective' (HMSO, 2012).

4.2.3 Baseline Conditions

An initial site-walk over has been undertaken on 20th March 2014 in order to determine the characteristic of the area in the vicinity of the A12. Noise Sensitive Receptors (NSRs) that would likely to be exposed to noise from the proposed road scheme have been identified.

It is noted that residential properties in the vicinity of the proposed routes are generally two storey buildings. No high density residential tower blocks have been identified.

It is understood that dominant noise source currently affecting NSRs is noise from traffic on the A12. Occasionally farm traffic associated with nearby farm activities on the local road network was noted, however noise from farm activities is not considered to affect the noise climate significantly.

In addition there is a railway which runs parallel to the A12 from Melton to Saxmundham and then continues north to Lowestoft. Noise from rail traffic to the south of the A12 was not audible at any of the sites at the time of the visit. Railway noise is considered unlikely to affect the noise climate at NSRs near to where the proposed routes are to be located. At a small number of farm houses located in the close vicinity of the existing railway it is likely that these will be dominated by noise from railway traffic.

No significant industrial or other noise sources in the area have been identified.

It is therefore considered that road traffic noise from the A12 is predominantly affecting most of the area in the vicinity of the proposed routes. Noise from road traffic on the local road network is considered relatively insignificant.

4.2.4 Study Area

The DMRB requires a corridor 600m either side of a scheme to be considered; due to limited information such as OS Mastermap, topographical data and address point data, this assessment however considers only known properties within a 200 m corridor. Only limited building layout and the address point data has been available. Predicted noise levels at some properties may have been over predicted due to the missing buildings (e.g. residential building, garages or farm buildings, which can act as a barrier) between noise sources and NSRs.

It is considered likely that at NSRs in excess of 200m from A12, noise from other roads would be the dominant noise source. Any proposed changes to the A12 would therefore have little impact at NSRs in excess of 200m from the A12.

Sample NSRs have been chosen to identify the potential noise impacts within the study area. These were selected as representative of the most affected by the proposed options. Table 4.2.1 provides the address of each sample, its location and the nearby proposed route option. The locations of these sample properties are graphically shown in Appendix 2.2.B. For each sample location the noise levels for all assessed scenarios have been estimated at 4m above ground, considered to be representative of first floor window height.

The sample NSRs have been grouped based on the locality of the proposed route options. It is anticipated that there are no changes in traffic flows on roads except on those which are directly connected to the proposed route options.

Table 4.2.1: List of sample NSRs

ID	Address	Usage	Easting	Northing	Nearby Proposed Route Option
South Western Area					
B129	1 IVY HOUSE COTTAGES, MARLESFORD, WOODBRIDGE, IP13 0BZ	RESIDENTIAL	632459.8	257539.5	LB3
B236	PEEL HOUSE MAIN ROAD MARLESFORD, WOODBRIDGE, IP13 0AZ	RESIDENTIAL	633606.6	258060.3	LB3 / SB4
B245	ABINGER MILL LANE MARLESFORD, WOODBRIDGE, IP13 0AJ	RESIDENTIAL	632944	258102.4	SB4
B524	THE MOAT FARM, LITTLE GLEMHAM, WOODBRIDGE, IP13 0BB	RESIDENTIAL	633448.5	258505.7	SB4
B531	THE OLD RECTORY MAIN ROAD LITTLE GLEMHAM, WOODBRIDGE, IP13 0BS	RESIDENTIAL	634113.4	258565.4	LB3
East Northern Area					

ID	Address	Usage	Easting	Northing	Nearby Proposed Route Option
B610	57 POND BARN COTTAGES, FARNHAM, SAXMUNDHAM, IP17 1LU	RESIDENTIAL	636582.3	259401.7	SB5
B630	PARK GATE FARMHOUSE MAIN ROAD STRATFORD ST. ANDREW, SAXMUNDHAM, IP17 1LG	RESIDENTIAL	635369.9	259554.3	SB5
B827	MILL HOUSE, STRATFORD ST. ANDREW, SAXMUNDHAM, IP17 1LH	RESIDENTIAL	635617.1	260200.5	SB2 / SB1
B852	MOLLETT'S FARM MAIN ROAD BENHALL, SAXMUNDHAM, IP17 1JY	RESIDENTIAL	636673.2	260234.5	SB5
B892	YEW TREE COTTAGE FRIDAY STREET FARNHAM, SAXMUNDHAM, IP17 1JX	RESIDENTIAL	637329.1	260354.1	SB5
B952	MAIN FARM GREAT GLEMHAM ROAD STRATFORD ST. ANDREW, SAXMUNDHAM, IP17 1LW	RESIDENTIAL	635483.7	260735.8	SB2
B784	THE LIMES, FARNHAM, SAXMUNDHAM, IP17 1LE	RESIDENTIAL	636236.8	260127.7	SB1

In addition to the sample residential properties, all properties within the study area have been identified using address point data. The property usages have been categorised as either sensitive receptors (including residential, health and educational) or non-sensitive receptors (including industrial/commercial and amenity/recreation). No health and educational facilities have been identified within the study area, therefore in this assessment; sensitive receptors are all residential.

4.2.5 Assessment Methodology

The methodology adopted in this report for assessing the noise and vibration impacts from the proposed improvement/bypass scheme follow that prescribed in the Highways Agency Design Manual for Roads and Bridges (DMRB) Volume 11 Section 3 Part 7 HD 213/11-Revision 1 Noise and Vibration published in November 2011. The DMRB describes the three noise assessment stages – Scoping, Simple, and Detailed.

This Scoping (Stage 1) assessment follows the DMRB procedures for assessing impacts as required for a scoping assessment in DMRB.

The aim of the scoping assessment is to report the likely impact from a change in either the noise or vibration levels at sensitive receptors within the study area from road traffic after the proposed scheme becomes operational and determine whether noise and vibration needs to be further assessed.

4.2.5.1 Noise

For noise, the assessment threshold levels for establishing whether the assessment should proceed to the Simple or Detailed Stage are as follows:

Short Term Impact (at opening):

- Whether there is likely to be a change in noise level of 1 dB $L_{A10,18h}$ or more at any sensitive receptor within the study area.

Long Term Impact (within 15 years of opening);

- Whether there is likely to be a change of 3 dB $L_{A10,18h}$ or more at any sensitive receptor within the study area;
- Whether there is likely to be a change of 3 dB $L_{night,outside}$ or more where a level of 55 dB $L_{night,outside}$ is exceeded at any sensitive receptor within the study area.

Where a long term night assessment is required, the Transport Research Laboratory (TRL) report 'Converting the UK traffic noise index $L_{A10,18h}$ to EU noise indices for noise mapping' (Abbott & Nelson, 2002) has been used to derive the $L_{night,outside}$ noise levels. This conversion method provides only an indication of night noise levels based on a broad relationship between day and night traffic flows. Providing there is no construction traffic during the night associated with the Sizewell C development, noise levels during the night at scheme opening are derived from day noise levels excluding construction traffic from the Sizewell C development. The night noise impacts at scheme opening for each option are identical irrespective of whether construction traffic from the Sizewell C development is included or excluded from the day assessment.

4.2.5.2 Vibration

For vibration, the DMRB sets an assessment threshold level of whether there is likely to be an increase in the Peak Particle Velocity (PPV) level of ground borne vibration above $0.3mm^{-1}$, or a predicted increase from an existing level of $0.3mm^{-1}$ at any sensitive receptor within the study area.

The generation of ground borne vibration from traffic on the proposed road improvement/bypass is associated with road surface irregularities causing vehicles' tyres to impact the road surface which can cause vibration at buildings in close proximity. At this stage, road surface details are not available. However, it is anticipated that there will be no road surface irregularities on the proposed scheme and therefore ground borne vibration is unlikely to be an issue.

4.2.5.3 Scoping DMRB Assessment

For the purpose of this scoping assessment, the significance of operational noise impacts are defined as shown in Table 4.2.2 and are based on those described in DMRB.

Table 4.2.2: Significance of Operational Noise Impacts

PERIOD	LEVEL OF SIGNIFICANCE BASED ON CHANGE IN NOISE LEVEL dB(A) [Do-Something(DS) – Do-Minimum(DM)]		
	ADVERSE	INSIGNIFICANT	BENEFICIAL
SHORT TERM			
Day	≥ 1	+0.9 to -0.9	≤ -1
LONG TERM			
Day	≥ 3	+2.9 to -2.9	≤ -3
Night $L_{night,outside}$ > 55 dB(A)[1]	≥ 3	+2.9 to -2.9	≤ -3

[1] $L_{night,outside}$ refers to the free-field level at the facade.
For an adverse impact the night noise with the option (DS) $L_{night,outside}$ > 55 dB(A) and the change in noise (DS-DM)>= +3
For a beneficial impact the night noise without the option (DM) $L_{night,outside}$ > 55 dB(A) and the change in noise (DS –DM)<= -3
For all other conditions the level of significance is assessed as insignificant

It is understood that the opening year of the proposed improvement works/bypass is in 2022, however it is anticipated higher traffic flows in 2024 due to the planned Sizewell C development construction work which is considered as a worst case scenario for short term impacts. In this assessment, traffic flows in 2024 including and excluding the construction traffic flows associated with Sizewell C development have been included.

In assessing the potential noise impact from road traffic the following scenarios have been considered with the assessment options described in Table 4.2.3:

- Do-Minimum scenario (DM) without Sizewell C construction traffic in 2024 and in 2035 (post-construction of Sizewell C development);
- Do-Something (DS) without Sizewell C construction traffic in 2024 and in 2035 (post-construction of Sizewell C development);
- Do-Minimum scenario (DM) with Sizewell C construction traffic in 2024 and in 2035 (post-construction of Sizewell C development);
- Do-Something (DS) with Sizewell C construction traffic in 2024 and in 2035 (post-construction of Sizewell C development).

For the Do-Something scenarios, it has been assumed that 5% of the total traffic flows will be on the bypassed roads and 95% of the total traffic will be on the bypass options.

Table 4.2.3: Assessed Proposed Options

Option	Road sections	Carriageway option	Single carriageway Speed, km/h	Dual carriageway Speed, km/h	Description
SB1	Link1 + SB1 + Link 2	Single	70	-	Improvement (Single carriageway) to Link 1 and Link 2 and a new single carriageway of SB1
SB2	Link 1 + SB2 + Link 2	Single/Dual	70	97	Improvement (Single carriageway) to Link 1 and Link 2 and a new single/dual carriageway of SB2
SB4	Link1 + SB4	Single/Dual	70	97	Improvement to Link 1 (Single carriageway) and a new single/dual carriageway of SB4
SB5	Link1 + SB5	Single/Dual	70	97	Improvement to Link 1 (Single carriageway) and a new single/dual carriageway of SB5
LB3	Link1 + LB3	Single/Dual	70	97	Improvement to Link 1 (Single carriageway) and a new single/dual carriageway of LB3

Additional Notes:

- Option SB1 (Link1 + SB1 + Link 2) is proposed to pass through the centre of Farnham village and offset from the existing A12 approximately 150m either side. The option SB1 only considers a single carriageway option.

- Option SB2 (Link 1 + SB2 + Link 2) is proposed to closely pass a number of villages; Farnham village and Stratford St Andrew village with single and dual carriageway options.

- Option SB5 (Link 1 + SB5) is proposed to pass to the south of Farnham village with single and dual carriageway options.

- Option SB4 (Link1 + SB4) is proposed to the west of Little Glemham village and about 400m to the west of the existing A12. Both single and dual carriageway options are proposed.

- Option LB3 (Link1 + LB3) is proposed to the south of the A12 and single and dual carriageway options are proposed.

All options are presented graphically in Appendix 2.2.C.

4.2.5.4 TAG Assessment

In assessing the change in noise impacts for each of the above comparisons, the current DMRB methodology requires the noise levels to be reported at the facade of each property where the least beneficial change in noise level occurs. This means that whilst the noise assessment is precautionary, potential benefits of a scheme can be underestimated. The previous DMRB methodology dating back to 1994 reported the noise levels at the facade of each property where the maximum noise level occurs i.e. the most exposed facade for each scenario. This approach allows the assessment of noise and vibration nuisance together with the assessment required for the monetary evaluation of road schemes (TAG) to be compatible. Both nuisance and monetary evaluations are based on the research findings which correlate the facade exposed to the highest noise level with residents' dissatisfaction with the noise experienced in their homes and which form the noise exposure response relationships described in the current DMRB methodology. Therefore the assessment has been based on the change in noise level for the most exposed façade of the property as previously intended in the DMRB methodology.

4.2.6 Noise Modelling

All road traffic noise levels have been calculated using the CadnaA© noise prediction software, which predicts the $L_{A10,18h}$ traffic noise level at dwellings and other NSR locations in accordance with the CRTN (Department of Transport, 1988). CadnaA© models have been built for the following traffic scenarios:

- Do-Minimum excluding of traffic associated with the Sizewell C Development in peak construction year 2024;
- Do-Minimum including of traffic associated with the Sizewell C Development in peak construction year 2024;
- Do-Something excluding of traffic associated with the Sizewell C Development in peak construction year 2024;
- Do-Something including of traffic associated with the Sizewell C Development in peak construction year 2024;

- Do-Something excluding of traffic associated with the Sizewell C Development in future year 2035; and
- Do-Something including of traffic associated with the Sizewell C Development in future year 2035.

All calculations are based on the provided traffic flows (18-hour Annual Average Weekday Traffic, AAWT), percentages of HGV and average speed. Note road traffic noise levels have been modelled for the A12 and the proposed route options only; since noise levels from other roads on the local network such as slip roads are unlikely to result in a significant impact on the assessment.

Additional noise model input data includes:

- Road speed in km/h (existing and single carriageway – 70km/h and dual carriageway – 97km/h) based on the road classification published in CRTN paragraph 14.2 for single carriageway roads subject to a speed limit of 50 mph and an all-purpose dual carriageway not subject to a speed limit of less than 60 mph, respectively;
- 18-hour Annual Average Weekday Traffic (AAWT) and HGV percentages (provided by AECOM);
- Existing topography (3D Digital terrain model (DTM) LIDAR) for the proposed route corridor;
- Ordnance Survey open data, Land-Form Panorama for a buffer distance on either side);
- Road surface types (standard surface conditions for DM scenarios and low noise surface conditions for DS scenarios);
- Ground type (taken as acoustically absorptive (G=1), except area within 4m buffer from any building assumed as hard ground);
- Existing building heights taken as 8m high, a common assumption made in noise mapping for typical two storey buildings.

Due to the lack of available information at this stage, road surface type and ground type have been assumed to be the same across all scenarios, which are considered to be reasonable. Topographical information for the proposed route corridor was not available at the time of the assessment. Consequently, it has been assumed that ground levels will not vary significantly from the existing situation after the proposed scheme is constructed.

4.2.7 Noise Modelling Assumptions

The following assumptions have been made in this assessment:

- Road traffic noise from the A12 is assumed to be the most significant noise source affecting NSRs in the vicinity of the A12 and the proposed routes.
- Noise from traffic on local road network nearby NSRs away from the A12 has been assumed to be insignificant in comparison to noise from the A12.

- For Do-Something scenarios traffic flows on Single and Dual carriageways are the same.
- For Do-Something scenarios, it is assumed that 5% of the total traffic flows will be on the bypassed roads and 95% of the total traffic flows will be on the proposed bypass options.
- Speed for Single carriageway and the existing A12 is assumed at 70km/h and for Dual carriageway is assumed at 97 km/h.
- At this stage, the differences between Single and Dual carriageway options in terms of the location of noise source lines are considered to be minor.
- No construction traffic related to the Sizewell C construction work in the future year scenarios 2035 after construction is completed.
- Construction traffic associated with the Sizewell C development will not affect night noise levels.

Due to the limited mapping information (including building footprints) available, sensitive receptors within 200m in either side of the proposed route (rather than 600m) have been considered in this assessment. It is considered for the purposes of a Stage 1 assessment; the key findings will remain valid.

4.2.8 Predicted Impacts

In order to assess the potential noise impacts for each option it is necessary to make comparisons of noise levels in the short term and long term. In summary, the assessed scenarios, for each option, are as follows:

SHORT TERM:

- Do-Minimum scenario 2024 excluding Sizewell construction traffic verses Do-Something scenario 2024 excluding Sizewell construction traffic;
- Do-Minimum scenario 2024 including Sizewell construction traffic verses Do-Something scenario 2024 including Sizewell construction traffic;

LONG TERM:

- Do-Minimum scenario 2024 excluding Sizewell construction traffic verses Do-Something scenario 2035 excluding Sizewell construction traffic;
- Do-Minimum scenario 2024 including Sizewell construction traffic verses Do-Something scenario 2035 excluding Sizewell construction traffic.

In the following Tables the assessments for sampled properties have been assessed at 4m above ground level representing first floor window height. Note that in accordance with DMRB, the assessment of night noise is not required for the short term assessment.

4.2.8.1 Sample NSR locations

For each option, the change in noise levels $L_{A10,\ 18h}$ for the above short and long term comparisons with and without the construction traffic associated with the Sizewell C Development at sample properties are presented Tables 4.2.4-4.2.8. As a worst case, assessment results shown in each table are for a 4m high receiver position representing first floor window level. Also, the changes in night time noise levels $L_{night, outside}$ for the above Long term comparisons with and without the Sizewell C Development are presented Table 4.2.9-4.2.13.

Detailed predicted noise levels and comparisons can be found in Appendix 2.2C.

4.2.8.2 Single Carriageway Option

Table 4.2.4: Option SB1 – Assessment at sampled NSR locations – Day

Property ID	Address	Assessment scenario	Change in Noise level, $L_{A10, 18h}$ dB (DS – DM)	Significance of Impact
B610	57 POND BARN COTTAGES, FARNHAM, SAXMUNDHAM, IP17 1LU	Short term excluding Sizewell	-0.6	Insignificant
		Short term including Sizewell	-0.7	Insignificant
		Long term excluding Sizewell	-0.1	Insignificant
		Long term including Sizewell	-1.6	Insignificant
B630	PARK GATE FARMHOUSE MAIN ROAD STRATFORD ST. ANDREW, SAXMUNDHAM, IP17 1LG	Short term excluding Sizewell	2.9	Adverse
		Short term including Sizewell	2.9	Adverse
		Long term excluding Sizewell	3.4	Adverse
		Long term including Sizewell	1.9	Insignificant
B784	THE LIMES, FARNHAM, SAXMUNDHAM, IP17 1LE	Short term excluding Sizewell	-8.8	Beneficial
		Short term including Sizewell	-8.9	Beneficial
		Long term excluding Sizewell	-8.2	Beneficial
		Long term including Sizewell	-9.7	Beneficial
B827	MILL HOUSE, STRATFORD ST. ANDREW, SAXMUNDHAM, IP17 1LH	Short term excluding Sizewell	-0.9	Insignificant
		Short term including Sizewell	-0.9	Insignificant
		Long term excluding Sizewell	-0.4	Insignificant
		Long term including Sizewell	-1.8	Insignificant
B852	MOLLETT'S FARM MAIN ROAD BENHALL, SAXMUNDHAM, IP17 1JY	Short term excluding Sizewell	-0.5	Insignificant
		Short term including Sizewell	-0.5	Insignificant
		Long term excluding Sizewell	0.0	Insignificant
		Long term including Sizewell	-1.4	Insignificant
B892	YEW TREE COTTAGE FRIDAY STREET FARNHAM, SAXMUNDHAM, IP17 1JX	Short term excluding Sizewell	0.0	Insignificant
		Short term including Sizewell	0.0	Insignificant
		Long term excluding Sizewell	0.6	Insignificant
		Long term including Sizewell	-0.9	Insignificant
B952	MAIN FARM GREAT GLEMHAM ROAD STRATFORD ST. ANDREW, SAXMUNDHAM, IP17 1LW	Short term excluding Sizewell	-0.5	Insignificant
		Short term including Sizewell	-0.6	Insignificant
		Long term excluding Sizewell	0.0	Insignificant
		Long term including Sizewell	-1.5	Insignificant

Table 4.2.4 shows the change in noise levels, $L_{A10, 18h}$ in the short and long term for the day period at the selected properties for Option SB1 including and excluding traffic associated with the Sizewell C development.

The results show that at the majority of NSRs the noise impacts during the day are insignificant or beneficial. However, at Property ID B630 changes in noise level in both the short and long term indicate that noise impacts are adverse significance, except for the long term including traffic associated with the Sizewell C development due to the high noise levels at opening caused by the construction traffic associated with the Sizewell C development. The reason for the adverse significant impact at this property compared with other locations is due to the close proximity to Option SB1.

Table 4.2.5: Option SB2 – Assessment at sampled NSR locations - Day

Property ID	Address	Assessment scenario	Change in Noise level, $L_{A10,\ 18h}$ dB (DS – DM)	Significance of Impact
B610	57 POND BARN COTTAGES, FARNHAM, SAXMUNDHAM, IP17 1LU	Short term excluding Sizewell	-1.4	Beneficial
		Short term including Sizewell	-1.5	Beneficial
		Long term excluding Sizewell	-0.9	Insignificant
		Long term including Sizewell	-2.4	Insignificant
B630	PARK GATE FARMHOUSE MAIN ROAD STRATFORD ST. ANDREW, SAXMUNDHAM, IP17 1LG	Short term excluding Sizewell	-0.3	Insignificant
		Short term including Sizewell	-0.2	Insignificant
		Long term excluding Sizewell	0.3	Insignificant
		Long term including Sizewell	-1.2	Insignificant
B784	THE LIMES, FARNHAM, SAXMUNDHAM, IP17 1LE	Short term excluding Sizewell	-10.0	Beneficial
		Short term including Sizewell	-10.1	Beneficial
		Long term excluding Sizewell	-9.4	Beneficial
		Long term including Sizewell	-10.9	Beneficial
B827	MILL HOUSE, STRATFORD ST. ANDREW, SAXMUNDHAM, IP17 1LH	Short term excluding Sizewell	13.5	Adverse
		Short term including Sizewell	13.5	Adverse
		Long term excluding Sizewell	14.1	Adverse
		Long term including Sizewell	12.6	Adverse
B852	MOLLETT'S FARM MAIN ROAD BENHALL, SAXMUNDHAM, IP17 1JY	Short term excluding Sizewell	0.1	Insignificant
		Short term including Sizewell	0.2	Insignificant
		Long term excluding Sizewell	0.6	Insignificant
		Long term including Sizewell	-0.8	Insignificant
B892	YEW TREE COTTAGE FRIDAY STREET FARNHAM, SAXMUNDHAM, IP17 1JX	Short term excluding Sizewell	0.2	Insignificant
		Short term including Sizewell	0.2	Insignificant
		Long term excluding Sizewell	0.8	Insignificant
		Long term including Sizewell	-0.7	Insignificant
B952	MAIN FARM GREAT GLEMHAM ROAD STRATFORD ST. ANDREW, SAXMUNDHAM, IP17 1LW	Short term excluding Sizewell	6.9	Adverse
		Short term including Sizewell	6.9	Adverse
		Long term excluding Sizewell	7.4	Adverse
		Long term including Sizewell	5.9	Adverse

Table 4.2.5 shows the change in $L_{A10,18h}$ noise levels, in the short and long term for the day period at the sampled properties for Option SB2 including and excluding construction traffic associated with the Sizewell C development.

The results show that at the majority of NSRs the noise impacts during the day are insignificant or beneficial. However, at Property ID B827 and B952 changes in noise in both the short and long term indicate that noise impacts are of adverse significance. The reason for this significant adverse impact is due to the close proximity to Option SB2 at these properties.

Table 4.2.6: Option SB4 – Assessment at sampled NSR locations - Day

Property ID	Address	Assessment scenario	Change in Noise level, $L_{A10,\ 18h}$ dB (DS – DM)	Significance of Impact
B75	BRICK KILN COTTAGE, CAMPSEA ASHE, WOODBRIDGE, IP13 0QL	Short term excluding Sizewell	0.1	Insignificant
		Short term including Sizewell	0.1	Insignificant
		Long term excluding Sizewell	0.6	Insignificant
		Long term including Sizewell	-0.9	Insignificant
B129	1 IVY HOUSE COTTAGES, MARLESFORD, WOODBRIDGE, IP13 0BZ	Short term excluding Sizewell	0.0	Insignificant
		Short term including Sizewell	0.0	Insignificant
		Long term excluding Sizewell	0.6	Insignificant
		Long term including Sizewell	-0.9	Insignificant
B236	PEEL HOUSE MAIN ROAD MARLESFORD, WOODBRIDGE, IP13 0AZ	Short term excluding Sizewell	-7.8	Beneficial
		Short term including Sizewell	-7.8	Beneficial
		Long term excluding Sizewell	-7.2	Beneficial
		Long term including Sizewell	-8.7	Beneficial
B245	ABINGER MILL LANE MARLESFORD, WOODBRIDGE, IP13 0AJ	Short term excluding Sizewell	0.0	Insignificant
		Short term including Sizewell	0.0	Insignificant
		Long term excluding Sizewell	0.5	Insignificant
		Long term including Sizewell	-1.0	Insignificant
B524	THE MOAT FARM, LITTLE GLEMHAM, WOODBRIDGE, IP13 0BB	Short term excluding Sizewell	2.2	Adverse
		Short term including Sizewell	2.2	Adverse
		Long term excluding Sizewell	2.7	Insignificant
		Long term including Sizewell	1.2	Insignificant
B531	THE OLD RECTORY MAIN ROAD LITTLE GLEMHAM, WOODBRIDGE, IP13 0BS	Short term excluding Sizewell	-1.3	Beneficial
		Short term including Sizewell	-1.4	Beneficial
		Long term excluding Sizewell	-0.8	Insignificant
		Long term including Sizewell	-2.3	Insignificant

Table 4.2.6 shows the change in $L_{A10,18h}$ noise levels, in the short and long term for the day period at the sampled properties for Option SB4 including and excluding construction traffic associated with the Sizewell C development.

The results show that at the majority of NSRs the noise impacts during the day are insignificant or beneficial. However, at Property ID B524 changes in noise in the short term indicate that noise impacts are adverse significance. The reason for the significant adverse impact is due to the close proximity to Option SB4 and traffic diversions on the bypassed roads in the short term.

Table 4.2.7: Option SB5 – Assessment at sampled NSR locations - Day

Property ID	Address	Assessment scenario	Change in Noise level, $L_{A10,\ 18h}$ dB (DS – DM)	Significance of Impact
B610	57 POND BARN COTTAGES, FARNHAM, SAXMUNDHAM, IP17 1LU	Short term excluding Sizewell	8.8	Adverse
		Short term including Sizewell	8.8	Adverse
		Long term excluding Sizewell	9.3	Adverse
		Long term including Sizewell	7.8	Adverse
B630	PARK GATE FARMHOUSE MAIN ROAD STRATFORD ST. ANDREW,	Short term excluding Sizewell	4.3	Adverse
		Short term including Sizewell	4.3	Adverse

Property ID	Address	Assessment scenario	Change in Noise level, $L_{A10,\ 18h}$ dB (DS – DM)	Significance of Impact
	SAXMUNDHAM, IP17 1LG	Long term excluding Sizewell	4.8	Adverse
		Long term including Sizewell	3.3	Adverse
B784	THE LIMES, FARNHAM, SAXMUNDHAM, IP17 1LE	Short term excluding Sizewell	-12.2	Beneficial
		Short term including Sizewell	-12.3	Beneficial
		Long term excluding Sizewell	-11.5	Beneficial
		Long term including Sizewell	-13.0	Beneficial
B827	MILL HOUSE, STRATFORD ST. ANDREW, SAXMUNDHAM, IP17 1LH	Short term excluding Sizewell	-2.1	Beneficial
		Short term including Sizewell	-2.1	Beneficial
		Long term excluding Sizewell	-1.6	Insignificant
		Long term including Sizewell	-3.1	Beneficial
B852	MOLLETT'S FARM MAIN ROAD BENHALL, SAXMUNDHAM, IP17 1JY	Short term excluding Sizewell	4.8	Adverse
		Short term including Sizewell	4.8	Adverse
		Long term excluding Sizewell	5.3	Adverse
		Long term including Sizewell	3.9	Adverse
B892	YEW TREE COTTAGE FRIDAY STREET FARNHAM, SAXMUNDHAM, IP17 1JX	Short term excluding Sizewell	3.2	Adverse
		Short term including Sizewell	3.3	Adverse
		Long term excluding Sizewell	3.7	Adverse
		Long term including Sizewell	2.3	Insignificant
B952	MAIN FARM GREAT GLEMHAM ROAD STRATFORD ST. ANDREW, SAXMUNDHAM, IP17 1LW	Short term excluding Sizewell	-1.0	Beneficial
		Short term including Sizewell	-1.1	Beneficial
		Long term excluding Sizewell	-0.5	Insignificant
		Long term including Sizewell	-2.0	Insignificant

Table 4.2.7 show the change in $L_{A10,18h}$ noise levels, in the short and long term for the day period at the sampled properties for Option SB5 including and excluding traffic associated with the Sizewell C development.

The results show that at some NSRs, the noise impacts during the day are insignificant or beneficial whilst at other NSRs the noise impacts are adverse significance. The reason for the significant adverse impacts is due to the close proximity to Option SB5 at these properties.

Table 4.2.8: Option LB3 – Assessment at sampled NSR Locations –Day

Property ID	Address	Assessment scenario	Change in Noise level, $L_{A10,\ 18h}$ dB (DS – DM)	Significance of Impact
B75	BRICK KILN COTTAGE, CAMPSEA ASHE, WOODBRIDGE, IP13 0QL	Short term excluding Sizewell	3.6	Adverse
		Short term including Sizewell	3.4	Adverse
		Long term excluding Sizewell	4.1	Adverse
		Long term including Sizewell	2.6	Insignificant
B129	1 IVY HOUSE COTTAGES, MARLESFORD, WOODBRIDGE, IP13 0BZ	Short term excluding Sizewell	5.1	Adverse
		Short term including Sizewell	5.0	Adverse
		Long term excluding Sizewell	5.6	Adverse
		Long term including Sizewell	4.2	Adverse

Property ID	Address	Assessment scenario	Change in Noise level, $L_{A10,\ 18h}$ dB (DS – DM)	Significance of Impact
B236	PEEL HOUSE MAIN ROAD MARLESFORD, WOODBRIDGE, IP13 0AZ	Short term excluding Sizewell	-0.2	Insignificant
		Short term including Sizewell	-0.4	Insignificant
		Long term excluding Sizewell	0.3	Insignificant
		Long term including Sizewell	-1.2	Insignificant
B245	ABINGER MILL LANE MARLESFORD, WOODBRIDGE, IP13 0AJ	Short term excluding Sizewell	-3.3	Beneficial
		Short term including Sizewell	-3.5	Beneficial
		Long term excluding Sizewell	-2.7	Insignificant
		Long term including Sizewell	-4.2	Beneficial
B524	THE MOAT FARM, LITTLE GLEMHAM, WOODBRIDGE, IP13 0BB	Short term excluding Sizewell	3.1	Adverse
		Short term including Sizewell	2.9	Adverse
		Long term excluding Sizewell	3.7	Adverse
		Long term including Sizewell	2.2	Insignificant
B531	THE OLD RECTORY MAIN ROAD LITTLE GLEMHAM, WOODBRIDGE, IP13 0BS	Short term excluding Sizewell	2.3	Adverse
		Short term including Sizewell	2.0	Adverse
		Long term excluding Sizewell	2.8	Insignificant
		Long term including Sizewell	1.3	Insignificant

Table 4.2.8 shows the change in $L_{A10,18h}$ noise levels, in the short and long term for the day period at the sampled properties for Option LB3 including and excluding construction traffic associated with the Sizewell C development.

The results show that at some of NSRs the noise impacts during the day are insignificant or beneficial and some other NSRs the noise impacts are adverse significance. The reason for this significant adverse impact is due to the close proximity to Option LB3 and some NSRs will be directly exposed to road traffic noise from Option LB3 bypass.

Table 4.2.9: Option SB1 – Assessment at sampled NSR locations – Night

Property ID	Address	Change in Noise level, $L_{night,outside}$ dB (DS – DM)	Significance of Impact
B610	57 POND BARN COTTAGES, FARNHAM, SAXMUNDHAM, IP17 1LU	-0.1	Insignificant
B630	PARK GATE FARMHOUSE MAIN ROAD STRATFORD ST. ANDREW, SAXMUNDHAM, IP17 1LG	3.4	Insignificant
B784	THE LIMES, FARNHAM, SAXMUNDHAM, IP17 1LE	-8.2	Insignificant
B827	MILL HOUSE, STRATFORD ST. ANDREW, SAXMUNDHAM, IP17 1LH	-0.4	Insignificant
B852	MOLLETT'S FARM MAIN ROAD BENHALL, SAXMUNDHAM, IP17 1JY	0.0	Insignificant
B892	YEW TREE COTTAGE FRIDAY STREET FARNHAM, SAXMUNDHAM, IP17 1JX	0.6	Insignificant

Property ID	Address	Change in Noise level, $L_{night,outside}$ dB (DS – DM)	Significance of Impact
B952	MAIN FARM GREAT GLEMHAM ROAD STRATFORD ST. ANDREW, SAXMUNDHAM, IP17 1LW	0.0	Insignificant

Table 4.2.9 shows the change in $L_{night,\ outside}$ noise levels, in the long term for the night period at the sampled properties for Option SB1.

The results show that at all NSRs the noise impacts during the night are insignificant. At Property ID B630, although the change in night noise in the long term exceed the 3dB(A) adverse criteria the absolute level for the Do-Something scenario is below 55 dB(A) $L_{night,outside}$.

Table 4.2.10: Option SB2 – Assessment at sampled NSR locations - Night

Property ID	Address	Change in Noise level, $L_{night,outside}$ dB (DS – DM)	Significance of Impact
B610	57 POND BARN COTTAGES, FARNHAM, SAXMUNDHAM, IP17 1LU	-0.9	Insignificant
B630	PARK GATE FARMHOUSE MAIN ROAD STRATFORD ST. ANDREW, SAXMUNDHAM, IP17 1LG	0.3	Insignificant
B784	THE LIMES, FARNHAM, SAXMUNDHAM, IP17 1LE	-9.4	Insignificant
B827	MILL HOUSE, STRATFORD ST. ANDREW, SAXMUNDHAM, IP17 1LH	14.1	Insignificant
B852	MOLLETT'S FARM MAIN ROAD BENHALL, SAXMUNDHAM, IP17 1JY	0.6	Insignificant
B892	YEW TREE COTTAGE FRIDAY STREET FARNHAM, SAXMUNDHAM, IP17 1JX	0.8	Insignificant
B952	MAIN FARM GREAT GLEMHAM ROAD STRATFORD ST. ANDREW, SAXMUNDHAM, IP17 1LW	7.4	Insignificant

Table 4.2.10 shows the change in $L_{night,outside}$ noise levels, in the long term for the night period at the sampled properties for Option SB2.

The results show that at all NSRs the noise impacts during the night are insignificant. However, at Property ID B827 and B952 night noise increases by more than 3 dB(A) but absolute noise levels are relatively low, (below 55 $L_{night,outside}$ dB).

Table 4.2.11: Option SB4 – Assessment at Sampled NSR Locations - Night

Property ID	Address	Change in Noise level, $L_{night,outside}$ dB (DS – DM)	Significance of Impact
B75	BRICK KILN COTTAGE, CAMPSEA ASHE, WOODBRIDGE, IP13 0QL	0.6	Insignificant
B129	1 IVY HOUSE COTTAGES, MARLESFORD, WOODBRIDGE, IP13 0BZ	0.6	Insignificant

B236	PEEL HOUSE MAIN ROAD MARLESFORD, WOODBRIDGE, IP13 0AZ	-7.2	Insignificant
B245	ABINGER MILL LANE MARLESFORD, WOODBRIDGE, IP13 0AJ	0.5	Insignificant
B524	THE MOAT FARM, LITTLE GLEMHAM, WOODBRIDGE, IP13 0BB	2.7	Insignificant
B531	THE OLD RECTORY MAIN ROAD LITTLE GLEMHAM, WOODBRIDGE, IP13 0BS	-0.8	Insignificant

Table 4.2.11 shows the change in $L_{night,outside}$ noise levels, in the long term for the night period at the sampled properties for Option SB4 with single carriageway. The results show that at all NSRs the noise impacts during the night are insignificant.

Table 4.2.1: Option SB5 – Assessment at sampled NSR locations - Night

Property ID	Address	Change in Noise level, $L_{night,outside}$ dB (DS – DM)	Significance of Impact
B610	57 POND BARN COTTAGES, FARNHAM, SAXMUNDHAM, IP17 1LU	9.3	Insignificant
B630	PARK GATE FARMHOUSE MAIN ROAD STRATFORD ST. ANDREW, SAXMUNDHAM, IP17 1LG	4.8	Insignificant
B784	THE LIMES, FARNHAM, SAXMUNDHAM, IP17 1LE	-11.5	Insignificant
B827	MILL HOUSE, STRATFORD ST. ANDREW, SAXMUNDHAM, IP17 1LH	-1.6	Insignificant
B852	MOLLETT'S FARM MAIN ROAD BENHALL, SAXMUNDHAM, IP17 1JY	5.3	Insignificant
B892	YEW TREE COTTAGE FRIDAY STREET FARNHAM, SAXMUNDHAM, IP17 1JX	3.7	Insignificant
B952	MAIN FARM GREAT GLEMHAM ROAD STRATFORD ST. ANDREW, SAXMUNDHAM, IP17 1LW	-0.5	Insignificant

Table 4.2.12 shows the change in $L_{night,\ outside}$ noise levels, in the long term for the night period at the sampled properties for Option SB5 including and excluding construction traffic associated with the Sizewell C development.

The results show that at all NSRs the noise impacts during the night are insignificant. However, at Property ID B610, B630, B852 and B892 night noise increases by more than 3 dB(A) but absolute noise levels are relatively low, (below 55 $L_{night,outside}$ dB).

Table 4.2.23: Option LB3 – Assessment at sampled NSR locations – Night

Property ID	Address	Change in Noise level, $L_{night,outside}$ dB (DS – DM)	Significance of Impact
B75	BRICK KILN COTTAGE, CAMPSEA ASHE, WOODBRIDGE, IP13 0QL	4.1	Insignificant
B129	1 IVY HOUSE COTTAGES, MARLESFORD, WOODBRIDGE, IP13 0BZ	5.6	Insignificant
B236	PEEL HOUSE MAIN ROAD MARLESFORD, WOODBRIDGE, IP13 0AZ	0.3	Insignificant
B245	ABINGER MILL LANE MARLESFORD, WOODBRIDGE, IP13 0AJ	-2.7	Insignificant
B524	THE MOAT FARM, LITTLE GLEMHAM, WOODBRIDGE, IP13 0BB	3.7	Insignificant
B531	THE OLD RECTORY MAIN ROAD LITTLE GLEMHAM, WOODBRIDGE, IP13 0BS	2.8	Insignificant

Table 4.2.13 shows the change in $L_{night,\ outside}$ noise levels, in the long term for the night period at the sampled properties for Option LB3 including and excluding construction traffic associated with the Sizewell C development.

The results show that at all NSRs the noise impacts during the night are insignificant. However, at Property ID B75, B129 and B524 night noise increases by more than 3 dB(A) but absolute noise levels are relatively low, (below 55 $L_{night,outside}$ dB).

4.2.8.3 Dual Carriageway Options (SB2, SB3, SB5 and LB3)

As previously stated due to the lack of information regarding the exact location of the dual carriageway options, the assessment for dual carriageways has been derived from predicted noise levels for single carriageway options corrected for the anticipated increase in traffic speed from 70km/h to 97km/h using the correction published in CRTN, Chart 4.

The correction is dependent on the percentage of HGVs in the traffic stream and therefore there are separate corrections depending on whether the option includes or excludes HGVs associated with the Sizewell C development.

Table 3.2.14 shows the corrections added to the noise levels for a single carriageway option to derive the noise levels for the corresponding dual carriageway option.

Table 4.2.34: Deriving dual carriageway noise levels from single carriageway assessment

Conversion to Dual Carriageway Option Scenario	Correction, dB
Correction to be added to single carriageway option where traffic includes HGVs from Sizewell	2.3
Correction to be added to single carriageway option where traffic excludes HGVs from Sizewell	2.5

It can be concluded that dual carriageway options are less beneficial than the corresponding single carriageway option. Detailed calculated noise levels with dual carriageway options can be found in Appendix 2.2C.

4.2.9 Summary for Sample properties

A summary of the results showing the significance of impacts for each option across all sampled properties are shown in Table 4.2.15 where construction traffic from the Sizewell C development has been included in the assessment.

Table 4.2.15: Summary of Results Showing Significant Impacts for Sample Properties including Sizewell Traffic

PERIOD	LEVEL OF SIGNIFICANCE	Number of properties for each option								
		SB1	SB2		SB4		SB5		LB3	
		SINGLE	SINGLE	DUAL	SINGLE	DUAL	SINGLE	DUAL	SINGLE	DUAL
Short Term Day	ADVERSE	1	2	3	1	2	4	4	4	3
	INSIGNIFICANT	5	3	3	3	3	0	0	1	1
	BENEFICIAL	1	2	1	2	1	3	3	1	2
Long Term Day	ADVERSE	0	2	2	0	1	3	3	1	3
	INSIGNIFICANT	6	4	4	5	4	2	2	4	3
	BENEFICIAL	1	1	1	1	1	2	2	1	0
Long Term Night	ADVERSE	0	0	0	0	0	0	0	0	0
	INSIGNIFICANT	7	7	7	7	7	7	7	7	7
	BENEFICIAL	0	0	0	0	0	0	0	0	0
TOTAL IMPACTS	**ADVERSE**	**1**	**4**	**5**	**1**	**3**	**7**	**7**	**5**	**6**
	INSIGNIFICANT	**18**	**14**	**14**	**15**	**14**	**9**	**9**	**12**	**11**
	BENEFICIAL	**2**	**3**	**2**	**3**	**2**	**5**	**5**	**2**	**2**

A similar summary without the Sizewell traffic is shown in Table 4.2.16.

Table 4.2.46: Summary of Results Showing Significant Impacts for Sample Properties excluding Sizewell Traffic

PERIOD	LEVEL OF SIGNIFICANCE	Number of properties for each option								
		SB1	SB2		SB4		SB5		LB3	
		SINGLE	SINGLE	DUAL	SINGLE	DUAL	SINGLE	DUAL	SINGLE	DUAL
Short Term Day	ADVERSE	1	2	3	1	2	4	4	4	4
	INSIGNIFICANT	5	3	3	3	3	0	0	1	1
	BENEFICIAL	1	2	1	2	1	3	3	1	1
Long Term Day	ADVERSE	1	2	2	0	1	4	4	3	3
	INSIGNIFICANT	5	4	4	5	4	2	2	3	3
	BENEFICIAL	1	1	1	1	1	1	1	0	0
Long Term Night	ADVERSE	0	0	0	0	0	0	0	0	0
	INSIGNIFICANT	7	7	7	7	7	7	7	7	7
	BENEFICIAL	0	0	0	0	0	0	0	0	0
TOTAL IMPACTS	**ADVERSE**	**2**	**4**	**5**	**1**	**3**	**8**	**8**	**7**	**7**
	INSIGNIFICANT	**17**	**14**	**14**	**15**	**14**	**9**	**9**	**11**	**11**
	BENEFICIAL	**2**	**3**	**2**	**3**	**2**	**4**	**4**	**1**	**1**

The results show that option SB4 with a single carriageway has the least number of adverse impacts across all assessment periods (1) irrespective of whether construction traffic from the Sizewell C development is included or excluded from the assessment. The cause for a significant adverse impact at this property is due to the close proximity to Option SB4 and traffic diversions on the bypassed roads in the short term.

It should stress that the sampled properties were selected as representative of those most affected by the various options and therefore may not provide a complete overview of the noise impact of each option within the study area. The next section addresses this concern by examining the impact on all residential properties within the study.

4.2.10 DMRB Summary tables for all NSRs within the study area

A total of 351 dwellings within the study area have been considered. Table 4.2.17 provides details of the noise assessment both in the short and long term for each option where the impact from construction traffic from the Sizewell C development has been excluded from the assessment.

Table 4.2.17 Summary of Results Showing Significant Impacts for all Properties within the Study Area Excluding Sizewell Construction Traffic

PERIOD	LEVEL OF SIGNIFICANCE	Number of properties for each option and level of significance								
		SB1	SB2		SB4		SB5		LB3	
		SINGLE	SINGLE	DUAL	SINGLE	DUAL	SINGLE	DUAL	SINGLE	DUAL
Short Term Day	ADVERSE	40	58	70	3	29	33	40	21	45
	INSIGNIFICANT	265	245	241	280	259	229	244	177	214
	BENEFICIAL	46	48	40	68	63	89	67	153	92
Long Term Day	ADVERSE	24	51	58	2	5	30	34	13	27
	INSIGNIFICANT	304	264	264	292	297	276	285	257	288
	BENEFICIAL	23	36	29	57	49	45	32	81	36
Long Term Night	ADVERSE	0	0	1	0	0	0	0	0	0
	INSIGNIFICANT	351	351	350	351	351	351	351	350	350
	BENEFICIAL	0	0	0	0	0	0	0	1	1
TOTAL COUNT	**ADVERSE**	**64**	**109**	**129**	**5**	**34**	**63**	**74**	**34**	**72**
	INSIGNIFICANT	**920**	**860**	**855**	**923**	**907**	**856**	**880**	**784**	**852**
	BENEFICIAL	**69**	**84**	**69**	**125**	**112**	**134**	**99**	**235**	**129**

Table 4.2.17 shows for each option the number of residential properties within each level of significance for the three assessment periods: short term day; long term day and long term night. By summing the totals for each level of significance within each option a comparison of the impacts across all options shows that the single carriageway Option SB4 has the least number of adverse impacts. However, this simple approach does not provide a clear assessment of which option is preferred. For example, the single carriageway option LB3 provides the highest beneficial count across all options. A more robust method based on ranking the impacts and applying a suitable weighting factor may provide a clearer indication of the preferred option.

Table 4.2.18 shows the results of the ranking method. The method is based on the development of a decision matrix using the significance of impacts as a weighting scale (WS) which can be applied to each assessment; short, long and night. Each option is ranked (R) according to the number of dwellings which fall within each weighting scale for each of the three types of assessment. Multiplying the weighting scale by the rank (WS.R) for each option allows a matrix to be populated as illustrated in Table 4.2.18. For adverse impacts the weighting scale is -1 whilst for beneficial impacts the weighting scale is +1. It should be noted that when ranking options for adverse impacts, the option with the most number of dwellings would be ranked the lowest i.e. 9th and similarly for beneficial impacts the option with the most dwellings would be ranked the lowest i.e. 9th. The noise impact index (NII) is derived by summing all the individual products of the weighting scale and ranking (NII = ∑(WS.R)) and the option with the highest value is the preferred option.

Table 4.2.18 Ranking Assessment of Preferred Options with Sizewell Construction Traffic Excluded

PERIOD	LEVEL OF SIGNIFICANCE	WS	Weighted Ranking (WS.R)								
			SB1	SB2		SB4		SB5		LB3	
			SINGLE	SINGLE	DUAL	SINGLE	DUAL	SINGLE	DUAL	SINGLE	DUAL
Short Term Day	ADVERSE	-1	-5	-8	-9	-1	-3	-4	-5	-2	-7
	INSIGNIFICANT	0	0	0	0	0	0	0	0	0	0
	BENEFICIAL	1	2	3	1	6	4	7	5	9	8
Long Term Day	ADVERSE	-1	-4	-8	-9	-1	-2	-6	-7	-3	-5
	INSIGNIFICANT	0	0	0	0	0	0	0	0	0	0
	BENEFICIAL	1	1	4	2	8	7	6	3	9	4
Long Term Night	ADVERSE	-1	-1	-1	-9	-1	-1	-1	-1	-1	-1
	INSIGNIFICANT	0	0	0	0	0	0	0	0	0	0
	BENEFICIAL	1	1	1	1	1	1	1	1	8	8
	Noise Impact Index (NII) ∑(WS.R)		**-6**	**-9**	**-23**	**12**	**6**	**3**	**-4**	**20**	**7**

Based on the ranking method employed, where the higher the number, the more beneficial the scheme; the results in Table 4.2.18 indicate that LB3 single carriageway option is the preferred option with the SB4 single carriageway option in second position.

The results from a similar assessment with the Sizewell construction traffic included is shown in Figure 4.2.19

Table 4.2.19 Summary of Results Showing Significant Impacts for all Properties within the Study Area Including Sizewell Construction Traffic

PERIOD	LEVEL OF SIGNIFICANCE	Number of properties for each option and level of significance								
		SB1	SB2		SB4		SB5		LB3	
		SINGLE	SINGLE	DUAL	SINGLE	DUAL	SINGLE	DUAL	SINGLE	DUAL
Short Term Day	ADVERSE	40	58	69	3	21	33	40	21	41
	INSIGNIFICANT	262	245	241	280	266	228	238	177	212
	BENEFICIAL	49	48	41	68	64	90	73	153	98
Long Term Day	ADVERSE	14	42	55	1	3	25	31	7	16
	INSIGNIFICANT	302	266	261	286	289	257	277	212	277
	BENEFICIAL	35	43	35	64	59	69	43	132	58
Long Term Night	ADVERSE	0	0	1	0	0	0	0	0	0
	INSIGNIFICANT	351	351	350	351	351	351	351	351	350

	BENEFICIAL	0	0	0	0	0	0	0	0	1
TOTAL COUNT	**ADVERSE**	**54**	**100**	**125**	**4**	**24**	**58**	**71**	**28**	**57**
	INSIGNIFICANT	**915**	**862**	**852**	**917**	**906**	**836**	**866**	**740**	**839**
	BENEFICIAL	**84**	**91**	**76**	**132**	**123**	**159**	**116**	**285**	**157**

Again, Option SB4 is shown to have the least number of adverse counts but a more detailed analysis which includes assessing the benefits of each option using the ranking method as described earlier is shown in Table 4.2.20.

Table 4.2.20 Ranking Assessment of Preferred Options with Sizewell Construction Traffic Included

PERIOD	LEVEL OF SIGNIFICANCE		Weighted Ranking (WS.R)								
			SB1	SB2		SB4		SB5		LB3	
			SINGLE	SINGLE	DUAL	SINGLE	DUAL	SINGLE	DUAL	SINGLE	DUAL
Short Term Day	ADVERSE	-1	-5	-8	-9	-1	-2	-4	-5	-2	-7
	INSIGNIFICANT	0	0	0	0	0	0	0	0	0	0
	BENEFICIAL	1	3	2	1	5	4	7	6	9	8
Long Term Day	ADVERSE	-1	-4	-8	-9	-1	-2	-6	-7	-3	-5
	INSIGNIFICANT	0	0	0	0	0	0	0	0	0	0
	BENEFICIAL	1	1	3	1	7	6	8	3	9	5
Long Term Night	ADVERSE	-1	-1	-1	-9	-1	-1	-1	-1	-1	-1
	INSIGNIFICANT	0	0	0	0	0	0	0	0	0	0
	BENEFICIAL	1	1	1	1	1	1	1	1	1	9
	Noise Impact Index (NII) ∑(WS.R)		**-5**	**-11**	**-24**	**10**	**6**	**5**	**-3**	**13**	**9**

From this analysis, the preferred option is shown to be the single carriageway LB3 option although the single carriageway SB4 option is close in second position.

In summary, the results from this analysis indicate that the preferred options that should be considered for a detailed assessment are the single carriage options SB4 and LB3. The dual carriageway Option SB4 is shown to be the preferred option in third position and may be considered for a detailed assessment if a dual carriageway option is preferred.

4.2.11 Monetary Valuation of Noise Impacts

The Monetary valuation of noise impacts from a road scheme is aimed at complementing the noise assessment and help in the decision process when comparing different transport options by placing a value on noise determined from people's willingness to pay to avoid transport related noise. The process for determining the monetary valuation of noise impacts from road schemes that is described in this section follows the procedure set out in the Department for Transport's "Transport Analysis Guidance" (TAG) Unit 3.3.2 The Noise Sub-Objective, January 2014.

For monetary valuation in TAG, it looks at the comparison between Do-Minimum and Do-Something in the design year, within 15 years after opening. Although the opening year is understood to be 2022, it has been assumed that there is no significant change in traffic growth from 2022 to 2024.

The TAG assessments in monetary and annoyance valuations are graphically presented in Figure 4.2.1 and Figure 4.2.2 respectively.

Figure 4.2.1 TAG Assessment – Monetary valuation

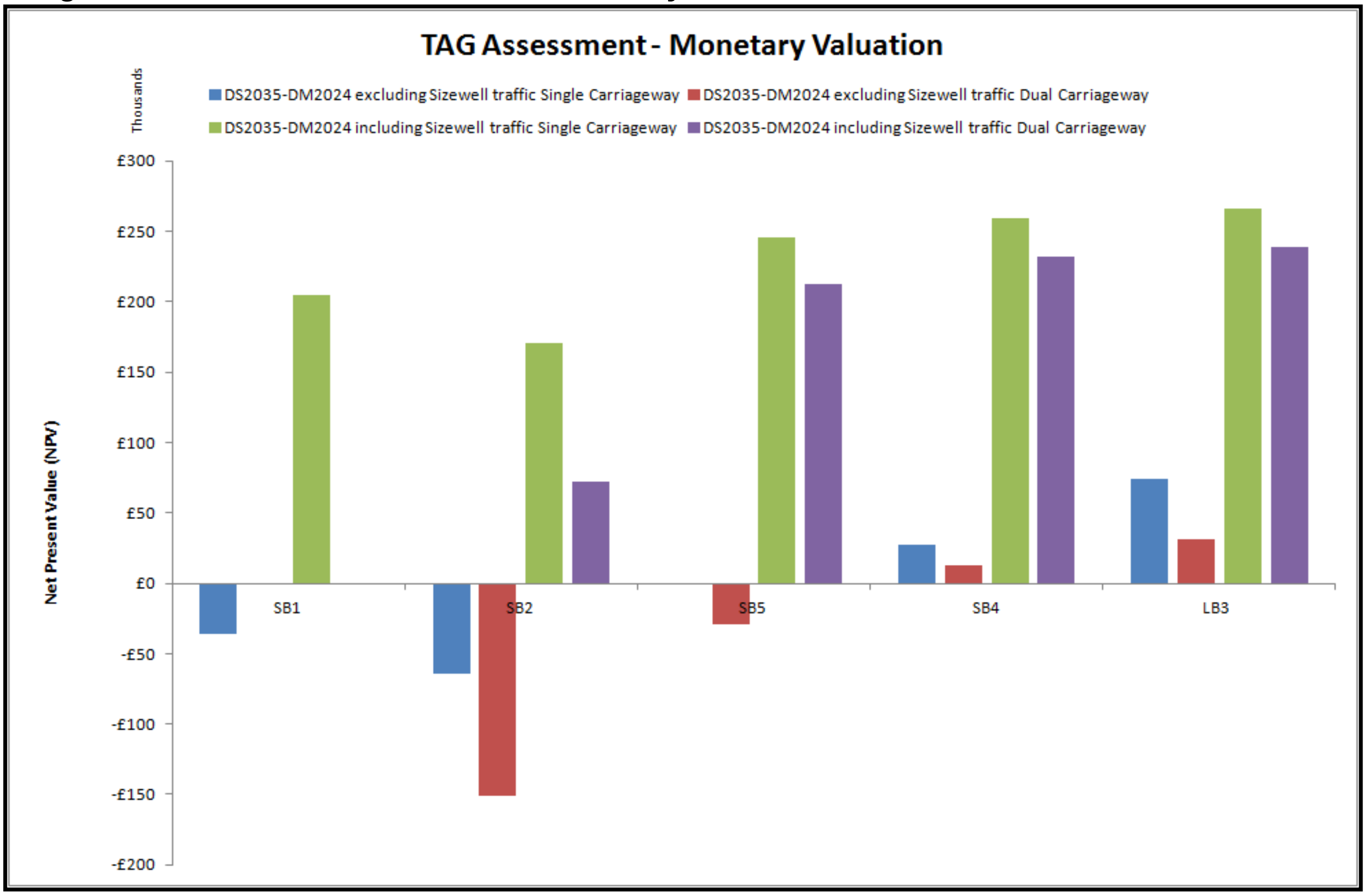


Figure 4.2.1 show the results from the TAG monetary valuation for the proposed options. The Net Present Value (NPV) prices shows that for DS2035 verses DM2024 including Sizewell traffic scenarios for both single and dual carriageway options there are positive values meaning there are net benefits. This trend can be explained because of the changes in traffic flows.

Based on this monetary valuation, option LB3 with single carriageway is considered to be the most beneficial option followed closely by the single carriageway option SB4. This assessment is in good agreement with that obtained from the ranking matrix described earlier.

Figure 4.2.2 TAG Assessment – Annoyance Evaluation

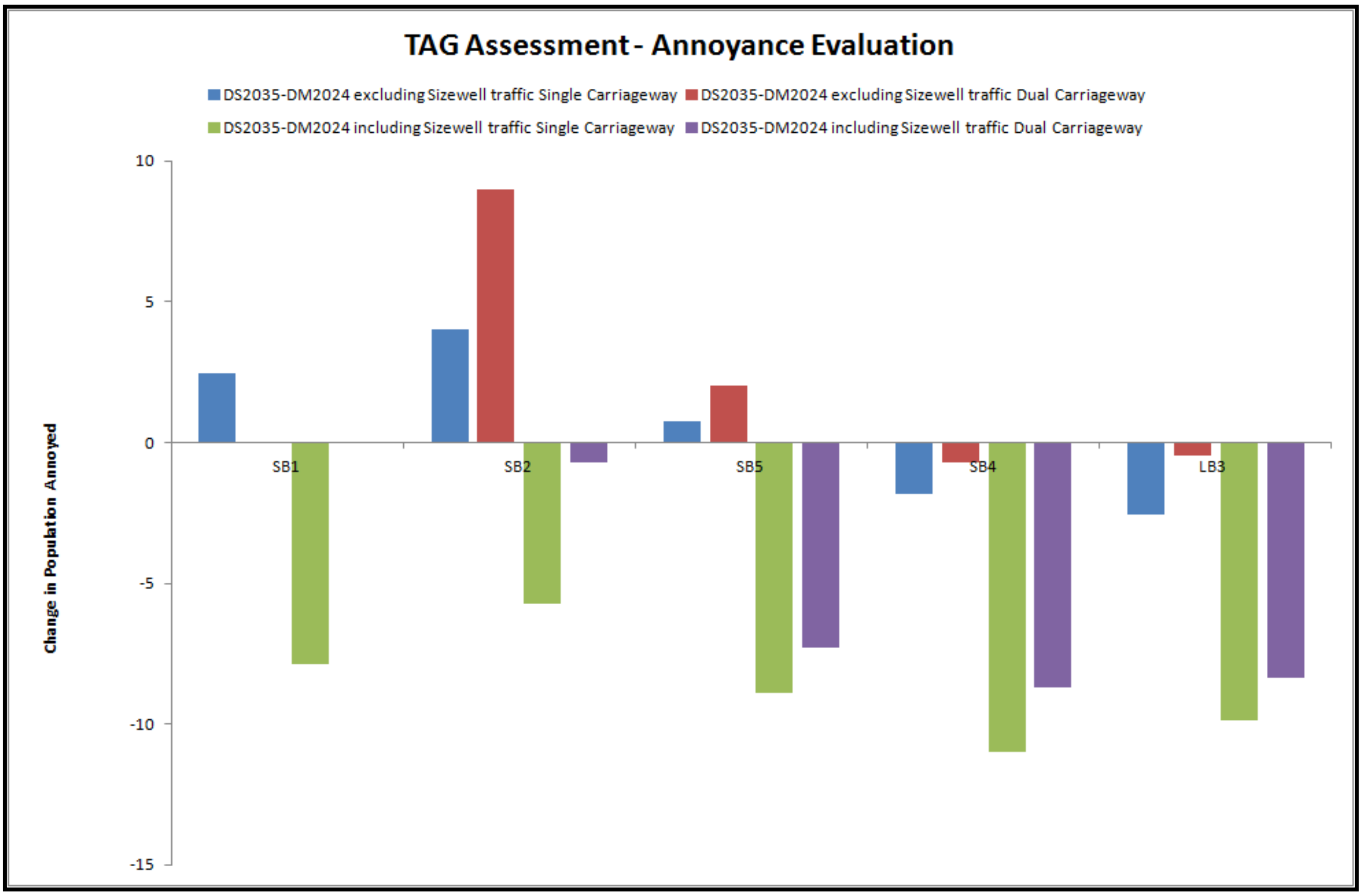


Figure 4.2.2 show the results from the TAG annoyance evaluation for proposed options, positive value shown in the figure reflects an increase in people annoyed by noise.

Option SB4 with single carriageway results in the least people annoyed by road traffic noise from its option.

It should be noted that due to the lack of detailed information regarding the study area and existing building footprints the above TAG assessment can only provide indicative monetary and annoyance estimates. However, for the purposes of this comparative study, the methodology is considered sufficiently robust for evaluating the most beneficial option.

To summarise, the results of the TAG assessment in monetary and annoyance valuations indicate that option LB3 with single carriageway will provide the most net benefits and option SB4 with single carriageway will result in the least people annoyed. It should be noted that the relative length of the proposed option SB4 is shorter than option LB3.

4.2.12 Opportunity for Mitigation and Enhancement

The proposed options (with either Single or Dual carriageway option) will increase noise levels at some nearby NSRs and would be likely to exceed the threshold noise levels in both the short and long term. All options would therefore require mitigation measures. Table 4.2.21 provides an indication of the mitigation required to ensure all properties are not adversely affected.

Table 4.2.21 For Each Option the Mitigation Required to Ensure all Properties are not Adversely Affected.

Option	Carriageway	Scenario	Maximum Noise Mitigation Required to Protect the Most Exposed Property, dB(A)		
			Short Term Day	Long Term Day	Long Term Night
SB1	SINGLE	Excluding Sizewell	7.4	8.0	-
		Including Sizewell	7.5	6.6	
SB2	SINGLE	Excluding Sizewell	29.1	29.7	-
		Including Sizewell	29.2	28.3	
	DUAL	Excluding Sizewell	31.6	32.2	-
		Including Sizewell	31.5	30.8	
SB4	SINGLE	Excluding Sizewell	5.7	6.2	-
		Including Sizewell	5.7	4.8	
	DUAL	Excluding Sizewell	8.1	8.6	-
		Including Sizewell	8.0	7.2	
SB5	SINGLE	Excluding Sizewell	17.3	17.8	-
		Including Sizewell	17.3	16.3	
	DUAL	Excluding Sizewell	19.8	20.3	-
		Including Sizewell	19.6	18.8	
LB3	SINGLE	Excluding Sizewell	9.6	10.1	-
		Including Sizewell	9.6	8.6	
	DUAL	Excluding Sizewell	12.1	12.6	-
		Including Sizewell	11.9	11.1	

Options SB2 and SB5 will require substantial mitigation compared with the other options to protect the most exposed property within each option.

In order to avoid the noise exceedances due to the proposed options, following mitigation measures should be considered:

- Where practicable road aligned to be as far as possible from highly populated areas.
- Carefully consider vertical alignment and use of cuttings etc to maximise the potential for screening.
- Use of acoustic barriers and bunds.

It should be noted that the above assessment has assumed that all new surfaces would be constructed using a low noise surface.

Detailed mitigation measurements should be considered in the detailed stages of the DMRB assessment process.

4.2.13Residual Impacts

It is anticipated that with appropriate mitigation, the predicted noise levels would be unlikely to exceed the threshold levels for short and long term for the preferred options single carriageway option LB3 and single carriageway option SB4. For options SB2 and SB5 substantial mitigation involving embankments/cuttings with possible changes in road alignment would be required to ensure all properties would not be adversely affected.

4.2.14 Summary Table

A Scoping DMRB noise assessment has been carried out in order to establish whether the assessment should proceed to either the Simple or Detailed Assessment by considering the increases in noise levels at NSRs associated with the proposed scheme options.

A ranking method devised for assessing noise impacts both in the short term and long term indicates that the single carriageway options LB3 and SB4 are the two most preferred options for the Detailed Assessment. The results of the TAG assessments support this view, indicating that both options LB3 and SB4 with single carriageway is considered to be the most beneficial option value among the proposed schemes.

Detailed mitigation measures should be considered in the later stages of the DMRB assessment. Residual effects with appropriate mitigation measures are considered to be insignificant but it is noted that substantial mitigation would be required for options SB2 and SB5 to ensure no residential property is adversely affected.

At this stage only noise impacts relating to the operational use of the proposed development is considered. Temporary impacts relating to the construction of the proposed scheme will be dealt with at the later stages of the assessment.

In conclusion, a detailed assessment will be required in order to assess noise and vibration impacts due to the proposed options in accordance with DMRB methodology. At Detailed assessment stage, the following information is required:

- Detailed information regarding the scheme proposals;
- Detailed electronic maps (OS Master map) showing the site layout and surrounding area in either .dwg or .dxf format;
- Detailed electronic maps for Do-Something scenarios show the road width, edge of roads, top and bottom of earth work in either .dwg or .dxf format;

- These maps should cover not just the proposed routes, but the wider area (including 1km buffer zone either side of the proposed routes);
- Topographical data cover the study area of 1km buffer zone from any proposed route options;
- Traffic data for the baseline (existing) year, opening year and future year (worst affected year within 15 years after opening year) for all affected road links;
- Traffic data is required in format of 18-hour (06:00 – 24:00) AAWT (Annual Average Weekday Traffic) flows with percentage of HGV (Heavy Good Vehicles are considered as weights greater than 3.5 tonnes);
- Average Speed in km/h;
- Width of roads (both a single and dual carriageway);
- Road surface type;
- Address point data is required regarding the uses of existing buildings in the surrounding area (for example, education / health facilities, residential / commercial units etc.);
- Information regarding Building heights of existing and proposed buildings;
- Information regarding any proposed location of barriers or topographic features, such as earth bunds; and
- Information regarding the proposed construction methods, plant and programme.

The required information listed above is essential in order to provide a robust detailed assessment.

A summary of the assessment findings are tabulated as below.

Table 4.2.5 Noise assessment summary table

Route	Qualitative Impacts	Assessment	Potential Mitigation	Residual Effects With Mitigation
SB1	This scheme will bring both beneficial and adverse noise impacts during the day but no adverse night impacts are expected	Adverse	Acoustic Noise Barrier	Insignificant
SB2	This scheme will bring both beneficial and adverse noise impacts during the day including adverse night impacts at one property	Adverse	Substantial Mitigation Requirements are likely	Adverse / Insignificant
SB4	This scheme will bring both beneficial and adverse noise impacts during the day but no adverse night impacts are expected. The single carriageway option is recommended for Detailed Assessment	Adverse	Acoustic Noise Barrier	Insignificant
SB5	This scheme will bring both beneficial and adverse noise impacts during the day but no adverse night impacts are expected.	Adverse	Substantial Mitigation Requirements are likely	Adverse / Insignificant

Route	Qualitative Impacts	Assessment	Potential Mitigation	Residual Effects With Mitigation
LB3	This scheme will bring both beneficial and adverse noise impacts during the day but no adverse night impacts are expected. The single carriageway option is recommended for Detailed Assessment	Adverse	Acoustic Noise Barrier	Insignificant

4.3 Biodiversity

4.3.1 Introduction

The Biodiversity section assesses the potential effect of the route options on the natural environmental capital within the area that have the potential to be directly or indirectly affected by the routes, Route Options Appraisal. The aim of the route options appraisal is to identify the potential for the Study Area to support protected or notable habitats and species that have the potential to be adversely affected by the route proposals (key receptors). Highlight the magnitude of the potential effects at the broad scale on these key receptors and identify which effects can be adequately mitigated for.

4.3.2 Quality Assurance

All AECOM Ecologists are members, at the appropriate level, of the Institute of Ecology and Environmental Management (IEEM) and follow their code of professional conduct when undertaking ecological work.

AECOM is ISO 9001:2008, ISO 14001:2004 and OHSAS 18001:2007 Health and Safety accredited.

4.3.3 Biodiversity Assessment Guidance

Biodiversity assessment guidance has followed a combination of WebTAG Unit A3 Environmental Impact Appraisal Chapter 9 Impacts on Biodiversity which also signposts DMRB 11.3.4 and ‘Guidelines for Ecological Impact Assessment in the UK’ (CIEEM,2006), developed by the Chartered Institute of Ecology and Environmental Management to promote good practice in Ecological Impact Assessment in the UK.

The methodology for appraising the impact of a scheme on the environmental topics landscape, townscape, the historic environment, biodiversity and the water environment follows a common general approach. Specific considerations for each environmental topic at each stage are described in subsequent Chapters. The generic steps are as follows:

- Step 1: Scoping and identification of study area
- Step 2: Identifying key environmental resources and describing their features
- Step 3: Appraise environmental capital
- Step 4: Appraise the proposal’s impact
- Step 5: Determine the overall assessment score

4.3.3.1 Step 1: Scoping and Identification of Study Area

A desktop study was undertaken to collate and analyse protected habitat and species information within 500m either side of each route option (hereafter referred to as the Study Area) for locally and nationally designated features and within 5km for internationally designated sites (Natura 2000).

The following publically available data were examined:

- Multi-Agency Geographic Information for the Countryside (MAGIC) website (2012)[37];
- National Biodiversity Network[38]
- Ordinance Survey Mapping
- Aerial Photography
- Suffolk Biodiversity Action Plan
- Environment Agency “What’s In your backyard” Interactive Maps[39]

Data was purchased from the following sources:

- Suffolk biodiversity records centre

These data were provided in GIS format.

4.3.3.2 Step 2: Identifying Key Environmental Resources and Describing their Features

‘Key environmental resources’ is the term used to describe site or location specific elements of the environment that provide qualities and functions which are considered by the community (local, regional, national or international) to be of particular value. In order to identify the key environmental resources within the Study Area, an ecological walkover scoping survey was conducted. The survey was undertaken of the Study Area on 31st March and the 1st of April 2014 by AECOM ecologists Dr Martina Girvan BSc(Hons) MSc CEcol MCIEEM and Dr Heather Oaten BSc(Hons) MSc MCIEEM.

Only features that were potentially directly affected by the road were directly assessed. The habitats were assessed in terms of their quality and potential to support the protected and notable species:

4.3.3.3 Step 3: Appraise Environmental Capital

The third step uses the concept of environmental capital, to assess what matters and why it is important. Note that it is important to assess what matters at present and how that may change over time in the absence of the proposal. This provides the baseline level of environmental capital against which the impact of the proposal can be appraised. The environmental capital methodology builds on information about environmental character by using a set of common

[37] http://magic.defra.gov.uk/website/magic/
[38] http://www.nbn.org.uk/
[39] http://maps.environment-agency.gov.uk/wiyby/wiybyController?ep=maptopics&lang=_e

indicators and definitions to add cultural and subjective values and assess impacts, in order to produce an overall qualitative summary of baseline environmental capital.

Table 4.3.1 presents guidance on describing and valuing features.

Table 4.3.1: Guidance on describing the biodiversity and earth heritage value of features

Value	Criteria	Examples
Very high	High importance and rarity, international scale and limited potential for substitution	Internationally designated sites
High	High importance and rarity, national scale, or regional scale with limited potential for substitution	Nationally designated sites Regionally important sites with limited potential for substitution
Medium	High or medium importance and rarity, local or regional scale, and limited potential for substitution	Regionally important sites with potential for substitution Locally designated sites
Low	Low or medium importance and rarity, local scale	Undesignated sites of some local biodiversity and earth heritage interest
Negligible	Very low importance and rarity, local scale	Other sites with little or no local biodiversity and earth heritage interest

Trend data was gathered using the following sources:

- Suffolk Biodiversity Action Plan http://www.suffolkbiodiversity.org/biodiversity-action-plans.aspx
- The State of our Environment Anglia (EA)
- Biodiversity 2020 (DEFRA)
- Natural England Designated Site Citations (NE)
- JNCC Designated Site Information Sheets (JNCC and DEFRA)
- UK BARS (Biodiversity Action Recording System)
- BTO Status Website http://www.bto.org/
- Fifth Otter Survey of England (Environment Agency 2010)
- Wildlife Trust Protected Species Records http://www.wildlifetrust.org.uk/urban/ecorecord/bap/html/gcnewt.htm

4.3.3.4 Step 4: Appraise the proposal's impact

This step in the approach involves describing and scoring the impact of the scheme on the baseline environmental capital established in the preceding step. The descriptions and scores produced in this step will inform judgement about the overall assessment score. Where a scheme affects a number of key environmental resources within a topic, its impact on each resource should be assessed separately.

Table 4.3.2 presents these criteria for assessing the magnitude of the impact.

Table 4.3.2: Criteria for determining the magnitude of the impact

Magnitude	Criteria
Major negative	The proposal (either on its own or with other proposals) may adversely affect the integrity of the key environmental resource, in terms of the coherence of its ecological structure and function, across its whole area, that enables it to sustain the habitat, complex of habitats and / or the population levels of species of interest.
Intermediate negative	The key environmental resource's integrity will not be adversely affected, but the effect on the resource is likely to be significant in terms of its ecological objectives. If, in the light of full information, it cannot be clearly demonstrated that the proposal will not have an adverse effect on integrity, then the impact should be assessed as major negative.
Minor negative	Neither of the above applies, but some minor negative impact is evident. (In the case of Natura 2000 sites a further appropriate assessment may be necessary if detailed plans are not yet available).
Neutral*	Although there may be a slight direct or indirect affect on the habitat no observable SIGNIFICANT impact in either direction.
Positive	Impacts which provide a net gain for wildlife overall.

*Description slightly expanded to incorporate CIEEM Guidelines on significance

4.3.3.5 Step 5: Overall Assessment Score

Step 5 combines the appraisal of biodiversity and earth heritage value of the features, with the appraisal of the magnitude of the impacts, to determine the consequence of those impacts. The assessment score should be determined using

Table 4.3.3: Estimating the overall assessment **score** and recorded on the Biodiversity Appraisal Worksheet. Where more than one key environmental resource is involved, an appraisal category is needed for each of these, which are then summarised in an overall summary score on the appraisal summary table for the scheme.

Where a scheme affects more than one key environmental resource, determining the overall summary score is more complex, since the different 'scores' for each key environmental resource considered need to be weighed up in an overall summary score. The guidelines given in Chapter 5 should be followed.

Table 4.3.3: Estimating the overall assessment score

Magnitude of impact	**Biodiversity and earth heritage value**				
	Very high	**High**	**Medium**	**Lower**	**Negligible**
Major negative	Very Large adverse	Very Large adverse	Moderate adverse	Slight adverse	Neutral
Intermediate negative	Large adverse	Large adverse	Moderate adverse	Slight adverse	Neutral
Minor negative	Slight adverse	Slight adverse	Slight adverse	Slight adverse	Neutral
Neutral	Neutral	Neutral	Neutral	Neutral	Neutral
Positive	Large beneficial	Large beneficial	Moderate beneficial	Slight beneficial	Neutral

4.3.4 Document Structure

The results are presented as outlined in 4.3.4

Table 4.3.4: Document structure

Item	Content	Location
WebTAG Biodiversity Impact Worksheet (Steps 1 to 5)	• **Step 1**: Scoping and identification of study area • **Step 2**: Identifying key environmental resources and describing their features • **Step 3**: Appraise environmental capital • **Step 4**: Appraise the proposal's impact • **Step 5**: Determine the overall assessment score • **For all route options**	Appendix 2.3A
Survey Locations and Target Notes	The OS grid reference for each location were a ground truthing survey was undertaken and the description of the habitats and protected species they may support	Text in Section 3
Biodiversity Assessment Summary Tables	Summary of potential impacts for each route option	Table 4.3.5, below.
Route overview presenting potential for indirect effects on internationally designated sites	Route Overview with 5km buffer showing Internationally Designated Sites	Figure 3.3.1
Route overview presenting potential for indirect effects on locally	Route Overview with 500km buffer (1k m route corridor) showing other	Figure 3.3.1

Item	Content	Location
and nationally protected sites	designated sites, protected species results and survey locations	
LB3 route presenting potential for direct and indirect effects on valued receptors	LB3 route with 500m buffer (1k m route corridor) with woodlands and hedgerows recorded from site survey with survey locations	3.3.3a and 3.3.3b
SB1 route presenting potential for direct and indirect effects on valued receptors	SB1 route with 500m buffer (1k m route corridor) with woodlands and hedgerows recorded from site survey with survey locations and woodland and watercourse names	3.3.4a and 3.3.4b
SB2 route presenting potential for direct and indirect effects on valued receptors	SB2 route with 500m buffer (1k m route corridor) with woodlands and hedgerows recorded from site survey with survey locations and woodland and watercourse names	3.3.5a and 3.3.5b
SB4 route presenting potential for direct and indirect effects on valued receptors	SB4 route with 500m buffer (1k m route corridor) with woodlands and hedgerows recorded from site survey with survey locations and woodland and watercourse names	3.3.6a and 3.3.6b
SB5 route presenting potential for direct and indirect effects on valued receptors	SB5 route with 500m buffer (1k m route corridor) with woodlands and hedgerows recorded from site survey with	3.3.7a and 3.3.7b

Item	Content	Location
	survey locations and woodland and watercourse names	
Link 1 route presenting potential for direct and indirect effects on valued receptors	Link 1 route with 500m buffer (1k m route corridor) with woodlands and hedgerows recorded from site survey with survey locations and woodland and watercourse names	3.3.8a and 3.3.8b
Link 2 route presenting potential for direct and indirect effects on valued receptors	Link 2 route with 500m buffer (1k m route corridor) with woodlands and hedgerows recorded from site survey with survey locations and woodland and watercourse names	3.3.9a and 3.3.9b

4.3.5 Geographical Information System Methodology

Therefore the ecological scoping walkover survey information has been converted to a GIS system that would enable any potential ecological constraints related to potential route option locations to be instantly investigated as well as provide a visual representation of the ecological constraints within the Study Area that can constantly be updated as further information, e.g. the results of species surveys, are gathered.

The OS Mastermap topography shapefile for the Study Area was downloaded to the GIS package ArcMap 10 (grid reference file S026NW at 1:1250 scale). This shapefile did not contain hedgerows, so hedgerows were digitised with the limitations as set out in section 4.3.11 Using site notes and a geo-referenced satellite image to determine their locations. Ecological constraints data were added to the shapefile dataset from site notes taken during the ecological scoping walkover survey. For each polygon, the total number of ecological constraints was calculated and a choropleth map produced to identify the distance of each of the habitats present within the Study Area.

4.3.6 Survey Limitations

The ecological walkover scoping survey and protected species assessment were subject to a number of limitations:

- Access to all areas of the site was not carried out as this was a scoping survey/ only access was available on publically accessible land.
- No buildings or trees were individually assessed for their potential to support bats.
- Only woodlands, waterbodies or hedgerows directly affected by the route were ground truthed.
- Only hedgerows with the potential to be affected by the route have been presented on the map.
- An ecological walkover scoping survey only provides a snapshot of the broad habitats and potential species present in an area at the time the survey is undertaken.
- Late March early April is not the optimal season for ecological habitat assessment; however there was sufficient information gathered via desk study and walkover to confidently determine the potential effects at the required level.
- Species are mobile and can move in to and out of an area quickly. The survey relies on evidence such as tracks and droppings to provide evidence that a species is present.
- The locations of all features and target notes are indicative and approximate only.
- AECOM take no responsibility for the accuracy of data provided by third parties.
- With relation to data from the local biological records centre, the information/data received was sourced from both listed recorders and members of the public. The information/data received was sourced from both published and unpublished material. The quality of the ecological data from the different sources is highly variable. The absence of records does not prove the absence of a species.

Incidental results for protected species have been reported, however these do not represent dedicated species surveys and confirmation of the potential suitability's of habitat to support protected species stated in this report will be confirmed by subsequent protected species surveys.

4.3.7 Regulatory / Planning Policy Framework

Target notes from the field visit are presented in Figure 4.3.2 and tabulated in Appendix 2.3B. The area surrounding the route options is dominated by the River Ore floodplain to the west surrounding in route options LB3 and SB4 and the River Alde floodplain to the east through which SB1, SB2 and SB5 pass. This is a largely arable (mostly oil seed rape) with occasional improved and semi-improved grassland, particularly within the floodplains of the rivers. The River Fromus and the River Deben lie to the west of the route options. A large number of ponds and wooded copses are present within the landscape. There are a large number of tributaries including the River Ore and River Alde that flow into the River Alde/Ore protected site (designated as an Special Protection Area (SPA), Special Area of

Conservation (SAC), Site of Special Scientific Interest (SSSI), County Wildlife Site and Ramsar) within 5km of the route options.

There are a large number of small plantation woodlands in the area and small semi-natural woodlands (that may have been planted over 100 years ago). There are two ancient woodlands (also CWS) within 500m of the route corridor, Great Wood to the north of the A12 that would be bisected by LB3 and SB4 and Foxburrow Wood to the south of the A12 which SB5 would potentially approach on the western side of the woodland.

The most relevant planning-related documents are presented in Appendix 2.3D along with a list of the most relevant LBAP species and include the following:

- The Conservation of Habitats and Species Regulations 2010 (as amended);
- The Wildlife and Countryside Act 1981 (as amended);
- Natural Environment and Rural Communities Act 2006;
- National Planning Policy Framework (2012);
- Suffolk Coastal District Local Plan - Core Strategy and Development Management Policies (2013)
- Suffolk Biodiversity Action Plan (2014)

4.3.8 Designated Sites

Designated sites are presented within the WebTAG Tables Appendix 2.3A and the definition of these designations is presented within Appendix 2.3C and their legislative protection in Appendix 2.3E. They have been presented within 5km for nationally and internationally designated sites and a 1km route corridor around the options for locally designated sites. The Alde/Ore Estuarine complex (designated as an SPA, SAC, SSSI, and Ramsar) is the key designated site that is connected to the study area via a network of rivers and small tributaries and relate principally to route options LB3, SB1 SB2 and SB5. Their floodplains are important ecosystem services supporting the local area. There is a SAC, Dew’s Pond SAC designated for great crested newts (GCN) which is over 3km away from these route options and not connected to the study area. The Sandlings SPA lies near the Suffolk coast between the Deben Estuary and Leiston.

There are a large number of plantation woodlands in the area and semi-natural woodlands. There are two CWS woodlands that are also on the Ancient Woodland Inventory that is Great Wood Ancient Woodland (adjacent to LB3 and SB4) and Foxburrow Wood Ancient Woodland (adjacent to SB5).

4.3.9 Habitats

Named woodlands and watercourses and there distance from the route options are recorded within the WebTAG tables Appendix 2.3A. Species rich hedgerows that were noted during site survey are also marked on the map (although see survey limitations). Woodlands, ponds and semi-improved grasslands have also been presented on the maps

(Figures 3.3.1a to 3.3.9b). Their conservation status relating to conservation objectives has been considered using the WebTAG methodology outlined in Section 2, above.

4.3.10 Hedgerows and Field Margins

The locations of the routes are largely arable fields with small or no field margins (which are an LBAP habitat), some improved and semi-improved pasture. The hedgerows are species rich with common elm, hawthorn, blackthorn, elder, ash, dog rose, hornbeam, oak and crab apple amongst the most dominant species. The ground flora of these hedgerows support typical woodland/ shade tolerant species such as primrose, lords and ladies, lesser celandine, ground ivy, red dead nettle cow parsley and alexanders. There are frequent mature standard trees within the hedgerows. These provide excellent nesting habitats for birds and foraging commuting and potentially roosting habitat for bats. They provide sub-optimal habitat for reptiles.

4.3.11 Semi-improved grassland

There were small areas of more species rich grassland within the floodplain of the water courses which come under the category of coastal and floodplain grazing marsh (LBAP Habitat). They were semi-improved neutral grassland with soft rush.

4.3.12 Woodlands

The agricultural landscape is dotted with small pockets of mature semi-natural broadleaved and mixed woodland, copses and old plantation shelter belts – not named (LBAP Habitat). These have well formed canopies including common elm and ash with occassional scots pine and larch and understories of hawthorn and elder with ground layers of violet, primrose, nettle, lords and ladies, lesser celandine, alexanders, wood avens, false oat grass and false brome amongest others. There are some areas where cherry laurel and rhododendron may become invasive. Many of these woodlands are linked to eachother via hedgerows and ditches and many support small waterbodies within. In addition to roosting foraging and commuting bats they are likely to support breeding great crested newts and setting badger.

4.3.13 Watercourses

There are two major rivers (designated as Main Rivers) River Alde, which, flows north to south crossing the existing A12 east of Stratford St Andrew and west of Farnham and the River Ore, which flows southeast through Marlesford before deviating eastwards before it joins the River Alde (approximately 25 km south of Farnham).

To the west of the proposed options the next Main River is the River Deben, whilst to the east the next main river is the River Fromus.

The Ore and the Alde have many tributaries in the area mostly low flow at the time of survey. Rapid flow through during heavy rain though as erosion was noted. Larger rivers have tree lined banks of mature willow and alder and have the potential to support otter and water vole and roosting, foraging and commuting bats. The riparian zone would also support reptiles. Occasionally, water vegetation such as water cress and flag iris was noted.

4.3.14 Ponds

There are a large number of ponds within the agricultural landscape, many within wooded copses. Many of these have the potential to support great crested newts (GCN).

4.3.15 Protected Species

Protected species records are provided in Appendix 2.3G. There legislative protection is outlined in Appendix 2.3E and their conservation status relating to conservation objectives has been considered using the WebTAG methodology outlined in section 2, above.

The following receptors were scoped out as either not present or not likely to be affected significantly by any of the route options:

- White clawed crayfish – no records and no suitable habitats
- Dormouse – no records and sub optimal habitats
- Wintering birds – unlikely to be significantly affected by any of the route options

Buildings were not assessed for their potential to support roosting bats or barn owl as in addition to lack of access for these areas it is assumed that no buildings will be demolished for the road construction.

4.3.15.1 Water vole and Otter

The Alde and the Ore rivers both have records of both water vole and otter and the banks of these rivers are suitable for otter holts and water vole burrows being grassy banks lined with mature willow and alder. The numerous tributaries of these rivers set within the flood plain would also provide suitable habitat for these species.

4.3.15.2 Great crested Newts (GCN)

There are a large number of ponds with the agricultural setting with the potential to support GCN and many are connected by hedgerows to other ponds and wooded copses. There are records of GCN in the area and Dew’s Pond SAC is within 3km that is specifically designated for GCN indicating that GCN are prevalent in the area.

4.3.15.3 Badger

The agricultural fields provide excellent foraging habitat and they are connected to multiple wooded copses that could support setting badgers. There are records of badgers in the area.

4.3.15.4 Nesting Birds

The hedgerows, woodlands and mature trees offer excellent nesting and foraging habitats for breeding birds. There were records of common birds in the area which is likely to support LBAP species such as dunnock, starling, song thrush, lapwing, tree sparrow, linnet, skylark, grey partridge and lesser spotted woodpecker.

4.3.15.5 Bats

The hedgerows, mature trees and woodlands combined with the waterbodies make excellent commuting and foraging habitat for bats which may roost within mature trees. There are records of common and soprano pipistrelle and brown long eared bat (BLE) in the area (LBAP species) including BLE and pipistrelle roosts in Benhall.

4.3.15.6 Reptiles

Although much of the habitat was sub-optimal, field margins, hedgerows and riparian corridors would support reptiles, there are records of grass snake within the study area and it is likely that the habitat would also support common lizard and slow worm also (LBAP species).

4.3.15.7 Fish and Aquatic invertebrates

These have not been assessed in detail and please see the Water Resource Section for greater detail but the majority of the watercourses would support stickleback and common invertebrates. The larger rivers would support eels (also an LBAP species), brook lamprey and sea trout and there are records from the River Ore of these species.

4.3.15.8 Other notable species

It is likely that the landscape would support UK and LBAP species such as brown hare, hedgehog, other amphibians and a range of terrestrial invertebrates.

4.3.16 Potential Impacts

Following identification of the key receptors the potential effects from the route options were assessed;

4.3.16.1 Construction Impacts

- Habitat Loss from the working corridor
- Fragmentation from the working corridor
- Direct Mortality from vegetation clearance and construction
- Disturbance from vegetation clearance and construction
- Pollution/Deposition from construction vehicles
- Pollution/Runoff from construction vehicles and sedimentation to water courses
- Lighting for late evening early morning working during winter

4.3.16.2 Operational Impacts

- Permanent Habitat Loss from the road
- Direct mortality/Road Traffic Accidents (RTAs)
- Noise from the traffic
- Severance permanently due to the road

- Disturbance from the traffic
- Pollution/Deposition from aerial particulates
- Pollution/Runoff from the road
- Recreational increased use of areas
- Littering/Vandalism
- Lighting

4.3.17 Summary Potential Effects

Please review Table 4.3.5 for the summary of the key potential effects and required mitigation for the route options that are of moderate adverse or above. The potential effects for all established potential effects are as detailed and summarised in the WebTAG Table in Appendix 2.3A Tables A1 to A4 for each receptor.

The illustrative alignment for SB5 has the potential to affect a number of habitats. Construction of this section of the road will likely cause direct habitat loss of arable fields, floodplain grazing marsh and sections of three woodlands. In addition, there is potential for indirect effects upon Foxburrow Wood Ancient Woodland, such as increased disturbance of wildlife and effects from increased accessibility and pollution. Two notable sections of hedgerow are to be bisected by the SB5 routing, causing fragmentation and damage to this important habitat and reducing its value as a movement corridor for wildlife. There will also be an increase in habitat fragmentation between different woodlands and ponds due to the road. This may affect multiple species and groups, but is likely to predominately affect bat commuting routes and increase isolation between GCN habitats, if this species is present).

The potential effects in general are habitat loss of small amounts of woodland and hedgerows and small amounts of agricultural land with significant effects on the floodplains of the River Alde and Ore. Some ponds may be lost and culverting of rivers and ditches may be required with potential for pollution to watercourses and watercourses that drain to Alde/Ore designated sites complex. There will be permanent fragmentation of these habitats prior to mitigation. There is also potential for direct mortality, habitat loss and fragmentation of habitat and disturbance to faunal receptors.

With regards to valued fauna, the routing is likely to affect a number of species and groups. The woodland plantations are likely to support badgers and nesting birds, and common reptiles are likely to be present within any field or woodland edge habitats as are commuting and foraging bats, there may also be tree roosts present. The river floodplains may support water vole populations of which are in national decline. A large number of ponds are present in the vicinity of the routing, therefore the potential presence of GCN must be considered, especially as there are records of GCN presence in the area. The works have the potential to cause a loss of GCN terrestrial habitat, fragmentation of meta populations and therefore a reduction of fitness in the overall GCN population which could compromise its favourable conservation status in the area.

In this summary only effects of moderate or above, that are likely to differentiate the route options are presented, full assessment is presented in the aforementioned appendices. Some species for example such as nesting birds will be slightly adversely affected on every route.

The mitigation for these works is likely to be significant and the success of which is uncertain, for example bridging certain areas may be required rather than culverting, under road tunnels for connectivity and offset mitigation in addition to the extensive surveying and protected species surveys, licensing, and potential translocation/ exclusion that will also be required, for example with regards to water vole bats, GCN and badger. Therefore the cost of mitigating impacts should be considered for each option during decision making.

Prior to mitigation the overall predicted significance of the impacts on each route is as follows:

- Link 1 Slight Adverse
- Link 2 Slight Adverse (1 Moderate adverse Benhall complex)
- SB1 Moderate Adverse
- SB2 Moderate Adverse
- LB3 Slight to Moderate
- SB4 Slight Adverse
- SB5 Moderate Adverse

4.3.17.1 Link 1

Summary assessment score: SLIGHT ADVERSE

The majority of impacts upon receptors associated with Link 1 are assessed as being neutral or slight adverse.

Qualitative comments:

The illustrative alignment for Link 1 does not bisect internationally designated sites and no sites of designated for national or international importance for nature is present within 500m of the works. Internationally designated sites are present within 5km of the routing; although the closest of these is over 3km from the proposed works they are hydrologically linked to the drainage systems in the areas therefore although it is considered unlikely there is a small chance that these designated sites would be adversely impacted by Link 1 as proposed.

Great Wood Ancient Woodland, which is a CWS, is approximately 300m from the works and not anticipated to be affected by Link 1.

The illustrative alignment for Link 1 has the potential to affect a number of habitats. Dualling of this section of the road will likely cause direct habitat loss of arable fields and sections of two plantation woodlands but these are not of more than local value. There will also be an increase in habitat fragmentation due to the increased width of the road; however the landscape is already bisected by the road so the resultant increase in fragmentation effect will be minor.

With regards to valued fauna, the routing is likely to affect a number of species and groups. The woodland plantations are likely to support badgers and nesting birds, and common reptiles are likely to be present within any field or woodland edge habitats. A number of ponds are present in the vicinity of the routing, therefore the potential presence of GCN must be considered, especially as there are records of GCN presence in the area. The works have the potential to cause a loss of GCN terrestrial habitat.

4.3.17.2 Link 2

Summary assessment score: SLIGHT ADVERSE (1 MODERATE, Benhall Plantation Complex)

All impacts upon valued receptors associated with the Link 2 proposal are assessed as being neutral or slight adverse with the exception of direct habitat loss to the Benhall Plantation Woodland Complex.

Qualitative comments:

The illustrative alignment for Link 2 does not bisect any nationally or internationally designated sites and no sites of designated importance for nature are presence within 500m of the works. Internationally designated sites are present within 5km of the routing, although the closest of these is over 3km from the proposed works they are hydrologically linked to the drainage systems in the areas therefore all though it is considered unlikely there is a small chance that these designated sites would be adversely impacted by Link 2 as proposed.

The illustrative alignment for Link 2 has the potential to have a slight adverse effect on a number of valuable habitats. Direct habitat loss resultant from the routing may cause the loss of young (<20 years old) broad-leaved and mixed plantation woodland. Although in itself not a hugely valuable habitat and not listed on the Suffolk BAP, this habitat has the potential to support a range of valued faunal species and groups, including badger and nesting birds. Multiple ponds are present in the vicinity of the routing and GCN are known to be in the area. Therefore, the routing has the potential to affect GCN terrestrial habitats and fragment populations resulting in a loss of fitness of the overall population.

4.3.17.3 SB1 (Pink Route)

Summary assessment score: MODERATE ADVERSE

The routing for SB1 impacts upon a range of receptors overall, most significantly is the River Alde and its associated floodplain.

Qualitative comments:

The illustrative alignment for SB1 does not bisect internationally designated sites. Internationally designated sites are present within 5km of the routing, although the closest of these is over 3km from the proposed works they are hydrologically linked to the drainage systems in the areas therefore all though it is considered unlikely there is a small chance that these designated sites would be adversely impacted by Routing SB1 as proposed.

The illustrative alignment for SB1 has the potential to affect a number of habitats. The moderate adverse effects come from the culverting of multiple tributaries of the River Alde which will support otter and water vole and associated habitat loss of the floodplain grazing marsh and the fragmentation of numerous ponds and water bodies that may support GCN.

Construction of this route will likely cause direct habitat loss of arable fields and sections of woodland and hedgerow, which potentially support species including bats, badgers and birds. Common reptiles are likely to be present within any field or woodland edge habitats. There will also be an increase in overall habitat fragmentation due to the creation of the road for this routing.

4.3.17.4 SB2 (Green Route)

Summary assessment score: MODERATE ADVERSE

The routing for SB2 impacts upon a range of receptors the majority of which are associated with the River Alde and fragmentation of ponds, woodlands and hedgerows.

Qualitative comments:

The illustrative alignment for SB2 does not bisect internationally designated sites. Internationally designated sites are present within 5km of the routing, although the closest of these is over 3km from the proposed works they are hydrologically linked to the drainage systems in the areas therefore all though it is considered unlikely there is a small chance that these designated sites would be adversely impacted by Routing SB2 as proposed. There is some potential for downstream impacts, discussed below.

The illustrative alignment for SB2 has the potential to affect a number of habitats. The key impacts will be upon habitats associated with the River Alde, namely the floodplain grazing marsh (a Suffolk BAP habitat) and a number of tributaries associated with the river. These habitats and features are inherently valuable, but may also support a number of protected and valuable floral and faunal species, including water voles, otters, birds and reptiles. There is also the potential for there to be impacts downstream upon the Alde and Ore Estuaries designated sites (i.e. from pollution effects). A significant number of ponds, woodlands and hedgerows would also be fragmented.

Construction of this routing will likely cause direct habitat loss of arable fields and sections of woodland. There will also be an increase in habitat fragmentation due to the creation of the road.

With regards to valued fauna, the routing is likely to affect a number of species and groups. The woodlands in the vicinity of the routing are likely to support badgers and nesting birds, and common reptiles are likely to be present within any field or woodland edge habitats. A number of ponds are present in the vicinity of the routing, therefore the potential presence of GCN must be considered and any pond fragmentation effects addressed. The routing has the potential to affect GCN terrestrial habitats and fragment populations resulting in a loss of fitness of the overall population. Water vole may also be moderately adversely affected due to the multiple tributaries crossed.

4.3.17.5 LB3 (Orange Route)

Summary assessment score: SLIGHT TO MODERATE ADVERSE

Overall, the majority of notable impacts to receptors are slight to moderate adverse.

Qualitative comments:

The illustrative alignment for LB3 does not bisect internationally designated sites. Internationally designated sites are present within 5km of the routing, although the closest of these is over 3km from the proposed works they are hydrologically linked to the drainage systems in the areas therefore all though it is considered unlikely there is a small chance that these designated sites would be adversely impacted by Routing SB3 as proposed.

Great Wood CWS which is woodland (within which there is an area of Ancient Woodland) is attached to Pound Wood which is bisected by the route to the north of the existing A12; although from the works do not directly affect the Ancient Woodland compartment. The likely impact upon this site may result from direct loss and damage of this habitat, pollution effects from the creation of the road and its operation, fragmentation increased RTA;'s and disturbance to and wildlife associated with the woodland during the construction of the road and its subsequent operation.

The illustrative alignment for LB3 has the potential to affect a number of valued habitat receptors. Construction of this section of the road will likely cause direct habitat loss of hedgerows, multiple woodlands in addition to any effects upon Great Wood CWS. The impacts to these woodlands will vary greatly, however the majority of impacts are assessed as being moderate adverse.

A notable section of hedgerow is be bisected by the LB3 routing, causing fragmentation and damage to this important habitat and reducing its value as a movement corridor for wildlife. There will also be an increase in habitat fragmentation due to the road. This may affect multiple species and groups, but is likely to predominately affect bat commuting routes and increase isolation between ponds (an issue with regards to GCN habitats, if this species is present).

With regards to valued fauna, the routing is likely to affect a number of species and groups. The woodland plantations are likely to support badgers and nesting birds, and common reptiles are likely to be present within any field or woodland edge habitats. A number of ponds are present in the vicinity of the routing, therefore the potential presence of GCN must be considered, especially as there are records of GCN presence in the area. The works have the potential to cause a loss of GCN terrestrial habitat and fragmentation of populations.

4.3.17.6 SB4 (Red Route)

Summary assessment score: SLIGHT ADVERSE

Overall, the majority of notable impacts to receptors are slight adverse.

Qualitative comments:

The illustrative alignment for SB4 does not bisect internationally designated sites. Internationally designated sites are present within 5km of the routing, although the closest of these is over 3km from the proposed works they are hydrologically linked to the drainage systems in the areas therefore all though it is considered unlikely there is a small chance that these designated sites would be adversely impacted by Routing SB4 as proposed.

Great Wood CWS which is woodland (on the Ancient Woodland Inventory) that is attached to Pound Wood which is bisected by the works, although from the works do not directly affect the Ancient woodland compartment. The likely impact upon this site may result from direct loss and damage of this habitat, pollution effects from the creation of the road and its operation, increased RTA;'s and disturbance to and wildlife associated with the woodland during the construction of the road and its subsequent operation.

The illustrative alignment for SB4 has the potential to affect a number of valued habitat receptors. There will be fragmentation of some woodlands and numerous ponds. A notable section of hedgerow is be bisected by the SB4 routing, causing fragmentation and damage to this important habitat and reducing its value as a movement corridor for wildlife. Habitat fragmentation may affect multiple species and groups, but is likely to predominately affect bat commuting routes and increase isolation between ponds (an issue with regards to GCN habitats, if this species is present).

With regards to valued fauna, the routing is likely to affect a number of species and groups. The woodland plantations are likely to support badgers and nesting birds, and common reptiles are likely to be present within any field or woodland edge habitats. A number of ponds are present in the vicinity of the routing, therefore the potential presence of GCN must be considered, especially as there are records of GCN presence in the area. The works have the potential to cause a loss of GCN terrestrial habitat. Therefore, the routing has the potential to affect GCN terrestrial habitats and fragment populations resulting in a loss of fitness of the overall population.

4.3.17.7 SB5 (Blue Route Dual)

Summary assessment score: MODERATE ADVERSE

The routing for SB5 impacts upon a range of receptors. Overall, the largest impact is on Foxburrow wood which would not be easily mitigated. Multiple fragmentations of woodlands, ponds and watercourses are also significant issue.

Qualitative comments:

The illustrative alignment for SB5 does not bisect internationally designated sites. Internationally designated sites are present within 5km of the routing, although the closest of these is over 3km from the proposed works they are hydrologically linked to the drainage systems in the areas therefore all though it is considered unlikely there is a small chance that these designated sites would be adversely impacted by Routing SB5 as proposed. Foxburrow Wood Ancient Woodland, which is designated as both an Ancient Woodland and a CWS, is approximately 10m from the works and the working corridor would likely cause direct adverse effects. The likely impact upon this woodland may result from direct loss and damage of this habitat, pollution effects from the creation of the road and its operation, increased RTA;'s and disturbance to and wildlife associated with the woodland during the construction of the road and its subsequent operation.

The illustrative alignment for SB5 has the potential to affect a number of habitats. Construction of this section of the road will likely cause direct habitat loss of arable fields and sections of three woodlands in addition to any effects upon Foxburrow Wood Ancient Woodland. Two notable sections of hedgerow are to be bisected by the SB5 routing, causing fragmentation and damage to this important habitat and reducing its value as a movement corridor for wildlife. There will also be an increase in habitat fragmentation due to the road. This may affect multiple species and groups, but is likely to predominately affect bat commuting routes and increase isolation between ponds (an issue with regards to GCN habitats, if this species is present).

With regards to valued fauna, the routing is likely to affect a number of species and groups. The woodland plantations are likely to support badgers and nesting birds, and common reptiles are likely to be present within any field or woodland edge habitats. A number of ponds are present in the vicinity of the routing, therefore the potential presence of GCN must be considered, especially as there are records of GCN presence in the area. Therefore, the routing has the potential to affect GCN terrestrial habitats and fragment populations resulting in a loss of fitness of the overall population. The works have the potential to cause a loss of GCN terrestrial habitat. Water vole may also be moderately adversely affected due to the multiple tributaries crossed.

SB5 (Blue Route Single)

Impacts relating to routing SB5 are associated with crossing of the River Alde, but also predicted impacts upon woodlands, including an ancient woodland which lies nearby, but is not bisected by the routing, Foxburrow Wood Ancient Woodland. This woodland is designated as both an Ancient Woodland and a CWS, and is approximately 20m south from the works. Although the working corridor would not be likely to cause direct loss and damage of this habitat, in direct operational effects from the creation of the road such as degradation of the habitat via increased particulate pollution deposition and recreation is possible.

The illustrative alignment for SB5 has the potential to affect a number of habitats in addition to direct habitat loss of arable fields, hedgerows and sections of three woodlands.

In addition numerous woodlands, hedgerows and ponds will be fragmented from each other by the SB5 routing.

With regards to valued fauna, routing SB5 is likely to affect a number of species and groups. The woodland plantations are likely to support badgers and nesting birds, and common reptiles are likely to be present within any field or woodland edge habitats. A number of ponds are present in the vicinity of the routing, therefore the potential presence of GCN must be considered, especially as there are records of GCN presence in the area. Therefore, the routing has the potential to affect GCN terrestrial habitats and fragment populations resulting in a loss of fitness of the overall population (if this species is present).

Overall, in the absence of mitigation, the impact of both routings with mitigation is foreseen to be Moderate Adverse. With the overall key impacts bring the potential fragmentation of the River Alde and the species it supports (GCN, water vole and otter) through multiple bridge and culverting and occasional fragmentation of woodlands, ponds, hedgerows and arable margins (SB1) and the frequent fragmentation of numerous woodlands, ponds, hedgerows and arable and the protected species they maintain.

4.3.18 Mitigation

Temporary construction effects will be mitigated by the construction mitigation presented in Appendix 2.3F. For example indirect pollution to hydrologically linked designated sites would be prevented by adherence to Pollution Prevention Guidelines resulting in no residual effects. Direct mortality of protected faunal species would be prevented via pre-construction surveys of the chosen route combined with the mitigation presented in Appendix 2.3F if required. Habitat not within the working corridor will be protected. Pre-construction surveys for key receptors would be required as outlined in Appendix 2.3F within the route corridor of the chosen route option to confirm the requirement of these mitigations. Seasonal survey timings are presented in Appendix 2.3E. In terms of residual temporary construction impacts only disturbance at a site level is predicted and this disturbance is not likely to be significant.

Operational effects will be mitigated through design as can be seen in Appendix 2.3F. Any habitat lost would be replaced and fragmentation minimised, for example new culverts would be designed to be suitable for safe passage for otter, water vole and bats. Population assessment of great crested newts would determine whether the fragmentation of ponds would adversely affect the favourable conservation status of that species and appropriate underpasses and replacement habitat would be created as required. Where online mitigation cannot be undertaken offset mitigation may be required.

Summary route option effects of those potential impacts greater than slight adverse and specific mitigation required is presented in Table 4.3.5, below.

N.B. Only impacts upon receptors assessed as ‘Moderate Adverse’ or larger are included within this table (with the exception of designated sites). All impacts are listed in WebTAG table Appendix 2.3A.

Table 4.3.5: Biodiversity Assessment Summary Table – A12 and Four Villages

Route	Qualitative Impacts	Assessment	**Mitigation** N.B. Please See Mitigation Table in Appendix F for full details.	Residual Effects With Mitigation
Link 1	**Designated Sites** Small potential for indirect effects to hydrologically linked designated sites.	**Slight Adverse**	Construction mitigation to prevent run off or sedimentation into connected drainage ditches and rivers	None
	All other impacts upon receptors Slight Adverse.	**Slight Adverse**	Construction good practice and positioning to reduce impacts. Mitigation for loss of habitat and replacement habitat. Species specific mitigation may be required.	None
Link 2	**Designated Sites** Small potential for indirect effects to hydrologically linked designated sites.	**Slight Adverse**	Construction mitigation to prevent run off or sedimentation into connected drainage ditches and rivers	None
	Butchers Hole and Benhall Lodge Park Woodland complex and hedgerow North of the existing A12 dualling would result in loss of habitat of this complex within which are ponds and connected woodland blocks. Benhall also supports pipistrelle and brown long-eared bat roosts.	**Moderate Adverse**	This habitat loss could be avoided if dualling was weighted towards the southern side of the existing road where there is less valuable habitat	None

Route	Qualitative Impacts	Assessment	**Mitigation** N.B. Please See Mitigation Table in Appendix F for full details.	Residual Effects With Mitigation
	All other impacts upon receptors Slight Adverse.	**Slight Adverse**	Construction good practice and positioning to reduce impacts. Mitigation for loss of habitat and replacement habitat. Species specific mitigation may be required.	Slight Adverse depending on the success of the mitigation
SB1	**Designated Sites** Small potential for indirect effects to hydrologically linked designated sites.	**Slight Adverse**	Construction mitigation to prevent run off or sedimentation into connected drainage ditches and rivers	None
	Butchers Hole and Benhall Lodge Park Woodland complex and hedgerows of the existing A12 dualling would result in loss of habitat of this complex within which are ponds and connected woodland blocks. Benhall also supports pipistrelle and brown long-eared bat roosts.	**Moderate Adverse**	This habitat loss could be avoided if dualling was weighted towards the southern side of the existing road where there is less valuable habitat	None

Route	Qualitative Impacts	Assessment	**Mitigation** N.B. Please See Mitigation Table in Appendix F for full details.	Residual Effects With Mitigation
	Coastal and Floodplain Grazing Marsh Much of the route is within this habitat to the north and south of the existing road this habitat is part of an important ecosystem complex that provides multiple services. The road would cause habitat loss and fragmentation	**Moderate Adverse**	Consideration should be given to a bridge crossing to minimise habitat loss and fragmentation. If a culvert is chosen culvert designs to be suitable for safe passage for otter, watervole and bats. Over road passage points will also be created via roadside planting to encourage bats and birds up and over the road.	Slight Adverse
	River Alde Crossing of river Alde will need to be a bridge designed with consideration of	**Moderate Adverse**	Consideration should be given to a bridge crossing to minimise habitat loss and fragmentation. If a culvert is chosen culvert designs to be suitable for safe passage for otter, watervole and bats. Over road passage points will also be created via roadside planting to encourage bats and birds up and over the road.	Slight Adverse

Route	Qualitative Impacts	Assessment	Mitigation N.B. Please See Mitigation Table in Appendix F for full details.	Residual Effects With Mitigation
	Numerous small tributaries of the River Alde Eight tributaries will be crossed by the current routing. Construction of crossings will need to be designed to ensure impacts upon the ecological value of these features is minimised.	**Moderate Adverse**	Consideration should be given to a bridge crossing to minimise habitat loss and fragmentation. If a culvert is chosen culvert designs to be suitable for safe passage for otter, watervole and bats. Over road passage points will also be created via roadside planting to encourage bats and birds up and over the road.	Slight Adverse to Moderate Adverse
	Water voles. Multiple tributaries which may support water voles may be culverted which would result in habitat loss and fragmentation of habitat	**Moderate Adverse**	Pre-construction surveys would be required and a Natural England Conservation Licence with appropriate translocation and habitat creation would be required. Offsite mitigation may be required.	Slight Adverse depending on the success of the mitigation
SB2	**Designated Sites** Small potential for indirect effects to hydrologically linked designated sites.	**Slight Adverse**	Construction mitigation to prevent run off or sedimentation into connected drainage ditches and rivers	None

Route	Qualitative Impacts	Assessment	**Mitigation** N.B. Please See Mitigation Table in Appendix F for full details.	Residual Effects With Mitigation
	Butchers Hole and Benhall Lodge Park Woodland complex North of the existing A12 dualling would result in loss of habitat of this complex within which are ponds and connected woodland blocks. Benhall also supports pipistrelle and brown long-eared bat roosts.	**Moderate Adverse**	This habitat loss could be avoided if dualling was weighted towards the southern side of the existing road where there is less valuable habitat	None
	Coastal and Floodplain Grazing Marsh Much of the route is within this habitat to the north and south of the existing road this habitat is part of an important ecosystem complex that provides multiple services. The road would cause habitat loss and fragmentation	**Moderate Adverse**	Consideration should be given to a bridge crossing to minimise habitat loss and fragmentation. If a culvert is chosen culvert designs to be suitable for safe passage for otter, watervole and bats. Over road passage points will also be created via roadside planting to encourage bats and birds up and over the road.	Slight Adverse

Route	Qualitative Impacts	Assessment	**Mitigation** N.B. Please See Mitigation Table in Appendix F for full details.	Residual Effects With Mitigation
	River Alde Crossing of river Alde will need to be a bridge designed with consideration of	**Moderate Adverse**	Consideration should be given to a bridge crossing to minimise habitat loss and fragmentation. If a culvert is chosen culvert designs to be suitable for safe passage for otter, watervole and bats. Over road passage points will also be created via roadside planting to encourage bats and birds up and over the road.	Slight Adverse
	Numerous small tributaries of the River Alde Eight tributaries will be crossed by the current routing. Construction of crossings will need to be designed to ensure impacts upon the ecological value of these features is minimised.	**Moderate Adverse**	Consideration should be given to a bridge crossing to minimise habitat loss and fragmentation. If a culvert is chosen culvert designs to be suitable for safe passage for otter, watervole and bats. Over road passage points will also be created via roadside planting to encourage bats and birds up and over the road.	Slight Adverse
	Water voles Multiple tributaries which may support water voles may be culverted which would result in habitat loss and fragmentation of habitat	**Moderate Adverse**	Pre-construction surveys would be required and a Natural England Conservation Licence with appropriate translocation and habitat creation would be required. Offsite mitigation may be required.	Slight Adverse depending on the success of the mitigation

Route	Qualitative Impacts	Assessment	**Mitigation** N.B. Please See Mitigation Table in Appendix F for full details.	Residual Effects With Mitigation
	Hedgerows At least six hedgerows will be bisected and / or directly affected by the routing. Mitigation to ensure the routing does not affect the connective properties of these features may be required (i.e. underpasses and / or bat crossings).	**Moderate Adverse**	Habitat will be replaced. Culvert designs to be suitable for safe passage for otter, watervole and bats. Over road passage points will also be created via roadside planting to encourage bats and birds up and over the road.	Slight Adverse
	Small tributaries and ditches (unnamed) Three tributaries will be crossed by the current routing. Construction of crossings will need to be designed to ensure impacts upon the ecological value of these features is minimised.	**Moderate Adverse**	Pre-construction surveys would be required and a Natural England Conservation Licence with appropriate translocation and habitat creation would be required. Offsite mitigation may be required.	Slight Adverse
	Water voles Multiple tributaries which may support water voles may be culverted which would result in habitat loss and fragmentation of habitat	**Moderate Adverse**	Pre-construction surveys would be required and a Natural England Conservation Licence with appropriate translocation and habitat creation would be required. Offsite mitigation may be required.	Slight Adverse depending on the success of the mitigation
LB3	**Designated Sites** Small potential for indirect effects to hydrologically linked designated sites.	**Slight Adverse**	Construction mitigation to prevent run off or sedimentation into connected drainage ditches and rivers	None

Route	Qualitative Impacts	Assessment	**Mitigation** N.B. Please See Mitigation Table in Appendix F for full details.	Residual Effects With Mitigation
	Pound Wood (plantation woodland which directly connects to Great Wood AWI) and other woodlands Habitat loss and fragmentation of Pound woodland which is directly connected to Great Wood. At least five additional named woodlands are likely to be fragmented or isolated. One other plantation of local value will be impacted by habitat loss	**Moderate Adverse**	Screening from the road via habitat replacement, offset mitigation via a management plans for the woodlands. Culvert designs to be suitable for safe passage for otter, watervole and bats. Over road passage points will also be created via roadside planting to encourage bats and birds up and over the road.	Slight Adverse
	Coastal and Floodplain Grazing Marsh Much of the route is within this habitat to the north and south of the existing road this habitat is part of an important ecosystem complex that provides multiple services. The road would cause habitat loss and fragmentation	**Moderate Adverse**	Consideration should be given to a bridge crossing to minimise habitat loss and fragmentation. If a culvert is chosen culvert designs to be suitable for safe passage for otter, watervole and bats. Over road passage points will also be created via roadside planting to encourage bats and birds up and over the road.	Slight Adverse

Route	Qualitative Impacts	Assessment	**Mitigation** N.B. Please See Mitigation Table in Appendix F for full details.	Residual Effects With Mitigation
	River Ore Crossing of river Ore will need to be a bridge designed with consideration of potential impacts upon the river and sites downstream. Design must ensure no loss of habitat connectivity.	**Moderate Adverse**	Consideration should be given to a bridge crossing to minimise habitat loss and fragmentation. If a culvert is chosen culvert designs to be suitable for safe passage for otter, watervole and bats. Over road passage points will also be created via roadside planting to encourage bats and birds up and over the road.	Slight Adverse
	Small tributaries and ditches (unnamed) There were multiple small tributaries or ditches within 500m of the road. The majority of these form part of a network of ditches associated with the River Ore. Construction of crossings will need to be designed to ensure impacts upon the ecological value of these features is minimised.	**Moderate Adverse**	Riparian habitat will be replaced. Culvert designs to be suitable for safe passage for otter, watervole and bats. Over road passage points will also be created via roadside planting to encourage bats and birds up and over the road.	Slight Adverse

Route	Qualitative Impacts	Assessment	**Mitigation** N.B. Please See Mitigation Table in Appendix F for full details.	Residual Effects With Mitigation
	Ponds Five ponds lie adjacent to the routing and may be directly impacted. In total twenty six ponds are in the vicinity of the routing, measures to ensure connectivity between them is maintained will be required. **Potential for moderate adverse impact upon GCN** Although no ponds will be directly impacted by the works, substantial areas of potential GCN terrestrial habitat will be lost and connectivity between ponds will be fragmented. Mitigation and licensing may be required.	**Slight/ Moderate Adverse**	Pre-construction surveys of the chosen route would be required. These surveys would reveal the connections between GCN meta populations and enable the design of suitable underpasses and replacement breeding and terrestrial habitat.NE protected species licensing and associated mitigation is likely to be required.	Slight Adverse depending on the success of the mitigation
	Water voles Multiple tributaries and closely positioned ponds which may support water voles may be culverted and or lost which would result in habitat loss and fragmentation of habitat	**Moderate Adverse**	Pre-construction surveys would be required and a Natural England Conservation Licence with appropriate translocation and habitat creation would be required. Offsite mitigation may be required.	Slight Adverse depending on the success of the mitigation

Route	Qualitative Impacts	Assessment	**Mitigation** N.B. Please See Mitigation Table in Appendix F for full details.	Residual Effects With Mitigation
SB4	**Designated Sites** Small potential for indirect effects to hydrologically linked designated sites.	**Slight Adverse**	Construction mitigation to prevent run off or sedimentation into connected drainage ditches and rivers	None
	Marlesford Roadside Nature Reserve (RNR) Supports a protected fungus within this site and the alignment would cause habitat loss.	**Moderate Adverse**	Avoid the area via road alignment design to prevent habitat loss.	None depending on the success of the mitigation
	Pound Wood (plantation woodland which directly connects to Great Wood AWI) and other woodlands Habitat loss and fragmentation of Pound woodland which is directly connected to Great Wood. Two unnamed woodlands will be directly impacted by the works, although no woodlands are bisected by the routing. At least five additional named woodlands are likely to be fragmented or isolated.	**Moderate Adverse**	Screening from the road via habitat replacement, offset mitigation via a management plans for the woodlands. Culvert designs to be suitable for safe passage for otter, watervole and bats. Over road passage points will also be created via roadside planting to encourage bats and birds up and over the road.	Slight Adverse

Route	Qualitative Impacts	Assessment	**Mitigation** N.B. Please See Mitigation Table in Appendix F for full details.	Residual Effects With Mitigation
	Ponds There were 21 unnamed ponds within 500m of the works Of these, five are adjacent or very close to the proposed route and are likely to be directly affected by the proposed works. **Potential for moderate adverse impact upon GCN** Ponds will be directly and indirectly impacted by the work and substantial areas of potential connecting GCN terrestrial habitat will be lost.	**Moderate Adverse**	Pre-construction surveys of the chosen route would be required. These surveys would reveal the connections between GCN meta populations and enable the design of suitable underpasses and replacement breeding and terrestrial habitat.NE protected species licensing and associated mitigation is likely to be required.	Slight Adverse depending on the success of the mitigation
SB5	**Designated Sites** Small potential for indirect effects to hydrologically linked designated sites.	**Slight Adverse**	Construction mitigation to prevent run off or sedimentation into connected drainage ditches and rivers	None
	Coastal and Floodplain Grazing Marsh Much of the route is within this habitat to the north and south of the existing road this habitat is part of an important ecosystem complex that provides multiple services. The road would cause habitat loss and fragmentation	**Moderate Adverse**	Consideration should be given to a bridge crossing to minimise habitat loss and fragmentation. If a culvert is chosen culvert designs to be suitable for safe passage for otter, watervole and bats. Over road passage points will also be created via roadside planting to encourage bats and birds up and over the road.	Slight Adverse

Route	Qualitative Impacts	Assessment	**Mitigation** N.B. Please See Mitigation Table in Appendix F for full details.	Residual Effects With Mitigation
	River Alde Crossing of river Alde will need to be a bridge designed with consideration of	**Moderate Adverse**	Consideration should be given to a bridge crossing to minimise habitat loss and fragmentation. If a culvert is chosen culvert designs to be suitable for safe passage for otter, watervole and bats. Over road passage points will also be created via roadside planting to encourage bats and birds up and over the road.	Slight Adverse
	Numerous small tributaries of the River Alde At least three tributaries will be crossed by the current routing. Construction of crossings will need to be designed to ensure impacts upon the ecological value of these features is minimised.	**Moderate Adverse**	Consideration should be given to a bridge crossing to minimise habitat loss and fragmentation. If a culvert is chosen culvert designs to be suitable for safe passage for otter, watervole and bats. Over road passage points will also be created via roadside planting to encourage bats and birds up and over the road.	Slight Adverse

Route	Qualitative Impacts	Assessment	**Mitigation** N.B. Please See Mitigation Table in Appendix F for full details.	Residual Effects With Mitigation
	Foxburrow Wood Ancient Woodland and CWS (County Wildlife Site) The working corridor of the route is likely to cause direct habitat loss to the north west corner of this currently isolated woodland this would result in habitat loss, fragmentation, disturbance and overall reduction in quality of the habitat	**Large Adverse**	Ancient woodland is not replaceable. Impacts upon this habitat, including indirect impacts should be avoided.	Slight Adverse
	Pond Wood and Nuttery Belt These woodlands will be affected by habitat loss and fragmentation, 10 other named woodlands would be indirectly affected	**Moderate Adverse**	Screening from the road via habitat replacement, offset mitigation via a management plans for the woodlands. Culvert designs to be suitable for safe passage for otter, watervole and bats. Over road passage points will also be created via roadside planting to encourage bats and birds up and over the road. Underpasses in the vicinity of Pond Wood and Nuttery belt should be considered.	Slight Adverse depending on the success of the mitigation

Route	Qualitative Impacts	Assessment	**Mitigation** N.B. Please See Mitigation Table in Appendix F for full details.	Residual Effects With Mitigation
	Ponds In total Seventeen ponds are in the vicinity of the routing, measures to ensure connectivity between them is maintained will be required. **Potential for moderate adverse impact upon GCN** Although no ponds will be directly impacted by the works, substantial areas of potential GCN terrestrial habitat will be lost and connectivity between ponds will be fragmented. Mitigation and licensing may be required.	**Slight/ Moderate Adverse**	Pre-construction surveys of the chosen route would be required. These surveys would reveal the connections between GCN meta populations and enable the design of suitable underpasses and replacement breeding and terrestrial habitat.NE protected species licensing and associated mitigation is likely to be required.	Slight Adverse depending on the success of the mitigation
	Water voles Multiple tributaries and closely positioned ponds which may support water voles may be culverted and or lost which would result in habitat loss and fragmentation of habitat	**Moderate Adverse**	Pre-construction surveys would be required and a Natural England Conservation Licence with appropriate translocation and habitat creation would be required. Offsite mitigation may be required.	Slight Adverse depending on the success of the mitigation

4.3.19 Enhancement

Many of the woodlands have patches of Schedule 9 (WCA, 1981 as amended) non-native invasive plant species such as cotoneaster and rhododendron within (also cherry laurel while not on schedule 9 is invasive). Enhancement of these woodlands could be achieved by management of these species and specific woodland management to increase biodiversity.

Many of the watercourses have been culverted with poor passage for fish and other species and un-natural banks. When extending existing culverts these areas could be more sympathetically designed to encourage passage and reduce fragmentation.

4.3.20 Residual Effects

No residual effects on internationally designated sites are predicted. Similarly no residual effects are predicted on the SSSI’s in the area. There may be temporary construction disturbance to faunal at the site level but this is not expected to be significant. There may be increased operational mortality to birds, bats, badger and otter although these are unlikely to be significant. Route SB5 is unlikely to be adequately mitigated for due to the fragmentation of large stretches of connected Greenfield habitat including floodplain grazing marsh and the habitat loss and fragmentation of Foxburrow Wood which is on the AWI and multiple other woodlands. SB1 crosses at least eight tributaries of the River Alde with considerable design required to prevent significant residual fragmentation as mitigation.

4.4 Landscape

4.4.1 Introduction

The objective of DMRB Stage 1 Landscape Effects assessment is to "*undertake sufficient assessment to identify the landscape constraints associated with particular broadly defined routes or corridors*" (Design Manual for Roads and Bridges, Volume 11, Section 3, Part 5).

This section of the report identifies the potential landscape and visual constraints and broad effects associated with the five bypass route options facilitating the provision of access for construction traffic to Sizewell nuclear plant. A desktop study has been undertaken to broadly determine the landscape and visual constraints associated with the study area and the potential for effects to the character of the landscape and the visual amenity, and to inform the option appraisal process.

The five proposed bypass route options are described within Chapter 2 of this report and in summary comprise the following:

- SB1 Pink Bypass of Farnham and Stratford St Andrew;
- SB2 Green Northern Bypass;
- SB4 Red Bypass of Little Glemham;
- SB5 Pale Blue Southern Bypass of Strafford St Andrew and Farnham; and
- LB3 Orange Route to the South of Marlesfield and the north of Little Glemham.

4.4.2 Scope of Study

The study area considers the landscape and visual resource within 2km of the route options corridor as it is considered, that this distance is the limit within which the significant effects may arise.

4.4.3 Regulatory / Planning Policy Framework

4.4.3.1 National Planning Policy

The National Planning Policy Framework 2012 (NPPF) seeks to protect the environment and promote sustainable growth.

The overarching presumption in favour of sustainable development should form the basis of every planning decision. The NPPF aims to conserve and enhance the natural environment in part through the protection of valued landscapes.

4.4.3.2 Local Planning Policy

The study area is covered by The Suffolk Costal District Local Plan-Core Strategies and Development Management Policies (adopted 2013). This is the current local plan which will guide development across the district until 2027 and beyond. Policies relevant to the landscape include the following:

- SP15- Landscape and Townscape - This policy states that the council will seek to protect and enhance the various landscape character areas in addition to the Suffolk Coast & Heaths Area of Outstanding Natural Beauty (AONB), the valleys and tributaries of the rivers, Blyth, Deben, Fynn, Hundred, Mill, Minsmere, Ore, Orwell and Yox, and the designated Parks and Gardens of Historic or Landscape Interest are considered to be particularly significant. This policy also seeks to enhance and preserve the attributes that contribute to the historical and architectural value of the towns and villages.
- SP17- Green Space- this policy seeks to ensure that communities have well managed access to green space within settlements, countryside and coastal areas in order to benefit health, community cohesion and greater understanding of the environment, without detriment to wildlife and landscape character.

In addition to the Suffolk Costal District Local Plan-Core Strategies and Development Management Policies, local planning policy also considers the ‘Saved Policies’ from the Suffolk Costal Local Plan (2013). The following ‘Saved Policies’ are relevant to this assessment:

- AP4- Historic Parks and Gardens: This policy states ‘The District Council will encourage the preservation and/or enhancement of parks and gardens of historic and landscape interest and their surroundings. Planning permission for any proposed development will not be granted if it would have a materially adverse impact on their character, features or immediate setting.’
- AP13- Special Landscape Areas: This policy states that ‘The valleys and tributaries of the Rivers Alde, Blyth, Deben, Fynn, Hundred, Mill, Minsmere, Ore and Yox, and the Parks and Gardens of Historic or Landscape Interest are designated as Special Landscape Areas and shown on the Proposals Map. The District Council will ensure that no development will take place which would be to the material detriment of, or materially detract from, the special landscape quality.’

4.4.4 Baseline Conditions

The study area is shown on Appendix 2.4 and is located in the east of Suffolk, north east of Ipswich, between the settlements of Marlesford, Little Glemham, Farnham and Stratford St Andrew. The study area encompasses the existing A12 from where the B1078 crosses the A12 north of Woodbridge and the junction between the A12 and A1094 north of Farnham. The study area also includes an active east coast railway line, which runs north - south between Ipswich and Norwich. The A12 route corridor within the study area crosses the River Ore, south of Marlesford and the River Alde through Farnham. The rivers have fairly small catchments, with their headwaters further inland in the chalky uplands which are mainly flat or gently rolling landscapes that limits views between them.

Within the study area the landscape is broken by gently undulating rolling topography, woodland, well-treed hedgerows and winding lanes. In addition the historic landscape parks have a considerable visual contribution to the landscape, especially in places where they are on the gentle slopes of the valley sides, as can be seen to the south of Marlesford Hall.

In the wider context, the site falls within the Suffolk Coast and Heath National Character Area which comprises a predominantly low-lying landscape with some areas along the coastal plain below or at sea level. Farm woodlands, plantations and field boundary trees provide a treed character. Ancient broadleaved woodland and parkland wood pasture cloak the southern River valley however the coastal levels are largely devoid of trees.

4.4.5 Designations

See Appendix 2.4 for Designations

4.4.5.1 Suffolk Coast & Heaths Area of Outstanding Natural Beauty (AONB)

Located on the coast of East Anglia, the Suffolk Coast & Heaths AONB encompasses 155 square miles of wildlife-rich wetlands, ancient heaths, windswept shingle beaches and historic towns and villages. The AONB extends from the Stour Estuary in the south to Kessingland in the north; it is a low lying costal area. The AONB sits across the character areas of: Estate Sandlands, Rolling estate Sandlands, Coastal Levels, Coastal Dunes and shingle ridges and Plateau estate farmlands. The Suffolk Coast & Heaths AONB is a nationally valued landscape and lies approximately 3.7km to the eastern boundary of the study area.

4.4.5.2 Special Landscape Areas (SLA)

Special Landscape Areas are locally designated landscapes where the inherent attributes of the landscape, which are particularly vulnerable to change, are protected due to their resulting special landscape quality. They include some river valleys which still possess traditional grazing meadows and marshes, with their hedgerows, dykes and associated flora and fauna. There is one SLA that covers the majority of the Study area:

- Upper Deben Valley SLA

4.4.5.3 Registered Parks and Gardens

The Register of Parks and Gardens, produced by English Heritage identifies England’s most important historic designed landscapes. The Suffolk Coastal District Council encourages the preservation and or the enhancement of parks and gardens of historic and landscape interest and their surroundings. There are two Registered Parks and Gardens of national importance within the study area:

- Campsey Ashe Park –the 17th century, 66.5 ha park lies in the southernmost section of the study area and consists of formal gardens, surviving canals, yew hedges and bowling green in addition to main avenues radiating from the House across the park.
- Glemham Hall Park - Glemham Hall lies along the eastern side of the A12 and is situated midway between the villages of Stratford St Andrew and Little Glemham

both of which lie just beyond the park boundary. The park covers 132ha, of which 2ha are gardens, and is divided by the A12 which runs north-east to south-west through the northern section of the designed landscape. Farmland and woodland encircle the site on all sides, with part of the eastern boundary formed by Tinker Brook road and the southern half of the western boundary by the A12.

4.4.5.4 Non-Registered Parks and Gardens

In addition to the National Register the following Parks and Gardens are recognised by Suffolk Coastal District Council for their character and appearance and should be safeguarded:

- Benhall Lodge Park – a 66ha designed landscape located to the north of Farnham adjacent to the A12, eastern access to the park is from the A12;
- Marlesford Hall Park- an undulating, 37ha, designed landscape with formal gardens and pleasure ground located to the north of the settlement of Marlesford and 1km north of the A12 route corridor.

4.4.5.5 Conservation Areas

Conservation areas are defined as 'areas of special architecture or historic interest, the character or appearance of which it is desirable to protect or enhance.' Within the study are there is one conservation area:

- Marlesford Conservation Area, which is located where the A12 intersects with Bell Lane.

4.4.5.6 Tree Preservation Orders (TPO)

A Tree Preservation Order is an Order made by a Council in respect of a tree(s) because the tree is considered to bring amenity value to the surrounding area. The Order makes it an offence to cut down, uproot, prune, lop or damage the tree in question without first obtaining the Council’s consent. Within the study area there are two woodland group TPOs and four individual TPOs located in close proximity to the Stratford Bridge on the A12.

4.4.6 Landscape Character

See Appendix 2.4 for Landscape Character

4.4.6.1 National Character Area

The study area sits within one national landscape character area profile; *NCA Profile 82 Suffolk Coast and Heath* (2013): The key characteristics include:

- A predominantly low-lying landscape with some areas along the coastal plain below or at sea level;
- Dynamic coast shaped by long sweeping bays, cut by the series of more sheltered estuaries. The shoreline is defined by shingle beaches and structures;
- Rivers flow west-east forming intimate, twisting alluvial valleys;

- Expansive coastal level grazing marshes divided by drainage dykes containing internationally important reed beds and fens;
- Farm woodlands, plantations and field boundary trees provide a treed character with substantial coniferous forest in the core of this NCA. Ancient broadleaved woodland and parkland wood pasture cloak the southern river valley and estuary slopes.
- Inland valleys contain small-scale historic patterns of irregular drained meadow enclosure, bounded by elm hedgerows;
- Settlement is sparse, with small, isolated villages and farmsteads. The larger urban settlements are confined to the north and south;
- Large developments such as Sizewell nuclear power station contribute to landmark diversity. Major transport infrastructure includes the eA14 and A12 and the main East Coast rail line; and
- Public access is extensive both on the land and rivers.

4.4.6.2 Local Landscape Character

Suffolk County Council Landscape Character Assessment (2011): The Suffolk Landscape Character Assessment has been carried out jointly by all the District Councils and The County Council. The Landscape Character Types (LCT) relevant to the study area includes the following:

1. Ancient Estate Claylands LCT

Key Characteristics:

- Gently rolling heavy clay plateaux with ancient woodlands and parklands;
- Dissected Boulder Clay plateau;
- Organic pattern of field enclosures;
- Straight boundaries where influence of privately owned estates is strongest;
- Enclosed former greens and commons;
- Parklands;
- WWII airfields;
- Villages with dispersed hamlets and farmsteads;
- Timber framed buildings;
- Distinctive estate cottages; and
- Ancient semi-natural woodland.

Condition - These landscapes are subject to considerable change which is promoted by their relationship to the A12 trunk road and the creation of airfields in the 1940s. There is considerable intrusion of suburbanisation with horse paddocks, barn conversions and ranch-style fencing. As on other parts of the plateau claylands, industrial agricultural buildings make a significant impact, especially where there is inadequate screening.

2. Ancient Rolling Farmland LCT

Key Characteristics:

A rolling landscape of medium clay soils studded with blocks of ancient woodland.

- Rolling arable landscape of chalky clays and loams;
- Dissected widely, and sometimes deeply, by river valleys;
- Field pattern of ancient random enclosure. Regular fields associated with areas of heathland enclosure;
- Hedges of hawthorn and elm with oak, ash and field maple as hedgerow trees;
- Substantial open areas created for airfields and by post WWII agricultural improvement;
- Scattered with ancient woodland parcels containing a mix of oak, lime, cherry, hazel, hornbeam, ash and holly;
- Network of winding lanes and paths, often associated with hedges, create visual intimacy;
- Dispersed settlement pattern of loosely clustered villages, hamlets and isolated farmsteads of mediaeval origin;
- Farmstead buildings are predominantly timber-framed, the houses colour-washed and the barns blackened with tar. Roofs are frequently tiled, though thatched houses can be locally significant; and
- Villages often associated with village greens or the remains of greens.

Condition- Although there are some areas of extensive field amalgamation, overall the landscape is largely intact, and accessible thorough a dense network of winding roads with wide verges. In some places there are significant areas of development pressure and land use change, for example through commercial activities, and by the creation of pony paddocks. These are especially noticeable adjacent to the A12, A14 and on the outskirts of Ipswich and Sudbury. In these areas the rural agricultural character of the landscape is clearly diluted. In both parcels of this landscape, but especially in the eastern part, the high-tension overhead power lines and pylons are a note of discord in the landscape.

3. Estate Sandlands LCT

Key Characteristics:

- A landscape of large geometric fields, plantation woodlands and remnant heathland comprising:

- Flat or very gently rolling plateaux of free-draining sandy soils, overlying drift deposits of either glacial or fluvial origin;
- Chalky in parts of the Brecks, but uniformly acid and sandy in the south-east;
- Absence of watercourses;
- Extensive areas of heathland or acid grassland;
- Strongly geometric structure of fields enclosed in the 18th & 19th century;
- Large continuous blocks of commercial forestry;
- Characteristic ‘pine lines’ especially, but not solely, in the Brecks;
- Widespread planting of tree belts and rectilinear plantations;
- Generally a landscape without ancient woodland, but there are some isolated and very significant exceptions;
- High incidence of relatively late, estate type, brick buildings;
- North-west slate roofs with white or yellow bricks. Flint is also widely used as a walling material; and
- On the coast red brick with pan-tiled roofs, often black-glazed.

Condition- The south-east of this LCT has a stronger urban influence. Martlesham has lost much of its rural character and most of the remnant heathland, such as at Rushmere and Foxhall, is in a suburban environment, further ‘tamed’ by being used for golf courses. Even in the central and northern parts of the coastal area there is a steady pressure of sub-urbanisation and tourism related development.

4. Plateau Estate Farmlands LCT

Key Characteristics:

A landscape of large regular fields with small woodlands on light loamy soils comprising:

- Flat landscape of light loams and sandy soils;
- Large scale rectilinear field pattern;
- Network of tree belts and coverts;
- Large areas of enclosed former heathland;
- 18th- 19th & 20th century landscape parks;
- Clustered villages with a scattering of farmsteads around them;
- Former airfields; and
- Vernacular architecture is often 19th century estate type of brick and tile.

Condition- The eastern parts of this landscape suffer considerable localised effects from the A14 and A12 trunk roads, while in the wider landscape hedges tend to have a lot of suckering elm and be in poor condition.

5. Rolling Estate Claylands LCT

Key Characteristics

A valley side landscape of clay loams with parklands and fragmented woodland comprising:

- Rolling valley-side landscape;
- Medium clay and loamy soils;
- Organic pattern of fields;
- Occasional areas of more rational planned fields;
- Numerous landscape parks;
- Substantial villages;
- Fragmented woodland cover, both ancient and plantation; and
- Winding hedged and occasionally sunken lanes.

Condition- The condition of these landscapes is very variable throughout and is often influenced by major transport routes such as the A12 and the presence of larger settlements such as Saxmundham and Wickham Market.

6. Rolling Estate Farmlands LCT

Key Characteristics

A valley side landscape of deep loams, with parklands plantations and Ancient Woodlands comprising:

- Gently sloping valley sides and plateau fringes;
- Generally deep loamy soils;
- An organic pattern of fields modified by later realignment;
- Important foci for early settlement;
- Coverts and plantations with some ancient woodlands;
- Landscape parks with a core of wood pasture; and
- Location for mineral workings and related activity, especially in the Gipping valley.

Condition- The influence of single estate ownership remains strong over much of this landscape, so the condition is often good despite the post war modification of the field patterns; in these areas hedges, woods and trees are well maintained as are many of the built features of an estate landscape. However, in the east on the Shotley Peninsula and around Rendlesham there are areas where the pattern and features of the landscape are highly modified by agricultural improvement.

7. Rolling estate Sandlands LCT

Key Characteristics:

- Rolling river terraces and coastal slopes;
- Sandy and free draining soils with areas of heathland;
- Late enclosure with a pattern of tree belts and straight hedges;
- Landscape parklands;
- A focus of settlement in the Estate Sandlands landscape;
- 19thC red brick buildings with black glazed pantiles in the east;
- Lark valley buildings are frequently of brick or flint with tiled or slate roofs;
- Tree belts and plantations throughout;
- Occasional and significant semi-natural woodlands and ribbons of wet woodland; and
- Complex and intimate landscape on valley sides.

Condition- Many of these valley side landscapes are under considerable development pressure because there are concentrations of settlement and land use change. However there are excellent areas of semi-natural landscapes and intact landscapes in many places.

8. Rolling Valley Claylands LCT

Key Characteristics:

- Gently sloping valleys on medium clay soils;
- Occasional notable steeper slopes;
- Fields often smaller than on surrounding plateaux;
- Localised influence of landscape parks;
- Focus of settlement;
- Few large greens or commons; and
- Ancient woodland on the upper fringes of the valley sides.

Condition- As these valleys are a focus of settlement they are often exposed to adverse change through intrusive valley side developments or changes of land use, especially, the expansion of garden curtilages and the widespread introduction of horse grazing. However they also have within them many areas of landscape in good condition that provide the appropriate context for the adjacent valley floor landscapes.

9. Valley Meadowlands LCT

Key characteristics:

Flat valley floor grasslands on silty and peat soils comprising:

- Flat landscapes of alluvium or peat on valley floors;
- Grassland divided by a network of wet ditches;
- Occasional carr woodland and plantations of poplar;
- Occasional small reed beds;
- Unsettled;
- Cattle grazed fields; and
- Fields converted to arable production.

Condition- Some of these landscapes are in excellent condition, however, many are affected by intakes into arable production, by horse grazing and by under-grazing. The sense of tranquillity and isolation of this landscape can also be intruded upon by the development of the adjacent rolling valley landscapes, which are often a focus for settlement and development.

4.4.7 Visual Context

The visual resource within the study area comprises the following key receptors:

- Settlements: There are a series of settlements and scattered properties within the study area. Towards the south- west of the study area is the village of Marlesford which is accessed off the A12. Little Glemham is located further north east along the A12 passing alongside individual residential and agricultural properties. Similarly there are a small number of properties heading further north east between Little Glemham and Stratford St Andrew. The settlement of Farnham adjoins Stratford St Andrew, through which the A12 passes. There are further sporadic patterns of settlements within the study area, small in nature and accessed by the network of minor roads.
- Public Rights of Way: Within the study area there are number of Public Rights of Way (PRoW). The PRoW provide a varied visual experience contrasting from enclosed views through woodland to more expansive views across agricultural land or parkland. The routes cross a number of PROW.
- Road Users: A network of minor roads within the study area some of which adjoin the A12. Many of these roads are bordered by hedgerows and intermittent parkland

trees which often limit visibility of the wider landscape. The nature of the views is transitory for road users passing through the landscape.

- Pedestrians: There is a network of footpaths that exist within the study area. The A12 also provides long sections of roadside footpath that link Little Glemham to Farnham.
- Railway: Within the study area there is an active railway following a south west to north east main line route, from Ipswich to Norwich. Views from the railway line are both contained by woodland planting as well as open, extending across the surrounding landscape both towards the A12 and the Suffolk Coast and Heaths AONB.

4.4.8 Assessment Methodology

The Stage 1 Landscape and Visual assessment was undertaken with reference to the following guidance:

- The Design Manual for Roads and Bridges (DMRB), Volume 11, Section 3, Part 5 Landscape Effects (The Highways Agency et al., 1993);
- Interim Advice Note 135/10 Landscape and Visual Effects Assessment (The Highways Agency et al., 2010);
- TAG Unit A3, Environmental Impact Appraisal (Department for Transport WebTAG, 2014); and
- Guidelines for Landscape and Visual Impact Assessment 3rd edition (GLVIA3), Institute of Environmental Management and Assessment (2013).

The DMRB, Stage 1 assessment requires a desk based appraisal to identify the landscape constraints associated with the route options under consideration. Consideration has been given to the wider landscape setting of the study area within the visual appraisal.

In accordance with TAG Unit A3, the character of the route corridor options and surrounding landscape is described in terms of the qualities/characteristics of pattern, tranquillity, cultural landscape, and land cover and these are presented in the Landscape Worksheets (Appendix 2.4).

Pattern refers to the topography, form, elevation, enclosure and scale; the way that these elements, in relation to each other form the landscape. Tranquillity refers to existence, or lack of, a sense of isolation and remoteness. Cultural features contribute elements of an historic or traditional nature, such as built forms and architectural styles, settlement and field patterns, archaeological sites, noted views and areas with a strong cultural association. Land cover determines land use and the contribution this makes to the character of the landscape. This includes cognisance of semi-natural habitats, whose importance to landscape can be cross referenced with nature conservation interests, particularly biodiversity. Vegetation would also be relevant.

The visual appraisal broadly considers the degree of anticipated change to visual amenity experienced by receptors. Receptors include residential properties, workplaces, recreational facilities, road users, pedestrians and other outdoor sites used by the public which would be likely to experience a change in existing views as a result of the proposed route options. A desk study was undertaken to inform the appraisal of visual effects.

The approach has involved a review of published documentation including the following:

- Aerial Photography;
- Ordnance Survey and Google Street View;
- Suffolk Costal District Local Plan-Core Strategies and Development Management Policies (adopted 2013);
- Countryside Character, Volume 7; South East & London (1999); and
- Suffolk County Council Landscape Character Assessment (2011).

4.4.9 Landscape Appraisal Criteria

The landscape appraisal criterion follows the methodology outlined in TAG Unit A3, Impacts on Landscape, Environmental Impact Appraisal (2014). The following table provides a description of the overall impact criteria used in identifying the overall effects on the landscape resource.

Table 4.4 1: Landscape affects criteria

Score	Comment
Very Large Adverse effect	The scheme would result in exceptionally severe adverse impacts on the landscape because it: • At complete variance with the landform, scale and pattern of the landscape; • Is highly visual and extremely intrusive, destroying fine and valued views both into and across the area • Would irrevocably damage a degrade, badly diminish or even destroy the integrity of characteristics and elements and their setting; • Would cause a very high quality or high vulnerable landscape to be irrevocably changed and its quality very considerably diminished; • Could not be integrated: there are no environmental design measures that would protect or replace the loss of a nationally important landscape; • Cannot be reconciled with government policy for the protection of nationally recognised countryside.
Large Adverse effect	The scheme is very damaging to the landscape in that it: • Is at considerable variance with the landform, scale and pattern of the landscape • Is visually intrusive and would disrupt fine and valued views of the area • Is likely to degrade, diminish or even destroy the integrity of a range of characteristics and elements and their setting • Will be substantially damaging to a high quality or highly vulnerable landscape, causing it to change and be considerably diminished in quality • Cannot be adequately integrated • Is in serious conflict with government policy for the protection of nationally recognised countryside

Score	Comment
Moderate Adverse effect	The scheme is: • Out of scale with the landscape, or at odds with the local pattern and landform • Visually intrusive and will adversely impact on the landscape • Not possible to fully integrate, that is, environmental design measures will not prevent the scheme from scarring the landscape in the longer term as some features of interest will be partly destroyed or their setting reduced or removed • Will have an adverse impact on a landscape of recognised quality or on vulnerable and important characteristics or elements • In conflict with local and national policies to protect open land and nationally recognised countryside
Slight Adverse effect	The scheme: • Does not quite fit the landform and scale of the landscape • Although not very visually intrusive, will impact on certain views into and across the area • Cannot be completely integrated because of the nature of the scheme itself or the character of the landscape through which it passes • Affects an area of recognised landscape quality • Conflicts with local authority policies for protecting the local character of the countryside

Score	Comment
Neutral effect	The scheme is well designed to: • Complement the scale, landform and pattern of the landscape • Incorporate environmental design measures to ensure that the scheme will blend in well with surrounding landscape characteristics and landscape elements • Avoid being visually intrusive nor have an adverse effect on the current level of tranquillity of the landscape through which the scheme passes • Maintain existing landscape character in an area which is not a designated landscape, that is, neither national or local high quality, nor is it vulnerable to change • Avoid conflict with government policy towards protection of the countryside.
Slight Beneficial effect	The scheme: • Fits well with the scale, landform and pattern of the landscape • Incorporates environmental design measures to ensure they will blend in well with surrounding landscape • Will enable some sense of place and scale to be restored through well-designed planting and environmental design measures • Maintains or enhances existing landscape character in an area which is not a designated landscape, nor vulnerable to change • Avoids conflict with government policy towards protection of the countryside

Score	Comment
Moderate beneficial effect	The scheme provides an opportunity to enhance the landscape because: • It fits very well with the scale, landform and pattern of the landscape • There is potential, through environmental design measures, to enable the restoration of characteristics, partially lost or diminished as the result of changes resulting from intensive farming or inappropriate development • It will enable a sense of place and scale to be restored through well-designed planting and environmental design measures, that is, characteristics are enhanced through the use of local materials and species used to fit the scheme into the landscape • It enables some sense of quality to be restored or enhanced through beneficial landscaping and sensitive design in a landscape which is not of any formally recognised quality • It furthers government objectives to regenerate degraded countryside
Major beneficial effect	The scheme provides an opportunity to greatly enhance the landscape because • It greatly enhances the character (including quality and value) of the landscape • It creates an iconic high quality feature and/or series of elements • It enables a sense of place, scale and quality to be restored in an area formerly of high landscape quality Note that very few, if any, schemes are likely to merit this score.

4.4.10Visual Appraisal Criteria

The landscape assessment has involved consideration of the extent to which the proposals would affect visual amenity, at a broad, study area wide level. Assessment is based on the information gathered through desk study analysis of the proposed options. A more detailed assessment of effects to specific receptors will be considered in greater detail at the next stage of the assessment process. The following criteria have been used when considering the appraisal of visual effects.

Table 4.4.2: Visual affects criteria

Degree of Effect	Description
Large Adverse /Beneficial effect	• Substantial alteration to elements/features of the baseline (pre-development) conditions. • Where the proposed development would cause a very noticeable alteration in the existing view • This would typically occur where the Development closes an existing view of a landscape of national importance and the proposed development would dominate the future view.
Moderate Adverse /Beneficial effect	• Alteration to one or more elements/features of the baseline conditions such that post development character/attributes of the baseline will be materially changed. • This would typically occur where the Development closes an existing view of a local landscape and the proposed development would be prominent in the future view.
Slight Adverse / beneficial effect	• A minor shift away from baseline conditions. • This would typically occur where change arising from the alternation would be discernible but the underlying character/composition/attributes of the baseline condition will be similar to the pre-development. • It would also occur where the Development newly appears in the view but not as a point of principal focus or where the proposed Development is closely located to the viewpoint but seen at an acute angle and at the extremity of the overall view.
Neutral effect	• Where there is no discernible improvement or deterioration in the existing view.

4.4.11 Assumptions and Degree of Certainty

The landscape and visual appraisal broadly considers the degree of anticipated change to the landscape character and visual amenity experienced by receptors which would potentially occur as a result of the proposed route options.

Assumptions have been made as to the likelihood of effects but are limited to the information available and desk based mapping and associated techniques as outlined in section 4.4.4 Assessment Methodology.

Temporary construction effects will be associated with all of the route options and will need to be assessed once the preferred options are developed further and detailed information becomes available. At this stage, temporary construction effects have not been considered for any of the options due to the high level nature of the study and insufficient level of information available to make any meaningful evaluation.

4.4.12 Predicted Impacts

Potential effects on the landscape resource may include the following:

- The route options may encroach into existing agricultural land, increasing the urbanisation of the landscape through which it passes;
- The route options may involve the loss or fragmentation of important and distinctive landscape elements (open space, woodland and trees, topographical features);
- The proposals may affect designated landscapes, such as Registered and Non-Registered Parks and Gardens, Special Landscape Areas, either directly (through encroachment/loss of landscape features) or indirectly, by affecting setting and/ or views to the designated landscapes.

Potential effects on visual amenity may include the following:

- The route options may intrude into existing views experienced by users of the study area, including local residents, road users and recreational users in the surrounding countryside;
- The route options may result in the loss of important landscape elements (e.g. hedgerows, roadside tree planting) or changes to cuttings and embankments, which may open up views of the existing road infrastructure which did not previously exist;
- The route options may increase the ‘corridor’ effect of the road, changing the way that people perceive the landscape;
- The route options may introduce lighting to previously unlit areas, intruding into night-time views experienced by local residents.

4.4.13 Opportunity for Mitigation and Enhancement

The route options should be developed to avoid key landscape and visual receptors, including settlements and dwellings, as well as designated landscapes and important landscape features such as woodland and TPOs.

The advice on good practice in landscape design provided in DMRB Volume 10 and Landscape Character documents (Suffolk County Council) should be adhered to. Objectives for possible landscape mitigation measures should include the following:

- Build on distinctive place, quality and character of the landscape
- Use of natural characteristics in design
- Retain existing features and re-use site-won materials
- Protect species, habitats and ecosystems
- Support biodiversity with native planting
- Design for low maintenance and management
- Secure adequate land to allow integrated solutions

With the following more specific measures:

- Achieving best fit with contours;
- Retaining existing vegetation;
- Optimising protection for nearby houses through use of cuttings or existing features;
- Avoiding loss or damage of landscape features;
- On and offsite planting;
- Mounding and earth shaping; and
- Consideration of the form and finish of structures and appearance of other features e.g. road signs.

Mitigation should seek to integrate the route options and associated structures into the landscape as far as possible. Potential mitigation could consist of screen planting or reinstatement of hedgerows to limit views of the bypass options from the wider area and to integrate structures (bridges, embankments, cuttings) into the landscape. Consideration should also be given to the siting of road signage and the height and appearance of lighting (where required for example at junctions) and the barriers used as a median closure. Mitigation should also consider sensitive siting of retention ponds and the use of native species of local provenance.

4.4.14 Residual Impacts

The Link 1 and Link 2- Would result in direct effects breaking the pattern of the landscape. Adjacent field boundaries arable and grazing land would be lost. Vegetation loss would include hedgerows, trees and agricultural land. Route widening of the existing A12 would bring the route closer to a small number of properties in close proximity to the road. Sensitive design of road embankments will be required to prevent further intrusion upon the setting of the Glemham Hall Park Registered Park and Garden (located at the western edge of Link 1) and the Non-registered Park and Garden of Benhall Lodge Park (located to the east of Link 2).

The following sets out the findings of the landscape and visual appraisal of the five route options and should be read in conjunction with the Landscape Appraisal Worksheets contained in Appendix 2.4 which provide further detail on the landscape features affected.

4.4.14.1 Option LB3: (Orange Route) to the south of Marlesford and north of Little Glemham

Landscape Character

The LB3 route would result in Large Adverse effects in year one due to the fragmentation of the landscape and the direct loss of important features including historic parkland landscape, boundary vegetation, mature woodland and riparian vegetation. Following the establishment of replacement planting and additional planted mitigation measures the effect has the potential to reduce to Moderate Adverse after fifteen years. There is the potential for localised adverse effects on the Upper Deben Valley SLA; however, the overall integrity of the SLA is unlikely to be substantially affected by the introduction of this route option.

Visual Amenity

This route option would result in a variety of visual effects ranging from Slight Adverse to Large Adverse depending on the type of receptor (residential properties are more sensitive to this type of development than drivers along the A12), proximity and orientation of the receptor in relation to the route corridor and the presence of intervening elements such as landform or planting which may screen elements of the route option from view.

Properties within the settlements of Marlesford and Little Glemham are likely to experience adverse effects on their visual amenity. Properties in Marlesford are likely to have more distant views of the LB3 route option although properties along the A12 to the south of Marlesford are likely to experience mid-ground views of the proposed road corridor although intervening land and vegetation may partially screen views. Properties on the southern and western edges of Little Glemham are likely to experience foreground to mid-ground views of the new road corridor with some properties experiencing Large Adverse effects where the road will appear in immediate views.

There are also a number of scattered properties and clusters of properties set within the wider landscape which has the potential to result in a range of visual effects. Property to the south of Little Glemham is likely to experience direct foreground views of the road corridor which would have the potential to result in Large Adverse effects. Conversely scattered properties along the A12 with more distant views of the proposed road corridor may result in Slight Adverse effects.

Road users along the existing A12 corridor and passengers travelling along the railway line will have the potential to experience transitory views of this route option; however, due to the transitory nature of the view the visual effect is not likely to be significant. A number of Public Rights of Way are likely to be crossed by this route option which would result in Large Adverse effects on the immediate visual amenity of users of sections of these routes.

Mitigation planting would help integrate the road corridor into the wider landscape and into views which combined with screen planting has the potential to reduce some of the visual effects by year fifteen.

4.4.14.2 SB1 (Pink Route) Bypass of Farnham and Stratford St Andrew

Landscape Character

The SB1 route would result in Large Adverse effects in year one due to the fragmentation of the landscape and the direct loss of important boundary vegetation, mature woodland and riparian vegetation. Following the establishment of replacement planting and additional planted mitigation measures the potential effect is unlikely to be reduced due to the complexity of the landscape along the proposed route corridor. As is the case with the previous option, there is potential for localised adverse effects on the Upper Deben Valley SLA, however, the overall integrity of the SLA is unlikely to be substantially affected by the introduction of this route option.

Visual Amenity

This route option would result in visual effects ranging from Slight Adverse to Large Adverse depending on the type of receptor, (residential properties and Glemham Hall Registered Park and Garden would be considered more sensitive than drivers along the A12) proximity and orientation including intervening elements which may disrupt and potentially screen some immediate views.

Properties within the settlements of Farnham and Stratford St Andrew are likely to experience large adverse effects on their visual amenity. Properties within both settlements would experience immediate foreground views of the proposed SB1 route corridor and associated junction. Vegetation that may partially screen views is limited as a result of the vegetation loss associated with this route option. Scattered properties that are outliers from the main settlements are likely to have mid-ground views of the proposed route corridor. There are also a number of properties that would experience more distant views of the proposed corridor which may result in slight adverse effects.

Road users along the existing A12 corridor and passengers travelling along the railway line will have the potential to experience transitory views of this route option however; due to the transitory nature of the view the visual effect is not likely to be significant.

Mitigation planting would help integrate the road corridor into the wider landscape and into views which combined with screen planting has the potential to reduce some of the visual effects by year fifteen.

4.4.14.3 SB2 (Green Route) Northern Bypass of Farnham and Stratford St Andrew

Landscape Character

The SB2 route would result in Large Adverse effects in year one due to the fragmentation of the landscape and the direct loss of important features including historic parkland landscape, boundary vegetation, and mature woodland and riparian vegetation. Following the establishment of replacement planting and additional planted mitigation measures the effect has the potential to reduce to Moderate Adverse after fifteen years and the establishment of mitigation planting.

Visual Amenity

This route option would result in a range of visual effects ranging from Moderate Adverse to Large Adverse dependent upon the type of receptor, orientation and proximity of the receptor in relation to the route corridor. Properties in Stratford St Andrew (properties on Low Road in particular) and Farnham are likely to have immediate foreground views of the proposed SB2 route corridor and associated junction. Benhall Lodge Park would have mid-ground views that maybe partially screened. The route corridor along with the existing A12 would result in a large adverse effect on visual amenity due to further disruption of valued views of the landscape to the north of Stratford St Andrew. The scattered properties and farmsteads outlying with the settlements are likely to have mid-ground to somewhat distant views of the proposed route and may result in moderate adverse effects.

Route SB2 is similar to SB1 with regard to road users along the existing A12 corridor and rail travellers. However SB2 differs in that SB2 is likely to cross a Public Right of Way which would result in Large Adverse effects on the immediate visual amenity of users of sections of this route.

As with previous route options, mitigation planting would help integrate the road corridor into the wider landscape and into views which combined with screen planting has the potential to reduce visual effects by year fifteen.

4.4.14.4 SB4 (Red Route) Bypass of Little Glemham

Landscape Character

The LB3 route would result in Moderate Adverse effects in year one due to the fragmentation of the landscape and the direct loss of important features including historic parkland landscape, boundary vegetation, mature woodland and riparian vegetation. Views from the designed landscape of Marlesford Hall Park and Garden including from the main house, may be affected by the route option with it appearing in mid to long range views from the designed landscape. Following the establishment of replacement planting and additional planted mitigation measures the effect has the potential to reduce to Slight Adverse after fifteen years and the establishment of mitigation planting.

Visual Amenity

Route Option LB3 would result in visual effects ranging from Slight Adverse to Large Adverse depending on the type of receptor, proximity and orientation of the receptor in relation to the route corridor. Properties with likely immediate foreground views are limited to the northern extents of Little Glemham and the properties along the A12 where this route option merges with the A12. Although vegetation may partially screen views these properties are likely to experience Large Adverse Effects. Properties in Marlesford may also experience Moderate to Large Adverse effects depending on their orientation to the proposed road.

Scattered clusters and dispersed properties within the landscape are likely to experience Slight to Moderate Adverse effects. The residential properties on Keepers Lane and associated local roads are likely to experience Large Adverse effects due to the proximity of the proposed route in addition to the potential views of the culvert crossing. Conversely settlements and properties with more distant views of the proposed road corridor may experience Slight Adverse effects.

Views along the existing A12 corridor and passengers will have direct but transitory views of the SB4 route options. Railway passengers will have the potential to experience distant views. Both these receptors are likely to result in Slight to Moderate Adverse effects.

4.4.14.5 SB5 (Blue Route) Southern Bypass of St Andrew and Farnham

Landscape Character

The SB5 route would result in Moderate Adverse effects in year one due to the fragmentation of the landscape and the direct loss of important features including historic parkland landscape, boundary vegetation, mature woodland and riparian vegetation. However, this judgement of effect is reliant upon the sensitive routing of the road corridor to avoid large swathes of Pond Wood, located to the east of the proposed under bridge. Should the route cross Pond Wood with the removal of large sections of woodland, effects would increase. It should also be noted that a large proportion of this route option falls outside the Upper Deben Valley SLA. It is unlikely that mitigation planting would substantially reduce the degree of effect on the overall character of the landscape.

Visual Amenity

This route option would result in a variety of visual effects ranging from Slight Adverse to Large Adverse depending on the type of receptor (residential properties are more sensitive to this type of development than drivers along the A12), proximity and orientation of the receptor in relation to the route corridor and the presence of intervening elements such as landform or planting which may screen elements of the route option from view.

Scattered properties to the south of Farnham that have close views of the proposed route corridor and the associated bridge crossings are likely to result in Large Adverse effects on visual amenity. However this route option unlike SB1 and SB2 provides a route option furthest away from the settlements of Farnham and Stratford St Andrew resulting in potentially Moderate and Slight Adverse Effects for properties within these settlements due to increased distance and intervening screening elements.

Road users along the existing A12 corridor and passengers travelling along the railway line will have the potential to experience transitory views of this route option. In addition a number of Public Rights of Way are likely to be crossed by this route option which would result in Large Adverse effects on the immediate visual amenity of users of sections of these routes.

As mentioned in previous options above, mitigation planting would help integrate the road corridor into the wider landscape with the potential to reduce some of the visual effects by year fifteen.

4.4.15 Summary Table

The following table provides a summary of the landscape and visual effects associated with each route option.

Table 4.4.3: Landscape and visual appraisal summary table

Route	Assessment	Mitigation	Residual Effects With Mitigation
LB3			
Landscape Character	Large Adverse	Reinstatement of boundary planting, structure screen planting	Moderate Adverse
Visual Amenity	Slight-Very Large Adverse		Slight- Large Adverse
SB1			
Landscape Character	Large Adverse	As above	Large Adverse
Visual Amenity	Slight- Large Adverse		Slight- Large Adverse
SB2			
Landscape Character	Large Adverse	As above	Moderate Adverse

Visual Amenity	Moderate to Large Adverse		Moderate to Large Adverse
SB4			
Landscape Character	Moderate Adverse	As above	Slight Adverse
Visual Amenity	Slight-Very Large Adverse		Slight-Large Adverse
SB5			
Landscape Character	Moderate Adverse	As above	Moderate Adverse
Visual Amenity	Slight- Large Adverse		Slight- Large Adverse

All of the proposed options have the potential to affect nationally and locally important designations and landscape character. The route options will be partially visible from the wider landscape including potentially long distance views from the Suffolk Coast AONB. SB1 is considered to result in the largest residual effect on landscape character due to the severance of the more intricate mosaic of grazing marsh and smaller landscape pattern. Route options LB3, SB2 and SB5 will all result in Moderate Adverse residual effects due to the fragmentation of the landscape and loss of landscape features. SB4 is considered to have the least effect on the landscape with Slight Adverse residual effects due to the more limited fragmentation of the landscape and limited loss of landscape features.

In terms of visual amenity, all route options would result in a range of effects which vary depending on the proximity of the receptor to the route corridor. All route options would be visible from the various settlements in the study area and from a number of scattered properties as well as PRoW and from the road and rail network. Route options SB1 and SB2 are closer to the settlements of Stratford St Andrew and Farnham thereby having the potential to affect the visual amenity from a greater number of properties, whereas SB5 is less likely to affect the visual amenity from as many properties although there will remain some properties in close proximity to the route resulting in Large Adverse effects. Similarly route SB4 has the potential to affect the visual amenity from fewer properties compared with option LB3 where views from properties in Little Glemham in particular will be adversely affected by the introduction of the road corridor and bridge crossing in foreground views.

All of the proposed options should adopt the use of good practice in landscape design identified in DMRB Volume 10. Landscape mitigation measures may include reinstatement boundary planting as well as structure and screen planting. They should build on the distinctive character and quality of the various landscapes, respecting setting and creating a sense of place experienced through a journey, travelling through the landscape. An important project objective should be to reconnect features, re-establish patterns and ensure continuity of elements in the landscape through good design.

More specifically avoidance of key landscape features is necessary to avoid and or limit effects on Marlesford Hall Park and Garden and the setting of Glemham Hall Park Registered Park and Garden and Benhall Lodge Park and Garden. Route SB1 should avoid the group TPO at the proposed SB1/A12 roundabout. Route SB5 should consider careful routing and use of embankments in close proximity to Pond Wood. Route SB5 should also consider appropriate softening and earthwork profiles at the A12/ SB5 roundabout.

4.5 Heritage

4.5.1 Introduction

The aim of this Scoping Assessment is to complete sufficient assessment to identify potential archaeological constraints associated with the A12 Four Villages Road Schemes. This section provides an assessment of the proposed bypasses on the archaeological remains, historic buildings and historic landscapes.

The A12 is the main route along the eastern coastline of Suffolk from Chelmsford to Great Yarmouth. There are five bypasses proposed between Lower Hacheston and Farnham. Details of these options can be found in Chapter 2.

The Design Manual for Roads and Bridges (DMRB) Volume 11 Environmental Assessment Section 3 Part 2 Cultural Heritage (HA 208/07) forms the basis for this assessment. The assessment of impacts on the known archaeological remains and built heritage was undertaken through the analysis of data obtained during the cultural heritage assessment to determine the potential impacts of five proposed road bypasses on the A12. Cultural heritage in this context means the above and below ground archaeological resource, the built heritage, and historic landscapes.

This original data was collected from:

- English Heritage Archives Services; and
- Suffolk Heritage Environment Records (HER).

Some of the data acquired from the HER is collected from the Portable Antiquities Scheme. As such, this data is confidential and has not been reproduced on the figure. However, it is included in the assessment as evidence for archaeology in the study area.

As part of this study the National Heritage List for England (www.list.english-heritage.org.uk/advancedsearch.aspx) was also consulted.

4.5.2 Regulatory / Planning Policy Framework

Key pieces of legislation and guidance relating to archaeology and cultural heritage are as follows:

- National legislation which is relevant to archaeology and cultural heritage comprises:
- Ancient Monuments and Archaeological Areas Act 1979;
- Planning (Listed Buildings and Conservation Areas) Act 1990; and
- National Planning Policy Framework (NPPF) (March 2012);

The local policy which is relevant to archaeology and cultural heritage are addressed in the Suffolk Coastal Local Plan (Adopted 2001). The relevant policies are:

- AP4 - Parks and Gardens of Historic or Landscape Interest
- AP6 - Preservation of Listed Buildings
- AP7 - Development of Archaeological Sites

Key pieces of guidance include the following:

- DMRB Volume 11 Environmental Assessment Section 3 Part 2 Cultural Heritage (HA 208/07);
- Institute for Archaeologists (IfA) (2012) *Standard and Guidance for Historic Environment Desk-Based Assessments*.

4.5.3 Baseline Conditions

4.5.3.1 LB3 (Orange Route) to the south of Marlesfield and to the north of Little Glemham

There are thirty-four assets recorded within the 300 m study area of the route between Marlesfield and Little Glemham. This includes one Registered Park and Garden and fourteen listed buildings. There are no Scheduled Monuments, Conservation Areas or Registered Battlefields.

The bracketed numbers after the sites within the text refer to the numbers on Figure 3.5.1 in Appendix 2.5.

The fourteen listed buildings are all Grade II and include eleven dwellings (4, 16, 18 - 22, 25, 28, 29 & 32), most of which are situated within Little Glemham. There is also one public house, The Lion (23), Little Glemham stores (24) and the Old School House (27). They are all post-medieval in date.

The Registered Park and Garden of Glemham Park is Grade II registered (33). The park consists of a 16th century deer park and 17th and 18th century formal gardens.

To the south of the route, the Portable Antiquities Scheme records a number of Neolithic to early Bronze Age scrapers (4000 BC to 1501 BC), Roman pot sherds (43 AD to 409 AD). A number of enclosures and cropmarks are associated with the artefacts.

There is one site and two find spots of prehistoric date recorded in the study area. The first find spot consists of Neolithic (3500 BC – 2000 BC) worked flint (70) and the second one of a Bronze Age (2000 BC – 700 BC) palstave or axe (57). The archaeological site consists of an Iron Age (700BC – AD 43) settlement (54). The settlement has associated finds including twenty-four coins of Iceni and Trinovantes/ Catuvellauni origin which show strong trade routes through this area (54). The settlement site also has archaeological evidence showing that it was in use during the Roman and early medieval periods (discussed below).

There are seven assets of Roman date (c.43 AD to 450) in the study area. The first, found through archaeological investigation, is a Romano-British settlement site known as Hacheston which dates to the 1st century AD (38). Roman material was found at the Iron Age settlement, described above (54). Excavations in 1973 revealed a Roman road, buildings and a well, as well as Roman coins and pottery sherds (54). This suggests that the settlement site was in continued use. In addition, later material was also recovered from this site (discussed below) The other six assets recorded in the study area include a pottery kiln or Roman oven (77), cropmarks of linear and rectilinear enclosures (55) and find spots of Roman potsherds (53, 78 & 79).

There is one Saxon site that dates to the early medieval period (450 – 1066) (45). Further excavation at the Iron Age and Roman site discussed above (38 & 54), revealed evidence for habitation into the early medieval period. A Saxon house and inhumation was excavated in 1986 (45). The building has been dated to the early to mid-Saxon period (450 – 600 AD) and is one of the few possible early Saxon sunken buildings to have been found in East Suffolk. There is no further information about the burial, although it is noted that it was unaccompanied by grave goods. As such, the area could hold important archaeological and historical information on the lives of the Saxon people during this period.

Artefacts from the medieval period (1066 – 1500) recorded in the study area include a bronze spout in the form of a dog’s head, which is possibly part of a 15th century bowl found alongside coins, and the find spot of a buckle, spur and weight (74). One find spot contained medieval and post-medieval pottery (53).

There are eighteen post-medieval (1500 – 1901) assets recorded in the study area. This includes a possible half-timbered building along with associated pottery excavated in 1965 (56). The remaining fifteen assets of post-medieval date comprise the listed buildings and Registered Park and Garden discussed above. There is also a bridge, recorded in Hodskinson’s map of 1783 which is presumably of post-medieval date, although the exact construction date is unknown (71).

There is one asset dated to the modern period (1901 – present). This comprises an aircraft crash site of a Supermarine spitfire Mark I which crashed near Marlesford (49). The first recovery operation was in 1940 with a more extensive excavation in 1981 which recovered remains including the pilot’s papers and maps.

There are four sites of unknown date. This includes a field system (75) and cropmarks which include a ring ditch or small circular enclosure (82) and a poorly defined example with no further information (76).

4.5.3.2 SB1 (Pink Route) Bypass of Farnham and Stratford St Andrew

There are eighteen assets within the study area of this bypass option, one of which is a Registered Park and Gardens and five are listed buildings. There are no recorded Scheduled Monuments, Conservation Areas or Registered Battlefields.

The five listed buildings include the Grade II* listed St Andrews Church and church yard (1) and the Grade II listed Four Cottages (5), Benhallstock Cottages (7), Elm Tree Cottage (9) and Elm Tree Farmhouse (10), all of post-medieval date.

The Registered Park and Garden is Grade II registered Glemham Park which has been described above, also of post-medieval date (33).

To the west of the route, the Portable Antiquities Scheme has records of a medieval to post-medieval artefact scatter.

A number of records detail groups of pottery sherds with more than one period represented in the assemblage, recorded by field walking and excavation (61, 63, 65, 85 & 89). The earliest asset of recorded date within the study area consists of Iron Age pottery sherds (61 & 63). Also found were Roman pottery sherds (61, 63 & 85). Four of the find spots (61, 65, 85 & 89) also contained medieval pottery, possibly coarse ware, and one contained post-medieval pottery (89).

There is a find spot of a hone[40] of semi-schist (37). This whetstone is probably of Anglo-Saxon date (410 – 1066) and was recovered from the River Alde.

There are ten post-medieval buildings consisting of a post mill and roundhouse, the former demolished and the latter in use as a store (43), farm buildings (60) and a timber-framed barn (69). There is also Stratford Bridge, shown on Bowens map of 1755 which is presumably of post-medieval date, although the exact construction date is unknown (84). The remaining six assets of post-medieval date comprise the listed buildings and Registered Park and Garden detailed above.

There is one asset from the modern period which is a pillbox, type FW3/22, on the outskirts of Stratford St Andrew (88). In the 1940s, preparations were made against a potential invading German army. Stratford St Andrew was designated as a first priority ‘Nodal Point’ along with several other towns and villages situated on the main road network which made up ‘stop lines’ across East Anglia. Later, they became known as ‘defended places’ and St Andrew was in Category A, as it was within 15 miles of the coast. The identified settlements were to be garrisoned by either the Field Forces or the Home Guard. The objective of a ‘Defended Place’ was to deny the use of roads to the enemy and impede and delay their advance. The pillbox was constructed as part of this defensive network to hold off the enemy.

[40] A whetstone, especially one used to sharpen razors (www.oxforddictionaries.com)

There is one find spot of unknown date which consists of unstratified potsherds (86).

4.5.3.3 SB2 (Green Route) Northern Bypass of Farnham and Stratford St Andrew

There are eleven assets recorded in the study area including one Registered Park and Gardens and two listed buildings. There are no recorded Scheduled Monuments, Conservation Areas or Registered Battlefields.

The two buildings, both Grade II listed, comprise Benhallstock Cottages (7) and Stratford Hall (32). Glemham Park, Grade II on the Register of Parks and Gardens (33), has been described in paragraph above. They are all of post-medieval date.

To the south of the route, the Portable Antiquities Scheme records a medieval to post-medieval artefact scatter.

Pottery sherds with often more than one period represented in the assemblage are recorded in the study area. There are two find spots of Iron Age pottery (61 & 63). Both assemblages also contain Roman pottery, and only one (61) also has medieval pottery sherds as well. The final find spot (65) contains medieval coarse ware sherds.

There are six assets of post-medieval date. This includes a post-mill and roundhouse, the former demolished and the latter in use as a store (43), a timber-framed barn (69) and a find spot of two gold coins of Henry III (90). The remaining three assets of post-medieval date comprise the listed buildings and Registered Park and Garden listed above.

There is an undated field system shown by cropmarks in the study area (87). There has been no archaeological investigation to determine a date. It is noted in the record that it is not shown on the old OS maps and therefore presumed to predate the post-medieval period.

The final site is a find spot of unknown date which comprises un-stratified potsherds (86).

4.5.3.4 SB4 (Red Route) Bypass of Little Glemham

There are twenty-one assets recorded in the study area including one Registered Park and Garden and eleven listed buildings, one of which (3), is within Marlesford Conservation Area (91). There are no recorded Scheduled Monuments or Registered Battlefields.

The listed buildings comprise nine dwellings, all of which are Grade II listed. These are9 to 13 Main Road (3 & 4), Bridge House (8), Milestone Farmhouse (13), Moat Farmhouse (14), Knoll Cottage (16), Hill House (17), The Rectory (18) and Peartree House (29). There is also a public house, Bell Inn (6), and an old Post Office (15).

The Registered Park and Garden is the Grade II registered Glemham Park (33), which has been described above.

Marlesford Conservation Area is a small, rural village enhanced by its fine agricultural landscape setting (91). The village and the river valley form part of the Ore Valley Special Landscape Area.

The only site of prehistoric date is the find spot of the tip of a late Bronze Age bronze socketed spearhead (58). Roman dated finds are also limited, and there is only one find spot of a sestertius coin of Marcus Aurelius (80).

Medieval assets consist of a bridge, shown on Bowens map of 1755, though the construction date is unknown (83), find spots of a pottery scatter and a coin of Edward II (41), sherds of coarse ware pottery (73) and an area of burnt clay which contained pottery and animal bones (81).

There are fifteen post-medieval assets including a 16th century moat (39) that surrounds the listed Moat Farmhouse (14), seven Tudor coins found to the south east of the moat (40) and a post-mill and roundhouse which were demolished in 1930 (42). The remaining twelve assets of post-medieval date comprise the listed buildings and Registered Park and Garden detailed above.

4.5.3.5 SB5 (Blue Route) Southern Bypass of Stratford St Andrew and Farnham

There are ten assets recorded in the study area of this bypass option, of which one is a Registered Park and Garden and one is a listed building. There are no recorded Scheduled Monuments, Conservation Areas or Registered Battlefields.

The listed building is a Grade II dwelling known as Farnham Manor and was built in 1602 (11). The Registered Park and Garden is Grade II registered Glemham Park (33) which has been described above.

To the west of the route, the Portable Antiquities Scheme records a medieval to post-medieval artefact scatter. This data is confidential and therefore has not been reproduced on the figure.

The earliest asset of definite date within the study area is a find spot consisting of three rim sherds of Neolithic pottery (36). Two were identified as Peterborough ware and the third Fengate ware. There are also three sites thought to be prehistoric in date though exact dates unknown. These are wide lithic scatters including worked artefacts and a pot boiler (66 & 67), cropmarks indicating probable field boundaries and a possible causewayed ring ditch (62).

There is a Roman road running from near Baylham to beyond Little Glemham although the start and end parts of the road are uncertain (47). It is thought that the modern A12 has been built over parts of the pre-existing Roman road.

There is one find spot of medieval artefacts including pottery sherds, querns, coins and a seal matrix[41] (64) as well as examples of medieval coarse ware pottery (65).

There are three post-medieval assets including a bronze token (64) as well as the listed manor (11) and registered park (33) detailed above.

Finally, there is one asset of unknown date comprising of ancient woodland (68).

4.5.3.6 Option 16: Existing route with SB5 (single carriageway) only

There are ten assets recorded in the 300m study area of this bypass option, including one Grade II listed building (11) and one Grade II entry on the Register of Parks and Gardens (33).

[41] The object used to make impressions in wax as seals (thesaurus.english-heritage.org.uk)

The Grade II listed building is a dwelling known as Farnham Manor and was built in 1602 (11). The Grade II entry on the Register of Parks and Gardens is Glenham Park (33) which is described in Option LB3 above.

To the west of the route, the Portable Antiquities Scheme records a medieval to post-medieval artefact scatter. This data is confidential and therefore has not been reproduced on the figure.

The earliest asset of definite date within the study area is a find spot consisting of three rim sherds of Neolithic pottery (36). Two were identified as Peterborough ware and the third was Fengate ware. There were also three sites thought to be prehistoric in date although the exact date is unknown. These are wide lithic scatters including worked artefacts and a pot boiler (66 & 67), cropmarks indicating probable field boundaries and a possible causewayed ring ditch (62).

There is a Roman road running near Baylham to beyond Little Glenham, although the start and end points of the road are uncertain (47). It is thought that the modern A12 has been built over parts of the alignment of the Roman road.

There is one find spot of medieval artefacts recorded along the route, which included pottery sherds, quern stones, coins and a seal matrix (64), as well as examples of medieval coarse ware pottery (65).

There are three post-medieval assets including a bronze token (64) as well as the Grade II listed manor (11) and Grade II entry on the Register of Parks and Gardens (33) detailed above.

Finally, there is one asset of unknown date comprising of ancient woodland (68).

4.5.4 Assessment Methodology

Following review of heritage assets in the study area of each option, it is recommended that each bypass option which are taken forward are further subjected to a Simple Assessment, as specified by DMRB Volume 11 Section 3 Part 2 Cultural Heritage (HA 208/07). This is to further assess the impacts on the recorded cultural heritage as researched by this assessment, as well as the likelihood for, and potential impacts on, previously unrecorded archaeology, not covered by this Scoping Assessment.

Consultation with the County Archaeologist should be undertaken as part of the simple assessment.

The Simple Assessment should also further outline mitigation measures. This may include further evaluation such as geophysical survey in the areas that have archaeological potential.

Any archaeological work carried out for the Simple Assessment must be undertaken in line with IfA guidance as well as DMRB.

4.5.5 Assumptions and Degree of Certainty

No additional working areas as part of the construction of the bypasses have been considered in this Scoping Assessment, such as construction compounds or areas for spoil and bunds. These could result in construction impacts.

This assessment has only dealt with previously recorded cultural heritage. There is potential for previously unrecorded archaeology to be discovered during the construction of the bypass. This potential will need to be assessed in a Simple Assessment.

4.5.6 Predicted Impacts

The potential impacts from the proposed development on cultural heritage comprise impacts to the significance of heritage assets. This may be caused by physical impacts on archaeological features or impacts on the setting of heritage assets.

These impacts may be temporary and permanent and can occur during construction and operation of the development.

4.5.6.1 LB3 (Orange Route) to the south of Marlesfield and to the north of Little Glemham

There could be one construction impact on a flint scatter (70). While surface finds have been recovered, the scatter could indicate that additional remains may survive below the surface. As such, the site has archaeological significance as the scatter could provide further information about the site. Due to its potential to contribute to local research objectives it is considered to be of low value. The LB3 route passes within 50 m of the scatter. This could mean the permanent, partial loss of any remains that may survive. This would therefore result in the partial loss of the significance of the asset. This would have a Moderate Negative magnitude of change upon the significance of this asset, resulting in a Slight Adverse significance of impact.

There is a possible impact to the setting of Glemham Park, a well preserved example of an 18th century formal garden and associated deer park (33) which is Grade II registered. It has historical significance for the information it provides on post-medieval landscape development. The setting of the asset is within a gently rural, rolling landscape. The HER makes it clear that the park has undergone several phases of restoration and remodelling to improve the park and its formal gardens, with avenues running up to them on the north, south, and west. This park is best understood within an agricultural setting and has clearly been designed to be part of the rural landscape of the area. As such, it is considered that setting contributes to its significance. Due to its designation, the asset is considered to be medium value. The LB3 routes cuts through the western edge of the park. This would result in a physical impact on the park, as well as causing an effect on its setting. This could have a magnitude of change of Moderate Negative on the significance of the park. On an asset of medium value, this results in a Moderate Adverse significance of impact.

A number of heritage assets within the village of Little Glemham will receive a positive impact as a result of anticipated reduced traffic amounts within the village centre. Little Glemham contains eight listed buildings within its centre (20 - 25, 27 & 28) and one bridge (71). As a group, they have architectural significance linked to the various styles which they represent. They also have historical significance associated with their role in the development of the settlement. It is surrounded by an open agricultural landscape which forms its setting. This agricultural setting is only considered to contribute to its significance to a minor extent. The majority of the buildings within the village are designed to be inward looking, rather than with views across the landscape.

As Grade II listed buildings, they are considered to be of medium value. The bypass will enhance the historic environment through reduction in volume of traffic which will lead to a drop in vehicle emissions, noise and pollution. This would have a magnitude of change of Minor Positive on the significance of the assets. This is because the setting of the village will be notably changed. On assets of medium value, this results in a Slight Beneficial significance of impact.

4.5.6.2 SB1 (Pink Route) Bypass of Farnham and Stratford St Andrew

There is one possible construction impact on a possible former field system which survives as cropmarks (87). The asset has archaeological significance as it can inform us about the past agricultural techniques. It also is of historical significance as it adds to the understanding about the development of the land and the past economies of the area. It is considered to be of low value. The proposed route will pass through part of this field system and as such would lead to the permanent, partial loss of the remains. This would therefore result in the partial loss of the significance of the asset. This would have a Moderate Negative magnitude of change upon the significance of the asset, resulting in a Slight Adverse significance of impact.

There is a possible impact by this route option on the setting of a World War II pillbox (88). The pillbox has historical significance as it adds to the information on Britain’s numerous defences against the potential invading German army during the war. The setting of the asset comprises the agricultural land that surrounds it and was placed close to the village of Stratford St Andrews. Having clear and long distance views were paramount to the operating of this pillbox and as such, setting is considered to contribute to the significance of this asset. It is considered to be of medium value due to its potential to contribute to regional research objectives. The SB1 route will cut across the otherwise uninterrupted south and south western views of the pillbox. This will mean an intrusion on the setting of the pillbox although the agricultural land around will remain. Therefore, the magnitude of change to the significance of the asset is considered to be Minor Negative. On an asset of low value, this results in a Slight Adverse significance of impact.

In addition there may also be a setting impact on the undesignated Benhall Lodge Park (BNL 020). The park has a number of cropmarks (63) within its grounds which suggest earlier settlement. The park therefore has the potential for further study to reveal material culture and construction evidence and as such, has archaeological significance. It also holds historical significance due to it being part of the developing medieval and post-medieval landscape. The parkland is set within an agricultural landscape and provides the setting for its associated listed buildings, which are outside the extent of the 200 m study area of this assessment. As part of the historical landscape of the area, the setting of the park is considered to contribute to the significance of the asset. The parkland is considered to be of low value due to its undesignated status. The SB1 route will cut through the south western edge of the parkland which would result in a physical impact on the park and will cause an effect on its setting, although this will be to a minor extent due to the location of the route. This could have a magnitude of change of Minor Negative on the significance of the park. On an asset of low value, this results in a Slight Adverse significance of impact.

A number of heritage assets within the settlements of Stratford St Andrew and Farnham will receive a positive impact as a result of anticipated reduced traffic amounts within the town centres.

Stratford St Andrew contains two listed buildings (1 & 5) and one other structure (43) within its centre. As a group, they have historical significance associated with their role in the development of the settlement, as well as architectural significance from the building styles and materials used. It is surrounded by an open agricultural landscape which forms its setting. This agricultural setting is only considered to contribute to its significance to a minor extent. The church is of high value whereas other assets are of medium value. The bypass will enhance the historic environment through reduction in volume of traffic which will lead to a drop in vehicle emissions, noise and pollution. This would have a magnitude of change of Minor Positive on the significance of the assets. This is because there will be a noticeable change to the setting of the settlement and a greater appreciation of the listed buildings. On assets assessed as high and medium value, this results in a Slight Beneficial significance of impact.

4.5.6.3 SB2 (Green Route) Northern Bypass of Farnham and Stratford St Andrew

There is one possible construction impact on an area in which numerous Iron Age, Roman and medieval pottery sherds have been found (61). While surface finds have been recovered, they could indicate that additional remains may survive below the surface. As such, the site has archaeological significance as they could provide further information about the development of the land. Due to the number and date of the sherds and their potential for subsurface remains they are considered to be of medium value. The SB2 route passes within the area of the scatter. This could mean the permanent, partial loss of any subsurface remains. This would therefore result in the partial loss of the significance of the asset. This would have a Moderate Negative magnitude of change upon the significance of this asset, resulting in a Moderate Adverse significance of impact.

In addition there may also be a setting impact on the undesignated Benhall Lodge Park (BNL 020). The park has a number of cropmarks (63) within its grounds which suggest earlier settlement. The park therefore has the potential for further study to reveal material culture and construction evidence and as such, has archaeological significance. It also holds historical significance due to it being part of the developing medieval and post-medieval landscape. The parkland is set within an agricultural landscape and provides the setting for its associated listed buildings, which are outside the extent of the 200 m study area of this assessment. As part of the historical landscape of the area, the setting of the park does contribute to the significance of the asset. The parkland is considered to be of low value due to its undesignated status. The SB2 route will cut through the western edge of the parkland which would result in a physical impact on the park and will cause an effect on its setting, although this will be to a minor extent due to the location of the route. This could have a magnitude of change of Minor Negative on the significance of the park. On an asset of low value, this results in a Slight Adverse significance of impact.

A number of heritage assets within the settlement of Stratford St Andrew will receive a positive impact as a result of anticipated reduced traffic amounts within the town centres. Stratford St Andrew contains two listed buildings (1 & 5) and one other structure (43) within its centre. As a group, they have historical significance associated with their role in the development of the settlement, as well as architectural significance from the building styles and materials used. . It is surrounded by an open agricultural landscape which forms its setting. This agricultural setting is only considered to contribute to its significance to a minor extent. The church is of high value whereas other assets are of medium value. The bypass will enhance the historic environment through reduction in volume of traffic which will lead to a drop in vehicle emissions, noise and pollution. This would have a magnitude of change of Minor Positive on the significance of the assets. This is because there will be a noticeable change to the setting of the settlement and a greater appreciation of the listed buildings. On assets assessed as high and medium value, this results in a Slight Beneficial significance of impact

4.5.6.4 SB4 (Red Route) Bypass of Little Glemham

There is a possible impact to the setting of Glemham Park, a well preserved example of an 18th century formal garden and associated deer park (33) which is Grade II registered. It has historical significance for the information it provides on post-medieval landscape development. The setting of the asset is within a gently rural, rolling landscape. The HER makes it clear that the park has undergone several phases of restoration and remodelling to improve the park and its formal gardens, with avenues running up to them on the north, south, and west. This park is best understood within an agricultural setting and has clearly been designed to be part of the rural landscape of the area. As such, it is considered that setting contributes to its significance. Due to its designation, the asset is considered to be medium value. The LB3 routes cuts through the western edge of the park. This would result in a physical impact on the park, as well as causing an effect on its setting. This could have a magnitude of change of Moderate Negative on the significance of the park. On an asset of medium value, this results in a Moderate Adverse significance of impact.

A number of heritage assets within Marlesford Conservation Area will receive a positive impact (91). Marlesford Conservation Area contains a number of listed buildings, although there is only one which is within the study area of the bypass (3). Marlesford has historical significance as the buildings show a clearly-defined relationship between the topography of the land and the historical development of the settlement. It has architectural significance as many of the buildings demonstrate traditional building forms, details and materials. The setting of the village is a small, rural settlement enhanced by its agricultural landscape setting. The village and the river valley form part of the Ore Valley Special Landscape Area. As such, setting contributes to the significance of the asset. The Conservation Area is considered to be of medium value. The bypass will enhance the historic environment through reduction in volume of traffic which will lead to a drop in vehicle emissions, noise and pollution. This would have a magnitude of change of Minor Positive on the significance of the assets. This is because there will be a noticeable change to the setting of the settlement and a greater appreciation of the listed buildings. On an asset of medium value, this results in a Slight Beneficial significance of impact.

4.5.6.5 SB5 (Blue Route) Southern Bypass of Stratford St Andrew and Farnham

There is one possible construction impact on a possible former field system which survives as cropmarks (87). The asset has archaeological significance as it can inform us about the past agricultural techniques. It also is of historical significance as it adds to the understanding about the development of the land and the past economies of the area. It is considered to be of low value. The proposed route will pass through part of this field system and as such would lead to the permanent, partial loss of the remains. This would therefore result in the partial loss of the significance of the asset. This would have a Moderate Negative magnitude of change upon the significance of the asset, resulting in a Slight Adverse significance of impact.

Two flint scatters (66 & 67) could also be affected. While surface finds including worked objects and pot boilers have been recovered, the two scatters could indicate that additional remains may survive below the surface. As such, the two areas have archaeological significance as they could provide further information about the use of each site. Due to their potential to contribute to local research objectives they are considered to be of low value. The SB5 bypass is likely to pass close by both areas. This would mean the permanent, partial loss of any remains that may survive below the ground. This would therefore result in the partial loss of the significance of the assets. This would have a Moderate Negative magnitude of change upon the significance of these assets. On assets of low value, this would result in a Slight Adverse significance of impact.

There may be effects on the setting of the listed Farnham Manor (11). The house has architectural significance as it demonstrates several phases of building techniques and use of materials. It also has historical significance as it is historically related to the use of the surrounding land for agricultural purposes. The setting of the asset comprises the agricultural land that surrounds it. Due to this relationship, the setting of the Manor is considered to contribute to the significance of the asset, although only to a minor extent. It is considered to be of medium value due to its designation. The SB5 route will run across the agricultural landscape surrounding the manor, interrupting the wider setting of the building. As the manor is surrounded by trees, the views are screened. Therefore, the magnitude of change to the significance of the asset is considered to be Minor Negative. On an asset of medium value, this results in a Slight Adverse significance of impact. A number of heritage assets within the settlement of Farnham will receive a positive magnitude of impact. The town of Farnham has six listed buildings (2, 9, 10, 12, 26 & 30) within its centre. As a group, they have architectural and historical significance associated with their role in the development of the settlement. The setting of the settlement is within agricultural land, bordered by areas of woodland. The church is of high value whereas other assets are of medium value. The bypass will enhance the historic environment through reduction in volume of traffic which will lead to a drop in vehicle emissions, noise and pollution. This would have a magnitude of change of Minor Positive on the significance of the assets. This is because there will be a noticeable change to the setting of the settlement and a greater appreciation of the listed buildings. On assets of high and medium value, this results in a Slight Beneficial significance of impact.

Stratford St Andrew contains two listed buildings (1 & 5) and one other structure (43) within its centre. As a group, they have historical significance associated with their role in the development of the settlement, as well as architectural significance from the building styles and materials used. It is surrounded by an open agricultural landscape which forms its setting. This agricultural setting is only considered to contribute to its significance to a minor extent. The church is of high value whereas other assets are of medium value. The bypass will enhance the historic environment through reduction in volume of traffic which will lead to a drop in vehicle emissions, noise and pollution. This would have a magnitude of change of Minor Positive on the significance of the assets. This is because there will be a noticeable change to the setting of the settlement and a greater appreciation of the listed buildings. On assets assessed as high and medium value, this results in a Slight Beneficial significance of impact.

4.5.6.6 Option 16: Existing route with SB5 (single carriageway) only

Anticipated impacts are likely to be the same as anticipated impacts discussed in section 4.5.6.5 above.

4.5.7 Comparison of SB1 (pink route) and SB5 (blue route)

Both options will have potential adverse effects on archaeological sites as well as beneficial effects on assets located in the villages which would be bypassed. Route SB1 will have an adverse physical effect on a former field system (87) and on the setting of a pillbox (88) and Benhall Lodge (BNL 020), while Route SB5 will have an adverse effect upon four assets. These include physical effects on the site of two lithic scatters (66 & 67) and on the same field system as SB1 (87). In addition, the setting of Farnham Manor (11) would also be affected.

As both routes will bypass villages, there will be beneficial effects on heritage assets located within them. SB1 will have beneficial effects on Stratford St Andrew, while SB5 will have beneficial effects on Stratford St Andrew and on Farnham.

There is no clear preferred route option between these routes as they have similar effects on heritage assets. However, as SB1 is slightly shorter it has a lower risk for previously unrecorded archaeological remains to be located.

4.5.8 Opportunity for Mitigation and Enhancement

A number of archaeological sites have been identified along the route of the proposed bypasses. A programme of further evaluation work is therefore recommended. A programme of further evaluation work is therefore recommended once the design of the final option is progressed. This could include targeted geophysical and/or field walking surveys. Depending upon the results of this evaluation, mitigation during construction may include archaeological excavation, strip, map and record or archaeological watching briefs. Where identified features cannot be avoided they must be fully excavated and recorded in advance of the road construction to allow preservation by record. Where earthworks are affected, such as the possible former field system (87), earthwork survey should be undertaken.

All further work will be undertaken in consultation with the County Archaeologist and will follow guidance from the Institute for Archaeologists (IfA).

Mitigation measures to minimise the setting impact of the proposed bypasses are limited. Screen planting along the roadside may assist in mitigating effects. It is recommended that photographic recording of the existing setting of sites should be undertaken prior to the start of construction.

4.5.9 Residual Impacts

With appropriate mitigation in place the magnitude of change on a number of sites will be reduced. Details are contained within Table 4.5.1.

Table 4.5.1: Residual impacts summary table

Route	Asset	Value	Magnitude of change	Significance of effect	Residual magnitude of change	Residual significance of effect
LB3	Flint scatter (70)	Low	Moderate negative	Slight adverse	Minor negative	Slight adverse
	Glemham Park (33)	Medium	Moderate negative	Moderate adverse	Minor negative	Slight adverse
	Little Glemham.	Medium	Minor positive	Slight beneficial	Minor positive	Slight beneficial
SB1	Old field system (87)	Low	Moderate negative	Slight adverse	Minor negative	Slight adverse
	Pillbox (88)	Low	Minor negative	Slight adverse	Minor negative	Slight adverse
	Benhall Lodge Park medieval settlement (BNL 020).	Low	Minor negative	Slight Adverse	Minor negative	Slight Adverse
	Assets in Stratford St Andrew	Medium - high	Minor positive	Slight beneficial	Minor positive	Slight beneficial
SB2	Pottery sherds (61)	Medium	Moderate negative	Moderate adverse	Minor negative	Slight adverse
	Benhall Lodge Park medieval settlement (BNL 020).	Low	Minor negative	Slight Adverse	Minor negative	Slight Adverse

Route	Asset	Value	Magnitude of change	Significance of effect	Residual magnitude of change	Residual significance of effect
	Assets in Stratford St Andrew	Medium - high	Minor positive	Slight beneficial	Minor positive	Slight beneficial
SB4	Glemham Park (33)	Medium	Moderate negative	Moderate adverse	Minor negative	Slight adverse
	Marlesford Conservation Area (91)	Medium	Minor positive	Slight beneficial	Minor positive	Slight beneficial
SB5	Old field system (87)	Low	Moderate negative	Slight adverse	Minor negative	Slight adverse
	Flint scatter (66)	Low	Moderate negative	Slight adverse	Minor negative	Slight adverse
	Lithic scatter (67)	Low	Moderate negative	Slight adverse	Minor negative	Slight adverse
	Farnham Manor (11)	Medium	Minor Negative	Slight Adverse	Minor Negative	Slight Adverse
	Assets in Farnham	Medium - high	Minor positive	Slight beneficial	Minor positive	Slight beneficial
	Assets in Stratford St Andrew	Medium - high	Minor positive	Slight beneficial	Minor positive	Slight beneficial
SB5 single	Old field system (87)	Low	Moderate negative	Slight adverse	Minor negative	Slight adverse
	Flint scatter (66)	Low	Moderate negative	Slight adverse	Minor negative	Slight adverse
	Lithic scatter (67)	Low	Moderate negative	Slight adverse	Minor negative	Slight adverse
	Farnham Manor (11)	Medium	Minor Negative	Slight Adverse	Minor Negative	Slight Adverse
	Assets in Farnham	Medium - high	Minor positive	Slight beneficial	Minor positive	Slight beneficial

4.5.10 Summary Table

This archaeological and cultural heritage chapter has collated baseline data within a study area of approximately 300 m from the proposed bypass, as required by guidance in DMRB.

Data was collected from Suffolk Historic Environment Record, The English Heritage Archives Services and historic maps. Ninety-three archaeological sites were identified within the study area. The different route options will have various effects to heritage assets. These are summarised in Table 4.5.2.

Given the number of sites within the study area, it is recommended that a Simple Assessment is undertaken of options taken forward. This should follow guidelines from the DMRB and the IfA and be undertaken in conjunction with consultation with the County Archaeologist.

There may be a requirement for further archaeological evaluation but this cannot be determined until the Simple Assessment has been completed.

While none of the options will have a significant effect on cultural heritage, options SB2 and SB4 have the least number of negative effects

Table 4.5.2: Heritage assessment summary table

Route	Qualitative Impacts	Assessment	Mitigation	Residual Effects With Mitigation
LB3	Flint scatter (70). Part or complete loss of asset	Slight Adverse	Simple Assessment followed by additional evaluation if required.	Slight Adverse
	Glemham Park (33). Partial loss of asset and effects on the setting of the asset	Moderate Adverse	Topographic and photographic recording, use of screening	Slight Adverse
	Little Glemham. Reduction of traffic	Slight Beneficial	N/A	Slight Beneficial

Route	Qualitative Impacts	Assessment	Mitigation	Residual Effects With Mitigation
SB1	Old field system (87). Part or complete loss of asset	Slight Adverse	Simple Assessment followed by additional evaluation if required.	Slight Adverse
	Pillbox (88). Effects on the setting of the asset	Slight Adverse	Photographic recording, use of screening	Slight Adverse
	Benhall Lodge Park medieval settlement (BNL 020). Partial loss of asset and effects on the setting of the asset	Slight Adverse	Simple Assessment followed by additional evaluation if required.	Slight Adverse
	Stratford St Andrew. Reduction of traffic	Slight Beneficial	N/A	Slight Beneficial
SB2	Pottery sherds (61). Part or complete loss of asset	Slight Adverse	Simple Assessment followed by additional evaluation if required.	Slight Adverse
	Benhall Lodge Park medieval settlement (BNL 020). Partial loss of asset and effects on the setting of the asset	Slight Adverse	Simple Assessment followed by additional evaluation if required.	Slight Adverse
	Stratford St Andrew. Reduction of traffic	Slight Beneficial	N/A	Slight Beneficial

Route	Qualitative Impacts	Assessment	Mitigation	Residual Effects With Mitigation
SB4	Glemham Park (33). Partial loss of asset and effects on the setting of the asset	Moderate Adverse	Topographic and photographic recording, use of screening	Slight Adverse
	Marlesford Conservation Area (91). Reduction of traffic in the Conservation Area	Slight Beneficial	N/A	Slight Beneficial
SB5	Old field system (87). Part or complete loss of asset	Slight Adverse	Simple Assessment followed by additional evaluation if required.	Slight Adverse
	Flint scatter (66). Part or complete loss of asset	Slight Adverse	Simple Assessment followed by additional evaluation if required.	Slight Adverse
	Lithic scatter (67). Part or complete loss of asset	Slight Adverse	Simple Assessment followed by additional evaluation if required.	Slight Adverse
	Farnham Manor (11). Effects on the setting of the asset	Slight Adverse	Photographic recording, use of screening	Slight Adverse
	Farnham. Reduction of traffic	Slight Beneficial	N/A	Slight Beneficial
	Stratford St Andrew. Reduction of traffic	Slight Beneficial	N/A	Slight Beneficial

Route	Qualitative Impacts	Assessment	Mitigation	Residual Effects With Mitigation
SB5 Single	Old field system (87). Part or complete loss of asset	Slight Adverse	Simple Assessment followed by additional evaluation if required.	Slight Adverse
	Flint scatter (66). Part or complete loss of asset	Slight Adverse	Simple Assessment followed by additional evaluation if required.	Slight Adverse
	Lithic scatter (67). Part or complete loss of asset	Slight Adverse	Simple Assessment followed by additional evaluation if required.	Slight Adverse
	Farnham Manor (11). Effects on the setting of the asset	Slight Adverse	Photographic recording, use of screening	Slight Adverse
	Farnham. Reduction of traffic	Slight Beneficial	N/A	Slight Beneficial
	Stratford St Andrew. Reduction of traffic	Slight Beneficial	N/A	Slight Beneficial

4.6 Water Environment

4.6.1 Introduction

A high-level optioneering assessment has been carried out in respect to the water environment for the A12 Four Villages with due regard to Transport Analysis Guidance (TAG) Unit A4 Environmental Impact Appraisal. The proposed new highway sections have the potential to effect the water environment during both construction and operation. As a high level optioneering assessment has been undertaken, the use of TAG to assess construction, as well as operational impacts, is considered appropriate even though TAG was originally intended to determine operational effects. Following acknowledgement of relevant regulatory and planning policy background and establishment of the existing baseline, potential effects have been identified and assessed. Where there could be significant adverse effects, options for mitigation measures have been considered. Any opportunities for enhancement (i.e. positive effects) have also been acknowledged with any remaining, or residual, effects then presented. Appropriate options recommendations are made in addition to, where relevant, recommendations for further survey and assessment.

As outlined in the Brief, this initial assessment (completed in April 2014)considered the following sub-options only: SB2, SB3, SB5, Link 1 and Link 2 as described further in Table 4.6.1, Chapter 2. Two additional options were considered in October 2014, and are indicated in grey in Table 4.6.1 and described further in Chapter 2.

Table 4.6.1 Assessed routes

Route / Sub-Option	New or Modified	Length of highway (km)	Carriageway
SB2	New	2.3	Single
SB3	New	5.0	Single and Dual
SB5	New	2.3	Single and Dual
Link 1	Modified	1.1	Dual
Link 2	New	0.4	Dual
SB5 (single)	New	2.3	Single
SB1	New	1.8	Single

4.6.2 Regulatory / Planning Policy Framework

This section establishes the legislative and planning context for the proposed A12 Four Villages options in relation to the water environment. Any proposed development will have to comply with the following European and national legislation, and planning policy.

4.6.2.1 Regulatory Framework

4.6.2.1.1. European Legislation

- EC Directive 2000/60/EC The 'Water Framework Directive' (WFD);
- EC Directive 2008/105/EC The 'Priority Substances Directive';
- EC Directive 2004/35/EC The 'Environmental Liability Directive';
- EC Directive 92/43/EEC The 'Habitats Directive'
- EC Directive 79/409/EEC The 'Birds Directive'
- EC Directive 91/676/EEC The 'Nitrates Directive'; and
- EC Regulation 1100/2007 the 'Eels Regulation'.

4.6.2.1.2. National Legislation:

- The Flood and Water Management Act 2010;
- The Water Act 2003;
- The Water Resources Act 1991 (as amended);
- The Conservation of Habitats and Species Regulations 2010;
- The Water Environment (Water Framework Directive) (England and Wales) Regulations 2003;
- The Land Drainage Act 1991 (as amended);

- The Environmental (England and Wales) Permitting Regulations 2010 (as amended 2012);
- The Environmental Damage (Prevention and Remediation) (Amendment) Regulations 2010; and
- The Control of Pollution (Oil Storage) (England) Regulations 2001.

4.6.2.2 Planning Policy

The National Planning Policy Framework (NPPF) (March 2012) replaced existing national planning policy that had been in place since 2004 (e.g. PPS23). In particular, Section 11 of the NPPF ‘Conserving and Enhancing the Natural Environment’ (paragraph 109) states that development should be prevented from contributing to; putting at unacceptable risk from; or being adversely affected by unacceptable levels of water pollution. Section 10 of the NPPF ‘Meeting the Challenge of Climate Change, Flooding and Coastal Change’ (paragraphs 94 and 99) emphasise the need to adopt proactive strategies to mitigate and adapt to climate change over the long term, taking into account flood risk and water supply and demand considerations.

In addition, ‘Future Water’, the Government’s ‘Water Strategy for England was published in February 2008. This strategy sets out the Government’s long-term vision for water and the framework for water management in England. This includes ensuring that the water environment is protected from pollution and physical damage.

Principally, local planning policy is determined by the Suffolk Coastal District Local Plan. Policy DM27 Biodiversity and Geodiversity within the Core Strategy are relevant for the water environment. In addition the Suffolk manual (Suffolk Council, 2000) provided highway design advice.

4.6.3 Baseline Conditions

4.6.3.1 Study Area

The proposed A12 bypass options lie between Snape Watering (in the east) and Wickham Market (in the west). The options would bring traffic relief to the villages of Marlesford, Little Glemham, Stratford St Andrew and Farnham, whilst the options themselves are located within rural areas. The sub-options assessed in this section are as follows:

- SB1 which is located between Farnham and Stratford St Andrea and is around 1.8km in length;
- SB2 which is located to the north of Farnham and Stratford St Andrew and is around 2.3km in length;
- SB5 which is located to the south of Farnham and Stratford St Andrew and is around 2.3km in length;
- SB3 which begins north of Little Glemham and extends 5km westwards to just east of Wickham Market;
- Link 1 which is located to the north of Little Glemham and is around 1.1km in length; and

- Link 2 which is located to the north east of Farnham and is around 0.4km in length.

Link 2 would not be required if SB5 (single and dual) was to be undertaken. Link 1 and Link 2 would not be required if SB1 or SB5 (single) were to be undertaken as both options are single carriage way only and so the existing carriageway where Link 1 and Link 2 would go could be retained. Other than this all other combination of sub-options could potentially be undertaken.

A 1 km study area has been considered round each of the proposed route options in order to identify the water features and their attributes that could be affected by any of the options. Isolated ponds that fall within this primary study area that are more than 100 m from a specific option have been scoped out of this assessment as they are considered unlikely to be impacted by the proposed highways due to lack of hydrological connectivity and the likely extent of construction works from the centre line of the route option. Once the final route has been confirmed, ponds that could potentially be impacted through construction or operations should be identified (noting that the routes provided so far are indicative and that construction working areas have not been identified).

It is noted that watercourses are dynamic features and it is possible that pollutants can be propagated downstream. Therefore, should a watercourse be crossed by a proposed option where direct effects may occur, indirect effects may result downstream. Therefore effects propagated beyond the primary study area downstream are considered within the secondary study area of up to 5 km downstream from the watercourse crossing point (noting that the risk will likely have diminished by this point unless a major pollution event has occurred).

The primary and secondary study areas are contained in the Environment Agency's (EA) East Suffolk management catchment. The topography of the area is generally flat and low lying (elevations in the study area generally range between 10m AOD and 20m AOD), resulting in coastal wetlands and lower channel velocities than elsewhere in the wider East Suffolk Catchment (Environment Agency, 2013). The common underlying geology in the study area is marine derived sands and gravels overlain by glacial till.

4.6.3.2 Surface Water Features

The River Alde, designated as a Main River, flows north to south crossing the existing A12 east of Stratford St Andrew and west of Farnham. Flow in the River Alde is measured at Farnham at which point the river has a catchment size of around 65 km^2. Between 1961 and 2012 the median flow was 0.31 m^3/s whilst low flows (Q_{95}) are around 0.04 m^3/s and high flows (Q_{10}) are around 0.65 m^3/s (CEH, 2014).

The River Ore, also designated as a Main River, flows southeast through Marlesford before deviating eastwards before it joins the River Alde (approximately 25 km south of Farnham). Just upstream of the confluence with the River Alde, flow in the River Ore is measured. At that point the River Ore has a catchment size of around 55km^2. Between 1965 and 2012 the median flow was 0.33 m^3/s whilst low flows (Q_{95}) are around 0.07 m^3/s and high flows (Q_{10}) are around 0.60 m^3/s (CEH, 2014).

To the west of the proposed options the next Main River is the River Deben, whilst to the east the next main river is the River Fromus. Parts of the proposed sub-options lie within the catchment of these rivers and so theoretically these could be impacted by construction works or receive surface water runoff during highway operation.

In addition to these rivers there are a number of other smaller unnamed watercourses, field drains and dykes that are typical in this lowland fenland environment.

Ordnance Survey maps also indicate that there are a number of ponds within the study area.

4.6.3.3 WFD

Existing WFD classifications for the rivers, described above, are detailed in Table 4.6.2 below (noting that only the larger watercourses within the study area are designated under the WFD). The waterbodies that each scheme options lie within the catchment of are also indicated within the table.

Table 4.6.2 WFD Classifications

Watercourse (WFD ID)	Hydro-morphological Status	2012 Ecological Status or Potential	Objective	Protected Areas	Sub-Options within waterbody catchment area
River Fromus (GB105035045980)	Not designated	Poor Status	Good Ecological Potential by 2027	Nitrates Directive	SB1, SB2, SB5, Link 2
River Alde (GB105035046060)	Not designated	Moderate Status	Good Ecological Status by 2027	Nitrates Directive	SB1, SB2, SB5, Link 2, Link 1, SB3
River Ore (GB105035045970)	Not designated	Poor Status	Good Ecological Status by 2027	Nitrates Directive	SB3
River Deben (GB105035046310)	Heavily Modified (due to flood protection)	Poor Potential	Good Ecological Potential by 2027	Freshwater Fish Directive, Natura 2000, Nitrates Directive	SB3

Source: Anglian RBMP (Environment Agency 2009) and Environment Agency consultation (2014))

The River Fromus's failure is driven by a Poor diatom status. Moderate fish status is attributed to barriers to migration and some historic pollution. Invertebrate status is currently at Good. Dissolved oxygen follows natural seasonal trend reducing dilution of effluent in the hotter months. Phosphorus levels are raised predominantly through point source sewage discharges with some diffuse input from land use practices.

The River Alde is impacted by sediment deposition from surrounding land use practices and failing with regard to dissolved oxygen.

The River Ore's failure is driven by Poor fish status since 2010 (due to barriers to migration). Previously moderate invertebrates are now at Good status. Phosphorus failure attributed to point source sewage and some diffuse land use sources.

The River Deben is currently failing for fish, phytobenthos, dissolved oxygen, phosphate and quantity and dynamics of flow. Of the mitigation measures identified for the River Deben 50% are currently in-place. Given that the river is not being crossed by the proposed highways works, and is approximately 700m from the development, the development is unlikely to impact on delivery of the mitigation measures. Similarly direct opportunities to support the mitigation measures are not considered likely.

4.6.3.4 Water Resources & Pollution Incidents

Within the primary study area, there are thirty-five discharge consents. The vast majority of these are associated with private individuals and are likely to be small. Anglian Water has three consented discharges into the River Deben (and associated tributaries) in Wickham Market (west of the proposed highway development although still in the primary study area).

There have been no reported pollution incidents to controlled waters within the primary study area during the past five years.

Six groundwater and two surface water abstraction licences are located within the primary study area.

4.6.3.5 Protected Sites / Species

Each sub-option is not likely to have any effect on the compliance of the watercourses that are designated under the Nitrates Directive and thus compliance with the Nitrates Directive is not considered any further in this assessment. This is because the proposed sub-options would not result in any application of nitrates to groundwater.

The Multi-Agency Geographic Information for the Countryside (MAGIC) interactive map was reviewed to assess for the presence of protected areas within the study area. Consideration was given to Sites of Special Scientific Interest (SSSIs), Ramsars, Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) as well as any Local Nature Reserves (LNRs).

There are no protected areas in the primary or secondary study area.

Consultation with the Environment Agency has indicated that eels (*Anguilla anguilla*) are present in the River Fromus, River Alde, River Deben and River Ore (indicating the presence of protected species within these watercourses).

4.6.4 Assessment Methodology

Optioneering has been undertaking utilising the methodology outlined in TAG.

This assessment is based on professional judgement and informed by best practice guidance, including TAG. The Highways Agency's Volume 11, Section 3, Part 10 of the '*Design Manual for Roads and Bridges (DMRB)*' has also been reviewed to aid the adaption of this method to this assessment.

In assessing the significance of potential effects of the Proposed Development, the following were taken into account.

- The importance of the receiving environment; and,
- The potential magnitude of the effect.

The terms receptor 'importance' and receptor 'sensitivity' are used interchangeably within impact assessments. However, in the context of assessing the effects on the water environment it is commonplace to refer to receptor 'importance' only. This is because larger watercourses have a greater potential to dilute and disperse pollutants (i.e. a greater buffering capacity) and are thus less sensitive, although they are often the waterbodies that support more diverse aquatic fauna and flora, more likely to be designated as a nature conservation site, and have more important socio-economic and aesthetic attributes. Therefore, to ensure that these waterbodies are given an appropriate consideration by the assessment, this impact assessment refers to 'importance' only and may differ from other topics as a result.

The importance of an attribute is defined using Table 4.6.3 as presented below:

Table 4.6.3 Guidance for estimating the importance of environmental attributes

Importance	Criteria	Examples
Very High	Attribute with a high quality and/or rarity, regional or national scale and limited potential for substitution	Site protected under EU or UK wildlife legislation (SAC, SPA, SSSI, Ramsar site); and / or Critical social or economic uses (e.g. water supply and navigation).
High	Attribute with a high quality and/or rarity, local scale and limited potential for substitution Attribute with a medium	WFD High status waterbody (surface water); Aquatic species protected under EU or UK wildlife legislation (e.g. Great Crested Newt); and / or

	quality and rarity, regional or national scale and limited potential for substitution	Important social or economic uses such as water supply, navigation or mineral extraction.
Medium	Attribute with a medium quality and/or rarity, local scale and limited potential for substitution Attribute with a low quality and rarity, regional or national scale and potential for substitution	WFD Good status waterbody (surface water); May be designated as a local wildlife site; May support a small / limited population of protected species; and / or Limited social or economic uses.
Low	Attribute with a low quality and rarity, local scale and potential for substitution	WFD less than Good status waterbody (surface water); No nature conservation designations; Low aquatic fauna and flora biodiversity and no protected species; and / or Minimal economic or social uses.

Adapted from TAG Unit A4 (Department for Transport, 2014)

The magnitude of impact considers the scale of the predicted change to baseline conditions resulting from a given impact and takes into account its duration (i.e. temporary or permanent). Definitions are described in Table 4.6.4:

Table 4.6.4 Guidance for determining magnitude of impact

Magnitude[42]	Criteria	Examples
Major Adverse	Results in a loss of attribute	Loss of Protected Area; Pollution of potable sources of water abstraction; and / or Deterioration of a waterbody leading to a failure to meet Good Ecological Status (GES) under the WFD and reduction in Class (or prevents the successful implementation of mitigation measures for heavily modified or artificial waterbodies).
Moderate	Results in impact on integrity	Discharge of a polluting substance to a

[42] Noting that options and sub-options may provide benefits too.

Adverse	or loss of part of attribute	watercourse but insufficient to change its water quality status (WFD class) in the long term; and / or No reduction in WFD class, but effect may prevent improvement (if not already at GES) or the successful implementation of mitigation measures for heavily modified or artificial waterbodies.
Minor Adverse	Results in minor impact on attribute	Temporary noticeable effect on designated site features, or key attributes of features; Temporary measurable changes in attribute but of limited size and / or proportion, which does not lead to a reduction in WFD status or failure to improve.
Negligible	Results in an impact on attribute but of insufficient magnitude to affect the use / integrity	No effect on designated site features, or key attributes of features; Discharges to watercourse but no significant loss in quality, fishery productivity or biodiversity; and / or No effect on WFD classification or waterbody target.

Adapted from TAG Unit A4 (Department for Transport, 2014)

The significance of a potential impact is estimated by its magnitude (determined using Table 4.6.3) and the importance of the affected attribute (determined using Table 4.6.4). Table 4.6.5 provides a guiding matrix to determine the significance of a potential effect.

Table 4.6.5 Criteria for estimating the significance of potential impacts

	Importance of Environmental Attribute			
Magnitude of potential impact	**Very High**	**High**	**Medium**	**Low**
Major	Very Significant	Highly Significant	Significant	Low Significance
Moderate	Highly Significant	Significant	Low Significance	Insignificant
Minor	Significant	Low Significance	Insignificant	Insignificant
Negligible	Low Significance	Insignificant	Insignificant	Insignificant

Source: TAG Unit A4 (Department for Transport, 2014)

4.6.5 Assumptions and Degree of Certainty

There is inherent uncertainty associated with this high level assessment, thus the approach seeks to outline risks to the environment and the typical measures that may be selected to address those risks. In doing so, the study has assumed a worst case approach. For example, at the time of assessment no design information relating to the highway drainage or the nature of proposed crossings, so we have assumed runoff will be discharged to the nearest watercourse and where river crossings are required we have assumed that this would be via a box culvert rather than an open-span design.

4.6.6 Predicted Impacts

Potential impacts of the options on the water environment are presented per sub-option. The water features associated with each sub-options are as follows:

- SB1: This sub-option crosses the River Alde and a number of ditches that ultimately join the river Alde. No ponds lie in the vicinity of the route.
- SB2: This sub-option crosses the River Alde and a number of ditches that ultimately join the river Alde. One pond lies in the vicinity of the route.
- SB5: Both sub-options cross the River Alde and a number of ditches that ultimately join the river Alde. One pond lies in the vicinity of the route.
- SB3: This sub-option crosses the River Ore and a number of ditches that ultimately join the River Ore. The River Deben lies within the primary study area and downstream of the western end of this route (although no surface watercourse draining the study area appears to flow to the River Deben). Five ponds lie within 100 m of the route corridor.
- Link 1: The Link 1 sub-option crosses one watercourse (a tributary of the River Alde). This River Alde lies within the secondary study area of this sub-option. There are two ponds within 100 m of the sub-option.
- Link 2: No flowing watercourses lie within the primary study area of this sub-option (and so secondary study area is not considered relevant). One pond lies within 100 m of the sub-option.

With reference to Table 4.6.4, the non-main watercourses and ponds are considered to be of low importance (relevant for all sub-options). This is because none of them are designated sites and they are of minimal economic or social use. It is not known if the non-main watercourses and ponds could potentially support Great Crested Newts. For the purposes of this high level optioneering assessment it is assumed that they do not. The main watercourses in the primary and secondary study areas (i.e. the Rivers Alde, Ore, Deben and Fromus) are considered to be of high importance given the presence of aquatic species protected under EU or UK wildlife legislation (i.e. eels *Anguilla anguilla*) (relevant for sub-options SB2, SB3 and SB5).

The following risks will be present in all options in construction and operation:

4.6.6.1 Construction

The magnitude of impacts has been downgraded for main watercourses in the secondary study area and the River Deben (which is not crossed by a sub-option and no surface watercourse draining the study area appears to flow to the River Deben). Given their distance from the works and lack of surface water connectivity this is considered appropriate.

- Silt-laden runoff (minor magnitude in the primary study area/ negligible magnitude in the secondary study area/ River Deben):

Construction work will generate silt-laden runoff which could cause short term, temporary, but potentially acute pollution of the surface waters if it is allowed to drain to a receiving watercourse without appropriate treatment. Once it reaches the river, the reduced water quality could have secondary effects on the aquatic ecosystem (e.g. fish, macroinvertebrates). In the case of sub-option’s SB1, SB2, SB3, SB5 (both sub-options) and Link 1 this risk would be present around the proposed river crossing locations. In the case of the ponds, for all sub-options, this risk of pollution would be isolated to adjacent ponds (and not downstream of them). In addition, material deposited on the existing carriageway by construction vehicles may be mobilised in runoff and reach nearby watercourses, depending on the drainage arrangement.

The significance of this impact for features considered to be of low importance (drains/ditches being crossed, adjacent ponds) is considered to be Insignificant. This is relevant for each of the sub-options.

The significance of this impact for features considered to be of high importance and in the primary study area (River Alde and River Ore crossings) is considered to be of Low Significance. Note this is only relevant for sub-options SB1, SB2, SB3 and SB5 (both sub-options).

The significance of this impact for features considered to be of high importance and in the secondary study area (as well as the River Deben) is considered to be Insignificant. Note this is only relevant for sub-options SB3 and Link 1.

- Chemical / fuel contamination and spillages or leaks (moderate magnitude in the primary study area/ minor magnitude in the secondary study area/ River Deben):

Construction processes could result in runoff contaminated with fuels and other pollutant substances (e.g. cement, paints, sealant, lime, etc.) which are either used or stored on site. In addition, there is also the potential risk of chemical and / or fuel spillages and leaks from plant and machinery. This could cause short term, temporary but acute pollution of the surface water environment if allowed to reach receiving watercourses in particular. Furthermore, secondary effects on the aquatic ecosystem could also occur as a result of the pollution incident. The risk to the water environment will be highest at crossing points and adjacent to ponds, although unknown land drains and surface water sewers could act as potential pathways to watercourses elsewhere.

The significance of this impact for features considered to be of low importance (drains/ditches being crossed, adjacent ponds) is considered to be Insignificant. This is relevant for each of the sub-options.

The significance of this impact for features considered to be of high importance and in the primary study area (River Alde and River Ore crossings) is considered to be Significant. Note this is only relevant for sub-options SB1, SB2, SB3 and SB5 (both sub-options).

The significance of this impact for features considered to be of high importance and in the secondary study area (as well as the River Deben) is considered to be of Low Significance. Note this is only relevant for sub-options SB3 and Link 1.

- Localised erosion of bed and banks (moderate magnitude in the primary study area/ minor magnitude in the secondary study area/ River Deben):

In the case of the options with watercourse crossings, localised erosion of the watercourse banks and bed may result during the construction period. In addition, should new outfalls associated to highway drainage be required there may be additional localised erosion.

The significance of this impact for features considered to be of low importance (drains/ditches being crossed) is considered to be Insignificant. This is relevant for each of the sub-options except Link 2.

The significance of this impact for features considered to be of high importance (River Alde and River Ore crossings) is considered to be Significant. Note this is only relevant for sub-options SB1, SB2, SB3 and SB5 (both sub-options).

The significance of this impact for features considered to be of high importance and in the secondary study area (as well as the River Deben) is considered to be of Low Significance. Note this is only relevant for sub-options SB3 and Link 1.

- Inappropriate disposal of waste on site (negligible magnitude):

Welfare services will be provided at the designated construction compound, and it is also expected and assumed that a limited number of portable toilets would be provided across the development working area. If it is not possible to connect these facilities to existing public foul sewers, waste water from these facilities will be regularly emptied by an appropriate specialist Contractor and disposed of off-site. Foul waste water from toilet and welfare facilities will not be discharged into a watercourse under any circumstances.

The significance of this impact for features considered being of low and high importance (drains/ditches being crossed, rivers being crossed or downstream of where they are crossed and adjacent ponds) is considered to be Insignificant. This is relevant for each of the sub-options.

4.6.6.2 Operation

- Water pollution from highway runoff (negligible magnitude):

The proposed options could result in changed discharges of highway runoff into receiving watercourses from highway drainage. Surface water runoff from roads can contain pollutants such as hydrocarbons, heavy metals, inert particulates, litter and organic matter which can cause chronic pollution of the water environment if allowed to enter watercourses without the appropriate treatment / dilution. Although the proposed sub-options would increase the surface area of impermeable road, and thus the volume of highway runoff into local watercourses, only a relatively low increase in traffic flows would occur as a result of the Sizewell development are predicted (less than 2000 additional vehicles assumed all the way along the A12). The additional flow is significantly below the threshold of 10,000 AADT that is widely accepted as the point where highway runoff can start to impact on receiving watercourses. Total traffic flow would be above the threshold, however, and so if the scheme is pursued a routine runoff assessment should be undertaken.

It is considered that appropriate levels of treatment will be applied during detailed drainage design in consultation with water quality specialists and thus the significance of this impact for features considered to be of low and high importance (drains/ditches being crossed, rivers being crossed or downstream of where they are crossed and adjacent ponds) is considered to be Insignificant. This is relevant for each of the sub-options.

- Spillage risk from polluting substances (negligible magnitude):

Preliminary traffic figures indicate an increase in vehicles using the proposed options (including HGVs). Given the location, near to the East Anglian coast and in a reasonably rural area, it is assumed that most HGVs using this route will be transporting goods that will be or have been carried by ocean going craft (rather than being used locally) via the port of Lowestoft. Goods carried by ocean going craft are typically not hazardous since carrying them on ocean going craft is considered to be a high risk activity. Hence goods on the HGVs using the proposed highways would similarly not be carrying hazardous materials.

Where there would be the introduction of new junctions that can have implications for spillage risk. Carriageway widening (e.g. for Links1 and 2), to accommodate the predicted increase in traffic flows, would have a minimal impact on spillage risk, which is greater where vehicles are making manoeuvres at junctions. Precautionary containment features will be in place along the highway to further minimise the risk from spillages.

The significance of this impact for features considered being of low and high importance (drains/ditches being crossed, rivers being crossed or downstream of where they are crossed and adjacent ponds) is considered to be Insignificant. This is relevant for each of the sub-options.

- Morphological effects (minor magnitude in the primary study area/ negligible magnitude in the secondary study area/ River Deben):

The location of new watercourse crossings (assumed to be box culverts) and any new outfalls to allow for highway drainage would have a long term morphological effect on the receiving watercourses.

The significance of this impact for features considered to be of low importance (drains/ditches being crossed) is considered to be Insignificant. This is relevant for each of the sub-options except Link 2.

The significance of this impact for features considered to be of high importance and in the primary study area (River Alde and River Ore crossings) is considered to be of Low Significance. Note this is only relevant for sub-options SB1, SB2, SB3 and SB5 (both sub-options).

The significance of this impact for features considered to be of high importance and in the secondary study area (as well as the River Deben) is considered to be Insignificant. Note this is only relevant for sub-options SB3 and Link 1.

- Potential loss of ponds (major magnitude):

As a result of each sub-option except SB1, adjacent ponds may be lost as a result of the proposed developments. From a water environment perspective the loss of these ponds may have drainage implications (noting that there may be biodiversity impacts also).

Acknowledging that these features are of low importance the significance of this impact is considered to be of Low Significance.

4.6.7 Opportunity for Mitigation and Enhancement

Mitigation measures and design measures that could be utilised within the scheme are presented below.

4.6.7.1 Construction

- General Measures:

It is recommended that construction work should be in accordance with best practice measures issued by the Environment Agency (e.g. Getting Your Site Right: Industrial and Commercial Pollution Prevention (2004) and Pollution Prevention Guidelines (various dates)) and CIRIA (e.g. Report 648: Control of Water Pollution from Linear Construction Projects –Technical Guidance (2006)).

In addition, all work would have to be carried out under appropriate consents / permits / licences, from the local planning authority, Environment Agency and Natural England, as required. For example, should trade effluent (including silt-laden runoff) be discharged into a controlled water a Water Activity Permit from the EA, under the Water Resources Act 1991 (as amended) and the Environmental Permitting (England and Wales) 2010, would be required. Temporary and permanent Flood Defence Consent would be required from the EA to cross Main Rivers or install highway drainage outfalls on the banks of Main Rivers.

- Silt-laden runoff:

To mitigate silt-laden runoff silt management and control measures can be proposed (and set out in the Construction Environmental Management Plan (CEMP) or a Silt Management Plan (SMP)). Works should be timed and undertaken to minimise the formation of silt laden runoff, with mitigation measures in place to intercept any that is generated so that it can be treated and discharged to ground or a watercourse to reduce the risk of adverse effects. For example, mud would l be controlled at entry and exits to the site using wheel washes and / or road sweepers, or site compounds and stockpiles will be located away from surface water attributes. Through utilisation of such mitigation it is considered that there would be a residual negligible impact on water features.

- Chemical / fuel contamination and spillages or leaks:

In order to mitigate this risk a number of measures would be proposed and set out in a pollution prevention plan (and CEMP). This would include measures such as refuelling of plant would take place in a designated area at the site compound only, with any stored fuel in a bunded container and an isolated drainage system to trap any spill and an Emergency Response Plan would be prepared. Through utilisation of such mitigation it is considered that there would be a residual negligible impact.

- Localised erosion of bed and banks:

From an environmental perspective it is recommended that open span structures are proposed at all watercourse crossings. However, should this not be feasible, it may be possible to design culverts that are environmentally sensitive (e.g. oversize arch allowing a natural channel and to allow light in to a larger percentage of the covered channel). The Environment Agency has a policy to generally object to new culverts and if any are proposed they would need to be adequately justified. Culverting a section of a WFD designated watercourse will also require an assessment to determine if this can be done without causing deterioration, preventing the watercourse from improving to meet standards, or compromising the implementation of mitigation measures. It is expected that the Environment Agency will insist on open-span crossings for any Main Rivers and WFD designated watercourses as a minimum requirement.

Through utilisation of such approaches it is considered that there would be a residual minor impact.

As highlighted above, all work adjacent to watercourses would be carried out with the appropriate consent in place (either from the Environment Agency, East Suffolk Internal Drainage Board (IDB) or Suffolk County Council who are the Lead Local Flood Authority (LLFA).

4.6.7.2 Operation

- Water pollution from highway runoff and spillage risk from polluting substances:

It is recommended that as the preferred option is development appropriate quantitative assessment in accordance with the methodologies to assess the risk to receiving watercourse from routine highway runoff and spillage risk described in HD45/09 of the DMRB are undertaken to inform the development of appropriate drainage systems is selected to treat the surface runoff and act as a storage environment for highway spillages (slowing their conveyance to the attributes). An appropriate ‘treatment train’ should be provided to treat the runoff. This may include swales / grassed channels, surface flow wetlands, balancing ponds or sedimentation ponds. These features would ‘fit’ well in the rural landscape. Should it be determined that there is a significant spillage risk, additional features like penstocks could be provided. Due to the anticipated risk from the new road and the availability of space for sustainable drainage systems, the residual impact would remain negligible as a result of this mitigation. Should these new treatment and attenuation features intercept runoff from existing roads there is the possibility of beneficial effects where no treatment or containment measures exist, although it is not possible to assess accurately at this stage.

- Morphological effects:

The morphological effects resulting from the presence of new outfalls (for highway drainage) can be softened by sensitive design or offset by habitat improvements locally around them. For example, coir rolls could be utilised to soften the appearance of the headwall and allow vegetation to establish, vegetation cut back to improve light availability or fences put up to prevent livestock poaching of the watercourse banks). The residual impact would still remain minor through inclusion of this mitigation as the physical presence of a new structure cannot be fully offset in the long term.

- Potential loss of ponds:

To avoid this impact we recommend that the proposed routes do not go through ponds but are diverted around. If the ultimate route results in the loss of ponds nearby, replacement ponds should be constructed and any adverse impact on drainage (e.g. surface and sub-surface flows) should be mitigated for. As a result of this it is considered that there would be a residual minor impact.

4.6.8 Residual Impacts

The residual impacts of the potential impacts are presented below in Table 4.6.6:

Table 4.6.6: Residual impacts pre and post mitigation (continued overleaf)

Potential impact	Pre-Mitigation		Post-Mitigation	
	Magnitude of Impact	Significance (Pre-Mitigation)	Magnitude of Impact	Significance (Post-Mitigation)
Construction				
Silt-laden runoff	Minor	SB1- Up to Low Significance	Negligible	SB1- Insignificant
		SB2- Up to Low Significance		SB2- Insignificant
		SB3- Up to Low Significance		SB3- Insignificant
		SB5 (both sub-options)- Up to Low Significance		SB5 (both sub-options)- Insignificant

		Link 1- Insignificant		Link 1- Insignificant
		Link 2- Insignificant		Link 2- Insignificant
Chemical / fuel contamination and spillages or leaks	Moderate	SB1- Up to Significant	Negligible	SB1- Insignificant
		SB2- Up to Significant		SB2- Insignificant
		SB3- Up to Significant		SB3- Insignificant
		SB5 (both sub-options)- Up to Significant		SB5 (both sub-options)- Insignificant
		Link 1- Up to Low Significance		Link 1- Insignificant
		Link 2- Insignificant		Link 2- Insignificant
Localised erosion	Moderate	SB1- Up to Significant	Minor	SB1- Up to Low Significance
		SB2- Up to Significant		SB2- Up to Low Significance
		SB3- Up to Significant		SB3- Up to Low Significance
		SB5 (both sub-options)- Up to Significant		SB5 (both sub-options)- Up to Low Significance
		Link 1- Up to Low Significance		Link 1- Insignificant
		Link 2- n/a		Link 2- n/a
Inappropriate disposal of waste	Negligible	SB1- Insignificant	Negligible	SB1- Insignificant
		SB2- Insignificant		SB2- Insignificant
		SB3- Insignificant		SB3- Insignificant
		SB5 (both sub-options)- Insignificant		SB5 (both sub-options)- Insignificant
		Link 1- Insignificant		Link 1- Insignificant

		Link 2- Insignificant		Link 2- Insignificant
Operation				
Water pollution from highway runoff	Negligible	SB1- Insignificant	Negligible	SB1- Insignificant
		SB1- Insignificant		SB2- Insignificant
		SB3- Insignificant		SB3- Insignificant
		SB5 (both sub-options)- Insignificant		SB5 (both sub-options)- Insignificant
		Link 1- Insignificant		Link 1- Insignificant
		Link 2- Insignificant		Link 2- Insignificant
Spillage risk from polluting substances	Negligible	SB1- Insignificant	Negligible	SB1- Insignificant
		SB2- Insignificant		SB2- Insignificant
		SB3- Insignificant		SB3- Insignificant
		SB5 (both sub-options)- Insignificant		SB5 (both sub-options)- Insignificant
		Link 1- Insignificant		Link 1- Insignificant
		Link 2- Insignificant		Link 2- Insignificant
Morphological effects	Minor	SB1- Up to Low Significance	Minor	SB1- Up to Low Significance
		SB2- Up to Low Significance		SB2- Up to Low Significance
		SB3- Up to Low Significance		SB3- Up to Low Significance
		SB5 (both sub-options)- Up to Low Significance		SB5 (both sub-options)- Up to Low Significance
		Link 1- Insignificant		Link 1- Insignificant
		Link 2- n/a		Link 2- n/a
Loss of Ponds	Major	SB1- Insignificant	Negligible	SB1- Insignificant

		SB2- Low Significance		SB2- Insignificant
		SB3- Low Significance		SB3- Insignificant
		SB5 (both sub-options)- Low Significance		SB5 (both sub-options)- Insignificant
		Link 1- Low Significance		Link 1- Insignificant
		Link 2- Low Significance		Link 2- Insignificant

4.6.9 Summary Table

An assessment of the potential significance of impacts associated with each of the proposed A12 sub-options has been undertaken. The assessment acknowledged the importance of watercourses in the vicinity and downstream of the works and the magnitude of potential impacts associated with the scheme (accounting for likely best practice mitigation).

It is difficult using this assessment methodology to distinguish clearly between options, especially since the application of mitigation can often be effective. However, the assessment has determined that both the Link 1 and Link 2 works are considered to have an insignificant impact on the surface water environment. Impacts associated with SB1, SB2, SB3 and SB5 (both sub-options) are considered to be of low significance. From a surface water environment perspective, there is little to contrast SB2 and SB5, which are alternate sub-options and a decision between the two may ultimately be based on other considerations. SB3 is more than twice as long as any other sub-options, crosses more watercourses and lies within three WFD waterbodies. As such it may prove to be the most challenging to undertake from a surface water environment, with the greater number of structures required to cross watercourses and the treatment of highway runoff requiring more assessment and separate Flood Defence Consents from the EA.

4.6.9.1 Preferred Options

The two additional sub-options considered in October 2014, SB1 and SB5 (single) (both single carriageways) are the preferred options.

Impacts of both sub-options on the surface water environment, assuming adherence to mitigation, are considered to be low significance (based on the TAG guidance). Both sub-options cross the River Alde however whilst sub-option SB5 (single) crosses the river in a perpendicular manner sub-option SB1 crosses more acutely. As such SB1 crosses more ditches that ultimately enter the river and crosses more of the rivers flood plain. The River Alde is a WFD watercourse and with more ditch crossings associated with SB1 in the vicinity of this watercourse the potential for detrimental impacts on the WFD watercourse is increased. As such from a surface water environment perspective SB5 (single) would be the preferred option.

Similarly as SB1 extends further within the flood plain of the River Alde (the main river crossed by both of the preferred options) it would be associated with potentially more flood risk effects. Hence from a broad flood risk perspective, SB5 would be the preferred option (note that flood risk should be considered in detail and to the requirements of the National Planning Policy Framework (NPPF) published on the 27 March 2012 (Department for Communities & Local Government, 2012)).

5 Mitigation Measures

5 Mitigation Measures – Noise Barriers

5.1 Introduction

It has been put forward by SCC that mitigation measures regarding the noise due to the proposed scheme developments is a significant issue. Following this raised concern; noise barrier proposals with the inclusions of costing have been explored.

5.2 Noise Barriers

The proposed routes of the Four Villages bypass will affect the noise levels experienced at properties in the vicinity of the routes. The large quantity of vehicles on the routes will generate a continuous stream of noise from the engine and tyres of the vehicles. Adverse or beneficial effects on present noise levels are dependent on the proximity of the property location to the proposed route. A preliminary calculation on where noise barriers may need to be constructed and the extent of the noise barriers is detailed below.

The lengths have been calculated using guidance from DMRB, HA 66/95.[43]. As can be seen in section 3.2 of the report, a 200m corridor was evaluated with Noise Sensitive Receptors (NSR) located at properties within this area. At a 200m distance the angle of view can be calculated to be approximately 89.1°, if a 3m high noise barrier is installed at the side of the highway. By taking this value, a degree multiplier of approximately two can be read off the graph below;

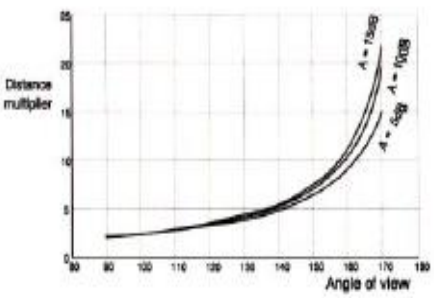


Figure 5.2.1: Graph representing distance multiplier compared to angle view of property (DMRB, 2005)

This graph is a rule of thumb that has been modified by the distance of the property from the road. It is also important to note that after 300m, the noise attenuation experienced with respect to the noise barrier is negligible in the rural location that

[43] DMRB, Volume 10, Section 5: Environmental Barriers, HA 66/95.

the proposed routes are in. This is because soft ground such as countryside absorbs sound waves, attenuating the noise quickly over a distance.

Properties with a change in 3dB $L_{night, outside}$ or more have been deemed to be above the threshold levels where a Do-Minimum vs Do-Something comparison has been made. These are properties that need measures to reduce the effect of increased noise by the construction of the proposed routes with the worst case scenario excluding Sizewell related traffic. AECOM are proposing to mitigate these effects by the construction of three metre high timber fencing, commonly known as noise or acoustic barriers.

Table 5.2.2, below, details the evaluation of the data from the NSR’s from the survey detailed in section 4.2 of the main report. An explanation and relevant assumptions for the table can be found in the section after the tables.

Table 5.2.2: Indication of noise barrier location and length

Route	Length of noise barrier fence (m)	No. of properties effected (from Noise Report)	Property affected	Change in Noise (long term) (dB)	Difference in level of road (m)	Fill/Excavation
SB1 (Pink Route)	400	24	Park Gate House Farmhouse NSR B630	3.4	-3.95	Proposed route same as existing level
SB2 (Green Route)	400	57	Mill House NSR B827	14.1	-5.37	Excavation needed greater than 3m needed from CH 6500-6750
	400		Main Farm NSR B952	7.4	-0.03	Fill along whole length
SB4 (Red Route)	0	3				
SB5 (Blue Route)	400	33	Pond Barn Cottages NSR B610	9.3	+6.00	Excavation needed along whole length greater than 3m

	400		Park Gate Farmhouse NSR B630	4.8	-3.95	Proposed route same as existing level
	400		Mollets Farm NSR B852	5.3	-3.85	Proposed route same as existing level
	400		Yew Tree Cottage NSR B892	3.7	-2.00	Proposed route same as existing level
LB3 (Orange Route)	400	26	Brick Kiln Cottage NSR B075	4.1	+7.23	Fill from 1000-1150 and then 1150-1400 excavated
	400		Ivy House Cottages NSR B129	5.6	-0.44	Fill along whole length
	400		Moat Farm NSR B524	3.7	-2.00	Fill along whole length

Table 5.2.3: Summary of length of noise barriers

Route Option	No. of noise barriers
SB1 (Pink Route)	1No. x 400m
SB2 (Green Route)	2No. x 400m
SB4 (Red Route)	0
SB5 (Blue Route)	4No. x 400m
LB3 (Orange Route)	3No. x 400m

5.3 Assumptions

- A 400m length noise barrier has been assumed as a conservative length to protect the properties. This is considered a worst case scenario and the length could be reduced by the following:
  - Data on the proximity of residential properties in relation to the proposed route. The closer the property to the road the smaller the noise barrier can be in accordance with Figure 5.2.1.
  - Topography data between the properties and the road. This could allow a natural noise barrier to be created between the road and the property reducing the need for a noise barrier.
- A three metre high fence has been calculated to be the optimum height for the noise barrier. This is calculated from guidance from the DMRB that noise barriers should be within two and five metres. This is also a readily available height for a fence panel.
- The noise barrier has been positioned in the most beneficial location to protect the respective property. This is affected by the curvature of the road and also the proximity of roundabouts and side road. This may skew the 400m length noise barrier to the left or right of the property, to allow the optimum protection to be achieved.

The ‘Difference in Level of the Road’ column gives an indication of the gradient of the proposed routes. The ‘Fill/Excavation’ column allows the reader to interpret whether there is a need for additional fill or the need to excavate when constructing the new route. This may allow for a natural barrier to be formed protecting.

6 Journey Times Accidents and CO2 Benefits

6 Journey Times Accidents and CO2 Benefits

6.1 Introduction

This chapter details the traffic and economic assessment that has been undertaken for the A12 between Wickham Market and the A1094 in relation to suggested off-line improvements. Carbon emissions have also been estimated as part of this assessment.

Traffic data has been sourced from Suffolk County Council (SCC) and automatic traffic counts (ATC) and ATC and junction counts undertaken on behalf of EDFE in 2011.

There is very limited information regarding expected Sizewell C traffic and has therefore been sourced from the December 2012 consultation documents and knowledge from discussions with EDFE in the intervening period.

This chapter has been updated from the previous analysis to incorporate a two stage building of the SB1 option at Farnham. SCC have requested that the northern section of this option is assessed first with a 2020 opening year followed by the southern section in 2024. For this additional assessment only the economic and accident data tables have been updated. All other assumptions are unchanged except that a reduced speed section is assumed due to the proposed roundabout linking the northern and southern sections of SB1 to allow for deceleration and acceleration characteristics. This note therefore includes new results for the SB1 northern and southern sections and a slight modification to the original SB1 results.

6.2 A12 Four Villages Traffic Data

Traffic data has been taken from the SCC permanent site near Farnham; this data were for 2012. EDFE temporary ATCs from May 2011 have also been reviewed. These were located at the eastern end of the Wickham Market bypass and west of the A1094 junction.

The EDFE data indicated that A12 traffic volumes are very similar at both ends of the Four Villages section of the A12. Other EDFE 12 hour turning counts indicated that traffic turning to/from minor roads between the two ATC sites was relatively low and suggests that around 95% of traffic between the two ends of the Four Villages section was ‘through’ A12 traffic.

As the traffic volumes at either end of the Four Villages section were very similar it has been assumed that traffic volumes on all bypass options will be the same.

Existing A12 traffic speeds have been obtained from 2012 TrafficMaster data, supplied by SCC. From the traffic volume and travel time data a speed-flow relationship has been derived for this section of the A12. This has been used to calculate travel times for traffic flow ranges in bands of 100 vehicles.

For the assessment it has been assumed that the speed-flow relationship is applicable to all sections of the A12 through the Four Villages section. This is an approximation as the route is subject to differing speed limits ranging from 30mph to 60mph.

This assumption results in the benefits per kilometre of route bypassed being the same for a given length of new bypass of the same standard.

For the assessment it has been assumed that DMRB speed-flow relationships will be applicable to the proposed new sections of bypass. For the two lane bypasses a speed limit of 60mph has been assumed and 70mph for the dual carriageway sections. It has been assumed that car and LGV traffic will have different speeds to HGVs for both single and dual carriageway options.

As a traffic model is not available it has been assumed that traffic demand is the same in the Do Minimum and Do Something scenarios, i.e. there is no trip generation due to the improved A12. It has also been assumed that there is no trip reassignment from alternative routes.

The Opening Year for the A12 scheme(s) has been assumed to be 2020, based on feedback from SCC in the Progress Meeting held on 25th March 2014.

Sizewell C peak construction year is assumed to be 2024 as recently indicated by EDFE. In the previous assessment it was assumed that construction would take about ten years to complete. It has been assumed that the first year of construction will be 2020 and the last year 2030.

For the economic assessment three years have been modelled: 2020, 2024 and 2031. Some construction traffic has been assumed in 2020 and none in 2031. Traffic volumes have therefore been calculated for each of these three forecast years. 2035 traffic volumes have also been calculated for environmental assessment purposes.

For the SCC ATC site at Farnham traffic data were provided at hourly intervals for the whole of 2012. This gave an Annual Average Daily Traffic (AADT) flow of 15,505 vehicles two-way, of which 12% where LGVs and just under 5% HGVs.

6.2.1 Traffic Speed Data

TrafficMaster traffic speed data were provided by SCC covering a number of months during 2012. These data have been used to determine a speed-flow relationship for the section of A12 being assessed. This section of the A12 has posted speed limits ranging from 30mph to 60mph. Using the available data the following formula was derived:

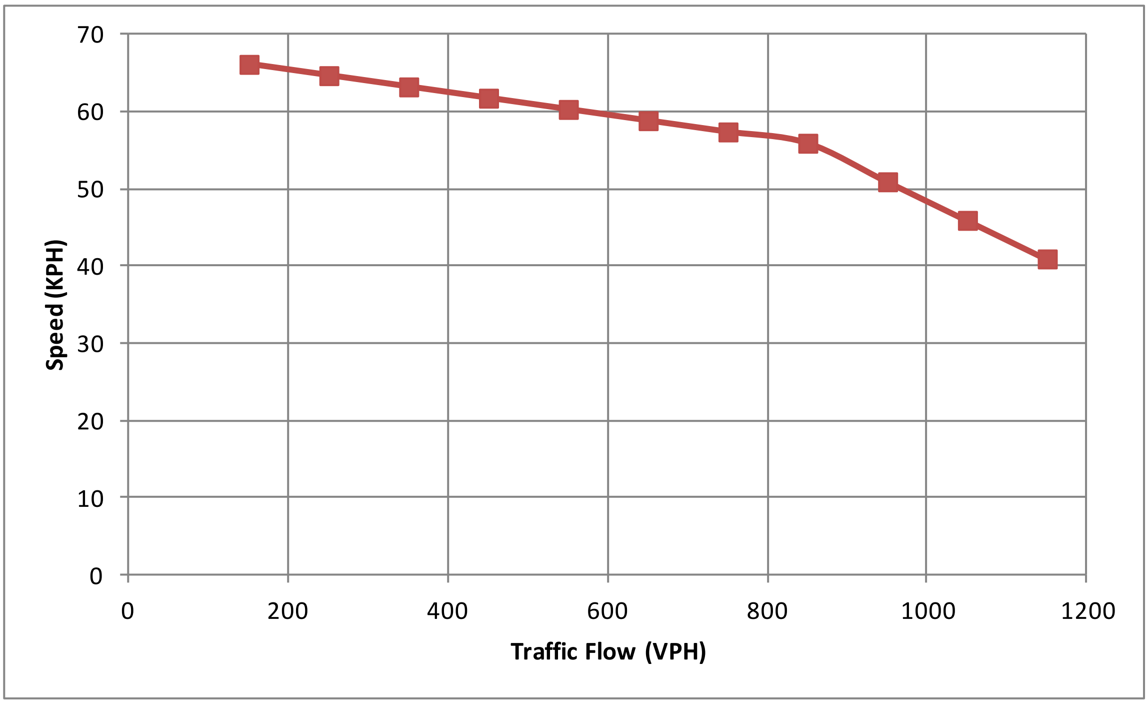
$$\text{Speed (kph)} = 68.35 - 0.0142*(\text{Traffic Flow})$$

Where *Traffic Flow* is the volume of traffic per hour per direction

From the TrafficMaster data it was observed that beyond 800-1000 vehicles per hour (vph) journey times can increase significantly, consistent with the normal parabolic speed-flow curves that are observed in practice with high vehicle flows as capacity is reached and exceeded. There is an absolute limit on the existing road of about 1,100 to 1,200 vph.

This speed-flow relationship is applicable up to traffic volumes of 850 vph. At traffic flows above 850 vph (or the 'breakpoint' flow) the COBA formula has been applied. Figure 6.2.1 indicates the speed-flow curve applicable to the existing A12 through the Four Villages.

Figure 6.2.1 : Existing A12 Speed-Flow Relationship



As speed is dependent on flow, traffic has been grouped into ten volume bands, in bands of 100 vehicles, ranging from <400 vph to >1200 vph. The midpoint of each band is used to determine the average speed of vehicle for that particular band. For the first and last bands values of 350 and 1250 respectively are used to calculate average speed.

6.2.2 Growth Data

To obtain future year car traffic volumes the TEMPRO version 6.2 database has been used to extract growth in trips from 2012. To these trip end growth factors fuel and income adjustment factors are applied using the current version of factors in the January 2014 version of the WebTAG databook.

LGV and HGV growth has been based on the most recent National Transport Model forecasts released in 2013.

Data for three forecast years have been derived:

- 2020 – Scheme Opening
- 2024 – Assumed Sizewell 'C' peak construction year

- 2031 – First forecast year without Sizewell 'C' construction traffic

Applying the above growth process results in the forecast two-way A12 AADT volumes as detailed in Table 6.2.1. By 2031 there is a forecast average daily volume of 20,922 which is some 35% higher than the 2012 volume.

Table 6.2.1: A12 Traffic Volumes

	2012	2020	2024	2031
Vehicle Type				
Car	12,934	14,432	15,151	17,260
LGV	1,857	2,195	2,427	2,822
HGV	713	766	783	840
Total Vehicles	**15,505**	**17,393**	**18,361**	**20,922**

6.3 Sizewell C Construction (Development) Traffic

There is only limited information available from the EDFE 2012 consultation documents. Based on what is stated in these the following summarises what information is provided and what assumptions have been included within the assessment.

6.3.1 Car trips

No detail is provided within the EDFE consultation documents as to how many car trips are likely to be generated by Sizewell C construction.

EDFE are proposing a 1,000 space on-site car park. In discussions with EDFE during 2013 AECOM considered that a 1,000 space car park would be used by around 1,200 cars per day for commuting purposes based on shift patterns, i.e. about 2,400 single trips.

It is considered by EDFE that the majority of car trips from the A12 south and A12 north will use the proposed park and ride sites.

AECOM have assumed that commuting trips using the on-site car park will originate from the following areas:

- 25% from areas east of the A12;
- 25% from areas west of the A12;
- 25% using the A12 south; and
- 25% using the A12 north.

There would also be car trips on business/visitor purposes which have not been defined by EDFE but have been assumed to be 200 two-way trips per day at peak construction. 66% of business/visitor trips have been assumed to originate from the A12 south and 34% from the A12 north.

6.3.2 LGV Trips

During peak construction EDFE have estimated that there would be on average 170 visits (340 movements), with the busiest day being some 50% higher than this, i.e. 255 visits (510 movements). EDFE do not provide any assessment of where these LGV trips will originate.

This assessment has used the average daily volume of 170 and assumed that 66% originate from the A12 south and 34% from the A12 north.

6.3.3 HGV Trips

During the construction peak EDFE have estimated that there would be between 100 and 300 HGV deliveries per day with the busiest day being some 50% higher than this. EDFE expect that 85% of HGVs would originate from the A12 south and 15% from the A12 north.

The assessment has used the upper average daily volume of 300 HGV deliveries (600 1-way trips) and assumed 85% originate from the A12 south and 15% from the A12 north.

6.3.4 Bus Trips

EDFE do not provide any indication as to the number of bus trips that are expected to be generated during construction. EDFE are proposing two park and ride sites on the A12 and some direct buses from Ipswich and from Saxmundham railway station.

For the purposes of this assessment it has been assumed that the P&R frequency is every 15 minutes or four buses per hour in each direction at both sites between 0600 and 2400. It has been assumed that there are two buses per hour between Ipswich and Sizewell and one bus per hour from Saxmundham.

6.3.5 Combined Trips

Although construction related traffic is likely to vary by day and hour it has been assumed for assessment purposes that traffic volumes will be constant across each day. The majority of Sizewell trips will occur between 0600 and 2400 and it has been assumed that volumes are evenly spread across each of these 18 hours. This results in the following construction related trips in 2024:

Table 6.3.1: Assumed hourly Sizewell C trips (2024)

Route	Car	LGV	HGV	Bus	Total Vehicles (Hourly By direction)	Total Vehicles (Daily Both directions)
A12 Four Villages	24	6	14	6	**50**	**1,814**
B1122*	29	3	17	4	**53**	**1,896**
B1119	32	6	0	7	**46**	**1,640**
D2 Route**	32	6	17	11	**66**	**2,384**

*It is assumed that all Sizewell C construction HGV trips will access the site via the B1122.

**It is assumed that all Sizewell C construction HGV and Bus trips will use the D2 route.

6.3.6 Benefits

This section of the report details the assessment of the A12 Four Villages scheme options. The assessment has been undertaken using the DfT's TUBA program. This uses a number of scheme specific inputs regarding traffic volumes, trip distance and travel times to determine economic benefits over a 60 year period.

6.3.6.1 Traffic Volumes

The traffic volumes input to TUBA are for the three forecast years including the Sizewell C development trips. Based on the hourly volumetric data traffic has been grouped into one of 10 flow groups ranging from <400 vehicles per hour (vph) to >1200 vph. These flow groups are used by TUBA to determine annual traffic volumes and are input for each of the three forecast years 2020, 2024 and 2031. Traffic is inputted for three vehicle types: car, LGV and HGV.

Volumes are required for the Do Minimum (Without Scheme) (DM) and Do Something (With Scheme) (DS) scenarios. Based on available A12 junction counts along the section of route being assessed it was determined that about 5% of traffic is 'local' traffic and would remain on the existing route if a bypass was built.

6.3.7 Traffic Speeds

For each of the ten flow groups an average travel time is calculated. Firstly an average speed is derived based on the mid-point volume of each flow group. The travel time is calculated assuming the average speed applies to the length of the appropriate DM and DS scheme distances.

Using COBA speed-flow relationships for new all-purpose roads, light vehicles (Car and LGV) are assumed to travel at higher speeds than HGVs. For the existing A12 all vehicles are assumed to travel at the same average speed.

6.3.8 Scheme Distances

Five main alternative scheme options have been assessed, with four of these being assessed for both single and dual carriageway options. The longest of the five scheme options is Long Bypass 3 (LB3). This commences on the western side of the B1078 junction at Wickham Market. For some of the dual carriageway options the overall scheme length is longer as they included additional sections of route.

Table 6.3.2: Scheme lengths (metres)

	SINGLE Carriageway Bypass		DUAL Carriageway Bypass	
	Existing A12	New Route	Existing A12	New Route
SB1	1,927	1,963	n/a	n/a
SB1 (North)	1,064	1,033	n/a	n/a
SB1 (South)	863	930	n/a	n/a
SB2	2,210	2,257	2,650**	2,697**
SB4	2,405	2,200	3,055***	2,850***
SB5	2,650	2,900	2,650	2,900
LB3*	4,620	4,900	5,270***	5,550***

*These are the full lengths of the LB3 scheme. In the assessment these are reduced by 1km.

**Includes Link 2 upgrade.

***Includes Link 1 upgrade.

6.3.9 Travel Time Savings

Table 6.3.3 provides a breakdown of the travel time savings for each of the scheme options and including single and dual carriageway alternatives. These have been calculated for each of the three model years and is the average time saving allowing for differing travel times between different hours of the day and days of the year.

For the shorter single carriageway bypasses the time savings are about 0.5 minutes whereas for the longer dual carriageway sections the time savings are slightly under 2 minutes. For the single carriageway options time savings are about 25% of existing route travel times which increases to around 40% for the dual carriageway options.

Table 6.3.3: Average travel time savings per vehicle (Minutes)

Option	2020		2024		2031	
	Single	Dual	Single	Dual	Single	Dual
SB1	0.42	n/a	0.45	n/a	0.49	n/a
SB1 (North)*	0.27	n/a	0.29	n/a	0.31	n/a
SB1 (South)*	n/a	n/a	0.16	n/a	0.17	n/a
SB2	0.59	1.11	0.61	1.16	0.65	1.21
SB4	0.83	1.43	0.86	1.49	0.90	1.56
SB5	0.56	0.99	0.59	1.04	0.63	1.09
LB3	0.81	1.66	0.85	1.75	0.91	1.84

6.3.10 Calculated Benefits

Table 6.3.4 provides a breakdown of benefits for each of the scheme options and including single and dual carriageway alternatives. The values shown are in £000's discounted to 2010 and are in 2010 prices and assume a standard sixty year assessment period from the opening year of 2020.

The TUBA outputs range from £8.8 million of benefits for the Short Bypass 1 (SB1) South single carriageway scheme to £98.7 million of benefits for the Long Bypass 3 (LB3) dual carriageway scheme.

Table 6.3.4: Benefit summary table (£000's)

Option	1	1a	1b	2a	2b	4a	4b	3a	3b	5a	5b
	SB1 S2	**SB1 (North)**	**SB1 (South)**	**SB2 S2**	**SB2 D2**	**SB4 S2**	**SB4 D2**	**SB5 S2**	**SB5 D2**	**LB3 S2**	**LB3 D2**
Greenhouse Gases	-86	59	-141	-180	-766	356	-270	-632	-1,244	-730	-1,710
Economic Efficiency: Consumer Users (Commuting)	2,629	1,798	829	3,512	6,470	5,470	8,936	2,948	5,321	4,426	9,271
Economic Efficiency: Consumer Users (Other)	11,675	7,901	3,731	15,845	29,169	24,057	39,670	13,744	24,461	20,395	42,272
Economic Efficiency: Business Users and Providers	12,749	8,663	4,043	17,173	30,898	26,357	42,526	14,684	25,518	21,902	44,384
Wider Public Finances (Indirect Taxation Revenues)	232	-159	352	480	2,032	-961	698	1,697	3,318	1,959	4,556
Present Value of Benefits (PVB)	**27,199**	**18,262**	**8,814**	**36,830**	**67,803**	**55,279**	**91,560**	**32,441**	**57,374**	**47,952**	**98,773**

6.4 Accidents

6.4.1 A12 Accident Data

For the A12 between the eastern end of the Wickham Market bypass and the A1094, Table 6.4.1 provides a breakdown of the accidents that were recorded during the three years from 1 Dec 2010. Of the twenty-eight accidents, eleven occurred in the first year, seven in the second and ten in the third. One accident resulted in a fatality.

Table 6.4.1: A12 Four Villages Observed Accident Data (1/12/10 to 1/12/13)

	Personal Injury Accidents	Casualties
Total	**28**	**47**
Fatal	1	1
Serious	1	4
Slight	26	43

The casualty split cannot be specified in COBALT and therefore only default splits can be applied to the calculated rate.

There are speed restrictions below the national speed limit to the existing A12 between Wickham Market and the A1094; these consist of sections of 30, 40 or 50mph limits. Based on speed limit and distance the weighted speed along the 6.9km between Wickham Market and the A1094 is 44mph.

According to the DfT (WebTAG/COBALT) accident data, roads with speed limits of >40mph have lower accident rates but higher casualty rates than roads of <40mph. There are a number of road types defined in COBALT as indicated in Table 6.4.2 whilst Table 6.4.3 provides the casualty rates by road type.

Table 6.4.2: WebTAG accident rates by road type (Year 2000)

Type	Description	Speed Limit (MPH)	Accident Rate (Combined Link & Junction)
4	Modern S2 Roads	30/40	0.844
4	Modern S2 Roads	>40	0.293
5	Modern S2 Roads with hard strip	30/40	0.844
5	Modern S2 Roads with hard strip	>40	0.232

6	Modern WS2 Roads	30/40	0.844
6	Modern WS2 Roads	>40	0.190
7	Modern WS2 Roads with hard strip	30/40	0.844
7	Modern WS2 Roads with hard strip	>40	0.171
8	Older S2 A Roads	30/40	0.844
8	Older S2 A Roads	>40	0.381
9	Other S2 Roads	30/40	0.844
9	Other S2 Roads	>40	0.404
10	Modern D2 Roads	30/40	1.004
10	Modern D2 Roads	>40	0.174
11	Modern D2 Roads with hard strip	30/40	1.004
11	Modern D2 Roads with hard strip	>40	0.131

Table 6.4.3: WebTAG casualty rates by road type (Year 2000)

Type	Description	Speed (MPH)	Fatal	Serious	Slight
4-8	S2 A Roads	30/40	0.0092	0.1392	1.157
4-8	*S2 A Roads*	*>40*	*0.0436*	*0.2855*	*1.286*
9	Other S2 Roads	30/40	0.0075	0.1379	1.124
9	*Other S2 Roads*	*>40*	*0.0262*	*0.2513*	*1.245*
10-15	Dual Carriageways	30/40	0.0093	0.1253	1.222
10-15	*Dual Carriageways*	*>40*	*0.0286*	*0.1861*	*1.314*

The existing A12 would be classed as Type 8 and for the section as a whole between Wickham Market and the A1094 the average speed is 44mph, hence the accident rate could be taken to be the value applicable to roads with a speed of >40mph, or 0.381.

However in the COBALT program the cut-off between the higher and lower rates is actually 50mph. Table 6.4.3 indicates that for both new and existing roads the casualty rates and splits are the same.

The A12 bypasses would be designed as either Type 5 for the single carriageway options or Type 11 for the dual carriageway option.

Using the observed accident data results in the following number of accidents and casualties calculated over the sixty year assessment period from 2020 for the 6.9km section of A12 with speed set to 50mph in COBALT:

Total Without-Scheme Accidents = 703.6

Total Without-Scheme Casualties (Fatal) = 25.4

(Serious) = 145.4

(Slight) = 886.8

Using default accident rates the following accidents and casualties were calculated:

Total Without-Scheme Accidents = 746.7

Total Without-Scheme Casualties (Fatal) = 28.9

(Serious) = 165.5

(Slight) = 1009.4

Therefore the observed accident rate (2011-2013) is lower than the national default rate for 'Older S2 A roads'.

With speed set at 44mph the following (default) accident outcomes were calculated;

Total Without-Scheme Accidents = 2006.7

Total Without-Scheme Casualties (Fatal) = 11.5

(Serious) = 193.6

(Slight) = 2564.6

The existing A12 along the section being assessed is really a 'rural' type road and as the bypass options are of varying distance the default rates for a road of >50mph have been used for the accident assessment.

As the scheme options being considered include both single and dual carriageway options two sets of COBALT assessments are required for four of the five schemes. Table 6.4.4 provides a breakdown of accident costs and benefits for the single carriageway options whilst Table 6.4.5 provides the accident assessment outcomes for the dual carriageway options.

Sixty year discounted accident benefits in 2010 prices range from £6.5 million for the SB1 single carriageway scheme to £28.8 million for the LB3 dual carriageway option. The number of accidents saved over the sixty year period ranges from seventy-six for the SB1 single carriageway scheme to 279 for the LB3 dual carriageway option.

Table 6.4.4: A12 Accident costs and benefits (SINGLE Carriageway options)

	SB1	SB1 (North)	SB1 (South)	SB2	SB4	SB5	LB3
Benefit Summary (£000s)							
Total Without-Scheme Accident Costs	17,946	9,894	7,678	20,550	22,363	24,641	33,660
Total With-Scheme Accident Costs	11,407	6,041	5,164	13,149	12,928	16,811	22,633
Total Accident Benefits Saved by Scheme	**6,539**	**3,852**	**2,514**	**7,401**	**9,435**	**7,830**	**11,028**
Accident Summary							
Total Without-Scheme Accidents	208.9	115.1	93.5	239.2	260.3	286.8	391.8
Total With-Scheme Accidents	132.8	70.3	62.9	153.0	150.5	195.7	263.4
Total Accidents Saved by Scheme	**76.1**	**44.8**	**30.6**	**86.1**	**109.8**	**91.1**	**128.3**
Casualty							

Summary							
Total Without-Scheme Casualties (Fatal)	8.1	4.4	3.6	9.2	10.1	11.1	15.1
(Serious)	46.3	25.5	20.7	53.0	57.7	63.6	86.8
(Slight)	282.3	155.7	126.3	323.3	351.8	387.7	529.6
Total With-Scheme Casualties (Fatal)	5.1	2.7	2.4	5.9	5.8	7.6	10.2
(Serious)	29.4	15.6	13.9	33.9	33.4	43.4	58.4
(Slight)	179.5	95.1	85.0	206.9	203.4	264.5	356.1
Total Casualties Saved by Scheme (Fatal)	**2.9**	**1.7**	**1.2**	**3.3**	**4.2**	**3.5**	**5.0**
(Serious)	**16.9**	**9.9**	**6.8**	**19.1**	**24.3**	**20.2**	**28.4**
(Slight)	**102.9**	**60.6**	**41.4**	**116.4**	**148.4**	**123.2**	**173.5**

Table 6.4.5: A12 Accident costs and benefits (DUAL Carriageway options)

	SB2	SB4	SB5	LB3
Benefit Summary (£000s)				
Total Without-Scheme Accident Costs	24,641	28,407	24,641	39,704
Total With-Scheme Accident Costs	6,498	6,979	6,899	10,873
Total Accident Benefits Saved by Scheme	**18,143**	**21,428**	**17,742**	**28,831**
Accident Summary				
Total Without-Scheme Accidents	286.8	330.6	286.8	462.1
Total With-Scheme Accidents	109.2	116.8	116.4	183.3
Total Accidents Saved by Scheme	**177.5**	**213.9**	**170.4**	**278.8**
Casualty Summary				
Total Without-Scheme Casualties (Fatal)	11.1	12.8	11.1	17.9
(Serious)	63.6	73.3	63.6	102.4
(Slight)	387.7	446.9	387.7	624.7
Total With-Scheme Casualties (Fatal)	2.1	2.3	2.3	3.6
(Serious)	15.0	16.1	15.9	25.0
(Slight)	153.1	163.6	163.3	256.9
Total Casualties Saved by Scheme (Fatal)	**8.9**	**10.5**	**8.8**	**14.3**
(Serious)	**48.6**	**57.2**	**47.7**	**77.4**
(Slight)	**234.5**	**283.3**	**224.4**	**367.7**

6.5 Carbon

Carbon emission data have been determined using the TUBA economic assessment software. Traded and untraded emissions data are available on a yearly basis in terms of tonnes and monetary costs. The monetary costs/benefits are provided in the economic output tables of which a summary in provided in Table 6.3.4. These generally indicate a cost in terms of additional greenhouse gases with two options, SB4 single carriageway and SB1 (North) showing a reduction in greenhouse gas emissions due to their shorter length compared to the existing A12.

7 Construction Cost Estimate

7 Construction Cost Estimates

7.1 Introduction

This chapter looks at the costs of construction for the five bypass route options detailed in Chapter 2 above. The costs are estimates only based on the information available when this report was written. The costs follow new road design guidelines provided in the DMRB and all required elements for constructing a new road have also been included.

A construction programme estimate has been put together based on previous experience to show the approximate years in which the design and construct will take place. The construction and time Table 7.2.1 shows a summary of the construction programme for each scheme. The durations of these may alter depending on extent of the further work.

Please note that durations stated above for design and construction months are to take place in the years noted below.

7.2 Methodology and Assumptions

The proposed estimates have been based on current rates appropriate to 1Q 2014. A number of assumptions have been made, some of which have been listed below:

- The site boundary takes into consideration the earthworks and any additional land which is required for the scheme.
- The carriageways have been considered as both single and dual carriageway with exception of SB1 (Pink Route) – single carriageway only.
- All costs are exclusive of VAT.

Table 7.2.1 Summary of construction cost estimates

Route	Carriageway	Length in metre	Design in months*	Construction in months*	Non Highway land required area (sq. m)	No of Structures	Cost Estimate* (£)
SB1 (Pink)	Single	1950	6	12	61,410	10	18, 651,620
	(SB1 Split) A12 North	1064	6	12		6	12,402,134
	(SB1 Split) A12 South	863	6	12		4	6,800,452
SB4 (Red)	Single	2850	6	12	87,036	2	16,245,913
SB4 (Red)	Dual	2200	6	18	121,850	2	25,650,099
SB2 (Green)	Single	2700	6	12	100,415	5	25,915,017
SB2 Including Link 1 & 2 (Green)	Dual	3500	6	18	143,057	5	44,057,647
SB5 (Blue)	Single	2630	6	12	92,148	4	26,517,383
SB5	Dual	3450	6	18	302,960	5	46,318,936

Including Link 1 (Blue)							
LB3 (Orange)	Single	4800	6	18	216,741	6	55,683,518
LB3 (Orange)	Dual	5550	9	24	312,107	6	92,404,852

* includes Optimum Bias, Contingency, Inflation etc. and excludes VAT

Table 7.2.1 above shows the cost for construction range from £7M for the SB1 (South) Route to £55M (LB3) for the single carriageway options and from £26M (SB2) to £92M (LB3) for the dual carriageway option. The design and construction estimates in the month column assume that the months calculated in the column, falls within the calendar year indicated in Table 7.2.2.

Table 7.2.2 Summary of construction programme

Activity	SB1	SB1 A12 North	SB1 A12 South	SB2	SB4	SB5	LB3
Carry out Preliminary Design and consultation	2014	2014	2014	2014	2014	2014	2014
Announce Preferred Route	2015	2015	2015	2015	2015	2015	2015
Carry out Detailed Design	2016	2016	2021	2016	2016	2016	2015/2016
Public Inquiry	2016	2016	2021	2016	2016	2016	2016
Order Publication Period and CPO	2017	2017	2022	2017	2017	2017	2017
Award of Tender	2018	2018	2023	2018	2018	2018	2018
Construction Period	2018/2019	2018/2019	2023/2024	2018-2020	2018-2020	2018-2020	2018-2020
Open to Traffic	2020	2020	2024	2020	2020	2020	2020

8 Summary and Conclusion

8 Summary and Conclusions

8.1 Assessment Summary

From the foregoing text it is apparent that a staged approach for the implementation of an improvement scheme for the length of A12 between Wickham Market bypass and the junction with A1094 Friday Street –termination point for this study– would be the most suitable solution. Currently the section of A12 between Marlesford and Little Glemham has a layout with comparatively acceptable road widths and geometry. The most difficult section with the worst geometric layout is that between Stratford St Andrew and a point north of Farnham. To summarise the findings in each of the categories investigated in this document the following is a distillation of tables of facts under each heading.

8.2 Costs

The following costs taken from the reporting are as follows;

Table 8.2.1 Construction cost estimate summary

Route (Road Area)		**Net Total (inc Opt Bias, Contingency, Inflation etc.)**
SB1 – Pink Route 21,262m2	Whole Scheme	£18,651,620
	A12 North (including roundabout)	£12,402,134
	A12 South	£6,800,452
SB2 – Green Route (Single Carriageway) 27,156m2		£ 25,915,017
SB2 – Green Route Including Link 1 and Link 2 (Dual Carriageway) 51,210m2		£ 44,057,647
SB4 – Red Route (Single Carriageway)		£ 16,245,913

28,040m2	
SB4 – Red Route (Dual Carriageway) 52,706m2	£ 25,650,099
SB5 – Blue Route (Single Carriageway) 34,234m2	£ 26,517,383
SB5 – Blue Route (Dual Carriageway) 68,463m2	£ 46,318,936
LB3 – Orange Route (Single Carriageway) 69,006m2	£ 55,683,518
LB3 – Orange Route (Dual Carriageway) 116,538m2	£ 92,404,852

8.3 Traffic

8.3.1 Traffic Summary

The traffic and economic assessment were undertaken, on the A12 between Wickham Market and A1094, were based on 2011 Traffic data and information sourced from previous studies.

The assessment was modelled for the three forecast years:

- 2020 – Scheme Opening,
- 2024 – Assumed Sizewell C Peak construction year, and
- 2031 – First forecast year without Sizewell C construction traffic

The results from this assessment show:

8.3.2 A 35% increase in the traffic volumes in 2031 compared to 2012 volumes (Cars, LGVs and HGVs) is predicted;

8.3.3 HGV Trips

	2012	**2020**	**2024**	**2031**
Vehicle Type				
HGV	713	766	783	840
Total Vehicles	**15,505**	**17,393**	**18,361**	**20,922**

During the construction peak EDFE have estimated that there would be between 100 and 300 HGV deliveries per day with the busiest day being some 50% higher than this. EDFE expect that 85% of HGVs would originate from the A12 south and 15% from the A12 north.

The assessment has used the upper average daily volume of 300 HGV deliveries (600 1-way trips) and assumed 85% originate from the A12 south and 15% from the A12 north.

8.3.4 Travel Time Saving

- Travel time savings of 0.5 minutes, approximately 25% of the existing times for the shorter single carriageway bypasses and under 2 minutes, approximately 40% for the longer dual carriageway bypasses.

8.3.5 Benefits

- Economic benefit for the proposed scheme options over a sixty year design period for both single and dual carriageway range from £27 million of benefits for (short bypass) SB1 single carriageway scheme to £99 million of benefits for the Long Bypass 3 (LB3) dual carriageway scheme.

8.3.6 Accidents

- Discounted accident benefits over sixty years range from £6.5 million for the SB1 single carriageway scheme to £28.8 million for the LB3 dual carriageway option.
- Number of accidents saved over the sixty year period ranges from seventy-six for the SB1 single carriageway scheme to 279 for the LB3 dual carriageway option.

Table 8.3.1 Average travel time savings per vehicle (Minutes)

	2020		2024		2031	
Option	**Single**	**Dual**	**Single**	**Dual**	**Single**	**Dual**
SB1	0.42	n/a	0.45	n/a	0.49	n/a
SB1 (North)	0.27	n/a	0.29	n/a	0.31	n/a
SB1 (South)	n/a	n/a	0.16	n/a	0.17	n/a
SB2	0.59	1.11	0.61	1.16	0.65	1.21
SB4	0.83	1.43	0.86	1.49	0.90	1.56
SB5	0.56	0.99	0.59	1.04	0.63	1.09

LB3	0.81	1.66	0.85	1.75	0.91	1.84

8.4 Environment Assessment Summary

A Transport Analysis Guidance (Web TAG) and the Design Manual for Roads and Bridges (DMRB) Volume 11 section 3 were one of the main sources used to undertake the Environmental Assessment for the proposed bypasses. The assessment carried out evaluated the potential significance of impacts, for the proposed bypasses, in:

8.4.1 Air Quality

The proposed bypasses are predicted to improve the overall air quality:

- Due to the reduction in traffic along the existing A12. However an adverse effect on the air quality is predicted to occur in receptors located close to the route.
- All the proposed road scheme options are predicted to lead to an overall improvement in air quality as the Total Net Assessment scores (Tables 4.1.13 and 4.1.14) are negative (excluding and including traffic from Sizewell C). However, the number of properties which will experience an improvement, no change and deterioration vary with options.
- Positive Total Net Present Value (Table 4.1.16) indicating a net beneficial impact over the lifetime of the schemes.
- Large beneficial change in NO_2 and PM_{10} concentrations near the A12.

Table 8.4.1 Overall evaluation of local air quality significance

Key Criteria Questions	Yes / No					
	SB1 – Pink Route	SB1 North – Pink Route	SB2 – Green Route	SB4 – Red Route	SB5 – Blue Route	LB3 – Orange Route
Is there a risk that environmental standards will be breached?	No	Yes	No	No	No	No
Will there be a large change in environmental conditions?	Yes	Yes	Yes	Yes	Yes	Yes
Will the effect continue for a long time?	N/A	N/A	N/A	N/A	N/A	N/A
Will many people be affected?	No	No	No	No	No	No
Is there a risk that designated sites, areas, or features will be affected?	No	No	No	No	No	No
Will it be difficult to avoid, or reduce or repair or compensate for the effect?	N/A	N/A	N/A	N/A	N/A	N/A

8.4.2 Noise

A Stage 1 noise assessment carried out was only related to the operational use of the bypass options. The findings, summarised in the below table, show a significant impact on the noise levels for all the proposed routes with mitigation measures (acoustic barriers) reducing all effects to insignificant excluding SB2 and SB5 where Adverse/Significant effects are predicted.

Table 8.4.2 Noise Assessment

Route	Qualitative Impacts	Assessment	Potential Mitigation	Residual Effects With Mitigation
SB1	This scheme will bring both beneficial and adverse noise impacts during the day but no adverse night impacts are expected	Adverse	Acoustic Noise Barrier	Insignificant
SB2	This scheme will bring both beneficial and adverse noise impacts during the day including adverse night impacts at one property	Adverse	Substantial Mitigation Requirements are likely	Adverse / Insignificant
SB4	This scheme will bring both beneficial and adverse noise impacts during the day but no adverse night impacts are expected. The single carriageway option is recommended for Detailed Assessment	Adverse	Acoustic Noise Barrier	Insignificant
SB5	This scheme will bring both beneficial and adverse noise impacts during the day but no adverse night impacts are expected.	Adverse	Substantial Mitigation Requirements are likely	Adverse / Insignificant
LB3	This scheme will bring both beneficial and adverse noise impacts during the day but no adverse night impacts are expected. The single carriageway option is recommended for Detailed Assessment	Adverse	Acoustic Noise Barrier	Insignificant

Comparing all the route options shown in Table 6 the single carriageway option for the SB4 and LB3 routes are recommended for detailed noise assessment

8.4.3 Biodiversity

The Operational and Construction impacts on the Habitats and Species were assessed for all bypass options. The findings from this assessment revealed:

- No residual effects are predicted on:
  - Internationally designated sites.
  - The SSSI's in the area.
- Temporary construction disturbance on the fauna (not expected to be significant)
- Increased operational mortality to birds, bats, badgers and otter (not expected to be significant)
- Residual fragmentation of large stretches of connected Greenfield habitat (River Alde, floodplain grazing, woodlands such as Foxburrow Wood)

Suitable mitigation measures should be in adopted to reduce the operational and construction effects of the proposed bypasses – construction mitigation measures are presented in Appendix 2.3. Table 8.4.3 below shows, in order of ranking, a summary of the adverse effects each scheme may have on the surrounding environment.

Table 8.4.3 Biodiversity Summary

Route	Summary Assessment Score	Comments	Mitigation	Residual Effects with Mitigation
SB4 (Red Route)	Slight Adverse	Presence of GCN to be considered. Possible loss of habitats and fragmentation of woodland. Proximity of ponds to construction works.	Screening from the road via habitat replacement. Construction mitigation to prevent run off into connected drainage ditches and rivers. Consideration for bridge crossings to minimise habitat loss and fragmentation. Culvert designs to be suitable for safe passage for otter, water vole and bats. Pre-construction surveys of the chosen route would be required, revealing the connections between GCN meta populations and enable the design of suitable underpasses and replacement breeding and terrestrial habitat. Avoid the area via road alignment design to prevent habitat loss.	Slight Adverse
LB3 (Orange Route)	Slight to Moderate Adverse	Effects on a number of species and groups including GCN and water vole, fragmentation of habitats and bisecting of small tributaries along route.	Construction mitigation to prevent run off into connected drainage ditches and rivers. Consideration for bridge crossings to minimise habitat loss and fragmentation. Culvert designs to be suitable for safe passage for otter, water vole and bats. Pre-construction surveys and a Natural England Conservation Licence would be required. GCN surveys and licence likely required	Slight Adverse

SB1 (Pink Route)	Moderate Adverse	Potential to affect many species at the River Alde and its associated flood plain. Loss of habitat at Butchers Hole and Benhall Lodge Park Woodland.	Construction mitigation to prevent run off into connected drainage ditches and rivers. Consideration for bridge crossings to minimise habitat loss and fragmentation. Culvert designs to be suitable for safe passage for otter, water vole and bats. Pre-construction surveys of the chosen route would be required, revealing the connections between GCN meta populations and enable the design of suitable underpasses and replacement breeding and terrestrial habitat.	Slight Adverse
SB2 (Green Route)	Moderate Adverse	Potential to effect many species at the River Alde and downstream. Possible fragmentation of ponds, hedgerows and woodland. Loss of habitat at Butchers Hole and Benhall Lodge Park Woodland.	Construction mitigation to prevent run off into connected drainage ditches and rivers. Consideration for bridge crossings to minimise habitat loss and fragmentation. Culvert designs to be suitable for safe passage for otter, water vole and bats. Pre-construction surveys and a Natural England Conservation Licence would be required. Replacement of hedgerow habitat.	Slight Adverse
SB5 (Blue Route)	Moderate Adverse	Potential to affect GCN terrestrial habitat. Water vole may be moderately adversely affected due to closure of tributaries. Possible	Construction mitigation to prevent run off into connected drainage ditches and rivers. Consideration for bridge crossings to minimise habitat loss and fragmentation. Culvert designs to be suitable for safe passage for otter, water vole and bats. Pre-construction surveys of the chosen route would be required, revealing the connections between GCN meta populations and enable the design of	Slight Adverse

		direct loss of Ancient Woodland.	suitable underpasses and replacement breeding and terrestrial habitat. Ancient woodland is not replaceable. Impacts upon this habitat, including indirect impacts should be avoided. Screening from the road via habitat replacement.	

8.4.4 Landscape

A landscape and visual constraints associated to the proposed bypass route options were undertaken on a study area of 2km from the route options. The findings from the appraisal revealed that

8.4.4.1 Landscape Effects

- The proposed options have the potential to affect both local and national designations and landscapes.
- Slight to Large adverse effects on the landscape character with and without mitigating measures:
    - Grazing marsh and landscape pattern (largest residual effect in SB1).
    - Fragmentation of landscape and loss of landscape features. (Bypass option LB3, SB2 and SB5)

8.4.4.2 Visual Effects

- The proximity of receptors to the route corridor influences the severity of the impacts to the visual amenity.
- The route options are visible from various locations within the study area.
- Slight to Large adverse effects on the visual amenity pre and post mitigating measures.

Landscape mitigating measures should be adopted in order to minimise adverse effects of the route options on the local landscape and visual amenity. The below table summarises the findings.

Table 8.4.4.1 Landscape assessment summary table

Route	Assessment	Mitigation	Residual Effects With Mitigation
LB3			
Landscape Character	Large Adverse	Reinstatement of boundary planting, structure screen planting	Moderate Adverse
Visual Amenity	Slight-Very Large Adverse		Slight- Large Adverse
SB1			
Landscape Character	Large Adverse	As above	Large Adverse
Visual Amenity	Slight- Large Adverse		Slight- Large Adverse

Route	Assessment	Mitigation	Residual Effects With Mitigation
SB2			
Landscape Character	Large Adverse	As above	Moderate Adverse
Visual Amenity	Moderate to Large Adverse		Moderate to Large Adverse
SB4			
Landscape Character	Moderate Adverse	As above	Slight Adverse
Visual Amenity	Slight-Very Large Adverse		Slight-Large Adverse
SB5			
Landscape Character	Moderate Adverse	As above	Moderate Adverse
Visual Amenity	Slight- Large Adverse		Slight- Large Adverse

8.4.5 **Heritage**

The archaeological and heritage assessment was undertaken for a study area of 300m from the proposed route options. The bypasses were found not to have a significant effect on culture heritage – summarised below. However it is recommended that a Simple Assessment should be completed in to determine whether further archaeological evaluation is required.

Table 8.4.5.1 Heritage assessment summary table

Route	Qualitative Impacts	Assessment	Mitigation	Residual Effects With Mitigation
LB3	Flint scatter (70). Part or complete loss of asset	Slight Adverse	Simple Assessment followed by additional evaluation if required.	Slight Adverse
	Glemham Park (33). Partial loss of asset and effects on the setting of the asset	Moderate Adverse	Topographic and photographic recording, use of screening	Slight Adverse
	Little Glemham. Reduction of traffic	Slight Beneficial	N/A	Slight Beneficial
SB1	Old field system (87). Part or complete loss of asset	Slight Adverse	Simple Assessment followed by additional evaluation if required.	Slight Adverse
	Pillbox (88). Effects on the setting of the asset	Slight Adverse	Photographic recording, use of screening	Slight Adverse

Route	Qualitative Impacts	Assessment	Mitigation	Residual Effects With Mitigation
	Benhall Lodge Park medieval settlement (BNL 020). Partial loss of asset and effects on the setting of the asset	Slight Adverse	Simple Assessment followed by additional evaluation if required.	Slight Adverse
	Stratford St Andrew. Reduction of traffic	Slight Beneficial	N/A	Slight Beneficial
SB2	Pottery sherds (61). Part or complete loss of asset	Slight Adverse	Simple Assessment followed by additional evaluation if required.	Slight Adverse
	Benhall Lodge Park medieval settlement (BNL 020). Partial loss of asset and effects on the setting of the asset	Slight Adverse	Simple Assessment followed by additional evaluation if required.	Slight Adverse
	Stratford St Andrew. Reduction of traffic	Slight Beneficial	N/A	Slight Beneficial
SB4	Glemham Park (33). Partial loss of asset and effects on the setting of the asset	Moderate Adverse	Topographic and photographic recording, use of screening	Slight Adverse
	Marlesford Conservation Area (91). Reduction of traffic in the Conservation Area	Slight Beneficial	N/A	Slight Beneficial

Route	Qualitative Impacts	Assessment	Mitigation	Residual Effects With Mitigation
SB5	Old field system (87). Part or complete loss of asset	Slight Adverse	Simple Assessment followed by additional evaluation if required.	Slight Adverse
	Flint scatter (66). Part or complete loss of asset	Slight Adverse	Simple Assessment followed by additional evaluation if required.	Slight Adverse
	Lithic scatter (67). Part or complete loss of asset	Slight Adverse	Simple Assessment followed by additional evaluation if required.	Slight Adverse
	Farnham Manor (11). Effects on the setting of the asset	Slight Adverse	Photographic recording, use of screening	Slight Adverse
	Farnham. Reduction of traffic	Slight Beneficial	N/A	Slight Beneficial
	Stratford St Andrew. Reduction of traffic	Slight Beneficial	N/A	Slight Beneficial
SB5 Single	Old field system (87). Part or complete loss of asset	Slight Adverse	Simple Assessment followed by additional evaluation if required.	Slight Adverse

Route	Qualitative Impacts	Assessment	Mitigation	Residual Effects With Mitigation
	Flint scatter (66). Part or complete loss of asset	Slight Adverse	Simple Assessment followed by additional evaluation if required.	Slight Adverse
	Lithic scatter (67). Part or complete loss of asset	Slight Adverse	Simple Assessment followed by additional evaluation if required.	Slight Adverse
	Farnham Manor (11). Effects on the setting of the asset	Slight Adverse	Photographic recording, use of screening	Slight Adverse
	Farnham. Reduction of traffic	Slight Beneficial	N/A	Slight Beneficial
	Stratford St Andrew. Reduction of traffic	Slight Beneficial	N/A	Slight Beneficial

8.4.6 Water Environment

The bypass impacts on the watercourses have been assessed for both the operational and construction phase. The impact was found to be:

- Between low – up to significant effect (without any mitigation measures) and
- Between insignificant – Up to low significance (with mitigation measures in place)

The below table summarises the assessment findings.

Table 8.4.6.1 Water environment assessment summary table

Potential impact	Pre-Mitigation		Post-Mitigation	
	Magnitude of Impact	Significance (Pre-Mitigation)	Magnitude of Impact	Significance (Post-Mitigation)
Construction				
Silt-laden runoff	Minor	SB1- Up to Low Significance	Negligible	SB1- Insignificant
		SB2- Up to Low Significance		SB2- Insignificant
		SB3- Up to Low Significance		SB3- Insignificant
		SB5 (both sub-options)- Up to Low Significance		SB5 (both sub-options)- Insignificant
		Link 1- Insignificant		Link 1- Insignificant
		Link 2- Insignificant		Link 2- Insignificant
Chemical / fuel contamination and spillages or leaks	Moderate	SB1- Up to Significant	Negligible	SB1- Insignificant
		SB2- Up to Significant		SB2- Insignificant
		SB3- Up to Significant		SB3- Insignificant
		SB5 (both sub-options)- Up to Significant		SB5 (both sub-options)- Insignificant
		Link 1- Up to Low Significance		Link 1- Insignificant
		Link 2- Insignificant		Link 2- Insignificant
Localised erosion	Moderate	SB1- Up to Significant	Minor	SB1- Up to Low Significance
		SB2- Up to		SB2- Up to Low

		Significant		Significance
		SB3- Up to Significant		SB3- Up to Low Significance
		SB5 (both sub-options)- Up to Significant		SB5 (both sub-options)- Up to Low Significance
		Link 1- Up to Low Significance		Link 1- Insignificant
		Link 2- n/a		Link 2- n/a
Inappropriate disposal of waste	Negligible	SB1- Insignificant	Negligible	SB1- Insignificant
		SB2- Insignificant		SB2- Insignificant
		SB3-		SB3-
		SB5 (both sub-options)- Insignificant		SB5 (both sub-options)- Insignificant
		Link 1- Insignificant		Link 1- Insignificant
		Link 2- Insignificant		Link 2- Insignificant
Operation				
Water pollution from highway runoff	Negligible	SB1- Insignificant	Negligible	SB1- Insignificant
		SB1- Insignificant		SB2- Insignificant
		SB3- Insignificant		SB3- Insignificant
		SB5 (both sub-options)- Insignificant		SB5 (both sub-options)- Insignificant
		Link 1- Insignificant		Link 1- Insignificant
		Link 2- Insignificant		Link 2- Insignificant

Spillage risk from polluting substances	Negligible	SB1- Insignificant	Negligible	SB1- Insignificant
		SB2- Insignificant		SB2- Insignificant
		SB3- Insignificant		SB3- Insignificant
		SB5 (both sub-options)- Insignificant		SB5 (both sub-options)- Insignificant
		Link 1- Insignificant		Link 1- Insignificant
		Link 2- Insignificant		Link 2- Insignificant
Morphological effects	Minor	SB1- Up to Low Significance	Minor	SB1- Up to Low Significance
		SB2- Up to Low Significance		SB2- Up to Low Significance
		SB3- Up to Low Significance		SB3- Up to Low Significance
		SB5 (both sub-options)- Up to Low Significance		SB5 (both sub-options)- Up to Low
		Link 1- Insignificant		Link 1- Insignificant
		Link 2- n/a		Link 2- n/a
Loss of Ponds	Major	SB1- Insignificant	Negligible	SB1- Insignificant
		SB2- Low Significance		SB2- Insignificant
		SB3- Low Significance		SB3- Insignificant
		SB5 (both sub-options)- Low Significance		SB5 (both sub-options)- Insignificant
		Link 1- Low Significance		Link 1- Insignificant

		Link 2- Low Significance		Link 2- Insignificant

8.5 Mitigation Measures

Following the raised concern by SCC that mitigation measures regarding the noise due to the proposed scheme developments is a significant issue, preliminary design of noise barriers has been carried out and incorporated into costings.

As a mitigation measure, preliminary design of noise barriers has been carried out at the request of SCC. It can be seen that with the exception of the split SB1 North section and SB4 (Red Route) there is a need for the installation of noise barriers to protect properties affected by the proposed routes. This would need developing at the preferred route stage of the project.

8.6 Conclusion

From the foregoing tabulated and reported information there will clearly need to be further work towards the assessment and design of a suitable improvement scheme in appropriate stages for the A12 Four Villages route. In order to address the most problematic part of the route, between Stratford St Andrew and Farnham three possible options have been identified, two of them examined for both dual carriageway and single carriageway scenarios.

On a cost basis, looking first at single carriageway options, the SB1 (Pink Route) has advantages over the SB2 (Green Route) and the SB5 (Blue Route). Time savings for the three routes are similar although accident savings are slightly better for the latter two. Additional greenhouse gases would be similar for all three. Noise would be reduced to acceptable levels by suitable mitigation on all three schemes between Stratford St Andrew and Farnham. It can be seen that with the exception of the split SB1 North section and SB4 (Red Route) there is a need for the installation of noise barriers to protect properties affected by the proposed routes. For Air Quality it is predicted that no environmental standards would be breached and that few people would be affected by the changes for any of the routes.

Landscape effects would be similar on these routes, varying from Moderate Adverse to Slight to Large Adverse on each. Regarding biodiversity, from the tabular presentation and descriptions in the reporting, all of the route options would have slight adverse effects causing habitat loss of small amounts of woodland and hedgerows and small amounts of agricultural land. Heritage effects would be slightly better for Route SB5 single as the broader field patterns and scale would better accommodate landscape mitigation measures For the dual carriageway versions of the SB2 (Green Route) and SB5 (Blue Route) there is a marked difference in costs compared with the single carriageway schemes.

Turning to the other two schemes, LB3 (Orange Route) and SB4 (Red Route) the latter has some clear advantages. The relatively low cost of the single carriageway version of SB4 (Red Route) together with its relatively good accident rate and journey time saving make it worthy of consideration should further testing be required. However SB4 would only provide a bypass of Little Glemham. The Orange

Route, whilst providing good bypass facilities of both Marlesford and Little Glemham and the best accident rate and journey time savings of all the routes, would be significantly more costly to construct than Route SB4

From the ecological walkover scoping survey, an assessment of the proposed routes has been carried out. SB4 (Red Route) has the least adverse effect on the environment with the environmental assessment deeming only Slight Adverse impact on the study area. All the routes will lead to fragmentation of habitats, with mitigation measures detailed to reduce the impact. The least favourable scheme option is SB5 (Blue Route) dual carriageway which may lead to the risk of directly impacting the Ancient Woodland of Foxburrow Wood. This can lead to irreparable damage if mitigation measures are not correctly adhered too. However the single carriageway option if SB5 Blue route dose not impact on Fox Burrow Wood due to its reduced width and siting.

Much work has been done in this report on the appraisal of the individual schemes. This has helped to provide reliable and scheme estimates. Although journey times would be significantly reduced with the dual carriageway versions there would need to be further assessment to establish cost/benefit ratios over a specified period in order to make a firm decision.

It is therefore suggested that for the selected schemes cost/benefit ratio analysis be undertaken alongside design refinement including mitigation measures, accurate costing analysis and traffic forecast and a detailed environmental assessment.

9 Next Steps

9 Next Steps

9.1 Consultation with the Environment Agency

9.1.1 Introduction

When selection of appropriate schemes has been made, following SCC's examination of the findings of this report, it is recommended that arrangement and attendance of a meeting with the Environment Agency (EA) regarding possible flood arches and other requirements for bridges on the River Alde and the River Ore flood plains. Following on from the discussions it will be possible to home in on the most effective structures from a cost and performance perspective.

The principle structures that are proposed on a flood plain for the Four Villages routes consist of:

Route	**Structure**
SB1 (Pink Route)	River Bridge (Over the River Alde)
SB2 (Green Route)	River Bridge (Over the River Alde)
SB5 (Blue Route)	River Bridge (Over the River Alde)
LB3 (Orange Route)	River Bridge (Over the River Ore)

The flood plain details for these routes can be seen in Figure 9.1.2.1 and Figure 9.1.3.1below. The structures mentioned above fall into Zone 2 and 3 of the flood plain assessment categories. There are also a number of culverts on each scheme, all of which will need to be discussed in detail.

9.1.2 Routes SB1, SB2 and SB5

Figure 9.1.2.1 Four Villages (SB1, SB2 and SB5 routes) River Alde Flood Plain Detail

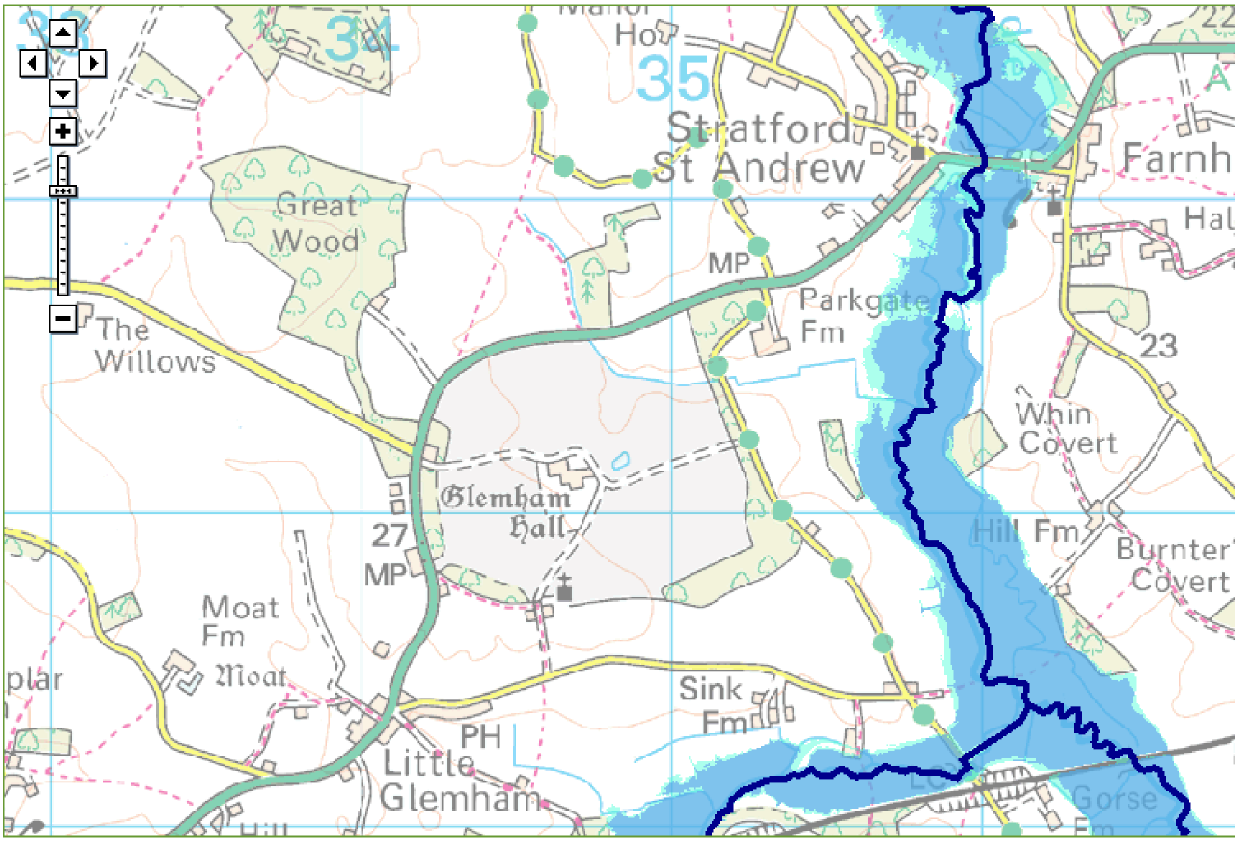


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Figure 9.1.2.1 shown above illustrates the flood plain detail for the River Alde. The following structures present within the flood plain are:

- The SB1 (Pink Route) river bridge
- The SB2 (Green Route) river bridge
- The SB5 (Blue Route) river bridge

9.1.3 Routes SB4 (Red Route) and LB3 (Orange Route)

Figure 9.1.3.1 Four Villages River Ore Flood Plain Detail

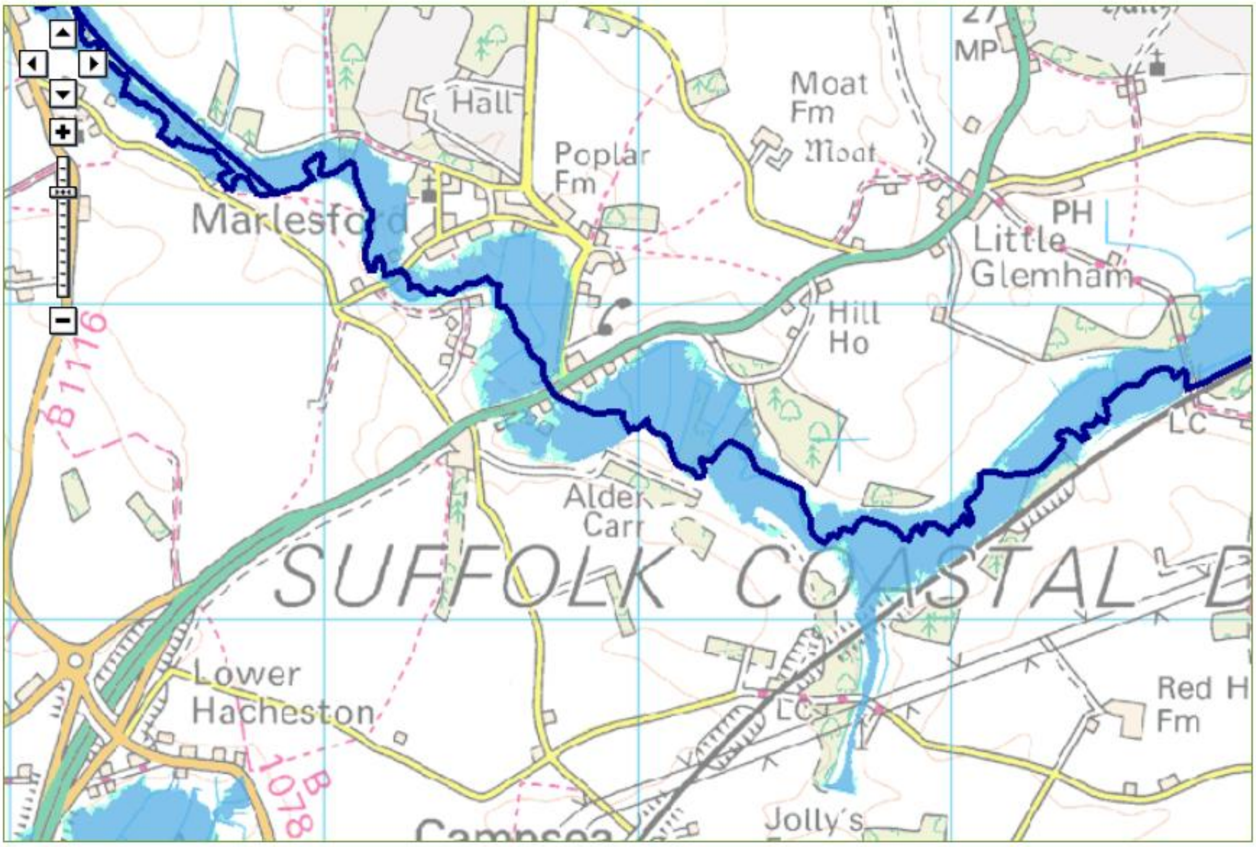

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Figure 9.1.3.1 shown above illustrates the flood plain detail for the River Ore. The following structures present within the flood plain are:

- The LB3 (Orange Route) river bridge

9.2 Environment Agency Guidance

The EA recommend that pre application discussions take place for developments. EA will usually provide comments at the planning application stage on Flood Risk Assessments (FRA) - unless otherwise indicated by Environment Agency Planning Liaison/Sustainable Places team in the area where the development is proposed.

The main concerns of the EA are:

- Ensuring that the design of the site drainage system meets the aims of sustainable drainage management, and does not increase, and where practicable reduces, the current runoff from the site
- If the proposal is within the Byelaw Distance of a Main River sea defence, or flood defence structure, then formal consent for the proposal may also be required from the EA.
- Prior to carrying out a FRA, developers should contact the Environment Agency and other operating authorities (such as the Lead Local Flood Authority in unitary or county councils or Internal Drainage Board as appropriate) to establish whether information is available relating to flood risk at the site they propose to develop. Account should also be taken of local knowledge of flooding held in the community. EA records of flooding are not exhaustive and the absence of information does not mean that a site will not flood.[44]

9.3 Statutory Undertakers

It will be necessary to consult early with the major Statutory Undertakers for the project once preferred Routes are established. For the A12 Four Villages schemes the following authorities were approached;

- BT Openreach
- Essex and Suffolk Water
- Ericsson Plant
- UK Power Networks

Clearly there will be other authorities with equipment situated in the A12 carriageways, verges and in the side roads. Once selected schemes are identified for further research there will be a need to conduct NRSWA C3 searches which will reveal necessary plant

[44] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/311502/LIT_9193.pdf

diversion routes and indicative costs (these will replace those in the existing report which are consultant's estimates only).

9.4 Cost Benefit Analyses

Once selected schemes have been identified for further examination, it will be necessary to conduct further traffic analysis with a view to identify the correct cost/benefit ratios utilising the costs from the revised structural and utilities estimates. It will not be possible to identify the ultimate ratios until the correct costs have been identified from the rounds of consulting with EA and Statutory Undertakers identified above.

9.5 Scheme Delivery

From the Scheme Development and Construction Programmes in Section 3 of this report it will be seen that packages of design and preparation works are required to be carried out in order to keep the project on track for delivery (open to traffic) in 2020. For all the options it would be preferable to have a preferred route announcement in 2015. For this reason it is recommended that discussions with all parties should commence as soon as possible with a view to defining the optimum scheme and taking it forward for ultimate construction and delivery.

10 Further Investigative Study for Preliminary Preferred Route

10 Further Investigative Study – Preliminary Preferred Route

10.1 Assessment Summary

The foregoing chapters of this report have drawn out the relative benefits of all routes under comparison as dictated by the December 2013 scheme brief. Following further instructions from SCC in October 2014 and in advance of discussions with the Sizewell C developers, EDF Energy, this section deals with two schemes in particular, SB1 Pink Route and SB5 Blue Route, assuming either would be progressed as a single carriageway road constructed to HA S2 standards. The purpose of the following text is to compare the Environmental and Cost issues associated with each route with a view to taking one forward as a preliminary Preferred Route.

For the purposes of this comparison the SB1 Pink Route North, SB1 Pink Route Full Scheme and SB5 schemes are further examined under the environmental headings:

- Community Impacts
- Mitigation Measures
- Net Benefits
- Summary

10.2 Community Impact

10.2.1 Segregation
Access to fields and farms will be affected by all bypass options and alternative routes will have to be provided for the local community.

SB1 full scheme and SB1 North will cut through fifteen and nine fields respectively including a field north of the existing A12 that is currently being used by the villages as an area for fetes and community activities.

Along the whole length of the SB5 bypass farmland will be affected and access to the fields will be impaired. The SB5 bypass would segregate:

- Farnham Hall Farm House from Farnham Hall which is a short distance along the road.
- Pond Cottages and Friday Street Farm will be separated from the rest of the villages.

Access, to the segregated areas, will need to be provided.

10.2.2 Pedestrian Amenity
All route options cause disruption to pedestrian users. SB1 full scheme and SB1 North affect two footpaths while SB5 affects six footpaths.

10.2.3 Cyclist Amenity
The cycle route that currently crosses the A12 from Tinker Brook to Mill Lane will be affected by SB1 causing slight delays to cyclists' journey time as the cycle route will be diverted due to the proposed roundabout at the A12 junction with Great Glemham road.

The SB5 will affect cyclist's access from Pond Barn Cottages to St Mary's Church. Cycle routes along the SB1 North route will not be affected as cyclists are required to use the current A12 south of the roundabout.

10.2.4 Driver Delay
Short delays will be caused by queuing at roundabouts for all the proposed bypasses.

SB1 will cause delays to approximately 14 properties along the current A12 as residents will be required to drive along the new mainline to the roundabout and turn left down the old A12 road to access their property.

SB5 will cause delays to motorists accessing Farnham Hall Farm House

10.2.5 Community Visual Impact

All options have various siting’s in the general area of Special Landscape Value as shown in the Local Plan. On balance SB1 will have a far greater effect on community visual impact with SB1 North slightly lesser so.

SB5 will have a localised Community Visual Impact affecting only a few properties south of the existing A12 including Farnham Hall House and Farnham Hall, Pond Cottages and Friday Street Farm.

Table10.2.1 A12 Community Impacts and Mitigation

Community Impact	SB1 Full Scheme	SB1 North	SB5
Segregation	Bypass cuts through 15 fields, including one used by village for community events	Bypass cuts through 9 fields, including one used by village for community events	Bypass cuts through 12 fields
	Existing segregation between Farnham and Stratford St Andrews' maintained and worsened over time	Existing segregation, especially south of the proposed roundabout at Stratford St Andrews will worsen over time	Farnham Hall Farm House will be separated from Farnham Hall
			Access to Pond Cottages and Friday Street Farm will be affected
Mitigation	Access points to farm land and other amenity will be provided	Access points to farm land and other amenity will be provided	Access to properties and farm land will be provided by diversions and structures to cross the A12
Pedestrian Amenity	2 pedestrian routes affected	2 pedestrian routes affected	6 pedestrian routes affected
Mitigation	Alternate access and diversions provided	Alternate access and diversions provided	Alternate access and diversions provided.
Cyclist Amenity	Cyclists will be required to use roundabout	Cyclists would have to continue to use existing A12 south of the roundabout	Access from Pond Barn Cottages to St Mary's Church affected
	Access across new A12 near turning for Tinker Brook interrupted		

Mitigation	Cycle path provided for access across A12	New cycle provisions would have to be made south of the roundabout	Alternate access provided
Driver Delay	Access to local properties will be diverted around the new bypass		Access to Farnham Hall Farm House will be cut off
	Short delays due to queuing at roundabout	Short delays due to queuing at roundabout	Short delays due to queuing at roundabouts
Mitigation	Further provisions to be introduced at detailed design stage		Alternate access provided
Community Visual Impact	A considerable number of properties on current main road, Great Glemham Road and The Street will be affected	A considerable number of properties in the north of the village will be affected	A relatively low number of properties will be affected
	Whole bypass cuts through the Upper Deben Valley Special Landscape	Whole bypass cuts through the Upper Deben Valley Special Landscape	Approximately half of the bypass cuts through the Upper Deben Valley Special Landscape

10.3 Mitigation Measures

The mitigation measures to be implemented for each of the bypass options are as follows:

10.3.1 SB1 Full Scheme

Segregation

The bypass will cut through a field that is used by the villages for fetes; the proposed mitigation for this is for the villages to utilise a smaller area of land.

Farm land which will be segregated by the proposed route will have alternative access tracks provided for field access. Residents will be re-directed along these tracks to ensure they can access the required fields.

Pedestrian Amenity

Two footpaths will be intercepted by the proposed route for the A12. Both footpaths cross the bypass on the north end; Benhall Street and the parallel footpath, which lies to the northeast, will both be affected.

A side road overbridge will be provided for the crossing of Benhall Street. The footpath to the northeast however, will be diverted back towards Harrow Lane and then onto Benhall Street.

Cyclist Amenity

Cyclists will be required to use the new roundabout which will slightly increase their travel time. Access across the A12 will be affected; a short cycleway will be available to aid crossing and ensure that when crossing cyclists do so at the shortest possible road width. A cycle path will be available for access to the old A12 road and Mill lane.

Driver Delay

Access to approximately 14 properties will be diverted around the new bypass which will cause a slight increase in the journey time for the residents of these properties. Drivers will experience short delays due to queuing at the roundabout.

10.3.2 SB1 North

Segregation

The bypass will cut through a field that is used by the village for fetes; the proposed mitigation for this is for the village to utilise a smaller area of land.
Farm land which will be segregated by the proposed route will have alternative access tracks provided for field access. Users will be re-directed along these tracks to ensure they can access the required fields.

Pedestrian Amenity;

Two footpaths will be intercepted by the new A12; Benhall Street and the parallel footpath, which lies to the northeast, will both be affected. A side road overbridge will be provided for the crossing of Benhall Street. The foot path to the northeast will be diverted back towards Harrow Lane and then onto Benhall Street.

Cyclist Amenity

Cyclists would have to continue to use existing A12 south of the roundabout

Driver Delay

Drivers will experience short delays due to queuing at the roundabout.

10.3.3 SB5

Segregation

The bypass will cut through access to Farnham Hall Farm House. An alternative route will be provided using an agricultural underpass that will travel under the A12 and allow access to the Farmhouse and fields on the opposite side of the new bypass.

Access to Pond cottages will be available via a side road overbridge that follows the current access track.

Friday Street Farm access will be diverted to the new roundabout on the A1094, along the old A12 to a local access track near Benhall Stock Cottages.

The field access track will be stopped on the southwest side of the bypass. An accommodation track will be provided with access travelling under the A12 allowing access to the fields as necessary.

Pedestrian Amenity

Six footpaths will be cut by the new A12. The two footpaths running either side of the Nuttery belt will be diverted back to the farm track and will follow it along the agricultural underpass which will allow access to Farnham Hall. The two footpaths branching from Farnham Hall Farm House will both be diverted along the agricultural underpass being provided for access to the farmhouse from Farnham Hall. The footpath that runs from Mollett's Farm to Friday Street will be disconnected and pedestrians diverted past Foxburrow Wood, down to the proposed agricultural underpass.

Cyclist Amenity

The cycle path from Pond Barn Cottages to St Marys Church will be accessible via the proposed side road overbridge.

Driver Delay

Drivers will experience short delays due to queuing at the roundabouts.

Access to Farnham Hall Farm House will be cut off due to the new road passing straight through the existing road. This will be solved by building a new agricultural underpass.

10.4 Net Benefits

The net benefits assessment takes into account the benefits and impacts of the preferred routes compared to the current A12. The assessment will cover environmental factors, community severance and construction costs associated to the preferred routes SB1North, SB1 whole and SB5.

10.4.1 Air Quality

Table 10.4.1 present the result of the modelling at receptors 1, 3 and 4, which are the receptors considered to be most affected by proposed Options 1, 16 and 17, SB1, SB5 and SB1(North) respectively. Receptors 1 and 4, which are located along the A12 where it passes through Farnham, while receptor 4 is located close to the route of the SB5 route.

Table 10.4.1: Predicted Annual Mean NO_2 Concentration ($\mu g/m^3$) at Receptor Locations for each Road Option

Option	Receptor	2024 DM Excluding Sizewell C Traffic	2024 DM Including Sizewell C Traffic	2024 DS Including Sizewell C Traffic
Option 1	1	32.5 (37.1)	**41.2 (47.0)**	21.3 (24.3)
	3	7.2 (9.0)	7.2 (9.0)	7.2 (9.0)
	4	23.5 (27.1)	29.7 (34.2)	8.2 (9.5)
Option 16	1	32.5 (37.1)	**41.2 (47.0)**	21.3 (24.3)
	3	7.2 (9.0)	7.2 (9.0)	10.7 (13.3)
	4	23.5 (27.1)	29.7 (34.2)	8.2 (9.5)
Option 17	1	32.5 (37.1)	**41.2 (47.0)**	**41.2 (47.0)**
	3	7.2 (9.0)	7.2 (9.0)	7.2 (9.0)
	4	23.5 (27.1)	29.7 (34.2)	8.2 (9.5)

Note: Values in parentheses calculated following the Highways Agency's Interim Advice Note (IAN 170/12) methodology

Receptor 1 is representative of a residential property where monitoring has shown that NO_2 concentrations currently exceed the annual mean AQS objective, though in the future (2024, excluding additional traffic flows associated with Sizewell C) the objective is predicted to be achieved.

However, without the proposed bypasses the traffic movements associated with Sizewell C are predicted to lead to an increase in NO_2 concentrations of between 8.7 $\mu g/m^3$ and 9.9 $\mu g/m^3$ at Receptor 1 and between 6.2 $\mu g/m^3$ and 7.1 $\mu g/m^3$ at Receptor 4. This increase in road emissions associated with Sizewell C will lead to NO_2 concentrations at this receptor exceeding the AQS objective.

While Option 17 (construction of the northern half of SB1 only) leads to an improvement in NO_2 concentrations at Receptor 4, this option does not reduce NO_2 concentrations at Receptor 1 where the most significant impacts of the Sizewell C development traffic occur.

Both Options 1 and 16 divert the Sizewell C construction traffic around Stratford St Andrew/Farnham resulting in reduced NO_2 concentrations at both Receptors 1 and 4, though Option 16 does lead to a slight increase in NO_2 concentrations at Receptor 3, however, this is of negligible significance.

The modelling predicts that all receptors located along the A12, except those located near the proposed bypass routes, are predicted to experience an improvement in air quality. Option 1 and Option 16 would remove an exceedance of the NO_2 objective in Stratford St Andrew that would occur with the Sizewell C traffic in 2024. This is a significant benefit of the schemes while Option 17 offers no benefit at any receptors where air quality is predicted to be a concern.

The positive Total Net Present Value presented in Table 4.1.16 for all the bypass options indicates a net beneficial impact (i.e. air quality improvement) over the lifetime of the scheme. Option 1 and Option 16 are the most beneficial in terms of monetisation, with a Total Net Present Value of Change in Air Quality of £ 881,309 and £ 865,382, respectively.

The WebTAG local air quality assessment results for the two preferred options are reported in Table 4.1.13 and Table 4.1.14. Option 16 shows lower assessment scores than Option 1, which indicates a better improvement in air quality, and a smaller number of properties which will experience deterioration in air quality. Based on this route option, 69 properties will experience an improvement in air quality, 17 properties experience a deterioration and 92 properties experiencing no change in air quality. This is in comparison to Option 1 where 69 experience an improvement, 36 a deterioration and 92 no change, and Option 17 where 55 experience an improvement, 28 a deterioration and 128 no change. It should be noted however, that Option 16 will lead to a greater increase in regional emissions than Option 1 and Option 17, due to the longer length of its route.

10.4.2 Noise

The noise impact from traffic using the Pink route SB1 with a single carriageway has been assessed and the results included in the above report.

Irrespective of whether the Sizewell construction traffic is included, the results show that the total number of adverse impacts is very similar, 64 impacts for SB1 compared with 63 for SB5 when excluding Sizewell construction traffic and 54 for SB1 compared with 58 for SB5 when including Sizewell construction traffic. However, the number of beneficial impacts is estimated to be almost double for the SB5 option compared with SB1; 69 for SB1 compared with 134 for SB5 when excluding Sizewell construction traffic and 84 for SB1 compared with 159 SB5 when Sizewell construction is included.

Neither option indicates an adverse impact during the night.

A qualitative assessment is given for the Northern Section of the Pink route SB1 North.

The SB1 North will move traffic further away from those properties in the village of Farnham which will be bypassed due to this option. However, properties along Low Road may be adversely affected as traffic is moved closer due to this option.

If only the Northern Section of the Pink Route is selected then compared with the Pink Route as a whole, those properties along the existing A12 which would be bypassed by the Southern Section of the Pink Route would therefore not benefit from any noise reduction.

From the monetary valuation of noise impacts described in section 4.2.11, the performance of the SB5 single carriageway option is better than compared with SB1 single carriageway option in terms of the NPV value (Figure 4.2.2) and the population annoyed (Figure 4.2.3) irrespective of whether the Sizewell construction traffic is included in the assessment.

Changes in the design of the SB5 single carriageway option and influence on comparing noise impacts with SB1.

10.4.3 Biodiversity
The two routes to be assessed were selected from a number of identified options and are referred to as ‘SB1’ (Pink Route) and ‘SB5’ (Blue Route). The purpose of the assessment was to determine the preferred routing for minimising impacts upon Biodiversity and identifying (at a high level) the potential mitigation required, including future surveying requirements. The primary difference between the routing as assessed in this addendum and as previously assessed is the reduction of routing SB5 from a dual carriageway to a single carriageway road. Table 2 and Table 3 below outline each of the key predicted impacts of each routing.

The illustrative alignment for both routes SB1 and SB5 do not bisect internationally designated sites. Internationally designated sites are present within 5km of the routings, although the closest of these is over 3km from the proposed works, they are hydrologically linked to the drainage systems in the areas. Therefore, although it is considered unlikely, there is a small potential that these designated sites would be adversely impacted by both routings.
Overall, significant impacts (assessed as moderate adverse or greater) associated with route SB1 are related to this routes multiple crossings of the River Alde and its tributaries, and its routing through the River Alde floodplain. Impacts include habitat fragmentation and loss of floodplain grazing marsh. There are potentially moderate adverse effects from the culverting and or bridging of the multiple tributaries of the River Alde which may support otter and water vole, and other species listed on the Suffolk Biodiversity Action Plan, including a range of invertebrates and botanical species.

Construction of this routing will likely cause direct habitat loss of pasture, hedgerow, arable field and sections of woodland, which potentially support species including bats, badgers and birds. Common reptiles are likely to be present within any field or woodland edge habitat. There will also be an increase in overall habitat fragmentation due to the creation of the road for this routing.
Primarily, impacts relating to routing SB5 are associated with crossing of the River Alde, but also predicted impacts upon woodlands, both fragmentation effects and direct habitat loss. Ancient woodland lies nearby, but is not bisected by the routing. This woodland is designated as both an Ancient Woodland and a CWS, and is approximately 20m south from the works. Although the working corridor would not be likely to cause direct loss and damage of this habitat, in direct operational effects from the creation of the road such as degradation of the habitat via increased particulate pollution deposition and recreation is possible. The routing also fragments this woodland from other woodlands to the west of the routing.

The illustrative alignment for SB5 has the potential to affect a number of habitats in addition to direct habitat loss of arable fields and sections of three woodlands. At

least two sections of hedgerow are to be bisected by the SB5 routing and multiple ponds will be fragmented from each other.
With regards to valued fauna, routing SB5 is likely to affect a number of species and groups. The woodland plantations are likely to support badgers and nesting birds, and common reptiles are likely to be present within any field or woodland edge habitat. A number of ponds are present in the vicinity of the routing, therefore the potential presence of GCN must be considered, especially as there are records of GCN presence in the area. Therefore, the routing has the potential to affect GCN terrestrial habitats and fragment populations resulting in a loss of fitness of the overall population (if this species is present).

Overall, in the absence of mitigation, the impact of both routings with mitigation is foreseen to be Moderate Adverse. With the overall key impacts being the potential fragmentation of the River Alde and impacts upon the species it supports (GCN, water vole and otter) through multiple bridge and culverting works and occasional fragmentation of woodlands, ponds, hedgerows and arable margins (SB1) and the frequent fragmentation of numerous woodlands, ponds, hedgerows and arable and the protected species they maintain.

Table 10.4.2: Predicted impacts of route SB1, extracted from WebTAG Table

Route	Qualitative Impacts	Assessment	Mitigation	Residual Effects With Mitigation
SB1	**Designated Sites** Small potential for indirect effects to hydrologically linked designated sites.	**Slight Adverse**	Construction mitigation to prevent run off or sedimentation into connected drainage ditches and rivers	None
	Butchers Hole and Benhall Lodge Park Woodland complex and hedgerows of the existing A12 dualling would result in loss of habitat of this complex within which are ponds and connected woodland blocks. Benhall also supports pipistrelle and brown long-eared bat roosts.	**Moderate Adverse**	This habitat loss could be avoided if dualling was weighted towards the southern side of the existing road where there is less valuable habitat	None
	Coastal and Floodplain Grazing Marsh Much of the route is within this habitat to the north and south of the existing road this habitat is part of an important ecosystem complex that provides multiple services. The road would cause habitat loss and fragmentation	**Moderate Adverse**	Consideration should be given to a bridge crossing to minimise habitat loss and fragmentation. If a culvert is chosen culvert designs to be suitable for safe passage for otter, watervole and bats. Over road passage points will also be created via roadside planting to encourage bats and birds up and over the road.	Slight Adverse

Route	Qualitative Impacts	Assessment	Mitigation	Residual Effects With Mitigation
	River Alde Crossing of river Alde will need to be a bridge designed with consideration of legally protected and notable species and Suffolk Priority Habitats	**Moderate Adverse**	Consideration should be given to a bridge crossing to minimise habitat loss and fragmentation. If a culvert is chosen culvert designs to be suitable for safe passage for otter, watervole and bats. Over road passage points will also be created via roadside planting to encourage bats and birds up and over the road.	Slight Adverse
	Numerous small tributaries of the River Alde Eight tributaries will be crossed by the current routing. Construction of crossings will need to be designed to ensure impacts upon the ecological value of these features is minimised.	**Moderate Adverse**	Consideration should be given to a bridge crossing to minimise habitat loss and fragmentation. If a culvert is chosen culvert designs to be suitable for safe passage for otter, watervole and bats. Over road passage points will also be created via roadside planting to encourage bats and birds up and over the road.	Slight Adverse to Moderate Adverse
	Water voles. Multiple tributaries which may support water voles may be culverted which would result in habitat loss and fragmentation of habitat	**Moderate Adverse**	Pre-construction surveys would be required and a Natural England Conservation Licence with appropriate translocation and habitat creation would be required. Offsite mitigation may be required.	Slight Adverse depending on the success of the mitigation

Table 10.4.3: Predicted impacts of route SB5, extracted from WebTAG Table

Route	Qualitative Impacts	Assessment	Mitigation	Residual Effects With Mitigation
SB5	**Designated Sites** Small potential for indirect effects to hydrologically linked designated sites.	**Slight Adverse**	Construction mitigation to prevent run off or sedimentation into connected drainage ditches and rivers	None
	Coastal and Floodplain Grazing Marsh Much of the route is within this habitat to the north and south of the existing road this habitat is part of an important ecosystem complex that provides multiple services. The road would cause habitat loss and fragmentation	**Moderate Adverse**	Consideration should be given to a bridge crossing to minimise habitat loss and fragmentation. If a culvert is chosen culvert designs to be suitable for safe passage for otter, watervole and bats. Over road passage points will also be created via roadside planting to encourage bats and birds up and over the road.	Slight Adverse
	River Alde Crossing of river Alde will need to be a bridge designed with consideration of legally protected and notable species and Suffolk Priority Habitats	**Moderate Adverse**	Consideration should be given to a bridge crossing to minimise habitat loss and fragmentation. If a culvert is chosen culvert designs to be suitable for safe passage for otter, watervole and bats. Over road passage points will also be created via roadside planting to encourage bats and birds up and over the road.	Slight Adverse

	Numerous small tributaries of the River Alde At least three tributaries will be crossed by the current routing. Construction of crossings will need to be designed to ensure impacts upon the ecological value of these features is minimised.	**Moderate Adverse**	Consideration should be given to a bridge crossing to minimise habitat loss and fragmentation. If a culvert is chosen culvert designs to be suitable for safe passage for otter, watervole and bats. Over road passage points will also be created via roadside planting to encourage bats and birds up and over the road.	Slight Adverse
	Foxburrow Wood Ancient Woodland and CWS (County Wildlife Site) Although there is not likely to be any direct habitat loss there is potential for fragmentation, disturbance and overall reduction in quality of the habitat	**Moderate Adverse**	Ancient woodland is not replaceable. Connectivity to the wider area should be maintained via underpasses, overpasses and increased green infrastructure connectivity to the wider area to the south of the proposed route	Slight Adverse
	Pond Wood and Nuttery Belt These woodlands will be affected by habitat loss and fragmentation, 10 other named woodlands would be indirectly affected	**Moderate Adverse**	Screening from the road via habitat replacement, offset mitigation via a management plans for the woodlands. Culvert designs to be suitable for safe passage for otter, watervole and bats. Over road passage points will also be created via roadside planting to encourage bats and birds up and over the road. Underpasses in the vicinity of Pond Wood and Nuttery belt should be considered.	Slight Adverse depending on the success of the mitigation

	Ponds In total Seventeen ponds are in the vicinity of the routing, measures to ensure connectivity between them is maintained will be required. **Potential for moderate adverse impact upon GCN** Although no ponds will be directly impacted by the works, substantial areas of potential GCN terrestrial habitat will be lost and connectivity between ponds will be fragmented. Mitigation and licensing may be required.	**Slight/ Moderate Adverse**	Pre-construction surveys of the chosen route would be required. These surveys would reveal the connections between GCN meta populations and enable the design of suitable underpasses and replacement breeding and terrestrial habitat.NE protected species licensing and associated mitigation is likely to be required.	Slight Adverse depending on the success of the mitigation
	Water voles Multiple tributaries and closely positioned ponds which may support water voles may be culverted and or lost which would result in habitat loss and fragmentation of habitat	**Moderate Adverse**	Pre-construction surveys would be required and a Natural England Conservation Licence with appropriate translocation and habitat creation would be required. Offsite mitigation may be required.	Slight Adverse depending on the success of the mitigation

10.4.4 Landscape

Landscape Character Comparison

All the preferred route options have the potential to affect nationally and locally important designations and landscape character and can be experienced from the wider landscape, including potential long distance views from the Suffolk Coast AONB. SB1North and SB1 fall entirely within the Upper Deben Valley SLA where as SB5 only falls within this SLA between Tinker Brook and Pond Wood. However the overall integrity of the SLA is unlikely to be substantially affected by any of the route option.

Despite mitigation measures SB1 is considered to give rise to far greater adverse effects on landscape character compared to SB5. SB1 is likely to cause severe disruption and severance of the landscape, in particular the intricate mosaic of grazing marsh and smaller landscape pattern that are characteristic of the Valley Meadowlands LCT. SB1 has the potential to be at considerable variance with the scale and pattern of the landscape and would diminish the range of characteristic elements and their setting; therefore a Large Adverse effect is predicted.

SB5 has the potential to be at odds with the local landscape pattern and some landscape features would be adversely affected. It is however easier to accommodate landscape mitigation measures into the landscape setting due to the broader field patterns and scale. As the landscape context would accommodate mitigation measures without further diminishing the existing the key characteristics, a Moderate Adverse residual effect is predicted.

Visual Amenity Comparison

Overall all the route options have similar effects on visual amenity which range from Slight Adverse to Large Adverse. A number of properties have the potential to experience long distant views of the route options resulting in Slight Adverse effects. Predicted Large Adverse effects are primarily due to the routes coming into close proximity with residential properties. However, in terms of visual amenity SB5 route option is preferred as there would be far fewer residential properties located in close proximity to the route, compared with route SB1 and SB1 North.

SB5 is the route option furthest away from the more populated settlements of Farnham and Stratford St Andrew, leading to lesser predicted effects on visual amenity than SB1.

Road users along the existing A12 corridor would have the potential to experience transitory views of the route options. Mitigation measures would be more effective in reducing potential adverse effects from the SB5 as it is more distant from the A12 than SB1 and SB1 North (which are in close proximity to the existing A12).

The potential for Large Adverse effects on landscape character as a result of the SB1 and SB1 North scheme is likely to be detrimental to a locally valued landscape, causing considerable disruption to the local landscape pattern. The effects of SB1 North on the landscape are deemed to be less detrimental than the SB1 due to the length of the route. The SB5 is deemed to be less scarring on the landscape character and has a greater chance of being integrated into the existing landscape. In addition SB5 is located further from the settlements of Farnham and Stratford St Andrew and the majority of residential properties, therefore the disruption to visual amenity is also predicted to be less than for SB1 and SB1 North. Taking all of this into account, it is considered that the SB5 route option would give rise to lesser adverse effects than SB1 and SB1 North.

In terms of landscape character and visual amenity it is considered that SB5 should be carried forward to the next stage of assessment as the preferred route option.

10.4.5 Heritage

All three options will have potential adverse effects on archaeological sites as well as beneficial effects on assets located in the villages which would be bypassed.

- Route SB1North will have an adverse physical effect on the setting of a pillbox (88). In addition, the setting of Benhall Lodge Park (BNL 020), a number of cropmarks (63) are present within its grounds, would also be affected.
- Route SB1 will have an adverse physical effect upon two assets. These include a former field system (87) and on the same of pillbox as SB1 North (88). In addition, the setting of Benhall Lodge Park (BNL 020), a number of cropmarks (63) are present within its grounds, would also be affected
- Route SB5 will have an adverse effect upon four assets. These include physical effects on the site of two lithic scatters (66 & 67) and on the same field system as SB1 (87). In addition, the setting of Farnham Manor (11), a Grade II listed building, and Benhall Lodge Park (BNL 020), a number of cropmarks (63) are present within its grounds which, would also be affected

As routes SB1 and SB5 will bypass villages, there will be beneficial effects on heritage assets located within them. SB1 will have beneficial effects on Stratford St Andrew, while SB5 will have beneficial effects on Stratford St Andrew and on Farnham. SB1 North will still affect assets in the village of Stratford St Andrew.

There is no clear preferred route option between these routes as they have similar effects on heritage assets. However, as SB1 North is slightly shorter it has a lower risk for previously unrecorded archaeological remains to be located.

10.4.6 Water

The impacts of the preferred options, SB1 North, SB1 and SB5, on the surface water environment, assuming adherence to mitigation, are considered to be low significance (based on the TAG guidance). The sub-options cross the River Alde however whilst sub-option SB5 (single) crosses the river in a perpendicular manner sub-option SB1 and SB1 North cross the river more acutely. As such SB1 crosses more ditches that ultimately enter the river and crosses more of the rivers flood plain, compared to the SB1 North and SB5. The River Alde is a WFD watercourse and with more ditch crossings associated with SB1 in the vicinity of this watercourse the potential for detrimental impacts on the WFD watercourse is increased. As such from a surface water environment perspective SB5 (single) would be the preferred option.

Similarly as SB1 extends further within the flood plain of the River Alde (the main river crossed by the preferred options) it would be associated with potentially more flood risk effects. Hence from a broad flood risk perspective, SB5 would be the preferred option (note that flood risk should be considered in detail and to the requirements of the National Planning Policy Framework (NPPF) published on the 27 March 2012 (Department for Communities & Local Government, 2012)).

Table 10.4.4: Summary of Environmental Net Benefits - SB1 North Advantages

Route Option	**Advantages**	**Evidence**
SB1 North	Avoids congestion in Farnham village	Beneficial effects to the properties in the vicinity of the old A12 as traffic is sited outside the village of Farnham By 2024 a forecast* average daily volume of 18,361 (over 17% LGVs and HGVs) – 14% higher than 2012 volume Overall Present Value Benefits** (PVB) of £18,262
	Removes vehicle threat in Farnham	£3,852 total accident benefits saved (44.8 accidents) over sixty years from 2020
	Removes air quality issues from Farnham	Air Quality: Improved local air quality along the A12 due to new route away from sensitive receptors One receptor will experience an improvement of more than 5% Removes exceedences on the A12 in Farnham only
	Removes traffic noise issues from Farnham	Traffic moved further away from properties along the A12 in the village of Farnham
	Reduction in greenhouse gas emissions due to length of route	Reduction of £59,000 in greenhouse gases***
	Less effects on archaeological assets	Slight adverse effects on the setting of one asset Pillibox (88) Lower risk for previously unrecorded archaeological remains to be located due to the length of the route
	Construction Costs	£12,402,134.21 with an area of 12,387m^2
*Includes Sizewell C Construction Traffic **Takes into account the greenhouse gas emissions, economic efficiencies for all road users, wider public finances ***Increase/Decrease compared to 2012 values ****Peak construction year for Sizewell C		

Table 10.4.5: Summary of Environmental Net Benefits - SB1 North Disadvantages

Route Option	Disadvantages	Evidence
SB1 North	Potential landscape impacts, on the nationally and locally important designations, close to Farnham and Stratford villages	Slight to very large adverse effects due to severance of the more intricate mosaic of grazing marsh and smaller landscape pattern. Upper Deben Valley a special landscape area is also being affected as the entire route is in the valley Potential damage to tree preservation area in Farnham
	Loss of amenity land	The amenity land currently enjoyed by the patrons of the Stratford St Andrew community facility will be difficult to replace with a similar well accessed locality
	Potential ecological damage in flood plain/flooding	Crosses four tributaries of the River Alde potential biodiversity effect (see below) Associated to flood risk effect as majority of the route crosses the river's flood plain
	Potential damage to the biodiversity	Moderate Adverse effect overall Crosses four tributaries of the River Alde and the river itself Loss of floodplain grazing marsh Loss of habitat for otters and water voles Potential residual fragmentation of the River Alde and numerous ponds and water bodies that may support great crested newts (GCN) Direct habitat loss of arable fields, floodplain grazing marsh and sections of woodland Potential effects on a number of notable species and groups, including bats, GCN, reptiles, badgers and birds
	Potential damage to the biodiversity during construction	Direct habitat loss of arable fields and sections of a woodland Potential effects on fauna thus affecting a number of species and groups
	No solution to Stratford St Andrew issues (congestion from turning traffic; noise on frontages; air quality issues)	The daily traffic volumes are predicted to increase by 18% (2,856) in year 2024**** of which 4% (783) vehicles are HGVs. This will lead to an increase in congestion and a deterioration in the noise levels and air quality for the village of Stratford St Andrew
*Includes Sizewell C Construction Traffic **Takes into account the greenhouse gas emissions, economic efficiencies for all road users, wider public finances ***Increase/Decrease compared to 2012 values ****Peak construction year for Sizewell C		

Table 10.4.6: Summary of Environmental Net Benefits - SB1 Full Scheme Advantages

Route Option	Advantages	Evidence
SB1	Avoids congestion in the villages of Farnham and Stratford St Andrew	Beneficial effects to the properties in the vicinity of the old A12 as traffic is sited outside the village of Stratford St Andrew and Farnham By 2024 a forecast* average daily volume of 18,361 (over 17% LGVs and HGVs) – 14% higher than 2012 volume Overall Present Value Benefits** (PVB) of £27,199
	Air quality - Large improvement for the villages of Farnham and Stratford St Andrew	Air Quality: Net Value Change of £881,309 along the A12 - a reduction of 913 T/y in NO2 and 173 T/y in PM10 Two receptors will experience an improvement of more than 5% Removes exceedences on the A12 between Stratford St Andrew and Farnham
	Noise levels	Total number of adverse impacts is 54 and total number of beneficial impacts is 84 with SB1.
	Improved road alignment by dealing with turning problems in Stratford St Andrew (Glemham Road and petrol station)	An improved situation with properly aligned approaches to a new roundabout and safer level of service for turning vehicles
	Less impact on archaeological assets close to village	Slight beneficial effects on archaeological assets in Stratford St Andrew as traffic is sited away from the village
*Includes Sizewell C Construction Traffic **Takes into account the greenhouse gas emissions, economic efficiencies for all road users, wider public finances ***Increase/Decrease compared to 2012 values ****Peak construction year for Sizewell C		

Table 10.4.7: Summary of Environmental Net Benefits - SB1 Full Scheme Disadvantages

Route Option	Disadvantages	Evidence
SB1	Increase in greenhouse gas emissions due to length of route	Increase of £86'000 in Greenhouse gases***
	Landscape impacts close to Farnham and Stratford St Andrew villages	Largest adverse effects due to severance of the more intricate mosaic of grazing marsh and smaller landscape pattern Upper Deben Valley a special landscape area is also being affected as the entire route is in the valley Potential damage to tree preservation area in Farnham
	Loss of amenity land	The amenity land currently enjoyed by the patrons of the Stratford St Andrew community facility will be difficult to replace with a similar well accessed locality
	Potential ecological damage in flood plain/flooding	Crosses eight tributaries of the River Alde Associated to more flood risk effect as it crosses more of the river's flood plain
	Potential damage to the biodiversity	Moderate Adverse effects: Crosses eight tributaries of the River Alde and the river itself Loss of floodplain grazing marsh. Loss of habitat for otters and water voles. Potential residual fragmentation of the River Alde and numerous ponds and water bodies that may support great crested newts (GCN). Direct habitat loss of arable fields, floodplain grazing marsh and sections of woodland. Potential effects on a number of notable species and groups, including bats, GCN, reptiles, badgers and birds.
	Potential damage to the biodiversity during construction	Direct habitat loss of arable fields and sections of a woodland, loss of floodplain grazing marsh. Potential effects on fauna thus affecting a number of species and groups
	Potential effects on archaeological assets	Adverse physical effect on a former field system (87) and on the setting of a pillbox (88) as SB1 North above
	Community severance between Farnham and Stratford St Andrew	Increase in community severance as traffic is directed between the villages

	Noise and disturbance only moved from front to back of eastern houses in Stratford St Andrew	Adverse effect on properties closer to the route option
	Greater cost than SB1 North	£18,651,620.28 with an area of 21,262m^2

*Includes Sizewell C Construction Traffic
**Takes into account the greenhouse gas emissions, economic efficiencies for all road users, wider public finances
***Increase/Decrease compared to 2012 values
****Peak construction year for Sizewell C

Table 10.4.8 Summary of Environmental Net Benefits - SB5 Advantages

Route Option	Advantages by comparison with SB1 North and SB1	Evidence
SB5	Avoids congestion in the villages of Farnham and Stratford St Andrew	Beneficial effects to the Conservation Area in Farnham and Stratford St Andrew due to reduction of traffic By 2024 a forecast* average daily volume of 18,361 (over 17% LGVs and HGVs) – 14% higher than 2012 volume Overall Present Value Benefits (PVB)** of £32,441
	Air quality - Significant improvement for the villages of Farnham and Stratford St Andrew	Air Quality: Net Value of Change £865,382 along the A12 - a reduction of 993 T/y in NO2 and 190 T/y in PM10 Two receptors will experience an improvement of more than 5%
	Noise levels - significant improvement for the villages of Farnham and Stratford St Andrew	Total number of adverse impacts is 58 and total number of beneficial impacts 159.
	Community severance issues from the villages	Reduced community severances as route directs traffic away from the villages
	Avoids landscape damage close to villages	Moderate Adverse residual effects due to the fragmentation of the landscape and loss of landscape features
	Avoids loss of amenity land close to villages	Less likely to affect the visual amenity from as many properties
	Less ecological impact in floodplain	Crosses two tributaries of the River Alde Less associated flood risk effects as it crosses less of the river's flood plain. Impacts upon Alde and its tributaries perceived by SCC as easier to mitigate against from this route option than SB1. Less impact upon priority species associated with River Alde and its floodplain
	Less impact on the landscape	Moderate Adverse residual effects due to the fragmentation of the landscape and loss of landscape features
	Less impact on archaeological assets close to villages	Slight beneficial effects on archaeological assets in Farnham and Stratford St Andrew as traffic is directed away from the villages
	Could become part of full 4VBP at	Careful alignment and junction treatment could future proof the scheme and provide

	a later date	connection to a full bypass of all four villages in time.
*Includes Sizewell C Construction Traffic **Takes into account the greenhouse gas emissions, economic efficiencies for all road users, wider public finances ***Increase/Decrease compared to 2012 values ****Peak construction year for Sizewell C		

Table 10.4.9 Summary of Environmental Net Benefits - SB5 Disadvantages

Route Option	Disadvantages by comparison with SB1 North and SB1	Evidence
SB5	Increase in greenhouse gases emissions due to length of route	Increase of £632,000 in Greenhouse gases***
	Biodiversity impacts upon Foxburrow Ancient Woodland	Potential indirect impact upon ancient woodland, Foxburrow Wood only 20m from routing, however, single carriageway sited to avoid direct habitat loss Foxburrow Wood but will be fragmented from the wider habitat. Potential for pollution and other indirect effects on this woodland.
	Biodiversity fragmentation effects	Routing SB5 is likely to have a significant impact on fragmentation of habitats, especially between hedgerows, woodlands and ponds in the routing vicinity. This may have a significant effect upon the fauna they support including GCN, bats and badger if they are found to be present
	Loss of amenity land close to route	Adverse effects on properties in close proximity to the route are likely.
	Potential effects on archaeological assets	Adverse physical effects on four assets which includes Farnham Manor (11) a Grade II listed building
	Some additional houses subject to noise and air quality issues	Adverse effect on properties closer to the route option
	Longer route and therefore greater cost	£26,517,382.68 with an area of 34,234m^2
*Includes Sizewell C Construction Traffic **Takes into account the greenhouse gas emissions, economic efficiencies for all road users, wider public finances ***Increase/Decrease compared to 2012 values ****Peak construction year for Sizewell C		

10.5 Summary

10.5.1 Environmental Comparison

- All the routes present improvements in Air Quality and Noise for the villages of Stratford St Andrew and Farnham as the traffic is directed away from the villages. The SB5 route shows the highest improvement in air quality and a smaller number of properties who will experience deterioration in air quality.

- Similarly SB5 was found to provide twice as many beneficial impacts compared to the SB1 route option with respect to Noise.

- In terms of Landscape all the preferred route options have the potential to affect nationally and locally important designations and landscape character; with the SB5 route potentially having less of an impact as the broader field patterns and scale would better accommodate landscape mitigation measures

- All options have various siting's in the general area of Special Landscape Value as shown in the Local Plan. On balance SB1 will have a far greater effect on Community Visual Impact with SB1 North slightly lesser so. It has been demonstrated that SB5 will have a localised Community Visual Impact affecting only a few properties south of the existing A12.

- Community Severance will be greater on Routes SB1 and SB1 North, as described in the foregoing text. Route SB5 would entail some local severance but this would be ameliorated by the provision of connecting roads and underpass works.

- The SB1 and SB5 routes were found to have beneficial effects on the villages (Stratford St Andrew and Farnham) Heritage assets but the SB1 North is likely to have a lower risk for previously unrecorded archaeological remains to be located as it is shorter route. Looking at the broader historic landscape it is considered that a new road on the Pink Route would be forming a wall (as it is mostly higher than existing ground level) that separates the settlement core (around the church) from the river – this settlement is one of many clearly sited on the Alde valley, and the name suggests it is at the point that a major Roman road (presumably a predecessor of the A12 route) crossed the river. Conversely the Blue Route might have a (more minor) impact on the setting of Farnham Church.

- Impacts of all options on the Surface Water environment are that they cross the River Alde, however whilst sub-option SB5 (single) crosses the river in a perpendicular manner, sub-option SB1 crosses more acutely. As such SB1 crosses more ditches that ultimately enter the river and crosses more of the rivers flood plain. The River Alde is a WFD watercourse and with more ditch crossings associated with SB1 in the vicinity of this watercourse the potential for detrimental impacts on the WFD watercourse is increased. As such from a Surface Water environment perspective SB5 (single) would be the preferred option.

- Similarly as SB1 extends further within the flood plain of the River Alde (the main river crossed by both of the preferred options) it would be associated with potentially more Flood Risk effects. Hence from a broad flood risk perspective, SB5 would be the preferred option (note that flood risk should be considered in detail and to the requirements of the National Planning Policy Framework (NPPF) published on the 27 March 2012 (Department for Communities & Local Government, 2012).

- From the aspect of Biodiversity, it is the case that all route options will lead to habitat loss and fragmentation. The magnitude of fragmentation of 'Suffolk Biodiversity Partnership Priority Habitats' is greater for Route SB1 (North and complete routes) in comparison with SB5. This is because route SB1 will fragment and reduce the connectivity of floodplain grazing marsh and associated ditch networks, which are a coherent and integrated habitat matrix. This habitat and multiple associated floral and faunal species including water vole, otter and a range of invertebrates are listed on the Suffolk Biodiversity Action Plan.

  Blue Route SB5 adds to the fragmentation of woodland and pond habitats within a largely arable landscape. It is determined that impacts associated with fragmentation attributable to route SB5 could be addressed with more practicable and likely more successful mitigation than those associated with route SB1.

10.6 General Conclusions from meeting with Environment Agency 29/10/2014

A meeting was held between Environment Agency (EA), AECOM Engineering staff and SCC environmentalists on the 29th of October. A summary of the discussions are as follows:

- From a Flood Risk perspective further work needs to be carried out on the preferred route option; including research using the existing flood model.

- The loss of any flood storage area must be compensated for the route options

- Route SB5 appears to need less compensation area as it affects a lesser area of land in the flood plain and the general surrounding topography appears to be higher. The flood storage compensatory areas can be either upstream or downstream of the river crossings.

- The span for the proposed River Alde Bridge on the SB5 route needs to accommodate the meanders in the river at the crossing point.

So as to ensure that the points raised by the EA are incorporated in the design of the route options the following steps need to be carried out:

- A full survey will have to be carried out to confirm the compensation areas for the preferred route.

- Hydraulic modelling tests will need to be carried out on the exact locations of the compensatory areas so as to ensure the necessary mitigations are provide; the areas are in direct hydraulic continuity with the River Alde and as close as possible to where the flood storage is being lost

- Fuller details of land ownership will need to be recorded in order that all current owners can be identified and their needs (such as accommodation roads) are fully addressed.

10.7 Conclusion

SB5 has a lesser impact on both Noise and Air Quality factors compared to both Pink SB1 and SB1 North options.

Both SB1 North and SB1 have a road corridor effect on numerous properties in Stratford St Andrew and Farnham, however SB5 will have a minor effect on approximately seven properties.

In terms of driver amenity all three routes have approximately the same benefits, however in terms of accident saving SB5 has a higher number.

All of the route options would have effects causing habitat loss of small amounts of woodland and hedgerows and small amounts of agricultural land. With regards to flood risk SB5 would need less compensation area than the other two schemes

From the foregoing it is clear that on Environmental grounds the provision of Route SB1 or SB1 North would have a far greater adverse impact on local settlements than the provision of Route SB5.

10.8 The Way Forward

AECOM have considered the next actions which would be necessary, following the current work and assuming the Blue Route SB5 goes forward.

These include the following:

- Carry out full topographical survey of the SB5 Blue Route corridor (currently all schemes are designed using EMAP and LIDAR backgrounds).
- Conduct soil surveys (currently no geotechnical information is available).
- Carry out further structural design based on geotechnical work.
- Develop a full construction cost estimate.
- Carry out land referencing.
- Conduct C2 and C3 Statutory Undertakers research.
- Carry out Preliminary Design and Consultation.
- Announce Preferred Route.
- Carry out Detailed Design.
- Public Inquiry.
- Order Publication Period and CPO.
- Award of tender.
- Construction Period.
- Open to Traffic.

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Appendix 1 – Bypass Options Drawing

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Appendix 2 – Environmental Assessment

Appendix 3 – Cost Breakdown