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A47 Dualling:

Economic Assessment Methodology

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Contents

1 Introduction

1.1 Purpose of this document

This note provides an overview of the methodology followed during the calculation of the indicative value for money (vfm) associated with proposals to dual the single carriageway sections of the A47. Although this methodology is based on DfT practice, it provides only a coarse approach to assessing vfm, which nonetheless is considered appropriate for this stage of the scheme development.

If they are progressed further the proposals will be subject to more detailed analysis which would be fully compliant with Department for Transport (DfT) guidance.

1.2 Summary of the A47 Dualling study

Mouchel was commissioned by Norfolk County Council to undertake an assessment of the benefits that could be derived from dualling the remaining single carriageway sections on the A47 and A12 between Wansford and Lowestoft. There are 15 such sections along this route and it is considered that upgrading these sections to dual carriageway standard and tie in with other sections already at this standard, would help boost the economic propensity of a large part of the east of England and contribute to national economic growth.

The assessment would consider the dualled sections individually and grouped together. On the A47 section between Wansford, at its junction with the A1, and Great Yarmouth there are 11 sections currently at single carriageway standard; on the A12 between Great Yarmouth and Lowestoft there are four such sections.

The assessment of benefits would be at a strategic high level and represent a broad indication of the benefits likely to be derived from the dualling. As such, the benefits would be limited to the time savings likely to be derived from greater speeds, and accident benefits likely to be derived from dualling to modern highway standards. These benefits have been calculated over a 60 year life which is standard practice for schemes such as this, and then compared to the estimated costs associated with the widening. A Benefit to Cost Ratio (BCR) has then been calculated to provide a broad indication of the vfm.

1.3 Overview of Methodology

In order to quantify and then consider the benefits against costs, the task was broken down into five components:

- Scheme(s) definition;
- Traffic data gathering;
- User Benefits calculation;
- Accidents Benefits calculation; and
- Scheme Costs estimation.

Details of each assessment are described in Section 2.

Methodologies and supporting data were sourced from software and supporting documentation produced by the DfT, as parts of their Design Manual for Roads and Bridges (DMRB), specifically COBA (Volume 13), and their Transport Analysis Guidance (WebTAG) for TUBA.

1.4 Assessment methods

The schemes considered were the 15 individual sections that could be upgraded from single to dual carriageways. Relevant speeds were assumed for each scheme based on their location in terms of surrounding development.

Traffic flow (volume) data were collated from a range of sources and checked for compatibility.

In terms of journey time savings, User Benefits were calculated by TUBA (Transport Users Benefit Appraisal version 1.9.3). TUBA is a software package approved by the DfT for calculating the overall cost-benefit assessment for schemes of this nature.

Accident benefits were calculated using a DfT-approved spreadsheet, using methods and data from their COBA cost-benefit methodology.

2 Process Followed

2.1 Appraisal Scheme Definition

A total of 15 schemes were identified, however, Section 4 was split in to two parts (4a and 4b) as requested by Norfolk County Council to quantify the cost and benefit of each section separately.

The total of 16 schemes are listed in Table 2-1 and are the sections of the A47 and A12 (between Wansford and Lowestoft) that are currently single carriageways. These were confirmed by the client.

The distances for each of the individual sections in Table 2-1 were identified using aerial photography.

Table 2-1 Scheme definition and length

Section Number	Section Name	Length (km)
1	A47 Wansford to Sutton	2.50
2	A47 Peterborough to Eye	1.30
3	A47 Eye to Thorney	5.60
4a	A47 Thorney Bypass to Guyhirn	8.30
4b	A47 Guyhirn to Wisbech	6.60
5	A47 Wisbech Bypass	7.40
6	A47 Tilney to East Coast Business Park	3.90
7	A47 King's Lynn to Swaffham	17.90
8	A47 Swaffham to Dereham	17.60
9	A47 Tuddenham to Easton	7.70
10	A47 Blofield to Burlingham	2.40
11	A47 Acle Straight	11.40
12	A12 from A47 Great Yarmouth to dualling at Gorleston bypass	1.90
13	A12 hospital to dualling between Lowestoft and Great Yarmouth	0.50*
14	A12 Lowestoft	4.20
15	A12 Bascule Bridge / 3rd crossing	0.07

*Section 13 is 0.9km long, however about half of it is already dual, therefore the length used in calculations was reduced to 0.5km

2.2 Traffic Data Gathering

The broad nature of the assessment and the relatively short timescale available led to using as much data as was readily available or already used in previous studies with the relevant level of checking. Traffic flow data were initially taken from a previous Consultant's study. The date these data were collected is important to traffic studies in order to treat such data in a consistent way, in respect of school holidays, bank holidays and other local issues affecting traffic at different times of the year, including the affect of the weather and occasionally traffic behaving differently from year to year in the winter due to darkness. The previous Consultant's traffic data were collected in September 2011. September is deemed to be a 'neutral' month by national DfT guidelines; that is, traffic data collected in this month is relatively stable and can be used to approximate yearly traffic flows. The traffic data taken from that study for use here were complemented by the traffic flows and vehicle proportions downloaded from the Highways Agency's Traffic Information Database (TRADS) website. To maintain consistency the data from September 2011 were extracted.

The data are considered to be reliable although there are three main limitations:

- not every appraised section has an associated count site (in which case the count located on the neighbouring link was used);
- due to the method in which TRADS classifies the vehicles, LGV proportions were assumed have 5.2 to 6.6m in wheelbase length and HGVs as in excess of 6.6m in wheelbase length (these categories are used to store the data from the traffic count equipment);
- single month (September 2011) data were used – despite this month's good neutrality as described above, the data are just from a single month which only meets the minimum requirement. More data from other months would increase the confidence of using September data.

The traffic flow data were used to derive speeds from speed-flow relationships as defined by COBA for different types of road. This formed the basis of the travel time saving that could be associated with the upgrade. In order to quantify the benefits, this information and the classification of the vehicle types (in terms of traffic proportions) were input to TUBA. Flow data and accident rates for different road types again as defined by COBA, were used in the accident benefit calculation. In

summary, the following traffic flow data in the format required were required to undertake the analysis (with the reasons for their need):

- Average Weekday AM Peak, Inter Peak and PM Peak Hour flow volumes (necessary for the COBA speed-flow relationships adjustment used to calculate travel times for TUBA assessment);
- Vehicle Proportions (Used to create TUBA trip matrices) by vehicle type; and
- Annual Average Weekday Traffic (AAWT) flows used for the accident benefits calculation.

It is a usual and accepted practice in TUBA for traffic flow data to be presented in the following time periods:

- AM Peak (7-10hrs hourly average);
- Inter-Peak (10-16hrs hourly average);
- PM Peak (16-19hrs hourly average);

With the Base Year for the appraisal established as 2011 to make direct use of the traffic flow data, growth factors were applied to the traffic flows to account for changes in traffic volumes between the base year and the expected Opening Year and Design Year. This process is normal practice and is in accord with national guidance. The Design Year for strategic schemes is usually set 15 years after the Opening Year. An Opening Year of 2021 was selected; it is understood that some of the individual schemes could be complete prior to this date, but others may not be open until afterwards. However, it seemed prudent to select 2021 as it fell mid-way through the full build-out periods. With a proposed Opening Year set at 2021 the Design Year would, therefore, be 2036.

National Traffic Model (NTM) growth factors were used as in the previous Consultant's assessment. This growth procedure and use of NTM factors are nationally recognised. For the sake of consistency it was decided to re-use the factors to derive the Opening Year and Design Year flows. The factors used for all traffic were:

- 1.205 (2011 to 2021); and
- 1.535 (2011 to 2036).

These factors were based on NTM's previous (2011) forecasts that would have been current at the time of the previous Consultant's study. New NTM growth rates from

July 2013 are lower. The earlier rates have been used in this study to maintain some consistency with the earlier study.

2.3 User Benefits Calculation (TUBA)

The TUBA appraisal process requires three types of 'matrices' (a file containing a table of traffic flows from a list of origins to a list of destinations) for all forecast periods (AM, Inter Peak and PM) and scenarios (DM 2021, DS 2021, DM 2036 and DS 2036). DM represents the Do-Minumum forecasts where there will be no changes to the road; DS represents Do-Something forecasts where the scheme would be in place. In total, there were 108 'matrix' files for each of the 15 sections, including:

- Distance Matrices;
- Trip Matrices (separately for Car, LGV and HGV); and
- Travel Time Matrices (separately for Car, LGV and HGV).

Distance matrices were defined based on the road length measurements utilising aerial photography. The results are tabulated in Section 2.1. Trip matrices were calculated based on the available TRADS information.

Travel times were estimated using hourly vehicle volumes individually for each section. Individually calculated speed-flow relationships were developed based on standard COBA relationships adjusted for the section length. Speed-flow curves were used for the following road classes:

- Rural Single A-Road Carriageways (7.0 meters wide, speed limit of 60mph);
- Rural Wide Single A-Road Carriageways (10.0 meters wide, speed limit of 60mph); and
- Rural All-Purpose Dual 2-lane Carriageways.

Additionally the following alterations were made to reflect the speed limits through the built-up areas:

- A12, hospital to the dualling between Lowestoft and Great Yarmouth (speed limit of 40mph in DM and DS scenarios);
- A12 Lowestoft (speed limit of 30 / 40mph in DM and DS scenarios respectively);
- A12 Bascule Bridge / 3rd crossing:

- maximum speed limit of 30 / 40mph in DM and DS scenarios respectively,
- minimum speed of 10mph in DM and DS scenarios (theoretical speeds derived from the speed-flow equation was unrealistically low. However, due to the short distance of 74 meters this did not impact the TUBA benefits)

After inputting all data above, separate TUBA runs were undertaken for each section. All monetary values were discounted to 2010 and presented in 2010 prices as defined by the current version of TUBA.

2.4 Accidents Benefits Calculation

Data consistent with the TUBA assessment (appraisal scenarios, distances, TRADS volumes, COBA link types) were input to the accident assessment spreadsheet separately for each link and the assessments were run.

The spreadsheet already contains accident rates for all road types. Once the traffic flow data are provided a 'macro' programme is run which outputs accident benefits (or dis-benefits) and number of accidents saved (or generated) by the upgrade for each year of the appraisal, discounted back to a 2010 total at 2010 prices.

2.5 Scheme Costs Estimation

Scheme costs were based on scheme specific data where available and estimated using an average cost per km from Highways Agency schemes where scheme specific data was unavailable.

Scheme specific data was available for the following schemes:

- A47 Blofield to Burlingham; and
- A12 Bascule Bridge / Third Crossing.

Discussion with the Highways Agency identified that work undertaken on the Blofield to Burlingham scheme had generated a cost range of £38m to £52m in 2010 prices; the mid point of £45m was used in the assessment. A Highways Agency report '*A12 Lowestoft Study Lake Lothing Third Crossing Feasibility Study*' identified a cost of £37m in 2007, inflation was applied using the TAG Data book to calculate a base cost of £39.5m in 2010 prices.

For the majority of the remaining sections an average cost per km was calculated using recent / current dualling schemes identified through discussion with the Highways Agency which were:

- A47 Blofield to Burlingham - £11.25m / km in 2010 prices;
- A11 Fiveways to Thetford Improvement - £6.9m / km in 2013 prices; and
- A453 Widening (M1 Junction 24 to A52 Nottingham) - £13.4m / km in 2012 prices.

The costs of these three schemes identify two higher costs and one lower cost which is considered to be an appropriate split. The costs were rebased to 2010 prices and the overall average was then calculated as £10.41m / km.

This approach was adjusted to account for the specific nature of the following schemes:

- A12 from A47 Great Yarmouth to dualling at Gorleston bypass to account for the lifting bridge; and
- A12 hospital to dualling between Lowestoft and Great Yarmouth, and A12 Lowestoft to account for the urban environment.

For the A12 from A47 Greatt Yarmouth to dualling at Gorleston bypass: in addition to the average cost per km an additional cost to account for the lifting bridge was calculated using the base costs identified for the Bascule Bridge (adjusted to account for distance).

To account for the constrained urban environment the average cost identified by one of Mouchel's Senior Quantity Surveyors for dualling sections of the A3 was used as this was considered more appropriate.

This provided base 2010 prices for each scheme as follows:

Section Number	Section Name	Price (£m)
1	A47 Wansford to Sutton	26.03
2	A47 Peterborough to Eye	13.54
3	A47 Eye to Thorney	58.31
4a	A47 Thorney Bypass to Guyhirn	86.42
4b	A47 Guyhirn to Wisbech	68.72
5	A47 Wisbech Bypass	77.05
6	A47 Tilney to East Coast Business Park	40.61
7	A47 King's Lynn to Swaffham	186.37
8	A47 Swaffham to Dereham	183.25
9	A47 Tuddenham to Easton	80.17
10	A47 Blofield to Burlingham	45
11	A47 Acle Straight	118.70
12	A12 from A47 Great Yarmouth to dualling at Gorleston bypass	138.36
13	A12 hospital to dualling between Lowestoft and Great Yarmouth	12.23
14	A12 Lowestoft	102.71
15	A12 Bascule Bridge / 3rd crossing	39.52

Based on the opening year of 2021 an assumed spend profile was applied as 2%, 3%, 5%, 10%, 20%, 30%, 30% for 2014/15 to 2020/21 respectively assuming feasibility, planning and preparation, followed by construction. This enabled a costing spreadsheet to account for inflation, discounting and VAT to calculate the present value cost for each scheme as shown in the results table.

3 Results and Summary

The final outputs from the assessment are shown in the table below:

Section	Length	Benefits			Cost	BCR	VfM
		TUBA (PVB)	Accidents (Total)	Total			
A12 Bascule Bridge / 3rd crossing	0.074	82,927	817	83,744	35,118	2.38	High
A12 Lowestoft	4.200	91,237	15,581	106,818	91,254	1.17	Low
A12 hospital to dualling between Lowestoft and Gt Yarmouth	0.500	71,385	5,372	76,757	10,864	7.07	Very High
A12 from A47 Gt Yarmouth to dualling at Gorleston bypass	1.900	390,155	24,675	414,830	122,930	3.37	High
Acle Straight	11.400	219,615	90,096	309,711	105,461	2.94	High
Blofield to Burlingham	2.400	186,722	26,232	212,954	39,983	5.33	Very High
Tuddenham to Easton	7.700	255,144	72,885	328,029	71,233	4.61	Very High
Swaffham to Dereham	17.600	210,434	116,781	327,215	162,817	2.01	High
King's Lynn to Swaffham	17.900	168,980	108,203	277,183	165,593	1.67	Medium
Tilney to East Coast Business Park	3.900	71,592	30,326	101,918	36,079	2.82	High
Wisbech Bypass	7.400	83,266	49,057	132,323	68,457	1.93	Medium
Guyhirn to Wisbech Bypass	6.600	158,034	56,984	215,018	61,057	3.52	High
Thorney Bypass to Guyhirn	8.300	196,968	71,661	268,629	76,783	3.50	High
Eye to Thorney	5.600	349,837	68,800	418,637	51,806	8.08	Very High
Peterborough to Eye	1.300	56,091	45,126	101,217	12,026	8.42	Very High
Wansford to Sutton	2.500	60,594	19,763	80,357	23,127	3.47	High
Total	**99.274**	**2,652,981**	**802,360**	**3,455,341**	**1,134,586**	**3.05**	**High**
	(km)	(£000s) 2010 values					

This demonstrates that the proposal to dual the remaining single carriageway sections would be expected to deliver a high level of value for money, with particular sections offering very high value for money.

4 Further Refinements

Whilst this approach is considered appropriate for this stage of the scheme development it is recognised that the assessment could provide more accurate results if the following data were used as input:

- More accurate Section distances;
- Annual traffic volumes surveyed on every section of the scheme;
- Refined speed – flow relationships (e.g. using Urban/Suburban COBA categories);
- Detailed scheme costs;
- Use of observed accident data; and
- Greater refinement of existing and proposed scheme details.