Great Yarmouth
Third River Crossing

OUTLINE BUSINESS CASE

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Appendix G – Note on TUBA Methodology

Norfolk County Council   Great Yarmouth Borough Council   New Anglia Local Enterprise Partnership for Norfolk and Suffolk

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Great Yarmouth Third River Crossing – TUBA Methodology and Annualisation Factors

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1 Introduction

This technical note outlines the methodology that was adopted to produce the TUBA benefits for the Great Yarmouth Third River Crossing (GYTRC). As part of the TUBA methodology, this note also describes the annualisation factors that have been derived from the observed count data that were collected during the development of the base year model.

1.1 Transport User Benefits

The calculation of transport user benefits is based on the conventional consumer surplus theory. For the purpose of the economic appraisal, use of the transport system is assumed to be the result of a balanced consideration of pros and cons by each individual decision-maker, subject to all the various constraints which exist.

Changes in the transport system give rise to changes in the perceived cost of personal travel and freight movement from certain points of origins to certain destinations. This perceived cost is a broadly defined measure of the inconvenience to the user of moving between two points, and includes changes in:

- Travel time;
- User charges (fares, tolls, etc.); and
- Vehicle operating costs met by users.

Consumer surplus is defined as the benefit that a consumer enjoys, in excess of the costs perceived. In the simplest case, where time of money costs change, but demand stays the same, the total change in consumer surplus equals:

Change in cost * number of travellers = $(P^0 - P^1) * T$

Where:

- P^i is the perceived cost of travel (note that the superscript i is used to denote the scenario – 0 for Do-Minimum, 1 for Do-Something), and

- T is the number of travellers. This is commonly referred to as the fixed demand scenario (where demand remains fixed in the Do-Minimum and Do-Something models.

Where, as is more usual, demand changes in response to the increase or decrease in travel costs, there is an additional impact on new or lost travellers. With a relatively small change in costs, the convention is to attribute half of the change in costs to the trips lost or gained. The total change in consumer surplus in this scenario is represented by:

(Change in cost*do-minimum demand) + (half change in cost*change in demand)

$$= (P^0 - P^1)T^0 + {}^1/_2\,(P^0 - P^1) * (T^1 - T^0)$$

$$= {}^1/_2\,(T^0 + T^1) * (P^0 - P^1)$$

This is referred to as the “rule of half” method, and is the recommended calculation to apply in variable demand scenarios.

1.2 Estimation of Transport Economic Efficiency Benefits

TUBA 1.9.8 has been used to estimate the Transport Economic Efficiency (TEE) benefits, which adopts the parameters such as Value of Time, fuel prices, changes in GDP etc., from the WebTAG Databook November 2016. These include estimation of benefits relating to travel times, vehicle operating costs, user charges, and private sector revenues, all of which contribute to the Present value of Benefits (PVB) of the proposed scheme.

TUBA is an industry-recognised software package, recommended by DfT for the appraisal of highway and public transport schemes. It is of particular use where variable demand responses have been included in the transport modelling, as TUBA is based on the “rule of half”, which allows for explicit calculation of changes in demand between the “Do-Minimum” and “Do-Something” scenarios.

Travel time savings are calculated using the rule of half that is applied to generalised time skims from the SATURN highway model. Since parking costs are not included in the forecast models, generalised time equates solely to in-vehicle times.

Vehicle operating costs are calculated for both fuel and non-fuel elements of the journey based on formulae that are set out in the WebTAG guidance. The rule of half formula is applied for travel times, but with vehicle operating costs being based on distance travelled and average vehicle speeds.

All the assumptions relating value of time, change in value of time, vehicle occupancies, fuel costs, duty, vehicle efficiency are contained within the default TUBA economic file, which is derived from the WebTAG Databook November 2016.

Travel times, travel distance and demand extracted from the traffic models are input into TUBA and annualised for each modelled period, so that AM peak, Inter-Peak, and PM peak travel time savings and vehicle operating costs can be calculated.

Annual time savings and vehicle operating costs are calculated for each modelled year. Benefits for non-modelled years are calculated via linear interpolation between modelled years, and flat-line extrapolation beyond the final modelled year. However, the impact of discounting on estimated benefits means that the benefits "curve" declines toward the end of the project lifetime.

1.3 Wider Public Finances

The impact of the scheme on central government indirect tax revenues, now known as the Wider Public Finances, is presented as part of the PVB.

Indirect Tax revenues are generated through fuel duty and any other charges incurred by transport uses (e.g. tolls) and providers (e.g. public transport revenues). In this instance, without road tolls and public transport included in the traffic models, the only impact on indirect tax revenues is through changes in fuel-related vehicle operating costs.

2 Estimation of Scheme Costs

2.1 Overview

This section explains the requirement for estimating scheme costs, which are subsequently included as inputs to TUBA, and the outturn costs that are presented in the Transport Economic Efficiency (TEE) and Public Accounts (PA) tables.

NATA-based economic appraisal requires realistic and accurate scheme costs to be produced. The costs of transport scheme are an integral component of the scheme appraisal process, particularly where they are subsequently used to form decision on scheme funding.

There are three main elements of a scheme cost estimate:

- **The Base Costs**: is the basic costs of a scheme before allowing for risks, but including realistic assumptions of changes in inflation over time (i.e. cost increases above the growth in "economy-wide" inflation);
- **Adjustment of Risks**: cover all the risks that can be identified, assessed and quantified through a Quantified Risk Assessment (QRA). The outcome from this process is the risk-adjusted cost estimate; and
- **Adjustment for Optimism Bias**: this is to reflect the well-established and continuing systematic bias for estimated scheme costs and delivery times to be too low and too short respectively, thus result in the risk and optimism bias-adjusted cost estimate.

2.2 GYTRC Scheme Costs

The costs calculated for the GYTRC scheme were provided by Norfolk County Council. Each element of the costs were then converted to Present Value of Costs (PVC) in accordance with the WebTAG A1.2 guidance and provided in a separate note.

3 Transport User Benefits for GYTRC

3.9 Introduction

A cost-benefit assessment was required to estimate the value for money that is produced by the proposed scheme. The tool adopted for the Great Yarmouth Third River Crossing proposed scheme is TUBA (Transport User Benefit Analysis), a computer programme developed for the Department for Transport (DfT) to undertake the appraisal of highway schemes and multi-modal transport studies.

DfT advises that the latest TUBA software should be used in any economic appraisal to produce the benefits in accordance with the latest WebTAG Databook's values of Values of Time (VoT) and other parameters such as change in VoT, fuel consumptions. The latest TUBA software was therefore used adopting the following parameters:

3.10 Main Parameters

As mentioned in the Traffic Forecasting Report, three forecast years were modelled to represent future condition of the proposed scheme, therefore the TUBA was run for the three modelled years, as below:

- TUBA version: v1.9.8 (with variable VoT by travelled distance);
- Opening Year: 2023
- Design Year: 2038
- Horizon Year: 2082 (60 years from the Opening year)
- Modelled years: 2023, 2038 and 2051

3.11 Time Slices

TUBA requires that the user benefits should be produced for all the hours within a year and allocates each of the hours in a year into one of the 5 time slices, as below:

- Weekday AM Period (07:00-10:00);
- Weekday Inter-Peak period (10:00-16:00);
- Weekday PM period (16:00-19:00);
- Weekday Off-peak period (19:00-07:00); and
- Weekend + bank holiday (24-hours).

The traffic models developed for the proposed scheme, however, only consists of the three distinct peak hours: AM peak hour (08:00-09:00), Inter-peak (average of 10:00-15:30), and PM Peak (16:30-17:30), it was therefore required that all the non-modelled hours should be included in the TUBA analysis either by expanding the modelled hour to the relevant period or by adopting a "donor" models. (Detail of this method, so called annualisation factors, is provided in the subsequent section). The TUBA analysis periods and the corresponding modelled hours are summarised below:

- Weekday AM Period: adopt AM peak hour model (08:00-09:00);
- Weekday Inter-Peak period: adopt average Inter-Peak hour model (10:00-15:30);
- Weekday PM Period: adopt PM peak hour model (16:30-17:30);

- Weekday Off-peak period: adopt average inter-peak hour model; and
- Weekend + bank holiday: adopt average inter-peak hour model.

3.12 Vehicle Types and User Classes

Seven user classes are defined in the TUBA standard economic file, representing 3 distinct trips purposes for car, two for LGV and 2 for HGVs that is based on different VoT and fuel consumptions for each vehicle types and purposes. The traffic models developed for the proposed scheme however consist of 5 user classes (user class 1: Car – Business, user class 2: Car – Commuting, user class 3: Car – other, user class 4: LGV and user class 5: HGV). It was therefore required that the user classes from the traffic models to be converted to TUBA standard vehicle type and trip purposes with relevant conversion factors for the purpose of economic appraisal of the proposed scheme. Table 3-1 below provides the correspondence between the model's user classes and the TUBA vehicle types/purposes with the associated conversion factors.

Table 3-1 Model User classes and TUBA standard User Classes

Model User Class	TUBA User Classes	TUBA Input		
		Veh / submode	purpose	Factor Split
1	1	1 (Car)	1 (Business)	1.00
2	2	1 (Car)	2 (Commuting)	1.00
3	3	1 (Car)	3 (Other)	1.00
4	4	2 (LGV personal)	0 (Commuting and Other)	0.12
4	5	3 (LGV freight)	0 (Business)	0.88
5	6	4 (OGV1)	0 (Business)	0.40
5	7	5 (OGV2)	0 (Business)	0.60

3.13 Non-modelled Hours and Annualisation factors

As mentioned in the previous section, the forecast models consist of three distinct peak hours: AM peak hour (08:00-09:00), average inter-peak hour (10:00-15:30), and PM peak hour (16:30-17:30). TUBA analysis is, however, required to be carried out for all the hours for the whole year.

For non-modelled hours (i.e. AM Peak shoulders (07:00-08:00 and 09:00-10:00), PM peak shoulders (15:30-16:30 and 17:30-18:30), off-peak and weekend + bank holiday), it is only appropriate to calculate benefits for hours in which traffic levels are similar to the modelled hours. For example, it would not be appropriate to expand the AM peak hour to the AM period in the event that traffic was significantly lower in the peak shoulders as it would result in significantly less actual delays caused by traffic in the peak shoulders as opposed to the peak hour, thus resulting in overestimating the modelled benefits of the proposed scheme if the peak shoulders were included in the calculation of benefits. TUBA guidance suggests that a conservative approach should be used to identify benefits/dis-benefits for non-modelled periods so that it would represent as close as possible the changes in travel time between Do-Minimum and Do-Something compared to the changes in the modelled hours.

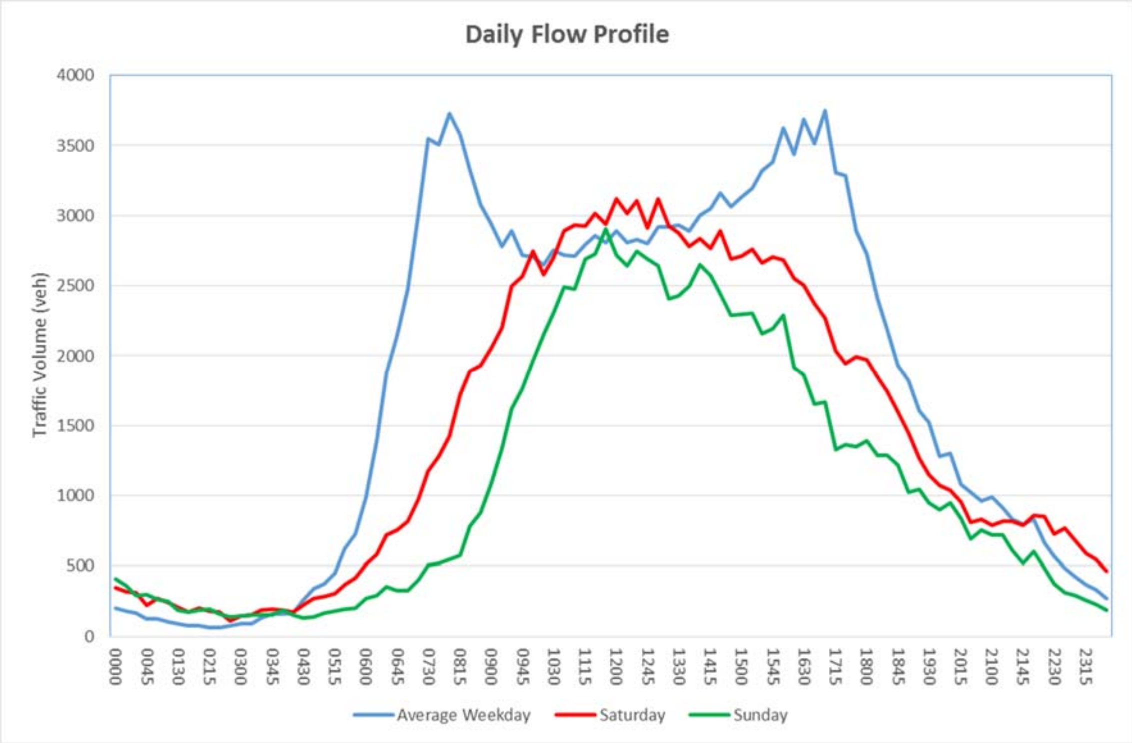
It is common practice that the peak shoulder traffic exceeding 90% of that in the peak hour should be included in the derivation of the annualisation factors as the change in travel time between the Do-Minimum and Do-Something in the peak shoulders would be close to the changes experienced in the peak hour. The 90% threshold was employed.

Observed traffic counts from 9 Automatic Traffic Counts (ATC) at the RSI locations in Great Yarmouth that were collected for the two weeks in November 2016 for the purpose of the base year model validation were used to identify this profile.

Figure 3-1 below shows the locations of the 9 ATC counts and Figure 3-2 provides a summary of the traffic daily profile that was produced from the sites.

Figure 3-1 Location of ATC counts

Figure 3-2 Traffic Flow Profile



As can be seen from the Figure 3-2, weekday traffic volume peaks between 08:00-09:00 before reducing significantly to the inter-peak. Peak conditions re-emerge at 15:30 and continue to 17:30 before receding into the off-peak period. During weekend, the traffic volume shows similarly to the inter-peak period on Saturday with slightly lower flow on Sunday. It was therefore suggested that only about 1.5 hours for the AM and about 2 hours for the PM period that will be used for the calculation of the benefits of the scheme. this was based on the assumption that the traffic volume in the peak shoulders of more than 90% of the peak hour volume is deemed to be appropriate to be included in the derivation of the annualisation factors.

Tables 3-2 to 3-4 below provide a quick summary derivation of the annualisation factors that have been adopted for the calculation of the TUBA benefits for the Great Yarmouth Third River Crossing scheme. Flows outside the 90% threshold are excluded.

Table 3-2 Derivation of Annualisation Factors – Weekday Traffic

Period	Hour	Volume	Donor Model	Factor / Donor	Include	Period	Hour	Volume	Donor Model	Factor / Donor	Include
AM Period	0700	2,479	IP	0.86	×	Off-Peak	1900	1,819	IP	0.63	×
	0715	3,015	IP	1.04	✓		1915	1,603	IP	0.55	×
	0730	3,547	AM	1.04	✓		1930	1,525	IP	0.53	×
	0745	3,508	AM	1.02	✓		1945	1,282	IP	0.44	×
	0800	3,728	AM	1.00	✓		2000	1,301	IP	0.45	×
	0815	3,574	AM	1.00	✓		2015	1,078	IP	0.37	×
	0830	3,328	AM	1.00	✓		2030	1,022	IP	0.35	×
	0845	3,078	AM	1.00	✓		2045	966	IP	0.33	×
	0900	2,939	IP	1.02	✓		2100	989	IP	0.34	×
	0915	2,779	IP	0.96	✓		2115	914	IP	0.32	×
	0930	2,893	IP	1.00	✓		2130	834	IP	0.29	×
	0945	2,720	IP	0.94	✓		2145	799	IP	0.28	×
Inter-Peak Period	1000	2,708	IP	1.00	✓		2200	833	IP	0.29	×
	1015	2,649	IP	1.00	✓		2215	666	IP	0.23	×
	1030	2,750	IP	1.00	✓		2230	570	IP	0.20	×
	1045	2,718	IP	1.00	✓		2245	484	IP	0.17	×
	1100	2,711	IP	1.00	✓		2300	426	IP	0.15	×
	1115	2,792	IP	1.00	✓		2315	371	IP	0.13	×
	1130	2,855	IP	1.00	✓		2330	333	IP	0.12	×
	1145	2,805	IP	1.00	✓		2345	269	IP	0.09	×
	1200	2,895	IP	1.00	✓		0000	200	IP	0.07	×
	1215	2,808	IP	1.00	✓		0015	184	IP	0.06	×
	1230	2,827	IP	1.00	✓		0030	168	IP	0.06	×
	1245	2,799	IP	1.00	✓		0045	127	IP	0.04	×

Period	Hour	Volume	Donor Model	Factor / Donor	Include
	1300	2,918	IP	1.00	✓
	1315	2,917	IP	1.00	✓
	1330	2,932	IP	1.00	✓
	1345	2,893	IP	1.00	✓
	1400	2,999	IP	1.00	✓
	1415	3,054	IP	1.00	✓
	1430	3,159	IP	1.00	✓
	1445	3,065	IP	1.00	✓
	1500	3,136	IP	1.00	✓
	1515	3,196	IP	1.00	✓
PM Period	1530	3,320	PM	0.93	✓
	1545	3,381	PM	0.95	✓
	1600	3,624	PM	1.02	✓
	1615	3,439	PM	0.97	✓
	1630	3,683	PM	1.03	✓
	1645	3,516	PM	0.99	✓
	1700	3,751	PM	1.05	✓
	1715	3,304	PM	0.93	✓
	1730	3,287	PM	0.92	✓
	1745	2,891	IP	1.00	✓
	1800	2,723	IP	0.94	✓
	1815	2,404	IP	0.83	×
Off-Peak	1830	2,186	IP	0.76	×
	1845	1,930	IP	0.67	×

Period	Hour	Volume	Donor Model	Factor / Donor	Include
	0100	126	IP	0.04	×
	0115	106	IP	0.04	×
	0130	91	IP	0.03	×
	0145	80	IP	0.03	×
	0200	78	IP	0.03	×
	0215	67	IP	0.02	×
	0230	66	IP	0.02	×
	0245	79	IP	0.03	×
	0300	90	IP	0.03	×
	0315	88	IP	0.03	×
	0330	133	IP	0.05	×
	0345	158	IP	0.05	×
	0400	159	IP	0.06	×
	0415	170	IP	0.06	×
	0430	255	IP	0.09	×
	0445	338	IP	0.12	×
	0500	376	IP	0.13	×
	0515	453	IP	0.16	×
	0530	626	IP	0.22	×
	0545	730	IP	0.25	×
	0600	990	IP	0.34	×
	0615	1,391	IP	0.48	×
	0630	1,878	IP	0.65	×
	0645	2,147	IP	0.74	×

Table 3-3 Derivation of Annualisation Factors – Saturday Traffic

Period	Hour	Volume	Donor Model	Factor / Donor	Include	Period	Hour	Volume	Donor Model	Factor / Donor	Include
AM Period	0700	817	IP	0.28	×	Off-Peak	1900	1,449	IP	0.50	×
	0715	975	IP	0.34	×		1915	1,270	IP	0.44	×
	0730	1,178	IP	0.41	×		1930	1,152	IP	0.40	×
	0745	1,283	IP	0.44	×		1945	1,070	IP	0.37	×
	0800	1,423	IP	0.49	×		2000	1,036	IP	0.36	×
	0815	1,723	IP	0.60	×		2015	957	IP	0.33	×
	0830	1,892	IP	0.65	×		2030	812	IP	0.28	×
	0845	1,929	IP	0.67	×		2045	832	IP	0.29	×
	0900	2,056	IP	0.71	×		2100	793	IP	0.27	×
	0915	2,200	IP	0.76	×		2115	815	IP	0.28	×
	0930	2,499	IP	0.86	×		2130	820	IP	0.28	×
	0945	2,564	IP	0.89	×		2145	792	IP	0.27	×
Inter-Peak Period	1000	2,744	IP	0.95	✓		2200	862	IP	0.30	×
	1015	2,583	IP	0.89	×		2215	852	IP	0.29	×
	1030	2,696	IP	0.93	✓		2230	731	IP	0.25	×
	1045	2,894	IP	1.00	✓		2245	769	IP	0.27	×
	1100	2,930	IP	1.01	✓		2300	678	IP	0.23	×
	1115	2,929	IP	1.01	✓		2315	586	IP	0.20	×
	1130	3,014	IP	1.04	✓		2330	546	IP	0.19	×
	1145	2,939	IP	1.02	✓		2345	465	IP	0.16	×
	1200	3,117	IP	1.08	✓		0000	348	IP	0.12	×
	1215	3,013	IP	1.04	✓		0015	323	IP	0.11	×
	1230	3,108	IP	1.08	✓		0030	314	IP	0.11	×
	1245	2,913	IP	1.01	✓		0045	223	IP	0.08	×

Period	Hour	Volume	Donor Model	Factor / Donor	Include	Period	Hour	Volume	Donor Model	Factor / Donor	Include
	1300	3,123	IP	1.08	✓		0100	273	IP	0.09	×
	1315	2,923	IP	1.01	✓		0115	241	IP	0.08	×
	1330	2,881	IP	1.00	✓		0130	210	IP	0.07	×
	1345	2,784	IP	0.96	✓		0145	174	IP	0.06	×
	1400	2,839	IP	0.98	✓		0200	204	IP	0.07	×
	1415	2,768	IP	0.96	✓		0215	181	IP	0.06	×
	1430	2,892	IP	1.00	✓		0230	172	IP	0.06	×
	1445	2,690	IP	0.93	✓		0245	110	IP	0.04	×
	1500	2,712	IP	0.94	✓		0300	147	IP	0.05	×
	1515	2,760	IP	0.95	✓		0315	155	IP	0.05	×
PM Period	1530	2,666	IP	0.92	✓		0330	190	IP	0.07	×
	1545	2,702	IP	0.93	✓		0345	198	IP	0.07	×
	1600	2,686	IP	0.93	✓		0400	186	IP	0.06	×
	1615	2,554	IP	0.88	×		0415	176	IP	0.06	×
	1630	2,502	IP	0.87	×		0430	225	IP	0.08	×
	1645	2,374	IP	0.82	×		0445	269	IP	0.09	×
	1700	2,269	IP	0.79	×		0500	282	IP	0.10	×
	1715	2,034	IP	0.70	×		0515	306	IP	0.11	×
	1730	1,947	IP	0.67	×		0530	369	IP	0.13	×
	1745	1,994	IP	0.69	×		0545	420	IP	0.15	×
	1800	1,972	IP	0.68	×		0600	510	IP	0.18	×
	1815	1,851	IP	0.64	×		0615	583	IP	0.20	×
Off-Peak	1830	1,742	IP	0.60	×		0630	723	IP	0.25	×
	1845	1,596	IP	0.55	×		0645	753	IP	0.26	×

Table 3-4 Derivation of Annualisation Factors – Sunday Traffic

Period	Hour	Volume	Donor Model	Factor / Donor	Include	Period	Hour	Volume	Donor Model	Factor / Donor	Include
AM Period	0700	329	IP	0.11	×	Off-Peak	1900	1,022	IP	0.35	×
	0715	400	IP	0.14	×		1915	1,047	IP	0.36	×
	0730	509	IP	0.18	×		1930	951	IP	0.33	×
	0745	520	IP	0.18	×		1945	899	IP	0.31	×
	0800	549	IP	0.19	×		2000	949	IP	0.33	×
	0815	575	IP	0.20	×		2015	840	IP	0.29	×
	0830	784	IP	0.27	×		2030	692	IP	0.24	×
	0845	879	IP	0.30	×		2045	752	IP	0.26	×
	0900	1,088	IP	0.38	×		2100	718	IP	0.25	×
	0915	1,338	IP	0.46	×		2115	719	IP	0.25	×
	0930	1,617	IP	0.56	×		2130	609	IP	0.21	×
	0945	1,766	IP	0.61	×		2145	521	IP	0.18	×
Inter-Peak Period	1000	1,965	IP	0.68	×		2200	602	IP	0.21	×
	1015	2,150	IP	0.74	×		2215	489	IP	0.17	×
	1030	2,305	IP	0.80	×		2230	378	IP	0.13	×
	1045	2,491	IP	0.86	×		2245	316	IP	0.11	×
	1100	2,479	IP	0.86	×		2300	294	IP	0.10	×
	1115	2,693	IP	0.93	✓		2315	256	IP	0.09	×
	1130	2,728	IP	0.94	✓		2330	229	IP	0.08	×
	1145	2,902	IP	1.00	✓		2345	188	IP	0.07	×
	1200	2,719	IP	0.94	✓		0000	411	IP	0.14	×
	1215	2,643	IP	0.91	✓		0015	361	IP	0.12	×
	1230	2,748	IP	0.95	✓		0030	289	IP	0.10	×
	1245	2,691	IP	0.93	✓		0045	302	IP	0.10	×

Period	Hour	Volume	Donor Model	Factor / Donor	Include	Period	Hour	Volume	Donor Model	Factor / Donor	Include
	1300	2,643	IP	0.91	✓		0100	264	IP	0.09	×
	1315	2,407	IP	0.83	×		0115	253	IP	0.09	×
	1330	2,429	IP	0.84	×		0130	191	IP	0.07	×
	1345	2,499	IP	0.86	×		0145	177	IP	0.06	×
	1400	2,650	IP	0.92	✓		0200	189	IP	0.07	×
	1415	2,572	IP	0.89	×		0215	196	IP	0.07	×
	1430	2,444	IP	0.85	×		0230	161	IP	0.06	×
	1445	2,290	IP	0.79	×		0245	143	IP	0.05	×
	1500	2,297	IP	0.79	×		0300	149	IP	0.05	×
	1515	2,307	IP	0.80	×		0315	151	IP	0.05	×
PM Period	1530	2,161	IP	0.75	×		0330	151	IP	0.05	×
	1545	2,193	IP	0.76	×		0345	157	IP	0.05	×
	1600	2,289	IP	0.79	×		0400	189	IP	0.07	×
	1615	1,916	IP	0.66	×		0415	153	IP	0.05	×
	1630	1,862	IP	0.64	×		0430	135	IP	0.05	×
	1645	1,654	IP	0.57	×		0445	140	IP	0.05	×
	1700	1,670	IP	0.58	×		0500	169	IP	0.06	×
	1715	1,326	IP	0.46	×		0515	181	IP	0.06	×
	1730	1,363	IP	0.47	×		0530	194	IP	0.07	×
	1745	1,349	IP	0.47	×		0545	204	IP	0.07	×
	1800	1,392	IP	0.48	×		0600	274	IP	0.09	×
	1815	1,289	IP	0.45	×		0615	289	IP	0.10	×
Off-Peak	1830	1,288	IP	0.45	×		0630	354	IP	0.12	×
	1845	1,218	IP	0.42	×		0645	329	IP	0.11	×

From the calculation set out in the Tables 3-2 to 3-4 above, the following factors were applied to the relevant modelled hour to include the non-modelled hours into the calculation of the TUBA benefits, thus derive the annualisation factors for the purpose of the TUBA benefits, as provided in Table 3-5 below.

Table 3-5 Annualisation Factors

No	Time Slice	Duration (min)	Traffic Model	Annualisation Factor
1	Weekday AM Period	60	AM Peak Hour Model	1.51 x 253 = 383
2	Weekday Inter-Peak Period	60	Inter-Peak Hour Model	7.23 x 253 = 1,828
3	Weekday PM Period	60	PM Peak Hour model	2.20 x 253 = 556
4	Weekday Off-Peak period	60	Inter-Peak hour model	0.00 x 253 = 0
5	Weekend	60	Inter-Peak hour model	8.06 x 52 = 419
Total annualised Hours				**3,186 hours**

Around 36% of annual hours are reflected in the annualisation. It is noted that the ATC counts were collected for 2 weeks during November 2016. They therefore do not represent the whole year of traffic travelling within the area, particularly during the summer seasons where weekend traffic volume are likely to be higher than those in November. Furthermore, the ATC counts during November do not include any bank holidays, therefore these benefits are also excluded. The annualisation factors derived for the weekends using November are therefore considered conservative in the calculation of the benefits for the proposed scheme.

3.14 Skimmed Time, Distance and Demand Data

The skimmed time, distance and demand data were extracted from the Great Yarmouth highway forecast models for each Origin-Destination (OD) pair and subsequently converted to the pre-defined format as required by TUBA.

As mentioned in the previous section, three modelled years forecasts have been developed for the proposed scheme (opening year 2023, Design year 2038 and the horizon year 2051), the following skimmed time, distance and demand data were extracted for the TUBA calculation:

- 2023 Do-Minimum/Do-Something AM, IP and PM peak hours by 5 user classes;
- 2038 Do-Minimum/Do-Something AM, IP and PM peak hour models models by 5 user classes; and
- 2051 Do-Minimum/Do-Something AM, IP and PM peak hour models by 5 user classes.

3.15 Reporting Sectors

It is recommended that an aggregation of modelled zones into different geographical areas should be provided for the TUBA analysis. This is used to ensure that the benefits produced by the proposed scheme are geographically appropriate given the scale and location of the scheme.

A 10x10 sector system was defined for the study area in order to assist the analysis of the benefits at sectoral level. An illustration of the 10x10 sector boundary is provided in Figure 3-3 and description of each sector is provided in Table 3-6 below.

Figure 3-3 Analysis Sector System

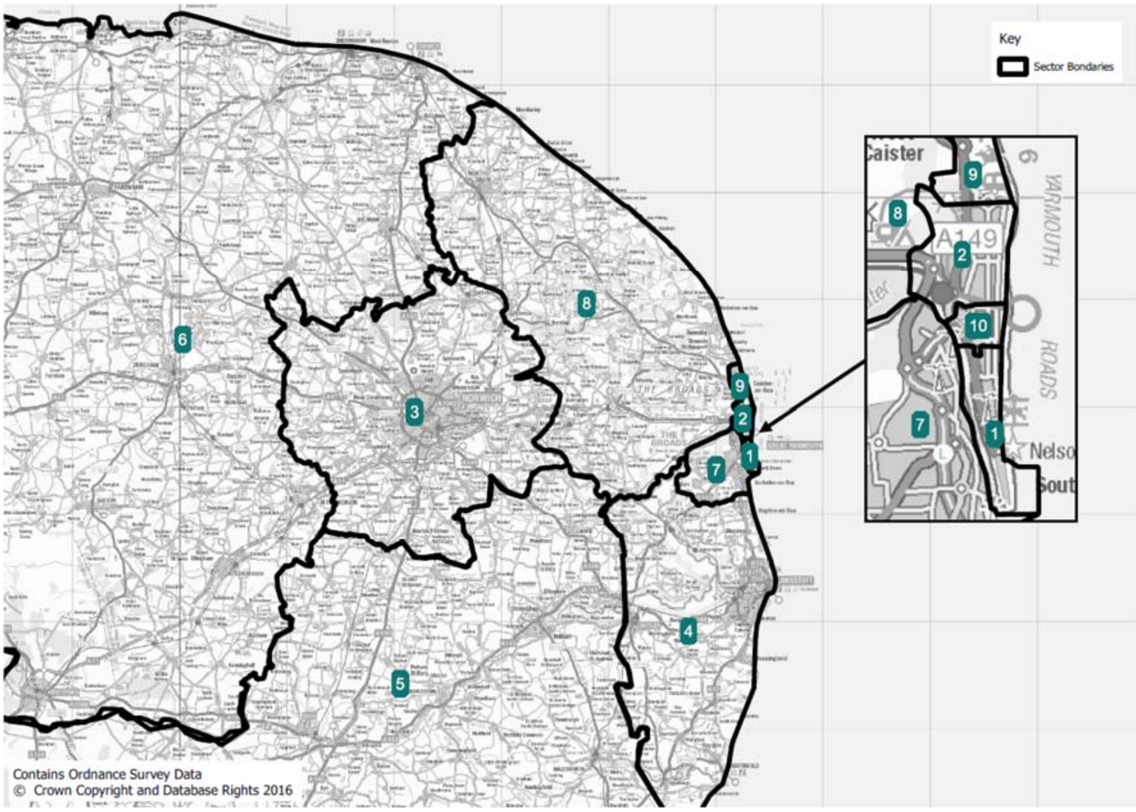


Table 3-6 Sector Description

Sector	Description
Sector 1	Great Yarmouth Peninsula
Sector 2	Great Yarmouth north town
Sector 3	Norwich
Sector 4	Lowestoft
Sector 5	South (London, Ipswich, etc.)
Sector 6	North/West (Midlands, Northwest, Northeast, etc.)
Sector 7	Rural areas south of Great Yarmouth
Sector 8	North of Great Yarmouth (Winterton-on-Sea, Horsey Corner, North Walsham)
Sector 9	Caister-on-Sea
Sector 10	Great Yarmouth mid-town

3.16 TUBA Runs

As mentioned in the previous section, TUBA runs were carried out for the following scenarios for both Fixed Demand and Variable Demand Models:

- Core scenario;
- Core scenario with Harfreys roundabout improvements as part of the proposed scheme;
- Core scenario with RIS schemes on the A12 in both Do-Minimum and Do-Something;
- Low growth scenarios; and
- High growth scenarios;

Prior to running TUBA, a verification process was carried out to ensure that:

- The skimmed time, distance and demand extracted were for the correct scenarios, years, cases (DM and DS), time periods and user classes;
- Demand matrices extracted to TUBA were checked against the forecast matrices from the forecast models to ensure accuracy; and
- The data extracted from the models were in the correct unit and format for TUBA.

The following sections only report the detailed TUBA benefits for the VDM Core scenario, the TUBA results for other scenarios are only reported at a high level such as total benefits by purposes and by time periods.

3.17 TUBA Output Checks

TUBA output files detail several analyses of the input data in order to facilitate checking of the runs by highlighting possible errors/issues or inconsistencies that might have occurred to the input data. TUBA produces a set of warnings as part of the standard output file based on changes in distance and time between the Do Minimum and Do Something models. These have been investigated thoroughly in order to identify correct any erroneous results. It should be noted that warnings of this sort are not necessarily an indicator of an error in the modelling however the TUBA warnings/errors can be used to feed back to the assignment model to investigate potential problems with the traffic models.

The following checks were undertaken on the TUBA output file.

- Number of warning messages were checked with regard to the following:
- Matrix totals by vehicle classes are consistent with the input data;
- High/Low DS/DM travel time ratios were justified and deemed acceptable;
- High/Low DS/DM travel distance ratios were justified and deemed acceptable;
- High/Low DM/DS speeds (derived from distance/time) were justified and deemed acceptable.

A detailed list and number of all the warnings produced by TUBA for the VDM core scenario is provided in Table 3-7 below.

Table 3-7 TUBA Warning Summary – VDM Core Scenario

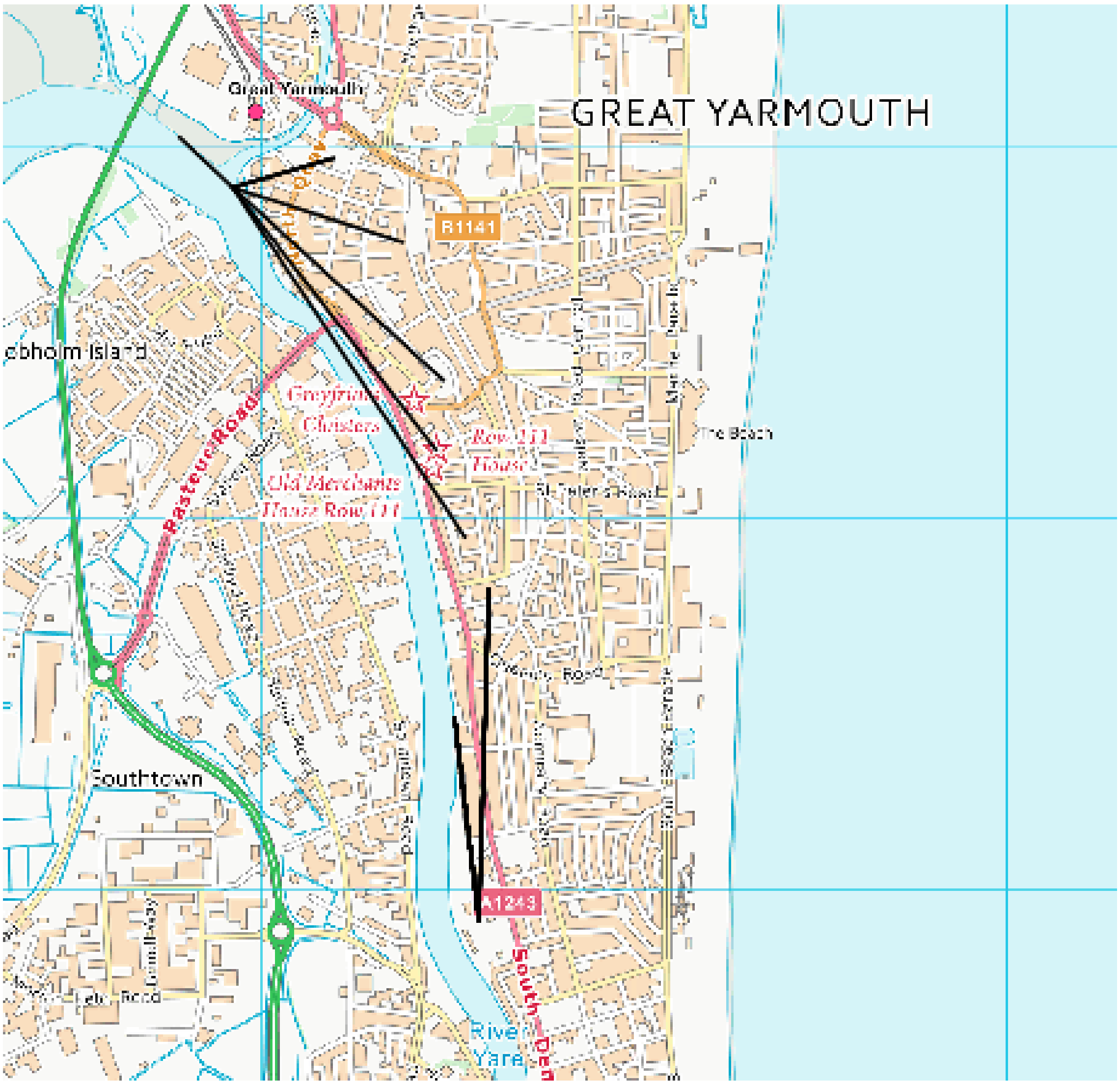
Warning Description	Total	Serious
Ratio of DM to DS travel time lower than limit (DM time < DM time)	88	0
Ratio of DM to DS travel time higher than limit (DM time > DS time)	70,110	1,196
Ratio of DM to DS travel distance lower than limit (DM dist < DS dist)	52	0
Ratio of DM to DS travel distance higher than limit (DM dist > DS dist)	45,196	45,196
DM speeds less than limit for the following	42	0
DS speeds less than limit for the following	0	0
Total Warnings	**115,488**	**46,392**

The checks of the above TUBA warnings are summarised below.

Ratio of DM to DS travel time lower than limit

These warnings occur when the travel time is higher in the Do Something than in the Do Minimum. The origins and destinations of these warnings are illustrated in Figure 3-4.

Figure 3-4 Ratio of DM to DS travel time lower than limit



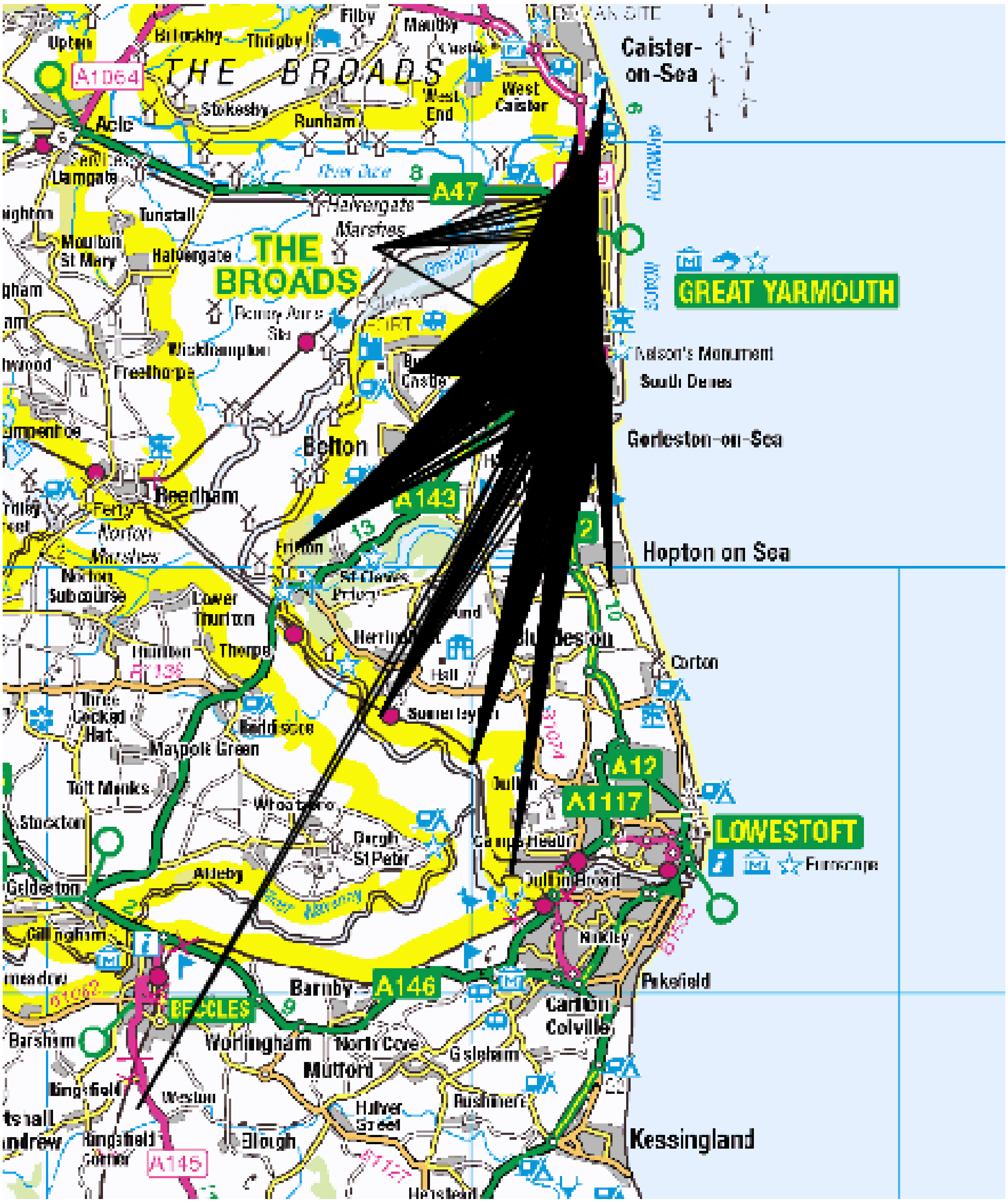
It is of note that all of these warnings apply to relatively short trips with all having a journey time of less than 7 minutes. With trips of this nature small absolute differences can flag up a warning within TUBA.

A number of these warnings apply to short distance trips which pass through the new traffic signal junction at the eastern end of the new bridge. Additional delay incurred by trips here results in an increase in journey times in the Do Something. The remaining warnings can be attributed to small increases in delay at isolated locations as a result of traffic rerouting in the Do Something

Ratio of DM to DS travel time higher than limit

This type of warning is the most common returned by the TUBA run. It occurs when travel times are lower in the Do Something when compared to the Do Minimum. In this instance a number of these warnings are expected as journey times are generally expected to reduce as a result of the scheme. The origins and destinations of these warnings are illustrated in Figure 3-5

Figure 3-5 Ratio of DM to DS travel time higher than limit



The majority of these warnings have origins or destinations on the peninsula and can be attributed to trips rerouting to the new bridge thus benefitting from journey time savings. Other warnings relate to trips which also benefit from journey time savings due to a reduction in congestion at various locations as a result of trips using the scheme.

Ratio of DM to DS travel distance lower than limit

The small number of warnings relate to trips which increase in distance in the Do Something compared to the Do Minimum. The origins and destinations of these warnings are illustrated in Figure 3-6.

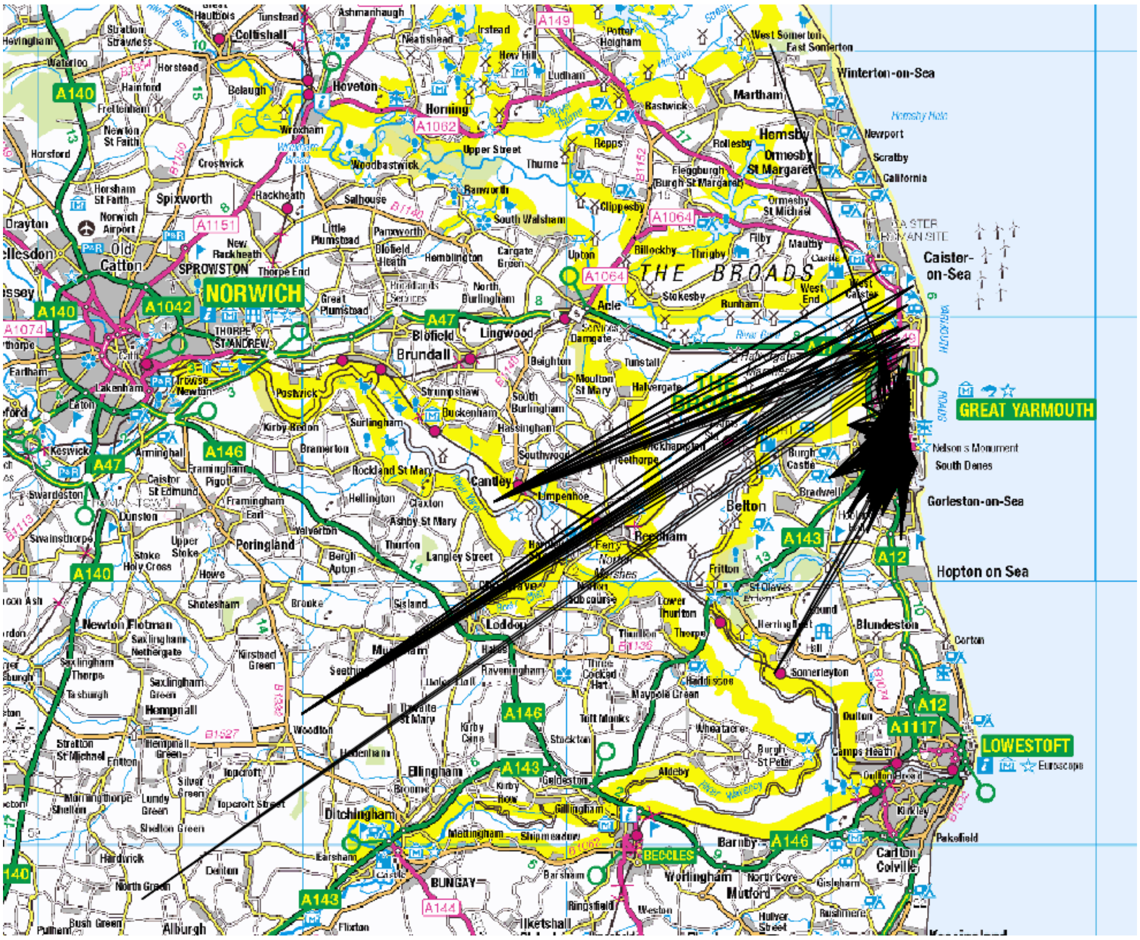
Figure 3-6 Ratio of DM to DS travel distance lower than limit

Similarly to warnings where journey times increase it is of note that these warning all relate to relatively short distance trips (all under 5km). These warnings all relate to trips in the vicinity of the A47 corridor. The increases in distance can be attributed to trips switching to the higher speed A47 from more direct local routes.

Ratio of DM to DS travel distance lower than limit

A high number of these warnings were returned as part of the TUBA run. These warnings occur when travel distances are lower in the Do Something when compared to the Do Minimum. In this instance a number of these warnings are expected as journey times are generally expected to reduce as a result of the scheme. The origins and destinations of these warnings are illustrated in Figure 3-7.

Figure 3-7 Ratio of DM to DS travel distance higher than limit



The majority of these warnings have origins or destinations on the peninsula and can be attributed to trips rerouting to the new bridge thus benefitting from a reduction in journey time distance. Other warnings, relating to longer distance between Great Yarmouth and other destinations in Norfolk, can be attributed to trips switching from the A47 to the A143 as a result of the result of a reduction in congestion afforded by the scheme.

DM Speeds lower than limit

These warnings occur when average journey speeds are very low. The origins and destinations of these warnings are illustrated in Figure 3-8.

Figure 3-8 DM Speed less than limit

It can be seen that these warnings relate to short distance trips with the urban area. The trips all pass through at least one set of traffic signals. Delays incurred at these junctions combined with the short journey distance result in very low average speeds. It is also of note that all these warnings occur in the 2051 model when congestion and delays are the highest.

Summary

Investigation of all the warnings show that they are sensible with nearly all the warnings associated with the introduction of the proposed bridge (i.e. faster travel time and shorter travel distance of traffic currently travelling from/to and across the study area).

4 TUBA Benefits – VDM Core Scenario

For the purpose of this note, TUBA benefits for the fixed demand models and other scenarios will be reported at a high level summary, this section only reports in detailed the TUBA benefits for the VDM Core scenario.

4.1 Transport Economic Efficiency Benefits

Table 4-1 below provides a summary of the Transport Economic Efficiency of the proposed scheme.

Table 4-1 Transport Economic Efficiency Table

Economic Efficiency of the Transport System (TEE)								
Non-business: Commuting	**ALL MODES**		**ROAD**		**BUS/COACH**	**RAIL**		**OTHER**
User benefits	**TOTAL**		**Private Cars/LGVs**		**Passengers**	**Passengers**		
Travel Time	60,952		60,952		0	0		0
Vehicle operating costs	1,418		1,418		0	0		0
User charges	0		0		0	0		0
During Construction & Maintenance	0		0		0	0		0
NET NON-BUSINESS BENEFITS: COMMUTING	**62,370**	*(1a)*	**62,370**		**0**	**0**		**0**
Non-business: Other	**ALL MODES**		**ROAD**		**BUS/COACH**	**RAIL**		**OTHER**
User benefits	**TOTAL**		**Private Cars/LGVs**		**Passengers**	**Passengers**		
Travel time	139,275		139,275		0	0		0
Vehicle operating costs	4,765		4,765		0	0		0
User charges	0		0		0	0		0
During Construction & Maintenance	0		0		0	0		0
NET NON-BUSINESS BENEFITS: OTHER	**144,040**	*(1b)*	**144,040**		**0**	**0**		**0**
Business			**ROAD**		**BUS/COACH**	**RAIL**		**OTHER**
User benefits	**TOTAL**		**Goods Vehicles**	**Business Cars/LGVs**	**Passengers**	**Freight**	**Passengers**	
Travel time	107,065		85,838	21,227	0	0	0	0
Vehicle operating costs	15,567		13,032	2,535	0	0	0	0
User charges	0		0	0	0	0	0	0
During Construction & Maintenance	0		0	0	0	0	0	0
Subtotal	**122,632**	*(2)*	**98,870**	**23,762**	**0**	**0**	**0**	**0**
Private sector provider impacts						**Freight**	**Passengers**	
Revenue	0							
Operating costs	0							
Investment costs	0							
Grant/subsidy	0							
Subtotal	**0**	*(3)*			**0**	**0**	**0**	**0**
Other business impacts								
Developer contributions	0	*(4)*						
NET BUSINESS IMPACT	**122,632**	*(5) = (2) + (3) + (4)*						
TOTAL								
Present Value of Transport Economic Efficiency Benefits (TEE)	**329,042**	*(6) = (1a) + (1b) + (5)*						

Notes: Benefits appear as positive numbers, while costs appear as negative numbers.
All entries are discounted present values, in 2010 prices and values (£,000s)

Overall, the scheme produces substantial benefits, about £329m over the 60 years appraisal period. The benefits are generated by travel time savings of £307m and vehicle operating costs of £22m. It is noted that the impacts during constructions and maintenance are not assessed for the proposed scheme. The benefits of the vehicle operating costs are anticipated as the proposed scheme promotes shorter travel distance via the new bridge as opposed to travelling on the A12 to cross the existing bridges to the Peninsula.

4.2 Spatial Distribution of Benefits

As stated in the previous section, sector analysis was undertaken to gain a better understanding of the journeys that generate the greatest benefits. The transport model zones were grouped into 10 sectors representing broad geographic areas.

Sector analysis provides an important check on whether or not the model produces plausible forecasts of the future year travel demand. It also shows the extent to which model "noise" is potentially having an impact on the results produced by TUBA. This is usually identified by counter intuitive benefits/dis-benefits for movements across the study area that are not expected to be affected by the scheme (e.g. external-external movements that do not pass through or within the influence of the scheme).

The sector analysis of the transport user benefits for each of the forecast years and over the appraisal period is presented in Tables 4-2 to 4-5 with the origin/destination benefits is presented in Figure 4-1 below.

Table 4-2 User Benefits at Sector Level - 2023

Sec	1	2	3	4	5	6	7	8	9	10	Orig
1	-4	-9	-1	145	15	-0	415	-1	-3	-3	554
2	16	6	1	18	2	0	90	2	3	2	140
3	13	10	-	5	-	-	48	0	0	5	82
4	229	39	9	1	1	35	8	22	12	116	473
5	27	7	0	1	-	0	6	0	0	11	54
6	6	2	-	5	0	-	34	0	0	2	51
7	925	224	73	22	4	41	208	127	86	477	2,187
8	11	4	0	8	0	0	36	-0	1	5	65
9	3	2	0	4	0	0	21	0	0	2	32
10	-1	-0	1	15	3	1	62	0	-1	0	80
Dest	1,226	286	82	223	25	78	928	152	100	618	3,717

Table 4-3 User Benefits at Sector Level - 2038

Sec	1	2	3	4	5	6	7	8	9	10	Orig
1	-4	-12	-5	111	12	-3	327	-8	-7	-9	403
2	7	14	-3	21	1	-3	109	-3	1	5	149
3	33	33	-	18	0	-0	176	2	2	26	289
4	234	74	11	1	1	36	5	45	31	141	578
5	29	12	0	2	0	0	20	1	1	15	81
6	13	16	-0	20	0	-0	121	1	1	11	184
7	929	361	123	23	7	73	396	201	179	630	2,922
8	13	17	1	17	0	1	88	0	2	16	156
9	0	7	1	6	0	1	53	0	-0	4	71
10	-0	-2	-5	16	2	-1	88	-8	-4	-1	85
Dest	1,254	520	123	235	23	103	1,382	232	205	838	4,916

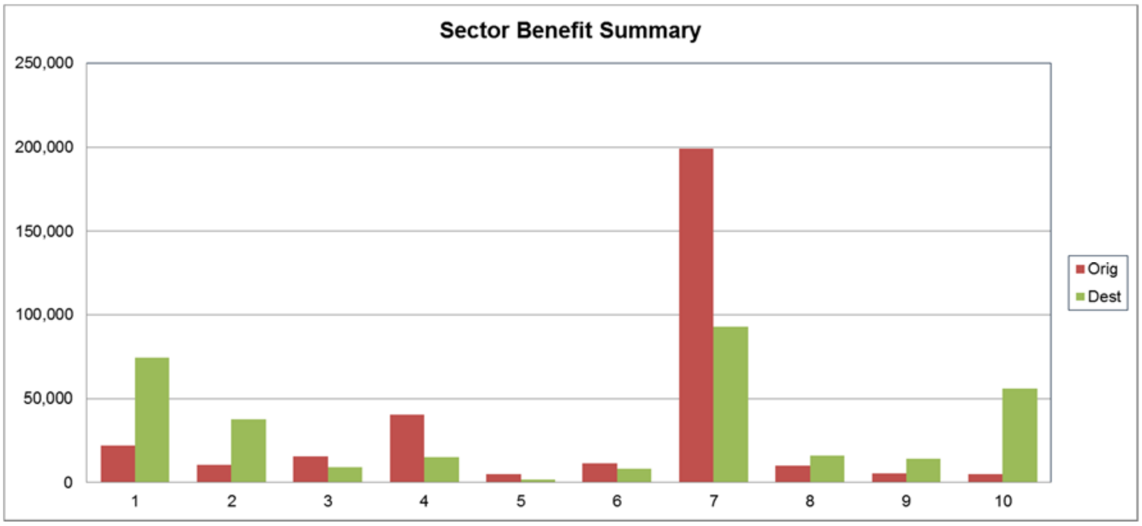
Table 4-4 User Benefits at Sector Level - 2051

Sec	1	2	3	4	5	6	7	8	9	10	Orig
1	-4	-15	-7	112	12	-4	318	-14	-13	-11	374
2	3	17	-2	37	2	-4	179	-11	-8	7	220
3	34	32	-	18	0	-0	201	2	3	29	320
4	270	120	17	1	1	43	79	65	51	197	844
5	33	16	0	2	0	0	29	1	1	20	103
6	16	23	-0	24	0	-0	154	1	2	15	233
7	1,042	605	196	42	14	145	622	301	288	871	4,126
8	12	24	1	28	1	1	130	1	3	18	219
9	-1	10	1	12	0	1	92	-0	-1	5	119
10	-5	-7	-7	26	3	-3	122	-15	-12	-2	99
Dest	1,399	825	199	302	34	179	1,926	333	314	1,149	6,659

Table 4-5 User Benefits at Sector Level – Appraisal Period

Sec	1	2	3	4	5	6	7	8	9	10	Orig
1	-228	-755	-313	6,384	687	-176	18,371	-611	-584	-520	22,256
2	311	843	-128	1,726	101	-182	8,321	-419	-233	320	10,662
3	1,705	1,623	-	916	2	-0	9,863	92	119	1,400	15,720
4	14,157	5,464	816	28	74	2,223	2,775	3,070	2,300	9,652	40,559
5	1,716	757	3	119	0	10	1,361	61	51	988	5,066
6	773	1,025	-1	1,183	4	-0	7,482	48	73	676	11,263
7	55,529	27,558	9,062	1,887	598	6,505	28,554	14,195	13,108	42,370	199,367
8	670	1,078	45	1,279	24	36	6,047	36	111	882	10,209
9	-1	444	36	517	16	25	4,096	-7	-30	228	5,325
10	-198	-276	-318	1,242	142	-125	5,866	-619	-494	-91	5,130
Dest	74,436	37,763	9,201	15,282	1,649	8,315	92,738	15,846	14,423	55,905	325,557

Figure 4-1 User Benefits by Sector



As can be seen, the majority of the benefits are from/to sector 7 (south of Great Yarmouth), to the Peninsula (sector 1 and 10). It is noted that the benefits is not symmetrical with higher benefits are claimed for northbound direction as opposed to southbound direction. This is anticipated as the major sources of delays on the network are on the A12 northbound approach at the Harfreys and Gapton roundabout, therefore the proposed scheme relieves congestion on the network would be expected to be toward Great Yarmouth or north bounded.

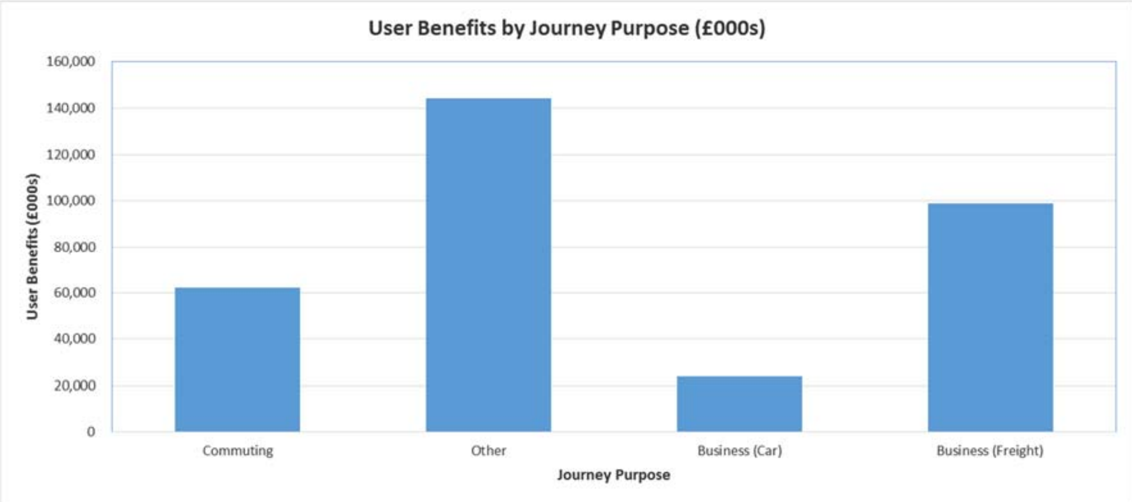
4.3 User Benefits by Purposes

Table 4-6 and Figure 4-2 provide summaries of the user benefits by journey purposes.

Table 4-6 User Benefits by Journey Purposes (£000s)

Purpose	Travel Time	Vehicle Operating Cost	Total	Proportion
Commuting	60,952	1,418	62,370	19.0%
Other	139,275	4,765	144,040	43.8%
Business (Car)	21,227	2,535	23,762	7.2%
Business (Freight)	85,838	13,032	98,870	30.0%
Total	**307,292**	**21,750**	**329,042**	**100.0%**

Figure 4-2 User Benefits by Purposes



Analysis of user benefits show that the majority of the benefits produced by the scheme is attributed to Others and Freights, with 44% and 30% respectively. This is anticipated given the nature of the area (i.e. to serve as major attractions for tourism and also fore freight).

4.4 User Benefits by Time Periods

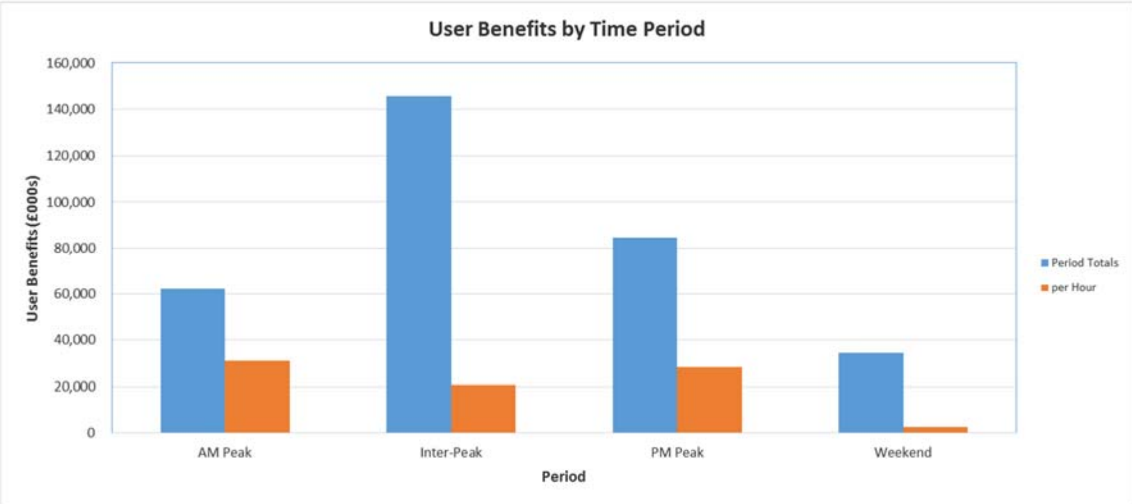
Table 4-7 and Figure 4-3 provide summaries of the user benefits by time periods.

Table 4-7 User Benefits by Time Period (£000s)

Period	Type	2023	2038	2051	60 years
AM Period	Time Savings	612	973	1,153	58,244
	VOC	89	75	75	3,877
	Total	**701**	**1,048**	**1,228**	**62,121**
	per Hour	*351*	*524*	*614*	*31,061*
Inter-Peak Period	Time Savings	1,506	1,780	2,831	134,354
	VOC	392	202	193	11,161
	Total	**1,898**	**1,982**	**3,024**	**145,515**

Period	Type	2023	2038	2051	60 years
	per Hour	*271*	*283*	*432*	*20,788*
PM Period	Time Savings	693	1,364	1,615	80,342
	VOC	94	76	83	4,155
	Total	**787**	**1,440**	**1,698**	**84,497**
	per Hour	*262*	*480*	*566*	*28,166*
Weekend	Time Savings	386	455	724	34,351
	VOC	90	47	44	2,558
	Total	**476**	**502**	**768**	**36,909**
	per Hour	*159*	*167*	*256*	*12,303*
Total	Time Savings	3,197	4,572	6,323	307,291
	VOC	665	400	395	21,751
	Total	**3,862**	**4,972**	**6,718**	**329,042**

Figure 4-3 User Benefits by Time Period



The user benefits increase over the forecast years consistently across all the time periods. The order of magnitude of benefits by time periods are plausible with the highest benefits per hour attributed to the AM and PM peak. It is anticipated as level of delays in the AM and PM peak are significantly higher than those in the Inter-peak or weekend period.

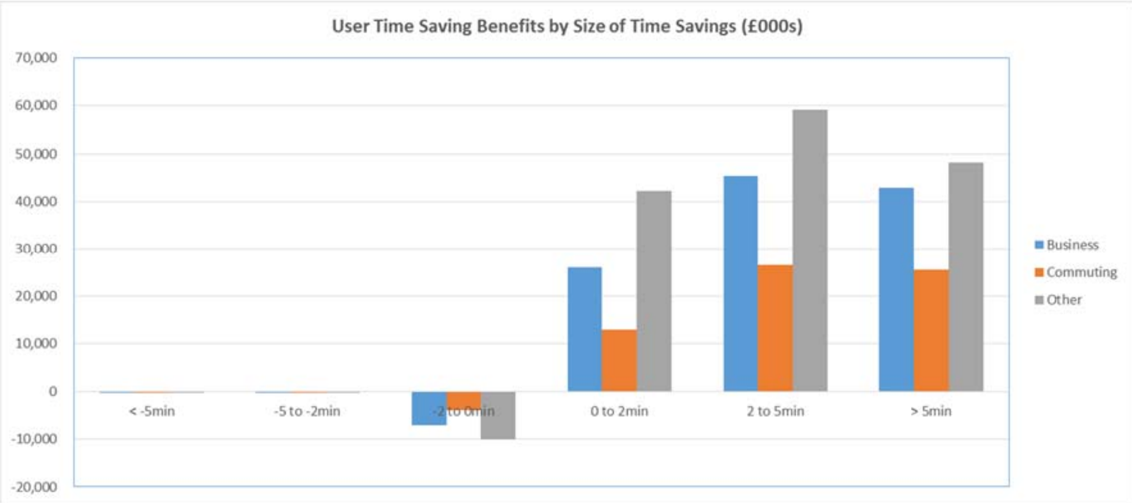
4.5 User Benefits by Size of Time Savings

Table 4-8 and Figure 4-4 provide summaries of the user benefits by size of time savings

Table 4-8 User Benefits by Size of Time Savings (£000s)

Veh. Type	Purpose	< -5min	-5 to -2min	-2 to 0min	0 to 2min	2 to 5min	> 5min	Total
Car	Business	0	-24	-1,205	6,107	9,878	6,471	**21,227**
Car	Commuting	-1	-205	-3,800	12,868	26,475	25,615	**60,952**
Car	Other	0	-205	-9,699	41,145	57,313	46,335	**134,889**
LGV	Personal	-4	-3	-293	1,009	1,838	1,839	**4,386**
LGV	Freight	-65	-46	-4,568	15,666	28,720	28,875	**68,582**
OGV1	Business	-2	-3	-530	1,703	2,709	3,024	**6,901**
OGV2	Business	-3	-4	-795	2,555	4,063	4,537	**10,353**
Total		**-75**	**-490**	**-20,890**	**81,053**	**130,996**	**116,696**	**307,290**

Figure 4-4 User Benefits by Size of Time Saving



The majority of the benefits are from all the time saving bands, which is anticipated as the objectives of the new bridge is to shorter travel time and distance of traffic to/from the Peninsula and also relieve congestion that currently an issue on the A12 at Gapton and Harfreys roundabouts. It is noted that a small proportion of the dis-benefits resulted by the scheme, which is also anticipated as some of the local traffic would suffer more delays as increase in traffic in the Peninsula as a result of the traffic re-assignment.

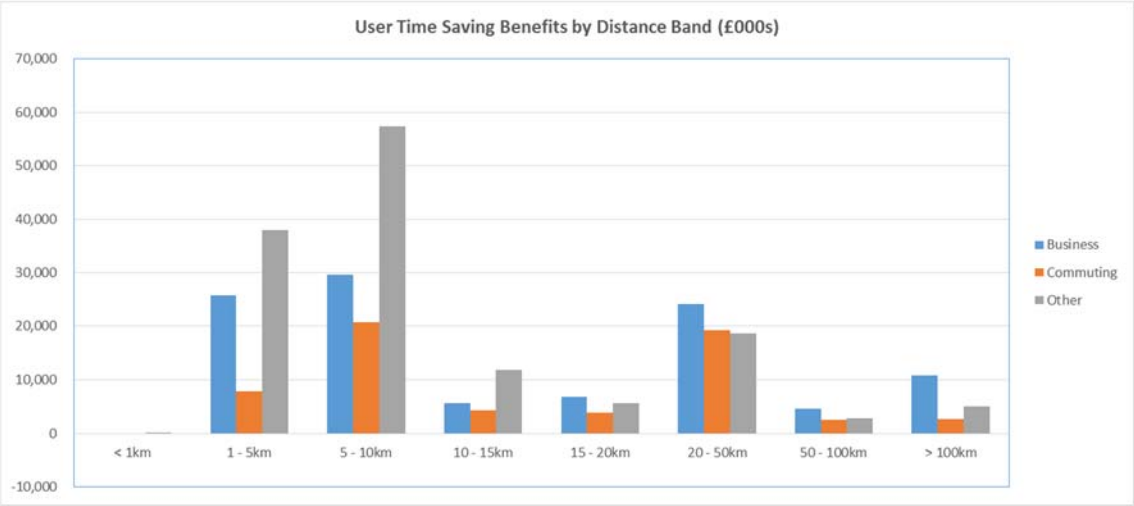
4.6 User Benefits by Travelled Distance

Table 4-9 and Figure 4-5 provide summaries of the user benefits by travelled distance.

Table 4-9 User Benefits by Size of Time Savings (£000s)

Veh Type	Purpose	< 1km	1 - 5km	5 - 10km	10 - 15km	15 - 20km	20 - 50km	50 - 100km	> 100km	Total
Car	Business	-2	4,153	5,049	765	1,196	5,954	1,621	2,491	**21,227**
Car	Commuting	-22	7,822	20,629	4,332	3,781	19,261	2,553	2,597	**60,953**
Car	Other	36	36,685	56,101	11,474	5,276	17,933	2,755	4,630	**134,890**
LGV	Other	0	1,261	1,301	286	311	750	96	380	**4,385**
LGV	Business	-2	19,591	20,311	4,495	4,873	11,804	1,517	5,994	**68,583**
OGV1	Business	0	773	1,658	144	281	2,549	600	896	**6,901**
OGV2	Business	0	1,160	2,488	216	421	3,824	900	1,345	**10,354**
Total	**Total**	**10**	**71,445**	**107,537**	**21,712**	**16,139**	**62,075**	**10,042**	**18,333**	**307,293**

Figure 4-5 User Benefits by Travelled Distance

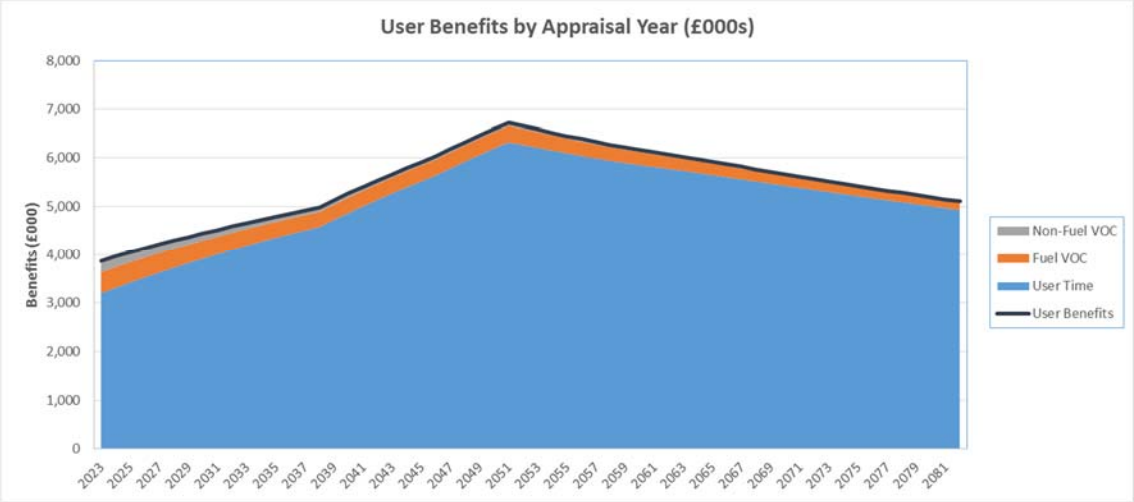


The majority of the benefits produced by the scheme are local traffic with travel distance ranges from 1-5km and from 5-10km. It is also noted that a modest amount of benefits are from the distance range 20-50km (such as from Norwich to Great Yarmouth or Lowestoft to Great Yarmouth).

4.7 User Benefits Profile

Figure 4-6 below provides a summary of the user benefits over the 60 year appraisal period.

Figure 4-6 User Benefits over 60 year appraisal period



The user benefits over 60 year appraisal periods show that the benefits increase during the modelled years up to 2051 before declining to the end of the appraisal period. The increase in benefits is anticipated as the increase in demand and value of time from the opening year 2023 to the last modelled year 2051. After the last modelled year, traffic growth assumes flat and only the impact of growth in value of time was included in the TUBA analysis. With the impact of discounting to the base 2010 prices and values, the benefits are reduced over time post 2015 to the end of the appraisal period.

5 TUBA benefits for Fixed Demand Model and Other scenarios

As stated in the previous chapter, the benefits for the fixed demand model assignments and other test scenarios for the Variable demand model assignments are only reported in high level.

Table 5-1 below provides a summary of the TUBA benefits for the Fixed demand assignments and other scenarios forecasts.

Table 5-1 Summary of TUBA Benefits – Other Scenarios

Element	Core	Core + Harfreys (DS)	Low	High	Core	Core + Harfreys (DS)	Low	High
Transport Efficiency								
Consumer User (Commute)	114,640	123,724	70,843	160,895	62,370	69,824	45,730	81,221
Consumer User (Other)	295,733	317,050	171,048	444,784	144,040	162,061	104,352	191,105
Business User and Provider	220,699	234,648	133,477	321,205	122,632	134,262	88,885	164,526
Indirect Tax Revenue	-14,393	-15,316	-8,816	-21,700	-3,485	-3,870	-3,049	-3,940
Greenhouse Gas	8,183	8,713	4,722	12,430	1,827	2,036	1,443	2,115
Present Value of Benefits (PVB)	**624,862**	**668,819**	**371,274**	**917,614**	**327,384**	**364,313**	**237,361**	**435,027**

6 TUBA Benefits with Inclusion of Summer Traffic

6.9 Introduction

As stated in section 3.13, the annualisation factors adopted for the calculation of the benefits for the proposed scheme were derived from data collected during November. This count data was normalised to the annual average weekday during the development of the base year models, and the methodology adopted takes into account the accrual of weekday benefits throughout the year at the level of an average neutral weekday.

However, the methodology adopted does not take into account additional benefits associated with seasonal variations in traffic across the whole year. More specifically, given the nature and geographical location of the study area, it is anticipated that increased traffic levels at weekends and bank holidays during non-neutral holiday periods would result in significant additional potential benefits.

This chapter describes an enhanced methodology which captures elements of these additional benefits by taking better account of seasonal variations in traffic at weekend and bank holidays.

6.10 Enhanced Annualisation Factors

Analysis of data from the two permanent WebTRIS sites on the A12 and A47 within Great Yarmouth for the whole year 2015 demonstrates that there are a high number of hours during summer weekend and bank holiday periods where traffic volume is greater than or similar to the inter-peak traffic volumes derived using the November data - 717 hours can be claimed to account for summer weekends and bank holidays compared with the 419 weekend hours that is currently adopted for the TUBA calculation.

Sensitivity tests were therefore undertaken with the inclusion of the additional hours for weekends and bank holidays in order to produce updated TUBA benefits. Table 6-1 below provides a summary of the TUBA benefits with the additional hours of weekend and bank holidays.

6.11 Summary

The inclusion of additional hours to account for summer weekends and bank holidays produces approximately 6% additional TUBA benefits compared with the values reported in Chapter 5.

However, it is acknowledged that the available traffic data on which this enhanced methodology has been based is limited and taken from just two sites on the strategic road network.

Therefore it is not considered that this provides sufficient level of assurance to be included in the core case, but rather this will be presented as a sensitivity test within the Economic Appraisal Report.

Table 6-1 Summary of TUBA Benefits with Additional Hours Included

Element	Core	Core + Harfreys (DS)	Low	High	Core	Core + Harfreys (DS)	Low	High
Transport Efficiency								
Consumer User (Commute)	119,769	129,149	73,634	169,080	65,083	72,812	47,597	85,119
Consumer User (Other)	324,229	347,116	186,385	490,649	157,684	177,129	113,834	210,163
Business User and Provider	239,002	253,833	143,812	350,085	132,525	144,951	95,802	178,416
Indirect Tax Revenue	-15,434	-16,396	-9,433	-23,390	-3,806	-4,209	-3,347	-4,270
Greenhouse Gas	8,776	9,330	5,043	13,418	1,986	2,204	1,577	2,279
Present Value of Benefits (PVB)	**676,342**	**723,032**	**399,441**	**999,842**	**353,472**	**392,887**	**255,463**	**471,707**