TUBA METHODOLOGY TECHNICAL NOTE

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Subject: TUBA Methodology and Annualisation Factors

Project: Great Yarmouth Third River Crossing

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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.

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.

Estimation of Transport Economic Efficiency Benefits

TUBA 1.9.13 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 May 2019. 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 May 2019.

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.

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.

ESTIMATION OF SCHEME COSTS

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.

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. This process is covered in detail in the Scheme Costs Technical Note (Supporting Document 6).

TRANSPORT USER BENEFITS FOR GYTRC

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.

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: v1.9.13 (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

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.

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*

*0-1*below provides the correspondence between the model's user classes and the TUBA vehicle types/purposes with the associated conversion factors.

Table 0-1 Model and TUBA User Classes

Model User Class	TUBA User Class	TUBA Veh/Submode	TUBA Purpose	TUBA 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

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.

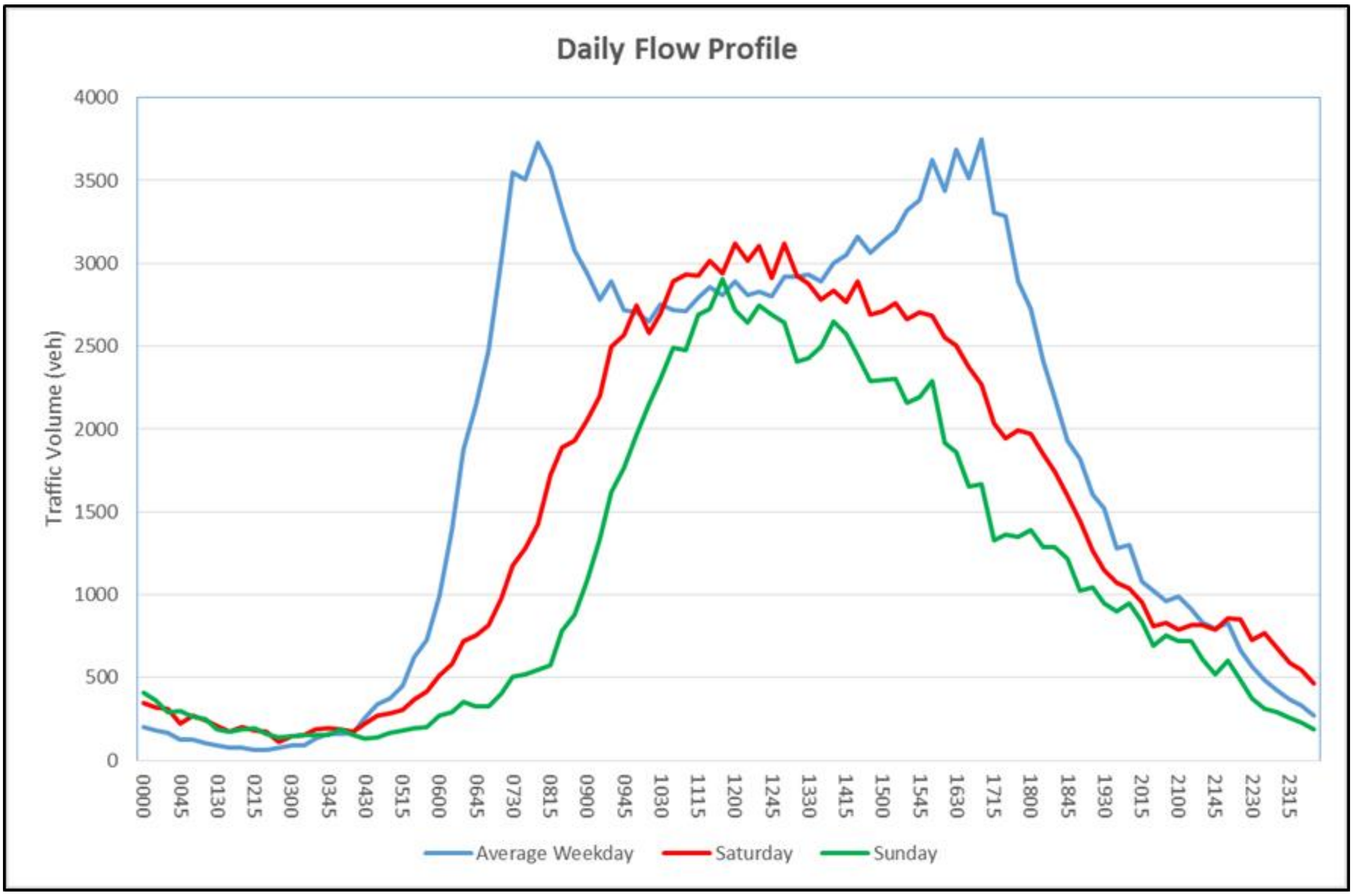
It is common practice that the peak shoulder traffic exceeding 90% of that in the peak hour should be included in the derivation of the annualisation factors as the change in travel time between the Do-Minimum and Do-Something in the peak shoulders would be close to the changes experienced in the peak 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 0-1 below shows the locations of the 9 ATC counts and *Figure 0-2* provides a summary of the traffic daily profile that was produced from the sites.

Figure 0-1 Location of ATC Counts

Figure 0-2 Traffic Flow Profile



As can be seen from the *Figure 0-2*, 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.

Table 0-2 to *Table 0-4* 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 0-2 Derivation of Annualisation Factors – Weekday Traffic

Period	Hour	Volume	Donor Model	Factor / Donor	Include	Period	Hour	Volume	Donor Model	Factor / Donor	Include
AM	700	2,479	IP	0.86	×	OP	1900	1,819	IP	0.63	×
AM	715	3,015	IP	1.04	✓	OP	1915	1,603	IP	0.55	×
AM	730	3,547	AM	1.04	✓	OP	1930	1,525	IP	0.53	×
AM	745	3,508	AM	1.02	✓	OP	1945	1,282	IP	0.44	×
AM	800	3,728	AM	1	✓	OP	2000	1,301	IP	0.45	×
AM	815	3,574	AM	1	✓	OP	2015	1,078	IP	0.37	×
AM	830	3,328	AM	1	✓	OP	2030	1,022	IP	0.35	×
AM	845	3,078	AM	1	✓	OP	2045	966	IP	0.33	×
AM	900	2,939	IP	1.02	✓	OP	2100	989	IP	0.34	×

AM	915	2,779	IP	0.96	✓	OP	2115	914	IP	0.32	×
AM	930	2,893	IP	1	✓	OP	2130	834	IP	0.29	×
AM	945	2,720	IP	0.94	✓	OP	2145	799	IP	0.28	×
IP	1000	2,708	IP	1	✓	OP	2200	833	IP	0.29	×
IP	1015	2,649	IP	1	✓	OP	2215	666	IP	0.23	×
IP	1030	2,750	IP	1	✓	OP	2230	570	IP	0.2	×
IP	1045	2,718	IP	1	✓	OP	2245	484	IP	0.17	×
IP	1100	2,711	IP	1	✓	OP	2300	426	IP	0.15	×
IP	1115	2,792	IP	1	✓	OP	2315	371	IP	0.13	×
IP	1130	2,855	IP	1	✓	OP	2330	333	IP	0.12	×
IP	1145	2,805	IP	1	✓	OP	2345	269	IP	0.09	×
IP	1200	2,895	IP	1	✓	OP	0	200	IP	0.07	×
IP	1215	2,808	IP	1	✓	OP	15	184	IP	0.06	×
IP	1230	2,827	IP	1	✓	OP	30	168	IP	0.06	×
IP	1245	2,799	IP	1	✓	OP	45	127	IP	0.04	×
IP	1300	2,918	IP	1	✓	OP	100	126	IP	0.04	×
IP	1315	2,917	IP	1	✓	OP	115	106	IP	0.04	×
IP	1330	2,932	IP	1	✓	OP	130	91	IP	0.03	×
IP	1345	2,893	IP	1	✓	OP	145	80	IP	0.03	×
IP	1400	2,999	IP	1	✓	OP	200	78	IP	0.03	×
IP	1415	3,054	IP	1	✓	OP	215	67	IP	0.02	×
IP	1430	3,159	IP	1	✓	OP	230	66	IP	0.02	×
IP	1445	3,065	IP	1	✓	OP	245	79	IP	0.03	×
IP	1500	3,136	IP	1	✓	OP	300	90	IP	0.03	×
IP	1515	3,196	IP	1	✓	OP	315	88	IP	0.03	×
PM	1530	3,320	PM	0.93	✓	OP	330	133	IP	0.05	×
PM	1545	3,381	PM	0.95	✓	OP	345	158	IP	0.05	×
PM	1600	3,624	PM	1.02	✓	OP	400	159	IP	0.06	×
PM	1615	3,439	PM	0.97	✓	OP	415	170	IP	0.06	×
PM	1630	3,683	PM	1.03	✓	OP	430	255	IP	0.09	×
PM	1645	3,516	PM	0.99	✓	OP	445	338	IP	0.12	×
PM	1700	3,751	PM	1.05	✓	OP	500	376	IP	0.13	×
PM	1715	3,304	PM	0.93	✓	OP	515	453	IP	0.16	×
PM	1730	3,287	PM	0.92	✓	OP	530	626	IP	0.22	×
PM	1745	2,891	IP	1	✓	OP	545	730	IP	0.25	×
PM	1800	2,723	IP	0.94	✓	OP	600	990	IP	0.34	×
PM	1815	2,404	IP	0.83	×	OP	615	1,391	IP	0.48	×
OP	1830	2,186	IP	0.76	×	OP	630	1,878	IP	0.65	×
OP	1845	1,930	IP	0.67	×	OP	645	2,147	IP	0.74	×

Table 0-3 Derivation of Annualisation Factors - Saturday Traffic

Period	Hour	Volume	Donor Model	Factor / Donor	Include	Period	Hour	Volume	Donor Model	Factor / Donor	Include
AM	700	817	IP	0.28	×	OP	1900	1,449	IP	0.5	×

AM	715	975	IP	0.34	×	OP	1915	1,270	IP	0.44	×
AM	730	1,178	IP	0.41	×	OP	1930	1,152	IP	0.4	×
AM	745	1,283	IP	0.44	×	OP	1945	1,070	IP	0.37	×
AM	800	1,423	IP	0.49	×	OP	2000	1,036	IP	0.36	×
AM	815	1,723	IP	0.6	×	OP	2015	957	IP	0.33	×
AM	830	1,892	IP	0.65	×	OP	2030	812	IP	0.28	×
AM	845	1,929	IP	0.67	×	OP	2045	832	IP	0.29	×
AM	900	2,056	IP	0.71	×	OP	2100	793	IP	0.27	×
AM	915	2,200	IP	0.76	×	OP	2115	815	IP	0.28	×
AM	930	2,499	IP	0.86	×	OP	2130	820	IP	0.28	×
AM	945	2,564	IP	0.89	×	OP	2145	792	IP	0.27	×
IP	1000	2,744	IP	0.95	✓	OP	2200	862	IP	0.3	×
IP	1015	2,583	IP	0.89	×	OP	2215	852	IP	0.29	×
IP	1030	2,696	IP	0.93	✓	OP	2230	731	IP	0.25	×
IP	1045	2,894	IP	1	✓	OP	2245	769	IP	0.27	×
IP	1100	2,930	IP	1.01	✓	OP	2300	678	IP	0.23	×
IP	1115	2,929	IP	1.01	✓	OP	2315	586	IP	0.2	×
IP	1130	3,014	IP	1.04	✓	OP	2330	546	IP	0.19	×
IP	1145	2,939	IP	1.02	✓	OP	2345	465	IP	0.16	×
IP	1200	3,117	IP	1.08	✓	OP	0	348	IP	0.12	×
IP	1215	3,013	IP	1.04	✓	OP	15	323	IP	0.11	×
IP	1230	3,108	IP	1.08	✓	OP	30	314	IP	0.11	×
IP	1245	2,913	IP	1.01	✓	OP	45	223	IP	0.08	×
IP	1300	3,123	IP	1.08	✓	OP	100	273	IP	0.09	×
IP	1315	2,923	IP	1.01	✓	OP	115	241	IP	0.08	×
IP	1330	2,881	IP	1	✓	OP	130	210	IP	0.07	×
IP	1345	2,784	IP	0.96	✓	OP	145	174	IP	0.06	×
IP	1400	2,839	IP	0.98	✓	OP	200	204	IP	0.07	×
IP	1415	2,768	IP	0.96	✓	OP	215	181	IP	0.06	×
IP	1430	2,892	IP	1	✓	OP	230	172	IP	0.06	×
IP	1445	2,690	IP	0.93	✓	OP	245	110	IP	0.04	×
IP	1500	2,712	IP	0.94	✓	OP	300	147	IP	0.05	×
IP	1515	2,760	IP	0.95	✓	OP	315	155	IP	0.05	×
PM	1530	2,666	IP	0.92	✓	OP	330	190	IP	0.07	×
PM	1545	2,702	IP	0.93	✓	OP	345	198	IP	0.07	×
PM	1600	2,686	IP	0.93	✓	OP	400	186	IP	0.06	×
PM	1615	2,554	IP	0.88	×	OP	415	176	IP	0.06	×
PM	1630	2,502	IP	0.87	×	OP	430	225	IP	0.08	×
PM	1645	2,374	IP	0.82	×	OP	445	269	IP	0.09	×
PM	1700	2,269	IP	0.79	×	OP	500	282	IP	0.1	×
PM	1715	2,034	IP	0.7	×	OP	515	306	IP	0.11	×
PM	1730	1,947	IP	0.67	×	OP	530	369	IP	0.13	×
PM	1745	1,994	IP	0.69	×	OP	545	420	IP	0.15	×
PM	1800	1,972	IP	0.68	×	OP	600	510	IP	0.18	×
PM	1815	1,851	IP	0.64	×	OP	615	583	IP	0.2	×

OP	1830	1,742	IP	0.6	×	OP	630	723	IP	0.25	×
OP	1845	1,596	IP	0.55	×	OP	645	753	IP	0.26	×

Table 0-4 Derivation of Annualisation Factors - Sunday Traffic

Period	Hour	Volume	Donor Model	Factor / Donor	Include	Period	Hour	Volume	Donor Model	Factor / Donor	Include
AM	700	329	IP	0.11	×	OP	1900	1,022	IP	0.35	×
AM	715	400	IP	0.14	×	OP	1915	1,047	IP	0.36	×
AM	730	509	IP	0.18	×	OP	1930	951	IP	0.33	×
AM	745	520	IP	0.18	×	OP	1945	899	IP	0.31	×
AM	800	549	IP	0.19	×	OP	2000	949	IP	0.33	×
AM	815	575	IP	0.2	×	OP	2015	840	IP	0.29	×
AM	830	784	IP	0.27	×	OP	2030	692	IP	0.24	×
AM	845	879	IP	0.3	×	OP	2045	752	IP	0.26	×
AM	900	1,088	IP	0.38	×	OP	2100	718	IP	0.25	×
AM	915	1,338	IP	0.46	×	OP	2115	719	IP	0.25	×
AM	930	1,617	IP	0.56	×	OP	2130	609	IP	0.21	×
AM	945	1,766	IP	0.61	×	OP	2145	521	IP	0.18	×
IP	1000	1,965	IP	0.68	×	OP	2200	602	IP	0.21	×
IP	1015	2,150	IP	0.74	×	OP	2215	489	IP	0.17	×
IP	1030	2,305	IP	0.8	×	OP	2230	378	IP	0.13	×
IP	1045	2,491	IP	0.86	×	OP	2245	316	IP	0.11	×
IP	1100	2,479	IP	0.86	×	OP	2300	294	IP	0.1	×
IP	1115	2,693	IP	0.93	✓	OP	2315	256	IP	0.09	×
IP	1130	2,728	IP	0.94	✓	OP	2330	229	IP	0.08	×
IP	1145	2,902	IP	1	✓	OP	2345	188	IP	0.07	×
IP	1200	2,719	IP	0.94	✓	OP	0	411	IP	0.14	×
IP	1215	2,643	IP	0.91	✓	OP	15	361	IP	0.12	×
IP	1230	2,748	IP	0.95	✓	OP	30	289	IP	0.1	×
IP	1245	2,691	IP	0.93	✓	OP	45	302	IP	0.1	×
IP	1300	2,643	IP	0.91	✓	OP	100	264	IP	0.09	×
IP	1315	2,407	IP	0.83	×	OP	115	253	IP	0.09	×
IP	1330	2,429	IP	0.84	×	OP	130	191	IP	0.07	×
IP	1345	2,499	IP	0.86	×	OP	145	177	IP	0.06	×
IP	1400	2,650	IP	0.92	✓	OP	200	189	IP	0.07	×
IP	1415	2,572	IP	0.89	×	OP	215	196	IP	0.07	×
IP	1430	2,444	IP	0.85	×	OP	230	161	IP	0.06	×
IP	1445	2,290	IP	0.79	×	OP	245	143	IP	0.05	×
IP	1500	2,297	IP	0.79	×	OP	300	149	IP	0.05	×
IP	1515	2,307	IP	0.8	×	OP	315	151	IP	0.05	×
PM	1530	2,161	IP	0.75	×	OP	330	151	IP	0.05	×
PM	1545	2,193	IP	0.76	×	OP	345	157	IP	0.05	×

PM	1600	2,289	IP	0.79	×	OP	400	189	IP	0.07	×
PM	1615	1,916	IP	0.66	×	OP	415	153	IP	0.05	×
PM	1630	1,862	IP	0.64	×	OP	430	135	IP	0.05	×
PM	1645	1,654	IP	0.57	×	OP	445	140	IP	0.05	×
PM	1700	1,670	IP	0.58	×	OP	500	169	IP	0.06	×
PM	1715	1,326	IP	0.46	×	OP	515	181	IP	0.06	×
PM	1730	1,363	IP	0.47	×	OP	530	194	IP	0.07	×
PM	1745	1,349	IP	0.47	×	OP	545	204	IP	0.07	×
PM	1800	1,392	IP	0.48	×	OP	600	274	IP	0.09	×
PM	1815	1,289	IP	0.45	×	OP	615	289	IP	0.1	×
OP	1830	1,288	IP	0.45	×	OP	630	354	IP	0.12	×
OP	1845	1,218	IP	0.42	×	OP	645	329	IP	0.11	×

From the calculation set out in the *Table 0-2* to *Table 0-4* 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 0-5* below.

Table 0-5 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.

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

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 0-3* and description of each sector is provided in *Table 0-6* below.

Figure 0-3 Analysis Sector System

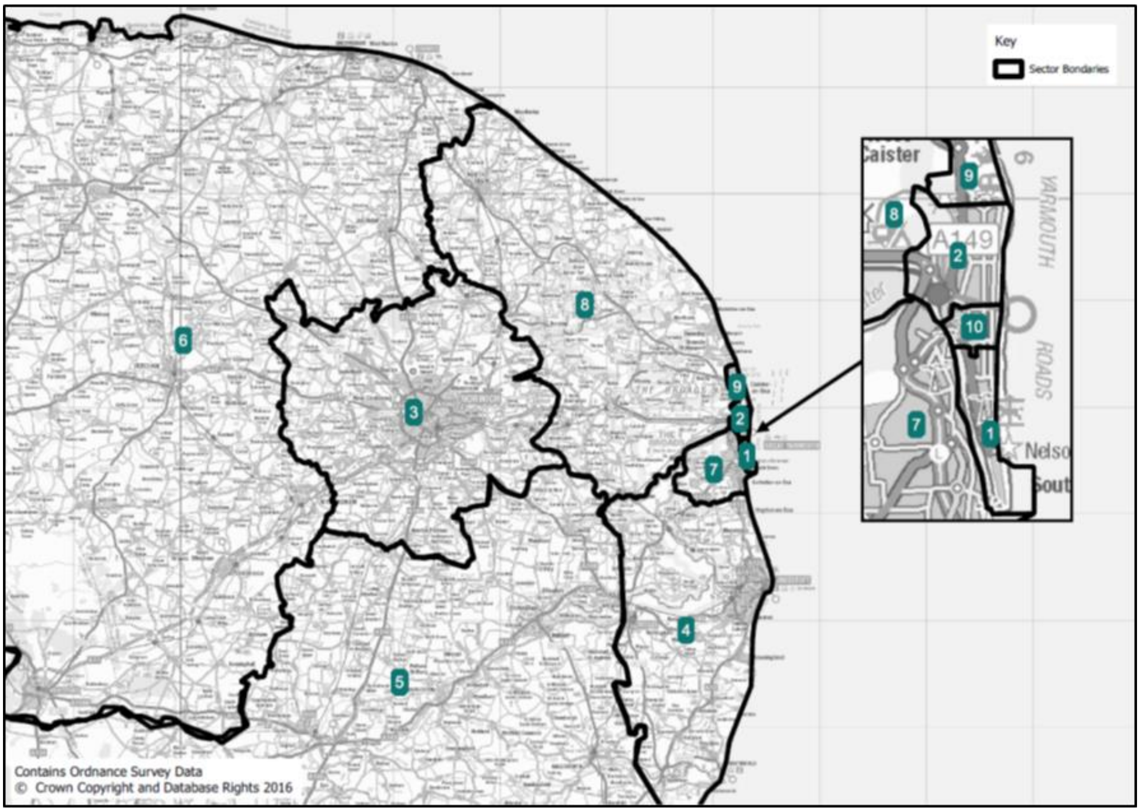


Table 0-6 Sector Description

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

TUBA Runs

TUBA assessments have been undertaken using the Variable Demand Models for the following scenarios:

- Core scenario;
- Low growth scenario;
- High growth scenario;
- Core scenario with alternative economic growth projection; and
- Core scenario with alternative Carbon valuation.

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.

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:

- 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 0-7* below.

Table 0-7 TUBA Warning Summary - VDM Core Scenario

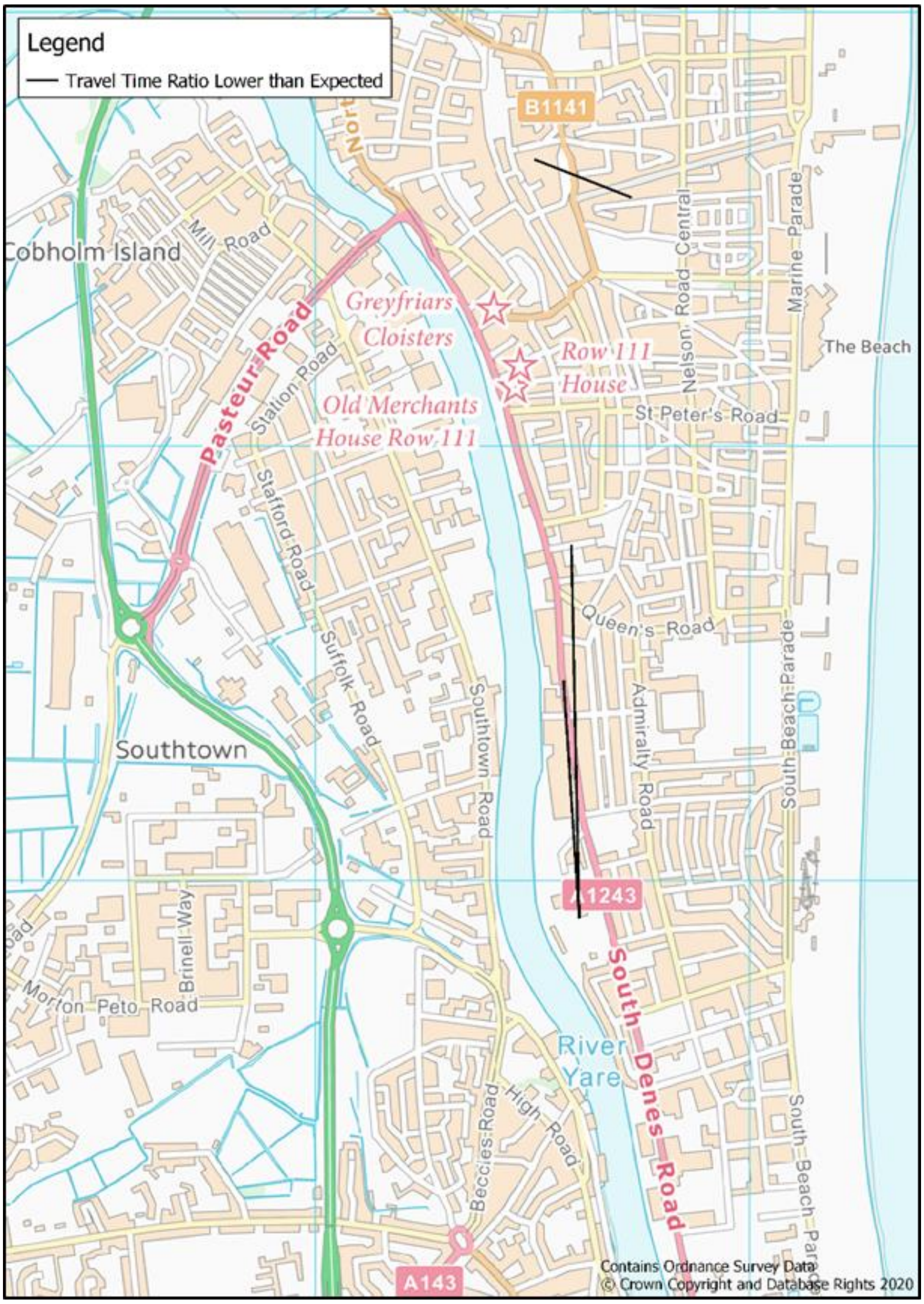
Warning Description	Total	Serious
Ratio of DM to DS travel time lower than limit (DM time < DM time)	194	0
Ratio of DM to DS travel time higher than limit (DM time > DS time)	129,010	694
Ratio of DM to DS travel distance lower than limit (DM dist < DS dist)	162	0
Ratio of DM to DS travel distance higher than limit (DM dist > DS dist)	104,197	871
DM speeds less than limit for the following	30	0
DS speeds less than limit for the following	15	0
Total Warnings	**233,608**	**1,565**

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 0-4*.

Figure 0-4 Ratio of DM to DS Travel Time Lower than Limit



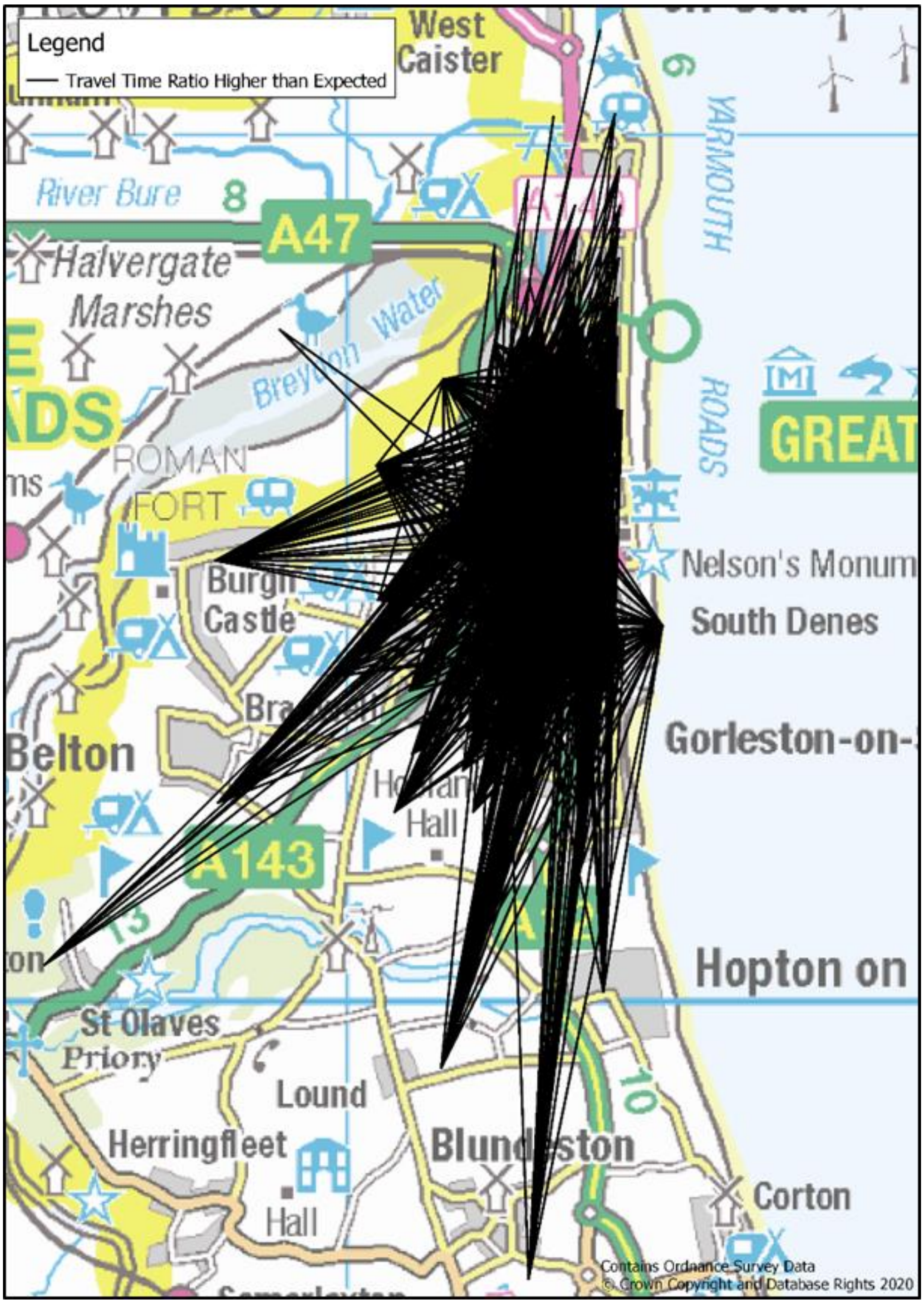
It is of note that all of these warnings apply to relatively short trips with all having a journey time of less than 5 minutes. With trips of this nature small absolute differences can flag up a warning within TUBA.

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 0-5*.

Figure 0-5 Ratio of DM to DS Travel Time Higher than Limit

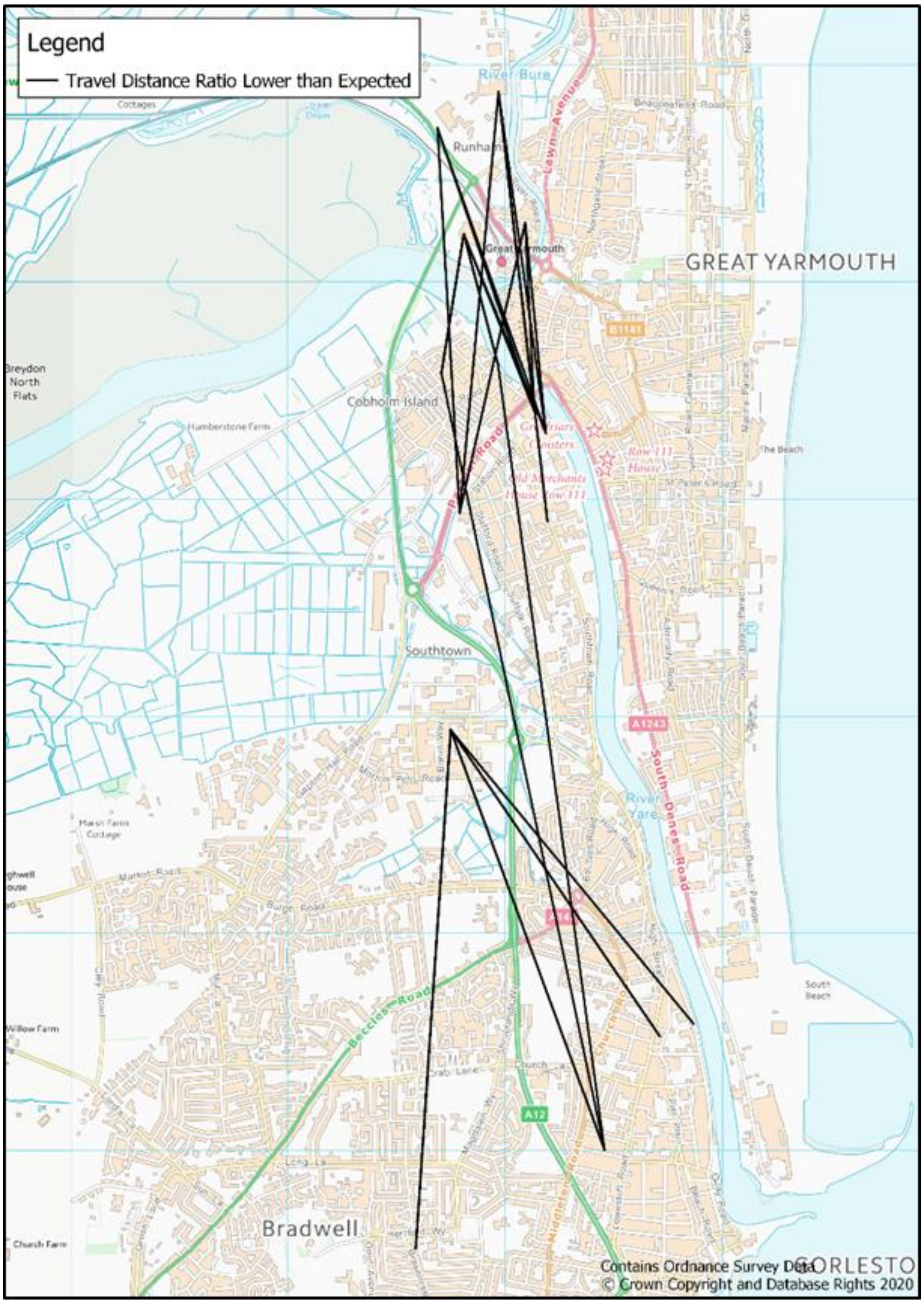


The majority of these warnings have origins or destinations on the peninsula and can be attributed to trips rerouting to the new bridge thus benefitting from journey time savings. Other warnings relate to trips which also benefit from journey time savings due to a reduction in congestion at various locations 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 0-6*.

Figure 0-6 Ratio of DM to DS Travel Distance Lower than Limit

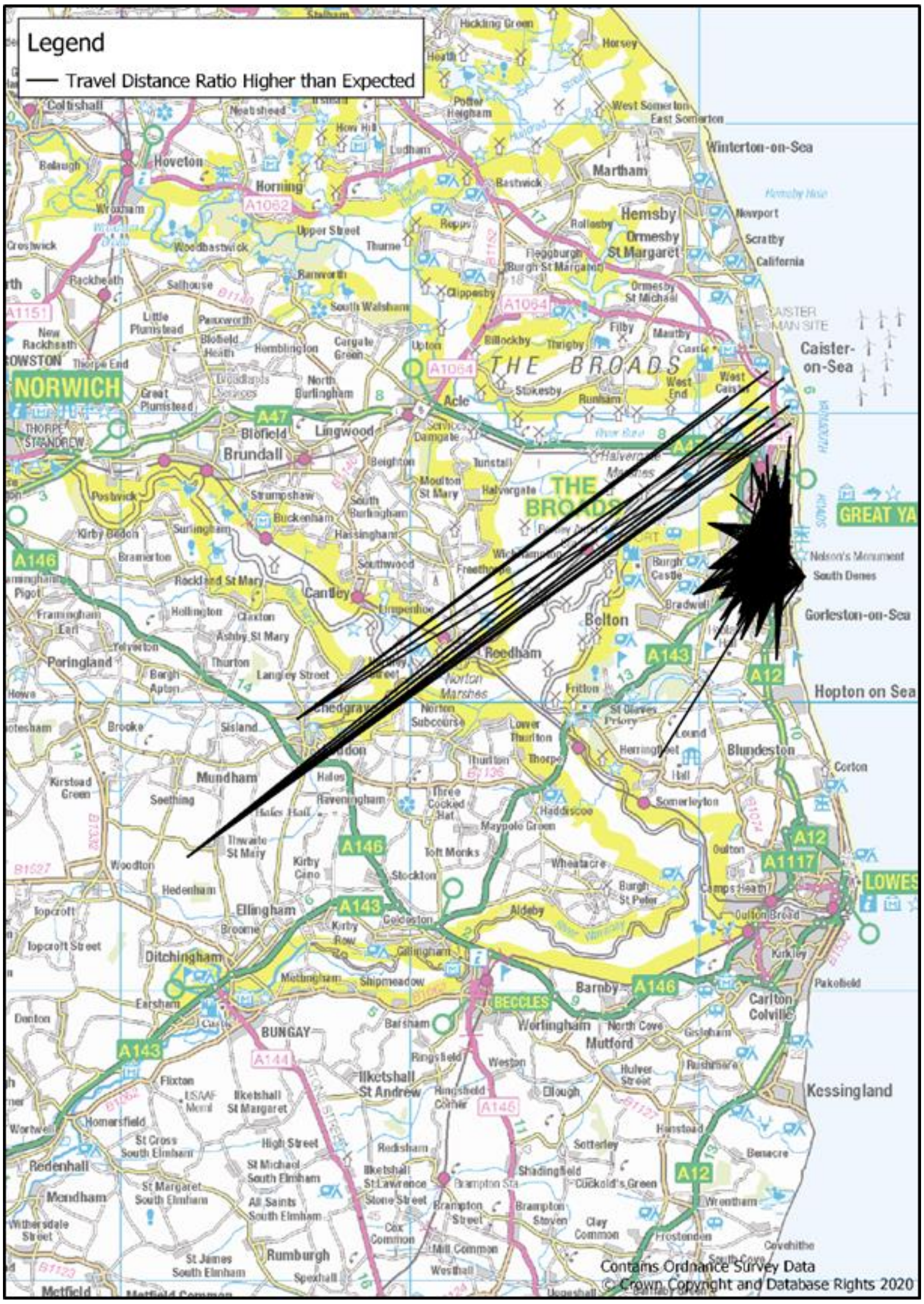


Similarly to warnings where journey times increase it is of note that these warning all relate to relatively short distance trips (all under 7km). These warnings all relate to trips in the vicinity of the A47 corridor. The increases in distance can be attributed to trips switching to the higher speed A47 from more direct local routes.

Ratio of DM to DS travel distance higher 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 distances are generally expected to reduce as a result of the scheme. The origins and destinations of these warnings are illustrated in *Figure 0-7*.

Figure 0-7 Ratio of DM to DS Travel Distance Higher than Limit

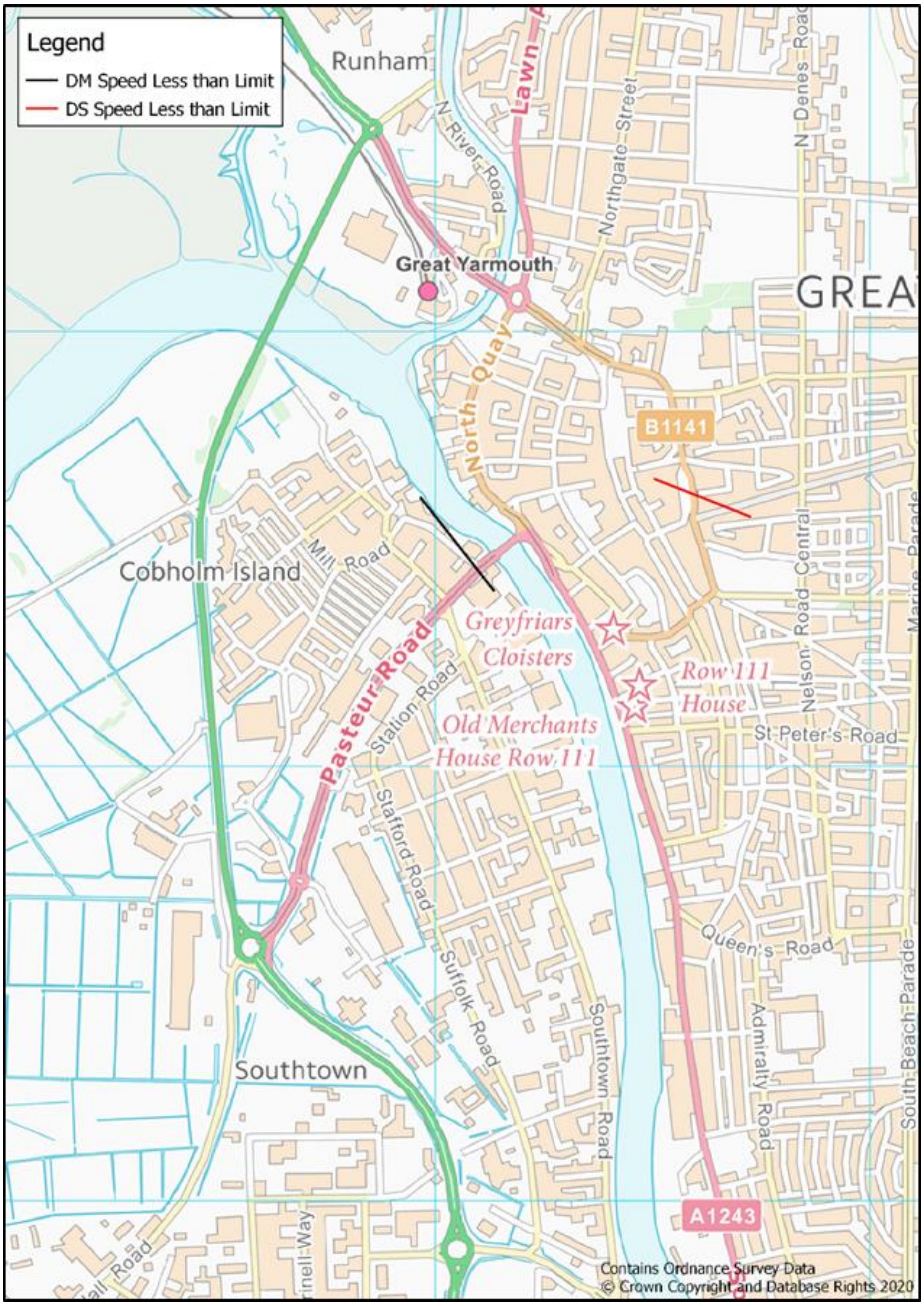


The majority of these warnings have origins or destinations on the peninsula and can be attributed to trips rerouting to the new bridge thus benefitting from a reduction in journey distance. Other warnings, relating to longer distance trips between Great Yarmouth and other destinations in Norfolk, can 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 or DS speed lower than limit

These warnings occur when average journey speeds are very low. The origins and destinations of these warnings are illustrated in *Figure 0-8*.

Figure 0-8 DM or DS Speed Lower 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.

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).

TUBA BENEFITS – VDM CORE SCENARIO

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

Transport Economic Efficiency Benefits

Table 0-1 below provides a summary of the Transport Economic Efficiency of the proposed scheme.

Table 0-1 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	41,191		41,191					
Vehicle operating costs	934		934					
User charges	0		0					
During Construction & Maintenance	0		0					
NET NON-BUSINESS BENEFITS: COMMUTING	42,125	*(1a)*	42,125		0		0	0
Non-business: Other	ALL MODES		ROAD		BUS/COACH	RAIL		OTHER
User benefits	TOTAL		Private Cars/LGVs		Passengers		Passengers	
Travel time	88,640		88,640					
Vehicle operating costs	7,175		7,175					
User charges	0		0					
During Construction & Maintenance	0		0					
NET NON-BUSINESS BENEFITS: OTHER	95,815	*(1b)*	95,815		0		0	0
Business	ALL MODES		ROAD		BUS/COACH	RAIL		OTHER
User benefits	TOTAL		Good Vehicles	Business Cars/LGVs	Passengers	Freight	Passengers	
Travel time	64,337		51,447	12,890				
Vehicle operating costs	12,876		11,040	1,836				
User charges	0		0	0				
During Construction & Maintenance	0		0	0				
Subtotal	77,213	*(2)*	62,487	14,726	0	0	0	0
Private sector provider impacts						Freight	Passengers	
Revenue	0				0			
Operating costs	0				0			
Investment costs	0				0			
Grant/subsidy	0				0			
Subtotal	0	*(3)*			0	0	0	0
Other business impacts								
Developer contributions	0	*(4)*					0	
NET BUSINESS IMPACT	77,213	*(5) = (2) + (3) + (4)*						
TOTAL								
Present Value of Transport Economic Efficiency Benefits (TEE)	215,153	*(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, around £215m over the 60-year appraisal period. The benefits are generated by travel time savings of £194m and vehicle operating cost savings of £21m. It is noted that the impacts during construction 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.

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 Table 0-2 to Table 0-5 with the origin/destination benefits is presented in Figure 0-1 below.

Table 0-2 - User Benefits at Sector Level – 2023 (£000s)

Sector	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Orig**
1	-4	-4	2	162	16	2	358	2	-2	-3	530
2	14	2	0	22	2	0	83	1	2	1	129
3	7	0	0	3	0	0	27	0	0	1	37
4	213	24	5	0	0	14	-5	11	6	99	368
5	23	4	0	0	0	0	1	0	0	9	38
6	4	0	0	2	0	0	20	0	0	1	27
7	698	133	32	30	2	19	148	69	45	381	1557
8	8	0	0	8	0	0	23	0	0	3	40
9	3	1	0	4	0	0	14	0	0	2	23
10	-5	0	-1	19	3	2	54	1	-2	0	72
Dest	**962**	**162**	**37**	**249**	**24**	**37**	**723**	**83**	**49**	**494**	**2820**

Table 0-3 - User Benefits at Sector Level – 2038 (£000s)

Sector	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Orig**
1	-3	-6	2	125	14	2	293	-1	-3	-8	**414**
2	9	8	0	30	3	1	122	2	3	2	**179**
3	7	2	0	7	0	0	62	0	0	3	**81**
4	189	31	5	0	0	17	-10	19	13	96	**361**
5	21	4	0	1	0	0	7	0	0	9	**42**
6	4	2	0	12	0	0	50	0	0	2	**71**
7	641	162	52	29	3	32	219	92	72	400	**1703**
8	4	3	0	15	0	0	57	0	0	5	**84**
9	0	3	0	7	0	0	42	0	0	3	**55**
10	1	1	2	18	3	3	88	2	0	0	**117**
Dest	**873**	**211**	**61**	**244**	**22**	**54**	**930**	**115**	**85**	**512**	**3107**

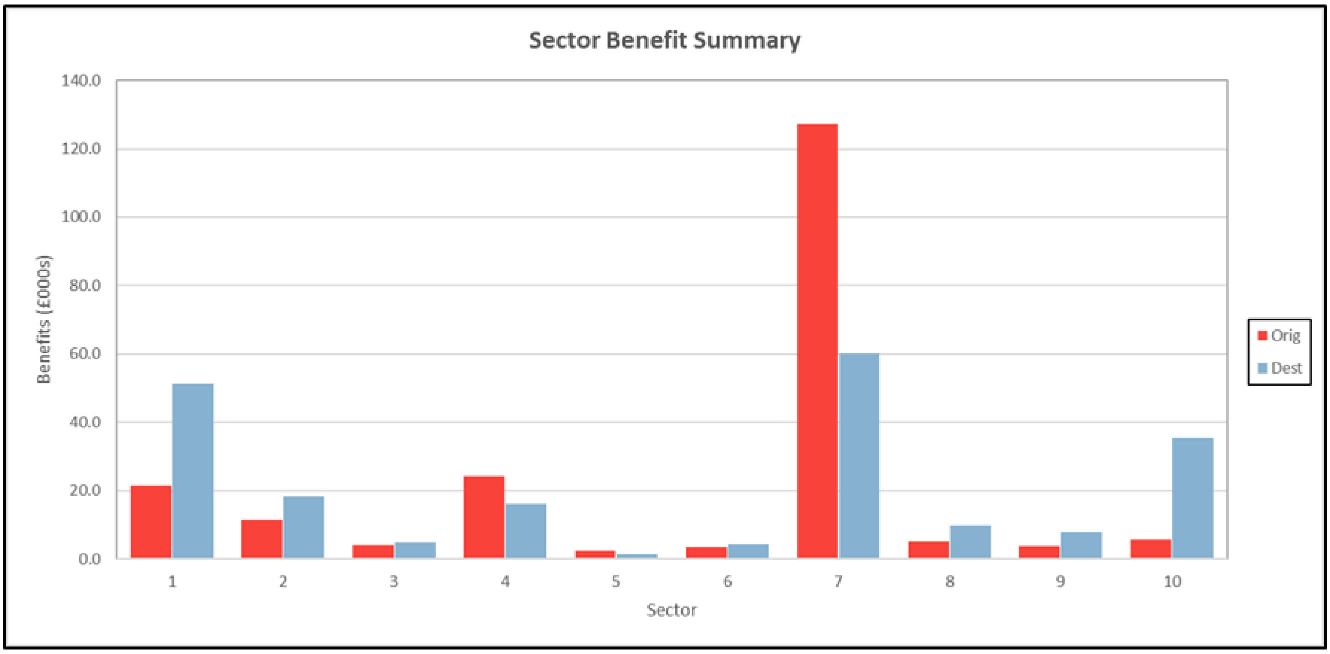
Table 0-4 - User Benefits at Sector Level - 2051 (£000s)

Sector	1	2	3	4	5	6	7	8	9	10	Orig
1	-4	-7	0	110	12	0	261	-2	-4	-8	**358**
2	13	16	-2	35	3	-2	161	0	4	4	**231**
3	9	2	0	6	0	0	54	0	0	5	**77**
4	199	61	8	0	1	28	-3	39	28	127	**486**
5	22	6	0	1	0	0	8	1	0	11	**49**
6	5	2	0	10	0	0	50	0	0	4	**72**
7	711	327	104	116	10	75	442	189	162	568	**2703**
8	3	5	0	19	0	0	76	0	0	6	**110**
9	-1	5	0	11	0	0	69	-1	0	3	**86**
10	-8	0	-2	18	2	0	109	-6	-5	0	**109**
Dest	**949**	**416**	**108**	**325**	**28**	**101**	**1228**	**219**	**186**	**721**	**4282**

Table 0-5 - User Benefits at Sector Level - Appraisal Period (£000s)

Sector	1	2	3	4	5	6	7	8	9	10	Orig
1	-196	-361	31	6593	705	45	15466	-91	-189	-407	**21597**
2	664	655	-71	1776	142	-65	7805	51	179	186	**11324**
3	452	108	0	307	1	0	2962	9	8	220	**4066**
4	10891	2674	370	-8	34	1310	-312	1678	1178	6409	**24224**
5	1195	280	1	43	0	3	387	25	16	567	**2517**
6	263	101	0	526	3	0	2594	10	12	168	**3677**
7	38129	14357	4537	4512	397	3158	19205	8239	6873	27704	**127109**
8	211	201	-4	926	1	3	3598	-10	9	299	**5235**
9	-30	213	-7	502	6	2	3048	-35	-15	155	**3840**
10	-296	35	-40	1018	137	31	5329	-192	-196	-8	**5816**
Dest	**51283**	**18263**	**4817**	**16195**	**1425**	**4488**	**60082**	**9682**	**7875**	**35293**	**209405**

Figure 0-1 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 are 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 roundabouts, therefore the proposed scheme relieves congestion on the network that would be expected to be toward Great Yarmouth or north bounded.

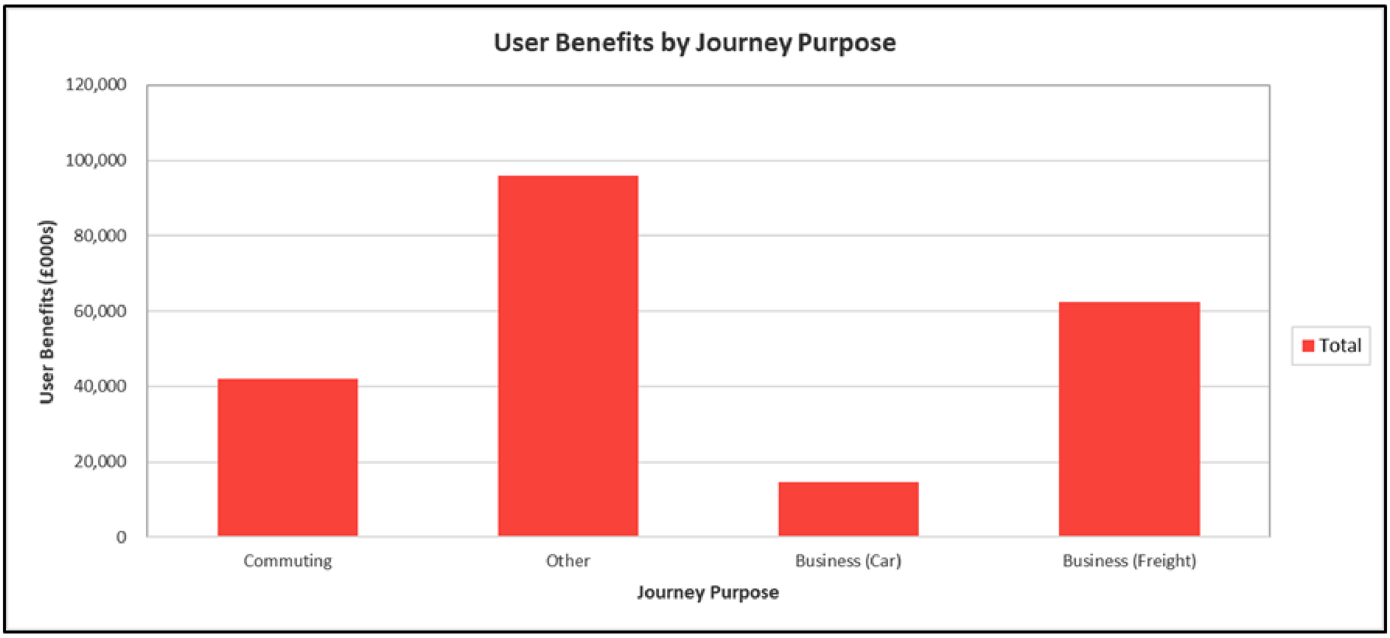
User Benefits by Purpose

Table 0-6 and *Figure 0-2* provide summaries of the user benefits by journey purpose.

Table 0-6 User Benefits by Journey Purpose (£000s)

Purpose	Travel Time	Vehicle Operating Cost	Total	Proportion
Commuting	41,191	934	42,125	19.8%
Other	88,640	7,175	95,815	45.1%
Business (Car)	12,890	1,836	14,726	6.9%
Business (Freight)	51,447	11,040	62,487	29.4%
Total	**194,168**	**20,985**	**212,357**	**100%**

Figure 0-2 User Benefits by Purpose



Analysis of user benefits show that the majority of the benefits produced by the scheme is attributed to Other and Freight trips, with 45% and 30% respectively. This is anticipated given the nature of the area (i.e. to serve as major attractions for tourism and for freight).

User Benefits by Time Period

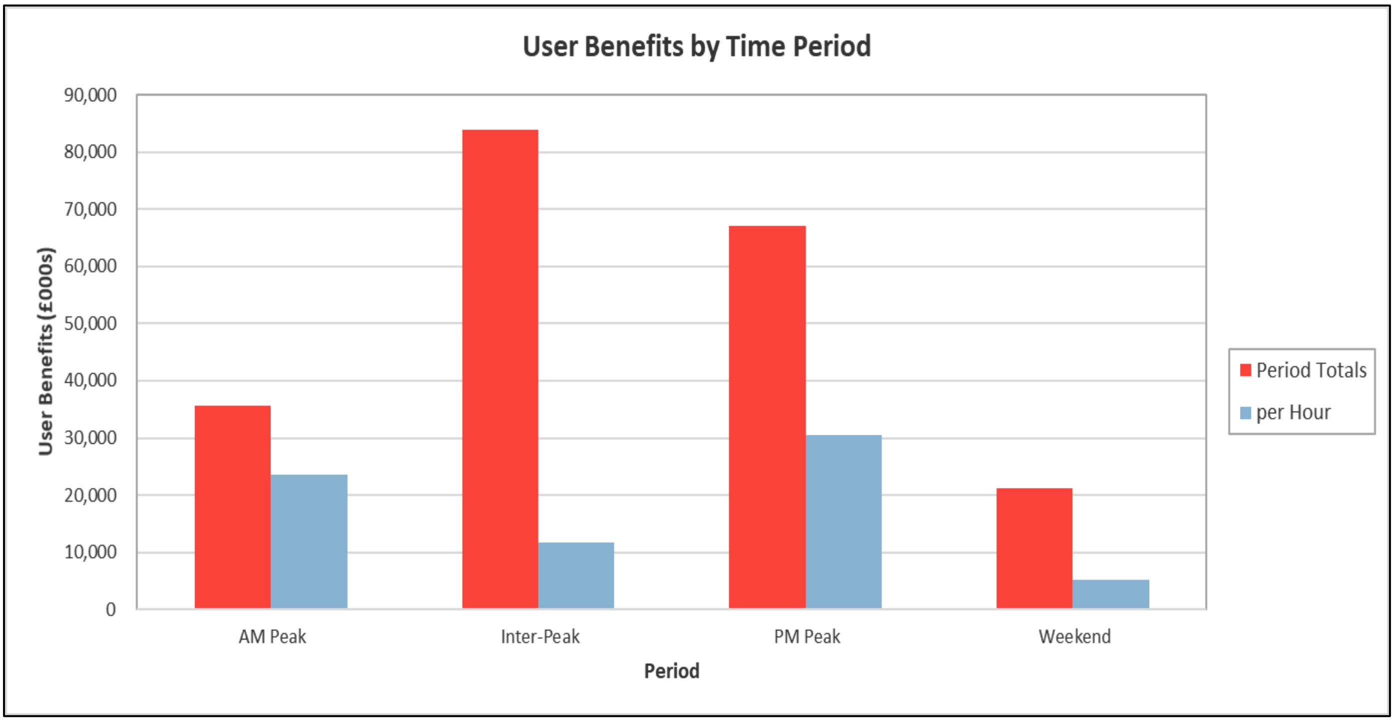
Table 4-7 and Figure 4-3 provide summaries of the user benefits by time periods.

Table 0-7 User Benefits by Time Period (£000s)

Period	Type	2023	2038	2051	60 years
AM Period	Time Savings	420	485	689	33,491
AM Period	VOC (fuel only)	65	44	39	2,224
AM Period	**Total**	**485**	**529**	**728**	**35,715**
AM Period	*per Hour*	*320*	*349*	*481*	*23,592*
Inter-Peak Period	Time Savings	1,071	1,096	1,576	77,204
Inter-Peak Period	VOC (fuel only)	209	138	113	6,726
Inter-Peak Period	**Total**	**1,280**	**1,234**	**1,689**	**83,930**
Inter-Peak Period	*per Hour*	*177*	*171*	*234*	*11,616*
PM Period	Time Savings	590	925	1,356	63,740
PM Period	VOC (fuel only)	81	66	62	3,328
PM Period	**Total**	**671**	**991**	**1,418**	**67,068**
PM Period	*per Hour*	*305*	*451*	*645*	*30,518*
Weekend	Time Savings	273	280	403	19,733
Weekend	VOC (fuel only)	48	32	26	1,542

Period	Type	2023	2038	2051	60 years
Weekend	**Total**	**321**	**312**	**429**	**21,275**
Weekend	*per Hour*	*80*	*77*	*106*	*5,281*
Total	Time Savings	2,354	2,786	4,024	194,168
Total	VOC (fuel only)	403	280	240	13,820
Total	**Total**	**2,757**	**3,066**	**4,264**	**207,988**

Figure 0-3 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. This is expected as level of delays in the AM and PM peak are significantly higher than those in the Inter-peak or weekend period.

User Benefits by Size of Time Saving

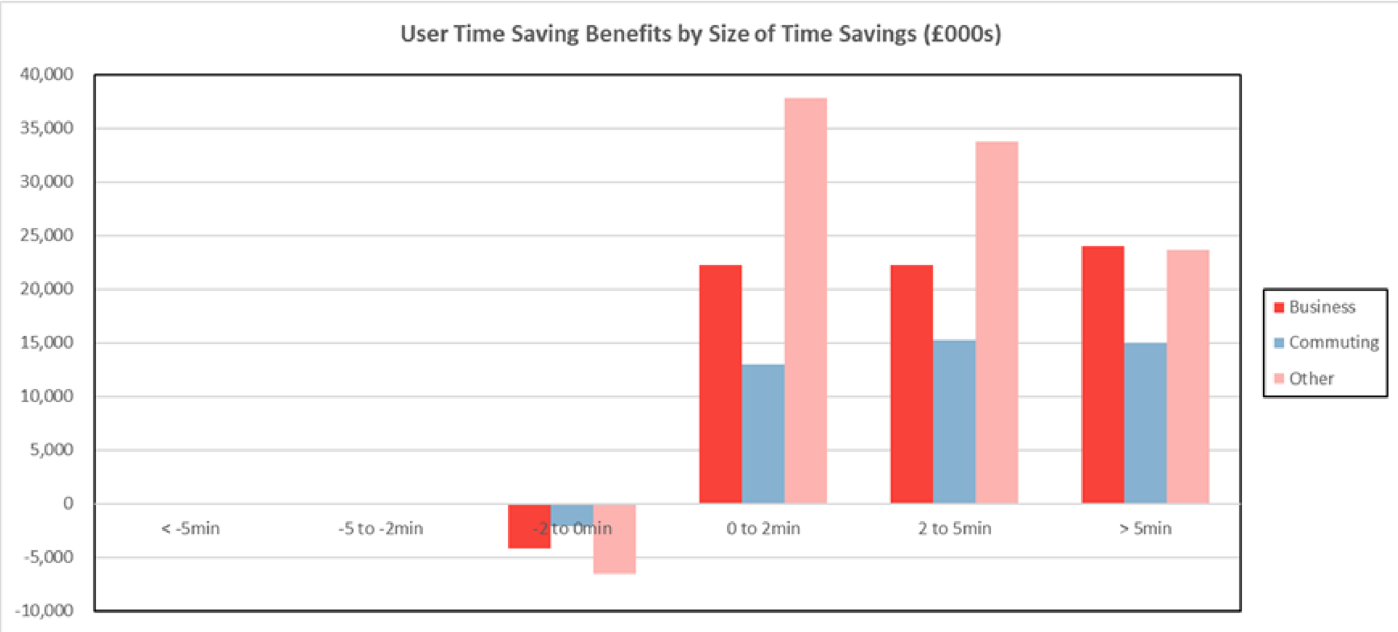
Table 4-8 and Figure 4-4 provide summaries of the user benefits by size of time saving.

Table 0-8 User Benefits by Size of Time Saving (£000s)

Veh. Type	Purpose	< -5min	-5 to -2min	-2 to 0min	0 to 2min	2 to 5min	> 5min	Total
Car	Business	-13	-5	-691	5,582	4,528	3,490	**12,891**
Car	Commute	0	-1	-2,106	13,032	15,283	14,982	**41,190**
Car	Other	-2	-18	-6,346	36,883	32,777	22,666	**85,960**
LGV	Personal	-2	-2	-171	898	961	996	**2,680**
LGV	Freight	-30	-27	-2,667	13,987	15,134	15,556	**41,953**

Veh. Type	Purpose	< -5min	-5 to -2min	-2 to 0min	0 to 2min	2 to 5min	> 5min	Total
OGV1	Business	-2	-5	-340	1,092	1,048	2,004	**3,797**
OGV2	Business	-2	-7	-510	1,638	1,572	3,006	**5,697**
Total	**Total**	**-51**	**-65**	**-12,831**	**73,112**	**71,303**	**62,700**	**194,168**

Figure 0-4 User Benefits by Size of Time Saving



The majority of the benefits are from the positive 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.

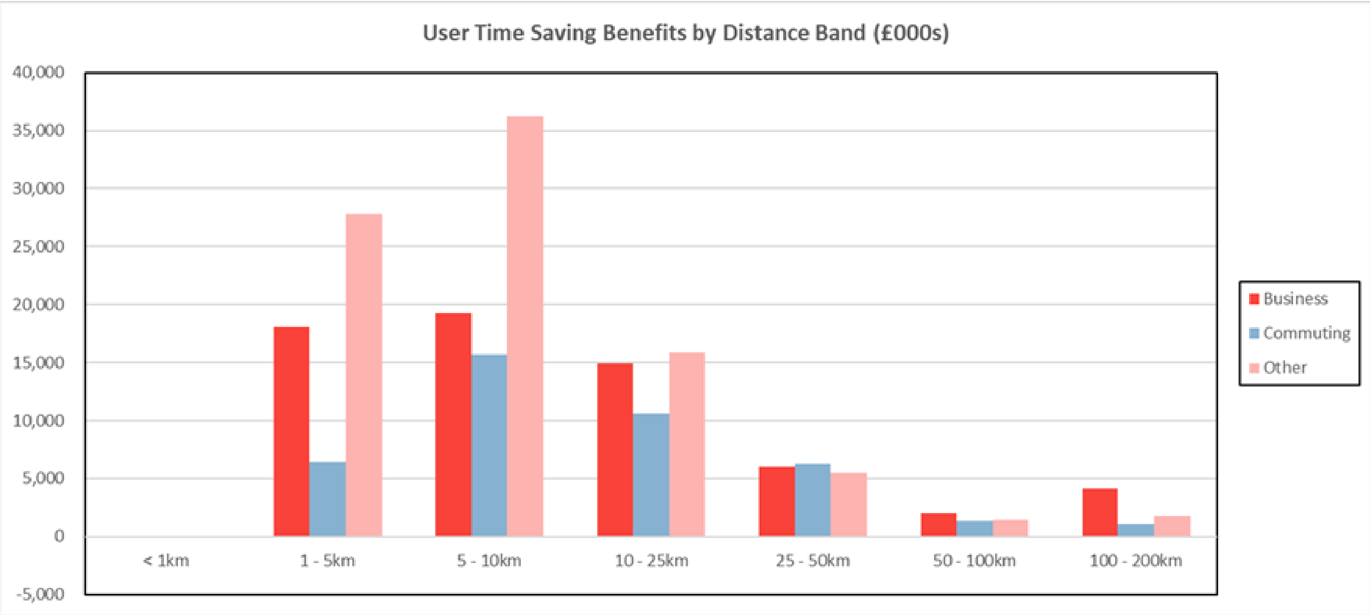
User Benefits by Travelled Distance

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

Table 0-9 User Benefits by Travelled Distance (£000s)

Veh Type	Purpose	< 1km	1 - 5km	5 - 10km	10 - 15km	15 - 20km	20 - 50km	50 - 100km	> 100km	Total
Car	Business	-1	3,141	3,320	3,058	1,492	885	993	0	**12,888**
Car	Commuting	-7	6,392	15,655	10,555	6,217	1,292	1,088	0	**41,192**
Car	Other	1	26,953	35,413	15,283	5,323	1,354	1,632	0	**85,959**
LGV	Other	-1	862	833	600	191	40	156	0	**2,681**
LGV	Business	-8	13,419	13,017	9,432	2,999	634	2,461	0	**41,954**
OGV1	Business	0	603	1,154	969	608	203	261	0	**3,798**
OGV2	Business	-1	905	1,730	1,453	912	305	392	0	**5,696**
Total	**Total**	**-17**	**52,275**	**71,122**	**41,350**	**17,742**	**4,713**	**6,983**	**0**	**194,168**

Figure 0-5 User Benefits by Travelled Distance

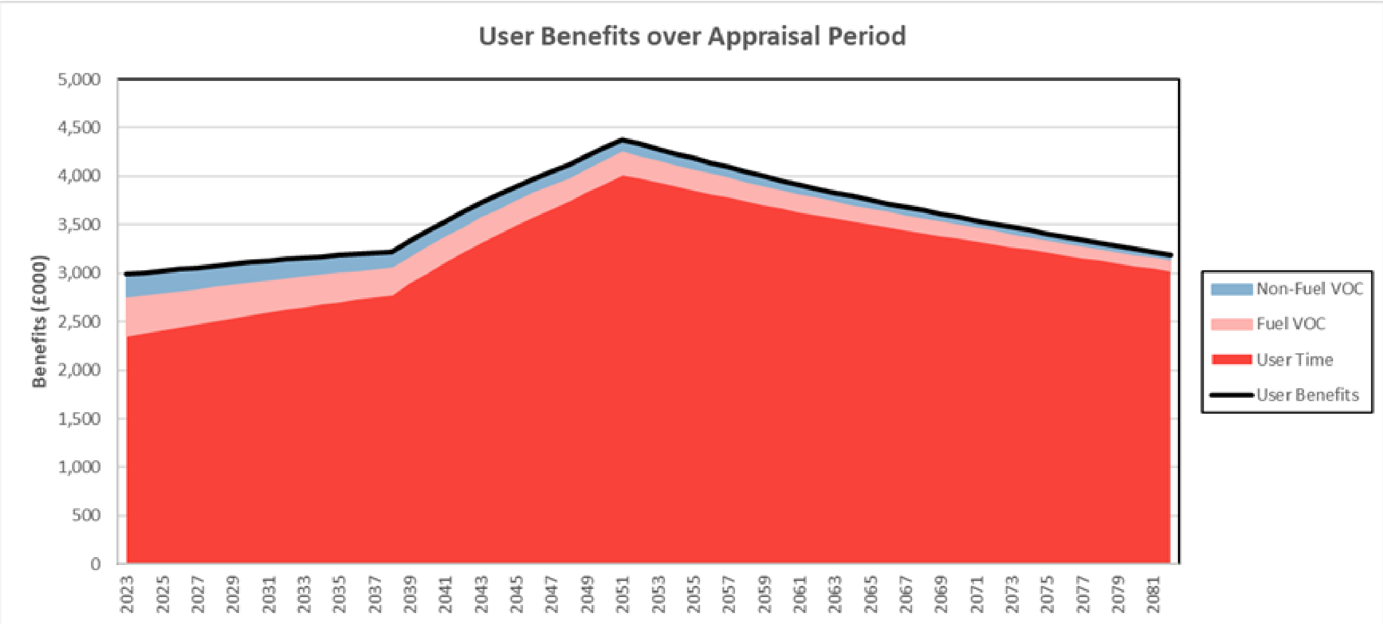


The majority of the benefits produced by the scheme are local traffic with travel distance ranges from 1-5km and from 5-10km. It is also noted that a modest amount of benefits are from the distance range 20-50km (such as from Norwich to Great Yarmouth or Lowestoft to Great Yarmouth).

User Benefits Profile

Figure 0-6 below provides a summary of the user benefits over the 60-year appraisal period.

Figure 0-6 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 2051 to the end of the appraisal period.

TUBA BENEFITS FOR SENSITIVITY TESTS

Table 0-1 below provides a summary of the TUBA benefits for the high and low growth scenarios.

Table 0-1 Summary of TUBA Benefits - Sensitivity Test Scenarios (£000s)

Benefits	Low Growth	Core Growth	High Growth
Consumer User (Commute)	29,597	42,125	55,666
Consumer User (Other)	67,557	95,815	132,940
Business User and Provider	56,452	77,213	104,043
Indirect Tax Revenue	-4,785	-5,747	-6,798
Greenhouse Gases	2,400	2,951	3,533
Present Value Benefits (PVB)	**151,221**	**212,357**	**289,384**

The low growth scenario produces a PVB that is 29% lower that the core scenario. The high growth scenario produces a PVB that is 36% higher that the core scenario.

Table 0-2 below provides a summary of the TUBA benefits for the alternative economic growth and alternative Carbon valuation scenarios.

Table 0-2 Summary of TUBA Benefits - Sensitivity Test Scenarios (£000s)

Benefits	Core Growth	Alternative Economic Growth	Alternative Carbon Valuation
Consumer User (Commute)	42,125	35,382	42,125
Consumer User (Other)	95,815	80,892	95,815
Business User and Provider	77,213	66,380	77,213
Indirect Tax Revenue	-5,747	-5,531	-5,747
Greenhouse Gases	2,951	2,785	4,554
Present Value Benefits (PVB)	**212,357**	**179,908**	**213,960**

The alternative Economic growth projection sensitivity test results in a reduction in benefits of £32.4m from the core scenario. This is approximately a 15% reduction. This is due to the lower forecasts for growth in values of time.

The alternative Carbon valuation sensitivity test produces an additional £1.6m in benefits over the 60-year appraisal period. This is because the scheme provides shorter quicker journeys and as a result less emissions are made.