The Norfolk County Council (Norwich Northern Distributor Road (A1067 to A47(T))) Order

5.6 Norwich Northern Distributor Road Traffic Forecasting Report: Volume 1

Planning Act 2008

Infrastructure Planning

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0	M Shahkarami I Conway	S Kirk R Tyler P Bugajski	C White G Kelly

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1 Key Summary

1.1 Overview

1.1.1 This report describes the traffic forecasting work undertaken for the NDR in connection with this Development Consent Order (DCO) application under the Planning Act 2008.

1.1.2 The outputs of the forecasting work provide:

- The future year design traffic flows
- Traffic flows for operational appraisal of the Scheme Junctions;
- Traffic impacts across the network and in the city centre;
- Inputs to the environmental appraisal; and
- Inputs to the economic appraisal.

1.1.3 The forecasting for the Scheme used the updated Norwich Area Transport Strategy (NATS) transport model. Separate transport models were produced for the AM peak hour (08:00-09:00), an average hour in the inter-peak (10:00 – 16:00) and the PM peak hour (17:00 – 18:00). This is to ensure the traffic characteristics for different time periods are modelled accurately. The NDR Local Model Validation Reports (document reference nos. 5.9 and 5.10) describe the updating of the transport models and the calibration and validation processes.

1.1.4 This report explains the preparation of the future year transport networks. These include modifications to account for changes, comprising the proposed NDR, complementary traffic management measures, city centre measures, developer link roads and other proposed improvements.

1.1.5 The development of the demand matrices is also described. It accounts for the Joint Core Strategy (JCS) spatial allocation of development for which trip generation has been assessed using the TRICS database. The growth has been controlled using the Department for Transport's National Trip End Model (NTEM) and Road Transport Forecast (RTF) databases, but reductions have then been applied for the JCS development trip generation to account for travel plans and the trip distribution for large mixed developments. Variable demand model processes have also been applied to account for behavioural changes of trip redistribution, mode choice and frequency responses to changing travel costs. The forecasting has been undertaken in line with the Department for Transport's Web-based Transport Appraisal Guidance WebTAG (unit 3.15.1).

1.1.6 Forecasts are presented for the proposed opening year of 2017 and a design year of 2032 and for scenarios with and without the proposed Scheme.

1.1.7 The report describes the changes in traffic and network performance that would occur with the implementation of the proposed transport interventions. It sets out the substantial reductions in traffic on existing orbital routes as a result of the reassignment of strategic traffic to the NDR. There would also be substantial reductions on the proposed developer link roads which would not be appropriate routes for carrying strategic traffic. Traffic levels would be reduced on routes in the Thorpe St Andrew, Old Catton and Hellesdon suburbs, including on the Outer Ring Road. Traffic flows in the city centre would also be reduced substantially as a result of the city centre measures that could be implemented with the introduction of the NDR, though there is some displacement to the Inner Ring Road.

1.1.8 Traffic flows travelling through the city would be reduced significantly with the NDR. The analysis shows that through the city centre the forecast traffic in 2032 would be almost half of that in the 2012 base year as a result of city centre measures. Traffic forecasts on the Inner Ring Road would be reduced in 2017 and 2032 to levels only just higher than in the base year. On the Outer Ring Road forecast traffic would reduce to levels below those in the base year.

1.1.9 Journey times from the strategic road network to the Airport and the proposed development location at Rackheath would be reduced significantly with the NDR implemented. In addition there are journey time reductions on radial bus routes into the city centre with improvements to journey time reliability.

1.1.10 Comparison of the overall queues within the transport model shows that there will be large increases without transport improvements, but these would be significantly reduced by the implementation of the scheme.

2 Introduction

2.1 Background

2.1.1 Mott MacDonald (MM) has been appointed by Norfolk County Council (NCC) to assist with the development and appraisal of the Norwich Northern Distributor Road, known as the NDR or referred to as the Scheme.

2.1.2 The Scheme would be a dual carriageway all-purpose strategic distributor road, to be classified as the A1270 Principal Road, which would link the A1067 Fakenham Road near Attlebridge, to the A47(T) Trunk Road at Postwick. This will be over a length of approximately 20.4km.

2.1.3 The NDR is a project of national significance which requires a Development Consent Order (DCO) under the Planning Act 2008 and this formal planning process began in early 2013. It is currently anticipated that the process will be completed in time for the NDR scheme to start construction in 2015 and to be opened in 2017.

2.1.4 This document is one of a number that support the DCO, each of which has its own unique document number, and should therefore be read in conjunction with the other documentation. The proposed layout of the NDR is shown in the General Arrangement Plans contained in document number 2.6, whilst the full needs case for the NDR is explained in the Statement of Reasons (document 4.1) and the Environmental Statement (document 6.1).

2.1.5 To support the process of scheme appraisal, the Norwich Area Transport Strategy (NATS) transport model has been updated to a 2012 base year. The forecasting has been carried out on a Production Attraction (PA) basis, a requirement of current WebTAG guidance, and the National Trip End Model (NTEM) and Road Transport Forecasts (RTF). . The forecast networks were developed on the basis of the WebTAG (unit 3.15.5) uncertainty log principles. Local development assumptions were based on the proposals for the Joint Core Strategy (JCS).

2.1.6 A plan of the scheme is shown in Figure B.1 in Appendix B of this Forecasting Report and further details are included in Section 4.4.

2.2 Overview of the forecasts presented

2.2.1 Traffic forecasts accounted for the JCS proposals for residential and employment developments as well as corresponding transport network changes that will provide access to the proposed developments. The forecast scenarios comprise the following:

- A set of transport network changes;
- Assumptions about changes in values of time and vehicle operating costs over time;
- A specific set of development assumptions;
- Application of National Trip End Model (NTEM) growth factors as a constraint on trip growth for private vehicle use; and
- Application of growth of freight traffic from the DfT Road Transport Forecasts (RTF).

2.2.2 The transport supply and development assumptions were arrived at through a process of identifying potential transport improvements and development proposals, and undertaking an assessment of the likelihood of each of these proposals coming forward in the context of the JCS.

2.2.3 The demand forecasting used the DIADEM variable demand modelling software forecasting procedures without and with a scheme intervention (also called Do-Minimum and Do-Something scenarios). It used a specific set of demand model parameters adjusting the sensitivity of destination, mode and frequency choices to changes in generalised cost. In addition, travel planning and distribution for new developments was taken into account.

2.2.4 The following demand forecasts were produced:

- The Reference Case which was a forecast of what is likely to happen if the travel costs remain the same in the future as in the base year i.e. it takes no account of changes in travel costs that would arise from the increased demand, or changes in fuel costs or the value of time.
- The Do-Minimum forecast which used variable demand modelling to account for changes in travel costs and the future transport network that excludes the Scheme.
- The Do-Something network which included all highway changes associated with the NDR Scheme, as well as Norwich city centre measures, and the forecast used variable demand modelling to account for changes in travel costs with this network.

2.3 Purpose and layout of Report

2.3.1 The report describes the traffic forecasts for the Scheme and sets out the assumptions on which these forecasts have been based.

2.3.2 The structure of this report is as follows:

- Chapter 3 presents an overview of the modelling system developed to assess the NDR;
- Chapter 4 documents the development of future year highway networks;
- Chapter 5 presents future year traffic growth forecasts;
- Chapter 6 provides analysis and discussion in relation to future year forecasts;
- Chapter 7 provides an analysis of effects of the NDR on traffic; and
- Chapter 8 contains a glossary of abbreviations.

3 Overall Modelling Framework

3.1 The Modelling Framework

3.1.1 The NATS transport modelling framework used to assess the NDR consists of three main elements:

- Highway Traffic Model: this is a SATURN model with 413 zones with an extensive detailed simulation area that goes beyond the main Norwich city urban area. The rest of the network is coded as a SATURN buffer network. The model has been validated to a 2012 base year.
- Public Transport Model: this is a VISUM public transport model covering bus and rail modes. The model covers the same area as the highway model plus the key rail routes into Norwich and represents the same base year of 2012.
- Demand Model: this is a DIADEM variable demand model. The model is an incremental model, and is set up in Production-Attraction format as required by WebTAG (unit 3.10.2).

3.1.2 The overall modelling framework has been developed to be consistent with the guidance set out in WebTAG (unit 3.1.1). The individual elements have been developed to be consistent with the guidance set out in WebTAG units 3.10, 3.11 and 3.19.

3.1.3 Full details of the first two model components are set out in the Highway Local Model Validation Report (document reference 5.9) and the Public Transport Local Model Validation Report (document reference 5.10). The demand model is described in this Forecasting Report.

3.2 Model Definition

Forecast Years

3.2.1 Future year traffic forecasts were developed for two years: 2017 and 2032. The future year of 2017 represents the programmed opening year of the proposed NDR, and 2032 represents the design year (15 years after scheme opening).

Time Periods

3.2.2 The highway and public transport assignment models have been developed for three time periods:

- AM Peak Hour (0800-0900hrs);
- Average Inter-Peak Hour (1000-1600hrs); and
- PM Peak Hour (1700-1800hrs).

3.2.3 An Off-Peak model representing an average hour for the period 1900 to 0700 hrs has also been developed for the purposes of demand modelling, where costs are required for all times of the day (it should be noted that this is not a fully validated model).

Demand Segmentation

3.2.4 The development of the 2012 base model produces highway assignments for five vehicle types/ user classes for each model hour at an O-D level. This representation of the demand is not sufficiently detailed to be used as inputs to the demand model for the following reasons:

- The demand model is applied to trips with an origin or destination inside the modelled area. Therefore, purely external-external trips need to be treated as fixed in a separate demand segment; and
- The home-based purposes need be modelled in PA (24 hour) format, not hourly O-D.

3.2.5 The highway demand was therefore split into ten demand segments, with five additional segments being included to model trips for PT users who have no access to a car. These fifteen demand segments are shown in Table 3.1. In addition the home-based demand segments are aggregated to a 24 hour level to be used in PA modelling.

Table 3.1: Demand Segments

User class	Vehicle Type	Description	Demand Model Segment
1	Car/ LGV/ PT	Home Based Work	Variable HBW - Car Available
2			Variable HBW - No Car Available
3	Car/ PT	Home Based Employer's Business	Variable HBEB - Car Available
4			Variable HBEB - No Car Available
5	Car/ LGV/ PT	Home Based Other	Variable HBO - Car Available
6			Variable HBO - No Car Available
7	Car/ PT	Non-Home Based Employer's Business	Variable NHBEB - Car Available
8			Variable NHBEB - No Car Available
9			Fixed NHBEB - (External-External Movements)
10	Car/ LGV/ PT	Non-Home Based Other	Variable NHBO - Car Available
11			Variable NHBO - No Car Available
12&13			Fixed NHBO & HBW - (External-External Movements)
14	LGV	Freight	Freight (LGV)
15	HGV	Freight	Freight (HGV)

3.3 Demand Modelling

3.3.1 The forecasting procedure was undertaken using DIADEM software (version 5.0). DIADEM implements variable demand modelling in line with WebTAG Unit 3.10. DIADEM does not include an assignment module; instead it relies on other software packages to carry out assignments, i.e. SATURN for the highway network and VISUM for the public transport network. The public transport and highway assignment models are external to DIADEM but the software packages exchange trip matrices and cost matrices.

3.3.2 DIADEM was set up to model the following demand responses:

- Frequency choice;
- Mode choice; and
- Re-distribution.

3.3.3 Frequency choice responses represent trip generation and trip suppression that a scheme might produce. Selection of this response is consistent with WebTAG 3.10.3 (Paragraph 1.4.3).

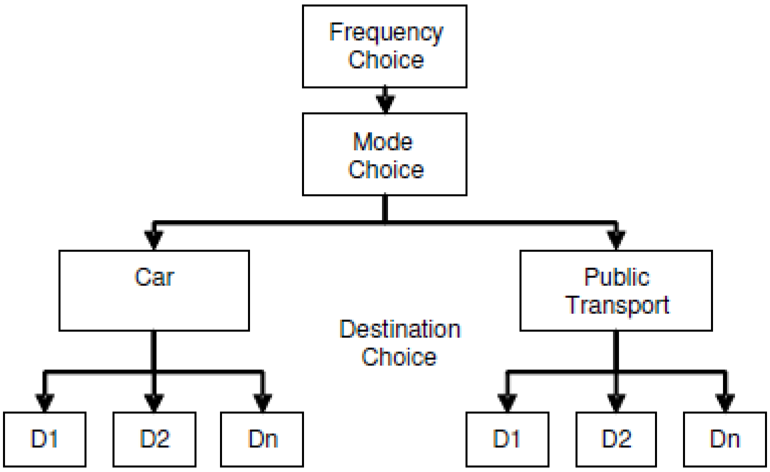
3.3.4 Mode choice represents switching of trips between public transport (PT) and highway modes of travel. This has been set up for car-available PT demand segments only.

3.3.5 Re-distribution (or destination choice) is likely to be the main demand response for the scheme. Travellers might change final destination of trips due to travel cost changes resulting from the Scheme.

3.3.6 Time period response is most relevant where a scheme imposes significant cost differences between travel during the peak period and travel during the inter-peak and off-peak periods. Substantial cost differences may result in drivers changing their period of travel. An example is a tolling regime that applies only to peak periods. It is perceived that journey time savings as a result of the scheme are likely to have a low influence on time-of-day travel. Therefore, macro time-of-day choice responses have not been modelled, in accordance with WebTAG 3.10.3 (Paragraph 1.4.13),

3.3.7 The hierarchy of response is consistent with WebTAG advice which identifies frequency (the least sensitive) at the top of the hierarchy and trip distribution (the most sensitive) at the bottom of the hierarchy. The hierarchy adopted is shown in Figure 3-1.

Figure 3-1: Hierarchy of Demand Responses



3.3.8 Demand model parameter values have been calibrated in line with WebTAG, as explained in section 6. The resultant parameter values are shown in Table 3.2. The frequency response is only applied to discretionary trips of which the ‘other’ trip purpose is mostly comprised.

Table 3.2: DIADEM Parameters

Journey Purpose	Highway Re-distribution	Public Transport Re-distribution	Mode Choice	Frequency
Home Based Work	-0.113	-0.033	0.68	-
Home Based Employer Business	-0.038	-0.036	0.45	-
Home Based Other	-0.074	-0.036	0.53	0.15
Non Home Based Employer Business	-0.069	-0.042	0.73	-
Non Home Based Other	-0.073	-0.033	0.81	0.15

3.3.9 A summary of the demand model set up is shown in Table 3.3. This was set up to be consistent with WebTAG requirements as set out in Unit 3.10.3 with home-based trips in Production Attraction (PA) format so that outbound and return journeys are made to have consistent destination and mode choice by modelling them as linked trips or tours. Home-Based-Work trips (HBW, also referred to as commuting trips) are doubly constrained while Home-Based-Other (HBO) are singly constrained by origin. In the singly-constrained models the trip ends are fixed for one of the trip ends, with no constraints on the other end. In the doubly-constrained models the total trip ends to and from each zone are fixed. For non-home-based trips it cannot be assumed that there are return trips so these are treated as single direction trips, and in DIADEM these are referred to as Origin Destination (OD) format (which is the same as single direction trips in PA format). Freight demand segments have been modelled as fixed OD-based demand and these are only subject to assignment in the Highway model, and it should be noted that some elements of private vehicle trips are fixed (external-external and development trips).

Table 3.3: Summary of Demand Model Set Up

Demand					Responses					
Mode	**Purpose**	**Car Availability**	**Format**	**Time Period**	**Model Format**	**Time Period Choice**	**Frequency**	**Mode Choice**	**Distribution**	**Single/ Double constrained**
		Na- not applicable **CA – car available** **NCA non car available**	**PA** **OD**	**24 hour or individual time period**	**Incremental PA** **Incremental OD** **Fixed** **Excluded**	**Y – yes** **N- No**	**Y – yes** **N- No**	**Y – yes** **N- No**	**Y – yes** **N- No**	**S - Singly (production or origin)** **D – Doubly constrained** **Na- not applicable**
Private	HBW	Na	PA	24 hr	Inc PA	N	N	Y	Y	D
	HBEB	Na	PA	24 hr	Inc PA	N	N	Y	Y	S
	HBO	Na	PA	24 hr	Inc PA	N	Y	Y	Y	S
	NHBEB	Na	OD	TP	Inc OD	N	N	Y	Y	S
	NHBO	Na	OD	TP	Inc OD	N	Y	Y	Y	S
	LGV (EB)	Na	OD	TP	Fixed	N	N	N	N	Na
	HGV	Na	OD	TP	Fixed	N	N	N	N	Na
Public	HBW	CA	PA	24 hr	Inc PA	N	N	Y	Y	D
	HBEB	CA	PA	24 hr	Inc PA	N	N	Y	Y	S
	HBO	CA	PA	24 hr	Inc PA	N	Y	Y	Y	S
	NHBEB	CA	OD	TP	Inc OD	N	N	Y	Y	S
	NHBO	CA	OD	TP	Inc OD	N	Y	Y	Y	S
	HBW	NCA	PA	24 hr	Exc	N	N	N	N	Na
	HBEB	NCA	PA	24 hr	Exc	N	N	N	N	Na
	HBO	NCA	PA	24 hr	Exc	N	N	N	N	Na
	NHBEB	NCA	OD	TP	Exc	N	N	N	N	Na
	NHBO	NCA	OD	TP	Exc	N	N	N	N	Na

3.4 Forecasting Scenarios

3.4.1 Separate DIADEM runs have been carried out for the Do-Minimum and the Do-Something scenarios, for the two forecast years. The demand modelling assesses the changes in travel costs as a result of traffic growth, so it requires reference travel costs which are taken from the 2012 base model and used as a baseline for measuring changes in travel costs in future years.

4 Forecast Year Networks

4.1 Requirements

4.1.1 For forecasting purposes transport networks representing the supply and cost of transport in future years were required as a basis to assess the impact of the proposed Scheme. Future year transport supply and costs relate to changes in the transport networks, for example new transport infrastructure or public transport services, and the cost of transport e.g. car parking charges or bus fares.

4.1.2 Highway and public transport networks for the JCS scenario (current at April 2013) have been produced for the two forecasting years 2017 and 2032.

4.2 Built Schemes

4.2.1 There have been no schemes built and opened since the base model development for October / November 2012 (current at April 2013).

4.3 Do Minimum Network

Approach

4.3.1 Information on planned schemes in Norwich City, South Norfolk and Broadland was provided by NCC. Details on future schemes in the remaining districts of Norfolk are not included as the model detail in those outlying districts is relatively coarse, and therefore including schemes would have minimal effect in the Greater Norwich area.

4.3.2 Data collated on future transport proposals was tabulated and an assessment of likelihood of them proceeding was carried out in April 2013. This assessment was in line with the definitions of uncertainty contained in WebTAG unit 3.15.5; these are reproduced in Table 4.1.

Table 4.1: Classification of Future Inputs

Probability of the Input	Status
Near Certain: The outcome will happen or there is a certain probability that it will happen	Intent announced by proponent to regulatory agencies. Approved development proposals. Projects under construction.
More than likely: The outcome is likely to happen but there is some uncertainty.	Submission of planning or consent application imminent. Development application within the consent process.
Reasonably foreseeable: The outcome may happen, but there is significant uncertainty	Identified within a development plan. Not directly associated with the transport strategy/scheme, but may occur if the strategy/scheme is implemented. Development conditional upon the transport strategy/scheme proceeding. Or, a committed policy goal, subject to tests (e.g. of deliverability) whose outcomes are subject to significant uncertainty.
Hypothetical: There is considerable uncertainty whether the outcome will ever happen.	Conjecture based upon currently available information. Discussed on a conceptual basis. One of a number of possible inputs in an initial consultation process. Or, a policy aspiration.

4.3.3 Classifications for each input were assessed in consultation with planning and transport officers at NCC, taking into account guidance, and drawing on local knowledge.

4.3.4 All schemes that are “near certain” or “more than likely” were included in the forecast networks.

Highway Network

4.3.5 Table 4.2 shows the highway schemes identified in consultation with NCC and the uncertainty level attributed to each scheme. The year shown is the first model year when it is expected that a scheme will be implemented by (so the scheme opening date could be earlier than the model year). All the near certain or more than likely schemes are expected to be implemented by 2017, so the resultant 2017 and 2032 Do Minimum networks are identical. Locations of all the highway schemes in the uncertainty log are shown in Figure A.1 in Appendix A.

Table 4.2: Uncertainty Log – Factors Affecting Highway Supply

SI number	Input	Uncertainty	Year	Comment	Status
1	Dereham Road/ Old Palace Road and Heigham Road junction improvement	Near certain (under construction)	2017	Improvements to facilitate bus rapid transit on Dereham Road bus corridor	Local authority scheme: programmed under construction
2	A11(T) Fiveways to Thetford improvement scheme	Near certain (under construction)	2017	Dualling of the last section of the trunk road route between the M11 and Norwich	Highways Agency scheme: under construction
3	Southbound bus lane Grapes Hill	Near Certain	2017	Improvements to facilitate bus rapid transit on Dereham Road bus corridor	Local authority scheme
4	Two way on Cleveland Road and a new junction arrangement at Cleveland Road/Chaplefield North	Near Certain	2017	New Junction arrangements to facilitate Chapelfield North scheme	Local Authority scheme: budgeted and Programmed
5	Bus only on Theatre Street and Chapelfield North and removal of general traffic except buses, taxis and cyclists from Rampant Horse Street	Near Certain	2017	Part of city centre measures to reduce through traffic	Local Authority scheme: budgeted and Programmed
6	Little Bethel Street closure	Near Certain	2017	Part of Chapelfield North scheme and city centre measures	Local authority scheme: budgeted and programmed

7	St Stephens Street and Surrey Street bus only	Near Certain	2017	Part of city centre measures	Local authority scheme: budgeted and programmed
8	Traffic signal priority for buses for signals on radial routes outside of Inner Ring Road	Near Certain	2017	General Signal timing upgrades across Norwich's road network	Local authority scheme: being built
9	Development Link Broadland Business Park to Plumstead Road	Near Certain	2017	Link Road to bypass narrow country road and Thorpe End connecting to Plumstead Road	Developer scheme:Planning Approval subject to S106
10	Salhouse Road - Wroxham Road Link Road	Near Certain	2017	New Road through new housing estate Connecting Wroxham Road to Salhouse Road	Developer scheme: approved planning permission
11	Tuckswood Roundabout Improvements, Norwich (Harford Place)	Near Certain	2017	Improvements to the approach of the roundabout and improved crossing facilities (Barrett Road)	Developer scheme: approved planning permission
12	Norwich Research Park Transport Infrastructure	Near Certain	2017	Junction Improvement on B1108/Hethersett Lane junction including signalisation	Developer scheme: approved planning permission
13	Westlegate - removal of straight ahead movement	Near certain	2017	Part of city centre measures to reduce through traffic	Local authority scheme: budgeted and programmed

14	Lenwade to Honingham	More than likely	2017	Improvement scheme to widen carriageway for HGV's	Local authority scheme: phased programme agreed and construction
15	Bus only on All Saints Green	More than likely	2017	Closure of All Saints Green to all general traffic except buses	Local authority scheme: feasible, but not programmed
16	Longwater Interchange Improvements – To mitigate impact of Lodge Farm 2 residential development	More than likely	2017	Free flow slip from A1074 westbound onto A47(T) eastbound and part signalisation of the south dumbbell roundabout	Developer scheme: planning application being assessed
17	Westbound bus lane on approach to Larkman Road, Costessey	Reasonably foreseeable		Improvements to facilitate bus rapid transit on Dereham Road bus corridor	Local authority scheme: investigation instigated without conclusion
18	Westbound bus lane on approach to Norwich Road , Costessey	Reasonably foreseeable		Improvements to facilitate bus rapid transit on Dereham Road bus corridor	Local authority scheme: investigation instigated without conclusion
19	John Lewis car park right turn in and out	Reasonably foreseeable		Car Park entrance changes allowing all movements	Local authority scheme: feasible, but not programmed
20	Thickthorn Roundabout Improvements	Reasonably foreseeable		Feasibility work currently under way	Highways Agency scheme: feasible, but not programmed

21	Eastbound bus lane on Dereham Road bypassing Bowthorpe Roundabout	Reasonably foreseeable		Improvements to facilitate bus rapid transit on Dereham Road bus corridor	Local authority scheme: feasible, but not programmed
22	Westbound bus lane on approach to Outer Ring Road/Dereham Road and junction improvement	Reasonably foreseeable		Improvements to facilitate bus rapid transit on Dereham Road bus corridor	Local authority scheme: feasible, but not programmed
23	Longwater Interchange – large scale improvement	Reasonably foreseeable		Feasibility work currently under way	Local authority scheme: feasible, but not programmed
24	Improvements to the A47(T) trunk road including junctions and dualling	Reasonably foreseeable		Road infrastructure improvements	Highways Agency schemes: feasible, but not programmed
25	Eastbound bus lane on Dereham Road on approach to Longwater Lane junction, Costessey	Reasonably foreseeable		Improvements to facilitate bus rapid transit on Dereham Road bus corridor	Local authority scheme: feasible, but not programmed

Public Transport Network

4.3.6 Table 4.3 shows the public transport schemes identified and the uncertainty of the schemes going ahead. Locations of all the public transport schemes in the uncertainty log are shown in Figure A.2 in Appendix A.

Table 4.3: Uncertainty Log – Factors Affecting Public Transport Study

Sl number	Input	Uncertainty	Year	Comment	Status
1	Extension of Postwick Park and Ride site	Near certain	2017	Capacity Improvements	Local authority scheme: has planning permission
2	Increase in frequency on the number of bus routes to reflect a minimum level of service	Reasonably Foreseeable/ Hypothetical	N/A	N/A	N/A
3	Increase frequency of rail services	Reasonably foreseeable/ Hypothetical	N/A	N/A	N/A
4	Norwich Bus Strategy	Hypothetical	N/A	N/A	N/A
5	New station to serve Rackheath Eco-community or relocation of existing Salhouse Station.	Hypothetical	N/A	N/A	N/A
6	New rail halt/station at Broadland Business Park/Dussindale Park	Hypothetical	N/A	N/A	N/A
7	New rail halt/station at Postwick Park and Ride	Hypothetical	N/A	N/A	N/A
8	New Park and Ride site at Trowse	Hypothetical	N/A	N/A	N/A

4.3.7 With the exception of extension of Postwick Park and Ride site, all the other public transport schemes as identified in Table 4.3 were given a reasonably foreseeable or hypothetical uncertainty level, and therefore based on this qualitative assessment these public transport schemes were not included in the Do-Minimum scenario. However, it must be noted that a number of schemes identified in the highway uncertainty log are focussed on providing bus priority and have been reviewed for inclusion based on their uncertainty level. All changes to the highway network that would impact on public transport were reflected in the public transport networks.

4.3.8 Rail services remain the same as in the base year as no schemes were identified following consultation that would have a significant impact on level of service.

4.4 Do Something Network

4.4.1 The Do Something networks consist of a number of elements:

- The Norwich Northern Distributor Road;
- Offline improvement measures; and
- City Centre network improvements.

Norwich Northern Distributor Road

4.4.2 The preferred route option for the NDR is shown in Figure B.1 in Appendix B. The NDR is proposed to commence in the west at a new junction on the A1067 north of Taverham and connect to the A47(T)to the east of Norwich at the Postwick junction. The total length of the proposed NDR is approximately 20.4km. It is of dual two lane carriageway standard for the entire length, with grade separated junctions at the Postwick Hub Junction with the A47(T) and at the A140 Cromer Road junction and at-grade roundabouts with other major radial routes.

4.4.3 Link lengths and planned junction layouts have been taken from the current design drawings. The NDR has been assigned a speed flow curve which corresponds to a D2 dual carriageway rural road.

Offline Improvement Measures

4.4.4 The following schemes are included as part of the NDR scheme and shown in Figure B.3 in Appendix B:

- Wroxham Road/ Green Lane junction improvement;
- North Walsham Road/ Crostwick Lane junction improvement; and
- Thorpe End: Traffic Management as per Parish Plan (two mini-roundabouts and a pedestrian crossing).

4.4.5 There are a number of locations in Norwich that currently experience rat running. In the northern suburbs it is anticipated that the NDR will reduce or remove these problems. It is felt by some that there may be increases in other locations. To assuage these fears, traffic levels at these locations will be monitored and traffic management measures implemented if required.

City Centre Network Improvements

4.4.6 In conjunction with the NDR, complementary traffic management measures are proposed for Norwich city centre, with the aim of discouraging through car trips and reducing the dominance of traffic in certain areas. The following schemes are included:

- Golden Ball Street and Farmers Avenue two-way;
- Removal of general traffic except buses, taxis and cyclists from Red Lion Street;
- Full closure of Westlegate;
- Removal of general traffic except buses, taxis and cyclists from Prince of Wales Road (except eastern section);
- Bus only on Prince of Wales Road and Agricultural Hall Plain; and
- Removal of some non-bus, taxi or cycle through traffic from Tombland – occurs as a consequence of the sum of the other measures.

4.4.7 Figure B.2 in Appendix B shows current proposals, and these have been modelled in the Do Something scenario.

4.5 Change in Travel Costs

4.5.1 Changes of travel costs in the opening and forecast years are to be expected due to increases in incomes and the value of time, changes in fuel costs and improvements in vehicle efficiency. Therefore, the cost assumptions of the validated base year models have been updated in the future year assignments.

4.5.2 Cost changes have been calculated for each forecast year and are applicable to both the Do Minimum and Do Something scenarios.

Highway Generalised Cost Parameters

4.5.3 The highway trip costs are made up of time, distance and charge impacts. The Value Of Time (VOT) and Vehicle Operating Cost (VOC) vary by journey purpose and also vary by forecast year to represent changes in fuel costs and income. Changes in fuel costs, vehicle efficiency and values of time included in WebTAG 3.5.6 issued in October 2012 have been used to calculate forecast year values of time and operating costs. Table 4.4 details the highway generalised cost coefficients used for 2012, 2017 and 2032 in pence per minute (PPM) and pence per kilometre (PPK). The values for cars have additionally been adjusted to take account of the proportion of non-freight LGVs which gives slightly different values for each time period.

4.5.4 The PPK values are expected to reduce from the 2017 to the 2032 forecasting year due to fuel efficiency improvements for cars and LGVs.

Table 4.4: 2012, 2017 and 2032 Highway Generalised Cost Coefficients (2010 Prices)

	AM		Inter Peak		PM	
	PPM	PPK	PPM	PPK	PPM	PPK
2012						
Work	12.39	7.51	12.29	7.51	12.10	7.51
Employer Business	53.83	13.74	52.61	13.74	51.85	13.74
Other	15.84	7.51	16.47	7.51	16.92	7.51
Light Goods Vehicles	20.66	15.95	20.66	15.95	20.66	15.95
Other Goods Vehicles	35.85	45.63	35.85	45.63	35.85	45.63
2017						
Work	13.41	7.09	13.30	7.09	13.10	7.09
Employer Business	59.45	13.39	58.09	13.39	57.25	13.39
Other	17.14	7.09	17.83	7.09	18.32	7.09
Light Goods Vehicles	22.78	15.52	22.78	15.52	22.78	15.52
Other Goods Vehicles	39.59	47.24	39.59	47.24	39.59	47.24
2032						
Work	16.62	5.38	16.48	5.38	16.24	5.38
Employer Business	77.72	11.97	75.95	11.97	74.85	11.97
Other	21.25	5.38	22.10	5.38	22.70	5.38
Light Goods Vehicles	29.65	14.16	29.65	14.16	29.65	14.16
Other Goods Vehicles	51.76	49.99	51.76	49.99	51.76	49.99

Public Transport Generalised Cost Parameters

4.5.5 As the generalised journey time (GJT) calculation in the public transport model includes fares, appropriate values of time and fare coefficients are required. VISUM operates in units of generalised time, the fare coefficient is the time equivalent (in minutes) of a £1 fare. The future year generalised times were calculated taking into account the assumed real growth in fares (presented in section 4.5.8), and future year Values of Time (extracted from WebTAG Unit 3.5.6, October 2012). Table 4.5 shows the future year Value of Time and resultant fare coefficients used for public transport in the base and forecast years.

Table 4.5: Values of Time and Fare Coefficients for PT Assignment (2010 Prices)

User Class	**Value of Time (£/hour)**			**Fare Coefficients (minutes/£)**		
	2012	**2017**	**2032**	**2012**	**2017**	**2032**
EB-(work)	21.7	23.96	31.32	2.77	2.5	1.92
Commute-(non-work)	6.46	6.99	8.67	9.29	8.58	6.92
Other-(non-work)	5.71	6.18	7.66	10.51	9.7	7.83

Car Parking and Park and Ride Charges

4.5.6 Future year parking charges for the main car parks in Norwich have been assumed to increase in real terms in line with the Gross Domestic Product (GDP) growth rates shown in WebTAG 3.5.6, October 2012; this amounts to a compound growth rate of 2% pa to 2032.

4.5.7 Similar to the parking charges, Park and Ride charges have been assumed to increase with the GDP growth rates as discussed above.

Public Transport Fares

4.5.8 In consultation with the Norfolk County Council, the public transport fare growth calculation for the forecast year models assumed real terms increase in fares as follows, based on local experience:

- Bus: 1.8% per annum; and
- Rail: 1% per annum.

5 Future Year Traffic Growth

5.1 Requirements

5.1.1 For forecasting purposes, future year demand matrices are required by mode and time period reflecting:

- National traffic growth forecasts; and
- Proposed developments spatially allocated according to the JCS, but growth constrained to national forecasts.

5.1.2 Future year matrices are required for the opening year (2017) and design year (2032). For home based trip purposes, demand matrices are required in 24 hour Production and Attraction (PA) format. For non-home based and freight trip purposes matrices are required for the following time periods:

- AM Peak hour (08:00 – 09:00);
- Average Inter Peak Hour (10:00 – 16:00);
- PM Peak hour (17:00 – 18:00); and
- Average Off Peak Hour (19.00 – 7.00).

5.2 Overview of Process

5.2.1 Two methods have been used to produce future trip levels with the method employed being dependent on geographic location.

5.2.2 For the Norwich, Broadland and South Norfolk areas, the trip generation of proposed developments likely to be completed between 2012 and 2032 has been predicted using the TRICS trip rate database. The trip totals for the combined Norwich, Broadland and South Norfolk area have then been controlled to the growth predicted in the NTEM 6.2 dataset for car trips (all purposes) and for LGV trips (commute and other purposes only). These proposed developments were incorporated into all the forecast matrices.

5.2.3 In the remaining areas of the model, including Breckland, Great Yarmouth, North Norfolk, King's Lynn and West Norfolk, and other areas of the model where the model detail is coarser, NTEM 6.2 growth factors were applied directly to the base year matrices for car trips (all purposes) and LGV trips (commute and other purposes only), with no account taken explicitly for completed developments as the remoteness from the Scheme means that the exact locations of development are not important for the purpose of the scheme appraisal.

5.2.4 Growth factors for employers business trips for Other Goods Vehicles (OGV) and Light Goods Vehicles (LGV) have been calculated using data from the Department for Transport's Road Transport Forecasts for 2013 (RTF13).

5.2.5 The reference case matrices developed specifically for the NDR model were identical for the Do-Minimum and Do-Something scenarios, with the same representation of development and the demand for both scenarios controlled to the same growth forecast from NTEM 6.2 and RTF 2013.

5.3 Developments

5.3.1 Proposed developments in the model area were assessed by NCC on the basis of the likelihood of completion and a set of most likely developments were input into the modelling process for explicit representation. The full list of developments that were included is contained in Appendices C and E and a graphical representation of these developments is shown in Appendices D and F.

5.4 Development Trip Generation

Production of TRICS Trip Rates

5.4.1 The TRICS 2012(b) trip rate database was used to derive average trip generation rates for residential, business and retail development land use types. As there are a large number of proposed developments, using average TRICS rates provides a reasonable estimate of the overall increase in trip generation from the developments. Trip rates were extracted for the following TRICS categories as shown in Table 5.1, below.

Table 5.1: Development Land Use Type and TRICS Category

Development Land Use Type	TRICS Category
Residential	03A Residential - Houses Privately Owned
B1 Business	02B Employment - Business Park
B2 Business	02D Employment - Industrial Estate
B8 Business	02F Employment - Warehousing

5.4.2 For all TRICS categories that were interrogated, only sites with multimodal surveys were selected so that multi-modal splits could be derived. Average trip rates were calculated for the following time periods:

- AM peak hour (08:00 – 09:00);
- Average inter-peak hour (Average hourly flow for 10:00 – 16:00);
- PM peak hour (17:00 – 18:00); and
- 12 hour total (07:00 – 19:00).

5.4.3 Selections were based on all available data between 01/01/2004 and 18/11/2011 for all locations in the dataset excluding London and Ireland. Trip rates were calculated for weekdays only, for the 12 hour period 07:00 to 19:00. Modal splits were derived for each land use type for the entire period of the surveys and applied to the trip rates for all vehicles for each time period. Key steps in building the matrices are described below.

Conversion of TRICS Vehicular Trip Rates to Trip Rates by Model Purpose

5.4.4 The TRICS vehicular trip rates, shown in the tables above, required conversion to the purposes used in the demand and assignment models. In addition, for the home-based production attraction purposes, trip rates were required for a 24 hour period. Use of CTripend data facilitated the production of trip rates in the required formats; CTripend is Department for Transport software.

Splitting of Trip Rates by Purpose

5.4.5 CTripend output data, available at zone level, was used to split the calculated vehicular TRICS trip rates into trip rates by purpose. The extracted data contains trip ends by time period, mode and journey purpose. The most appropriate existing zones were selected by land-use type using local knowledge to represent the built development, as follows:

- Residential – Zone 8 (Thorpe Mariott);
- Retail – Zone 8 (Riverside Retail Park); and
- Business – Zone 121 (Sweet Briar Industrial Estate) and Zone 349 (Broadland Business Park).

5.4.6 Trip purpose proportions were then calculated for these areas and used to split the trip rates from TRICS into purposes, so that the development trip generation could be added into the user classes of the model.

Splitting of Trip Rates by Mode

5.4.7 Multimodal surveys for each TRICS category were used to produce modal splits between car, public transport, LGV and HGV for each development land-use type.

5.4.8 An average was calculated for each land-use using all of the surveys available which had full multi-modal splits for the complete survey day.

5.4.9 Further splitting of the public transport trip rates into bus and rail trip rates was achieved using CTripend data for each land use type to find the proportions of trip-ends at zones appropriately matching each land-use type.

Controlling to NTEM and RTF

5.4.10 The forecasts are controlled to NTEM and RTF. This is explained in section 5.9.

Adjustment for Travel Planning and Distribution

5.4.11 It is considered that the impact of travel planning will have the effect of reducing vehicle trip generation at the proposed developments. To model this effect, an 11% reduction to the vehicle trip generation predicted by TRICS has been made to car trips. This is taken from the Department for Transport's documents 'Making Residential Travel Plans Work' (2007) and Making Personal Travel Planning Work: A practitioners' Guide (2008). This reduction is consistent with the reduction accepted by NCC development control for the Beyond Green development at North Spowston and Old Catton, and it is within the range suggested in WebTAG Unit 3.10.6.

5.4.12 For the Rackheath Eco Town and Beyond Green developments a pragmatic approach was adopted to account for the reduced vehicular trip generation that would be likely to occur at these developments when compared with more typical sites found in TRICS. A 30% reduction to the vehicular trip generation was made for these two sites, which represents the 'internalisation' of the trip generation within each respective site. This is consistent with the assumed reduction that has been accepted by NCC development control for the Beyond Green development at North Spowston and Old Catton.

5.4.13 It should be noted that the reductions to development trips to take account of travel planning and for the different nature of the Rackheath Eco Town and of the Beyond Green developments were made after the constraint to NTEM was achieved. Therefore, the growth in reference case highway trips from the base year to the forecast years will be less than that predicted by NTEM.

5.4.14 The outturn vehicle trip rates for each time period and land use (see paragraph 5.4.11) are shown below in Table 5.2 to Table 5.9. The car trip rates allow for an 11% reduction to account for travel plans. Full TRICS outputs are attached at Appendix G (these are the trip rates directly from TRICS prior to the adjustment).

Table 5.2: TRICS Residential Trip Rates (Vehicle Trips per Dwelling)

Vehicle type	AM Peak (8:00-9:00)		Inter Peak (10:00-16:00)		PM Peak (17:00-18:00)		12 Hour (07:00-19:00)	
	IN	OUT	IN	OUT	IN	OUT	IN	OUT
Car	0.127	0.327	0.158	0.149	0.307	0.184	2.055	2.117
LGV	0.016	0.041	0.020	0.019	0.038	0.023	0.256	0.264
HGV	0.002	0.005	0.002	0.002	0.005	0.003	0.031	0.032

Table 5.3: TRICS B1 Trip Rates (Vehicle Trips per 100sqm Gross Floor Area)

Vehicle type	AM Peak (8:00-9:00)		Inter Peak (10:00-16:00)		PM Peak (17:00-18:00)		12 Hour (07:00-19:00)	
	IN	OUT	IN	OUT	IN	OUT	IN	OUT
Car	1.159	0.218	0.245	0.272	0.144	0.944	4.093	4.047
LGV	0.128	0.024	0.027	0.030	0.016	0.104	0.452	0.447
HGV	0.026	0.005	0.006	0.006	0.003	0.021	0.093	0.092

Table 5.4: TRICS B2 Rates (Vehicle Trips per 100sqm Gross Floor Area)

Vehicle type	AM Peak (8:00-9:00)		Inter Peak (10:00-16:00)		PM Peak (17:00-18:00)		12 Hour (07:00-19:00)	
	IN	OUT	IN	OUT	IN	OUT	IN	OUT
Car	0.199	0.100	0.118	0.132	0.050	0.160	1.383	1.468
LGV	0.106	0.053	0.063	0.07	0.027	0.086	0.739	0.784
HGV	0.041	0.02	0.024	0.027	0.01	0.033	0.285	0.302

Table 5.5: TRICS B8 Trip Rates (Vehicle Trips per 100sqm Gross Floor Area)

Vehicle type	AM Peak		Inter Peak		PM Peak		12 Hour	
	(8:00-9:00)		(10:00-16:00)		(17:00-18:00)		(07:00-19:00)	
	IN	OUT	IN	OUT	IN	OUT	IN	OUT
Car	0.045	0.024	0.037	0.039	0.018	0.045	0.409	0.438
LGV	0.015	0.008	0.013	0.014	0.006	0.015	0.14	0.15
HGV	0.019	0.01	0.016	0.017	0.008	0.019	0.177	0.19

Table 5.6: TRICS DIY Store Trip Rates (Vehicle Trips per 100sqm Gross Floor Area)

Vehicle type	AM Peak		Inter Peak		PM Peak		12 Hour	
	(8:00-9:00)		(10:00-16:00)		(17:00-18:00)		(07:00-19:00)	
	IN	OUT	IN	OUT	IN	OUT	IN	OUT
Car	0.632	0.391	1.590	1.559	1.131	1.266	15.389	14.649
LGV	0.091	0.056	0.229	0.225	0.163	0.183	2.221	2.114
HGV	0.018	0.011	0.046	0.045	0.033	0.037	0.447	0.426

Table 5.7: TRICS Non Food Superstore Trip Rates (Vehicle Trips per 100sqm Gross Floor Area)

Vehicle type	AM Peak		Inter Peak		PM Peak		12 Hour	
	(8:00-9:00)		(10:00-16:00)		(17:00-18:00)		(07:00-19:00)	
	IN	OUT	IN	OUT	IN	OUT	IN	OUT
Car	0.296	0.152	2.040	1.970	1.299	1.379	17.344	16.703
LGV	0.009	0.005	0.064	0.061	0.04	0.043	0.541	0.521
HGV	0.001	0.001	0.007	0.007	0.004	0.005	0.059	0.057

Table 5.8: TRICS Fast Food Drive through Trip Rates (*Vehicle Trips per 100sqm Gross Floor Area)

Vehicle type	AM Peak		Inter Peak		PM Peak		12 Hour	
	(8:00-9:00)		(10:00-16:00)		(17:00-18:00)		(07:00-19:00)	
	IN	OUT	IN	OUT	IN	OUT	IN	OUT
Car	2.284	1.054	6.600	6.552	6.186	6.533	67.612	64.725
LGV	0.276	0.127	0.797	0.791	0.747	0.789	8.164	7.816
HGV	0	0	0	0	0	0	0	0

Table 5.9: TRICS Private Fitness Club Trip Rates (Vehicle Trips per 100sqm Gross Floor Area)

Vehicle type	AM Peak		Inter Peak		PM Peak		12 Hour	
	(8:00-9:00)		(10:00-16:00)		(17:00-18:00)		(07:00-19:00)	
	IN	OUT	IN	OUT	IN	OUT	IN	OUT
Car	0.452	0.713	0.596	0.602	1.535	0.832	9.082	7.896
LGV	0.015	0.023	0.019	0.019	0.05	0.027	0.294	0.256
HGV	0.002	0.002	0.002	0.002	0.005	0.003	0.03	0.026

5.5 Development at Broadland Gate

5.5.1 Due to the location and considerable size of the proposed Broadland Gate development, modelling of this development was carried out using a different methodology to that used for the other proposed developments.

5.5.2 As with the other developments, average TRICS trip rates have been used to calculate the trip generation, however, special attention has been afforded to this development to ensure that the inbound and outbound generated trips were consistent between the assignment models and those predicted by TRICS. Due to the 24 hour format of the Home Based Work, Home Base Employers Business and Home Based Other user classes, this was completed by preparing bespoke DIADEM time period factors for this development.

5.5.3 The peak hour trip generation for the Broadland Gate development was based upon the following development quantum taken from the Broadland Gate Transport Assessment.

Table 5.10: Broadland Gate Development Quantum

Land Use	Development Quantum	TRICS Category
B1/ B2/ B8	42,000 sqm	02B Employment – Business Park 02D Employment – Industrial Estate 02F Employment – Warehousing
Hotel	120 beds	06A Hotels Food & Drink – Hotels
Leisure Club	1,890 sqm	07K Leisure – Fitness Club (Private)
Residential Apartments	75 no.	03C Residential – Flats Privately Owned
Medical Facility	3,150 sqm	05B Health – General Hospital Without Casualty
Ancillary Retail	2,400 sqm	01G Retail – Other Individual Non-Food Superstore
Car Showroom	1,208 sqm	14A Car Show Rooms – Car Show Rooms
Pub/ Restaurant	1,575 sqm	06C Hotels Food & Drink – Pub/ Restaurant
Nursery	420 sqm	04D Education – Nursery

5.5.4 In consultation with NCC, it has been assumed that 10% of the development will be completed and occupied by 2017 and that it will be fully completed and occupied by 2032.

5.5.5 Average TRICS trip rates have been used for the development with an 11% reduction for travel plans (as described in Paragraph 5.4.11) and are shown in Table 5.11 and Table 5.12. Full TRICS outputs are attached at Appendix G.

Table 5.11: Average TRICS Business Trip Rates (Vehicle Trips per 100sqm)

Land Use	AM Peak (8:00-9:00)		Inter Peak (10:00-16:00)		PM Peak (17:00-18:00)	
	IN	OUT	IN	OUT	IN	OUT
B1	1.313	0.247	0.278	0.309	0.163	1.070
B2	0.347	0.173	0.206	0.229	0.086	0.279
B8	0.079	0.042	0.066	0.070	0.031	0.079

Table 5.12: Average TRICS Residential Trip Rates (Vehicle Trips per Dwelling / 100sqm)

Land Use	AM Peak (8:00-9:00)		Inter Peak (10:00-16:00)		PM Peak (17:00-18:00)	
	IN	OUT	IN	OUT	IN	OUT
Hotel with integrated conference and leisure facilities	0.153	0.194	0.089	0.091	0.153	0.135
Residential	0.070	0.261	0.084	0.082	0.242	0.113
Leisure Club / Swimming Pool	0.468	0.737	0.617	0.622	1.588	0.861
Medical Facility	1.061	0.339	0.633	0.683	0.150	0.470
Ancillary Retail	0.306	0.157	2.108	2.036	1.342	1.425
Car Show room	0.750	0.279	0.505	0.506	0.253	0.628
Pub / Restaurant	0.000	0.000	1.364	1.209	2.522	1.917
Nursery	4.167	3.577	0.908	0.938	2.637	2.935

5.5.6 The trip generation rates shown above were applied to the development quantum for the development shown in Table 5.10 resulting in the trip generation shown in Table 5.13.

Table 5.13: Broadland Gate Generated Trips (Vehicles)

	AM Peak (8:00-9:00)		Inter Peak (10:00-16:00)		PM Peak (17:00-18:00)	
	IN	OUT	IN	OUT	IN	OUT
Trips	644	191	246	256	224	583

5.6 Trip Distribution

5.6.1 The gravity model developed during the construction of the base year model was used to distribute development generated trips. The gravity model was given the following inputs:

- Origin/Production or Destination/Attraction development generated trips by purpose for each zone;
- Row or Column totals from base matrix including development;
- Concentration parameter for appropriate purpose; and
- Trip lengths by mode.

5.6.2 Trip length skims from the base year model were used. Analysis has been carried out using skims from the forecast models to confirm that the forecast trip lengths are broadly consistent with the base year trip lengths.

Concentration Parameters

5.6.3 In the context of trip distribution modelling, concentration defines how spread out (or concentrated) the two ends of a trip are, with a strongly negative concentration parameter indicating a relatively concentrated distance between the two trip ends and therefore trip length and a weakly negative or positive concentration parameter indicating trip ends that relatively spread out with a longer trip length. The concentration parameters were taken from the calibrated trip distribution models. For the home based other and non-home based other purposes the concentration parameters were split into several sub-purposes, namely education, personal business, recreational, shopping and visiting friends.

5.6.4 Weighted average concentration parameters for home based other and non-home based other purposes were calculated using trip-ends split by the named sub-purposes from CTripend as the weightings. A summary of the concentration parameters used in the gravity model is shown in Table 5.14.

Table 5.14: Concentration Parameters (Value relate to trip distance in metres)

Mode	Home Based Work	Home Based Employers Business	Home Based Other	Non-Home Based Employers Business	Non-Home Based Other	LGV	HGV
Highway	-0.00012	-0.00005	-0.00032	-0.00005	-0.00022	-0.00004	-0.00003
Bus	-0.00085	-0.00071	-0.00094	-0.00068	-0.00079	N/A	N/A
Rail	-0.000814	-0.00068	-0.00091	-0.00062	0.00001	N/A	N/A

5.6.5 The concentration parameters shown above in Table 5.14 show that distributed car trips are likely to be more spread out than distributed trips by rail and bus, with LGV and HGV trips being even more spread out.

5.7 NTEM 6.2 Growth

5.7.1 NTEM 6.2 growth factors were extracted using TEMPRO by mode, purpose and time period and then applied to existing traffic patterns in order to calculate the overall NTEM 6.2 growth constraints.

5.7.2 Growth factors have been extracted using TEMPRO software for all NTEM zones in the study area. Growth factors for key TEMPRO / NTEM zones for home based trips are presented in Table 5.15 to Table 5.17.

Table 5.15: NTEM6 2 Car Driver Growth Factors

Region	2012-2017						2012-2032					
	HB Work		HB EB		HB Other		HB Work		HB EB		HB Other	
	P	A	P	A	P	A	P	A	P	A	P	A
East of England	1.046	1.054	1.050	1.060	1.065	1.074	1.105	1.135	1.114	1.150	1.247	1.279
Norfolk	1.049	1.051	1.052	1.055	1.074	1.077	1.135	1.141	1.146	1.148	1.291	1.310
Broadland	1.047	1.056	1.051	1.062	1.069	1.091	1.169	1.137	1.184	1.151	1.321	1.362
Norwich	1.083	1.064	1.092	1.061	1.087	1.063	1.208	1.163	1.220	1.149	1.298	1.222
South Norfolk	1.049	1.055	1.051	1.058	1.070	1.086	1.167	1.169	1.175	1.175	1.317	1.368

Table 5.16: NTEM6 2 Bus Growth Factors

Region	**2012-2017**						**2012-2032**					
	HB Work		**HB EB**		**HB Other**		**HB Work**		**HB EB**		**HB Other**	
	P	**A**	**P**	**A**	**P**	**A**	**P**	**A**	**P**	**A**	**P**	**A**
East of England	0.998	1.007	1.024	1.031	1.022	1.031	1.002	1.032	1.093	1.117	1.172	1.213
Norfolk	0.998	1.002	1.028	1.030	1.022	1.028	1.016	1.031	1.121	1.130	1.179	1.199
Broadland	1.011	1.002	1.038	1.038	1.032	1.034	1.066	1.018	1.177	1.132	1.251	1.250
Norwich	0.990	1.010	1.018	1.037	1.006	1.030	1.027	1.044	1.101	1.134	1.131	1.159
South Norfolk	1.017	1.001	1.040	1.000	1.036	1.031	1.081	1.048	1.187	1.125	1.254	1.264

Table 5.17: NTEM6 2 Rail Growth Factors

Region	**2012-2017**						**2012-2032**					
	HB Work		**HB EB**		**HB Other**		**HB Work**		**HB EB**		**HB Other**	
	P	**A**	**P**	**A**	**P**	**A**	**P**	**A**	**P**	**A**	**P**	**A**
East of England	1.015	1.026	1.038	1.043	1.028	1.042	1.019	1.057	1.089	1.112	1.189	1.229
Norfolk	1.022	1.028	1.041	1.043	1.032	1.042	1.063	1.076	1.116	1.119	1.216	1.247
Broadland	1.028	1.026	1.041	1.054	1.043	1.053	1.108	1.063	1.159	1.135	1.292	1.302
Norwich	1.028	1.035	1.057	1.050	1.008	1.037	1.092	1.089	1.153	1.121	1.139	1.196
South Norfolk	1.032	1.028	1.043	1.034	1.046	1.053	1.114	1.098	1.157	1.138	1.291	1.311

5.8 Freight Growth

5.8.1 Freight growth factors have been extracted from RTF 2013 as shown in Table 5.18. The values for the East of England were used. As the NATS model has a single OGV matrix, a weighted average of rigid and articulated HGV growth rates were applied based on the RTF 2013 proportional split

Table 5.18: 2013 Road Transport Forecasts – Growth Factors

Vehicle type	**East of England**	
	2012-2017	**2012-2032**
LGV	1.096	1.545
OGV - Rigid	0.989	1.075
OGV - Artic	1.057	1.343
OGV (combined)	1.018	1.190

5.9 Derivation of 2017 and 2032 Reference Case Trip Matrices

5.9.1 The methodology is explained in the sections below. This same methodology is used for all modes, journey purposes, time periods, and is applied to both matrix formats i.e. Production and Attraction matrices; and Origin and Destination matrices.

Step 1 - Apply national forecast growth and determine NTEM zone constraints

5.9.2 NTEM 6.2 growth factors were applied to the 2012 base year matrices using a doubly constrained Furness. The Furness takes as input a set of column and row growth factors calculated for each zone in the model. It uses an iterative technique to produce a forecast matrix with each zone displaying a close match between the input tripend growth factor and the implied output tripend growth for both rows and columns. When using this process to growth matrices based on trip end growth factors, it is normal for there to be a very small imbalance between the output growth in the rows and the output growth in the columns when compared to the input growth factors after a number of loops of the furness. It is therefore necessary to adjust the matrix afterwards to match the overall growth factors for the rows, the growth factors for the columns or to for an average of the two. The matrices have been controlled to the average of the rows and the columns.

5.9.3 For LGV and HGV user classes, regional growth factors were calculated using observed and forecast journey distances presented in the Department for Transport's Road Transport Forecast 2013 data. The calculated factors were applied to all trips using a simple matrix factor.

5.9.4 The calculated forecast matrices were then converted to NTEM zone level matrices to obtain their trip end totals so that these can be used as constraints in subsequent steps.

Step 2 - Calculate Trip-ends for Development Zones

5.9.5 For zones with development, development trips were calculated by applying the relevant trip rates to the identified quantum of development.

Step 3: Calculate Trip Distribution for Development Zones

5.9.6 For each development zone, trip distribution by trip purpose was calculated by applying the gravity models developed during the development of the base year model. NTEM growth was not applied to the development generated trips.

Step 4: Create Prior Matrices

5.9.7 The outputs from Step 3 (development matrices) were combined with the 2012 base year matrices to create overall prior matrices. Matrix totals at NTEM zone level were also calculated.

Step 5: Create Constrained Reference Demand Matrices

5.9.8 Trip end totals at NTEM zone level for the prior matrices (Step 4) and NTEM growth only matrices (Step 1) were compared and adjustment factors were calculated. The adjustment factors were applied to the prior matrices but were calculated so as to adjust only the factored base year traffic patterns (Step 1) and not the development trip generation (from Step 3). This results in the production of the final reference case matrices constrained to NTEM.

5.9.9 The above process is applicable to the 2017 and 2032 matrices. Therefore, the 2017 and 2032 matrices contain development trips, but also with the inclusion of a constraint to NTEM 6.2 at NTEM zone level.

5.10 Forecast Reference Demand

5.10.1 The forecast reference demand developed using the above process is presented below.

5.10.2 Future year Reference Case estimates of Home Based (HB) highway trips in 24 hour Production and Attraction (PA) format are presented in Table 5.19. The 24 hour PA trip numbers represent a summation of fixed and variable trips. The growth for HB other trips is higher than for HB work and employers business trips.

5.10.3 Table 5.20 to Table 5.22 present future year Reference Case non-home based trips in Origin to Destination (OD) format, segmented by assignment user class, for the respective AM, IP and PM modelled time periods.

5.10.4 The growth in non-home based trips from base year to the future year of 2017 is estimated to be around 6% to 7%, while 2032 is forecast to be around 16% to 23%.

5.10.5 In terms of freight, OGVs are forecast to grow at 2% up to 2017, and 19% up to 2032. LGV trips are forecast to increase by 10% from base year to 2017 and by 55% from base year to 2032.

Table 5.19: Highway Reference Demand – Home Based Purposes (trips – 24 hour PA format)

		2017 24 Hour			2032 24 Hour		
Purpose	**Base Year**	**Ref**	**Diff**	**Growth from Base**	**Ref**	**Diff**	**Growth from Base**
HB WORK	64,297	67,980	3,682	6%	75,010	10,713	17%
HB EB	11,666	12,370	435	6%	13,667	2,001	17%
HB OTHER	132,768	142,857	34,920	8%	173,413	40,645	31%

Table 5.20: Highway Reference Demand – Non-Home Based Purposes – AM Peak Hour Trips – OD Format

		2017 AM Peak Hour			2032 AM Peak Hour		
Purpose	**Base Year**	**Ref**	**Diff**	**Growth from Base**	**Ref**	**Diff**	**Growth from Base**
NHBEB	1,320	1,396	76	6%	1,528	208	16%
NHBO	2,671	2,826	156	6%	3,092	422	16%
LGV	6,533	7,161	628	10%	10,097	3,564	55%
OGV	12,104	12,326	223	2%	14,406	2,302	19%
Total	22,627	23,710	1,083	5%	29,123	6,496	29%

Table 5.21: Highway Reference Demand – Non Home Based Purposes – IP Peak Hour Trips – OD Format

		2017 IP Peak Hour			2032 IP Peak Hour		
Purpose	**Base Year**	**Ref**	**Diff**	**Growth from Base**	**Ref**	**Diff**	**Growth from Base**
NHBEB	2,670	2,826	156	6%	3,092	422	16%
NHBO	5,786	6,173	387	7%	7,079	1,294	22%
LGV	4,970	5,447	478	10%	7,681	2,711	55%
OGV	12,108	12,331	223	2%	14,411	2,303	19%
Total	25,534	26,778	1,243	5%	32,264	6,729	26%

Table 5.22: Highway Reference Demand – Non-Home Based Purposes – PM Peak Hour Trips – OD Format

		2017 PM Peak Hour			2032 PM Peak Hour		
Purpose	**Base Year**	**Ref**	**Diff**	**Growth from Base**	**Ref**	**Diff**	**Growth from Base**
NHBEB	2,858	3,024	165	6%	3,310	452	16%
NHBO	7,629	8,143	514	7%	9,364	1,735	23%
LGV	5,301	5,811	509	10%	8,193	2,892	55%
OGV	6,026	6,137	111	2%	7,172	1,146	19%
Total	21,815	23,115	1,300	6%	28,040	6,225	29%

5.11 Constraint to NTEM 6.2

5.11.1 In accordance with Department for Transport guidance set out in WebTAG 3.15.1 demand matrices have been constrained to NTEM 6.2 at NTEM sector level. The use of NTEM allows consistency between different parts of the country when justifying transport proposals. However the reference trip totals have been adjusted due to the assumptions used on travel planning and for the internalisation of trips at the Rackheath Eco Town and Beyond Green sites.

5.11.2 Appendix H provides a summary of demand by geographical sectors for home based purposes. This includes 2012 base demand then future year demand levels which are shown for the application of only NTEM growth, the development trips and then the combined demand in which the NTEM growth is adjusted to make allowance for the development trips. This is shown for the two forecast years 2017 and 2032. For a number of the sectors the forecast growth is taken directly from NTEM but for the more local zones, especially Broadland, Norwich and South Norfolk, there is a contribution derived from development that has been built and spatially allocated.

5.11.3 Taking the Table H.1 in Appendix H as an example it shows that Broadland, Norwich and South Norfolk TEMPRO sector 2012 base year productions of 52,046 grow to 55,192 with the application of NTEM growth to 2017, and to 61,554 by 2032. Development productions are estimated at 5,910, and 22,396 in the two forecast years and these have been added, but then the total growth is controlled to NTEM as shown in the combined column. The figures in the reference column match exactly the NTEM growth thus showing that the constraint has been correctly applied.

6 Variable Demand Traffic Forecasts

6.1 Overview

6.1.1 The modelling framework has been used to determine variable demand forecasts for the Do Minimum and Do Something scenarios, defined as follows:

- Do-Minimum - without the proposed transport intervention; and
- Do-Something - with the proposed transport intervention and associated improvements as well as city centre transport management measures.

6.1.2 The demand model parameters were adjusted in accordance with WebTAG guidance to make sure that realistic elasticity of demand to cost change is produced by the model. The demand model was run to convergence and the convergence statistics checked against WebTAG targets to make sure that a stable model at equilibrium has been produced. The effects of the demand modelling on the reference forecasts have been assessed. The following sections describe the analyses undertaken.

6.2 Demand Model Realism Testing

6.2.1 Realism testing was undertaken on the base-year demand model in accordance with WebTAG 3.10.4.

6.2.2 Two new sets of variants of the generalised cost coefficient files have been created. These contain the generalised cost with a rise in fuel prices.

Fuel Cost Elasticity

6.2.3 The demand model was run with a 10% fuel cost increases. This increase was reflected in the model by revised assignment generalised costs in the SATURN networks.

6.2.4 The fuel-cost elasticity tests began with WebTAG median parameters and two further tests were run until the final parameters were reached. The final calibrated demand model parameters and outturn elasticities are shown in Table 6.1 and Table 6.2 respectively. The parameters used are within the range suggested in WebTAG 3.10.4 and are thus considered to provide reasonable variable demand response to changes in travel costs.

Table 6.1: Calibrated Demand Model Parameters

Purpose and Mode	WebTAG			NDR Model
Car	**Minimum**	**Median**	**Maximum**	
HBW	0.054	0.065	0.113	0.113
HBEB	0.038	0.067	0.106	0.038
HBO	0.074	0.090	0.160	0.074
NHBEB	0.069	0.081	0.107	0.069
NHBO	0.073	0.077	0.105	0.073

Table 6.2: Outturn Elasticities

Purpose	NDR Elasticity	WebTAG Targets
Work	-0.18	-0.30
EB	-0.15	-0.10
Other	-0.53	-0.40
Total	-0.39	-0.30

6.3 Convergence

6.3.1 One requirement for robust forecasting is that iterative demand and assignment models are well converged. The demand and assignment model convergence statistics are shown in Table 6.3.

6.3.2 The demand model convergence ‘gap’ statistics are between 0.06% and 0.10% for the forecast model scenarios which are below the WebTAG target of 0.2% (values lower than this target means that the model is better converged). This shows that the demand model has converged acceptably well.

6.3.3 Similarly, for all time period models, forecasting years and scenarios, the assignment model convergence ‘gap’ is below the recommended WebTAG value of 0.1% by a substantial margin, generally about ten times less that the target (values lower than this target means that the model is better converged). The measurements of flow and cost changes also exceed the

98% target in all cases (in these cases values higher than the target show that the model is better converged).

6.3.4 The ‘gap’ measures the proximity to an equilibrium solution for the iterative assignment process and the flow and cost changes measure the stability of the solution from one iteration to another. The above shows that the demand model and the assignment model compare very well with the WebTAG targets and it is considered that all of the model runs are well converged

Table 6.3: Convergence Parameters

	2017				2032			
Time Period	**Demand model Gap (Target = 0.2%)**	**Assignment model Gap (Target = 0.1%)**	**Assignment model % Flows (Target = 98%)**	**Assignment model % Costs (Target = 98%)**	**Demand model Gap (Target = 0.2%)**	**Assignment model Gap (Target= 0.1%)**	**Assignment model % Flows (Target = 98%)**	**Assignment model % Costs (Target = 98%)**
Do-Minimum - Scenario A	0.06	N/A			0.10	N/A		
AM	-	0.036	99.7	99.5	-	0.0018	99.6	99.6
IP	-	0.0014	99.8	99.8	-	0.0014	99.8	99.7
PM	-	0.0043	99.4	99.6	-	0.0030	99.3	99.5
OP	-	0	100	100	-	0	99.6	100
Do-Something - Scenario C	0.10	N/A			0.08	N/A		
AM	-	0.0037	98.4	99.2	-	0.0033	99.8	99.8
IP	-	0.00070	99.7	99.9	-	0.0010	99.8	99.8
PM	-	0.0041	99.6	99.5	-	0.0040	99.6	99.4
OP	-	0	100	100	-	0	99.6	100

6.4 Do-Minimum Demand Forecast

6.4.1 The Do-Minimum forecasts of highway demand for home based purposes compared with the reference case are presented in Table 6.4, for the 24 hour PA variable trips. It must be noted that the analysis in Table 6.4 only considers the change in variable HB trips, and does not include the fixed trip element. Therefore a direct comparison cannot be made to Table 5.19, which presents a summation of both fixed and variable trips.

6.4.2 The 24 hour PA comparison (variable trips only) shows that there are very small changes in the home-based highway trip numbers between the Reference Case and the Do Minimum scenario for all forecasting years.

Table 6.4: Do Minimum 24 Hour PA Highway Demand (Variable Trips Only)

	2017				**2032**			
Purpose	**Reference Case**	**Do Minimum**	**Absolute Change**	**% Change**	**Reference Case**	**Do Minimum**	**Absolute Change**	**% Change**
HBW	66,863	66,880	17	0.0%	68,373	68,458	85	0.1%
HBEB	12,229	12,233	4	0.0%	12,856	12,869	13	0.1%
HBO	141,323	141,778	455	0.3%	165,782	168,338	2556	1.5%

6.4.3 The demand model uses a fifteen demand segment setup, disaggregating home based and non-home based trips and also trips that are subject to variable demand modelling changes and those that are not. In order to make the modelling process more efficient, these demand segments are converted into seven user classes for assignment purposes. The private vehicle user class demand from the assignment set up compared with the reference case is reported in Table 6.5 to Table 6.7 for the Do Minimum and Table 6.9 to Table 6.11 for the Do Something.

6.4.4 Table 6.5 to Table 6.7 show a comparison between reference case and Do Minimum future year demand trips (both fixed and variable demand in OD format), for the respective AM, IP and PM peak hours. From the comparison of these it is evident that there are minimal changes in the trip numbers in the AM, inter and PM peaks as a results of the application of variable demand.

Table 6.5: Do Minimum Highway Demand – AM Peak Hour Trips – OD Format

	2017 AM Peak Hour				2032 AM Peak Hour			
Purpose	**Ref**	**DM**	**Diff**	**% Diff**	**Ref**	**DM**	**Diff**	**% Diff**
Work	21,920	21,925	5	0.0%	22,323	22,350	27	0.1%
EB	3,462	3,463	1	0.0%	3,566	3,568	2	0.1%
Other	21,077	21,141	64	0.3%	24,365	24,725	361	1.5%
Total	46,459	46,530	70	0.2%	50,254	50,643	390	0.8%

Table 6.6: Do Minimum Highway Demand – Average IP Hour Trips – OD Format

	2017 IP Peak Hour				2032 IP Peak Hour			
Purpose	**Ref**	**DM**	**Diff**	**% Diff**	**Ref**	**DM**	**Diff**	**% Diff**
Work	2,716	2,717	1	0.0%	2,847	2,851	4	0.1%
EB	4,704	4,704	1	0.0%	4,986	4,988	3	0.1%
Other	26,800	26,884	84	0.3%	31,109	31,600	491	1.6%
Total	34220	34305	85	0.2%	38942	39439	497	1.3%

Table 6.7: Do Minimum Highway Demand – PM Peak Hour Trips – OD Format

	2017 PM Peak Hour				2032 PM Peak Hour			
Purpose	**Ref**	**DM**	**Diff**	**% Diff**	**Ref**	**DM**	**Diff**	**% Diff**
Work	18,574	18,578	4	0.0%	18,920	18,942	22	0.1%
EB	4,832	4,832	1	0.0%	5,072	5,074	2	0.0%
Other	27,763	27,837	74	0.3%	31,943	32,367	425	1.3%
Total	51,169	51,248	79	0.2%	55,935	56,383	448	0.8%

6.5 Do Something Demand Forecasts

6.5.1 Forecasts of HB highway trip demand (24 hour PA format) for the Do Something scenario compared with the reference case scenario are shown in Table 6.8. It must be noted that the 24 hour PA comparison only compares the change in variable trips from Reference to Do Something scenario. From comparison to the Reference scenario, it can be noticed that the relative change in HB trips is very small for all forecast years.

Table 6.8: Do Something Highway Demand – 24 Hour PA (Variable Trips Only)

	2017				2032			
Purpose	**Reference Case**	**Do Something**	**Absolute Change**	**% Change**	**Reference Case**	**Do Something**	**Absolute Change**	**% Change**
HBW	66,863	66,878	15	0.0%	68,373	68,465	92	0.1%
HBEB	12,229	12,233	4	0.0%	12,856	12,869	14	0.1%
HBO	141,323	142,212	889	0.6%	165,782	168,700	2918	1.8%

6.5.2 Table 6.9 to Table 6.11 show Do Something future year demand trips (both fixed and variable demand in OD format) compared with the reference case, for the respective AM, IP and PM peak hours. From the comparison of these it is evident that there are only very minimal changes in trip numbers across all trip purposes and time periods.

Table 6.9: Do Something Highway Demand – AM Peak Hour Trips – OD Format

	2017 AM Peak Hour				2032 AM Peak Hour			
Purpose	**Ref**	**DS**	**Diff**	**% Diff**	**Ref**	**DS**	**Diff**	**% Diff**
Work	21,920	21,925	5	0.0%	22,323	22,354	31	0.1%
EB	3,462	3,463	1	0.0%	3,566	3,568	3	0.1%
Other	21,077	21,216	139	0.7%	24,365	24,828	463	1.9%
Total	46,459	46,604	145	0.3%	50,254	50,750	496	1.0%

Table 6.10: Do Something Highway Demand – Average IP Hour Trips - OD Format

	2017 IP Peak Hour				2032 IP Peak Hour			
Purpose	**Ref**	**DS**	**Diff**	**% Diff**	**Ref**	**DS**	**Diff**	**% Diff**
Work	2,716	2,717	1	0.0%	2,847	2,851	4	0.1%
EB	4,704	4,704	1	0.0%	4,986	4,989	3	0.1%
Other	26,800	26,958	158	0.6%	31,109	31,696	587	1.9%
Total	34220	34379	159	0.5%	38942	39536	594	1.5%

Table 6.11: Do Something Highway Demand – PM Peak Hour Trips – OD Format

	2017 PM Peak Hour				2032 PM Peak Hour			
Purpose	**Ref**	**DS**	**Diff**	**% Diff**	**Ref**	**DS**	**Diff**	**% Diff**
Work	18,574	18,578	4	0.0%	18,920	18,945	25	0.1%
EB	4,832	4,832	1	0.0%	5,072	5,074	2	0.0%
Other	27,763	27,940	177	0.6%	31,943	32,500	558	1.7%
Total	51,169	51,351	182	0.4%	55,935	56,519	585	1.0%

6.5.3 Table 6.12 to Table 6.14 compares the trip numbers in the Do Something and Do Minimum matrices. It can be seen that the variable demand process makes very little difference to the trip numbers between the two.

Table 6.12: Do Something Compared with Do Minimum Trip Numbers AM

	2017 AM Peak Hour				2032 AM Peak Hour			
Purpose	**DM**	**DS**	**Diff**	**% Diff**	**DM**	**DS**	**Diff**	**% Diff**
Work	21,925	21,925	0	0.0%	22,350	22,354	4	0.0%
EB	3,463	3,463	0	0.0%	3,568	3,568	0	0.0%
Other	21,141	21,216	75	0.4%	24,725	24,828	102	0.4%
Total	46,530	46,604	75	0.2%	50,643	50,750	107	0.2%

Table 6.13: Do Something Compared with Do Minimum Trip Numbers Inter-Peak

	2017 IP Peak Hour				2032 IP Peak Hour			
Purpose	**DM**	**DS**	**Diff**	**% Diff**	**DM**	**DS**	**Diff**	**% Diff**
Work	2,717	2,717	0	0.0%	2,851	2,851	0	0.0%
EB	4,704	4,704	0	0.0%	4,988	4,989	1	0.0%
Other	26,884	26,958	74	0.3%	31,600	31,696	96	0.3%
Total	34305	34379	74	0.2%	39439	39536	97	0.2%

Table 6.14: Do Something Compared with Do Minimum Trip Numbers PM

	2017 PM Peak Hour				2032 PM Peak Hour			
Purpose	**DM**	**DS**	**Diff**	**% Diff**	**DM**	**DS**	**Diff**	**% Diff**
Work	18,578	18,578	0	0.0%	18,942	18,945	3	0.0%
EB	4,832	4,832	0	0.0%	5,074	5,074	0	0.0%
Other	27,837	27,940	103	0.4%	32,367	32,500	133	0.4%
Total	51,248	51,351	103	0.2%	56,383	56,519	136	0.2%

7 Network Performance

7.1 Traffic Impact

7.1.1 The forecast traffic flows on the NDR and the surrounding area are shown in Figures I.1 and I.2 in Appendix I. Traffic flows at Wensum Valley section of the network are shown in Figure I.3. Locations in this area have been selected to indicate traffic movements between the A47(T) and the A1067. These show the AADT traffic flows for the different forecast scenarios. The traffic flows for these scenarios for each time period is shown in Tables I.1 to I.5 in Appendix I. The following sections describe key changes in traffic flows at AADT level on the network.

Strategic traffic movements

7.1.2 A number of the model links that carry strategic traffic flows are outside the fully modelled area and as they are outside this area they are not calibrated or validated to observed data. As a result of this the base year flows on these links may not be fully representative of total traffic levels. However, it is considered that the forecast changes in traffic levels on these links as a result of the scheme are still valid.

7.1.3 In providing better access to northern Norwich suburbs and the proposed new development locations in the North East Growth Triangle from the proposed new junction with the A47(T) at Postwick, the routes from the east become more attractive via the A47(T) east of Norwich (see Figure I.4 in Appendix I). In 2017 there is an estimated switch of 1100 AADT from the A146 and the A149 to the A12(T)/A47(T) (sites 2 and 4 to site 1). In 2032 the corresponding figure is 2500 AADT. This represents a reduction of 4% (site 2) on the A146 between Beccles and Trowse junction with the A47(T) in 2017 and 7% in 2032, and as a result of these reductions there is a reassignment in the peak hours in 2032 that relieves the B1135/B1527/B1332 route between Dereham and Bungay to the south of the southern bypass which amounts to an AADT reduction 300 (4%) in 2032 (site 5). In addition there are reassignments of traffic north of Great Yarmouth on the A149 route from Caister on Sea resulting in reductions of 300 AADT in 2017 and 1000 AADT in 2032 (4% and 11% respectively) (site 4). The increase in traffic using the A47(T) between Great Yarmouth and Acle (the switching of 1100 AADT in 2017 and 2500 AADT in 2032) represents an increase of 4% in 2017 and 8% in 2032 (site 1). On the A47(T) east of Postwick there is an increase of 3800 AADT in 2017 and 4100 AADT in 2032, representing proportional changes of 11% in both years (site 3).

7.1.4 To the east of Norwich the NDR results in orbital traffic reducing on the existing routes between the A47(T) and A1151 Wroxham Road via Church Road / Broad Lane / Green Lane West through Great Plumstead and Woodbastwick Road / B1140 Low Road and Bell Lane through Salhouse. The first route via Great Plumstead experiences reductions of 4100 AADT (66%) in 2017 and 7100 AADT (72%) in 2032 (site 11), and the reductions on the second route via Salhouse are 3000 AADT (70%) in 2017 and 3900 AADT (67%) in 2032 (site 6).

7.1.5 To the west of Norwich the NDR results in an increase in traffic using Fakenham Road, with some trips reassigning on this route from the direction of Kings Lynn. The reassignment onto Fakenham Road amounts to an increase of 1900 AADT in 2017 and 2900 in 2032 (18% and 22%) (site 9). There is a consequential reduction on the A47(T) west of Dereham Road junction of 800 AADT in 2017 and 400 AADT in 2032 (3% and 1%), and reductions on routes to the north of Norwich, as explained below (site 8).

7.1.6 North of Norwich there are existing routes that experience substantial reductions in traffic with the NDR. To the north west the B1145 route between Bawdeswell / Fakenham Road and Aylsham via Reepham experiences reductions of 400 AADT (10%) in 2017 and 1200 AADT (22%) in 2032 (site 10). The route between Reepham and Hoveton on the A1151 Norwich Road via Buxton Road, Cawston Road and B1354 Coltishall Road carries significant orbital traffic movements in absence of NDR, despite its poor standard. With NDR, traffic on this route reduces by 2900 AADT (60%) in 2017 and 4500 AADT (66%) in 2032 (site 7). Another route that carries orbital traffic around northern Norwich is Spixworth Road / Crostwick Lane via Spixworth. Traffic flows reduce by 2400 AADT (35%) in 2017 and by 4900 AADT (52%) in 2032 (site 12).

7.1.7 A graphical representation of traffic flow changes on five selected strategic sites is shown in Figure 7-1. Clearly, the inclusion of the NDR results in a reduction of flows.

Wider Impacts to the West of Norwich

7.1.8 The model runs have been analysed to understand the impact of NDR on traffic levels on routes between the A1067 (Fakenham Road) and the A47(T) (see figure I.3 in Appendix I). The NDR runs between the A1067 west of Taverham and extends to the A47(T) at Postwick junction east of Norwich. Concern has been expressed that because the NDR does not extend to the A47(T) in the west, traffic will increase on routes between the A1067 and the A47(T).

7.1.9 To assess this, modelled traffic flows on an imaginary line running between the A1067 and the A47(T) have been investigated. The results are presented in Table 7.1.

Table 7.1: Modelled Daily Traffic Flows on Routes Between the A1067 and the A47(T)

24 hour two-way flows	2012	2017 DM	2017 DS	2032 DM	2032 DS	NDR change 2017	NDR change 2032
Low Road (A81)	4000	4600	4000	4900	4100	-13%	-16%
Costessey Lane (A89)	3300	4000	3800	4800	4900	-5%	2%
Taverham Lane (A25)	5700	5700	4700	6200	4700	-18%	-24%
Ringland Road (A31)	3600	4900	3500	8000	6300	-29%	-21%
C167 Weston Longville (A105)	1400	1700	3300	3100	5500	94%	77%
C173 Lenwade to Hockering (A106)	3000	3400	3500	3300	3600	3%	9%
Total	**21000**	**24300**	**22800**	**30300**	**29100**	**-6%**	**-4%**

7.1.10 The above shows that the NDR leads to a decrease in daily traffic on the above routes that connect the A1067 with the A47(T) to the west of Norwich of 6% in 2017 and 4% in 2032.

7.1.11 Traffic levels on the three key routes between Taverham and Costessey (Costessey Lane, Taverham Lane and Ringland Road) are predicted to reduce significantly, except for Costessey Lane where the predicted reduction is relatively small in 2032 and traffic levels are predicted to increase by 2% in the DS scenario.

7.1.12 Low Road provides an alternative route into the west of Norwich that avoids the A1067. Traffic levels are predicted to significantly decrease on this route with the NDR in place.

7.1.13 Further out from Norwich however, traffic levels are predicted to increase significantly on the C167 through Weston Longville and slightly on the C173 between Lenwade and Hockering with the NDR in place. Presently the flows on this route are significantly lower than any of the parallel routes compared in Table 7.1 reflecting the character of this route through Weston Longville where it is a single file lane.

7.1.14 To address existing HGV problems on routes between the A1067 and the A47(T), a route is presently being upgraded to accommodate such traffic. This route runs from Lenwade and uses the C173 in the north and the C167 Wood Lane in the south. Additional traffic management and / or signage should be used to encourage all traffic onto this improved HGV route to avoid Weston Longville and Hockering in future years; the HGV improvements thereby also being a solution to any increase in traffic on these two routes due to NDR.

Suburban traffic impacts

Table 7.2: NDR Impact on Suburban Routes and Developer Link Roads

Route / Link Road	2017 AADT change (DS – DM)	2032 AADT change (DS – DM)
Thorpe St Andrew area		
Yarmouth Road (West) (Site A65)	-3700 (-13%)	-2000 (-6%)
Route via Thunder Lane / Woodside Road / Blue Boar Lane between Thorpe St Andrew and Sprowston (Site A20)	-4300 (-33%)	-3300 (-28%)
A1042 Outer Ring Road (north east quadrant, at A1042 Mousehold Lane) (Site A7)	-4000 (-16%)	-4000 (-15%)
C283 Salhouse Road (Site A45)	-1100 (-8%)	-1600 (-10%)
A1151 Wroxham Road Site (A43)	-2900 (-15%)	-3600 (-16%)
Old Catton area		
A1042 Outer Ring Road (Chartwell Road) (Site A26)	-3700 (-13%)	-4700 (-15%)
B1150 North Walsham Road (Site A92)	-2000 (-18%)	-3600 (-27%)
St Faiths Road (Site A37)	-2600 (-17%)	-3000 (-19%)
Hellesdon area		
A140 Boundary Road / Outer Ring Road (Site A5)	-2100 (-9%)	-1500 (-6%)
A140 Cromer Road (Site A35)	-3600 (-21%)	-3300 (-18%)

Route / Link Road	2017 AADT change (DS – DM)	2032 AADT change (DS – DM)
A1067 Drayton Road (Site A32)	-1400 (-7%)	-2000 (-10%)
Reepham Road (Site A33)	1600 (16%)	700 (7%)
Middleton's Lane (between Cromer Road and Reepham Road) (site A83)	-1100 (-11%)	-1300 (-11%)
Drayton area		
School Road (north of Fakenham Road) (site A21)	-2000 (-18%)	-2400 (-19%)
Fakenham Road (through Taverham) (site A54)	-2600 (-26%)	-2600 (-23%)
Link Roads		
Beyond Green (between B1150 N Walsham Road and A1151 Wroxham Road) (site A96)	-3500 (-42%)	-6100 (-45%)
White House Farm (between A1151 Wroxham Road and Salhouse Road) (site A98)	600 (27%)	-3600 (-32%)
Salhouse Road to Plumstead Road (only in place in 2032) (site A100)	n/a	-3400 (-23%)
Brook Farm / Laurel Farm link road (site A104)	-4000 (-78%)	-8700 (-67%)

7.1.15 In the Thorpe St Andrew area (see figure I.2 in Appendix I) traffic is reduced on Yarmouth Road (West) by 3700 AADT (13%) in 2017 and by 2000 AADT (6%) in 2032, refer to Table 7.2 (negative figures indicate reductions with NDR). There is a significant reduction on the north-south suburban route Thunder Lane / Woodside Road / Blue Boar Lane between Thorpe St Andrew and Sprowston of 4300 AADT (33%) in 2017 and 3300 AADT (28%) in 2032. There are significant reductions in traffic on the A1042 Outer Ring Road around the north east quadrant with traffic flows on the A1042 Mousehold Lane reducing by 4000 AADT (16%) in 2017 and 4000 AADT (15%) in 2032. On the radial routes into the city through city's north eastern suburbs in Spowston and Thorpe St Andrew there is a small reduction in forecast traffic on C874 Plumstead Road but larger reductions on C283 Salhouse Road and A1151 Wroxham Road. The Salhouse Road reduction is 1100 AADT (8%) in 2017 and 1600 AADT (10%) in 2032. On Wroxham Road the traffic reduces by 2900 AADT (15%) in 2017 and 3600 AADT (16%) in 2032.

7.1.16 In Old Catton the traffic reduces on the A1042 Outer Ring Road (Chartwell Road) by 3700 AADT (13%) in 2017 and 4700 AADT (15%) in 2032. The traffic flows also reduce across the radial routes on B1150 North Walsham Road, C246 Spixworth Road and C251 St Faiths Road. The main reductions are on North Walsham Road of 2000 AADT (18%) in 2017 and 3600 AADT (27%) in 2032, and on St Faiths Road of 2600 AADT (17%) in 2017 and 3000 AADT (19%) in 2032.

7.1.17 In Hellesdon (see figure I.1 in Appendix I) the traffic reduces on the A140 Boundary Road Outer Ring Road by 2100 AADT (9%) in 2017 and 1500 AADT (6%) in 2032. On the radial routes traffic is reduced on A140 Cromer Road and A1067 Drayton Road. On the A140 Cromer Road traffic reduces by 3600 AADT (21%) in 2017 and 3300 AADT (18%) in 2032, and on A1067 Drayton Road traffic reduces by 1400 AADT (7%) in 2017 and 2000 AADT (10%) in 2032. However the traffic on Reepham Road increases by 1600 AADT (16%) in 2017 and 700 AADT (7%) in 2032, although on Middleton's Lane between Cromer Road and Reepham Road traffic reduces by 1100 AADT (11%) in 2017 and 1300 AADT (11%) in 2032 (site A83). In Drayton the traffic reduces on the School Road north of A1067 Fakenham Road by 2000 AADT (18%) in 2017 and 2400 AADT (19%) in 2032 (site A21) and on Fakenham Road through Taverham traffic reduces by 2600 AADT (26%) in 2017 and 2600 AADT (23%) in 2032 (site A54).

7.1.18 With the implementation of the JCS planned development a number of developer link roads are assumed to be provided as part of the developments. These are designed to act either as urban high streets to serve walking and cycling movement as well as traffic access for the development or as local development distributor roads. In absence of NDR these link roads carry very high traffic flows that is incompatible with their intended purposes, but these traffic flows are relieved substantially by the NDR as shown in Table 7.2.

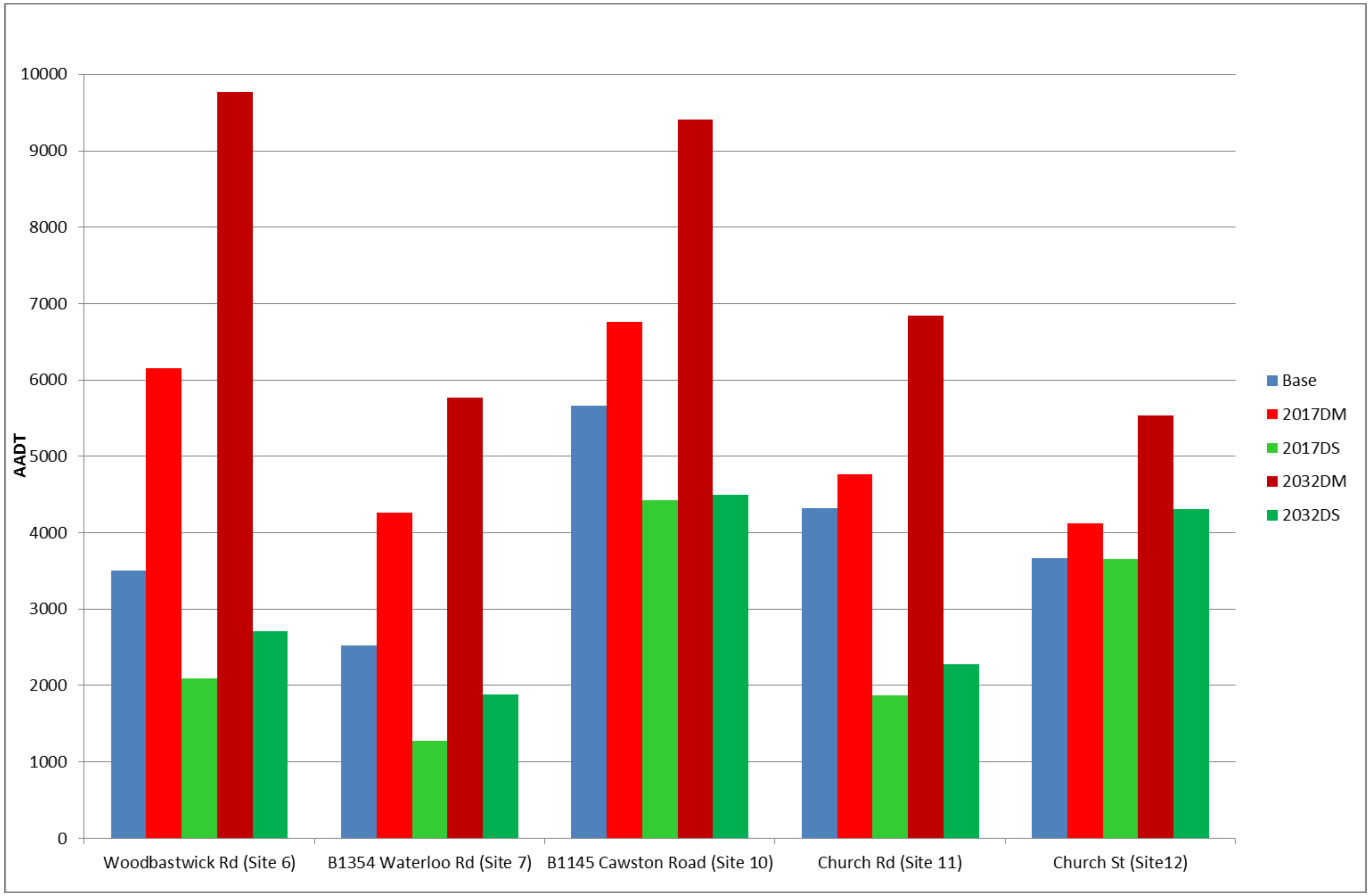
City centre traffic impacts

7.1.19 Traffic impacts in the city centre occur due to a combination of impacts resulting from the NDR and complementary traffic management measures in the city centre that would be introduced should the NDR scheme proceed. The traffic management measures effect restrictions to general traffic crossing the city centre and thus displace traffic movements to the Inner Ring Road.

7.1.20 These changes are captured at several locations along the inner ring road and radial routes into the city centre as shown in Figure I.5 in Appendix I.

- Carrow Road (site 13) increased by 200 AADT (1%) in 2017 and increased by 2200 AADT (8%) in 2032;
- A147 Chapelfield Road (site 14) increased by 200 AADT (1%) in 2017 and 1100 AADT (4%) in 2032;
- A147 Grapes Hill Road (site 15) reduced by 400 AADT (1%) in 2017 and increased by 3000 AADT (9%) in 2032;
- A147 St Crispins Road (west) (site 16) decreased by 400 AADT (1%) in 2017 and 2200 AADT (6%) in 2032; and
- A147 St Crispins Road (east) (site 17) stays the same in 2017 and increased by 800 AADT (3%) in 2032.

Figure 7-1: Comparison of Traffic Flows on Inappropriate Routes



7.2 Traffic Queues

7.2.1 The network queues estimated by SATURN have been examined and presented in Table 7.3. These are produced in the detailed model area where traffic queues are simulated by the model. These comprise transient queuing such as produced by traffic signal cycles and overcapacity queuing. The total queues are shown in Figure 7-2 and Figure 7-3 for the base, DM and DS scenarios for the AM and PM peaks respectively. In the AM peak the queues increase from a base of 2831 PCU.hrs to 3372 PCU.hrs in 2017 DM and 4265 PCU.hrs in 2032 DM. These levels are reduced with the scheme by 13% in 2017 to 2948 PCU.hrs and by 8% in 2032 to 3908 PCU.hrs. Changes in the PM peak are from a base of 2353 PCU.hrs to 3116 PCU.hrs in 2017 DM and 4201 PCU.hrs in 2032 DM. These levels are reduced with the scheme by 7% in 2017 to 2889 PCU.hrs and by 5% in 2032 to 3993 PCU.hrs. It should be noted that the queues are representative of the whole of the city network (the detailed model area) so in this context the Scheme would have a significant effect, especially in the AM peak.

Table 7.3: Queue estimated by SATURN (PCU hrs)

Scenario	Transient queues (PCU hrs)				Over-capacity queues (PCU hrs)				Total queues (PCU hrs)			
	AM	IP	PM	OP	AM	IP	PM	OP	AM	IP	PM	OP
2012 Base	2,165	1,248	2,062	267	666	35	290	0	2,831	1,283	2,353	267
2017 Do Minimum	2,466	1,394	2,463	286	906	58	653	0	3,372	1,451	3,116	286
2017 Do Something	2,336	1,339	2,350	282	612	47	539	0	2,948	1,386	2,889	282
2032 Do Minimum	2,910	1,739	2,904	328	1,355	170	1,296	0	4,265	1,909	4,201	328
2032 Do Something	2,743	1,664	2,691	321	1,165	167	1,301	0	3,908	1,832	3,993	321

Figure 7-2: Overall Queue Comparison - AM peak

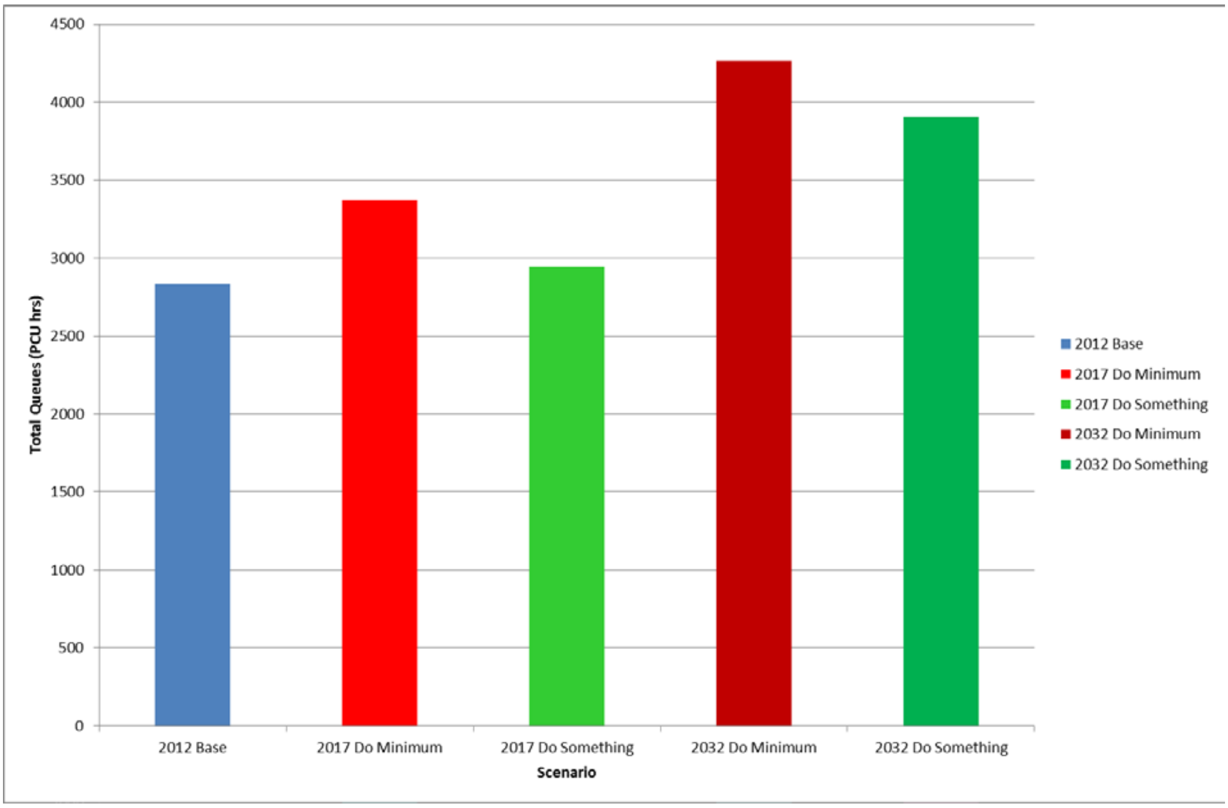
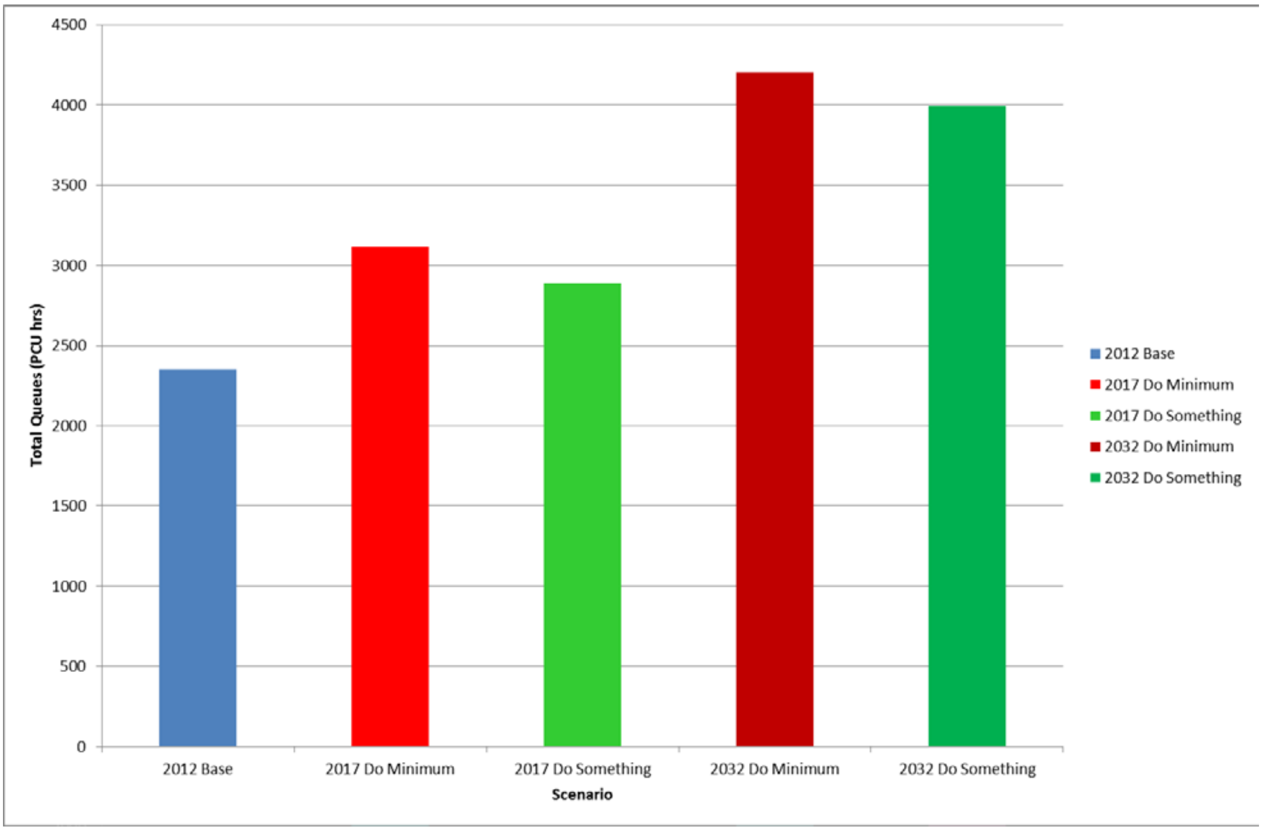


Figure 7-3: Overall Queue Comparison - PM peak



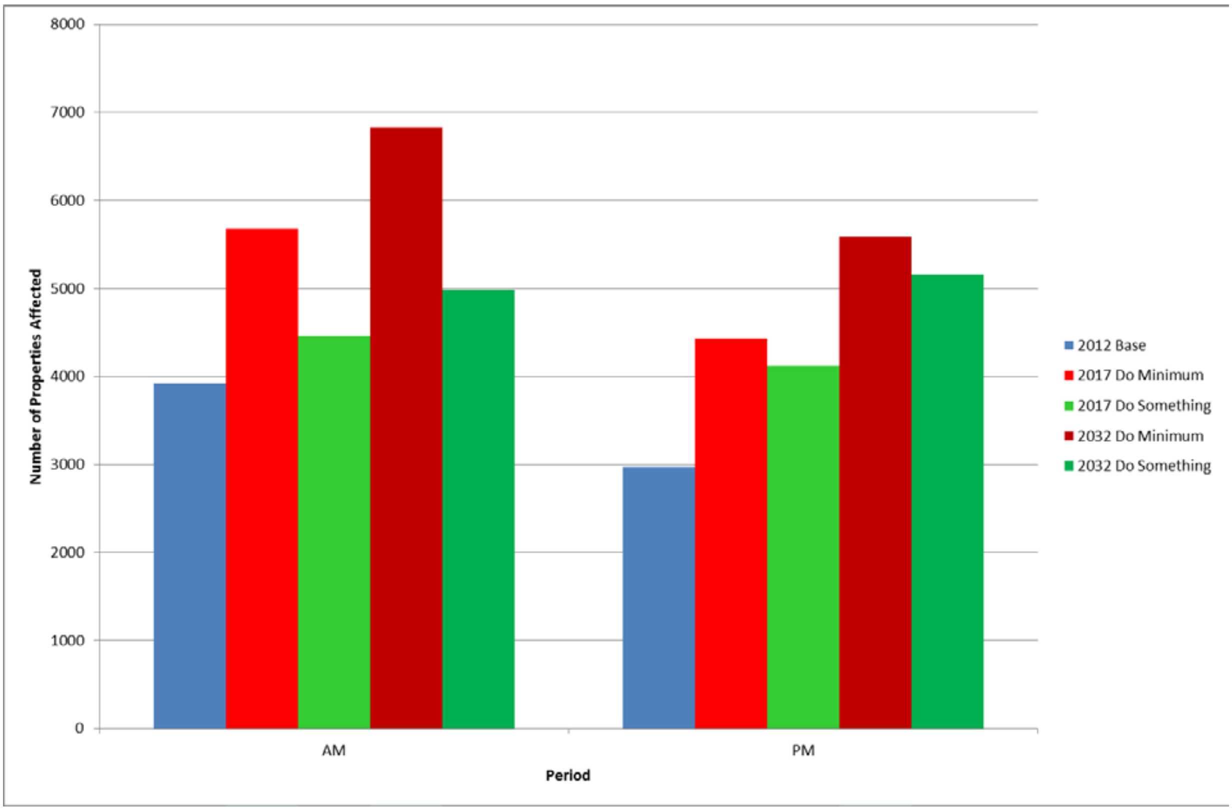
7.3 Effects on People

7.3.1 The Effects on People are evaluated in Table 7.4 by calculating the number of dwellings within 50 metres of roads with a Volume to Capacity ratio of over 90%. This uses existing address point data, so the analysis does not account for proposed new dwellings. A graph representing this data is shown in Figure 7-4.

Table 7.4: Number of Dwellings within 50 metres of roads

	2012	2017		2032	
	Base	**Do Minimum**	**Do Something**	**Do Minimum**	**Do Something**
AM	3922	5676	4456 (-21%)	6824	4989 (-27%)
PM	2973	4432	4123 (-7%)	5587	5163 (-8%)

Figure 7-4: Effects on People



7.4 City Centre through Traffic

7.4.1 City centre through traffic has been calculated in Table 7.5 by establishing 3 cordons. These cordons are:

- Inner Ring Road Inner – just inside the Inner Ring Road;
- Inner Ring Road Outer – just outside the Inner Ring Road; and
- Outer Ring Road Outer – just outside the Outer Ring Road.

7.4.2 Using these we can show the amount of traffic using the city centre, the inner ring road, and the outer ring road for through trips. One of the aims of the NDR is to decrease the amount of traffic and congestion that in part is due to travel through and across the city. In addition, the complementary city centre traffic management measures will substantially reduce through traffic in the city centre.

Table 7.5: City Centre through Traffic (AADT)

	2012	2017		2032	
	Base	**Do Minimum**	**Do Something**	**Do Minimum**	**Do Something**
Inner Ring Road Inner Cordon	9477	8159	6787 (-17%)	9236	4726 (-49%)
Inner Ring Road Outer Cordon	77825	82152	78369 (-5%)	88368	80352 (-9%)
Outer Ring Road Outer Cordon	68117	73691	63421 (-14%)	79151	66780 (-16%)

7.4.3 A graphical representation of this is shown in Figure 7-5 to Figure 7-7 which illustrate the reduction of through trips in the Do Something Scenario. Tables showing this information by time period are contained in Appendix J.

7.4.4 With the proposed city centre traffic management measures in the Do Something scenario through traffic in the city centre is reduced from the Base level and almost halved in 2032.

7.4.5 On the Inner Ring Road cross city traffic that uses the Inner Ring Road reduces with the Scheme by 3783 AADT (5%) in 2017 and by 8016 AADT (9%) in 2032 to levels only just higher than those in the base year.

7.4.6 On the Outer Ring Road, cross city traffic is reduced with the scheme by 10270 (14%) in 2017 and by 12371 (16%) in 2032 to levels below those in the base year.

Figure 7-5: Through Trips crossing Inner Ring Road Inner Cordon

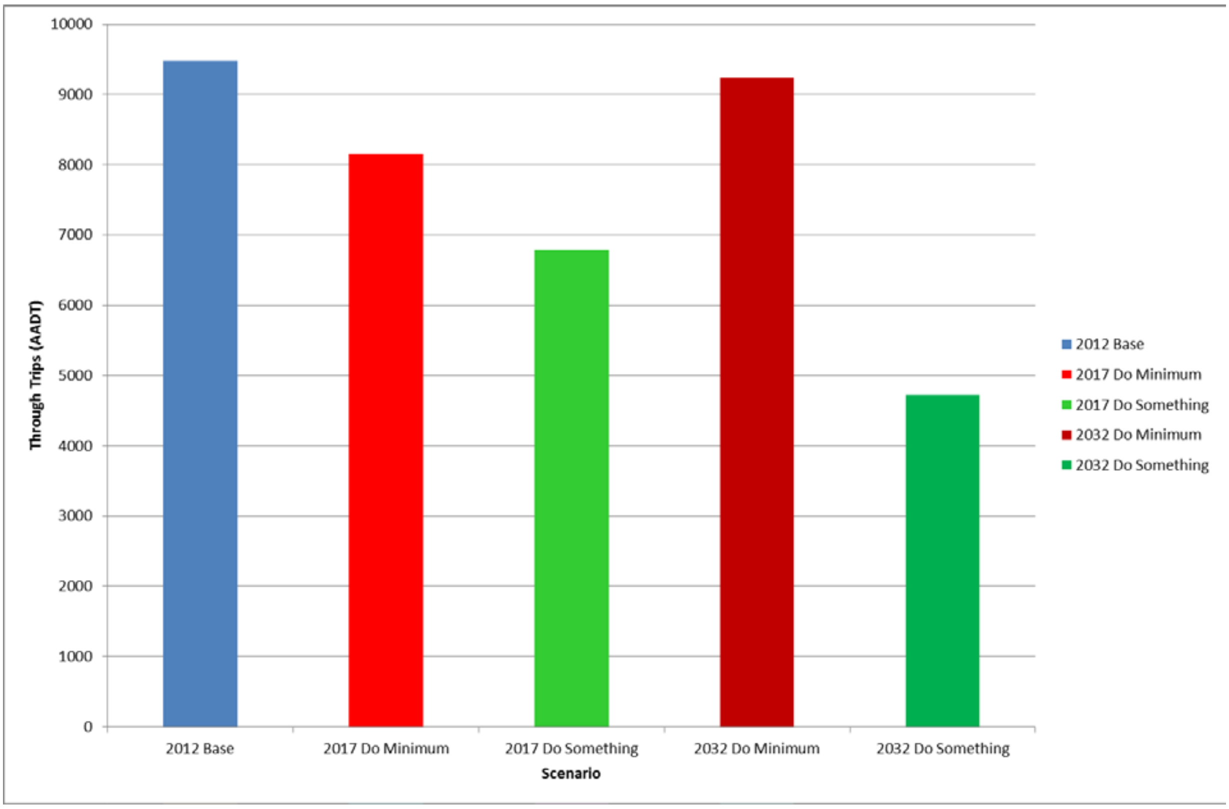


Figure 7-6: Through Trips crossing Inner Ring Road Outer Cordon

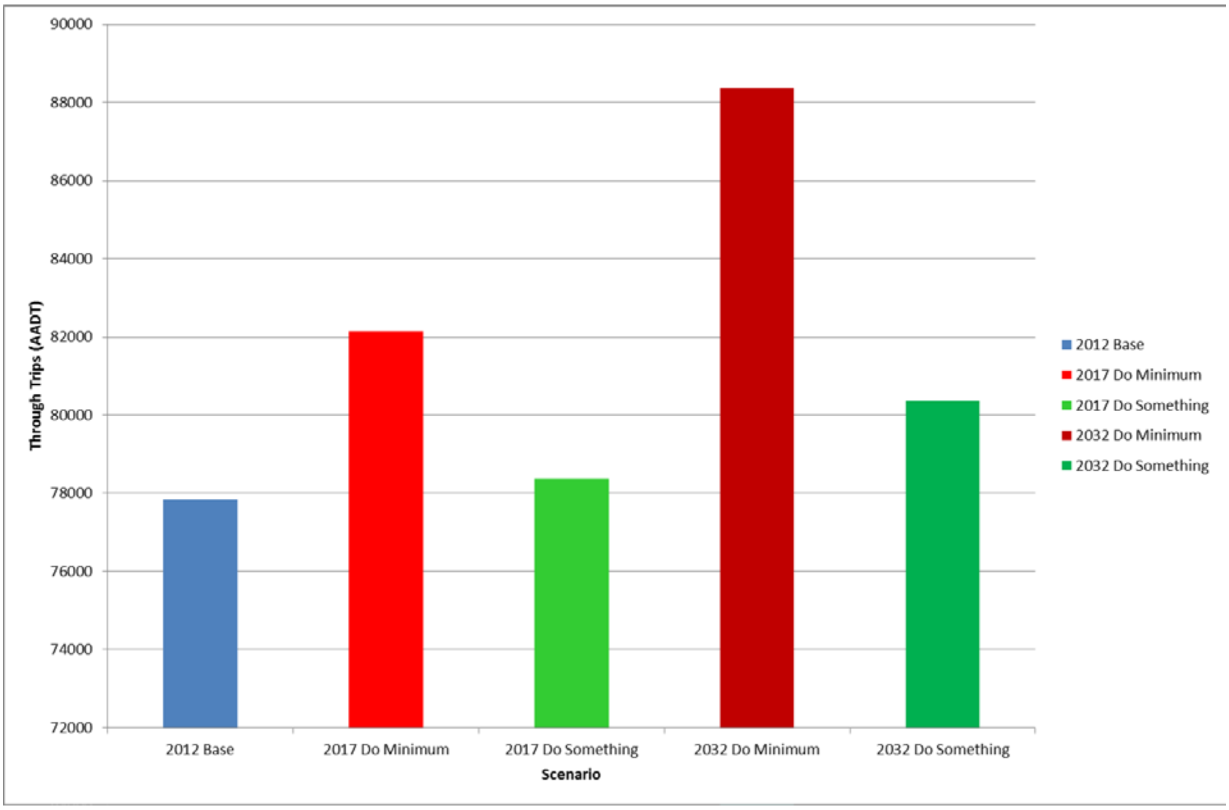
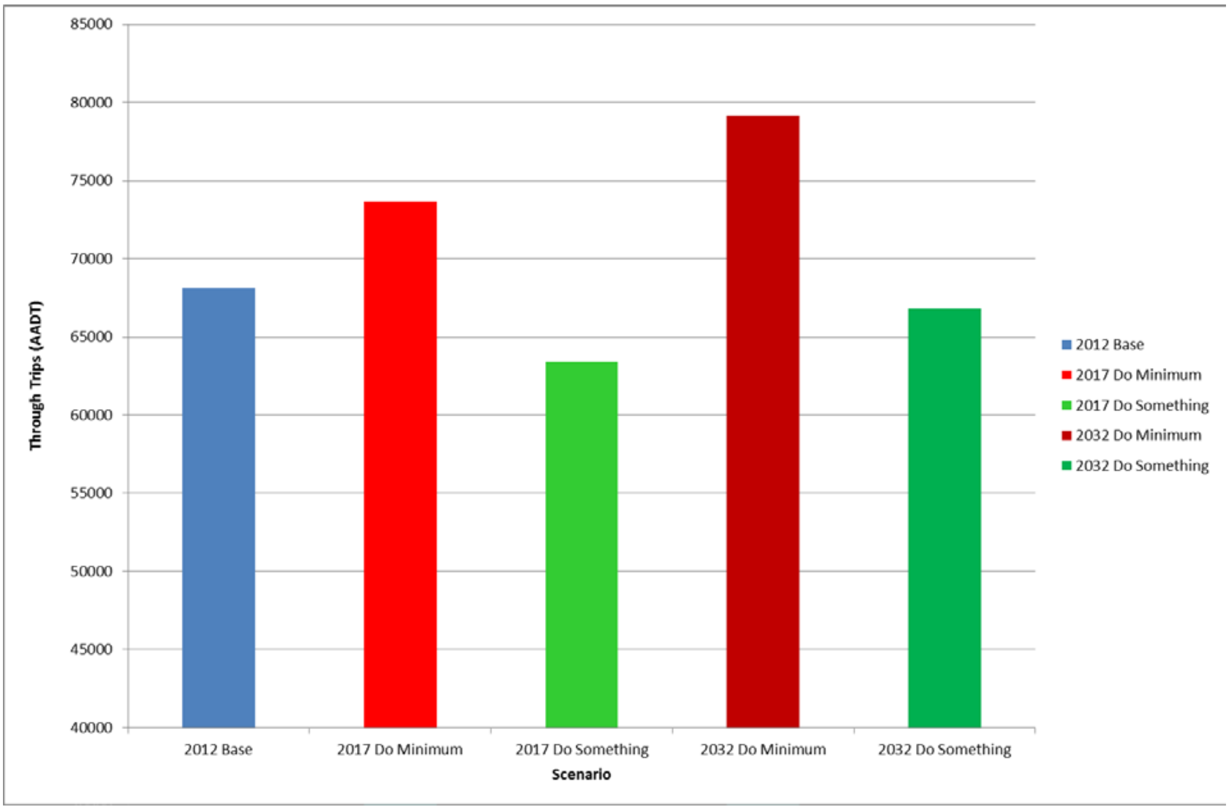


Figure 7-7: Through Trips crossing Outer Ring Road Outer Cordon



7.5 Highway Journey Times

7.5.1 Highway journey times between four locations on strategic routes and three proposed development locations have been compared between scenarios. The locations are shown in Figure 7-8 and stated below:

- A47(T) West;
- A11(T) (Thickthorn Roundabout);
- A47(T) East (Brundall);
- A1067 Fakenham Road (Attlebridge);
- Norwich International Airport;
- Rackheath; and
- Broadland Gate

7.5.2 Figure 7-9 and Figure 7-10 show a comparison of average journey times for the AM peak and PM peak respectively, these are arithmetic means of the journey time for both directions. These Figures show the journey times for the base year and for Do Minimum and Do Something scenarios for the forecast years. The data for these Figures is presented in Table 7.6 and Table 7.7, as well as the percentage changes for the Do Something compared with the Do Minimum scenario.

7.5.3 The Figures and Tables show that with the Scheme there would be substantial reductions in journey times between the trunk road network and the Airport and Rackheath, with journey times from the A47(T) East to the Airport reducing by over eight minutes in 2017 and over ten minutes in 2032, or by over one third. In addition the journey times for orbital movements between Fakenham Road, Airport, Rackheath and Broadland Gate reduce by between 30% and 50% in 2017 and by between 29% and 52% in 2032. This data demonstrates that the Scheme would substantially improve access times between the strategic highway network and the planned development locations in the JCS plan and would provide a significant improvement for orbital movements to the north of the City between the proposed major development locations.

Figure 7-8: Route Locations

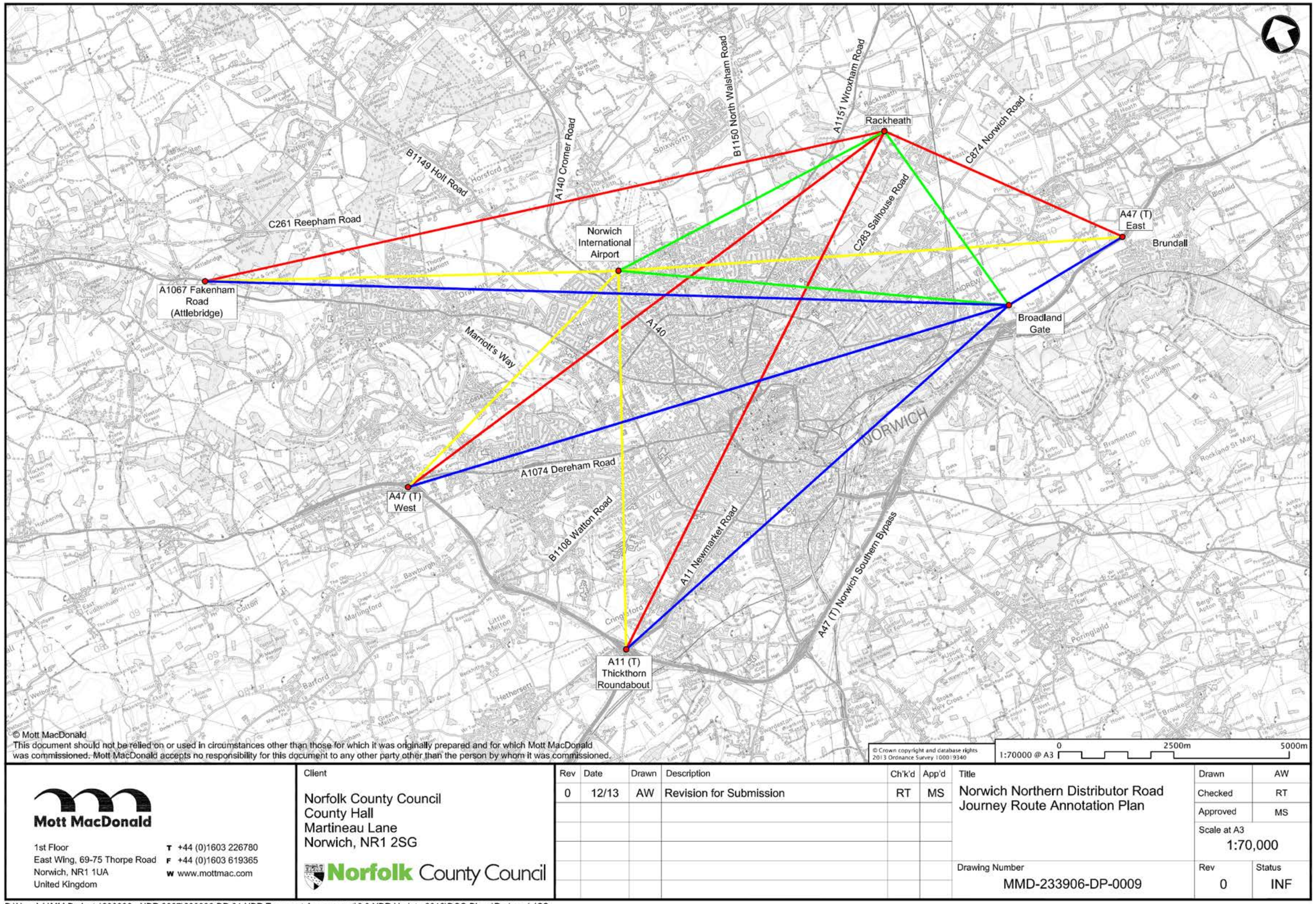


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Table 7.6: Average Journey Times - AM Peak

			2012	2017			2032		
Route no	**Journey**		**Base (mm:ss)**	**DM (mm:ss)**	**DS (mm:ss)**	**% Change**	**DM (mm:ss)**	**DS (mm:ss)**	**% Change**
1	A47(T)W	Airport	22:41	24:43	19:34	-21%	25:03	21:13	-15%
2	A11(T)	Airport	22:10	23:41	22:48	-4%	25:08	24:22	-3%
3	A47(T)E	Airport	23:37	24:37	16:00	-35%	27:14	16:48	-38%
4	Fakenham Rd	Airport	15:31	15:57	11:11	-30%	16:22	11:48	-28%
5	A47(T)W	Rackheath	22:15	23:02	19:44	-14%	26:10	23:44	-9%
6	A11(T)	Rackheath	17:22	18:20	14:28	-21%	22:25	18:52	-16%
7	A47(T)E	Rackheath	09:40	09:42	07:41	-21%	10:08	08:31	-16%
8	Fakenham Rd	Rackheath	26:56	28:13	13:33	-52%	29:37	14:19	-52%
9	Airport	Rackheath	16:26	17:46	11:31	-35%	19:27	12:06	-38%
10	A47W	Broadland Gate	14:30	14:31	14:21	-1%	16:25	16:24	0%
11	A11	Broadland Gate	09:37	09:48	09:42	-1%	12:39	13:04	3%
12	A47E	Broadland Gate	03:13	03:21	03:43	11%	06:20	03:46	-41%
13	Fakenham Rd	Broadland Gate	28:40	26:02	15:28	-41%	29:43	16:23	-45%
14	Rackheath	Broadland Gate	08:22	09:30	05:06	-46%	10:42	05:54	-45%
15	Airport	Broadland Gate	21:21	22:45	13:26	-41%	22:29	14:10	-37%

Table 7.7: Average Journey Times - PM Peak

			2012	2017			2032		
Route no	**Journey**		**Base (mm:ss)**	**DM (mm:ss)**	**DS (mm:ss)**	**% Change**	**DM (mm:ss)**	**DS (mm:ss)**	**% Change**
1	A47(T)W	Airport	21:53	23:45	19:06	-20%	24:51	20:15	-19%
2	A11(T)	Airport	23:11	24:17	22:51	-6%	25:50	25:26	-2%
3	A47(T)E	Airport	22:58	24:52	17:10	-31%	26:06	18:26	-29%
4	Fakenham Rd	Airport	16:29	16:53	12:01	-29%	16:18	12:26	-24%
5	A47(T)W	Rackheath	25:07	23:42	20:43	-13%	27:04	21:59	-19%
6	A11(T)	Rackheath	17:56	18:35	14:36	-21%	22:19	19:09	-14%
7	A47(T)E	Rackheath	09:40	09:43	07:55	-19%	09:59	09:04	-9%
8	Fakenham Rd	Rackheath	26:49	27:28	13:38	-50%	29:37	14:09	-52%
9	Airport	Rackheath	17:06	17:55	12:32	-30%	18:02	12:36	-30%
10	A47W	Broadland Gate	14:55	15:11	15:03	-1%	18:20	17:24	-5%
11	A11	Broadland Gate	10:11	10:04	10:00	-1%	13:35	12:57	-5%
12	A47E	Broadland Gate	03:17	03:22	03:32	5%	05:46	04:19	-25%
13	Fakenham Rd	Broadland Gate	27:45	25:25	15:25	-39%	29:26	16:44	-43%
14	Rackheath	Broadland Gate	08:23	09:37	05:03	-47%	10:05	05:48	-42%
15	Airport	Broadland Gate	21:03	23:17	15:36	-33%	23:13	15:10	-35%

Figure 7-9: AM Peak Highway Average Journey Times

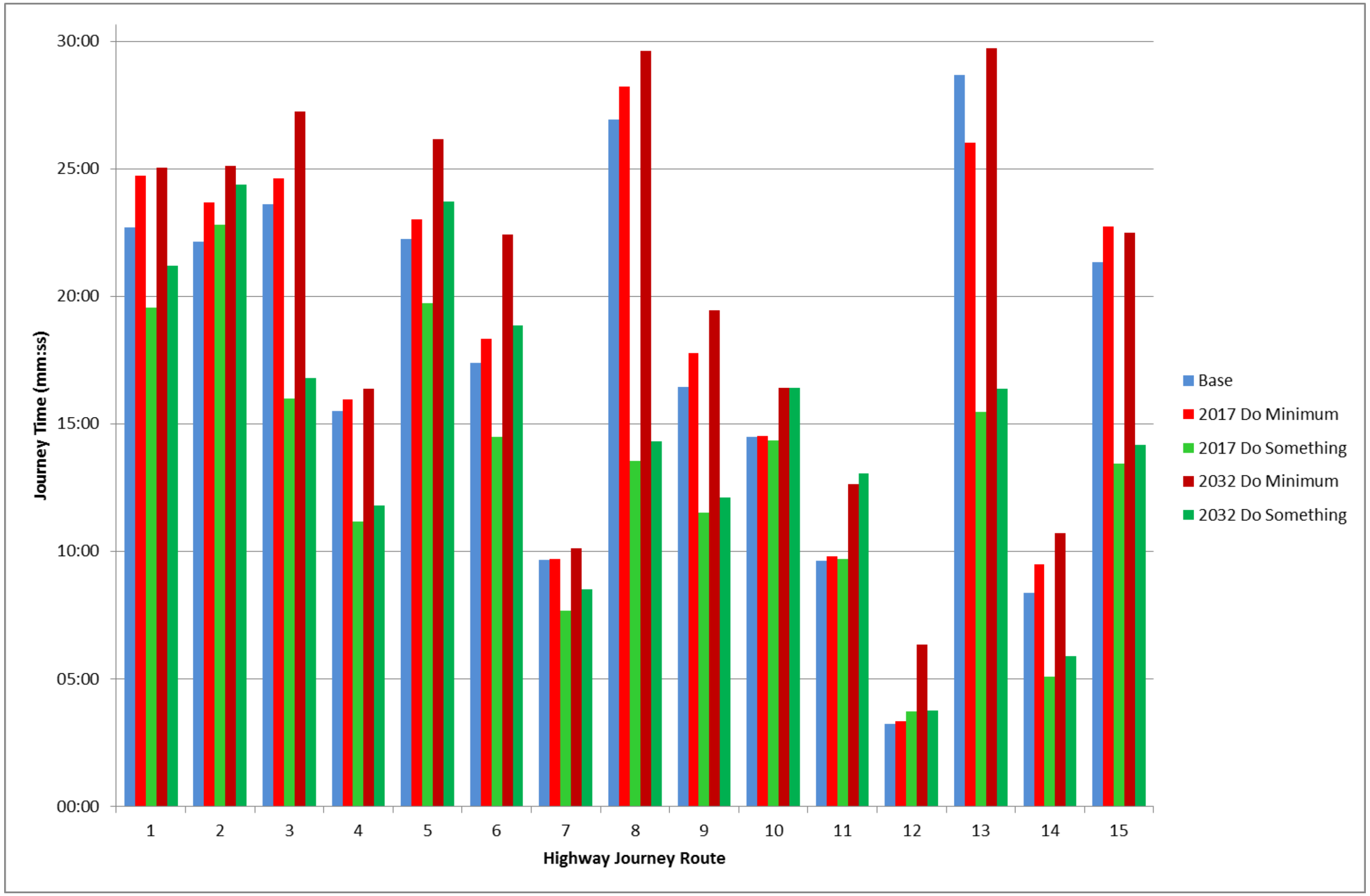
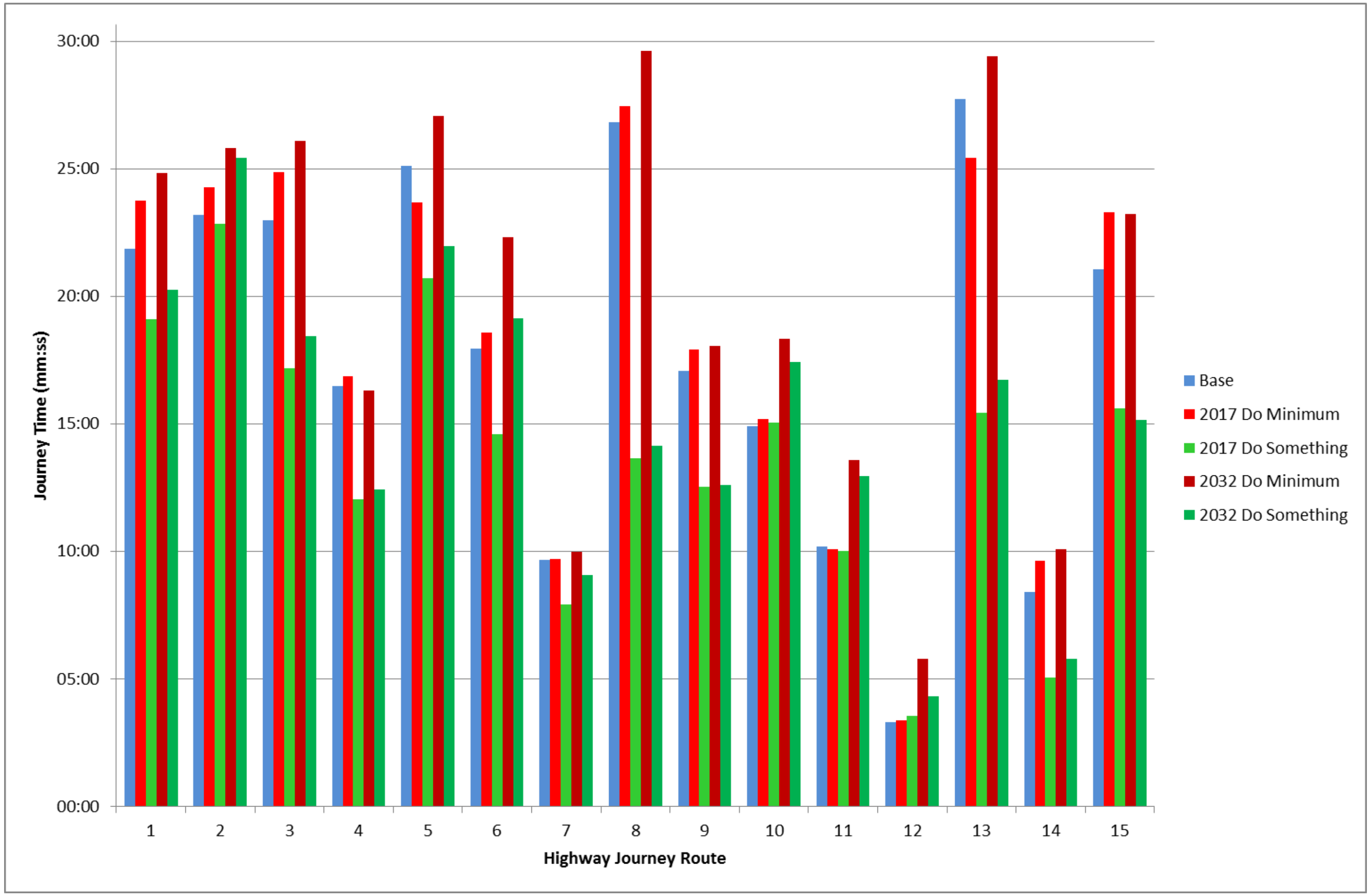


Figure 7-10: PM Peak Highway Average Journey Times



7.6 Journey Times on Public Transport Routes

7.6.1 For the 2017 and 2032 AM and the PM peaks, journey times on five public transport routes carrying high patronage levels into the city have been examined and compared between scenarios. These do not account for stopping times for bus services, but serve to show the changes in running times. The five routes are:

- Fakenham Rd/ Drayton High Rd to Fakenham Rd/Fir Covert Rd Junction;
- Cromer Road to Holt Rd/ Cromer Road Junction;
- Wroxham Road to Wroxham Road/ Green Lane W Junction;
- Plumstead Road to Plumstead Road/ Broad Lane Junction; and
- Yarmouth Road to Postwick NW Roundabout.

7.6.2 Figure K.1 in Appendix K shows the five routes and Figure 7-11 to Figure 7-14 show the graphical representation of journey times for the Do-Minimum and the Do-Something scenarios. Calculated journey time savings are set out in Table 7.8 and Table 7.9 for inbound and outbound directions respectively. In these tables, the journey time variability for each route is shown using the formula in paragraph 3.3.2 in WebTAG Unit 3.5.7.

7.6.3 In 2017 AM peak journey times into the city centre reduce with the Scheme by between 5% and 14%, with a journey time reliability improvement of around half of one minute. In the 2017 PM peak the journey times out of the city centre reduce with the Scheme by between 1 % and 13%, with an average journey time reliability improvement of around one quarter of a minute. Journey time changes in 2032 are more affected by the complementary city centre measures. In 2032 AM peak journey times into the city centre change with the scheme by between a 1% increase and an 11% reduction, with the average journey time reliability improvement of 18 seconds. In the 2032 PM peak the journey times for routes out of the city reduce by between 3% and 24%, with an average journey time reliability improvement of around half of one minute.

Figure 7-11: Inbound Public Transport Journey Times – AM Peak

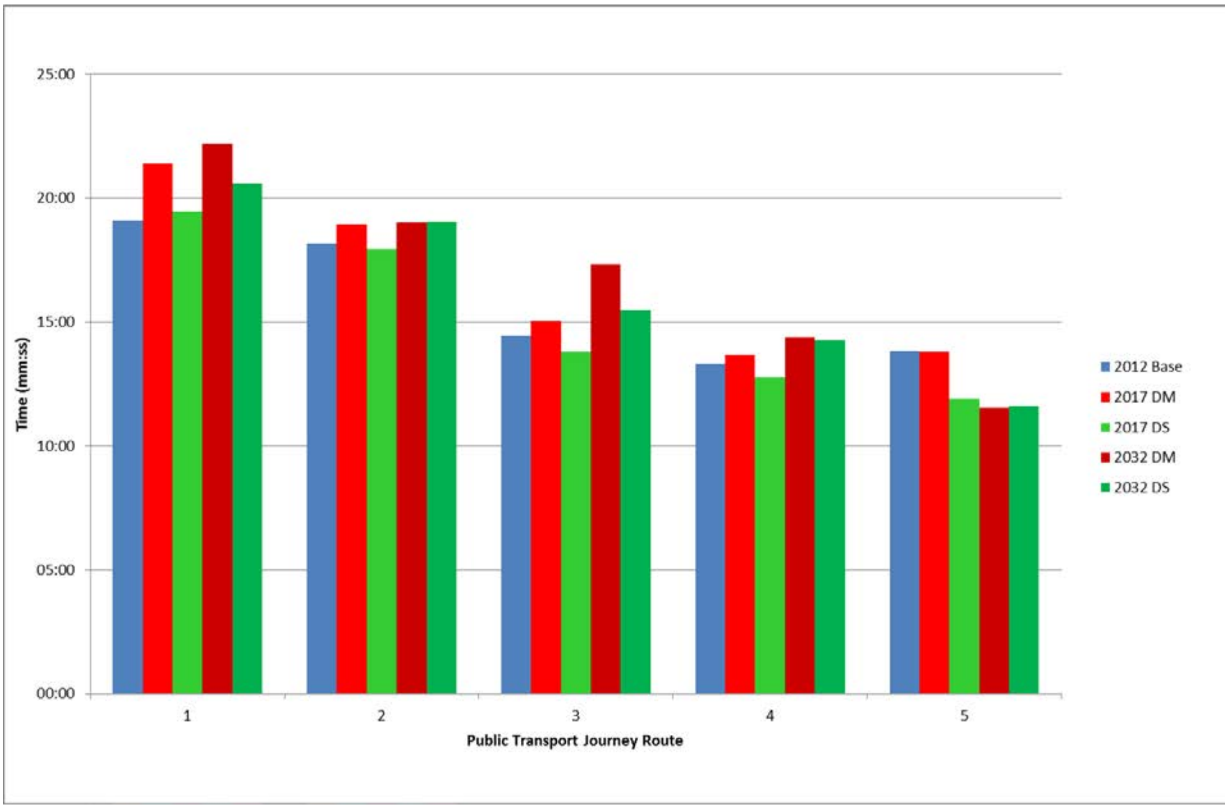


Figure 7-12: Inbound public Transport Journey Times – PM Peak

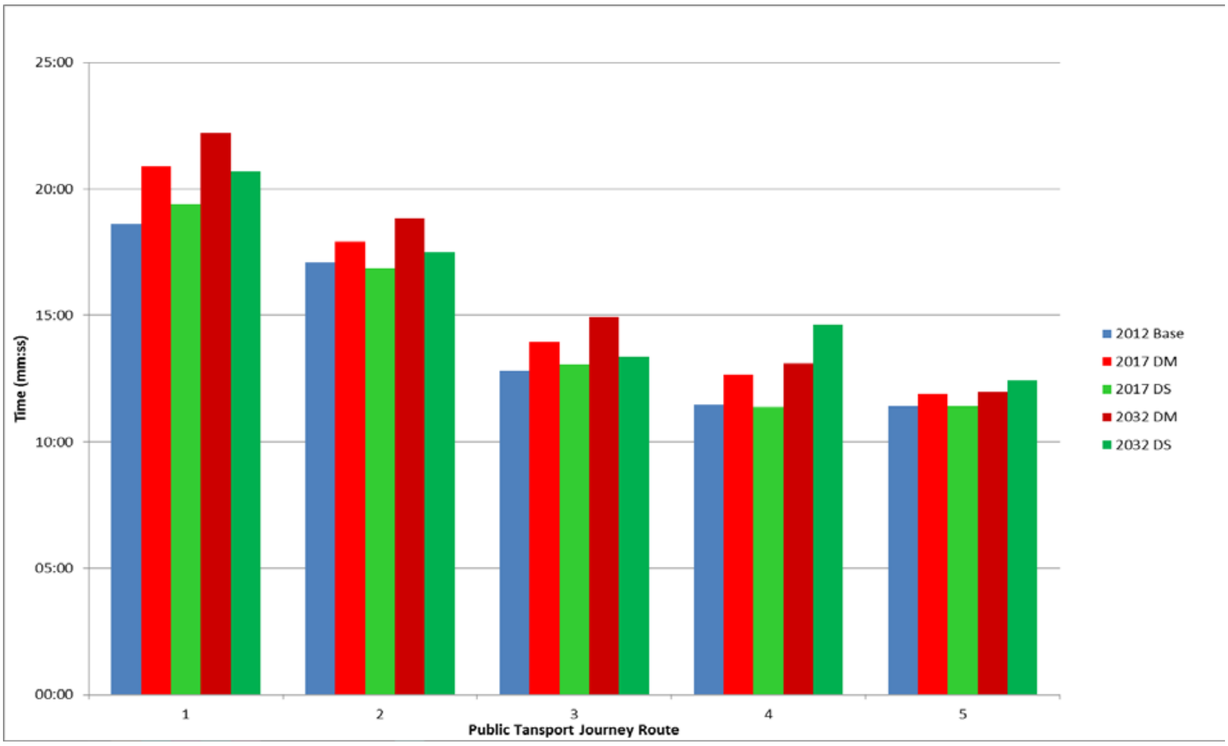


Figure 7-13: Outbound Public Transport Journey Times – AM Peak

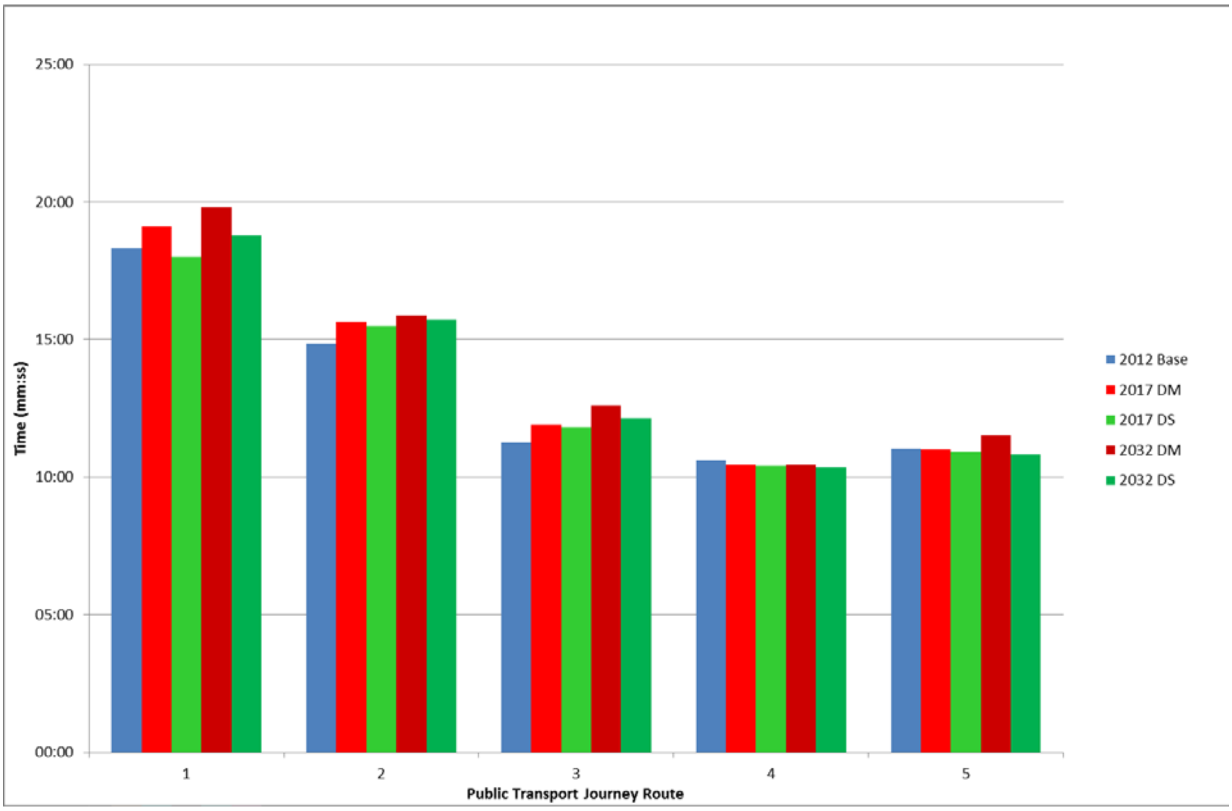


Figure 7-14: Outbound Public Transport Journey Times – PM Peak

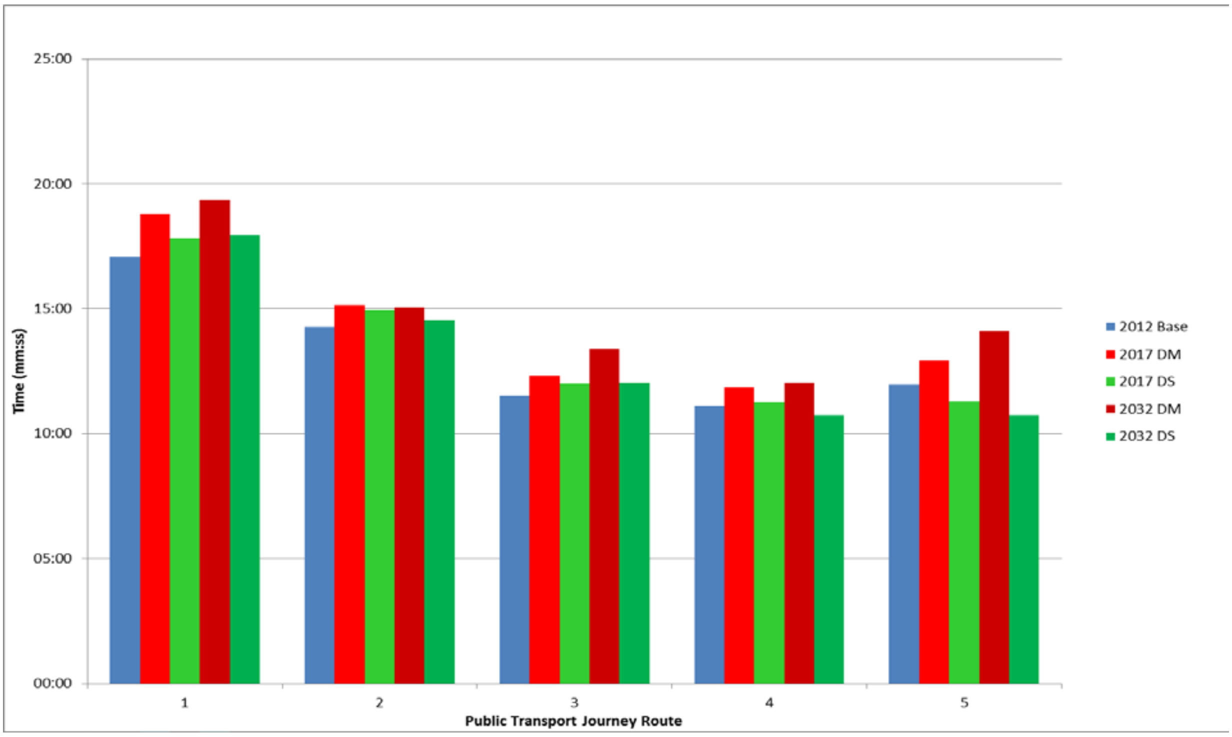


Table 7.8: Inbound Public Transport Journey Times and Journey Time Reliability

Route	Peak	Base		2017				2032				JT savings (%)		Change in standard deviation of journey time	
				Do Minimum		Do Something		Do Minimum		Do Something		2017	2032	2017	2032
		Time (mm:ss)	Distance (m)	Time (mm:ss)	Distance (m)	Time (mm:ss)	Distance (m)	Time (mm:ss)	Distance (m)	Time (mm:ss)	Distance (m)				
1	AM	19:07	9610	21:24	9610	19:28	9610	22:12	9610	20:35	9610	9.0	7.3	-45	-40
	PM	18:37	9610	20:54	9610	19:24	9610	22:13	9610	20:42	9610	7.2	6.8	-35	-37
2	AM	18:10	6943	18:57	6943	17:56	6943	19:00	6943	19:03	6943	5.4	-0.3	-31	2
	PM	17:07	6943	17:56	6943	16:53	6943	18:51	6943	17:30	6943	5.9	7.2	-30	-41
3	AM	14:28	6741	15:03	6742	13:49	6742	17:19	6742	15:29	6742	8.2	10.6	-30	-51
	PM	12:49	6741	13:58	6742	13:04	6742	14:56	6742	13:22	6742	6.4	10.5	-21	-38
4	AM	13:20	5822	13:41	5836	12:46	5836	14:24	5836	14:15	5836	6.7	1.0	-24	-4
	PM	11:28	5822	12:40	5836	11:23	5836	13:07	5836	14:39	5836	10.1	-11.7	-31	43
5	AM	13:51	5872	13:48	5873	11:55	5878	11:32	5873	11:36	5878	13.6	-0.6	-48	1
	PM	11:25	5872	11:54	5873	11:24	5878	11:58	5873	12:26	5878	4.2	-3.9	-12	11

Table 7.9: Outbound Public Transport Journey Times and Journey Time Reliability

Route	Peak	Base		2017				2032				JT savings (%)		Change in standard deviation of journey time	
				Do Minimum		Do Something		Do Minimum		Do Something		2017	2032	2017	2032
		Time (mm:ss)	Distance (m)	Time (mm:ss)	Distance (m)	Time (mm:ss)	Distance (m)	Time (mm:ss)	Distance (m)	Time (mm:ss)	Distance (m)				
1	AM	18:19	9386	19:07	9509	18:01	9386	19:48	9509	18:48	9386	5.8	5.1	-21	-19
	PM	17:05	9386	18:47	9509	17:50	9386	19:20	9509	17:56	9386	5.1	7.2	-17	-27
2	AM	14:52	6757	15:39	6757	15:29	6757	15:53	6757	15:43	6757	1.1	1.0	-4	-4
	PM	14:17	6757	15:09	6757	14:57	6757	15:03	6757	14:32	6757	1.3	3.4	-5	-13
3	AM	11:15	6702	11:55	6702	11:49	6702	12:36	6702	12:09	6702	0.8	3.6	-2	-10
	PM	11:31	6702	12:19	6702	11:59	6702	13:24	6702	12:02	6702	2.7	10.2	-7	-30
4	AM	10:37	5942	10:27	5957	10:25	5957	10:27	5957	10:22	5957	0.3	0.8	-1	-2
	PM	11:07	5942	11:50	5957	11:16	5957	12:01	5957	10:44	5957	4.8	10.7	-13	-28
5	AM	11:01	5857	11:00	5857	10:54	5853	11:32	5857	10:49	5853	0.9	6.2	-2	-16
	PM	11:57	5857	12:55	5857	11:18	5853	14:05	5857	10:44	5853	12.5	23.8	-39	-83

8 Abbreviations

AADT	Average Annual Daily Traffic
ATC	Automatic Traffic Count
DfT	Department for Transport
DIADEM	Dynamic Integrated Assignment and Demand Modelling - software released by the Department for Transport
DM	Do Minimum
DMRB	Design Manual for Roads and Bridges – a Highways Agency publication setting out guidance and good practice for design and appraisal of road schemes
DS	Do Something
COBA	DfT's Cost-Benefit Analysis tool
EB	East Bound or Employer's Business
GAP	Minimum gap (in seconds) accepted by a vehicle which gives way at priority junctions or traffic signals. Also a measure of Wardrop equilibrium assignment convergence
GAPR	As GAP above in relation to junctions but for entry onto roundabouts
GEH	Statistical tool to measure closeness of model to observed flows
GIS	Geographic Information System - designed to capture, store, manipulate, analyse, manage, and present all types of geographical data
GPS	Global Positioning System
HA	Highways Agency
HB	Home-based
HBEB	Home-based Employers Business
HBO	Home-based Other
HBW	Home-based Work
HGV	Heavy Goods Vehicle
JT	Journey Time

LGV	Light Goods Vehicle
LMVR	Local Model Validation Report
MCC	Manual Classified Count (for a link)
MCTC	Manual Classified Turning Count
ME	Matrix Estimation
NATS	Norwich Area Transportation Strategy
NB	North Bound
NCC	Norfolk County Council
NDC	Nationwide Data Collection (company specialising in traffic surveys)
NDR	Norwich Northern Distributor Road
NHB	Non-home-based
NHBEB	Non-home based Employer's Business
NHBO	Non-home –based Other
NTEM	National Trip End Model
NTS	National Travel Survey
OD	Origin Destination
OGV	Other Goods Vehicle
OGV1	A sub-category of OGV. Includes all rigid vehicles over 3.5 tonnes gross vehicle weight with two or three axles
OGV2	A sub-category of OGV. Includes all rigid vehicles with four or more axles and all articulated vehicles
OP	Off-peak
PA	Production-Attraction
PCU	Passenger Car Unit
PPK	Pence per Kilometre
PPM	Pence per Minute

RSI	Road Side Interview
SATURN	Simulation – Assignment model of Traffic on Urban Road Networks software
SB	South Bound
SRN	Strategic Road Network
TRADS	Traffic flow Data System – the Highways Agency's database of traffic count data
TRICS	Trip Rate Information Computer System
VISUM	Transport modelling software used (in this case) for public transport modelling
VOC	Vehicle Operating Cost
VOT	Value of Time
WB	West Bound
WebTAG	Web-based Transport Analysis Guidance produced by the Department for Transport

9 Appendices A to G – See Volume 2 of the Forecasting Report

10 Appendices H to K – See Volume 3 of the Forecasting Report