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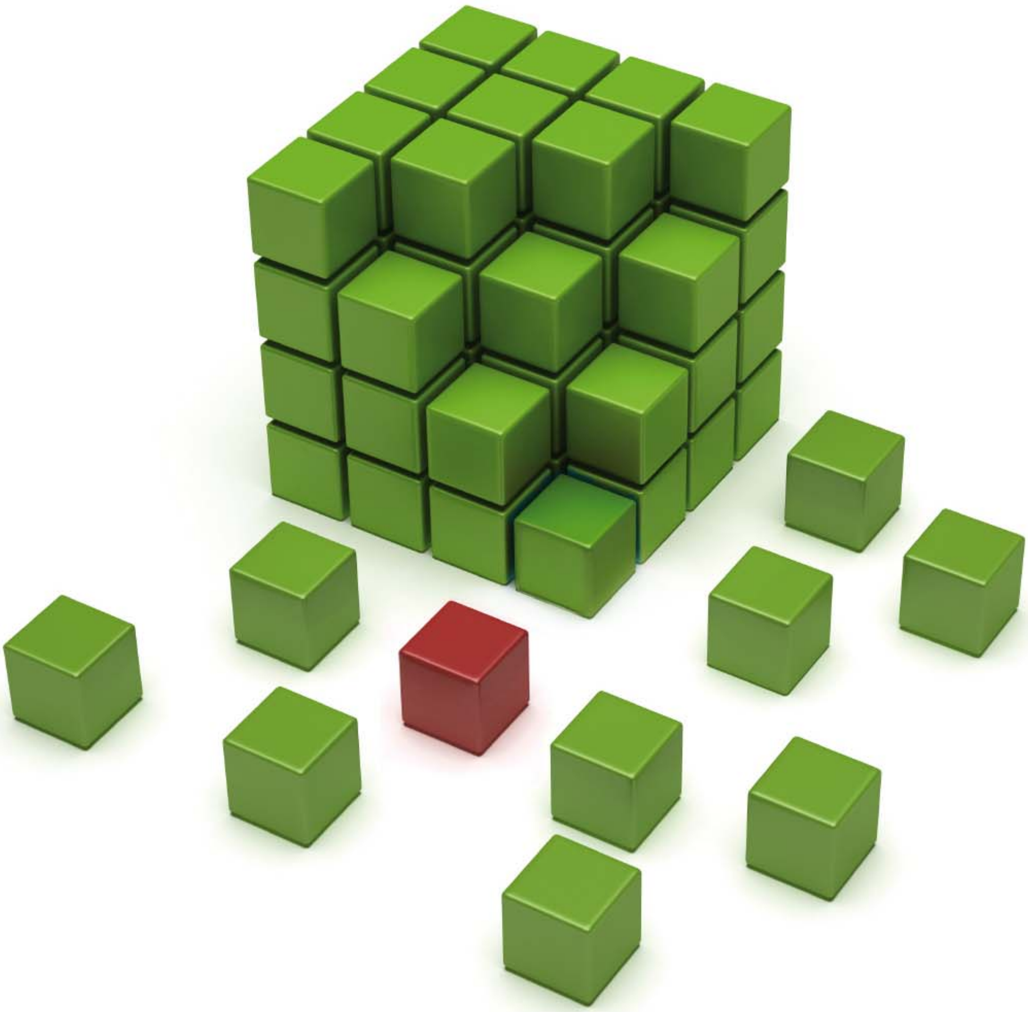
Thurrock Infrastructure Prioritisation and Implementation Programme 2006-2025

Report 4.2: Transport Modelling - Final

Colin Buchanan



Report 4.2

February 2010

TRANSPORT TRAFFIC DEVELOPMENT PLANNING URBAN DESIGN ECONOMICS MARKET RESEARCH

Thurrock Infrastructure Prioritisation and Implementation Programme

4.2 Transport Modelling for Preferred Option - Final

Thurrock Council

February 2010

Thurrock Infrastructure Prioritisation and Implementation Programme

4.2 Transport Modelling for Preferred Option - Final

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Contents

Page

Tables *Page*

Figures *Page*

1 Introduction

1.1 Introduction

1.1.1 Colin Buchanan (CB) has been commissioned by Thurrock Council to carry out transport modelling as part of a wider study of Thurrock's Infrastructure Prioritisation and Implementation Programme.

1.1.2 The approach to the study has been carefully considered to complement, rather than duplicate, the work that is currently being undertaken by Mouchel Parkman on the TGSE model on behalf of the Thames Gateway South Essex Partnership.

1.1.3 The purpose of the transport modelling aspect of this study therefore is predominately to assess the impact of the emerging future population and employment scenario on the highway networks within Thurrock and to identify any problems or shortfall in the existing infrastructure.

1.1.4 The key objective of this study is to identify any problem related to the capacity and the operation of the transport network within the local area on the existing network (2007) and in the future scenarios (2021 and 2025) when the Council's preferred land use option is in place.

1.1.5 The results of this study will be used to assist in identifying a suitable scheme or a package of measures which will improve the transport network. The study will also inform the Council which of these schemes/measures should be implemented first, or require most urgent attention and will therefore inform the phasing of development.

1.2 Previous study

1.2.1 Colin Buchanan carried out a previous study on Infrastructure Deficit in 2006. This study was based on a simple spreadsheet model to calculate the capacity of the key carriageways in Thurrock before and after developments in 2021. However, the previous analysis was based on a more simplistic approach and made no allowance for the existing congestion and delays at the key junctions. Although, the above approach was considered sufficient for the purpose of the Infrastructure Deficit Study, it was agreed during discussion with the Council that this approach would need to be refined to take account of the delays at key junctions during the AM peak hour.

1.2.2 In addition, the capacity of the passenger rail network was also analysed as part of this study, albeit in lesser detail.

1.2.3 In June of 2008 this initial study was further expanded to consider the two emerging land use options (options 2 and 4) coming forward as part of the overall LDF work. This study expanded on the previous infrastructure deficit work and assessed the delays at key junctions for 2016 as the interim year and 2021 as the year when any land use option is likely to be implemented. Again, the capacity of the passenger rail network was also analysed as part of this study, albeit in lesser detail. This study did not account for any development at Lakeside Basin.

1.3 Lakeside Basin

1.3.1 On the 3rd April 2009 the East of England Regional Assembly submitted to the Government Office its draft review of policy ETG2 Thurrock Key Centre for Development and Change. The draft Policy is based on a study led by GVA Grimley. The Basin Development has therefore been considered in this revised study and the impact of the development has been explicitly considered in the assessment of the morning peak hour period.

1.3.2 Furthermore, owing to the significant retail and leisure components proposed for the Basin the greatest trip generation will occur in the evening peak hour period for this development, an additional evening peak hour assessment has therefore been undertaken accordingly. However, this covers a reduced study area owing to the limited amount of traffic survey data available.

1.3.3 MVA acting as transport consultants for this development have also produced their own assumptions relating to land use quantum and the expected trip rates. As a sensitivity test, the MVA scenario has also been assessed against the LDF development proposals. This is set out in Appendix A of this report.

1.4 Outline Methodology

1.4.1 As part of the overall study it was necessary to construct a four-stage spreadsheet demand model and produce a forecast of future demand, taking into account the additional development (households, population, jobs) that are expected in the future. The four stage model is a behavioural model which can be described simply as representing four decisions made by transport users on:

- Trip Ends (where shall I travel to?)
- Distribution (where shall I travel from?)
- Modal Split (which mode shall I take, car, public transport, walking or cycling?)
- Assignment (which route shall I take?)

1.4.2 The future forecast years considered were 2021 and 2025. Forecasts of growth were constructed by applying growth in population and jobs from 2006 to 2021 and 2025. All trip generation estimates for the new land uses was derived from TRICS.

1.4.3 Other changes related to policy and demand management were also incorporated in the traffic growth where sufficient data were available or alternatively simple assumptions on the % changes were agreed with Thurrock Council.

1.4.4 It was agreed that some 34 junctions will be assessed for the morning peak hour period of 0800-0900. For the evening peak hour period the study area has been reduced and concentrates upon the 16 junctions in closest proximity to the Lakeside Basin development where the impact of new development will be greatest. The junctions included in this assessment are shown in Figure 1.1

1.4.5 The capacity of all the junctions within the study area has been considered, in detail for each scenario. Where any junction is considered to be at or approaching capacity by 2025, mitigation measures have been proposed along with an indicative costing.

1.4.6 The assessment scenarios can therefore be defined as:

- 2021 AM peak hour with LDF and Lakeside Basin Development for all 34 junctions
- 2021 PM with LDF and Lakeside Basin for 16 junctions
- 2025 AM peak hour with LDF and Lakeside Basin Development for all 34 junctions
- 2025 PM with LDF and Lakeside Basin for 16 junctions

1.5 Report Structure

1.5.1 The report contains 6 sections:

Section 1 includes the introduction and scope of the study;

Section 2 provides a summary of the preferred land use scenario for each forecast year as well as the estimate level of trip generation

Section 3 gives an outline of the methodology;

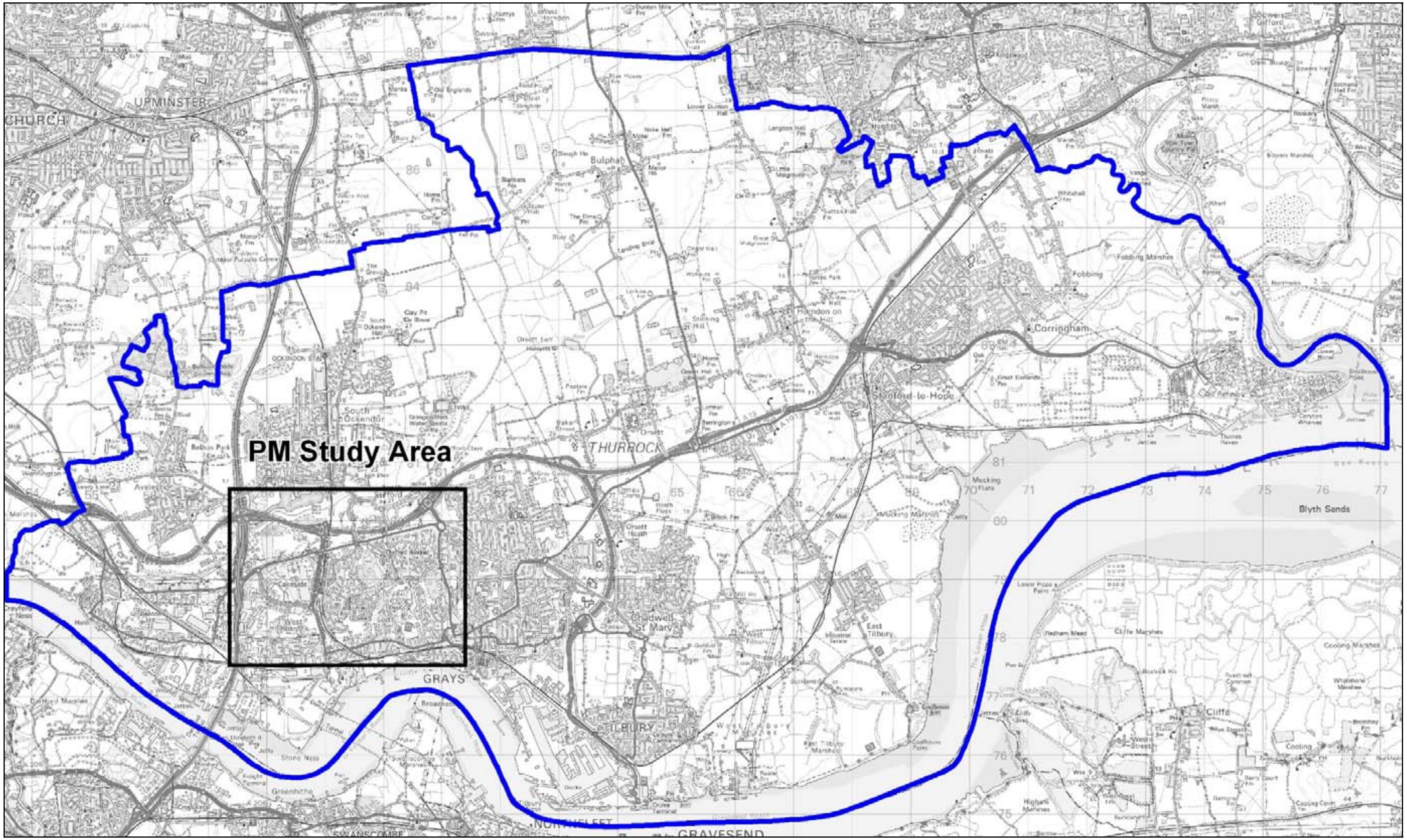
Section 4 details the assessment of the existing situation and contains the approach adopted and the results;

Section 5 includes the assessment of the future scenario for each option and presents the results;

Section 6 contains a list of recommendations on possible solutions and measures on the transport network;

Section 7 contains the conclusions.

Figure 1.1: Agreed Study Area



2 Land Use Options

2.1 Introduction

2.1.1 Whilst the exact form of the land uses has obviously yet to be determined, the preferred Land Use Option has now been identified. This therefore allows the proposed quantum of development, the likely use class and the location of development to come forward by 2021 and 2025 to be appropriately assessed. This information has been used to inform the modelling work undertaken.

2.1.2 The proposed land uses are summarised in Table 2.1 below.

Table 2.1: Preferred LDF land Use Option

LDF Designation	Total Areas	Land Use Mix	Existing Sites split of overall area	Proposed Sites split of overall area
Primary Industrial commercial	8,270,000sqm	B1- Light Industry	10%	10%
		B2 General Industry	40%	40%
		B8 – Warehousing	50%	50%
Secondary Industrial	840,000sqm	B1- Light Industry	10%	50%
		B2 General Industry	40%	N/A
		B8 – Warehousing	50%	50%
Mixed Use	822,000sqm	Various	100%	100%
Other	812,000sqm	Leisure	N/A	100%

2.1.3 For the preferred option, it has been assumed that all employment changes would happen between 2008 and 2021. In addition, there will be some 19,530 additional houses between 2008 and 2026 including 3,732 dwellings in Lakeside. Figure 2.1 and Figure 2.2 show the locations of the employment and houses for the preferred option respectively.

Figure 2.1: Location of preferred LDF Employment Space

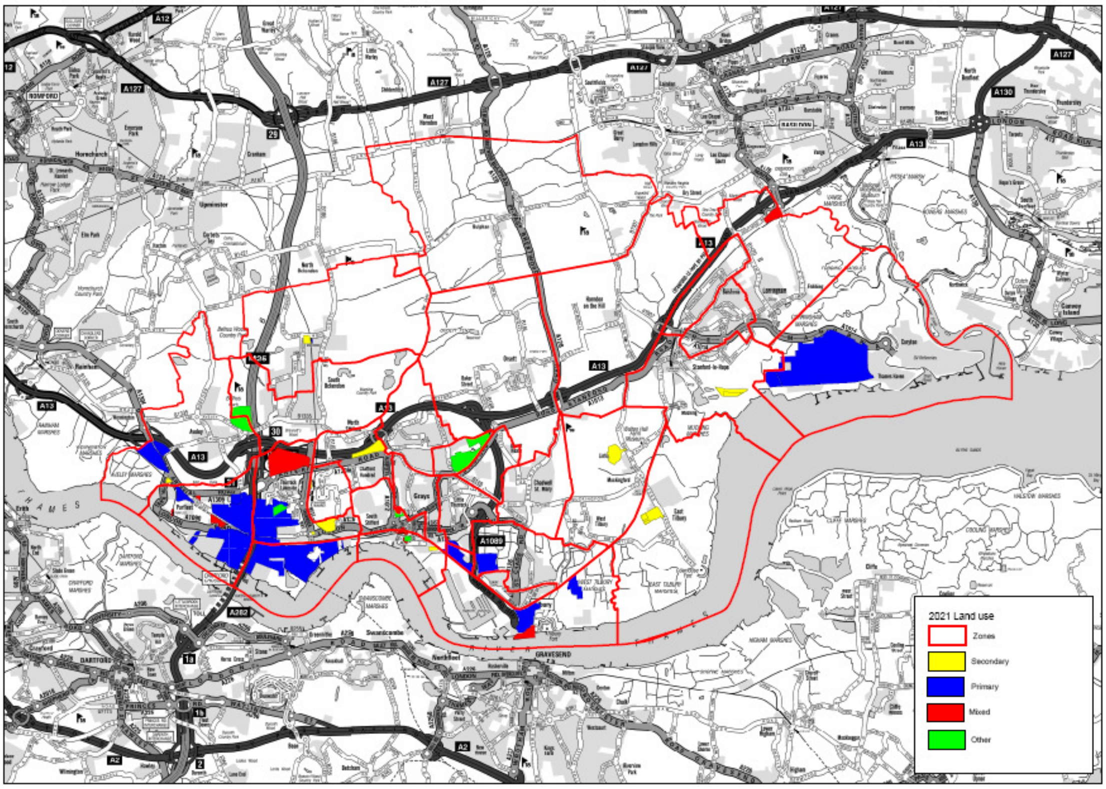
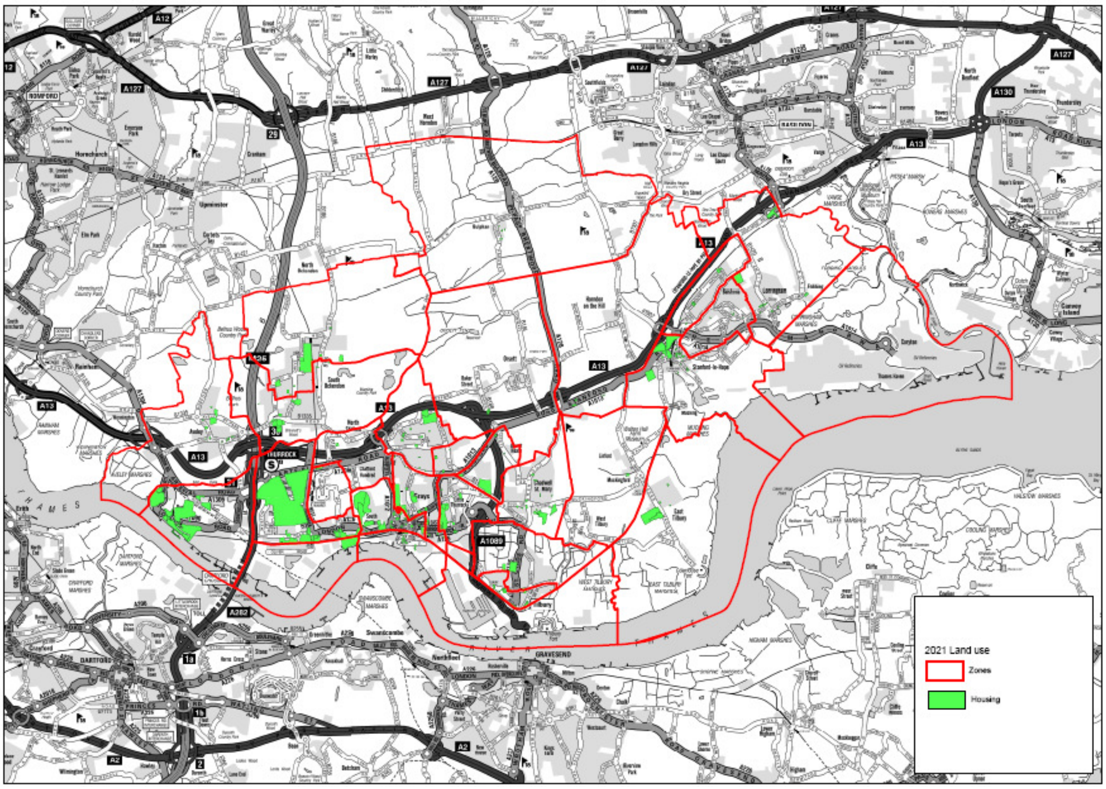


Figure 2.2: Location of preferred LDF Housings



2.1.4 As discussed, in addition to the preferred LDF land use option this assessment has also considered the likely quantum of development which will come forward in the Lakeside Basin area.

2.1.5 Since this has yet to be finalised, two spatial options have been identified as being appropriate for testing the PM peak hour. Option 1 is based upon the TBC assumption of the likely development quantum to come forward in this location and is the option considered in this report. Option 2 is based upon the land use assumption put forward in the work undertaken by MVA. For comparative purposes both land use options are set out in Table 2.2. A sensitivity test of the impact of MVA option has been considered further in **Appendix A** of this report.

Table 2.2: Lakeside Basin land Use Options

Land Use	TBC Assumption	MVA Assumption
A1 Retail	49,320sqm	39,500sqm
B8 Warehousing	57,200sqm	40,400sqm
B2 Industrial	40,850sqm	40,400sqm
B1 office	50,000sqm	50,000sqm
leisure	77,350sqm	77,350sqm
Residential	49,320sqm (=3,732 dwellings)	39,500sqm

2.2 Trip Generation

2.2.1 Prior to determining the impact of the development and what network upgrades will be required to support the quantum of development proposed, an analysis of the level of trips that could be expected to be generated by the mixed-use development has been undertaken. For the purposes of this analysis the TRICS database has been used.

2.2.2 TRICS is a large database of traffic information relating to land use categories, from various locations across the UK. It provides survey counts relating to car and/or multi-modal trip rates relevant to a wide variety of development types and sizes. Hence, the database can be used to produce trip generation and attraction rates for new developments based upon previous surveyed developments with similar characteristics.

2.2.3 To assess the impact of the proposed land use options and to identify which of the junctions studied will require improvement, it is necessary to calculate the likely level of trips that will be generated by the new land uses

2.2.4 At this stage, site selection criteria have been based on location and development density only for each land use. As the area wide development progresses the selection criteria will be refined to take account of the land use type and enhancements to public transport modes.

2.2.5 The resulting person trip rates derived from the TRICS data are summarised in the table below for the morning and evening peak hour periods.

Table 2.3: Total All Person Trips derived From TRICS

	Morning peak hour		Evening Peak hour	
Land use	**Trip Rate In**	**Trip Rate Out**	**Trip Rate In**	**Trip Rate Out**
B1- Light Ind	1.537	0.062	0.107	1.334
B2 General Ind	0.229	0.054	0.020	0.020
B8 – Warehousing	0.335	0.085	0.120	0.402
C1 - Hotel	0.760	0.727	0.710	0.620
D2 – Leisure (Lakeside)	0.499	0.349	1.77	1.03
D2 Leisure (other)			0.546	0.413
Education	9.821	0.563	0.103	0.312
Residential	0.133	0.322	0.214	0.093
A1 - Retail Park	0.655	0.235	3.207	3.426
C2 - Hospital	1.960	0.415	0.536	1.496

2.2.6 It is anticipated that many of the trips generated by new development will be trips that already exist on the network or will be trips that visit more than one of the new development sites. To account for this, it has been assumed that those trips to the leisure and retail areas are likely to be linked trips and therefore a reduction of 30% has been applied to the estimated total trip generation.

3 Methodology

3.1 Introduction

3.1.1 As previously mentioned, as part of the overall study it was necessary to construct a four-stage spreadsheet demand model and produce a forecast of future demand, taking into account the additional development (households, population, jobs) that are expected in the future. The four stage model is a behavioural model which can be described simply as representing four decisions made by transport users on:

- Trip Ends
- Distribution
- Modal Split
- Assignment

3.1.2 To assess the impact on each link within the study area, a similar methodology has been used to that adopted in the previous Infrastructure Deficit study. This includes the development of a spreadsheet model to calculate Congestion Reference Flows (CRF) on the road network before and after development. The CRF gives an estimate of the Annual Average Daily Traffic (AADT) flow at which the carriageway is likely to be congested in the peak period on an average day.

3.1.3 In addition, 36 key intersections (of which 16 were assessed in the evening peak hour) were selected for the junction assessment based on discussions with Thurrock Council. The capacities of these junctions have been assessed using the appropriate DfT software packages such as LINSIG, ARCADY and TRANSYT.

3.1.4 The forecast models were developed for 2021 and 2025 by applying relevant TEMPRO growth factors to the existing traffic for a “Do Minimum” (DM) scenario plus the likely traffic generated from the developments in each option to produce a “Do Something” (DS) situation. Other changes related to policy change and demand management were also incorporated in the traffic growth where sufficient data were available. Alternatively, simple assumptions on the % changes were agreed with Thurrock Council and were included in the forecast.

3.2 Assessment Approach

3.2.1 The existing highway demand has been calculated from the existing 2006 traffic data supplied by Mouchel Parkman and supplemented by additional data collected as part of this study in October 2007.

3.2.2 The observed data have been used directly to assess:

- link flows, on an Annual Average Daily Traffic (AADT) basis compared with the CRF;
- junction capacities during the AM peak hour (0800-0900);
- junction capacities during the PM peak hour (1700-1800).

3.2.3 Where no observed data was available, synthesized flow were extracted from the TGSE model. These junctions were 6, 9, 32, 33 and M25-J31.

3.2.4 Figure 3.1 shows the locations of links and junctions assessed for this study.

3.2.5 Following discussion with the Council, it was agreed that this study will also include Junction 30 and 31 on the M25.

3.2.6 It is acknowledged that Junction 30 is over capacity in the base scenario (2006) and will remain so without future intervention. This study is primarily concerned with infrastructure deficits and interventions that will be delivered locally. The solutions for Junction 30 will be taken forward by the Department for Transport/Highways Agency.

3.2.7 Schemes to address the deficit at Junction 30 are currently at pre-feasibility stage. A preferred option is not expected until later in 2009 at the earliest. However, it is possible to assess this junction based on the current interim proposals put forward by the Highways Agency. At this stage it is considered that the development growth in Thurrock, and the proposed interventions set out in this report, will almost certainly be delivered before any large scale intervention at Junction 30.

3.2.8 For rail, the existing demand has been calculated using a spreadsheet demand model (please see Section 5.2 for full description). The demand from the model has then been used to assess the capacity of the rail system based on the existing frequency and the number of seats available in each service.

3.2.9 Future demand is forecast using a spreadsheet demand model which produces demand matrices for the base year 2006 and for all future years:

- for highway, the incremental change in demand from 2006 is used to calculate the change in link flows and junction turning counts between 2006 and the two forecast years;
- for rail, the demand from the future year spreadsheet model is used to assess the capacity of the rail system in the same way as for the base year.

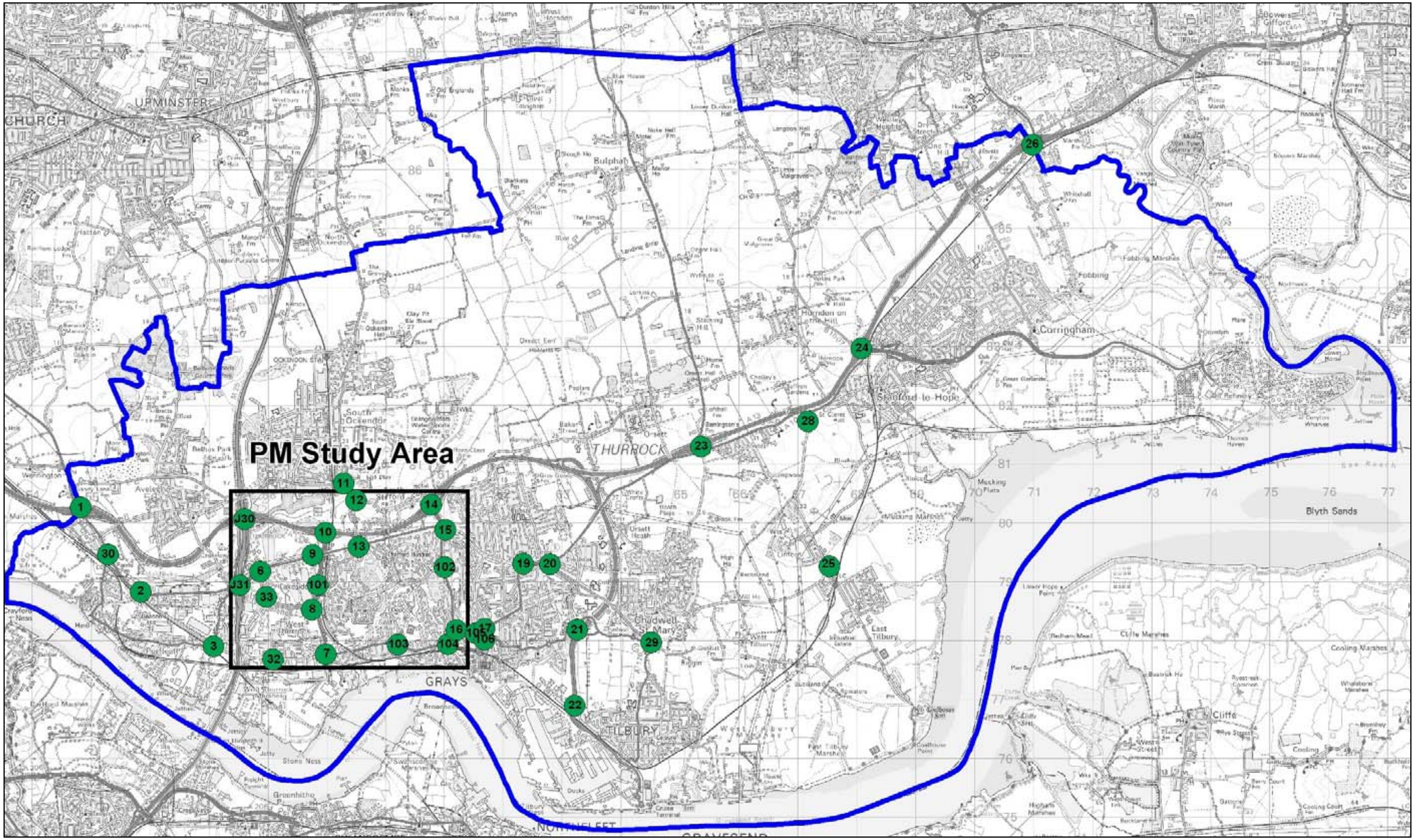
3.2.10 The future year scenarios which have been assessed are as follows:

- 2006 (baseline) morning peak hour period (all junctions)
- 2021 morning peak hour period (all junctions)
- 2025 morning peak hour period (all junctions)
- 2021 evening peak hour period (16 junctions in proximity to Lakeside Basin)
- 2025 evening peak hour (16 junctions in proximity to Lakeside Basin)

3.2.11 The detailed description of the assessment of the existing situation and the future scenarios are set out in sections 4 and 5 respectively.

COLIN BUCHANAN

Figure 3.1: Highway Link and Junction Sites Considered for the Survey



3.3 Assessment Components and Parameters

3.3.1 The main components of the transport analysis can be identified as being:

- ***Highway links:*** analysis of highway link flows compared with capacity (as defined by the CRF - Congestion Reference Flow);
- ***Highway junctions:*** analysis of highway junction flow and capacity using appropriate software (ARCADY, PICADY, LINSIG or TRANSYT depending on junction);
- ***Rail:*** analysis of rail passenger demand and capacity using a spreadsheet model.

3.4 Highway Links

3.4.1 In order to assess link capacity, link flows are compared with link capacity as defined by the CRF, using a spreadsheet. Link flows are taken directly from 2006 surveys in the baseline case, with the exception of a few junctions which have been taken from TGSE as explained earlier in 3.2.3.

3.4.2 The CRF is defined in the Design Manual for Roads and Bridges (DMRB) Volume 5, Section 1, Annex D as an estimate of the Annual Average Daily Traffic (AADT) flow for which the carriageway is likely to be congested at the peak periods on an average day. The full definition is also copied below:

CRF = CAPACITY * NL * Wf * 100/PkF * 100/PkD * AADT/AAWT

where:

- CAPACITY is the maximum hourly lane throughput (see **Note 1** below);
- NL is the Number of Lanes per direction;
- Wf is a Width Factor (see **Note 2** below);
- PkF is the proportion (percentage) of the total daily flow (2-way) that occurs in the peak hour;
- PkD is the directional split (percentage) of the peak hour flow;
- AADT is the Annual Average Daily Traffic flow on the link;
- AAWT is the Annual Average Weekday Traffic flow on the link.

Note 1: CAPACITY - the maximum sustainable hourly lane throughput.

In reality this value varies day to day due to the prevailing conditions (for example, day/night, wet/dry, percentage heavy vehicles, regular/holiday traffic) and values used must be an average.

For **new links** and **existing links not currently experiencing congestion** the capacity, in vehicles per lane per hour, can be estimated from the following relationship:

CAPACITY = [A - B * Pk%H]
where, Pk%H is the percentage of 'Heavy Vehicles' in the peak hour. The term 'Heavy Vehicles' always includes the vehicle categories OGV1, OGV2 and PSVs according to the COBA definition;
A and B are parameters dependant on road standard;

Table 3.1: Capacity Parameters

	A	B
Single Carriageway	1380	15.0
Dual Carriageway	2100	20.0
Motorway	2300	25.0

For **existing links already experiencing congestion** the maximum hourly throughput should ideally be an observed, robust estimate. This can be determined from observations on a minimum of ten days in fine, dry, daylight conditions. When observing the maximum hourly throughput the major problem is to determine when the link is actually operating at "capacity" (paragraph D.1 describes the likely traffic conditions at "capacity").

Note 2: Width factor.

This factor is designed to adjust the CRF for all-purpose links, generally single carriageways, with non-standard lane widths. Carriageway width is defined as the total paved width of the carriageway less the width of ghost islands and hard strips.

Motorways - the width factor Wf should always be unity for motorways as there is no evidence to suggest that the maximum hourly throughput of motorway links is affected by minor changes in lane width.

All-purpose dual carriageways - to reflect the different standards of some dual carriageways. The width factor is given by:

Wf = Carriageway Width / (Number of Lanes * 3.65).

The majority of dual carriageways will have lane widths of 3.65 metres and hence a width factor of unity. Some will have reduced lane widths, generally those built to older design standards, and in these cases the width factor can be less than unity. Should the lane width be greater than 3.65 metres the width factor should be restricted to a maximum value of unity.

Single carriageways (2-lane) - the main purpose of the width factor is to differentiate between the different carriageway width standards of single carriageways. The width factor is given by:

Wf = (0.171 * Carriageway Width) - 0.25
Roads built to modern designs usually have 7.3 metre of 10 metre carriageways, that is, a width factor of unity or 1.46. The width of older roads can vary significantly but the width factor relationship is not valid for road widths less than 5.5 metres or greater than 11 metres. For roads with widths outside these limits the traffic analyst must use judgment to decide on the relevant value.

3.5 Highway Junctions

3.5.1 Junction analysis has been undertaken for 34 key junctions in the AM peak hour period and 16 junctions in the evening peak hour, in the Thurrock local authority area as illustrated in Figure 3.1. This has been done using different junction software according to the different junction types:

- ARCADY: for all non-signalised roundabouts;
- PICADY for all priority junctions;
- LINSIG for all signalised junctions except signalised roundabouts;
- TRANSYT for all signalised roundabouts.

3.5.2 A complication arises in analysing the flow/capacity outputs from these software packages. Unlike links (for which we have calculated a single flow/capacity value), each junction has multiple flow/capacity values with one for each arm of the junction. In order to summarise the junction analysis graphically, we have developed two approaches to combine the results from each arm:

- Flow weighted average;
- Highest Flow/Capacity.

Flow weighted average

3.5.3 The flow weighted average is calculated by the following formula:

$$FWA = \sum_i (V/C)_i * F_i$$

where:

i is an arm of the junction;
$(V/C)_i$ is the flow/capacity for arm i;
F_i is the flow entering the junction through arm i.

3.5.4 This means that the flow/capacity ratio is given more weight for busier arms. It can also be interpreted as the average flow/capacity for a vehicle using the junction, irrespective of which arm they use. Consequently it is a good indicator of how the junction as a whole is performing.

3.5.5 The disadvantage of this analysis is that it frequently fails to highlight where the problems are, because in the vast majority of cases the flow weighted average is below 70% and hence junctions are simply classified as 'below capacity'.

Highest Flow/Capacity

3.5.6 The alternative approach is to take the highest flow/capacity of any arm on the junction. This approach highlights any junctions where the flow/capacity for any arm is above 70%; hence in practice it is more informative than the flow weighted average.

3.5.7 Having considered both of these approaches for reporting the junction delay results, we have reported the 'Highest Flow/Capacity' value.

3.6 Rail

3.6.1 Rail demand data for 2006 is calculated using a spreadsheet demand model (the same one as used to forecast future highway link flows, as described in Section 5.2).

3.6.2 This is compared with the following measures of train capacity:

- Train seating capacity;
- PiXC (Persons in Excess of Capacity) capacity;
- Crush Capacity.

3.6.3 The passenger flow/capacity has been illustrated in a stress factor diagram in Figure 4.3 in a similar way to the highway link and junction capacity with colour coding of rail links according to the demand/capacity ratio.

3.7 Outputs

3.7.1 To demonstrate the performance of the highway network, the outputs of the above assessment of each link and junction have been grouped into five categories for each assessment period, based on the capacity of each link or junction. These categories can be summarised as:

- ***Well above capacity*** (Flow/Capacity above 115%);
- ***Above capacity*** (Flow/Capacity between 100% and 115%);
- ***Above desired capacity*** (Flow/Capacity between 85% and 100%);
- ***Approaching desired capacity*** (Flow/Capacity between 70% and 85%);
- ***Below capacity*** (Flow/Capacity below 70%).

3.7.2 For rail links, similar categories have been developed.

- ***Above crush capacity*** (Passenger Flow/Seating Capacity greater than 191%);
- ***Above PiXC capacity*** (Flow/Capacity between 144% and 191%);
- ***Above seating capacity*** (Flow/Capacity between 100% and 144%);
- ***Approaching seating capacity*** (Flow/Capacity between 85% and 100%);
- ***Below capacity*** (Flow/Capacity below 85%).

3.7.3 These ranges are based on the capacity of the Class 357 train units used by c2c, the rail company which operates all trains through Thurrock. These trains can be summarised as having a seating capacity per 4-car unit: of 282 a PiXC (Persons in excess of Capacity) standing capacity per unit of 124 and a Crush capacity per unit of 257.

3.7.4 Once each output for the highway and rail assessment has been classified the results have been plotted in stress factor diagrams using GIS software (MapInfo) with a different colour coding to identify each of the five categories. It is considered that these categories will best represent the performance of the network under each scenario tested:

4 Baseline Assessment

4.1.1 Highway Links and Junctions Figure 4.1 and Figure 4.2 show the highway link flows for the AM and PM peaks respectively in the base year (2006) compared with the CRF.

4.1.2 Junction Flow/Capacity calculations are also shown in the same figure using a similar colour scheme as detailed below. The Flow/Capacity ratios shown represent the degree of saturation for the worst arm at each junction.

- Red: Well above capacity (Flow/Capacity above 115%);
- Orange: Above capacity (Flow/Capacity between 100% and 115%);
- Yellow: Above desired capacity (Flow/Capacity between 85% and 100%);
- Green: Approaching desired capacity (Flow/Capacity between 70% and 85%);
- Blue: Below capacity (Flow/Capacity below 70%).

4.1.3 As can be seen from the figure, the majority of links and selected junctions are either well below capacity or approaching the desired maximum capacity of 85%. Only four junctions and four links were reported as being above capacity (above 100%) in the base case whereas a number of junctions and a further four links were reported as being above the desired capacity of 85%.

4.1.4 The junctions which were found to be above capacity in the base case are junction 12 in the North Stifford area and junction 106 in Grays town centre and 103 in the South Stifford Area and junction 14.

4.1.5 The junctions that were found to be above desired capacity were mainly in Grays Town Centre (junctions 17, 104 and 105), Chafford Hundred (junctions 15 and 102), on and around the A13 near Orsett (junctions 23 and 28), and in South Ockendon (junction 11).

Rail links

4.1.6 The passenger flow/capacity calculations for each rail link are shown in Figure 4.3 using a similar colour coding to the previous figure:

- ***Red:*** Above crush capacity (Passenger Flow/Seating Capacity greater than 191%);
- ***Orange:*** Above PiXC capacity (Flow/Capacity between 144% and 191%);
- ***Yellow:*** Above seating capacity (Flow/Capacity between 100% and 144%);
- ***Green:*** Approaching seating capacity (Flow/Capacity between 85% and 100%);
- ***Blue:*** Below capacity (Flow/Capacity below 85%).

4.1.7 This analysis is based on morning peak hour demand with train services in the London-bound direction (the time of highest demand).

4.1.8 The map of results clearly indicates that the current Thurrock rail passenger flows are well below capacity – in fact the ratio of passenger flow to seating capacity does not exceed 50% on any rail links in Thurrock.

4.1.9 The analysis of rail crowding has focused on the Thurrock area only, and not on the whole corridor towards London. It would be expected that some crowding may occur on trains as they approach London. However, the impact of this on passengers joining trains in Thurrock is expected to be minimal, as there is sufficient seating capacity to accommodate all passengers east of Barking.

Figure 4.1: Baseline AM Peak Flow/Capacity – Highway Links and Junctions

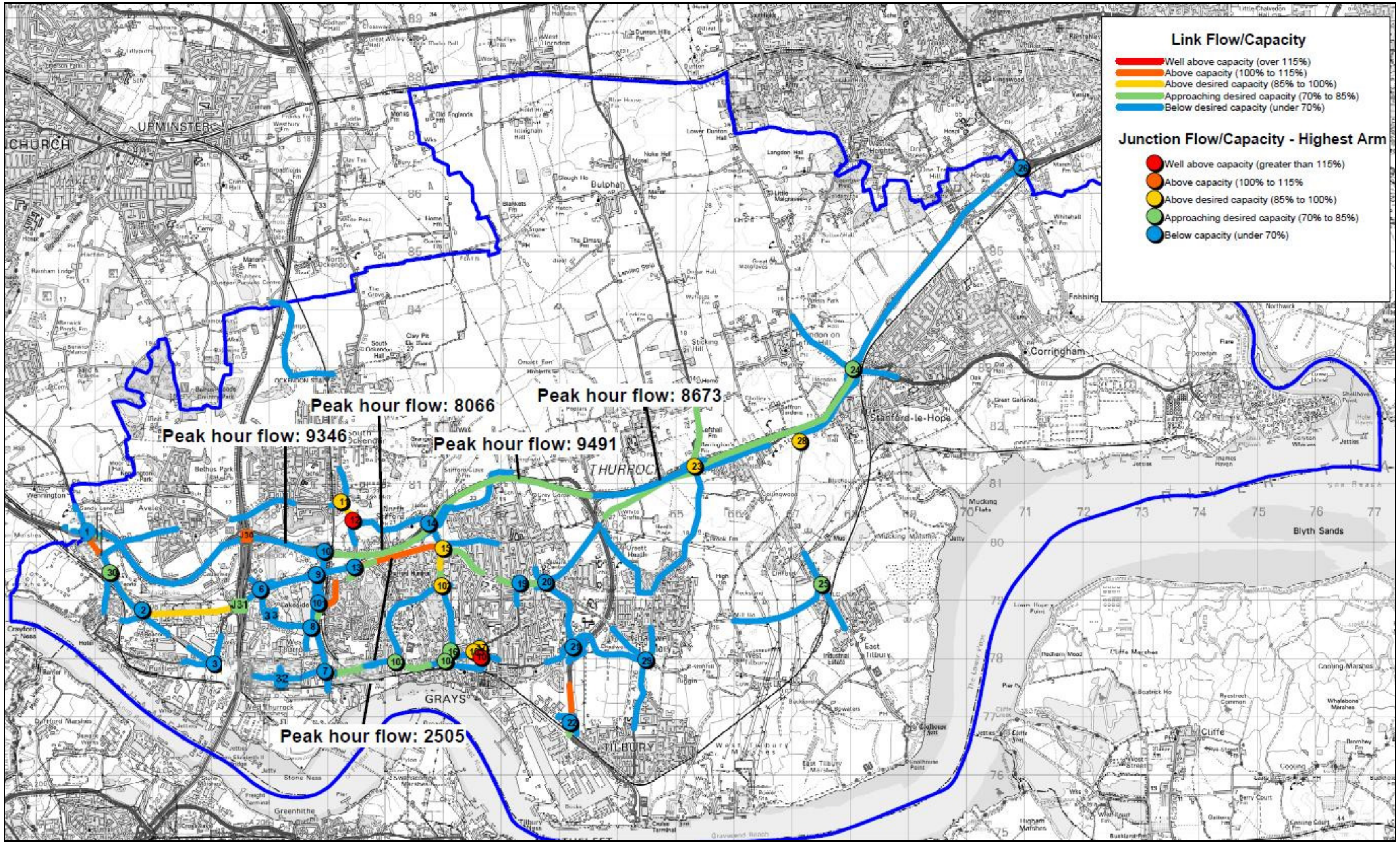


Figure 4.2: Baseline PM Peak Flow/Capacity – Highway Links and Junctions

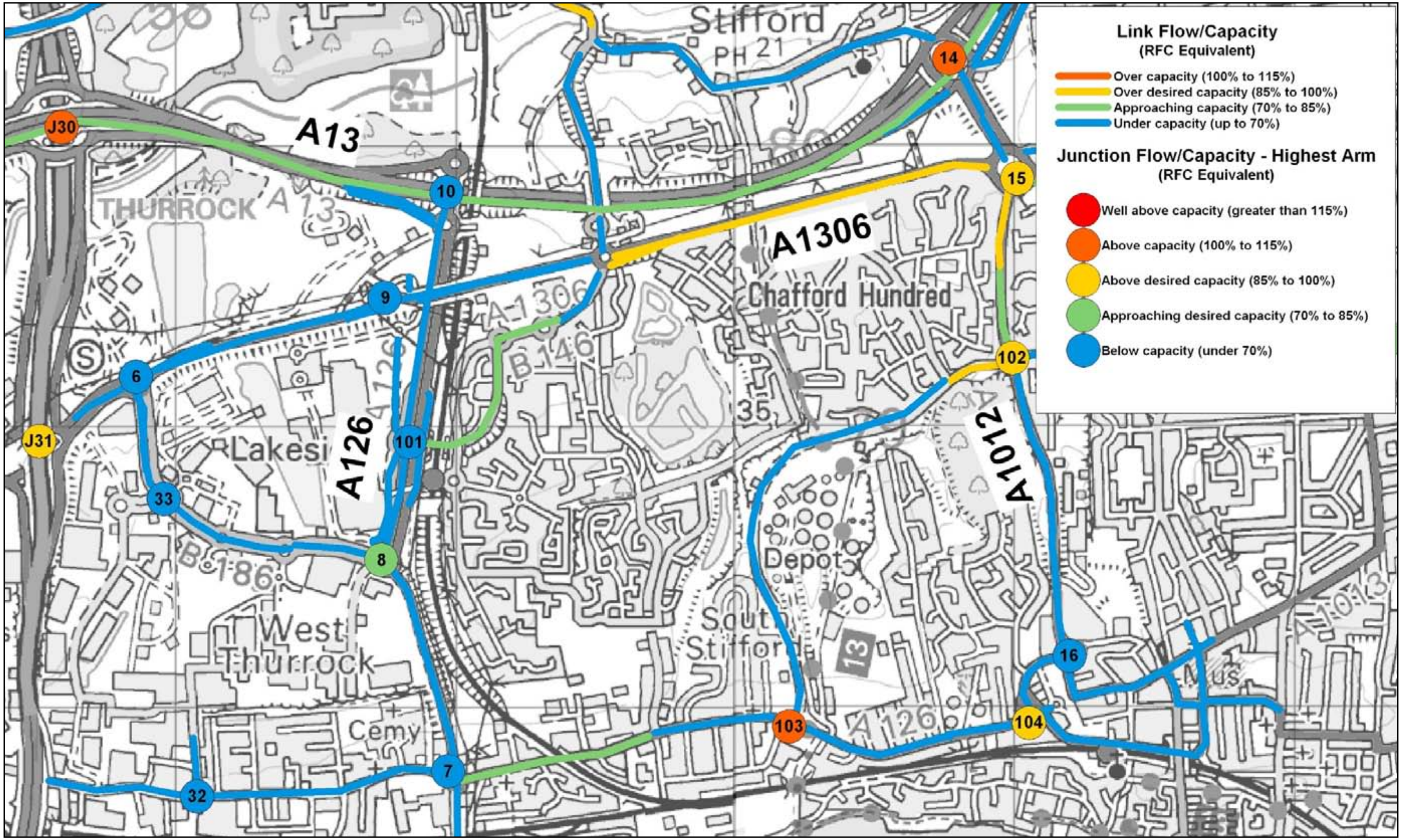
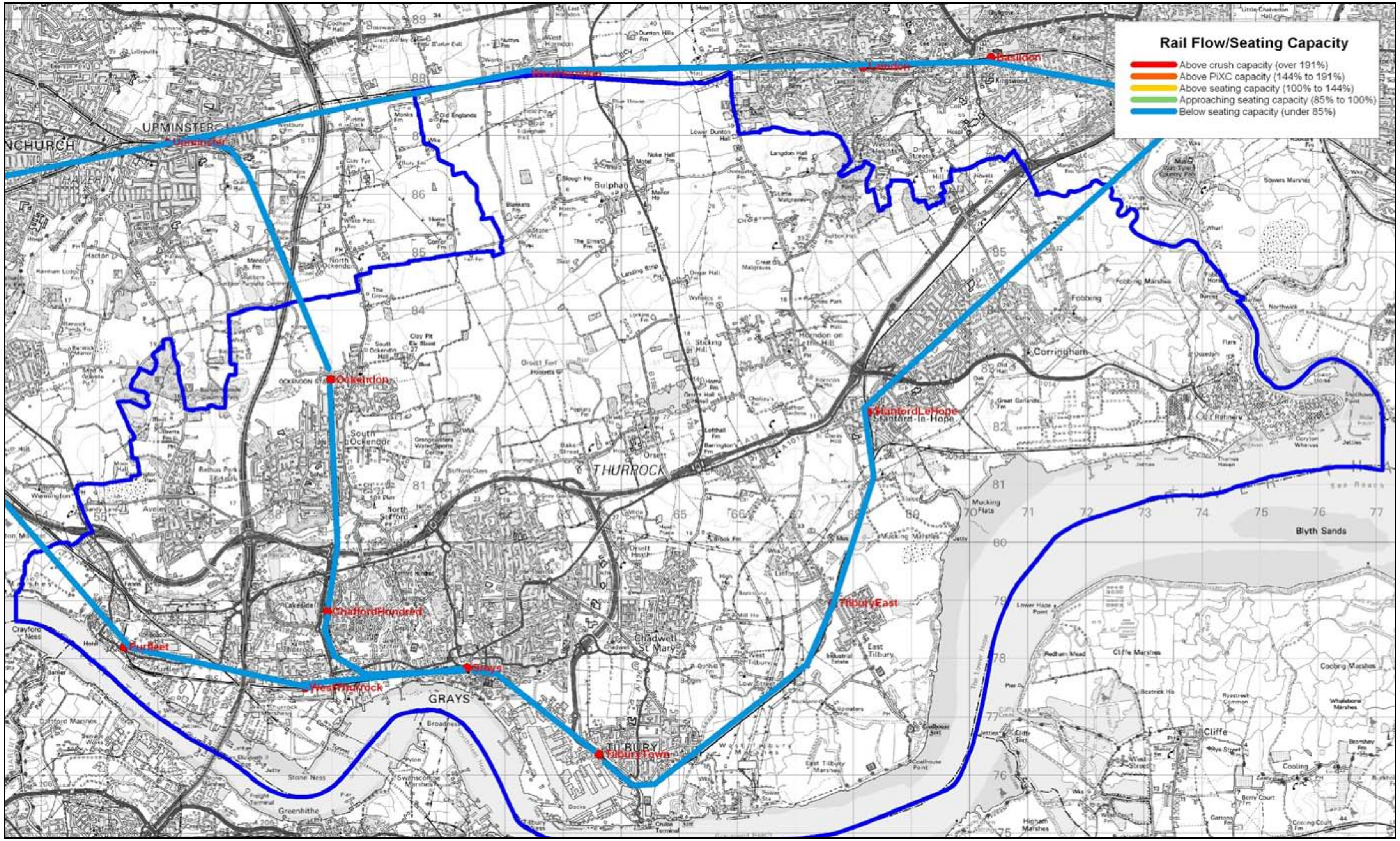


Figure 4.3: Baseline Flow/Capacity – Rail Links



5 Assessment of Future scenarios

5.1 Approach

5.1.1 In order to produce analysis of the transport network in the future scenarios, it was necessary to produce a forecast of future demand, taking into account the additional development (households, population, jobs) that are expected in the future. To do this, the TRICS data set out in Table 2.3 has been used and has been applied to each zone based on the total proportion of land area.

Highway Demand

5.1.2 For highways, the forecast ***changes*** in demand from 2006 onwards have been added to the observed 2006 data to produce 2021 and 2025 forecasts. This incremental approach is considered to be superior to the creation of a fully synthesised model since it makes use of the observed dataset.

Rail Demand

5.1.3 The rail demand calculations are based on the synthetic matrices from the spreadsheet demand model, in the same way as for the 2006 rail demand calculations discussed in Section 3.6.

5.2 Spreadsheet Demand model

5.2.1 For this project, it was decided that it would be more appropriate to use a simplified version of the classical four-stage transport model. This has the advantage of showing the interaction between changes in both households and employment.

5.2.2 The four-stage model is a behavioural model which can be described simply as representing four decisions made by transport users:

- Trip Ends (where shall I travel from?);
- Distribution (where shall I travel to?);
- Mode Split (which mode shall I take – car, public transport (rail or bus), walking or cycling?)
- Assignment (which route shall I take?).

5.2.3 The last three of these steps are sometimes repeated because:

- the assignment generates, or adjusts, costs according to congestion or crowding;
- the distribution and mode split components are cost dependent, and hence may be adjusted by costs from the assignment.

5.2.4 The Thurrock model uses a very simple assignment to establish the demand on each link, without full analysis of costs. For this reason the last three steps have not been repeated for the purpose of this study. In addition, Thurrock is a predominantly rural area and hence is mostly less congested than cities to which the classical transport model is usually applied.

5.2.5 The model makes maximum use of freely available data. This includes:

- the 2001 Census (including travel to work data);
- other Office of National Statistics (ONS) data regarding education places and retail floor space;
- the National Trip End Model program (TEMPRO);
- the National Travel Survey (available from the DfT website).

5.2.6 Five trip purposes have been selected as follows:

- Commuting
- Business
- Education
- Shopping
- Other

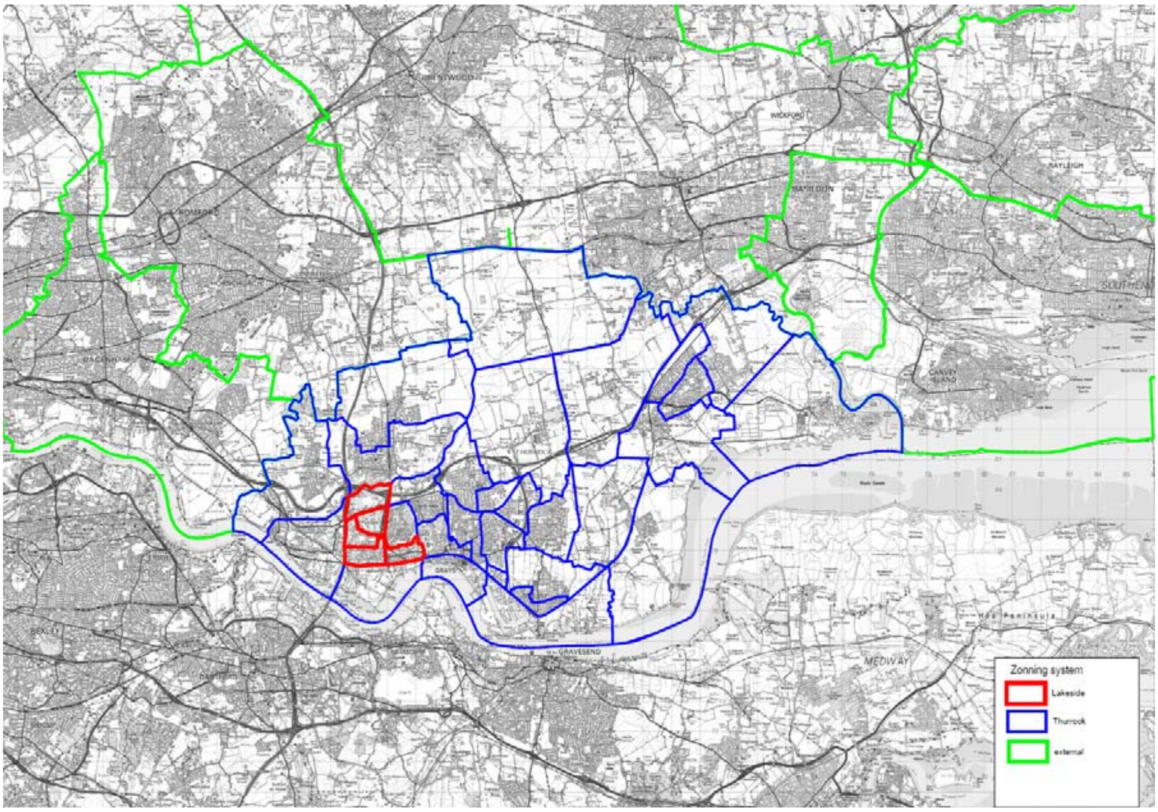
Additionally, the model calculates a separate goods vehicle matrix, but this is not subject to the mode split procedure.

Zoning System

5.2.7 The zoning system covers a wide area and is shown in Figure 5.1 with a total of 46 zones as follows:

- Detailed Zones- 34 zones within Thurrock including 5 zones representing lakeside Basin ;
- Intermediate zones- 6 zones representing the rest of Essex along the A13 corridor between Barking/Upminster and Southend.
- Coarse zones- 6 zones representing the South East, London and the East of England.

Figure 5.1: Zoning System



Trip Ends

5.2.8 Trip ends are constructed by multiplying suitable planning data by trip rates. The planning data has been taken from the 2001 Census, whilst the trip rates were taken from the National Travel Survey for the East of England region. Trips to and from the zones within Thurrock and Lakeside were adjusted to match the TRICS trip rates

5.2.9 Both production trip ends and attraction trip ends are specified for the following trip purposes;

- Commuting
- Business
- Education
- Shopping
- Other
- Goods

Distribution

5.2.10 The trip distribution model uses a mathematical function (power functions) to calculate the number of trips between each pair of zones, based on the cost of travelling between them. The power value used in the power function varies by trip purposes according to the average length of trips derived from National Travel Survey.

5.2.11 In the distribution step, the trip productions and attractions are combined to obtain production-attraction trips. The distribution of trip attraction zones for trips from a given trip production zone are dependent on:

- the distance between the production and attraction (the greater the distance, the less attractive);
- the number of attractions in the attraction zone.

5.2.12 These effects are represented, respectively, by:

- raising the distance between the trip production and trip attraction to a negative power (typically between -2 and -3);
- multiplying by the number of attractions.

5.2.13 The power value used in the power function varies by trip purpose, according to the average length of trips for that purpose (which again is derived from National Travel Survey data). The power p is calculated using the following formula, which was established from using calculus between a 'minimum' distance c (in km) and infinity:

$$p = -\frac{(2*M - c)}{(M - c)}$$

where M is the average distance for the purpose in km.

5.2.14 The distribution model is calibrated using Census 2001 journey to work data, for the commuting purpose only. The same model is used for all the other trip purposes, but with the value M adjusted in the formula for p above to reflect the different average distances for each trip purpose.

Mode Split

5.2.15 The mode choice model calculates the number of trips that will use each available mode based on their relative costs using a Logit model. This is done separately for each zone pair in the model and also for different trip purposes and mode as follows:

- Car driver
- Car passenger
- Rail
- SERT
- Bus
- Cycle & Walk
- Computer (e.g. home working or home shopping).

5.2.16 The costs are derived from applying a ratio to crowfly distance and an average speed, with the exceptions of:

- rail costs which are derived from c2c timetables;
- car costs, which are based on the highway assignment under free-flow conditions.

5.2.17 Although all the above listed modes are taken into account within the mode split model, the cycle, walk and computer matrices are not actually generated in order to save computing space.

Future Year Public Transport Improvements and Traffic Demand Management

5.2.18 Future car demand per person is expected to be reduced in Thurrock by the implementation of public transport improvements and traffic demand management (TDM) measures. Some of these measures can be achieved without increasing the cost of motoring (e.g. travel plans).

5.2.19 For the purpose of this test, public transport improvements, TDM and other soft measures were modelled by adding an additional cost to all car trips, to encourage shift to other modes where possible. The costs were calibrated to produce a given reduction in demand. Table 5.1 below shows the assumptions made for the car demand reductions by purpose. These were agreed with Thurrock Council. The reduction of 25% in car demand for the education purpose (school run) trips for 2006 has already been achieved.

Table 5.1: Reductions in Car Demand

	2006	2021	2025
Education	25%	35%	35%
All other purposes	0%	10%	10%

Future Year Treatment of London Gateway Port, Shell Haven

5.2.20 The London Gateway Port will be a major employment site generating a high density of HGV trips in addition to work and business car trips. Table 5.3 shows the proposed land use for this site.

Table 5.2: London Gateway Port Land Use

	Description	Gross Floor Space
B8	Distribution	718,516 sq m
B2	Manufacturing	97,856 sq m
B1	High Tech and Light Industrial	120,148 sq m

Source: Thurrock Employment Land Review, URS.

5.2.21 The total demand to and from the London Gateway Port was calculated from the above table using trip rates from TRICS. Trips to and from the zone containing London Gateway Port, taken from the spreadsheet demand model, were adjusted to match this demand.

Highway Assignment

5.2.22 A simple SATURN link-based assignment is used to assign highway vehicles to different routes. The purpose of this simple assignment was to model the changes in link and junction flows between the base and future year demands before adding these changes to the corresponding observed data for 2006.

5.2.23 It should be noted that the assignment model did not include detailed junction modelling as junctions were analysed separately using the junction modelling software such as LINSIG, ARCADY and TRANSYT.

Adjustment of Link Flows

5.2.24 For the Link and Junction Flow/Capacity calculations, base year (2006) flows are taken from observed data. The spreadsheet model is used to calculate base (2006) and future year demand matrices. The future demand is calculated by:

- subtracting the base (2006) demand from the future demand, to obtain a growth matrix;
- assigning this growth matrix to obtain the change in link flows and junction turning counts;
- adding the change in link flows and junction turning counts to the corresponding observed data for 2006.

5.3 Highway Links

5.3.1 As described previously, future year link flows are obtained by assigning the growth in demand between the base year (2006) and the future year, and adding this to the base year link flows.

5.3.2 This provides a future year demand assumption which is compared with the capacity in the same way as the base (2006) flow/capacity calculations (as discussed in Section 4).

5.3.3 For future scenarios where there are changes to the link capacity (for example widening from 2 to 3 lanes), these capacity changes can be easily incorporated into the spreadsheet analysis prior to running the update.

5.4 Highway Junctions

5.4.1 Similarly, future year junction turning counts are obtained by assigning the growth in demand between the base year (2006) and the future year, and adding this to the corresponding base year junction turning counts.

5.4.2 This provides a future year demand assumption which is compared with the capacity in the same way as the base (2006) junction flow/capacity calculations. For each of the selected junctions, a junction model using ARCADY, PICADY, LINSIG or TRANSYT is used as appropriate.

5.4.3 For future scenarios where there are changes to the link capacity (for example widening one of the roads on approach to a key junction), these capacity changes can be incorporated into the junction models prior to running the updated flow/capacity calculations.

5.4.4 For junctions operating below their desired capacity, junction analyses were not repeated where the approaching flows (in PCU) differed by less than 10% on each arm compared with the turning flows for the same junction in a different scenario.

5.5 Rail

5.5.1 The rail demand is updated by using the spreadsheet model as described previously in this section.

5.5.2 Accordingly, the future rail flow/capacity was calculated using the same methodology as for the 2006 base year rail flow/capacity calculations.

5.6 Results

2021 Peak Hour analysis

5.6.2 The analysis shows that no major problems will occur on the rail network and there will be sufficient capacity in the network for rail passengers in Thurrock. However, there will be a number of deficits on the highway infrastructure both on the strategic and on local road networks.

5.6.3 In the 2021, the main changes to the highway network arise from the London Gateway Port development at Shell Haven. This causes an increase in congestion along the A13, with the greatest increase being between the A128 and A1014 (between junctions 23 and 24) which would need to be widened to 3-lane to accommodate the growth in traffic.

5.6.4 The main changes in junction congestion are also along the A13, with junctions 14 and 24 in particular needing attention, with the eastbound off slips requiring signalisation in both instances.

5.6.5 The morning peak hour only has a limited impact on the rest of the highway network. The only junctions that have been identified as requiring attention in the morning peak hour, other than those that were identified in the baseline case are junction 3 (in Purfleet) and junction 13 (Pilgrims Roundabout).

5.6.6 The evening peak hour period requires more significant levels of mitigation across the wider area, with 11 junctions requiring some form of intervention.

5.6.7 The results of the highway link and junction analysis are shown in Figure 5.2 and 5.3 for the AM and PM peak hours respectively.

Figure 5.2: 2021 AM Peak Flow/Capacity Ratio – Highway Links and Junctions

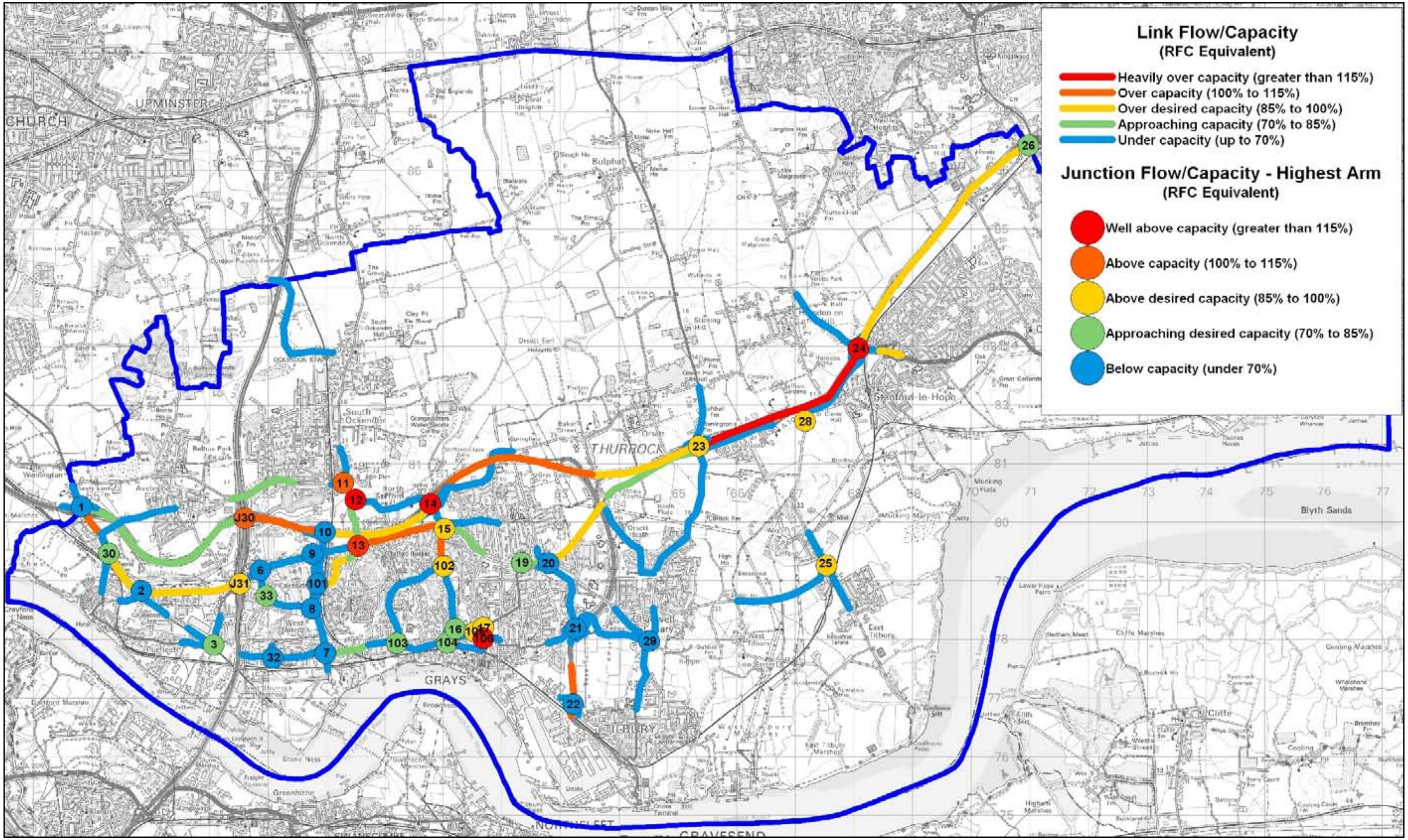
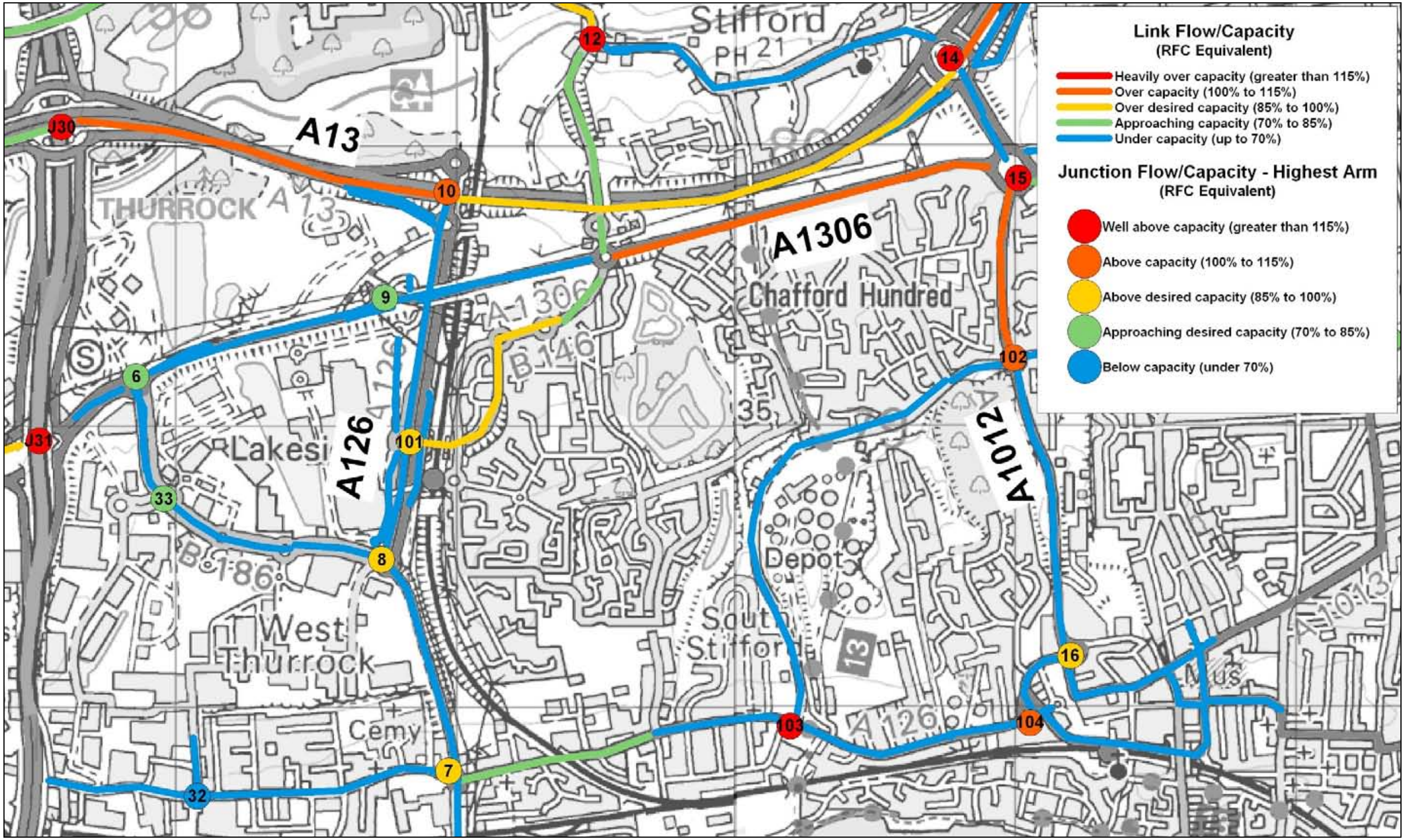


Figure 5.3: 2021 PM Peak Flow/Capacity Ratio – Highway Links and Junctions



2025 Peak Hour Assessment

5.6.8 As with 2021, the main changes to the 2025 highway network are considered to be from the London Gateway Port development at Shell Haven. This causes an increase in congestion along the A13, with most links on the A13 within the area of study being above desired capacity. Again, the worst section is between the A128 and A1014 (between junctions 23 and 24) which would need to be widened to at least 3-lane to accommodate the growth in traffic.

5.6.9 The main changes in junction congestion are also along the A13, with junctions 14, and 24 in particular needing attention. Elsewhere, junction 11, in South Ockendon, requires attention in addition to the junctions that were identified as requiring attention in the base case.

5.6.10 Since it is assumed that the full Lakeside Basin Development is in place by 2021 along with the LDF employment land it is considered that only localised interventions will be required by 2025.

5.6.11 The results of the highway link and junction analysis are shown in Figure 5.4 and Figure 5.5 for the AM and PM peaks respectively.

5.6.12 As with the baseline scenario, the peak-hour rail model did not identify any problems with passenger rail capacity on the network. The results of the rail capacity analysis are shown in Figure 5.6.

Figure 5.4: 2025 AM Peak Flow/Capacity Ratio – Highway Links and Junctions

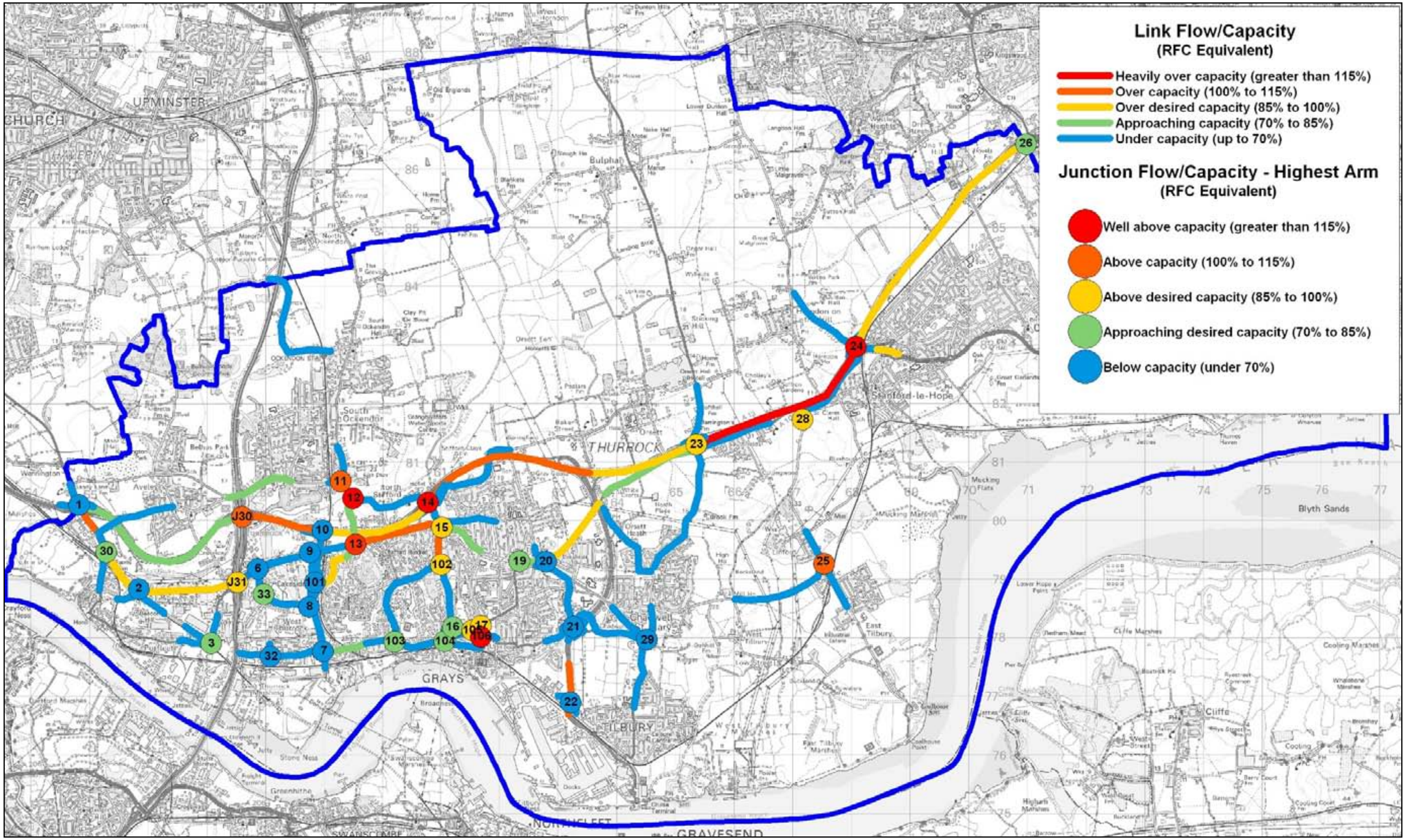


Figure 5.5: 2025 PM Peak Flow/Capacity Ratio – Highway Links and Junctions

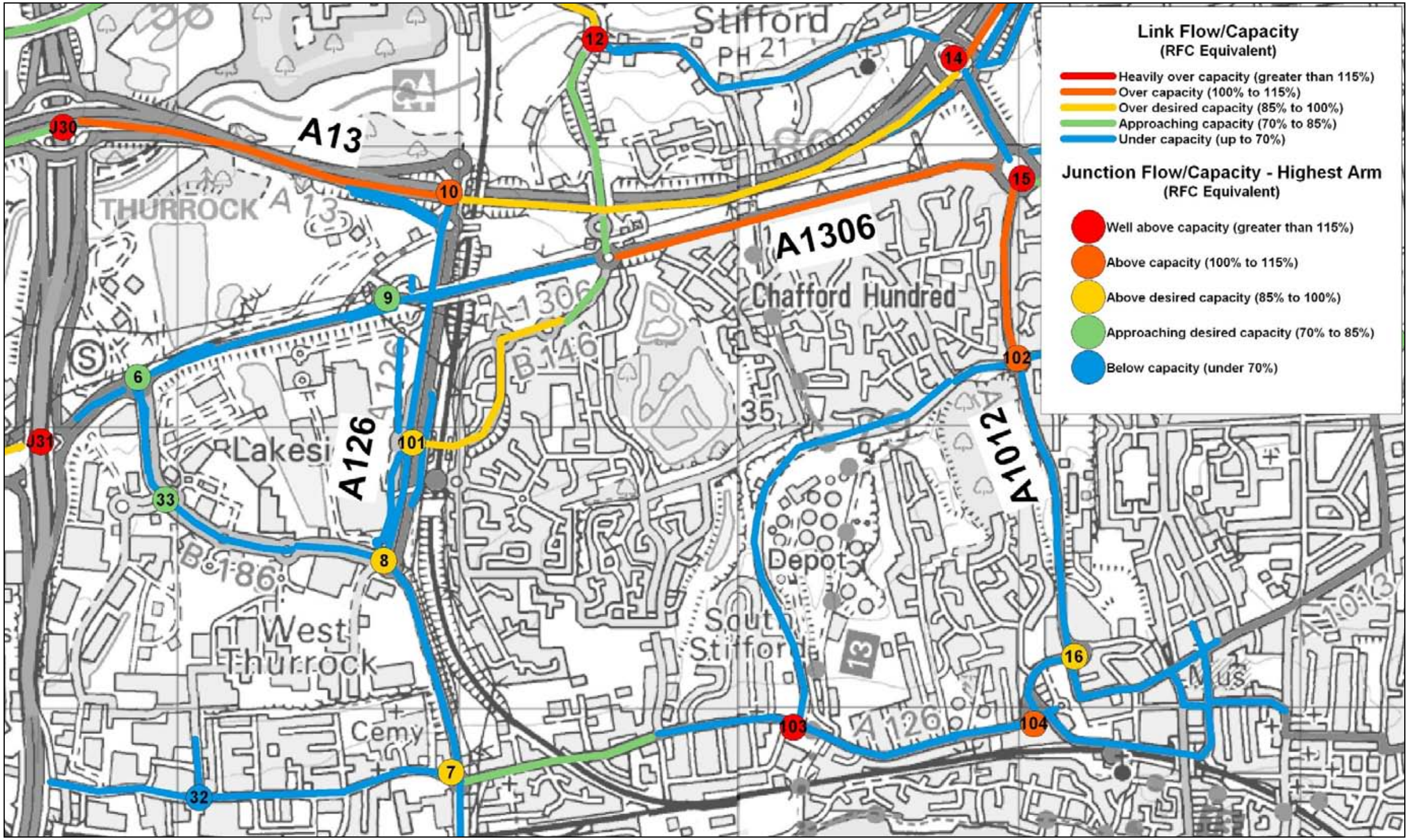
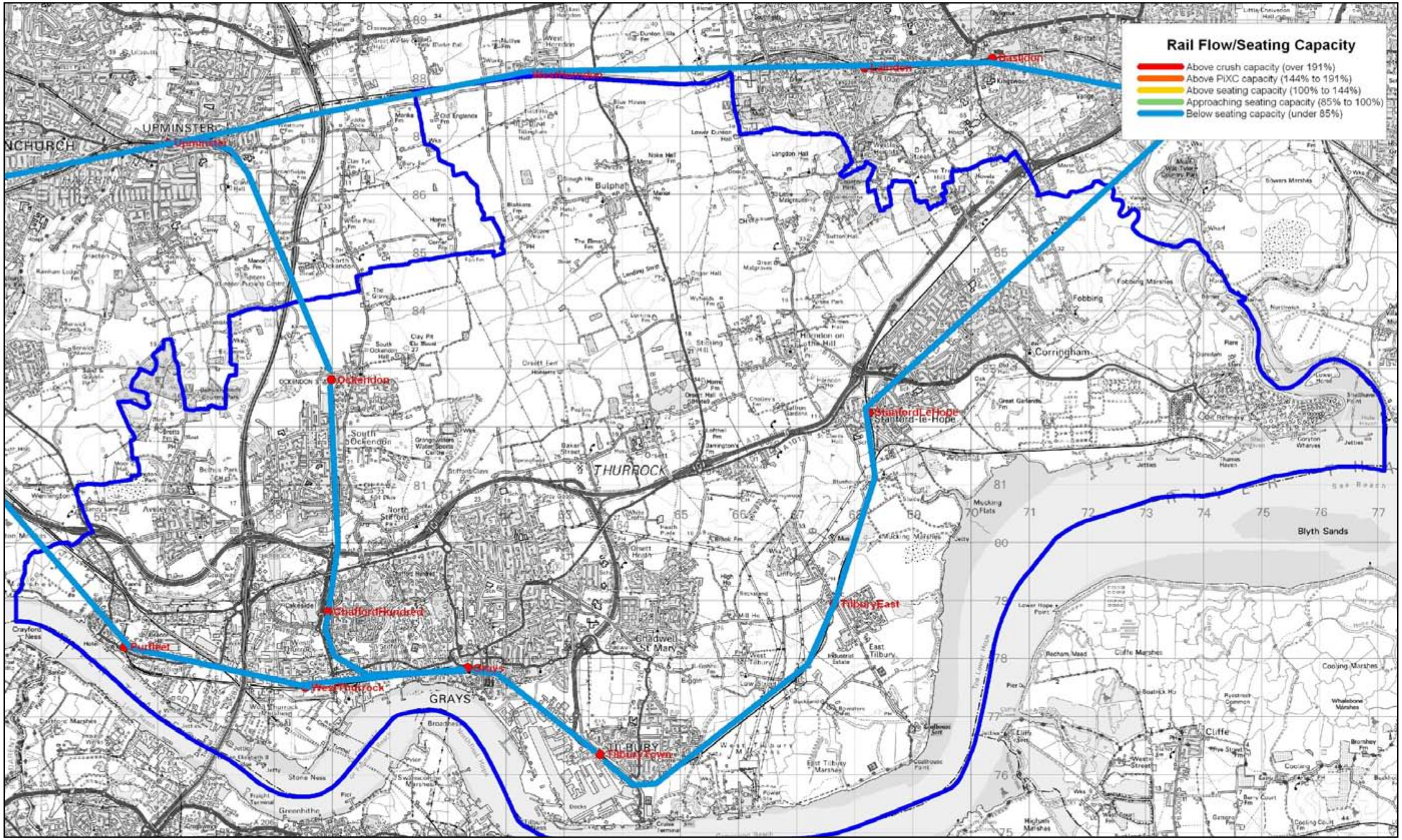


Figure 5.6: 2021 and 2025 Flow/Capacity Ratio – Rail



6 Possible Solutions, Measures and Costs

6.1 Key Highway Link Deficits

6.1.1 The main highway link deficits in the future scenario are:

- on the A13 between the A216 and the M25
- on the A1306 between A1012 and B186
- on the A1012 between Hogg lane and Lodge Lane

6.1.2 Problems elsewhere are confined mainly to short sections of road; these include:

- the A1013 between junctions 20 and 23;
- the slip roads to the A1089 just north of junction 22.

6.1.3 These deficits will be considered in turn.

A13 Deficits

6.1.4 The deficits on the A13 are caused mainly by the development of the London Gateway Port at Shell Haven and the growth in retail proposed for the Lakeside Basin

6.1.5 Two schemes TSR4 and TSR5 have been proposed to alleviate this congestion. Both involve widening of sections of the A13:

- TSR4 involves widening the A13 between the M25 and A126 junctions;
- TSR5 involves widening the A13 between the A128 and A1014.

6.1.6 Our analysis suggests that TSR5 is essential before 2016, whichever of the development options is chosen. This section of road currently has two lanes in each direction and is insufficient for the extra traffic generated by the London Gateway Port.

6.1.7 TSR4, meanwhile, would be less critical, but would be needed to mitigate congestion by 2021.

6.1.8 The section of the A13 between the A1012 and the A1089 is also expected to be congested by 2021 and would benefit from further widening.

6.1.9 Between the A126 and A1012 junctions, the congestion is lower because the junction with the A126 (junction 10 in our analysis) has no east-facing slips. These have been proposed in scheme TSR3, but this scheme is not committed.

A1306 Arterial Road

6.1.10 This road is congested even in the base (2006) case, although in the future scenarios it does not deteriorate further. Congestion on this section of road could be mitigated by road widening with the possibility of an additional lane in each direction.

6.1.11 Another possible measure may be to construct east-facing slips on the A13/A126 junction (junction 10, uncommitted scheme TSR3) allowing more direct access to Lakeside from the east direction.

A1012 (between Hogg Lane and Lodge Lane)

6.1.12 It would be recommended that the carriageway is widened along the A1012 between Hogg Lane and Lodge Lane; this would assist in alleviating the congestion expected by 2021.

6.1.13 The preliminary cost estimates for the highway link improvements are detailed in Table 6.1 below

Table 6.1: Thurrock Highway Links - Cost of Improvements

Link location	Link length (km)	Solution	Cost	Assumption on cost
A13 (M25 to A126)	1.45	Widening by 1 lane	£6,775,000	Carriageway widening Bridging works, gantries and traffic signal costs Not inclusive of stat costs
A13 (A126 to A1012)	1.91	Widening by 1 lane	£9,190,000	Carriageway widening Bridging works and gantries Not inclusive of stat costs
A13 (A1012 to A1089)	2.76	Widening by 1 lane	£12,175,000	Carriageway widening Bridging works Not inclusive of stat costs
A13 (A1089 to A128)	2.25	Widening by 1 lane	£10,275,000	Carriageway widening Bridging works Not inclusive of stat costs
A13 (A128 to A1014)	3.35	Widening by 1 lane	£19,300,000	Carriageway widening Bridging works Not inclusive of stat costs
A13(A1014 to A176)	4.66	Widen by 1 lane	£20,600,000	Carriageway widening Bridging works Not inclusive of stat. Costs
A1306 Arterial Road	2.23	Widening by 1 lane	£9,600,000	No factoring applied to allow for a lower category of road over dual carriageway. Not inc. of stat. cost
A1306 London Road	1.32	Widening by 1 lane	£5,700,000	No factoring applied to allow for a lower category of road over dual carriageway. Not inc. of stat. costs
A1089 Slips (near jct 22)	0.6	New bus/cycle link	£2,600,000	No factoring applied to allow for a lower category of road over dual carriageway. Not inclusive of stat. costs
Total Highway Link Costs			**£96,215,000**	

6.2 Key highway junction deficits

6.2.1 Of the 36 junctions analysed, many were well below capacity in all the future forecasts. The junctions showing a high level of flow/capacity on at least one arm, and therefore requiring attention, are summarised in Table 6.2 for the AM peak and Table 6.3 for the PM peak.

6.2.2 It should be noted that junction capacity indices are based on the worst arm which means that at least one arm of the junction is above 100% threshold and require at a minimum traffic management intervention to improve the junction. The alternative approach is to take the weighted average of all approaching arms which may be a better indicator of the junction performance. In this case, the junction shown in **bold** are over 100% saturated even under weighted average assessment and therefore require more strategic intervention.

Table 6.2: Summary of AM Junction Deficits and Possible Solutions

Junction number	Description	Below capacity	Above desired capacity	Above capacity	Possible solution	Cost Estimate
1	A13 / A1306	√				
2	A1306 London Rd / A1306 Arterial Rd / Purfleet Bypass / Botany Way	√				
3	A1090 / A126 / Purfleet Bypass	√				
6	A1306 / Thurrock Service Area / B186	√				
7	A126 / London Rd West Thurrock	√				
8	A126 / B186	√				
9	A1306 / Back Lane / Lakeside Shopping	√				
10	A126 / A13	√				
11	B1335 / B186 South Rd / B186 Stifford Hill		√		Re-phasing of lights to avoid each approach controlled by a single stage	£520,000
12	B186 Stifford Hill / B186 Pilgrims Lane			√	Convert from a mini to standard roundabout	£640,000
13	A1306 / B186 Pilgrims Lane / B186 Burghley Rd		√		Widen the road, formalise two lanes on northern approach	£120,000
14	A13 / A1012		√		Signalise the A1012 and A13 Eastbound Off-slip	£1,200,000
15	A1306 / A1012		√		Adjust Offset and Green time on all arms.	£36,000
16	A1012 / A126 Crown Rd	√				
17	A1013 / A126		√		Increase cycle time from 60 sec to72 sec	£4,000
19	A1013 Lodge Lane / A1013 Southend Rd	√				
20	A1013 / B149	√				
21	A126 Marshfoot Rd / A1089 Dock Approach Rd	√				

Junction number	Description	Below capacity	Above desired capacity	Above capacity	Possible solution	Cost Estimate
22	A1089 Dock Rd / Thurrock Park Way / A1089 St Andrews Rd	√				
23	A13 / A128		√			
24	A13 / A1014 / A1013			√	Signalise the A1013 and A13 Eastbound Off-slip	£325,000
25	East Tilbury Rd / Muckingford Rd		√		Extend flare on southern arm	£35,000
26	Bells Hill Rd / A13	√				
28	A1013 / Buckingham Hill Road		√		Signalise or build roundabout.	£520,000 sig £295,000 rbt
29	A126 / B149 / Chadwell Hill	√				
30	A1306 / A1090 New Tank Hill Rd	√				
101	A126 / B146	√				
102	A1012 / Hogg Lane / Devonshire Rd		√		Increase Flare on Northern Approach	£34,000
103	A126 / Devonshire Rd	√				
104	A126 London Rd / Eastern Way	√				
105	A1013 / Derby Rd	√			Cycle time needs to be increased from 70s to 80s	£4,000
106	A126 Stanley Rd / A126 Clarence Rd		√		Extra lanes required or increasing cycle time from 90s to 100s results in all approaches under 0.90 RFC.	£545,000
M25J30	Junction of M25 and A13		√		Additional capacity is required on each arm of the roundabout in particular the Eastern approach.	Beyond Scope of this Study
M25J31	M25 / A1306 / A1090	√			Additional capacity might be required on both M25 off-slips and A1306 West approach.	Beyond Scope of this Study
32	B186 / Weston Ave Rbt	√				
33	London Rd / Weston Ave / St Clements Way	√				
					Total cost for AM peak related improvements	**£3,758,000**

Table 6.3: Summary of PM Junction Deficits and Possible Solutions

Junction number	Description	Below capacity	Above desired capacity	Above capacity	Possible solution	Cost Estimate
10	A126 / A13			√	Improve the flaring at the southern and western approaches	£240,000
14*	A13 / A1012			√	Signalise the A1012 and A13 Eastbound Off-slip	*(£1,200,000 inc in AM)*
15	A1306 / A1012			√	An extra lane on A1036 and Long Lane.	£285,000
102*	A1012 / Hogg Lane / Devonshire Rd			√	Increase Flare on Northern Approach	*(£34,000 inc in AM)*
16	A1012 / A126 Crown Rd		√			
104	A126 London Rd / Eastern Way			√	A short two lane approach would be helpful	£40,000
103	A126 / Devonshire Rd			√	Re-phasing of lights to include indicative arrow and flared entry and exit for A126 Westbound	£200,000
7	A126 / London Rd West Thurrock		√		Line remarking to improve flaring on London Rd West approach	£2,000
8	A1306 / A1012		√		Improve flaring on Heron Way approach	£30,000
101	A126 / Fenner Rd / Lakeside		√		Minor flare widening on the Fenner Rd approach	£25,000
9	A1306 / Back Lane / Lakeside Shopping	√				
6	A1306 / Thurrock Service Area / B186	√				
32	B186 / Weston Ave Rbt	√				
33	London Rd / Weston Ave / St Clements Way	√				
M25J30	Junction of M25 and A13			√	A fully grade-separated junction is likely to be required.	Beyond Scope of this Study
M25J31	M25 / A1306 / A1090			√	Providing an extra lane on A1306 West and A1090 West approaches.	Beyond Scope of this Study
					Additional Costs for PM peak related improvements	**£822,000**

* Improvement required in both AM and PM peaks therefore cost already accounted for in Table 6.2.

6.2.3 These junctions will be considered in turn throughout the remainder of this section.

Junction 7 – West Thurrock Way / Stoneness Rd/ London Rd

6.2.4 The London Rd approach is above the desired capacity in the PM peak Simple changes to the line marking to provide longer flaring will increase the capacity on this approach.

Junction 8 - A1306 / A1012

6.2.5 The Heron Way approach is above the desired capacity in the PM peak Widening and lengthening of the flaring on this approach will reduce the flow/capacity ratio below 85%.

Junction 10 - B1335 / B186 South Rd / B186 Stifford Hill

6.2.6 In the PM peak there are large increases of traffic from the A13 off slip and from the southern Approach. Both approaches would need improvements to the flaring to increase the capacity on each approach.

Junction 11 - B1335 / B186 South Rd / B186 Stifford Hill

6.2.7 The approach from the south (B186 Stifford Hill) would need to be widened to 2 lanes and improvements to the signal staging to maintain a flow/capacity ratio below 85%.

Junction 12 - B186 Stifford Hill / B186 Pilgrims Lane

6.2.8 To reduce the flow/capacity ratio below 85%, the mini roundabout would need to be remodelled as a standard roundabout with flaring on each approach.

6.2.9 There may be a complication with this as on the north arm (B186 Stifford Hill), the approach is from a bridge. This may mean that the development of a flare on this approach could be limited. The junction is already above capacity in the baseline forecast.

Junction 13 - A1306 / B186 Pilgrims Lane / B186 Burghley Rd

6.2.10 The B186 Pilgrims Lane entry needs to be widened with a formal 2-lane approach.

Junction 14 - A13 / A1012

6.2.11 This roundabout would need to be signalised in order to control the heavy traffic flows between the A13 (west) and A1012 arms. It may be that only these two approaches would need signalisation.

6.2.12 Scheme TSR3, an uncommitted scheme to remodel junction 10 to include east-facing slips, could in theory reduce the deficit at junction 14 by transferring Lakeside traffic from the east direction to junction 10. However, this would not relieve the most critical movements at junction 14.

Junction 15 - A1306 / A1012

6.2.13 This signalised roundabout would need an adjustment of the offset and green time on all arms in order to keep flow below desired capacity in the AM peak. Increases in traffic in the PM peak would require an extra flared lane on the Long Lane and A1036 West approaches. The junction is above desired capacity in the baseline forecast.

Junction 17 - A1013 / A126

6.2.14 Two options have been suggested for this junction:

- increase cycle time to 72 seconds,
- split pedestrian stage on Orsett Road (west) and remove pedestrian stage on Stanley Road.

Junction 24 - A13 / A1014 / A1013

6.2.15 This junction has heavy flows between A13 (south) and A1014, due to the London Gateway Port development at Shell Haven. Most of the other arms are above capacity due to large volumes of conflicting traffic.

6.2.16 The roundabout needs to be signalised but it may be that only the A13 (south) and A1014 approaches need signalisation. The gaps in traffic created by the signals may keep the other arms below desired capacity.

Junction 25 - East Tilbury Rd / Muckingford Rd

6.2.17 This junction is above desired capacity on the East Tilbury Road (south east) arm. This could be solved by extending the flare on this approach to provide two lanes.

Junction 28 - A1013 / Buckingham Hill Road

6.2.18 This junction will either need to be signalised or rebuilt as a roundabout. The junction is above desired capacity in the baseline forecast.

Junction 101 - A126 / Fenner Rd / Lakeside

6.2.19 The Fenner Rd approach is just above the desired capacity in the PM peak Minimal widening of the flaring on this approach will reduce the flow/capacity ratio below 85%.

Junction 102 - A1012 / Hogg Lane / Devonshire Rd

6.2.20 The flare on the A1012 Elizabeth Road arm needs to be extended.

Junction 103 – A126 / Devonshire Rd

6.2.21 The eastern approach of this junction exceeds capacity in the PM peak. Re-phasing of lights to include indicative arrow for the right turn and flared entry and exit for A126 Westbound through movement would resolve capacity issues.

Junction 104 – Eastern Way / London Rd / Maidstone Rd

6.2.22 The flow on western approach of London Road in the PM peak exceeds the theoretical capacity of the approach. The unusual alignment for this priority junction affords very good visibility of opposing traffic so the actual capacity could be higher than currently assumed. It is however recommended that a short two lane approach is formed on this approach which could be done at minimal cost.

Junction 105 - A1013 / Derby Rd

6.2.23 The cycle time needs to be increased from 70s to 80s in order to reduce the flow/capacity ratio below 85%. The junction is above desired capacity in the baseline forecast.

Junction 106 - A126 Stanley Rd / A126 Clarence Rd

6.2.24 The Stanley Road (north) approach will need an extra southbound right turn lane (possible but space constrained).

6.2.25 The Clarence Road (east) approach could be improved by realigning central line to provide a two lane approach, and to remove parking.

6.2.26 Increasing the cycle time from 90s to 100s results in all approaches with flow/capacity ratio below 90% but would still be slightly above the desired capacity.

M25 Junction 30

6.2.27 All approaches to the roundabout are over 90% saturated with the eastern arm from the A13 exceeding capacity in the base. The interim design for this junction does not provide sufficient capacity improvements to reduce the flow/capacity ratio below 85% in the either of the AM or PM future forecasts. The PM Peak is well over capacity on the Eastern and Southern approaches in particular.

M25 Junction 31

6.2.28 In the AM peak the junction as a whole operates below the desired capacity however some arms operate just above the desired capacity including both the M25 off-slips and A1306 Western approach. In the PM peak heavy flow from the western approaches results in capacity issues. Additional or lengthened flares on these approaches is recommended.

6.2.29 Table 6.4 below summarises the updates required for each of the scenarios studied.

Table 6.4: Summary of Junction Updates Required

Jct No.	Location	Improvement needed	2006 Base	2021	2025	Cost Estimate	Assumption on Cost
7	West Thurrock Way / Stoneness Rd/ London Rd	Remarking to improve flaring on one approach		√	√	£2,000	No construction work required
8	A1306 / A1012	Improve flaring on one approach		√	√	£30,000	Not inclusive of stat costs
10	A126 / A13	Improve flaring on both approaches		√	√	£240,000	Not inclusive of stat costs
11	B1335 / B186 South Rd / B186 Stifford Hill	1 arm upgrade to 2 lanes	√	√	√	£520,000	Inclusive of junction resurfacing and replacement of traffic signals Not inclusive of stat. costs
12	B186 Stifford Hill / B186 Pilgrims Lane	Convert from mini to standard roundabout	√	√	√	£640,000	Inclusive of junction resurfacing Not inclusive of stat. costs
13	A1306 / B186 Pilgrims Lane / B186 Burghley Rd	1 arm upgrade to 2 lanes		√	√	£120,000	Widening to northern arm only - signal timing changes throughout Not inclusive of stat cost
14	A13 / A1012	Signalise roundabout	√	√	√	£1,200,000	Inclusive of a nominal amount of £250,000 for resurfacing Not inclusive of stat. costs
15	A1306 / A1012	Adjust signal timings and additional lanes on two arms	√	√	√	£321,000	Not inclusive of stat costs
17	A1013 / A126	Adjust signal timings		√	√	£4,000	No construction work required
24	A13 / A1014 / A1013	Signalise roundabout		√	√	£325,000	Assume cable-less linking Not inclusive of Stat costs. Allowance made for re-surfacing
25	East Tilbury Rd / Muckingford Rd	Extend flare on 1 arm		√	√	£35,000	Not inclusive of stat costs
28	A1013 / Buckingham Hill Road	Signalisation/roundabout	√	√	√	£520,000/ £295,000	Traffic signals, inc junction resurfacing Roundabout inc resurfacing Not inclusive of stats costs
101	A126 / Fenner Rd / Lakeside	Minor flare widening on one approach		√	√	£25,000	Not inclusive of stat costs
102	A1012 / Hogg Lane / Devonshire Rd	Extend flare on 1 arm	√	√	√	£34,000	Not inclusive of stat costs
103	A126 / Devonshire Rd	Adjust signal phasing and create flared entry and exit	√	√	√	£200,000	Not inclusive of stat costs
104	A126 London Rd / Eastern Way	Create short two lane approach on one arm	√	√	√	£40,000	Not inclusive of stat costs
105	A1013 / Derby Rd	Signal timings	√	√	√	£4,000	No construction work required
106	A126 Stanley Rd / A126 Clarence Rd	Additional Lanes, remove parking or signal timings	√	√	√	£545,000	Tight junction assumed CPO required to provide additional carriageway Not inclusive of stat costs Parking to be removed
M25J30	Junction of M25 and A13	Additional capacity is required on each arm of the roundabout.	√	√	√	Beyond Scope of this Study	
M25J31	M25 / A1306 / A1090	Additional capacity would be required on both M25 off-slips and A1306 West approach.		√	√	Beyond Scope of this Study	
					Total cost of all junction improvements		**£4,580,000**

6.3 Key Rail Link Deficits

6.3.1 Our analysis shows that there are no deficits in passenger rail capacity in Thurrock. This is consistent with previous Infrastructure Deficit Study carried out by CB.

6.4 Assumptions on Costs

6.4.1 As discussed above the Table 6.1 shows the costs for highway link improvements and Table 6.2, 6.3 and 6.4 show the cost of construction of the schemes for highway junctions. These costs have been estimated by CB Traffic Engineers.

6.4.2 The following caveats apply throughout Tables 6.1, 6.2, 6.3 and 6.4:

- The costs are at 2008 prices and no allowance has been made for inflation etc.;
- The costs have been estimated without design layouts for each link/junction;
- All estimates are subject to detailed site investigation;
- Cost of bridge modifications works etc are subjective as details are limited at this time with respect to the possibility of using existing hard shoulders or narrow lanes etc.;
- For links it is assumed that widening work can be accommodated within the confines of the existing dual carriageway;
- Costs for links are derived from the provision of a standard rate per km. For a more detailed estimate each link should be reviewed with regards to specific works encountered;
- The cost of acquiring land is not included;
- The costs of Stats is not included.

6.4.3 Please also note the assumptions made in Table 6.1 and Table 6.4 in column 'Assumption on Costs' on the right in each table.

6.4.4 For junction 28, two possible solutions have been considered - a signalised junction or a roundabout. Both solutions are priced in Table 6.2 and Table 6.4. The roundabout is the cheaper option (not including the cost of acquiring land) and it is therefore assumed that this solution will be applied in estimating the total infrastructure bill.

7 Conclusion

7.1 Highway

7.1.1 We have analysed a number of key highway links and junctions within the Thurrock Unitary Authority area, comparing their traffic flows with capacity and identifying any measures required.

7.1.2 Our analysis of the highway links and key junctions shows that infrastructure deficits in 2021 would be confined mainly to the following areas and corridors:

- A13 links and junctions between the M25 and A1014, due to the increase in HGV traffic to the London Gateway Port at Shell Haven;
- the A1306 between Pilgrims Roundabout and Treacle Mine roundabout
- junctions in the South Ockendon/North Stifford area;
- junctions in Grays Town Centre.

7.1.3 In all, about 20 of the 34 junctions studied require improvement before 2025 and we have recommended what improvements may be required to these junctions. For three of the junctions, the only improvements are changes to signal timings.

7.1.4 The preliminary cost estimate for all link improvements is £96,215,000 whereas all junction improvements are estimated to cost £4,580,000. This means a total infrastructure investment of £100,795,000 is required.

7.1.5 It should be noted that in the future forecasts for 2021 and 2025, it is assumed that a proportion of car trips are shifted to other modes due to sustainability and 'soft' measures. The proportion of trips that has been shifted from car is 10% for most trip purposes, but there is a greater proportional reduction of 35% for the education trip purpose (which includes the 25% reduction already achieved by 2007). If this mode shift is not achieved in reality, then clearly the highway demand will be higher in some parts of the network.

7.1.6 The modelled trip suppression would have the greatest effect on congestion in areas with the greatest number of alternatives to using a car. The main example of this within the modelled area is Grays town centre. Four junctions in this area are reported as "approaching desired capacity" by 2021; it is possible they could exceed the desired capacity of 85% by 2021 if the modelled mode shift is not achieved.

7.2 Rail

7.2.1 Passenger rail demand in Thurrock can easily be accommodated by the train service in the base scenario and in all future scenarios tested.

7.2.2 For the future year scenarios, it should be noted that a mode shift from car has been applied in order to model sustainability and 'soft' measures. This increases rail demand slightly.

7.2.3 In our forecasts, we have not included any measures which would cause a mode shift to rail from all other modes (e.g. promotion of rail mode). It is possible that such measures could further increase rail demand, but the demand would not exceed seating capacity unless a radical mode shift was achieved.

7.2.4 The analysis of rail crowding has focused on the Thurrock area only, and not on the whole corridor towards London. It would be expected that some crowding may occur on trains as they approach London. However, the impact of this on passengers joining trains in Thurrock is expected to be minimal, as there is sufficient seating capacity to accommodate all passengers east of Barking.

Appendix A

Land Use Options for Lakeside Basin

As discussed, in addition to the preferred LDF land use option this assessment has also considered the likely quantum of development which will come forward in the Lakeside Basin area.

For the purpose of this study, two alternative options have been identified as being appropriate for testing the impact of Lakeside Basin. The development quantum for both options is assumed to be the same and it is as provided by TBC for the preferred LDF work. The only differences between the two options are the assumptions with regards to trip rates and modal split where:

- Option 1 assumptions are based on Colin Buchanan's (CB) assessment of the LDF work, whereas
- Option 2 uses the assumptions put forward in the work undertaken by MVA.

For comparative purposes the quantum of the developments between and LDF preferred option and EERA assumptions are set out in Table A.1. As it is seen from this table, the quantum of the developments between the LDF and EERA options are similar for retail and warehousing, slightly different for industrial and residential but significantly different for offices/business park.

For the purpose of this assessment, both options have been used to test the impact of the Lakeside Basin on the wider area for the forecast year of 2021 during the PM peak hour only.

Table A.1: Lakeside Basin Land Use Options

Land Use	TBC Assumption (2021)	MVA Assumption
Retail	50,000sqm GFA	50,000sqm GFA
Warehousing	40,850sqm GFA	40,400sqm GFA
Industrial	57,200sqm GFA	40,426sqm GFA
Office	49,320sqm GFA	3,480sqm GFA
Business Park	0	36,000sqm GFA
Community	0	1,450sqm GFA
Leisure/Recreation	77,350sqm GFA	77,350sqm GFA
Hotel	0	200 Rooms
Residential	3,732 Units	3,817 Units

Assessment of Transport Network

The transport assessment includes the following;

- **Highway links**: analysis of highway link flows compared with capacity (as defined by the CRF - Congestion Reference Flow). The CRF gives an estimate of the Annual Average Daily Traffic (AADT) flow at which the carriageway is likely to be congested in the peak period on an average day.
- **Highway junctions**: analysis of highway junction flow and capacity using appropriate DfT packages;
- **Rail**: analysis of rail passenger demand and capacity using a spreadsheet model

For the Link and Junction Flow/Capacity calculations, base year (2006) flows have been taken from observed data. The observed data have been supplied by HA and Mouchel for PM peak hour between 1700-1800.

The future demand is calculated incrementally by:

- assigning base (2006) and future (2021) synthetic demand to SATURN network to obtain the predicted link flows and junction turning counts;
- subtracting the base and future flows to obtain the changes in flows ;
- adding the change in link flows and junction turning counts to the corresponding observed data for 2006.

The capacity of the 16 selected junctions have been assessed using the standard industry software packages such as ARCADY, LINSIG and TRANSYT as appropriate. Where any junction is considered to be at or approaching capacity by 2021, mitigation measures have been proposed.

For rail, the existing demand has been calculated using a spreadsheet demand model. The demand from the model has then been used to assess the capacity of the rail system based on the existing frequency and the number of seats available on each service. The demand from the future year spreadsheet model is used to assess the capacity of the rail system in the same way as for the base year. This is compared with key train capacity indicators such as train seating capacity, PiXC (Persons in Excess of Capacity) and Crush Capacity.

The results of the above analysis are then represented using GIS (MapInfo) in a number of stress factor diagrams.

Assessment Criteria

To show the performance of the highway network more clearly, the outputs of the above assessment have been grouped into five categories based on the capacity of the network. A series of stress diagrams is then produced to help in understanding the impact of the preferred option on the network more clearly. These categories are summarised below:

For highways:

- **Well above capacity** (Flow/Capacity above 115%); shown in Red
- **Above capacity** (Flow/Capacity between 100% and 115%);shown in Orange
- **Above desired capacity** (Flow/Capacity between 85% and 100%); shown in Yellow
- **Approaching desired capacity** (Flow/Capacity between 70% and 85%); shown in Green
- **Below capacity** (Flow/Capacity below 70%); shown in Blue

For rail links:

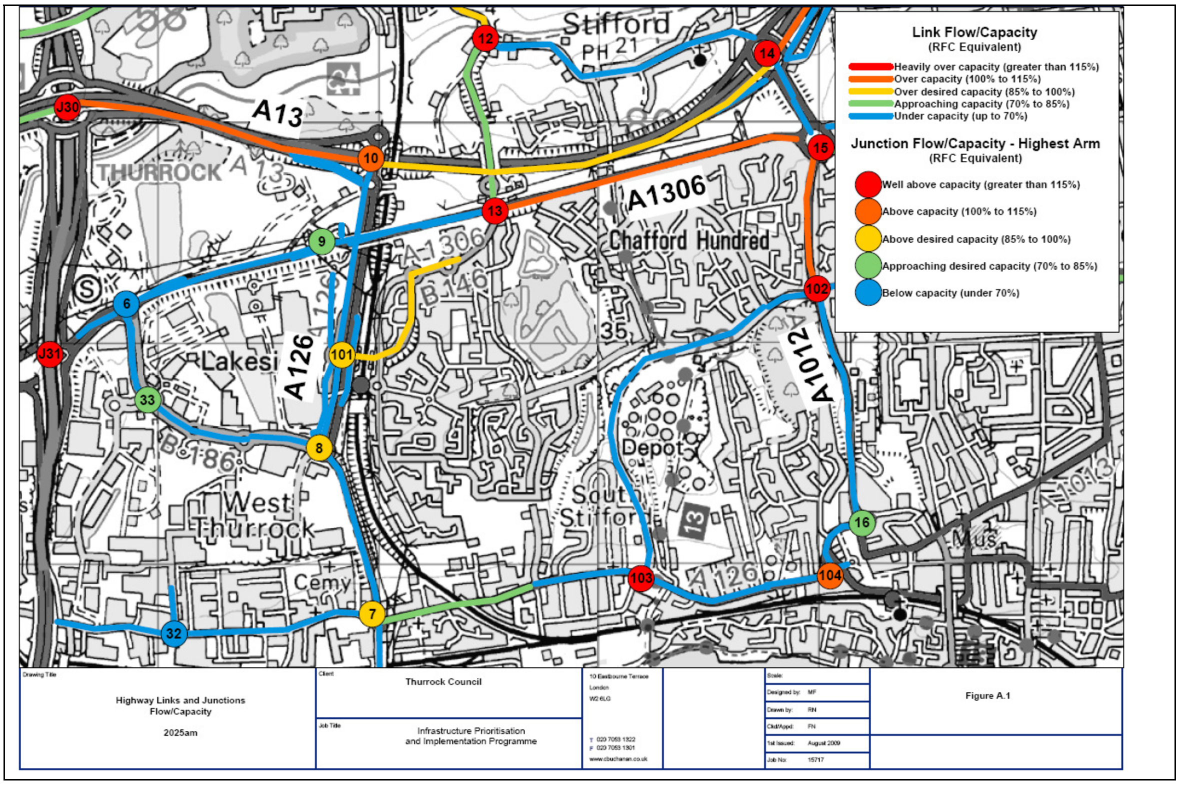
- **Above crush capacity** (Passenger Flow/Seating Capacity greater than 191%); shown in Red
- **Above PiXC capacity** (Flow/Capacity between 144% and 191%); shown in Orange
- **Above seating capacity** (Flow/Capacity between 100% and 144%); shown in Yellow
- **Approaching seating capacity** (Flow/Capacity between 85% and 100%); shown in Green
- **Below capacity** (Flow/Capacity below 85%). shown in Blue

These ranges are based on the capacity of the Class 357 train units used by c2c, the rail company which operates all trains through Thurrock. These trains can be summarised as having a seating capacity per 4-car unit of 282 a PiXC (Persons in excess of Capacity) standing capacity per unit of 124 and a Crush capacity per unit of 257.

Results.

The result of the highway assessment for 2021 Option 2 during the PM peak hour is shown by a stress diagram in Figure A1. The stress diagrams for the base 2006 and Option 1 have already been included in the main report in Figure 4.2 and Figure 5.3 respectively.

Figure A.1: Highway Network – 2021 Option 2 PM



The analysis shows that no major problems will occur on the rail network and there will be sufficient capacity in the network for rail passengers in Thurrock. However, there will be a number of deficits on the highway infrastructure both on the strategic and on local road networks. Both Option 1 and Option 2 show a similar level of congestions on the network, although the degree of saturation in Option 2 are slightly less than Option 1 for some of the junctions tested. The links and junctions showing a high level of flow/capacity in 2021 during the PM peak hour with recommended interventions are shown in Section 6 of the main report.

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