# Economic Costs of Congestion in the East Midlands

## A report prepared for *emda*

Atkins

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# Economic Costs of Congestion in the East Midlands

## Study Report

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# Executive Summary

## BACKGROUND

1. Atkins was appointed by East Midlands Development Agency (*emda*) in December 2006 to undertake a regional assessment, using existing data, to estimate the current levels and quantify the economic costs of congestion to the East Midlands region. It is intended that the study will be of interest to, and used by, a range of partners to help inform ongoing regional and sub-regional debate and policy development work relating to the issues of congestion and demand management in the region. This is expected to include, but not be limited to, the Congestion Transport Innovation Fund (TIF) project being undertaken in the Three Cities sub-area.

2. The study sits in the context of a clear regional policy, captured in the Regional Spatial Strategy (RSS) and more recently in the new Regional Economic Strategy (RES), to promote behavioural change and manage demand and the need to travel. While it is understood that the issues relating to congestion are complex, with implications for a range of policy themes and agendas, it is important to note that the objective of this study is to approach this issue from an economic perspective.

3. The study has comprised three phases of work, as follows:

- The objective of Phase 1 was to review the existing literature and research in relation to the links between transport, congestion and economic performance and, as a result, to recommend the preferred approach to the subsequent phases of work;
- Phase 2 required the analysis of transport and travel data to calculate the extent of congestion on the East Midlands road network; and
- Phase 3 used the data assembled in Phase 2 to calculate an estimation of the economic costs of congestion in the region.

## REPORTING FROM THE STUDY

4. The Final Report describes the outcomes from the study. It builds upon detailed technical work that is described in two separate technical reports[1] [2].

5. The Final Report includes the following elements:

- A brief overview of the economic geography of the East Midlands, which has assisted in understanding the different transport and economic issues that were to be considered in different parts of the region;
- A description of the approach to the measurement of congestion developed in response to the issues facing different parts of the region;
- Analysis of the congestion data, including an overview of the methodological challenges encountered;

[1] Technical Report 1: Development of Methodology, Atkins, June 2007
[2] Technical Report 2: Measurement of Congestion, Atkins, June 2007

- Presentation of the economic costs that were derived from the analysis of the congestion data, which includes both "direct" economic costs and a set of "wider" economic costs in response to emerging thinking on the relationship between transport and regional economic performance; and
- Conclusions from the study, including the limitations of the existing dataset, and some suggestions for how the findings could be taken forward.

6. The following sections set out the key findings from the study.

### EXTENT OF CONGESTION IN THE REGION

7. Analyses were undertaken for both the strategic (motorway and trunk road) network and for urban areas in the region. Engagement with local authorities revealed that there is virtually no quantified data on congestion in rural areas in the East Midlands.

8. Analyses for the **strategic road network** show that:

- The total delay is greatest on the A1 and M1, which is due primarily to the lengths of these routes, and volume of traffic on the M1;
- Substantial total delays are also experienced on the A14, A38, A43, A46 and A52, which were somewhat shorter in length; and
- There were smaller total levels of delay on the A453 and A628, due to their relatively short lengths, despite the relatively long delays experienced over the short length of each route.

9. In the case of the local authority road networks, within the **urban areas**, it was found that:

- The total delays are, by a considerable margin, highest in the two largest urban areas of Greater Nottingham and Central Leicestershire;
- Modelled delays appear to be lower but still significant in Derby and Northampton;
- Lincoln has the lowest levels of total delay, by a large margin, of the five PUAs. This reflects its small relative size and comparably low levels of congestion;
- Congestion in Mansfield, which is of a similar size to Loughborough, is only a quarter of that of the latter; and
- Congestion in the smaller towns is much less than the larger towns.

10. Congestion data is not currently available for a large number of urban centres, including some large towns such as Chesterfield. It was therefore necessary to make a series of estimates and assumptions in calculating the potential economic costs of congestion for these centres. These assumptions are described in the Technical Reports and were discussed with local partners.

### TOTAL ECONOMIC COSTS

11. On the basis of the available data, it is estimated that the total direct costs of congestion are around **£825 million** per annum, which comprise around £430 million incurred by business users and £395 million incurred by other users. In addition, it is estimated that the wider economic impacts of congestion (including competition,

agglomeration and labour market effects) total around **£110 million** per year. In total, it is therefore estimated that congestion costs the East Midlands economy around **£935 million per annum**.

12. The wider economic impacts appear, in general, to be modest, and are primarily due to competition effects and agglomeration diseconomies in the larger urban centres. The analyses suggest that congestion has no impact on overall participation in the labour market of the region.

13. The economic costs of congestion were then compared to the economic outputs of the region, which uses the Gross Value Added (GVA) measure. Overall, across the whole region, **congestion is estimated to result in costs of around 0.7 % of annual GVA**, with an economic cost of around £270 per employee in GVA terms.

14. **The economic costs are highest in the Three Cities sub-area** , at 0.7% of GVA, and **lowest in the Northern, Eastern and Peak sub-areas** , exerting costs equivalent to only 0.1-0.2% of annual GVA. It is important to recognise that, in the latter cases, this congestion would be focused on particular hotspot areas, generally in urban areas such as Lincoln and Chesterfield.

15. These findings correspond with the national picture, as evidenced from the Eddington Study, which demonstrated the importance of the UK's main urban areas and the strategic network as the key drivers of the national economy in transport terms. Overall, however, the analysis here indicates slightly lower total costs than those suggested by national figures included in the recent Eddington Report.

16. Road traffic in the East Midlands is increasing – between 1994 and 2004 traffic on major roads increased faster than in any other region[3] – and the costs of congestion can therefore be expected to increase unless these trends are altered.

17. There is therefore a strong economic case to continue to pursue measures to tackle congestion in the region.

[3] Source: Chart 2, Page 219, The East Midlands in 2006: Evidence Base for the East Midlands Regional Economic Strategy, 2006-2020.

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# 1. Introduction

## BACKGROUND

1.1 Atkins was appointed by East Midlands Development Agency (*emda*) in December 2006 to undertake a regional assessment, using existing data, to estimate the current levels and quantify the economic costs of congestion to the East Midlands region. It is intended that the study will be of interest to, and used by, a range of partners to help inform ongoing regional and sub-regional debate and policy development work relating to the issues of congestion and demand management in the region. This is expected to include, but not be limited to, the Congestion Transport Innovation Fund (TIF) project being undertaken in the Three Cities sub-area.

1.2 The study sits in the context of a clear regional policy, captured in the Regional Spatial Strategy (RSS) and more recently in the new Regional Economic Strategy (RES), to promote behavioural change and manage demand and the need to travel. While it is understood that the issues relating to congestion are complex, with implications for a range of policy themes and agendas, it is important to note that the objective of this study is to approach this issue from an economic perspective.

1.3 The study has comprised three phases of work, as follows:

- The objective of Phase 1 was to review the existing literature and research in relation to the links between transport, congestion and economic performance and, as a result, to recommend the preferred approach to the subsequent phases of work;
- Phase 2 required the analysis of transport and travel data to calculate the extent of congestion on the East Midlands road network; and
- Phase 3 used the data assembled in Phase 2 to calculate an estimation of the economic costs of congestion in the region.

## STRUCTURE OF THIS REPORT

1.4 This document is the final deliverable from the study. It briefly describes the approach taken to the work, before describing the measurement of congestion and its economic costs to the East Midlands region. It is structured as follows:

- Chapter 2 provides a brief overview of the economic geography of the East Midlands, by drawing upon evidence from the regional strategies. This has assisted in understanding the different transport and economic issues that were to be considered in different parts of the region.
- Chapter 3 describes the approach to the measurement of congestion that was developed in response to the issues facing different parts of the region.
- Chapter 4 describes the analysis of the congestion data, including an overview of the methodological challenges that were faced.
- Chapter 5 presents the resultant economic costs that were derived from the analysis of the congestion data. It includes both “direct” economic costs and a

set of "wider" economic costs in response to emerging thinking on the relationship between transport and regional economic performance.

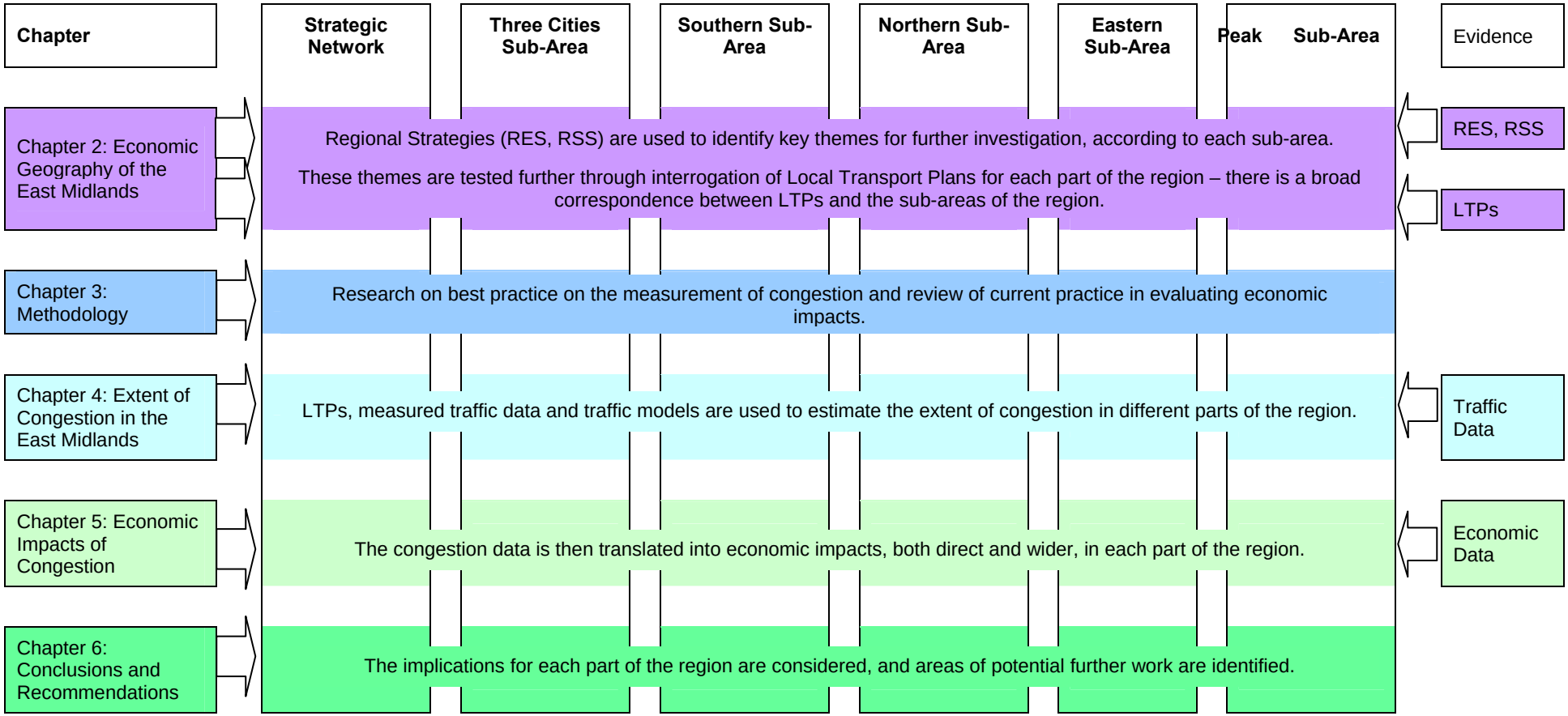
- Chapter 6 sets out the conclusions from the study, including the limitations of the existing dataset, and provides some suggestions for how the findings could be taken forward.

1.5 Separate Technical Reports[4] [5] describe the background to the development of the methodology for the project and the approach taken to the measurement of congestion and its economic costs.

1.6 Figure 1.1 overleaf provides a visual representation of the structure of the report. It illustrates the focus of each Chapter, and the main sources of evidence and data underpinning them.

[4] Technical Report 1: Development of Methodology, Atkins, June 2007
[5] Technical Report 2: Measurement of Congestion, Atkins, June 2007

**Figure 1.1 – Signposting of the Document**



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# 2. Transport and the Economy in the East Midlands

## INTRODUCTION

2.1 This chapter explores the potential impacts of transport, accessibility and congestion on the economic performance of the region. This draws upon policy and evidence set out in the Regional Economic, Spatial and Transport Strategies to form initial views on the potential influences of transport on the performance of the economy in the region. Further evidence is then taken from the Local Transport Plans for each part of the region, to identify specific concerns in different areas.

2.2 The regional strategies and Local Transport Plans are described in more detail in the separate Technical Reports.

## REGIONAL SPATIAL STRATEGY

2.3 The East Midlands Regional Spatial Strategy (RSS8) (or East Midlands Regional Plan)[6] has been prepared by the East Midlands Regional Assembly in collaboration with its partners across the region.

2.4 The Regional Plan and the Regional Economic Strategy, described below, should be mutually consistent, and develop a spatial framework that will support the region's aspirations for sustainable economic growth.

2.5 The Regional Plan recognises the great diversity of the region, in terms of the problems, issues and opportunities that are faced. With this in mind, the Plan has identified a series of Sub-Areas, which guide regional thinking. These five Sub-Areas, together with regional linkages, are shown in Figure 2.1 overleaf.

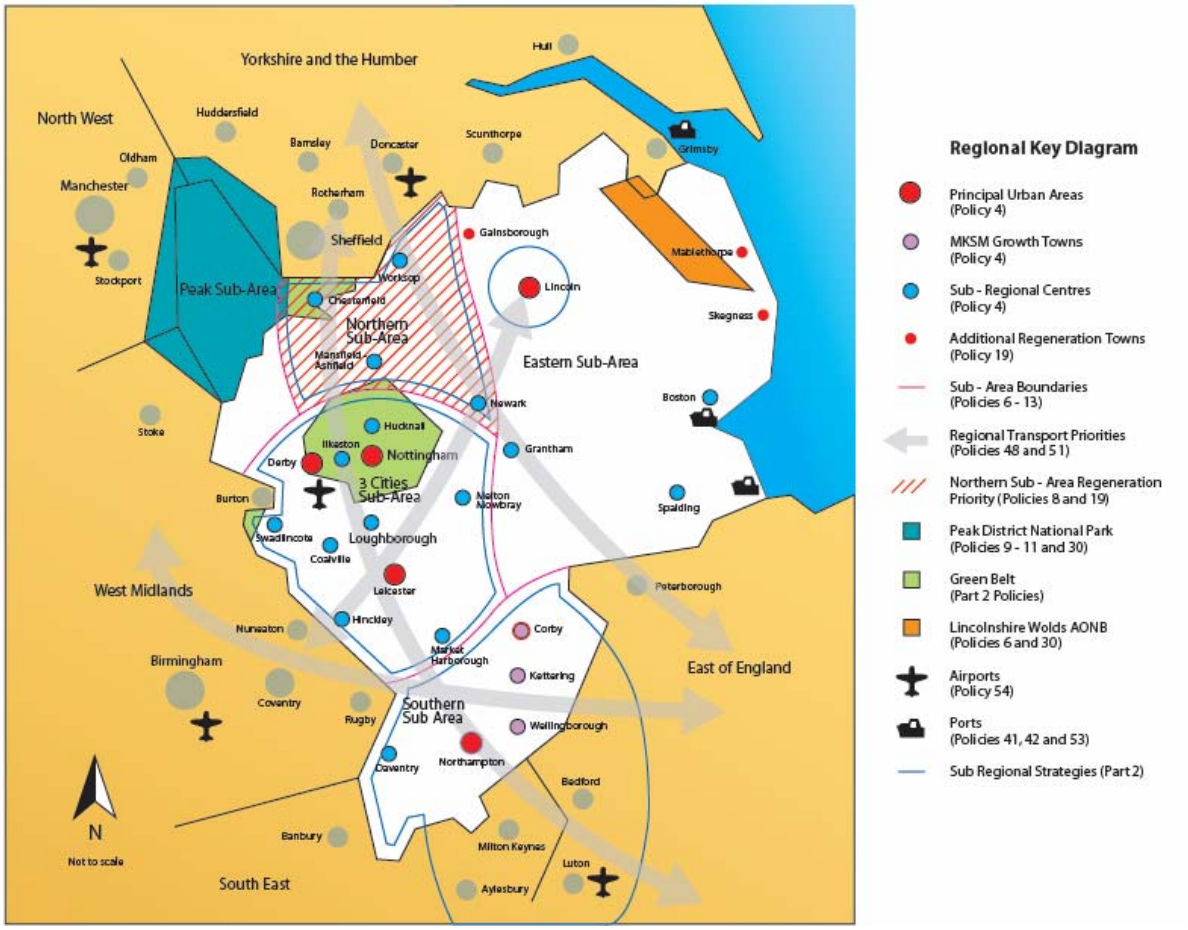
2.6 This Regional Key Diagram illustrates the key spatial issues that are addressed, including:

- The five Sub-Areas (Peak, Northern, Eastern, Three Cities and Southern);
- Categorisation of urban areas (Principal Urban Areas, Growth Towns, Sub-Regional Centres, Additional Regeneration Towns); and
- Strategic linkages and regional transport priorities.

2.7 It shows that the region is polycentric, with no single dominant centre, but instead with complex and varied relationships between its economic centres. In addition, the region is bordered by five other regions, with strong relationships to the adjacent regions in the Northern Sub-Area (with the Sheffield City Region), Peak (with Greater Manchester), and Southern (as part of the MKSM Growth Area). In addition, south Lincolnshire has strong functional relationships with Peterborough, and there are strong linkages between South Derbyshire and East Staffordshire, and between Leicestershire and northern Warwickshire.

[6] Draft East Midlands Regional Plan (RSS8), East Midlands Regional Assembly, 2006

**Figure 2.1 – Regional Key Diagram[7]**




2.8 The Regional Plan contains a series of policies that provide important context to the assessment of congestion in the region. The objectives of the Regional Transport Strategy (RTS)[8] are designed to support the wider objectives of the Regional Plan. These are described for reference in the separate Technical Report.

2.9 The transport objectives for each Sub-Area are, to some extent, inter-related, although there are distinct differences in certain cases. In the case of the cities, the emphasis is on transport connections to enable the cities to operate efficiently and to tackle social exclusion. There is also a strong emphasis on improving linkages to strategic gateways and to adjacent city-regions. There is a different theme for the Eastern Sub-Area: tackling peripherality, which is not related to congestion, but is instead due to the relatively long distances from major markets.

2.10 The RTS sets out a number of policies to address the challenges posed by continuing growth in travel demand (particularly traffic growth) across the region. This includes a focus on promoting behavioural change, managing demand, encouraging walking, cycling and the use of public transport and, in certain cases, highway investment.

[7] Source: Regional Plan
[8] The Regional Transport Strategy (RTS) forms an integral part of the Regional Plan.

## REGIONAL ECONOMIC STRATEGY

2.11 The third Regional Economic Strategy (RES) for the East Midlands[9] was published in 2006. The detailed evidence provided in the Strategy enables hypotheses to be made about the potential relationships between transport and economic performance in each of the Sub-Areas of the region, which were tested during the subsequent phases of this project.

2.12 The RES sets out the economic outlook for the region. It notes, as a baseline, that the regional economy is forecast to increase by 2.6% per year in the period 2004-2014, equivalent to an absolute increase of £18 billion to the region's GVA. Employment growth is likely to be 0.4% per year in the period 2004-14, equivalent to a net absolute increase of 63,000 jobs by 2014. With the implementation of the RES, growth is forecast to increase to 2.8% per year, a 0.2% increase on the baseline.

2.13 Two critical factors will drive future growth in the East Midlands economy:

- **Employment rates** – the number of people in work; and
- **Productivity levels** – the value generated by each hour worked.

2.14 For these reasons, the two key measures of Gross Value Added (GVA) and Employment Rates will be used to measure the progress of the region in the coming years.

2.15 The East Midlands continues to demonstrate a **productivity gap** with the UK average: in 2003, GVA per hour worked in the East Midlands was only 96.9% of the UK average. Tackling this productivity gap is key to the future success of the region, and the RES sets out the key drivers of productivity, including investment, innovation, skills, enterprise and competition.

2.16 This problem of low productivity in the East Midlands is associated with a "low-wage, low-skill" equilibrium in the region, which is characterised by a high employment rate coupled with low demand for skills and comparatively low wages.

2.17 The **vision** in the RES is for the East Midlands to be *a flourishing region*, which will be measured using the Regional Index of Sustainable Wellbeing. This will allow progress towards the twin aims of sustainable economic growth and economic wellbeing to be monitored. The vision is underpinned by three structural themes: raising productivity, ensuring sustainability and achieving equality, which will be delivered through ten strategic priorities.

2.18 These themes and priorities are set out, together with the potential supporting role of transport policy, in the separate Technical Report. However, in summary, it is considered that transport will take the following key roles in supporting the RES:

- As an enabler of economic growth, through **improved connectivity in the region**;
- **Improved accessibility between people and jobs**, improving the mobility of the labour market, enabling people to move into better jobs in growth sectors; and

[9] A flourishing region; Regional Economic Strategy for the East Midlands 2006-2020, emda, 2006

- **Development of agglomeration economies**, in clusters of highly competitive businesses, with a focus on innovation to enable competition in a global economy, which is supported by strong connections in urban areas.

2.19 This study has not addressed the potential impacts of *improved social inclusion* – any benefits will be considered to be broadly addressed under the impacts set out above.

2.20 The study has also not considered the *environmental impacts* of congestion (and the potential resultant indirect economic costs, or lost opportunities). However, it is important to note that these impacts would represent additional 'costs' of congestion to the region, and so in focusing on the economic perspective this study aims to give just a partial picture.

2.21 While congestion is perceived to be an issue facing much of the region, there was no evidence at a broad regional level to suggest that the development of employment sites is generally constrained by particular congestion issues. However, further more detailed evidence was also examined, including Local Transport Plans, to determine if this was in fact the case.

2.22 As with the Regional Plan, the RES has identified five Sub-Areas: Eastern, Northern, Peak, Southern and the Three Cities. These Sub-Areas reflect the geographical diversity of the East Midlands, and ensure that the RES is fully aligned, in spatial terms, with the Regional Plan. Importantly, the different Sub-Areas face different economic challenges, with different transport issues to be considered. These differences are reflected in the transport objectives for each Sub-Area, developed within the Regional Transport Strategy.

### KEY ISSUES AT THE REGIONAL LEVEL

2.23 As previously stated, there are strong synergies between the Regional Spatial, Economic and Transport Strategies. The key policy issues, and the supporting role that transport must play, are set out in Table 2.1 overleaf.

2.24 Issues relating to **growth and productivity** are shown in **blue**. Transport policy is geared to driving forward growth in the five PUAs and Growth Towns and, to a lesser extent, the sub-regional centres. The PUAs and Growth Towns will be the engines of growth in the region, and capacity is required to unlock their potential. This will mean tackling congestion, which could potentially constrain physical growth and growth in productivity.

2.25 **Regeneration** issues are shown in **pink**. Transport policy is geared towards supporting regeneration priorities, particularly in terms of improving access to jobs and services. Helping people move into better jobs is also a key element of driving forward productivity, and is therefore also shown in blue.

2.26 Consideration needs to be given to the extent to which congestion could be constraining the operation of the labour market in the Three Cities and in the north of the region. Elsewhere, particularly in the east, there needs to be greater focus on overcoming peripherality, which is not related to congestion, but instead due to distance from the remainder of the region.

2.27 Issues relating to the **needs of rural areas** are shown in **green**. In this case, again, there is limited evidence of the role of congestion, with a greater focus on accessibility by public transport, first to reflect the particular needs of the Peak District and second to address the needs of rural residents without access to a car.

2.28 Finally, this is all underpinned by the need to make the best use of the East Midlands' **strategic connections**, shown in **purple**. This means consideration must be given to congestion and reliability on the strategic network, as well as access to the international gateways through East Midlands Airport and the East Coast Ports.

## Table 2.1 – Regional Spatial and Economic Policy and the Role of Transport

| | Themes in RSS | Themes in RES | Themes in RTS | Key transport/congestion related issues |
|---|---|---|---|---|
| Growth & Productivity | Development to be focused in the five PUAs (Nottingham, Leicester, Derby), Northampton, Lincoln). | **Enterprise and business support**: Highly productive, globally competitive businesses. | Support growth in the PUAs. Reduce traffic growth by reducing the need to travel and promoting mode shift. Reduce congestion and improve safety. | Congestion in five PUAs. Impact of congestion on agglomeration / productivity. |
| | Development within the Growth Towns in the **South** (Kettering, Wellingborough, Corby). | **Innovation**: innovative and knowledge focused businesses competing successfully in a global economy. | Support development in the Growth Towns. Encourage mode switch, improve access to East Coast Ports. | Congestion in Growth Towns. Future congestion limiting growth. Potential impacts on agglomeration. |
| | Consolidation and strengthening of the sub-regional centres across the E Mids. | | Support sustainable development in the sub-regional centres. | Congestion in sub-regional centres, where there is evidence. |
| Regen-eration | Regeneration within the **Three Cities** (Nottingham, Leicester, Derby). | **Employment, learning and skills**: move more people into better jobs in growing businesses. | Support regeneration priorities: improve access to jobs and services within the cities. | Congestion in Three Cities, potentially limiting access between jobs and labour market. |
| | Regeneration in the Sub-Regional Centres in the **North** (Chesterfield, Mansfield/Ashfield, Worksop, Newark). | **Economic Renewal**: ensure all people have the opportunity to create sustainable economic futures. | Support regeneration priorities: improve access to jobs and services. Make best use of proximity to M1 to develop new job opportunities. Reduce congestion on M1. | Congestion in the towns in the north, potentially limiting access between jobs and labour market. |
| | Regeneration of towns in the **East** (Gainsborough, Skegness, Mablethorpe). | | Support regeneration priorities. Improve access to Lincs coast. | No evidence of congestion. Problem due more to isolation. |
| | Overcoming peripherality in the far east of the region. | **Economic Inclusion**: overcome barriers that prevent people from participating fully in the economy. | Overcome peripherality in the east of the region and overcome rural isolation. | No evidence of congestion. Problem of isolation from the rest of the region & **distance** from markets. |
| Rural Issues | Sustainable development in the **Peak**. | **Environmental Protection**: protect and enhance the region's environment through sustainable economic growth. | Improve sustainable linkages to the NW. | Limited evidence of congestion. |
| | Addressing the needs of the **rural areas**. | | Promote accessibility and overcome isolation in rural areas. | No evidence of congestion. Problem due more to rural accessibility / isolation. |
| Strategic Connections. | | **Transport**: better connectivity. | Improve inter-regional linkages. | Congestion & reliability on strategic network. Access to key gateways. |

### TRANSPORT AND THE LOCAL ECONOMY

2.29 Table 2.1 shows that there are different issues in relation to transport and the economy in different parts of the region. The evidence gathered from the Regional Plans was then tested by reviewing the Local Transport Plans for each part of the region.

2.30 The Local Transport Plan (LTP) sets out the transport policies and strategy for a local area. The second round of Plans (LTP2) is required to address four key priorities that have been agreed between central and local government; tackling congestion, improved accessibility, safer roads and improved air quality. The theme of tackling congestion is therefore particularly appropriate to this study; the LTP2 for each area was examined to better understand the congestion issues.

2.31 The analysis of congestion issues identified in each LTP2 is described in the second Technical Report, which focuses on the approach to the collation of congestion data in each area. The key issues identified from each LTP2 were as follows:

#### Three Cities Sub-Area

- **Greater Nottingham** has been successful in controlling the growth of congestion in the conurbation, but there is a danger that growth will result in future congestion, which will itself deter new investment in the city;
- **Central Leicestershire** has little spare road capacity during peak periods, and unplanned events can cause severe problems;
- **Derby** also suffers from congestion problems, particularly along the key arterial routes into the city, and the surrounding part of **Derbyshire** experiences hotspots in places such as Swadlincote; and
- In addition to the problems experienced in the Central Leicestershire conurbation, **Leicestershire** also experiences problems in Loughborough, Hinckley, Coalville, Market Harborough and Melton Mowbray.

#### Northern Sub-Area

- In **North Nottinghamshire**, it is noted that current levels of congestion are unlikely to be detrimental to the economic well-being of the area. Whilst the LTP places particular importance on regeneration, the focus is more on promoting multi-modal accessibility and improving the physical environment; and
- In this part of **Derbyshire**, however, congestion is a growing problem, in both urban and rural areas. The strategy for tackling congestion sits alongside work to support regeneration. Problems of congestion are most acute in Chesterfield, which also has a number of potential development sites.

#### Peak Sub-Area

- In the Peak area of **Derbyshire**, congestion is a growing problem in both the towns and in rural areas. The strategy for tackling congestion sits alongside work to support tourism and the rural economy, and hotspots are identified in places such as Buxton, Matlock and Glossop.

### Eastern Sub-Area

- In **Rutland**, congestion has not been identified as a problem – rural accessibility to key services is considered to be a more pressing issue; and
- Likewise, in **Lincolnshire**, access to key services is more important, and the peripherality of the County is a particular concern, although congestion is now becoming a more significant issue in the larger urban areas.

### Southern Sub-Area

- **Northamptonshire** has experienced significant traffic growth (in response to relatively rapid economic growth), and problems are now experienced in the larger towns of Northampton, Kettering and Wellingborough.

2.32 It can therefore be seen that there are distinct differences in the issues that are faced in different parts of the East Midlands, reflecting the very diverse nature of the region.

### CONCLUSIONS FROM ANALYSIS OF REGIONAL AND LOCAL STRATEGIES

2.33 Table 2.2, set out below, provides a summary of the key issues in the region, drawing upon both the regional and local policy evidence base.

2.34 These issues were then subject to scrutiny through the analysis of traffic data, which is described in the chapters that follow.

## Table 2.2 – Issues Identified in Regional and Local Strategies

| | Strategic Network | Three Cities Sub-Area | Southern Sub-Area | Northern Sub-Area | Eastern Sub-Area | Peak Sub-Area | Evidence |
|---|---|---|---|---|---|---|---|
| Chapter 2: Economic Geography of the East Midlands | Congestion and journey reliability on the strategic network.<br><br>Access to key gateways: EMA (M1 / A42), East Coast Ports (A14). | Congestion in Nottingham, Leicester, Derby, and also sub-reg. centres.<br><br>Impacts on agglomeration economies (productivity).<br><br>Potential impacts on access between jobs and labour market. | Congestion in Northampton. Potential congestion in other towns.<br><br>Impacts on agglomeration economies (productivity). | Potential congestion in towns.<br><br>Potential impacts on access between jobs and labour market. | Congestion in Lincoln, potential congestion in sub-regional centres.<br><br>Problems elsewhere more likely to be due to peripherality. | Limited evidence of congestion.<br><br>Issues in rural areas are more related to accessibility to services. | RES, RSS |
| | Several LTPs identify problems on the strategic network and the impacts on local areas, including A38 through Derby, A14 at Kettering, A45 through Northampton. | **(Gtr Nott'm, Central Leics, Derby, Derbys, Leics)**<br><br>Congestion problems in three cities. Hotspots in other towns.<br><br>Noted that congestion could constrain economic activity.<br><br>No major problems in rural areas. | **(Northants)**<br><br>Congestion in Northampton & Kettering. | **(North Notts, Derbys)**<br><br>Issues in Chesterfield, Bolsover areas.<br><br>Not considered to be a problem in North Notts. | **(Lincs, Rutland)**<br><br>Congestion in Lincoln, Grantham & Boston.<br><br>Peripherality (not congestion) is an issue elsewhere.<br><br>Poor tpt i'structure constraining econ. development in Lincolnshire. | **(Derbys)**<br><br>Problems in Buxton & other towns.<br><br>Issues identified in National Park. | LTPs |

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# 3. Development of Methodology

## INTRODUCTION

3.1 This chapter first describes the theoretical background to the relationships between transport and the economy, drawing in particular on the recent Eddington Study. It then describes the approach to determining the extent of congestion in the region and concludes by describing how this congestion is translated into economic costs to the region.

3.2 A more detailed commentary on the approach taken is provided in the first Technical Report produced for the study.

## BACKGROUND THEORY ON TRANSPORT AND THE ECONOMY

3.3 The evidence base on the impacts of the transport network on economic performance is rapidly developing. In the recent years there has been a move towards more fully capturing the economic impacts of the transport network, which has been the subject of both academic research and practical application to provide a greater focus for national transport policy.

### The Eddington Transport Study

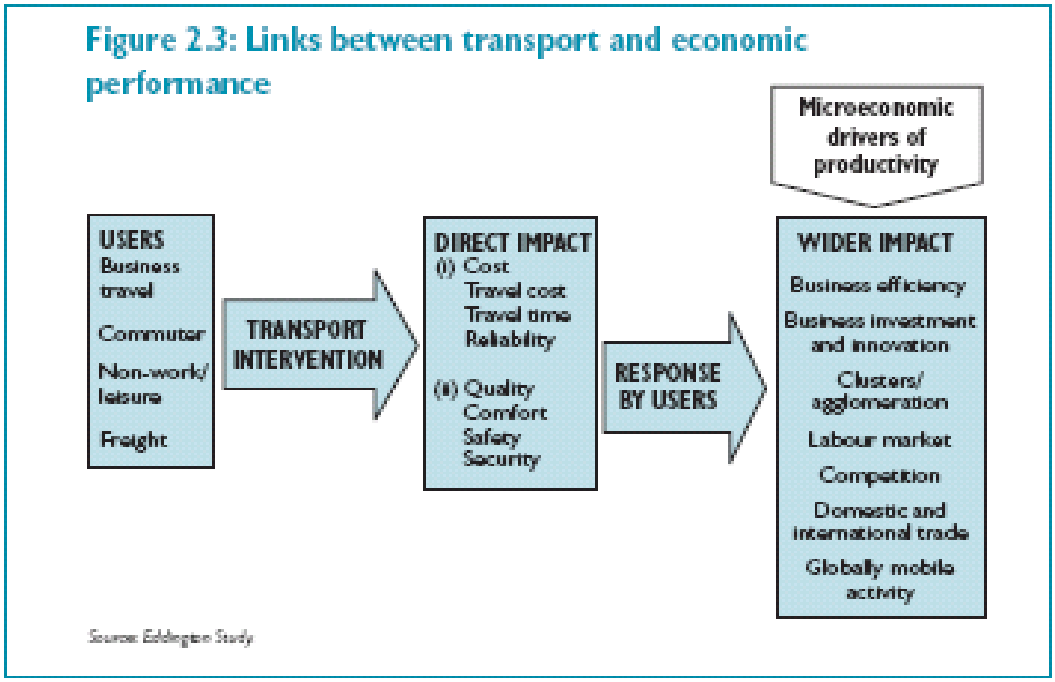
3.4 The recent Eddington Transport Study[10], commissioned by HM Treasury and the Department for Transport, considered this issue in considerable depth. It noted that the UK transport network is already well developed, and there is little evidence that improved transport would deliver a step-change in national economic performance. On the other hand, it noted that a lack of adequate capacity can start to constrain economic growth. This is the case with congestion, and the report set out the potential benefits to the national economy of tackling congestion problems.

3.5 The Eddington Study noted that, in most cases, the best signals that transport is acting to hold back economic growth are the presence of clear signs of economic success (economic growth, high wages and high land prices) and that transport demand is starting to outstrip supply (signs of congestion and reduced journey reliability).

3.6 The Study highlighted the key drivers of improved accessibility and considered how they impact on the microeconomic drivers of productivity. These are shown in Figure 3.1 overleaf.

[10] The Eddington Transport Study. Main Report: Transport's role in sustaining the UK's productivity and competitiveness, Sir Rod Eddington, December 2006.

**Figure 3.1 – Links between Transport and Economic Performance [11]**




3.7 The "direct impacts" and "wider impacts" shown in the figure above are further explained in the following section.

### Approaches to Capturing Economic Impacts

3.8 The calculation of the economic benefits of transport improvements has been a long-established element of appraisal. Traditionally, a number of assumptions have been made about the operation of the market – conventional appraisal assumes no market imperfections, whilst recent developments in appraisal techniques have helped to ensure that wider implications and "real world" conditions are more accurately reflected.

### "Conventional" Economic Appraisal

3.9 "Conventional" economic appraisal addresses the "direct impacts" that are described in Figure 3.1 above. Traditionally, values have been attributed to changes in travel time and vehicle operating costs to determine overall benefits of transport improvements. Similarly, it is possible to estimate the economic costs imposed by congestion resulting from the additional travel times and operating costs.

3.10 It is important to separately consider **working** trips and **non-working** trips. This is because, for non-working trips, some costs are assumed not to be perceived, and different indirect taxation rates and values of time apply to work and non-work trips.

[11] The Eddington Transport Study, Main Report. Volume 1, Page 24.

3.11 In the case of **time** spent travelling, values of time can be applied to the differences in journey times between congested and uncongested conditions, to determine an economic cost of delay.

3.12 The use of the road system by cars and lorries also gives rise to **operating costs** for the user. These include fuel, oil and tyres and an element of vehicle maintenance, as well as depreciation, and the productivity of the use of the vehicle in the case of goods vehicles.

3.13 By comparing journey speeds for congested and uncongested conditions, it is possible to determine the additional operating costs incurred as a result of congestion.

### Wider Economic Impacts

3.14 The "wider impacts" box shown in Figure 3.1 includes all of those impacts that are not addressed through the direct impacts described above. Recent work has shown that the application of monetary values to travel time savings does not fully capture the range of responses in the economy.

3.15 Conventional appraisal assumes that the benefit from being able to arrive at a destination more quickly is equal to the value of the travel time saved. This is generally a good first approximation, and works perfectly if there are no market imperfections. However, markets are imperfect in the real world, and hence it is important to understand the wider impacts caused by imperfections, including:

- Agglomeration impacts;
- Competition effects; and
- Labour supply changes.

3.16 A full description of these issues is provided in a discussion document issued by the Department for Transport[12], and the section that follows provides a brief summary of these wider impacts.

#### *Agglomeration Impacts*

3.17 Recent research[13] demonstrates the importance of the quantification of so-called **agglomeration** impacts, which were not previously addressed in conventional economic appraisal. This draws upon research by academics into the geography of high-performing areas, which demonstrates the importance of effective density of employment in local economies. This has demonstrated that, by increasing density (by increasing the number of businesses or by reducing travel costs between these businesses or between the businesses and their potential employees), productivity benefits are likely to follow.

#### *Competition Effects*

3.18 The recent DfT Guidance suggests, cautiously, that there is no impact from transport in improving **competition**. This is due to the fact that the UK already has an

[12] Transport, Wider Economic Benefits and Impacts on GDP, DfT, July 2005
[13] As described in Transport, Wider Economic Benefits and Impacts on GDP, July 2005

extensive transport network, and most of the theoretical effects apply where firms can make connections that were not previously available, and there are very few examples of this in the UK. Likewise, there is no evidence to suggest that congestion results in market connections not otherwise being made.

3.19 There is, however, an impact from the presence of imperfect competition in transport-using industries. These imperfections increase the scale of economic benefits caused by transport improvements and are inevitable, because of increasing returns to scale. The DfT recommend that this issue is addressed by adding a further 10% to the value of business time savings.

*Labour Supply Changes and Tax Effects*

3.20 The economic benefits from **increased employment** and **relocation of employment** to more productive locations, resulting from commuting time savings, also need to be addressed. The benefits to the individual commuter are captured in the travel time savings included in the direct impacts described above. However, these are measured post-tax, and it is necessary to also include the **benefits to the Exchequer** of increased tax receipts arising from increased employment and resultant output.

3.21 Previous research has indicated that the inclusion of these wider economic benefits can add significantly to the economic case for transport investments. Conversely, this could also mean that the wider economic impacts could be adding significantly to the **costs** of congestion.

### The Differences between "Social Welfare" and Productivity

3.22 There are two alternative methods for presenting the economic impacts of transport. The approach described above estimates effects in **social welfare** terms, which measures the impacts on society as a whole. However, when the main focus of interest is the impact of transport on economic growth, the alternative approach of assessing impacts in **productivity** terms is more useful.

3.23 Whilst savings to both working time and non-working time contribute to national welfare, only working time savings contribute to economic productivity. There are also other benefits resulting from transport investment, including environmental, social and safety impacts, which contribute to overall national welfare. Again, however, these do not contribute to economic productivity.

3.24 The aim of this study is to assess the impacts of congestion on the East Midlands economy. It is therefore important to assess these costs in terms of both overall social welfare and productivity[14].

### Measures of Productivity

3.25 The guidance issued by the Department for Transport (DfT) for the assessment of wider economic impacts[15] sets out an approach for the consideration of impacts on productivity in terms of **Gross Domestic Product (GDP)**. However, productivity in

[14] A more detailed discussion of this issue is provided in the second Technical Report for this study.
[15] Transport, Wider Economic Benefits and Impacts on GDP, DfT, July 2005

regional development terms is more commonly considered using an alternative measure, **Gross Value Added (GVA)**.

3.26 GVA measures output at basic prices, ie excluding the effects of taxation and subsidies, whereas GDP includes the effects of taxation and subsidies. However, it is very difficult to measure taxation and subsidies at a regional level, so these are removed from analyses, with measurement of output being based upon basic prices.

3.27 This is taken into account when considering the impacts of congestion on the regional economy, which is explained in Chapter 5 of this report.

### WHAT IS MEANT BY "CONGESTION"?

3.28 This study has drawn upon extensive research on the subject of congestion and a full evidence base is provided in the first Technical Report. It was concluded at an early stage that the most appropriate measure of congestion would be a measure of the difference between the theoretical maximum speed on a road (in free-flowing conditions) and the actual speed that is experienced.

3.29 This was translated into the travel time per kilometre, per vehicle, greater than the free-flow travel time on the link. This measure is termed throughout as the "lost time per vehicle-kilometre", and this approach has been adopted on other studies measuring congestion in other parts of the UK, including London and Scotland[16].

### The Differences between Congestion and Lower Speeds

3.30 Long journey times or low journey speeds are not necessarily due to congestion on the road network. In the case of Lincolnshire, for example, some long journey times are experienced in reaching other parts of the region. However, this is due to the long distances in crossing the county and because virtually all the road network in Lincolnshire is single-carriageway, with lower free-flowing speeds, and lower speed limits, than dual carriageways. Unless the road is operating near capacity, the lower speeds are not therefore necessarily due to congestion.

3.31 For this reason, it is appropriate to measure the traffic speeds on different types of road and to compare these with the typical default free-flow speeds. Congestion is measured as the difference between the two values. Whilst drivers on single carriageway roads might be frustrated by the relatively low journey speed, in many cases this is not necessarily due to congestion. In Lincolnshire, this translates into perceptions of peripherality (and not congestion), which was described in Chapter 2.

3.32 The objective of this study was to consider the issues relating to congestion; issues relating to peripherality have not therefore been considered in this study, and these would need to be considered separately.

[16] Described in Technical Report 1: Development of Methodology, Atkins, June 2007.

## ESTIMATION OF THE ECONOMIC IMPACTS

3.33 A two-stage process was undertaken to determine the economic impacts resulting from congestion in the region. The detail of, and the reasoning for, the approach taken is set out in the first Technical Report.

### Direct Economic Impacts

3.34 The first stage was to apply values of time to the lost time due to congestion. Default values produced at the national level by the Department for Transport were applied to determine the split of time that is spent on employer's business, commuting and during leisure time. From this, it was possible to calculate the total cost due to the lost time for each journey purpose.

3.35 It was initially intended to calculate the additional vehicle operating costs due to congestion. However, this was not possible, because link speeds were averaged across the network and by time of day. This means that it was not possible to determine the detailed impacts of localised congestion and stop-start traffic on operating costs.

### Wider Economic Impacts

3.36 The second stage was to undertake additional analyses to determine the wider economic benefits of tackling congestion, i.e. the additional costs from congestion.

#### *Agglomeration Impacts*

3.37 This initially focused on potential "agglomeration impacts" in the Principal Urban Areas (PUAs). This made use of data on travel patterns in the local area, to determine how congestion increases journey times within economic clusters. By tackling congestion, these journey times could be reduced, and hence the "effective density" of employment increased. This was translated into a productivity benefit, through the use of elasticity values that have recently been developed for DfT.

#### *Competition Effects*

3.38 Account was also taken of the effects of imperfect competition, by adding a further 10% to the value of business time savings. This is consistent with the approach advocated nationally by the Department for Transport.

#### *Labour Market Impacts*

3.39 The scope of the analysis of the impacts on the labour market was limited. It was possible to determine the GDP impacts of more people being able to enter the labour market through tackling the congestion problem. In addition, the Exchequer consequences of increased GDP (through increased labour market participation) were also taken into account.

3.40 However, it was **not** possible to address the impacts on the location of employment, as this requires sophisticated land use – transport modelling. The development of modelling tools for the East Midlands region could help to explore this aspect further at a later date, which is discussed in Chapter 6 of this report.

# 4. Extent of Congestion in the East Midlands

## INTRODUCTION

4.1 This chapter describes the findings from the analyses of traffic data and other evidence to provide a commentary on the extent of congestion in the East Midlands.

4.2 It first describes congestion on the strategic road network. This is then followed by a commentary on congestion on the local road networks, with a focus on the different issues that face each of the five sub-areas of the region.

## STRATEGIC ROAD NETWORK

4.3 The strategic road network in the East Midlands is shown in Figure 4.1 overleaf.

4.4 It can be seen that the strategic road network is focused on the central core of the region; the M1 north-south corridor cuts through the central spine and carries a mix of long-distance, intra-regional and local traffic. The A17 route between Newark and King's Lynn, which passes through the east of the region, was recently de-trunked and is now under the stewardship of the local highway authorities. The A628, which passes through the far north-west of the region, acts as the key strategic route between Manchester and Sheffield.

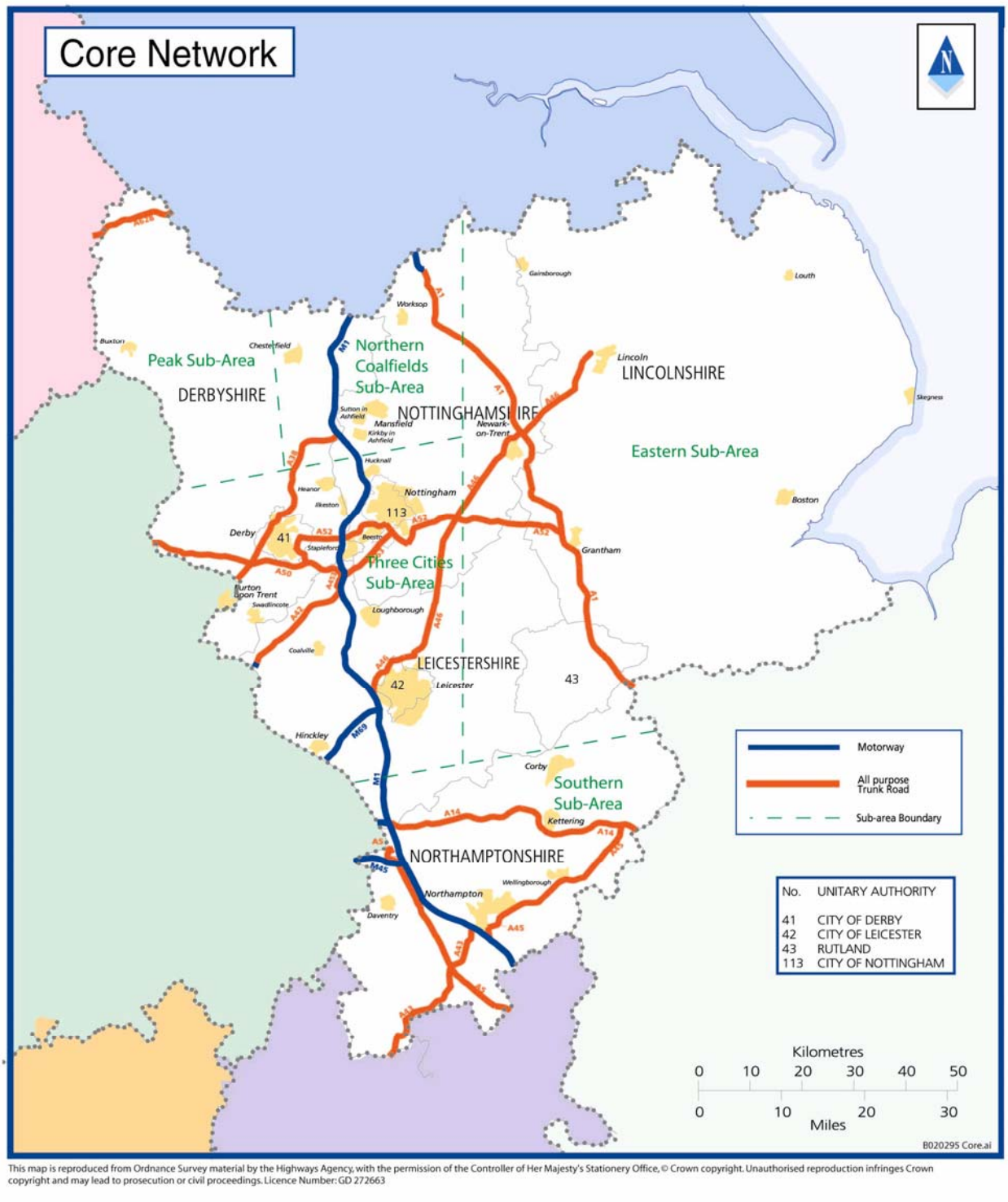
4.5 In the East Midlands, the two routes of ***national*** importance are the M1 (between London and the North) and the A14, linking the Midlands to the East Coast Ports. All other routes are predominantly of ***regional*** importance.

### Delays on the Strategic Network

4.6 Figures 4.2 and 4.3 (overleaf) show the key delay hotspots in the East Midlands, in terms of recurrent and non-recurrent delay on the strategic road network. Recurrent delay refers to delay occurring on a regular basis (e.g. high peak-hour traffic volumes due to commuting) and non-recurrent delay relates to incidents that occur randomly, such as accidents.

4.7 These show total vehicle hours of delay over the daytime period from 6am to 8pm. The links shown in **red** are the **worst 15% of links**, those in **orange** are the **next worst 15%**, and the **remaining 70%** are shown in **green**. Those links that are both heavily trafficked and suffer delays suffer the highest level of total delay.

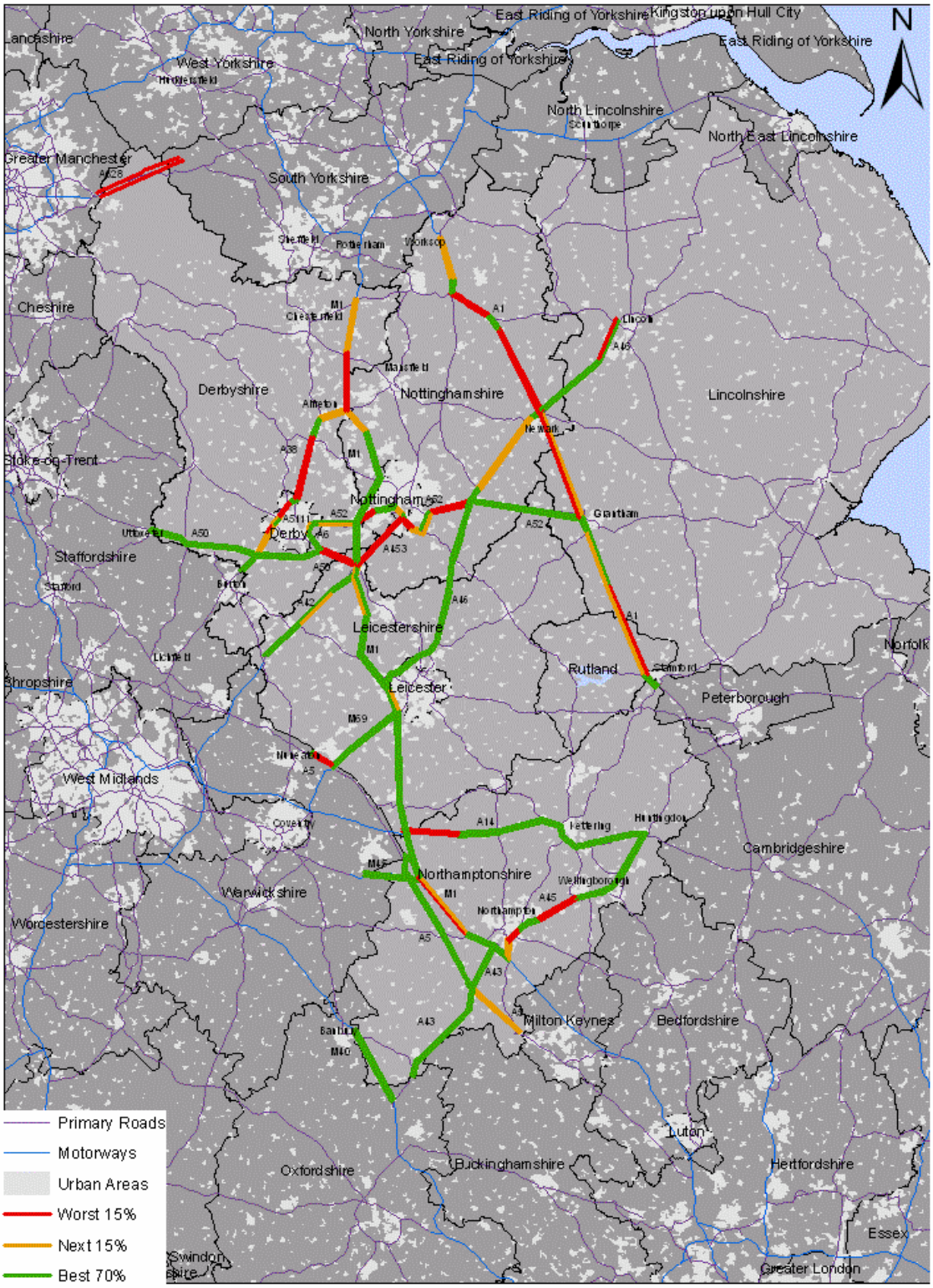
**Figure 4.1 – Strategic Road Network in the East Midlands [17]**





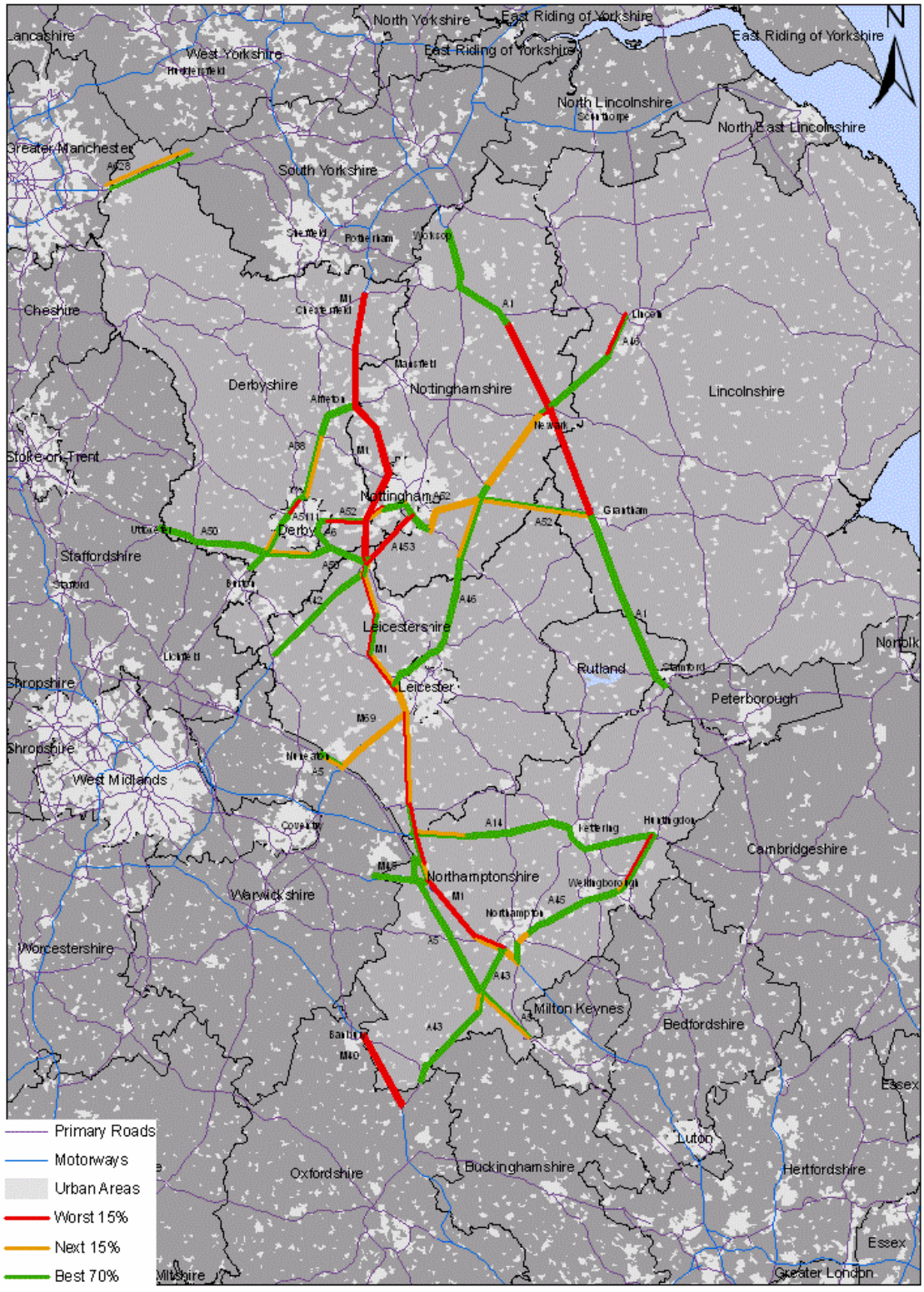

[17] Source: Figure 2.1, East Midlands Regional Network Report, Highways Agency (October 2005)

## Figure 4.2 – Recurrent Delay on East Midlands Strategic Road Network [18]




[18] Source: Figure 2.4, East Midlands Regional Network Report, Highways Agency (October 2005)

## Figure 4.3 – Non-Recurrent Delay on East Midlands Strategic Road Network[19]




[19] Source: Figure 2.5, East Midlands Regional Network Report, Highways Agency (October 2005)

4.8 In the case of **recurrent** delays, the following are notable:

- In many cases, the worst delays appear to be on the approaches to junctions or on single carriageway sections;
- Delays associated with the approaches to junctions include:
  - the A14 westbound approach to M1 Junction 19;
  - A50 approach to M1 Junction 24;
  - A52 west of Nottingham;
  - A38 junctions in Derby; and
  - Roundabouts along the length of the A1.
- Delays associated with single carriageways include:
  - the A628 (passing through the villages of Tintwistle and Mottram);
  - A453 between Nottingham and the M1; and
  - A52 east of Nottingham, between Radcliffe and Bingham.

4.9 All of these congestion problems have previously been identified and studied, with various solutions being taken forward.

4.10 In the case of **non-recurrent** delays, it can be noted that there are particular problems with the M1 along much of its length between Northampton and Chesterfield. This is effectively the full length of the East Midlands stretch of the M1 and appears to be due to the motorway operating near capacity, with small incidents acting to cause significant disruption on the route. Again, action is being taken to tackle congestion on the motorway through the proposed widening scheme.

### Analyses of Data

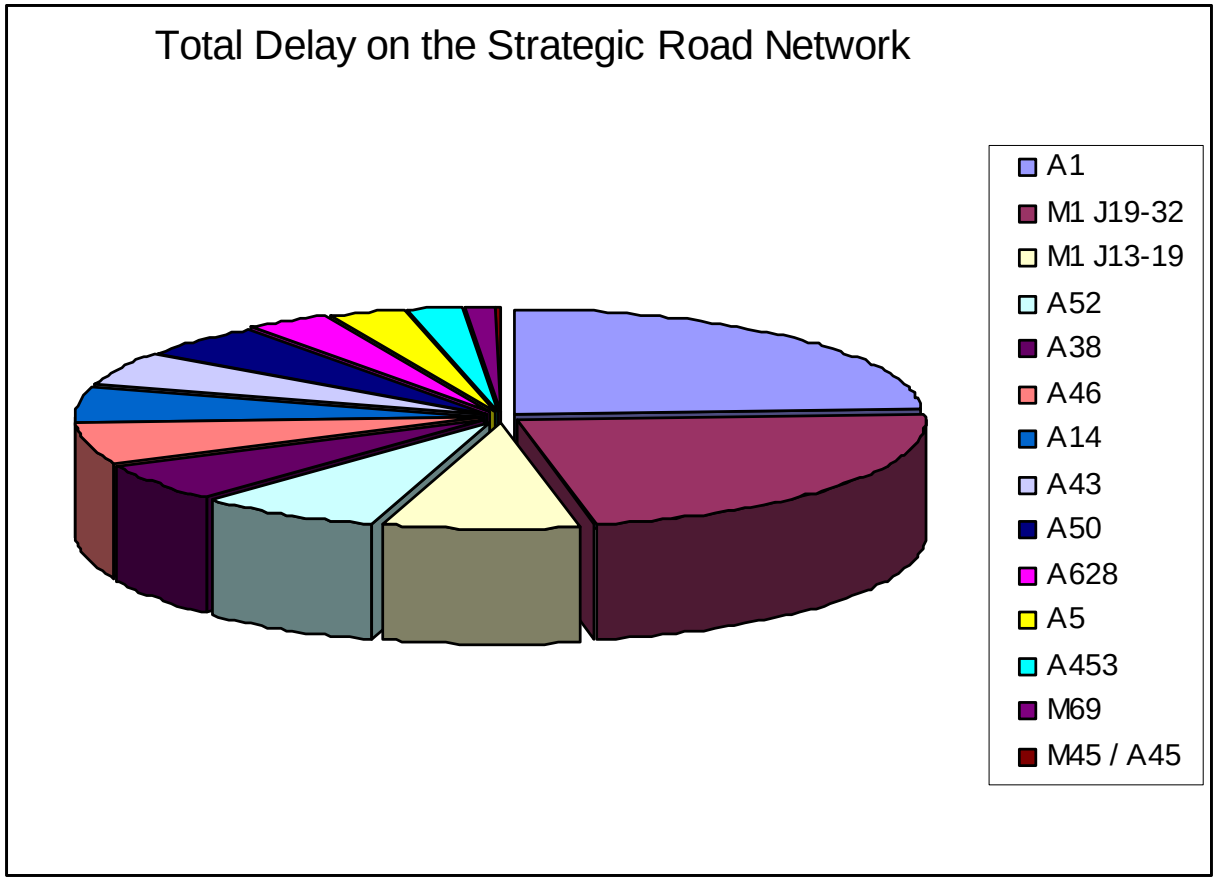
4.11 The data used to generate Figures 4.2 and 4.3 was obtained from the Highways Agency (HA) to calculate the total extent of congestion on the strategic road network. The dataset included all strategic roads in the region, except the A42 and A45, for which the data was poor and could not be used.

4.12 The analysis of congestion was based upon the differences between the actual speeds of traffic on each route and the potential speeds of traffic in free-flowing conditions. These free-flowing speeds are based upon the speed limit of the road and take into account junctions, at which traffic needs to reduce speed, along the route.

4.13 The resultant “lost time” to congestion was then multiplied by the total traffic flows to determine the total delay on each route.

4.14 The analysis of the data showed that the total delay, based upon data from August 2004 to July 2005, was 12,900 vehicle-hours per year. The contributions made by different routes to this total delay are shown in Figure 4.4 below.

**Figure 4.4 – Total Vehicle Delay on East Midlands Strategic Road Network**




Note: total delay = 12,900 vehicle hours. This excludes A42 (M42 J11 to M1 J23A) and A45 from M1 to A14 due to poor data quality.

4.15 In summary, it can be concluded that, on the strategic road network:

- The total delay is greatest on the A1 and M1, which is due primarily to the lengths of these routes (145 km and 151 km respectively) and volume of traffic on the M1;
- Substantial total delays are also experienced on the A14, A38, A43, A46 and A52, which were somewhat shorter in length; and
- There were smaller total levels of delay on the A453 and A628, due to their relatively short lengths, despite the relatively long delays experienced over the short length of each route[20].

4.16 These total vehicle delays were taken forward into the next phase of the project, to calculate the total monetised cost. This is described in Chapter 5 which follows.

[20] The A628 route extends from the edge of Greater Manchester to the M1 north of Sheffield but the route length in the East Midlands is very short as it passes through the northernmost part of Derbyshire, as shown in Figure 4.2.

### LOCAL AUTHORITY HIGHWAY NETWORK

4.17 This covers all roads in the region that are not part of the strategic road network, and ranges from country lanes in Lincolnshire to the congested urban networks of the largest towns and cities in the region.

### Engagement with Local Authorities

4.18 The Local Transport Plans (LTPs) from across the region were used to provide contextual information and data where possible, and Chapter 2 provides a summary of the evidence that was collated. However, in most cases it was necessary to seek additional data in order to quantify the extent of congestion in each area.

4.19 The approach was to engage with each of the highway authorities to obtain the best possible evidence on congestion on their networks. In some cases, transport models were obtained and interrogated whilst in other cases there was very limited data available and it was necessary to make a number of judgements.

4.20 In general, from the review of the LTPs and discussions with local authority officers, it was concluded that congestion is concentrated in urban areas, with little evidence of congestion occurring on the rural road network. The analyses therefore focused on the measurement of congestion in towns and cities.

### Analyses of Data

4.21 The analysis of congestion was based upon the differences between actual speeds of traffic in each town and the potential speeds of traffic in free-flowing conditions.

4.22 It is well understood that traffic congestion increases with the volume of traffic on the network. On the other hand, traffic congestion is reduced with less traffic, and congestion should theoretically be removed if there is only very small demand on the network. Traffic speeds (and congestion) on the network are therefore sensitive to the volume of traffic.

4.23 The approach was to make use of traffic models for a number of towns and cities across the region. The traffic speeds in each town were estimated by applying the actual level of demand to the traffic model. Traffic speeds in “free-flow” conditions were then determined by applying a very small demand to the model, reflecting the relative ease of travelling when there are few other vehicles present.

4.24 The level of delay in each town or city was therefore estimated from the difference in the total travel times for all traffic between the actual and “free-flow” conditions.

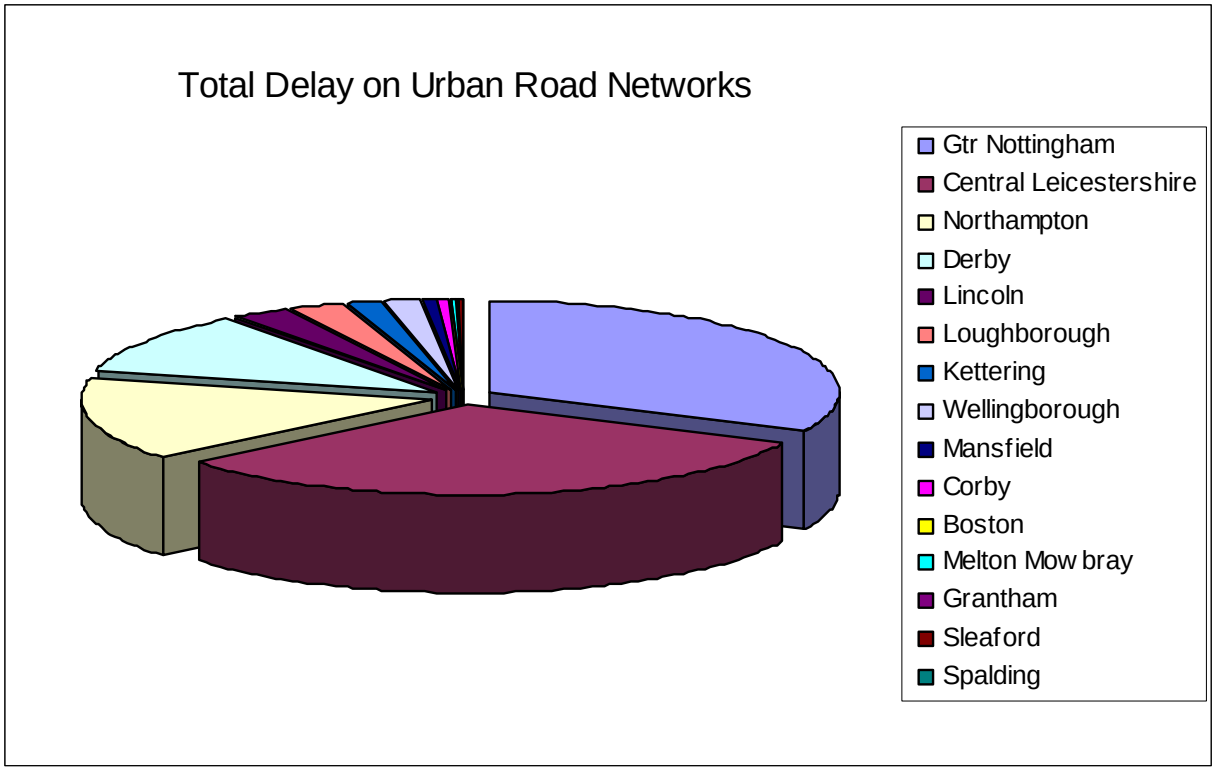
4.25 The analyses shows that the “lost time” for each vehicle on the network is much higher in the larger urban areas than in smaller towns, although there are some very large differences between some of the sub-regional centres. For example, the analyses suggest that the lost time for traffic in Loughborough is some four times greater than in Mansfield.

4.26 These analyses were then translated into calculations of total delays experienced by all traffic in the network. In addition, it was considered necessary to take into account the potential delays experienced by bus passengers. Whilst these delays were

estimated to be significant in the four largest urban areas, they were forecast to be minor in other centres.

4.27 Figure 4.5 presents the distribution of delay in the urban areas of the region.

**Figure 4.5 – Total Vehicle Delay in East Midlands Urban Areas**




Note: total delay = 32,800 vehicle hours. This only includes urban areas for which traffic data is available.

4.28 In summary, it can be concluded that, for the local authority road network:

- The total delays are, by a considerable margin, highest in the two largest urban areas of Greater Nottingham and Central Leicestershire;
- Modelled delays appear to be lower but still significant in Derby and Northampton;
- Lincoln has the lowest levels of total delay, by a large margin, of the five PUAs. This reflects its small relative size and comparably low levels of congestion;
- Congestion in Mansfield, which is of a similar size to Loughborough, is only a quarter of that of the latter; and
- Congestion in the smaller towns is much less than the larger towns.

4.29 There are notable absences in the above analysis, including large towns such as Chesterfield, for which data could not be made available. It was therefore necessary to make a series of estimates and assumptions in calculating the potential economic costs of congestion for these centres, as described in the following Chapter.

# 5. Economic Impacts of Congestion

## INTRODUCTION

5.1 This chapter describes the analyses of the economic impacts of congestion in the East Midlands. In accordance with the principles described in Chapter 3, it first describes the direct economic impacts and then considers the wider impacts on the economy of the region. The supporting Technical Report describes the basis of these calculations in more detail.

## DIRECT ECONOMIC IMPACTS

5.2 The traffic and congestion data described in the previous chapter was used to estimate the direct economic impacts, in terms of the value of time lost on the road network, within the region. Consideration was given to the strategic road network, urban areas and the rural / interurban network, the costs of which are described below. The basis for the development of these estimates is described in detail in the supporting Technical Report.

### Strategic Network

5.3 The strategic road network is operated by the Highways Agency, and includes both routes of national significance (M1 and A14), which carry relatively large volumes of long distance traffic, and routes of regional significance.

5.4 Traffic using the strategic network is estimated to suffer direct economic costs of around **£175 million** per annum. This calculation was compared with headline figures developed for the Eddington Study (described in Chapter 3), and it was found that there was a high degree of consistency between the two estimates.

5.5 This is split between routes of national and regional significance. The total delay cost on **routes of national significance** is estimated to be **£65 million** per annum, which includes a (relatively small) proportion of traffic that passes through the region. The delay cost on **routes of regional significance** is estimated to be **£110 million per annum**, which is largely imposed on traffic within or heading to / from the region.

5.6 The analyses indicate that 22% of the total delay cost is borne by large goods vehicles travelling on the strategic road network. The total cost to business (which includes goods vehicles and time spent travelling on business) is estimated at around £110 million per annum with around £65 million per annum costs imposed on leisure and commuting trips.

### Principal Urban Areas

5.7 The **two largest urban areas** (Greater Nottingham and Central Leicestershire) are estimated to suffer direct economic costs of around **£310 million** per annum. Again, there is a high degree of consistency between the data from this study and that used for the Eddington Transport Study.

5.8 In the case of Greater Nottingham and Central Leicestershire, the analyses suggest that a significant proportion of the delay cost is experienced by bus passengers.

5.9 There is also a reasonably clear picture in the **three other PUAs** (Derby, Northampton and Lincoln), with direct economic costs in the region of around **£130 million** per annum. The total delay cost in all five PUAs of the East Midlands is therefore around **£440 million** per annum.

5.10 In all five PUAs, the analyses indicate that a very small proportion of the total delay is experienced by large goods vehicles, which appears to reflect that deliveries are made outside the congested peak periods. The total cost to business in the PUAs is estimated to be around £220 million per annum, with around £220 million imposed on leisure and commuting trips.

### Smaller Urban Areas

5.11 The costs of delays in the **smaller urban areas** are less clear. The calculations undertaken for this study indicate a total cost of around £80 million per annum, but the work for Eddington suggests that the total for the smaller urban areas in the region should be closer to £260 million. There is, therefore, a large difference (>£180 million) in this respect. However, the data used for the Eddington analysis is intended primarily for strategic analysis with less detail and accuracy in local areas. It may therefore overestimate delay levels in the smaller urban and rural areas.

5.12 In the light of this uncertainty, it has been assumed that the total congestion costs in the smaller urban areas would lie between the two figures described above, i.e. around **£160 million** per annum. There is currently no evidence to suggest if the actual congestion costs would be lower or higher than this figure, and this is an area that will require significant further work at a later date.

### Rural Areas

5.13 This study has not attempted to calculate the costs of congestion on the **rural** (non-strategic) network. The work for the Eddington Study has indicated that this would only total around **£50 million** per annum in any case, which is small in comparison with the costs that are experienced in the PUAs and on the strategic network.

### Limitations of the Analysis

5.14 It has been necessary to make a number of assumptions, estimates and simplifications in the process of developing the costs described above.

- There is very significant uncertainty about the extent of congestion in the sub-regional centres and smaller urban areas. Congestion data was not available for large parts of the region, including major centres such as Chesterfield, and it was necessary to make estimates of the costs of congestion in these cases.
- There are limitations in the treatment of congestion as experienced by buses and bus passengers. It is likely that the estimates of the impacts of congestion on bus passengers are higher than those actually experienced in the larger urban areas.

- The analysis presented in this report does not take into account the deterioration in journey time reliability and the resultant impacts on economic performance. There is, at present, insufficient data to quantify journey time reliability on the whole of the region's network, and a more qualitative approach is instead required.
- It has not been possible to analyse the additional vehicle operating costs resulting from vehicles idling in queues of traffic. Vehicle operating costs are highly sensitive to operating speeds, and the analyses have shown that congested speeds and "free-flow" speeds differ in each of the urban centres, with speeds also varying within each network. This meant that, in practice, it was extremely difficult to derive an accurate forecast of the additional operating costs resulting from congestion in the region.

5.15 In practice, this would mean that the figures quoted slightly under-estimate the direct economic costs of congestion in the region. It is considered that the main element of potential additional costs would be due to vehicle operating costs, although it is not possible to state by how much, and further work would be required in this respect.

5.16 It should be noted that the economic costs described in this chapter are theoretical maxima of benefits that could be achieved through congestion relief. The full value of benefits could not be practicably achieved because measures to relieve congestion require investment and the time delays resulting from congestion only form part of the overall journey cost. Future measures designed to tackle congestion, by influencing the demand for travel, including road user charging and workplace parking levies, could be important factors. Such initiatives, in introducing new financial elements to the overall journey cost, would act to offset benefits achieved through reductions in journey times from reduced congestion. In practice, therefore, the potential economic benefits in tackling congestion would be lower than the total economic costs of congestion described above.

## WIDER ECONOMIC IMPACTS

5.17 As described in Chapter 3, it is also important to capture the wider responses that take place in the economy in response to congestion. These include agglomeration impacts, competition effects and labour market responses.

### Agglomeration Impacts

5.18 Assessments were undertaken to consider the impacts of congestion on agglomeration economies in the four largest centres of Nottingham, Leicester, Derby and Northampton.

5.19 It is estimated that entirely removing congestion in the four major urban centres could theoretically deliver agglomeration economies of around **£70 million** per annum.

5.20 However, the time delays resulting from congestion only form part of the overall journey cost. As a result, other elements forming part of the journey cost influence the scope for agglomeration economies. Future measures that are designed to tackle congestion, in introducing new financial elements to the overall journey cost, could act to offset reductions in journey times from reduced congestion, as discussed in Paragraph 5.16 above.

### Additional Impacts of Imperfect Competition

5.21 This issue is addressed by applying a 10% factor to the total delay costs for business, which were shown to be as follows:

- Approximately £110 million on the strategic network; and
- Around £220 million in the Principal Urban Areas.

5.22 The total delay costs for business on other parts of the network are less clear – reflecting the uncertainty discussed in Chapter 4. However, the available evidence indicates that, in other places with modelled data, around 50% of the total delay cost is loaded on the business community. On this basis, the remaining costs to business are estimated to be:

- Around £80 million in other towns across the region; and
- Around £20 million on the rural network.

5.23 This suggests that the total delay cost to business, across the whole region, is in the order of £430 million per annum.

5.24 Applying the 10% factor, it is estimated that the additional impact of congestion relief in imperfect markets would be in the order of **£40 million** per annum.

### Impacts on Labour Market

5.25 In this case, consideration was given to the number of people who currently choose not to participate in the labour market as a result of the additional costs imposed by congestion.

5.26 The analyses took place for the four centres of Nottingham, Leicester, Derby and Northampton. These demonstrated that the benefits for all four centres would total less than £100,000 per annum, which are considered to be negligible. As a result, it is more appropriate to assume that congestion has **no impact** on the number of people entering the labour market.

5.27 Congestion could impact on the locational decisions of businesses and workers, but this issue cannot be addressed through this study. This will instead require consideration through the future modelling and appraisal workstream in support of the Transport Innovation Fund (TIF) study for the Three Cities sub-area.

### TOTAL IMPACTS

5.28 On the basis of the above analyses it is estimated that the total direct costs of congestion are around **£825 million** per annum. This comprises around £430 million incurred by business users (goods vehicles and journeys for business purposes) and £395 million incurred by other users. In addition, it is estimated that the wider economic impacts of congestion (including competition, agglomeration and labour market effects) total around **£110 million** per year. In total, it is estimated that congestion costs the East Midlands economy around **£935 million per annum**.

## ECONOMIC IMPACTS IN THE SUB-AREAS OF THE EAST MIDLANDS

5.29 Chapter 2 highlighted the following issues that have been identified in regional policies for the East Midlands:

- Congestion in the five Principal Urban Areas of the region, which would also impact on productivity through agglomeration diseconomies;
- Congestion in the growth areas in the south of the region;
- Congestion in the sub-regional centres across the region;
- Congestion in the towns in the north of the region; and
- Congestion and reliability on the strategic network, which also affects access to key international gateways.

5.30 It was noted that there is no evidence that congestion is a major problem in the east of the region and in the Peak sub-area.

5.31 These principles were tested using the data that was made available through the study. The headline findings, in terms of the economic costs imposed by congestion in the different sub-areas of the East Midlands, are presented in Table 5.1 overleaf, which shows both the direct costs and wider impacts.

5.32 The issues discussed in Chapter 2 appear to have been confirmed in the analyses undertaken in this study. Table 5.1 shows that around half of the total economic cost is experienced in the Three Cities sub-area, with significant costs also experienced in the Southern Sub-Area. The total economic cost of congestion on the strategic network is also important.

5.33 The costs imposed by congestion in the Eastern and Peak sub-areas are modest. It is also interesting to note the modest congestion costs in the Northern sub-area.

5.34 The analyses have demonstrated that congestion does not have any impact on participation in the labour market. However, congestion is an important factor at play in reducing the productivity of the larger urban areas of the region.

## Table 5.1 – Distribution of Costs of Congestion in the East Midlands[21]

| | Strategic - National | Strategic - Regional | Three Cities | Southern | Northern | Eastern | Peak | Total |
|---|---|---|---|---|---|---|---|---|
| **Direct Economic Impacts:** | | | | | | | | |
| Delay costs (£m, 2005 values and prices) | | | | | | | | |
| Strategic Roads | 65 | 110 | | | | | | 175 |
| Principal Urban Areas | | | 355 | 65 | | 20 | | 440 |
| Other Urban Areas | | | 60 | 60 | 20 | 15 | 5 | 160 |
| Rural Areas | | | 10 | 10 | 10 | 10 | 10 | 50 |
| **Total Direct Economic Impacts (£m)** | **65** | **110** | **425** | **135** | **30** | **45** | **15** | **825** |
| Costs incurred by Business Users (£m) | 40 | 70 | 205 | 70 | 15 | 20 | 10 | **430** |
| Costs incurred by Other Users (£m) | 25 | 40 | 220 | 65 | 15 | 25 | 5 | **395** |
| **Wider Economic Impacts:** | | | | | | | | |
| (£m, 2005 values and prices) | | | | | | | | |
| Agglomeration Impacts | | | 55 | 15 | | | | 70 |
| Impacts of Imperfect Competition | 5 | 5 | 20 | 10 | 0 | 0 | 0 | 40 |
| Impacts on Labour Market | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Wider Economic Impacts (£m)** | **5** | **5** | **75** | **25** | **0** | **0** | **0** | **110** |
| **Total Direct + Wider Impacts (£m)** | **70** | **115** | **500** | **160** | **30** | **45** | **15** | **935** |

[21] Note: costs are rounded to the nearest £5 million.

## CONGESTION AND PRODUCTIVITY IN THE EAST MIDLANDS

5.35 Analyses were undertaken to evaluate these costs in relation to the total productivity of the region.

### Scope of Impact on Productivity

5.36 In considering this issue, it is important to recognise that not all of the costs shown in Table 5.1 have an impact on productivity. Chapter 3 included a discussion of different measures of economic impact, in terms of social welfare and productivity[22].

5.37 Delay costs during non-working time (i.e. by **non-business users**) are experienced by private users, in their own time, and do not impact on the productivity of the region. However, the costs experienced by **business users**, together with the wider economic impacts, impact on the **productivity** of the region.

### Measures of Productivity

5.38 Chapter 3 also described the different measures of productivity used by the Department for Transport (DfT) and the Regional Development Agencies, including *emda*[23]. The approach developed by the DfT for the measurement of productivity impacts (and adopted in this study) is in terms of Gross Domestic Product (GDP), whilst the measure used by *emda* is Gross Value Added (GVA).

5.39 It is necessary to ensure that the costs described in Table 5.1 are consistent with the GVA measure used by *emda*. Table 5.2 overleaf presents these calculations.

[22] Refer to Paragraphs 3.22 – 3.24 of this report.
[23] Refer to Paragraphs 3.25 – 3.27 of this report.

## Table 5.2 – Costs of Congestion, GDP and GVA in the East Midlands

| | Strategic - National | Strategic - Regional | Three Cities | Southern | Northern | Eastern | Peak | Total |
|---|---|---|---|---|---|---|---|---|
| **Regional Economic Data** | | | | | | | | |
| Total GDP (£m) (2005 Estimate) | - | - | 38,703 | 13,826 | 10,519 | 10,846 | 5,089 | 78,984 |
| Total GVA (£m) (2005 Estimate) | - | - | 34,739 | 12,373 | 9,433 | 9,719 | 4,578 | 70,843 |
| Ratio GVA/GDP | | | 90% | 89% | 90% | 90% | 90% | 90% |
| Total No. of Employees (2005 Estimate) | - | - | 864,814 | 297,361 | 246,108 | 247,947 | 118,090 | 1,774,319 |
| Average GDP per Employee (£) | | | 44,753 | 46,495 | 42,741 | 43,744 | 43,096 | 44,515 |
| Average GVA per Employee (£) | | | 40,169 | 41,611 | 38,329 | 39,199 | 38,767 | 39,927 |
| Total GDP Impacts of Congestion (£m) | 45 | 75 | 280 | 95 | 15 | 20 | 10 | 540 |
| Total GVA Impacts of Congestion (£m) | 40 | 67 | 251 | 85 | 13 | 18 | 9 | 484 |
| Total GVA Cost of Congestion as % of GVA | - | - | 0.7% | 0.7% | 0.1% | 0.2% | 0.2% | 0.7% |
| Total GVA Cost of Congestion per Employee | - | - | 290 | 287 | 55 | 72 | 76 | 273 |

**Notes:**

(a) Data on 2005 GDP, GVA and Numbers of Employees has been estimated from 2002 NOMIS data provided by DfT and appropriate growth and inflation rates.
(b) GDP Impacts of congestion are calculated from costs to business users plus wider economic impacts. For example, the East Midlands total (£540 million) is derived from costs to business users (£430 million) + Agglomeration (£70 million) + Effects of Imperfect Competition (£40 million) + Labour Market Impacts (nil). This data has a 2005 base.
(c) GVA measures output at basic prices, ie excluding the effects of taxation and subsidies, whereas GDP measures output in market prices, which includes the effects of taxation and subsidies. However, it is very difficult to measure taxation and subsidies at a regional level, so these are removed from analyses, with measurement of output being based upon basic prices.

5.40 Table 5.2 presents the impacts of congestion on productivity in each part of the region. The congestion costs on the strategic network have not been allocated to individual sub-areas, but are assumed to be experienced by the region as a whole.

### Commentary on Impacts

5.41 The total impact of congestion on the Gross Added Value (GVA) of the region is estimated to be around £480 million per annum. Overall, across the whole region, this **results in costs of around 0.7% of annual GVA and GDP, with an economic cost of around £270 per employee in GVA terms (£300 in GDP terms)**.

5.42 **The economic costs are highest in the Three Cities sub-area**, at 0.7% of GVA/GDP, and **lowest in the Northern, Eastern and Peak sub-areas**, exerting costs equivalent to only 0.1-0.2% of annual GVA/GDP. It is important to recognise that, in the latter cases, this congestion would be focused on particular hotspot areas, generally in urban areas such as Lincoln and Chesterfield.

5.43 These findings have been compared against other sources reviewed in this project. First, the CBI has suggested that congestion costs the UK economy up to £20 billion per year. This estimate is based upon a report from the Organisation for Economic Cooperation and Development (OECD) that estimated the cost as being 2.6% - 3.2% of GDP.

5.44 However, a number of criticisms have been directed at this £20 billion figure. Firstly, there is no evidence that this is based on actual network conditions in the UK, and secondly, this takes no account of the opportunity costs in tackling congestion.

5.45 Further work undertaken by researchers has suggested that that the economic benefit of tackling congestion across the UK would be in the region of £7 billion per year. On the basis of the UK economy totalling around £1 trillion per annum, this would be equivalent to around 0.7% of annual GDP.

5.46 In the East Midlands, the total cost of congestion is estimated at around 0.7% of GDP/GVA. Whilst further work will be required to establish the potential benefits of tackling congestion in the region, the benefits would be less than the 0.7% cost figure. This would appear to be consistent with the national picture. As large parts of the East Midlands region are rural, and congestion has a much lower influence in the rural areas, it should be expected that the relative impact of congestion in the region would be lower than in some of the UK's more urbanised regions.

5.47 Chapter 6 considers these issues further, and provides pointers to the potential next steps in addressing the issue of congestion and its economic impacts in the East Midlands.

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# 6. Conclusions and Recommendations

## INTRODUCTION

6.1 This chapter sets out the key conclusions from the work undertaken in this study. It first discusses the areas of uncertainty that have been identified from the review of existing data, and hence the limitations and caveats that need to be applied to the data. From this, it sets out a series of recommendations on the next steps that could be taken by the partners. Finally, it concludes with the headline findings from the study, in terms of the economic costs of congestion and its impacts on the regional economy.

## LIMITATIONS AND CAVEATS

6.2 The analyses have maximised the use of existing data sources, and have addressed the project objective to provide an estimate of the economic cost of congestion to the region. Whilst the figures developed in the report have been developed using robust methodologies, as stressed elsewhere in the report, assumptions and estimates were required to fill gaps in the evidence base.

6.3 This study has demonstrated that a great deal of further work is still required to provide the detail necessary to refine these calculations. The expectation is that, in the case of the Three Cities area, the TIF project will produce updated and more consistent data on the scale and location of congestion problems which could help inform a range of future policy and investment decisions. However, in more general terms, the following points should be noted:

- There is significant uncertainty about the extent of congestion in the sub-regional centres and smaller urban areas. Congestion data was not available for large parts of the region, including major centres such as Chesterfield, and it was necessary to make estimates of the costs of congestion in these cases.
- There are limitations in the treatment of congestion as experienced by buses and bus passengers, and further work will be required to better measure the impacts of congestion on bus passengers, particularly within the larger urban areas.
- There has been no account taken of the deterioration in journey time reliability and the resultant impacts on economic performance. There is, at present, insufficient data to quantify journey time reliability on the region's network.
- It has not been possible to analyse the additional vehicle operating costs resulting from vehicles idling in queues of traffic.

6.4 In practice, this would mean that the figures quoted in this report slightly under-estimate the direct economic costs of congestion in the region, with the main element likely to be vehicle operating costs, and further work would be required in this respect.

6.5 However, it should be noted, as described in the previous chapter, that the potential economic benefits in tackling congestion would be lower than the total economic costs of congestion described in this report.

## RECOMMENDATIONS FOR NEXT STEPS

6.6 One of the key objectives of this study was to review the existing data in relation to congestion and identify the gaps in this dataset. These gaps have been highlighted above, and in the light of these caveats, it is recommended that the regional partners consider further actions to provide more detail for the evidence base. These potential actions are described in Appendix A and can be summarised as follows:

- **Strategic Modelling**: the new transport model for the Three Cities sub-area, termed PTOLEMY[24], should be used to further examine the current extent of congestion on the strategic road network and in the urban areas of the Three Cities sub-area. It should then be used to model the onset of congestion in future, with analysis of the future impacts on regional GVA.
- **Principal Urban Areas**: This study has only been able to provide a snapshot of the issues faced in the five PUAs. It has not considered in detail the locations and severity of congestion and the detailed impacts on each urban area. Further analysis could take place at two levels: firstly through examination of the effects at a more strategic level, using the PTOLEMY model of the Three Cities, and secondly using the local traffic model for each urban area.
- **Improved modelling of delays experienced by public transport**: within this study, very broad estimates were made of the number of people travelling by bus in the urban areas. Observed bus passenger data should be used to refine these estimates, and more detailed account should also be taken of the impacts of bus priority measures.
- **Addressing the evidence gap for the sub-regional centres**: further evidence should be collated for the larger towns for which evidence is not currently available, for example Chesterfield. In this case, given that tackling congestion has been highlighted as a potential issue in supporting regeneration activity, the problems associated with congestion should be quantified and more specific evidence collated on the problem.
- **Calculation of Vehicle Operating Costs**: this study has not been able to calculate the additional vehicle operating costs due to congestion. However, the TIF modelling stream planned for the Three Cities sub-area will provide the ideal tool for the analysis of the impact of congestion on operating costs across a large part of the region. The modelling tool should provide the mechanisms for the calculation of additional operating costs through the comparison of vehicle speeds, on each link of the network, with and without congestion.
- **Reliability Impacts**: this study has not been able to quantify the impacts of congestion on the reliability of journeys. Whilst data on the variability of journey times is available for the strategic (trunk) road network, it is not readily available for the urban areas. In addition, there is a very limited research base on the response of industry to variable journey times, in which case structured primary research amongst businesses could be beneficial.
- **Land Use / Locational Decisions**: this study has not found any evidence that congestion has a serious impact on locational decisions for businesses in the region. However, the onset of congestion could cause increasing future

[24] PTOLEMY is a land use and transport interaction model being developed by the Highways Agency, *emda*, EMRA and East Midlands Airport, focused on the Three Cities area, building on local transport models held by local partners.

problems of particular sites becoming unattractive due to traffic problems, and general dispersal of activity away from the more productive (but more congested) urban areas. It is recommended that the PTOLEMY model is used to explore the impacts of congestion on land use activity within the Three Cities sub-area.

- **Environmental Costs**: monetary values can now be applied to the environmental impacts of travel. In particular, the onset of climate change is driving the application of carbon costs in terms of $CO_2$ emissions from transport. This issue is being separately explored by *emda* through work on the economic impacts of climate change.
- **Economic Benefits from Tackling Congestion**: the introduction of new fiscal measures to influence journey choices will affect overall journey costs. More sophisticated modelling will be needed to consider this issue. Within the Three Cities sub-area, the modelling workstream of the TIF package (using the PTOLEMY suite) could explore this issue further.

### CONCLUSIONS

6.7 This project has demonstrated that congestion does indeed have an impact on the operation of the economy of the East Midlands. Using existing datasets, and based on standard methodologies, it is estimated that the total cost to the East Midlands economy is around **£935 million** per annum. This comprises around £825 million in direct costs and a further £110 million per annum in wider economic impacts.

6.8 The wider economic impacts appear, in general, to be modest, and are primarily due to competition effects and agglomeration diseconomies in the larger urban centres. The analyses suggest that congestion has no impact on overall participation in the labour market of the region.

6.9 Part of the total cost is absorbed by private individuals in the course of commuting and leisure journeys, with the balance being imposed on business, which impacts on the productivity of the economy. The total impact on the Gross Added Value (GVA) of the region is estimated to be around £480 million per annum, or **0.7% of annual output**.

6.10 The impacts would be greatest in the Three Cities and Southern sub-areas, due to congestion in the larger urban areas, and on the strategic network. The impacts would be much more modest in the Peak, Northern and Eastern sub-areas, particularly in the more rural parts of the region.

6.11 These findings correspond with the national picture, as evidenced from the Eddington Study, which demonstrated the importance of the UK's main urban areas and the strategic network as the key drivers of the national economy in transport terms.

6.12 Road traffic in the East Midlands is increasing – between 1994 and 2004 traffic on major roads increased faster than in any other region[25] – and the regional costs of congestion can therefore be expected to increase unless these trends are altered.

[25] Source: Chart 2, Page 219, The East Midlands in 2006: Evidence Base for the East Midlands Regional Economic Strategy, 2006-2020.

6.13 There is therefore a strong economic case to continue to pursue measures to tackle congestion in the region.

# 7. Appendix A: Recommendations for Next Steps

## INTRODUCTION

7.1 This appendix describes the next steps that could be taken by the regional partners to provide more detail in relation to the evidence base on the costs of congestion in the region.

## STRATEGIC MODELLING

7.2 The three cities[26] and three counties[27] (as 'the 6Cs') are currently considering the scope for demand management and congestion charging in the sub-region through the congestion stream of the Transport Innovation Fund (TIF). A key workstream is to develop a strategic model of the Three Cities sub-area, which also incorporates land use responses to transport provision and congestion.

7.3 This study has used various sources of existing data and has also made a number of assumptions and estimates, as described above. It will be important to test the initial conclusions from this project using the improved datasets that become available in the near future from work such as the TIF project.

7.4 In particular, the new transport model, named PTOLEMY[28], should be used to examine the current extent of congestion on the strategic road network and in the urban areas of the Three Cities sub-area. It should then be used to model the onset of congestion in future, with analysis of the future impacts on regional GVA. It is expected that, without intervention, the growth of congestion could exceed growth in productivity, which will result in congestion becoming an increasingly serious problem to the economy of the region.

## PRINCIPAL URBAN AREAS

7.5 It will be important to further analyse the extent and costs of congestion in the five Principal Urban Areas (PUAs) of the region. This study has only been able to provide a snapshot of the issues faced in the five PUAs. It has not considered in detail the locations and severity of congestion and the detailed impacts on the functioning of each urban area.

7.6 The study has used model data provided by each of the Local Authorities and has not checked the operation of each model in detail. It is recommended that each of the Local Authorities should review the resultant calculations of congestion and its costs.

7.7 This review process could take place at two levels:

[26] Nottingham, Leicester, Derby
[27] Nottinghamshire, Leicestershire, Derbyshire
[28] The PTOLEMY model is a Land Use and Transport Interaction model – its name reflects the main elements of the model: Planning, Transport and Land Use in the East Midlands Economy.

- Firstly through examination of the effects at a more strategic level, using the PTOLEMY model described above (for the three cities of Nottingham, Leicester and Derby); and
- Secondly using the local traffic model for each urban area.

7.8 Future TIF project outputs should also be of real value in terms of providing updated and consistent data.

### IMPROVED MODELLING OF DELAYS EXPERIENCED BY PUBLIC TRANSPORT

7.9 It is recognised that public transport needs to take more of the load in catering for urban transport needs. This desire is articulated in both the Regional Transport Strategy and in the Local Transport Plans across much of the region, particularly in the urban areas. However, buses already cater for heavy volumes of demand in the larger centres of the East Midlands, particularly in Central Leicestershire and Greater Nottingham. Buses, and their passengers, therefore experience congestion in the urban areas, and it is important that it is quantified.

7.10 In developing estimates of congestion delays (and costs) for bus passengers, this study has had to make a number of assumptions and estimates. However, given the significance of bus travel in the larger urban areas, the resulting delay costs should be further refined.

7.11 In particular, very broad estimates were made of the number of people travelling by bus in the urban areas. Observed bus passenger data should be used to refine these estimates. In addition, it was assumed that buses would experience congestion in the same way as other general traffic. However, extensive bus priority has already been introduced in many urban areas and buses do not, therefore, experience the same delays as other traffic. Further more detailed analyses of bus delays should therefore be undertaken.

### ADDRESSING THE EVIDENCE GAP FOR THE SUB-REGIONAL CENTRES

7.12 The brief for this study was to make the best possible use of existing data in quantifying the extent and costs of congestion in the East Midlands, and new data was not therefore collected as part of the work. It was therefore necessary to make informed estimates in those cases for which data was not available.

7.13 In a number of major urban centres within the region, for example Chesterfield, there was a complete lack of quantitative evidence about congestion. It was therefore necessary to use the data collated for other centres in the region to make informed estimates about the potential scale of the problem in those places for which data was missing.

7.14 The resultant “bottom-up” calculation of the total cost of congestion in the region’s smaller urban centres was then compared to estimates prepared for the Eddington review, and very large differences in the costs of congestion were identified. The extent and costs of congestion in the East Midlands’ sub-regional centres and smaller towns is therefore highly uncertain, and further work is required to develop the evidence base.

7.15 In particular, it is recommended that evidence is collated for the larger towns for which evidence is not currently available, for example Chesterfield. In this case, given that tackling congestion has been highlighted as a potential issue in supporting regeneration activity, it is considered important that the problems are quantified and more specific evidence is collated on the problem.

### CALCULATION OF VEHICLE OPERATING COSTS

7.16 This study has also not been able to calculate the additional vehicle operating costs due to congestion. This is because operating costs are highly sensitive to traffic speeds and the coarse nature of the assessment has not provided the sensitivity necessary to calculate the operating costs with and without congestion on the network.

7.17 However, the TIF modelling stream planned for the Three Cities sub-area will provide the ideal tool for the analysis of the impact of congestion on operating costs across a large part of the region. The modelling tool should readily provide the mechanisms for the calculation of additional operating costs through the comparison of vehicle speeds, on each link of the network, with and without congestion.

### RELIABILITY IMPACTS

7.18 Likewise, this study has not been able to quantify the impacts of congestion on the reliability of journeys. Transport appraisal has conventionally assumed, for each link, a fixed relationship between traffic flow and speed, with progressively slower traffic as vehicle flows increase. However, recent research has shown that the reliability of journeys becomes progressively worse as the capacity of a road is reached. This means that journey times become more variable, which itself would be likely to have economic impacts.

7.19 For the purposes of this study, “average” congested journey speeds have been assumed. Whilst these do not take into account the variability of journey times, it is reasonable to assume that some journeys would be quicker and some would be slower than the average. The delays calculated in this project are a fair reflection of the “average” journey times that are encountered with congestion on the network.

7.20 The key issue that has not been addressed is how the variability of journey times impacts on the economy. In direct terms, the variability in the delay cost can be quantified with relative ease. Guidance from the Department for Transport suggests that the variability of journey times can be quantified in a similar way to average delay. If journey time variability is valued identically to delay, the average of variable journey times is equal to the average delay. The calculations undertaken in this project are therefore robust.

7.21 However, it is recognised that journey time variability is perceived differently by different road users, and it is likely that this leads to further economic impacts, in particular, through people making additional scheduling allowance. For example, the logistics industry does not use average journey times as the basis for making deliveries: it must instead use a “worse than average” time. The industry therefore requires low variability in journey times. Indeed, by reducing the spread of journey

times on a route, for example by better managing incidents, it could be argued that businesses could reduce their scheduling allowances.

7.22 This study has, therefore, not been able to quantify this issue. Whilst data on the variability of journey times is available for the strategic (trunk) road network, it is not readily available for the urban areas. In addition, there is a very limited research base on the response of industry to variable journey times, in which case structured primary research amongst businesses could be beneficial.

### LAND USE / LOCATIONAL DECISIONS

7.23 This study has not found any evidence that congestion has a serious impact on locational decisions for businesses in the region. However, this is based upon review of secondary evidence from Local Transport Plans, and is not based upon analysis of quantitative data.

7.24 The onset of congestion could cause increasing problems of particular sites becoming unattractive due to traffic problems, and indeed a general dispersal of activity away from the more productive (but more congested) urban areas. The PTOLEMY model is capable of modelling land use responses to congestion, and it is recommended that it is used to explore the impacts of congestion on land use activity within the Three Cities sub-area.

### ENVIRONMENTAL COSTS

7.25 There is a rapidly evolving agenda for the application of monetary values to the environmental impacts of travel. In particular, the onset of climate change is driving the application of carbon costs in terms of $CO_2$ emissions from transport. The continued rise in the demand for travel is resulting in increased $CO_2$ emissions from the transport sector, jeopardising the ability to reach targets for reduced emissions.

7.26 Carbon emissions also increase with congestion. Without action to tackle increased demand for travel (by car), there is the potential for serious future environmental costs. This issue is being separately explored by *emda* through work on the economic impacts of climate change underway at the time of writing.

7.27 Furthermore, it is well understood that idling traffic results in increased emissions of particulates and nitrogen oxides. Whilst the economic impacts are not directly quantified, it is recognised that these detract from the quality of the urban environment and can cause health problems for nearby residents.

### ECONOMIC BENEFITS FROM TACKLING CONGESTION

7.28 As previously highlighted, total journey costs comprise more than just journey time. If new fiscal measures are introduced to influence journey choices, this will affect overall journey costs. More sophisticated modelling will be needed to consider this issue. Within the Three Cities sub-area, the modelling workstream of the TIF package (using the PTOLEMY suite) could explore this issue further.