# 6Cs Congestion Management Study

## Summary Report

April 2008

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Version 1.1
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# 1 INTRODUCTION

1.1 This is the Summary Report for the 6Cs Congestion Management Study. It draws on the overall Project Report for the study and on the range of technical reports and technical notes produced during the course of the study.

1.2 The 6Cs Congestion Management Study was led by a partnership of three city councils and three county councils from the East Midlands, collectively known as the 6Cs, and took place between February 2007 and March 2008. The local authorities who led the study were Leicestershire County Council, Derby City Council, Derbyshire County Council, Leicester City Council, Nottingham City Council and Nottinghamshire County Council. The 6Cs were supported in the study by the Highways Agency, East Midlands Development Agency (emda), the Government Office for the East Midlands and the Department for Transport.

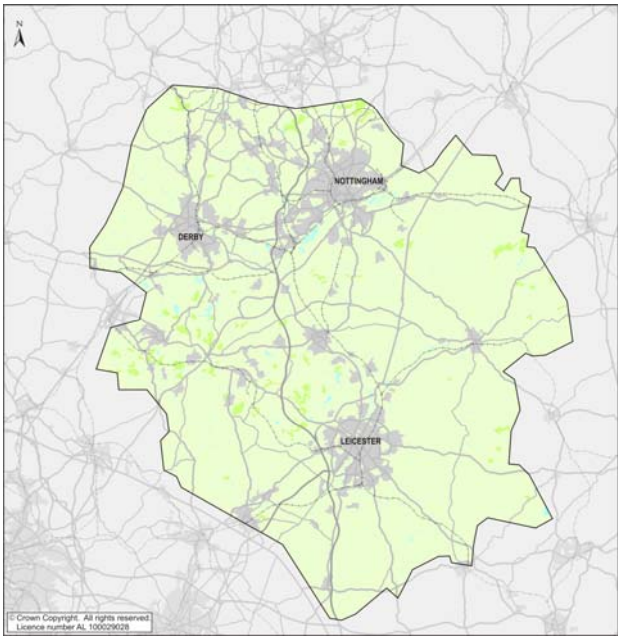
1.3 The overall aims of the study were:

- To investigate the extent and severity of traffic congestion over the next 10 to 20 years and the effects that it may have on the local economy and on local people; and
- To research how, in the medium to long term future, congestion could be managed and reduced across the sub-region.

1.4 The 6Cs study area was the 3 Cities sub-region of the East Midlands (see Figure 1.1). This includes the Derby, Leicester and Nottingham conurbations, together with other congested areas of Leicestershire, South Nottinghamshire and Southern Derbyshire. The primary focus was on the urban road network, although some key inter-urban roads that form important transport links between the urban areas were also considered.

1.5 Much of the initial scheme research and appraisal work within the study was undertaken using transport models working at 2002 values and prices. It should therefore be noted that all financial values quoted in this report are in 2002 prices, except where otherwise stated.

**Figure 1.1 – The study area**



## 2 THE CURRENT SITUATION

### Congestion in the 6Cs area

2.1 Before the start of the Congestion Management Study, the 6Cs local authorities were already well aware from previous local data collection and analysis activities that congestion is a problem in the study area at some times of day and on some important roads. However, it was important within the context of the study that the six local authorities enhanced their evidence-base to obtain a consistent and comparable picture of levels of congestion across the study area. This would provide an appropriate starting point to inform development and assessment of future options for tackling congestion.

2.2 A major congestion survey was undertaken using surveyors' cars fitted with Global Positioning System (GPS) satellite tracking equipment to enable journey times to be measured on different road sections. Journeys were made using these vehicles in both typical peak and inter peak period traffic and in free flow conditions late at night. Traffic delays due to congestion were then calculated by comparing journey times during different periods of the day with those achieved at night.

2.3 The results of the congestion survey for the morning peak hour (8am to 9am) are shown in Figure 2.1 in terms of delay per mile on each of the routes covered. The survey found that the areas worst affected by congestion are the radial routes running in and out of the three main conurbations of Nottingham, Leicester and Derby and on city ring roads, where delays are at their most severe in the peak periods. This finding was backed up by model-based problem analysis of the current situation. Each conurbation experiences very similar levels of peak hour delay – just over 2 minutes per mile travelled during the morning peak compared with free-flow traffic conditions. The survey also showed that there are congestion problems in a number of other towns in the study area, even if generally rather less severe than in the conurbations.

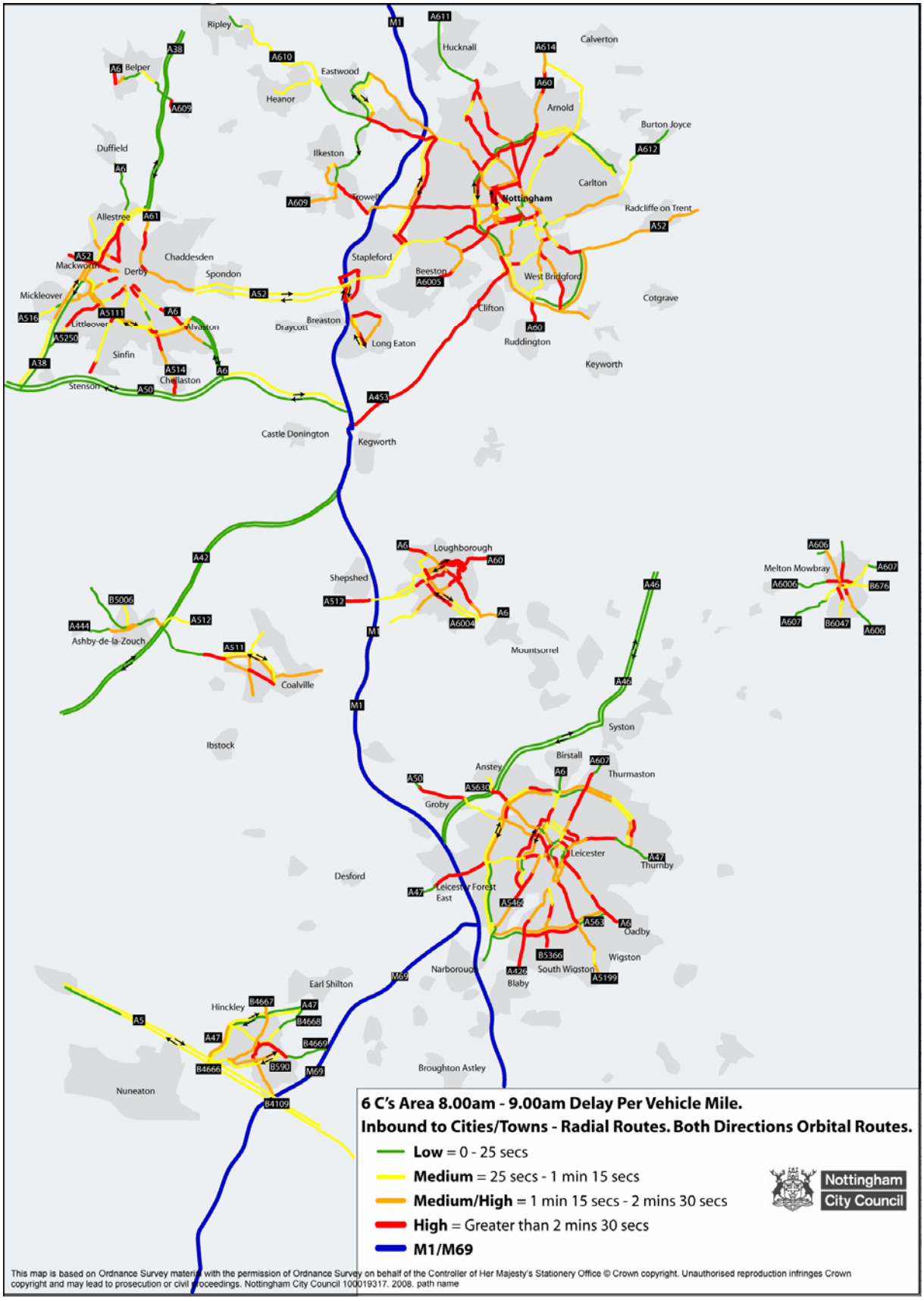
### The economic costs of congestion

2.4 East Midlands Development Agency (emda) commissioned research into the economic costs of congestion across the East Midlands region, which reported in the summer of 2007. This estimated the total economic cost of road traffic congestion to the East Midlands region at £935 million per annum. The 3 Cities sub-region was found to incur easily the highest cost of congestion – over £500m per year. The study found that more than half of the total economic cost of congestion is loaded onto the business community, through delays to business users of the road network and wider economic impacts.

### Initial stakeholder views on congestion issues

2.5 Views of key stakeholder groups on current congestion issues were sought as part of a first wave of engagement events running from May 2007 to January 2008. This included engagement events with business organisations (including the East Midlands Business Forum) and with other non-business stakeholder groups.

**Figure 2.1 Morning peak hour delays per mile as measured by the congestion survey**



2.6 Key stakeholder perceptions of the traffic congestion problem and its impacts expressed through these events were as follows:

- Traffic congestion is widely recognised as a problem in the 6Cs sub-area – at certain times of day and in certain places. It is not perceived as just a city centre problem, because it occurs on the main radials outside city centres and on orbital routes. Congestion is particularly bad where busy radials meet busy orbital routes, but also hinders sub-regional movements and through-traffic.
- The variability of congestion on certain roads in the sub-area, at certain times of day, was identified as a key cause of unreliable journey times and is of particular concern to business stakeholders.
- There was widespread recognition that congestion costs are incurred by businesses. Congestion delays result in increased costs of running freight transport and haulage operations in the region.
- Transport was identified as one of the key considerations for businesses when they locate. Business stakeholders feel there is a need for urban renewal to be supported by high quality public transport systems, in order to provide suitable business locations.
- Congestion causes significant problems for bus operators in delivering punctual and reliable services. If congestion is allowed to increase, it will mean bus operators have to use more resources (drivers, vehicles) to deliver bus services, which will increase costs, which will raise fares, which will make public transport less attractive – a vicious circle.

**Future trends and pressures**

2.7 The amount of road travel within the 6Cs study area is likely to increase significantly over the next 10 to 20 years, without significant intervention. This is partly because of increasing car ownership per head of population (which is forecast by Government to continue throughout the next 20 years), and partly because of plans for increasing economic activity and growth in population in the study area. The transport modelling activities undertaken within the study took account of these plans and confirmed that this will all place significant extra pressure on the transport system.

## 3 THE TRANSPORT MODELLING SYSTEM

3.1 A key part of the 6Cs Congestion Management Study involved testing and investigation of alternative scenarios for future congestion management in the study area. A large part of this testing and investigation was undertaken using a transport modelling system. This modelling system was assembled for the project by making best use of existing models (principally the PTOLEMY strategic model and SATURN models for the Derby, Leicester and Nottingham conurbations, with support from SATEASY and the Derby Demand Model). Enhancements to the existing models were implemented to make them as internally consistent and as “fit for purpose” as possible within the study time and budget constraints.

3.2 While this modelling system was seen by the study team as being adequate for the level of investigation being undertaken by this initial study on congestion management options, it is

recognised that it does not fully meet Department for Transport (DfT) model requirements for more detailed appraisal of options that would be needed as part of preparation of a full business case for any future congestion management strategy. Substantial further model development would therefore be needed if the 6Cs congestion management initiative was taken forward beyond this initial study, in order to ensure that appraisals based on modelling are sufficiently robust to satisfy both Government and local scrutiny.

## 4 ALTERNATIVE FUTURE SCENARIOS

*4.1* Alternative strategy scenarios for congestion management in the future were developed and tested as a major part of the study. These were intended to *"tackle congestion problems throughout the study area in order to provide support for the economic development of Derby, Leicester and Nottingham together with sub-regional centres such as Loughborough and Long Eaton, whilst promoting social inclusion for the whole area.*"

### Development and testing of scenarios

4.2 The study defined and tested three main future scenarios:

- Do Nothing Scenario
- Current Strategy Continuation Scenario
- Innovative Package Scenario

4.3 These were compared with each other within the study for the target appraisal year of 2016 and (for the latter two strategies) for 2026 as a longer term target appraisal year.

### Do Nothing Scenario

4.4 The Do Nothing Scenario was defined as a useful hypothetical baseline with which other scenarios could be compared, although it was recognised that this is an unlikely scenario in the real world. It refers to a scenario in which no further public sector investment is made in the transport system after 2006 other than schemes under construction.

### Current Strategy Continuation Scenario

4.5 The Current Strategy Continuation Scenario comprised a realistic set of additional schemes and measures that are likely to be in place by 2016 given present understanding of problems to be addressed and funding constraints. This can be viewed as the 'most likely' scenario at present. The schemes and measures included in this scenario were defined by officers from the six local authorities and the Highways Agency, working in conjunction with the scenario testing consultant team. They included:

- Highway improvement schemes
- Car park facilities
- Bus priority measures
- Bus infrastructure schemes
- Bus quality measures
- Park & Ride facilities
- Tram network extensions (Greater Nottingham – NET Phase 2)

- Rail improvements
- Workplace Parking Levy scheme (Nottingham)

**Innovative Package Scenario**

4.6 The Innovative Package Scenario was developed as an example of a combination of some form of congestion charging scheme with a range of other complementary transport measures. This is the sort of package that could potentially be eligible for significant financial support from DfT's Transport Innovation Fund, if it was found to be appropriate as a solution to the sub-region's congestion problems and a robust business case could be made. Development of the Innovative Package Scenario involved initial testing of a wide range of possible charging scheme options for the study area, sifting and refinement of those options, and combination of a promising option with a package of other measures that would complement and reinforce the charging scheme in achieving congestion reduction and other objectives.

*Charging scheme option investigation*

Time-distance-place charging

4.7 One of the first charging options to be tested within the study was time-distance-place (TDP) charging covering the entire study area. TDP charging essentially charges the road user according to the time of travel, the distance travelled on a particular road link and the place of travel. Charging according to distance travelled generally requires an onboard unit with a vehicle positioning capability (e.g. through the Global Positioning System (GPS)).

4.8 However, TDP charging is considered unlikely to be feasible as a main basis for congestion charging in the 6Cs study area by 2016. There are significant barriers to be overcome, including technological and enforcement issues, cost issues and legal issues associated with mandatory use of the technology required. There is also no existing TDP scheme experience in an urban context anywhere in the world, and reliable cost estimates could not be made for input to economic appraisal.

4.9 Testing of TDP was therefore limited to a theoretical option, with optimal charges for each network link in each modelled time period calculated using a model-based approach to estimation of optimum "Marginal Social Cost" prices for each road link. Such a scenario is not fully realistic for a number of reasons – including the consideration that road users would probably find the resulting large number of different charge levels for different roads difficult to understand.

4.10 The modelled traffic and travel impacts of this TDP charging option showed substantial reductions in traffic levels and transport economic benefits of around £200 million per year (before deduction of scheme costs) in 2016. However, TDP charging was not taken forward into the Innovative Package Scenario for further investigation because (as outlined above) it is considered unlikely to be feasible as a main basis for congestion charging by the year 2016 (although it could form one of a number of options within a feasible charging scheme).

Cordon based charging options

4.11 The major part of congestion charging option development and testing focussed on cordon based charging options for the three major city conurbations – Derby, Leicester and Nottingham. This included a number of single and double cordon arrangements in each conurbation, in which a charge would be levied each time a vehicle crossed a charging site on a cordon around a defined area.

4.12 A number of cordon charging options were initially developed and appraised using the SATEASY element of the modelling system. A limited sub-set of the options thus developed were then tested using the PTOLEMY model. Some further investigation of effects was also undertaken using the more comprehensive Derby Demand Model. A cordon charging scheme cost model was developed and applied to provide input to cordon charging scheme appraisal.

4.13 For reasons of available time and budget, a number of constraining assumptions were applied in developing and testing cordon charging scheme options. These were:

- A maximum of two cordons per conurbation;
- Peak period charging only; and
- Single direction charging only:
  - Morning peak (07.00 – 10.00) inbound charging; and
  - Afternoon peak (16.00 – 19.00) outbound charging.

4.14 The results from the initial SATEASY testing and use of the cordon charging cost model suggested that the economic case for cordon charging on its own was not strong with any of the cordons tested. Following completion of the initial SATEASY-based testing, two cordon charging tests were carried out using the full PTOLEMY core model for the morning peak period (and afternoon peak for Test 1 only). These were as follows:

1. Test of the best performing single cordons from the initial SATEASY testing for each of the three conurbations.
2. Test of urban fringe cordons in Derby and Nottingham, with a Leicester cordon as per test 1.

4.15 The charges applied to each crossing of the cordons (inbound in the morning peak and outbound in the afternoon peak) were each of the order of £2. The exact values used in the tests were selected on the basis of economic modelling for the particular cordon locations – it should be noted, however, that these charges would need to be revisited, refined as appropriate and balanced between the three city conurbations should the 6Cs Congestion Management initiative be taken forward into a more detailed investigation and business case preparation phase.

4.16 Appraisals were carried out to predict the impacts of the scheme options, with benefits (primarily time savings and vehicle operating cost savings) converted into monetary values for comparison with estimated scheme costs. The results of this process for the congestion charging scheme options on their own showed an annual benefit of £19.2 million for the morning peak period for Test 1, and £16.7 million for the afternoon peak. The urban fringe cordon option (Test 2) gave an annual benefit of £19.9 million for the morning peak period.

This compares with an estimated annualised cost for setting-up and operating the charging scheme under the Test 1 option (the Test 2 option cost was assumed to be similar) of £34.4 million.

4.17 Total scheme revenue (before deduction of operating costs) was calculated to be £161 million for the Test 1 option. Deducting the annualised scheme cost would leave net annual revenue of around £127m in 2016. Because the urban fringe cordon option (Test 2) was only modelled for the morning peak, an equivalent net revenue figure was not calculated – however, it would be likely to be of the same order of magnitude.

4.18 From these results it can be seen that the performance of the two cordon charging schemes fully tested using the PTOLEMY model would appear very similar in terms of impacts, transport economic benefits and revenue generation. The charging scheme option taken forward to form part of the Innovative Package Scenario was the scenario tested under Test 1 with the PTOLEMY core model. It should be noted that this option is not viewed as an optimal cordon charging scheme at this stage – merely one of the more promising of the options tested to date for addressing congestion.

Workplace parking levy

4.19 A workplace parking levy (WPL) was given some consideration as an alternative to congestion charging through extrapolation of financial and other key considerations from the existing Nottingham WPL scheme appraisal to Derby and Leicester.

4.20 Appraisal of WPL in Nottingham showed the following characteristics, which could also be expected in the other two cities for a similarly specified WPL scheme:

- A relatively low direct impact on congestion;
- Encouragement of employers to participate in 'Smarter Choices' type activities, particularly workplace travel plans; and
- Generation of modest funds (£24m between the three cities) for an investment package of alternatives to car travel that is expected to have an impact in reducing congestion.

*Complementary measures*

4.21 An example package of complementary measures was defined and tested that would reinforce the effects of the charging scheme and provide travel alternatives to the private car in particular. Complementary measures should also help mitigate any undesirable impacts of a charging scheme. The measures included within the Innovative Package Scenario for testing comprised three main sets:

- Core measures – These are primarily concerned with significantly improving public transport alternatives to the private car. The "core measures" examined included Bus Rapid Transit in Derby, extension of the tram network (NET Phase 3) in Nottingham and a possible city centre "personal rapid transit" scheme in Leicester. These would be complemented by bus priority measures, bus service frequency increases, bus quality measures, improved public transport stops and interchanges, highway improvements, new Park and Ride facilities and smartcard ticketing to facilitate bus use.

- Public transport fare reduction – The set of complementary measures tested included a 30% reduction in peak period bus, tram and Park & Ride fares, on the assumption that such reductions could be implemented under new regulatory arrangements allowed by current legislation.
- Smarter choices – This would involve implementing a high intensity programme of interventions to encourage and enable people to make travel choices other than use of the private car. This would include major increases in investment in areas that have been shown by DfT-sponsored research to be highly cost-effective in inducing changes in travel habits – including, in particular, personal travel planning (PTP), workplace travel plans, and school travel plans.

4.22 These measures would be in addition to those included in the Current Strategy Continuation Scenario. They represent an initial attempt to define a sensible set of complementary measures, but this is an area that would need significant further research and investigation in any future stages of the 6Cs congestion management initiative. Initial appraisal was undertaken of the three sets of measures on their own before they were taken forward into testing and appraisal within the complete Innovative Package Scenario.

## 5 MAIN RESULTS AND CONCLUSIONS

### Traffic and travel impacts

5.1 The Current Strategy Continuation Scenario and the Innovative Package Scenario developed within the study were tested using the core modelling system for three time periods (morning peak, inter-peak and afternoon peak) for the year 2016. The Innovative Package Scenario was also tested for the morning peak period for the later year of 2026, to provide a benchmark of how benefits from the package change with the rise in levels of congestion anticipated between 2016 and 2026. The Leicester personal rapid transit possibility was excluded from the modelling and appraisal work on the Innovative Package Scenario, as the concept required a level of development before it could be modelled that was not possible within the study timeframe.

5.2 The conclusions reached by the study team from the transport modelling investigations of the alternative scenarios are:

- Under the Current Strategy Continuation Scenario, in 2016 delays due to traffic congestion are likely to be significantly worse in the Derby, Leicester and Nottingham conurbations than at present. This would impose further economic costs on the area and may hinder the economic growth, regeneration and housing plans for the area.
- The Innovative Package Scenario would give significantly better congestion reduction results in 2016 than the Current Strategy Continuation Scenario. Under the Innovative Package Scenario, the transport modelling results predict that car-kilometres travelled in the three conurbations in the morning peak period would be 16-20% lower than under the Current Strategy Continuation Scenario. A similar impact is predicted for the afternoon peak period, with a smaller effect in the inter-peak period. A significant number of roads within the conurbations would see average speed increases of between 10 and 20%.

- The reduction in congestion and improvement in journey speeds would result from the effectiveness of the Innovative Package Scenario in encouraging people to use non-car modes in peak times. The initial modelling results predict that the number of morning peak bus trips would be 70% higher under the Innovative Package Scenario than under the Current Strategy Continuation Scenario., the number of tram trips (in Nottingham) would be 67% higher, the number of park-and-ride trips would be 172% higher, the number of train trips would be 7-8% higher, and the number of cycling or walking trips would be 7-8% higher.
- The results of morning peak period testing for 2026 showed similar patterns of results but with slightly greater magnitude impacts, as projected untreated congestion levels in 2026 would be worse.

**Transport economic appraisal**

5.3 Economic appraisal was undertaken targeted on the possible first year of implementation of the full package – 2016. The economic appraisal results showed total annual benefits (principally from journey time savings and vehicle operating cost savings) of implementing the Innovative Package Scenario (rather than the Current Strategy Continuation Scenario) worth £106 million for the morning peak period, £115 million for the inter-peak and £80 million for the afternoon peak period in 2016. This gave a total annual benefit of £301 million in 2016. For 2026, in terms of economic performance there was calculated to be a significant but not huge benefit increase over the 2016 position, with net annual morning peak benefits of £118m rather than £106m.

5.4 The annual costs of implementing and operating the Innovative Package Scenario (above those of the Current Strategy Continuation Scenario) in 2016 were also estimated for comparison. For this exercise, the capital costs associated with implementing the core complementary measures were converted into an annual debt repayment sum. The estimated costs are shown below[1].

| | |
|---|---|
| Core complementary Measures capital repayment costs | £100m pa |
| Core complementary measures operating costs | £16.5m pa |
| Smarter Choices costs | £19.2m pa |
| Charging scheme annualised capital and operating costs | £34.4m pa |
| Total annual costs | £170.1m |

5.5 Comparing the calculated benefits with the estimated costs gives a benefit / cost ratio of around 1.8 for 2016.

**Financial analysis**

5.6 Gross revenue (before deduction of operating costs) from the congestion charging scheme element of the Innovative Package was estimated to be approximately £139m per year in 2016. This would be put towards meeting the costs shown above. As can be seen, Government funding (from TIF in particular) would also be needed to support the overall package. The magnitude of the initial revenue and cost estimates and the funds potentially

[1] The cost of fare reduction intervention is more than offset by increased fare revenue, so this is not included.

available from TIF are such that the study team concluded that the Innovative Package Scenario could be financially viable.

**Wider economic and business impacts of alternative future scenarios**

5.7 This study did not explicitly assess the potential wider economic impacts in the sub-region of alternative future scenarios, which would depend on the balance between any cost increases resulting from the charging scheme element and the potential economic benefits arising from reduced congestion and better accessibility resulting from the package as a whole. However, some initial indications of possible positive business impacts were drawn from the modelling activities and a small number of business impact case studies funded by emda will also shortly report their findings. This is, though, an area that would need further detailed consideration in any further work that the 6Cs may decide to undertake on the congestion management initiative.

**Potential social impacts**

5.8 The 6Cs Congestion Management Study started to explore the potential social impacts of future congestion management scenarios. These primarily concern changes in accessibility and changes in how external impacts of traffic (such as air and noise pollution, accident risk etc) bear on different community sectors.

5.9 Nine focus groups were undertaken with people from potentially vulnerable sectors of society (particularly various low income groups) across the sub-region. These suggested that the Innovative Package Scenario could have a broadly positive social impact for many vulnerable members of society – although initial views of many participants were opposed to congestion charging in principle. Many low income households do not have access to a car and are reliant on public transport, cycling and walking – facilities for which could all be significantly improved under this package. The predictions of increasing congestion under the Current Strategy Continuation scenario were generally viewed as undesirable but unsurprising.

5.10 However, there are some people within the low income sectors of society who are strongly car-reliant – such as some carers, working mothers and residents of remote rural areas. Without measures specifically targeted at helping them, these people could potentially find themselves more socially excluded by a package that includes a congestion charge - though the fact that only a peak period charge is envisaged would provide a large measure of mitigation in this respect. This issue would need to be given specific consideration (alongside broader quantitative analyses of social impacts) in any further work on congestion management in the 6Cs area.

**Overall conclusion**

5.11 The overall conclusion reached from the study is that an Innovative Package including congestion charging and a range of other complementary transport measures could more effectively tackle future congestion and produce better economic net benefits than continuing with the current strategy under the usual public sector funding constraints. The congestion charging element would generate an income stream sufficient (with additional capital funding from the Government's Transport Innovation Fund) to support the complementary transport measures.

5.12 Finally, it is recognised that the Innovative Package Scenario tested within this study is by no means viewed as being the "best of its kind" for the sub-region. Rather, it is seen as representing one possible example of what could be done. The initial nature of the study means that there is a need for significant further investigation, development, refinement and appraisal of alternatives. This would need to be included within a detailed business case investigation before any decision could be reached on whether to move forward towards implementation, and the precise nature of proposals for implementation. Such a detailed business case investigation would require significant further investment of time, effort and funds.