Northampton Town Centre
VISSIM Model Report
Northamptonshire Highways
28 April 2011
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Executive Summary

This report provides a summary of the extensive micro-simulation modelling exercise that has been undertaken on the Northampton town centre highway network. It is the final in a number of reports, and therefore should be read in conjunction with previous work, which have detailed each stage of the modelling process and the associated results. The premise for the VISSIM model has been to provide an insight and an understanding of current congestion problems in Northampton town centre, and the types of solutions which can be offered to increase capacity in the short term, whilst assisting some way to mitigating future traffic growth. The town has aspirations for growth through development and regeneration. The VISSIM model is used as a tool to help plan for the transport related issues that these aspirations could create. Regard has been taken of key documents, namely the Central Area Action Plan, which highlights the aspirations for the layout and operation of the future town centre highway network. It is the purpose of this study to provide information on specifically which areas of the network currently are affected by congestion, those that will be worst affected by traffic growth and to develop solutions which serve regeneration aspirations, whilst providing maximum network capacity. In order to achieve this, a micro-simulation model has been produced representing the performance of Northampton’s current highway network. This has provided a base upon which analysis has been undertaken to develop options related to reducing congestion in the town.

The focus of this report is to summarise the study to date and provide detail on the latest modelling work undertaken, testing the impact of traffic growth on the existing network layout and proposed options. The key conclusions to draw from the modelling exercise are as follows:

- The current highway network experiences a level of delay not uncommon in comparison to many town centres across the country. Modelling indicates in morning peak periods vehicles spend approximately 54% of their trip duration in delay, where actual speed is below desired speed. This figure increases to 94% in the PM peak period as a result of congestion in the network.

- An exercise in analysing traffic patterns reveals that the network currently accommodates high volumes of traffic; approximately 37500 in the AM modelled period (07:30 – 09:30) and 50000 in the PM modelled period (16:30 – 18:30). The base models revealed some specific areas of concern. The key congestion hotspots have previously been subject to more detailed investigation of their operational capacity.

- As a consequence of this analysis, options have been primarily designed along two key principles. One is to provide a new route for the ring road which does not intersect the town centre, allowing regeneration and utilising roads which currently don’t experience such high traffic density. Secondly and closely linked is to provide options to reduce delay and increase capacity in the peak periods. This process has aimed to produce feasible options, largely accommodated within existing highway constraints, whilst supporting wider regeneration and public realm aspirations within the town.

- The areas of the network subject to option development and testing are as follows:
  - Abington Square including Upper and Lower Mounts
- Horsemarket including Broad Street and Regents Square
- The Plough Gyratory
- Victoria Promenade and Cheyne Walk
- Bedford Road and Cliftonville Road

These options were tested individually, where the remaining Northampton highway network remains unchanged, as well as all together as a single network model, to provide a view of the capacity and look of the proposed future highway network.

With current flows these options showed improvement in capacity, and reductions in delay, across both the network as a whole and the individual junctions which the options were developed to benefit.

The aspiration was to use traffic flows from the Northamptonshire Strategic Transport Model (NSTM) for the future year testing of the options. However after extensive analysis and iterative modelling process, the flows contained in the NSTM could not be accommodated in the VISSIM model. This may in part be a result of the development in the NSTM being coarsely loaded, causing changes to the distribution of traffic through the model, but in large part due to the scale of traffic growth forecast and as a result of the NSTM not including development related traffic mitigation.

As a consequence of these issues and through consultation with Northamptonshire County Council it was agreed to use TEMPRO growth rates to test the capacity of the existing network and proposed options.

A stable VISSIM model was reached in the AM peak with matrices scaled up by 17%; TEMPRO estimates this level to an approximate future year of 2021. At this point the AM models on average experience around 15% additional delay, when compared to output from current year flows. The modelling has demonstrated that this level of growth is where the network reaches capacity.

The performance of the option models is encouraging with the majority showing a reduction in delay across the network compared to the existing network. At specific junctions the options show an increase in traffic volume and decrease in delay, demonstrating that they provide additional capacity and a more efficient operation.

With existing traffic patterns there is little capacity for growth in the PM peak. It is a model which already contains over 30% more traffic than the AM peak. An iterative exercise of scaling back TEMPRO growth rates was undertaken on both peak periods with the PM peak only accommodating around 5% growth. This is the point at which the network reaches capacity, the result being models which are difficult to produce stable levels of growth which work consistently. The results show varying increases in delay across the models, highlighting the difficulty of using fixed growth factors which cannot alter the distribution of traffic within the origin-destination matrix unlike the NSTM.

The results clearly demonstrate that the option to extend the ring road is a viable one; in addition a number of the regeneration and CAAP aspirations for the transport network can be accommodated within the design options.

Following the comprehensive modelling exercise and after reviewing the operation of the network across a wide range of scenarios the following recommendations are provided to inform decisions regarding the future use of the VISSIM model:

- The methodology employed for this study has meant a great deal of work on existing junctions in the network, attempting to gain the maximum capacity possible to accommodate traffic growth. The results outlined in this report
demonstrate that there is additional capacity available within the existing highway network. The recommendation is that support is given to the maintenance, continuous evaluation and upgrade of the traffic signal operation across the network.

- With the data available, the VISSIM model provides an indication of the likely impact of future year development traffic on the Northampton network. Areas of the network which will suffer most from this growth have been highlighted and analysed as well as a network wide capacity test demonstrating the likely growth that can be accommodated. However the data has highlighted that it is imperative the VISSIM model is kept up to data and in line with the NSTM. Further refinement of the strategic model, currently underway, will improve the forecast distribution of traffic through Northampton. The refinement and inclusion of further mitigation measures, associated with new development, will be key in ensuring an accurate picture of the performance of the network in the future is achieved, particularly at peak times (as the strategic model has the ability to re-assign traffic strategically).

- The option modelling exercise has revealed that in concept the designs provide an improvement in capacity at key locations in the network, with the additional benefit of reducing delay in the AM peak. The PM peak is less conclusive due to the degree of saturation at which the network already operates. However the recommendation should not be to disregard any of the options developed in this study, but to continue to develop them ensuring they provide the maximum available benefit.

- The VISSIM model should be viewed as a powerful tool upon which the microscopic impact of developments can be tested. It is a robust tool which will accurately demonstrate the ‘knock on’ impacts of junction mitigation upon the wider network. This is particularly relevant in Northampton where specific developments are likely to impact on traffic circulation around the town centre. Therefore it needs to become an integral part of the development planning process, testing proposed solutions which allow Northampton to overcome its transport challenges in delivering the aspirations for large scale regeneration and development.
1 Introduction

1.1 BACKGROUND

1.1.1 MGWSP were appointed by Northamptonshire County Council in March 2010 to construct a micro-simulation VISSIM model of Northampton Town Centre. The purpose of the model is to support regeneration and development work in Northampton, by highlighting those junctions that may require mitigation in order to unlock further capacity within the highway network.

1.1.2 A validated model has been produced which is representative of the traffic conditions experienced in Northampton. A Local Model Validation Report (LMVR) was submitted in April 2010 which explained the reliability of the model, providing a basis upon which data relating to the performance of the network could be obtained. Following this, work moved forward focussing upon the congestion hotspots in the network highlighted in the VISSIM model analysis report submitted in July 2010. From the results of this work scheme design and testing was undertaken for solutions aiding traffic flow around the town centre.

1.2 REPORT OBJECTIVES

1.2.1 This report will summarise the methodology and modelling results of the work that has been undertaken to date. In addition this document will report on the performance of the town centre highway network in the future. Focus will be given to the ability for proposals to mitigate the additional traffic growth related to the regeneration and development in and around the town centre.

1.3 REPORT STRUCTURE

- Study approach and forecast modelling– explanation of the context for the VISSIM model and the methodology undertaken to complete the study.
- VISSIM Model Construction – data collected and used, summary of LMVR work, assessment methodology i.e. scenarios
- Design of Options – description of options designed to alleviate congestion in the network, including preliminary modelling results.
- Modeling Results – performance of the network in with traffic growth including comparison to current year performance.
- Conclusions & Recommendations – key conclusions and recommendations drawn of the modelling exercise and wider study as a whole.
2 Study approach and forecast modelling

2.1 INTRODUCTION

2.1.1 The Northampton Town Centre VISSIM Model has been developed to assist in the planning of transport systems throughout the town centre area as part of Northamptonshire County Council’s Local Transport Plan. In addition the model provides an insight into where highway investment is required, to mitigate current congestion problems and accommodate future development and regeneration. Whilst progressing the study regard has been shown to Northampton Borough Council’s Central Area Action Plan to ensure highway network changes are sympathetic to aspirations for the town centre.

2.1.2 This study has highlighted hotspot areas of the current highway network which experience congestion and delay for traffic. Following this, options have been developed which aim to alleviate congestion in these areas of the network. After preliminary assessment for viability using LINSIG, these options have been input into the VISSIM model for the town centre, where they were tested with current traffic flows to determine the benefit they will bring to junctions currently operating with congestion. Subsequently these options have been tested with future year traffic growth to determine their longevity.

2.2 NORTHAMPTON TOWN CENTRE POLICY

2.2.1 The Central Area Action Plan (CAAP) has been prepared in response to Northampton’s growth agenda. With Northampton being selected by Government as somewhere offering opportunity for further, albeit now scaled down growth, the plan will provide the foundations of how to manage growth in a strategic and sustainable manner. The plan has undergone a formal consultation period, beginning in November 2010, and is currently awaiting adoption. The CAAP forms an element of the Local Development Framework and is prepared within the context of the vision for Northampton set out in the Northampton Sustainable Community Strategy 2008-2011 and the West Northamptonshire Joint Core Strategy. The plan will guide where and how development should take place over the coming years and will be used by the Borough Council when making planning decisions about the town centre.

2.2.2 The future growth of Northampton provides an exciting opportunity to plan the Central Area in a way that ensures any growth supports and enhances the needs of people, both today and in the future. The Central Area Action Plan (CAAP) is the Development Plan which will ensure that development opportunities which arise are built in a way that meets Northampton Borough Council’s (NBC) vision.

2.2.3 CAAP is for the citizens of Northampton who might live in, work in or visit Northampton’s town centre. NBC has reached the final stages of the Action Plan’s development. Before submitting it to Central Government for examination (expected to
be summer 2011) they have published the Pre-Submission Draft Central Area Action Plan.

2.2.4 Following this publication period, NBC will prepare a summary of the main issues raised by the representations. This will help NBC to review the representations and to consider what, if any, changes should be made to the draft Central Area Action Plan. These will then be taken into account by the Planning Inspector at the examination in public which will follow. Following that, the plan can be adopted as the new Development Plan Document for the Central Area.

2.2.5 In writing the Central Area Action Plan, NBC has been talking to and listening to the citizens of Northampton and partner organisations since 2005, to ensure that issues and challenges facing the Central Area are fully understood. They have been gathering views, opinions and ideas on what to change and how. The Action Plan shapes the future of development and change within the Central Area of Northampton up to 2026.

2.2.6 The CAAP sets a clear vision for the Central Area in 2026. It is accompanied by eight strategic objectives which set out how NBC will meet the vision. These relate to:

- Regeneration
- Walking, Cycling and Public Transport
- Design
- Rejuvenation
- Safe Environment
- Housing
- Public Realm
- Sustainability

“By 2026, Northampton City Centre will be firmly established as the economic and cultural centre for Northamptonshire. It will be the destination of choice for people within the County and beyond to live, work and relax. The City Centre will be using its strengths, in particular its architectural heritage, its riverside, a distinctive retail offer and its cultural offer as a key to its success…”

2.2.7 There are clear issues relating to accessibility and movement within the Central Area. Pedestrians and cyclists face fragmented routes, there is congestion at peak times and the bus and train stations are out dated and in need of redevelopment. Car use is not to be excluded but by improving streets and open spaces, to make a safe and pleasant environment, NBC hope that walking, cycling and bus use will become the preferred way for people to get to where they want to be.

2.2.8 The inner ring road policy will enhance the inner ring road; access for cars is still important, but the environment must be improved for pedestrians and cyclists particularly along Victoria Promenade, St Peter’s Way, Horsemarket and Upper and Lower Mounts.
2.2.9 The bus station will be demolished and replaced with a bus interchange facility. This policy outlines the requirements of the new bus interchange, for example, that it should contain toilets, a cafeteria and high quality pedestrian access to the rest of the Central Area.

2.2.10 The disused railway line that exists along the southern boundary of the Central Area could provide a good public transport link into the centre of town. The policy protects it for this purpose should it no longer be needed for railway purposes.

2.2.11 The pedestrian and cycle access policy requires developers to carry out a cycling and walking audit to find out where there are gaps in or improvements needed on the cycling and pedestrian networks. Developers will be asked to make a financial contribution to fill gaps and/or make improvements that link in with their proposed site.

2.2.12 Car parking is critical to the future of the Central Area: to employers, commuters, shoppers and visitors. However the amount of parking needs to be balanced against the protection of the environment and avoidance of congestion by encouraging alternative ways of travelling. This Action Plan does not look to stop car use but it does detail how many car parking spaces are permitted and where.

2.2.13 The Infrastructure Delivery policy will ensure future needs like new open spaces, new schools and better roads are provided. The following organisations are just some of the examples who NBC will be working closely with:

- West Northamptonshire Development Corporation and its successor
- Northamptonshire County Council
- Environment Agency
- Homes and Communities Agency

2.2.14 NBC will also continue to form partnerships with the private sector to deliver developments. NBC are working with Legal & General, to deliver the redevelopment of the Grosvenor Centre and have signed a development agreement for the St John’s site.

2.3 THE USE OF VISSIM

2.3.1 Due to the complex nature of the highway network under consideration, a micro simulation model was needed in order to assess differing junction types within the Northampton network. The benefit of using this type of model is that it enables identification of problems as well as the impact of these across the wider network. The model is stringently calibrated and validated to traffic data, ensuring that it is truly representative of existing traffic conditions on the network. This is then a base point against which to assess potential traffic engineering measures.

2.3.2 In addition to modelling various different types of junction, the program can also analyse other typical traffic operations, such as bus stops / public transport routes, road user behaviour under differing conditions and the effect of various network constraints such as traffic signal control, lane configuration, traffic composition etc.
2.3.3 VISSIM has the benefit of being able to combine detailed traffic modelling with state of the art presentation and 3D visualisation. This is particularly beneficial in places such as Northampton where public realm forms a key part of the traffic engineering solutions being developed. When this capability is employed it enables a unique opportunity to engage and integrate the public and key stakeholders into the decision-making process.

2.4 VISSIM METHODOLOGY

2.4.1 The Local Model Validation Report (LMVR) of April details the methodology of constructing the VISSIM model for Northampton town centre. However a summary is provided in this section in order to give context of the results reported in this document.

2.4.2 Primarily, the link structure, upon which the vehicles travel through the model, was built on scaled OS mapping provided by MGWSP, which included junction layout and lining details. Once the link structure was completed site visits were undertaken to check whether it would allow for traffic to behave in a manner reflecting reality. This meant observing the formation and location of queuing, vehicle speeds and driving behaviour when merging and diverging.

2.4.3 Further detail was then added to the link structure to produce a physical network; including:

- Speed Decisions – enabling changes to vehicle speeds related to speed limits;
- Reduced Speed Areas – short sections of slower vehicle speeds such as on tight bends;
- Conflict Areas – areas where vehicle movements can cause conflict, including physical rules to prioritise movements accordingly;
- Priority Rules – used to determine right of way for vehicle movements at non-signalised junctions;
- Traffic Signals and detectors – define the location of vehicle stop lines and operation of a signalised junction; and
- Bus Stops – identify links that contain bus stops and define their location.

2.4.4 In addition to the physical characteristics noted above, the model also includes elements that reflect road user behaviour. For example, cost coefficients which weight a number of factors affecting the desirability of routes between origins and destinations have been developed. These coefficients have been used to help reflect the behaviour of local drivers, normal commuters, rat running commuters, visitors to the town and HGV’s. In addition they influence route choice but do not affect actual driving behaviour. As a consequence, a number of behaviour types have been introduced which determine the way that vehicles move along links. These alter braking and acceleration profiles, safety distances between vehicles and behaviour during lane changes. The behaviour types have been classified as follows: Urban aggressive drivers, urban passive drivers and two behaviours relating to how buses re-join traffic flow; bus stop/lay-by on link and lay-by on link/overtake on link.

2.4.5 Following the construction of the physical network a demand matrix is formulated which is used as a basis for the traffic volume undertaking origin to
destination trips through the model. The matrix does not specify the routes traffic take through the model; this is done through a process of dynamic assignment where ‘virtual costs’ are attributed to different routes reducing or increasing their appeal.

2.5 NORTHAMPTONSHIRE STRATEGIC TRANSPORT MODEL

2.5.1 As part of the sustainable transport highway services contract for Northamptonshire County Council the MGWSP joint venture was commissioned by NCC to combine and update the two existing strategic transportation models:

- North Northamptonshire Highway Model (SATURN)
- West Northamptonshire Multi-Modal Model (SATURN and EMME/2)

2.5.2 Under this commission the existing models have been combined and updated to produce a countywide strategic transport model. The SATURN (Simulation and Assignment of Traffic in Urban Road Networks) suite of programs was used to build the observed highway model while EMME/2 has been used to build the Demand Model and the Public Transport Model. The strategic model developed by WSP offers an integrated system for a range of transport modes, representing private and public transport as well as modal interchange behaviour such as walking. The model will have the ability to quantify the benefits of a policy change or new transport infrastructure in Northamptonshire, enabling the testing of future transport proposals and developments (including developer led) in an efficient, consistent and evidentially based manner.

2.5.3 The model specification was developed in accordance with current Department for Transport guidelines detailed in the Web based Transport Analysis Guidance (Web TAG), which is aimed at ensuring a consistent and reputable basis for forecasting. The highway model was developed in line with Design Manual for Roads and Bridges (DMRB) guidance.

2.5.4 This involved a multi-modal data collection exercise with the end result being a fully calibrated and validated Multi-Modal Transport Model of Northamptonshire County and the surrounding areas, hereinafter referred to as the Northamptonshire Strategic Transport Model (NSTM).

2.5.5 The purpose of the NSTM is to inform the assessment of the Local Development Framework (LDF) Core Strategy, and will subsequently be used to assess individual development proposals and highway infrastructure schemes.

2.5.6 The NSTM represents, at the strategic level, the main long-distance transport routes in the entire study area. There is a detailed representation of traffic and public transport service levels.

2.5.7 The NSTM is built on a behavioural basis that determines the travel demand from the underlying characteristics of the transport supply and characteristics of the travellers in the area. Key features of the model are:

- The input of detailed planning / land use assumptions
- The generation of trips by all modes of travel for the different segments of the population
- The choice of mode of travel
- The distribution of the different trip types to the various destinations available
- The choice of routes of travel
- An accurate representation of the observed base year travel patterns
- Realistic representation of the observed base year, congestion and queuing in the AM Peak and PM Peak periods

2.5.8 This list of requirements is a mixture of the features typically found in strategic transport models, focusing primarily on travel demand choices, and the features of a local highway model, representing the local road network in detail incorporating junction delays and queuing.

2.5.9 The NSTM consists of two main models:
- Observed assignment model
- Synthetic or Demand model, incorporating the traditional four stages of trip generation, mode choice, trip distribution and assignment which uses the observed assignment model outputs

2.5.10 Of the two models, the observed model is the more accurate representation of the current (base year) conditions simply because it is based on the best significant volumes of directly observed data. However, the future will bring complex changes to land use and transport infrastructure that will have a significant impact on travel demand. In this case the observed model becomes less reliable if taken forward in its own right. The Demand Model uses the synthetic approach to develop the best estimate of changes in demand over time and as such is the ideal tool for forecasting as it considers so many of the complexities that the observed model cannot, such as destination choice and mode shift between all motorised and slow modes.

2.5.11 In order to develop a realistic model of future traffic conditions it is necessary to include the infrastructure that is likely to be implemented in the future.

2.5.12 One of the principal purposes of the model is to assess the infrastructure required to support the development proposals contained in the adopted Northamptonshire Core Spatial Strategy (CSS). It is therefore important that the Reference Case model highlights the areas of the network that will exhibit congestion and delays (network “stress”) if the forecast changes in land use were to be realised.

2.5.13 As a result of the above, only those elements of the highway or public transport networks that have already been completed since the validated base year of 2008, or projects which were fully committed, were included in the Reference Case networks.

2.5.14 The SATURN assignment program incorporates an option to automatically optimise signal settings. However, optimising signal times network wide while simultaneously achieving stable traffic flows is a complex task, and while SATURN features an algorithm that provides a form of solution, the results are limited, and the SATURN manual advises that this should be used with caution.
2.5.15 As a result, signal timings for the Reference Case models were identical to those used in the base year model. This is considered to be the most robust approach. When assessing the impacts of future schemes, it should be noted that there may be potential savings to be made from localised optimisation of traffic signals.

2.6 FORECAST NORTHAMPTONSHIRE STRATEGIC TRANSPORT MODEL

2.6.1 The NSTM is an absolute model, applied incrementally. This means that a synthetic forecast model is produced based on forecast planning assumptions, which yields a set of forecast matrices. The differences between the forecast and base synthetic matrices are applied to the base observed matrices to generate the final forecast matrices. Consequently, changes in forecast travel demand are dependent on changes in planning data.

2.6.2 Forecast planning data was obtained from the relevant planning authorities for the following developments:

- Completions since 2008
- Outstanding planning permissions, not yet completed
- Known proposed developments, thought to be likely to go ahead, even though planning application may not yet have been submitted

2.6.3 Data was also provided regarding the development sites allocated in the Core Spatial Strategies for the county. Data provided was consistent with the following documents:

- Adopted North Northamptonshire Core Spatial Strategy (June 2008)
- West Northamptonshire Emergent Joint Core Strategy (July 2009)

2.6.4 These documents set out the delivery mechanism by which Northamptonshire County Council will meet its housing and employment targets under the Local Development Framework (LDF).

2.6.5 Housing developments larger than 10 households and all employment and retails sites were identified with appropriate OSGR (Ordinance Survey Grid Reference) co-ordinates and allocated a model zone number using GIS (Geographical Information Systems). Housing developments smaller than 10 households were aggregated by district and distributed according to the existing housing distribution within each district. Some sites, principally the urban extensions contained in the Core Spatial Strategies, were sufficiently large that they were modelled explicitly.

2.6.6 The NSTM demand model generates traffic flows on an aggregated basis for the whole country using the same planning inputs as used for zones within Northamptonshire. To ensure that growth in background traffic is represented in the NSTM, it was necessary to adjust planning inputs for external zones to match forecast expectations.

2.6.7 Because it was not practical to obtain and process planning data from other planning authorities, forecast planning data for zones external to Northamptonshire was taken from the TEMPRO dataset version 6.1.
2.7 INTEGRATING FUTURE YEAR FLOWS INTO THE VISSIM MODEL

2.7.1 The process of combining the SATURN future year matrix into the VISSIM model is complex due to a difference in the level of detailed zone allocation for Northampton town centre. As the NSTM is a county wide model there are a relatively small number of town centre zones which act as origin/destinations for traffic. The VISSIM model conversely includes a large amount of detail of the town centre including 115 zones used as trip origins and destinations.

2.7.2 The first task in the process is to create a difference matrix by subtracting the future year SATURN matrix from the base year SATURN matrix. This provides a matrix highlighting which origin destination trips have growth and those where the number of trips will reduce. Then an exercise is undertaken which matches the SATURN and VISSIM zones together. Often this is not a like for like match due to the discrepancy in the number of zones between the two models. However the exercise is undertaken in a manner which ensures the correct traffic from the future year matrices is applied to the relevant area of the highway network. It is common for up to four VISSIM zones to represent a single SATURN zone. Therefore the growth traffic taken from the difference matrix is divided proportionally across the four VISSIM zones, depending on their trip volume from the base matrices. Once this combination process is complete the original difference matrix has been converted into a VISSIM matrix for all of the 115 zones. At this point a number of checks are completed which ensure that the correct volume of traffic from the future year SATURN model have been converted into the VISSIM matrices.

2.7.3 The VISSIM model is built over a two and a half hour AM and PM time period, allowing the impact of the peak period to be viewed across a wider time frame. Traffic is fed into the model based upon 15 minute matrices, calculated from observed turning counts. As the difference matrix taken from SATURN represents a single peak hour, it is necessary to proportionately distribute it across each 15 minute period, using a ratio from observed traffic data. This process results in individual 15 minute matrices which detail the growth for each origin to destination relation for the 2026 development scenario. The final part of the process is to add the individual 15 minute difference matrices to the original 15 minute base matrices, creating a final future year set of matrices.
3 VISSIM Model Construction

3.1 INTRODUCTION

3.1.1 The validated base model has been constructed for both the AM and PM peak periods. Approximately 75 kilometres of the town’s road network is included in the model. The model extends from the A45 Weedon Road roundabout in the west to the A45 Bedford Road roundabout to the east and from the Kingsthorpe Road just north of the Burleigh Road junction in the north to its southern extent at the junction of London Road and Euston Road. Figure 3.1 below highlights the overall extent of the modelled network.

**Figure 3.1: Overall extent of VISSIM model**

3.2 TRAFFIC DATA

3.2.1 Traffic data has been used to inform all elements of the models' construction. An extensive data collection exercise was undertaken during July 2009 which resulted in the collation of the following data sets:

- 37 Manual Classified Turning Counts;
- 18 Queue Length Counts;
Saturation Flows;
15 Automatic Traffic Counts;
Journey Time Data for five routes across the town centre; and
Car Park Surveys.

Figure 3.2: Data Collection Locations

3.2.2 The data collected has been used to construct the traffic matrices within the model, as well as to form the basis of the validation process.

3.3 BASE MODEL VALIDATION & CALIBRATION

3.3.1 As reported in the Northampton Local Model Validation Report (LMVR) in April 2010, the base model has been calibrated in accordance with current guidelines within the Design Manual for Roads and Bridges (DMRB) Volume 12, Section 2, Chapter 4. Also used was advice within IAN 36-01 ‘The Use and Application of Micro-Simulation Models’.
3.3.2 The purpose of the model calibration is to ensure that the various assignments, such as traffic routing, vehicle speeds and other traffic behaviour are appropriate. The main emphasis of the calibration is to ensure that, during the modelled periods:

- Traffic patterns in the area are modelled accurately
- Key junctions in the area are modelled accurately; and
- Traffic volumes on side roads and alternative routes are modelled accurately.

3.3.3 During calibration the model is continually revised to ensure that the most accurate replications of base year conditions are represented. The process is iterative and includes:

- Checking the coding of the network; i.e. the structure of links, operation of traffic signals and priority junctions etc.
- Ensuring that the assignment procedure is appropriate; and
- Refining and adjustment of the trip matrices; i.e. the origin and destination matrix for all of the zones.

3.3.4 Throughout the calibration process checks were carried out to ensure that the model was working correctly, making comparisons between observed and modelled turning counts and link flows. The traffic data used in the calibration included counts from the available surveyed database. The comparison was made using an average of six ‘random seeds’. These seeds aim to replicate differences in traffic flow profiles from one day to the next by varying the distribution of how traffic is fed into the model from the matrices.
3.3.5 The aim of the iterative calibration process is to gain a representative model; a convergence test supports the calibration process by ensuring that the model has reached an acceptable level of stability. This is determined by two different factors, namely vehicle delay across the network and model route choice. In order for a model to be converged it has to have six model runs where total delay experienced by all vehicles across the network does not vary by more or less than 5%. Likewise the route through the network taken by vehicles, to satisfy their origin to destination trip, should not vary by 10%. Each possible route between an origin and destination zone is assigned a cost, depending on a variety of factors including route length and journey times. During every model run, VISSIM calculates route costs and distributes traffic flows amongst all available paths, storing the information in a cost file. Subsequent runs of the model continue to redistribute traffic amongst available paths until route choice conditions reach the certain degree of stabilisation.

3.4 BASE MODEL VALIDATION – TURNING MOVEMENTS

3.4.1 The full performance validation for the base model is provided in the LMVR (April 2010), however a summary is provided here for context.

3.4.2 The model has been validated against the three main criteria namely turning movements at junctions, queue lengths at junctions and journey times across the network.

3.4.3 For the turning movement validation, turning counts in the model are compared with the survey data. Any differences between modelled and surveyed turning counts are then converted into a GEH statistic, a form of chi squared statistic which seeks to remove relative and absolute errors. This statistic is reported as being fewer than five; between five and 10, or over 10. The DMRB standard for validation is to have 85% of turning movements with a GEH of under five.

Table 3.1: Turning movement validation results

<table>
<thead>
<tr>
<th>Time Period</th>
<th>GEH &lt;5</th>
<th>GEH 5-10</th>
<th>GEH &gt;10</th>
</tr>
</thead>
<tbody>
<tr>
<td>07:30 – 09:30</td>
<td>76%</td>
<td>14%</td>
<td>10%</td>
</tr>
<tr>
<td>16:30 – 18:30</td>
<td>70%</td>
<td>19%</td>
<td>11%</td>
</tr>
</tbody>
</table>

3.4.4 Table 3.1 shows that in the AM peak (07:30 to 09:30) 90% of the turning movements validate with a GEH value of under 10, with 76% of those measures meeting the requirement of a GEH value under 5. This means that of the movements with a GEH value larger than five, 14% are very close to meeting the required criteria.

3.4.5 The PM peak results show a model performance similar to that of the AM peak. For the PM peak (16:30 to 18:30) 89% of movements have a GEH value of under 10, of which 70% of movements achieve the required GEH value of under five.

3.4.6 The DMRB also states a requirement to validate link flows within the model. This validation uses a series of weighted calculations (details can be found in Appendix 4).
to test the modelled flows against surveyed data. In order to be considered as validating, a minimum of 85% of flow counts need to fall within the acceptable range.

3.4.7 In the AM peak model, the link flow validation returned a value of 88% for the network, demonstrating that the volume of traffic within the network falls well within standard criteria. The PM peak model results were not quite as good, but still returned a link flow validation value of 82%; this is acceptable considering the total volume of traffic in the PM network.

3.5 BASE MODEL VALIDATION – JOURNEY TIMES

3.5.1 Journey Time validation does not use the GEH statistic but instead compares the percentage difference between modelled and observed journey times.

3.5.2 During the models’ construction, timing points were added to the network at the same GPS co-ordinates given by the survey company when the journey time surveys were conducted.

3.5.3 The observed journey times (from survey), are an average of six timing runs between the survey points and were recorded during both modelled peak periods.

3.5.4 The modelled data against which the survey data is compared is an average journey time of all vehicles between the timing points set out in the model, which on certain sections can run to hundreds of separate readings.

3.5.5 As a consequence there is an element of potential inaccuracy in comparing surveyed journey times with those from the model, as there can be such a large difference in survey size.

3.5.6 In order to mitigate the impact that the relatively small surveyed sample size may have, the total time for the journey time routes has been used for validation; rather than the individual timing points, helping to counter the problem of using a small sample size. The standard defined in the DMRB is for 85% of the modelled journey times to be within 15% of the observed times.

### Table 3.2: Journey Time Validation Performance

<table>
<thead>
<tr>
<th>Time Period</th>
<th>Within 5%</th>
<th>5% - 15%</th>
<th>15%+</th>
</tr>
</thead>
<tbody>
<tr>
<td>07:30 – 09:30</td>
<td>50%</td>
<td>30%</td>
<td>20%</td>
</tr>
<tr>
<td>16:30 – 18:30</td>
<td>20%</td>
<td>40%</td>
<td>40%</td>
</tr>
</tbody>
</table>

3.5.7 The AM peak shows that 80% of the modelled journey times within the AM peak period are within 15% of the route timings recorded during the surveys, with the majority of these being within 5%.

3.5.8 The PM peak journey time results shown in Table 3.2 below are slightly lower as only 60% of modelled journey times validate to within 15% of the surveyed journey times, with a further 20% only being out by up to 10%. This is considered to be at least
partly due the problems highlighted with using separate sample sizes, and is considered as acceptable considering the results from all other validation tests.

3.6 NETWORK PERFORMANCE – QUEUE LENGTHS

3.6.1 The queue length validation follows the same principles as that undertaken upon the turning movements. The GEH statistic was calculated for queue lengths on each individual arm of each junction within the model.

3.6.2 For the purpose of this analysis the results are grouped into the same categories as the turning movement validation, i.e. under five, between five and 10, and over 10.

3.6.3 At present, there is no agreed national standard definition of a queue (i.e. what is defined as a queue rather than just slow moving traffic). Therefore, for the basis of this model a queue has been counted when the speed of a vehicle falls below eight mph and continues until the speed of the vehicle increases above 10mph. In addition the headway, i.e. bumper to bumper distance, has been set to count anything that falls below eight metres.

3.6.4 Finally, as the surveyed queue lengths were measured in number of vehicles and VISSIM measures queue lengths in metres, the observed queue lengths have been converted into metres.

3.6.5 The general conversion value to metres for a Passenger Car Unit (PCU) is between five and six metres per vehicle. As this measure deals with queuing traffic the lower of these values has been used as it is assumed vehicles queue closer together.

Table 3.3: Journey Time Validation Performance

<table>
<thead>
<tr>
<th>Time Period</th>
<th>GEH &lt;5</th>
<th>GEH 5-10</th>
<th>GEH &gt;10</th>
</tr>
</thead>
<tbody>
<tr>
<td>07:30 – 09:30</td>
<td>87%</td>
<td>11%</td>
<td>2%</td>
</tr>
<tr>
<td>16:30 – 18:30</td>
<td>76%</td>
<td>24%</td>
<td>0%</td>
</tr>
</tbody>
</table>

3.6.6 In the AM peak 98% of modelled queues validate with a GEH value of under 10, with 87% having a GEH value of under five. Only two percent of queue counts resulted in a GEH value of over 10.

3.6.7 The PM peak does not perform quite so well, although 100% of queue counts return with a GEH value of under 10, a smaller 76% have a GEH value of 5 or under. Whilst there is no national standard for the validation of queues and taking into account the number of junctions where queue validation is taken, the results shown demonstrate the model reflects observed queue lengths.

3.7 CONCLUSION

3.7.1 This section has summarised the performance of the base Northampton Town Centre model against observed traffic conditions. Overall, these statistics demonstrate
that the base model (within both peak periods) validates to a level that can be considered acceptable for a model of this size and complexity. All DMRB criteria are either met or are close to being met. The flow, queue and turning movement validation parameters are excellent, with the journey time validation a little less consistent (in part due to variations in sample sizes).

3.7.2 It is acknowledged that a higher validation performance may have been achieved in an individual peak. However, as the aim in modelling is to have a matching physical network for the AM and PM peaks, the process of improving one peak can reduce the performance of the other. This has been the case in the on-going process of calibrating the models.

3.7.3 With the model reaching an acceptable level of validation it is now possible to undertake a process of designing improvements to junctions and testing their effects. The base model will be able to produce a variety of statistics indicating delay experienced by vehicles in the network. This can then be compared to proposed improvement options to ensure that they are viable and provide benefits to the operation of the network.
4 Design of Options

4.1 BACKGROUND

4.1.1 With a validated base model produced work continued focussing on identifying areas of the network where delay is most likely to occur during peak periods. Details of these locations and the performance of the network in the base year (2009) are provided in the Northampton Town Centre VISSIM Phase 2 report (January 2011). The output of this analysis is shown below in Figure 4.1 presenting the locations where average per vehicle delay exceeded 30 seconds.

Figure 4.1: Junction hotspot analysis

4.1.2 Following the analysis of the current traffic situation, attention turned to option testing to reduce the delay experienced on the network during times of congestion. Preliminary work has offered some localised improvements which are based upon aspirations from Northamptonshire County Council to reduce congestion in key areas of the network and more general aspirations in the CAAP.

4.2 STATUS OF THE RING ROAD

4.2.1 It is clear from analysis of the base model that areas of congestion focus on where primary routes intersect the existing ring road. Through consultation with Northamptonshire County Council, with regard to the CAAP and analysis of the base model it was considered viable to pursue the option of re-designating the ring road. This would better serve Northampton to deal with future network pressures imposed by...
large scale development whilst aiming to remove large traffic volumes from the town centre to allow significant regeneration. In addition it is hoped that by extending the ring road motorists will use it more for circulation around the town rather than direct routes through it. This would provide a more balanced traffic volume throughout the network improving junction performance and freeing up capacity for future growth. The proposed re-designated route of the ring road is shown below.

**Figure 4.2: Re-designated ring road**

4.2.2 A key factor of the design process in order to necessitate this change is to ‘downgrade’ the Horsemarket section of the network. This will be discussed in more detail later in this section but the aim was to reduce capacity on the route, meaning only north-south travelling traffic use it, rather than traffic using it as a ring road. Likewise aspirations in the CAAP are to downgrade the areas such as Cheyne Walk, this has been taken into account and options developed which aim to reduce traffic in this section of the network. However in order to reduce capacity on such a major route it has required other elements of the network to be upgraded in order to cope with the increased traffic demand.

4.2.3 The design work has been based on the premise of individual junction improvements which link to provide an overall gain in performance for the network Accordingly, options have been developed with the aspiration for a phased implementation, as part of an upgrade to the network as a whole. Whilst the overarching aim has been to improve junctions which currently restrict traffic flow around the town centre, the designs and subsequent modelling have also sought to accommodate forecasted growth and developments identified in the Central Area Action Plan (CAAP). Where appropriate design work has tried to coincide and deliver the overall aim of the CAAP:
4.2.4 At the time of developing the options it is not clear what proposals for the expansion of the Grosvenor Centre and regeneration of the Bus Station are. The designs that have been produced can accommodate a variety of options for the area around Greyfriars but the specifics of these developments have not been included.

4.3 LINKING WITH THE CAAP

4.3.1 There are certain areas of the town centre where the car dominates over other road users, such as pedestrians and cyclists. An area of the town centre where this is particularly obvious is along Horsemarket and outside the Bus Station on Greyfriars and Lady’s Lane. Through discussions with Northamptonshire County Council, and whilst having regard to the CAAP, designs have been developed which look to move the existing inner ring road further out. This will then remove the ‘concrete collar’ which is preventing the extension of the retail areas of the town centre and forms a physical barrier to pedestrians accessing the central retail area. This will particularly benefit pedestrians wishing to access areas such as the Drapery and Market Square, from Spring Boroughs and other developments on the western side of the central area. Pedestrian movements have also been considered and prioritised around St Johns and the Plough Hotel gyratory in the proposed designs. This is to accommodate potential regeneration of the St Johns area including new office space as well as providing a pedestrian friendly link between the central shopping area and new developments at the Waterside. Likewise proposed changes to the Victoria Promenade/Cheyne Walk junction seek to maximise vehicular throughput whilst providing a better pedestrian link to Beckett’s Park from the central area.

4.3.2 Changes to the highway network can aid a great deal in creating a more sustainable town and one which promotes design excellence. The process that has been undertaken has looked wherever possible to improving the public realm, creating open spaces and re-addressing the balance between space for vehicles and space for pedestrians. The CAAP mentions the importance of ‘gateway features’ identifying to road users that they are entering the town centre. Within in the design process regard has been given to certain ‘gateway junctions’ such as Regents Square, Abington Square and the Plough Gyratory, ensuring that space is available to accommodate such public realm features. In certain instances this can cause an element of tension, trying to ensure that the maximum capacity is gained from the network for vehicular traffic, whilst ensuring that in the future changes to the highway will not create barriers for pedestrians and cyclists. Another element of public realm and pedestrian safety that has been considered is the removal of existing subways particularly around the Greyfriars and Lady’s Lane area of the town. This is an aspiration identified in the CAAP and the designs have attempted to adhere to this where possible.

4.3.3 Northampton has aspirations to improve its retail offering, with major developments in the town centre aiming to attract anchor high street retail chains. However the CAAP also recognises the importance of secondary retail areas and the link between these and the primary shopping streets around the Grosvenor Centre. In parallel with improving pedestrian access to and from the town centre, designs around Abington Square look to re-allocate road space to enable the retail offering along Abington Street to extend beyond the existing limits of Lower Mounts. Whilst this area
provides an important through route for traffic, there is a lot to be done in the proposals to re-direct traffic and make better use of St. Michaels Street to create a viable option for upgrading Abington Square's retail offering and environment for pedestrians, cyclists and public transport users.

4.3.4 The highway improvements will be a critical element in the economic development of Northampton towards 2026. This report will look at the impact of traffic and development growth on both the existing highway network and the proposed changes in the future. The vision for Northampton in 2026 is one of quality retail offerings, arts and cultural areas with new leisure and employment developments. In order for this to be achievable an improved transport infrastructure is required to enable people to easily access these services.

4.4 REGENTS SQUARE

4.4.1 The Regent Square option has been developed in-line with the principle of downgrading Horsemarket. The premise has been to design a junction which operates to the maximum capacity within the available carriageway space, therefore it does not require additional land take. Compared with the existing junction layout the proposal aims to accommodate the heavier east–west movements caused by the Horsemarket downgrade and subsequent redistribution of traffic. The southbound approach has a redistribution of traffic lanes with a right turn lane and a right turn with an ahead lane, catering for a larger right turn movement towards Grafton Street.

4.4.2 Significant changes have been made to the traffic signal timings at the junction in the model to reflect the changes in traffic distribution. Therefore the heavier east-west traffic movement is accommodated in the signal timings by reducing the green time given to the smaller north-south movement.

4.4.3 Other important changes are the upgrade of pedestrian facilities including an additional signal crossing on the northern (Barrack Road) arm of the junction. Due to rationalisation of vehicle lanes on this arm further space has been created for pedestrians, meaning refuge widths have increased to required standards. The carriageway on the Broad Street/Horsemarket approach to the junction has been narrowed to single lane north and south bound with an additional bus lane on the northbound approach only. This is to lessen the visual impact Broad Street/Horsemarket has on the area as well as continuing the scheme designed for the Lady’s Lane/Greyfriars area.

4.4.4 The option also shows a signalised junction towards Campbell Square at its junction with Church Lane. This has been developed to accommodate future development of the Grosvenor Centre site as a concept of possible access arrangements. As it is such a preliminary concept it has not been included in the modelling exercise.
1. Re-designated traffic lanes to accommodate increased right turn traffic caused as a consequence of 'downgrading' Horsemarket.

2. Additional signalised pedestrian crossing replacing existing uncontrolled crossing on northern arm. All pedestrian refuges upgraded in width to meet current design standards.

3. Reduced carriageway on southern arm of Regent Square provides potential to accommodate gateway feature or public art attraction as an opening to central area.

4. The design reduces traffic flow along Horsemarket which caters for aspirations in CAAP to create a 'Gateway' at Regents Square enhancing the vista of historic buildings along Sheep St.

5. Horsemarket carriageway reduced to single lane southbound and single lane with Bus Lane northbound. This is to soften the visual impact that the current dual carriageway has on the central area. The reduced carriageway space discourages all but north-south vehicular movements.

6. Increased east-west traffic caused by downgrading Horsemarket is accommodated in traffic signal timings due to smaller north-south traffic volumes.

7. Signalised junction added as a concept for access to future town centre developments such as the Grosvenor Centre. Due to its preliminary concept status the design has not been included in the modelling.
4.5 HORSEMARKET / LADYS LANE / GREYFRIARS

4.5.1 The option for the Horsemarket area, shown overleaf, was borne out of the aspiration to downgrade this section of the network as previously explained. Therefore the concept has been to develop a ‘boulevard’ type feel to the area with wide footways on each side of the road and a wide central refuge between north and southbound carriageways. This re-designation of road space would aim to address the current imbalance between highway space and open public space giving more room to pedestrians and cyclists.

4.5.2 There is a single lane north and southbound for all traffic with the addition of bus lanes along this section. This physical narrowing of the route also includes a reduced speed limit to 20mph to further decrease the attractiveness of Horsemarket for traffic circulating the town centre. It was decided to include bus lanes along this section of Horsemarket due to the number of route and frequency of services to and from the bus station. The bus lanes should bring an improvement to journey times in this area and provide more reliable traffic conditions from which to timetable.

4.5.3 The junctions of Ladys Lane and Greyfriars with Horsemarket have some minor re-alignment in order to tie in with the single traffic lanes associated with the downgrading of the area. In addition the junctions have been designed to accommodate pedestrian movements, which could facilitate the removal of current pedestrian subways. All vehicular movements are still permitted and the designs have been developed within the existing highway boundary to eliminate any land acquisition.

4.5.4 Horsemarket remains a key access corridor to the town centre and future development sites around Market Square, The Drapery and the redevelopment of the Grosvenor Centre. These developments will have a large bearing on the road layout in the vicinity of Greyfriars and Ladys Lane. Therefore whilst the option shown overleaf incorporates changes to the highway network in this location, it has not been included in the modelling exercise due to the uncertainty regarding the timescales and extent of the developments. In general terms the option gives access to the Grosvenor Centre and the bus station but is provided as a conceptual design.
Currently, Horsemarket forms the existing inner ring road and creates a barrier to pedestrian access. It possesses a disproportional amount of highway space compared to open public space.

1. The design option aspires to downgrade the Horsemarket corridor by reducing traffic flow to a single lane. This is designed to discourage circulating ring road traffic from using the town centre.

2. By reducing the carriageway space along the corridor, additional space is created for other road users such as pedestrians and cyclists who benefit from increased footway widths and a boulevard public realm identity to the area. Areas of widened footway and central refuge can benefit from planting to soften the impact of the highway.

3. Bus lanes have been included to improve journey times and reliability to and from the bus station, promoting the use of public transport.

4. The design incorporates the removal of existing subway arrangements providing pedestrian crossings at road level to cater for desire lines.

5. Changes to the Grosvenor Centre and Bus Station will likely have a big impact on the traffic movements along Lady's Lane and Greyfriars. Although not tested in the existing traffic model, this design option caters for access to a new bus station and car park at the Grosvenor Centre. It is likely that options will need to be considered for this area once more details on the nature of the developments is forthcoming.

Under proposals in the CAAP, Horsemarket will remain a key corridor as it will be the main access to development sites around Market Square, The Drapery and the redevelopment of the Bus Station and Grosvenor Centre.
4.6 ABINGTON SQUARE

4.6.1 The option that has been developed for Abington Square significantly alters the way that traffic moves around the area. The proposal removes the current gyratory arrangement replacing it with two way traffic flow along the south of Abington Square. Traffic travelling to Kettering Road uses St. Michaels Road where the right turn onto Abington Square has been removed in order to reduce traffic flow and facilitate a narrowing of the road in front of residential properties. Traffic wishing to travel along Wellingborough Road will use Lower Mounts and the southern side of Abington Square, rather than St. Michaels Road or the current gyratory system around the northern side of Abington Square. This creates an opportunity for a bus only link across the northern side of Abington Square which can be served by a bus interchange. This will improve the desirability of retail units in the area whilst also removing the current on-street bus stop arrangement which affects traffic flow.

4.6.2 These changes will provide a reduction in road space which will enable public realm enhancements in the area along the concept of a gateway feature to the town centre. From a pedestrian and public realm perspective the option will look to extend the Abington Street shopping area into Abington Square.

4.6.3 The option has been developed to simplify traffic movements by removing the number of possible routes through the area. The impact on the Upper and Lower Mounts junctions is small as all movements remain, however the pedestrian facilities have been upgraded, with the addition of a pedestrian crossing at Lower Mounts to Abington Street. Also to increase capacity on the re-designated ring road, two lanes are provided northbound at Upper Mounts as opposed to the existing single lane arrangement.

4.6.4 There is a significant change to the operation of the St. Michaels Street Kettering Road junction due to the removal of the right turn out of St. Michaels Street. This means that southbound traffic along Kettering Road no longer require traffic signals as there is no movement from St. Michaels Street opposing it. In addition because the northern side of Abington Square is bus only the junction can operate with demand dependency. Consequently traffic is only stopped on St. Michaels Street when there is a bus travelling northbound along Kettering Road. This will allow increased capacity at the junction to accommodate future growth and reduce delay.

4.6.5 As a consequence of these changes it is necessary to provide a signalled junction where Kettering Road meets Wellingborough Road. At present this operates as traffic naturally merging between lanes but in the proposal Wellingborough Road will have two-way traffic, therefore necessitating a signalled junction with Kettering Road.

4.6.6 In the modelling exercise the entry/exit to Lady’s Lane is also kept as existing due to the uncertainty regarding developments in this area of the town centre. The option overleaf show segregated bus lanes; these are shown as a concept for ideas around access to and from the bus station and so have not been developed further at this time.
5. Downgrade St. Michaels St by removing the right turn onto Kettering Rd, rerouting traffic via Lower Mounts. This allows road narrowing at residential properties, parking formalised and a more efficient operation of the St. Michaels St/Kettering Rd junction.

6. New signalised junction required due to two-way operation of Wellingborough Road at Abington Square.

1. Similar junction layout to existing with additional northbound vehicle lane.

2. Exit/entry at Lady’s Lane has been considered in the context of redevelopment of the Bus Station and Grosvenor Centre. Allowing segregated bus/private vehicle access and the option for no through traffic.

3. Removal of gyratory system provides opportunity to create key bus interchange within a ‘bus only’ facility, improving desirability of retail units at this location.

4. Reduction of road space fulfils the CAAP objectives of creating a ‘Gateway’ at Abington Square and improving the public realm in the area around the garden of rest.

7. Reduced traffic flow along York Road/Cheyne Walk, which are identified as boulevards in CAAP, achieved by removal of gyratory system at Abingdon Square.
4.7 PLOUGH GYRATORY

4.7.1 In order to downgrade some areas of the highway network it is necessary to provide further capacity at others in order to accommodate the volume of traffic in the town centre. The aim has been to increase capacity in areas of the model where major routes intersect, attracting vehicles to designated routes through the network rather than providing a number of different routes. One of those areas providing potential to operate more efficiently for a re-designated ring road is the Plough Gyratory. The option was developed to prioritise the east-west movement as with the Regent Square option to aid the traffic flow around the ring road. Consequently, as can be seen overleaf in the illustration, the top of the existing gyratory at St. Johns Street is removed and east west traffic passes two way through the middle of the existing gyratory. This means that traffic making this movement only passes through two signalised junctions whereas currently travelling around the gyratory there are four junctions to pass through. Accommodating this option requires additional land acquisition on the southern side of the junction.

4.7.2 With the removal of the northern end of the gyratory, Bridge Street and Victoria Gardens need to operate as two way roads in order for vehicles to gain access onto St. Peters Way. As southbound traffic is permitted along Bridge Street there is alteration to the Commercial Way junction which allows a right turn out. Two southbound lanes are provided, segregated as a right turn and a left with ahead movement at the junction with St. Peters Way. On the southern side of the junction Bridge Street has three northbound lanes segregated as left, ahead and right as well as a single southbound lane for vehicles travelling on Bridge Street from the town centre.

4.7.3 On the eastbound carriageway there are also two right turn lanes for traffic wishing to travel southbound along Cattle Market. This simplifies the movement as at present vehicles have to travel around the gyratory in order to proceed southbound. Co-ordination of the traffic signals between the two junctions and the provision of two right turn lanes means that there is minimal queuing within the junction itself.

4.7.4 Victoria Gardens operates on the same principle as Bridge Street with two way traffic and is the route for traffic into and out of St. Johns Street. Westbound traffic cannot turn right into Victoria Gardens at the junction, an alternative route is provided around the existing open surface car park at St. Johns. This involves upgrading St. Johns Street and Swan Street to a two way road and would require re-allocation of car park spaces at the open surface car park; however the same total volume can be accommodated. This option has been developed in this way to enable the impact of traffic to and from a development in St. Johns, to be incorporated within the changes to the Plough junction.

4.7.5 Overall there is extensive re-alignment and re-designation of traffic movements at this location. However the option proposed simplifies the movement of east-west traffic which is in line with the aim of enhancing capacity around the ring road. Vehicular movements into and out of the town centre via Bridge Street are still permitted and access arrangements for changes to St. Johns are also incorporated.
3. The design accommodates the potential for development around Project Angel and new council offices.

5. Bridge Street operates as two way north and south of St. Peters Way. It retains its function as the route into the central shopping area.

6. In line with the CAAP pedestrian movements are prioritised in order to encourage links between the Waterside and the central area shopping area.

8. Two right turn lanes provided onto Cattle Market Road in order to accommodate demand and prevent any queuing traffic disrupting west-east movements.

9. With additional land acquisition the visual impact of increased highway can be softened with additional public realm features and wider/intersecting pavements.

4. Enhanced public realm and pedestrian links can be achieved around the Bridge Street, Angel Street and St. Johns Street area by removing the northern collar of the gyratory.

7. St. John’s Street/Swan Street can be upgraded to a two way road with a redesign of the open air car park. This improves access to any development under Project Angel, also it provides access for vehicles approaching from the east as no right turn is permitted at the Plough junction.

1. Realignment of the Plough junction in order to remove the need for the gyratory.

2. In order to accommodate two-way operation additional land acquisition is needed at the south side of the junction.
4.8 VICTORIA PROMENADE / CHEYNE WALK

4.8.1 The option developed for this junction alters the traffic movement significantly with the emphasis on increasing the capacity for the main road movement. Traffic counts at the junction show that the predominant movement is between Bedford Road and Victoria Promenade. Consequently the option re-designates the road space so that the road bends around to follow this movement, as shown overleaf in the illustration. With a higher traffic flow for west to east two vehicle lanes have been provided compared to a single lane for east to west. As this movement becomes the shape of the road there is no longer a junction at this location and so vehicles moving east west and vice versa only have to stop for a pedestrian crossing. This should therefore increase capacity and reduce delay for all traffic travelling around the ring road.

4.8.2 The northbound movement from Victoria Promenade to Cheyne Walk is also still permitted although there are restrictions on a number of other movements. For example a left turn northbound onto Cheyne Walk is the only permitted movement for vehicles exiting Derngate. Similarly southbound vehicles from Cheyne Walk can only turn left onto Bedford Road and so are not able to continue along Victoria Promenade. Finally the only traffic that can enter Derngate is from Victoria Promenade.

4.8.3 The concept upon which this junction option was developed was for prioritising the predominant traffic flow which inherently has simplified its layout. Through this a number of movements at the junction are no longer permitted as they require the junction to operate as a crossroads. It is this operation which currently causes queuing due to the number of vehicles travelling from Victoria Promenade onto Bedford Road. Of the movements that have been prevented all can be accommodated with a small amount of re-routing through the local highway network using Spencer Parade, Billing Road and St. Johns Street.

4.8.4 A pedestrian crossing is provided to increase permeability for pedestrians between the marina/riverside, Becketts Park and the central shopping area. This and other pedestrian crossings are provided to serve existing desire lines whilst also supporting aspirations for pedestrian movements in the CAAP.

Compared to the existing situation the junction will be able to accommodate additional traffic volume due to its simplified layout. This has been considered in conjunction with previously detailed changes to the Plough gyratory and Horsemarket, the impact of which will cause traffic to re-route via this junction resulting in higher traffic volume. Similarly this option links to the Abington Square proposal, where the removal of gyratory traffic means that vehicles cannot access York Road and Cheyne Walk from Lower Mounts. This and the removal of the straight over movement at this junction from Cheyne Walk to Victoria Promenade are aimed at encouraging traffic to use the re-designated ring road via Cliftonville Road.
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1. The junction has been simplified by removing the cross roads in favour of continuing Victoria Promenade through the junction aiding the predominant traffic flow. Proposed changes to the Plough gyratory and Abingdon Square are likely to increase this movement hence the need for this option. This flow will be unopposed except when the pedestrian crossing to Becketts Park is demanded.

2. Southbound traffic prevented from proceeding onto Victoria Promenade in order to reduce congestion along Georgian Boulevard of Cheyne Walk.

3. Junction operates to promote the use of the newly designated ring road. Therefore movements at the junction are prevented to reduce attractiveness of driving into the pedestrian friendly centre.

4. New pedestrian crossings provided to increase permeability of pedestrians between the main riverside, Becketts Park and the central shopping area. This is in line with aspirations contained with the CAAP.

Existing traffic flows create queueing at the junction which is heavily influenced by traffic patterns at Abingdon Square and the Plough Gyratory.
4.9  BEDFORD ROAD / CLIFTONVILLE ROAD

4.9.1 The layout of the Bedford Road/Cliftonville Road junction has been influenced by proposed changes at Abington Square and Victoria Promenade/Cheyne Walk. The changes proposed at these two junctions moves the existing route of the ring road westwards so that it routes along Cliftonville Road rather than Cheyne Walk. This re-routing means that the Bedford Road/Cliftonville Road junction is likely to see an increase in traffic volume.

4.9.2 The junction currently experiences congestion in the morning and evening due to the volume of inbound traffic to the town centre along Bedford Road. The proposed design (see overleaf) seeks to minimise this delay by increasing capacity through redesignating traffic lanes and alterations to the traffic signal operation. Pedestrian crossings are provided in the existing locations and with widening of the central refuges to provide added protection.

4.9.3 The proposed layout for the junction includes an additional right turn lane from Cliftonville Road onto Bedford Road. This has been provided to accommodate the anticipated increase in traffic making this movement as a result of the changes at Cheyne Walk preventing traffic travelling straight ahead along Victoria Promenade. As this junction will become the first on the ring road from the A45, the northbound right turn up Cliftonville Road has also been prioritised, again this is to mitigate for changes made at Abington Square and Cheyne Walk. As a whole the junction does not change substantially from its current operation. The emphasis has been to increase capacity in line with anticipated developments in the east of Northampton and re-routing traffic through the town centre due to proposed new route of the ring road.
The layout of the junction has been influenced by changes at Abingdon Square which moves the ring road onto Cliftonville Road creating a higher southbound traffic flow.

A junction which currently experiences congestion due to inbound traffic volumes during the morning and evening peaks.

The impact of future significant development at Nunn Mills, as highlighted in the CAAP, will have to be considered as it will have a direct impact on the volume of traffic travelling east-west at this junction.

Operation of the junction is similar to existing, the aim, has been to increase efficiency in the traffic signals and provide the most capacity.

1. Additional right turn lane included to accommodate increased traffic volumes on this movement caused by removing southbound traffic at Bedford Rd/Victoria Promenade junction.
5 Modelling Results

5.1 INTRODUCTION

5.1.1 This section of the report will summarise the results of the future year modelling exercise, providing a comparison with base year results previously reported (Northampton Town Centre VISSIM Model Phase 2, January 2011). The methodology for the future year modelling has remained the same as for the base year. There are individual option models which assess the performance of each junction described in the previous section, as well as a base model, where the highway network remains as present. The purpose of future year modelling has been to test whether the Northampton town centre network can accommodate forecast development aspirations and at what capacity the junction proposals operate.

5.1.2 In the first instance the objective was to use traffic flows from Northamptonshire Strategic Transport Model (NSTM) for the year 2026. These flows were received and converted into VISSIM matrices using the process described in section 2.7. Once this conversion process had taken place and matrices construction for individual 15 minute periods from 07:00 to 09:30 and 16:00 to 18:30 the models were run with the future year traffic volume. It became clear that the network was not able to cope with future year traffic flows. With extensive model runs and changes to the operation of traffic signals the models still didn’t reach a point of convergence, meaning reliable data could not be obtained. None of the models could accommodate all of the traffic that were contained in the matrices and so reached a point of network gridlock. At this point the matrices were scaled back, a percentage at a time, to determine the point at which the network would reach capacity. The current network contains around 37500 vehicles during the AM model period and 49750 during the PM model period. During the scaling back exercise the percentage was reduced to a point where the traffic volume was less than in the current network. Further analysis of the matrices revealed that the problem was caused by the significant re-distribution of traffic through the network. Therefore whilst the volume of traffic was lower than is currently experienced certain zone to zone relationships had disproportionate increases in volume. This was occurring in areas of the network which could not accommodate the volume increases, causing the models to gridlock. The progress of the NSTM meant that data received included coarse loading of developments for Northampton, hence traffic was not necessarily loaded onto the most appropriate links in the model. In addition the NSTM version used included no mitigation for these developments. Following an extensive process of trying to integrate the NSTM traffic flows into the model it was apparent that reliable data outputs would be difficult to obtain within the VISSIM model. Therefore through consultation with NCC it was decided to try an alternative methodology to model the impact of future year traffic growth.

5.1.3 The agreed methodology utilised TEMPRO version 6.2 dataset 5.4 to obtain growth factors to apply to the existing base matrices. The growth factors were obtained
for 2016, 2021 and 2026 so that the VISSIM model could show which development year the existing Northampton network would reach capacity. Whereas the NSTM created large scale re-distribution of traffic throughout the model this methodology will use the same patterns as the base because it is a flat growth factor on existing origin destination relationships. There will be an element of re-distribution in the model but this is purely related to routing decisions based on delay caused by the increased volume, there is no re-distribution of traffic in the matrices.

5.2 AM PEAK NETWORK PERFORMANCE

5.2.1 Detailed network performance results for the all of the option models in the base year scenario have been analysed in the proceeding Northampton Town Centre VISSIM Model Phase 2 report, January 2011. This section of the report will provide the same analysis for results from the future year model scenarios for each option. In addition a summary which compares the performance of the models between the base and future year is provided to determine the impact of traffic growth.

5.2.2 Using the previously explained methodology the traffic in the AM matrices have been ‘growthed’ to a point where the network is operating as close to capacity as possible for results to still be obtained. In this instance a figure of 17% growth over the current AM peak traffic flow was achieved. Therefore the sum total of traffic in the AM models has grown from 37500 in the current year models to 44200 vehicles in the future year models. The TEMPRO growth obtained for Northampton for the years 2009 to 2021 is 17.9% meaning that these results can be interpreted as representing traffic flows in Northampton around this time period.

Figure 5.1: AM Peak network performance analysis

5.2.3 Figure 5.1 demonstrates the performance of all of the future year models against a base future year model, which contains no highway upgrades. The graph shows data that has been obtained for the entire two and a half hour model run over the full network and so does not present the results of individual junctions. The data
presented shows the total travel time, which is the sum of journey times for each individual vehicle; the average speed of each vehicle and finally the average per vehicle delay. This is the time spent by each vehicle travelling at a speed which is below its desired speed. As the chart shows a number of the option models have an increase in per vehicle delay across the model when compared to the base. There are a number of explanations for why this is the case the main being the number of vehicles in the models. Statistics for these results are only collected from vehicles which have completed their origin to destination trip. The total travel time information shows there is an increase over the base which is a factor of more vehicles being contained in the option models, thus causing more delay. Whilst inherently the increase in total travel time is caused by increase in per user delay, the increase seen is not fully concurrent with delay alone and is related to an increase in traffic volume. Secondly the option models contain a specific option with the remaining highway network unchanged. Some junction options such as the Horsemarket downgrade, Abington Square and Cheyne Walk/Victoria Promenade there is a big impact on the way in which traffic moves around the network. Therefore the models show that whilst delay can decrease at the junctions in question there is an increase in per vehicle delay over the network due to traffic finding alternative routes. This is reinforced by the performance of the Total Network option compared against the base. This model contains all of the options and shows improved performance compared to the base with an 8% reduction in per vehicle delay and 5% increase in average vehicle speeds. Therefore it is clear that when all the inter-related junction options are implemented the network is better at accommodating re-routed traffic than the current highway network. This will be analysed further when the performance of individual junctions are assessed later in this section.

5.2.4 From the above data the amount of delay in the network can be obtained demonstrating a useful summary statistic upon which to compare the option models. The total travel time is known from the network performance data and so is the volume of traffic in the matrices. By dividing the total travel time by the number of vehicles an approximate average journey time for each vehicle can be calculated. The average per vehicle delay is also known from the network performance data so this can be divided by the average journey time to provide an approximate percentage of time spent in delay. For example if the average delay per vehicle is 154 seconds and the average journey time is calculated as 282 seconds it can be inferred that 54% of that vehicles’ journey was spent in delay.

5.2.5 Figure 5.2 shows that there is little variation between the performances of the models with regards to proportion of journeys spent in delay conditions. In the base year all of the option models show a decrease in delay conditions when compared to the base model. In the future year all but two, Horsemarket and Cheyne Walk/Victoria Promenade models, show a decrease in delay compared to the base. Due to the methodology used to calculate this comparison statistic, support is given to the justification that the option models accommodate an increase traffic volume compared to the base. Therefore when compared with average journey times a reduction in delay is shown, although the figures are relatively small decreases. When comparing results
from the base and future year models the increase in delay averages at 15% related to a 17% traffic growth.

**Figure 5.2: AM percentage of journey time spent in delay comparison**

5.2.6 The same network analysis has been undertaken for the PM model period. The base PM model contains 49750 vehicles which is 12000 vehicles more than the corresponding AM peak period and 5500 vehicles more than the AM future year peak traffic flow. Therefore, considering the point at which the AM peak network gridlocks, the PM peak has little room for traffic growth. During testing for capacity, using TEMPRO growth factors, the network in the PM peak can only accommodate five percent traffic growth before it reaches capacity. This equates to 52250 vehicles which is the maximum capacity of the town centre network, on existing traffic distribution patterns, for the PM peak.

5.2.7 The data shown in **Figure 5.3** for the PM future year peak looks encouraging as generally there is a decrease in delay and total travel time for the option models when compared to the base model. This would indicate that the option models handle the traffic growth across the whole network better than the base model containing the existing highway operation. The lowest delay per vehicle is shown in the Horsemarket downgrade option closely followed by the model containing changes to the Bedford Road/Cliftonville Road junction and then the Abington Square option model. The models show between 25%-40% reduction in delay time across the network for each vehicle which corresponds with a large increase in average vehicle speeds. The explanation of this improvement is likely to be changes made to the traffic signals around the model in order to accommodate the additional traffic growth. The process adopted meant that all of the signal timings through the option models have been re-optimised. This means that whilst watching the models through junctions are analysed...
to see where queues are forming; the signal timings are then altered to ensure that queuing is balanced across all junction approaches. In the PM peak this process has been undertaken, but the network has only seen a five percent increase in traffic, explaining why the delay statistics are improved over the base future year model. However, it is important to note that network performance data is only collected for completed vehicle trips. When looking at the models there are some locations which show excessive queuing, vehicles within these queues will not produce results relating to delay etc unless they complete their trip within the model period. This could also be a contributing factor as to why the delay statistics show such an improvement compared to the base and will be investigated further by looking at individual junction performance.

**Figure 5.3: PM Peak network performance analysis**

5.2.8 The above analysis shows that there is a decrease in delay for each vehicle in the network but it doesn’t provide context over how much delay there is in the first place. For example in the future year the average per user delay; recorded as the amount of time the vehicle travel at a speed which is below its desired speed is 352 seconds. When considering that there are 52250 vehicles in the PM model period and the total travel time for all vehicles in the base future year model is 5306 hours, it can be calculated that 96% of the time taken to complete journey’s in the PM peak is spent in delay conditions. It is important to note that this figure does not refer to the journey time; i.e. the time spent to complete the journey is not 96% longer.

The comparison of percentage delay between all of the option models and the base for both the current and future year models is provided in Figure 5.4. Delay statistics support the data shown in the network performance graph as there is a slight reduction compared to the base in all of the option models. In the base year the range of percentage delay variation is small, with Abington Square providing the best results. Traffic in the base model experiences delay for 74% of journey’s whereas the Abington
Square option has 66% delay conditions over journey trips. The future year models show a little more variation, the percentages are also significantly higher. Again the base future year model is the worst performing and also represents the largest increase in delay of all models when compared to the current year. This demonstrates that the current network is close to capacity in the PM and so small increases in traffic volume have a large impact in the amount of delay.

Figure 5.4: PM percentage of journey time spent in delay comparison

5.3 SPECIFIC JUNCTION ANALYSIS – AM PEAK

5.3.1 Following analysis for general performance of the network on each option model data has also been gained for specific junctions and each option model. This will provide more detail regarding exactly what is happening to traffic movements around the town centre as a result of the proposed changes to the network. The following data compares the traffic volume and delay at 12 key junctions across the network against the base model. This analysis will help to quickly identify the junctions which have increased traffic volumes, caused by re-routing traffic as a result of changes in the option models. In addition it will be quick to identify those junctions which are best at coping with the increased traffic volume by seeing whether the amount of delay increases or decreases in line with the traffic volume. The ideal situation is to see an increase in traffic volume and a decrease in delay, indicating that the junction can accommodate more traffic and still provide an improvement in performance.

5.3.2 Figure 5.5 presents the results for the AM model period for the Abington Square option. There are three junctions around Abington Square which are affected by the removal of the gyratory; namely St. Michaels Street, Lower Mounts and Upper Mounts. Looking at the graph all of these junctions show an increase in traffic volume and decrease in delay in both the current and future year scenarios. This means that traffic is re-routing through these junctions, using the new option because it is an attractive
route due to better traffic flow. The data shows that the area handles on average 30% additional traffic compared to the base model, providing a 60% reduction in delay. This has been achieved by the changes to the highway alignment, reported in the previous section, as well as alterations to the traffic signals. The future year model shows increased traffic volumes compared to the base at these locations but an increase in delay savings. This indicates that the model is close to reaching capacity as the maximum benefit that can be gained has been and so additional traffic erodes any gains made.

5.3.3 Looking across the network the other pattern to note is the impact that the removal of the gyratory system has on southbound traffic at Abington Square. The option means that traffic can no longer move from Upper Mounts and Lower Mounts to Cheyne Walk due to the removal of the gyratory system and right hand turn out of St. Michaels Street. The result is traffic re-routing via Horsemarket to the southern side of the ring road continuing along St. Peters Way and Victoria Promenade. Consequently there are increases in traffic volume and delay at the Mayorhold, Gas Street roundabout and the Plough gyratory. Interestingly the Regent Square junction shows a rise in traffic flow, likely to be related to the increased attractiveness of the northern ring road route caused by changes to Abington Square. In the base scenario there is also a decrease in the delay, whilst in the future year a further increase in traffic flow creates additional delay than its current operation. This indicates that capacity is reached at this junction in the future year.

Figure 5.5: AM Peak Abington Square Option performance

5.3.4 Figure 5.6 presents the results for the Plough option model which removes the gyratory movement at this location. Visually the model looks good at this location, traffic flow is improved and queue lengths are reduced compared to the existing situation. The data shows that there is actually an increase in delay at this location
which does not seem to match with the visual image of the operation of this junction. The explanation of these results can be attributed to the Gas Street roundabout operation. Both this and the Plough junction option accommodate increased traffic flows when compared to the base scenario. This proves that the route is more attractive to vehicles and the junctions can accommodate more traffic. This does not lend itself to the large increases in delay which are also reported. The issue is that because of the close proximity of the junctions delay data is obtained for each of them, thus unfortunately being effectively double counted. The data is collected for 250 metres from each junction; this means that the Plough junction data will include the delay data from the Gas Street Roundabout. This explains why both data sets in the bar chart are similar in size. An important conclusion can be gained from this as it is apparent that increased volumes of traffic are put onto the Gas Street roundabout as a result of the changes to the Plough junction. The result is that the roundabout cannot accommodate this additional traffic, it does not cause the model to gridlock, but does have a large increase in delay compared to the base. To add weight to the conclusion that the operation of the Plough is improved the Victoria Promenade / Cheyne Walk results can be considered. Here there is a significant increase in traffic volume and a reduction in delay. The vast majority of this traffic originates or has a destination of the Plough showing that there is increased volume moving through the junction. In addition the improved delay statistics mean that delay at the Plough cannot be as significant as recorded, otherwise it would affect the operation of this junction. Likewise the Bedford Road / Cliftonville Road junction operates with improved efficiency and increased volume. This demonstrates that increased traffic is using the southern side of the ring road due to changes at the Plough junction improvements across the wider network are generally attributed to signal optimisation, particularly in the future year to attempt to accommodate additional traffic.

Figure 5.6: AM Peak Plough Option performance
5.3.5 The Horsemarket downgrade option, shown in Figure 5.7, follows the same performance patterns at the Plough option. Generally there is a redistribution of traffic around the network which explains why the other junctions see an increase in traffic volume. This is as a result of downgrading the Horsemarket / Broad Street area to single lane in order to discourage all but north-south travelling traffic. The key junctions in this option are Mayorhold / Greyfriars which shows a large increase in delay. This is to be expected, measures on this route were introduced to discourage vehicles from using it in order to reduce traffic flow. What the traffic volume indicates is that without upgrades to other areas of the network the appeal of alternative routes is not sufficient to attract traffic away from Horsemarket. Therefore traffic continues to use Horsemarket even though there is an increase in delay. This is not necessarily a negative conclusion as the physical highway measures still exist in this option, showing that even with little variation in traffic flow the route can accommodate the traffic without gridlocking the network.

5.3.6 Other important conclusions relate to junctions within close proximity of Horsemarket along the ring road namely, Regents Square, Gas Street roundabout and the Plough gyratory. Of these junction Regents Square shows the best performance and is the only one of the three that has had physical changes made to it in line with the Horsemarket option. It can accommodate more traffic in the base model whilst still reducing delay whereas in the future year the additional 17% traffic growth causes its operation to tip and delay actually increases over the base. This shows that capacity is reached at this junction at around this volume increase. As identified in the previous option the operation of the Gas Street roundabout is sensitive as it is close to capacity. Therefore relatively small increases in volume have a big impact on delay at the roundabout and the Plough. This can be explained by small local redistribution of traffic as well as the impact of physical changes to the Horsemarket highway alignment affecting the way traffic exits these junctions.

**Figure 5.7: AM peak Horsemarket downgrade model performance**
5.3.7 The model performance for the Victoria Promenade / Cheyne Walk option shows an increase in traffic volume and reduction in delay at a number of junctions. The option for the junction brings an increase in traffic volume and a significant reduction in delay, up to 87% in the current year scenario. The important factor in this data is the increase in traffic volume even though certain movements at the junction are prohibited. Therefore traffic using the main movement, for which the option prioritises, has increased significantly to still show an overall increase in volume when other movements no longer use the junction. The increase in this traffic volume again demonstrates the problems with the Plough Gyratory and the Gas Street roundabout Black Lion Hill area. The increase in traffic volume has a disproportionately large increase in delay, particularly in the future year scenario. This indicates that at present the junctions operate close to capacity and so with increases in traffic, whether through redistribution due to option changes or future traffic growth, they quickly reach capacity and cause large amounts of delay.

5.3.8 **Figure 5.8** also shows the impact of removing the southbound movement along Cheyne Walk to Victoria Promenade on junctions in the north of the town. Around Abington Square, Upper Mounts and Lower Mounts traffic volume increases with a reduction in delay. This is caused by re-routing traffic avoiding the area, creating additional time in the traffic signals for the predominant movements. For example, vehicles wanting to travel south from the Upper Mounts and Regent Square area avoid Abington Square due to the changes to the Victoria Promenade / Cheyne Walk junction. As a result the route becomes more attractive for other traffic as movements causing delay are removed. This delay is then transferred onto junctions along Broad Street / Mayorhold and Horsemarket which becomes the southbound route for re-distributed vehicles. This explains the increase in volume and reduction in delay for the junctions along this route and around the south of the ring road.

**Figure 5.8: AM peak Victoria Promenade / Cheyne Walk model performance**

![AM Peak Option Model performance against Existing Scenario (Base Year) - Victoria Promenade / Cheyne Walk Option Model](image-url)
5.3.9 Figure 5.9 shows that the option to increase capacity at the Cliftonville Road / Bedford Road junction is successful in both the current and future year scenarios. The junction can accommodate an additional 70% traffic in both scenarios, whilst delivering a 28% reduction in delay in the current year, and a 24% reduction in delay in the future year when compared to the base. This volume of traffic meant that there had to be significant work undertaken to the operation of the traffic signals at other locations in the model. This particular junction is the first in the network on the eastern side of the town and so whilst the option can get additional traffic into the town it has to then be accommodated throughout the other junctions. This required a lot of optimisation of traffic signals in the Abington Square option due to the increased volume of traffic travelling up Cliftonville Road. The bar chart shows that this optimisation was successful in increasing capacity whilst reducing delay compared to the current junction performance. The same results can be seen at the Plough and Gas Street roundabout as other models with an increase in traffic volume corresponding to an increase in delay. This is due to the lack of additional capacity which is available in these junctions.

5.3.10 The chart shows consistent performance against the other option models. This shows a level of stability in the option models; all have had network optimisations in order to gain the maximum capacity out of junctions not benefitting from physical alterations. As the same traffic matrices are used in all of the models and the same amount of optimisation has been undertaken the performance of the junctions is comparative and reliable. The encouraging element of this conclusion is that the option at Cliftonville Road / Bedford Road provides an improvement at this location without detrimentally impacting other locations in the model apart from those which are already operating close to capacity.

Figure 5.9: AM peak Cliftonville Road / Bedford Road model performance
5.3.11 The methodology for comparing the performance of the Total Network option model is different from all of the other option models. It is unrealistic to compare the performance against the current base year, as the other models are, because all of the changes would not be implemented in sufficient time for the traffic volumes to remain accurate. Consequently the Total Network option model has been tested against the future year base model to gauge the impact of making changes to the network against leaving it as existing.

5.3.12 Reassuringly even though the Total Network option model is a separate model the data presented in Figure 5.10 supports the conclusions and results displayed in the individual option models. Overall the performance shows that making the design option changes the network as a whole performs better than making no alterations to the highway. The graphs show that in the majority of cases the Total Network option shows a reduction in delay compared to the base model. The performance of the Plough gyratory should also be highlighted as in the future year existing network model the junction operates with a massive increase in delay compared to the base year. However with all of the related network changes, forming the Total Network option model, it operates with increased volume and a reduction in delay in the future year. This supports the conclusion that in order for this junction to provide improvement it would need to be implemented in line with other junction improvements at Victoria Promenade / Cheyne Walk. The only two junctions which show a reduction in performance in the Total Network option are Gas St roundabout and Mayorhold / Greyfriars. These are directly related to downgrading Horsemarket which creates increases in delay in order to reduce the appeal of the route.

Figure 5.10: AM peak Total Network Option performance

5.3.13 The data shows that the changes proposed prove the network can accommodate a 17% increase in traffic volume across the origin destination matrices,
whilst significantly improving performance compared to current delay statistics. What the Total Network option model proves is that the network is able to accommodate redistributed traffic as a result of improvement options suggested.

5.4 SPECIFIC JUNCTION ANALYSIS – PM PEAK

5.4.1 The previous Northampton Town Centre Phase 2 report (January 2011) provided the results of the option models exercise in the base year. Following issues with the NSTM data the aspiration of the modelling exercise has shifted to identify the point at which the network reaches saturation rather than testing specific future year traffic scenarios. It has been a particular challenge to complete this approach for all models in the PM peak. Due to the high volumes of traffic in the base year (over 30% more than the AM peak) there was far less scope to accommodate large volume increases across the network.

5.4.2 The exercise of stress testing the network to identify the point at which it reaches capacity has been completed through a thorough iterative modelling process. Following the methodology using TEMPRO in the first instance the traffic matrices were iteratively scaled back from 2021 growth figures until 2016 growth figures were reached. At this point the network was still not at accommodating the 8% growth indicated by TEMPRO. Therefore the iterative scaling back exercise was continued until the traffic growth reached 5%. By TEMPRO’s rationale this would equate to approximately three years of future traffic growth. At this point the models were able to complete full runs but not consistently suggesting an unacceptable level of stability with regards to valid data. Further work was undertaken to rectify this problem by changing the traffic signal timings in all of the option models attempting to minimise network bottlenecks which could cause gridlock. This exercise was completed and the results are shown on the following pages.

5.4.3 The results show anomalies which are inherent with a network of this size operating at this level of over-saturation and instability. It is difficult to create a clear picture of the performance of these options, either junction by junction or on the network as a whole. In reality re-distribution would happen across a much wider network than the current model extents accommodate which would require the origin destination matrices to change. With this in mind the following charts will show increases in delay to a level which in reality would not be tolerated by the vast majority of motorists in the network. Unfortunately at this point VISSIM is constrained by a fixed origin destination matrix stopping vehicles on longer cross town routes from re-distributing. This problem would require input from the strategic model to address the issue of the redistribution of traffic to routes around the wider Northampton network. In addition to this as 5% was only an approximate representation of three years growth there was little value in repeating the time consuming iterative process of scaling back the matrices further.

5.4.4 The results on the following pages are included to provide details on the modelling work that has been undertaken for the PM peak. From the data a clear picture of junction performance for the proposed options cannot be obtained. Whereas in the AM peak it is possible to track the re-distribution of traffic around the network,
and so understand the delay, the equivalent data does not allow the same analysis for the PM peak. All that can be conclusively taken from each of the charts is the representation of a network which, at 5% growth, is clearly over capacity.

Figure 5.11: PM peak Abington Square option model performance

![PM Peak Option Model performance against Existing Scenario (Base Year) Abington Square Option Model](chart1.png)

Figure 5.12: PM peak Plough Option model performance

![PM Peak Option Model performance against Existing Scenario (Base Year) The Plough Option Model](chart2.png)
Figure 5.13: PM peak Horsemarket downgrade option model performance

![Graph of PM peak Horsemarket downgrade option model performance]

Figure 5.14: PM peak Victoria Promenade/Cheyne Walk option model performance

![Graph of PM peak Victoria Promenade/Cheyne Walk option model performance]
Figure 5.15: PM peak Total Network model option performance
6 Conclusions & Recommendations

6.1 INTRODUCTION

6.1.1 This study has been carried out with the aim of:

- Highlighting current network congestion ‘hotspots.’
- Testing a series of resulting junction redesign and mitigation options all created with the intention of producing a final vision for the highway network in Northampton with a greater alignment to CAAP aspirations.
- Testing the existing and proposed ability to accommodate future growth at each key junction, allowing an assessment of where and when capacity issues are likely to be experienced.

6.1.2 The identification of junction hotspots was largely in line with expectations and the resulting option design process led to a series of options which, when tested in the base year (2009), proved that in most cases considerable improvements in capacity could be found. Where this wasn’t the case it often proved to be as a result of re-routing, which in options such as the downgrading of Horsetmarket, was actually the desired result.

6.1.3 The main benefit of this modelling exercise is that a solid modelling platform has been provided, upon which further potential mitigation options can be developed to help deliver specific development growth identified for Northampton. Upon completion of the next phase of work on the NSTM there will be the ability to include much more detailed information about origin-destination distribution patterns, which will serve to create a far more detailed platform for the testing of specific future year and development scenarios. Even without that detail, the process of testing using globally applied TEMPRO growth factors is able to give a good indication of areas of the network most at risk of reaching critical levels of delay and constriction to the network as a whole.

6.2 CONCLUSION

6.2.1 It very quickly became obvious that areas of the network already operate at or over their current capacity, leading to considerable delay during morning and evening peaks. This is particularly apparent in the evening peak, which already comprises of over 30% more traffic than is found in the morning peak. As a result of problems experienced with the NSTM data, detailed in section 5.1, the future year stress-testing exercise could only be carried out using current traffic distribution patterns and growth originally derived from TEMPRO. The main limitation of this methodology is that it does not allow a realistic picture to be created of how traffic would redistribute as a result of changes to origins/destinations from new development sites and as a result highway changes. It is however still a useful exercise, delivering results which are less of an actual future year test and more of a junction and network capacity assessment.
6.2.2 The net outcome as a result of this methodology is that there is almost no capacity for growth with existing traffic patterns during the evening peak. It is likely that the network as a whole can accommodate somewhere between two and five percent growth with current evening traffic distributions, however it was very difficult to reach a stable level of growth which would work consistently in all options. This is a drawback of VISSIM as a tool for future year modelling – even though it will model the redistribution of traffic on different routes between any given origin-destination pairing as a result of changing network conditions, there is no inbuilt ability to alter the distribution of traffic within the origin-destination matrix itself. This is the point where there is a need for strategic modelling, which adjusts the origin-destination matrix for VISSIM as a result of new developments and changing network conditions across a much larger network than is modelled here.

6.2.3 As a result of the ability to accommodate considerable amounts of growth, the morning peak models are able to provide much more consistent and stable data regarding network performance and junction capacity. This allows a clearer picture to be formed about the relative potential improvements to be gained from signal timing optimisation and individual junction realignment, as well as the resulting changes to internal traffic routing distributions. Although demonstrating the proximity to capacity in the evening peak is in itself seen as a result, the indicative data obtained regarding capacity from the morning peak models is considered to be more in line with the likely outcome in both peaks once the NSTM output is fully integrated.

6.2.4 In order to fully understand the implications of this study, it is felt to be important to stress exactly what is being demonstrated by the results contained within this report. This is very much a preliminary study – a proof of concept – looking at assessing the viability of the overall aim of extending the scope of the ring road whilst satisfying a broad range of CAAP objectives at individual locations. In a broad sense this is successfully achieved – the Total Proposed Network model works well whilst accommodating up to 17% additional traffic volume during the morning peak. However, it is important to highlight that, whilst this study represents a large volume of design and modelling work, the area being considered is very large – essential all of Northampton town centre and its arterial routes. This has meant there has only been the scope to develop one option at each of the highlighted areas, leading to only one option for the overall network. These are therefore not in any way guaranteed to be the best options, nor are they necessarily the ones which achieve the best co-ordination in regard to each other or future development needs. What they do represent though is proof that the network can be improved to accommodate high levels of growth, whilst also achieving broader and more long-term goals with the operation of the highway network as a whole.

6.3 RECOMMENDATIONS

6.3.1 All tested options showed marked improvements in delay whilst accommodating a greater traffic volume at most locations during the morning peak. An important factor to consider here is the relatively large time savings achieved at a number of junctions due to the associated signal optimisation exercise which was carried out during the
calibration stage of each options modelling. In order to create a realistic impression of this study is to highlight the proven benefit of signal re-optimisation and maintenance.

6.3.2 In a broader sense, a benefit of testing individual options within a large and detailed network model has been to demonstrate the sensitivity of key junctions, particularly as they become close to saturation. It can be clearly seen that individual junctions are not only often very sensitive to changes, but that the results of any changes can have a wide-ranging impact on the network as whole, completely changing the appeal of routes and having a consequential knock-on effect at different junctions right across the entire network. The junctions affected are often difficult to predict, proving the benefit of this kind of testing as well as indicating the need for all solutions and future development mitigation considerations to be delivered where possible with regard to the entire network and not just the immediately surrounding junctions.