2. DATABASE FOR A DEMAND MODEL

2.1 MODEL STRUCTURE

The structure of the model has been defined recognising three analysis areas:

- Inner Modelling Area (IMA)
- Greater Modelling Area (GMA)
- Remote Modelling Area (RMA)

These areas have been defined recognising the requirements of the model, the nature of data sources and the role of the M1 Corridor transportation model. The three areas and the study area are illustrated in Figure 2.1.

The demand modelling has been undertaken for a Greater Modelling Area consisting of the three counties of Nottinghamshire, Derbyshire and Leicestershire. The results of this modelling are however applied only to an Inner Modelling Area covering Greater Nottingham and an extension in a westerly direction to just west of the M1 and in a southerly direction to a line between junction 23A of the M1 and the junction between the A46 and A606 at Widmerpool. Figure 2.2 illustrates the extent of the Greater Modelling Area and the Inner Modelling Area.

The reason for using these different areas is the need to reflect competing attractions outside the Inner Modelling Area which influence trip distribution within the Inner Area (commuters, shopping and leisure trips). This is an influence which may change in future due to different transport policies.

Trips from the Greater Modelling Area into the Inner Modelling Area and trips though the Inner Modelling Area are added into the matrices at a later stage. These trips are based on the results of roadside interview and public transport screenline surveys at the outer screenlines.

Due to the location of the outer screenlines within the Inner Modelling Area, trips assigned to network links crossing the screenlines include longer distance movements from the surveys and local movements from the synthetic demand model. For example the amount of external traffic at the A453 Thrumpton site is likely to exceed that of the internal traffic by a significant amount despite being well within the inner (synthetic) model area.

The VISEM software package has been used to generate the demand matrices. The demand model generates matrices representing the patterns of journeys between the zones of the model for the defined demand segments. It is a synthetic model utilising data from several different sources:

- Structural (planning) data from local sources and the DTLR national planning data base (NTEM)
- Data from roadside and public transport screenline surveys
- Structural, behavioural and travel data from household surveys

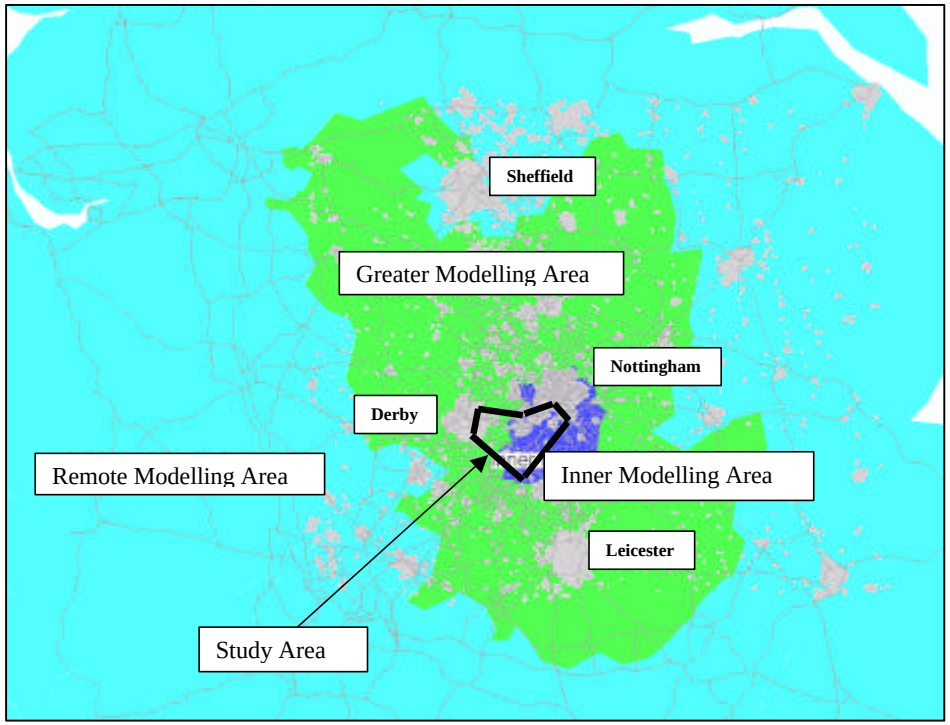


Figure 2.1 Modelling Areas

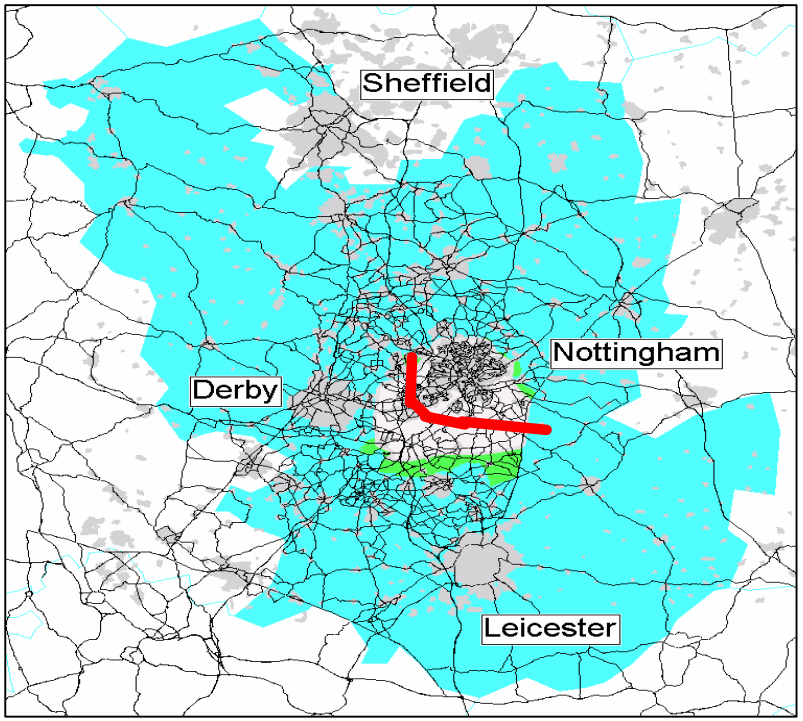


Figure 2.2: Greater and Inner Modelling Areas

KEY
- Greater Modelling Area
- Inner Modelling Area
- Urban Area
- Screenline locations

2.2 DATA RESOURCES

Data for demand modelling were available from the study transport surveys and from DTLR national transport models.

Data from a number of transport surveys were included in model development:

- Household surveys
- Driver, origin-destination surveys
- Public Transport passenger (bus and rail) origin-destination surveys
- Traffic counts on motorways and other roads
- Journey time surveys on selected routes between Nottingham and Derby
- Cycle and pedestrian origin-destination surveys

In addition planning and trip end data were available from national data bases and trip end models (NTEM and TEMPRO) compiled by the DTLR and local planning data from Local Authority sources.

2.3 TRANSPORT SURVEYS

2.3.1 Introduction

This section of the report summarises the surveys undertaken to provide the database for the A453 MMS. A full description may be found in the Travel Survey Report.

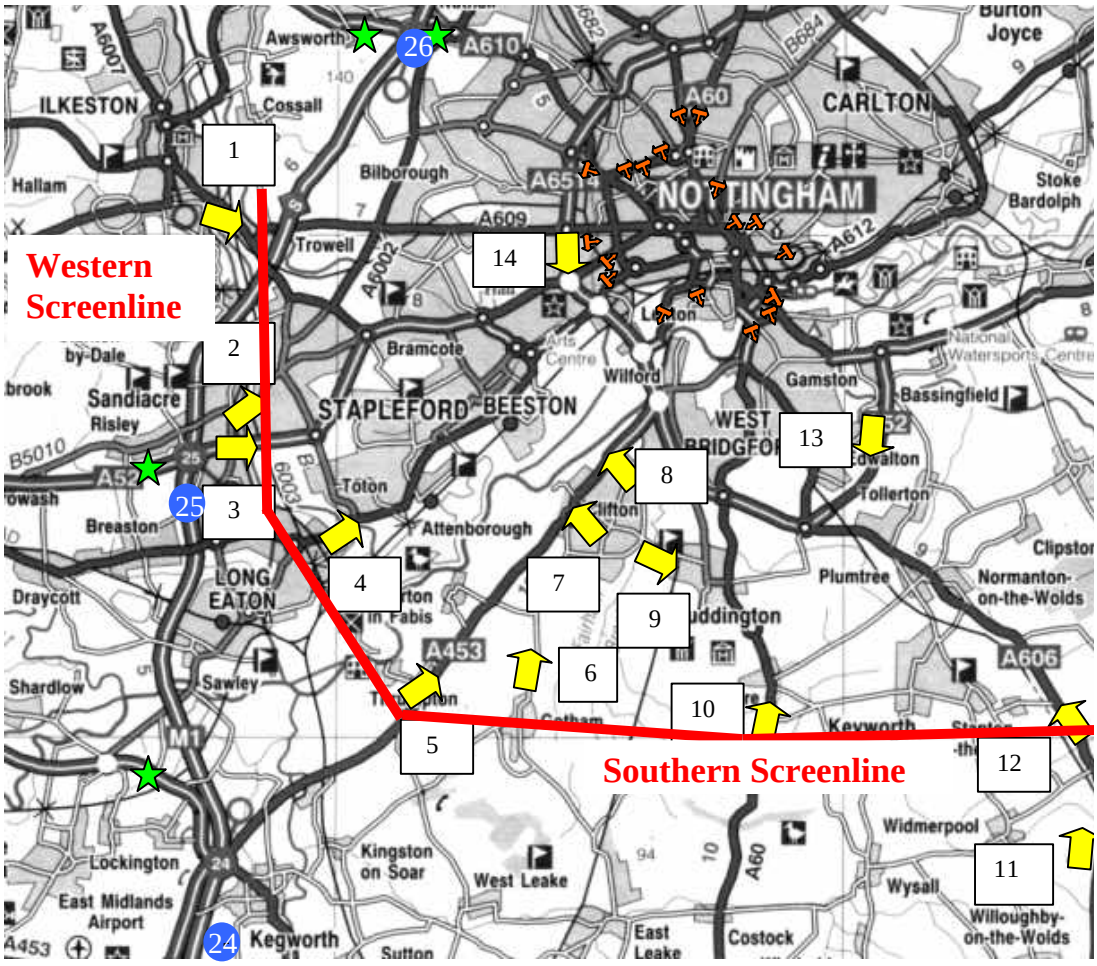
2.3.2 Roadside Interviews

The transport model database includes three sources of road side interviews of motorised traffic. Surveys undertaken for this study (referred to as A453 *RSI*) have been supplemented with results from surveys for the M1 Multi-Modal Study *(M1 MMS RSI*) and also data from the Nottingham City Study (*Nottingham City Council RSI)*. All these data were collected in the period from April to June 2000. An overview of the location of these survey sites is given in Figure 2.3.

2.3.2.1 A453 MMS RSI Survey

Roadside Interviews for the A453 MMS study were undertaken at 14 sites within the study area (Table A1 in Appendix A). On typical weekdays vehicle drivers were asked a number of questions about their current trip or were handed postcards with the same questions and asked to return them by post (postfree) where traffic conditions did not permit direct interview. The data sought included:

- Vehicle category and number of occupants
- Address of the origin and the destination of the trip
- Activity at the origin and at the destination of the trip
- Parking facility at the origin and at the destination of the trip.



Screenline locations

PF (A453 MMS) RSI location (direction of survey)

WSA (M1MMS) RSI location

Nottingham City Council location for postcard based interview surveys (April – June 2000)

Figure 2.3: Roadside Interview Sites

A sample of vehicles passing a site were surveyed during the 12 hours between 7.00 a.m. and 7.00 p.m. However 12 hour manual classified and 24 hour automatic traffic count data was available so that the results for the samples could be expanded to values for the annual average weekday traffic volumes. This process is described in section 2.3.3. Summary survey statistics are given in Table A1 in Appendix A.

2.3.2.2 RSI for the M1 MMS

Simultaneously to the A453 Multi-Modal Study WS Atkins undertook a study for the M1 corridor in the same region. It was agreed that results of traffic surveys should be exchanged between the two studies. In this way it was possible to achieve a broader survey data base for both projects, and avoid duplication.

Summary statistics for the M1 MMS survey sites are given in Table A2 in Appendix A. Local sites are illustrated on Figure 2.3.

2.3.2.3 Nottingham City Council RSI

Concurrent Roadside Interview Surveys were also undertaken on a cordon around Nottingham City Centre by the City Council. The prepaid postal return approach was used for this survey. This data was also made available for the A453 MMS.

A summary of the results is given in Table A3 in Appendix A, and the location of sites is indicated on Figure 2.3.

2.3.2.4 Automatic Traffic Counts

The survey results as described in section 2.3.2 allow in-depth studies of traffic behaviour. However, these roadside interview data form only a sample of the total traffic which is modelled for the 24 hours of an average weekday (AAWT – Annual Average Weekday Traffic). To develop the model it is therefore necessary to expand the 12 or 16 hour counted figures to average daily figures, based upon longer term automatic counts.

In general Automatic Traffic Count sites undertaken for the MMS studies recorded vehicle movements in each direction. Data is therefore also available in the non-interview direction for use in model validation.

2.3.2.5 Estimation of General Expansion Factors

Two further sources of data were available for the estimation of general expansion factors:

- Data from traffic surveys in the City of Nottingham. - In addition to comprehensive traffic data from their UTC system City of Nottingham have also undertaken traffic counts at the river Trent bridges.
- Data from automatic traffic counts for the M1 multi-modal study.

Initially it was assumed that traffic characteristics for interurban motorways and trunk road sites may be different from the urban situation. Expansion factors to the all day period calculated from these two different data sources did not show big differences and are summarised in Table 2.1.

Table 2.1: Expansion factors from the City of Nottingham and M1-study surveys (Daily)

Expansion	City of Nottingham	M1 Multi-modal study
12 ⇒ 16 hrs	1,177	1,166
16 ⇒ 24 hrs	1,073	1,082
12 ⇒ 24 hrs	1,263	1,261

Due to the similarity between the two data sources, factors were derived from the combined data sources and are illustrated in Table 2.2. Furthermore, the other factors for the computation of the AAWT, namely weekly and monthly adjustment factors were available from the City of Nottingham general traffic census.

Table 2.2: Expansion factors for the City of Nottingham and M1-study surveys (Seasonal)

Short period count factors (16 hr, 18 hr and 24 hour from shorter periods)	16/9 hr	1,529
	16/12 hr	1,177
	16/AM peak hr	11,773
	16/PM peak hour	11,898
	18/16 hr	1,040
	24/16 hr	1,073
	24/12 hr	1,263
Daily factors (Day of week to Monday to Friday average)	Monday	1,060
	Tuesday	1,024
	Wednesday	1,003
	Thursday	0,977
	Friday	0,945
	Saturday	1,071
	Sunday	1,475
Monthly factors (Month to average month)	Jan	1,016
	Feb	0,990
	Mar	0,976
	Apr	0,967
	May	0,975
	June	0,981
	July	0,986
	Aug	1,025
	Sep	0,976
	Oct	0,974
	Nov	0,967
	Dec	0,941

2.3.3 Traffic Flows in Model Validation

Directional traffic flows for use in model development and validation from the various survey sources are given in Tables A4 to A6 in Appendix A.

The adjustment factors summarised in Table 2.2 were applied according to the nature of the data collected which is summarised below.

2.3.3.1 ATC Data for the A453 MMS Sites

The 24-hour figures originate from averages derived from counts over two weeks in May and June 2000. The 16-hour MCC figures were counted at the RSI sites on the days of the A453 RSI for the same time periods, whilst the interviews were being conducted.

2.3.3.2 ATC Data for the M1 MMS Sites

The 24-hour figures originate from averages derived from counts over two or three weeks during May and June 2000. The 16-hours-figures of the MCC have been counted on the days of the M1 MMS RSI for the same time period.

2.3.3.3 ATC Data from Nottingham City Council Sites

The 24-hour figures originate from one day 12 hour counts in April and June 2000. The 12 hour MCC data has been expanded using one area wide factor to expand to the 24 hour day and factors for individual sites to adjust for surveys being undertaken on different days of the week and months of the year.

2.3.3.4 Adopted Count Data

Independently collected traffic count data was obained from Local Authority sources to enhance the validation set. These counts were also adjusted to the AAWT model base using the adopted factors. These data are presented in Chapter 6.

2.3.4 Car Journey Time Surveys

Journey time measurements for passenger cars have been undertaken on four routes in each direction for the four time periods AM peak, AM inter-peak, PM inter-peak, and PM peak. In every time period between 5 and 11 journeys have been recorded. Table 2.3 describes the routes which are illustrated in Figure 2.4.

Table 2.3: Routes for Car Journey Time Surveys

No	Connection	Road
1	Nottingham – Spondon	A6005
2	M1 – Nottingham	A453
3	Derby – Nottingham	A52
4	Derby - M1	A6/A50

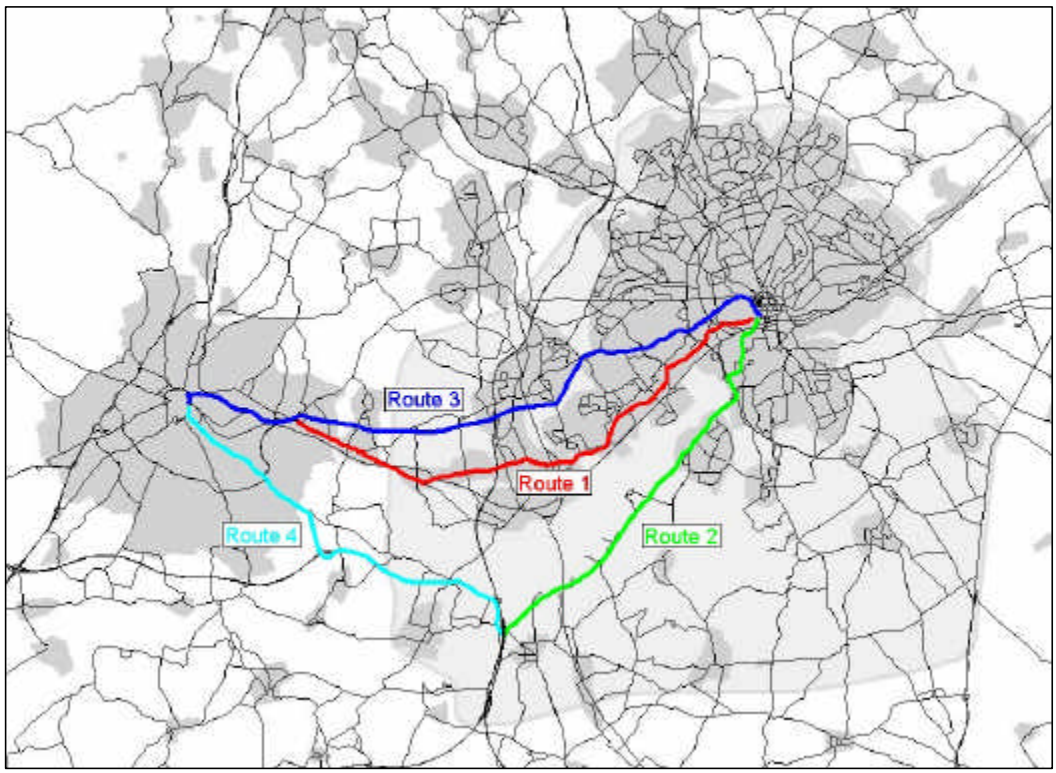


Figure 2.4: Routes for Car Journey Time Surveys

Figure 2.5 summarises the analysis of the recorded journey times. For each direction of the four routes the bandwidth of journey times is given with the minimum value, the mean and the maximum for the four given time periods from AM peak to PM peak.

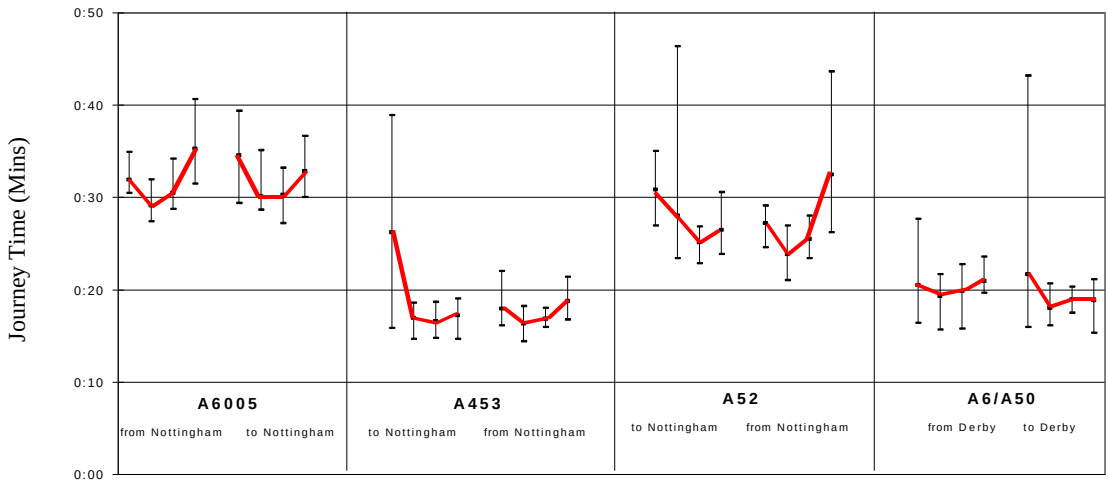
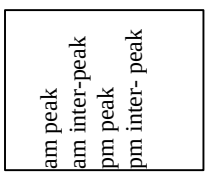


Figure 2.5: Car Journey Times Survey Analysis

Key



2.3.5 Public Transport Surveys

2.3.5.1 Rail Survey

Origin - Destination (OD) Data were received from the M1 Corridor MMS for including: Nottingham, Derby, Long Eaton, Beeston, and Attenborough. These data were used to generate a matrix of OD relations in public transport crossing the borders of the study area.

A supplementary count survey of the number of passengers boarding and alighting selected trains at Nottingham station was undertaken by Pell Frischmann in October 2001 to cover trains not covered by the earlier surveys due to operational difficulties.

Data on through movements by train was also obtained from the M1 MMS study team.

2.3.5.2 Bus and Bus Passenger Surveys

Bus passenger origin - destination surveys were undertaken at screen lines to the south and the west of Nottingham illustrated in Figure 2.6 in June 2000. OD data was collected using the prepaid postal return method. Approximately 2,850 valid responses were received, which is equivalent to 24% of the total forms distributed. The numbers and types (sizes) of buses were also recorded as well as the numbers of passengers.

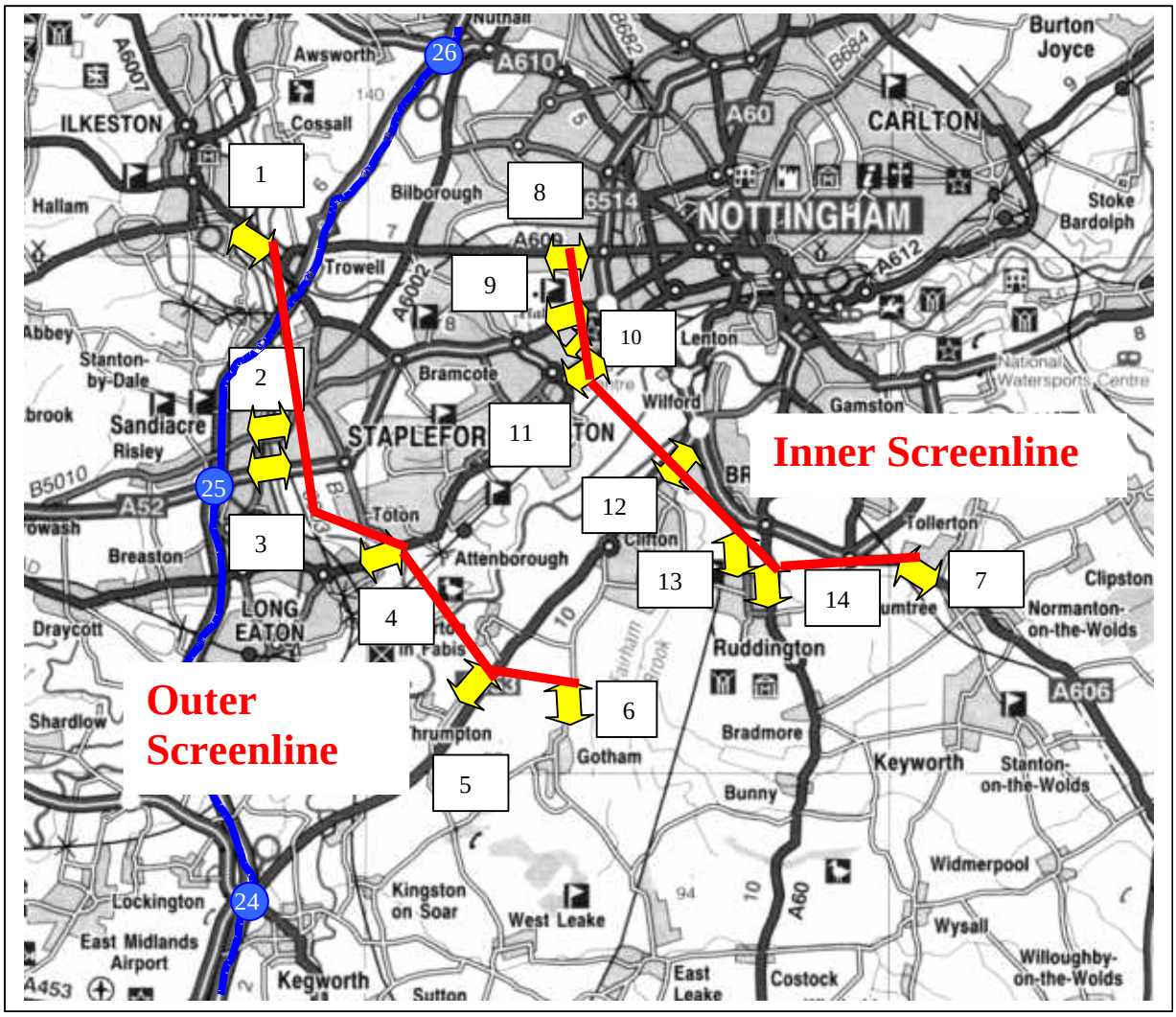
Comprehensive data from Nottingham City Council (corridor counts and bus stop surveys) were also supplied. These data were collected between November 2000 and January 2001 and have been used for model validation to supplement data collected by the A453 MMS team.

The data supplied by Nottingham City Council was collected as part of wider surveys associated with the development of a transport model for the whole of Nottingham. This included OD data collected using prepaid postcards and records of passengers boarding and alighting services at selected stops, including all city centre bus stops. Counts were undertaken at a number of points that coincided with the sites illustrated in figure 2.6, although not all sites were duplicated. In general the inner screenline (sites 7-14) was duplicated more than the outer Screenline (sites 1-6).

Significant differences were found between the results of these two surveys for passenger flows especially across the Inner Screenline. The full reasons for the differences are unlikely to ever be fully explained but the contributing factors are known to include:

- Inherent variability of bus passenger movements.
- Difficulties in estimating bus occupancy from the kerbside when buses could not be stopped.
- Late running services.
- Cancelled services.
- Occasional overwhelming of survey crews.

For some survey sites and in both surveys, there were significant differences between the number of buses recorded crossing the inner screenline and the expectation based upon timetable.Both sets of data were recognised in validation and the process is described in Chapter 6. The Pell Frischmann data is referred to as survey one, and the NCC data as survey two.



KEY

PF (A453 Nottingham) OBI screen-line location

1 **Site number**

Figure 2.6 Bus Passenger Interview Survey Sites

2.3.5.3 Coach surveys

A survey of coach passengers at the coach stations in Nottingham, Leicester, and Derby was undertaken for the M1 MMS and made available to the A453 study team.

The file reported only 677 trips for the 12 hour survey period. Just 150 of these included the postcodes of the origin and destination which could have been allocated to model zones. All of the trips can be summarised as external traffic. Since including these data would have required a separate demand segment for just one hundred trips (to prevent transfers between coach and rail services), it was decided that no coach trips should be included in the model.

2.3.6 Pedestrian and Cyclist Interviews

Origin-destination interview surveys for cyclists and pedestrians were undertaken at a screenline across the corridor located just outside the Nottingham City Ring Road. A summary of survey locations is given in Table A7 in Appendix A.

2.3.7 Survey Analysis

Processing of the survey data to create clean files of interview records with all expansion factors appended has been described in detail in the Survey Report. Building of matrices of external movements for incorporation into the transport model trip matrices is described in section 5.5.

2.4 HOUSEHOLD SURVEYS

Household surveys were undertaken made in two parts, a Revealed Preference (RP) and a Stated Preference (SP) survey with different objectives. While the RP survey aimed at recording actual travel behaviour (e.g. activities, mode choice), in the SP survey the participants were given questionnaires in which they were requested to state their preferences on individually prepared new travel choices in a future scenario.

These surveys comprised the main database for the development of the synthetic demand model covering movements within the GMA. The surveys provided the basis of the development of generation, distribution and modal choice models and is therefore reported in Chapter 4.