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THE GLASGOW RAIL IMPACT STUDY

by

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# THE GLASGOW RAIL IMPACT STUDY

## ABSTRACT

The Glasgow Rail Impact Study is a study of the effects of two rail improvements in the Glasgow area; the modernisation of the Underground, and the linking of the railway systems north and south of the Clyde by the Argyle Line, which allows through journeys and provides new stations in the city centre. The rail improvements opened for passenger traffic in the winter of 1979/80.

The study, which is being conducted by the Scottish Development Department, TRRL and Martin and Voorhees Associates, aims to assess the impact of the investment, including the social effects on different sectors of the population and to measure the effect of the changes in the transport system.

The results from the study will be directly relevant to SDD, British Rail and Greater Glasgow PTE in developing the best use of the new facilities, to Central Government in guiding future investment decisions, and to TRRL in research into forecasting methods.

The main data source for the study is a series of 'before' and 'after' surveys covering households in the corridor affected by the new services, passengers on bus, rail and Underground, and users of a range of activities including shopping, hospital visiting and outpatients, leisure and recreation, and employment.

## 1. INTRODUCTION

### 1.1 *Aims of the study*

The Glasgow Rail Impact Study has been designed to measure and interpret the effects – on travel, activities and land use – of the changes to the rail system in Glasgow which were made in November 1979 and April 1980. The study is being carried out by the Transport and Road Research Laboratory, Scottish Development Department and Martin and Voorhees Associates. Similar studies of the impacts of urban rail systems have been made in several cities in France and in the USA.

### 1.2 *The rail improvements*

The Glasgow conurbation has an extensive suburban railway network. Much of this was electrified during the early 1960s but the electric systems on the north and south sides of the Clyde remained separate. In 1977 the network was carrying 45.1 million passengers per year within the Greater Glasgow PTE area, and patronage was falling.

In November 1979 a new suburban rail link – the Argyle Line – was opened, connecting for the first time the north and south electric routes and joining Rutherglen and the south-eastern suburbs to Partick and the north-western area (Figure 1). With eight new or resited stations and a route passing under Central Station and the major shopping area of Argyle Street, the line was planned to give both improved access to the city centre and to permit direct cross-city journeys.

In April 1980 the Glasgow Underground, which had been closed in 1977, was reopened for passenger service with new stock, reconstructed and improved stations and improvements to the infrastructure (Figure 1). During its final years patronage of the old Underground had declined from 38,700 passengers per day in 1975 to 23,300 per day at the time of closure. Between 1977 and 1980 its former passengers appear to have transferred to bus services although the only special replacement service provided was on the lower cross-river link. The modernised Underground has been linked to the suburban rail network by specially designed interchanges at Partick and at Buchanan Street/Queen Street.

These changes in public transport supply have been accompanied by a revised fares system, a major marketing exercise aimed at promoting an integrated public transport network and some restructuring of bus routes. They have also coincided with the completion, in April 1980, of the M8 – Monklands Motorway running east-west across central Glasgow, and with a major urban renewal programme (GEAR) in the eastern area of the city.

### 1.3 *The need for an impact study*

Total investment in the two rail improvements in the Glasgow area has been some £83m and, as a major provider of these funds, the Scottish Development Department (SDD) is concerned to learn the effects of the changes, particularly in relation to other policies affecting areas or groups experiencing social disadvantage, in order to ensure that the maximum benefit is obtained from this investment. Thus SDD is seeking both quantitative and qualitative assessments of the investment.

On a wider front, comparison of the effects of the public transport changes in Glasgow and in other cities should indicate which effects are locality-specific and which are more generally applicable and should contribute to the growing body of knowledge on the impact of large scale public transport investment.

This report describes the design of the Glasgow Rail Impact Study, including a more detailed description of some of the surveys carried out before the opening of the Argyle Line and modernised Underground.

## 2. STUDY OBJECTIVES

The objectives of the Glasgow Rail Impact Study as given in the Study Definition Report<sup>1</sup> are to:

- i) Record changes in public transport services and accessibility to key activities.
- ii) Describe before and after travel patterns and measure changes.
- iii) Estimate responses of different social groups and assess the investments in relation to social policies.
- iv) Measure changes in activity levels, activity catchment areas and access modes.
- v) Relate changes in land use, property development, residential property values and economic activity to the public transport changes.
- vi) Assist in developing policies to improve the patronage and operation of the new systems.
- vii) Examine costs and benefits.

### 3. STUDY DESIGN

The study design is based on 'before' and 'after' surveys of travel and access to activities, complemented by continuous data on public transport patronage and on land-use change, house prices and similar topics from existing data. The 'before' surveys were carried out in the autumn of 1978 and spring of 1979, while the 'after' surveys were in the late spring and the autumn of 1980. Initial analysis and reporting is due to be completed by 30 September 1981 although it is expected that further analysis will continue in TRRL and SDD for some considerable time, particularly in respect of longer term changes such as land use and property values. It could well prove desirable to repeat some of the 'after' surveys in about 1986 to observe medium term changes in travel patterns, particularly for travel to work, although at present there are no firm plans to do this. The following paragraphs enlarge on particular aspects of the Study.

#### 3.1 *Travel data*

Information on journeys and the people who make them come from a variety of sources, some from specially-mounted surveys and some from existing data. The surveys include:

- i) Survey of 24 hours' trip-making by all members of 2600 households in a corridor following the suburban electric line linking Dumbarton to Hamilton and the circle of the Underground (Figure 2).
- ii) A simplified control survey of travel by 1400 households in areas unaffected by the rail service changes.
- iii) A survey of all passengers on rail services which will be affected by the Argyle Line (involving coverage of 57 stations in the 'before' survey and 64 in the 'after' survey).
- iv) A survey of bus passengers in selected areas along the rail and underground corridors.
- v) A survey of underground passengers ('after' only).
- vi) Counts of rail passengers at selected rail stations immediately before and after opening of the underground.

In addition, existing data can be used to provide a more continuous estimate of the amount of passenger travel taking place. These data include:

- i) Counts of passengers on the British Rail suburban network, using ticketing information from NPAAS (British Rail's National Passenger Accounting and Analysis System).
- ii) Data on the ridership on bus services, from Greater Glasgow PTE and the Scottish Bus Group.
- iii) Road vehicle traffic counts and parking surveys routinely made by Strathclyde Regional Council.
- iv) Counts of cars parked near stations and in the city centre derived from aerial photographs.
- v) Automatic counts of passengers using the Underground.
- vi) Information on bus and train reliability.

#### 3.2 *Data on access to activities*

Most of the information on travel to activities and the use of activities has been obtained from special surveys. These cover a wide range of activities; inevitably, the associated study of the activity itself can only be, at best, superficial. The special surveys are (with sample sizes for the 'before' surveys):—

- i) A survey of journey to work for 2259 employees in firms or organisations in 5 areas of the conurbation.
- ii) A survey of travel factors affecting the search for work by 124 unemployed people contacted outside Unemployment Benefit Offices.
- iii) A survey of 4311 shoppers in 5 areas of central Glasgow, supplemented by counts of pedestrian flows, and in 4 district shopping centres.
- iv) A survey of 1025 outpatients at 10 hospitals/health centres.
- v) A survey of 360 visitors at 7 hospitals.
- vi) A survey of 435 users at 6 libraries.
- vii) A survey of 247 users at one museum.
- viii) A survey of 936 patrons at 4 cinemas at two distinct time periods.
- ix) A survey of 1067 patrons at 4 bingo clubs.
- x) A survey of 2138 students at the two Universities.

The above mentioned activity centre surveys are supplemented by collection and analysis of other data provided by activity centre 'operators'. These include:

- i) Information on monthly turnover, supplied by 140 retail outlets.
- ii) Weekly attendance figures, supplied by 4 cinemas.
- iii) Home location of applicants for membership, supplied by 11 bingo clubs.
- iv) Home location of customers, supplied by a chain of dry cleaners.
- v) Home location of applicants, supplied by a teacher training college.
- vi) Addresses at which persons registered at 4 Unemployment Benefit Offices eventually find jobs, supplied by Department of Employment.

The first two items are being analysed to establish trends and discontinuities, the last 4 items to show any changes in catchment areas.

### 3.3 *Land use data*

There are six main elements within the land use component of the Study.

- i) An important part of the Study is to be aware of the policy initiatives being taken by Local Authorities and other public bodies. For each Authority and each part of the study area a descriptive account of the policies currently applying has been written and will be reviewed every six months.
- ii) Monitoring of planning applications is taking place in an attempt to identify significant patterns of change.
- iii) Environmental change potentially related to rail improvements can show itself in various ways. Traffic flow and parking data are being examined to provide a rough identification of environmental circumstances. The pattern of creation or re-use of vacant or derelict land relative to rail services is being investigated. A simple qualitative survey of incremental improvements in a district shopping centre is being done and updated at frequent intervals.

- iv) In selected study areas the sale price of houses is being monitored, using Sasines information. The Sasines is a register, dating from early in the last century, of all transactions and changes of use of premises in Scotland. No similar register exists in England and Wales.
- v) Unlike the private sector, where pressure in stable areas will be expressed by rising property values, there is no monetary mechanism for expressing rising demand for public authority houses. Instead vacancy rates for selected areas are being monitored.
- vi) Discussions are being held with any individual, body or organisation who appears to be connected with any observed changes in any of the elements described above in order to probe whether the rail changes in fact had any influence and, if so, the nature of that influence.

#### 4. SURVEYS BEFORE THE RAIL IMPROVEMENTS

Space does not allow a description of all the surveys that were conducted in 1978 and 1979, before the opening of the Argyle Line and of the modernised underground. As examples of the procedures adopted, this section describes the household and rail passenger travel surveys, and the surveys of access to health services.

##### 4.1 *Household travel survey*

The household survey was conventional and provided details of one weekday's travel by all members of a sample of households along the suburban rail corridor from Dumbarton to Hamilton and around the circle of the underground (Figure 2). The area to be surveyed was defined as that within 1 km of railway and underground stations. An additional sample was taken from between 1 km and 2 km of two stations (Hamilton and Bearsden).

Within this area addresses were selected randomly from Regional Assessors' rating lists. They were grouped, for convenience of fieldwork, into 55 clusters of about 60 addresses each. The main sample was stratified into 5 bands based on rail journey time to central Glasgow. In each household all residents aged over 5 were asked to supply details of their travel during the previous day, including journeys on foot of more than 5 minutes. The survey also obtained basic classificatory data on the household as a unit and on each individual within it.

The fieldwork for the survey was disrupted by a strike of GGPTTE maintenance staff that caused GGPTTE bus services to be withdrawn for 4 weeks. This was followed by partial withdrawal of rail services on the Dumbarton Line for 6 weeks for engineering work on the Yoker tunnel. Each of these disturbances prevented survey work in some parts of the area thus making it impossible to conduct the survey as planned and requiring heavy investment in fieldwork control and supervision. Despite these difficulties, three-quarters of the household interviews were completed in the autumn of 1978 and the remaining quarter in the spring of 1979. The overall response rate was 84 per cent, although this did vary between 80 per cent and 90 per cent in different parts of the Study Area.

One member of each household was asked to return a self-completion questionnaire giving the journeys they made on the Saturday following their interview. This was less successful with a response rate of only 44 per cent and a lower quality of data.

In addition to the 2598 households interviewed in the areas affected by the Argyle Line and the Underground, a further 1414 households in an unaffected area (essentially any part of Glasgow District outwith the defined rail corridor – see Figure 2) provided shorter interviews as a control sample, a response rate of 88 per cent.

#### 4.2 *Rail survey*

The rail passenger survey was planned to provide data on the characteristics of journeys on the suburban rail network on a Thursday and a Saturday. These characteristics included origin and destination stations, access and egress modes, addresses of start and finish points for the complete journey, trip purpose, household car ownership and driving licence possession by the traveller. It was possible, by careful monitoring of all entrances and exits, to operate a closed-system survey covering 57 stations, and on each of the survey days all rail passengers entering, leaving or travelling within this between 0700 and 1530 hours were given brief self-completion questionnaires at their stations of origin. These were collected at the destination station and, even if not completed, the questionnaires provide data on the origin and destination stations and time of journeys. Counts of passengers boarding and alighting from every train were made at each station together with records of timings. In order to obtain details of trips made in the evening, a short additional interviewer-administered survey of rail passengers was conducted at 8 stations on Thursday evening and 7 on Saturday evening.

#### 4.3 *Surveys of health services*

In order to assess the effect of the improved rail services on travel to hospitals and health centres, two surveys were done: one of hospital outpatients and one of people visiting friends or relatives in hospital.

Those hospitals, health centres and clinics within one kilometre of a relevant station were extracted from a list supplied by Greater Glasgow Health Board, giving a sampling frame of 18 hospitals, 6 health centres and 26 clinics. As with all the activity centre surveys, selection of the sample of centres was influenced primarily by whether they had wide catchment areas and whether access to them was likely to be improved by the new services. No empirical data was available on this but discussions with hospital administrators enabled the sampling frame to be further reduced. Some special purpose clinics were also removed from the sample.

In addition, since the sample did not include any general or long-stay hospitals, one general and one geriatric hospital lying more than 1 km from the nearest station were added to the sample. This made a total of 10 hospitals, health centres and clinics in the sample.

For the outpatients survey, a sample also had to be made of days and times, taking account of the frequency at which different types of clinics were held and the number of patients at each, so that as wide a variety of clinics as possible was sampled consistent with economy in interviewer-hours. In most cases interviewing of outpatients was carried out on 3 days at each centre, and a total of 1025 interviews were obtained.

A similar sampling procedure was followed in the case of the hospital visitors survey; however the selection of times for sampling visitors had to take account of visiting times and within these limits the time when visiting peaked. Preliminary counts were carried out for two days at one hospital at which there was unrestricted visiting in order to determine the times of day at which interviewing of visitors should be conducted. Ideally every visitor

to a hospital on the sample day should have been given a chance of inclusion in the sample. One danger of restricting sampling to selected times is that travel patterns and ease of travel may be affected by the time of day. However it was ascertained that on the two days 83 per cent and 88 per cent respectively of the visitors entered the hospital between 1330 and 1900 hours. The cost per interview of sampling outside these times could not be justified by the increase in the efficiency of the sample. Interval sampling of visitors at hospital entrances was conducted which corresponds to the interval sampling within waiting areas which was done for the outpatients survey. The final coverage of the sample was 7 locations for hospital visitors, at which a total of 360 interviews were done. A number of the interviewing sites for the hospital visitors survey were very unproductive and it was decided not to include them in the 'after' surveys.

## 5. APPROACH TO ANALYSIS

In analysing the large amount of data collected during the impact study, it is not sufficient just to observe differences in travel, activities and land use in the Glasgow area between 1979 and 1980 and, having found some, to try to relate them to the rail investments. The variety of possible changes and of possible causes is too vast, and it is necessary to separate those changes which are due to alterations in the transport system from those due to other causes. In order to do this, the study must be brought to a focus by defining the specific questions which the study will attempt to answer, and the analysis must be organised in a methodical way.

The method used for the closer definition of the Study has been to work through a process of specifying objectives, questions and topics. The starting point was the investment objectives for the Argyle Line and the Underground and the study objectives of TRRL, SDD and GGPTE. From these were developed a large number (almost 120) detailed questions that the Study should attempt to answer. Some questions were phrased in the form of hypotheses about the effects of the investments. The questions have been grouped into topics for analysis. Each topic is the responsibility of a member of the Study Team, each one will be the subject of an individual Working Paper and will also be the subject of a section or chapter of the Final Report. Work on the topic can begin before all the data are collected and has in fact already begun. The complete list of 21 topics, grouped as they are expected to appear in the Final Report, is shown in Table 1, and an example of the questions constituting one of the topics is shown in Table 2.

The second requirement, the setting up of a framework for the analysis of change, involves organisation of the necessarily fragmentary and diverse pieces of evidence which have been gathered over a period of time and from a situation over which the observer has no control. The hypotheses which are to be tested concern the way in which changes in local public transport services affect travel patterns, activities and land use in Glasgow, and it is reasonable to assume that the effects of the rail changes will be most apparent in the catchment area of the stations. So for each station catchment area the following four sets of data are collected and recorded:

- i) primary characteristics of rail services to other stations,
- ii) local access characteristics (ie accessibility to stations including the effect of feeder services),
- iii) trip production characteristics (ie population-related variables) and
- iv) trip attraction characteristics (ie activity-related variables).

If, now, an apparent relationship between one of these characteristics and the observed travel patterns, activity or land use emerges from the preliminary analysis, it can be tested for general applicability by applying it to equivalent activity centres or types of household in catchment areas which are experiencing different rail changes. In other words, it is hoped that the geographical distribution of effects and the relations between effects and accessibility changes will give a clear indication of which differences were caused by transport supply changes and which by other factors. This framework does not presume that relationships exist but enables data to be collected and examined systematically to ensure that if there are direct consequences resulting from the rail changes they can more readily be identified.

This approach to the analysis can be applied to each of the topics listed in Table 1. Thus the study of the use of public transport will draw on data from the rail and bus surveys, the household survey, NPAAS data, estimates of bus patronage and may also include data from the activity centre surveys.

The foregoing has described the first stage of the analysis, which is concerned with the *identification* of changes with reasonable confidence that they are due to the changes in transport investment. The second stage, which concerns the *quantitative description* of how changes in travel, activities and land use depend on changes in transport provision, involves various forms of statistical analysis of the data. It will almost certainly be desirable to explore changes in travel behaviour quantitatively by using behavioural models with small data sets. There is no intention to develop a large transport model for the conurbation or even for the rail corridor affected, but rather to use a small data set to explore the importance of factors such as access distance, time and mode, travel time and cost, alternative mode availability, and so on. The importance of the use of small data sets is to enable many quick, cheap, computer analyses to be made, and to allow the analyst to concentrate on understanding and interpreting the data rather than on mechanical processes of network coding and data cleaning and handling.

## 6. CONCLUSION

This Report has given a broad overview of the Glasgow Rail Impact Study, and described some of its surveys in more detail. Work on the study is due to continue until September 1981.

## 7. ACKNOWLEDGEMENTS

The work described in this Report forms part of the research programme of the Access and Mobility Division of the Transport Operations Department of TRRL. The work is being carried out by a team drawn from the Scottish Branch of TRRL, the Scottish Development Department, and Martin and Voorhees Associates. The valuable contributions made to the study by British Rail, Greater Glasgow Passenger Transport Executive, and Strathclyde Regional Council are gratefully acknowledged.

## 8. REFERENCE

1. MARTIN AND VOORHEES ASSOCIATES, SCOTTISH DEVELOPMENT DEPARTMENT, TRANSPORT AND ROAD RESEARCH LABORATORY. Glasgow Rail Impact Study: Study Definition Report. GRIS Working Paper I, 1978.

## TABLE 1

### List of topics for the analysis

#### Overview

Topic 1: Cost and Benefits

#### Characteristics of the area

Topic 2: Study Area Characteristics

Topic 3: Station Catchment Areas

#### Travel Patterns

Topic 4: Travel Trends

Topic 5: Patterns of Rail Travel

#### Travel for Specific Purposes

Topic 6: Work

Topic 7: Shopping

Topic 8: Education

Topic 9: Leisure and Recreation

Topic 10: Health Services

#### Travel Within the Central Area

Topic 11: Travel within the Central Area

#### Competition Between and Coordination of Modes

Topic 12: Competition between Rail and Bus

Topic 13: Competition between Underground and Bus

Topic 14: Competition between Public and Private  
Transport

Topic 15: Coordination of Modes

#### Transport and Social Policy

Topic 16: Travel by the Disadvantaged

Topic 17: Transport and Social Policy

#### Effect of Transport on Activities, Land Use and Environment

Topic 18: Impact on Activities

Topic 19: Land Use

Topic 20: Environmental Change

Topic 21: Market Forces

TABLE 2

Example of the questions within a topic

*Topic 17: Transport and Social Policy*

17.1 Is accessibility improved for populations rehoused from the central area to peripheral areas? Do they respond to the changes? Do they perceive an improvement?

17.2 Similarly, is accessibility improved for populations of areas of multiple social deprivation adjacent to the rail and underground lines? Do they respond to the changes? Do they perceive an improvement?

17.3 How do changes in traffic volumes in areas of multiple social deprivation compare with changes in traffic volumes elsewhere?

17.4 Do the changes in accessibility affect the way in which groups of the population view a place with a consequent effect on the character of that place?

17.5 Do places where there are populations with high public transport dependency coincide with a) areas of multiple social deprivation, b) areas affected by the rail changes?

17.6 What is the impact of rail changes on unemployment? Are there places where this is particularly marked?

17.7 How are costs and benefits of the rail changes distributed over different geographical areas?



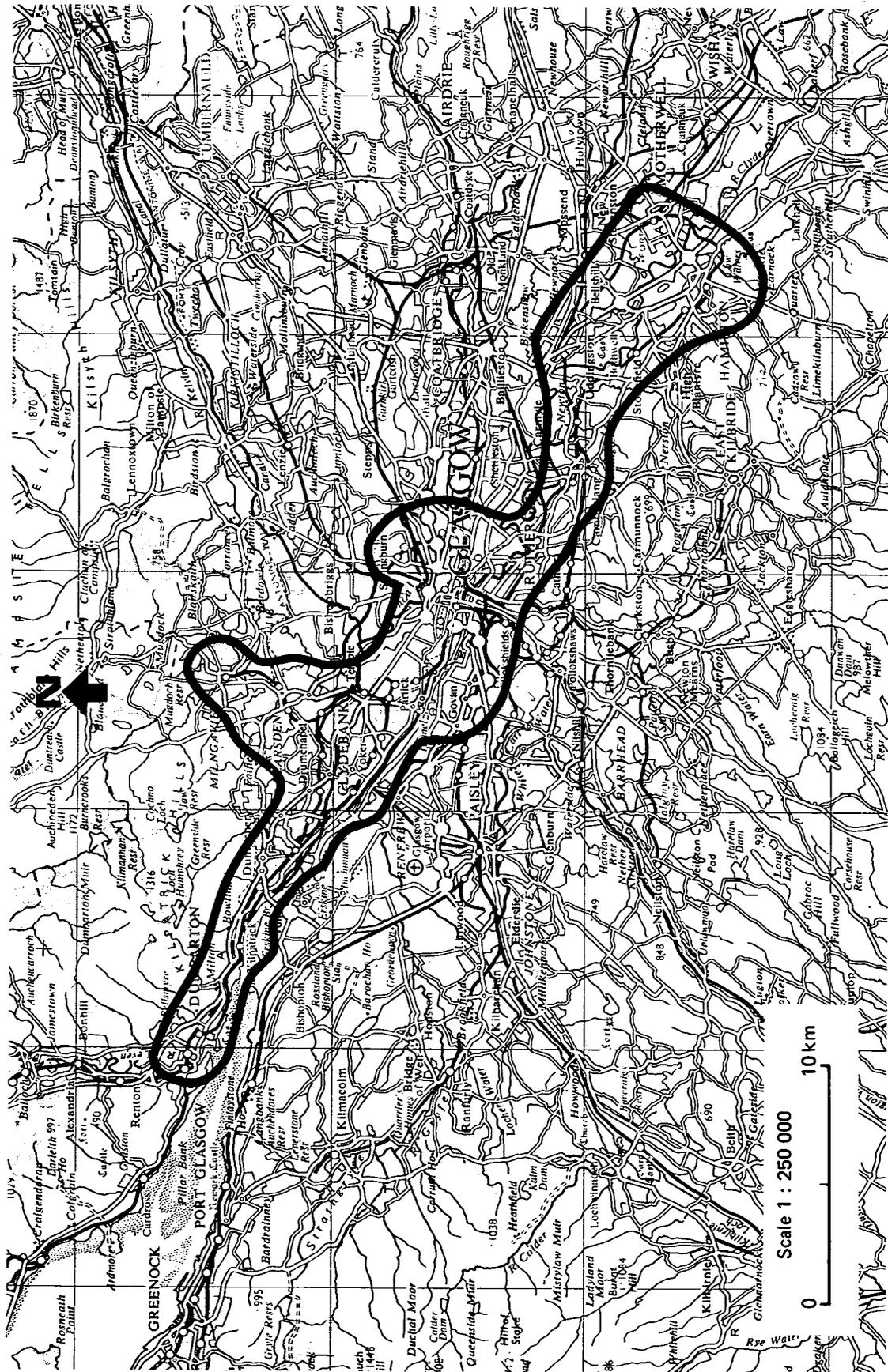


Fig. 2 BOUNDARY OF HOUSEHOLD SURVEY AREA (including areas within 1 km of railway and underground stations, excluding control areas)

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