SCOTTISH EXECUTIVE
Central Research Unit

ACCESSIBILITY: REVIEW OF MEASURING TECHNIQUES AND THEIR APPLICATION

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CONTENTS

EXECUTIVE SUMMARY

Integrated transport policy aims to improve travel choices; and accessibility measurements have the potential to provide an indicator of whether these aims are being achieved. Accessibility measures seek to define the level of opportunity and choice taking account of both the existence of opportunities, and the transport options available to reach them. Good accessibility as a transport objective also carries very broad support from every strand of opinion within society. There are therefore very practical advantages in demonstrating the effects of transport projects and plans in terms of accessibility.

This project considers the need for accessibility analysis in land use and transport appraisal, summarises current practice for such analysis in Scotland, demonstrates the use of such techniques through case studies, and suggests how guidance could widen the use of these techniques.

Current land use and transport appraisal requirements require accessibility to be considered:

- To local facilities by walking and cycling
- To public transport services
- To opportunities such as jobs, education, shops etc.
- As ratios comparing accessibility for different mobility groups
- For the planning of freight transport

To identify the use of, and views on, accessibility analysis in Scotland, surveys were undertaken of 29 relevant organisations to obtain a representative range of views. These surveys identified that accessibility issues were viewed as an important part of integrated transport appraisal, but that detailed guidance would be needed if new techniques were to become an established part of the decision making process.

All accessibility measures relate to a specific location, origin or destination, and include representation of defined opportunities and a separation element between these opportunities and the location. The opportunity terms, deterrence functions and the sizes of the zones for considering accessibility need to be expressed at a level of detail appropriate for the needs of the particular situation.

For the purposes of the practical application of these measures, there are three generic but overlapping types of indicator which can be described as:

- Simple indicators – With these, the representation of transport and/or opportunity within the accessibility equation is simplified by defining thresholds or contours.
- Opportunity measures – These sum all the available opportunities and weight them by a measure of deterrence based upon how easily the opportunities can be reached.
- Value measures – These seek to define the attractiveness of the available opportunities to represent their value as a transport choice.

To illustrate how accessibility techniques could be applied to policy and scheme appraisal in practical situations, four case studies were undertaken: Gartcosh Regeneration in North Lanarkshire; Braehead Retail Park in Glasgow/Renfrewshire; the New Royal Infirmary in Edinburgh; and the expansion of the Robert Gordon University in Aberdeen.

These cover a variety of geographical locations, demographic issues, and type of land use and transport change. Practical approaches to data collection and analysis were identified, tailored to the policy needs of each case study. In each case, origin and destination accessibility is considered separately. Various trip purposes and population sectors are examined using the three main forms of index.

Overall, the case studies confirm that quantitative accessibility analysis using the three main types of index is both practical and useful and has considerable potential for widespread application. Simple measures are fairly easy to understand and are most useful for local walking and cycling trips including assessing access to public transport services. Opportunity measures also have the benefit of being easy to understand since, like the simple measures, they are expressed in terms of number of jobs, number of people etc. They have many potential uses including: the comparison of accessibility changes for different population groups, the identification of the catchment for destination, and the comparison of accessibility for car available and non-car available trips. Value or utility indices are expressed in generalised time or cost so findings can be more difficult to interpret. However by providing a direct measure of the value of transport systems they are powerful appraisal tools.

Accessibility considerations are also important in planning for freight transport. Freight accessibility is best considered by type of distribution premises within the context of the characteristics of the individual supply chain. Strategic planning for freight should ideally model these supply chains using sophisticated logistics software packages. This prospect should be more practical once improved data are available on logistics operations throughout the country. In the meantime, simple analytical techniques can be adopted based upon isochrone and iso-cost maps. These can be used to structure the market area for depots, distribution centres and inter-modal terminals in a way that minimises total distribution costs.

It is recommended that accessibility analysis techniques are progressively implemented more widely within land use and transport appraisal at national, regional and local levels. Uses could include: the definition of transport performance requirements and targets; the development of transport plans; and the evaluation of the impacts of proposals.

As part of this research a software package has been produced to assist with further development of the techniques through practical applications and research.

1. INTRODUCTION

1.1 This report describes research undertaken for the Scottish Executive Central Research Unit to review the application of accessibility measurement techniques in Scotland and to prepare guidelines for good practice.

1.2 The guidance is provided as an Annex to this report, and a software package is also included to enable the various accessibility measures to be calculated easily.

1.3 The research considers the need for accessibility analysis in land use and transport appraisal, summarises current practice for such analysis in Scotland, demonstrates the use of such techniques through case studies, and suggests how guidelines for good practice could widen the use of these techniques.

1.4 The new integrated transport policies bring major challenges for national government, local authorities, developers and transport operators to bring forward approaches to transport consistent with a broad spectrum of public policy. Of particular importance are the links between transport and land use planning. Accessibility considerations describe the links between transport and everything else so have a major role to play in developing these integrated transport solutions.

1.5 Recent research for DETR (Simmonds 1998) has provided a comprehensive theoretical structure for the development of accessibility analysis showing how accessibility measures allow the quantitative consideration of the links between transport and other issues. The research has identified that accessibility techniques could be used either as an alternative to or alongside other analysis, but further work is necessary to develop these concepts towards their practical application in appraisal.

1.6 For major transport projects such as trunk road improvements, there has already been considerable work undertaken to develop traditional analysis approaches towards a more integrated approach. There is now a large quantity of guidance available on modelling for multi-modal transport systems to support more integrated approaches to appraisal (e.g. DETR 2000). Within this new approach a wide range of issues can now be quantified, but analysis of impacts and interactions with other policies and with non-motorised modes continues to be restricted to a qualitative level.

1.7 New national guidance on transport and planning (Scottish Office 1999 - NPPG17, PAN 57) also suggests a more integrated approach within which accessibility considerations are given a more central role for assessing how different modes are affected by land use changes.

1.8 This new appraisal agenda therefore introduces the need for more rigorous analysis of accessibility issues, but there has been limited guidance available on practical techniques. This project aims to provide a practical framework within which accessibility analysis can be pursued within land use and transport appraisal.

1.9 The project team for the work was Derek Halden, David McGuigan, Andrew Nisbet and Alan McKinnon.

2. WHY CONSIDER ACCESSIBILITY?

2.1 The economic and social welfare for any individual is dependent upon the opportunities or choices available to them. The demand for travel is derived from the needs of individuals and businesses to reach opportunities not available at the trip origin. Accessibility measures seek to define the level of opportunity and choice taking account of both the existence of opportunities, and the transport options available to reach them. If the aim of national policy is to improve travel choices, then accessibility measurements have the potential to provide as direct an indicator as is theoretically possible of whether these aims are being achieved.

2.2 Whether or not accessibility measurements are also a practical tool to assist in the planning of transport improvements, depends partly upon the policy and administrative approach to transport. In the past in Scotland there has been a complex mix of weak linkages between transport supply and demand; some managed through various semi-regulated private sector structures and some managed wholly through a political process. The general assumption, although probably impractical, was that transport supply could be maintained through public funding at a quality level which roughly met the perceived demands of the population. The main focus of transport analysis was therefore on transport demand.

2.3 However, the demands of the population have increased to a level that cannot be accommodated in physical terms or matched by public funding, and this has been a key factor in creating pressure for transport policy changes. Within the new integrated transport policies, it is recognised that strong policy linkages are needed between transport supply and demand, and that these should be based upon wider economic, social and environmental objectives. Since accessibility measures provide the links between transport supply and these wider policy areas they are likely to have a major role in helping to define how transport policy objectives can be delivered through practical policies.

2.4 Good accessibility as a transport objective also carries very broad support from every strand of opinion within society. There are therefore very practical advantages in demonstrating the effects of transport projects and plans in terms of accessibility. This is very different from other approaches to transport analysis focusing on demand, where it is much harder to build consensus.

3. THE APPRAISAL CONTEXT

3.1 In considering the development of accessibility analysis techniques it is helpful to start with consideration of the context provided by current appraisal methods for integrated transport in Scotland. In this section, the potential role of accessibility analysis is considered with reference to existing guidance on appraisal for land use and transport as follows:

- Land use planning - NPPG 17, PAN 57
- Transport - including trunk roads, local transport strategies, and public transport funding.

3.2 When looking at the Scottish appraisal needs it is helpful to draw from other work elsewhere in the world, and in particular the new appraisal approaches being developed by the Department of Transport, Environment and the Regions in England. The discussion therefore touches on international best practice where relevant, and English guidance where this is at a more advanced state of development than in Scotland. It is important that the approaches in Scotland benefit from this wider experience whilst recognising particular Scottish national, regional and local administrative structures.

Land use planning

3.3 Accessibility analysis in various forms is widely used around the world in land use planning. These approaches provide specified information relevant to the statutory planning framework so the approach adopted must be viewed within the context of the local legislation. In England, Planning Policy Guidance Note 13 was published in 1994 and this identified the important policy linkages between transport and planning. Various authorities have responded to this by developing accessibility analysis techniques and this has been highlighted in guidance documents as best practice (e.g. IHT 1999). In some cases these authorities have adopted approaches which are in use in other countries. For example the “ABC Location Policy” adopted in the Netherlands (DOE/DOT 1995) matches simple levels of accessibility with the mobility needs of developments, and similar approaches have now been adopted in parts of England (e.g. LPAC 1994).

3.4 A new draft of PPG13 has recently been published and this seeks further strengthening of accessibility considerations within the planning process. This draft suggests that a key planning objective should be to ensure that jobs, shopping and leisure services are highly accessible by walking, cycling and public transport. To achieve this, it is proposed that "regional planning guidance should set a strategic framework for location decisions through the use of public transport accessibility criteria". It is stated that this may involve specifying levels of access, or proximity, to an identified network of public transport routes and interchanges.

3.5 In Scotland, the main statutory requirements for integrating land use and transport planning are set out in NPPG17 and PAN57 (Scottish Office 1999).

These documents specifically identify the need for accessibility analysis in the following situations:

- When ***selecting appropriate sites for development***, "accessibility profiles" are required for public transport, walking, and cycling.
- Within ***transport assessments*** proposed developments should be assessed in terms of both the potential and likely accessibility for people and freight by all modes.
- ***New developments*** should be accessible to bus services, with indicative guidance that 50% of new housing should be within 400 metres, and 80% within 800 metres, of a 15 minute frequency bus service, with other developments generating over 250 return trips per day being similarly accessible.
- Programmes of ***traffic management*** should be developed which boost the "relative accessibility" of locations by discriminating between classes of road user.
- The approach to ***parking standards*** should be based upon securing adequate accessibility to sites by all modes.

3.6 Accessibility considerations will therefore be important for a wide range of planning decisions at national, regional and local levels. However there is little guidance available about the methodology for practical assessments.

3.7 Planning policy guidance for various purposes, defines strategic location characteristics qualitatively (e.g. NPPG8, NPPG15 and NPPG17). If these types of location can be expressed in more quantitative accessibility terms then this could help to support the implementation of the guidance through development planning and development control decisions.

3.8 The above suggests that integrated land use and transport planning decisions will be assisted by accessibility analysis methods which include:

- measures of accessibility by walking and cycling to local facilities
- measures of the level of access to public transport
- quantification of the role of public transport systems in providing practical access to local and strategic destinations
- comparisons of accessibility by car with accessibility by public transport walking and cycling
- considerations of freight accessibility issues

Transport appraisal

3.9 Considerable work has already been undertaken to develop the transport appraisal framework towards a more integrated approach. The Government's five criteria of integration, accessibility, economy, environment and safety have been incorporated in guidance as follows:

- Strategic Roads Review (Scottish Executive 1999) - The current appraisal approach is described in the review explaining the background to current techniques and the plans for further improvements. It is of interest to note

that the review includes a very simple approach to accessibility analysis to assist with project evaluation. Within the economy criterion for each scheme, the average time saved by a vehicle is shown. This type of approach has been commonly used internationally, often using journey time isochrones to demonstrate the geographical distribution of transport scheme impacts (eg Kronbak and Rehfeld 1999, Vickerman 1995).

- Appraisal requirements for local transport strategies (Scottish Executive 1999) - These emphasise that appraisal is essential for rational decision making and helps determine in a balanced way the most efficient allocation of resources. A new approach to appraisal is under development building on the framework established for trunk roads.
- Scottish Office Circular 12/99 inviting Public Transport Funding submissions - This suggests that, for funding decisions, project appraisals should deal primarily with economic and financial issues. It also gives guidance on the appraisal of environmental and social issues, which cannot be evaluated in monetary terms.

3.10 All the above guidance identifies that a comprehensive integrated transport methodology for Scotland is planned dealing with all these issues. Given that accessibility issues are central to the new approach to integrated transport it is anticipated that accessibility analysis will be an important part of this framework.

3.11 The new approach to transport appraisal which has been published in England (DETR 2000) is probably a useful guide to the type of issues which may be included in the new Scottish approach. The English guidance identifies the need for accessibility considerations in several places within the assessment framework. The assumption for current use in England is that these considerations will mainly be at a qualitative level. However it is likely that, as new techniques are developed, a more quantitative approach will prove to be possible. Table 1 identifies the main accessibility measures which are required.

Criterion	**Element**	**Measure/Attribute**
Environment	Health impacts	Access to health services, countryside, social support networks and other opportunities affecting good health.
		Improved public transport accessibility: changes to bus and rail services which affect access to health or recreation facilities
	Quality of journey	Easy access to vehicles, stops and stations and transport reliability issues.
Economy	Economic efficiency	The current view is that accessibility issues are largely covered within cost benefit analysis but an alternative approach for the future could be to use composite utility based accessibility indices.
	Wider economic impacts	Use of accessibility indices as part of examination of positive and negative pressures in approach recommended by SACTRA

Accessibility	Access to the transport system	Accessibility indices to profile the population in terms of their car ownership etc.
		Accessibility indices to describe aspects of the transport system including service frequency, fares, journey times etc.
	Option values	Accessibility indices measure the size of the population affected by the transport option and the scale of the change in the option.
	Severance	Impacts of motorised modes on accessibility by walking and cycling.
Integration	Transport interchange and contribution to resolving transport system problems	Define interchange costs, reliability and quality.
	Land use policy	Consistency with development plan
	Other government policy and integration between local and regional transport objectives	Consistency with health, education etc. policies
	Distribution and equity issues	Study of impacts on different user groups by mode trip, purpose and type of benefit.
	Affordability, financial sustainability, practicality and public acceptability	Revenues and costs from the CBA or Utility analysis

Table 1 - Accessibility considerations transport appraisal - DETR

3.12 Although the Scottish approach to appraisal will be tailored to Scottish circumstances, and the structure of the framework may be different, it is anticipated that many of the same elements will be present within the framework.

3.13 From this analysis it can be concluded that accessibility analysis to support transport policy and project appraisal should include the following elements:

- Measures of transport system accessibility by population sector to: employment, education, recreation, health services, social support networks, and countryside.
- Measures of accessibility to public transport services.
- Accessibility to local facilities by walking and cycling
- Economic appraisal using composite utility calculations.

4. ACTIVITY ON ACCESSIBILITY ANALYSIS

4.1 To identify the use of, and views on, accessibility analysis in Scotland, telephone surveys were undertaken of relevant organisations to obtain a representative range of views. Questions were asked about:

- The main decisions which organisations needed to make
- What analysis methods were used to help make these decisions including the role of accessibility analysis.

4.2 In total 17 local authorities, 2 transport operators and 10 developers and consultants were interviewed. A number of common views emerged as shown in Table 2.

Local authorities	
Key issues and decisions	• Authorities are faced with overcoming the major inconsistency between development plans and new transport policies. Current development plans will significantly reduce levels of access to public transport • There is a need achieve consistency between local and strategic issues. Co-ordinating strategic transport issues within current institutional structures was identified as a particular problem. • Cultural and operational barriers between transport operators and local authorities are a problem. • A challenge was how to define consistent levels of service for transport modes in both urban and rural areas. • Authorities are concerned about increasing fuel costs, since these have major impacts on accessibility and transport plans particularly in rural areas. • Action is considered to be necessary to overcome the incompatibility between national grant aided expenditure funding and integrated transport needs. • Decisions need to take a more consistent approach to parking within transport strategies and transport assessments. • There are concerns about how to achieve access to basic services for less mobile members of the population.
Analysis	• Frequently, decision making is being taken on an intuitive basis. Only the larger authorities seem to have the capability to carry out significant technical appraisals. • Appraisal is still using traditional modelling methods, but adapted to deal with demand management. • Many authorities are requiring green travel plans from developers, but have difficulty in assessing how credible the proposals may be, and how they can be enforced. • 80 per cent of the Councils interviewed are using accessibility methods. Usually these are variations on the simple contour methods. Most are at an early stage in developing techniques. • Decision making tools for bus subsidy allocation seem to be particularly poorly developed. Very few councils have clearly defined criteria. Where they do exist they are rarely needs related. • Guidance on accessibility analysis would be welcomed.

Transport operators	
Forward planning of services	• Traditionally forward planning has sought to follow trends in demand. • There is recognition that changing transport policy creates a greater need for planning but initiatives are fragmentary. There is still very limited staff time available for planning. • Operators do not have the staff to undertake anything other than the most basic forecasting.
Analysis	• The focus of analysis is commercial viability of services. Links are weak with local authority budgetary planning processes although there is potential for developing new commercial services through partnership working. • Rail and air analysis takes account of accessibility to services taking account of planned land use changes. • Bus operators are more interested in the detailed access arrangements than strategic accessibility by bus. However there is frustration that design for the bus is often only considered at a late stage.
Developers and consultants	
Site location issues	• Site catchment is a key issue based upon drive time. However increasing attention is being given to available travel options by all modes. • There is a gap between the NPPG requirements and public aspirations. This creates conflict in determining suitable locations and current development plans are not helpful.
Analysis of transport needs	• There is considerable frustration with the lack of consistency both within and between transport authorities in the approaches to the new transport agenda. This leads to many different approaches to analysis in bringing forward development proposals. • Increasingly analysis within transport assessments includes accessibility by public transport, walking and cycling and this is linked to green transport plans. • Analysis of accessibility to public transport is undertaken at many levels of detail from qualitative assessments to detailed quantitative approaches.

Table 2 - Summary of Survey Responses

4.3 Overall it is clear that there is a need for clear guidance on consistent approaches to land use and transport appraisal which recognises the new transport agenda. Appraisal of land use planning issues is the greatest concern of all groups.

4.4 For local authorities, institutional issues are a significant concern in delivering integrated transport. There is recognition within some authorities that rigorous analysis of potential transport policies could help to build consensus amongst the various stakeholders, but significant technical appraisals appear to be restricted to larger authorities.

4.5 Across the interviews it was clear that different people viewed accessibility in different ways and used a range of terminology to describe the same concepts. A common theme was the need to develop a consistent nomenclature for the different approaches to accessibility measurement.

5. MEASURING ACCESSIBILITY

5.1 Comprehensive reviews of accessibility theory are reported elsewhere (Jones 1981, Simmonds 1998). These reviews define accessibility concepts and explain the many ways in which accessibility can be measured and used.

5.2 For the purposes of the practical application of these measures, there are three generic but overlapping types of indicator which can be described below as:

- Simple indicators – With these, the representation of transport and/or opportunity within the accessibility equation is simplified by defining thresholds (e.g. number of relevant opportunities within a given travel cost, time, etc.; measures of the travel cost, time, etc. required to reach a given number of opportunities; shopping or employment opportunities with more than a defined floorspace or number of jobs etc.)
- Opportunity measures – These sum all the available opportunities and weight them by a measure of deterrence based upon how easily the opportunities can be reached.
- Value measures – These seek to define the attractiveness of the available opportunities to represent their value as a transport choice.

5.3 All accessibility measures relate to a specific location, origin or destination, and include representation of defined opportunities and a separation element between these opportunities and the location. The **opportunity** terms, **deterrence** functions and the sizes of the **zones** for considering accessibility need to be expressed at a level of detail appropriate for the needs of the particular situation. Before looking in more detail at the different types of measures, some comments are made on these three elements of accessibility analysis.

Opportunity terms

5.4 The type of opportunities depend upon whether origins or destinations are being considered.

- Origin accessibility considers the opportunities available to an individual or a business. The opportunity term is therefore usually based upon the land uses at alternative destinations.
- Destination accessibility considers the catchments for a destination. The opportunity term is therefore usually based upon the land uses and type of person or traveller at alternative origins.

5.5 Land uses of interest include:

- Employment, Education and Training – Employment locations, schools, colleges, universities, training centres.
- Health and Social – Health centres, hospitals, social security offices, job centres, post offices.

- Shopping and Leisure – Shops/shopping centres, cinemas, theatres, sports centres, outdoor activity opportunities, centres for religious activity, pubs, clubs.

5.6 Types of person or traveller take account of:

- Mobility – Car ownership, disability.
- Employment status – unemployed, economically active etc.
- Age – Retired, adult, children, etc.

Deterrence functions

5.7 The deterrence function can be measured as time, travel cost, distance, or generalised cost/time. It aims to represent real behaviour and perception of travel. This must include the relative deterrent effect of different types of travel, and the costs associated with each, including issues such as the greater deterrent effect of time waiting for a vehicle when compared with the same time spent travelling in a vehicle.

5.8 It is usually helpful to look separately at the deterrence functions for car available and non-car available trips. Many trips will involve a combination of several modes and for non-car available trips the car options are excluded from the calculation. For example a car available trip to a city centre from a rural area may involve a car element to a park and ride site, a bus element from the edge of the city to the centre and a walk element from the bus terminus to the destination. The non-car available alternative would consider only the public transport, walking and cycling options to reach the city centre.

5.9 However each trip has other characteristics which can make generalisation for the purpose of analysis difficult. The reason for not making a walking or public transport trip may be the need to carry goods, the need to take other people, the weather, the perceived quality of the route including personal security and safety considerations, or simply a lack of knowledge of available options. All these factors can be affected by transport policy decisions, so it is desirable if appraisal can take account of them in a meaningful way.

5.10 To ensure a robust approach, calibration against observed behaviour should provide a firm foundation on which to build. The accuracy of the calibration is heavily dependent upon the quantity and quality of the travel survey data, and this can be expensive to collect. However it is of note that data availability on travel patterns is improving, including surveys to support local transport strategies and the major Scottish Household Survey which includes detailed questions on trip patterns by purpose.

5.11 One further aspect demands comment. Travel patterns are not static, so observations of travel behaviour should ideally take account of trends in trip making rather than simply observed demand. There is no reason in principle why deterrence functions and accessibility indices should not be able to incorporate these more dynamic relationships. Nevertheless, such techniques have rarely been adopted in practice to date although they have been shown

through research to have considerable potential (e.g. Levinson 1995). In the meantime, dynamic accessibility analysis must therefore be considered as a future aspiration rather than a practical prospect.

Zones

5.12 The extent of the zoning system and the level of detail will depend upon the policy issues being examined and how much effort can be afforded on the analysis. Strategic transport improvements will require a wide geographical coverage, but a fairly coarse zoning system may be adequate, whereas a local issue such as the accessibility of a school will require very detailed local representation.

5.13 Reliable data are usually easier to obtain for coarser zones and in practice accessibility analysis will often be able to adopt zoning systems defined within established transport demand models which have generally been designed to take account of the geography of transport networks.

Types of measure

5.14 Table 3 shows how many of the commonly used indices are categorised under each of these three main types identified above.

Index	**Description and Uses**
Simple measures	
Catchment/Contour indices	These count the number of people, jobs, shops etc within a threshold travel cost (distance, time etc.) from a defined location. They are used for a wide variety of planning purposes for both land use and transport infrastructure and are often used by developers to consider the potential commercial viability of a potential development location.
Access to public transport	Rather than looking at transport network accessibility to destinations, these measure walking access time to the public transport services themselves. Walking time or distance thresholds to the public transport services are set and summed across all the available services. The quality of public transport being accessed is categorised on a scale which takes account of service frequency, type of service (i.e. rail/bus/light rail etc.) and service reliability. Although of limited scope, the simplicity of this approach has proved attractive and the calculation and mapping procedures have been automated and marketed by various organisations.
Peripherality indices/ Rural accessibility	These identify thresholds in terms of cost, distance, time etc from defined types of opportunity. These are usually calculated from major centres of population such as towns or cities or public services such as hospitals, but have also been used to study accessibility to transport networks including the European Community Trans European Networks.
Time space geographic measures	These measures simplify travel behaviour and choice in terms of the opportunities available within a limited travel time budget. The threshold is therefore the travel time available for a particular individual or group. These are widely used in logistics planning for freight but are equally applicable to people accessibility issues.

Opportunity measures	
Hansen indices	The simple measures above are all special forms of Hansen indices incorporating thresholds to simplify data or analysis requirements. Hansen indices have had wide application within research and are used within transport models to estimate trip distribution.
Shimbel measures	These are a specific case of the Hansen indices in which all specified opportunities are assumed to have the same weighting. The measure is simply the sum of the cost (time etc.) to each of the opportunities.
"Economic potential" measures	Where the opportunities being considered in the Hansen index are regional incomes, and the deterrence function is measured in distance, then the accessibility index is sometimes described (Keeble 1982) as the economic potential of a location.
Value Measures	
Utility based measures	These measure the value to an individual or group of the choices available to them. The main difference from the opportunity measures is that additional opportunities only provide an increase in accessibility if they provide some additional value. If there is already a surfeit of opportunities available, adding more will result in little change in the index. The normal units of measurement are generalised cost or time and these measures are widely used within transport models.

Table 3 – Types of Accessibility Measure

5.15 Each of the above measures can be expressed in many different ways. The approach chosen will reflect the needs of the particular situation. At its simplest level qualitative descriptions can be used to define the accessibility of a location. Terms such as town centre, rural area, remote area, and "accessible location" can be used as simple qualitative accessibility measures describing locations in terms of the population, availability of local opportunities, and sometimes transport supply. Several National Planning Policy Guidance definitions illustrate this approach.

5.16 However analysis to support practical decision making will usually benefit from a more rigorous approach so qualitative (i.e. good, average, poor) or quantitative indicators are widely used within multi-criteria framework analysis. Indicators can be used to identify: the catchment area for a facility (e.g. shopping centre, fire station, hospital); areas with poor access to particular facilities; and strategic assessment of transport corridors to help define optimum strategies for action.

5.17 This type of analysis often lends itself to Geographical Information Systems (GIS) for presentation and analysis. Since accessibility measures describe the characteristics of a location, origin or destination, GIS are powerful tools with which to present such information in a way which aids decision making.

6. APPLICATION OF MEASURES

6.1 The discussion in Chapter 3 suggests a wide range of uses for accessibility analysis within the appraisal process. Some types of analysis are well established; others are still in the development stages; and some are longer term aspirations. Overall the existing appraisal needs suggest six main types of analysis:

- Accessibility to local facilities by walking and cycling
- Accessibility to public transport services
- Transport system accessibility to opportunities such as jobs, shops etc.
- Ratios comparing accessibility for different mobility groups
- Accessibility for freight
- Economic appraisal using composite utility measures

6.2 This project has examined the use of the first four of these techniques through case studies, as a basis for guidance on practical approaches. Some comments on freight accessibility are also given in Chapter 12.

6.3 Accessibility analysis can be incorporated within transport and land use appraisal as shown in Figure 1. This shows that demand analysis, which in the past was often the primary criterion in appraisal, continues to be an important input to the accessibility analysis. However the new demand management agenda requires that it is accessibility rather than demand which determines the priorities for implementation.

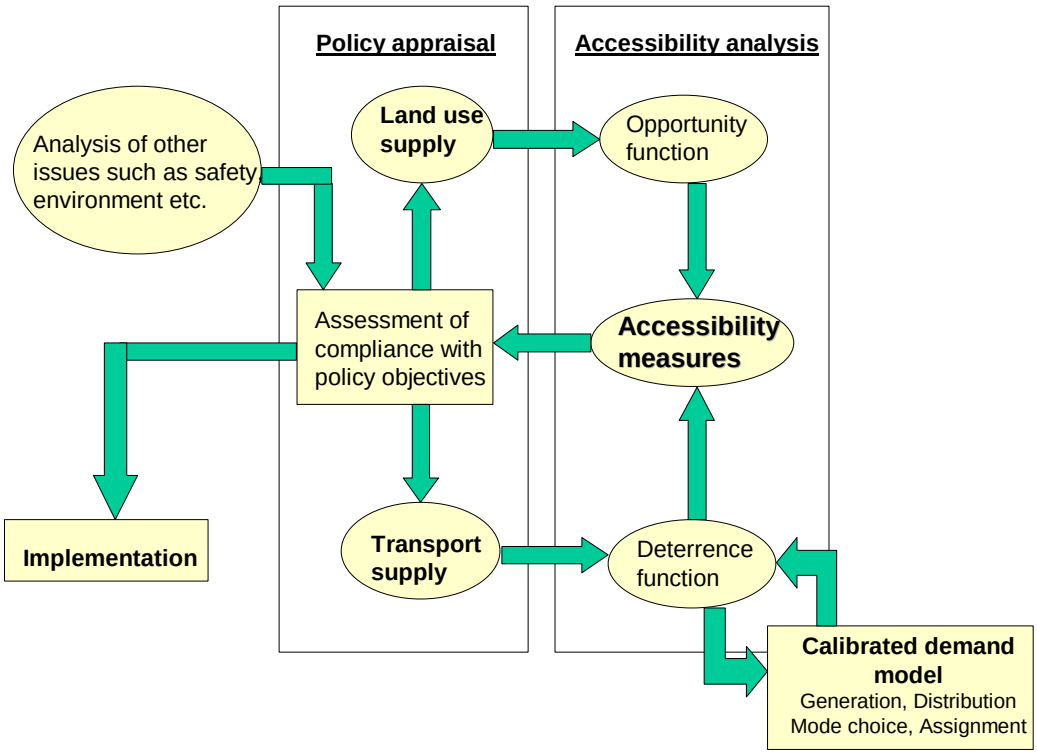


Figure 1

6.4 Before looking in detail at the application of accessibility analysis techniques to four case studies, the general approach adopted to the calculation of each type of accessibility measure is explained below. As noted in Chapter 5 there are many types of measure. The main aim of the case studies is to illustrate basic techniques using Simple, Opportunity, and Value measures, so that it should be apparent how other more specialised approaches can be derived.

Simple Measures

6.3 Various time and distance thresholds have been adopted within these measures. The accessibility measure for a location (i) is calculated as the sum of the opportunities available at alternative locations (j) within the defined threshold.

$$A_i = \sum O_j \, d_{ij} \, .$$

Where $\delta = 1$ if the opportunity is within the time or distance threshold, and $\delta = 0$ otherwise.

6.4 The use of time is the simplest representation of the transport system and has been used for much of the case study work. Where costs such as parking charges or fares have been incorporated, then values of generalised time have been calculated using the standard values of time from the UK Design Manual for Roads and Bridges.

6.5 The choice of thresholds must accurately reflect some aspect of travel behaviour for these measures to be useful. For local access by walking, a 5 minute walk equates to about 400 metres, a 10 minute walk to about 800 metres and a 20 minute walk to about 1600 metres. These can be taken to represent thresholds for a short walk, a normal walk and a maximum walk respectively. Beyond the 1600 metres threshold, very few trips are made by walking (Ecotec 1993). Recent guidance in England (DETR 2000) also identifies 250 metres as a walking threshold for access to public transport.

6.6 For more strategic destinations, thresholds based upon observed behaviour are harder to define, but the use of a range of values such as 15 minutes, 30 minutes and 60 minutes can give useful information. However care needs to be exercised. A major opportunity which is 31 minutes from an origin in a base situation may fall within a threshold within a design situation giving a misleading impression about the real impacts of a transport change. Decisions related to thresholds must ultimately be defined using behaviour specific to local characteristics.

Opportunity Measures

6.7 The Opportunity measure for a location (i) is calculated as the sum of the opportunities available at locations (j) factored by a deterrence function based upon the travel time between i. and j.

$$A_i = \sum O_j \exp\left(- l t_{ij}\right)$$

Where exp(-λt) is the deterrence function, and O_j is the opportunity available within zone j.

6.8 The accessibility of zone i. is the total opportunity, with the units being the number of jobs, retail opportunities, etc. This means that 10 jobs in the zone i. contribute 10 to the employment accessibility index for zone i., but 10 jobs which require 30 minutes of travel contribute only 4.06 jobs to the same index (assuming λ = 0.03).

6.9 In order to achieve the correct sensitivity of the indices to travel time, the deterrence function is calibrated using the λ factor. A higher value of λ means that travel time is more of a deterrent. In many transport models the calibration of λ against observed travel patterns is undertaken as part of the trip distribution stage.

6.10 However accessibility analysis can still be useful without local calibration of the deterrence function, since default values of λ by trip purpose can be used to give meaningful results. It would be helpful if guidance on accessibility analysis could provide appropriate look up tables by trip purpose for urban and rural areas, but this would require more comprehensive research on travel behaviour than can be undertaken as part of this project. In the meantime the adoption of values of λ in the range 0.02 to 0.06 for the simple exponential deterrence function above gives a scale of deterrence compatible with the distribution functions within urban and rural transport models (Halcrow Fox 1995, Halden 1995). For the purpose of the current research, accessibility to jobs, education and hospitals uses λ = 0.03 and for access to shopping 0.05.

Value Measures

6.11 The Value measure for a location uses the same input data as for the opportunity measures but the equation has been transformed so that it represents the value of the opportunities in (generalised) time, or cost. The relatively simple form of the Utility index used in the case studies is as follows:

$$A_i = \frac{1}{l} \ln \frac{\sum \left[\exp\left(l t_{ij}\right) O_j\right]}{\sum O_j}$$

6.12 For the reasons set out in 6.4, time or generalised time has been used in the case studies. The units of the accessibility indices are therefore also time or generalised time.

6.13 It is also worth noting at this stage the potential for utility indices to be used in economic analysis combining the consideration of benefits for motorized and unmotorized travel. Simmonds (1998) notes that "properly constructed composite utilities represent the best measure that transport economics has so far devised to measure the overall ease or difficulty of travel from a particular place, by particular groups of people, for a particular purpose, and that the formula that is obtained from measuring changes in accessibility in this way is identical with the one used to measure changes in user benefit". However the development of a new approach to economic analysis for integrated transport using such techniques is beyond the scope of this project so has not been tested through the case studies.

7. OVERALL APPROACH TO THE CASE STUDIES

7.1 It was considered to be important to demonstrate the use of accessibility analysis through their application on four real life case studies. The survey work described in Section 4 identified the main sources of data which were being used for accessibility analysis. In selecting the case studies it was decided to consider a range of approaches to data assembly covering the typical issues facing practitioners noting that:

- Planning and transport data were available within various forms in many Scottish local authorities. For the central belt, this data had been zoned as an input to the Central Scotland Transport Model and this had been made available by the Scottish Executive to all relevant Councils. Accessibility techniques which can use these data should therefore have wide applicability.
- Geographical Information Systems are increasingly being used by consultants, developers and local authorities. These generally include detailed planning data. With the addition of appropriate transport data, these techniques have the potential to provide comprehensive data sources.
- Even where data was not easily available from either of the above sources, useful analysis should still be possible drawing from other statistical databases which cover the whole of Scotland.

7.2 It was also important to demonstrate the techniques for a balance of geographical locations, demographic issues, and type of land use and transport change. In consultation with the Project Advisory Group four case studies were selected to demonstrate the use of accessibility analysis in practice:

- Gartcosh Regeneration, North Lanarkshire
- Braehead Retail Park, Glasgow/Renfrewshire
- The New Royal Infirmary in Edinburgh
- The Expansion of the Robert Gordon University in Aberdeen

7.3 For each of the four studies, several policy questions have been asked and the role of accessibility analysis in answering them is demonstrated. All the case studies used data readily available from the local Councils.

7.4 The case studies look at various techniques, rather than contribute to practical project or policy appraisal. It must be emphasised that only certain aspects of accessibility have been studied in each case and the analysis does not offer a comprehensive picture of the impacts of plans for project and scheme appraisal. The studies are therefore presented for illustrative purposes only.

7.5 Each case study compares:

- Three alternative ways of measuring accessibility
- Car available and non-car available travel
- The base situation with the effects of some proposed land use or transport changes.

7.6 Table 4 gives a broad overview of the coverage, approach and data sources for each of the studies.

Case Study	Policy Issues	Approach and data
Gartcosh, North Lanarkshire	Economic development and social inclusion	Although major transport models such as the Central Scotland Transport Model and Strathclyde Integrated Transport Model can produce accessibility indices directly, this study demonstrates how simple spreadsheets can be used to calculate accessibility from readily available planning and transport data without the use of the models themselves. Land use and transport proposals identified in policy documents from North Lanarkshire Council have been studied to examine their impacts in accessibility terms.
Braehead, Glasgow/Renfrewshire	Access to shopping and employment	Planning policy guidance on transport and retailing emphasises the importance of location choice. Using input data and zoning from the Strathclyde Integrated Transport Model, this study demonstrates how the characteristics of alternative locations can be defined in accessibility terms.
New Royal Infirmary, Edinburgh	Identifying traffic reduction policies which achieve improved access to healthcare	The relocation of the New Royal Infirmary introduces particular policy challenges to provide good accessibility by all modes of transport and for all groups in society to the hospital's new location. Travel plans for the proposed hospital have identified many possible measures. Using data from the City of Edinburgh Council's geographical information systems, the accessibility of the new hospital has been investigated.
Robert Gordon University Garthdee Campus, Aberdeen	Access to higher education	This study demonstrates how accessibility analysis techniques can be used even if no transport data are available. Using population census data, and estimating travel time by mode, useful analysis can be undertaken to examine the potential impacts of alternative policies to improve accessibility for various groups in society.

Table 4 – Summary of Case Studies

8. GARTCOSH REGENERATION, NORTH LANARKSHIRE

Policy aims

8.1 The regeneration of the Gartcosh area is a major priority for North Lanarkshire Council. Plans involving a mix of land use and transport changes are being brought forward by the Council.

8.2 Regeneration objectives from the local strategy relevant to strategic accessibility include:

- Improving the competitive position of North Lanarkshire for a balance of inward investment and indigenous activity;
- Making a strategic contribution to medium/long term employment land supply in the context of the progressive completion of the Lanarkshire Enterprise Zone sites;
- Removing existing and historic impediments to the successful development of the site for general industry and distribution type uses.

8.3 Overall local transport strategy objectives are to promote a healthy, inclusive and prosperous society. Key themes include:

- Access for all,
- Linking people to jobs,
- Promoting hubs,
- Improving links to surrounding areas.

8.4 Specific opportunities and challenges are identified for the regeneration of sites such as Ravenscraig and Gartcosh to set national standards including for the use of sustainable transport. It is noted that “Gartcosh has unique potential for road and rail access. Effective delivery of these and integration with other modes of transport will offer employment opportunities for many in North Lanarkshire and for our neighbours in Falkirk and Glasgow”.

Project proposals

8.5 North Lanarkshire Council is promoting a mixed use development, with transport improvements, at Gartcosh as part of an integrated approach to regeneration. The main proposals examined in the analysis below are:

- New development bringing around 4,000 new jobs
- 270 new homes
- A new motorway junction providing a direct connection between the site and the M73 Glasgow to Stirling motorway
- A new railway station on the Glasgow to Falkirk line.

8.6 The detailed specification of the test programme and the results are given in Appendix A.

Data

8.7 A review of available data identified that accessibility analysis could be based upon:

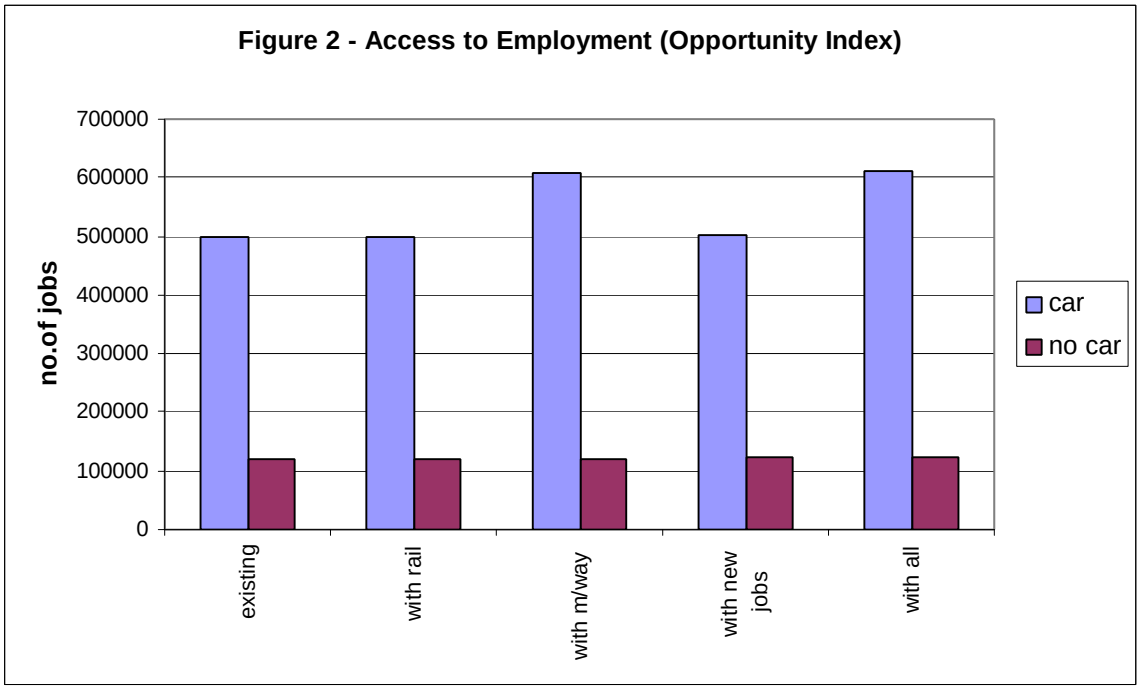
- Planning and transport data from the Central Scotland Transport Model/Strathclyde Integrated Transport Model.
- Regeneration project proposals from the bid to the Scottish Office for Challenge Funding by Gartcosh Regeneration Partnership.
- Rail proposals from a bid to the Scottish Executive Public Transport Fund.

8.8 Zone to zone travel times were estimated for both car available and non-car available travellers by the quickest option. The main components of travel time were car in-vehicle time, bus in-vehicle time, walking access time to the nearest bus stop or train station, and the wait time for the bus or train.

Origin Accessibility

8.9 There are 345 households in the Gartcosh zone and it is informative to look at the impacts of the development for their access to employment including the competitive position of public transport. It can be seen from Figure 2 that this location on the north east side of Glasgow has good access to employment particularly if a car is available.

Figure 2 - Access to Employment (Opportunity Index)

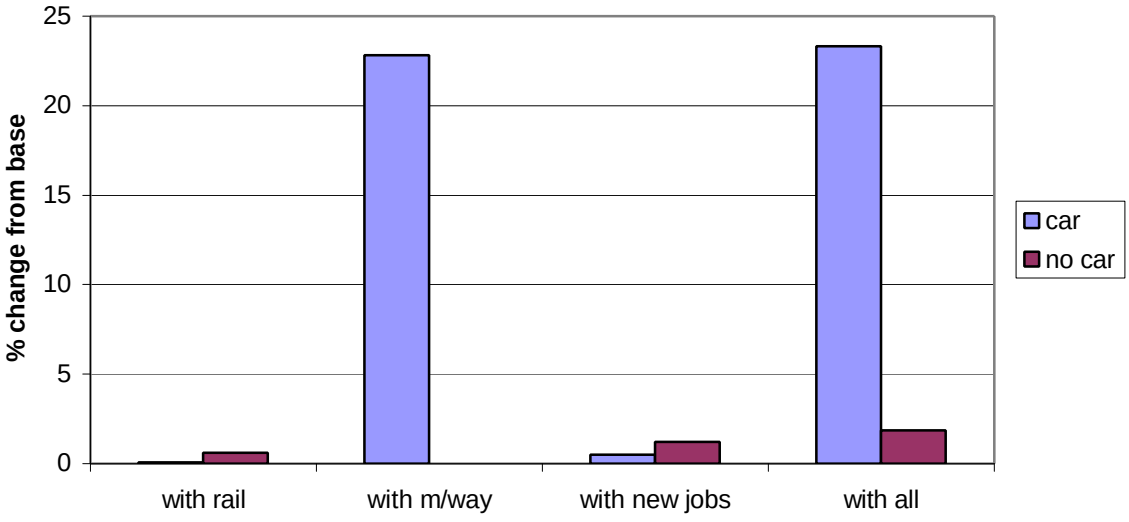


8.10 The Opportunity indices compare the equivalent number of jobs available for people with a car available with that for people with no car available. It can be seen from Figure 2 that if a car is available, the number of equivalent jobs is nearly 500,000. This increases by over 100,000 with the introduction of the motorway junction but only by about 250 with the introduction of the railway station. The main reason for this is that for car available trips, public transport is

not competitive for access to jobs in the existing situation. It should be emphasised that this assumes that free parking is available at the workplace. With the addition of the new station, rail becomes a competitive mode for access to a few zones near the railway station in Glasgow city centre. Analysis for practical project assessment would need to take account of important issues such as the price of city centre parking in order to make robust policy conclusions.

8.11 For people who do not have a car available, the equivalent number of jobs available is much lower, at less than 120,000 but increases by nearly 2,000 with the introduction of the rail station. The motorway junction makes no difference since the responses of bus operators to take account of the new junction are unknown. As can be seen from Figure 3, non-car available trips benefit from the

Figure 3 - Access to Employment (change in value index)



rail station with only a 1% change in the Value index. This emphasises how important in relative terms existing bus services to jobs are, for this out of centre location.

8.12 Two thresholds were considered for the Simple analysis: the number of jobs within 30 minutes travel time and the number of jobs within 30km distance from Gartcosh. The distance threshold is not particularly useful as it cannot take account of the characteristics of the transport systems. The 30 minute threshold has no particular basis in travel behaviour but it is interesting to note that 379 of the total 597 zones are considered to be accessible by car within this time. This covers a population of nearly 1.5 million people.

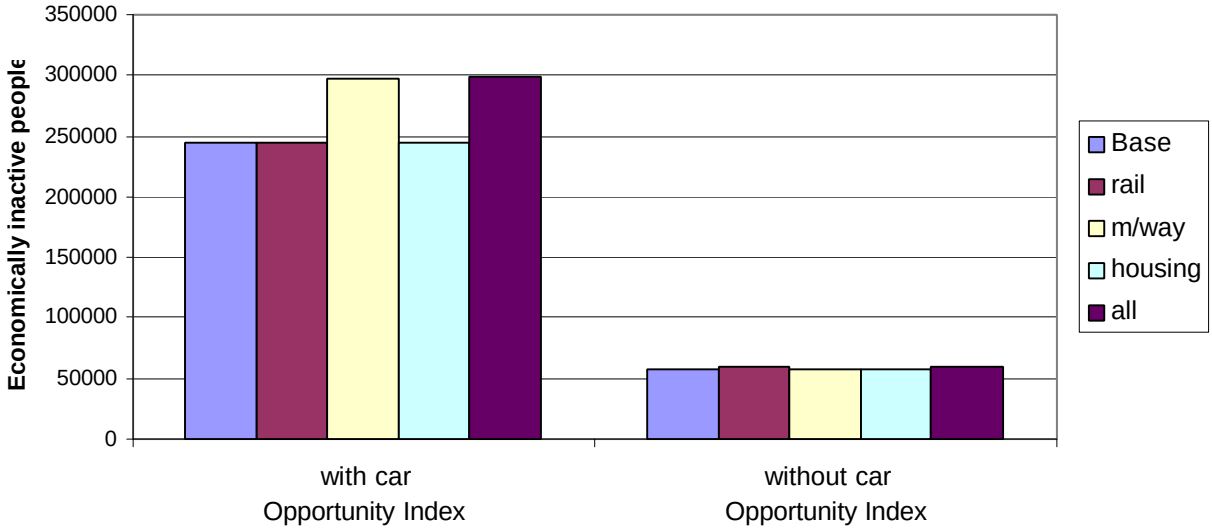
Destination Accessibility

8.13 To test how effective the Gartcosh proposals are at working towards the local Council's transport strategy aims of: access for all, linking people to jobs, promoting hubs, and improving links to surrounding areas, it is important to look at accessibility for each population sector. The impacts of the road, rail, housing and jobs developments are therefore tested individually and in conjunction for

economically inactive people, economically active people, all adults, and households by car ownership characteristics.

8.14 The Opportunity or Value indices can be directly compared with other competing sites to assist with location policy decisions or used to assess the impact of alternative schemes at Gartcosh. Test 5, 6 and 7 look at the impacts of the various elements of the Gartcosh proposals. In Test 5, the Simple index identifies that there are over 700,000 economically inactive adults within the modelled area. It is not known from the data which of these people have a car available so Opportunity indices are shown in Figure 4 showing accessibility indices for car available and non-car available people.

Figure 4 - Economically Inactive People Access to Gartcosh



8.15 It can be seen that there is a large catchment of economically inactive people for the Gartcosh development. As might be expected, the rail improvements make only a very small increase of just over 800 people in the catchment given that relatively few zones are significantly affected by the change. However if a car is available, the motorway junction improves the index by 53,000 people.

8.16 The impacts of the various options by population sector are compared in Tests 7-11. The trends are very similar for all groups indicating that the proposals do not introduce major inequities. However this also indicates that if the improvements are intended to have a greater impact on disadvantaged groups, then transport improvements would need to be brought forward to particularly target these groups. This might include introducing new bus services to areas of high unemployment. Such proposals could be developed as part of the travel plans for the businesses at Gartcosh.

9.0 BRAEHEAD RETAIL PARK, GLASGOW/RENFREWSHIRE

Policies

9.1 Braehead is a major out of town shopping and leisure development on the western outskirts of Glasgow. Transport appraisal in support of planning decisions for shopping centres such as this can offer significant challenges. Among the many issues which planners need to consider are:

- The impacts on accessibility to shopping which the development makes to each group in society.
- The competitive position of public transport as a mode of transport to the site.
- The impact of the development on the local economy.

9.2 This case study aims to illustrate how such issues can be studied. Accessibility indices are useful for both site selection and scheme design to ensure that optimum locations are chosen and that public transport can be competitive for as many trips as possible.

9.3 Since the policy issues focus on the comparisons of locations for shopping, and comparisons of accessibility between different groups of people, ratios of accessibility are particularly useful. These allow direct comparisons to be made between different locations and different groups which can be particularly valuable for certain types of decisions. For example a car available person will always have better accessibility than a non-car available person since they have an additional mode available. Plans which significantly reduce the ratio of car available accessibility to non car available accessibility can help to develop more equitable and efficient patterns of land use and transport.

9.4 In addition to looking specifically at Braehead, the accessibility indices are compared with equivalent indices for Glasgow City Centre and Rutherglen sub-urban centre. This gives an indication of the range of accessibility to existing shopping centres and the context within which new accessible retail opportunities at Braehead are being planned.

Data

9.5 A review of available data identified that accessibility analysis could be based upon:

- Planning and transport data from the Central Scotland Transport Model/Strathclyde Integrated Transport Model.
- Transport assessments for development at Braehead.
- Retail impacts assessments for the development.

9.6 Unfortunately, the developers did not release the transport assessments and retail impact assessments for use as part of the research. The analysis below is therefore based largely upon the transport modelling data. Overall retail floorspace within business parks in the relevant area was also made available.

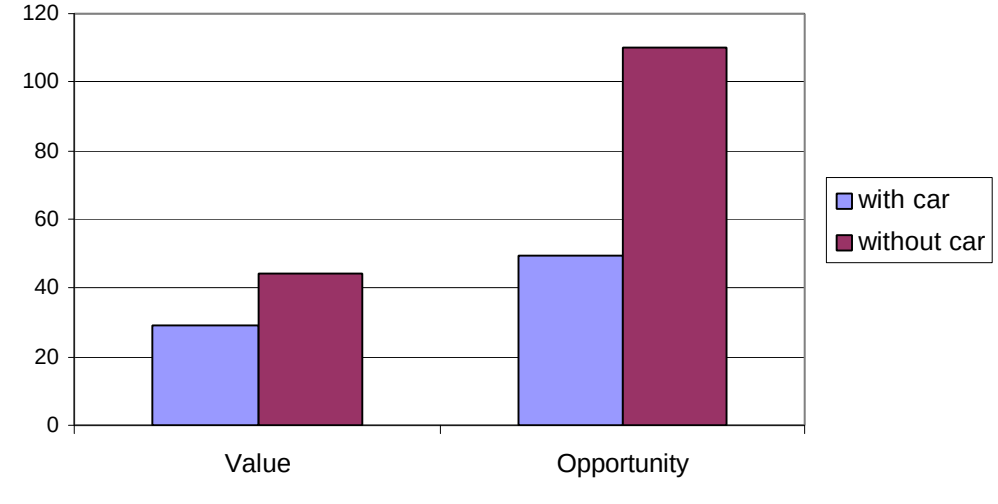
9.7 Detailed results are given in Appendix B.

Origin accessibility

9.8 There are 143 households in the Braehead zone and the origin accessibility measures can help to identify the impacts of the Braehead shopping complex on their access to shopping and employment. Looking first at access to shopping opportunities, two different measures have been adopted: the floorspace within major retail centres such as Glasgow, Greenock, Paisley, East Kilbride, etc.; and the number of retail jobs (as a proxy measure for all shopping opportunities). In practice, shoppers for comparison goods, are likely to perceive their opportunities in terms of access to the major shopping centres even though there are many other opportunities to purchase the same goods in other smaller centres.

9.9 Figure 5 compares the impact of the developments on accessibility to shopping for car available and non-car available households. Indices are also given in Appendix B for access to comparison goods shopping centres and for all retail opportunities.

Figure 5 - % Change in Accessibility to Comparison Shopping



9.10 Those with a car available, benefit from significantly improved accessibility to all shopping with a 6% increase in the Value index and an 11% increase in the Opportunity index. For those without a car available the increases are much larger at 11% and 36% respectively. The relative changes are much higher for comparison goods shopping centres, particularly for non-car available households. This is of course an extreme case with a major shopping centre being located within the origin zone.

9.11 Employment considerations are also of major importance in location decisions for a major new shopping centre. However Test 3 indicates that there is already good accessibility to employment for Braehead residents, so the new jobs only make small overall changes in the indices. This confirms the findings of many

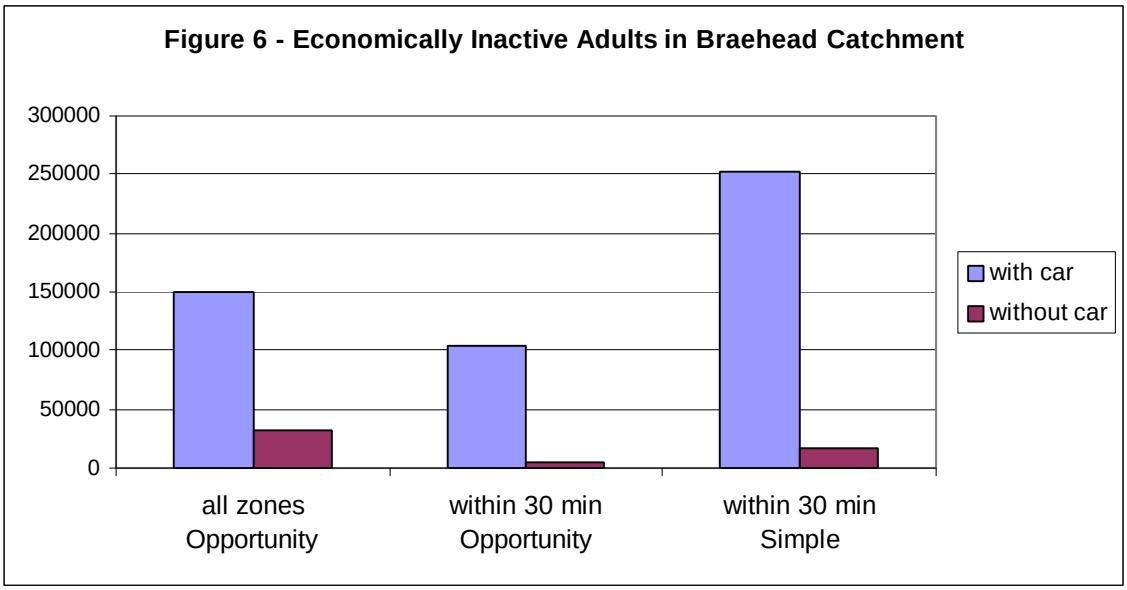
studies looking at travel to work patterns (e.g. Dasgupta 1994). Simply locating jobs near to housing will not introduce significant pressures for residents of the housing to work locally even for non-car available households. Overall employment effects are significant in terms of the overall employment supply as discussed below.

Destination accessibility

9.12 The success of the new development in serving the shopping and employment needs of the Greater Glasgow area can be examined by looking at its catchment and the accessibility of different population groups to the site.

9.13 In Test 5 the Simple index indicates that there are over 700,000 economically inactive adults within the modelled area. It is not known from the data which of these people have a car available so Opportunity and Simple indices are shown in Figure 6 showing values for car available and non-car available people.

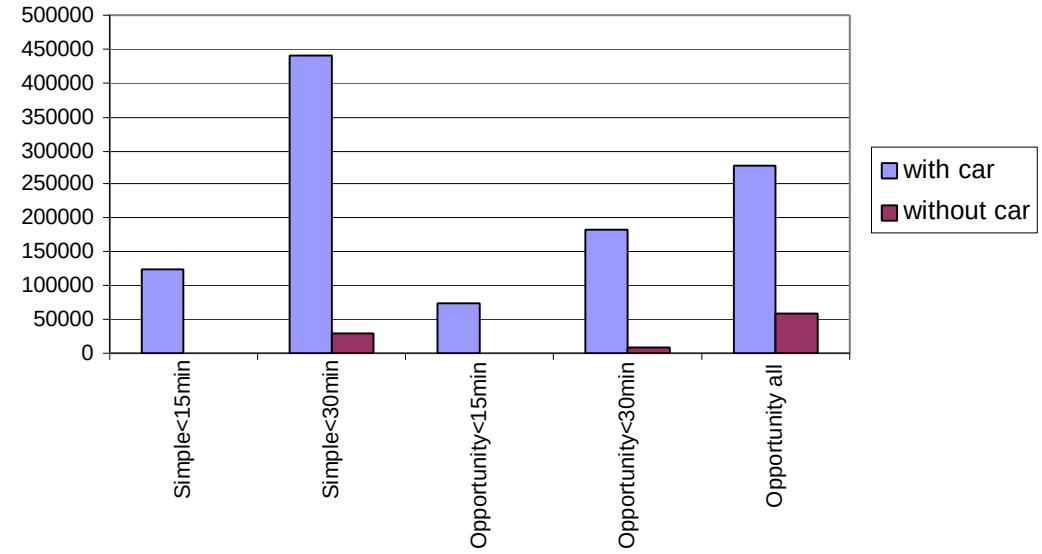
Figure 6 - Economically Inactive Adults in Braehead Catchment



9.14 From these indices, a developer could conclude that at least 30,000 economically inactive people could be considered to be accessible to the development, growing to around 150,000 dependent upon car ownership. This type of conclusion would be very useful for comparison with other potential retail sites. It can also be seen that although the data requirements of the Simple index are similar to the Opportunity index, the wider range of uncertainty is much less useful for practical policy making.

9.15 The potential catchment for shoppers is perhaps best seen from the household data. Figure 7 shows the Simple and Opportunity indices for: all zones, and travel time thresholds of 15 minutes and 30 minutes. The Opportunity index of nearly 277,000 for car available households can be compared with the index for other potential sites and provides a much more accurate indication of the catchment given the large differences in the 15 and 30 minute thresholds for the Simple indices.

Figure 7 - Household Access to Braehead



9.16 These figures highlight that accessibility is much poorer if a car is not available. In order to meet policy objectives for public transport to be more attractive, a developer may wish to test alternative options for improving public transport. It is helpful to compare the Braehead location with Glasgow City Centre and Rutherglen Town Centre in the suburbs of Glasgow as shown below.

Ratio of Hansen indices	**Glasgow**	**Rutherglen**	**Braehead**
Accessibility by car/accessibility without car	1.52	3.70	4.46

9.17 Accessibility for those with a car available will always be better than accessibility for those without a car since the car available trip has an additional travel option. However, the relative advantage of the car falls as public transport improves, and in city centres this ratio is often as low as 1.5. It can be seen from the table that the good public transport to Glasgow city centre achieves this level.

9.18 Glasgow City Centre is one of the most accessible locations for travel by public transport in Scotland, and new developments cannot expect to be as accessible as this. However, transport assessments for new development, could usefully make comparisons such as the one above with a view to bringing forward transport or location changes for proposed developments to achieve target ratios consistent with planning and transport policy aims.

10.0 NEW ROYAL INFIRMARY, EDINBURGH

Policies and proposals

10.1 There are major changes taking place in healthcare in Edinburgh including the relocation of many hospital services on a new site in the south east of the city. This decision raises a number of transport challenges to:

- Ensure that all sectors of the population can have good access to the new hospital.
- Provide adequate public transport, walking and cycling services to the site.
- Ensure that the development is consistent with the traffic reduction policies of the City of Edinburgh Council.

10.2 If the Council's targets to reduce traffic levels by 30% by 2010 are to be met then the new hospital, as a very significant attractor of trips, will have a major role to play in helping to develop public transport, walking and cycling alternatives. An important step has been to develop a transport plan for the new hospital with a range of measures to manage car traffic to the site and parking on the site within severe constraints.

10.3 The detailed package of measures for implementation within the plan is still being devised but will almost certainly include:

- Improvements to walking and cycling routes in the immediate area around the hospital.
- Improved bus services to the city centre and other peripheral areas.
- Parking management including the application of charges for at least some users.

10.4 The New Royal Infirmary (NRI) will attract about 10,100 trips per day (Royal Infirmary 1997). In order to restrict the number of car trips, action is required on a number of fronts. It is not economic to improve public transport to all wards within Edinburgh to a standard that will be competitive with car travel so it is important to be able to prioritise improvements for those wards with the greatest accessibility need. This research looks at the accessibility impacts of the decisions which have been made on the transport provision for the NRI.

10.5 The detailed test programme and results is set out in Appendix C.

Data

10.6 Edinburgh Council maintain a database for the City on a geographical information system. This includes detailed planning and transport data. For this case study, data was extracted at ward level showing the population by age group, employment characteristics and car ownership data in addition to the travel times by mode to and from the NRI site. For this study only the impacts on the City of Edinburgh have been considered. There will also be significant impacts on neighbouring Council areas such as Mid Lothian, which would need

to be considered within practical scheme analysis, but this analysis covers only the Edinburgh issues.

10.7 Detailed analysis of staff and patient travel is contained in several reports for the Hospital Trust. These focus mainly on travel demand issues by mode looking at the possible impacts of alternative measures. The draft travel plan for the hospital site has been used to look at how the proposed changes in transport supply affect accessibility for different groups within the Council area.

Origin accessibility

10.8 Origin accessibility has been calculated for each of the zones in Edinburgh for access to the NRI by each mode. The impacts of the proposals are shown in Appendix C Figures C1-C13. This analysis identifies that if none of the actions in the Travel Plan are implemented then for car available trips, car will be the optimum mode for access from all zones. For most zones, cycling is the next most competitive mode, followed by bus and then walking.

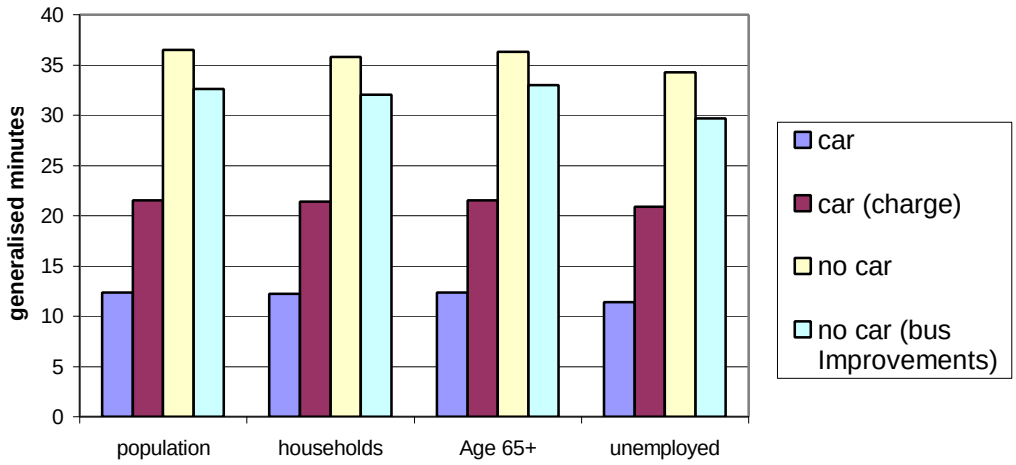
10.9 The introduction of parking charges for staff, patients and visitors is to make bus travel and cycling more competitive. For staff, cycling becomes the optimum mode for most zones inside the City Bypass and bus becomes more competitive than car for a significant population in east and central Edinburgh. For patients and visitors the effects are much less marked with only a small area in eastern Edinburgh becoming competitive by bus.

10.10 Introducing the new bus services to the City Centre, also linking with the University Kings Buildings, has a small effect, but when combined with the parking charges at the NRI the effects are very significant. The direct bus services from the NRI to other peripheral areas have a significant effect in increasing the number of zones where accessibility by bus to the NRI can be described as reasonable with an index of less than 45 generalised minutes. However it should be noted that the lower levels of demand from these peripheral areas may mean that the cost of subsidising bus services to these areas is high. As shown in Figure C11, the combined bus improvements and parking charges result in bus becoming a competitive mode for most zones within the City Bypass for staff.

Destination accessibility

10.11 NRI needs to be accessible by public transport for a wide range of non-car available groups in society. Figure 8 shows that elderly people have a similar level of accessibility to the NRI as the population as a whole. However the distribution of the unemployed population in Edinburgh means that they have better accessibility to the NRI site by all modes than the average for the population. Also the introduction of the improved bus services produces a larger improvement for unemployed people than for the overall population.

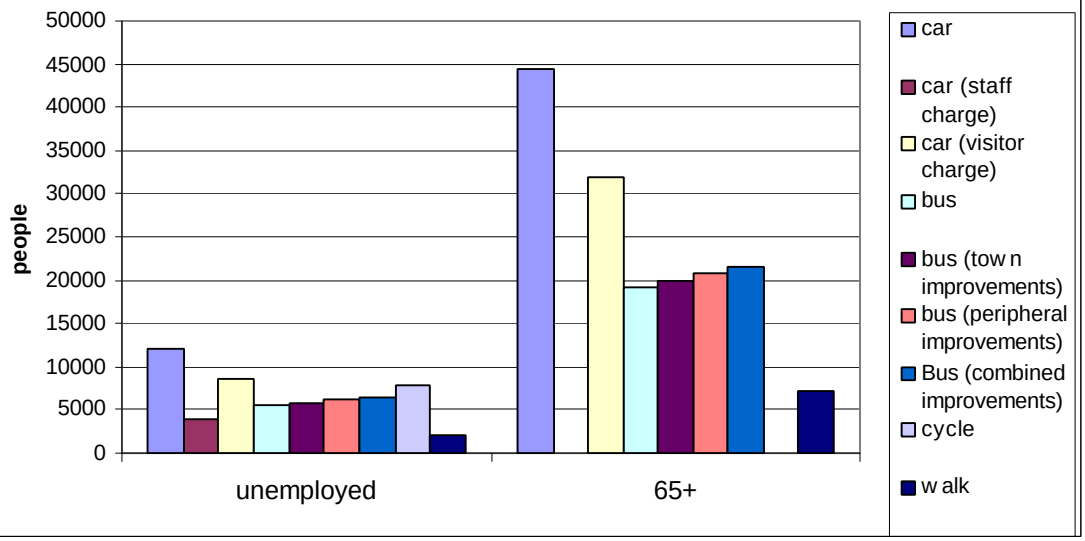
Figure 8 - Value Index by Population Group



10.12 If a car is available then overall it remains the most competitive mode for patient and visitor transport even when a car parking charge is introduced and improved bus services are provided. However the changes in the indices when these improvements are made indicates that they are having an effect on a section of the population.

10.13 It is also useful to look at how the accessibility indices change with the transport proposals for each of the affected population groups. Figure 9 shows the effects of the proposals for unemployed and elderly people.

Figure 9 - Opportunity Indices for Unemployed and Elderly People



10.14 There are more elderly people than unemployed, so the absolute values demonstrate this difference in scale. Other trends are very similar confirming that the parking charge is the single most important change if accessibility by cycling or bus is to become competitive with car travel.

10.15 The new bus services to peripheral areas improve accessibility for unemployed people by 13% compared with only 4% for the town centre service enhancements. This compares with equivalent figures for the whole population of 10% and 4% and 8% and 4% for the elderly. It can be seen from this that new bus services to peripheral areas are likely to have a greater impact on accessibility if targeted at particular population sectors.

10.16 Simple indices show that the walk in catchment is substantial with 7900 people within 30 minutes walk of the hospital. Looking at the different groups, 2.5% of unemployed people in Edinburgh live within 30 minutes walking distance compared with only 1.9% for the population as a whole. 18% of the entire population of Edinburgh are within 60 minutes walking time of the NRI, so walking has the potential to be a widely used mode of travel if sufficiently attractive routes can be provided. The perception of routes and local obstacles is not easy to quantify but can be resolved through joint working with the local community.

11. ROBERT GORDON UNIVERSITY, ABERDEEN

Policies and proposals

11.1 Aberdeen City Council has a transport strategy, which seeks to reduce the number of car journeys and to promote walking, cycling and public transport use. As a major employer and trip attractor, the Robert Gordon University (RGU) needs to ensure that its travel plans are consistent with this strategy for the city.

11.2 RGU is based at three main sites, two of which are in the city centre and the third, Garthdee in the western suburbs. The university is expanding and much of this expansion is based around the Garthdee campus. In order to ensure consistency with the Council transport strategy, transport assessments for the new buildings at Garthdee have suggested a number of improvements to public transport and cycle facilities.

11.3 In order to manage the implementation of these measures a consultation draft of a green transport strategy has been prepared for the University. This identifies a number of possible measures to improve the accessibility of the Garthdee Campus including:

- Upgraded walking and cycling paths
- A new shuttle bus between the Campus and the City Centre/Schoolhill Campus.
- Fare discounts or subsidies negotiated with the local bus companies (40% reduction in generalised travel time tested).
- Parking restraint and charges, and an associated residents parking scheme.

11.4 These measures should offer some degree of improvement in accessibility to the site by public transport walking and cycling. Accessibility analysis can assist in quantifying the level and scale of these improvements, identifying the distribution of the benefits by population sector and geographical area.

Data

11.5 No suitable traffic or transport model is available for the area. The Council's strategy has been developed using a three zone model, covering the city centre, suburban zones and Aberdeenshire. This level of detail in zoning could be used for accessibility analysis but it is much more informative to adopt a finer zoning system.

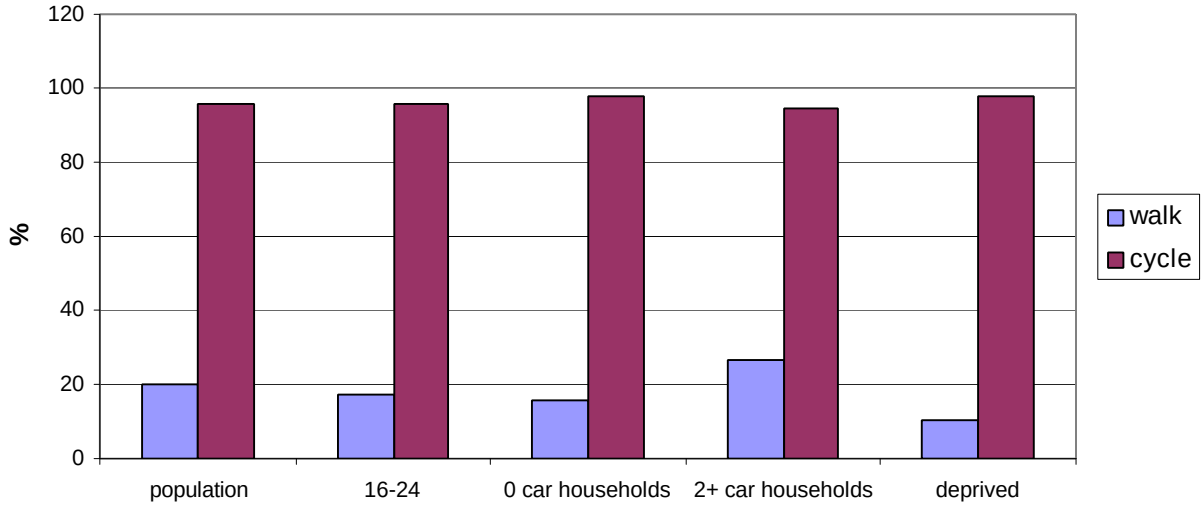
11.6 Ward boundaries were therefore adopted to define 50 zones in the city. Planning data for these zones was readily available from published Council information sheets, profiling the population and household characteristics in each zone. Data for people on income support were also available so this has been used to estimate a deprivation index.

11.7 Transport data were estimated using road distances between zone centroids scaled from a plan. Based upon typical speeds for each mode, travel times between zones were estimated for car, bus, walking and cycling. The bus times took account of bus routes across the city. This very simple representation of the transport system could clearly be improved upon for practical analysis. Nevertheless, even this basic data allows some useful analysis.

Destination accessibility

11.8 Walking and cycling are practical modes for accessibility to the Garthdee campus for a high percentage of the residents of Aberdeen City. Figure 10 compares the population catchments for several population sectors using the Simple indicators and a threshold travel time of 30 minutes.

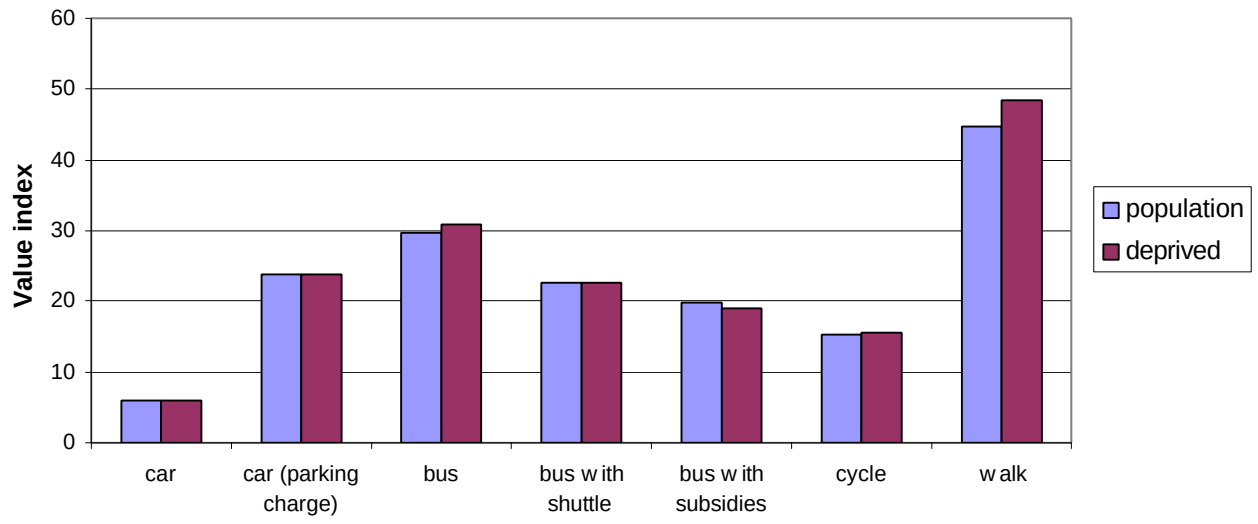
Figure 10 - Access by Walking and Cycling to Garthdee by Population Group



11.9 It is interesting to note that the wealthiest members of the population have the best access by walking to the site given the location of the site in the relatively affluent suburbs. Cycling should be practical for many people with about 95% of the population of the city being within 30 minutes travel time of the site. However people will only walk or cycle if travel by these modes is a pleasant experience.

11.10 It is also interesting to compare the impacts of the changes on different sectors of the population. Figure 11 shows that the distribution of the population in relation to Garthdee, results in generally more favourable accessibility for the total population than for deprived residents. However the reduction in bus fares has a slightly more favourable effect on the deprived population.

Figure 11 - Comparison of Accessibility for Total Population and Relatively Deprived People



11.11 It can also be seen that the parking charge in combination with the bus improvements can make bus competitive. Achieving this level of investment in bus services could be challenging but car park charges could generate considerable revenue. The accessibility analysis offers a simple tool to help define an optimum approach. Practical proposals can then be brought forward to deliver the desired level of reduction in generalised travel time by bus.

12. FREIGHT ACCESSIBILITY

12.1 Accessibility considerations are important in planning for freight transport. Public policy and commercial aims, are to improve the economic efficiency of supply chains taking account of the social and environmental impacts of various options. Decisions need to take account of:

- The accessibility factors which affect location choices.
- The efficiency and reliability of companies' delivery operations and how they are affected by accessibility changes.
- The competitiveness of: alternative modes, different sizes and weights of vehicle, and the opportunities for inter-modal trips.
- The impacts on overall traffic levels. Access restrictions can increase the number of vehicle trips to meet delivery requirements.
- The links between accessibility and environmental impact. Restricting access at particular times of day in residential areas or shopping centres needs to be viewed within the overall supply-chain context.

12.2 The national strategy for sustainable distribution (DETR 1999) identifies how the various commercial and policy aims can be managed through freight quality partnerships. The intention is that these partnerships will increasingly influence logistics decisions towards patterns of activity that optimise commercial, social and environmental aims.

12.3 Specific planning policy aims are defined in NPPG17. This requires development plans to identify sites where there are opportunities for locating distribution or freight operator centres, including consideration of access to the rail network, ports, and airports.

12.4 For analysis purposes, accessibility is best considered by type of distribution premises within the context of the characteristics of the individual supply chain. Table 5 identifies twelve classifications and the important accessibility issues which need to be considered in relation to each type.

12.5 For detailed decisions it should be noted that each business will have their own accessibility requirements based upon the needs of upstream sources of supply and downstream customers. In commercial terms much more emphasis is usually placed on accessibility for downstream customers than for upstream suppliers. This is because outbound delivery costs are usually much higher than inbound delivery costs and because decision makers generally have more responsibility for downstream than upstream effects.

12.6 Regional and national distribution centres are not particularly sensitive to location within a radius of 30 to 40 miles. This means that decisions about such centres will often involve more than one Structure Plan area. In many cases qualitative accessibility analysis will be adequate in planning decisions supporting locations near motorways, and locations with rail access, port and airport access as appropriate.

12.7 Local distribution centres will usually be more captive to road transport and be served by smaller vehicles. However these deliveries will also be more time constrained and will be affected by and contribute to peak period road congestion.

Premises	Function	Area Served	Nature of the Transport Operation
1. Primary Consolidation Centre (PDC)	Merge the output of different factories into consolidated loads for delivery to RDCs	Regional / national	Bulk loads in and out. Mostly articulated vehicles. Mainly direct deliveries of full loads
2. Regional Distribution Centre (RDC)	Consolidate inbound supplies from producers (either directly from factory or via a PDC) into mixed loads for delivery to shops. A proportion of the supplies will be stored, the remainder merely cross-docked.	Regional for groceries / fast-moving consumer goods National for most non-foods.	For supermarket chains, mostly articulated vehicles inbound and outbound with direct single-drop deliveries to shops. For some non-food retailers, artics inbound and rigids outbound, the rigids making multiple drop deliveries.
3. Parcel / Pallet-load Hub	Receipt of parcel / pallet load traffic collected from local depots, its sortation by destination and despatch to appropriate local depot for final delivery	Mostly national from locations in and around the Midlands	Articulated vehicles inbound and outbound.
4. Local Parcel Depot	Local collection and delivery of parcel traffic	Regional	Rigids for multiple collection / delivery rounds in local areas. Artics for trunk movements to and from the hub.
5. Road Haulage Depot	Base for vehicle fleet, often combined with break-bulk service	Varies: usually regional/ local	Either articulated inbound and outbound on trunk movements or mixture of artic trunking and local delivery on rigids.
6. Traditional Warehouse	Long-term storage	Usually regional / national	Usually articulated vehicles inbound and outbound
7. Wholesale Warehouse	Stocking and assembling mixed orders for delivery to retailers / catering outlets	Usually local / regional	Articulated vehicles inbound. Rigids outbound, the rigids making multiple drop deliveries.
8. Cash and Carry	Sale of mixed supplies in bulk to retailers / caterers	Local	Inbound mainly in artics. Outbound: collection by small traders in small vans and cars.
9. Railhead depot	Similar to 5 but offering the transfer of non-unitised loads between road and rail	Regional/national/ international	Either articulated inbound and outbound on trunk movements or mixture of artic trunking and local delivery on rigids.
10. Intermodal terminal (road – rail)	Transfer of unitised loads between road and rail	Regional/national/ international	Articulated vehicle movements in and out carrying containers / swap-bodies
11. Port	Transfer of unitised or bulk loads between road and ship often with associated storage	Regional/national/ international	Generally articulate vehicle movements inward and outward
12. Airport	Transfer of freight between road vehicles and aircraft, often with associated storage and customs clearance	Regional/national/ international	Mixture of articulated and rigid vehicles and small vans on both inbound and outbound movements.

Table 5: Classification of Distribution Premises.

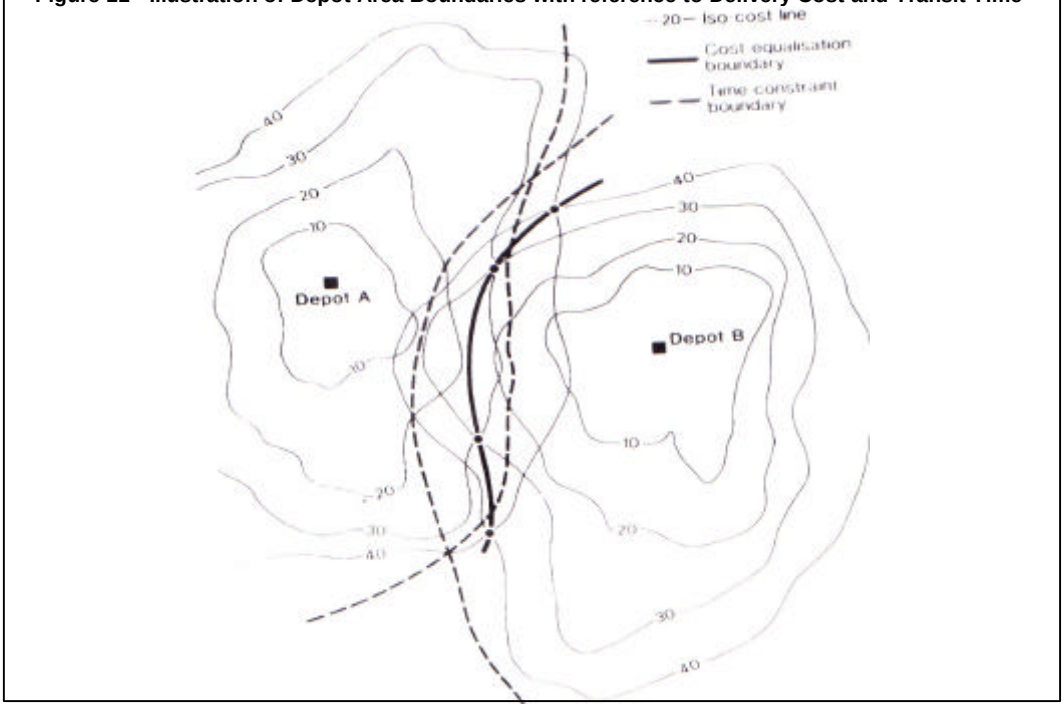
12.8 The measurement of accessibility for distribution purposes has traditionally involved the construction of isochrone and iso-cost maps. This can be

undertaken by dividing a market area between depots and distribution centres in a way that minimises total distribution costs (McKinnon 1989). Iso-chrones can then be used to show the pattern of delivery times around the depots.

12.9 Total daily driving time is constrained by legal restrictions on driver's hours. For most local delivery operations, however, in which the driver spends much of his time loading and off-loading goods, the distance than can be served is constrained much more by the length of the driver's shift and the 'drop density' (number of outlets per square km).

12.10 The time-constraint boundaries drawn around adjoining depots usually overlap. Where this occurs, service areas are delimited with respect to distribution costs. Iso-cost lines show how delivery costs increase with distance from the depot. The depot area boundary is generally defined by the points of intersection between iso-cost line of similar value drawn around adjoining depots as shown in Figure 11.

Figure 11 - Illustration of Depot Area Boundaries with reference to Delivery Cost and Transit Time



12.11 Some companies base their iso-cost line calculations solely on outbound delivery costs. It is preferable, however, to include depot operating costs in the calculation as these can vary between depots and account for a significant proportion of total distribution costs. Another factor influencing the configuration of depot boundaries is the size of the vehicle fleets based at the depots.

12.12 In recent years, many companies have abandoned rigid depot boundaries allowing vehicles based at one depot to encroach on what was previously the territory of another. This 'flexing' of depot boundaries allows companies to make better use of vehicle capacity. For example, when Scottish Brewers restructured its distribution system in 1992-4 it moved to more flexible delivery planning (McKinnon 1997). Some of the large grocery retailers have extended

this principle and now pool their vehicle fleets at a national level, allowing vehicles to migrate between distribution centres, shops and suppliers' premises. Within these new 'network systems', more complex measures of accessibility are required.

12.13 Sophisticated logistics software packages are now widely used to help firms manage their distribution operations. These software tools employ road network databases and a combination of optimising and heuristic algorithms to plan vehicle routes, allocate customers to depots and simulate the effects of changing various distribution system parameters.

12.14 These packages can model distribution operations with respect to transit times and transport costs, the latter based on detailed vehicle operating cost data. Transit time estimates are usually based on average speeds assigned to different classes of road. However individual companies usually calibrate transit times between particular locations on the basis of journey records. For longer distance road trips, particularly on motorways, there is increasingly comprehensive data on congestion by time of day allowing more accurate estimates of travel time and scheduling.

13. LESSONS FROM THE CASE STUDIES

13.1 The case studies identify a number of points about the practical application of accessibility analysis. These cover the strengths and weaknesses of each type of index and the data requirements to undertake such assessments and are discussed below.

Accessibility to local facilities by walking and cycling

13.2 A maximum threshold of 1600 metres for walk in catchments is broadly in line with observed travel behaviour (Ecotec 1993). The deterrent effect of distance within the 0-1600 metres range is less clear. Edinburgh Council suggest (Gainey 2000) an average weighting of 0.5 for population within 500 metres and 0.35 for population from 500 to 800 metres.

13.3 In the case studies, the deterrence functions in the opportunity indices have been based mainly around in-vehicle time and give a deterrence of about half of that in the Edinburgh Council research. In reality the deterrent effect of walking distance depends heavily upon individual attitudes, so the quality of the experience may be more important than time or distance in themselves. These quality issues do not lend themselves to quantification or generalisation. However, research on walking (Scottish Office 1999) provides an insight into walking behaviour.

13.4 PAN 57 (Scottish Executive 1999) suggests 400 metres and 800 metres as suitable thresholds for the accessibility of housing to public transport. 400 metres may often be perceived as excessive for access to bus services and 800 metres is probably too low as a threshold for rail access. Thresholds will therefore never be ideal, but Simple indices using such thresholds should provide as clear an indication as is generally needed of the walk in catchment for local facilities.

13.5 If there is a significant walk in population within 800 metres, then improvements to the quality of the walking and cycling network will be the major factors in increasing accessibility by walking and cycling. Local people are best placed to identify the problems in their local streets, which act as deterrents to walking and cycling. Good practice in planning such improvements for access to schools is now set out in Scottish Executive guidance (Scottish Executive 1999), and the same general approach can be followed for other trip attractors such as hospitals.

Accessibility to and by public transport services

13.6 This is a special case of the general walking and cycling indices, but the opportunities of interest are public transport services. If public transport services can be classified accurately in terms of their frequency or destination, then these indices can give a useful picture of accessibility to and by public transport. Such indices were first developed in London where the characteristics of public transport provision are easier to classify than for the four case studies being studied in this project (LPAC 1994).

13.7 The transport assessments for the NRI, define bus corridors in Edinburgh as either “weak” or “strong”. This level of detail can be sufficient for a general overview of accessibility. In the case of the NRI this overview was used to match estimated demand for public transport with the proposed supply. However public transport affects many important policy areas and more detail is usually required to look at the impacts on different groups of people, or geographical areas.

13.8 Obtaining detailed data, on the origins, destinations, and routes of all bus services in a study area can be a major exercise, although automated techniques using computerised public transport information can simplify this. Also, given the range of services and destinations from the case study zones, a simple classification of services is unlikely to be feasible. This emphasises the point made by Simmonds(1998) that this type of accessibility analysis has a limited scope, designed for particular purposes. Significant effort to calculate such indices could probably only be justified if decisions were required about major re-routing of bus services or if there were significant changes in the location of trip generation or attraction in an area. Guidance is already available on this very specific type of accessibility analysis and there is considerable activity developing these indices within some Councils.

13.9 For most project assessments the accessibility **to** public transport can be considered as described in paragraphs 13.2-13.5. The accessibility **by** public transport and comparisons of access between modes are discussed below.

Transport system accessibility to opportunities.

13.10 A transport improvement, or an increase in the number of opportunities will increase accessibility. It is not easy to assess the scale of the change through qualitative comparisons, so a robust quantitative approach is needed. The Gartcosh and Braehead studies demonstrate how indices can be used to examine alternative development locations including the relative impacts of land use and transport changes.

13.11 The Opportunity indices are easy to interpret and use showing, for example, how many more people can access the new development jobs at Gartcosh if a motorway junction is built or a railway station is opened. The Value indices are a more powerful measure of the efficiency of the transport systems but the index in itself is less descriptive.

13.12 The Simple indices are of more limited use since they are generally too sensitive to the thresholds chosen. Even if thresholds can be clearly defined, it is more useful to use these within an Opportunity index than with the Simple measure. Most of the effort required for accessibility analysis is associated with data collection rather than analysis. If there are sufficient data for a Simple analysis then there should be little problem undertaking a more accurate Opportunity analysis.

13.13 The impacts of some of the transport and land use changes in the case studies are spread over large geographical areas. Practical analysis depends

upon a manageable approach to data assembly. The planning data presents little problem since this is readily available down to small zones. The main challenge is the calculation of accurate transport data at small zone level. For the Gartcosh and Braehead developments the travel data could be obtained directly from existing major transport models with each separate transport option having its own travel data file. However the size of the data files was large, and data management became a much more significant task than for the Edinburgh and Aberdeen studies. The Edinburgh and Aberdeen studies required more work to assemble the base travel time data, and given the relatively small number of zones estimating the impact of possible future options was relatively easy.

Ratios comparing accessibility for different mobility groups

13.14 A major strength of accessibility analysis is that it focuses on the people rather than transport modes. The case studies compared accessibility for people who had access to a car with people who did not. In each of the case studies, car available travellers had much better accessibility than those who were dependent upon public transport, walking and cycling. However, even for car available trips, public transport was competitive with the car for some trips.

13.15 One of the most helpful measures is the ratio of accessibility for car available to non-car available people. These ratios allow consistent comparisons to be made between locations. It is probably clearer and more accurate to base these upon Opportunity indices.

Freight Accessibility

13.16 In developing a partnership approach to sustainable distribution, accessibility analysis is best undertaken using proprietary logistics management software. These packages can be used at national/regional levels (e.g. to identify strategic locations for intermodal terminals), or at a more local level (e.g. to look at the implications of delivery time constraints for a local shopping centre). Where a simpler approach is required, helpful analysis can be undertaken using iso-cost and isochrone mapping techniques.

13.17 However effective freight transport planning depends upon the availability of a database of freight movements. At present this is largely undertaken at an individual company level, since each company is aware of its own needs. If more efficient transport systems are to be developed which reflect collective needs within Scotland, then improved national data on freight movements needs to be available from which to build a strategic picture of how systems can be improved.

14. RECOMMENDATIONS

14.1 There are many ways that accessibility analysis can be taken forward within land use and transport appraisal to support integrated transport objectives. Public policy decisions on transport are made at three levels in Scotland: National, Regional and Local.

14.2 At a national level it is recommended that the use of accessibility measures is considered as follows:

- In the definition of overall performance levels for integrated transport in Scotland and targets for improvement.
- To help define the performance aims for the strategic road network in terms of accessibility. Trunk roads are very important for the accessibility needs of people and businesses in Scotland. If the trunk road network is to better serve these needs in the future, improvements need to be more effectively targeted at these accessibility issues in order to meet national social, economic and environmental aims.
- To help define strategic rail network plans which maximise accessibility for all. For example, through joint working between the Scottish Executive, the Strategic Rail Authority and others, plans for the rail network can be developed perhaps starting from an analysis of the 10 year plans in Railtrack's Network Management statement.
- For assessing the impacts of local and regional transport plans and strategies for consistency with the accessibility aims within national policy.
- Within national and regional planning guidance accessibility aims can be presented in more quantitative terms.

14.3 At a regional level, transport planning and policy is led by local authorities working in partnership. It is recommended that accessibility analysis should be used to:

- Identify equitable approaches for joint transport plans and road charging schemes both geographically and by type of traveller. Accessibility analysis can identify the impacts of alternative options on each group in society.
- Define accessibility targets within Structure plans.

14.4 More locally, strategies, plans and detailed scheme proposals can all be assessed using accessibility analysis as defined in transport appraisal guidance and national planning policy. Since accessibility measures show the links between transport and other areas of policy they are likely to be helpful in developing transport proposals which can gain wide acceptance including the necessary funding support.

14.5 It is therefore recommended that guidance on accessibility analysis should be published by the Scottish Executive covering:

- Accessibility to local facilities by walking and cycling
- Accessibility to public transport services
- Transport system accessibility to opportunities such as jobs, education, etc.
- Ratios comparing accessibility for different mobility groups
- Accessibility for freight

14.6 It should be recognised that accessibility analysis techniques are evolving as they become utilised in land use and transport appraisal. The publication of the guidance should provide a framework for further development of the techniques. Much of this further development work may be through practical application, and some aspects may require additional national research. It is recommended that the guidance is regularly reviewed and updated over the next few years to take account of developing approaches.

14.7 In particular, it has been noted in paragraph 6.13 that development of techniques for full economic analysis using accessibility techniques is beyond the scope of this project. There are nevertheless strong arguments in favour of economic appraisal using composite utility indices. In particular:

- By combining the consideration of benefits for motorised and non-motorised travel within the same quantitative economic appraisal, a more comprehensive and integrated approach is possible.
- Transport options, and increased flexibility in the way people choose to travel or do business, have a value to people which is often not measurable through demand e.g. security of accessibility if a car breaks down or the opportunity to seek work in new areas.
- This approach to economic analysis would appear to progress the SACTRA (DETR 1999) recommendations for greater clarity in economic analysis regarding: the rationale for transport improvements; and the spatial, sectoral and social gains and losses resulting from an intervention.

15. CONCLUSIONS

15.1 There are many strong reasons why policy and project appraisal for integrated transport should be able to benefit from accessibility analysis, since accessibility measures the opportunities and choices available for people and businesses. National requirements for transport and land use appraisal are increasingly requiring that accessibility issues are considered. Current practice relies mainly upon qualitative approaches.

15.2 Although there is a large and sometimes confusing range of accessibility measurement techniques available, there are three generic types:

- Simple indicators (Contour measures)
- Opportunity measures (Hansen indices)
- Value measures (Utility indices)

15.3 All three types of indicator have a role to play in policy and scheme appraisal, since different decisions require information to be presented in different ways.

15.4 Local authorities, developers and consultants in Scotland have noted that they would welcome national guidance on accessibility analysis. This would help to support wider use of techniques and allow a more standardised approach.

15.5 Four case studies have been undertaken to look at a range of accessibility measurement techniques and these confirm that accessibility analysis is both practical and useful.

15.6 For local walking and cycling access, Simple measures will usually be sufficient. For more strategic analysis, reliable thresholds are difficult to define and Opportunity or Value measures will be preferable.

16. ACKNOWLEDGEMENTS

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16.3 The Scottish Executive client project manager was David Seaman and the Project Advisory Group were John Dowie, Tom Williamson, Phil Noble and Graham Buchan.

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Appendix A

Gartcosh Redevelopment, North Lanarkshire
Test Specification and Results

Test Data

Zones – *All zones and planning data were taken from the Central Scotland Transport Model data. Detailed zones were adopted within the Strathclyde Integrated Transport Model area and other Council external areas were considered as single zones including Edinburgh, West Lothian, Falkirk, Stirling and Clackmannanshire Council areas.*

Travel times – These were taken from the 2000 base Strathclyde Integrated Transport Model.

Scheme specification was taken from various North Lanarkshire Council policy documents with:

- 270 new homes in zone 449 from regeneration proposals.
- 4,000 new jobs in zone 449 from regeneration proposals.
- A new rail station at Gartcosh providing direct access by rail to Glasgow City Centre and Falkirk as specified in the North Lanarkshire submission to the Scottish Executive Public Transport Fund.
- A new motorway junction with the M73 at Gartcosh as specified in the 1995 report by the Director of Roads at Strathclyde Regional Council.

GARTCOSH: TEST 1

Test Ref	Test theme/detail	Data	Thresholds	Travel times	Index	Value	Zones	Time file	Planning file
1	Car available population in Gartcosh zone access to employment:								
1.0H	base: existing travel	SITM model zones plus aggregate jobs from CSTM data for Edinburgh, West Lothian, Falkirk, Stirling, Clackmannan, Fife, Ayrshire (E, N & S) and west West Dunbarton council areas	All zones covered by the data	Average of travel time from am and pm peak times. In the am, time is from zone 449 to destination zone and in pm peak time is from destination zone to 449	Hansen	498930	597	base_c_from	base_jobs
1.1H	new rail station					499200	597	rs_c_from	base_jobs
1.2H	new M/Y junction					607827	597	mj_c_from	base_jobs
1.3H	new rail station and M/Y junction					607827	597	mjrs_c_from	base_jobs
1.4H	4,000 new jobs					502930	597	base_c_from	base_jobs+4000
1.5H	4,000 new jobs + rail station					503200	597	rs_c_from	base_jobs+4000
1.6H	4,000 new jobs + M/Y junction					611827	597	mj_c_from	base_jobs+4000
1.7H	4,000 new jobs + rail station and M/Y junction					611827	597	mjrs_c_from	base_jobs+4000
1.0U	base: existing travel				Utility	35.48	597	base_c_from	base_jobs
1.1U	new rail station					35.46	597	rs_c_from	base_jobs
1.2U	new M/Y junction					28.89	597	mj_c_from	base_jobs
1.3U	new rail station and M/Y junction					28.89	597	mjrs_c_from	base_jobs
1.4U	4,000 new jobs					35.30	597	base_c_from	base_jobs+4000
1.5U	4,000 new jobs + rail station					35.28	597	rs_c_from	base_jobs+4000
1.6U	4,000 new jobs + M/Y junction					28.77	597	mj_c_from	base_jobs+4000
1.7U	4,000 new jobs + rail station + M/Y junction					28.77	597	mjrs_c_from	base_jobs+4000
1.0S	base: existing travel				Simple	1446248	597	base_c_from	base_jobs
1.1S	new rail station						597	rs_c_from	base_jobs
1.2S	new M/Y junction						597	mj_c_from	base_jobs
1.3S	new rail station and M/Y junction						597	mjrs_c_from	base_jobs
1.4S	4,000 new jobs					1450248	597	base_c_from	base_jobs+4000
1.5S	4,000 new jobs + rail station						597	rs_c_from	base_jobs+4000
1.6S	4,000 new jobs + M/Y junction						597	mj_c_from	base_jobs+4000
1.7S	4,000 new jobs + rail station + M/Y junction						597	mjrs_c_from	base_jobs+4000

GARTCOSH: TEST 2

Test Ref	Test theme/detail	Data	Thresholds	Travel times	Index	Value	Zones	Time file	Planning file
2A	Car available population in Gartcosh zone access to employment:								
2A.0H	base: existing travel	SITM model zones plus aggregate jobs from CSTM data for Edinburgh, West Lothian, Falkirk, Stirling, Clackmannan, Fife, Ayrshire (E, N & S) and west West Dunbarton council areas	All zones covered by the data within 30 minutes travel time	Average of travel time from am and pm peak times. In the am, time is from zone 449 to destination zone and in pm peak time is from destination zone to 449	Hansen	291958	379	base_c_from	base_jobs
2A.1H	new rail station					292229	379	rs_c_from	base_jobs
2A.2H	new M/Y junction					410584	379	mj_c_from	base_jobs
2A.3H	new rail station and M/Y junction					410584	379	mjrs_c_from	base_jobs
2A.4H	4,000 new jobs					295958	379	base_c_from	base_jobs+4000
2A.5H	4,000 new jobs + rail station					296229	379	rs_c_from	base_jobs+4000
2A.6H	4,000 new jobs + M/Y junction					414584	379	mj_c_from	base_jobs+4000
2A.7H	4,000 new jobs + rail station and M/Y junction					414584	379	mjrs_c_from	base_jobs+4000
2A.0U	base: existing travel				Utility	19.70	379	base_c_from	base_jobs
2A.1U	new rail station					19.67	379	rs_c_from	base_jobs
2A.2U	new M/Y junction					15.50	379	mj_c_from	base_jobs
2A.3U	new rail station and M/Y junction					15.50	379	mjrs_c_from	base_jobs
2A.4U	4,000 new jobs					19.50	379	base_c_from	base_jobs+4000
2A.5U	4,000 new jobs + rail station					19.47	379	rs_c_from	base_jobs+4000
2A.6U	4,000 new jobs + M/Y junction					15.38	379	mj_c_from	base_jobs+4000
2A.7U	4,000 new jobs + rail station + M/Y junction					15.38	379	mjrs_c_from	base_jobs+4000
2A.0S	base: existing travel				Simple	527293	379	base_c_from	base_jobs
2A.1S	new rail station					527293	379	rs_c_from	base_jobs
2A.2S	new M/Y junction					653701	379	mj_c_from	base_jobs
2A.3S	new rail station and M/Y junction					653701	379	mjrs_c_from	base_jobs
2A.4S	4,000 new jobs					531293	379	base_c_from	base_jobs+4000
2A.5S	4,000 new jobs + rail station					531293	379	rs_c_from	base_jobs+4000
2A.6S	4,000 new jobs + M/Y junction					657701	379	mj_c_from	base_jobs+4000
2A.7S	4,000 new jobs + rail station + M/Y junction					657701	379	mjrs_c_from	base_jobs+4000

GARTCOSH: TEST 2

Test Ref	Test theme/detail	Data	Thresholds	Travel times	Index	Value	Zones	Time file	Planning file
2B	Car available population in Gartcosh zone access to employment:								
2B.0H	base: existing travel	SITM model zones plus aggregate jobs from CSTM data for Edinburgh, West Lothian, Falkirk, Stirling, Clackmannan, Fife, Ayrshire (E, N & S) and west West Dunbarton council areas	All zones covered by the data within 30 km distance	Average of travel time from am and pm peak times. In the am, time is from zone 449 to destination zone and in pm peak time is from destination zone to 449	Hansen	367342	588	base_c_from	base_jobs
2B.1H	new rail station							rs_c_from	base_jobs
2B.2H	new M/Y junction							mj_c_from	base_jobs
2B.3H	new rail station and M/Y junction							mjrs_c_from	base_jobs
2B.4H	4,000 new jobs					371342	588	base_c_from	base_jobs+4000
2B.5H	4,000 new jobs + rail station							rs_c_from	base_jobs+4000
2B.6H	4,000 new jobs + M/Y junction							mj_c_from	base_jobs+4000
2B.7H	4,000 new jobs + rail station and M/Y junction							mjrs_c_from	base_jobs+4000
2B.0U	base: existing travel				Utility	23.89	588	base_c_from	base_jobs
2B.1U	new rail station							rs_c_from	base_jobs
2B.2U	new M/Y junction							mj_c_from	base_jobs
2B.3U	new rail station and M/Y junction							mjrs_c_from	base_jobs
2B.4U	4,000 new jobs					23.71	588	base_c_from	base_jobs+4000
2B.5U	4,000 new jobs + rail station							rs_c_from	base_jobs+4000
2B.6U	4,000 new jobs + M/Y junction							mj_c_from	base_jobs+4000
2B.7U	4,000 new jobs + rail station + M/Y junction							mjrs_c_from	base_jobs+4000
2B.0S	base: existing travel				Simple	752257	588	base_c_from	base_jobs
2B.1S	new rail station							rs_c_from	base_jobs
2B.2S	new M/Y junction							mj_c_from	base_jobs
2B.3S	new rail station and M/Y junction							mjrs_c_from	base_jobs
2B.4S	4,000 new jobs					756257	588	base_c_from	base_jobs+4000
2B.5S	4,000 new jobs + rail station							rs_c_from	base_jobs+4000
2B.6S	4,000 new jobs + M/Y junction							mj_c_from	base_jobs+4000
2B.7S	4,000 new jobs + rail station + M/Y junction							mjrs_c_from	base_jobs+4000

GARTCOSH: TEST 3

Test Ref	Test theme/detail	Data	Thresholds	Travel times	Index	Value	Zones	Time file	Planning file
3	Non car available population in Gartcosh zone access to employment:								
3.0H	base: existing travel	SITM model zones plus aggregate jobs from CSTM data for Edinburgh, West Lothian, Falkirk, Stirling, Clackmannan, Fife, Ayrshire (E, N & S) and west West Dunbarton council areas	All zones covered by the data	Average of travel time from am and pm peak times. In the am, time is from zone 449 to destination zone and in pm peak time is from destination zone to 449.	Hansen	118691	597	base_nc_from	base_jobs
3.1H	new rail station					120524	597	rs_nc_from	base_jobs
3.2H	new M/Y junction					n/a	597	mj_nc_from	base_jobs
3.3H	new rail station and M/Y junction					n/a	597	mjrs_nc_from	base_jobs
3.4H	4,000 new jobs					122691	597	base_nc_from	base_jobs+4000
3.5H	4,000 new jobs + rail station					124524	597	rs_nc_from	base_jobs+4000
3.6H	4,000 new jobs + M/Y junction					n/a	597	mj_nc_from	base_jobs+4000
3.7H	4,000 new jobs + rail station and M/Y junction					n/a	597	mjrs_nc_from	base_jobs+4000
3.0U	base: existing travel				Utility	83.34	597	base_nc_from	base_jobs
3.1U	new rail station					82.83	597	rs_nc_from	base_jobs
3.2U	new M/Y junction					n/a	597	mj_nc_from	base_jobs
3.3U	new rail station and M/Y junction					n/a	597	mjrs_nc_from	base_jobs
3.4U	4,000 new jobs					82.33	597	base_nc_from	base_jobs+4000
3.5U	4,000 new jobs + rail station					81.83	597	rs_nc_from	base_jobs+4000
3.6U	4,000 new jobs + M/Y junction					n/a	597	mj_nc_from	base_jobs+4000
3.7U	4,000 new jobs + rail station + M/Y junction					n/a	597	mjrs_nc_from	base_jobs+4000
3.0S	base: existing travel				Simple	1446248	597	base_nc_from	base_jobs
3.1S	new rail station						597	rs_nc_from	base_jobs
3.2S	new M/Y junction					n/a	597	mj_nc_from	base_jobs
3.3S	new rail station and M/Y junction					n/a	597	mjrs_nc_from	base_jobs
3.4S	4,000 new jobs					1450248	597	base_nc_from	base_jobs+4000
3.5S	4,000 new jobs + rail station						597	rs_nc_from	base_jobs+4000
3.6S	4,000 new jobs + M/Y junction					n/a	597	mj_nc_from	base_jobs+4000
3.7S	4,000 new jobs + rail station + M/Y junction					n/a	597	mjrs_nc_from	base_jobs+4000

GARTCOSH: TEST 4A

Test Ref	Test theme/detail	Data	Thresholds	Travel times	Index	Value	Zones	Time file	Planning file
4A	Non car available population in Gartcosh zone access to employment:								
4A.0H	base: existing travel	SITM model zones plus aggregate jobs from CSTM data for Edinburgh, West Lothian, Falkirk, Stirling, Clackmannan, Fife, Ayrshire (E, N & S) and west West Dunbarton council areas	All zones covered by the data within 30 minutes travel time	Average of travel time from am and pm peak times. In the am, time is from zone 449 to destination zone and in pm peak time is from destination zone to 449	Hansen	3365	9	base_nc_from	base_jobs
4A.1H	new rail station					3788	9	rs_nc_from	base_jobs
4A.2H	new M/Y junction					n/a	9	mj_nc_from	base_jobs
4A.3H	new rail station and M/Y junction					n/a	9	mjrs_nc_from	base_jobs
4A.4H	4,000 new jobs					7365	9	base_nc_from	base_jobs+4000
4A.5H	4,000 new jobs + rail station					7788	9	rs_nc_from	base_jobs+4000
4A.6H	4,000 new jobs + M/Y junction					*n/a*	9	mj_nc_from	base_jobs+4000
4A.7H	4,000 new jobs + rail station and M/Y junction					*n/a*	9	mjrs_nc_from	base_jobs+4000
4A.0U	base: existing travel				Utility	19.00	9	base_nc_from	base_jobs
4A.1U	new rail station					20.19	9	rs_nc_from	base_jobs
4A.2U	new M/Y junction					n/a	9	mj_nc_from	base_jobs
4A.3U	new rail station and M/Y junction					n/a	9	mjrs_nc_from	base_jobs
4A.4U	4,000 new jobs					10.62	9	base_nc_from	base_jobs+4000
4A.5U	4,000 new jobs + rail station					11.33	9	rs_nc_from	base_jobs+4000
4A.6U	4,000 new jobs + M/Y junction					n/a	9	mj_nc_from	base_jobs+4000
4A.7U	4,000 new jobs + rail station + M/Y junction					n/a	9	mjrs_nc_from	base_jobs+4000
4A.0S	base: existing travel				Simple	5949	9	base_nc_from	base_jobs
4A.1S	new rail station					6941	9	rs_nc_from	base_jobs
4A.2S	new M/Y junction					n/a	9	mj_nc_from	base_jobs
4A.3S	new rail station and M/Y junction					n/a	9	mjrs_nc_from	base_jobs
4A.4S	4,000 new jobs					9949	9	base_nc_from	base_jobs+4000
4A.5S	4,000 new jobs + rail station					10941	9	rs_nc_from	base_jobs+4000
4A.6S	4,000 new jobs + M/Y junction					n/a	9	mj_nc_from	base_jobs+4000
4A.7S	4,000 new jobs + rail station + M/Y junction					n/a	9	mjrs_nc_from	base_jobs+4000

GARTCOSH: TEST 4B

Test Ref	Test theme/detail	Data	Thresholds	Travel times	Index	Value	Zones	Time file	Planning file
4B	Non-car available population in Gartcosh zone access to employment:								
4B.0H	base: existing travel	SITM model zones plus aggregate jobs from CSTM data for Edinburgh, West Lothian, Falkirk, Stirling, Clackmannan, Fife, Ayrshire (E, N & S) and west West Dunbarton council areas	All zones covered by the data within 30 km distance	Average of travel time from am and pm peak times. In the am, time is from zone 449 to destination zone and in pm peak time is from destination zone to 449	Hansen	98034	588	base_c_from	base_jobs
4B.1H	new rail station						588	rs_c_from	base_jobs
4B.2H	new M/Y junction						588	mj_c_from	base_jobs
4B.3H	new rail station and M/Y junction						588	mjrs_c_from	base_jobs
4B.4H	4,000 new jobs					102034	588	base_c_from	base_jobs+4000
4B.5H	4,000 new jobs + rail station						588	rs_c_from	base_jobs+4000
4B.6H	4,000 new jobs + M/Y junction						588	mj_c_from	base_jobs+4000
4B.7H	4,000 new jobs + rail station and M/Y junction						588	mjrs_c_from	base_jobs+4000
4B.0U	base: existing travel				Utility	67.92	588	base_c_from	base_jobs
4B.1U	new rail station						588	rs_c_from	base_jobs
4B.2U	new M/Y junction						588	mj_c_from	base_jobs
4B.3U	new rail station and M/Y junction						588	mjrs_c_from	base_jobs
4B.4U	4,000 new jobs					66.77	588	base_c_from	base_jobs+4000
4B.5U	4,000 new jobs + rail station						588	rs_c_from	base_jobs+4000
4B.6U	4,000 new jobs + M/Y junction						588	mj_c_from	base_jobs+4000
4B.7U	4,000 new jobs + rail station + M/Y junction						588	mjrs_c_from	base_jobs+4000
4B.0S	base: existing travel				Simple	752257	588	base_c_from	base_jobs
4B.1S	new rail station						588	rs_c_from	base_jobs
4B.2S	new M/Y junction						588	mj_c_from	base_jobs
4B.3S	new rail station and M/Y junction						588	mjrs_c_from	base_jobs
4B.4S	4,000 new jobs					756257	588	base_c_from	base_jobs+4000
4B.5S	4,000 new jobs + rail station						588	rs_c_from	base_jobs+4000
4B.6S	4,000 new jobs + M/Y junction						588	mj_c_from	base_jobs+4000
4B.7S	4,000 new jobs + rail station + M/Y junction						588	mjrs_c_from	base_jobs+4000

GARTCOSH: TEST 5

Test Ref	Test theme/detail	Data	Thresholds	Travel times	Index	Value	Zones	Time file	Planning file
5	Economically inactive people with access to a car								
5.0H	base: existing travel	SITM model zones plus aggregate jobs from CSTM data for Edinburgh, West Lothian, Falkirk, Stirling, Clackmannan, Fife, Ayrshire (E, N & S) and west West Dunbarton council areas	All zones covered by the data	Average of travel time from am and pm peak times. In the am, time is from relevant SITM zone to zone 449 and in pm peak time is from zone 449 to relevant SITM zone	Hansen	244939	597	base_c_to	base
5.1H	new rail station					244945	597	rs_c_to	base
5.2H	new M/Y junction					297883	597	mj_c_to	base
5.3H	new rail station and M/Y junction					297883	597	mjrs_c_to	base
5.4H	270 new houses					245093	597	base_c_to	base+270
5.5H	270 new houses + rail station					245600	597	rs_c_to	base+270
5.6H	270 new houses + M/Y junction					298037	597	mj_c_to	base+270
5.7H	270 new houses + rail station and M/Y junction					298037	597	mjrs_c_to	base+270
5.0U	base: existing travel				Utility	35.45	597	base_c_to	base
5.1U	new rail station					25.45	597	rs_c_to	base
5.2U	new M/Y junction					28.92	597	mj_c_to	base
5.3U	new rail station and M/Y junction					28.92	597	mjrs_c_to	base
5.4U	270 new houses					35.43	597	base_c_to	base+270
5.5U	270 new houses + rail station					35.43	597	rs_c_to	base+270
5.6U	270 new houses + M/Y junction					28.91	597	mj_c_to	base+270
5.7U	270 new houses + rail station and M/Y junction					28.91	597	mjrs_c_to	base+270
5.0S	base: existing travel				Simple	709396	597	base_c_to	base
5.1S	new rail station						597	rs_c_to	base
5.2S	new M/Y junction						597	mj_c_to	base
5.3S	new rail station and M/Y junction						597	mjrs_c_to	base
5.4S	270 new houses					709550	597	base_c_to	base+270
5.5S	270 new houses + rail station						597	rs_c_to	base+270
5.6S	270 new houses + M/Y junction						597	mj_c_to	base+270
5.7S	270 new houses + rail station and M/Y junction						597	mjrs_c_to	base+270

GARTCOSH: TEST 6

Test Ref	Test theme/detail	Data	Thresholds	Travel times	Index	Value	Zones	Time file	Planning file
6	Economically inactive people without access to a car								
6.0H	base: existing travel	SITM model zones plus aggregate jobs from CSTM data for Edinburgh, West Lothian, Falkirk, Stirling, Clackmannan, Fife, Ayrshire (E, N & S) and west West Dunbarton council areas	All zones covered by the data	Average of travel time from am and pm peak times. In the am, time is from relevant SITM zone to zone 449 and in pm peak time is from zone 449 to relevant SITM zone	Hansen	58354	597	base_nc_to	base
6.1H	new rail station					59212	597	rs_nc_to	base
6.2H	new M/Y junction					n/a		mj_nc_to	base
6.3H	new rail station and M/Y junction					n/a		mjrs_nc_to	base
6.4H	270 new houses					58508	597	base_nc_to	base+270
6.5H	270 new houses + rail station					59366	597	rs_nc_to	base+270
6.6H	270 new houses + M/Y junction					n/a		mj_nc_to	base+270
6.7H	270 new houses + rail station and M/Y junction					n/a		mjrs_nc_to	base+270
6.0U	base: existing travel				Utility	83.26	597	base_nc_to	base
6.1U	new rail station					82.78	597	rs_nc_to	base
6.2U	new M/Y junction					n/a		mj_nc_to	base
6.3U	new rail station and M/Y junction					n/a		mjrs_nc_to	base
6.4U	270 new houses					83.18	597	base_nc_to	base+270
6.5U	270 new houses + rail station					82.70	597	rs_nc_to	base+270
6.6U	270 new houses + M/Y junction					n/a		mj_nc_to	base+270
6.7U	270 new houses + rail station and M/Y junction					n/a		mjrs_nc_to	base+270
6.0S	base: existing travel				Utility	709396	597	base_nc_to	base
6.1S	new rail station						597	rs_nc_to	base
6.2S	new M/Y junction					n/a		mj_nc_to	base
6.3S	new rail station and M/Y junction					n/a		mjrs_nc_to	base
6.4S	270 new houses					709550	597	base_nc_to	base+270
6.5S	270 new houses + rail station						597	rs_nc_to	base+270
6.6S	270 new houses + M/Y junction					n/a		mj_nc_to	base+270
6.7S	270 new houses + rail station and M/Y junction					n/a		mjrs_nc_to	base+270

GARTCOSH: TEST 7

Test Ref	Test theme/detail	Data	Thresholds	Travel times	Index	Value	Zones	Time file	Planning file
7A	Economically inactive people accessibility to Gartcosh								
7A.0H	base: existing travel	SITM model zones plus aggregate jobs from CSTM data for Edinburgh, West Lothian, Falkirk, Stirling, Clackmannan, Fife, Ayrshire (E, N & S) and west West Dunbarton council areas	All zones covered by the data within 30 minutes travel time	Average of travel time from am and pm peak times. In the am, time is from relevant SITM zone to zone 449 and in pm peak time is from zone 449 to relevant SITM zone	Hansen	134631	362	base_c_to	base
7A.1H	new rail station					134637	362	rs_c_to	base
7A.2H	new M/Y junction					201817	362	mj_c_to	base
7A.3H	new rail station and M/Y junction					201817	362	mjrs_c_to	base
7A.4H	270 new houses					134785	362	base_c_to	base+270
7A.5H	270 new houses + rail station					134791	362	rs_c_to	base+270
7A.6H	270 new houses + M/Y junction					201971	362	mj_c_to	base+270
7A.7H	270 new houses + rail station and M/Y junction					201971	362	mjrs_c_to	base+270
7A.0U	base: existing travel				Utility	18.70	362	base_c_to	base
7A.1U	new rail station					18.70	362	rs_c_to	base
7A.2U	new M/Y junction					19.91	362	mj_c_to	base
7A.3U	new rail station and M/Y junction					15.91	362	mjrs_c_to	base
7A.4U	270 new houses					18.69	362	base_c_to	base+270
7A.5U	270 new houses + rail station					18.96	362	rs_c_to	base+270
7A.6U	270 new houses + M/Y junction					15.90	362	mj_c_to	base+270
7A.7U	270 new houses + rail station and M/Y junction					15.90	362	mjrs_c_to	base+270
2A.0S	base: existing travel				Simple	235963	362	base_c_to	base
2A.1S	new rail station					235963	362	rs_c_to	base
2A.2S	new M/Y junction					325281	362	mj_c_to	base
2A.3S	new rail station and M/Y junction					325281	362	mjrs_c_to	base
2A.4S	270 new houses					236117	362	base_c_to	base+270
2A.5S	270 new houses + rail station					236117	362	rs_c_to	base+270
2A.6S	270 new houses + M/Y junction					325435	362	mj_c_to	base+270
2A.7S	270 new houses + rail station and M/Y junction					325435	362	mjrs_c_to	base+270

GARTCOSH: TEST 7B

Test Ref	Test theme/detail	Data	Thresholds	Travel times	Index	Value	Zones	Time file	Planning file
7B	Economically inactive people accessibility to Gartcosh								
7B.0H	base: existing travel	SITM model zones plus aggregate jobs from CSTM data for Edinburgh, West Lothian, Falkirk, Stirling, Clackmannan, Fife, Ayrshire (E, N & S) and west West Dunbarton council areas	All zones covered by the data within 30 km distance	Average of travel time from am and pm peak times. In the am, time is from zone 449 to destination zone and in pm peak time is from destination zone to 449	Hansen	183816	588	base_c_to	base
7B.1H	new rail station					183822	588	rs_c_to	base
7B.2H	new M/Y junction					222476	588	mj_c_to	base
7B.3H	new rail station and M/Y junction					222476	588	mjrs_c_to	base
7B.4H	270 new houses					183970	588	base_c_to	base+270
7B.5H	270 new houses + rail station					183976	588	rs_c_to	base+270
7B.6H	270 new houses + M/Y junction					222630	588	mj_c_to	base+270
7B.7H	270 new houses + rail station and M/Y junction					222630	588	mjrs_c_to	base+270
7B.0U	base: existing travel				Utility	24.55	588	base_c_to	base
7B.1U	new rail station					24.55	588	rs_c_to	base
7B.2U	new M/Y junction					18.19	588	mj_c_to	base
7B.3U	new rail station and M/Y junction					18.19	588	mjrs_c_to	base
7B.4U	270 new houses					24.54	588	base_c_to	base+270
7B.5U	270 new houses + rail station					24.54	588	rs_c_to	base+270
7B.6U	270 new houses + M/Y junction					18.18	588	mj_c_to	base+270
7B.7U	270 new houses + rail station and M/Y junction					18.18	588	mjrs_c_to	base+270
7B.0S	base: existing travel				Simple	383957	588	base_c_to	base
7B.1S	new rail station						588	rs_c_to	base
7B.2S	new M/Y junction						588	mj_c_to	base
7B.3S	new rail station and M/Y junction						588	mjrs_c_to	base
7B.4S	270 new houses					384111	588	base_c_to	base+270
7B.5S	270 new houses + rail station						588	rs_c_to	base+270
7B.6S	270 new houses + M/Y junction						588	mj_c_to	base+270
7B.7S	270 new houses + rail station and M/Y junction						588	mjrs_c_to	base+270

GARTCOSH: TEST 8

Test Ref	Test theme/detail	Data	Thresholds	Travel times	Index	Value	Zones	Time file	Planning file
8	Adults in Gartcosh catchment with access to a car								
8.0H	base: existing travel	SITM model zones plus aggregate jobs from CSTM data for Edinburgh, West Lothian, Falkirk, Stirling, Clackmannan, Fife, Ayrshire (E, N & S) and west West Dunbarton council areas	All zones covered by the data	Average of travel time from am and pm peak times. In the am, time is from relevant SITM zone to zone 449 and in pm peak time is from zone 449 to relevant SITM zone	Hansen	695164	597	base_c_to	base
8.1H	new rail station					695180	597	rs_c_to	base
8.2H	new M/Y junction					846910	597	mj_c_to	base
8.3H	new rail station and M/Y junction					846910	597	mjrs_c_to	base
8.0U	base: existing travel				Utility	36.73	597	base_c_to	base
8.1U	new rail station					36.73	597	rs_c_to	base
8.2U	new M/Y junction					30.15	597	mj_c_to	base
8.3U	new rail station and M/Y junction					30.15	597	mjrs_c_to	base
8.0S	base: existing travel				Simple	2092622	597	base_c_to	base
8.1S	new rail station						597	rs_c_to	base
8.2S	new M/Y junction						597	mj_c_to	base
8.3S	new rail station and M/Y junction						597	mjrs_c_to	base

GARTCOSH: TEST 9

Test Ref	Test theme/detail	Data	Thresholds	Travel times	Index	Value	Zones	Time file	Planning file
9	All households (1991) accessibility to Gartcosh								
9.0H	base: existing travel	SITM model zones plus aggregate jobs from CSTM data for Edinburgh, West Lothian, Falkirk, Stirling, Clackmannan, Fife, Ayrshire (E, N & S) and west West Dunbarton council areas	All zones covered by the data	Average of travel time from am and pm peak times. In the am, time is from relevant SITM zone to zone 449 and in pm peak time is from zone 449 to relevant SITM zone	Hansen	520062	597	base_c_to	base
9.1H	new rail station					520071	597	rs_c_to	base
9.2H	new M/Y junction					635213	597	mj_c_to	base
9.3H	new rail station and M/Y junction					627894	597	mjrs_c_to	base
9.0U	base: existing travel				Utility	39.71	597	base_c_to	base
9.1U	new rail station					39.71	597	rs_c_to	base
9.2U	new M/Y junction					33.04	597	mj_c_to	base
9.3U	new rail station and M/Y junction					33.04	597	mjrs_c_to	base
9.0S	base: existing travel				Simple	1711569	597	base_c_to	base
9.1S	new rail station						597	rs_c_to	base
9.2S	new M/Y junction						597	mj_c_to	base
9.3S	new rail station and M/Y junction						597	mjrs_c_to	base

GARTCOSH: TEST 10

Test Ref	Test theme/detail	Data	Thresholds	Travel times	Index	Value	Zones	Time file	Planning file
10	All 0 car owning households (1991) accessibility to Gartcosh								
10.0H	base: existing travel	SITM model zones plus aggregate jobs from CSTM data for Edinburgh, West Lothian, Falkirk, Stirling, Clackmannan, Fife, Ayrshire (E, N & S) and west West Dunbarton council areas	All zones covered by the data	Average of travel time from am and pm peak times. In the am, time is from relevant SITM zone to zone 449 and in pm peak time is from zone 449 to relevant SITM zone	Hansen	82537	597	base_nc_to	base
10.1H	new rail station					83629	597	rs_nc_to	base
10.2H	new M/Y junction					n/a		mj_nc_to	base
10.3H	new rail station and M/Y junction					n/a		mjrs_nc_to	base
10.0U	base: existing travel				Utility	94.08	597	base_nc_to	base
10.1U	new rail station					93.65	597	rs_nc_to	base
10.2U	new M/Y junction					n/a		mj_nc_to	base
10.3U	new rail station and M/Y junction					n/a		mjrs_nc_to	base
10.0S	base: existing travel				Simple	1388207	597	base_nc_to	base
10.1S	new rail station						597	rs_nc_to	base
10.2S	new M/Y junction					n/a		mj_nc_to	base
10.3S	new rail station and M/Y junction					n/a		mjrs_nc_to	base

GARTCOSH: TEST 11

Test Ref	Test theme/detail	Data	Thresholds	Travel times	Index	Value	Zones	Time file	Planning file
11	All households with no cars or 1 car accessibility to Gartcosh (non-car travel)								
11.0H	base: existing travel	SITM model zones plus aggregate jobs from CSTM data for Edinburgh, West Lothian, Falkirk, Stirling, Clackmannan, Fife, Ayrshire (E, N & S) and west West Dunbarton council areas	All zones covered by the data	Average of travel time from am and pm peak times. In the am, time is from relevant SITM zone to zone 449 and in pm peak time is from zone 449 to relevant SITM zone	Hansen	108188	597	base_nc_to	base
11.1H	new rail station					109588	597	rs_nc_to	base
11.2H	new M/Y junction					n/a		mj_nc_to	base
11.3H	new rail station and M/Y junction					n/a		mjrs_nc_to	base
11.0U	base: existing travel				Utility	90.24	597	base_nc_to	base
11.1U	new rail station					89.81	597	rs_nc_to	base
11.2U	new M/Y junction					n/a		mj_nc_to	base
11.3U	new rail station and M/Y junction					n/a		mjrs_nc_to	base
11.0S	base: existing travel				Utility	1621463	597	base_nc_to	base
11.1S	new rail station						597	rs_nc_to	base
11.2S	new M/Y junction					n/a		mj_nc_to	base
11.3S	new rail station and M/Y junction					n/a		mjrs_nc_to	base

Appendix B

Braehead Retail Park, Glasgow/Renfrewshire
Test Specification and Results

Test Data

Zones – *All zones and planning data were taken from the Central Scotland Transport Model data. Detailed zones were adopted within the Strathclyde Integrated Transport Model area and other Council external areas were considered as single zone including Edinburgh, West Lothian, Falkirk , Stirling and Clackmannanshire Council areas.*

Travel times – These were taken from the 2000 base Strathclyde Integrated Transport Model.

Scheme specification - Retail floorspace estimates were provided by Glasgow City Council and Renfrewshire Council.

BRAEHEAD TEST 1A

Test Ref	Test theme/detail	Retail opportunities	Data	Thresholds	Travel times	Index	Value	Zones	Time file	Planning file
1A	Car available population in Braehead zone access to shopping:									
1A.0H	base: existing travel	retail jobs	SITM model zones plus aggregate jobs from CSTM data for Edinburgh, West Lothian, Falkirk, Stirling, Clackmannan, Fife, Ayrshire (E, N & S) and west West Dunbarton council areas. Floorspace data from retail impact study data.	All zones covered by the data	Average of travel time from am, ip and pm times. Time is average travel time betwen zone 329 and destination zone.	Hansen	50439	597	base: car	retail_jobs
1A.1H	with retail development	retail jobs					55939	597	base: car	retail_jobs+
1A.2H	base: existing travel	floorspace					218891	6	base: car	floorspace
1A.3H	with retail development	floorspace					327398	6	base: car	floorspace+
1A.0U	base: existing travel	retail jobs				Utility	29.39	597	base: car	retail_jobs
1A.1U	with retail development	retail jobs					27.82	597	base: car	retail_jobs+
1A.2U	base: existing travel	floorspace					23.12	6	base: car	floorspace
1A.3U	with retail development	floorspace					17.97	6	base: car	floorspace+

BRAEHEAD TEST 1B

Test Ref	Test theme/detail	Retail opportunities	Data	Thresholds	Travel times	Index	Value	Zones	Time file	Planning file
1B	Non-car available population in Braehead zone access to shopping:									
1B.0H	base: existing travel	retail jobs	SITM model zones plus aggregate jobs from CSTM data for Edinburgh, West Lothian, Falkirk, Stirling, Clackmannan, Fife, Ayrshire (E, N & S) and west West Dunbarton council areas. Floorspace data from retail impact study data.	All zones covered by the data	Average of travel time from am, ip and pm times. Time is average travel time betwen zone 329 and destination zone.	Hansen	15261	597	base: non-car	retail_jobs
1B.1H	with retail development	retail jobs					20761	597	base: non-car	retail_jobs+
1B.2H	base: existing travel	floorspace					98495	7	base: non-car	floorspace
1B.3H	with retail development	floorspace					207002	7	base: non-car	floorspace+
1B.0U	base: existing travel	retail jobs				Utility	53.30	597	base: non-car	retail_jobs
1B.1U	with retail development	retail jobs					47.64	597	base: non-car	retail_jobs+
1B.2U	base: existing travel	floorspace					39.09	7	base: non-car	floorspace
1B.3U	with retail development	floorspace					27.14	7	base: non-car	floorspace+

BRAEHEAD TEST 2A

Test Ref	Test theme/detail	Retail opportunities	Data	Thresholds	Travel times	Index	Value	Zones	Time file	Planning file
2A	Car available population in Braehead zone access to shopping:									
2A.0H	base: existing travel	retail jobs 15 mins	SITM model zones plus aggregate jobs from CSTM data for Edinburgh, West Lothian, Falkirk, Stirling, Clackmannan, Fife, Ayrshire (E, N & S) and west West Dunbarton council areas	All zones covered by the data within 15 mins and 30 mins	Minimum of car and public transport	Hansen	19284	123	base_pt	retail_jobs
2A.1H	with retail development	retail jobs 15 mins					27484	123	base_pt	retail_jobs+
2A.2H	base: existing travel	floorspace 15 mins					30359	1	base_pt	sqm
2A.3H	with retail development	floorspace 15 mins					138866	2	base_pt	sqm+
2A.4H	base: existing travel	retail jobs 30 mins					37009	443	base_pt	retail_jobs
2A.5H	with retail development	retail jobs 30 mins					42509	443	base_pt	retail_jobs+
2A.6H	base: existing travel	floorspace 30 mins					195997	3	base_pt	sqm
2A.7H	with retail development	floorspace 30 mins					304504	4	base_pt	sqm+
2A.0U	base: existing travel	retail jobs 15 mins				Utility	10.17	123	base_pt	retail_jobs
2A.1U	with retail development	retail jobs 15 mins					8.32	123	base_pt	retail_jobs+
2A.2U	base: existing travel	floorspace 15 mins					13.15	1	base_pt	sqm
2A.3U	with retail development	floorspace 15 mins					3.70	2	base_pt	sqm+
2A.4u	base: existing travel	retail jobs 30 mins					16.03	443	base_pt	retail_jobs
2A.5U	with retail development	retail jobs 30 mins					14.54	443	base_pt	retail_jobs+
2A.6U	base: existing travel	floorspace 30 mins					21.09	3	base_pt	sqm
2A.7U	with retail development	floorspace 30 mins					15.81	4	base_pt	sqm+
2A.0S	base: existing travel	retail jobs 15 mins				Simple	32066	123	base_pt	retail_jobs
2A.1S	with retail development	retail jobs 15 mins					37566	123	base_pt	retail_jobs+
2A.2S	base: existing travel	floorspace 15 mins					58591	1	base_pt	sqm
2A.3S	with retail development	floorspace 15 mins					167098	2	base_pt	sqm+
2A.4S	base: existing travel	retail jobs 30 mins					82463	443	base_pt	retail_jobs
2A.5S	with retail development	retail jobs 30 mins					87963	443	base_pt	retail_jobs+
2A.6S	base: existing travel	floorspace 30 mins					562783	3	base_pt	sqm
2A.7S	with retail development	floorspace 30 mins					671290	4	base_pt	sqm+

BRAEHEAD TEST 2B

Test Ref	Test theme/detail	Retail opportunities	Data	Thresholds	Travel times	Index	Value	Zones	Time file	Planning file
2B	Non-car available population in Braehead zone access to shopping:									
2B.0H	base: existing travel	retail jobs 15 mins	SITM model zones plus aggregate jobs from CSTM data for Edinburgh, West Lothian, Falkirk, Stirling, Clackmannan, Fife, Ayrshire (E, N & S) and west West Dunbarton council areas	All zones covered by the data within 15 mins and 30 mins	Public transport	Hansen	1402	2	base_pt	retail_jobs
2B.1H	with retail development	retail jobs 15 mins					6902	2	base_pt	retail_jobs+
2B.2H	base: existing travel	floorspace 15 mins					-	0	base_pt	sqm
2B.3H	with retail development	floorspace 15 mins					108507	1	base_pt	sqm+
2B.4H	base: existing travel	retail jobs 30 mins					3485	25	base_pt	retail_jobs
2B.5H	with retail development	retail jobs 30 mins					8995	25	base_pt	retail_jobs+
2B.6H	base: existing travel	floorspace 30 mins					-	0	base_pt	sqm
2B.7H	with retail development	floorspace 30 mins					108507	1	base_pt	sqm+
2B.0U	base: existing travel	retail jobs 15 mins				Utility	2.03	2	base_pt	retail_jobs
2B.1U	with retail development	retail jobs 15 mins					0.43	2	base_pt	retail_jobs+
2B.2U	base: existing travel	floorspace 15 mins					-	0	base_pt	sqm
2B.3U	with retail development	floorspace 15 mins					0	1	base_pt	sqm+
2B.4u	base: existing travel	retail jobs 30 mins					17.39	25	base_pt	retail_jobs
2B.5U	with retail development	retail jobs 30 mins					8.60	25	base_pt	retail_jobs+
2B.6U	base: existing travel	floorspace 30 mins					-	0	base_pt	sqm
2B.7U	with retail development	floorspace 30 mins					0	1	base_pt	sqm+
2B.0S	base: existing travel	retail jobs 15 mins				Simple	1552	2	base_pt	retail_jobs
2B.1S	with retail development	retail jobs 15 mins					7052	2	base_pt	retail_jobs+
2B.2S	base: existing travel	floorspace 15 mins					0	0	base_pt	sqm
2B.3S	with retail development	floorspace 15 mins					108507	1	base_pt	sqm+
2B.4S	base: existing travel	retail jobs 30 mins					8314	25	base_pt	retail_jobs
2B.5S	with retail development	retail jobs 30 mins					13814	25	base_pt	retail_jobs+
2B.6S	base: existing travel	floorspace 30 mins					0	0	base_pt	sqm
2B.7S	with retail development	floorspace 30 mins					108507	1	base_pt	sqm+

BRAEHEAD TEST 3

Test Ref	Test theme/detail	Retail opportunities	Data	Thresholds	Travel times	Index	Value	Zones	Time file	Planning file
3A	Car available population in Braehead zone access to employment:									
3A.0H	base: existing travel	all jobs	SITM model zones plus aggregate jobs from CSTM data for Edinburgh, West Lothian, Falkirk, Stirling, Clackmannan, Fife, Ayrshire (E, N & S) and west West Dunbarton council areas.	All zones covered by the data	Average of travel time from am, ip and pm times. Time is average travel time betwen zone 329 and destination zone.	Hansen	518500	597	base_car	total_jobs
3A.1H	with retail development	all jobs					524000	597	base_car	total_jobs+
3A.0U	base: existing travel	all jobs				Utility	34.19	597	base_car	total_jobs
3A.1U	with retail development	all jobs					33.97	597	base_car	total_jobs+

BRAEHEAD TEST 3B

Test Ref	Test theme/detail	Retail opportunities	Data	Thresholds	Travel times	Index	Value	Zones	Time file	Planning file
3B	Non-car available population in Braehead zone access to employment:									
3B.0H	base: existing travel	all jobs	SITM model zones plus aggregate jobs from CSTM data for Edinburgh, West Lothian, Falkirk, Stirling, Clackmannan, Fife, Ayrshire (E, N & S) and west West Dunbarton council areas.	All zones covered by the data	Average of travel time from am, ip and pm times. Time is average travel time betwen zone 329 and destination zone.	Hansen	219629	597	base_pt	total_jobs
3B.1H	with retail development	all jobs					225129	597	base_pt	total_jobs+
3B.0U	base: existing travel	all jobs				Utility	62.83	597	base_pt	total_jobs
3B.1U	with retail development	all jobs					62.13	597	base_pt	total_jobs+

BRAEHEAD TEST 4A

Test Ref	Test theme/detail	Retail opportunities	Data	Thresholds	Travel times	Index	Value	Zones	Time file	Planning file
4A	Car available population in Braehead zone access to employment:									
4A.0H	base: existing travel	all jobs 15 mins	SITM model zones plus aggregate jobs from CSTM data for Edinburgh, West Lothian, Falkirk, Stirling, Clackmannan, Fife, Ayrshire (E, N & S) and west West Dunbarton council areas	All zones covered by the data within 15 mins and 30 mins	Minimum of car and public transport	Hansen	149811	123	base_car	total_jobs
4A.1H	with retail development	all jobs 15 mins					155311	123	base_car	total_jobs+
4A.2H	base: existing travel	all jobs 30 mins					303260	443	base_car	total_jobs
4A.3H	with retail development	all jobs 30 mins					308760	443	base_car	total_jobs+
4A.0U	base: existing travel	all jobs 15 mins				Utility	10.92	123	base_car	total_jobs
4A.1U	with retail development	all jobs 15 mins					10.59	123	base_car	total_jobs+
4A.2U	base: existing travel	all jobs 30 mins					16.21	443	base_car	total_jobs
4A.3H	with retail development	all jobs 30 mins					15.98	443	base_car	total_jobs+
4A.0S	base: existing travel	all jobs 15 mins				Simple	207883	123	base_car	total_jobs
4A.1S	with retail development	all jobs 15 mins					213383	123	base_car	total_jobs+
4A.4S	base: existing travel	all jobs 30 mins					493116	443	base_car	total_jobs
4A.5S	with retail development	all jobs 30 mins					498616	443	base_car	total_jobs+

BRAEHEAD TEST 4B

Test Ref	Test theme/detail	Retail opportunities	Data	Thresholds	Travel times	Index	Value	Zones	Time file	Planning file
4B	Non-car available population in Braehead zone access to employment:									
4B.0H	base: existing travel	all jobs 15 mins	SITM model zones plus aggregate jobs from CSTM data for Edinburgh, West Lothian, Falkirk, Stirling, Clackmannan, Fife, Ayrshire (E, N & S) and west West Dunbarton council areas	All zones covered by the data within 15 mins and 30 mins	Public transport	Hansen	4226	2	base_pt	total_jobs
4B.1H	with retail development	all jobs 15 mins					9726	2	base_pt	total_jobs+
4B.2H	base: existing travel	all jobs 30 mins					25113	25	base_pt	total_jobs
4B.3H	with retail development	all jobs 30 mins					30613	25	base_pt	total_jobs+
4B.0U	base: existing travel	all jobs 15 mins				Utility	5.91	2	base_pt	total_jobs
4B.1U	with retail development	all jobs 15 mins					2.7	2	base_pt	total_jobs+
4B.2U	base: existing travel	all jobs 30 mins					22.37	25	base_pt	total_jobs
4B.3H	with retail development	all jobs 30 mins					19.31	25	base_pt	total_jobs+
4B.0S	base: existing travel	all jobs 15 mins				Simple	5046	2	base_pt	total_jobs
4B.1S	with retail development	all jobs 15 mins					10546	2	base_pt	total_jobs+
4B.4S	base: existing travel	all jobs 30 mins					49132	25	base_pt	total_jobs
4B.5S	with retail development	all jobs 30 mins					54632	25	base_pt	total_jobs+

BRAEHEAD TEST 5A

Test Ref	Test theme/detail	Thresholds	Data	Travel times	Index	Value	Zones	Time file	Planning file
5A	CAR AVAILABLE ECONOMICALLY INACTIVE PEOPLE ACCESS TO BRAEHEAD FOR SHOPPING								
5A.0H	base: existing travel	all zones	SITM model zones plus aggregate jobs from CSTM data for Edinburgh, West Lothian, Falkirk, Stirling, Clackmannan, Fife, Ayrshire (E, N & S) and west West Dunbarton		Hansen	149626	597	base_car	popn_inact
5A.1H	base: existing travel	< 15 mins				40336	123	base_car	popn_inact
5A.2H	base: existing travel	< 30 mins				103816	443	base_car	popn_inact
5A.0U	base: existing travel	all zones			Utility	31.13	597	base_car	popn_inact
5A.1U	base: existing travel	< 15 mins				10.25	123	base_car	popn_inact
5A.2U	base: existing travel	< 30 mins				17.70	443	base_car	popn_inact
5A.0S	base: existing travel	all zones			Simple	709396	597	base_car	popn_inact
5A.1S	base: existing travel	< 15 mins				67338	123	base_car	popn_inact
5A.2S	base: existing travel	< 30 mins				251520	433	base_car	popn_inact

BRAEHEAD TEST 5B

Test Ref	Test theme/detail	Thresholds	Data	Travel times	Index	Value	Zones	Time file	Planning file
5B	NON-CAR AVAILABLE ECONOMICALLY INACTIVE PEOPLE ACCESS TO BRAEHEAD FOR SHOPPING								
5B.0H	base: existing travel	all zones	SITM model zones plus aggregate jobs from CSTM data for Edinburgh, West Lothian, Falkirk, Stirling, Clackmannan, Fife, Ayrshire (E, N & S) and west West Dunbarton		Hansen	31614	597	base_pt	popn_inact
5B.1H	base: existing travel	< 15 mins				70	2	base_pt	popn_inact
5B.2H	base: existing travel	< 30 mins				4638	25	base_pt	popn_inact
5B.0U	base: existing travel	all zones			Utility	62.22	597	base_pt	popn_inact
5B.1U	base: existing travel	< 15 mins				3.15	2	base_pt	popn_inact
5B.2U	base: existing travel	< 30 mins				25.61	25	base_pt	popn_inact
5B.0S	base: existing travel	all zones			Simple	709396	597	base_pt	popn_inact
5B.1S	base: existing travel	< 15 mins				82	2	base_pt	popn_inact
5B.2S	base: existing travel	< 30 mins				16692	25	base_pt	popn_inact

BRAEHEAD TEST 6A

Test Ref	Test theme/detail	Thresholds	Data	Travel times	Index	Value	Zones	Time file	Planning file
6A	Car available economically inactive people access to Braehead for shopping								
6A.0H	base: existing travel	all zones	SITM model zones plus aggregate jobs from CSTM data for Edinburgh, West Lothian, Falkirk, Stirling, Clackmannan, Fife, Ayrshire (E, N & S) and west West Dunbarton		Hansen	253076	597	base_car	popn_act
6A.1H	base: existing travel	< 15 mins				63564	123	base_car	popn_act
6A.2H	base: existing travel	< 30 mins				159719	443	base_car	popn_act
6A.0U	base: existing travel	all zones			Utility	33.97	597	base_car	popn_act
6A.1U	base: existing travel	< 15 mins				10.36	123	base_car	popn_act
6A.2U	base: existing travel	< 30 mins				17.46	443	base_car	popn_act
6A.0S	base: existing travel	all zones			Simple	1383226	597	base_car	popn_act
6A.1S	base: existing travel	< 15 mins				106694	123	base_car	popn_act
6A.2S	base: existing travel	< 30 mins				382313	443	base_car	popn_act

BRAEHEAD TEST 6B

Test Ref	Test theme/detail	Thresholds	Data	Travel times	Index	Value	Zones	Time file	Planng file
6B	Non-car available economically inactive people access to Braehead for shopping								
6B.0H	base: existing travel	all zones	SITM model zones plus aggregate jobs from CSTM data for Edinburgh, West Lothian, Falkirk, Stirling, Clackmannan, Fife, Ayrshire (E, N & S) and west West Dunbarton		Hansen	52486	597	base_pt	popn_act
6B.1H	base: existing travel	< 15 mins				73	2	base_pt	popn_act
6B.2H	base: existing travel	< 30 mins				6787	25	base_pt	popn_act
6B.0U	base: existing travel	all zones			Utility	65.43	597	base_pt	popn_act
6B.1U	base: existing travel	< 15 mins				3.61	2	base_pt	popn_act
6B.2U	base: existing travel	< 30 mins				25.48	25	base_pt	popn_act
6B.0S	base: existing travel	all zones			Simple	1383226	597	base_pt	popn_act
6B.1S	base: existing travel	< 15 mins				88	2	base_pt	popn_act
6B.2S	base: existing travel	< 30 mins				24267	25	base_pt	popn_act

BRAEHEAD TEST 7A

Test Ref	Test theme/detail	Thresholds	Data	Travel times	Index	Value	Zones	Time file	Planning file
7A	Car available all households access to Braehead for shopping								
7A.0H	base: existing travel	all zones	SITM model zones plus aggregate jobs from CSTM data for Edinburgh, West Lothian, Falkirk, Stirling, Clackmannan, Fife, Ayrshire (E, N & S) and west West Dunbarton		Hansen	277309	597	base_car	hh_all
7A.1H	base: existing travel	< 15 mins				74163	123	base_car	hh_all
7A.2H	base: existing travel	< 30 mins				183863	443	base_car	hh_all
7A.0U	base: existing travel	all zones			Utility	32.66	597	base_car	hh_all
7A.1U	base: existing travel	< 15 mins				10.36	123	base_car	hh_all
7A.2U	base: existing travel	< 30 mins				17.43	443	base_car	hh_all
7A.0S	base: existing travel	all zones			Simple	1419951	597	base_car	hh_all
7A.1S	base: existing travel	< 15 mins				124475	123	base_car	hh_all
7A.2S	base: existing travel	< 30 mins				439602	443	base_car	hh_all

BRAEHEAD TEST 7B

Test Ref	Test theme/detail	Thresholds	Data	Travel times	Index	Value	Zones	Time file	Planng file
7B	Non-car available all households access to Braehead for shopping								
7B.0H	base: existing travel	all zones	SITM model zones plus aggregate jobs from CSTM data for Edinburgh, West Lothian, Falkirk, Stirling, Clackmannan, Fife, Ayrshire (E, N & S) and west West Dunbarton		Hansen	59270	597	base_pt	hh_all
7B.1H	base: existing travel	< 15 mins				161	2	base_pt	hh_all
7B.2H	base: existing travel	< 30 mins				8030	25	base_pt	hh_all
7B.0U	base: existing travel	all zones			Utility	63.53	597	base_pt	hh_all
7B.1U	base: existing travel	< 15 mins				2.26	2	base_pt	hh_all
7B.2U	base: existing travel	< 30 mins				25.39	25	base_pt	hh_all
7B.0S	base: existing travel	all zones			Simple	1419951	597	base_pt	hh_all
7B.1S	base: existing travel	< 15 mins				180	2	base_pt	hh_all
7B.2S	base: existing travel	< 30 mins				28578	25	base_pt	hh_all

BRAEHEAD TEST 8

Test Ref	Test theme/detail	Thresholds	Data	Travel times	Index	Value	Zones	Time file	Planng file
8	0 Car households (1991) access to Braehead for shopping								
8.0H	base: existing travel	all zones	SITM model zones plus aggregate jobs from CSTM data for Edinburgh, West Lothian, Falkirk, Stirling, Clackmannan, Fife, Ayrshire (E, N & S) and west West Dunbarton		Hansen	31046	597	base_pt	hh0
8.1H	base: existing travel	< 15 mins				10	2	base_pt	hh0
8.2H	base: existing travel	< 30 mins				5013	25	base_pt	hh0
8.0U	base: existing travel	all zones			Utility	59.89	597	base_pt	hh0
8.1U	base: existing travel	< 15 mins				0	2	base_pt	hh0
8.2U	base: existing travel	< 30 mins				25.44	25	base_pt	hh0
8.0S	base: existing travel	all zones			Simple	620083	597	base_pt	hh0
8.1S	base: existing travel	< 15 mins				10	2	base_pt	hh0
8.2S	base: existing travel	< 30 mins				17891	25	base_pt	hh0

TEST 9A

Test Ref	Test theme/detail	Thresholds	Data	Travel times	Index	Value	Zones	Time file	Planning file
9A	Accessibility to Glasgow City Centre car available for shopping								
9A.1H	Economically active people in town centre catchment	all zones	SITM model zones plus aggregate jobs from CSTM data for Edinburgh, West Lothian, Falkirk, Stirling, Clackmannan, Fife, Ayrshire (E, N & S) and west West Dunbarton council areas	Average of am, ip and pm for zone 4 City Centre	Hansen	208269	597	base_car_cc	popn_act
9A.2H	Economically inactive people in town centre catchment					124379	597	base_car_cc	popn_inact
9A.3H	Retail jobs in town centre catchment					50868	597	base_car_cc	retail_jobs+
9A.4H	Total population within town centre catchment					514281	597	base_car_cc	popn_total
9A.5H	Economically active people in town centre catchment	< 30 mins				115088	433	base_car_cc	popn_act
9A.6H	Economically inactive people in town centre catchment					82227	433	base_car_cc	popn_inact
9A.7H	Retail jobs in town centre catchment					39071	433	base_car_cc	retail_jobs+
9A.8H	Total population within town centre catchment					304860	433	base_car_cc	popn_total
9A.1u	Economically active people in town centre catchment	all zones			Utility	37.86	597	base_car_cc	popn_act
9A.2u	Economically inactive people in town centre catchment					34.82	597	base_car_cc	popn_inact
9A.3u	Retail jobs in town centre catchment					29.72	597	base_car_cc	retail_jobs+
9A.4U	Total population within town centre catchment					36.86	597	base_car_cc	popn_total
9A.5U	Economically active people in town centre catchment	< 30 mins				22.88	433	base_car_cc	popn_act
9A.6U	Economically inactive people in town centre catchment					22.03	433	base_car_cc	popn_inact
9A.7U	Retail jobs in town centre catchment					18.21	433	base_car_cc	retail_jobs+
9A.8U	Total population within town centre catchment					22.60	433	base_car_cc	popn_total
9A.1S	Economically active people in town centre catchment	all zones			Simple	1383226	597	base_car_cc	popn_act
9A.2S	Economically inactive people in town centre catchment					709396	597	base_car_cc	popn_inact
9A.3S	Retail jobs in town centre catchment					224777	597	base_car_cc	retail_jobs+
9A.4S	Total population within town centre catchment					3247411	597	base_car_cc	popn_total
9A.5S	Economically active people in town centre catchment	< 30 mins				361260	433	base_car_cc	popn_act
9A.6S	Economically inactive people in town centre catchment					247457	433	base_car_cc	popn_inact
9A.7S	Retail jobs in town centre catchment					97092	433	base_car_cc	retail_jobs+
9A.8S	Total population within town centre catchment					943955	433	base_car_cc	popn_total

TEST 9B

Test Ref	Test theme/detail	Thresholds	Data	Travel times	Index	Value	Zones	Time file	Planning file
9B	Accessibility to Glasgow City Centre no-car available for shopping								
9B.1H	Economically active people in town centre catchment	all zones	SITM model zones plus aggregate jobs from CSTM data for Edinburgh, West Lothian, Falkirk, Stirling, Clackmannan, Fife, Ayrshire (E, N & S) and west West Dunbarton council areas	Average of am, ip and pm for zone 4 City Centre	Hansen	137432	597	base_pt_cc	popn_act
9B.2H	Economically inactive people in town centre catchment					81336	597	base_pt_cc	popn_inact
9B.3H	Retail jobs in town centre catchment					40217	597	base_pt_cc	retail_jobs+
9B.4H	Total population within town centre catchment					336976	597	base_pt_cc	popn_total
9B.5H	Economically active people in town centre catchment	< 30 mins				44066	226	base_pt_cc	popn_act
9B.6H	Economically inactive people in town centre catchment					34320	226	base_pt_cc	popn_inact
9B.7H	Retail jobs in town centre catchment					25890	226	base_pt_cc	retail_jobs+
9B.8H	Total population within town centre catchment					118677	226	base_pt_cc	popn_total
9B.1U	Economically active people in town centre catchment	all zones			Utility	46.18	597	base_pt_cc	popn_act
9B.2U	Economically inactive people in town centre catchment					43.32	597	base_pt_cc	popn_inact
9B.3U	Retail jobs in town centre catchment					34.42	597	base_pt_cc	retail_jobs+
9B.4U	Total population within town centre catchment					45.31	597	base_pt_cc	popn_total
9B.5U	Economically active people in town centre catchment	< 30 mins				22.92	226	base_pt_cc	popn_act
9B.6U	Economically inactive people in town centre catchment					22.4	226	base_pt_cc	popn_inact
9B.7U	Retail jobs in town centre catchment					15.52	226	base_pt_cc	retail_jobs+
9B.8U	Total population within town centre catchment					22.84	226	base_pt_cc	popn_total
9B.1S	Economically active people in town centre catchment	all zones			Simple	1383226	597	base_pt_cc	popn_act
9B.2S	Economically inactive people in town centre catchment					709396	597	base_pt_cc	popn_inact
9B.3S	Retail jobs in town centre catchment					224777	597	base_pt_cc	retail_jobs+
9B.4S	Total population within town centre catchment					3247411	597	base_pt_cc	popn_total
9B.5S	Economically active people in town centre catchment	< 30 mins				138583	226	base_pt_cc	popn_act
9B.6S	Economically inactive people in town centre catchment					105204	226	base_pt_cc	popn_inact
9B.7S	Retail jobs in town centre catchment					56255	226	base_pt_cc	retail_jobs+
9B.8S	Total population within town centre catchment					371747	226	base_pt_cc	popn_total

TEST 10A

Test Ref	Test theme/detail	Thresholds	Data	Travel times	Index	Value	Zones	Time file	Planning file
10A	Accessibility to sub-urban centre in Rutherglen for shopping (car available)								
10A.1H	Economically active people in town centre catchment	all zones	SITM model zones plus aggregate jobs from CSTM data for Edinburgh, West Lothian, Falkirk, Stirling, Clackmannan, Fife, Ayrshire (E, N & S) and west West Dunbarton council areas	Average of am, ip and pm for zone 162 Rutherglen	Hansen	241013	597	base_car_r	popn_act
10A.2H	Economically inactive people in town centre catchment					142304	597	base_car_r	popn_inact
10A.3H	Retail jobs in town centre catchment					46932	597	base_car_r	retail_jobs+
10A.4H	Total population within town centre catchment					592224	597	base_car_r	popn_total
10A.5H	Economically active people in town centre catchment	< 30 mins				160726	436	base_car_r	popn_act
10A.6H	Economically inactive people in town centre catchment					106126	436	base_car_r	popn_inact
10A.7H	Retail jobs in town centre catchment					35468	436	base_car_r	retail_jobs+
10A.8H	Total population within town centre catchment					410685	436	base_car_r	popn_total
10A.1U	Economically active people in town centre catchment	all zones			Utility	34.95	597	base_car_r	popn_act
10A.2U	Economically inactive people in town centre catchment					32.13	597	base_car_r	popn_inact
10A.3U	Retail jobs in town centre catchment					31.33	597	base_car_r	retail_jobs+
10A.4U	Total population within town centre catchment					34.03	597	base_car_r	popn_total
10A.5U	Economically active people in town centre catchment	< 30 mins				19.41	436	base_car_r	popn_act
10A.6U	Economically inactive people in town centre catchment					19.2	436	base_car_r	popn_inact
10A.7U	Retail jobs in town centre catchment					20.23	436	base_car_r	retail_jobs+
10A.8U	Total population within town centre catchment					19.32	436	base_car_r	popn_total
10A.1S	Economically active people in town centre catchment	all zones			Simple	1383226	597	base_car_r	popn_act
10A.2S	Economically inactive people in town centre catchment					709396	597	base_car_r	popn_inact
10A.3S	Retail jobs in town centre catchment					224777	597	base_car_r	retail_jobs+
10A.4S	Total population within town centre catchment					3247411	597	base_car_r	popn_total
10A.5S	Economically active people in town centre catchment	< 30 mins				424202	436	base_car_r	popn_act
10A.6S	Economically inactive people in town centre catchment					277151	436	base_car_r	popn_inact
10A.7S	Retail jobs in town centre catchment					97529	436	base_car_r	retail_jobs+
10A.8S	Total population within town centre catchment					1079170	436	base_car_r	popn_total

TEST 10B

Test Ref	Test theme/detail	Thresholds	Data	Travel times	Index	Value	Zones	Time file	Planning file
10B	Accessibility to sub-urban centre in Rutherglen for shopping (no car available)								
10B.1H	Economically active people in town centre catchment	all zones	SITM model zones plus aggregate jobs from CSTM data for Edinburgh, West Lothian, Falkirk, Stirling, Clackmannan, Fife, Ayrshire (E, N & S) and west West Dunbarton council areas	Average of am, ip and pm for zone 162 Rutherglen	Hansen	64483	597	base_pt_r	popn_act
10B.2H	Economically inactive people in town centre catchment					39169	597	base_pt_r	popn_inact
10B.3H	Retail jobs in town centre catchment					15045	597	base_pt_r	retail_jobs+
10B.4H	Total population within town centre catchment					159460	597	base_pt_r	popn_total
10B.5H	Economically active people in town centre catchment	< 30 mins				20178	68	base_pt_r	popn_act
10B.6H	Economically inactive people in town centre catchment					12004	68	base_pt_r	popn_inact
10B.7H	Retail jobs in town centre catchment					3317	68	base_pt_r	retail_jobs+
10B.8H	Total population within town centre catchment					49095	68	base_pt_r	popn_total
10B.1u	Economically active people in town centre catchment	all zones			Utility	61.32	597	base_pt_r	popn_act
10B.2u	Economically inactive people in town centre catchment					57.93	597	base_pt_r	popn_inact
10B.3u	Retail jobs in town centre catchment					54.08	597	base_pt_r	retail_jobs+
10B.4U	Total population within town centre catchment					60.28	597	base_pt_r	popn_total
10B.5U	Economically active people in town centre catchment	< 30 mins				22.24	68	base_pt_r	popn_act
10B.6U	Economically inactive people in town centre catchment					22.69	68	base_pt_r	popn_inact
10B.7U	Retail jobs in town centre catchment					21.01	68	base_pt_r	retail_jobs+
10B.8U	Total population within town centre catchment					22.36	68	base_pt_r	popn_total
10B.1S	Economically active people in town centre catchment	all zones			Simple	1383226	597	base_pt_r	popn_act
10B.2S	Economically inactive people in town centre catchment					709396	597	base_pt_r	popn_inact
10B.3S	Retail jobs in town centre catchment					224777	597	base_pt_r	retail_jobs+
10B.4S	Total population within town centre catchment					3247411	597	base_pt_r	popn_total
10B.5S	Economically active people in town centre catchment	< 30 mins				61349	68	base_pt_r	popn_act
10B.6S	Economically inactive people in town centre catchment					37337	68	base_pt_r	popn_inact
10B.7S	Retail jobs in town centre catchment					9486	68	base_pt_r	retail_jobs+
10B.8S	Total population within town centre catchment					105019	68	base_pt_r	popn_total

Appendix C

New Royal Infirmary, Edinburgh
Test Specification and Results

Test Data

Zones – *The zones identified by the 58 ward boundaries in the City of Edinburgh area. The planning data was extracted from a Geographical Information System for the City.*

Travel times – The inter zone travel times were estimated by Edinburgh Council. Given the wide variety of times of day for travel to and from the Infirmary, all day average times have been used. The bus times include walking access time and wait time. The car, walk and cycle times assume door to door travel.

Scheme specification was taken from consultancy reports for the Hospital Trust by Buchanan and Partners and JMP Consultants. Schemes being tested include:

- Improved bus services to the City Centre and Kings Buildings at the University.
- Improved bus services to south west and south east peripheral areas of the city.
- Parking charges at the hospital supported by a controlled parking zone near the hospital - Patient/visitor charge £0.60 and staff parking charge of £2 per day.
- Facilities for 300 staff to live on site.

NEW ROYAL INFIRMARY OF EDINBURGH

Test	Test theme/detail	Simple <30 mins	Simple <60 mins	Simple <90mins	Hansen	Utility
2	Accessibility of elderly people 65+ to NRI					
2.1	Car: base	69027	69027	69027	44358	14.74
2.2	Car: staff parking	n/a	n/a	n/a	n/a	n/a
2.3	Car: patient parking	50593	69027	69027	31890	25.74
2.4	Bus: base	12159	44797	69027	19147	42.74
2.5	Bus: town centre imps	13418	44797	69027	19973	41.34
2.6	Bus: peripheral imps	13347	534408	69027	20758	40.05
2.7	Bus: combined imps	14606	53408	69027	21584	38.75
2.8	Cycle	n/a	n/a	n/a	n/a	n/a
2.9	Walk	1238	13121	31629	7179	75.44
3	Accessibility of unemployed people to NRI					
3.1	Car: base	18275	18275	18275	12004	14.01
3.2	Car: staff parking	0	17072	18275	3839	52.01
3.3	Car: patient parking	13690	18275	18275	8630	25.01
3.4	Bus: base	4526	11069	18275	5471	40.20
3.5	Bus: town centre imps	4707	11069	18275	5715	38.74
3.6	Bus: peripheral imps	4817	14810	18275	6187	36.10
3.7	Bus: combined imps	4998	14810	18275	6431	34.81
3.8	Cycle	9542	17642	18275	7960	27.70
3.9	Walk	453	3928	9386	2080	72.45
4	Accessibility of all households to NRI					
6.1	Car: base	185936	185936	185936	120063	14.58
6.2	Car: staff parking	0	167444	185936	38398	52.58
6.3	Car: patient parking	139464	185936	185936	86316	25.58
6.4	Bus: base	36190	117753	185936	52615	42.08
6.5	Bus: town centre imps	39649	117753	185936	55106	40.54
6.6	Bus: peripheral imps	39065	144513	185936	57676	39.02
6.7	Bus: combined imps	42524	144513	185936	60167	37.61
6.8	Cycle	91479	176988	185936	78167	28.89
6.9	Walk	3270	33233	87586	19062	75.92
5	Accessibility of 0 car owning households to NRI					
5.1	Car: base	86345	86345	86345	56829	13.94
5.2	Car: staff parking	0	81617	86345	18175	51.94
5.3	Car: patient parking	67235	86345	86345	40856	24.94
5.4	Bus: base	19234	57721	86345	26074	39.91
5.5	Bus: town centre imps	20382	57721	86345	27275	38.41
5.6	Bus: peripheral imps	20657	72326	86345	28819	36.58
5.7	Bus: combined imps	21805	72326	86345	30020	35.22
5.8	Cycle	47717	84353	86345	38024	37.34
5.9	Walk	1912	16842	45525	9697	72.88
6	Accessibility of population to NRI					
6.1	Car: base	418748	418748	418748	268861	14.77
6.2	Car: staff parking	0	370521	418748	85987	52.77
6.3	Car: patient parking	305839	418748	418748	193291	25.77
6.4	Bus: base	78109	254471	418748	115634	42.89
6.5	Bus: town centre imps	84748	254471	418748	120602	41.49
6.6	Bus: peripheral imps	85411	317024	418748	127681	39.59
6.7	Bus: combined imps	92050	317024	418748	132649	38.32
6.8	Cycle	196952	394182	418748	173640	29.34
6.9	Walk	7902	77810	190079	42774	76.04

Appendix D

Expansion of the Robert Gordon University, Aberdeen

Test Specification and Results

Test Data

Zones – *The zones are the 50 ward boundaries in the Aberdeen City area. The planning data was obtained from the City Council based from published information at a ward level.*

Travel times – The inter zone travel times were estimated directly from a ward map supplied by Aberdeen City Council. Based upon typical speeds for each mode, travel times between zones were estimated for car, bus, walking and cycling. The bus times took account of the existing bus routes, and were factored to include a wait time and walk access time.

Scheme specification was taken from the transport assessments for the University by consultants Babtie and the consultative draft of green transport plan by consultants Fairhurst. Schemes being tested include:

- Upgraded walking and cycling paths
- A new shuttle bus between the Campus and the City Centre/Schoolhill Campus.
- Fare discounts or subsidies negotiated with the local bus companies (40% reduction in generalised travel time tested).
- Parking restraint and charges and an associated residents parking scheme.

Robert Gordon University

Test	Test theme/detail	Simple <30 mins Value	Simple <30 mins Zones	Simple <60 mins Value	Simple <60 mins Zones	Hansen	Utility	Zones
1	Accessibility of population to Garthdee							
1.1	Car: base	204413	50	204413	50	171712	5.81	50
1.2	Car: site parking charge	196102	48	204413	50	100065	23.81	50
1.3	Bus: base	70415	18	196102	48	83568	29.82	50
1.4	Bus: with shuttle bus improvements	106661	27	204413	50	103260	22.76	50
2.6	Bus: subsidies	191648	47	204413	50	116338	19.79	50
2.8	Cycle	196102	48	204413	50	129768	15.15	50
2.9	Walk	40607	10	130910	32	53403	44.74	50
2	Accessibility of polulation aged 16-24 to Garthdee							
2.1	Car: base	28216	50	28216	50	23611	5.94	50
2.2	Car: site parking charge	26946	48	28216	50	13759	23.94	50
2.3	Bus: base	10059	18	26946	48	11388	30.24	50
2.4	Bus: with shuttle bus improvements	15168	27	28216	50	14252	22.77	50
2.5	Bus: subsidies	26278	47	28216	50	15963	18.99	50
2.6	Cycle	26946	48	28216	50	17720	15.51	50
2.7	Walk	4830	10	17891	32	7059	46.18	50
3	Accessibility of all households to Garthdee							
3.1	Car: base	87842	50	87842	50	74003	5.71	50
3.2	Car: site parking charge	84712	48	87842	50	43125	23.71	50
3.3	Bus: base	32392	18	84712	48	36532	29.25	50
3.4	Bus: with shuttle bus improvements	49521	27	87842	50	45375	22.02	50
3.5	Bus: subsidies	83067	47	87842	50	50599	18.39	50
3.6	Cycle	84712	48	87842	50	56113	14.94	50
3.7	Walk	17498	10	58316	32	23173	44.42	50
4	Accessibility of 0 car owning households to Garthdee							
4.1	Car: base	35186	50	35186	50	29688	5.66	50
4.2	Car: site parking charge	34430	48	35186	50	17301	23.66	50
4.3	Bus: base	12369	18	34430	48	14383	29.82	50
4.4	Bus: with shuttle bus improvements	21251	27	35186	50	18107	22.15	50
4.5	Bus: subsidies	34085	47	35186	50	20162	18.56	50
4.6	Cycle	34430	48	35186	50	22426	15.01	50
4.7	Walk	5574	10	23991	32	8912	45.78	50
5	Accessibility of 2+ car owning households to Garthdee							
5.1	Car: base	14776	50	14776	50	12443	5.73	50
5.2	Car: site parking charge	13953	48	14776	50	7251	23.73	50
5.3	Bus: base	6171	18	13953	48	6421	27.78	50
5.4	Bus: with shuttle bus improvements	7919	27	14776	50	7764	21.45	50
5.5	Bus: subsidies	13353	47	14776	50	8679	17.74	50
5.6	Cycle	13953	48	14776	50	9516	14.67	50
5.7	Walk	3882	10	9459	32	4175	42.13	50
6	Accessibility of deprived areas to Garthdee							
6.1	Car: base	19671	50	19671	50	16486	5.89	50
6.2	Car: site parking charge	19348	48	19671	50	9607	23.89	50
6.3	Bus: base	6803	18	19348	48	7826	30.72	50
6.4	Bus: with shuttle bus improvements	11684	27	19671	50	9954	22.71	50
6.5	Bus: subsidies	19266	47	19671	50	11121	19.01	50
6.6	Cycle	19348	48	19671	50	12284	15.69	50
6.7	Walk	1981	10	12560	32	4603	48.41	50

Annex

Guidance on Accessibility Measuring Techniques and their Application

CONTENTS

1. INTRODUCTION

The primary aim of transport is to enable people and businesses to gain access to jobs, shops, friends, family, and many other activities. The ease with which these activities can be accessed depends not just upon transport systems but upon patterns of land use. Accessibility measures seek to define the level of opportunity and choice taking account of both the existence of opportunities, and the transport options available to reach them. They therefore provide as direct a measure as is theoretically possible of whether integrated transport is meeting the needs of society and the economy.

This guidance:

- Describes where accessibility is needed within land use and transport planning,
- Identifies the accessibility analysis techniques available
- Illustrates the application of these techniques through case studies

It is recognised that best practice for accessibility analysis is evolving. This guidance aims to provide a framework within which techniques can be further developed towards a more comprehensive and standardised practice consistent with the new integrated transport policies.

In the past, the main focus of transport analysis for new land use developments or transport projects has been on transport demand. However, the demands of the population are increasing to levels that cannot be physically accommodated within existing urban areas and which are not sustainable in economic or environmental terms. The new integrated transport policies therefore recognise the need to manage both transport supply and demand, based upon overall economic, social and environmental objectives. Since accessibility measures describe the links between transport supply and these wider policy areas they have a major role in helping to define how transport policy objectives can be delivered through practical policies.

This guidance demonstrates how accessibility measurements can be used to support practical decision making by local authorities, developers, national government and others. Good accessibility as a transport objective carries very broad support from every strand of opinion in society so there are very practical advantages in demonstrating the effects of transport changes in terms of accessibility.

In some circumstances qualitative assessments can be helpful but in many cases quantitative accessibility analysis is needed. This guidance explains how to tackle five main types of accessibility analysis which are currently identified within national land use and transport planning guidance.

- Accessibility by walking and cycling
- Public transport accessibility
- Transport system accessibility to opportunities
- Ratios comparing accessibility for different mobility groups
- Freight accessibility

2. THE NEED FOR THE GUIDANCE

Research for the Scottish Executive has identified that practitioners in Scotland recognise the need for:

- Simple analytical techniques which can be used to support decisions about policies and projects
- Analysis methods which identify the relationships between transport issues and wider policies particularly land use, economic development, health and education.
- Analysis which takes account of the needs of walkers and cyclists.
- Consistent approaches for considering travel by all modes.

Accessibility analysis techniques have the potential to meet all these needs. A wide variety of approaches have been in use for many years including catchment measures, peripherality indices, time space geography analysis, rural accessibility measures, public transport accessibility, economic potential analysis, utility analysis, and many more. Some of the simpler techniques have been adopted by transport and land use professionals but the more complex methods have largely been restricted to use within research.

Given the new focus on accessibility within national integrated transport policies, there is a need for wider and more consistent application of these techniques. Specific requirements for such analysis are now included in national planning policy and transport appraisal procedures.

Transport and land use practitioners ir Scotland have noted that:

"Decisions are being made by local authorities largely on an intuitive basis."

"There is a need for a more consistent approach to transport planning and levels of service between local and strategic issues."

"Commercial development has traditionally used accessibility techniques to determine catchments based upon drive time. Increasing attention now needs to be given to catchments by all modes."

"Local authorities are faced with overcoming the major inconsistency between existing development plans and new transport policies, since current development plans will significantly reduce overall levels of access to public transport."

"Traditionally transport operators have followed demand when planning changes to services. There is now recognition that new transport policies creates a need for new approaches."

"Guidance on accessibility analysis would be welcomed."

Land Use Planning

Increasingly accessibility considerations are driving land use and transport appraisal. National Planning Policy Guidance Note 17 and Planning Advice Note 57 identify the need for accessibility to be considered within:

- Site selection for new developments
- Transport assessments
- Traffic management proposals
- Parking standards

The general approach identified within the NPPG is to prioritise accessibility within the integrated transport system both in terms of mode and of best value. This new

focus on multi-modal analysis, particularly when linked to overall economic and social policy, introduces new challenges for analysis.

Accessibility in transport appraisal

The national transport White Paper defines five key criteria against which transport proposals will be assessed: integration, accessibility, economy, environment and safety. The details of how accessibility issues will be considered under each of these criteria is the subject of current work on transport appraisal for the Scottish Executive. However the main components of accessibility which are likely to be included are measures of:

- Consistency between transport policy and other public policy objectives including land use, health, education, and regional development.
- Local access opportunities by walking and cycling
- Transport system accessibility (i.e. including all modes, interchange issues, cost, time, reliability, and quality) to opportunities such as employment, shopping, health services, social service support networks, recreation, countryside etc.
- The value of additional travel options for each sector within society.
- Access to public transport services including bus stops, stations, and vehicles
- How impacts are distributed across geographical areas, population groups, trip purposes and modes of travel including compatibility with equity objectives.

In the past, transport demand modelling has been a direct input to the policy appraisal. Under the new integrated transport policies, demand modelling continues to be an important input to the analysis but it is viewed within the context of strategic accessibility objectives as shown in Figure 1. This ensures that a consistent approach is taken to all modes including walking and cycling (where demand is not a major influence on accessibility). It also allows a much wider range of policy impacts to be studied since as many user groups as is appropriate can be investigated without increasing the complexity of the demand modelling.

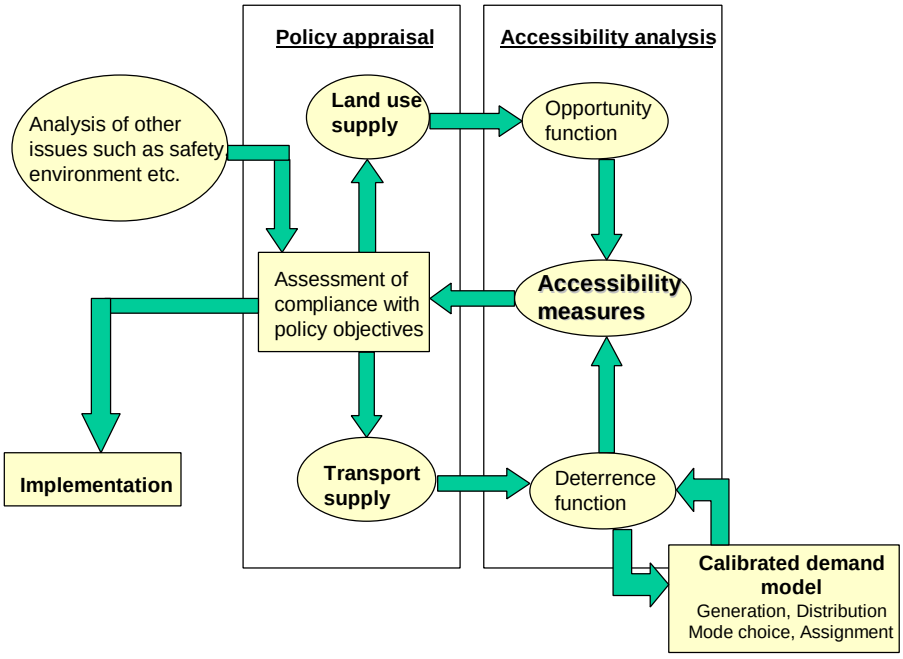


Figure 1

3. WHAT IS ACCESSIBILITY?

All accessibility measures relate to a specific location, origin or destination, and include representation of defined opportunities and a separation element between these opportunities and the location. The **opportunity** terms, **deterrence** functions and the sizes of the **zones** for considering accessibility need to be expressed at a level of detail appropriate for the needs of the particular situation.

Opportunity terms

The type of opportunities depend upon whether origins or destinations are being considered.

- Origin accessibility considers the opportunities available to an individual or a business. The opportunity term is therefore usually based upon the land uses at alternative destinations.
- Destination accessibility considers the catchments for a destination. The opportunity term is therefore usually based upon the land uses and type of person or traveller at alternative origins.

Land uses of interest include:

- Employment, Education and Training – Employment locations, schools, colleges, universities, training centres.
- Health and Social – Health centres, hospitals, social security offices, job centres, post offices.
- Shopping and Leisure – Shops/shopping centres, cinemas, theatres, sports centres, outdoor activity opportunities, centres for religious activity, pubs, clubs.

Types of person or traveller take account of:

- Mobility – Car ownership, disability.
- Employment status – unemployed, economically active etc.
- Age – Retired, adult, children, etc.

There are therefore a very large number of possible combinations of person types and land uses for both origin and destination accessibility e.g.:

- Accessibility for disabled people to shopping. (origin accessibility)
- Accessibility for car available people to employment opportunities. (origin accessibility)
- The number of non-car available unemployed people who have access to a new factory. (destination accessibility)
- The catchment of a major hospital for non-car available retired people (destination accessibility)

It is clearly not feasible to look at all such accessibility issues in any individual situation. The starting point is therefore the main policy objectives for the location in question. Accessibility for any of the above situations could be improved with a new opportunity (e.g. a new factory or a new hospital) or a transport change (e.g. a new bus service or a new road). Accessibility analysis helps to define the optimum approach for achieving the policy objectives.

Deterrence functions

The deterrence function can be measured as time, travel cost, generalised cost/time, and (less usefully) distance. It aims to represent real behaviour and perception of travel. This must include the relative deterrent effect of different types of travel, and the costs associated with each. (e.g. the greater deterrent effect of time waiting for a vehicle when compared with the same time spent travelling in a vehicle).

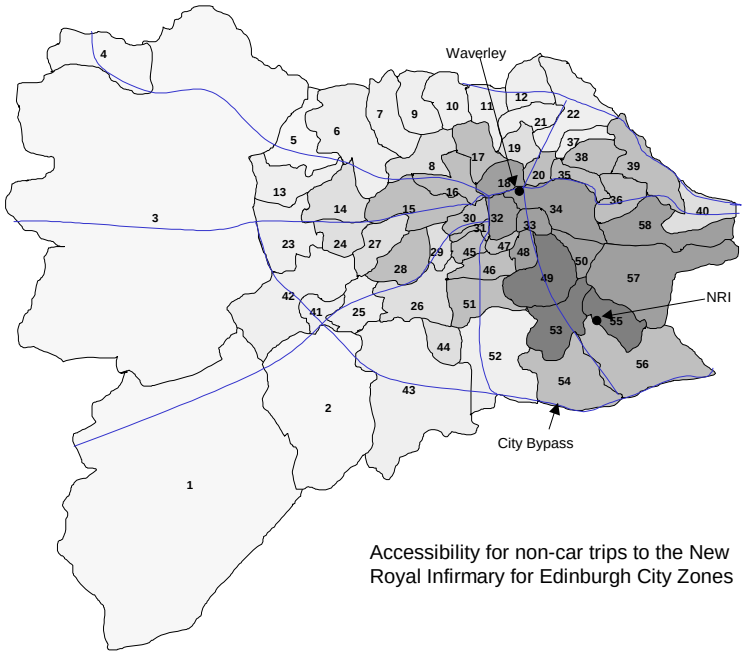
It is usually helpful to look separately at the deterrence functions by person group (e.g car available or non-car available), and by time of day (e.g. peak period or inter peak period). Many trips will involve a combination of several modes, and for non-car available trips the car options are excluded from the calculation. For example a car available trip to a city centre from a rural area may involve a car element to a park and ride site, a bus element from the edge of the city to the centre and a walk element from the bus terminus to the destination. The non-car available alternative would consider only the public transport, walking and cycling options to reach the city centre.

To ensure robust consideration of complex travel behaviour issues, calibration of deterrence functions against observed travel behaviour is recommended. This can be achieved with a transport demand model calibrated for the relevant time periods. However, where such modelling cannot be justified, accessibility analysis based upon more simplistic estimation of deterrence functions is still useful.

Zones

The extent of the zoning system and the level of detail will depend upon the policy issues being examined and how much effort can be afforded on the analysis. Strategic transport improvements will require a wide geographical coverage, but a fairly coarse zoning system may be adequate, whereas a local issue such as the accessibility of a school will require very detailed local representation.

In practice accessibility analysis will often be able to adopt zoning systems defined within established transport demand models which have generally been designed to take account of the geography of transport networks.



Accessibility for non-car trips to the New Royal Infirmary for Edinburgh City Zones

4. ACCESSIBILITY BY WALKING AND CYCLING

These techniques are used to assess what opportunities are available and to identify problems faced by walkers and cyclists.

Walking and cycling are the most efficient modes of transport for many short trips. They also make an important contribution to overall transport system accessibility as discussed in section 5. This section identifies how a rigorous approach can be taken to analysing the opportunities and choices available for local trips by walking and cycling as follows:

- *Origin accessibility* – Assessment of the opportunities for an individual or a small groups of households for access to local schools, shops, health centres or other facilities. Origin accessibility will usually be measured using indicators such as floorspace, or numbers of jobs, or numbers of facilities of a particular type.
- *Destination accessibility* – Determining the walk in catchment to a facility such as a local shop, health centre, employment centre or school. This will be of interest in planning the location of public services and maximising the walk in catchment as part of business travel planning both for commercial and efficiency purposes. Destination accessibility will usually be measured as the number of people or households, sometimes taking account of population groupings.

Techniques

Analysis needs to map walking and cycling routes and the distances between houses and local facilities. Capacity is rarely an issue for these routes but the quality of the routes, particularly where crossings of busy roads are involved, is an important factor.

Case Study – Walking and Cycling to the Robert Gordon University Garthdee Campus

Accessibility contours show that 20% of the population of Aberdeen City is within 30 minutes distance of the Garthdee Campus and over 90% are within 30 minutes cycling distance.
The upgrading of walking and cycle routes including the Deeside Railway Path are therefore a key part of the travel plans for the Campus development.
No transport data were available at a small zone level for the City. Travel times were estimated by measuring distances on a plan of the City and using average travel speeds to calculate travel time. This approach was sufficiently accurate to allow useful conclusions to be drawn.

Accessibility measures based upon simple thresholds give a good indication of the opportunities available. For distances over 1600 metres very few trips are made by walking. 800 metres is about a 10 minute walk and 400 metres a 5 minute walk. These thresholds are widely used for identifying general maximum, normal and short walking distances respectively. 5, 2, and 1 kilometres can be adopted as similar cycling thresholds.

Where more refined analysis is needed, then effort is best directed at working with local people including existing and potential walkers and cyclists to identify how problems or perceived problems can be overcome. Such approaches are becoming increasingly common within modern community planning agendas such as safer routes to school initiatives, healthy living centres, and social inclusion partnerships.

Key steps in assessing accessibility by walking and cycling		
Step	**Description**	**Methods and Data**
1.	Using either GIS software linked to footpath and cycleway data, or manually scaling from a map, plot the distance contours for walking and cycling.	Normal thresholds include: • Short walk (5 minutes) – 400 metres • Normal walking distance - 800 metres • General maximum walking distance - 1600 metres • Short cycle - 1000 metres • Normal cycling distance - 2000 metres • General maximum cycling distance 5000 metres. Accessibility measures with more than one threshold can be calculated by combining and weighting the measures for each contour to reflect increasing time/distance from the origin or destination. Oscar road centreline data within a GIS can automate the calculation of distances for many walking trips.
2.	Undertake a similar exercise as in Step 1 including only routes that do not involve crossing or cycling on busy roads except at Pelican or Toucan crossing facilities.	Quiet roads are usually regarded as carrying less than 2,000 vehicles per day and busy roads can be considered to be those carrying more than 8,000 vehicles per day.
3.	Using appropriate data (population, children by age, unemployed adults, retail floorspace, jobs etc.) calculate the opportunities available within the threshold distances identified in 1 and 2.	National census data is readily available at a small zone level. Councils have access to the data down to ennumeration zone levels. Other planning data such as retail floorspace is usually included in statistical appendices to development plans.
4.	Test the changes in the numbers of opportunities available within the thresholds with alterations to the pedestrian and cycle network including new road crossings, and new paths.	
5.	Assess qualitative aspects of travel by walking and cycling on appropriate routes in consultation with local people.	Aim to achieve: • Direct routes avoiding detours, restrictions, and underpasses • Smooth wide unobstructed footpaths • Good lighting • High levels of pedestrian activity and other improvements to give confidence about personal security. General approaches to community engagement and joint working for schools (Scottish Executive 1999) can be applied more generally to overcoming problems for other walking and cycling routes.

5. PUBLIC TRANSPORT ACCESSIBILITY

This type of analysis is used to identify how well bus and rail services meet the needs of the people they are intended to serve, to assist with the planning bus routes and development planning. It is most suited to dense urban areas.

This is a special case of the general walking and cycling indices, but the opportunities of interest are public transport services. If public transport services can be classified accurately in terms of their frequency and destination then these indices can give a useful picture of public transport accessibility. This type of analysis has been increasingly used throughout the UK within development planning for a number of purposes including the definition of parking standards, site selection and determining development plot ratios (the ratio of the volume of development on a site to the size of the site).

The main strength of the approach is that it is easy to understand. It is likely to be most applicable within dense urban areas where there is reasonably comprehensive public transport provision. Such indices were first developed in London (LPAC 1994) where the characteristics of public transport provision are easier to classify than the service structures in much of Scotland. There are now various software packages available, which help to automate data management, analysis and presentation (e.g. ACCMAP).

However, obtaining detailed data, on the origins, destinations, and routes of all bus services in a study area is a considerable task. Even once this task has been completed for most situations in Scotland, a simple classification of services is unlikely to be feasible. This type of accessibility analysis therefore has a limited scope, and is best designed for particular purposes within major cities. Significant effort to calculate such indices would probably be justified if decisions were required about major re-routing of bus services or if there were significant changes in the location of trip generation or attraction in an area.

Case Study - New Royal Infirmary in Edinburgh (NRI)
The transport assessments for the NRI, define bus travel opportunities to 12 zones within the city as: "weak", "strong" or "bus hopping" based upon the service frequency by time of day, and for weekdays and weekends.
Current work has not yet analysed walking access times within zones to these routes. However the travel plan for the NRI matches the three categories of public transport accessibility measure with the estimated demand for staff and patient/visitor travel so that useful negotiations can take place with bus companies about the provision of new services which improve accessibility.

Data - In Edinburgh data on public transport travel times were estimated by interrogating computerised public transport information linked to a GIS using database software.

Techniques

There are many approaches being employed, each with slightly different techniques. Where this type of analysis is considered to be necessary, further information can be obtained from the public transport accessibility level (PTAL) Development Group at the London Borough of Hammersmith and Fulham. However a brief summary of the method for calculating origin indices is given below.

Key steps in assessing public transport accessibility		
Step	**Description**	**Methods and Tips**
1.	For any location or zone calculate the walking distance/time to alternative bus stops or railway stations.	***Normal thresholds include:*** • Short walk 400 metres • Normal walking distance 800 metres Data Sources • The OSCAR road centreline data can be added as a data set within GIS to provide road lengths and avoid the need for time consuming calculations
2.	Classify public transport services in terms of destination and service frequency and represent their relative value as an index.	***Classification of public transport services might include:*** • Rail or bus services to major urban centres or other key strategic destinations.. • Service frequencies of 15 minutes, 30 minutes, 60 minutes and less frequent than 60 minutes. ***Data sources*** • Public transport timetable information provides data on services. Computer timetable information can be queried using database software to automate the classification of services past each bus stop or rail station location.
3.	Calculate the equivalent doorstep frequency of public transport services at the origin zone by factoring the indices in step 2 according to the walking distance.	***Conversion factors*** • Walking trips of up to 400 metres can be treated as 0.85 of the equivalent doorstep frequency index at the relevant bus stop or rail station. • Walking trips of between 400 metres and 800 metres can be treated as 0.35 of the equivalent doorstep frequency index at the relevant bus stop or rail station. ***Data sources*** • Most GIS have population census data at small zone levels allowing the calculation of bus stop catchments.
4.	Add the equivalent doorstep frequency indices together for each zone to calculate the appropriate PTAL.	Mapping of results by banding them according to the PTAL value can show areas of good and poor public transport accessibility.

Similar thresholds and weightings can be used to calculate public transport destination indices. For these the “destination zone” is defined according to the public transport service classification and includes all bus stops or railway stations which offer the relevant level of service. (e.g. 15 minute or more frequent bus services). The accessibility indices are then based on the population catchments within threshold distances from these bus stops or railway stations.

For example PAN 57 suggests that over 50% of new housing should be within 400 metres and 80% within 800 metres of a 15 minute frequency bus service. Simple catchment analysis such as this can be undertaken very easily with GIS using a population data set at a small zone level.

6. TRANSPORT SYSTEM ACCESSIBILITY TO OPPORTUNITIES

This type of analysis is used to analyse consistency between transport and wider policy objectives such as:

- What is the accessibility to employment opportunities from an origin zone?
- What is the accessibility to designated tourist attractions from an origin zone?
- What is the catchment of unemployed people for a new development site?
- What will be the impact of a new retail development on the accessibility of the population to shopping?

Accessibility measures take account of the travel opportunities for people rather than vehicles. A transport improvement or an increase in the number of opportunities will increase accessibility. It is not easy to assess the scale of the change through qualitative comparisons of alternative schemes, so a robust quantitative approach is needed. These quantitative measures can therefore be considered in many different ways as summarised in Table 1.

For the purposes of the practical application of these quantitative measures there are three generic but overlapping types of measures which can be described below as:

- **Simple indicators** – With these, the representation of transport and/or opportunity within the accessibility equation is simplified by defining thresholds (e.g. number of relevant opportunities within a given travel cost, time, etc., measures of the travel cost, time, etc. required to reach a given number of opportunities, shopping or employment opportunities with more than a defined floorspace or number of jobs).
- **Opportunity measures** – These sum all the available opportunities and weight them by a measure of deterrence based upon how easily the opportunities can be reached.
- **Value measures** – These seek to define the attractiveness of the available opportunities to represent their value as a transport choice.

Table 1

Index	Description and Uses
Simple measures	
Catchment/ Contour indices	These count the number of people, jobs, shops etc within a threshold travel cost (distance, time etc.) from a defined location. They are used for a wide variety of planning purposes for both land use and transport infrastructure and are often used by developers to consider the potential commercial viability of a potential development location.
Peripherality indices/ Rural accessibility	These identify thresholds in terms of cost, distance, time etc from defined types of opportunity. These are usually calculated from major centres of population such as towns or cities or public services such as hospitals, but have also been used to study accessibility to transport networks including the European Community Trans European Networks.
Time space geographic measures	These measures simplify travel behaviour and choice in terms of the opportunities available within a limited travel time budget. The threshold is therefore the travel time available for a particular individual or group. These are widely used in logistics planning for freight but are equally applicable to people accessibility issues.
Opportunity measures	
Hansen indices	The simple measures above are all special forms of Hansen indices incorporating thresholds to simplify data or analysis requirements. Hansen indices have had wide application within research and are used within transport models to estimate trip distribution.
Shimbel measures	These are a specific case of the Hansen indices in which all specified opportunities are assumed to have the same weighting. The measure is simply the sum of the cost (time etc.) to each of the opportunities.
"Economic potential" measures	Where the opportunities being considered in the Hansen index are regional incomes, and the deterrence function is measured in distance, then the accessibility index is sometimes described (Keeble 1982) as the economic potential of a location.
Value Measures	
Utility based measures	These measure the value to an individual or group of the choices available to them. The main difference from the opportunity measures is that additional opportunities only provide an increase in accessibility if they provide some additional value. If there is already a surfeit of opportunities available, adding more will result in little change in the index. The normal units of measurement are generalised cost or time and these measures are widely used within transport models.

Techniques - Given the range of needs for this type of analysis, there are a wide variety of approaches which can be adopted. The main steps below will apply to the calculation of most origin and destination measures.

Key steps in assessing transport system accessibility		
Step	**Description**	**Methods and Data**
1.	Assemble data on opportunities for the chosen analysis zoning system,	Type of opportunities are as follows: • ***Origins*** - The opportunity term is usually based upon the land uses at alternative destinations. • ***Destinations*** - The opportunity term is usually based upon the land uses and type of person or traveller at alternative origins. The zoning system should be large enough to take account of the key issues important to the policy decision.
2.	Estimate travel times between the zone being assessed and the zones in which the opportunities lie for each time period of interest. Separate travel times are required for each person group being considered based upon the modes available to them.	• The lowest generalised time option between zones is taken for each person group. Optimum trips include as many modes as necessary, but appropriate interchange times need to be included to reflect the attractiveness of the choices available. • Travel costs such as public transport fares or parking charges can be converted to equivalent times using the values of time in the Design Manual for Roads and Bridgeworks. • If the zoning within transport demand models is acceptable then travel times can easily be extracted and the impacts of transport improvements on travel time estimated. • Proprietary software is available (e.g. ACCMAP) to link travel times by walking, car and public transport with a map base. • Where access to employment is being considered it will normally be peak hour travel times which are of interest. For most other purposes daily averages will be acceptable. However for more detailed analysis, separate peak and of peak measurements may be merited. • Some computer based public transport timetable information can be queried using database software to estimate public transport journey times.
3.	There are many options for the analysis of this data. The ACCALC software with this guidance automates techniques for calculating Simple, Opportunity and Value measures. Alternatively spreadsheets can be used and an illustrated worked example is included on the ACCALC software disc.	• Exponential deterrence functions are often used within the calculation of Opportunity and Value measures. These functions are best calibrated against observed behaviour but useful measures can still be calculated using default values. • Thresholds such as 15, 30, and 60 minutes need to be adopted within the Simple analysis. However there are no clear behavioural thresholds for most trip purposes so these thresholds are merely illustrative.

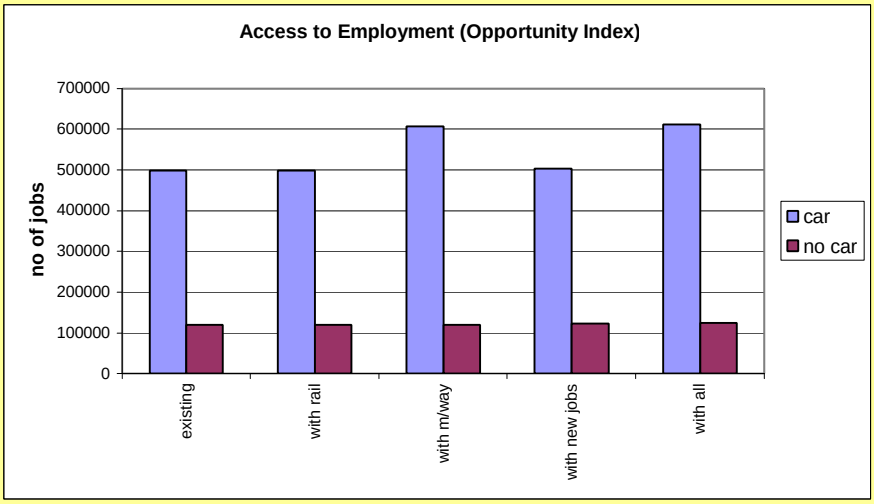
Case study - Gartcosh

The regeneration of the Gartcosh area is a major priority for North Lanarkshire Council. Plans involving a mix of land use and transport changes are being brought forward by the Council including new jobs, homes, a motorway junction and a railway station.

Opportunity Indices show the equivalent number of jobs available to people in the Gartcosh zone with each of the development changes. As shown on the graph below, this location on the north east side of Glasgow has good access to employment particularly if a car is available. The case study also shows that public transport can be competitive with the car, for trips to Glasgow City centre and the addition of the rail station improves the competitive position of public transport. However local bus services are relatively more important for access to jobs for non-car available people for this out of centre location.

data

- Planning and transport data were taken from the Central Scotland Transport Model/Strathclyde Integrated Transport Model.
- Access times by public transport combined an average walking access time to the nearest bus stop or train station with the wait time for the bus or train and the in-vehicle time.



Choice of index

The Opportunity indices are easy to interpret and use showing, for example, how many more people can access new jobs at a proposed development with alternative transport options. The Value indices are a more powerful measure of the efficiency of the transport systems but the index has less obvious meaning.

The Simple indices are less useful since they are heavily dependent upon the chosen thresholds. Even if thresholds are clearly defined, it is more useful to use these within an Opportunity index than with the Simple measure. Most of the effort required for accessibility analysis is associated with data collection rather than analysis. If there are sufficient data to calculate Simple indices then there should be little problem undertaking a more accurate Opportunity analysis.

Indices can be output directly from the Central Scotland Transport Model but only for the five modelled trip purposes. The trip purposes which are most relevant to demand issues will not always be those which are of greatest interest from a policy point of view.

Travel Data from Central Scotland Transport Model	
Times of day	am peak 0700-1000, am peak hour 0800-0900
	pm peak 1600-1900, pm peak period 1700-1800
	off peak 1000-1600
Person types	Non car available
	Car available
Modelled trip purposes	home based work, home based employer's business, home based other, non-home based employer's business and non-home based other.

ACCALC

Software has been developed to automate the calculation of Simple, Opportunity and Value measures using a simple exponential deterrence function for travel to defined opportunities.

Users of this software simply need to input data tables for each of the travel options and opportunities. The travel times, costs, generalised time etc need only be calculated for the zone to zone links which are relevant to the accessibility calculation.

Opportunity data can be drawn from many sources such as those shown below.

Trip purpose	Opportunity Data
Employment, Education and Training	
Access to work	Number of jobs perhaps by sector of the economy. Available from employment census.
Access to school or other education centres	Floorspace of educational establishments including schools, number of students, employees. Available from council education departments.
Health and Social	
Access to healthcare facilities	Floorspace of healthcare premises, number and type of employees, number of hospital beds. Available from health authority.
Post offices, job centres, social security offices	Number and location of facilities.
Shopping and Leisure	
Access for shopping - In appraising the impact of a new retail development the impact on the development on access to shopping for various groups in society may be of interest.	Retail floorspace or retail jobs could be used as an indicator of shopping opportunities. Available from most local authorities.
Access to leisure	Number of seats in cinemas, floorspace of leisure centres, size of parks, designated tourist attractions.

These data are provided by the user as spreadsheets called "data_opps" and "data_dets". The user of ACCALC then simply runs the program making the required choices, such as the indices to be calculated, when prompted.

All the calculations are automated. However users have the flexibility to change any of the parameters if they wish.

Results are exported to a spreadsheet to allow users to graph results or present them in whatever way suits the particular application.

Comprehensive on screen help facilities are provided and a detailed manual is provided with the software.

7. RATIOS COMPARING ACCESSIBILITY FOR DIFFERENT MOBILITY GROUPS

This type of analysis is used to identify the changes that are needed to make public transport, walking and cycling more competitive and specifically:

- To identify the competitive position of public transport, walking and cycling by comparing accessibility with and without a car available.
- To assist with planning decisions about location choice or in undertaking transport assessments.
- To define appropriate parking standards consistent with the accessibility of the location.
- When considering relative accessibility for fully mobile and mobility impaired people.

Ratios allow direct comparisons between different locations and different groups of people. This can be particularly helpful for certain types of decision. For transport improvements, there is sometimes a need to look at the competitive position of public transport, walking and cycling by comparing accessibility with and without a car available. This can help to identify the choices faced by people and how these choices can be influenced by land use or transport changes. Car available people will always have better accessibility than non car available people since they have an additional mode available. The ratio of accessibility indices quantifies this difference in a way which can be compared between locations or between types of project.

Planning policy seeks to locate new development at locations for which public transport, walking and cycling are competitive. Specifically NPPG 17 seeks to support development patterns which facilitate a reduction in car use and support more use of walking, cycling and public transport. There may be existing public transport services to some developments or new services proposed, possibly as part of a legal agreement to allow the development to proceed. Accessibility ratios can be used to compare access opportunities with and without a car in order to bring forward plans consistent with the NPPG aims.

A national policy aim is to manage the availability of parking to encourage greater use of walking, cycling and public transport. Increasingly maximum parking standards are being adopted both nationally and locally and accessibility characteristics of locations may be used to define appropriate standards. Ratios of accessibility for car available and non car available trips can help to ensure a consistent approach to the implementation of policies at a local and national level.

Techniques

Within national planning guidance, qualitative definitions are given for various locations taking account of accessibility issues as follows:

- Town centres – City, town and district centres, irrespective of size, which provide a broad range of facilities and services and which fulfil a function as a focus for both the community and public transport.
- Out of centre – A location which is separate from a town centre but within the urban area, including programmed extensions in approved or adopted development plans.

- Commuter rural – Residents are within one hour travel time by either road or rail of a principal centre.
- Intermediate rural – Residents will be typically one to two hours travel from a principal centre.
- Remote rural – Characterised by their remoteness with residents more than 2 hours travel from the nearest principal centre.

Ratios of accessibility for car available and non-car available trips can give a more quantitative assessment of these location characteristics. Whilst there has been no research to define accessibility in terms of the above definitions, Table 2 shows ratios for six types of location to illustrate the typical range of values which can be expected.

Location	***Ratio*** Car accessibility/ accessibility without a car
City centre	1.5
Town centre	2.5
Edge of town centre	3
Edge of town	4
Out of town	6
Rural/ remote	>10

Table 2 (from DETR 1995)

Calculation methods are identical to those described in section 6. Simple or Opportunity measures are usually used in the calculation of these ratios.

Key steps in comparing accessibility with and without a car		
Step	**Description**	**Methods and Data**
1.	Calculate transport system accessibility for car available people.	Data and methods as described in Section 6.
2.	Calculate transport system accessibility for non car available people.	Data and methods as described in Section 6
3.	Calculate ratio of car available to non car available accessibility.	

Case study – Braehead Retail Park, Glasgow/Renfrewshire

Braehead is a large retail development site on the western outskirts of Glasgow. It is recognised as being important to take forward this development to maximise the benefits to all sections in society including those who have no access to a car. The success of the new development in serving the shopping and employment needs of the Greater Glasgow area can be examined by looking at its catchment and the accessibility of different population groups to the site.

For this out of centre location accessibility is much poorer if a car is not available. In order to meet policy objectives for public transport to be more attractive, alternative options for improving public transport can be tested. It is helpful to compare the Braehead location with Glasgow City Centre and Rutherglen Town Centre in the suburbs of Glasgow as shown below.

Ratio of Opportunity indices	**Glasgow**	**Rutherglen**	**Braehead**
Accessibility by car/accessibility without car	1.52	3.70	4.46

Glasgow City Centre is one of the most accessible locations for travel by public transport in Scotland, and new developments cannot expect to be as accessible as a city centre. However, the transport assessments for this site could aim to identify transport solutions to reduce the ratio.

8. FREIGHT ACCESSIBILITY

Freight accessibility needs to be considered:

- By companies planning their logistics operations
- In development planning
- When planning strategic transport infrastructure
- When considering local access restrictions in town centres or residential areas.

Public policy and commercial aims, are to improve the economic efficiency of supply chains taking account of the social and environmental impacts of various options. The national strategy for sustainable distribution (DETR 1999) identifies how the various commercial and policy aims can be managed through freight quality partnerships. The intention is that these partnerships will increasingly influence logistics decisions towards patterns of activity that optimise commercial, social and environmental aims.

Key Freight Accessibility Issues

Decisions need to take account of:

- The accessibility factors which affect location choices.
- The efficiency and reliability of companies' delivery operations and how they are affected by accessibility changes.
- The competitiveness of: alternative modes, different sizes and weights of vehicle, and the opportunities for inter-modal trips.
- The impacts on overall traffic levels. Local access restrictions can increase the number of vehicle trips to meet delivery requirements.
- The links between accessibility and environmental impact. Restricting access at particular times of day in residential areas or shopping centres needs to be viewed within the overall supply-chain context.

Specific planning policy aims are defined in NPPG17. This requires development plans to identify sites where there are opportunities for locating distribution or freight operator centres, including consideration of access to the rail network, ports, and airports.

Techniques

For analysis purposes, accessibility is best considered by type of distribution premises taking account of the characteristics of the relevant supply chains. Table 3 identifies twelve classifications and the important accessibility issues which need to be considered in relation to each type.

Although each business will have its own accessibility requirements based upon the needs of upstream sources of supply and downstream customers some general principles are relevant for transport and development planning:

- Regional and national distribution centres are not particularly sensitive to location within a radius of 30 to 40 miles. This means that decisions about such centres will often involve more than one Structure Plan area. In many cases qualitative accessibility analysis will be adequate in planning decisions supporting locations near motorways, and locations with rail access, port and airport access as appropriate.
- Local distribution centres will usually be more captive to road transport and be served by smaller vehicles. However these deliveries will also be more time constrained and will be affected by and contribute to peak period road congestion.

- When considering local traffic management changes such as restrictions on time of day or types of freight vehicle it is important to take account of the implications for distribution at a local and regional level. A clearly defined transport network hierarchy with performance standards appropriate for each level will not only help to serve the needs of freight transport, but should help to provide greater certainty for the freight industry to plan efficient future supply chains.

The measurement of accessibility for distribution purposes has traditionally involved the construction of iso-chrone and iso-cost maps. This can be undertaken by dividing a market area between depots and distribution centres in a way that minimises total distribution costs (McKinnon 1989). Iso-chrones can then be used to show the pattern of delivery times around the depots.

Total daily driving time is constrained by legal restrictions on driver's hours. For most local delivery operations, however, in which the driver spends much of his time loading and off-loading goods, the distance than can be served is constrained much more by the length of the driver's shift and the 'drop density' (number of outlets per square km).

The time-constraint boundaries drawn around adjoining depots usually overlap. Where this occurs, service areas are delimited with respect to distribution costs. Iso-cost lines show how delivery costs increase with distance from the depot. The depot area boundary is generally defined by the points of intersection between iso-cost lines of similar value drawn around adjoining depots.

Case study
Scottish Brewers and some large grocery retailers have restructured their distribution systems to allow more flexible delivery planning. Vehicle fleets are now pooled at a national level, allowing vehicles to migrate between distribution centres, shops and suppliers' premises.

Some companies base their iso-cost line calculations solely on outbound delivery costs. It is preferable, however, to include depot operating costs in the calculation as these can vary between depots and account for a significant proportion of total distribution costs. Another factor influencing the configuration of depot boundaries is the size of the vehicle fleets based at the depots.

In recent years, many companies have abandoned rigid depot boundaries allowing vehicles based at one depot to encroach on what was previously the territory of another. This 'flexing' of depot boundaries allows companies to make better use of vehicle capacity. Within these new 'network systems', more complex measures of accessibility are required.

Sophisticated logistics software packages (e.g CAST-dpm) are now widely used to help firms manage their distribution operations. These software tools employ road network data bases and a combination of optimising and heuristic algorithms to plan vehicle routes, allocate customers to depots and simulate the effects of changing various distribution system parameters. These packages can model distribution operations with respect to transit times and transport costs, the latter based on detailed vehicle operating cost data. As more comprehensive data on freight operations becomes available, these packages should become increasingly mainstream tools in transport planning.

Premises	Function	Area Served	Nature of the Transport Operation
1. Primary Consolidation Centre (PDC)	Merge the output of different factories into consolidated loads for delivery to RDCs	Regional / national	Bulk loads in and out. Mostly articulated vehicles. Mainly direct deliveries of full loads
2. Regional Distribution Centre (RDC)	Consolidate inbound supplies from producers (either directly from factory or via a PDC) into mixed loads for delivery to shops. A proportion of the supplies will be stored, the remainder merely cross-docked.	Regional for groceries / fast-moving consumer goods National for most non-foods.	For supermarket chains, mostly articulated vehicles inbound and outbound with direct single-drop deliveries to shops. For some non-food retailers, artics inbound and rigids outbound, the rigids making multiple drop deliveries.
3. Parcel / Pallet-load Hub	Receipt of parcel / pallet load traffic collected from local depots, its sortation by destination and despatch to appropriate local depot for final delivery	Mostly national from locations in and around the Midlands	Articulated vehicles inbound and outbound.
4. Local Parcel Depot	Local collection and delivery of parcel traffic	Regional	Rigids for multiple collection / delivery rounds in local areas. Artics for trunk movements to and from the hub.
5. Road Haulage Depot	Base for vehicle fleet, often combined with break-bulk service	Varies: usually regional/ local	Either articulated inbound and outbound on trunk movements or mixture of artic trunking and local delivery on rigids.
6. Traditional Warehouse	Long-term storage	Usually regional / national	Usually articulated vehicles inbound and outbound
7. Wholesale Warehouse	Stocking and assembling mixed orders for delivery to retailers / catering outlets	Usually local / regional	Articulated vehicles inbound. Rigids outbound, the rigids making multiple drop deliveries.
8. Cash and Carry	Sale of mixed supplies in bulk to retailers / caterers	Local	Inbound mainly in artics. Outbound: collection by small traders in small vans and cars.
9. Railhead depot	Similar to 5 but offering the transfer of non-unitised loads between road and rail	Regional/national/ international	Either articulated inbound and outbound on trunk movements or mixture of artic trunking and local delivery on rigids.
10. Intermodal terminal (road – rail)	Transfer of unitised loads between road and rail	Regional/national/ international	Articulated vehicle movements in and out carrying containers / swap-bodies
11. Port	Transfer of unitised or bulk loads between road and ship often with associated storage	Regional/national/ international	Generally articulate vehicle movements inward and outward
12. Airport	Transfer of freight between road vehicles and aircraft, often with associated storage and customs clearance	Regional/national/ international	Mixture of articulated and rigid vehicles and small vans on both inbound and outbound movements.

Table 3: Classification of Distribution Premises.

9. FURTHER READING

Walking and cycling

9.1 Various Local Walking Strategies (e.g. City of Edinburgh Council Pedestrian Strategy, Putting London back on its feet – A Strategy for Walking in London)

9.2 Scottish Executive 1999. Guidance How to Run a Successful Safer Routes to School Project.

9.3 Scottish Office 1999. Research on Walking – System 3. Central Research Unit.

Public transport accessibility

9.4 ACCMAP - Journey Access and Travel Time Mapping Software. MVA Consultancy.

9.5 Department of the Environment and Department of Transport 1995. PPG 13 - A Guide to Better Practice. HMSO.

9.6 Department of Transport Environment and the Regions 2000 - Guidance on the Methodology for Multi-Modal Studies

9.7 Institution of Highways and Transportation. 1999. Planning for Public Transport in Developments.

9.8 Kerrigan 1992. Measuring Accessibility – A Public Transport Accessibility Index. PTRC.

9.9 London Planning Advisory Committee (LPAC). 1994. Advice on Strategic Planning Guidance for London.

Transport system accessibility to opportunities

9.10 Highways Agency, Scottish Office, Welsh Office, Northern Ireland Department of the Environment. Design Manual for Roads and Bridges. Volume 13.

9.11 Jones 1981. Accessibility Measures: A Literature Review. Transport and Road Research Laboratory. Report 967.

9.12 David Simmonds Consultancy, University of Leeds, MVA, Oxford Brookes University. 1998. Accessibility as a Criterion for Project and Policy Appraisal. Unpublished Report for the Department of Environment, Transport and the Regions.

Freight

9.13 Department of the Environment, Transport and the Regions 1999 - Sustainable Distribution Strategy.

9.14 McKinnon, A.C. Physical Distribution Systems. Routledge, London, 1989.

9.15 www.radical.co.uk – CAST-dpm and other logistics planning support.