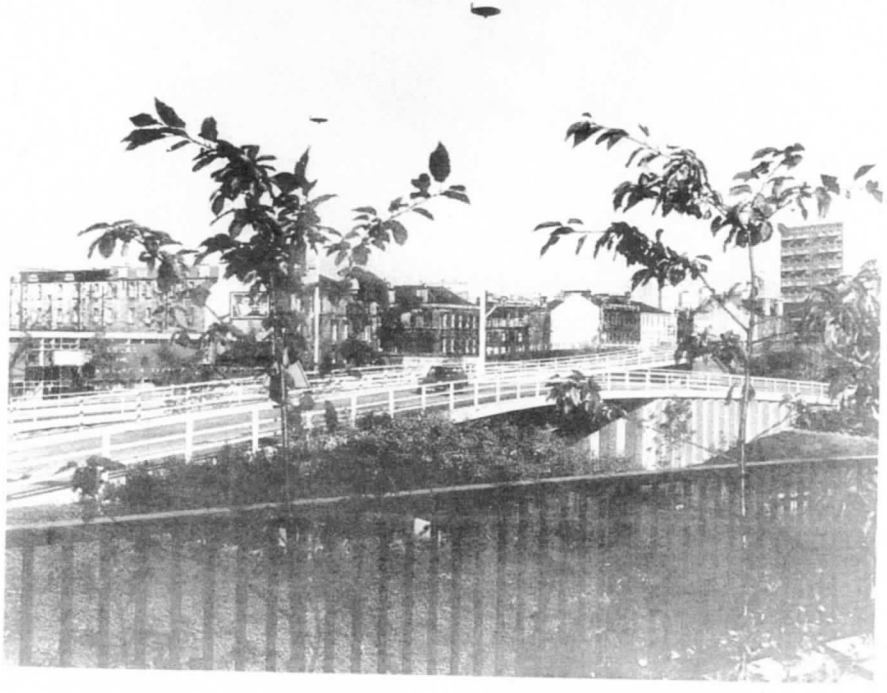

Motorways in Glasgow
Environmental Aspects
JP McCafferty

1972

1975

Buchanan Street, Glasgow

Surface Street



Motorway

Motorways in Glasgow
Environmental Aspects

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MOTORWAYS IN GLASGOW

ENVIRONMENTAL ASPECTS

1. INTRODUCTION

1.1 Object of Paper

The paper discusses environmental issues concerning urban motorways with reference to motorways in Glasgow. The motorways in Glasgow which are especially referred to are those which form part of the first major stage of the Glasgow motorway programme.

Public concern with the environment has become more intense in recent years and urban motorways in particular have received much publicity as having adverse effects upon the environment. Undoubtedly, some urban motorways in the United States and in Britain have had such adverse effects and may have contributed to their current unpopularity.

We would argue that the adverse effects of motorways can be largely mitigated with good design and that the environmental gains can greatly outweigh the environmental losses.

The point of interest about the Glasgow case is that environmental considerations have been a major factor in all planning and design since the beginning of the programme in 1960. Sufficient roadworks have now been completed to permit assessment of the extent to which the design intentions have been achieved.

1.2 Main Points

The main topics covered are as follows:

(i) A brief description of the motorways planned and constructed in Glasgow.

(ii) The adverse environmental effects of urban motorways and how to mitigate them.

(iii) The assessment of the adverse effects of the motorway as compared with the benefits realised in other areas of the City due to the reduction in traffic.

(iv) A description of how the roads have been designed to achieve the best possible appearance.

1.3 Reasons for Building Motorways

The primary reasons for building new roads are:

(i) To reduce travel time.

(ii) To reduce accidents.

(iii) To make travel by road a more pleasant experience.

Motorways generally achieve those ends to a greater degree than all-purpose roads.

1.4 Environmental Benefits of Motorways

The incidental benefits of new roads are that they reduce traffic on the existing road system, which can produce very considerable environmental benefits. This is because the existing street

network has generally a high concentration of houses, shops and other similar places, and more people suffer the adverse effects of traffic - noise, visual intrusion, delay in crossing roads.

Indeed, the construction of the new road can permit the complete elimination of traffic in streets with large concentrations of pedestrians; ie certain streets can be turned into pedestrian precincts.

Another incidental effect that has not been sufficiently appreciated is the considerable benefits that can accrue to public transport. This is through the reduced delays to buses. Apart from the operation of express buses on motorways, the reduction in delays due to traffic congestion to buses operating on the conventional surface streets can be largely due to diversion of traffic from the streets to the new motorways.

1.5 Relevant Publications

Two publications in Britain are especially relevant to the subject of this paper.

These are firstly "Traffic in Towns", more commonly known as the "Buchanan Report", and secondly "New Roads in Towns" - Report of the Urban Motorway Committee. The work in Glasgow has been entirely consistent with the principles contained in them.

1.6 Public Transport

Although public transport does not fall within the province of this paper, we do not wish to create the impression that transport policies in Glasgow consider only motorways. On the contrary, a Land Use Transportation Study has been carried out and extensions to the already extensive rapid transit rail system are currently under way.

1.7 Design Team

Much has been said in recent years concerning the need for an interdisciplinary approach. We consider that such an approach was followed in Glasgow. This may have stemmed from the fact that the Traffic Engineering and Highway and Structural Engineering were the responsibility of one Consultant, that the original appointment was made by the Town Planning Department, and that the Architects and Planning Consultants were appointed independently and simultaneously.

Interdisciplinary cooperation is of the greatest importance in the early stages of the design. It is at this stage, when all options are still open, that the best solution can be found.

Continuity of the design team is important to ensure that the design at the tactical level can be guided by the earlier design at the strategic level.

2. GLASGOW HIGHWAY PLAN

In the late 1950's, the City of Glasgow was preparing a revised development plan for the City. Many areas of the City were in bad condition and were considered to require comprehensive redevelopment. Twenty-nine areas, totalling 1360 hectares, were designated Comprehensive Development Areas, or CDA's. Some of these were round the Central Area and the Inner Ring Road that was tentatively proposed at that time passed through these same CDA's, some of which were programmed for early treatment.

Clearly, the redevelopment of these areas could not proceed without preparing designs for the Inner Ring Road that passed through them.

Scott Wilson Kirkpatrick & Partners were appointed in 1960 "to produce as a matter of urgency a definitive design for the Inner Ring Road". This appointment was soon extended to cover highway proposals for the whole City.

An Origin-Destination survey was carried out, based on roadside interviews on a series of cordon and radial screen lines, which produced a table of current zone-to-zone traffic movements. Projections were made to produce an Origin-Destination table for the chosen design year of 1990. The most significant factor in determining the future traffic volumes was the predicted 1990 car ownership. The average car ownership in the conurbation was projected to be 27 cars per 100 persons. (The current estimate is for 25 cars per 100 persons in 1990 and a tentative estimate of 30 cars per 100 persons in the year 2000).

A limit was placed on vehicle trips to the Central Area on the basis that the alternative travel by public transport was relatively convenient and to provide for unrestrained traffic in the Central Area would be relatively expensive as well as environmentally undesirable.

It was decided that the most practical means of limiting trips to the Central Area was by controlling the number of parking places. These were limited to 23,000 spaces, which happened to correspond to the then current number of parking spaces in American cities of similar size.

The 1990 traffic pattern was used to produce a highway plan which had the following features:

(i) The plan consisted of a network of motorways of ring and radial pattern.

(ii) Some sections of the system had projected traffic volumes in excess of 100,000 vehicles per day.

(iii) The whole system was designed in sufficient detail that realistic land requirements could be determined and realistic costs estimated. Subsequent events have largely confirmed these studies.

(iv) The prime determinant of the system was the need for the motorway to follow corridors of minimum intrusion and to connect to already committed motorway routes outside the City.

(v) It was proposed to pedestrianise the main shopping streets in the Central Area and to limit the use of most of the Central Area streets to service traffic only.

(vi) The high traffic volumes and close proximity of junctions on the Inner Ring Road presented traffic operational problems of extreme difficulty, involving especially weaving, lane balance and signing. Perhaps the most technically difficult part of the entire study was the geometric design of the Inner Ring Road to solve these problems.

(vii) The construction of the network would require to be staged over a considerable period. The entire network was programmed for completion in the year 2000.

Much attention was given to planning the staging. The most important feature of any programme must be the maximum return from investment at the earliest possible date. This cannot be done unless all of the roads are in balance.

The total plan was sub-divided into three major stages, the completion of each stage producing a coherent plan with maximum benefits and of such a form that it could be sensibly left in that form for a period or, indeed, indefinitely, should actual traffic growth so dictate.

The completion of the first major stage was designated Target 1. Target 1 was planned for completion in 1975. In fact, in 1975, all but one section was completed or under construction. Construction is planned to start on this remaining section soon.

The motorways comprising Target 1 have been chosen as a case study to demonstrate the principles described in this paper.

3. THE ADVERSE EFFECTS OF URBAN MOTORWAYS

3.1 Visual Intrusion

This expression is intended to mean primarily the intrusion of moving vehicles into the field of vision of people in the vicinity of the motorway, especially residents. This includes loss of privacy due to the motorway overlooking properties. However, the motorway works themselves, such as retaining walls, bridges, embankments, can also constitute a visual intrusion. Generally, measures taken to reduce the influence of noise, such as earth mounds and walls, will incidentally eliminate or reduce the visual intrusion of vehicles. So far as the visual effects of the actual works are concerned, the aim should be to design the works to be as pleasant to the eye as possible, and in many instances the works can be a positively attractive feature, rather than an ugly one.

3.2 Noise

Noise is an all-pervading nuisance in urban areas and road traffic is a major source of noise, and with the growth of traffic, conditions could deteriorate further. There does not appear to be any immediate prospect of vehicles becoming less noisy.

Much work has been done on noise in recent years and it is now possible to calculate with reasonable accuracy the noise which given traffic on a given road will produce at any given point. These procedures are set down in the Building Research Establishment Digest 153 which forms the basis for calculating noise levels as now required by legislation. The Noise (Scotland) Regulations 1975 provide certain rights to insulation against traffic noise arising from the use of new or improved roads. Residents have a right to noise insulation if the noise level exceeds 68 dB(A).

3.3 Severances

Specifically, this refers to the barrier effects of the motorway, especially to pedestrians, and can be alleviated by the provision of adequate pedestrian routes.

It is also generally accepted that existing communities should not be severed by roads, although the desire to choose a route with the minimum of property acquisition costs and minimum public opposition will normally lead to minimum severance.

3.4 Disturbance

It is not immediately clear whether disturbance should be considered as an environmental factor but there is no doubt that some people who live in houses which have to be demolished and who have to move reluctantly to other accommodation suffer distress which is not necessarily adequately compensated by money.

3.5 Other Factors

Other factors that could be considered are as follows:

(i) Disturbance during the construction period.

(ii) Loss of daylight or sunlight.

(iii) Vibration.

(iv) Fumes.

(v) Dirt and dust.

In our opinion, the last three are, in Glasgow at any rate, of minor importance.

Regarding disturbance during construction, this problem as regards noise is now covered by legislation.

Design to satisfy the main environmental factors will go some way to minimise the construction disturbance. One of the worst problems in Glasgow is the tracking of mud from the construction site to adjacent streets. The solutions are simple but in practice constant vigilance of the contractor is required.

If visual intrusion is avoided, it will be rare that loss of daylight or sunlight will be a problem.

4. DESIGN TO MITIGATE ADVERSE EFFECTS - ENVIRONMENTAL DESIGN

4.1 Overall Planning

The planning of the new roads should form an integral part of the town planning process and should form part of the total transportation plan.

In the case of Glasgow, this total approach was encouraged because the motorway studies arose out of the designation of Comprehensive Development Areas and was initiated by the Planning Department of Glasgow Corporation.

4.2 Route Selection

The first and most important step in good motorway design is to select the best route.

Where the route can be located through Comprehensive Development Areas, the maximum opportunities are available in the planning of the new developments to mitigate the adverse effects of the motorway.

This can obviously be achieved by locating sensitive developments, such as houses, schools and hospitals, away from the motorway and locating tolerant developments, such as warehousing, industry and playing fields, close to the motorway. Where possible, suitable buildings can be placed to screen sensitive areas from the motorway.

In the case of Glasgow, it was possible to locate considerable sections of the motorway in redevelopment areas. Fortunately, this was especially so in the more densely developed areas and the greater part of the Inner Ring Road lies within these areas.

Where it has not been possible to locate in redevelopment areas, we have endeavoured to route through a gap in the urban fabric. This is most easily achieved by following some existing barrier, such as railway, canal, river or edge of an industrial area. By so doing, severance will obviously be lessened and frequently less sensitive properties will lie along the routes of this kind.

Naturally, buildings of architectural or historic value should be avoided and important buildings have been considered as an absolute control. Fortunately, it has generally proved possible to avoid affecting buildings of merit.

The accompanying drawings, showing the routes of the first stage of the motorways, illustrate these points.

(i) Renfrew Motorway

This motorway route passes through open ground from the existing Renfrew Bypass and then along a main railway line before following the edge of an industrial area to the Inner Ring Road.

(ii) West and North Sides of Inner Ring Road

The west and north sides of the Inner Ring Road are routed through Comprehensive Development Areas, apart from a short length of 650 metres on the west side.

In the latter section, the motorway was fully depressed with full height retaining walls and all interchanges and ramps were eliminated.

(iii) Monkland Motorway

This motorway follows the line of the disused Monkland Canal. The proposed motorway does not always closely follow the existing canal line which is somewhat tortuous; nevertheless, the severance caused by the canal has so shaped development that disturbance is reduced to a minimum.

(iv) Clydeside Expressway

For the most part, this road follows a railway through the dock area close to the River Clyde, which provides an excellent location for the expressway and, in consequence, it has been possible to place this road for the most part at ground level.

4.3 Road Design

Following the choice of route, the next step is to determine the number of lanes required and the location and general form of interchanges. Environmental considerations have some bearing on the latter.

4.4 Horizontal Alignment

Apart from the usual engineering considerations, the horizontal alignment is determined by the requirement to keep as far as possible from environmentally sensitive areas, such as housing.

A line consisting entirely of curves is to be preferred with long transition lengths desirable.

4.5 Vertical Alignment

Where the motorway is close to sensitive areas, it is generally desirable to depress the motorway. In Glasgow this has usually been achieved.

Sometimes much higher costs are required to depress the motorway under existing features, such as railways, and it is in these cases that it is especially difficult to balance the benefits of depressing the road against significant extra costs.

In highly sensitive areas, it may be necessary to place the motorway underground, normally by cut and cover. In the Target 1 motorway system, only a short section is in cut and cover (110 metres), but future proposals include two sections of cut and cover. One is on the East Side of the Inner Ring Road where the route runs between Strathclyde University and Glasgow Cathedral. The cut and cover sections will enable the University campus to be continuous with the Cathedral precinct area.

The other section of cut and cover occurs on the proposed Hamilton Motorway. A section of this motorway runs along the edge of Glasgow Green, a public park. The cut and cover section occurs adjacent to a museum in the park and also adjacent to a proposed housing development and will permit unimpeded access from the housing area into the main park area.

To the maximum extent possible, the horizontal and vertical alignment has been coordinated to produce an aesthetically satisfying alignment.

4.6 Interchanges

Subject to the need to provide adequately for predicted traffic movement, environmental considerations have been the principal controls on the location and design of interchanges. Direct ramps have, on occasion, been omitted and the movement redirected via surface streets.

Every effort has been made to ensure that the interchange is fully compatible with the urban form. To achieve this, certain geometric design standards have been treated as flexible, especially sight distances, vertical curves and the minimum radius of loops. In one critical location, a loop radius of 23 metres has been used and has proved to be satisfactory in practice.

4.7 Design for Pedestrians

It is essential in the early stages of the design to consider the pedestrian movement that will be affected by the motorway for this may demand independent structures of its own to be related to the adjoining development and

landscape. The pedestrian movement cannot just be fitted in; it is an essential part of the urban pattern and should be considered as an integral part of the design problem. A route which crosses the motorway without an abrupt change in level or direction is more acceptable to the pedestrian; it does not present the visual and physical difficulties associated with a 6 metres change in level. Where land acquisition will allow, changes in level should occur gradually over as long a distance as possible.

Where possible, pedestrian overbridges should not be less than 3 metres wide. The pedestrian should never be conscious of using a confined and artificial route.

Pedestrian underpasses need careful design; all too often they are constructed as narrow sewers, ill-lit and with a pervading and rancid aroma. They must be made wide and provide a direct and easy route for the user.

Naturally, all pedestrian routes crossing the motorway are grade-separated. However, at interchanges there are sometimes large traffic volumes on the surface streets and consideration is given to pedestrian movement across these streets.

Our policy has been to provide pedestrian underpasses where feasible to the major pedestrian movements, and to make these as inviting as possible, but to accept that some pedestrians will still make some movements at road level and to provide small footpaths for these movements.

4.8 Construction Boundary

Since the sphere of influence of the motorway had determined a broad land use policy throughout the alignment, a construction line boundary was determined. This line encompassed more land than that physically necessary to achieve the construction of the carriageways, interchanges and pedestrian movements. In many cases, the areas to be acquired necessitated the acquisition of property which could be physically avoided; however, it was felt that the future proximity of the motorway would make them untenable for a variety of reasons.

The benefits derived from this policy were that additional recreational open space associated with an adjacent new or existing land use could be provided for the people living or working in the area. This policy also achieved the continuity of landscaping and planting commensurate with the scale of the motorway and its associated movements.

In many cases, apart from improving the quality of the environment alongside the route, space has been available to deposit excess unsuitable excavated material within the site, ensuring a considerable saving in construction costs.

These newly established land uses have subsequently been incorporated into the approved development plan zonings for the City as a matter of future planning policy for the control of future development along the lines of the motorways.

5. AESTHETIC DESIGN AND LANDSCAPING

A full treatment of the aesthetic design of the motorways is outside the scope of this paper but some of the main points are described.

There are two aspects of a motorway route in an urban setting:

(i) Its effect on the natural environment of the area through which it passes, as seen by the pedestrian.

(ii) Its appearance and relation to the general urban structure, as seen by the motorway driver.

The scale of a modern motorway is so vast, and its visual direction so powerful, that it cannot be considered as secondary to its surroundings; in its siting, careful attention must be given to the existing city structure and the redevelopment programme.

The design objectives for landscaping within the motorway corridor must be related to two different functions - the macro-environment and the micro-environment. While both make a contribution to the achievement of overall integration, the form and scale of suitable landscaping differs for each.

The form and scale of landscaping in the macro-environment is concerned with the motorist's conception of his surroundings. When travelling at speed, the planting of trees and shrubs must have mass and continuity - odd clumps of small scale planting are meaningless to the motorist, and likely to be a cause of irritation. The continuity of side slopes and the cross-section must be maintained, avoiding spasmodic sections and abrupt changes. The form of landscape treatment can give an added definition to distant landmarks, views or important points of decision for drivers.

An adequate landscaped buffer strip should, therefore, be provided within the motorway corridor, between the edge of the carriageway and the built environment. Even if this cannot be included in the first stage of construction, provision should be made for its ultimate achievement.

The form and scale of landscaping within the micro-environment is concerned more with the elements of detail and small areas of space seen by the casual observer viewing the motorway complex from nearby as a pedestrian or as a person who lives, works or plays within its vicinity. In this context, landscaping is used to reduce the impact and scale of the motorway and its design is related to walking speed, when smaller masses of landscaping can be appreciated in contrast to the larger scale required for the motorway structures.

Trees and shrubs are in themselves beautiful and their extensive use can generally beautify and "soften" the motorway, apart from having specific uses as follows:

(i) The planting of trees and shrubs can be used as a means of integrating the motorway with the adjoining open spaces, and urban development.

(ii) When trees and shrubs are used in places adjacent to elevated structures, they help to reduce the disparity in scale between the motorway and its surroundings.

(iii) Shrubs can be used to conceal or screen undesirable objects or vistas.

(iv) Shrubs not only form an effective means of screening unsightly boundary fences, but in course of time may also take over the function of the fence.

(v) Planting can be used to form a windbreak in exposed areas.

(vi) Shrubs and trees can provide sheltered enclosures for pedestrian routes and also help to provide a diversity of interest.

(vii) Shrubs can be used to canalise pedestrian movement at focal points, or at the approaches to pedestrian underpasses or bridges.

(viii) Shrubs provide easily maintained ground cover on steep banks where access is difficult.

In cut and fill areas, an attempt should be made to mould contours into the natural landscape. For heights under 6 metres, it is most desirable that the slopes formed should be flat or not more than 1 in 3; they should not all be graded to the rigid standard of 1 in 2. Steep slopes are disturbing to the viewer and tend to create a visual barrier between the road and its surroundings. Apart from careful contouring, slopes should be rounded at top and bottom with an elongated 'S' section.

To achieve thick foliage cover at an early date, trees should be planted at close spacings with the intention of thinning at a later date and using the thinnings elsewhere.

Bridges

Every effort has been made to ensure that all bridges over or under the motorway are of a pleasing appearance. To date, these have all been insitu reinforced concrete, commonly post-tensioned.

Retaining Walls

We considered that large areas of plain concrete are, generally speaking, not pleasing to the eye. This is particularly so in the climate that applies in Scotland, with appreciable amounts of rain and many dull, dark days in the winter. One section of the motorway has stone facing, the material being red sandstone of which the buildings in much of the City have been built. We consider that the result has been successful and helps to soften and humanise an inevitably rather massive roadworks. However, this treatment is expensive and in most of the motorway sections the retaining walls have been faced with precast aggregate panels which have also served as formwork. This, we believe, has been successful and is continuing to be used.

Lighting

Where conventional lighting is adopted at major interchanges, the multiplicity of lighting poles and lamps tends to be unsightly both in the daytime and at night, and consequently high mast

lighting was adopted. This has proved so successful that high mast lighting has been generally adopted for virtually all sections of the motorways to date.

Bridge Parapets

The bridge parapets have been standardised throughout the motorways. The design chosen, although naturally designed to contain heavy vehicles striking it, is basically open and, we consider, of pleasing appearance.

Direction Signs

All of the motorways built to date are multi-lane with frequent interchanges, and traffic operation requirements have dictated overhead gantry signs. To achieve the best possible appearance, these have been designed as internally lit and the structural supports standardised and designed to be as pleasing to the eye as possible.

Road Surface Treatment

All the roads constructed to date have been blacktop, with the blacktop surfacing carried over structures. The edges of the roadway and shoulders are delineated by white lines or substantial concrete gutter and this has produced a crisp well-defined roadway.

6. ASSESSMENT OF BENEFITS

6.1 Reduction in Travel Times

Travel times have been dramatically reduced following the opening of the motorway. For example, the average speed on the Inner Ring Motorway is 72 km/h (45 mph) compared with the previous average speed in the Central Area streets of approximately 20 km/h (13 mph).

6.2 Accidents

Accident rates on the urban motorways have proved to be substantially lower than those on the normal City streets. For example, the accident rate on the part of the Inner Ring Road currently in operation has been measured and the table below sets out the comparable figures:

	Rates per 100 million veh km		
	Injury Accidents	Casualties	Fatalities
Glasgow Motorways (Inner Ring Road) 1972	26	33	1.2
All Roads in City of Glasgow 1970 (with negligible motorways in use)	316	395	9.9
All Urban Roads (except motorways) in Gt Britain 1968	199	246	3.7
All Roads in Study Area in 1978 (Projd)	242	304	7.6

We estimate that upon completion of Target 1 the annual vehicle kilometres on the motorway system will be 770 million and will result in approximately the following reductions in accidents in the first year of the completed system:

Injury Accidents	-	1,200
Casualties	-	1,500
Fatalities	-	35

6.3 Driver Comfort

How road users react to different categories of road is a subjective matter but it is our opinion that most road users enjoy driving unimpeded on the new motorways rather than the stop-and-go conditions experienced on the conventional streets.

6.4 Environmental Benefits

(i) Many more dwellings have been relieved of the adverse effects of heavy traffic volumes than have suffered the additional adverse effects where situated beside motorways. Considering the Target 1 motorway system in Glasgow, we estimate that 1,750 dwellings in the vicinity of motorways will be subjected to noise in excess of 68 dB(A). On the other hand, the number of dwellings situated alongside conventional roads which have been almost entirely relieved of traffic amounts to 6,450.

Alongside the roads which have been relieved of through traffic, there are approximately 950 shops, public houses, restaurants, etc, which benefit greatly from the virtual elimination of traffic. The large numbers of people whose daily activities take them to these conventional roads are relieved of the adverse effects of traffic and can also cross the roads freely.

(ii) Central Area

The most significant indirect effect is the removal of traffic from the Central Area of the City. This effect has not yet been fully measured but a good indication can be obtained from the traffic on the four Central Area bridges where a 29% reduction in traffic has been achieved over a period where the overall growth of traffic in the City was 25%. This can be considered as a relative drop of 43% as a consequence of the construction of the Ring Road.

This reduction in traffic has made possible the pedestrianisation of the main shopping section of Sauchiehall Street and Buchanan Street which are now landscaped and an immensely improved environment created for pedestrians.

7. ORGANISATION

The planning and design of urban motorways is a long and complex process.

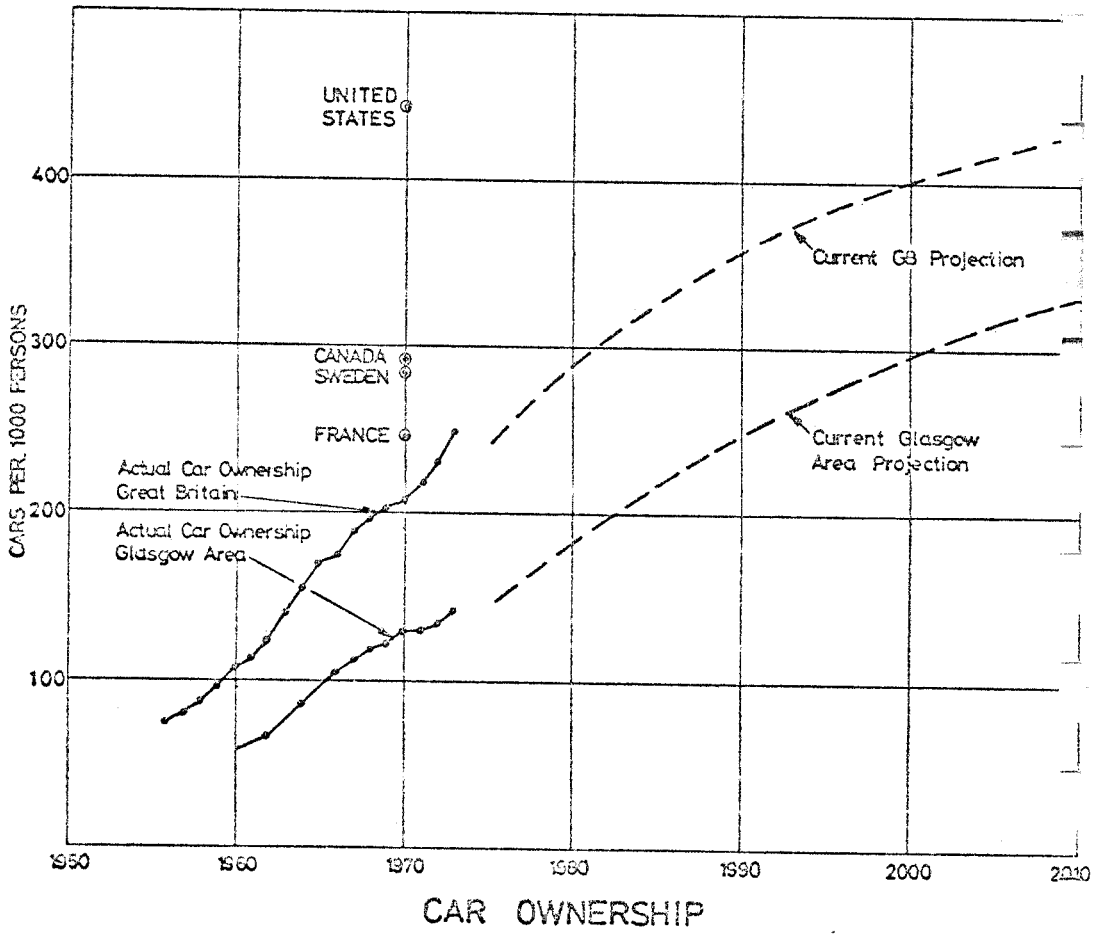
To achieve success we believe four main things are required:

(i) A strong desire - perhaps nothing less than enthusiasm - is required on the part of everyone concerned to achieve high standards.

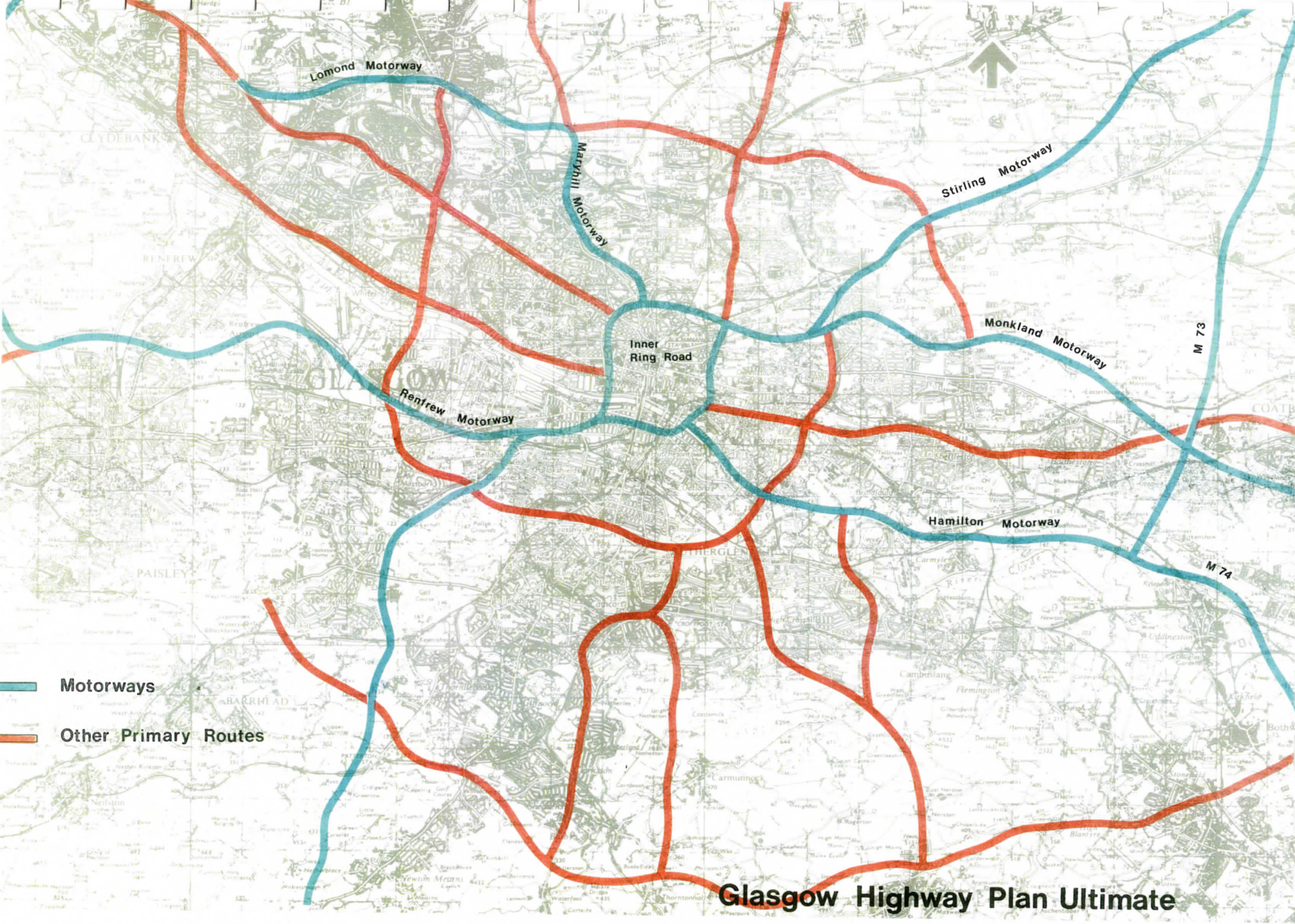
(ii) A suitable administrative structure is required to enable the various necessary skills to be coordinated.

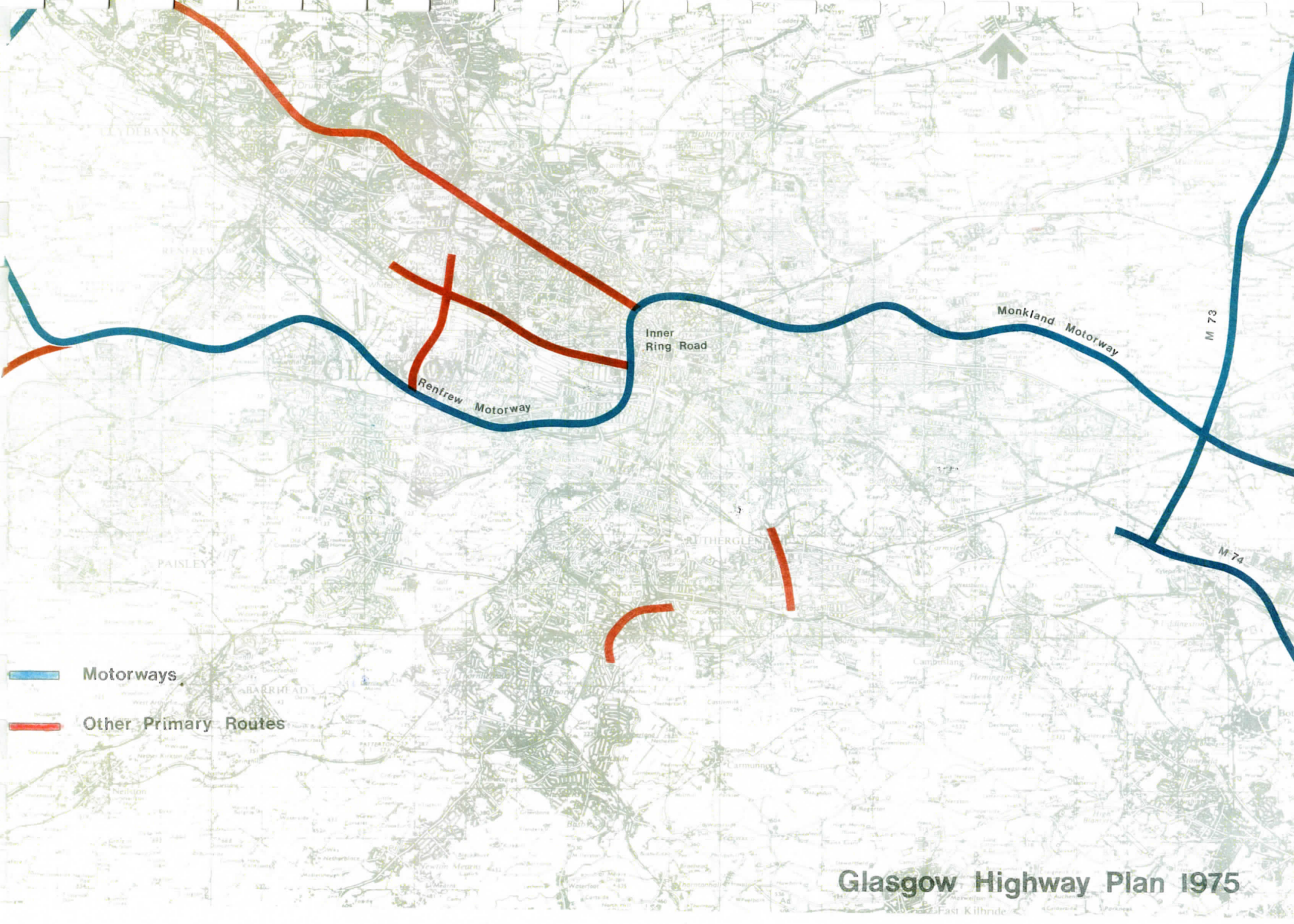
(iii) The planning and construction of a motorway system extends over a long period of years (fifteen years to date in Glasgow) and we believe that some degree of continuity in the large design team required is desirable.

(iv) A genuine spirit of cooperation is required which seeks to understand the views of the various other professional disciplines which must contribute to the overall project.

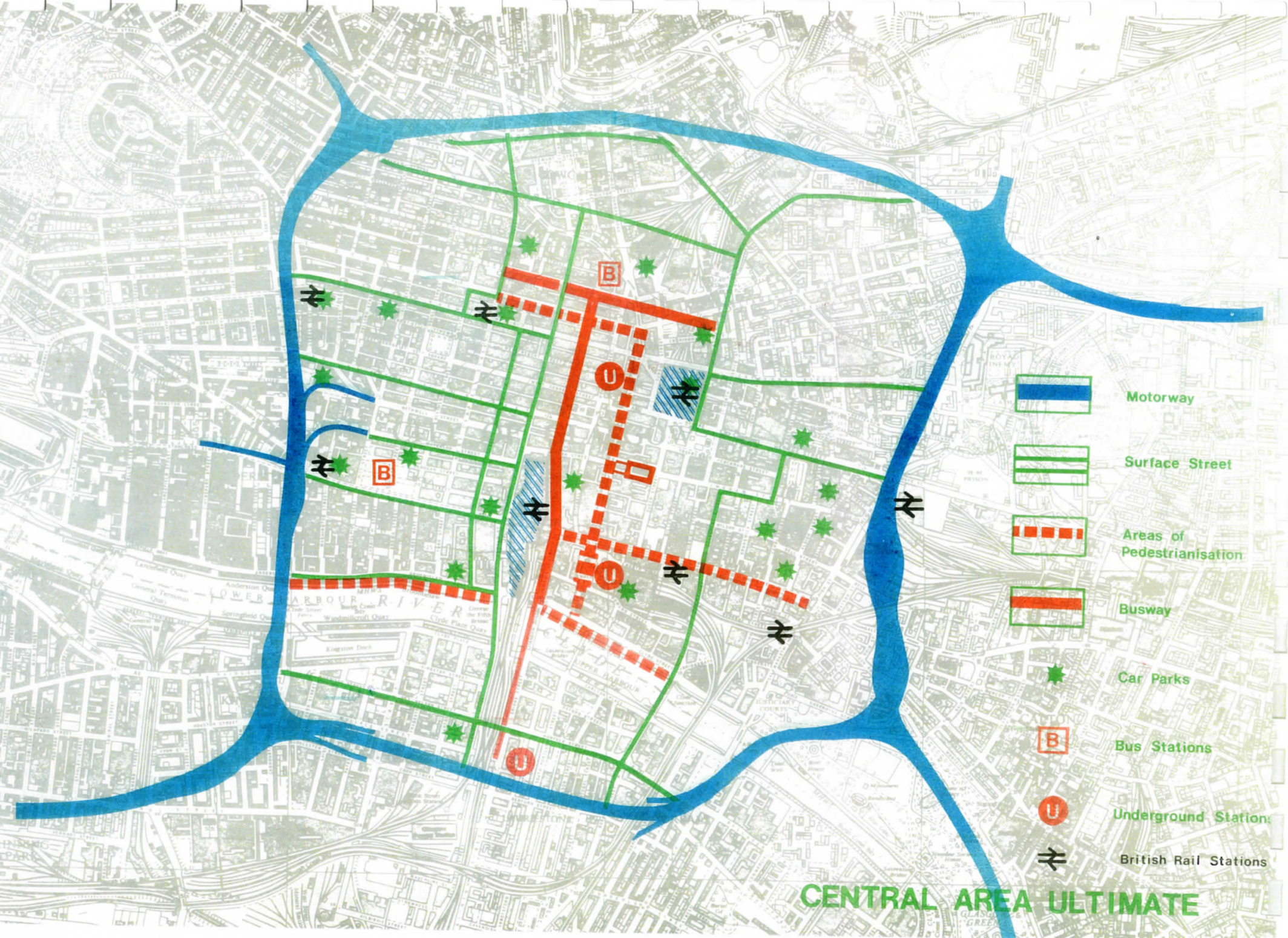


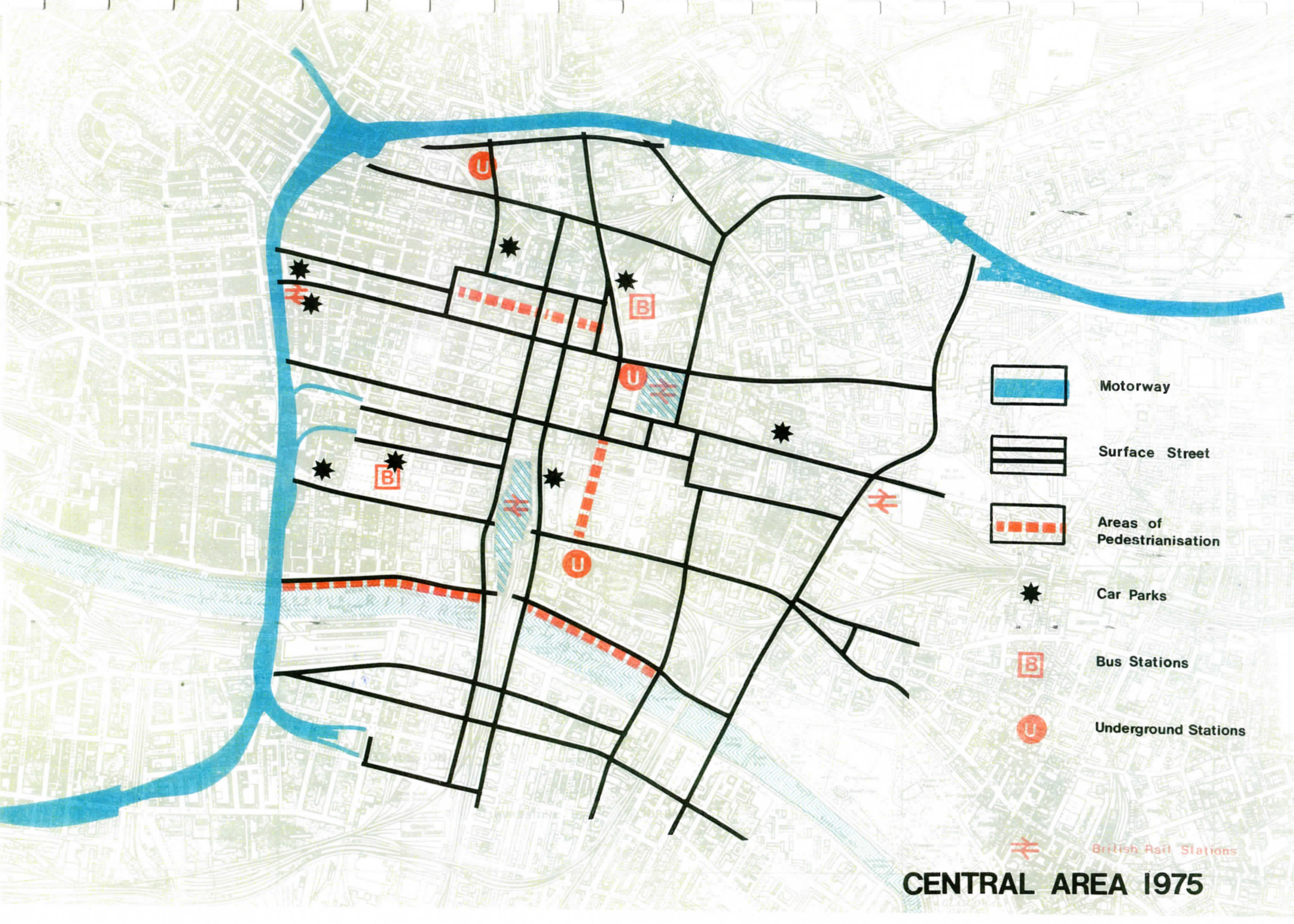
Drawings


Lomond Motorway
Maryhill Motorway
Stirling Motorway
Inner Ring Road
Monkland Motorway
M 73
Renfrew Motorway
Hamilton Motorway
M 74
Motorways
Other Primary Routes
Glasgow Highway Plan Ultimate

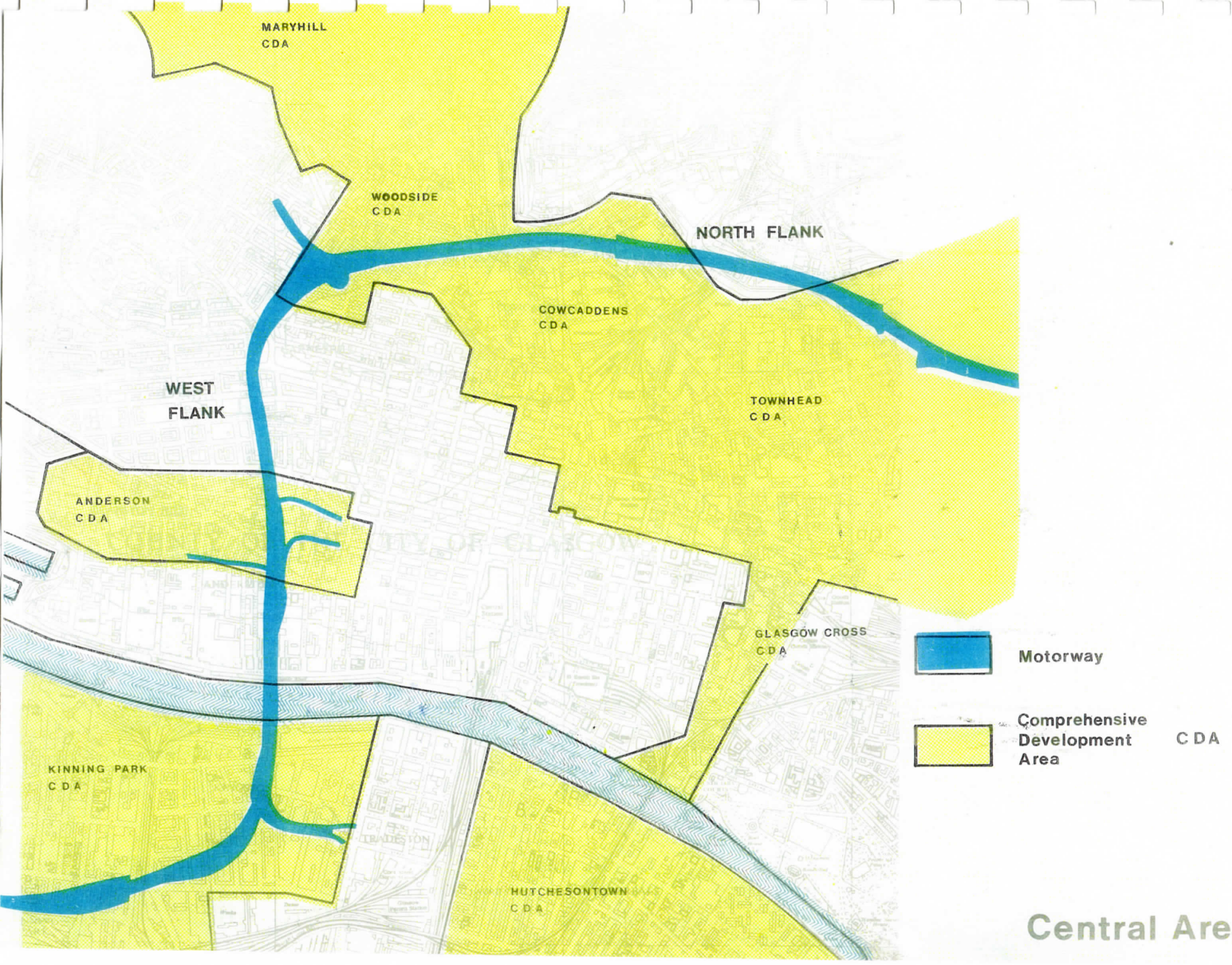


Glasgow Highway Plan 1975

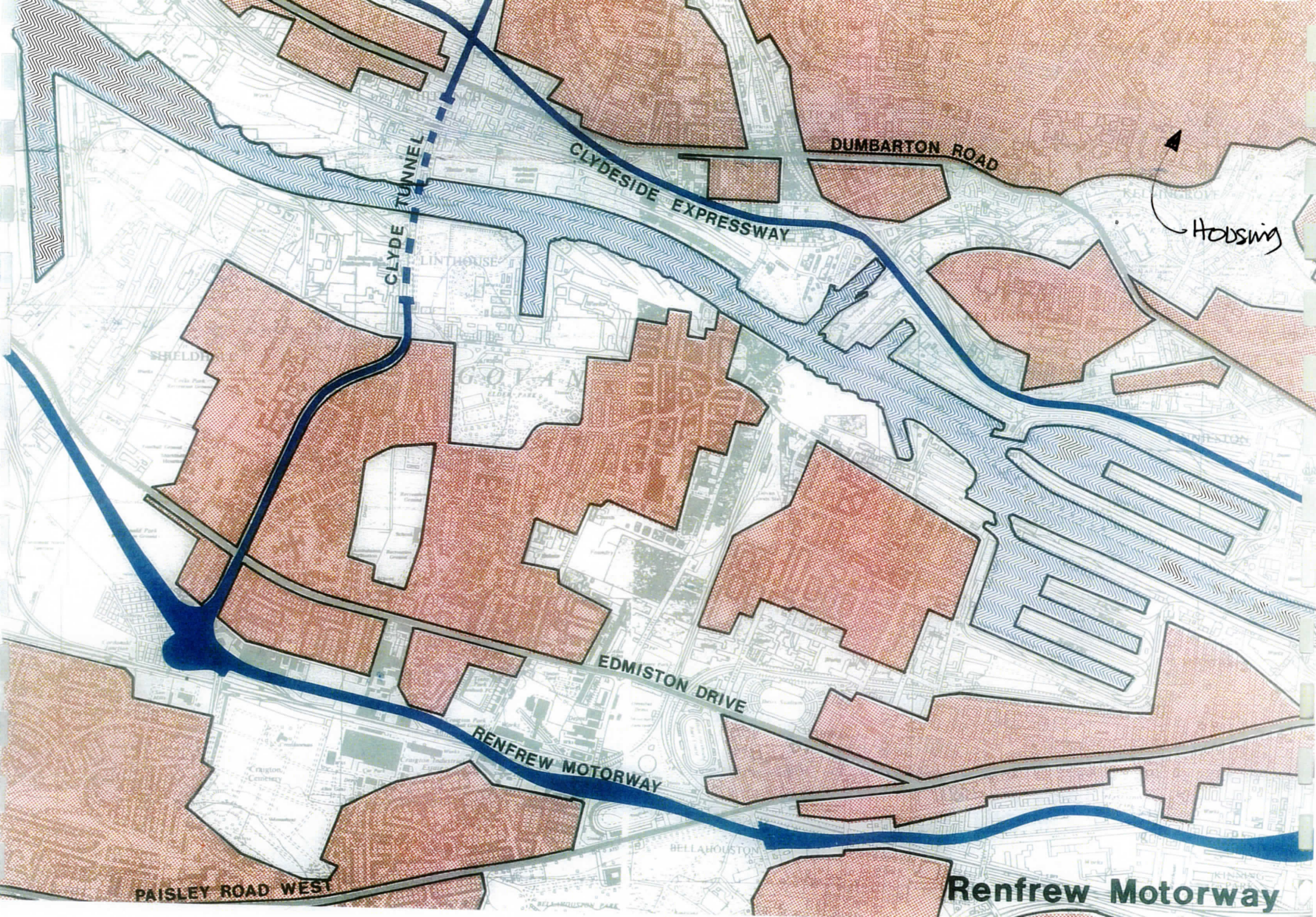

Motorway
Surface Street
Areas of Pedestrianisation
Busway
Car Parks
Bus Stations
Underground Stations
British Rail Stations
CENTRAL AREA ULTIMATE

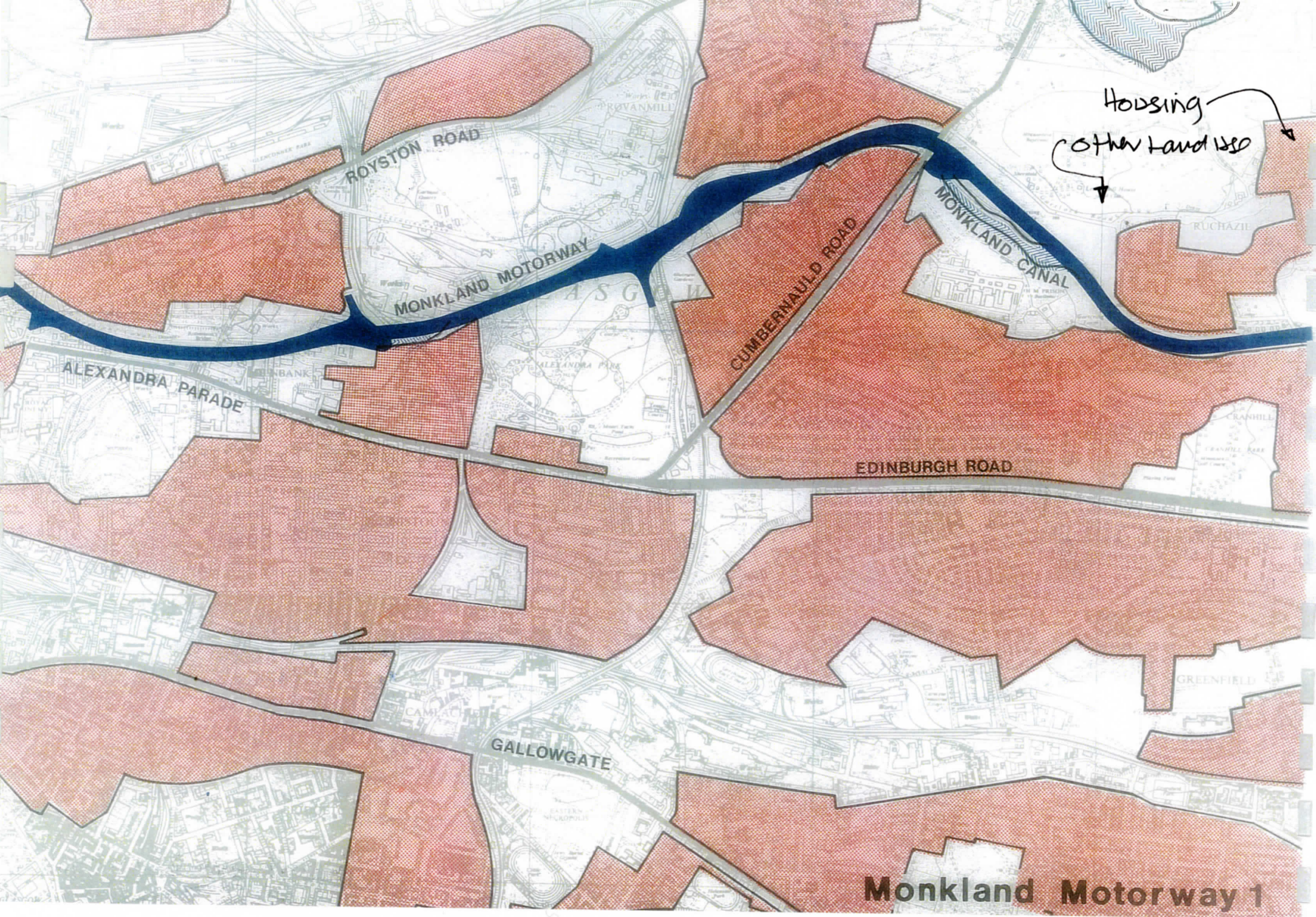


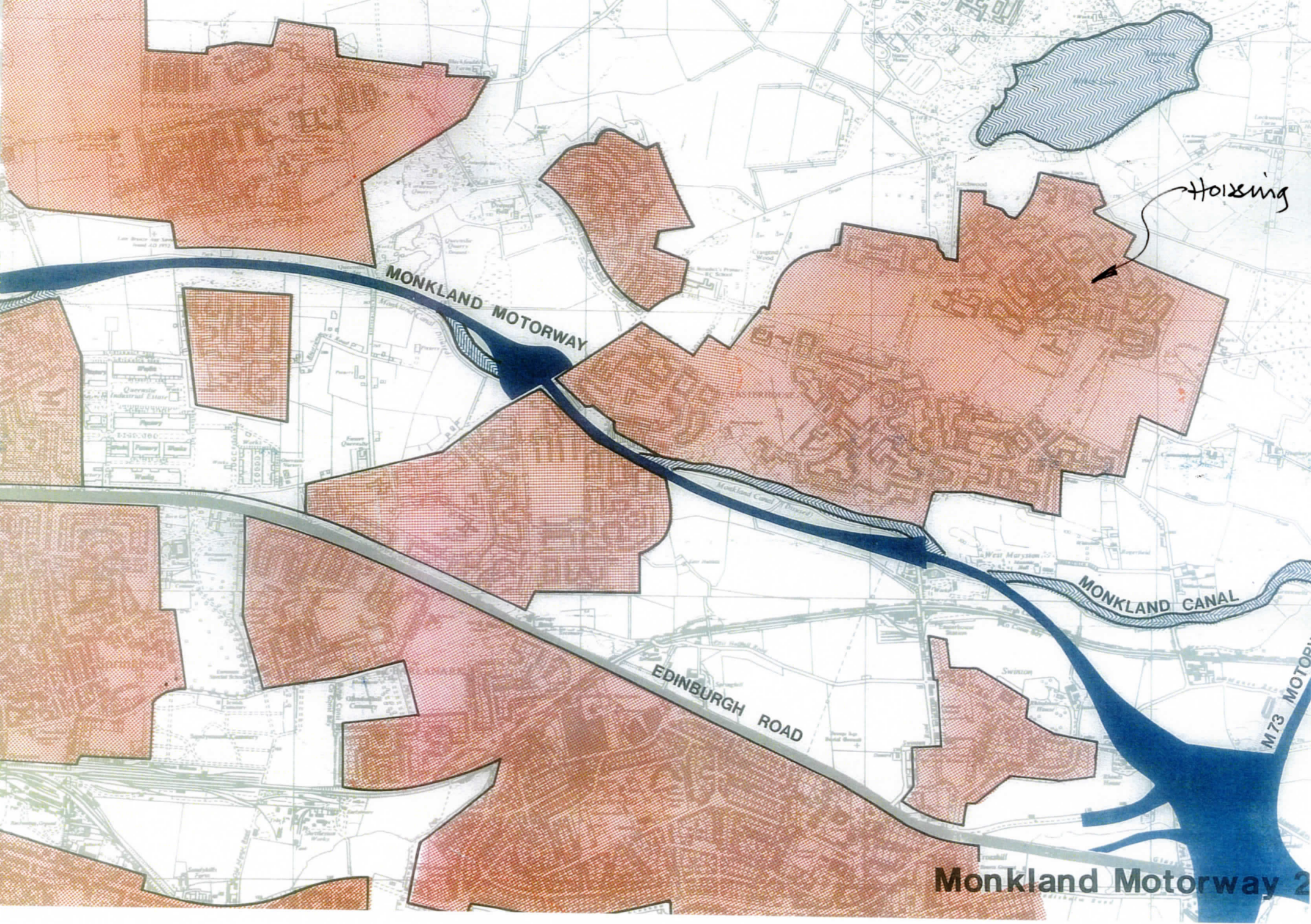
CENTRAL AREA 1975



Central Area


DUMBARTON ROAD
CLYDESIDE EXPRESSWAY
CLYDE TUNNEL
Housing
EDMISTON DRIVE
RENFREW MOTORWAY
PAISLEY ROAD WEST
Renfrew Motorway


Housing
Other Land Use
ROYSTON ROAD
MONKLAND MOTORWAY
CUMBERNAULD ROAD
MONKLAND CANAL
ALEXANDRA PARADE
EDINBURGH ROAD
GALLOWGATE
Monkland Motorway 1

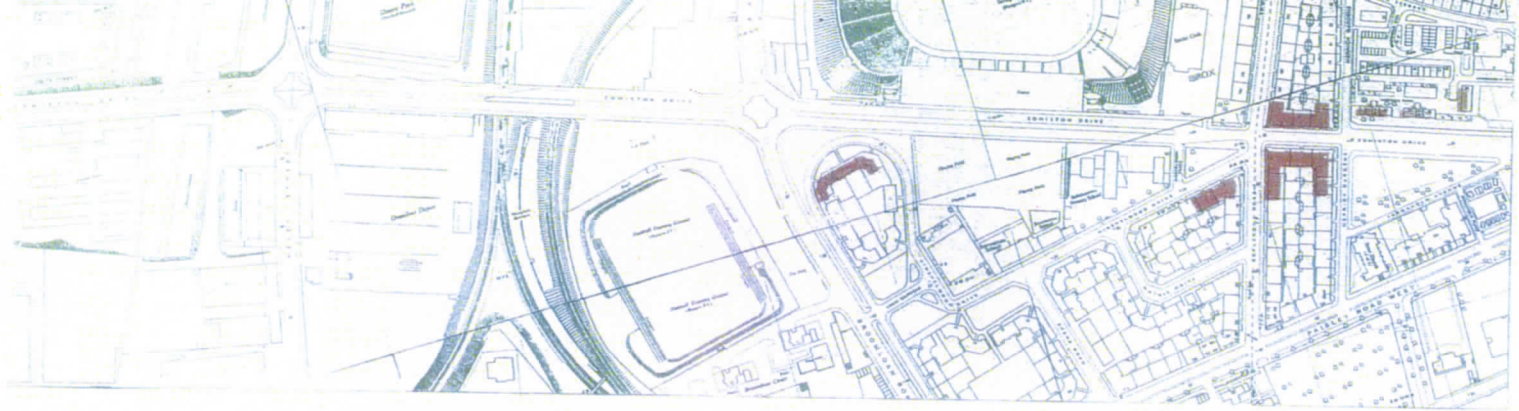

Housing
MONKLAND MOTORWAY
MONKLAND CANAL
EDINBURGH ROAD
M73 MOTOR
Monkland Motorway 2

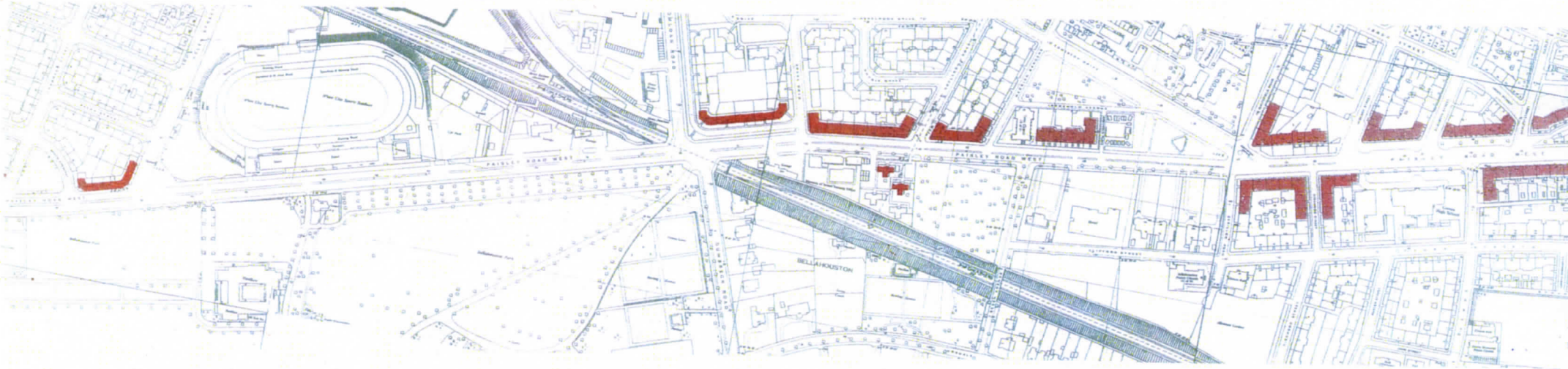

WOODSIDE
CDA
COWCADDENS
CDA

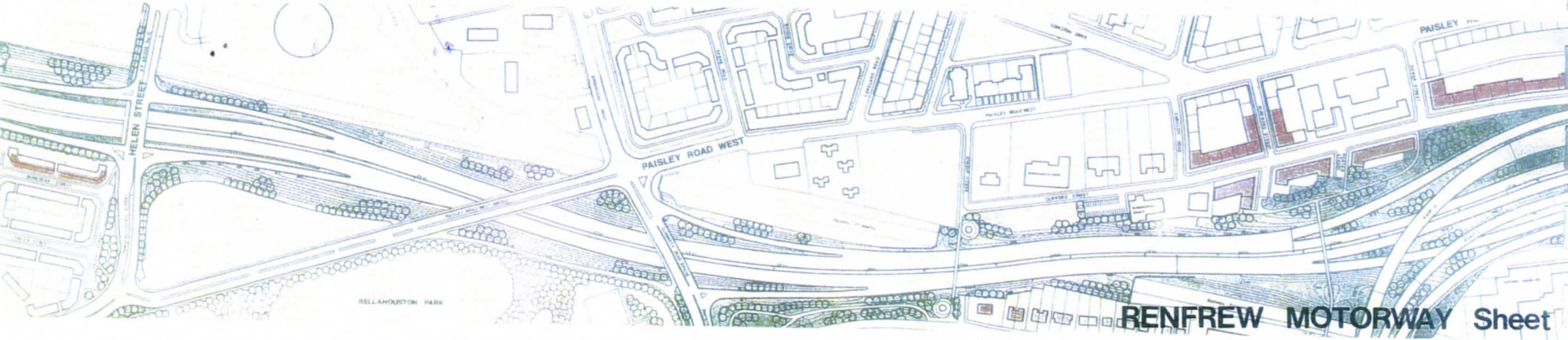
INNER RING ROAD - NORTH FLANK


ROYSTON
CDA
TOWNHEAD
CDA
BAIRD STREET
EXTENSION
RAMP
SPRING BURN
CASTLE STREET
SECONDARY SCHOOL
PRIMARY SCHOOL
SECONDARY SCHOOL
REALIGNED
ALEXANDRA
PARADE
HOSPITAL
PRIMARY SCHOOL
EAST FLANK
CATHEDRAL
STREET
CATHEDRAL
ALEXANDRA
PARADE

INNER RING ROAD - NORTH FLANK



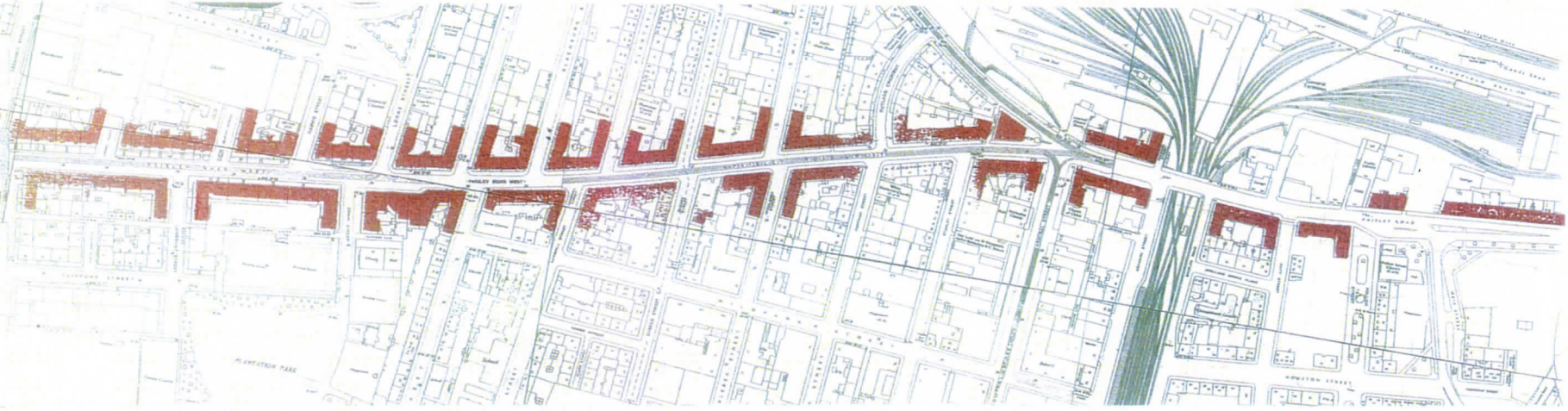


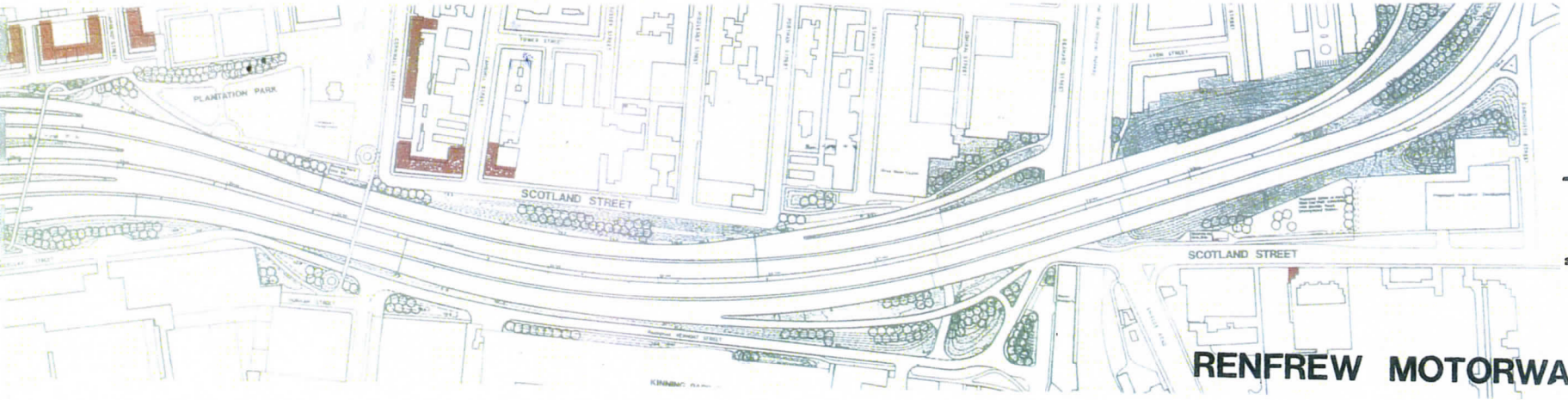


RENFREW MOTORWAY Sheet

NOISE.

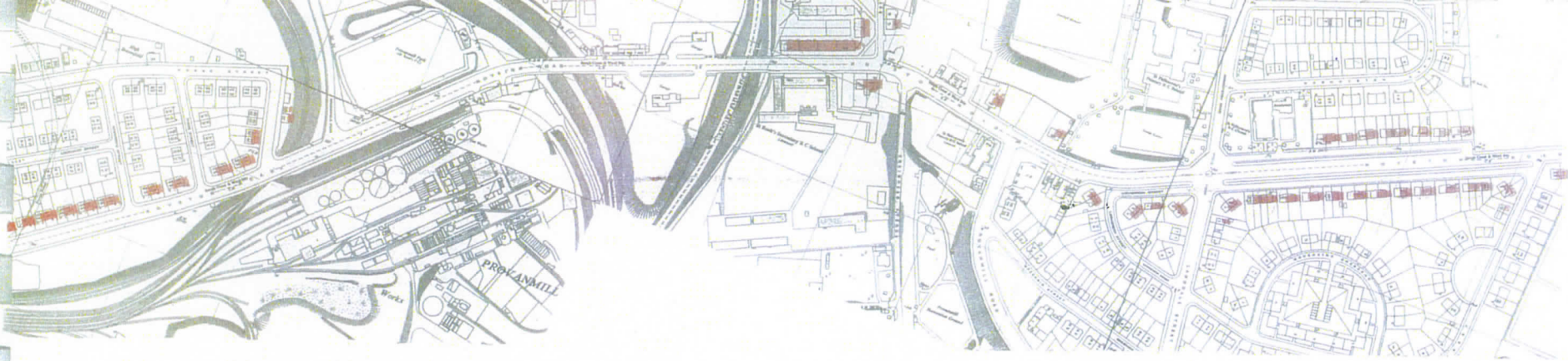
Dwellings Affected.	Parallel Arterial Roads Relieved.
Motorway.	
90	
1347	
542	
542	1437

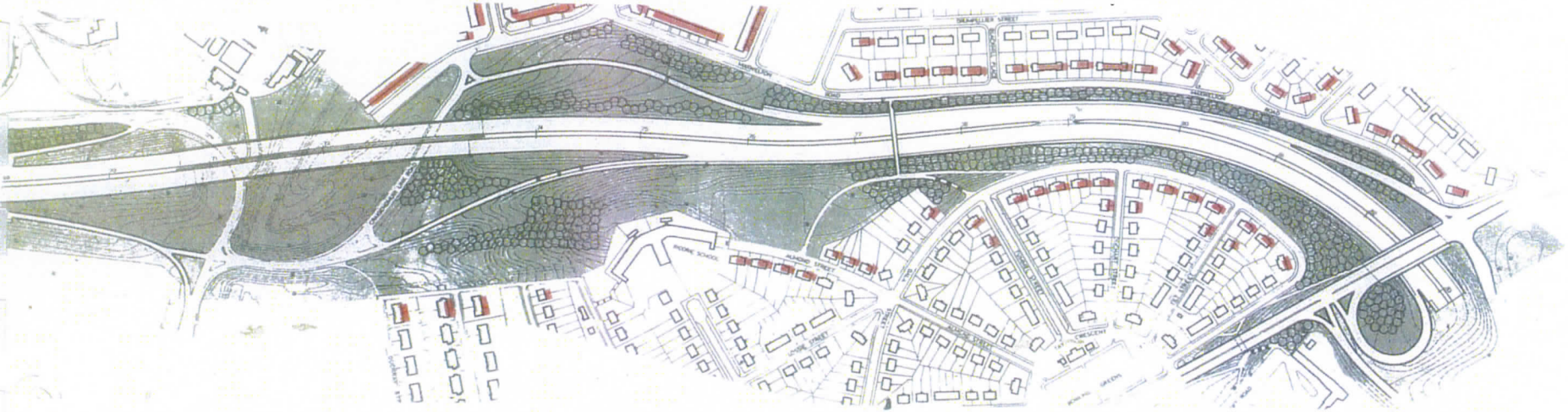




RENFREW MOTORWAY Sheet 2.

MONKLAND MOTORWAY Sheet 1.





NOISE.

Dwellings Affected	Parallel Arterial Roads Relieved
Motorway.	678
	435
	1290
435	1968

MONKLAND MOTORWAY Sheet 2