work of this kind has been done will it be possible to consider how such components can be organised to produce the overall flexibility required in the larger context.

20. One of the most important aspects of planning is the organisation of transport. While maximum accessibility is of paramount importance, the form this will take depends upon two variables, the standards of personal convenience demanded and the willingness or ability to pay for it. The increased use of the motor car is evidence of the demand for more personal convenience, but the willingness to pay for the ultimate consequences has not yet been demonstrated.

21. Clearly this is a decision which cannot be forecast, and therefore provision should be made in immediate developments for any of the range of possibilities to be fulfilled. This means, in effect, that development has to be planned to accept the possibilities of both maximum personal mobility and maximum public transport.

Public transport

22. Theoretical studies, combined with experience in the U.S.A., have shown that even with a decision by the bulk of the population to use personal transport, there will always be a proportion who use a public transport system. In addition it has been demonstrated that the transport system can be greatly reduced in cost if the bulk of the population can accept the use of public transport for the peak journeys, those from work to home and home to work.

23. A public transport system places considerable discipline upon the form and organisation of any town. Basically this can be summarised by saying that all forms of public transport move along a line, and stop to collect or distribute passengers at predetermined points. These stopping places become the focal points for the surrounding areas which can be divided into two concentric zones, that from which people walk to the stopping point, and that from which they would normally drive to it. The distance that people will walk to a stopping point is estimated at about 5—7 minutes or about one-third of a mile. The distance from which people will drive to a stopping point with no public transport alternatives is more difficult to determine as it depends upon a large number of variables.

24. The effect a public transport system would have of generating a series of catchment areas around its stopping points is illustrated by the accompanying diagrams 19 and 21.

25. Although a public transport system has definite implications on town form, the decision as to the type of system can be suited to demand and programmed to match the degree of personal mobility chosen by the community.

26. The problem becomes accentuated in a new development by questions of programming and phasing, expecially in a development the ultimate size of which is indeterminate. Different sizes of town can support different types of public transport. A small town, or the first stage of a larger town, may barely be able to support a bus system, while at very much larger scales a rail system could be required. The uncertainty of the ratio of the demand for public and private transport systems, combined with the requirements arising from different stages of development, make it imperative that both the type of system and its relation to private transport be considered on a flexible basis.

Private transport

27. The system required to deal with the traffic generated by large-scale private mobility would have to be based on a clear road hierarchy, with pedestrian segregation from all but the most lightly-used roads.

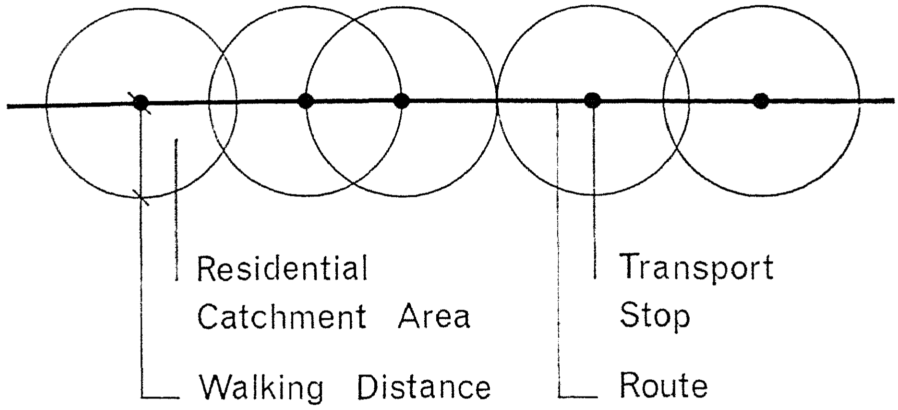


Diagram 19 Catchment areas generated by a public transport line.

28. The critical load expected for any road system is usually that generated by work journey movements. The peaks involved are dependent upon the degree of concentration of employment opportunities, an even disposition of employment and housing producing minimum peak demand. This relationship is illustrated by the theoretical calculations in Appendix II.

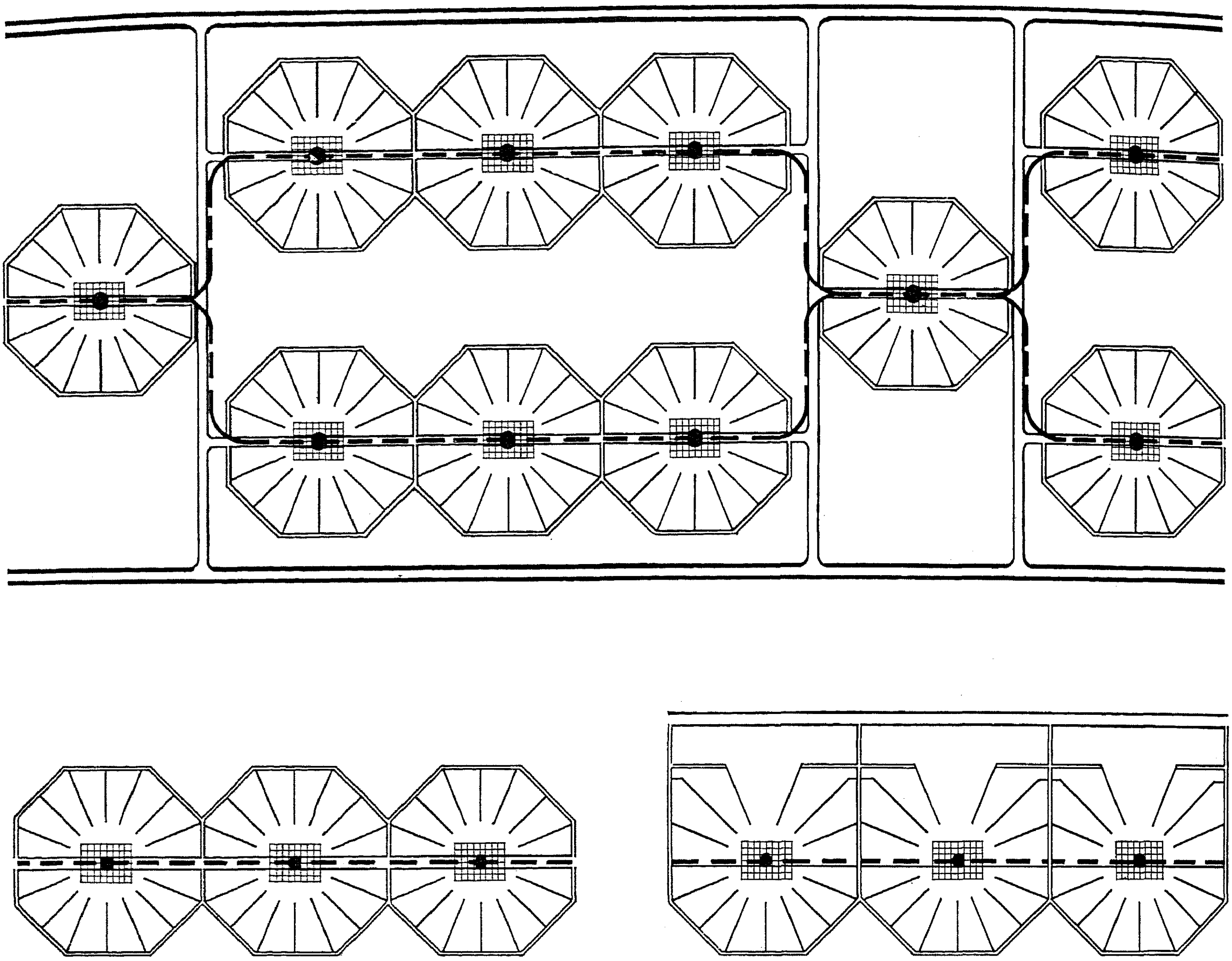
29. Studies carried out in America have shown that within about a 15-mile radius there is a comparatively even attraction of jobs for people. Beyond this distance the length of travel involved becomes significant and people are thus less likely to seek employment. Therefore, if optimum population densities for an area are assessed, and stipulations are made as to the degree of concentration of industry, a relationship can be formulated between developments and the roads required to serve them. Calculations illustrating this are given in Appendix II.

30. Investigations into the relationship between industrial and residential areas have indicated that an example proportion of about 1 : 3 is roughly satisfactory and using this proportion an arrangement of industry, residential areas and roads is illustrated in diagram 21. Other examples are given in Appendix II. For any overall pattern built up from the development principles outlined in diagram 21 the relationship between land use and road requirements will be constant. This is of great value in flexibility of design at the city region scale.

Combined transport system

31. The relative weights placed upon private or public transport will be determined by decisions as to which will provide the greater social benefit. Ultimately, however, both systems will be required, with the possibility of either becoming the main method of transport. Therefore, allowances should be made in the planning for maximum provision of either system to develop.

32. Interaction between public and private elements of the transport system has considerable influence on the organisation of town form. The requirements of both transport systems could be combined into a series of catchment areas which are also environmental areas. Designs for such areas should reinforce the original concept of pedestrian segregation from vehicles. Vehicular movement can be controlled by simple devices such as kerbs and bollards, but the pedestrian cannot be contained to a similar degree. Therefore planning should encourage a general pedestrian movement away from the main road system, possibly by the use of a Radburn plan with a central attraction point of public transport stop and



EXAMPLES OF LINEAR GROUPING

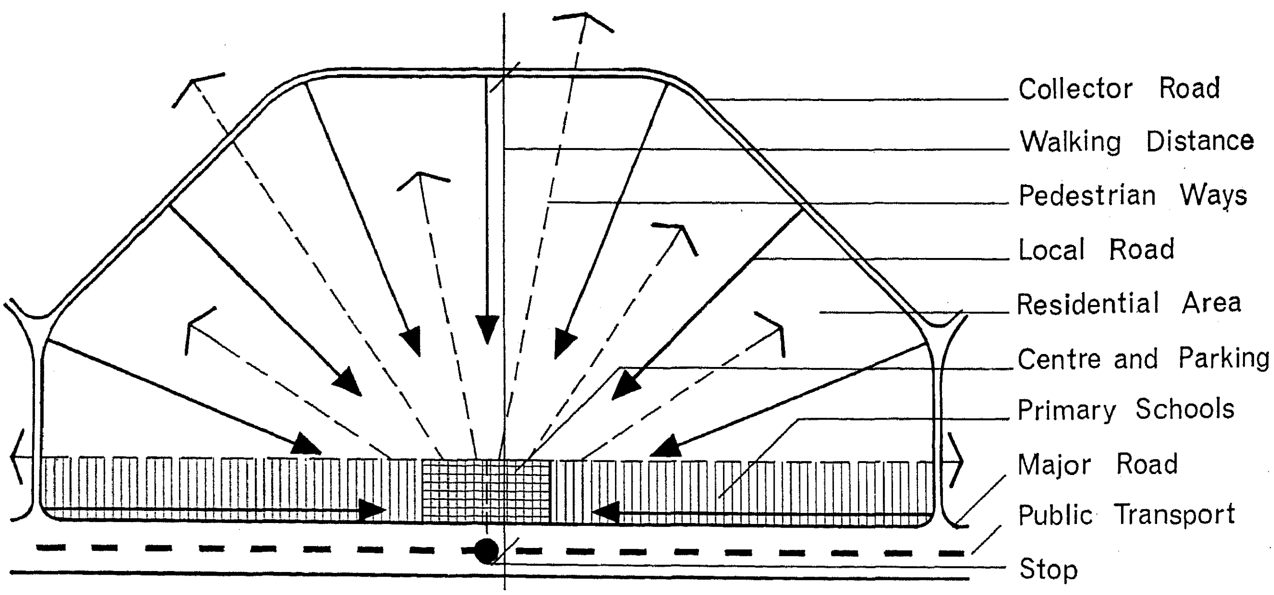


Diagram 20 Examples of residential unit organisation.

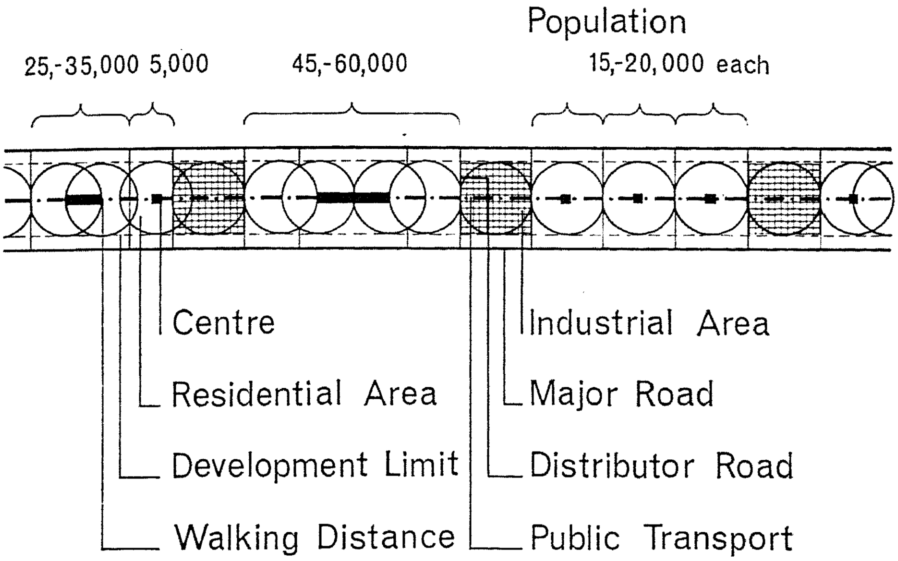


Diagram 21 Relationship of residential to industrial areas.

community facilities. If vehicular access is placed at the opposite extremity the natural internal circulation movements of pedestrians and vehicles would tend to separate. This is illustrated by the organisations postulated in diagram 20.

33. The requirements of walking distance to public transport stopping points result in a corridor of accessibility of varying width extending approximately 1,250—1,750 ft. on either side of the transport line. Addition of rather more car-orientated development on the extremities would result in an overall corridor of potential development of between $\frac{3}{4}$ and 1 mile wide. This could accommodate roughly 20,000 persons per mile length (though the principle would operate satisfactorily at much lower densities). If the relationship of residential to industrial land were 3 : 1 and similar walking distances were maintained within industrial areas, the overall land use organisation would be similar to that illustrated in diagram 21.

Social organisation and land use effects on city components

34. Most people consider it of paramount importance that their village, town or city should have its own character and identity. This is intimately connected with the way of life of the individual concerned and the environment he chooses to live in. Wide variations in personal taste foster demands for many environments, often of widely differing types. A major factor influencing the environmental type is the size of unit considered. A village of 5,000 people produces a different environment to a town of 60,000 which in turn differs from a metropolitan residential area. In a democratic society it is obviously essential to enable people to choose the type of environment they wish to live in. This in turn implies a large measure of uncertainty as environmental demands are both changing and difficult to forecast, and consequently the desirable distribution of settlements of varying sizes becomes indeterminate.

35. Utilising the principles of planning discussed, an overall plan can be produced well before the time when it becomes necessary to lay down specific sizes for residential units and centres. This would enable different types of environment to be developed according to current demands, instead of according to a previously determined plan, while still maintaining a planned overall structure. The largest residential unit which could be accommodated in a line of development would be related to the maximum walking distance, but its population may well reach

50,000 or even 100,000 people. Larger towns would inevitably be composed of a series of walking distance units grouped together and linked by transport systems to a major centre.

Summary of effects on city components

36. Thus the major demands for flexibility at the smaller scales revolve around the transport system and sizes of population units. During the course of this chapter the various factors affecting the degrees of flexibility required have been assessed and a possible system that could satisfy these demands has been postulated. The system could develop at this scale any combination of transport facilities that are likely to be required and change it with the demand as the town develops. It could at the same time incorporate any combinations of the various sizes of population units that could be demanded by current social opinion. The degree of flexibility obtainable within the organisation outlined could effectively remove the monotony and lack of character previously associated with systems of infinite growth based on series of identical units.

Effects of social organisation on city cluster scales

37. So far the requirements of infinite growth have been considered at a local scale, and an example of a system which could satisfy these has been postulated. It is now necessary to examine methods by which this system could be organised into larger scales of development; towns, cities and even sub-regions.

38. Investigation at this larger scale involves an aspect not considered so far; that is the main city or regional centre. Major facilities are generally concentrated in the main centre, but in addition it also serves as a local centre for the population immediately surrounding it. It is possible that this duality of function has, in the past, been responsible for the intensity of use, and thus congestion, at the major centre. However, this is not to infer that a major centre could consist entirely of major facilities since many of these depend upon an associated concentration of demand facilities and thus a fairly large dependent local population. Studies on the optimum size of such a population which provide both a wide range of facilities and the possibility of full private mobility are too dependent upon individual plan type to enable a generalised statement to be made with any accuracy. However, it would appear that the 200–300,000 range can provide the majority of such facilities as theatres, art gallery, football club, etc., and it may well be that a high degree of private mobility would still be possible.

39. The hinterland to a city plays an important part in supporting its major facilities; theoretically, the larger the hinterland the better the standard of facilities. The congestion which could be caused in individual cities by regional use could be alleviated by having several major centres within a region, each specialising in the provision of certain facilities and being linked by good communications. However, since many facilities depend upon a concentration of supporting ones, there would still be a necessity for regional centres to be on a considerable scale. The answer to the provision of good major facilities and a high degree of private mobility would appear to be in the provision of an efficient communication system between regional centres and large hinterlands.

40. The intercommunication of major centres and lines of development facilitates a movement between them which could have considerable effect on the social organisations possible. Previously, the main social organisation has emphasised local loyalties, a person identifying himself and his interests with his own town, county or residential area. This system can continue in the forms shown, each centre building up its own identity and its own introverted social group, extending for some distance into a hinterland, until a watershed is reached with the next

town. However, increased specialisation and mobility is leading to the development of new social structures, which owe allegiance not to places but to activities. Thus a person may belong to a social group supporting an opera house in one centre, theatre in another and a political club in a third. This group may draw members from a wide regional area, the generating factor being a common interest within these common locations. Such a social system can support very specialised facilities and may release interests which previously have not had the correct environment for their expression.

41. It is important that this type of development should not be confused with conurbations which have developed naturally. There are many different ways in which settlements have developed to conurbations, but the common factor in all of these is that there has been no planning. Generally the result has been confused, congested and has in many cases led to a lack of identity due to the absence of clear hierarchy of activities. In addition the prevalence of old speculative property has led to the development of many slums intermingled with haphazard industrial and transport areas, the whole producing a very unpleasant environment. Inevitably, this has resulted in a social prejudice against conurbations. However, such prejudice should not be allowed to negate the considerable advantages to be gained by large population groupings, since in a planned system the disadvantages of the spontaneous conurbations can be reduced.

42. Clearly, in a system as flexible as the one postulated the main centres will also require a considerable degree of flexibility in both size and organisation. While this is feasible for a new central town, the re-planning of an existing town on this basis is likely to present greater difficulties. However, these are not insurmountable but they would require a new approach to both land use and design.

43. Land use survey would require a far greater emphasis on potential redevelopment dates. If estimates are then made of maximum areas likely to be required for a wide range of future possibilities, plans may be arranged so that at any time the most suitable areas are available for expansion. While this would be difficult to achieve completely in many areas, its consideration during early stages of redevelopment would result in maximum flexibility and minimum uneconomic redevelopment.

44. Expendability would be the most fundamental change required in architecture. Design for a planned life of buildings would greatly increase future growth and reorganisation possibilities, and would eventually prove more economic as buildings are continually designed according to current social and economic criteria. This principle is already used by speculative developers and industrial concerns where economic return is vital.

45. The demands of flexibility would also influence central area planning. With changing regional and city functions, the scale and organisation would have to alter; both overall and development area plans would have to take account of this, and should be considered from the start on a flexible basis as a potential part of a larger development. Maximum change of use should be allowed for, in some cases to the extent of flexible use buildings.

46. It is important that flexible re-planning of existing centres is considered from the start, and it is fundamental for any plans prepared for Bedford and Northampton.

Transport and land use aspects of city cluster scales

47. The necessity for good communications, interconnecting major centres and hinterlands will be a critical factor of regional planning whatever hierarchy of

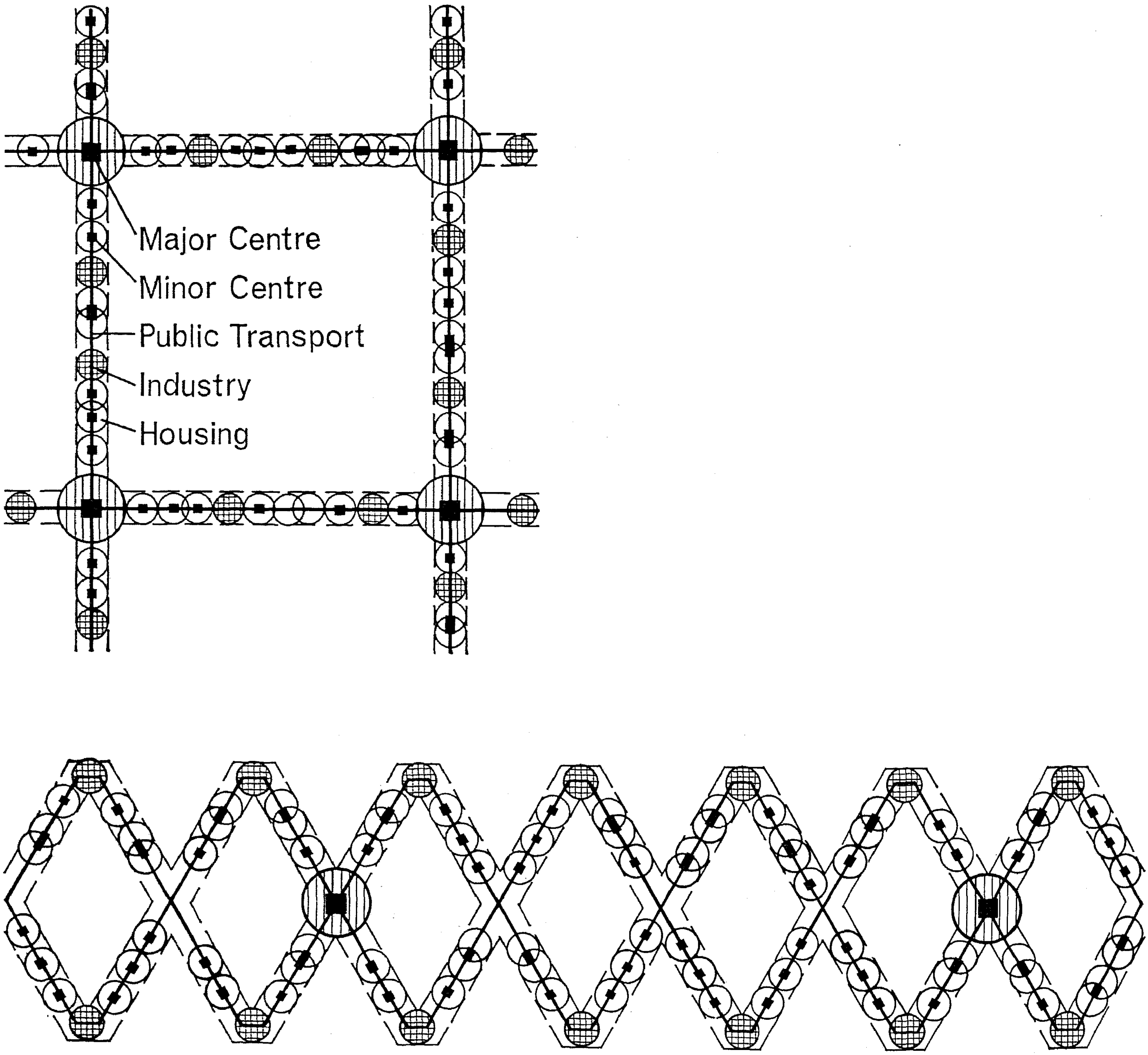


Diagram 22 Examples of large-scale organisation patterns.

centres is evolved. The demands mentioned at the beginning of the chapter for a regional flexibility of size and form have considerable effect on the transport patterns required.

48. Public transport is likely to provide the most critical requirements due to considerations of routing and services. Basically, the simpler the route pattern, the better the service provided; simple lines and loops being highly efficient. The best standards of service are provided where the number of routes needed to inter-relate all points are at a minimum.

49. Since the development is flexible, and thus can expand to any required size, the organisation adopted for the transport system must also be capable of expansion with a minimum increase in complexity. The most efficient system for both service and free expansion is the line. However, the application of this may be limited within the system outlined above since the population that any one line could support may not generate a very large centre. But these objectives could be achieved by patterns of organisation composed of several open-ended lines of communication or more complex public transport patterns.

50. A pattern built up from a series of lines appears to offer better opportunities for expansion than one built up from loops, which generally require construction in a series of finite stages. Several examples of possible organisation of lines of transport in major centres are illustrated in diagram 22.

Summary of effects at city cluster scale

51. At the city region scale the requirements of both national scales and residential scales have considerable effects on the planning organisation. Major centres play an important part in the national and regional growth pattern by their ability to provide for the higher facilities capable of generating a counter attraction to those of existing conurbations. Provision of these facilities without undue congestion is dependent upon the relationship between the major centre and its hinterland. Choice and the provision of the highest facilities can be provided by a regional interdependence of centres, while the interconnection of centres and hinterlands can enable a new social structure to develop.

52. Success of such a large-scale organisation is very much dependent upon an efficient transport system. Public transport requirements in particular will influence the regional organisation pattern, leading to a series of linear developments interconnecting major centres. Linear organisations have the additional advantage of growth flexibility when the regional pattern adopted consists of a series of open-ended lines of development.

Theoretical example

53. In order to illustrate the principle discussed in this chapter one example has been applied to the study area. It is not intended to be taken as a recommendation, and has only been considered inasmuch as it demonstrates the ideas of growth and flexibility outlined so far. This example is illustrated by diagrams 23–26.

54. In the initial stages expansions at Bedford and Northampton are of the scales and on the sites suggested in Chapter 4. Main roads connecting the two towns to the new town site at Bletchley are renewed, and in parts relocated to produce the patterns shown on diagram 23. Development of residential and industrial areas takes place along these routes; two at Northampton and one at Bedford. Each area is related to its central road in the manner discussed in paragraphs 23–26. Thus the breakdown of the area is into a series of walking distance units with a central area directly related to the public transport system using the main road. At this stage this is a bus service.

Theoretical example of inter-related de…

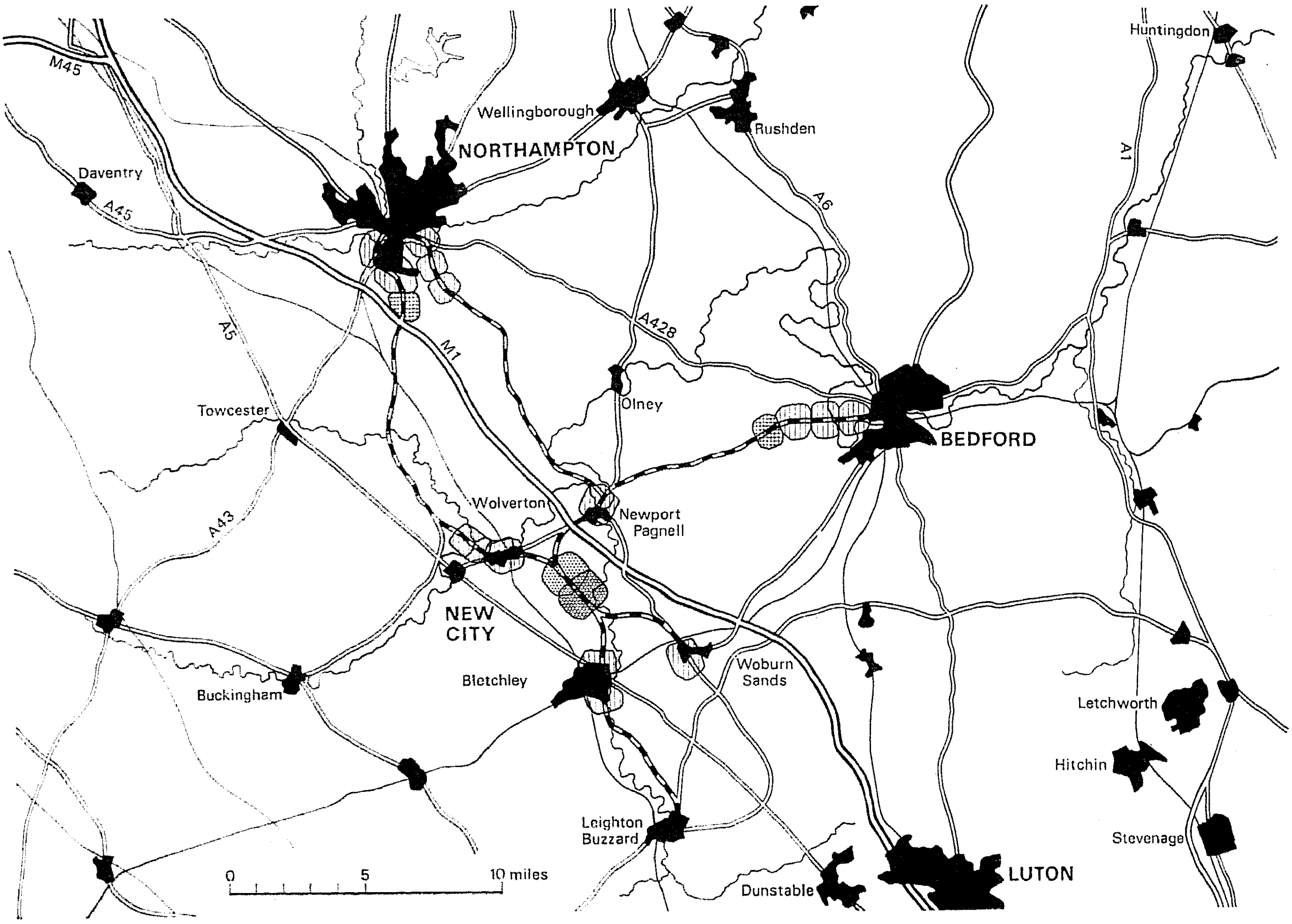


Diagram 23 Stage one.

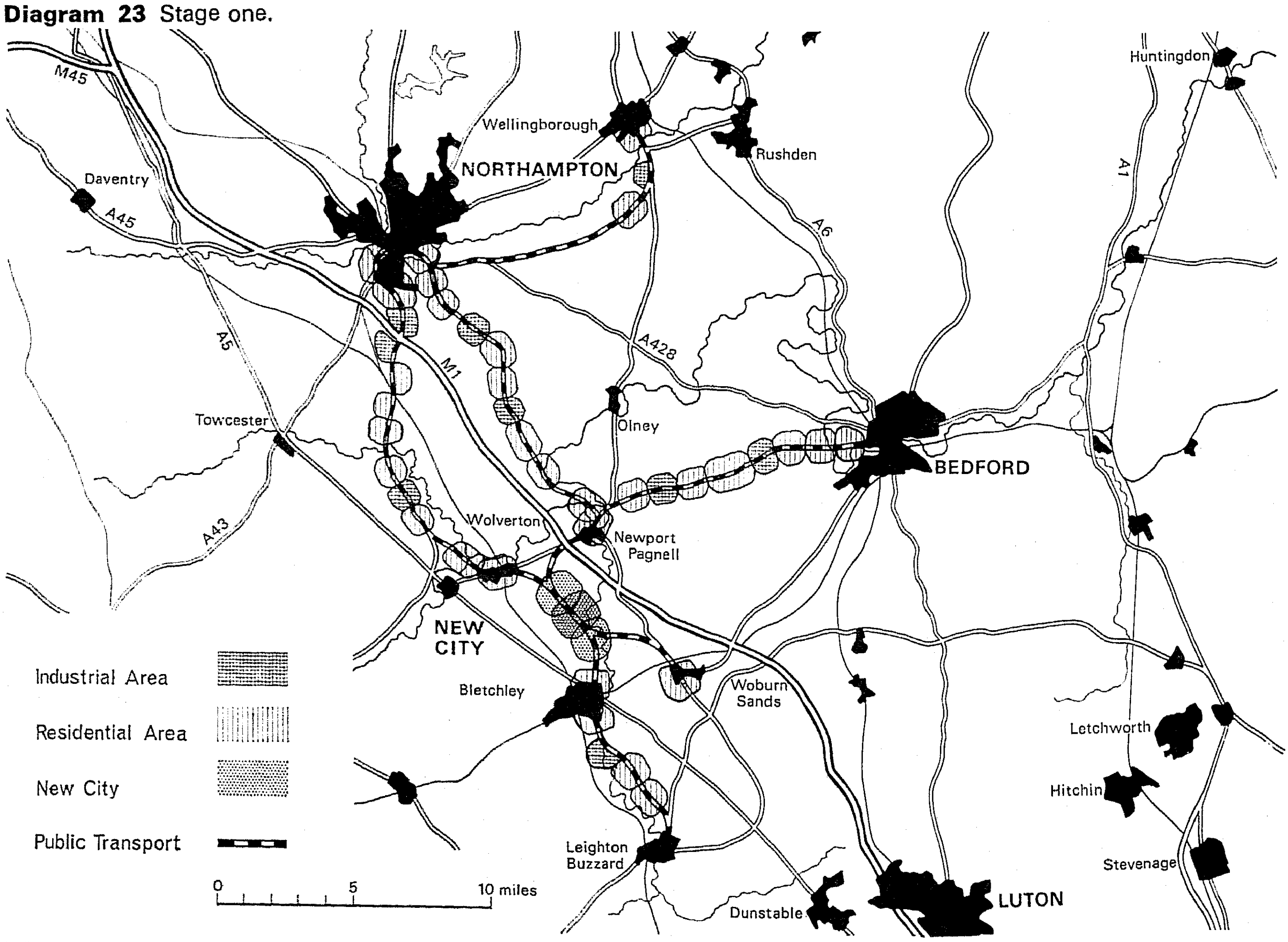


Diagram 24 Stage two.

elopment applied to the study area

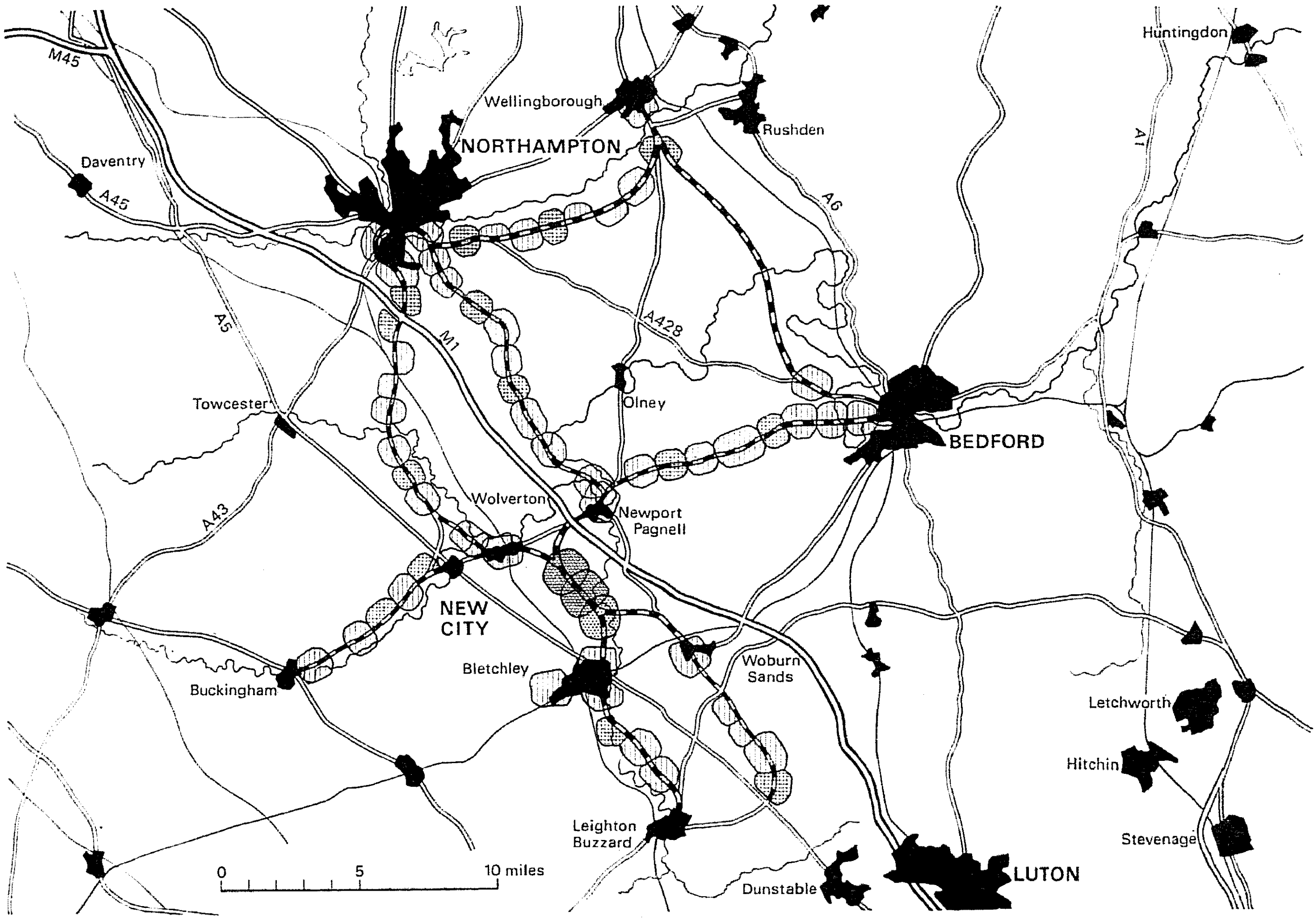


Diagram 25 Stage three.

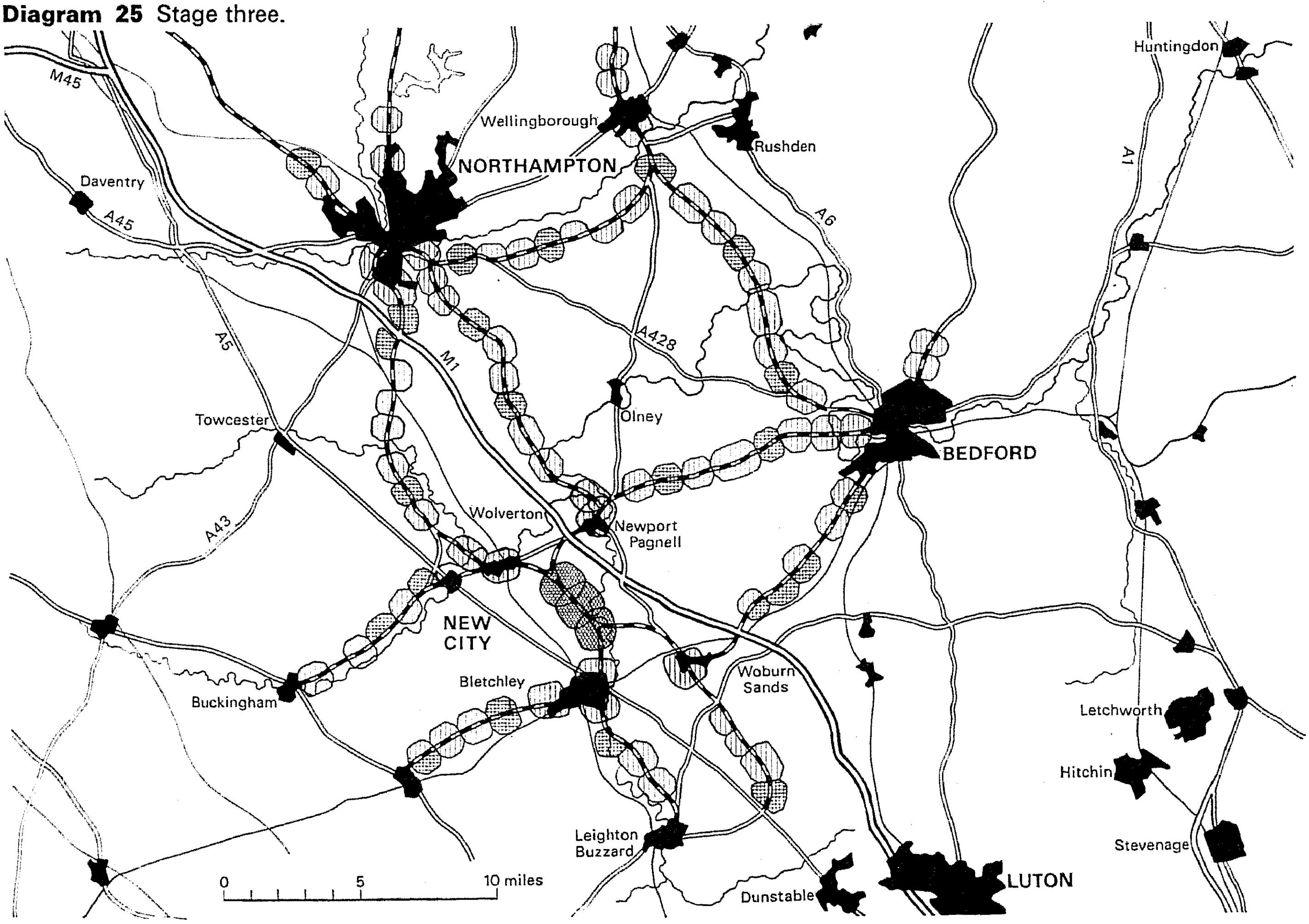


Diagram 26 Stage four

55. Individual unit sizes depend upon the social structure desired at the time of development, site conditions, central area facilities required, etc. Study limitations have prevented detailed town analyses to determine appropriate residential unit sizes, and in the diagrams the examples are assumed to vary from 5,000 to 20,000 people.

56. The central road and public transport route connects each residential unit directly to the central area of its parent town. In both Northampton and Bedford central area redevelopment would have to be undertaken on the assumption that they may become the central towns of developments of the scale of stages 2, 3, 4 and even beyond. Planning and architectural aspects of this development should be organised so that the centres are at once entities and part of a larger potential development. This would mean consideration of the overall town redevelopments in relationship to the redevelopment potential map and the potential land use requirements of central areas and roads. Thus at any point in the future, if expansion of either of these elements becomes necessary, land ripe for development would occur in approximately the areas required for expansion. This would require individual town plans to be considered not as final designs in themselves but as one stage in a continuous process.

57. The new city has been sited in accordance with the recommendations of Chapter 4, with a population of about 200,000 by stage 1. The city could ultimately form one of four major centres in a regional plan similar to that outlined in diagrams 24–26. Therefore it has been planned to be capable of accepting both this role and its present one of a separate city.

58. The main city centre has about half this population living directly around it, representing the first stage of an ultimate population of 200–300,000 in possible later developments. The remainder are located at some distance from the main centre along the new road and public transport routes to which they are related in a similar manner to the expansion areas of Bedford and Northampton. Existing towns of Bletchley, Wolverton, Newport Pagnell and Woburn Sands are used to provide nuclei for four clusters of associated development thus reducing the adverse effects of a new centre on the surrounding towns and providing the initial incoming population with a series of existing centres. If the future allowance for expansion proved unnecessary the situation could remain at the stage of diagram 23. This would give two expanded towns, and a new city planned as a major centre with four associated developments.

59. However, the framework has been laid for any one of a number of regional organisations to develop. Several potential lines of development inter-connect the main regional centres. By the end of the first stage all of these remain open for development although in diagrams 23–26 one particular series have been followed out. Alternatively, by the end of stage 1 development could interconnect the new city with Wellingborough, Northampton with Bedford, etc., to produce regional patterns similar to diagram 22.

60. By stage four regional development could support well over a million people. Individually, major centres could provide the facilities directly supported by several hundred thousand people, and between them they could support the specialised facilities generated by over one million. The region would thus become endowed with a wide choice and the highest facilities without the congestion normally ensuing from one major centre.

61. Public transport could develop through road bus service, separate bus service lanes, to a rail system, all using the main central transport lines inter-connecting lines of development and major centres. Alternatively, a demand for private transport could result in a further provision of roads, as outlined in paragraphs

27–30, by-passing sections of the linear developments. These would be able to both by-pass major centres and penetrate right to the central area, using the open space between development lines.

62. The example shown in diagrams 23–26 is included only to illustrate some of the points outlined in this chapter. It is by no means fully considered and does not represent working proposals for the area. These would require study in far greater depth, although it is considered that they should follow generally the guiding principles developed in this report.

Summary and recommendations

63. The scale of possible population increases plus the position of the site make it imperative that research is undertaken into regional organisation on much larger time and space scales. To provide an effective counter-attraction to existing conurbations development should be concentrated and closely associated with major national transport links. Only by these means can similar opportunities, choice and amenities be offered.

64. The uncertainty of future population increase scales, social structures and living standards makes a flexible approach to design at all scales imperative. It should be considered a major design aspect for both the Bedford and Northampton expansions and their central area redevelopments. It is essential that considerable emphasis be placed on flexibility and growth in the design of the new city. If it is not considered, serious and far-reaching damage could be done to the futures of all three towns, regional and national development possibilities.

65. In particular the uncertainty and high cost of future transport demands require a flexible approach with very close attention to land use and transport phasing. This is not the correct time to make a prediction for the future transport picture and it would be dangerous to base any town plan on one irrevocably fixed transport pattern, public or private.

66. A flexible approach to transport, social grouping and land use is possible and one has been outlined in this chapter, although there are doubtless many more. This type of approach is wholly compatible with present-day demands, and is capable of satisfying the requirements presented in Chapters 3 and 4. Thus it could be capable of both solving existing problems and laying a sound framework for future growth.

Appendix I: Statistics

Roads

1. To supplement the general observations on road conditions and density of use presented in Chapter 2, a more detailed study has been made of the major roads in the area. This is presented in a tabulated form to facilitate evaluation.

South East Regional Study—Bedford, Northampton, Bletchley

Route Evaluation

Highway	*General observations*	*Traffic density*
M1	**2. M.10 to Toddington** Junction of M1 and M10 via Beechtree ('Y') Junction south of which both motorways are dual two lane. From Beechtree to Toddington and beyond to Kilsby the M1 is dual three lane. Other junctions are: 1. Breakspears Interchange (trumpet): A414 2. Friar's Wash Interchange (semi-clover-leaf): A5 3. Pepperstock Junction (elevated roundabout) 4. Luton—Dunstable Road Interchange (depressed roundabout): A505	1960: 25,495 p.c.u's*= 100% 1961: 29,461 p.c.u's = 115% 1962: 34,030 p.c.u's = 134% 1963: 33,899 p.c.u's = 133% 1964: 34,946 p.c.u's = 137% *Flows for a 16-hour week-day in August, at a point near Newport Pagnell Service Station. 'Night flow' is approx. 16% of 16-hour flow. 'August flow' is approx. 116% of average monthly flow.
	3. Toddington to Upper Heyford Toddington Interchange is an elevated diamond carrying the A5120 across the M1 and providing links to Toddington in the south and *Bedford* in the north (via Westoning, Flitwick, and Ampthill). Toddington to Husborne Crawley is approx. 6½ miles. Husborne Crawley Interchange is an elevated diamond carrying the B557 over the M1 and providing links to *Bletchley* in the south (via Aspley Guise, Woburn Sands and Bow	

E

Highway	General observations	Traffic density
M1 *cont'd.*	Brickhill) and to *Bedford* in the north (via Marston Moretaine and Kempston). Husborne Crawley to Broughton is approx. 4¾ miles. Broughton Interchange is an elevated roundabout carrying the A50 over the M1 and providing links to Newport Pagnell, Wellingborough and *Bedford* in the north and indirectly to *Bletchley* (via Broughton and Woburn Sands) in the south and to the A5 at Hockliffe. Broughton to Collingtree is approx. 12 miles. Collingtree Interchange is an elevated roundabout carrying the A508 over the M1 and providing links to *Northampton* in the north and Stony Stratford and the A5 in the south (via Roade, Grafton Regis, Yardley Gobion and Old Stratford). Collingtree to Upper Heyford is approx. 6 miles. Upper Heyford is an elevated roundabout carrying the A45 over the M1 and providing links to *Northampton* in the east and Daventry in the west (thence to Coventry). **4. Upper Heyford Northwards** The M1 continues northwards to link with the M45 at Kilsby Junction, thus providing access to Birmingham and the Midlands. Construction of the London – Yorkshire motorway (M1) is in progress beyond the Crickspur and on completion will provide links to Leicester and Nottingham. Further planned extensions will provide access to Leeds, Doncaster and the north. The planned extension of the Carlisle – Birmingham motorway through the Midlands will link the M1 to the industrial belt and the north. When the flows on the M1 reach saturation level, it is unlikely that the route would be widened and more probable that an alternative route would be constructed. Although it is undesirable to increase junction frequency along the	

Highway	General observations	Traffic density
M1 *cont'd.*	motorway, it is conceivable that the junction 'forms' could be re-designed to meet the needs of any planned development.	
A5 (T)	5. **North of Weedon** Generally a single two-lane highway, but substantially widened and improved north of Crick.	
	6. **Weedon to Old Stratford** Generally a single three-lane highway and the proposed by-pass of Towcester should relieve this pinchpoint.	
	7. **Old Stratford to Bletchley** The route between Old Stratford and Stony Stratford is a single two-lane highway with an equally wide bridge over the River Ouse. The route from Stony Stratford to the outskirts of *Bletchley* is a three-lane single highway but reservation has been made for future dualling. The route is virtually frontage free, Loughton having been by-passed at an earlier date. Pinchpoints occur at the narrow bridge under the main London railway and on either side of the cross-roads at the traffic signals controlled junction of A5 and B488.	1954 : 16,200 p.c.u's 1961 : 10,700 p.c.u's 1964 : 12,800 p.c.u's * *Projected 16-hour day flows for a week-day in August.
	8. **Bletchley to Friar's Wash Interchange M1** Generally a single three-lane highway with provision for dualling except for the section through Dunstable.	1954 : 19,186 p.c.u's 1959 : 25,903 p.c.u's = 100% 1960 : 11,980 p.c.u's * = 46% 1961 : 11,911 p.c.u's = 45% 1962 : 12,250 p.c.u's = 48% 1963 : 12,450 p.c.u's = 49% 1964 : 13,000 p.c.u's = 51%
A43 (T)	9. **Northampton to Towcester** This is a single two-lane highway and planned improvements include a diversion at Milton Bends and a by-pass at Blissworth. No connections are available at the intersection of the A43 and the M1 some 1¾ miles north of Collingtree Roundabout.	1964 : 7,000 p.c.u's
A45 (T)	10. **Upper Heyford to Northampton** This route, providing the main link from *Northampton* to the north-west, is a single two-lane highway approx.	1964 : 7,500 p.c.u's

Highway	General observations	Traffic density
A45 (T) *cont'd.*	24 ft. wide. Horizontal and vertical alignment are fair and there are ample opportunities for improvements. The route is a 'clearway' over a considerable length. Outside *Northampton* there is only limited semi-frontage development but within *Northampton* both sides of the route have been built up. A dual two-lane highway is planned for this route.	
	11. Northampton to Wellingborough The route is presently an admixture of two-lane, three-lane and dual two-lane facilities. The planned improvements between *Northampton* and Earls Barton and the by-passes of Wilby and Wellingborough will provide a dual two-lane route.	1964 : 11,250 p.c.u's
A428 (T)	**12. Northampton to Bedford** Generally a single two-lane highway with rather poor alignment. Planned improvements include by-pass as at Little Houghton, St. Peter's level-crossing and Bromham where the long, very narrow bridge over the River Ouse is a 'listed monument'. This route could be developed to form an east – west artery but the economies of this and an alternative route on a more direct line between Northampton and St. Neot's (as suggested by the County Surveyor of Northamptonshire) require detailed consideration.	1964 : 7,000 p.c.u's
A50/508	**13. Northampton to A50/A508 Junction** This route providing the main link from *Northampton* to the south is generally a two-lane single highway but a section of dual carriageways has been constructed at Phipps Brewery. The route crosses the Wellingborough/Bedford rail lines via a level-crossing at Cotton End. Up to this point the route has frontage development and frequent accesses on both sides, but beyond this point frontage is limited to the west side, with open parkland on the east side.	1964 : 14,000 p.c.u's
A50	**14. A50/A508 Junction to Newport Pagnell** Generally a single two-lane highway of fair alignment. No improvements have been planned.	964 : 14,000 p.c.u's

Highway	General observations	Traffic density
A50 cont'd.	**15. Newport Pagnell to M1 at Broughton Interchange**	
	Through Newport Pagnell this route is a narrow, all-purpose street with right-angled junctions, traffic signal controls and has frontage development on either side. Beyond Newport Pagnell the route comprises a two-lane single highway, approx. 24 ft. wide, and well aligned.	1964: 11,800 p.c.u's
	16. Broughton Interchange to A5 at Hockliffe	
	From Broughton to Woburn Sands the road is approx. 24 ft. wide, but is twisty with several severe bends and a level-crossing at the Bedford/Bletchley rail line. Between Woburn Sands and Woburn the route is a single two-lane highway approx. 22 ft. wide, but through Woburn it narrows and has frontage development on either side. Beyond Woburn it is generally 22 ft. wide and frontage-free to Hockliffe.	1962: 1,700 p.c.u's 1964: 1,920 p.c.u's
A508	**17. A50/A508 Junction to M.1. at Collingtree Roundabout**	
	This route is presently being reconstructed to provide dual two-lane carriageways and this may be indicative of the relative values of this route and the A45 as links to the motorway, i.e. this suggests that *Northampton* looks towards London rather than Birmingham, which is contrary to opinions expressed at various sources.	
	18. Collingtree Roundabout to Old Stratford	
	This route links the M1 to the A5 at Old Stratford via Roade, Grafton Regis and Yardley Gobion and is generally a two-lane single highway approx. 22 ft. wide. From the M1 to Roade, where there is a very narrow bridge over the main London railway, the road is twisty with several severe double bends but free of frontage problems. From Roade to Grafton Regis the road alignment is similar and pinchpoints occur at a narrow bridge under the disused Bedford/Banbury railway; a bridge over the Grand Union Canal and two minor bridges over streams. Some	1964: 7,800 p.c.u's

Highway	General observations	Traffic density
A508 *cont'd.*	fair gradients (+ve and −ve) occur on the approach to Grafton Regis. From Grafton Regis to Yardley Gobion the route is still quite twisty with a right-angle junction at Yardley Gobion where a minor road provides a link (signposted) to the A5. From Yardley Gobion to Old Stratford the road is still twisty with one narrow bridge across a minor stream and links to the A5 at Old Stratford via a direct cross-roads. This route could readily be developed as the spine of an expansion in the area between the M1 and A5, thus providing direct communications between Bletchley and Northampton.	
A422	19. **Stony Stratford to Newport Pagnell** Generally a single two-lane highway but pinch points occur at Stony Stratford and Wolverton. Traffic directed to the M1 via this route has to cross the motorway, pass through Newport Pagnell and thence loop back to the motorway via A50 to gain access at Broughton Roundabout.	
	20. **Newport Pagnell to Bridge End** The route has largely been re-constructed as a single two-lane highway to north-east of Chicheley but beyond this it is generally narrow and twisty, especially at Stagsden.	1964 : 3,200 p.c.u's*
A509	21. **Wellingborough to Newport Pagnell** Generally a single two-lane highway providing a direct link to the M1 and the south. Projected 16-hour day flows for a week-day in August.	1964 : 3,400 p.c.u's*
B557	22. **Bletchley to M1 at Husborne Crawley Interchange** The route is a two-lane single highway generally in the order of 20 ft. wide. The section through Bow Brickhill is narrow with frontage development on both sides, but the right-angled bends (right and left) at either end of the village facilitate by-passing the built-up area.	
B557	The route from Bow Brickhill to, and through, Woburn Sands, Aspley Guise and Husborne Crawley has narrow and	

Highway	*General observations*	*Traffic density*
B557 *cont'd.*	twisty sections and a cross-roads at Woburn Sands which makes it totally inadequate as a link to the M1 and *Bedford.*	
	23. **Husborne Crawley Interchange to Bedford** This route has been reconstructed as a two-lane 24 ft. wide single highway from the M1 to the junction with the minor road to Lidlington. Beyond this point the route has several twisty sections but is frontage-free except for Marston Moretaine and Kempston. This route appears to form the main link from *Bedford* to the M1 in preference to the Ampthill/Toddington route.	
A418/ A5120	24. **Bedford to M1 at Toddington** Generally a single two-lane highway of moderate standards. The planned by-passes of Ampthill and Flitwick will provide considerable relief and enhance this route to the M1 and the south.	
	25. **Northampton and Bedford Boroughs** A detailed study of the Boroughs' traffic problems and road networks is beyond the scope of our brief and it would be premature to propound proposals which will rightfully emerge from the comprehensive survey work now in progress. However, the data available indicates that some form of peripheral by-pass routes are desirable to facilitate sub-regional movements.	

Employment

26. In Chapter 2, paragraph 29, the susceptibility of the study area to employment trends in the surrounding regions is pointed out. In succeeding paragraphs major changes in these regions are outlined and some evaluation is made of the implications. A full study has been undertaken of the employment structures in the regions shown in diagram 8, and the results are summarised by diagrams 27–30.

27. A similar but more detailed investigation for the major towns in the study area was necessary for the survey and analysis in Chapters 2 and 3. Results of this study are included to substantiate statements made there.

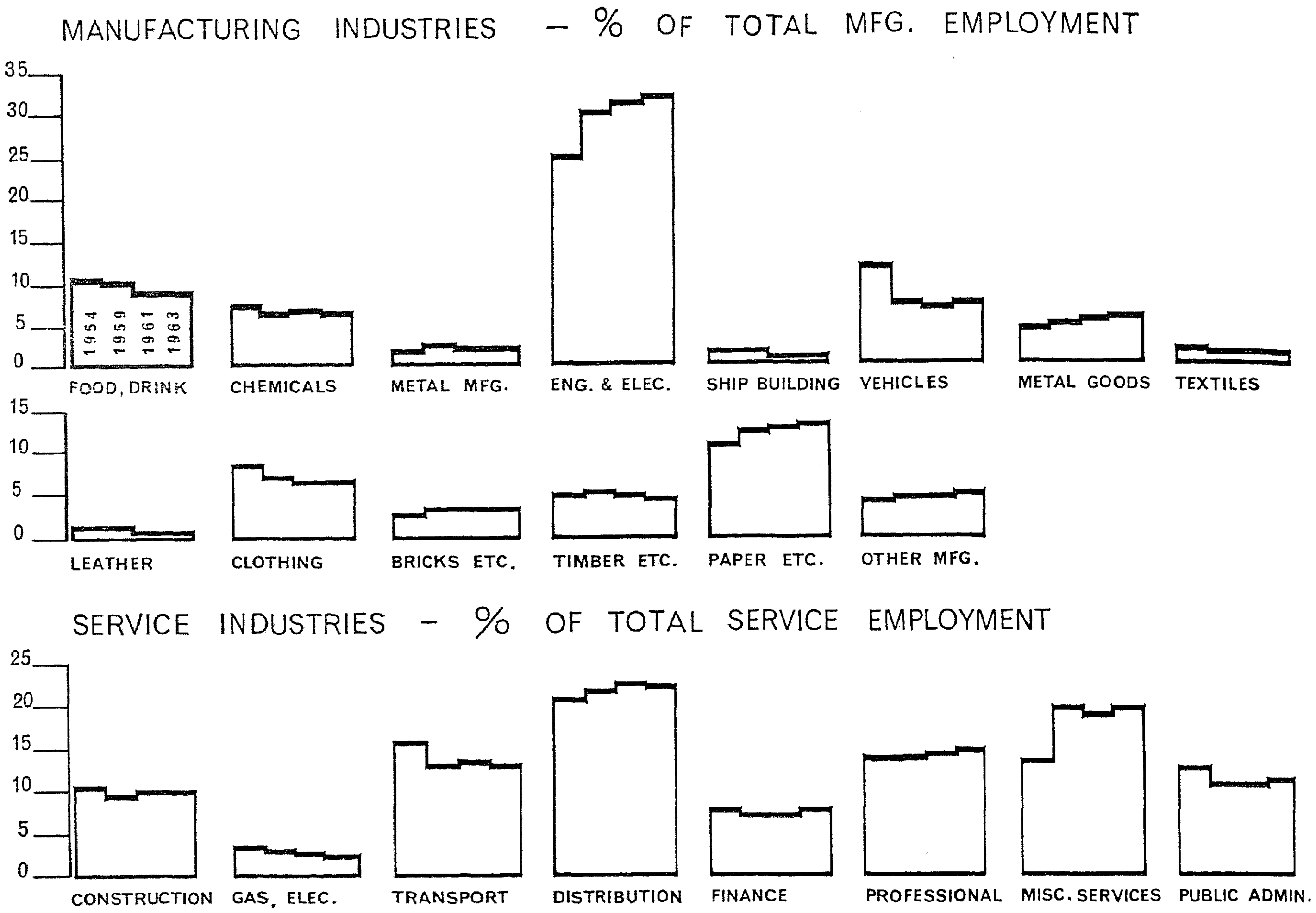


Diagram 27 London and the South East region.

Diagram 28 Eastern and Southern regions.

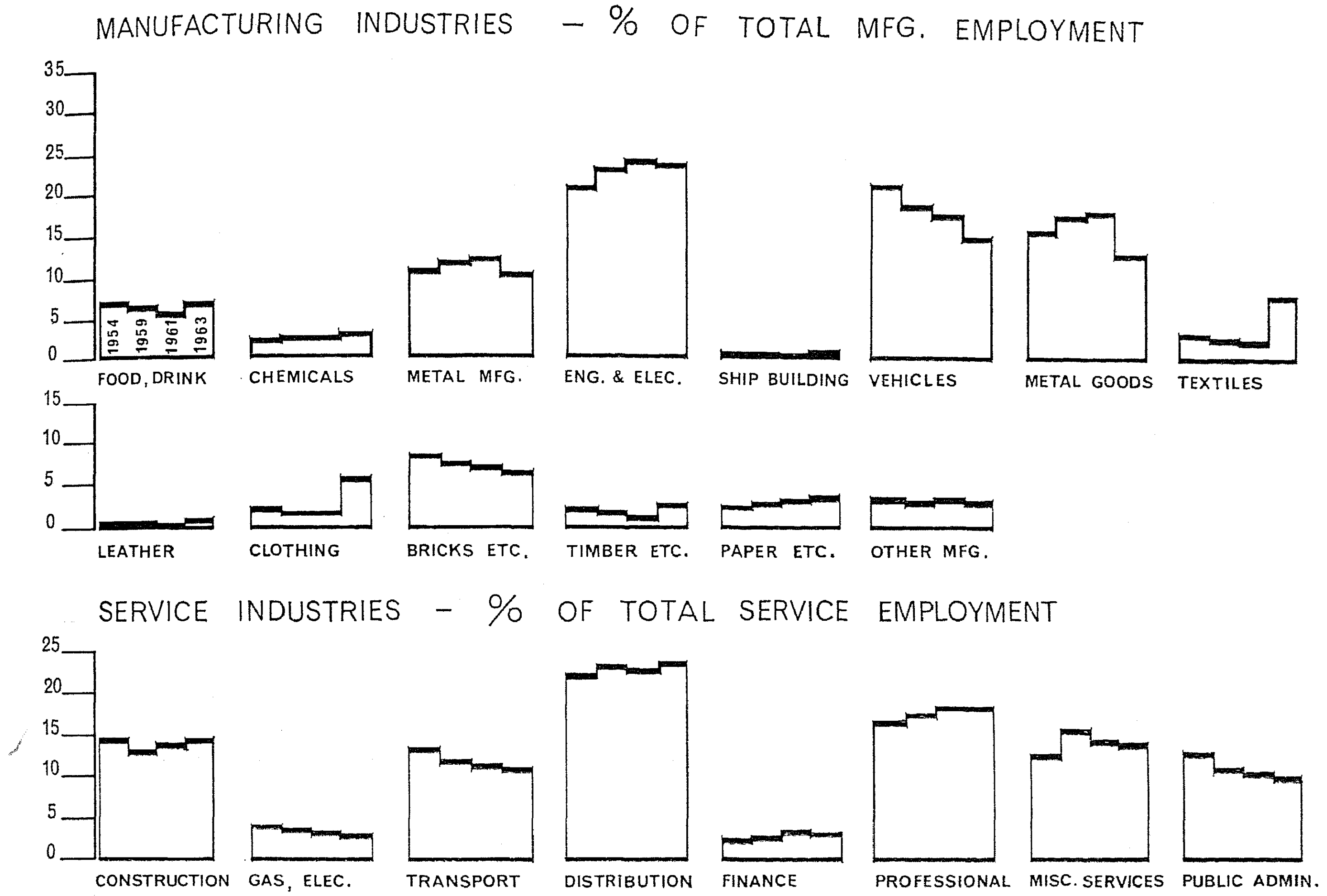


Diagram 29 Midlands region.

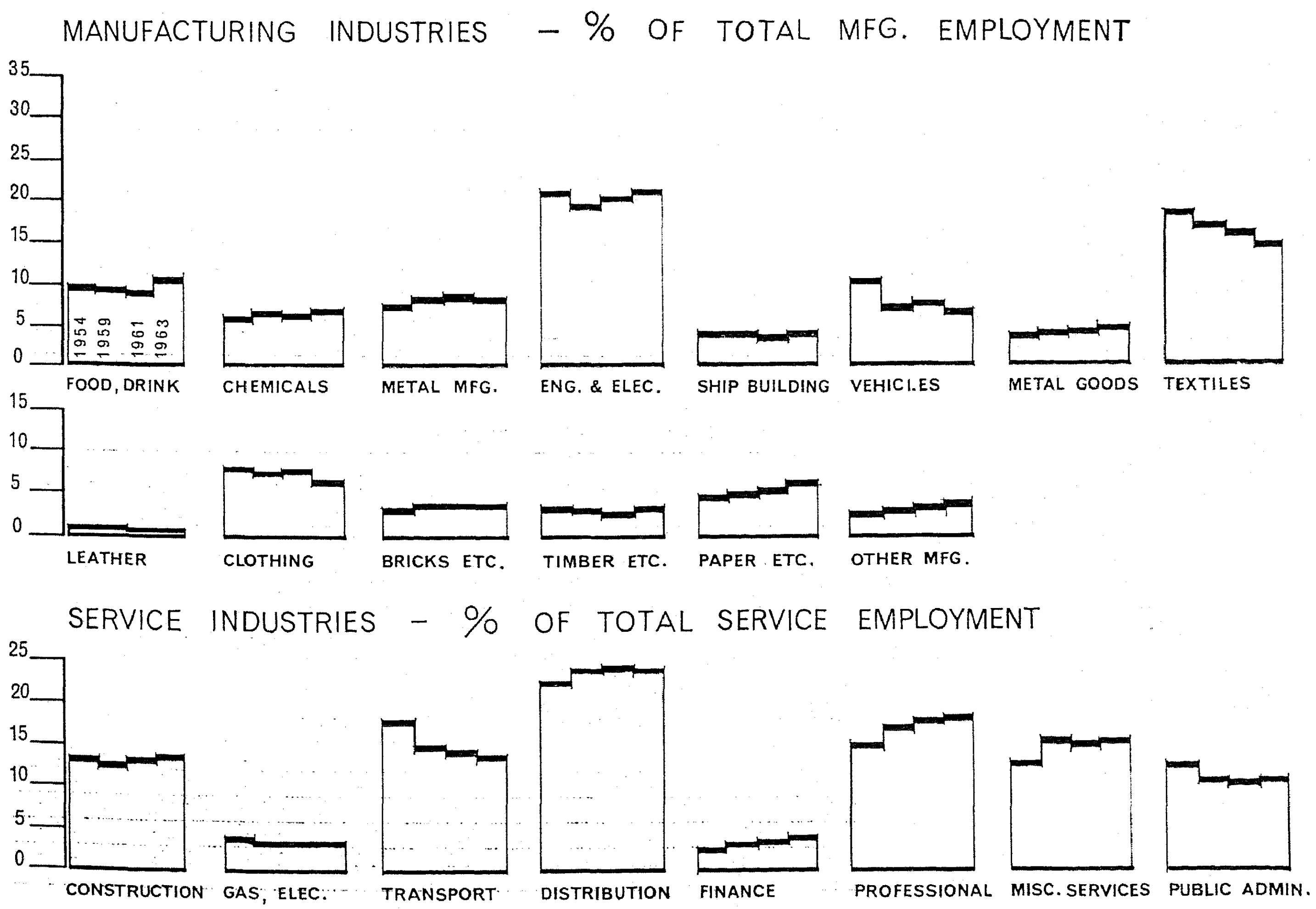


Diagram 30 Rest of Great Britain.

Employment Distribution—Northampton

Date	*Total*	*% Services XVII-XXIV*
1951	68,920	42%
1955	61,293	38.5%
1958	62,775	38.5%
1961	64,959	43%
1963	67,670	45%

Employment Distribution—Northampton

Date	*I Ag. F & F*	*II Mining*	*III Food D & T*	*IV Chemicals*	*V Metal Mfg.*	*VI Eng. & Elec.*	*VII Ships*	*VIII Vehicles*
1951	2,592	120	1,407	255	288	6,524	—	2,941
1955	1,588	133	1,641	278	297	7,013	—	3,741
1958	1,554	194	1,683	268	268	8,095	—	3,991
1961	1,202	127	1,699	645	290	9,163	—	2,483
1963	1,165	117	2,049	1,211	240	9,014	49	2,738

Employment Distribution—Northampton, expressed as % of total emploment

1951	3.7%	.2%	2.0%	.4%	.4%	9.4%	—	4.3%
1955	2.6%	.2%	2.7%	.4%	.5%	11.4%	—	6.1%
1958	2.5%	.3%	2.7%	.4%	.4%	12.9%	—	6.4%
1961	1.8%	.2%	2.6%	1.0%	.4%	14.1%	—	3.8%
1963	1.7%	.2%	3.0%	1.8%	.4%	13.3%	.1%	4.0%

Employment Distribution—Northampton

Date	*IX Metal Goods*	*X Textiles*	*XI Leather*	*XII Cloth. & Foot.*	*XIII Bricks*	*XIV Timber, etc.*	*XV Paper*	*XVI Other Mfg.*
1951	125	251	1,825	15,625	154	1,035	1,930	774
1955	118	262	1,827	12,974	173	1,166	1,814	424
1958	136	152	1,457	12,419	167	1,095	1,670	647
1961	141	155	1,424	11,741	186	1,200	1,279	1,060
1963	345	175	1,352	10,607	282	1,290	1,430	1,145

Employment Distribution—Northampton, expressed as % of total

1951	.2%	.4%	2.6%	22.6%	.2%	1.5%	2.8%	1.1%
1955	.2%	.4%	3.0%	21.1%	.3%	1.9%	3.0%	.7%
1958	.2%	.2%	2.3%	20.0%	.3%	1.7%	2.7%	1.0%
1961	.2%	.2%	2.2%	18.0%	.3%	1.8%	2.0%	1.6%
1963	.5%	.3%	2.0%	15.7%	.4%	1.9%	2.1%	1.7%

Employment Distribution—Northampton

Date	*XVII Constr.*	*XVIII Gas, Elec. & W.*	*XIX Transp.*	*XX Dist. Tr.*	*XXI Ins. B & F*	*XXII Prof.*	*XXIII Misc. Serv.*	*XXIV P. Admin.*
1951	3,675	1,810	4,669	7,345	728	7,063	4,118	3,611
1955	4,199	1,581	3,285	7,047	848	4,927	3,419	2,525
1958	4,597	1,573	3,324	7,160	939	5,512	3,026	2,650
1961	4,188	1,532	2,910	8,568	1,227	5,410	4,721	2,576
1963	4,313	1,551	3,188	8,962	1,519	6,900	5,222	2,805

Employment Distribution—Northampton, expressed as % total

1951	5.3%	2.6%	6.7%	10.6%	1.1%	10.2%	6.0%	5.2%
1955	6.8%	2.6%	5.3%	11.4%	1.4%	8.0%	5.5%	4.1%
1958	7.3%	2.5%	5.3%	11.4%	1.5%	8.8%	5.1%	4.2%
1961	6.4%	2.3%	4.5%	13.1%	1.9%	9.9%	7.2%	4.0%
1963	6.4%	2.3%	4.7%	13.2%	2.2%	10.1%	7.7%	4.1%

Employment Distribution—Bedford

Date	Total	% Services
1951	40,213	50%
1955	40,527	42%
1958	41,981	43%
1961	45,001	47%
1963	47,618	50%

Employment Distribution—Bedford

Date	I Ag. F & F	II Mining	III Food D & T	IV Chemicals	V Metal Mfg.	VI Eng. & Elec.	VII Ships	VIII Vehicles
1951	2,094	44	1,811	137	987	6,620	8	584
1955	2,185	181	2,533	129	1,044	4,848	2,343	1,371
1958	1,882	158	2,873	102	1,107	5,143	2,328	1,864
1961	1,885	30	2,633	293	1,245	5,167	2,556	360
1963	2,024	28	2,078	287	1,296	5,535	2,157	682

Employment Distribution—Bedford, expressed as % of total

1951	5.2%	.1%	4.5%	.3%	2.4%	16.4%	—	1.5%
1955	5.4%	.4%	6.2%	.3%	2.6%	12.0%	5.8%	3.4%
1958	4.4%	.4%	6.8%	.2%	2.6%	12.2%	5.5%	4.4%
1961	4.2%	.1%	5.8%	.6%	2.8%	11.4%	5.7%	.8%
1963	4.3%	.1%	4.4%	.6%	2.7%	11.6%	4.5%	1.4%

Employment Distribution—Bedford

Date	IX Metal Goods	X Textiles	XI Leather	XII Cloth. & Foot	XIII Bricks	XIV Timber etc.	XV Paper	XVI Other Mfg.
1951	133	26	483	600	3,005	382	637	295
1955	88	32	435	668	3,318	322	696	382
1958	107	29	409	736	3,034	328	872	379
1961	66	28	399	702	3,257	174	994	350
1963	67	30	396	649	3,267	172	1,121	514

Employment Distribution—Bedford, expressed as % of total

1951	.3%	.1%	1.2%	1.5%	7.5%	.9%	1.6%	.7%
1955	.2%	.1%	1.1%	1.6%	8.2%	.8%	1.7%	.9%
1958	.3%	.1%	1.0%	1.7%	7.2%	.8%	2.1%	.9%
1961	.1%	.1%	.9%	1.6%	7.2%	.4%	2.2%	.8%
1963	.1%	.1%	.8%	1.4%	7.2%	.4%	2.3%	1.1%

Employment Distribution—Bedford

Date	XVII Constr.	XVIII Gas & Elec.	XIX Transp.	XX Dist. Tr.	XXI Ins. B & F	XXII Prof.	XXIII Misc. Serv.	XXIV P. Admin.
1951	2,261	2,315	2,097	4,015	488	3,915	2,547	4,683
1955	3,010	859	1,877	4,515	625	3,295	2,132	3,604
1958	2,484	1,070	1,810	4,727	766	3,373	2,768	3,629
1961	3,583	1,162	1,625	5,339	790	6,438	2,983	2,847
1963	3,234	1,245	1,685	6,150	943	7,492	3,327	3,022

Employment Distribution—Bedford, expressed as % of total

1951	5.7%	5.7%	5.9%	10.0%	1.2%	9.7%	6.3%	11.6%
1955	7.4%	2.1%	4.9%	11.1%	1.6%	8.1%	5.3%	9.0%
1958	6.0%	2.5%	4.3%	11.2%	1.8%	8.0%	6.5%	8.6%
1961	8.0%	2.6%	3.6%	11.8%	1.8%	14.3%	6.7%	6.3%
1963	6.3%	2.8%	3.5%	13.0%	2.0%	15.8%	7.0%	6.4%

Employment Distribution—Bletchley

Date	*Total*	*% Services*
1951	8,156	40%
1955	10,417	40%
1958	10,726	40%
1961	11,198	39%
1963	12,851	41%

Employment Distribution—Bletchley

Date	*I Ag. F & F*	*II Mining*	*III Food D & T*	*IV Chemicals*	*V Metal Mfg.*	*VI Eng. & Elec.*	*VII Ships*	*VIII Vehicles*
1951	634	—	125	24	—	553	—	119
1953	539	—	154	96	4	825	—	273
1958	396	—	232	110	114	856	—	273
1961	306	—	185	157	153	670	—	147
1963	410	—	288	213	180	978	—	144

Employment Distribution—Bletchley, expressed as % of total

1951	7.8%	—	1.5%	.3%	—	6.7%	—	1.5%
1953	5.2%	—	1.5%	.9%	—	8.0%	—	2.6%
1958	3.7%	—	2.2%	1.0%	1.1%	8.0%	—	2.5%
1961	2.7%	—	1.7%	1.5%	1.5%	6.0%	—	1.3%
1963	3.2%	—	2.2%	1.9%	1.6%	7.6%	—	1.1%

Employment Distribution—Bletchley

Date	*IX Metal goods*	*X Textiles*	*XI Leather*	*XII Cloth. & Foot.*	*XIII Bricks*	*XIV Timber, etc.*	*XV Paper*	*XVI Other Mfg.*
1951	—	—	—	279	2,592	86	121	403
1953	4	14	18	398	3,334	111	159	379
1958	161	20	20	439	3,068	124	246	362
1961	43	27	20	382	3,381	384	443	480
1963	54	18	17	196	3,296	447	670	635

Employment Distribution—Bletchley, expressed as % of total

1951	—	—	—	3.4%	32.0%	1.0%	1.5%	5.0%
1953	—	.1%	.2%	3.8%	32.0%	1.1%	1.5%	3.6%
1958	1.5%	.2%	.2%	4.1%	28.6%	1.2%	2.3%	3.4%
1961	.4%	.2%	.2%	3.4%	30.0%	3.4%	4.0%	4.3%
1963	.4%	.1%	.1%	1.5%	25.7%	3.5%	5.2%	5.0%

Employment Distribution—Bletchley

Date	*XVII Constr.*	*XVIII Gas & Elec.*	*XIX Transp.*	*XX Dist. Tr.*	*XXI Ins. B & F*	*XXII Prof.*	*XXIII Misc. Serv.*	*XXIV P. Admin.*
1951	538	12	1,086	669	76	104	509	226
1953	702	139	1,035	722	140	427	617	327
1958	641	124	1,048	894	91	610	496	401
1961	624	134	953	949	90	813	533	324
1963	984	170	992	1,092	148	999	595	325

Employment Distribution—Bletchley, expressed as % of total

1951	6.6%	.1%	13.4%	8.2%	.9%	1.3%	6.2%	2.8%
1953	6.7%	1.3%	10.0%	6.9%	1.3%	4.0%	5.9%	3.1%
1958	6.0%	1.2%	9.8%	8.4%	.8%	5.7%	4.6%	3.7%
1961	5.6%	1.2%	8.5%	8.5%	.8%	7.2%	4.8%	2.9%
1963	7.7%	1.3%	7.7%	8.5%	1.2%	7.8%	4.7%	2.5%

Employment Distribution—Whole region

Date	Total	% Services
1951	168,771	39%
1955	167,615	36%
1958	171,546	36%
1961	178,881	40%
1963	186,750	42%

Employment Distribution—Whole region

Date	I Ag. F & F	II Mining	III Food D & T	IV Chemicals	V Metal Mfg.	VI Eng. & Elec.	VII Ships	VIII Vehicles
1951	8,333	805	4,734	829	2,290	15,224	8	9,252
1955	6,862	990	5,805	865	2,799	15,062	2,343	11,254
1958	6,229	1,090	6,515	886	2,658	16,809	2,328	11,673
1961	5,704	923	6,137	1,655	2,866	18,556	2,560	7,477
1963	6,064	857	6,705	2,363	2,688	19,356	2,214	7,465

Employment Distribution—Whole region, expressed as % of total

1951	4.9%	.5%	2.8%	.5%	1.4%	9.0%	—	5.5%
1955	4.1%	.6%	3.5%	.5%	1.7%	9.0%	1.4%	6.7%
1958	3.6%	.6%	3.8%	.5%	1.5%	9.8%	1.4%	6.8%
1961	3.2%	.5%	3.4%	.9%	1.6%	10.3%	1.4%	4.2%
1963	3.2%	.5%	3.6%	1.3%	1.4%	10.3%	1.2%	4.0%

Employment Distribution—Whole region

Date	IX Metal Goods	X Textiles	XI Leather	XII Cloth. & Foot.	XIII Bricks	XIV Timber, etc.	XV Paper	XVI Other Mfg.
1951	401	348	4,110	32,801	6,843	1,728	4,081	2,397
1955	329	417	3,727	29,492	8,067	1,895	4,513	2,422
1958	598	274	3,446	28,679	7,212	1,873	4,627	2,770
1961	471	265	3,370	27,528	7,889	2,091	4,716	3,420
1963	754	239	3,330	25,602	7,827	2,245	5,009	3,023

Employment Distribution—Whole region, expressed as % of total

1951	.3%	.2%	2.4%	19.5%	4.0%	1.0%	2.4%	1.4%
1955	.2%	.3%	2.2%	17.6%	4.8%	1.1%	2.7%	1.4%
1958	.4%	.2%	2.0%	16.7%	4.2%	1.1%	2.7%	1.6%
1961	.3%	.1%	1.9%	15.4%	4.4%	1.2%	2.6%	1.9%
1963	.4%	.1%	1.8%	13.7%	4.2%	1.2%	2.7%	1.6%

Employment Distribution—Whole region

Date	XVII Constr.	XVIII Gas & Elec.	XIX Transp.	XX Dist. Tr.	XXI Ins. B & F	XXII Prof.	XXIII Misc. Serv.	XXIV P. Admin.
1951	9,437	4,633	11,179	15,869	1,647	13,325	9,872	9,616
1955	11,060	3,255	9,059	16,188	2,064	11,529	9,272	8,321
1958	11,980	3,295	8,921	16,749	2,215	12,865	9,313	8,524
1961	11,538	3,363	8,032	19,524	2,605	17,891	12,579	7,594
1963	12,373	3,488	8,580	21,282	3,135	20,038	13,798	8,082

Employment Distribution—Whole region, expressed as % of total

1951	5.6%	2.7%	6.6%	9.4%	1.0%	7.9%	5.8%	5.7%
1955	6.6%	2.0%	5.4%	9.6%	1.2%	6.9%	5.5%	5.0%
1958	7.0%	1.9%	5.2%	9.8%	1.3%	7.5%	5.4%	5.0%
1961	7.5%	1.9%	4.5%	10.9%	1.4%	10.6%	7.0%	4.2%
1963	6.6%	2.0%	4.6%	11.4%	1.7%	10.7%	7.4%	4.3%

Costs of developments

28. When considering the merits and demerits of expansion schemes and new town schemes in Chapter 4, the assumption was made that new towns are cheaper in cost per person accommodated than are town expansions. This assumption is not accepted by all authorities, and therefore it is necessary to outline here the reasons for using it.

29. Very little research work has been done on this subject and published reports on development costs of large-scale schemes are extremely limited. However, two major investigations have been carried out within the last five years on developments of a comparable scale to the ones considered in this study, and in sufficient detail to enable some comparisons to be made. In 1961 the L.C.C. published 'The Planning of a New Town', describing a town for 100,000 people at Hook. A costing is included in this report, in which 1960 prices have been adjusted to 1963 prices. In 1963 three expansion studies commissioned by the Ministry of Housing and Local Government from private consultants were published, dealing with Ipswich, Worcester and Peterborough.

30. Since these studies are fairly similar in scales and degrees of detail, they are considered to be the most suitable recent sources for a cost comparison, although the town expansions were designed before the Buchanan Report and may therefore under-estimate the true transport costs. It should be emphasised that these figures by no means present a fully conclusive case for the assumption that town expansions are more expensive than new towns but are simply the best evidence available.

31. Results of the four costings are shown in table 6 where the effect of different scales of increase is also indicated. The Peterborough study dealt with expansions of 50%, 100% and 150%, and these are compared diagrammatically with the Hook report in diagram 31, in an attempt to illustrate the areas of additional expenditure.

32. From the diagram it can be seen that the bulk of additional cost is incurred in the redevelopment of the central area, and in the new transport system. It should be pointed out that these improved facilities will be enjoyed by the existing community of a new town, and thus the increased expenditure may be fully justified. Final answers to this question could only be arrived at by a full-scale cost/benefit study which included all benefits gained by both incoming and existing population.

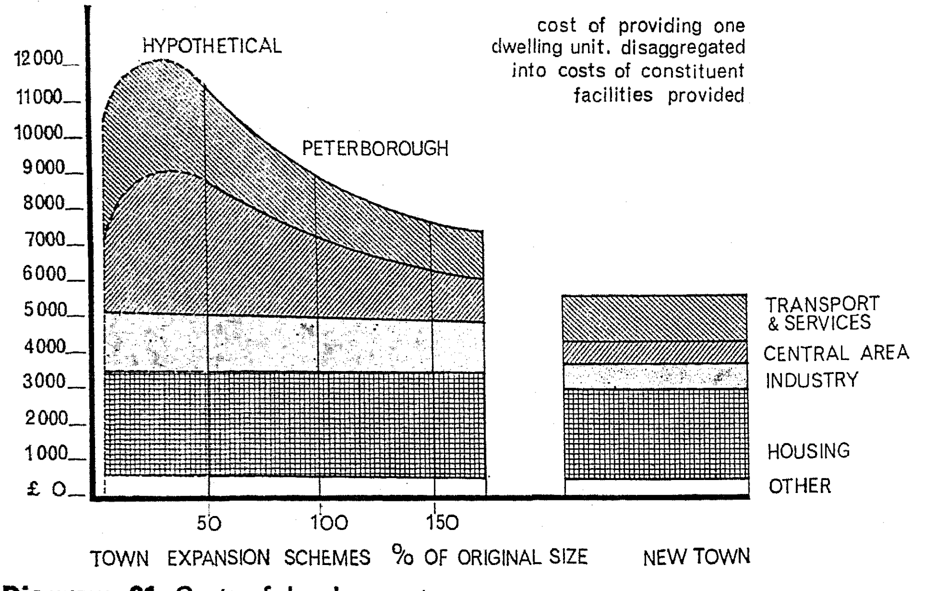


Diagram 31 Costs of development.

33. The assumption that town expansion is more expensive than new towns is disagreed with by a number of authorities using more theoretical studies made prior to the reports discussed above. The most noted of these is P. A. Stone, who, in the book 'Housing, Town Development, Land and Costs', derives estimates of £1,180/person for a new town and £1,100/person for a town expansion. He also brings the New Towns Committee estimate up to date, and arrives at a figure of £1,200/person, while Dr. Nathaniel Lichfield estimates town expansion costs at £1,000/person. This would indicate that town expansions are the cheaper solution.

34. Thus the subject of development-costing on this scale is open to widely varying conclusions. However, for the reasons quoted in paragraph 30 the assumption has been made in this study that new towns are cheaper per person accommodated than are town expansions.

	Ipswich		Worcester at 15 years		Peterborough			Hook
Expansion Scheme	50%	100%	50%	100%	50%	100%	150%	New Town Adjustment
Transport and Services	668	627	1,621	1,106	2,703	1,685	1,360	1,325
Central Area	1,118	840	268	281	3,730	2,133	1,400	550
Industry	561	588	1,041	988	1,558	1,460	1,430	680
Housing	2,839	2,846	3,670	3,518	2,919	2,925	2,929	2,430
Other	859	844	482	375	601	593	585	515
Total/dwelling	**6,873**	**6,397**	**7,081**	**6,281**	**11,511**	**8,796**	**7,700**	**5,500**
Total/person	**1,980**	**1,830**	**2,000**	**1,780**	**2,875**	**2,375**	**2,075**	**1,780**

Sources:
Ipswich Expansion Report.
Worcester Expansion Report, at 15 year development.
Peterborough Expansion Report, Appendix 23, summarised.
'The Planning of a New Town', Table 8, years 0–50, summarised adjusted to 1963 prices.

Table 6: **Development Costs in £'s.**

Appendix II: Example of development

Example of development aiming at a high environmental standard in which encouragement of the use of public transport can accommodate growth beyond designed limits without prejudice to that standard.

Problem

1. With new urban settlements of a size substantially beyond that of the existing New Towns more thought must be given to the integration of all forms of transport.

2. Should these cities, when built, grow or be expanded beyond the initial target populations their traffic problems, and particularly the relative importance of public transport, will markedly increase.

3. Therefore some form of development is needed which relates growing traffic to growing development in such a way that the capacity of the traffic facilities can maintain an acceptable level at all stages without over-provision. Since this must be done against the background knowledge that free movement of the motor-car becomes increasingly difficult with increasing size, the system must accommodate the possiblity of a change from private towards public transport as the city grows.

4. The city form must allow for flexibility and growth in both the transport sectors and, while allowing the maximum private facility (i.e. roads, etc.) that good traffic planning and the public purse can provide, it must also encourage a growth of public transport which is sound enough to take an increasing load as circumstances require it (diagram 32).

Concept

5. This example is an attempt to solve the problem by careful planning both in space and time of the locations and capacities of both private and public transport facilities in relation to the development they serve.

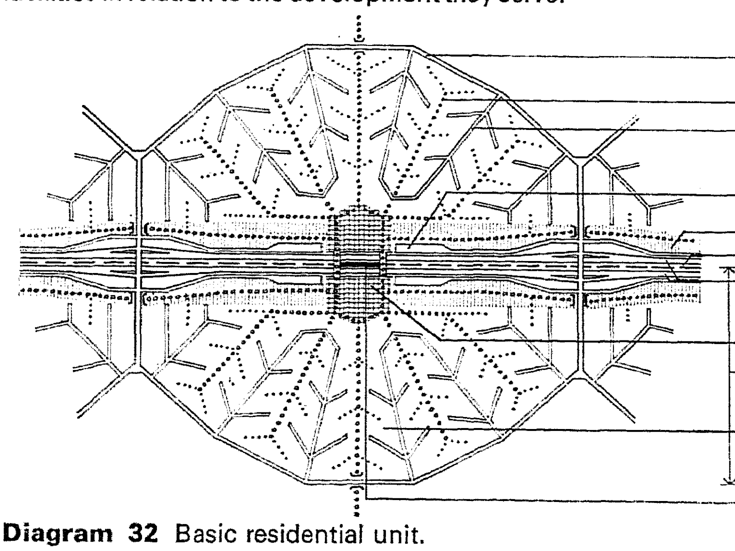


Diagram 32 Basic residential unit.

6. The essence of mass public transport is a line of movement with stopping points to which people either walk or go by taxi or car. It follows that development could be in the form of areas or 'units' based upon walking distances and containing either residential, industrial or recreational development with their related uses and being connected to each other and the city centre by the public transport line, roads and footpaths.

7. The form of this example relates this pattern to a road system and allows reservations for both forms of transport to grow in capacity allowing free choice between them, based upon acceptability and cost.

8. Residential units should be designed as areas of good environment and, among other things, pedestrian and vehicular movement should be properly integrated.

9. While the penetration of the vehicle can be controlled simply by the use of kerbs and bollards, etc., the pedestrian cannot be so controlled and, since in these areas the two must meet, nothing can prevent pedestrians straying onto the roads.

10. Pedestrian movement falls into three categories: firstly the pedestrian journey —from house to work, shops, school and the like; secondly the vehicle-orientated journey—to cars, deliveries, etc.; and thirdly random journeys, such as children at play and the walking of dogs, etc. The conflict of each of these categories with the vehicular movement in a residential area needs a special approach and, while the problems of the second and third categories are very difficult to solve, much can be done to alleviate those of the first by segregation layouts.

11. This example suggests therefore that pedestrians should be encouraged to move away from the more heavily trafficked roads by concentrating the local community facilities of a housing area to one side of it and the vehicular access to the other (diagram 33). (N.B.—Pedestrians should, of course, be physically prevented from crossing main roads except by grade-separated paths involving underpasses or bridges—see later calculations.)

12. A 'basic residential unit' is shown for purposes of calculation and incorporates a pattern based on this principle in which the community facilities, i.e. local shops, pubs, schools, churches, halls and public transport stops (which is the access to the other facilities of the city, the city centre, industry, secondary schools, recreation, etc.), are all located on one side of the housing area whose extent is related to walking distance from all of these facilities.

13. On the other side are the collector roads, dangerous for direct pedestrian crossing, from which service roads penetrate into the housing area, and also feed car parks serving jointly the community facilities and public transport stop.

14. The collector roads lead to major town roads (urban motorways) which could be located on either side or both sides of the basic unit depending on the number and arrangement of the units (see paragraph 24). These roads would be crossed as necessary by bridges or underpasses.

15. Pedestrians, although encouraged to move radially to the local centre, would be able to walk from one 'basic unit' to another, or out into the hinterland.

16. Industrial units and recreational units can be regarded in the same way as the 'Basic Residential Unit' and their sizes, location and capacities at any time can be related to the general communications pattern. Their layout will depend upon similar criteria in addition to requirements arising from the particular uses concerned.

17. The central area of such a settlement is more complex and depends upon the total population it serves and therefore no isolated study has been attempted

here. However, since certain central area activities, e.g. shopping and offices, generate co-incident trips, consideration should be given to separating such uses in their relation to communications.

Theoretical considerations

18. Basic unit: factors affecting its size

(A) *Residential sub-unit,* or the area of development served by one residential road.

Factors determining the theoretical size and population of a residential sub-unit having frontage development of roads:

(a) Maximum acceptable volume of moving traffic in conjunction with frontage, pedestrian activity, parking, etc.;
(b) Net density (persons per acre);
(c) Average persons per family;
(d) Car ownership and car usage factors.

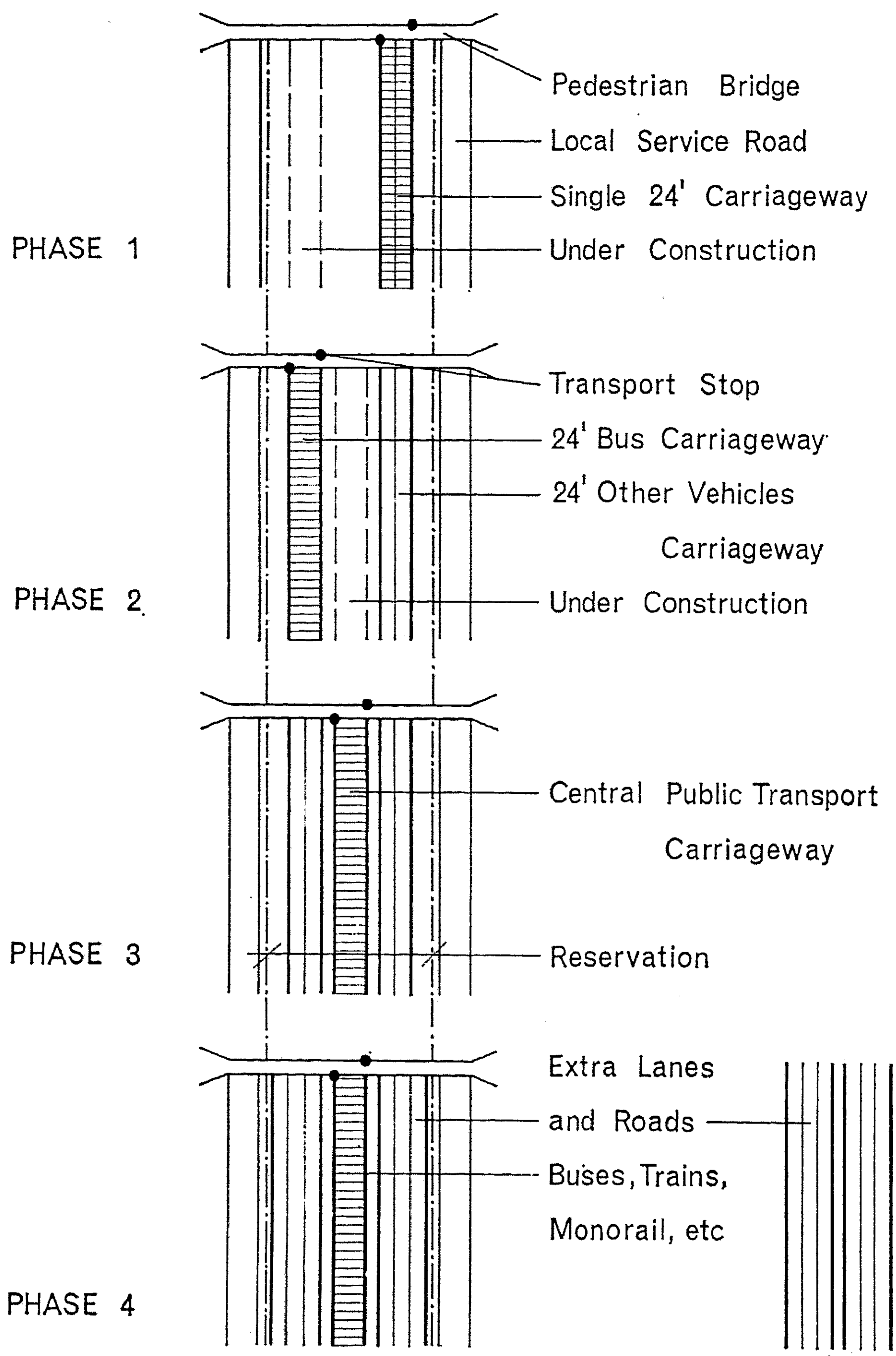


Diagram 33 Growth of communications.

(B) *Basic residential unit*

Factors determining the theoretical size and population of the basic residential unit:

(a) Walking distance to local shopping centre, schools and public transport halts;
(b) Proportion of dwellings within walking distance;
(c) Gross density (persons per acre);
(d) Capacity characteristics of peripheral roads and their junctions;
(e) Peak vehicle generation of housing sub-unit.

(C) *Basic industrial unit*

Factors determining the theoretical size and population of a basic industrial unit:

(a) Walking distance to public transport halts;
(b) Gross density (workers per acre);
(c) Capacity of peripheral roads and access points.

19. Sample calculations of size of basic unit

(A) *Residential sub-unit*

Assume:

(a) Maximum peak flow=300 v.p.h.—at this flow on a two-lane, two-way road, the presence of a parked vehicle causes 50% of the traffic to be delayed for an average period of two seconds and 30% of the gaps in the traffic stream are less than four seconds, which has been shown to be the minimum gap a pedestrian will accept to cross an 18-ft. road. (Source: 'Random theory on traffic flows and study of gaps between vehicles' —Adams);
(b) Net density=50 persons per acre;
(c) Average family consists of 3.5 persons;
(d) Average car ownership=1.2 cars per family;
(e) Work-journey car usage=50%.

N.B.—It is assumed that a 'poor' public transport system will generate a 75% car usage; a 'good' public transport system and 'free use' of the private car will generate a 50% usage and a 'good' public transport system and 'restriction on use' of the private car will generate a 25% usage.

Based on these assumptions, the size of a residential sub-unit is determined as follows:

300 v.p.h. at 50% usage	= 600 cars owned
600 cars at 1.2 cars per family	= 500 families
500 families at 3.5 persons per family	= 1,750 population

Diagram 34 represents a graphic correlation from which the results of this calculation may be obtained for a variety of values assigned to the basic assumptions.

(B) *Basic residential unit*

Assume:

(a) Maximum walking distance = $\frac{1}{2}$ mile;
(b) Proportion of dwellings within walking distance = 100%;
(c) Gross density = 30 persons per acre;
(d) Capacity of peripheral road characterised by uncontrolled surface junctions with feeder having a maximum aggregate of conflicting flows at any junction = 1,200 v.p.h.

N.B.—Beyond 1,200 v.p.h. some control would be required.

(e) Peak vehicle generation of housing sub-unit = 300 v.p.h.

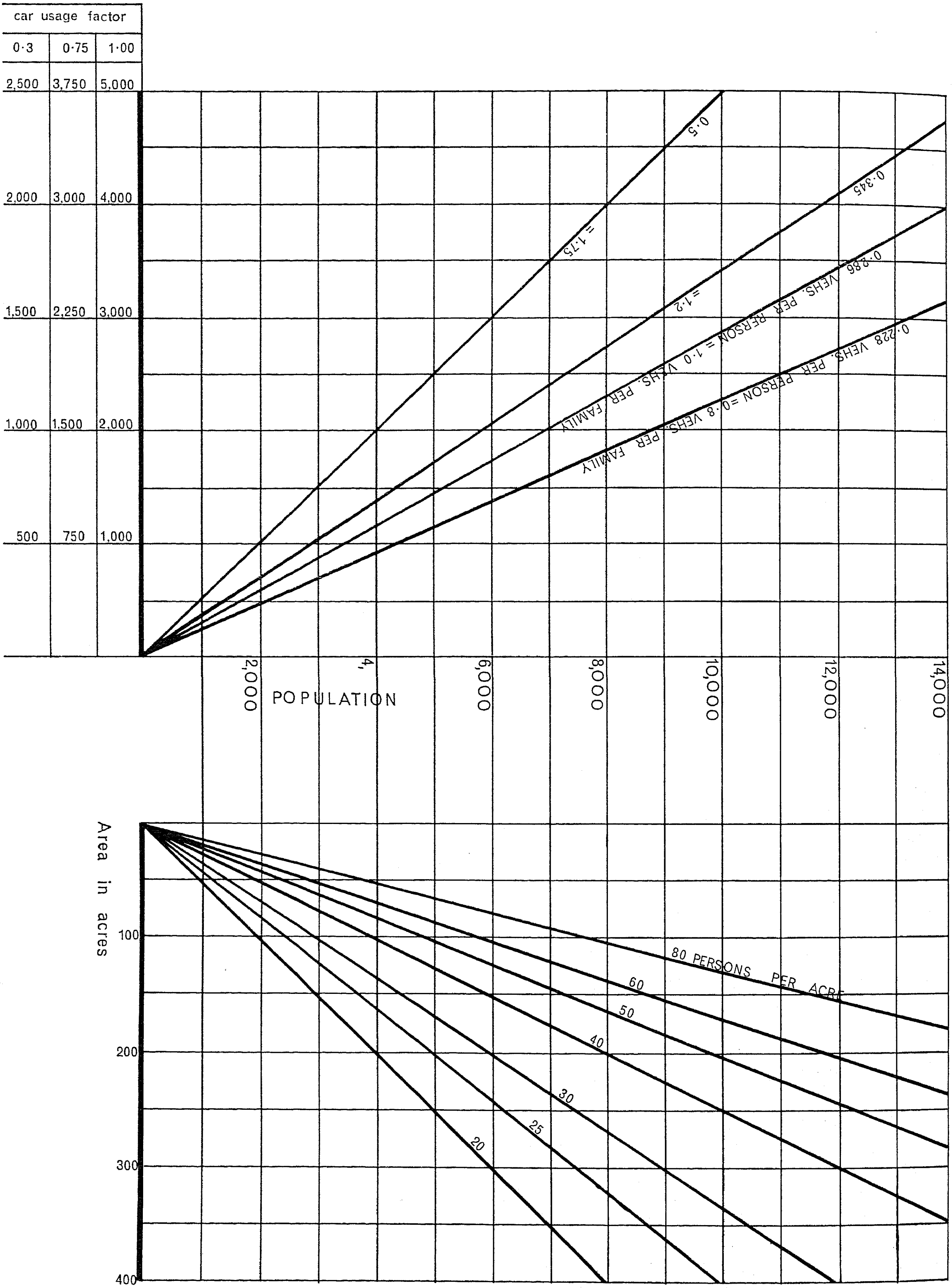


Diagram 34 Relationship between area, density, vehicle usage and traffic generation.

Based on these assumptions, the residential unit can be qualified as follows:

Base dimension of unit = 1 mile

Area of residential unit = $\frac{1}{2}\pi R^2$ where $R = \frac{1}{2}$ mile = 250 acres

250 acres at 30 persons per acre = 7,500

No. of sub-units per basic unit = $\frac{7{,}500}{1{,}750}$ = 4.3, say *5*

Length of peripheral road = 2,640 yards

No. of surface junctions = 5 + 2 for local centre

∴ Spacing of junctions = $\frac{2{,}640}{8}$ = 330 yards

Peak number of work journey vehicles on road = 5 x 300 = 1,500 v.p.h.

Assuming an even directional distribution of peak-hour traffic, the maximum flow of work-journey vehicles=750 v.p.h. Thus, the minimum facility required is a three-lane highway with surface junctions where the centre lane is reserved for turning traffic. Diagram 35 is a diagrammatic representation of the alternative forms which the service roads to the sub-units might take. Diagram 36 is a diagrammatic representation of the interaction of adjacent units having different degrees of bias for the peripheral traffic.

(C) *Basic industrial unit*

Assume:

(a) Maximum walking distance = $\frac{1}{2}$ mile;

(b) Gross density of workers per acre = 30;

(c) 1.5 workers per family, i.e. $\frac{1.2}{1.5}$ = 0.8 cars per worker;

(d) 50% car usage, i.e. 0.4 cars per worker appear in work-journey flows.

Based on these assumptions, the industrial unit can be qualified as follows:

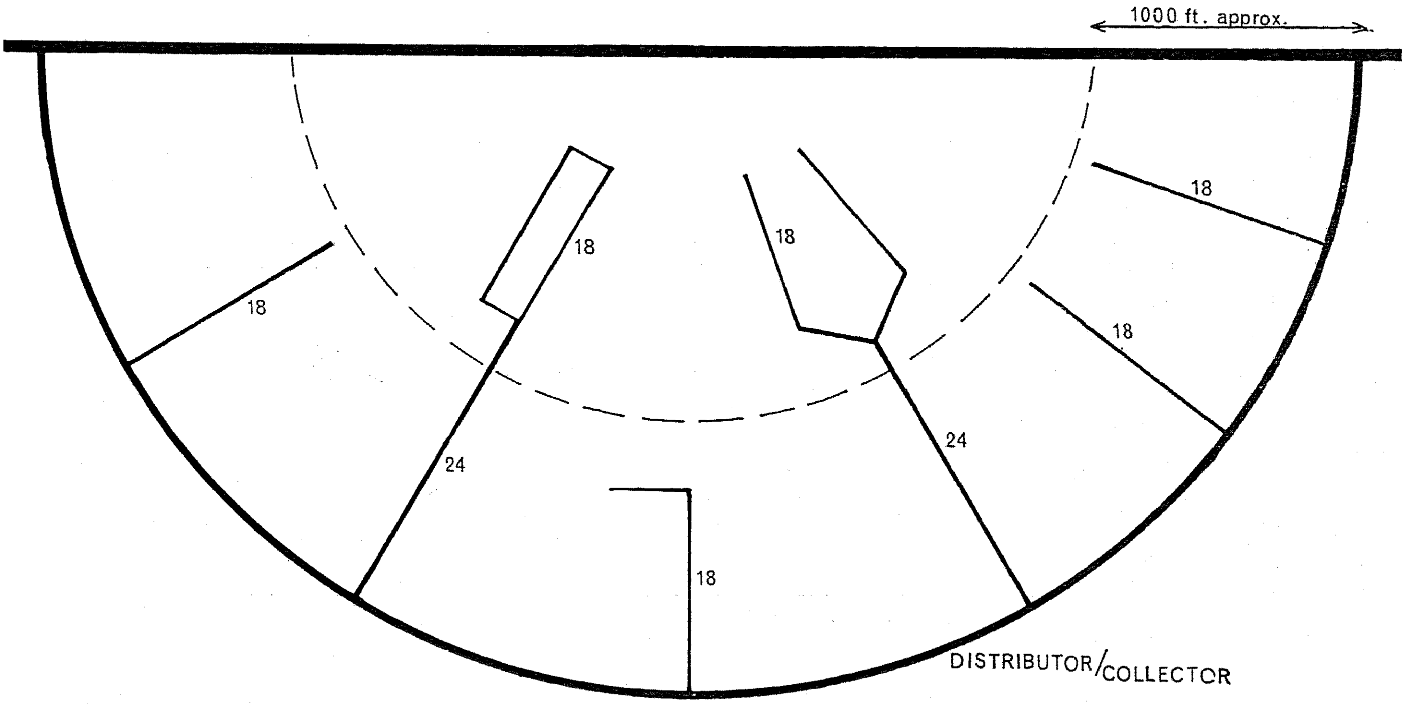
Base dimension of unit = 1 mile

Area of industrial unit = 250 acres approximately

250 acres at 30 workers per acre = 7,500 workers

7,500 workers at 0.4 cars per worker = 3,000 cars

Assuming an even directional distribution of peak-hour traffic, the maximum work-journey exodus=1,500 vehicles in each direction. Thus a two-lane dual



LIMITING LENGTH OF 18′—0″ CUL-DE-SAC = 1000 ft. approx.
24′—0″ FEEDER ROAD REQUIRED FOR DISTANCES IN EXCESS OF 1000 ft. FROM COLLECTOR/DISTRIBUTOR ROAD
PEDESTRIAN/VEHICLE CONFLICT ACCEPTABLE ON ROADS WITH VOLUMES LESS THAN 300 V.P.H.

Diagram 35 Feeder road standards.

carriageway facility is required and for surface junctions some means of control may be required during the peak traffic periods.

20. Combination of units – residential industrial ratio

Assume:

(a) Basic residential unit = 7,500 population
i.e. Basic residential unit = 2,200 families
Basic residential unit = 3,300 workers
(b) ⅛th of workers employed in central area, i.e. 400 workers;
(c) ⅛th of workers employed locally within basic unit, i.e. 400 workers;
(d) Basic industrial unit employs 7,500 workers;
(e) Balanced settlement, i.e. theoretically no commuting.

Based on these assumptions, the residential industrial ratio is determined as follows:

Workers travelling from each residential unit to industrial unit = 3,300 – 800
= 2,500
Workers employed in each industrial unit = 7,500
∴ Ratio of residential units to industrial units = 3 to 1

In arranging combinations of units it is desirable to distribute the residential and industrial units in these proportions in order to achieve maximum dispersal of traffic and hence efficient use of both road-space and public transport.

City form

21. The organisation of a city based upon these 'basic units' is, of course, in a linear form. Effects on traffic of growing lines of development and of patterns of

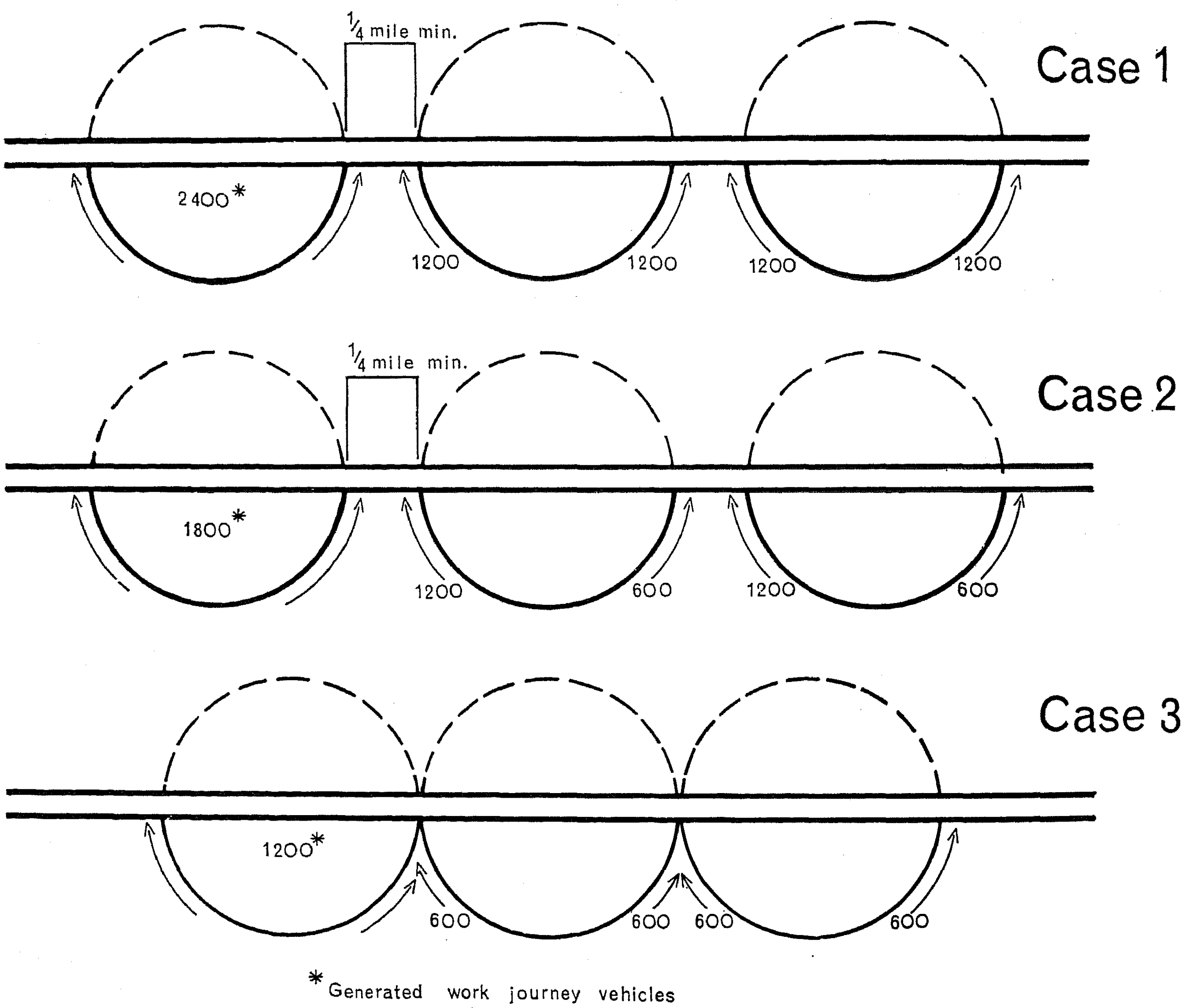


Diagram 36 Interaction of units.

lines of development have been studied. While some forms show great promise in that development can expand without growth of transport appearing to get out of hand, other forms quickly lead to situations which increase traffic volumes in a most alarming way. However, studies in this direction have not reached a point where any definite conclusions can be reached.

Flexibility

22. Flexibility is possible in the 'basic unit' both in its initial design and its growth over a long period of time. Within a basic framework of planning and communications principles, units are capable of independent design and thus variety can be achieved in population, density, form, nature, character and layout of development. The ratio of public to private transport can vary as the city grows since a greater emphasis than hitherto is placed upon increasing widths of existing roads and increasing frequency of buses than for the construction of new roads.

23. Flexibility is also possible in the arrangement of 'basic units', also subject to certain disciplines. They can be thought of as separate units or can merge into each other in varying degrees. Ten to fifteen units could form a 'New Town' (which could later expand); two, i.e. one double unit, could form a small town with easy connections to others or as a satellite to a larger town; a large number in various combinations could form a 'New City' (which could also grow, though probably at the eventual expense of private mobility). The units within these groupings would be capable of development at different rates and either according to a closely-planned programme or in an *ad-hoc* manner. An infinite extension may be theoretically possible. Also the system allows the suitable siting of units on land appropriate to the uses contained within it and a merging of the new pattern with the existing settlement pattern.

24. A fundamental feature of the basic unit is the association of the public transport and private transport systems in a communication corridor. This association induces a flexibility in economic growth, on a time scale related to the rate of general development. The stages of growth of the transport corridor are:

(a) Single carriageway road with mixed private cars and buses;
(b) Single carriageway road for private transport and public transport to an adjacent separated facility;
(c) Dual carriageway road for private transport with the separated public transport facility now forming the central reservation;
(d) Extra lanes to carriageways, or separate by-pass roads for private transport. More efficient forms of public transport along the existing line culminating in rail, monorail, hovercraft, etc.;

The development of the public transport system from buses to any other form (rail, hover, etc.) need only occur when the town growth and usage make it economic to do so. Buses could even be retained on the segregated facility as the ultimate public transport service.

25. However, the following points are of vital importance:

(1) The public transport must provide journey times comparable with private transport and, therefore, must not be impeded by private vehicles.
(2) It must evolve economically as growth takes place.
(3) It must have superior terminal penetration to the major destinations.

26. Finally, through the designed location of the communications together with a complementary policy of developing both the public transport system and the road network only to capacities related to short-term population forecasts, it may well be possible to cater for unforeseen marked fluctuations in the rate of building growth without at any stage allowing the area to become either grossly over- or under-provided with communications.

Appendix III: Theoretical considerations for co-ordinated linear growth

Object

1. The object of this appendix is to quantify the transportation implications of combinations of the basic land-use units determined in Appendix II.

2. It is not possible to deal with all the possible permutations of the many variables in land-use development; but an attempt is made to outline principles of land-use allocation which are consistent with minimising the transportation facilities, thus facilitating the development of an economic, optimum network.

3. In order to provide a lucid appreciation of the transportation implications of land-use allocation, several specific forms of development are considered and the resulting trip generation is outlined along with comments on the transportation facilities required for various modal splits.

Theoretical considerations

4. **Basic assumptions**

(a) Residential units are consistent in terms of form and size with the basic unit established in Appendix II.
(b) The working population and the opportunities of employment within the town are balanced.
(c) One-eighth of the working population finds employment locally in the basic unit.
(d) One-eighth of the working population finds employment in the central area.
(e) Three-quarters of the working population are distributed to the industrial areas in a specified manner. (Excluding tertiary employment, e.g. offices).
(f) The work journey is the appropriate movement for the determination of the requisite transportation facilities.

5. Initially, movements are quantified in terms of person trips on the home to work journey unrelated to a time scale and on the assumption that no commuting either 'in' or 'out' of the town occurs.

6. In order to compare the various schemes on a uniform base, the worker trips have been translated into vehicular trips on the basis of 50% car usage, i.e. on the assumption that a 'good' public transport system is provided and highway capacities facilitate 'free use' of the private car. Thus 0.4 cars per worker will appear in the work journey flows.

7. In determining the highway capacity requirements, no reduction in worker trips resulting from shift work has been considered and a spread of one hour has been adopted for the peak work journey period.

8. The number of traffic lanes indicated in the various sketches is based on lane capacity of 1,000 private cars per hour on work journey trips. This leaves a reserve

capacity to accommodate ancillary traffic flows comprising:

(a) Commercial vehicles;

(b) Private and goods vehicles on local movements other than work journey trips;

(c) Traffic making sub-regional through movements.

9. Linear type development is not conducive to more than three parallel lines of road, i.e. one central and two peripheral. Although dual carriageway facilities up to a maximum of six directional lanes is practical, four lanes are considered to be a desirable limit from the safety and environmental viewpoints, thus 12 directional lanes have been used as the limiting factor in determining whether or not the proposed 50% car usage can be achieved.

Finite development

10. Three forms of finite development comprising an arbitrary population of 360,000 are considered hereunder. Trip generation is based on each opportunity of employment in the industrial areas providing 'common attraction', irrespective of the location of the workers (with the exception of the first distribution in paragraph 12).

11. A finite town of 360,000 population, laid out on 'traditional' lines with the residential units forming spokes of a wheel around the central area and with industrial units at the end of each spoke.

Layout

Eight-spoked wheel with the radials interconnected by means of an inner and outer ring-road system.

Basic units

(a) Residential—total population	=15,000
working population	= 6,000
workers employed locally	= 800
workers employed in c.a.	= 800
workers to be distributed to industrial areas	= 5,000
(b) Industrial—opportunities for employment	=15,000
(c) Central area—opportunities for employment	=19,200

Combination of units

Three residential units and one industrial unit on each of eight routes radiating from the c.a.

Distribution of workers

Assuming 'even' distribution to all industrial areas, 625 workers 'commute' from each residential unit to each industrial unit.

Worker trip diagrams

Major worker trip desire lines are concentrated on radial routes connecting central area and industrial areas, peak flows being 15,000 worker trips.

Traffic flow diagram and highway network

The outer ring road poses no problem but the inner ring road would require a dual four-lane highway throughout. The radial routes would require four- to six-lane dual carriageways to serve the traffic demands of the private vehicles work journey alone.

Level of motorisation

This form of development is neither conducive to 'good' public transport nor economic highway use, but a 50% car usage could be achieved if special care is taken in the design of the radials at the approaches to the industrial areas.

12. A finite town of 360,000 population laid out in linear form with the central area at the centre and two industrial areas at the extremities of the line.

Layout
Linear form.

Basic units
(a) Residential as in paragraph 11.
(b) Industrial—opportunities of employment = 60,000 per unit
(c) Central area—opportunities of employment = 19,200 total

Combination of units
Twelve residential units developed between the central area and each industrial unit.

Distribution of workers
First distribution—No movements through the central area.
Second distribution—'even' distribution to each industrial area irrespective of residential location.

First distribution

Worker trip diagrams
Tidal flows to the industrial areas vary from zero to 60,000 person trips. Complementary flows of 9,600 person trips are generated by the central area—see diagram 37.

Traffic flow diagrams
The traffic flow diagrams for private transport on the work journey would be of a form similar to those shown for the worker trips, the peak flows being 24,000 per hour.

Highway network
A dual four-lane highway would adequately serve the traffic demands near the centre of the town for the work journey private cars alone, but on the approaches to the industrial areas 24 lanes would be required in either direction to accommodate private cars on the work journey.

Level of motorisation
The directional peak flows generated by this layout will create uneconomic highway and public transport demands, and a car usage of 50% is quite impractical.

Second distribution

Worker trip diagrams
The tidal flows show a spread wider than that of the first distribution, but the peak flows of 60,000 person trips are similar. The flow through the central area reaches a much higher peak of 39,600 person trips—see diagram 38.

Traffic flow diagrams
The traffic flow diagrams for private transport on the work journey would be of a similar form to those shown for the worker trips and as in the first distribution the peak flows would be 24,000 cars per hour.

Highway network
A minimum of 16 and a maximum of 24 directional lanes would be required.

Level of motorisation
Whilst the flows are still tidal in nature, the overlapping form will induce the two-

way use of public transport, which will consequently be more economic. However, a 50% car usage is still impractical.

Finite development

13. A finite town of 360,000 population, laid out in linear form but having industrial units and residential units interspersed in a 'balanced' relationship.

Layout

Linear form—see diagram 39.

Basic units

(a) Residential as in paragraph 11.
(b) Industrial—opportunities of employment = 15,000 per unit
(c) Central area—opportunities of employment = 19,200 total

Combination of units

Basic units combined to form composite sectors comprising three residential units and one industrial, thus providing a 'balance' of working population and opportunities in the sector.

Distribution of workers

Even distribution to each industrial area irrespective of residential location.

Worker trip diagrams

Compared to paragraph 12, the flow pattern is much more uniform. The peak flows of 41,200 are considerably lower and these occur near the centre of the town as against the extremities.

Traffic flow diagrams

The traffic flow diagrams for private transport on the work journey are of a similar form to those shown for the worker trips, the peak flows being 16,500 cars per hour.

Highway network

A minimum of four directional lanes are required at the extremities, but this increases towards the centre to a maximum of 16.

Level of motorisation

The layout will generate economic public transport but a 50% car usage cannot be achieved.

Infinite development

14. Trip generation is based on there being a limiting factor governing the distribution of workers to industrial areas. This fact should relate to a' time-distance' scale but, on the basis of transportation facilities having a common 'design speed', this factor can be simplified to a 'distance' scale. In the following cases a 15-mile limit has been applied to the work journey movements and, whilst variations in this limit would affect the peak value of trips generated, the graphic form would remain unchanged.

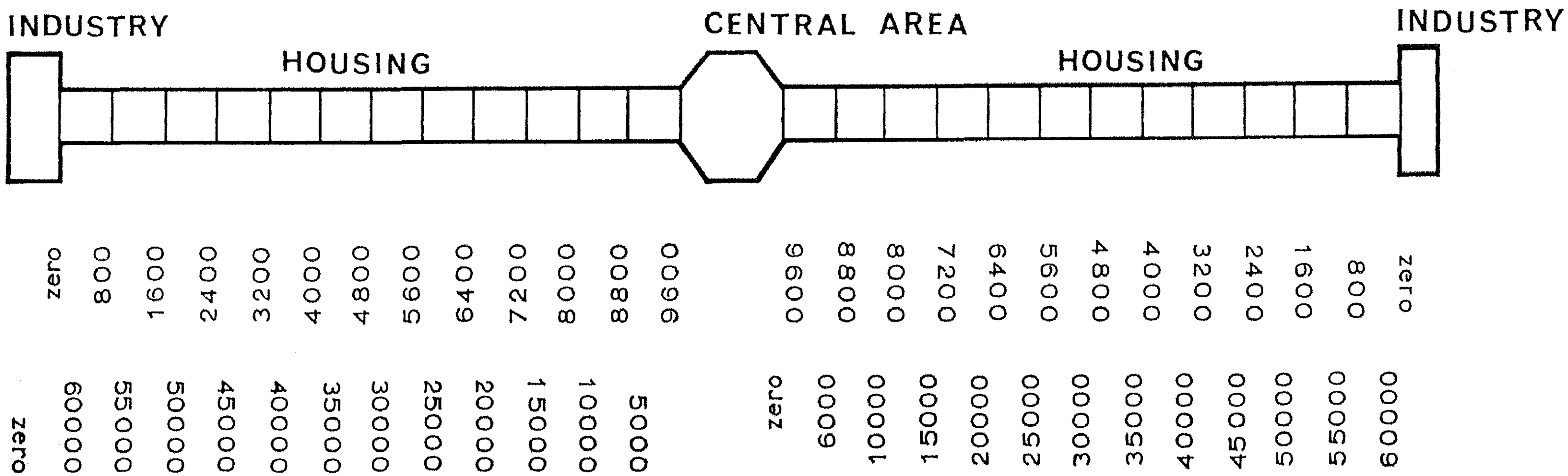
A linear town open-ended at either extremity would thus theoretically permit infinite growth and having industrial units and residential units interspersed in a 'balanced' relationship. Continuous development on this basis would create major 'centres' at 30-mile intervals.

Layout

Linear form—see diagram 40.

Diagram 37 Traffic generation.

WORKER TRIPS

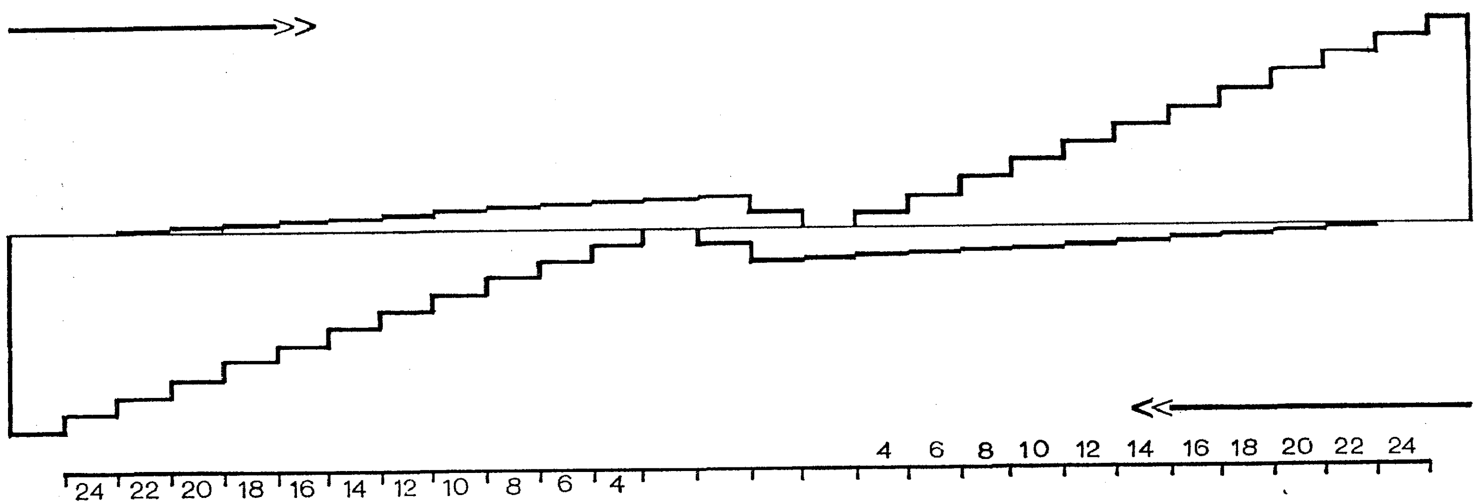


Home to Central Area

First Distribution
Home to Industry

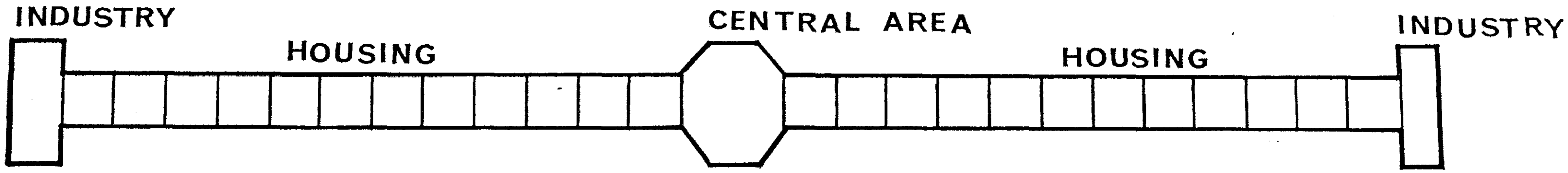
WORKER TRIP DIAGRAM

a.m. flows



Number of traffic lanes in each direction

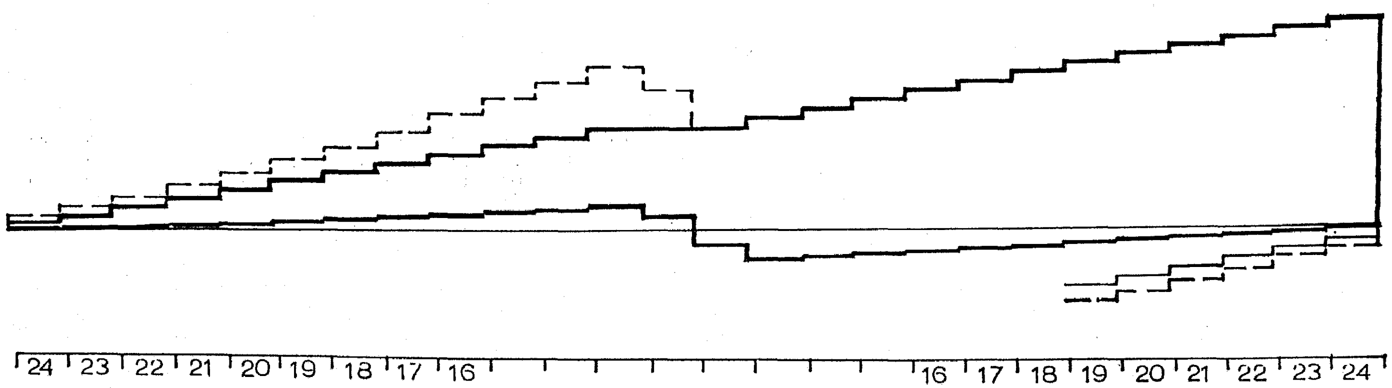
Diagram 38 Traffic generation.



WORKER TRIPS

Home to Central Area	zero	800	1,600	2,400	3,200	4,000	4,800	5,600	6,400	7,200	8,000	8,800	9,600	9,600	8,800	8,000	7,200	6,400	5,600	4,800	4,000	3,200	2,400	1,600	800	zero
Second Distributon Home to Industry	zero	2,500	5,000	7,500	10,000	12,500	15,000	17,500	20,000	22,500	25,000	27,500	30,000	30,000	32,500	35,000	37,500	40,000	42,500	45,000	47,500	50,000	52,500	55,000	57,500	60,000
	60,000	57,500	55,000	52,500	50,000	47,500	46,000	42,500	40,000	37,500	35,000	32,500	30,000	30,000	27,500	25,000	22,500	20,000	17,500	15,000	12,500	10,000	7,500	5,000	2,500	zero
	zero	3300	6600	9800	13200	16500	19800	23100	26400	29700	33000	36300	39600	30,000	32,500	35,000	37,500	40,000	42,500	45,000	47,500	50,000	52,500	55,000	57,500	60,000
Home to Central Area and Industry	60,000	57,500	55,000	52,500	50,000	47,500	46,000	42,500	40,000	37,500	35,000	32,500	30,000	39,600	36,300	33,000	29,700	26,400	23,100	19,800	16,500	13,200	9,900	6,600	5,300	zero

WORKER TRIP DIAGRAM



Number of traffic lanes in each direction

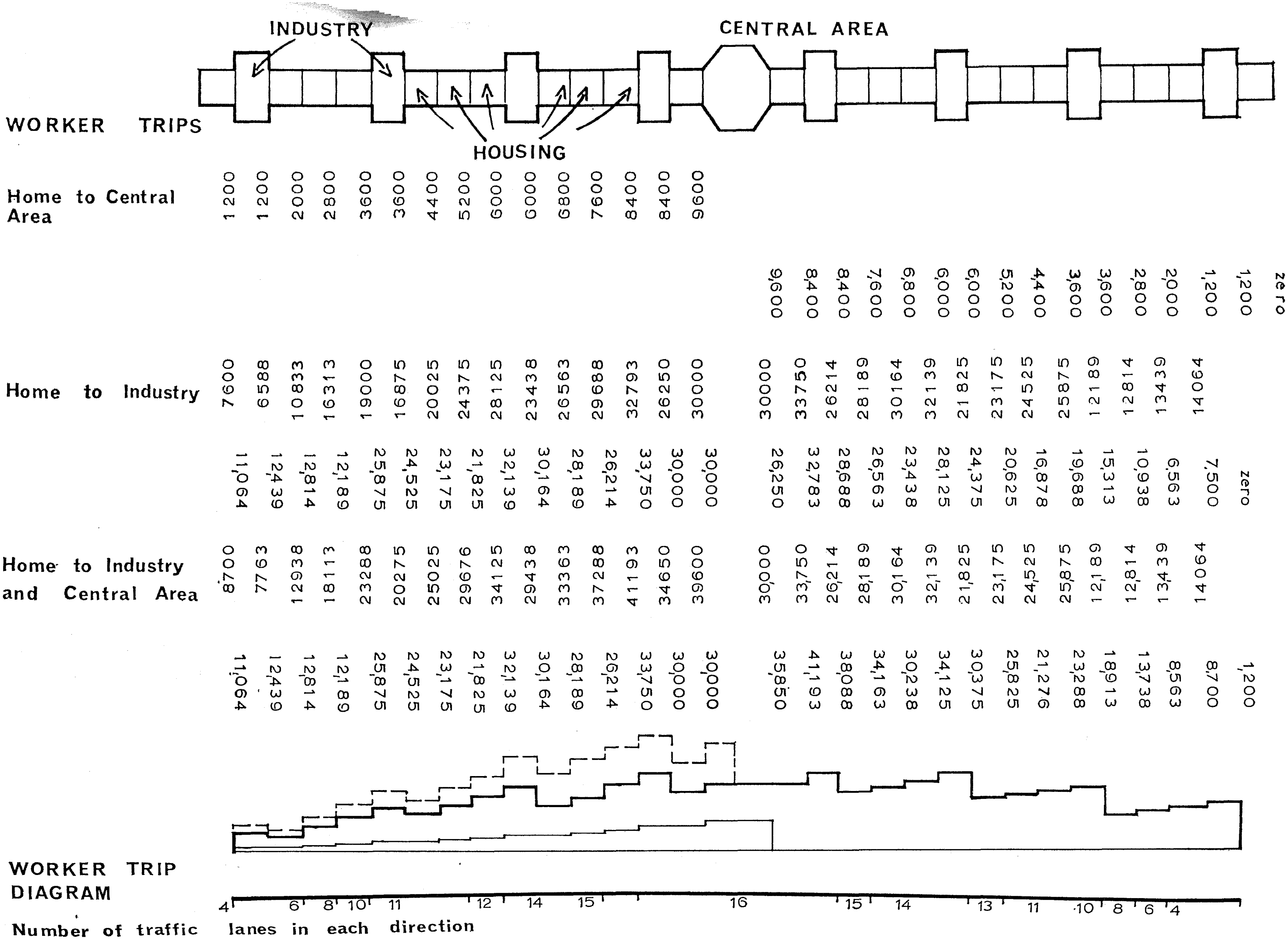
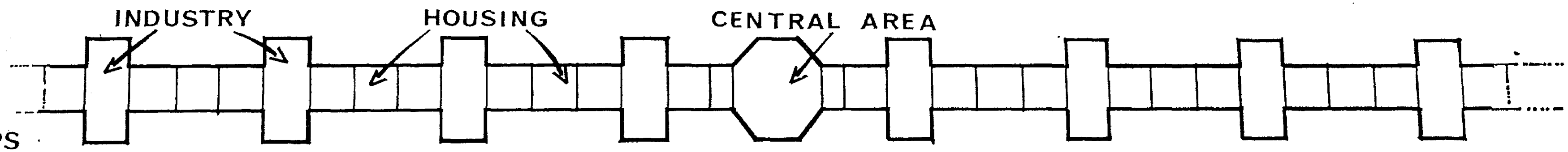


Diagram 39 Traffic generation.

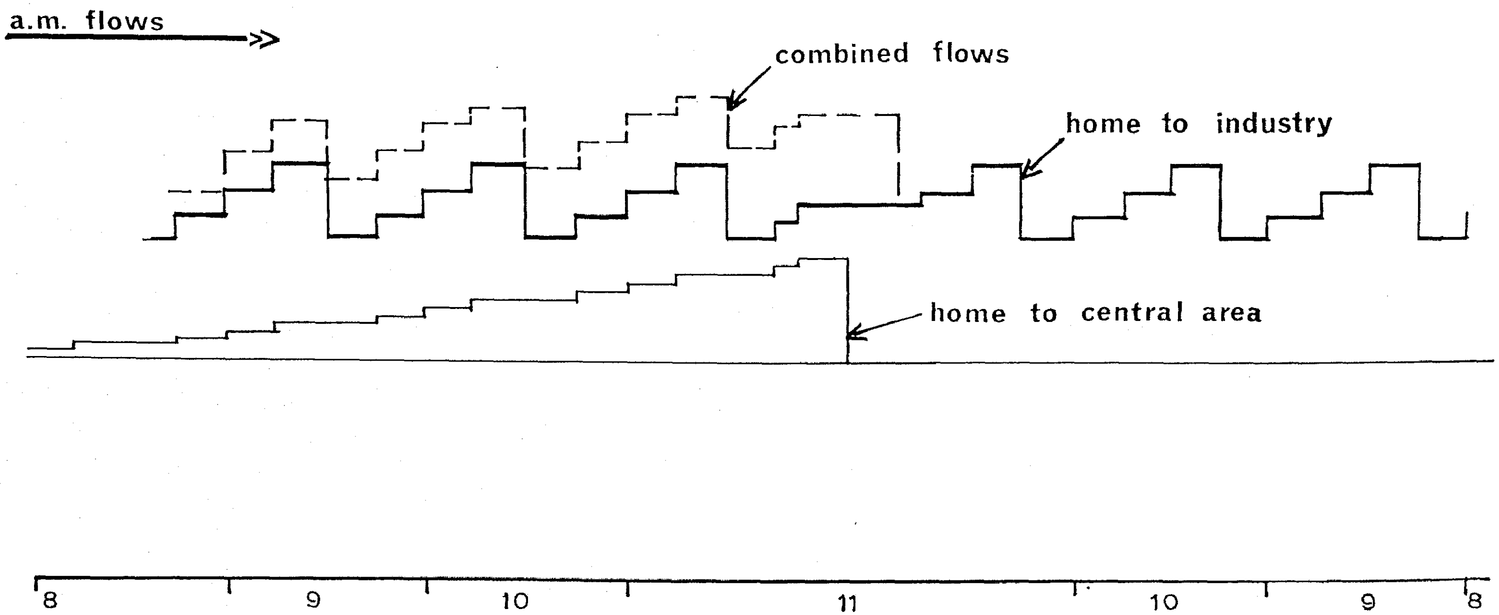
Diagram 40 Traffic generation.

WORKER TRIPS



Home to Central Area	400	1,200	1,200	2,000	2,800	3,600	3,600	4,400	5,200	6,000	6,000	6,800	7,600	8,400	8,400	9,200	9,600
Home to Industry	16,250	18,750	11,250	13,750	16,250	18,750	11,250	13,750	16,250	18,750	11,250	13,750	16,250	18,750	11,250	13,750	15,000
Home to Industry and Central Area	16,650	19,950	12,450	15,750	19,050	22,350	14,850	18,150	21,450	24,750	17,250	20,550	23,850	27,150	19,650	22,950	24,600

Home to Industry	15,000	16,250	18,750	11,250	13,750	16,250	18,750	11,250	13,750	16,250	18,750	11,250	13,750	16,250	18,750	11,250	13,750
Home to Industry and Central Area	15,000	16,250	18,750	11,250	13,750	16,250	18,750	11,250	13,750	16,250	18,750	11,250	13,750	16,250	18,750	11,250	13,750



WORKER TRIP DIAGRAM

Number of traffic lanes in each direction

Northampton, Bedford and North Bucks study

Correction

Page 28 – para 46

delete
"The towns involved and their population increases are:"
Together with the whole of the table commencing "Bletchley 35,000 . . ."

and insert
"The towns involved, and the possible scale of their population increases after 1964, are:

Bletchley	15,000	Buckingham	10 – 13,000
Wolverton	4 – 6,000	Newport Pagnell	7 – 10,000
Winslow	7 – 9,000	Olney	7 – 13,000

In the line commencing "This gives a total growth of . . ."
delete "90 – 106,000"
and insert "50 – 66,000"

Ministry of Housing & Local Government
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