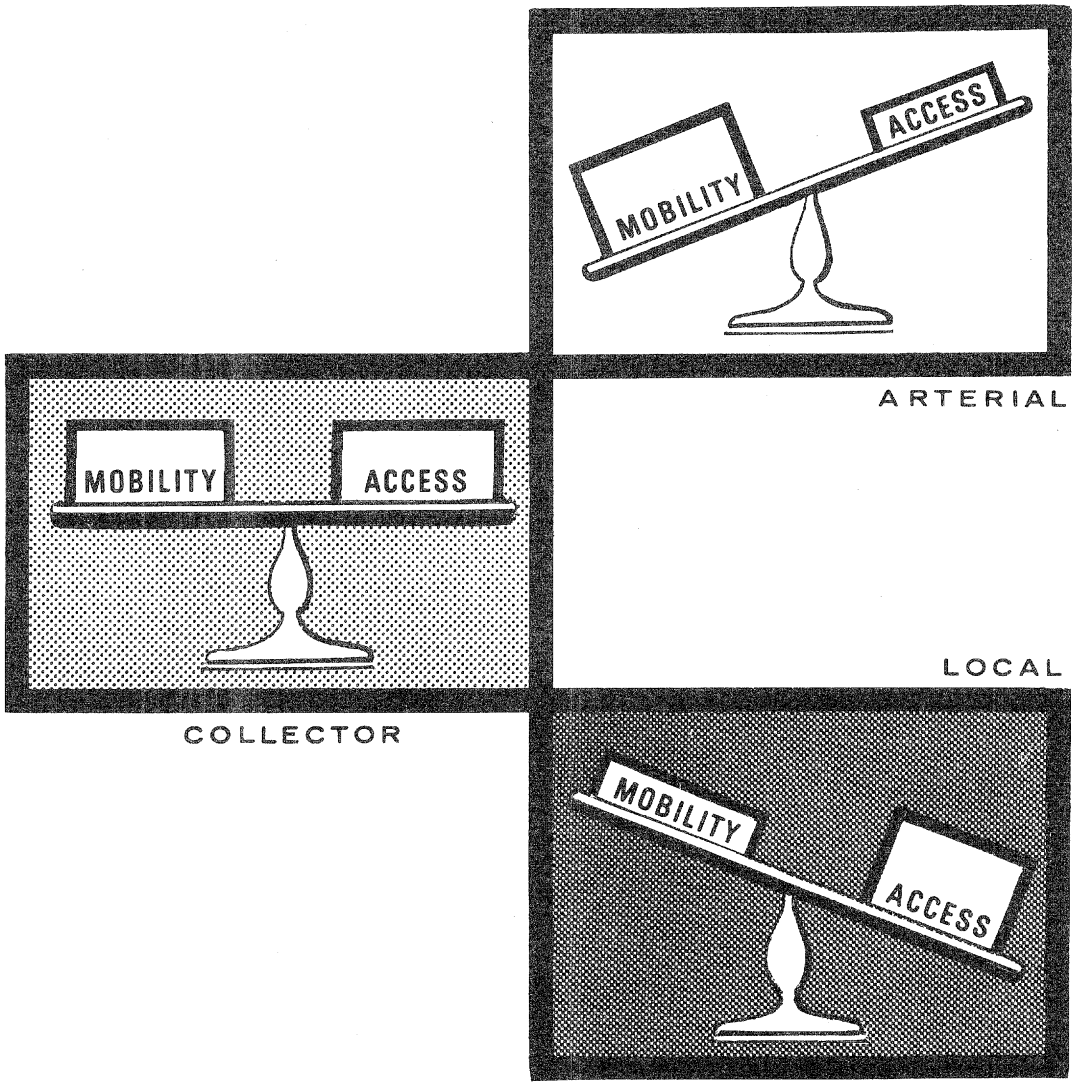
Mueller

1968
National Highway Functional Classification Study Manual

As Required by Section 17 of the 1968 Federal-Aid Highway Act



U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
BUREAU OF PUBLIC ROADS
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CONTENTS

CONTENTS (Continued)

APPENDICES

SECTION I--PURPOSE, SCOPE, AND ORGANIZATION

PURPOSE

The Congress, in Section 17 of the Federal-Aid Highway Act of 1968, directed the Secretary of Transportation to report in January 1970 ". . .the results of a systematic nationwide functional highway classification study to be made in cooperation with State highway departments and local governments. . ." The results of this study will be reported by the Secretary of Transportation to the Congress as part of the required biennial report on "Highway Needs."

The requirement for this classification study is, in part, an outgrowth of recommendations in the "1968 National Highway Needs Report" to the Congress. The initial study undertaken, under the uniform procedures prescribed in this manual, provides for classifying all existing roads and streets in the Nation into a limited number of consistently defined functional classes, but is in no way intended to supersede existing classifications that have been established within individual States. This study is basically designed to compare existing Federal-aid systems with logical functional usage of existing facilities to serve current travel demands.

Subsequent studies are expected to involve the development of a functional classification plan to serve estimated future (probably 1990) population, land use, and travel, and estimation of the costs and benefits of developing such a plan. The results of the entire series of studies, after thorough review and analysis, will form the basis for future recommendations to the Congress on specific changes considered desirable with respect to the character and size of Federal-aid systems and programs.

SCOPE

This manual provides background data, definitions, methods, and data submittal instructions for the conduct of the study by all States, the District of Columbia, and Puerto Rico, with the cooperation of their local units of government.

339-708 O - 69 - 3

All existing public roads and streets within a State are to be classified on the basis of the most logical usage of existing facilities to serve present travel and land use. With the exception of the Interstate System, the classification should be made without regard to present Federal-aid or jurisdictional classification. (Data for the completed portions of the Interstate System are to be identified and reported separately because of that System's unique and well recognized position in the functional hierarchy.) Existing facilities will include all roads and streets reported on PR-528, "Summary of Existing State and Local Roads and Streets," as of December 31, 1968, with the exception of those roads defined as primitive roads and trails in the instructions for reporting highway statistics. In addition, adjustments may be necessary in some States to include frontage road mileage.

Separate but related definitions and classification procedures are included for three types of areas: (1) Urbanized areas (50,000 and over population); (2) small urban areas (5,000 to 49,999 population); and (3) rural area (the remaining area of the State). Suggested procedures are provided for estimating 1968 population and travel for the above areas. Both subjective and quantifiable criteria and tests for identifying functional highway systems are included.

The functionally classified systems developed during this study in no way represent a commitment to particular systems, plans, or construction programs by the Department of Transportation, the States, or the local participating units of government.

ORGANIZATION FOR THE STUDY

The functional highway classification study is, appropriately, a joint enterprise of the Federal, State, and local governments. While organization, guidance, and final synthesis are the responsibility of the Department of Transportation, the actual classification will be done by the State highway departments, with the cooperation of local governmental units.

Bureau of Public Roads Functions

The Bureau of Public Roads, Office of Planning, is responsible for overall coordination of the study, but while Washington office personnel may offer some assistance in field review, their field travel must necessarily be limited. The major responsibility for guiding the States in the use and interpretation of this manual will rest with the Federal Highway Administration's regional and division offices.

In line with their usual function in studies of this kind, the regional offices will be responsible for periodically examining the work of the States within their regions to insure the highest possible degree of consistency, coordination, and agreement among the States in the interpretation and use of instructions and guideline criteria. In addition, the regional offices will be responsible for checking to see that routes of rural and urban arterial systems are appropriately coordinated at State boundaries within and between regions.

Within each State, the Public Roads division office will assist the State in interpreting the manual, and will periodically review study work and results for conformity with the manual.

State Highway Department Functions

The State highway departments are responsible for developing an adequate and consistent functional highway classification, under the guidelines of this manual, and for the timely submittal of study results in the prescribed form. They are also responsible for developing the maximum practicable participation in the study by city, county, and other local governments and by the urban transportation planning study organizations. The general approach to the study and the procedure for developing cooperative relationships with local governments must necessarily be worked out within each State. Maximum possible utilization should be made of local government resources and personnel.

Participation of Local Governments

Local cooperation in the study is required by Section 17 of the Federal-Aid Highway Act of 1968. The State highway departments must provide for such local participation.

The States are encouraged to establish a statewide advisory committee of official county and city representatives having an interest in transportation planning. The advisory committee should have the opportunity to become well informed on the study in early planning stages and to follow the course of the study through its completion. The committee can provide counsel on various factors that will affect local governments and can suggest the most helpful and practical form of local governmental participation within the time available. Considering limitations of time, it may be advisable to call upon existing committees or organizations of city and county officials, such as local chapters of the National Association of Counties, the National League of Cities, and the National Association of County Engineers, to serve in the capacity of an advisory committee.

Participation of Urban Transportation Planning Study Organizations

Direct participation by the urban transportation planning study organizations is to be obtained by the State highway departments to the maximum feasible extent. This includes utilizing both technical staffs, to assist in accomplishing the classification, and existing committees, to provide overall guidance to the classification process for their particular urban area.

It is recognized, however, that the status of the transportation planning process differs among urbanized areas in terms of active staff and accomplishments. Therefore, participation by such organizations will have to be consistent with these factors.

From a technical point of view it is recognized that not all urbanized areas have yet amassed and analyzed the full range of comprehensive transportation planning data and estimates proposed for use under the criteria and procedures described in this manual. The methods described herein should be used along with the established data insofar as possible. The functional systems developed in this study should be reviewed by the local technical and advisory committees, and their comments should accompany the data when submitted to the Public Roads Washington office.

Coordination with Other Agencies

The State highway departments are required to coordinate the classification of all arterials at the State line with neighboring highway departments to insure interstate continuity. Where State planning, development, toll authority, and similar agencies exist, they should be consulted and called upon to contribute to the study. The systems developed for this study should be coordinated with other transportation modes at the terminal facilities (e.g. airports).

Classification of facilities under the control of other Federal and State agencies having responsibility for public road and street systems should be coordinated with the agency involved. Federal agencies having this responsibility include the Bureau of Indian Affairs, Bureau of Land Management, Forest Service, and Park Service. These agencies have been advised at the Washington level that such coordination will be requested by the States. In some States, agencies such as State forest and parks departments have jurisdiction over certain roads and streets.

Use of Previous Classification Study Data

In a number of States, highway functional classification studies have been conducted within the last few years. The results of these may be applicable, or at least adaptable, to this study.

Concordance of the individual State study and this nationwide study cannot be presumed, however, and their relationship can be determined only by careful study of this manual and the criteria by which the State study was conducted. It is recognized that all truly functional system studies are made without regard to existing administrative systems; but the individual State studies have been made for internal use in each case and the number of functional systems and/or their definitions may not coincide with those established for the national study as described in this manual.

SECTION II--CONCEPTS, DEFINITIONS, AND SYSTEM CHARACTERISTICS

THE CONCEPT OF FUNCTIONAL CLASSIFICATION

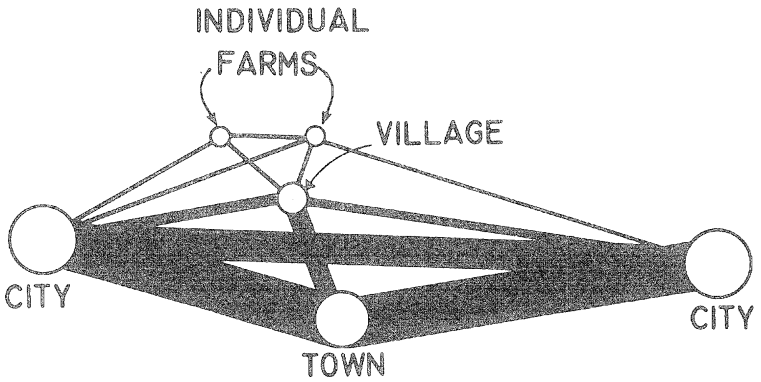
Functional classification is the process by which streets and highways are grouped into classes, or systems, according to the character of service they are intended to provide. Basic to this process is the recognition that individual roads and streets do not serve travel independently in any major way. Rather, most travel involves movement through a network of roads. It becomes necessary then to determine how this travel can be channelized within the network in a logical and efficient manner. Functional classification defines the nature of this channelization process by defining the part that any particular road or street should play in serving the flow of trips through a highway network.

A schematic illustration of this basic idea is provided in figure II-1. In the upper diagram, lines of travel desire are shown as straight lines connecting trip origins and destinations. Relative widths of lines indicate relative amounts of travel desire. Relative sizes of circles indicate relative trip generating or attracting power of the places shown. Since it is impractical to provide direct-line connections for every desire line, trips must be channelized on a limited road network in a logical and efficient manner. This can be done as shown in the lower diagram of figure II-1. Note that the heavy travel movements are directly served or nearly so; and that the lesser ones are channeled into somewhat indirect paths. The facilities shown in the diagram have been labeled local, collector and arterial; terms which are descriptive of their functional relationships. Note particularly that this hierarchy of functional types relates directly to the hierarchy of travel distances which they serve.

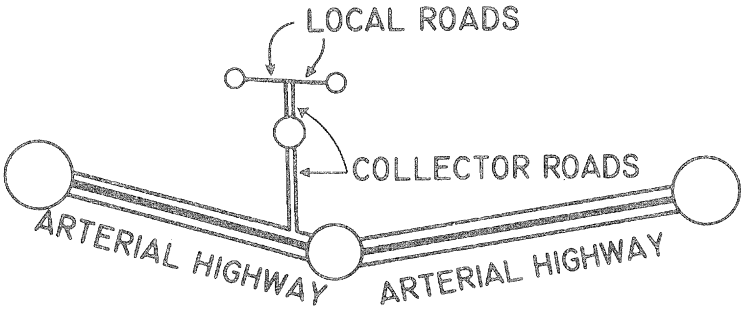
A more complete (though still schematic) illustration of a functionally classified rural network is shown in figure II-2. Since the cities and larger towns generate and attract a large proportion of the relatively longer trips, the arterial highways generally provide direct service for such travel. The intermediate functional category, the collectors, serves small towns directly, connects them to the arterial network, and collects traffic from the bottom-level system of local roads, which serves individual farms and other rural land uses.

FIGURE II-1

CHANNELIZATION OF TRIPS



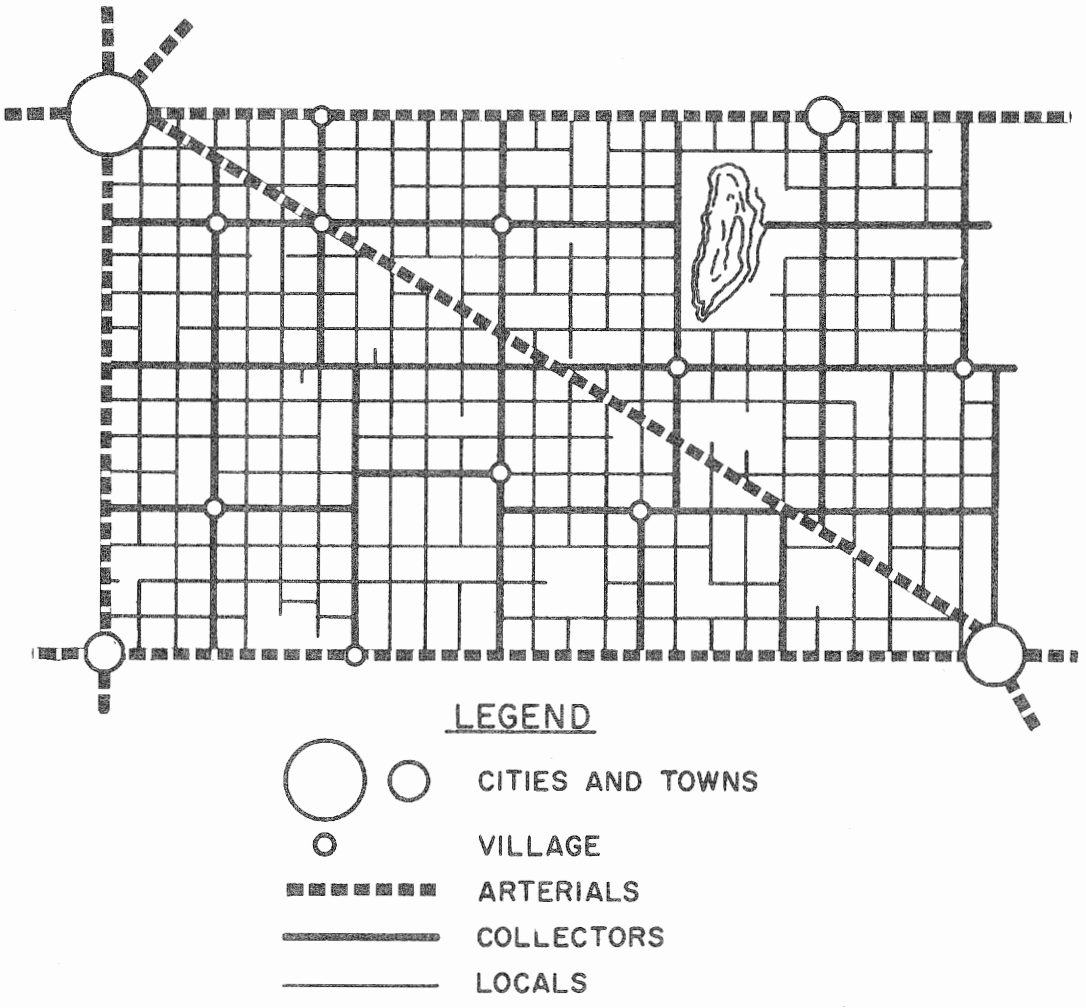
(A) DESIRE LINES OF TRAVEL



(B) ROAD NETWORK PROVIDED

FIGURE II-2

SCHEMATIC ILLUSTRATION OF A FUNCTIONALLY CLASSIFIED RURAL HIGHWAY NETWORK



Although the above example has a rural setting, the same basic concepts apply in urban areas as well. A similar hierarchy of systems can be defined; however, because of the high intensity of land use and travel throughout an urban area, specific travel generation centers are more difficult to identify. In urban areas additional considerations, such as spacing, become more important in defining a logical and efficient network. A schematic illustration of a functionally classified urban street network is shown in figure II-3.

Allied to the idea of traffic channelization is the dual role the highway network plays in providing (1) access to property, and (2) travel mobility. Access is a fixed requirement, necessary at both ends of any trip. Mobility, along the path of such trips, can be provided at varying levels, usually referred to as "level of service." It can incorporate a wide range of elements (e.g., riding comfort and freedom from speed changes) but the most basic is operating speed or trip travel time.

It was pointed out in the discussion of figure II-1 that the concept of traffic channelization leads logically not only to a functional hierarchy of classes, but also to a parallel hierarchy of relative travel distances served by those classes. This hierarchy of travel distances can be related logically to a desirable functional specialization in meeting the access and mobility requirements. Local facilities emphasize the land access function. Arterials emphasize a high level of mobility for through movement. Collectors offer more-or-less balanced service for both functions. This is illustrated conceptually in figure II-4.

Functional classification can be applied in planning highway system development, determining the jurisdictional responsibility for particular systems, and in fiscal planning. These applications of functional classification are discussed in "A Guide for Functional Highway Classification" (reference number 1 in Appendix A).

STATISTICAL AREA DEFINITIONS

Urban and rural areas have fundamentally different characteristics as to density and types of land use, density of street and highway networks, nature of travel patterns, and the way in which all these elements are related in the definitions of highway function. Consequently, this manual requires separate classification of urban and rural functional systems. Furthermore, because functional system definitions relate to land use, road network, and travel characteristics, the urban and rural definitions used in this study are based on what is urban or rural in fact, regardless of corporate or other jurisdictional boundaries. The urban boundaries identified for this study will then be the base from which future urban growth can be projected for subsequent studies.

FIGURE II-3
SCHEMATIC OF A PORTION OF AN URBAN STREET NETWORK

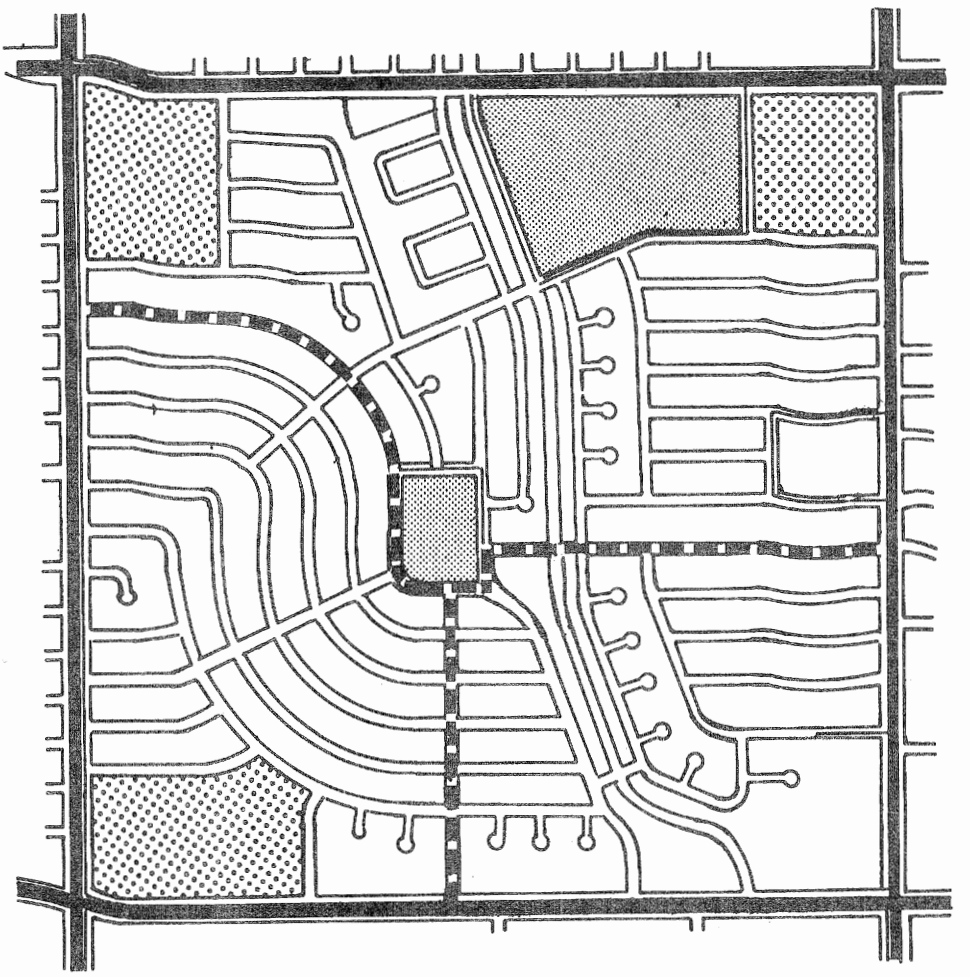
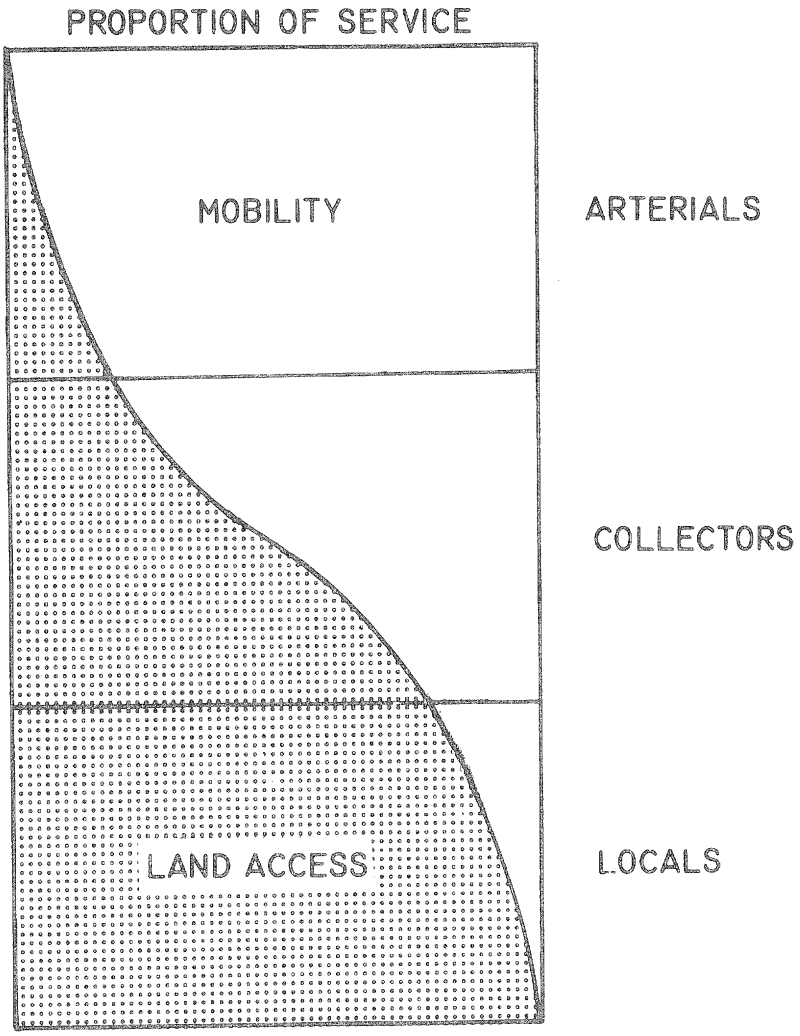


FIGURE II-4

RELATIONSHIP OF FUNCTIONALLY CLASSIFIED SYSTEMS IN SERVING TRAFFIC MOBILITY AND LAND ACCESS



Experience has shown that extensions of rural arterial and collector routes provide an adequate arterial street network in places of less than 5,000 population. Consequently, classification of urban systems will be required only in those places of 5,000 or over population.

For this study, there are two categories of places defined as urban: Small urban areas will include places of 5,000 to 49,999 population; urbanized areas will include places of 50,000 and over population.

Small Urban Areas

Small urban areas are those "urban places" (as defined by the U. S. Bureau of the Census) that: (1) Have in 1968 a population of 5,000 or more, and (2) do not meet the criteria for urbanized areas (as defined below).

Item 1 is compatible with the Federal-aid urban area definition contained in Public Roads PPM 10-5. The segregation of urbanized areas from small urban areas in this study makes item 2 a necessity.

Urbanized Areas

Urbanized areas for the purpose of this study consist of: (1) Those places, of 50,000 population or more, that meet the U. S. Bureau of the Census' urbanized area qualification criteria, have been certified as such, 1/ and which are therefore subject to the urban transportation planning requirements of Section 134, Title 23, U.S.C.; (2) other urban places that have a 1968 population of 50,000 or more within the urban-in-fact boundary.

Rural Areas

"Rural," for this study, comprises the area outside the boundaries of the urban areas defined above.

Urban Boundaries

The boundaries for small urban areas and urbanized areas to be used in this study should encompass an area that is urban-in-fact and representative of 1968 conditions.

If the Federal-aid urban boundary, as defined in PPM 10-5, approximates 1968 urban development and includes only that area which has definite urban characteristics, then this boundary is urban-in-fact and meets the requirements of this study.

1/ A list of the places certified as urbanized areas by the Bureau of the Census is included in appendix E, table E-2.

Where a Federal-aid urban boundary does not reflect current conditions or includes area that is not urban-in-fact, a boundary should be established for this study that includes only that area which has definite urban characteristics. Fringe areas with a population density of 1,000 or more inhabitants per square mile will be considered urban. Large nonresidential tracts devoted to urban uses, such as railroad yards, factories, parks, airports, schools, and cemeteries, should be included in the urban area but are to be excluded in computing the population density of the fringe area.

To delineate the boundaries for small urban areas, recent aerial photographs and current street layouts on local planning maps should be consulted, if available. Local officials may be of help in defining the study boundary, based on their knowledge of local development. Judgment will be necessary in bounding the area which exhibits urban characteristics.

To delineate the boundaries for urbanized areas, the procedures described above are also applicable. An additional data source is available for urbanized areas in that the boundary definition above is basically compatible with the definition of urbanized areas used by the Bureau of the Census.1/ There are some "overbounded" places which include large rural areas, not urban-in-fact, within the corporate limits. In such cases, the urban-in-fact portion of the city should be used, that is, that portion having urban characteristics; and the remaining portion included in the rural area category.

The Census Bureau is now estimating the boundaries of urbanized area units for 1970, by examining current street layouts on census metropolitan maps on a 1" to 800' scale, and by considering all areas that could conceivably have 1,000 or more inhabitants per square mile by 1970. The Census Bureau has compiled these boundaries for the majority of the larger urban areas and presently has 175 areas mapped.2/ These 1970 Census outer limit boundaries, where available, may serve as useful guides in establishing boundaries for urbanized areas that are consistent from State to State in reflecting current conditions and contain areas that are reasonably urban-in-fact.

1/ If States desire to obtain large scale maps of the areas delineated by the 1960 census and shown in the "PC(1) Series" Census report, write to Mr. William T. Fay, Chief, Geography Division, Bureau of the Census, Washington, D. C. 20233. The cost ranges from $5 to over $100 depending on the size of the area. The sketch map, used in conjunction with the 1960 census boundary and the current Federal-aid boundary should facilitate delimiting the study boundary.

2/ The Bureau of Public Roads will endeavor to supply these sketch maps to the respective States.

FUNCTIONAL SYSTEM CHARACTERISTICS

The following pages are devoted to separate descriptions of the characteristics of the basic functional systems and their subsystems for: (1) Rural areas, (2) urbanized areas, and (3) small urban areas. The primary functional categories to be used in this study for each of the three area types are presented in table II-1.

Table II-1--The hierarchy of functional systems

Rural areas	Urbanized areas	Small urban areas
Principal arterials	Principal arterials	Principal arterials
Minor arterial roads	Minor arterial streets	Minor arterial streets
Collector roads	Collector streets	Collector streets
Local roads	Local streets	Local streets

Since there is a wide variation in the characteristics and magnitude of service provided by each of these basic functional systems, further stratification of routes in these systems is prescribed to insure greater consistency and uniformity for analysis. In rural areas, routes on the principal arterial system are to be identified as Interstate and other principal arterials; and routes on the collector road system are to be subclassified as major collector roads and minor collector roads. In urbanized and small urban areas, the routes on the principal arterial system are to be identified as Interstate, other freeways and expressways, and other principal arterials.

For internal use, States may desire to further stratify routes within the basic functional systems. For this study, data for any additional substratifications shall be aggregated and reported for the systems and stratifications discussed above.

Functional Systems for Rural Areas

Rural roads consist of those facilities that are outside of the urban boundaries used in this study. They are to be classified into four major systems: Principal arterials, minor arterial roads, major and minor collector roads, and local roads.

Guidelines for the extent of mileage on these systems are shown in table II-2 (page II-13).

Rural principal arterial system

The rural principal arterial system consists of a connected rural network of continuous routes having the following characteristics:

1. Serve corridor movements having trip length and travel density characteristics indicative of substantial statewide or interstate travel.

2. Serve 1/ all, or virtually all, urban areas of 50,000 and over population and a large majority of those with population of 25,000 and over.

3. Provide an integrated network without stub connections except where unusual geographic or traffic flow conditions dictate otherwise (e.g., international boundary connections and connections to coastal cities).

In the more densely populated States, this class of highway may not include all heavily traveled routes which might warrant multilane improvements. It is likely, however, that in the majority of States the principal arterial system will include most, if not all, existing rural freeways.

The principal arterial system should be stratified into the following two categories:

Interstate System.--The Interstate subclassification should include all completed portions of the Interstate System.

Other principal arterials.--This subclassification consists of all non-Interstate principal arterials. It should include adequate mileage to provide continuity to the Interstate System where it is not now completed.

Rural minor arterial road system

The rural minor arterial road system should, in conjunction with the principal arterial system, form a rural network having the following characteristics:

1/ The term "serve" is difficult to define on a national basis since it varies according to the size of the urban area, the functional system under consideration, and the effects of natural barriers where they exist. As a guide for this study, the rural principal arterial system may be considered to "serve" an urban area if the system either penetrates the urban boundary, or comes within 10 miles of the center of the place and is within 20 minutes travel time (off-peak periods) of the center of the place via a minor arterial highway. The rural minor arterial road system "serves" an urban area if the system either penetrates or comes within 2 miles of the urban boundary.

1. Link cities and larger towns 1/ (and other traffic generators, such as major resort areas, that are capable of attracting travel over similarly long distances) and form an integrated network providing interstate and intercounty service.

2. Be spaced at such intervals, consistent with population density, so that all developed areas of the State are within a reasonable distance of an arterial highway.

3. Provide (because of the two characteristics defined immediately above) service to corridors with trip lengths and travel density greater than those predominantly served by rural collector or local systems. Minor arterials therefore constitute routes whose design should be expected to provide for relatively high overall travel speeds, with minimum interference to through movement.

Rural collector road system

The rural collector routes generally serve travel of primarily intracounty rather than statewide importance and constitute those routes on which (regardless of traffic volume) predominant travel distances are shorter than on arterial routes. Consequently, more moderate speeds may be typical, on the average.

In order to define more clearly the characteristics of rural collectors for this study, this system should be subclassified according to the following criteria:

Major collector roads.--These routes should: (1) Provide service to any county seat not on an arterial route, to the larger towns not directly served by the higher systems, and to other traffic generators of equivalent intracounty importance, such as consolidated schools, shipping points, county parks, important mining and agricultural areas, etc.; (2) link these places with nearby larger towns or cities, or with routes of higher classification; and (3) serve the more important intracounty travel corridors.

1/ The definition of a "large" town, in terms of population, cannot be arbitrarily determined in such a way as will fit all States. It can be determined in each State during the classification process by building the system "from the top down," in terms of size of places served, and evaluating successive system increments on a diminishing returns basis, in terms of population service or traffic service. This is discussed in greater detail in section III.

339-708 O - 69

Minor collector roads.--These routes should: (1) Be spaced at intervals, consistent with population density, to collect traffic from local roads and bring all developed areas within a reasonable distance of a collector road; (2) provide service to the remaining smaller communities; and (3) link the locally important traffic generators with their rural hinterland.

Rural local road system

The rural local road system should have the following characteristics: (1) Serve primarily to provide access to adjacent land; and (2) provide service to travel over relatively short distances as compared to collectors or other higher systems. Local roads will, of course, constitute the rural mileage not classified as principal arterial, minor arterial road, or collector road.

Extent of rural systems

The systems criteria above have been expressed primarily in qualitative, rather than quantitative terms. Because of varying geographic conditions (population density, spacing and size of cities, density and pattern of road network) it is not feasible to establish uniform nationwide criteria on size of population centers, on trip length and traffic volume, or on spacing of routes, that would apply to all systems in all States. The results of classification studies conducted in many States throughout the country do, however, show considerable consistency in the relative extent of each system, expressed as a percentage of total rural road mileage.

The systems developed for this study are generally expected, in all States except Alaska and Hawaii, to fall within the percentage ranges shown in table II-2. Any exception should be analyzed and an explanation for the variation should be included in the narrative report.

The higher values in table II-2 should apply to States which have a less extensive total road network than is typical of States of similar population density. In States having a more extensive total network, the lower values would be expected to apply. The range of percentages for rural collectors is for the total mileage of both major and minor collector roads, and applies to the statewide rural mileage totals; the percentage in any particular county may vary considerably from the statewide average. Areas having an extensive grid pattern of roads will usually have a lesser percentage of collectors than areas wherein geographic conditions have imposed a restricted or less regular pattern of road development.

Table II-2--Guidelines on extent of rural functional systems

Systems	Percentage of total rural miles
Principal arterial system	2-4
Principal arterial plus minor arterial road system	6-12, with most States falling in 7-10 percent range
Collector (major plus minor) road system	20-25
Local road system	65-75

Functional Systems in Urbanized Areas

The four functional systems for urbanized areas are urban principal arterials, minor arterial streets, collector streets, and local streets. The differences in the nature and intensity of development between rural and urban areas cause these systems to have characteristics that are somewhat different from the correspondingly named rural systems.

Guidelines for the extent of mileage and travel on these systems are shown in table II-3 (page II-15).

Urban principal arterial system

In every urban environment there exists a system of streets and highways which can be identified as unusually significant to the area in which it lies in terms of the nature and composition of travel it serves. In smaller urban areas (under 50,000) these facilities may be very limited in number and extent and their importance may be primarily derived from the service provided to travel passing through the area. In larger urban areas their importance also derives from service to rural oriented traffic, but equally or even more important, from service for major movements within these urbanized areas.

This system of streets and highways, called here the urban principal arterial system, should serve the major centers of activity of a metropolitan area, the highest traffic volume corridors, and the longest trip desires; and should carry a high proportion of the total urban area travel on a minimum of mileage. The system should be integrated, both internally and between major rural connections.

The principal arterial system should carry the major portion of trips entering and leaving the urban area, as well as the majority of through movements desiring to bypass the central city. In addition, significant intra-area travel, such as between central business districts and outlying residential areas, between major inner city communities, or between major suburban centers should be served by this class of facilities. Frequently the principal arterial system will carry important intraurban as well as intercity bus routes. Finally, this system in urbanized areas should provide continuity for all rural arterials which intercept the urban boundary.

Because of the nature of the travel served by the principal arterial system, almost all fully and partially controlled access facilities will be part of this functional class. However, this system is not restricted to controlled access routes. In order to preserve the identification of controlled access facilities in subsequent tabulations which will be required, the principal arterial system should be stratified as follows: (1) Interstate (consisting of only completed Interstate mileage), (2) other freeways and expressways, and (3) other principal arterials (with no control of access).

The spacing of urban principal arterials will be closely related to the trip-end density characteristics of particular portions of the urban areas. While no firm spacing rule can be established which will apply in all, or even most circumstances, the spacing of principal arterials (in larger urban areas) may vary from less than one mile in the highly developed central business areas to five miles or more in the sparsely developed urban fringes.

For principal arterials, the concept of service to abutting land should be subordinate to the provision of travel service to major traffic movements. It should be noted that only facilities within the "other principal arterial" subclass are capable of providing any direct access to land, and such service should be purely incidental to the primary functional responsibility of this class of roads.

Urban minor arterial street system

The minor arterial street system should interconnect with and augment the urban principal arterial system and provide service to trips of moderate length at a somewhat lower level of travel mobility than major arterials. This system also distributes travel to geographic areas smaller than those identified with the higher system.

The minor arterial street system includes all arterials not classified as principal and contains facilities that place more emphasis on land access than the higher system, and offer a lower level of traffic mobility. Such facilities may carry local bus routes and provide intracommunity continuity, but ideally should not penetrate identifiable neighborhoods. This system should include urban connections to rural collector roads where such connections have not been classified for internal reasons as urban principal arterials.

The spacing of minor arterial streets may vary from 1/8 - 1/2 mile in the central business district to 2 -3 miles in the suburban fringes, but should normally be not more than 1 mile in fully developed areas.

Urban collector street system

The collector street system differs from the arterial systems in that facilities on the collector system may penetrate neighborhoods, distributing trips from the arterials through the area to the ultimate destination which may be on a local or collector street. Conversely, the collector street also collects traffic from local streets in the neighborhood and channels it into the arterial systems. In some cases, due to the design of the overall street system, a minor amount of through traffic may be carried on some collector streets.

The collector system provides both land access service and for local traffic movements within residential neighborhoods, commercial areas, and industrial areas. Such facilities contain the collector portion of some bus routes.

Urban local street system

The local street system comprises all facilities not on one of the higher systems. It serves primarily to provide direct access to abutting land and access to the higher order systems. It offers the lowest level of mobility and usually contains no bus routes. Service to through traffic movement usually is deliberately discouraged.

Extent of mileage and travel on urban systems

Table II-3 contains guideline ranges of travel volume (VMT) and mileage of each of the four functional systems for urbanized areas. It is expected that the systems developed for each area would fall within the percentage ranges shown; any exceptions should be carefully analyzed and explained.

Table II-3--Guidelines on extent of urban functional systems

System	Range (percent)	
	VMT	Miles
Principal arterial system	40 - 55	5 - 10
Principal arterial plus minor arterial street systems	65 - 75	15 - 25
Collector street system	5 - 10	5 - 10
Local street system	15 - 30	65 - 80

Functional Systems for Small Urban Areas

The systems and their characteristics listed for urbanized areas are also generally applicable to small urban areas. The basic difference is that, by nature of their size, many small urban areas will not generate internal travel warranting urban principal arterial service.

Thus the principal arterial system for small urban areas will largely consist of extensions of rural arterials into and through the areas. In many instances, these extensions will be located so as to relieve critical sections of the street system while providing efficient movement of travel around (e.g., bypasses) and through the area. The larger urban areas within this population group, particularly those above 25,000 population, may have major activity centers which warrant principal arterial service in addition to that provided by extensions of rural arterials.

The extent of the principal arterial system mileage and travel will vary significantly among the small urban areas, but will normally fall on the low side or below the guidelines shown in table II-3.

The characteristics for the minor arterial street systems, collector street systems, and local street systems in small urban areas are similar to those for urbanized areas.

Special Urban-Rural Identification

The criteria in this section define urban and rural streets and highways according to their functional character. To assure continuity of the rural arterial systems through urban areas, it is desirable to doubly identify (as indicated below) the urban arterials which form connecting links of the rural arterials. The term "connecting links" means those urban routings which will provide rural-to-rural continuity for the rural arterial systems. A connecting link may traverse the urban area from one boundary to another, or may simply connect to another previously delineated connecting link. (The mileage of any connecting link should not be included more than once.) The necessary continuity may be provided by loop or bypass routes. It is recommended that the identification be made after both the urban and rural functional classifications have been accomplished.

As specified in the systems characteristics in this section, connecting links for the rural principal and minor arterial systems will be on the urban principal arterial system (continuity for the rural Interstate will, of course, be provided by urban Interstate). Connecting links for rural principal arterials should be identified prior to selecting those for minor arterials. The routing of the connecting link for a rural principal arterial should normally be fairly direct, while that for a rural minor arterial may involve some indirection of travel.

The following categories are to be used in identifying these connecting links on the urban principal arterial system:

Other freeways and expressways:

Connecting links of non-Interstate rural principal arterials
Connecting links of rural minor arterials

Other urban principal arterials:

Connecting links of other rural principal arterials
Connecting links of rural minor arterials

A recommended color coding scheme for identifying these routes on the urban systems maps is discussed on page IV-8.

Classification Criteria for Alaska, Hawaii, and Puerto Rico

The classification of rural and urban systems in Alaska, Hawaii, and Puerto Rico should generally be consistent with the functional system characteristics described in the preceding sections. However, there may be roads on small islands or in other areas that are isolated from the remaining parts of the State or Commonwealth, and none of these roads may meet the criteria for classification as arterial because of the absence of long distance, through trips. Conversely, there may be undeveloped areas that have very few miles of collector and local roads. Thus, because of the considerably different geographic conditions existing in these areas as compared to the other 48 States, the systems extent for the rural functional classes may vary a great deal from that shown in table II-2. The systems extent for the urban functional classes should be fairly consistent with that shown in table II-3.

SECTION III - PROCEDURES

INTRODUCTION

This section of the manual suggests procedures for classifying all roads and streets into functional systems for rural, urbanized and small urban areas, based on the most logical use of the existing facilities to serve present travel. An optional procedure for estimating 1968 travel on these systems is also included.

Existing facilities will include all roads and streets reported on PR-528, "Summary of Existing State and Local Roads and Streets," as of December 31, 1968, but excluding those roads defined as primitive roads and trails in the instructions for reporting highway statistics, and including frontage roads (where the mileages were not reported separately) on access-controlled facilities.

One-way streets should be classified individually, and their mileage and travel accumulated on an individual basis, not in pairs. Frontage roads should be classified independently of the controlled-access facility on which they abut. The classification of frontage roads, based upon the criteria presented in this manual should normally be in the collector or local category.

Upon completion of the classification, summaries of mileage and travel by functional and Federal-aid systems, a cross-classification of the functional systems with Federal-aid systems, and systems maps are to be submitted. Detailed instructions for submittal of these data are included in section IV.

CLASSIFICATION PROCEDURES FOR RURAL SYSTEMS

The existing rural road network is to be functionally classified in accordance with the system characteristics defined in section II. As already noted, existing facilities are those roads reported on Bureau of Public Roads form PR-528 (excluding primitive roads and trails but including frontage roads) that were complete and open to traffic on December 31, 1968.

Rural classification procedures apply to those areas outside of urbanized or small urban area boundaries, although many rural routes particularly arterials, continue into or through the latter areas.

Identifying and Ranking Population Centers and Other Travel Generators

The procedure for rural functional classification, as outlined in this subsection, initially involves connecting traffic generators in such a manner as to logically channelize the trips on the road network. Since most trips begin or end in a city or town, population centers are the primary traffic generators considered. However, since travel is also generated by recreation areas, such as national parks, ski resorts, lakes, and beaches, that have little resident population, instructions are included here for comparing the importance of these areas to that of a city or town.

The population of a place generally reflects its capacity for generating and attracting travel. Socio-economic factors, such as trade, employment, etc., may also indicate the importance of a place in relation to intercity travel. Urban areas of similar population and economic activity (and consequently travel generation and attraction) should be identified and service provided to them by routes of the same statewide functional system.

For this study, population centers should be ranked according to their estimated current population.1/ Available socio-economic data (e.g. sales tax receipts, retail trade, employment, etc.) may be used along with population in this ranking if the State feels that such factors are significant for the area under study. Each urban area should be treated as one center, even if several jurisdictional units are involved and even if part of the population is in an adjoining State.

1/ A list of agencies preparing current population estimates for the various States is given in appendix B.

Since this ranking process is one of the means of determining the population centers for which service by a particular functional system is to be provided, all places thought qualified for service by the major collector road or any higher system should be ranked.

Major travel generators other than cities, such as recreation areas (National and State parks, State fairgrounds, ski resorts, lakes, beaches, etc.) and military installations should be treated separately during the ranking process because of their unique, predominant land activity. Usual trip generation yardsticks, such as population, employment, and related factors which measure the socio-economic status of the area and its population, are not applicable to such generators because of their atypical travel generation potential. For example, National parks and State fairgrounds contain little or no resident population and, in general, contain no commercial or industrial activity other than facilities to serve tourists. Hence, these centers require that other data be employed during the ranking process.

For this study, the annual number of visitors to such a recreation area can be equated to an urban area's population as shown in figure III-1. The recreation area can then be grouped with population centers of similar trip generation potential, and service provided by the same functional system.

Where several recreation areas are located close together and can be served by only one possible route, such as on a coastal peninsula or in a mountainous area, the equivalent populations may be combined in ranking the area.

Visitation data for recreation areas administered by the State and Federal Governments should be available from the Bureau of Outdoor Recreation liaison officer in each State. A list of those representatives is included in appendix D.

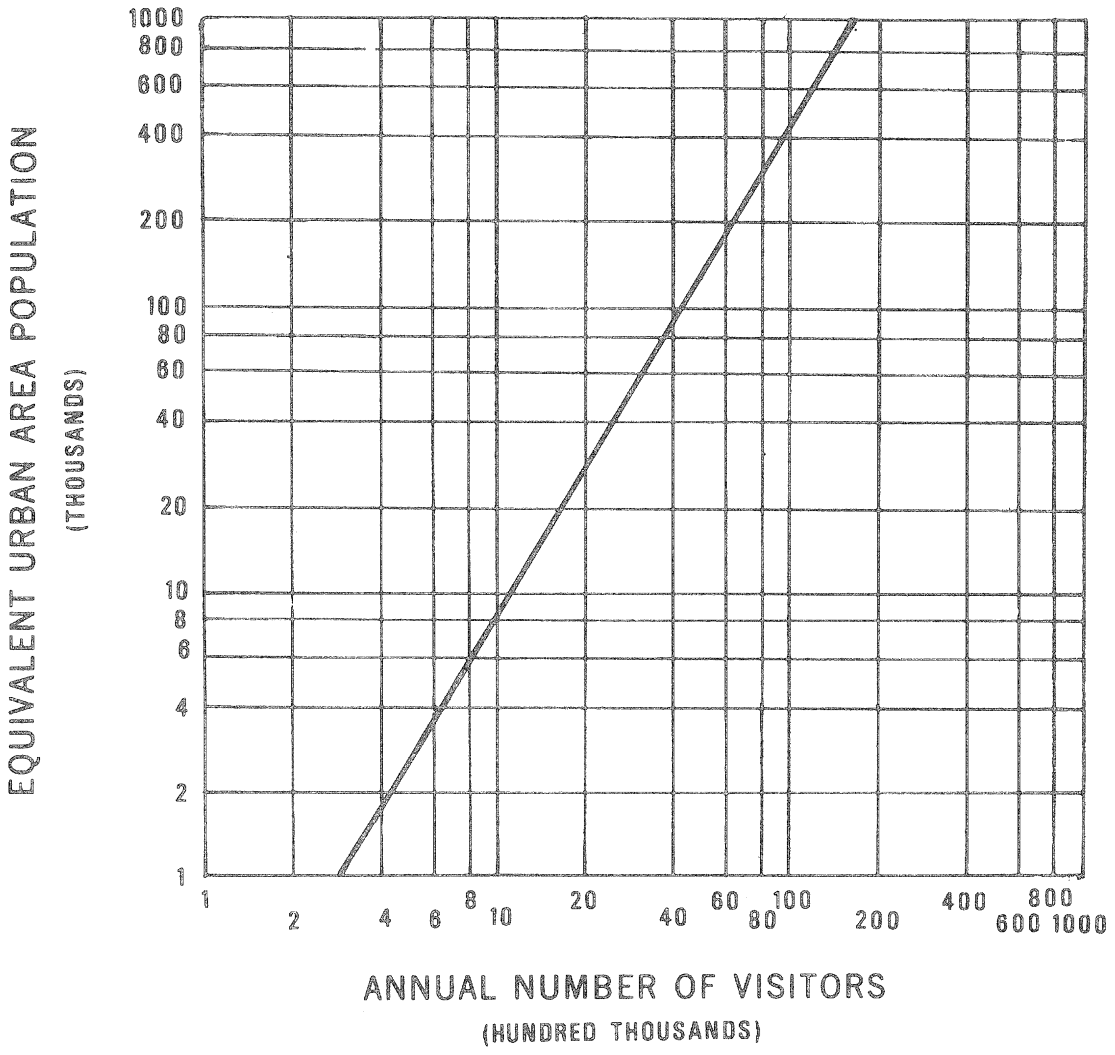
The importance of recreation and other generators can be inferred from traffic flow data if there are no other data available for ranking purposes.

Classification of Rural Systems

As stated earlier, the procedure for rural functional system classification initially involves connecting traffic generators in such a manner as to logically channelize the trips on the road networks. The preceding discussion explains procedures for ranking population and other centers of traffic generation. These procedures do not eliminate judgment from the classification process, but when used as a guide they do help to apply judgment in a sound and orderly fashion.

FIGURE III-1

VISITATION VS. EQUIVALENT POPULATION
FOR RANKING RECREATION GENERATORS



Rural principal and minor arterial systems

The procedures for functional classification of rural roads into the principal arterial and minor arterial systems are described in the following enumerated steps:

1. One of the initial steps in the classification of rural routes is the preparation of road network maps. Maximum use should be made of existing maps although reference to administrative or jurisdictional systems should not be considered in the classification process. The instructions for preparing the final documentation maps to be submitted for this study are discussed in section IV.

2. Rank travel generators as described in the immediately preceding pages. Plot generators graphically, in order to ranking, and divide into groups, with centers of similar rank in each grouping, as illustrated in figure III-2. While no hard and fast rules apply, six to eight groupings will usually be typical. Too many are better than too few, particularly toward the lower end of the scale. This ranking and grouping will aid in determining which centers qualify for minor arterial service or major collector service, and which will be adequately served by minor collector roads.

3. Identify pertinent travel generators in adjoining States. Judgment should be used in selecting the centers to be included. Larger out-of-State generators have traffic attraction relationships over a considerable distance while smaller out-of-State generators may be of influence only when close to the State boundary. Fit these selected out-of-State generators into the appropriate size group determined for the in-State generators in Step 2 above.

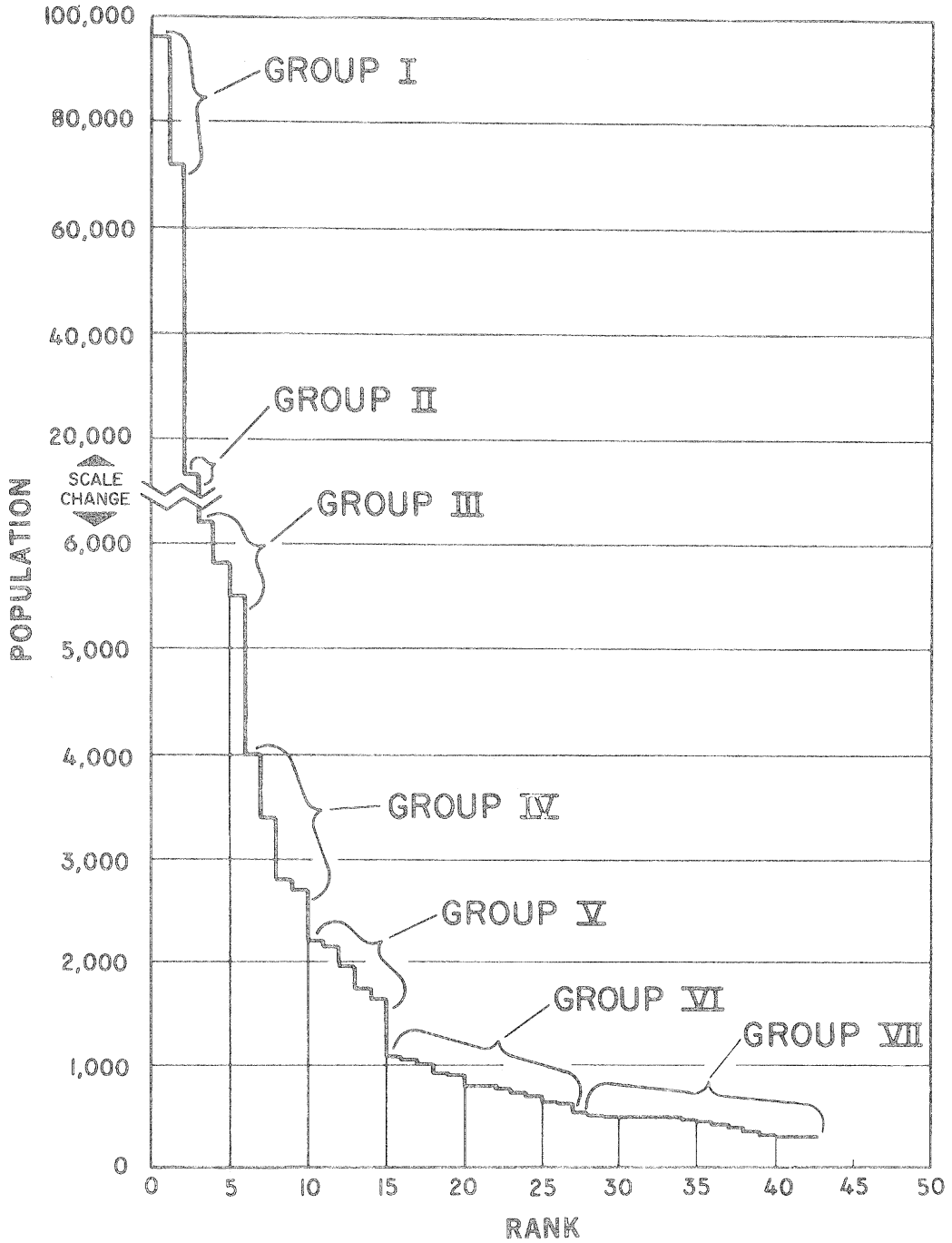
4. Develop a map symbol (a simple open or lightly shaded circle) for each size group of travel generators, with the size of the map symbol indicating the population range of centers in the group. Plot the generators on a statewide map. A tracing overlay superimposed on the statewide road map is recommended. The few pertinent out-of-State generators which may fall outside the State map can be dealt with by plotting them on a regional map. Once the appropriate routings to the out-of-State generators have been selected, they can be shown on the statewide map by placing arrows at the State line.

5. Delineate present (1968) urbanized area boundaries on the statewide map as accurately as possible. (Subsequent accurate mileage determinations will probably require reference to large-scale maps, particularly when measuring mileages within urban limits.)

6. Delineate the sections of rural Interstate routes that are completed and open to traffic and the traveled-way routes necessary to provide continuity for the Interstate System.

FIGURE III- 2

GRAPHIC RANKING AND GROUPING OF TRAVEL GENERATORS
(FOR A TYPICAL STATE)



7. Select the remaining rural principal arterial routes and, following that, the rural minor arterial routes, in a general sequence that will "work down from the top" to reflect a gradation of the following route characteristics, considered in combination: (a) Size of travel generators connected; (b) predominant travel distances served; and (c) size of tributary area or "travel shed" served. The term "in sequence" does not mean an exact numercial ranking of routes since in many cases several routes may be deemed nearly equal in the above characteristics.

The size of the travel generators being connected has been visually symbolized on the map. The predominant travel distance and size of the tributary area or "travel shed" can be inferred visually from the size of centers served, their spacing and orientation, and the size and shape of traffic flow bands of traffic maps.

Judgment must be exercised in determining which, among all possible connections, should be made, especially when dealing with medium sized and smaller centers. It will be helpful to keep in mind that this procedure is based on an indirect and inferential approach to the traffic attraction between centers. Therefore, the traffic flow map will help to indicate which, of all possible connections, is the most significant for the level or size of center being considered. When medium and small sized centers are under consideration, a connection with the nearest larger center is usually more significant than a connection with a center of equal size. Where alternatives are equal in terms of mileage, the most heavily traveled and the better improved route should normally be selected.

The termini for the routes being added to each system should be selected so that a continuous system is always maintained (i.e., each route is connected to routes of the same or higher level system).

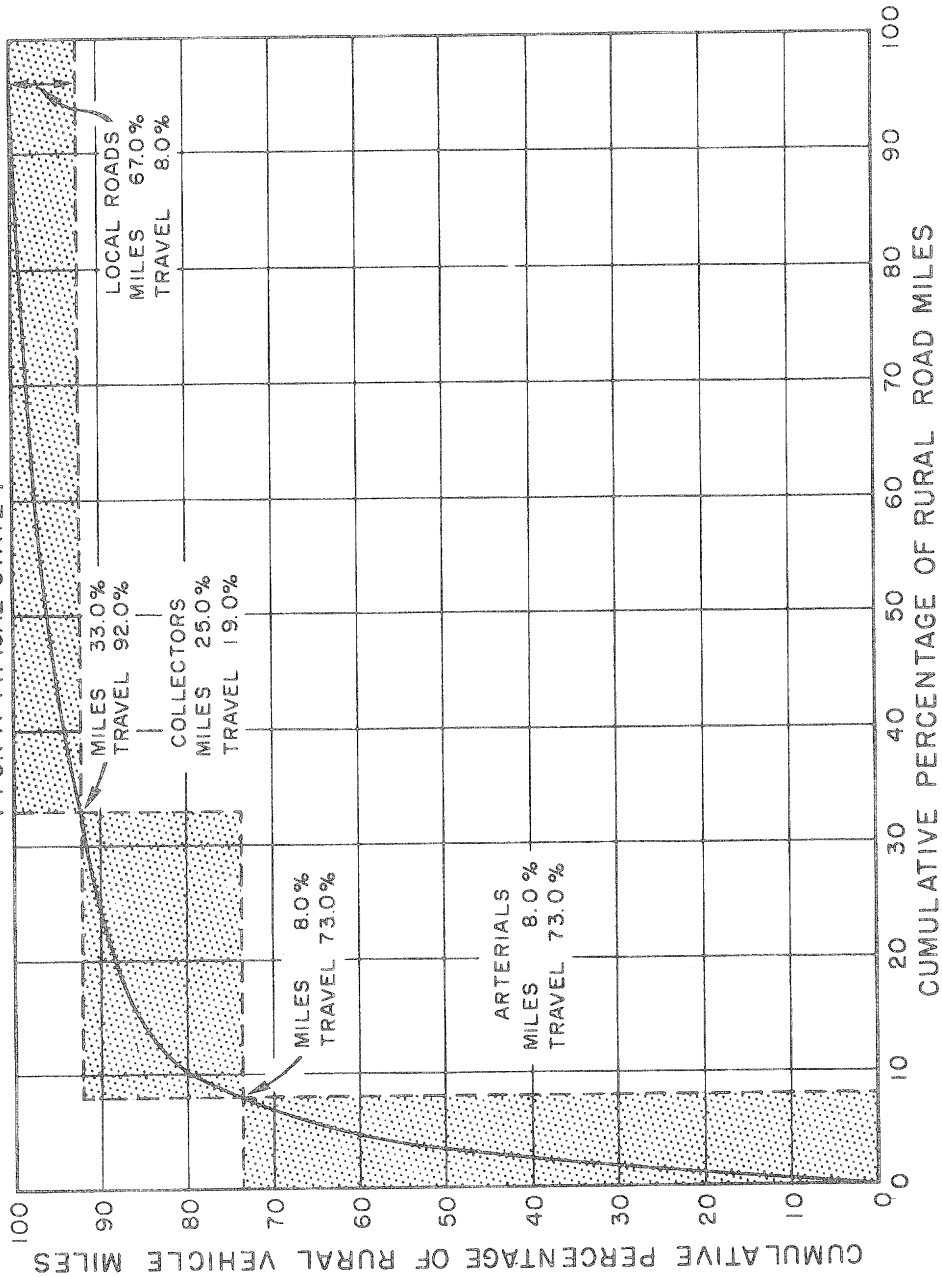
8. Determine the total length of the rural principal arterial system in accordance with the system characteristics and the guide on system mileage extent in section II, page II-13.

9. Determine the lower size limit of population centers to be served as a group by the minor arterial system. In the criteria for this system, the diminishing returns concept is mentioned. This means that in adding routes to a system, a point is reached at which the rate of increase in mileage begins to exceed markedly the rate of increase of highway service, indicating that the lower limit of the system under consideration has been determined. Figure III-3, on which cumulative system mileage has been plotted against cumulative service as measured by vehicle-miles of travel, is an illustration of this concept.

FIGURE III-3

PLOT OF CUMULATIVE ROAD MILEAGE VERSUS CUMULATIVE VEHICLE MILES SERVED

(FOR A TYPICAL STATE)



The concept illustrated in Figure III-3 can be applied during the classification process by visual evaluation of the system map in conjunction with basic data on traffic flow and population. The following considerations, used in conjunction, should apply. First, as indicated in section II, page II-13, a combined mileage of rural principal arterial and minor arterial classes of between 7 and 10 percent of total rural mileage is the normal maximum extent. Considering this as the limit being approached, then: (1) Would adding routes to serve a next group of smaller generators result in adding a considerable mileage of routes carrying, as a group, substantially less traffic than routes already added? (2) Is the radius of traffic attraction of this next group of smaller generators, as implied by their size, their distance from larger generators, or by traffic flow data, substantially less than that of places already served? If the answer to either question is yes, than a logical lower limit of the minor arterial system has been reached, as far as service to travel generators is concerned.

10. Add such other routes to the minor arterial system as are required by the defined system characteristics. Such routes will include:

(a) Service to corridor movements with trip lengths and volumes equivalent to those of routes already added, as determined from traffic flow maps.

(b) Service to all areas of the State, with spacing of routes at reasonably consistent intervals, as tempered by consideration of population density.

(c) Such additions as are clearly needed for adequate statewide continuity (but only where significant travel patterns serve to justify them).

11. Inclusion in the system of additional alternative routes is a problem that will occasionally arise. In most cases a single connection between two centers is all that is needed. Some instances where alternative routes may have to be considered are:

(a) Where two apparently alternative routes are separated by geographic barriers and each is needed for minor arterial service to some qualified intermediate center or for connection to another intersected minor arterial route.

(b) Where one major facility is a parkway from which commercial vehicles are excluded.

(c) Where the total traffic volume cannot practicably be handled by one facility.

(d) Where one facility is a toll road.

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12. Those States having a computerized statewide traffic assignment network and a travel model may use trip service characteristics (average trip length and volume-trip length index) to evaluate the rural arterial systems. The recommended computerized approach, discussed on pages III-26-28 for urbanized areas should be applicable for this rural system analysis as well.

Rural collector system

The step-by-step procedure just described for laying out the rural principal arterial and minor arterial systems can be extended in a qualitative sense, to the development of the rural collector system. However, precise quantitative data as to size of traffic generators and amount of traffic movement are usually not available to the same degree at the collector level. Also, population density and distribution and basic road patterns vary widely at this level. Accordingly, the procedure as described here is somewhat more generalized than that described for the higher systems. In any case, it should be borne in mind that what is being laid out is the backbone network of traffic circulation at the county or local level.

Before selecting any routes for the rural collector system a preliminary visual and mental assessment of the entire local picture should be made, considering the following:

1. Location of population centers (including county seats) not already served by the higher systems.

2. Location of important local traffic generators other than population centers: consolidated schools, shipping points, county parks, etc. Aerial photographs, where available, should prove helpful in locating these local traffic generators.

3. Location of any heavier-than-average corridor movements within the county, from traffic flow data.

4. Location of existing freeway interchanges or important river crossings that may be key location controls with regard to the collector system.

5. Rural population and land-use distribution within the county as regards uniform or nonuniform density of development.

Selection of major collector routes.--In many instances, selection of a few major collector routes can be made and shown on the statewide map which has been used to delineate the arterial systems. This is a practical matter of working with whatever map offers the most convenient scale. Completion of the collector classification, however, should be done on maps of county scale, preferably those of the county highway planning series. A mosaic of maps of the county being

classified and the bordering counties will be helpful in determining the function of routes crossing the county line. The designated principal arterial and minor arterial systems and any collector routes already designated on the statewide map should be transferred to the county map before any additional routes are selected. The major collector routes should then be selected to accomplish the following:

1. Connect the county seats and the larger population centers not served by the higher systems with such systems and/or directly with nearby larger population centers served by those higher systems.

2. Link the more important local traffic generators with nearby population centers or with this or a higher system.

3. Serve corridor movements with traffic volumes and trip lengths comparable to those of major collector routes already selected.

Selection of minor collector routes.--The routes selected up to this point serve to connect population centers and other traffic generators of like magnitude. However, there will be many areas with clustered residents at considerable distance from the previously selected systems. Within reasonable economic limits, minor collector or "spacer" routes should be designated to serve these areas, interconnect the small communities, and link the locally important traffic generators with their rural hinterland.

These "spacer" routes should be selected so as to provide approximately equal distance between arterial or collector routes for equal rural population densities so that equitable service is provided to all rural areas of the State. The approximate population density within each area bounded by major collector or arterial routes can be determined, either from census data or by an approximate house count from the county highway map, and the existing spacing of routes already selected can be measured. Areas with poor service can then be identified by comparing those data with a table of desirable collector spacing (miles between routes) versus population density (people per square mile) and additional routes selected and added to the collector system where necessary.

Local rural roads

The remaining rural mileage not otherwise classified as principal arterial, minor arterial, or collector should be assigned to the rural local road system.

FUNCTIONAL CLASSIFICATION PROCEDURES FOR URBANIZED AREAS

Introduction

This subsection of the manual presents a procedure which can be used to develop functionally classified street and highway systems in urbanized areas. No such procedure can be used mechanically or without judgment. Rather, it is intended to serve as a guide, and if proper application is made of the definitions and criteria, the resultant systems will be fully appropriate for this nation-wide study and should provide an excellent base for local transportation planning.

It should be mentioned at the outset that the procedures presented in this section are suggested as a logical approach to urban functional classification. They are designed to conform with the needs and capabilities of most of the urbanized areas. For those areas in which all of the procedures outlined here cannot be followed, the suggested methods may still be adhered to as closely as available data permit. (It is recognized, for example, that application of the volume-trip length index outlined later in this subsection will not be possible in all urbanized areas.)

Listed below are the basic steps which comprise the suggested procedure for functional classification in urbanized areas (each step is discussed in the following text):

1. Determine and map the urban area boundary.
2. Map the road network.
3. Perform a preliminary classification of the total arterial system.
4. Classify the final arterial system.
5. Classify the principal and minor arterial street systems.
6. Substratify the principal arterial system.
7. Classify collector and local streets.

Classification Procedures

1. Determine and map the urban area boundary

The determination of the urban area boundary is discussed under "Statistical Area Definitions" on page IL-4 of the manual.

2. Map the road network

A base map should be prepared containing the street and highway network within the urbanized area as of December 31, 1968. Where possible, it may be desirable to include all streets: but as a suggested minimum, every facility which (by subjective determination) may possibly be considered as an arterial should be included on this map. In most urbanized areas, preparation of such a map will simply involve updating existing maps.

3. Perform a preliminary classification of the total arterial system

The preliminary classification is directed toward establishing a tentative division between arterials and all other streets and highways, based upon all available criteria. Where the choice between arterial and collector is borderline or unclear, the facility should be included in the preliminary arterial system. Resolution will come with more detailed analysis in the final arterial system classification when additional criteria may be applied.

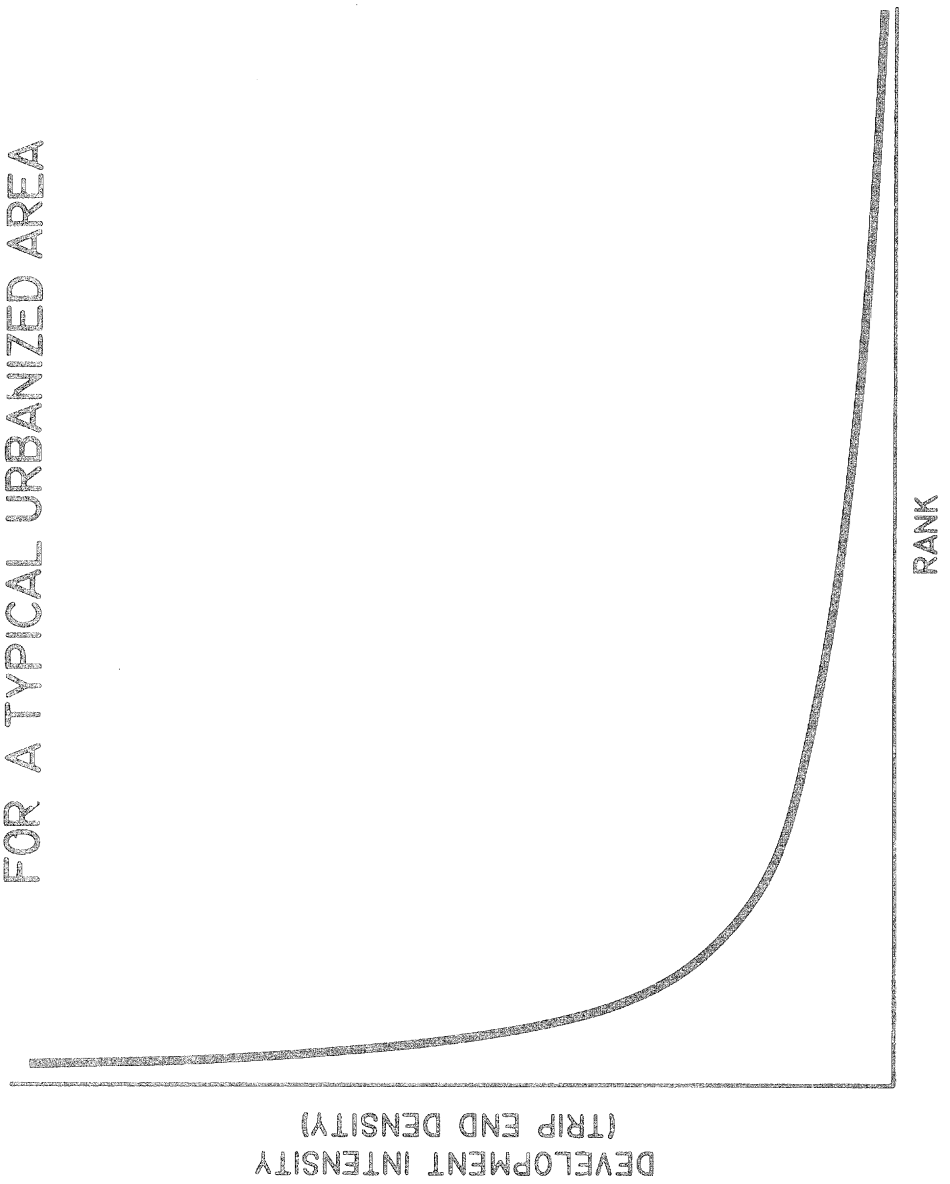
Functional system criteria are related to trips served, areas served, and characteristics of the facilities themselves. Within this basic framework, specific measures can be identified as being particularly applicable in assigning facilities to predefined functional classes. For urban functional classification, the criteria measures deemed most useful include service to urban activity centers, system continuity, land use considerations, route spacing, trip length, traffic volume, and control of access. Naturally, none of these can be applied independently, or to the exclusion of all others, in developing functional systems. It is hoped that as many of these as are feasible will be considered in arriving at a logical functional classification. The application of these criteria in classifying a preliminary arterial system is described below.

a. Service to urban activity centers

The greater the importance of an urban activity center, in terms of the nature and quantity of travel generated, the wider is its range of trip attraction and, therefore, the greater its need to be served by a higher type system. Some urban activity centers may be evaluated for relative importance by quantitative measures of size and intensity of use, such as number of employees, trip-end density, and the like. In determining the hierarchy of trip generation centers, it may be helpful to consider them in groups arranged according to such measures. These can be plotted from high to low, in the manner shown in figure III-4. Such an analysis may be useful in identifying the trip generators that should be served by each functional system. Typically, there are comparatively few very large generators in an urbanized

FIGURE III- 4

DISTRIBUTION OF DEVELOPMENT INTENSITIES
FOR A TYPICAL URBANIZED AREA



area and these should be served by the principal arterial system.

Where urban activity centers of social and economic importance to the area cannot be weighed quantitatively they should be identified, subjectively ranked, and appropriately served by the principal or minor arterial system as warranted. Subjective comparison of the relative importance of these centers to those of the first type may be helpful.

Centers appropriately served by arterials should generally include traffic generators of regional or community importance. These consist of the business districts of the central city as well as those of satellite communities, shopping centers, recreational facilities which serve larger than purely local areas, transportation terminals, industrial centers, large high-density residential developments, and the like. These travel generators may be considered to be served by arterials if such a facility passes within one-quarter to one mile of the limits of the activity center, depending upon the type of arterial and the size of the generator. All trip generators which warrant arterial service should be located on a suitable map or overlay, identified according to relative importance.

b. System continuity

The arterial system should be completely integrated, with stub ends occuring only at the urban area boundary (in which case they connect with a rural arterial or a rural collector) or in areas having unusual topographic features, such as sea coasts.

In rare instances system continuity should not be an absolute constraint for the functional classification of systems. Exceptions could be permitted where long-distance trips end at major centers, such as airports.

C. Land-use considerations

Land use is a primary consideration in functional classification, for the mosaic of existing land use largely governs overall travel patterns, travel density, and street spacing.

The transportation system is a major structural element of the community. It serves as a circulatory system providing travel mobility, but it serves equally as a skeletal system providing a relatively permanent framework which delineates and influences the pattern of land development, and within which residential neighborhoods and other land uses may develop and function. The preservation of neighborhoods, the stabilization of desirable land uses, and the encouragement of orderly development are among the basic considerations in the development of functional street systems.

The concept of streets as a land use is also important in functional classification. In the same manner that industrial activities usually make undesirable neighbors for residential districts, but make suitable neighbors for railroads, so must streets and traffic be viewed in terms of their impact upon as well as service to adjacent land uses. The classification of streets into functional types recognizes this and encompasses, at one extreme, local streets which furnish access to abutting land and discourage through-traffic movement, and at the other extreme, arterials which furnish a primary service to through travel and avoid penetrating identifiable neighborhoods where possible. Establishment of functional street systems and unification of these systems into a balanced network are basic to comprehensive urban planning and must be concurrently accomplished as an integral component of urban planning procedures.

Using suitable overlays on the base transportation network, maps should be prepared which identify all sizeable areas of similar land-use characteristics, such as industrial, commercial, institutional, open space, or residential. Maps such as this are readily available in most urbanized areas in a form requiring little or no additional work.

d. Spacing between routes

The geometric configuration of highway and street systems must be related to the spatial distribution of the activities to be served and to the density of traffic generated. Generally, the more intense the development, the closer the spacing required. In the less dense suburban portions of an urbanized area, neighborhoods tend to be larger than in the more dense central cities. These less dense areas will not require the same close spacing of facilities to serve traffic as the areas closer to the central business district (CBD).

Based upon these considerations table III-1 presents a general indication of desirable arterial spacing according to type of area. In addition, figure III-5 provides a measure of theoretical arterial spacing required to serve travel to varying intensities. It is recognized that neither the spacing guidelines included in the table nor the theoretical spacing reflected by the curves in figure III-5 will apply universally to the spacing of existing arterials. However, they may prove particularly useful in borderline cases where other criteria cannot fully indicate the appropriate functional class of a particular facility.

FIGURE III-5

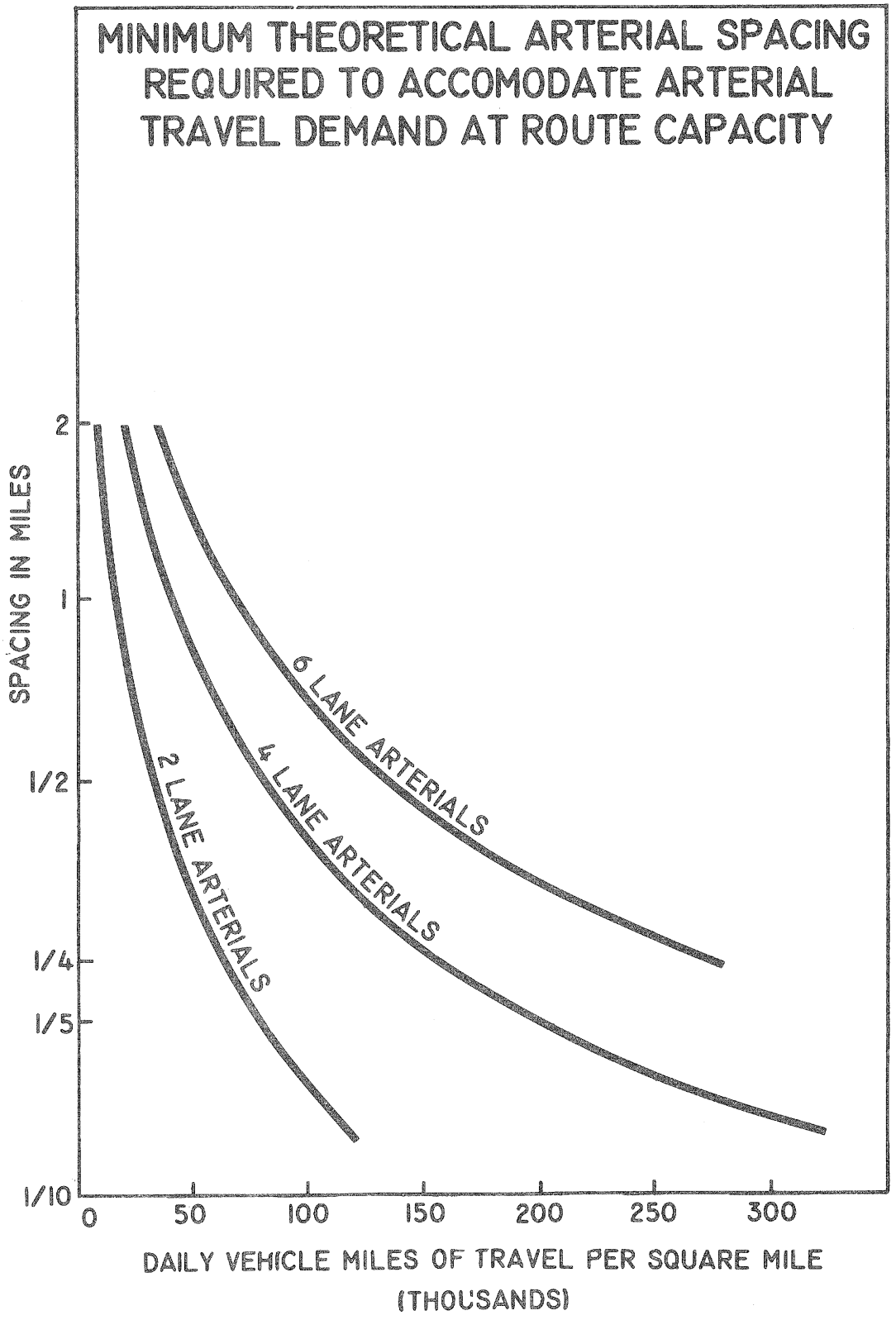

MINIMUM THEORETICAL ARTERIAL SPACING REQUIRED TO ACCOMODATE ARTERIAL TRAVEL DEMAND AT ROUTE CAPACITY
SPACING IN MILES
2
1
1/2
1/4
1/5
1/10
6 LANE ARTERIALS
4 LANE ARTERIALS
2 LANE ARTERIALS
0
50
100
150
200
250
300
DAILY VEHICLE MILES OF TRAVEL PER SQUARE MILE
(THOUSANDS)

Table III-1--Arterial spacing guidelines

Area type	Arterial spacing
Central business district.....	1/8 - 1/2 mile
Urban (central city except CBD)	1/2 - 1 mile
Suburban.....	1 - 2 miles
Lowest density development.....	2 - 3 miles

e. Average trip length

A basic assumption in assigning facilities to logical functional groupings is that higher order systems should generally serve the longest trips. Figure III-6 illustrates a characteristic high-to-low ordering of average trip lengths on segments of a highway network in a large urban area. Only comparatively few miles of urban streets and highways serve trips of any great length; a somewhat greater mileage serves trips of moderate length; and a substantial mileage serves comparatively short trips. The approximate break points between these trip-length groupings can suggest possible ranges of average trip length for each of the functional systems.

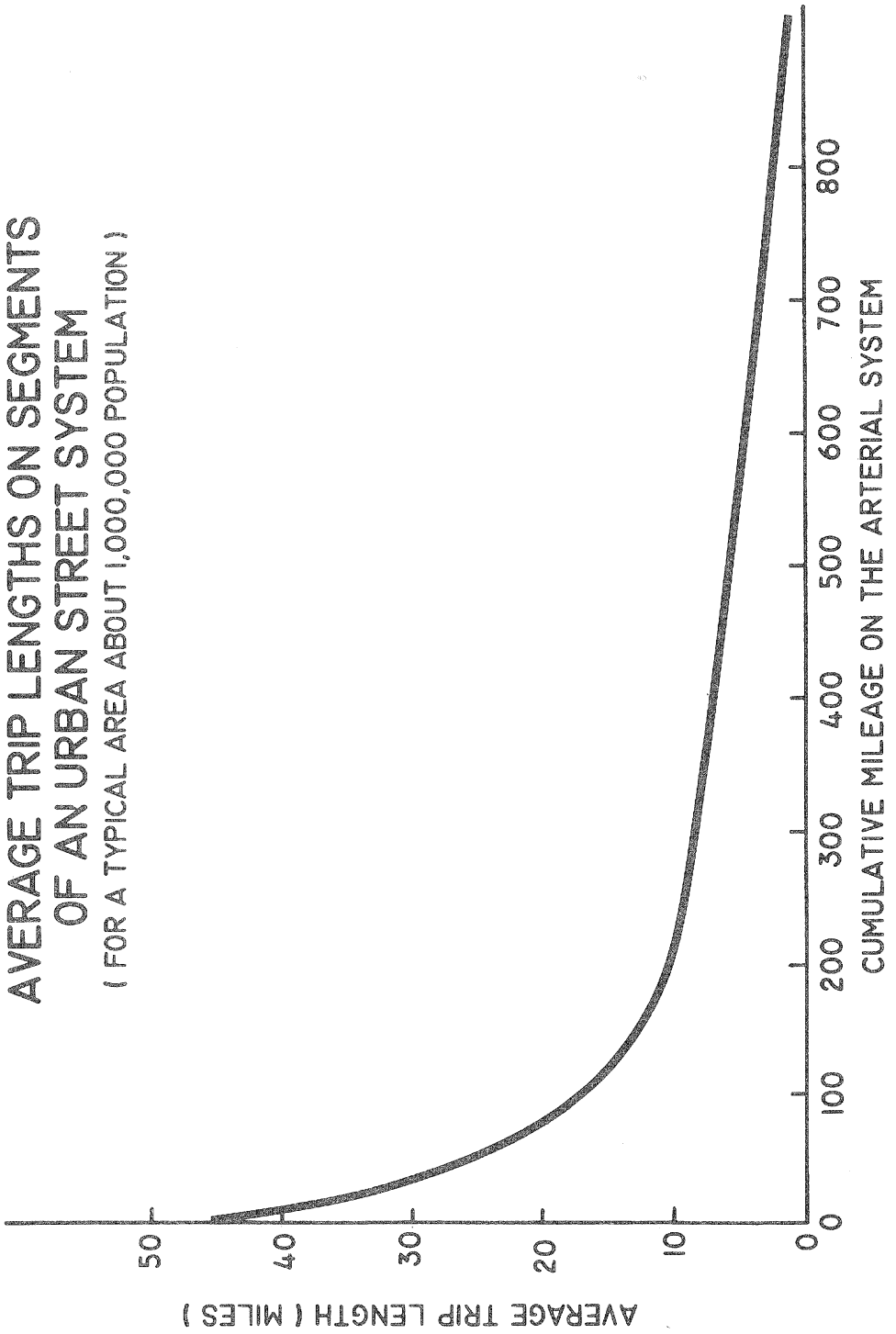
A quantitative measure of average trip length on a facility can be obtained if desired via the traffic assignment process, as described in appendix C. However, it is also possible to apply this criterion in a generalized way without the benefit of quantitative measurements. This requires a knowledge of the nature of travel served by individual roads. Facilities which serve relatively long trips (including trips passing through the urban area, trips between the suburbs and central city, trips between outlying communities, and long trips occurring within the central city) are likely to be functioning as arterials and should be considered for inclusion in the preliminary arterial system.

An exception in application of the average trip length criteroin lies in the existence of outlying minor routes which, by virtue of their distance from the metropolitan center, may carry an unusually high proportion of long trips; indeed, longer average trip lengths than on some principal arterials located closer to the center of the metropolitan area. Consequently, it is necessary to consider trip length within the basic framework of other criteria that reflect the other characteristics of a facility as well as the type of area the facility is in.

FIGURE III-6

AVERAGE TRIP LENGTHS ON SEGMENTS OF AN URBAN STREET SYSTEM

(FOR A TYPICAL AREA ABOUT 1,000,000 POPULATION)



f. Traffic volume

In functional classification, the routes with the highest traffic volumes are likely to be included in the highest type systems, although this is by no means a firm rule. To assist in developing specific volume criteria for an individual urban area, it is suggested that a list of volumes on individual route segments be plotted (from high to low) against the mileage of routes included as shown in figure III-7. Notice that there are usually relatively few miles of the system that carry high volumes and a modest mileage carrying moderate volumes, but that most mileage comprises low-volume routes.

Most high-volume streets and highways in an urban area function as arterials. But there are exceptions, notably in intensely developed areas where high-volume facilities function as collectors, serving traffic movements between local streets and arterials, or providing a high degree of direct access service to abutting property. For example, some roads which border on large traffic generators may carry proportionately high volumes of traffic while functioning as collectors.

To use the volume criterion as an aid in establishing a preliminary arterial system, it is desirable to have traffic volume data on all segments that probably will be classified as arterials and on all or most facilities which will eventually comprise the "upper" portion of the next lower functional class of roads. This is necessary for determining the approximate volume range in which the break between arterials and collectors occurs (considering the exceptions noted above), as exemplified by the curve in figure III-7. Traffic volume flow maps as well as a rank order distribution of road segments based upon volume can also assist in the analysis.

It is not intended that traffic counts be made specifically for this analysis. Rather, it is hoped that extensive use will be made of the most recent data already available.

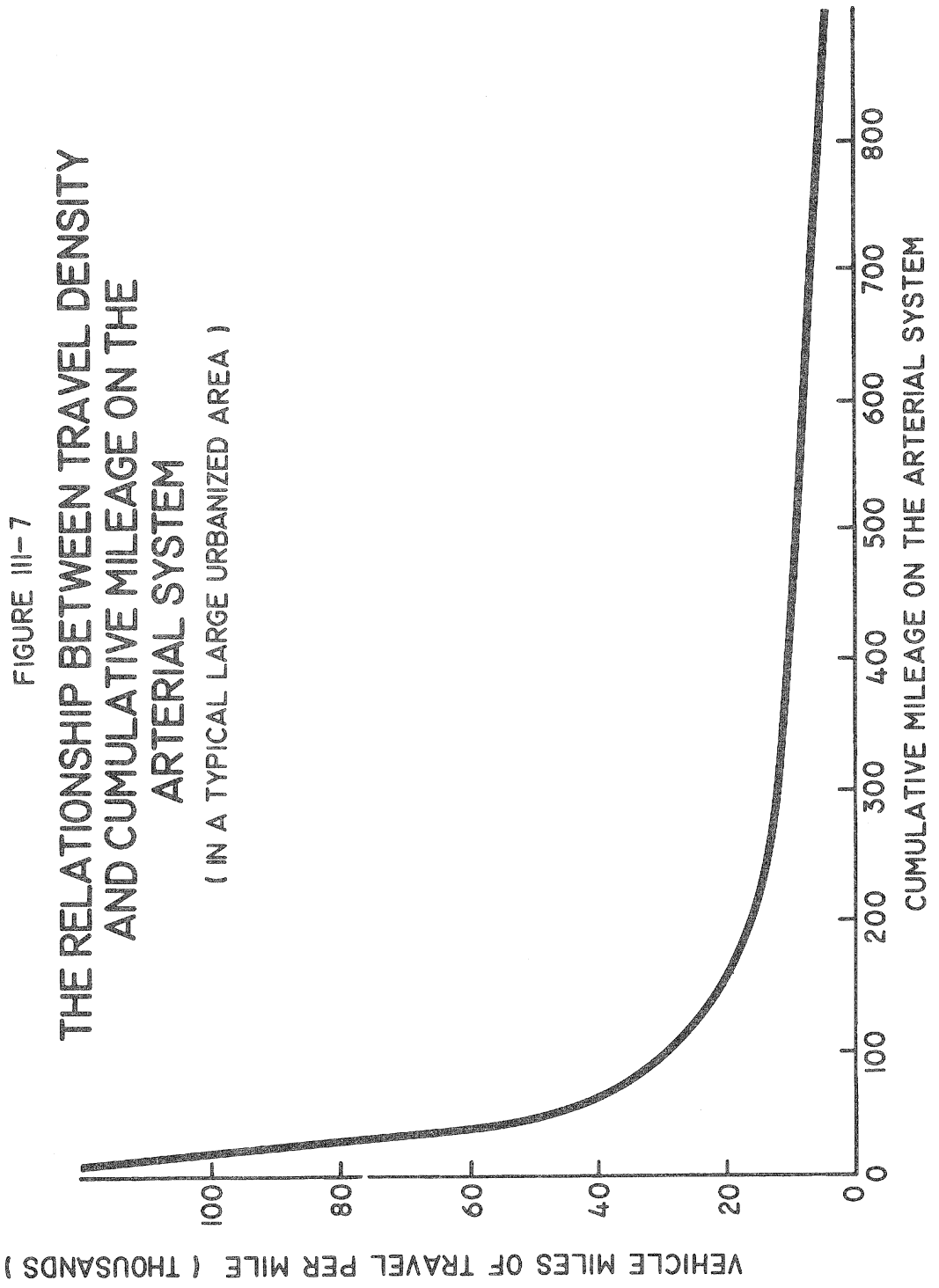
g. Volume-trip length index

Certain disadvantages were noted in the use of traffic volumes and average trip lengths as criteria for functional classification. These problems can be reduced, and best advantage obtained, when the two criteria are combined into a single one, the volume-trip length index (VTLI). VTLI is simply the product of the average trip length of the traffic on a particular route segment multiplied by the average daily traffic volume (ADT) on that segment. For purposes of selecting the preliminary arterial system, however, use of the separate traffic volume and trip length criteria is sufficient. The application of the VTLI criterion measure is described fully in steps 4 and 5g.

FIGURE III-7

THE RELATIONSHIP BETWEEN TRAVEL DENSITY AND CUMULATIVE MILEAGE ON THE ARTERIAL SYSTEM

(IN A TYPICAL LARGE URBANIZED AREA)



h. Control of access

Control of access is perhaps the easiest criterion to apply, since facilities with full or partial control of access will almost always be in the arterial class. It may therefore be advantageous to delineate these facilities at the very outset, thereby providing for a convenient starting point in defining a preliminary system of arterials.

i. Vehicle-miles of travel and mileage

The extent of vehicle-miles of travel and system mileage to be included in the preliminary arterial system classification should be on the high side of the values entered in table II-3, page II-15. This will be the natural outcome of including in this system all facilities about which serious question remains as to whether they are arterials or collectors. It is logical to include such facilities initially in order that they may be subjected to the more stringent analyses described in step 4.

4. Classify the final arterial system

The result of the preceding phase of the urban functional classification procedure should be a first approximation of an arterial system. At this point a reevaluation of the preliminary system is undertaken in order to define a final system of arterials.

The procedure used to determine the final arterial system will be highly dependent upon individual study circumstances. In cases where the preliminary arterial system is judged to be adequate, with relatively few facilities in question as to whether they logically function as arterials or collectors, this phase in the analysis may only involve a refinement of the application of the criteria described in step 3. In cases where there are numerous questions regarding the proper functional classification of facilities (arterials versus collectors), several options are available depending on the status of the transportation planning process. Where a particular transportation study's computer network extends beyond arterials to include collectors, the volume-trip length index criterion may be applied to resolve the functional designation of facilities which, according to all remaining criteria, are borderline cases between arterials and collectors.

Where the computer network does not contain a significant number of links which were selected in the preliminary arterial system, a decision will be required as to whether link additions should be made, or whether the existing computer network will be used as is. If missing links are not added, it will still be possible to determine volume-trip length indexes to aid in establishing the split between principal and minor arterials described in step 5.