TWENTY-FOUR YEARS OF PROGRESS

In

HIGHWAY DEVELOPMENT

1924 - 1948

A SUMMARY OF PERFORMANCE

In

PLANNING, DESIGN AND CONSTRUCTION

By

THE DEPARTMENT OF HIGHWAYS

Of

THE DISTRICT OF COLUMBIA

*****

Prepared and Published

By

The Department of Highways

Washington, D. C.

This publication is dedicated to the memory of an Engineer who, as Engineer of Streets from 1931 to 1941, directed the activities of the Street and Bridge Divisions, and was largely responsible for the progress made during the last quarter of a century.

LEONARD PAUL ROBERTSON

1887 - 1941

Leonard Paul Robertson rose from the grade of Chainman, which he held in 1907, to become the head of the Street Division. His professional ability, leadership and efficiency fostered a spirit of loyalty among his employes, and raised the efficiency of the Division to a high degree. He made possible the accomplishments outlined herein by the present staff of the Street and Bridge Divisions.

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FOREWORD

What is the present highway situation in the District of Columbia?

What is being done to provide highway facilities adequate to meet future requirements? What has been done in the past to anticipate the great traffic burden now being borne by our highway transportation system?

These are questions which have no doubt occurred to many of us, particularly to the motor vehicle owner, who finances such improvements through gasoline taxes and fees, and to members of the Congress who have so understandingly provided the necessary legislation and appropriations, and who in return must expect results from those entrusted with the planning and execution of this work.

If all of us were highway engineers and had a knowledge of the many factors which go into the planning, financing, and execution of highway development programs, this summary of the activities of the District of Columbia Department of Highways over the past twenty-four years could be briefer. However, since we cannot all be familiar with highway engineering, this report has been prepared in somewhat more detail, hoping it will indicate that the trust and responsibility reposed in us have not been misplaced and that they have been discharged faithfully.

The title for this report, "Twenty-Four Years of Progress in Highway Development", was selected because the first gasoline tax was imposed in the District of Columbia just twenty-four years ago. By coincidence, this period approximately covers the tenure in office of most of the personnel, now in key positions, who have

contributed so much of their talents and skills, and who have made these accomplishments possible.

The planning and construction of an adequate highway and bridge system is not alone a question of proficiency in mathematics and engineering. A far more important element is experience or "know-how" which can be acquired only through many years of actual work in the planning and execution of urban highway improvements. We have been very fortunate in having in our organization numerous employees in key positions who have gained such experience through long service in the Department. The work we have accomplished is in large part due to the loyalty and constant interest of these employees, and a word here concerning them is considered proper.

The following employees have been in the District of Columbia Highway Organization for varying periods, in some cases exceeding the period covered by this report. While it is not our intention to extoll the virtues of these employees, their contribution to these accomplishments has been great and it is appropriate to acknowledge this fact here.

	Administrators	Years Service
Herbert C. Whitehurst	Director of Highways	22
John N. Robertson	Deputy Director of Highways	31
Samuel R. Harrison	Deputy Engineer of Streets	27
Harry R. Howser	Engineer of Bridges	31
	Engineers	
Leland M. Hedgcock	Chief of Construction & Design	23
Harold F. Clemmer	Engineer of Tests and Materials	18
Albert Green	Resident Engineer (Bridges)	13
Joseph G. Rousseau	Asst.Chief of Construction & Design	29

Engineers		Years Service
Judson A. Sencindiver	Asst. Chief of Construction and Design	28
Lewis R. Watson	Office Engineer	28
Douglas S. Brinkley	Chief Planning Engineer	23
John J. Curtin	Chief of Assessment & Permit	44
Leo A. Haller	Chief of Finished Concrete	31
John F. Hoover	Chief of Special Projects	23
John R. Neate	Engineer of Major Finished Concrete	32
Kenneth W. Cole	Engineer of Major Finished Concrete	28
Philip T. May	Engineer of Major Finished Concrete	23
Joseph T. Elbert	Engineer of Contracts	40
James Joseph Sweeney	Resident Engineer (Bridges)	28
Miles F. Rouse	Chief of Bituminous Unit	25
William R. MacGregor	Chief of Sheet Asphalt Unit	36
James C. Wade	Engineer of Alleys	25
Thomas E. Lepson	Engineer of Sidewalks	25
Joseph D.A. Handiboe	Engineer of Asphalt Widening Projects	25
Charles Vogel Brown	Engineer of Building Grades	30
Boyd F. Rohrback	Engineer of Basic Grades	24
Ralph W. Wilton	Engineer of Plant Inspection	29
Arthur W. Clark	Design Engineer (Bridges)	20
Medford C. Frazier	Engineer of Minor Finished Concrete	20
Reverdy Donaldson Marcey	Engineer of Curb and Gutter	21

Maintenance Superintendents		
Roy L. Bourgeois	Superintendent of Maintenance	27
Harry A. Key	Asst. Superintendent of Maintenance	29
William B. McKinney	Asst. Superintendent of Maintenance	21

Inspectors & Engineering Aides		
Morris A. Gainey	Chief Inspector (Street Division)	43
Dennis J. Fitzpatrick	Inspector	42
Joslyn W. Minckler	Principal Inspector	18
Cornelius Cain	Inspector	34
Walker M. Moore	Principal Inspector	20
Ralph H. Dick	Inspector	32
Leman H. Nevitt	Engineering Aide	29
George S. Wilson	Inspector	24
Lester Howard Stull	Engineering Aide	23
Arthur M. Isherwood	Inspector	21
Joseph M. Wetzel	Inspector	21
Howard C. Jenkins	Inspector of Utility Cuts	20
Clayton B. Donaldson	Inspector	20

Inspectors and Engineering Aides		Years Service
Paul M. McMurry	Chief Inspector (Bridge Division)	20
William L.Travers	Principal Inspector	20
George E. Travers	Engineering Aide	20

Special Assignments

William Lissek	Administrative Officer	21
Constantine Chase	Purchasing Clerk	43
Percival G.Melbourne	Chief Draftsman	20
Frank J. Neff	Administrative Assistant to Director of Highways	26

Foremen, Overseers, Bridge Operators, Guards

Andrew Mullen	Foreman	45
John J. Mahoney	Foreman	29
George E. Mullen	Foreman	25
Marshall G.Henderson	Foreman	25
Dorsey L.Reynolds	Foreman	24
Louis F.Woods	Foreman	22
John E. Dell	Foreman	21
John Naylor	Foreman	20
Emmet H. Hidey	Foreman	20
Howard C.Jenkins	Foreman	20
Julius Morcock	Overseer	27
Edward Williams	Overseer	25
Robert E. Sherry	Bridge Operator	40
George Ricketts	Bridge Operator	22
William M.Clampitt	Guard	21

Still other employees, no longer with the Department, due to death or retirement, contributed to our accomplishments, through long and faithful service and we wish to chronicle here our thanks for their efforts.

Engineers & Superintendents		Years Service
C.B. Hunt	Engineer of Highways	40
*Clifford R.Whyte	Engineer of Bridges	36
*Leonard P.Robertson	Engineer of Streets	34
J.W.Dare	Construction Engineer	49
*Lloyd D. Smoot	Engineer of Structures and Grades	45
E. G. Emack	Engineer	37
Henry G. Darling	Engineer	41
L.R.Grabill	Engineer of Maintenance	33
William W.Curtiss	Engineer	42
Charles E. Wager	Engineer	19
William B. Champion	Engineer	30
Stuart John Gass	Engineer	39
Aloysius S.Fennell	Engineer	44

Engineers & Superintendents		Years Service
George Lawrence Quinn	Engineer	40
Christopher Armat	Engineer	37
Frank B. Couch	Superintendent of Cuts	26

Inspectors

*Samuel R. Beall	Principal Inspector	21
Walter L.Hoover	Inspector	30
Charles F.Myers	Inspector	39
Frederick P.Causey	Inspector	21
Edmund B.Coolidge	Inspector	25
Philip B.Darling	Inspector	23
Clarence E.Fisher	Inspector	37
William P.Hanlon	Inspector	20
W. M. Barton	Inspector	40
Harry T. Wallace	Inspector	21
Frank A. McNamee	Inspector	25

Overseers, Foremen, Guards and Others.

Presley Griffin	Bridge Overseer	21
William W. Swaggart	Overseer	30
John William White	Foreman	33
G. B. Brady	Foreman	18
Andrew J.White	Foreman	39
Darius Gaskins	Foreman	35
William Lee Britton	Foreman	28
*Eugene Lynch	Foreman	31
Albert C. Berger	Foreman	23
John H. Grove	Foreman	26
*John T. Creegan	Foreman	16
Almanza S. Lindsey	Draw Operator	21
William S. Hull	Watchman	21
Charles Mottern	Guard	19
Marion H. Lynn	Computer	22
E. S. Greenwell	Chief Clerk	39
*Robert J.Johnson	Master Mechanic	46

* Deceased in service.

Many changes have taken place during this twenty-four year period. These changes are evidenced not only in the growth of the city of Washington and in new transportation methods due to mass adoption of the motor vehicle, but also in the internal organization of the Department and in procedures and techniques, so as to keep pace with the accelerated tempo of the times. The impact of motor vehicle use and city growth on the Department

and its resources was tremendous. The need for modernizing our internal organization, which will be described in more detail in the following pages, had to be foreseen and the Department gradually perfected itself as we moved along into this streamlined age.

One of the most important of these changes was the establishment and development of evaluating procedures to predetermine the highway requirements of the District of Columbia, including adequate connections to the roadway system of adjacent areas of Maryland and Virginia within the Washington Metropolitan Area. We distinguish between "highway development planning" and "city planning", The Department of Highways is concerned with the former and not the latter, except in the matter of adherence to master city plans in the formulation of development programs. The Department, through its Highway Planning Unit, operated in cooperation with the Public Roads Administration, is constantly studying the travel habits and origins and destinations of persons and vehicles moving within our jurisdiction. Traffic volumes and other economic data, which are needed to forecast requirements and to plan the scope and sequence of construction, are collected and analyzed on a continuing basis. Indeed, it would be entirely correct to state that the Department of Highways is the agency within our jurisdiction which has a staff organized for and capable of forecasting the required capacity and planning the geometrics of projects in future highway development programs based upon up-to-date factual data.

P A R T I

A D M I N I S T R A T I O N

(A) Personnel and Organization: Early in the administrative and legal history of the District of Columbia, highway development received recognition as a major function. The Organic Act of 1878, which created a Commission consisting of three persons, including an officer of the United States Army Corps of Engineers, set a general administrative pattern for organization. In 1924 two important legislative acts affecting District highway administration were enacted namely, the original Motor Vehicle Fuel Tax Act, which levied a tax of two cents per gallon on gasoline, the revenue to be used exclusively for street and road improvement and repair, and the Classification Act of 1923, which required evaluation and classification of all statutory positions by the federal Personnel Classification Board.

The highway system of the District of Columbia includes all streets, bridge structures, alleys, and sidewalks in the District of Columbia, except those controlled by the Federal Government, mostly in the National Capital Parks. They have been located in accordance with the permanent Highway Plan, established by law and extended or modified from time to time by the District Government as approved by the National Capital Park and Planning Commission.

The District Commissioners approve the width and physical features of each project before it is actually constructed, usually in accordance with standards established by the U. S.

Public Roads Administration. The Highway Department determines the relative needs for various projects and establishes their priority. Accomplishment of any construction requires approval of the District Board of Commissioners, appropriation of funds by Congress, and actual collection of Highway Fund revenues with which to perform the work.

Any highway organization must perform planning, design, construction, repair, administration, and research functions. It should provide a basic organizational pattern which is stable and enduring, with orderly promotions of personnel within the organization, but it must also be adaptable to increased or decreased work-loads and to changing problems and concepts, as required. Highway procedures in any large municipal area require close coordination with other engineering activities and with public services, such as police and fire departments. Because the District of Columbia is the national capital, it is, in an architectural sense, a monumental city. Hence, the Department here cannot escape a special responsibility for upholding and developing the high standards of structural and esthetic adequacy which are appropriate to the capital of a great and progressive nation.

It is believed that this Department has demonstrated both basic soundness and sensitiveness to changing demands through the years. In the following pages some of the significant improvements will be high-lighted, and some of the unfulfilled plans for further progress will be indicated. We shall begin by comparing the organizational and functional patterns for 1924 and 1948, respectively, and then summarize some of the

important steps which have led to the present system.

(2) Comparison 1924 and 1948: In 1924 the forerunner of the present Street and Bridge Divisions was known as the Surface Division, headed by the Engineer of Highways. He supervised directly nine group heads: engineers in charge of street construction, bridge activities, and office engineering, respectively, superintendents in charge of repairs to city streets, suburban roads, and utility cuts, respectively, superintendent of stables, inspector of asphalts and cements in charge of materials inspection, and a chief clerk. The total personnel numbered sixty-two annual statutory positions, eight miscellaneous trust fund positions, and nearly five hundred per diem laborers.

In 1948 the Director of Highways is responsible for a broader program: Street and Bridge Divisions, which largely comprise what, in 1924, was the Surface Division, and in addition the Office of Coordinator of Surface and Subsurface Work, the Electrical Division, the Division of Trees and Parkings, and the Central Garage. The Street Division has been consolidated into three groups: Administration and Maintenance Section, Construction and Design Section, and Materials Section. The Bridge Division is composed of the Office Engineering Section, Field Engineering Section, Operations Section, and Maintenance Section.

(a) - Planning: Planning in 1924 included a visual inspection of requested or proposed projects by the construction engineers and the Engineer of Highways, to evaluate the need for new construction in terms of percentage of adjacent area already containing buildings, whether the street was a connecting link

between two sections of improved roadway, and the condition of the existing surface. The recommendations of the Engineer of Highways were subject to approval by the District Commissioners and action by Congress. Each project was authorized in the annual appropriation acts.

In 1948 planning is based partially on the subjective conclusions of experienced observation and judgment, but it relies increasingly on statistical data obtained and analyzed according to modern scientific methods by the Highway Planning Unit in the Administration and Maintenance Section. This unit is composed of three sub-units: Statistical Surveys, Plans and Development, and Publications, each with a small nuclear force capable of expansion whenever the program warrants. The Statistical Surveys Sub-Unit has four major functions, namely, (1) to collect numerical data regarding present traffic loads, turning movements, etc., (2) to collect numerical data regarding present desires for various traffic routes in the District, (3) to consolidate and interpret these data in terms of expected civic development, population trends, etc., in order to guide sound planning of directions and dimensions of the most needed highways, and (4) to establish and analyze a perpetual inventory of all paving in the District, in order to ascertain definitely the relationships between type of construction and durability of pavements, age of roadways and cost of maintenance, to guide annual programming of replacement projects and long-range economical planning of types of construction and other policy matters. This last-named function remains to be implemented, but has passed through most of the preparatory stages in cooperation with Public

Roads Administration. The functions of the Plans and Development Sub-Unit are (1) to ascertain the most economical locations for desired highway improvements and extensions, (2) to develop geometric designs for grade separations, surface channelization, and other projects, and (3) to prepare engineering exhibits regarding proposed major projects for presentation in public hearings, etc. The functions of the Publications Sub-Unit are (1) to compose textual reports, (2) to prepare photographic exhibits regarding the work accomplishments or the program proposals of the Department, (3) to arrange for printing, and (4) to maintain a library of publications regarding local and general civic planning problems and techniques. The personnel force of the Highway Planning Unit totals approximately twenty-five on a regular basis, but at present is being expanded to 150-200 for a temporary traffic survey project to be completed within the year. These objective statistical procedures for ascertaining paramount highway needs represent a far cry from the guess work upon which the administration had to rely in 1924.

(b) Street Design and Construction: The design and construction of streets a quarter-century ago were relatively simple. The construction work was performed by contractors, except for temporary surfacing by maintenance forces, using chiefly hand labor. Except for the avenues and downtown streets, most roadways were only thirty feet wide. They could be closed to traffic during construction without seriously disrupting traffic. Vehicular loads were lighter then. Relatively little was understood or attempted in the way of expansion-contraction joints, structural reinforcements, and special design features. Rather limited

drawings were prepared to guide the layout and the setting of grade pegs, to assure conformance with the basic grade plan established for the District Engineer Department many years before and to serve as construction records for future reference. Specifications were prepared for each contract. Supervision of the contractor's work was divided among three groups: (1) the engineering field parties, who conducted the surveys, prepared the drawings, specifications, and estimates, staked out the projects, and measured the finished work; (2) inspectors, who enforced the terms of the contract and the specifications regarding methods of work and materials received at the site; and (3) the Inspector of Asphalts and Cements, who operated a laboratory for testing the quality of paving materials and certified the materials which left the contractors' plants for highway jobs.

The engineering parties numbered seven or eight and each consisted of a highway engineer, who had risen from the ranks, and two field aides. One official who served as deputy to the Engineer of Highways, supervised all these parties. Since there were relatively few complications, in either design or construction, little review or guidance was necessary. Two field parties usually engineered new concrete paving, two or three resurfacing and widening of asphalt roadways, one sidewalks, one alleys, and one heavy grading projects.

Two regular inspectors, with some per diem assistants, were able to handle the street, sidewalk, and alley work, since seldom would contractors be doing the same thing simultaneously.

The Inspector of Asphalts and Cements supervised (according to the annual payrolls for 1924) three inspectors, one

laboratory assistant, and a skilled laborer, besides some per diem laborers.

In 1948 street design and construction are both more complex. The construction work (except for temporary surfaces) is performed by contractors, using heavy machinery. This not only means that more new line and grade pegs are needed each day, but also results in many pegs being disturbed, so that they must be re-established. Design is now a definite function, instead of being incidental to the construction. Because of greater street widths and complexity, the average project today requires more thorough application of mathematical design techniques than in 1924. Because every effort must now be made to keep heavy volumes of traffic moving, the sequence of work must be carefully planned, and special quick-setting mixtures used in intersections. Standard specifications, prepared and published by the D. C. Department of Highways, guide the design of structural features, joints, mix formulas, etc., modified as necessary by special provisions for a particular contract. On each project involving Federal Aid grants, the Public Roads Administration requires an entire set of detailed engineering drawings. This work is performed by four groups: the engineering parties and the Field Inspection Unit, both in the Construction and Design Section, the Drafting Sub-Unit in the Administration and Maintenance Section, and the Materials Section.

The number of engineering field parties has been doubled since 1924, being fourteen on a regular basis, with temporary expansion possible during periods of excessive work loads. Each party now consists of a highway engineer and three, instead of

two, engineering aides who perform subordinate design as well as construction work. The highway engineers direct the engineering surveys to locate lines, grades, obstructions, etc., in the field, adapt the geometric design of the Highway Planning Unit to the existing conditions, and develop all horizontal and vertical curves, curb features, off-set measurements, joint layouts, reinforcements, cuts, fills, special mixtures, construction methods and sequence, and any other details required in advance of the work. They also prepare the detailed contract estimates on which the bids are let and the work programmed, and notify property owners to perform any necessary underground work in advance of the paving. To obtain satisfactory results in 1948, a high type of employee is required. The present organization provides a chain of advancement, with minimum qualifications for each level, to attract and keep capable and ambitious men. Personnel turnover used to be very high in the subordinate positions, but since this organization was put into effect only one employee has left the Department, and that was to resume his college studies.

The Field Inspection Unit is a pool of ten regular inspectors and thirty per diem assistants. A chief inspector instructs them in uniform techniques and assigns them to various projects from day to day. They represent the project engineers on District work. They are responsible for carrying out the engineers' instructions, deciding minor details, and requiring conformance to the standard specifications, the contract terms, and accepted construction practice. In addition to District paving, these men also supervise highway construction performed for property owners in connection with housing developments, etc., by contractors

at private expense under permits granted by the District on a "whole cost" basis.

The Drafting Sub-Unit, under the Office Engineer, prepares the Federal Aid drawings, the plats, some of the working maps, and other drawings needed for the engineering projects. It also is responsible for keeping the"counter" maps current and accurate for public reference, checking data in the field and in the records of the Surveyor's Office. This force consists of a chief draftsman and six engineering draftsmen, ranging upward from apprentice.

The Materials Section inspects concrete aggregates, bituminous mixtures, soils, steel reinforcement materials, and construction equipment before their use in construction work. Other departments must reimburse the Street Division for non-highway inspections and tests. Now, instead of operating a separate laboratory, the Engineer of Materials obtains from the National Bureau of Standards or the Public Roads Administration laboratories whatever chemical or physical tests are required, except for certain field tests which must be made to guide the preparation or use of the materials pending official tests. Most of the Materials Section is still on a temporary basis. The organization is being crystallized into three units: Engineering, Inspection, and Administrative. The Engineering Unit, with its three sub-units, composed of eleven positions (including per diem), is responsible for soils mechanics, obtaining and interpreting tests, training inspectors, conducting surveys of materials performance under traffic, approving joint layouts, and developing standard specifications. The Inspection Unit, which includes from forty

to sixty positions in four sub-units, is responsible for accepting all materials at the plants or transportation terminals, inspecting concrete mixtures and soil compaction on the project sites, assuring the strength of concrete before traffic is permitted, and approving all equipment to be used in District construction. The Administrative Unit requires six employees to keep and correlate records, prepare vouchers for reimbursable tests and inspections, check vouchers from the Bureau of Standards, etc., and perform routine services.

(c) Bridge Design and Construction: The bridge program in the District a quarter-century ago was virtually at a stand-still. From 1922 to 1927 a single grade crossing was built. The engineering force consisted of the Engineer of Bridges, his assistant, and two aides. They were responsible for developing the design for all structures and for supervising the construction by contractors. In addition, the Engineer of Bridges, under supervision of the Engineer of Highways, was also responsible for the operation of draw-bridges and the maintenance of all District Bridge structures. It was the procedure during this pre-war period to wait until a project was authorized in appropriations before starting to design it. Then the development and checking of the design were rushed through like an emergency by many hours overtime each day. Whenever a consultant was hired, it was for consultation and review of the design, not for actual preparation of the entire set of drawings and specifications. The general type of structure and the estimated cost were determined on very short notice.

Bridge design today involves all the structural and architectural aspects present before 1924, and in addition carbon monoxide control features for underpass tunnels, advance planning and development of preliminary design prior to estimate and appropriation, and studies to determine the most economical type of structure for a specific purpose and location. Bridge projects to be constructed in 1951-1953 are already being planned in the Bridge Division. At present nine major structures and numerous lesser ones are in various stages of design, and several others have been released by the Office Engineering Section (a few prepared by consulting engineers); in addition, specifications are being prepared or shop drawings are being checked for four other major projects for which contracts have been let. The Office Engineering Section includes normally three bridge designers, three subordinate engineers, and two draftsmen, but varies according to the work-load and available qualified personnel. As necessary, contracts are now let to consultants for development of designs and specifications; however, the Bridge Division is responsible for a thorough check and acceptance of the results. Bridge construction now includes five important projects. Under the Chief of the Field Engineering Section each project is supervised by a resident engineer, one or two assistant engineers, and one or two subprofessional assistants, making a total of twenty on the force at the present time. These are all temporary, as are the members of the Office Engineering Section, in the sense that each is hired specifically for the duration of a project.

(d) Maintenance: Highway maintenance in 1924 was almost entirely by District day labor forces. The Superintendent of

Streets (in the old City of Washington, bounded by Florida Avenue and the rivers), the Superintendent of Suburban Roads, and the Superintendent of Cuts each supervised about six or eight foremen or inspectors, besides a per diem force. The Superintendent of Stables had a staff of five statutory employees and forty-seven per diem employees, mostly drivers. There were three auto repair mechanics and a few laborers, sixteen auto drivers, and four rollermen for steam rollers. The cost of hiring teams and wagons was over $20,000 a year, about the same as the expenditures for operation and maintenance of trucks and automobiles at that time. Most of the trucks were hired from trucking contractors.

The Engineer of Bridges still used a carriage for his inspection trips. A bridge inspector ascertained the repairs needed on various bridges, inspecting them on a scheduled basis annually, semi-annually, or monthly, according to the type and condition of each bridge. A bridge overseer supervised a gang of ten laborers (carpenters, painters, etc.), who made the actual repairs to bridges. The Highway Bridge had four draw operators and four watchmen, the Anacostia Bridge had two draw operators and two watchmen, or bridge keepers, to prevent excessively heavy loads from endangering the bridge and to stop traffic when the draw had to be opened.

The miles of streets to be maintained have almost doubled since 1924. The Maintenance Unit under the Superintendent of Maintenance has been created out of the four separate groups which existed previously. It has been organized under assistant

superintendents in charge of all concrete repairs, bituminous repairs, and shops, machinery, and special construction. Although the Maintenance Unit includes nineteen statutory positions and approximately two hundred thirty per diem workers, repair contracts amounting to approximately $900,000 were executed last year, about half of which was for repairs of cuts, chargeable to miscellaneous trust funds. Part of the work performed by the bituminous repair gangs is the construction of temporary surfaces on newly graded streets, using "old material" broken up and specially treated. An important change has taken place here. The old policy was to construct "old material" roadways, following the contours of the land with only a few modifications, leaving the correction of the grades to the construction force when permanent paving was installed. During the intervening years, however, property owners naturally constructed their leads, driveways, and even buildings in conformance with the temporary grades. Now a special unit in the Construction and Design Section furnishes grades to the maintenance forces so that the temporary roadways will conform from the beginning and so prevent many problems. Although the total maintenance forces have slightly decreased in the past two decades, they turn out more work because of increasing mechanization. There are now sixty car and truck drivers and seventeen operators of heavy powered equipment, which includes not only several rollers, graders, shovels, loaders, and bull-dozers, but also a mudjack for restoring sunken pavements, drills for obtaining test cores of concrete or soil materials, concrete mixers, air compressors, and electric welders. The present organization is able to do not only more work per man, but also more difficult

and valuable types of work. It has been able to save much construction which, without this modern equipment, would have required replacement.

The Maintenance Section of the Bridge Division has no statutory positions, operating a storehouse and supervising two repair gangs, totaling fifteen per diem workers. Associated with bridge maintenance is the Operation Section which has twenty-three statutory positions and two per diem laborers. Most of these are drawbridge operators and guards. One or two, however, are responsible for inspecting the carbon monoxide control equipment in the underpasses every few days and for making adjustments and repairs as needed.

(e) Administration: The Surface Division in 1924 relied heavily upon the Engineer of Highways for policy decisions and even fairly detailed supervision. The administrative work was performed by two small groups, one headed by the chief clerk, the other by the office engineer. Two computers and two copyists assisted the chief clerk in preparing and processing personnel actions, payrolls, purchase requisitions, vouchers, accounts, and budget estimates. Time and leave records were kept by the individual foremen or other supervisors. The Office Engineer also supervised four employees. One of these computed basic grades and prepared recommendations regarding them for concurrence by other divisions of the Engineer Department. Another made inspections regarding permit applications for driveways and other actions affecting public space, and contacted the construction branches of other District agencies and of the telephone, light,

gas, and transit companies immediately prior to commencement of street work, to ascertain whether or not they had any pending order to perform underground work. Another employee checked the mathematical computations on the engineers' final measurement sheets, from which the contractors were paid, and furnished information for the office estimates and the annual reports. Each individual street intended for construction had to be included in the budget estimates and was specifically authorized in appropriation acts. Scheduling and coordination of the work consisted of listing the various streets authorized to be paved, designating the type of construction and limits of work, and rather arbitrarilly setting the starting date for each contract.

Today the Administration and Maintenance Section furnishes administrative services and control to both Street and Bridge Divisions . The section includes the Office Engineering Unit and Accounts and Personnel Unit, besides the two already described (Highway Planning and Maintenance).

The Office Engineering Unit has seventeen employees in five sub-units: Release, Contract, Basic Grades, Permits and Public Records, and Drafting (also previously described). The Office Engineer acts as the representative of the Highway Department with the Public Road Administration and various other agencies and coordinating committees regarding highway programming and contract execution. The placing of various facilities is coordinated through the work of the engineer responsible for developing basic grades and that of the underground construction office. The timing of these activities is coordinated by the Release Officer, his two assistants, and the administrative assistant in

the office of the Director of Highways. Every effort is made to keep cuts in permanent pavements at a minimum. Scheduling of highway construction today means not only deciding which projects shall be undertaken and how they shall be designated, but also coordinating advance plans by the utility companies, other engineering agencies, and even the property owners involved. The Release Officer apprizes the utility organizations well in advance of the streets contemplated for surfacing, ascertains their major future development plans, and prepares a joint schedule to facilitate each phase of the work, both surface and subsurface, in order to assure completion of their work by the time the Highway Department is ready to start, thus disturbing traffic a minimum length of time. This procedure has yielded large dividends in reducing traffic tie-ups, expensive repairs, and marred surfaces which formerly resulted from cuts required soon after the laying of permanent pavements. Greater internal as well as external coordination of the steps in the design and construction process is now being achieved by the use of a central control system which shows at a glance when each step should be started and completed, and which are on schedule or need expediting. Frequent analysis of these data enables the administrative officials to locate and correct the causes of delays or to plan more realistically in the future. The master control is maintained by the Office Engineering Unit in the Administration and Maintenance Section. Subsidiary charts are located throughout the Street Division at all necessary control points.

The Accounts and Personnel Unit is divided into four subunits: Departmental Accounts with eight employees, Miscellaneous

Trust Funds with five, Personnel with four, and, temporarily, Classification and Organization with three, all supervised by the Administrative Officer. The Departmental Accounts Sub-Unit has several functions: preparing budget estimates, auditing vouchers, maintaining soundness of funds, analyzing maintenance costs, initiating purchases, and issuing supplies. The Miscellaneous Trust Funds Sub-Unit processes detailed records of deposits and monthly statements, charges, and refunds regarding guaranteed construction or repairs to pavements cut or damaged by private builders.

The Personnel Sub-Unit processes personnel actions regarding statutory and other annual positions and per diem employment, prepares payrolls, administers time and leave regulations, investigates duties and qualifications of per diem employees, facilitates payments to beneficiaries, retired annuitants, and injured employees, and processes efficiency ratings. The Classification and Organization Sub-Unit investigates individual responsibilities in the Highway Department, and prepares organization charts and position descriptions.

Study and improvement of the different parts of the Department have progressed to varying stages. The engineering units of the Construction and Design Section have gained most from this work to date. An attempt has been and is being made to help the employees understand clearly their own responsibilities, to standardize and streamline the procedures, to adjust inequities in rates of pay, and to recommend additional statutory positions in place of per diem or construction roll positions where such

action is warranted. When a re-grouping of functions has seemed desirable, recommendation is made to the administrative officials responsible for making the decisions.

Promotion of qualified personnel into established vacancies has been stepped up on a systematic basis. Employees have been encouraged to take the initiative and to offer suggestions for the good of the service. Some of these suggestions have been adopted with good results.

(f) Research: The research to which any highway organization should keep alert is chiefly along two lines: highway economics, to be sure of what is needed and where, and highway engineering, to improve the materials, design, and methods of meeting those needs.

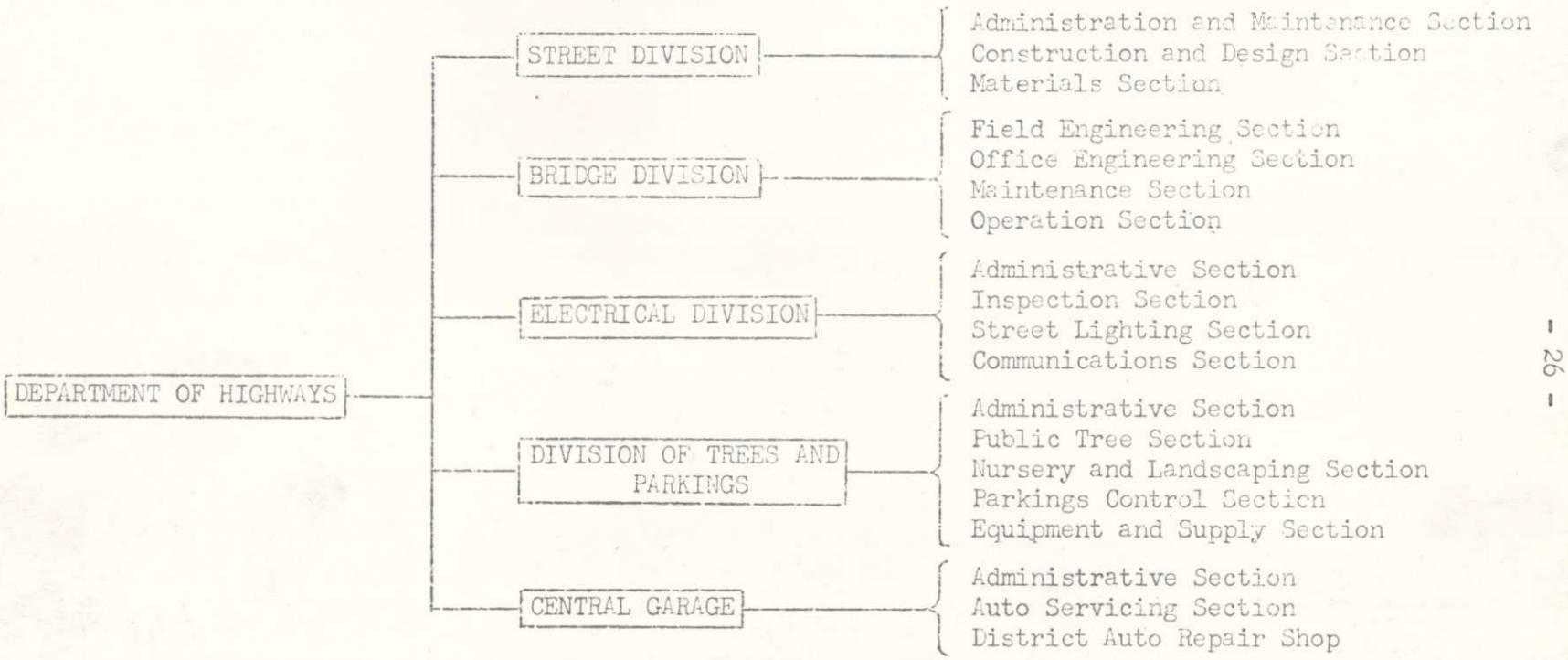
In 1924 little scientific effort was made in either of these directions. As for economics, the need for improved roadways was perhaps so widespread that any progress might be desirable. Unit costs were smaller and traffic densities were lighter, so that mistaken judgment was less serious. As for engineering, weight loads were less and roadways took less punishment. Projects were smaller and replacement was less costly. During the years following the twenties, the value of scientific research became evident, due to increased traffic volumes and loads on our pavements. Therefore, the Department instituted advancements in this field of activity.

By 1948 economic research has become fairly well developed in the Highway Planning Unit, as previously discussed. The Materials Section, while it spends most of its time on inspection and control of materials, must also keep alert to the possibility

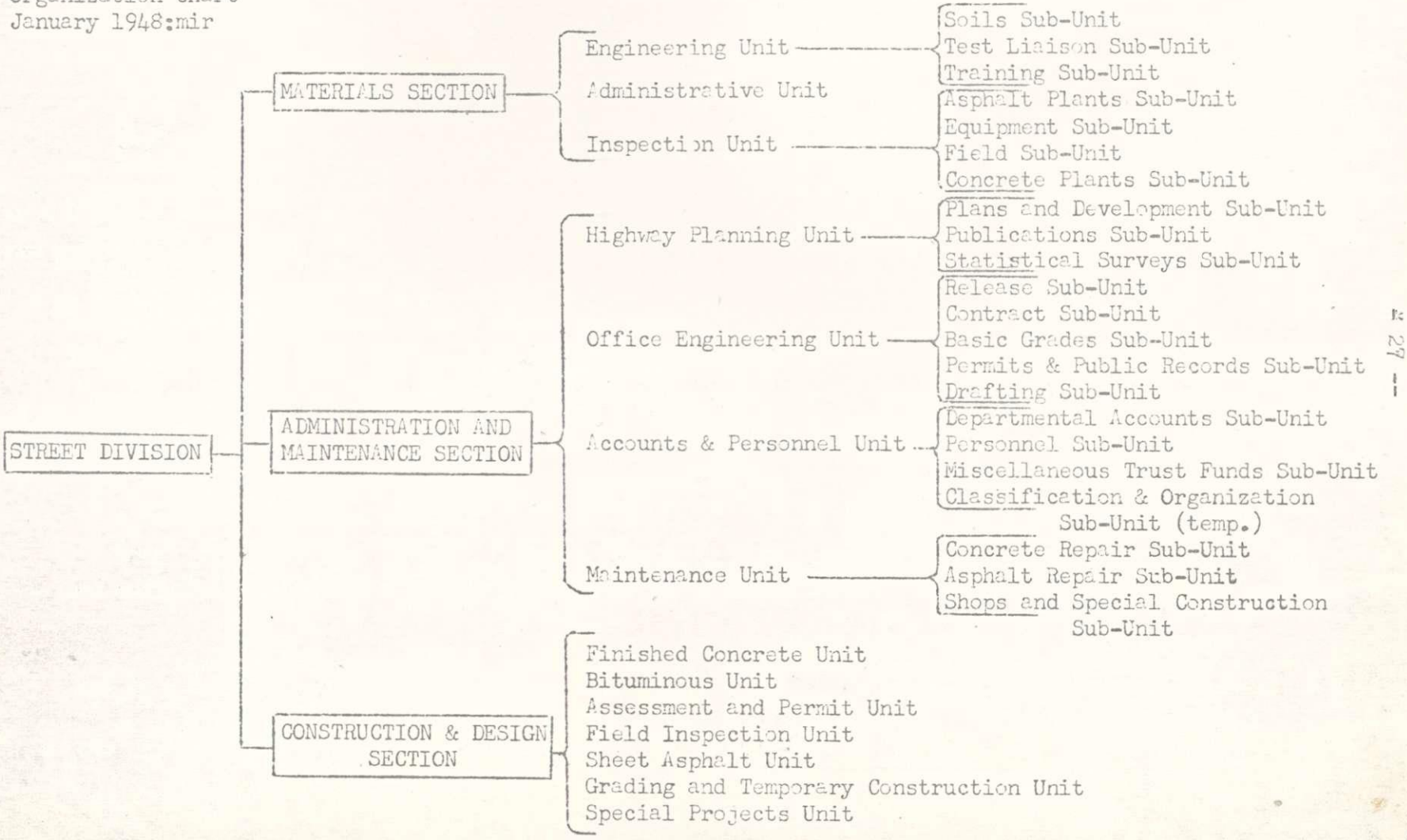
of new formulas, methods, and structural designs. The District of Columbia was one of the pioneers in developing a sound engineering design for rigid-type pavements, using expansion-contraction joints to prevent buckling and splitting of the concrete surface during seasonal temperature changes. It has developed a concrete design which will support traffic in one or two days instead of a ten-day or longer curing period as formerly required. It has conducted field experiments by laying a small section of each type of material, where traffic would be the same on all, and analyzing the results. The dividends from these and similar studies dictated the gradual expansion of what has become the Materials Section, to make it include three or four key positions responsible for keeping in touch with the experience of other jurisdictions and for taking the initiative in local investigations and surveys. These men, such as the chiefs of the Engineering Unit, the Soils Sub-Unit, and the Test Liaison Sub-Unit, carry on these studies along with their exercise of routine controls. The Chief of the Inspection Unit also makes constant comparisons between the routine test results as charted, and cooperates in ascertaining the causes and results of the deviations which appear.

(3) Organizational Charts: It is thought that the two organization charts found on pages 26 and 27, will substitute for a concluding summary of the foregoing presentation of the Department and its divisions today. Since the Street Division is so much larger and more complex than the Bridge or other divisions, a more detailed chart of the Street Division is added, with most of its organizational breakdowns.

DEPARTMENT OF HIGHWAYS
DISTRICT OF COLUMBIA
Organization Chart
January 1948:mir



DEPARTMENT OF HIGHWAYS
DISTRICT OF COLUMBIA
STREET DIVISION
Organization Chart
January 1948:mir



(4) Some Organizational Highlights Since 1924:

1924 1. Establishment of Motor Vehicle Fuel Tax at two cents per gallon, to be used exclusively for highway improvement and repair.

2. Establishment of classifications for sixty-two statutory positions and eight miscellaneous trust fund positions by federal Personnel Classification Board.

3. Construction and design program expanded to include widening of permanent pavements.

1927 1. Bridge Division resumed the function of designing.

1928 1. Engineer of Maintenance appointed.

2. Purchase of Highway Department Fleet of thirty-five trucks for maintenance forces in place of hiring trucks.

1929 1. Establishment of office of Coordinator and Chief Engineer to secure joint planning by the District Engineer departments, public utilities and individuals performing surface and subsurface work.

2. Division of Materials established in place of inspector of Asphalts and Cements, to test concreting material, asphalt materials and mixtures, steel, and other materials for the entire Engineer Department.

3. Standard specifications for Pavement, Street and Alley Improvements and work incidental thereto issued March 1929.

1930 1. Negotiated first contract for bridge design with engineer consultant to accomplish program because work load was temporarily greater than Bridge Division facilities.

1930 2. Highway garage, and shops established at 2nd and Bryant Streets, N. W.

1931 1. Materials Laboratory expanded as a leading road material laboratory in U. S. with emphasis on soils research.

1932 1. Re-organization of the nineteen Divisions in the Engineer Department. Department of Highways, one of the four new subordinate Departments, had the following divisions: Office of Coordinator of Surface and Subsurface Work, Street Division, Bridge Division, Electrical Division, Surveyor's Office, Division of Trees and Parkings, Central Garage, D.C. Auto Repair Shop. (Surveyor's Office since assigned directly under Engineer Commissioner).

2. First revision of Standard Specifications published.

1933 1. Purchase of modern machinery to facilitate soils research and testing as well as repair of depressed pavement areas by mudjack method.

1934 1. Division of Materials began analytical field experiments regarding performance of paving materials.

1937 1. Revenue Act established Highway Fund, and authorized 38 additional statutory positions, making a total of 117 in Street and Bridge Divisions.

1938 1. Federal Aid Highway Act amended and for first time provided for allocation of funds to District on same basis as the several states.

1939 1. Highway Planning Survey established pursuant to terms of Federal Aid Highway Act of 1938.

1939 2. Second revision of Standard Specifications published.

1940 1. Introduction of carbon monoxide control in underpasses as part of bridge function.

1943 1. Transfer of specialized soil sampling and mudjacking equipment from the Division of Materials to the maintenance forces with responsibility for analysis in the Division of Materials.

1944 1. Post war bridge program initiated; in furtherance of fixed policy, temporary overload of design work let by contract to consultant engineers.

2. Cost analysis system instituted on all construction or maintenance projects.

1945 1. New budget procedure established detailed justification for lump sum appropriations.

2. Accounting system modernized to separate capital outlay from operating expenses.

3. Third revision of Standard Specifications published.

1946 1. Study initiated for reorganization of Department and reclassification of positions.

1947 1. Reorganization of Construction and Design Section completed, all positions reclassified, fixing responsibilities and providing for progressive promotion of employees.

2. Office Engineering Section established in Bridge Division.

3. Central control system established for maximum coordination and follow-up on construction program.

(B) Growth of Washington

(1) General Statement: In order to appreciate the serious nature of the problems which have confronted the Department during the past twenty-four years, it is necessary to recall some of the conditions prevailing at the time when the Department of Highways initiated actions indicated by this report. A mere recital of pavement and structural improvements made, is not adequate to tell the full story of its accomplishments. The problems with which the Department has had to deal, have been largely dynamic in character, and how these problems have been faced and how timely was the action cannot be appreciated without some indication of the conditions prevailing at the time when decisions had to be made. How effectively the Department has acted can now be judged in the cold light of some years of actual experience by applying the test. "What would have been the result if these improvements, now in place, had not been made?" It is realized that all decisions and actions were not perfect, but it can be stated that our efforts were sustained and progressive, and the results good.

Because of limitations of space, no attempt will be made here to describe in detail the conditions prevailing prior to or during the 24 year period covered by this report. However, it is believed that a few reference points will suffice to gain some measure of comparison. Those readers interested in more details are therefore referred to the Washingtoniana Section of the Central Library which has a wealth of information on all aspects of the origin, growth, and development of the Nation's Capital City.

The needs for highway improvements are directly related to population, and the necessity for safe, rapid intercommunication

between residential areas and centers of employment and business. They are also related to repair, replacement, and modernization needs as well as to the parking situation and to the ability of the transit companies to continue a vigorous program of improvement. Let us review some of the highlights or main factors affecting the highway problem.

(2) Population: Growth of the District of Columbia has been characteristically upward. In 1800 the population was 21,000; in 1850, 40,000; in 1900, 279,000; and the estimated figure for 1950 is 893,000.(1) Census figures indicate that the population increase during the 24-year period, 1924 to 1948, is approximately equal to the total population growth for the preceding 124 years. This indicates clearly that a vigorous highway development program has been a vital necessity.

A fact about Washington population growth, perhaps not realized by many, is that important gains in population have been made in sudden spurts, and these have coincided with National emergencies. The Water Report referred to previously points out this fact clearly in these words: "During the thirteen decades of the life of the District of Columbia since 1810, the five decades during which wars and economic crises occurred produced an increase in population of 437,224 or 67 percent of the total increase as against an increase during the eight decades of normal National life of 217,659 or 33 percent of the total increase in population." Bearing this fact in mind, it becomes clear that highway improvements must be carried out in time to serve with reasonable efficiency, the critical demands thrown upon the local highway system during periods

(1) House Document 480 (Water Report)

of National emergency. When highway improvements have been proposed by the Department, there has not always in the past been complete agreement as to the necessity for such proposals. Many times it has been argued that such improvements, though meritorious, were not needed yet. However, Congress in its wisdom has seen fit to support, on numerous occasions during the past 24 years, the Department's recommendations, and proof of the need lies in the simple truth that these improvements have served critical needs at critical times, and a return to the former status would produce intolerable conditions.

(3) Pattern of Residential Development. The pattern of residential distribution in Washington has been an important factor relating to the necessity for highway improvements. Space will not permit detailed comment, but suffice it is to say that it was not until near the turn of the Century that the population began to "spill-over" beyond the "Old City", the area bounded by Rock Creek Park, Florida Avenue, the Anacostia River and the Potomac River.

As outward growth continued, various types of barriers have influenced the pattern of residential development. These barriers have been of two types: (1) natural, and (2) man-made. Those coming under the former are rivers, and other topographical obstacles to highway development. Man-made barriers to highway facilities include railroads, large reservoirs, and extensive park areas. As needs for the improved intercommunication between various portions of the city have evolved, the Highway Department has taken the lead in seeking ways and means to improve the accessibility of these newly developing areas.

How effectively the Highway Department has kept up with the expanding needs of a rapidly growing city is clearly indicated in Chart I, on page 35 which shows assessed real estate values. It will be noted that during the twenty-four year period, 1924 - 1948, that total values have increased from 779 millions to one billion 573 million dollars. Thus, during the first 124 years of development of the Nation's Capital City, assessed real estate values built up to a total of three-quarters of a billion dollars, and during the next 24 years of growth these values have doubled. Accessibility through good street facilities is a prerequisite to such enhancement of property values.

Greater accessibility has been brought about by widening, improved alignment, new bridges, grade separations, channelization, the opening of new highways, and the like. The more important of these improvements are discussed in Part II of this report. The departmental publication entitled "Washington's Bridges" describes and illustrates these structures in detail. For the overall view of the growth of Washington's highway system, the readers attention is directed to Chart 2, on Page 36, which shows that expansion of new roadways into new areas has been orderly, with consistent yearly gains averaging 18 miles. Here too, it will be seen that during the first 124 years of development of the city, 544 miles of highway were brought into existence while during the next 24 years this mileage has nearly doubled. (Now 980 miles of equivalent 30-foot roadway.)

(4) Public Transportation: Changes of public transportation have also had an influence on highway development in the District of Columbia. For example bus lines were in their early infancy

CHART I

ASSESSMENTS OF LAND AND IMPROVEMENTS

DISTRICT OF COLUMBIA —— 1889—1948

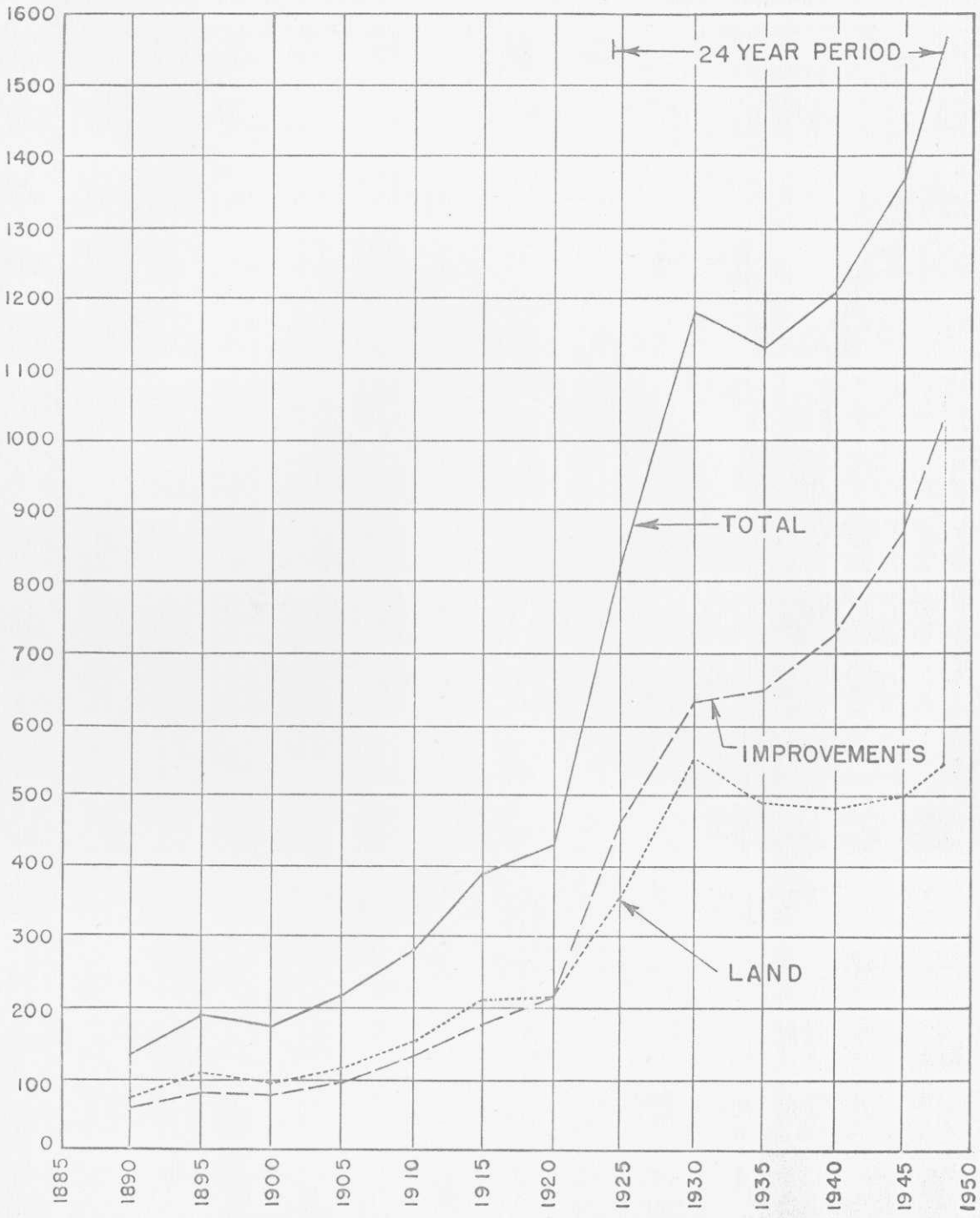
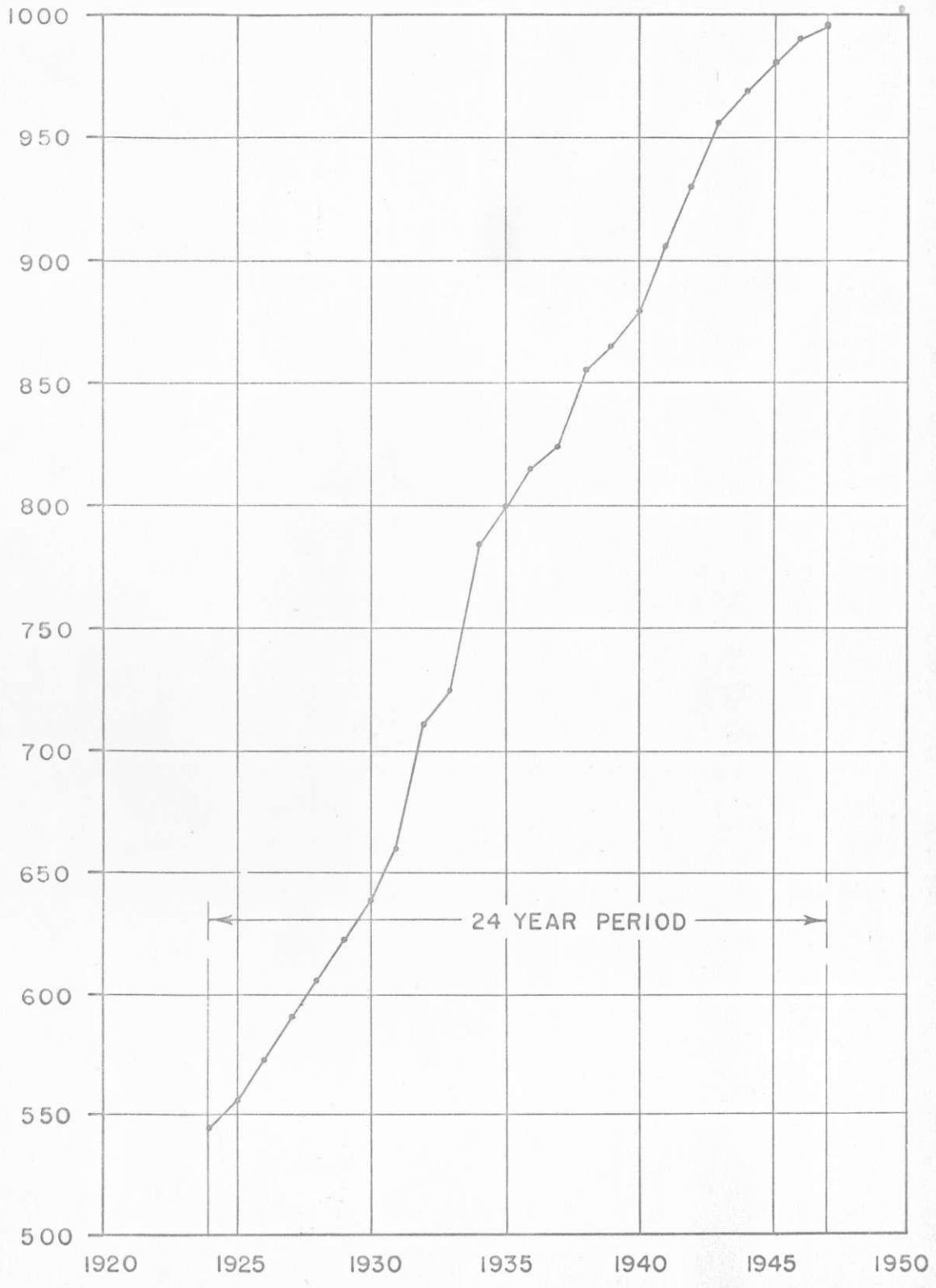


CHART 2

MILES OF HIGHWAY IN THE DISTRICT OF COLUMBIA



back in 1924. At that time only about 4.4%[1] of the local transportation within the District of Columbia was served by bus line operation.

In 1924 the local bus lines then operating outside the "Old City" followed these principal streets:

1. Massachusetts Avenue.
2. Connecticut Avenue to Chevy Chase.
3. 16th Street (Washington Rapid Transit Company).
4. Bladensburg Road.
5. Good Hope Road, Hillcrest via the Old Pennsylvania Avenue Bridge.
6. Anacostia- Congress Heights.

In comparison with existing conditions today, there are many more bus routes providing a better pattern of distribution and service. Today the bus lines provide roughly 34%[1] of the local transportation service. Growth in the size and capacity of these vehicles have added to the highway problems as they relate to curb radii, street width, and maintenance costs.

It can be readily seen that on residential streets having relatively narrow width roadways, many of the bus-type vehicles eight feet in width, can complicate the highway problem, particularly at turns, bridges and other restricted points.

It is interesting to recall that back in 1925, two street railway companies provided the street car service within the District of Columbia. Outside of the "Old City" the Capital Traction Company operated over these principal routes:[1]

(1) Source: Capital Transit Company

1. To Rosslyn Virginia via Georgetown.

2. Connecticut Avenue to Chevy Chase.

3. 14th Street, Colorado Avenue, Takoma.

The Washington Railway and Electric Company operated over these routes:

1. Cabin John, Glen Echo, Maryland.

2. Wisconsin Avenue to Rockville, Maryland.

3. Georgia Avenue

4. Mt. Ranier, Maryland

5. Brookland

6. Kenilworth

7. Anacostia, Congress Heights via 11th Street Bridge.

It is also interesting to note that the Connecticut Avenue Street Car Line north of Calvert Street has benn replaced by buses, and that the street car line across the 11th Street Bridge has also been replaced. Other changes such as, for example, the Benning Line now scheduled for conversion to bus operation will necessitate highway modifications involving a substantial sum of money.

These items are merely pointed out to indicate in a general way, the magnitude of changes that have taken place in transit facilities during the past 24 years, and to indicate how they relate to the highway problem. The reader's attention is also called to the fact that a vigorous program of improvement in addition to that heretofore undertaken in transit facilities and service must be made if the transit riding habit is to be encouraged and stimulated. If this is not achieved, then it is inevitable that Washingtonians will turn to private passenger car in larger

numbers and, thereby, produce traffic loads far in excess of existing street capacities.

There were, in addition, a number of interurban electric railway lines in existence. Two of these lines are interesting to recall. One, the Washington-Virginia Railway Company operated from a terminal station on ground now occupied by the Federal Triangle and crossed the Potomac on the Highway Bridge. The other interurban line, the Washington, Baltimore and Annapolis Electric Railway Company terminated at 12th and New York Avenue at the site of the present Greyhound Bus Terminal.

In addition to local transit, interurban lines and bus lines, the other facilities available for local travel were: 553 taxicabs, 72,482 passenger automobiles and 59 sightseeing buses.

(5) Automobile Ownership and Use: The emergence of the automobile as an important factor in urban transportation has influenced the pattern of growth and, for the past 24 years, has influenced the extent and character of highway improvements. For this reason, it is of special interest to trace this evolution.

The District of Columbia first began to feel the effects of the automobile revolution about 1920. In October of that year the Police Department found it necessary to establish a Traffic Bureau. Net registrations in that year were about 34,200. By 1924 registrations had increased to 88,800. This 250% increase during a four-year period imposed severe burdens upon the highway system. The total mileage of highway system in 1924 was 544 miles of pavement (equivalent 30-foot roadway). This pavement classification by type was as follows:

Sheet Asphalt and coal tar	183
Gravel and unimproved (traveled)	160
Macadam	108
Asphalt block	31
Granite block and rubble	18
Cement concrete	24
Asphaltic or Bituminous concrete	7
Asphaltic surface	10
Vitrified block	1
Cobble	2
	544

At that time there were approximately 700,000 square yards of highway over 30 years old. Many of these streets, though satisfactory for horse-and-buggy travel were not suited to automobiles with high pressure tires. The bridge structures then in existence were comparatively few and those which were in use were not adequate for the growing volume of automobile traffic.

Chart 3 on page 41 shows the net vehicle registrations estimated by calendar years. Referring now to this chart for the year 1924, it will be noted that the real impact of the automotive revolution was just beginning to be felt on the streets of Washington. The problem of street traffic control had become an important consideration. On March 3, 1925, an Act of Congress established the Office of Director of Traffic, which began operation March 25, 1925.

It seems hard now to recall the conditions existing back in those days, so perhaps this tabulation, which shows the number of passenger automobiles by type, will help refresh the reader's memory:

Passenger car type	Registration
Touring	37,542
Sedans	14,447
Coupes	9,245
Roadsters	6,235
Coaches	2,693
Misc. types	2,320

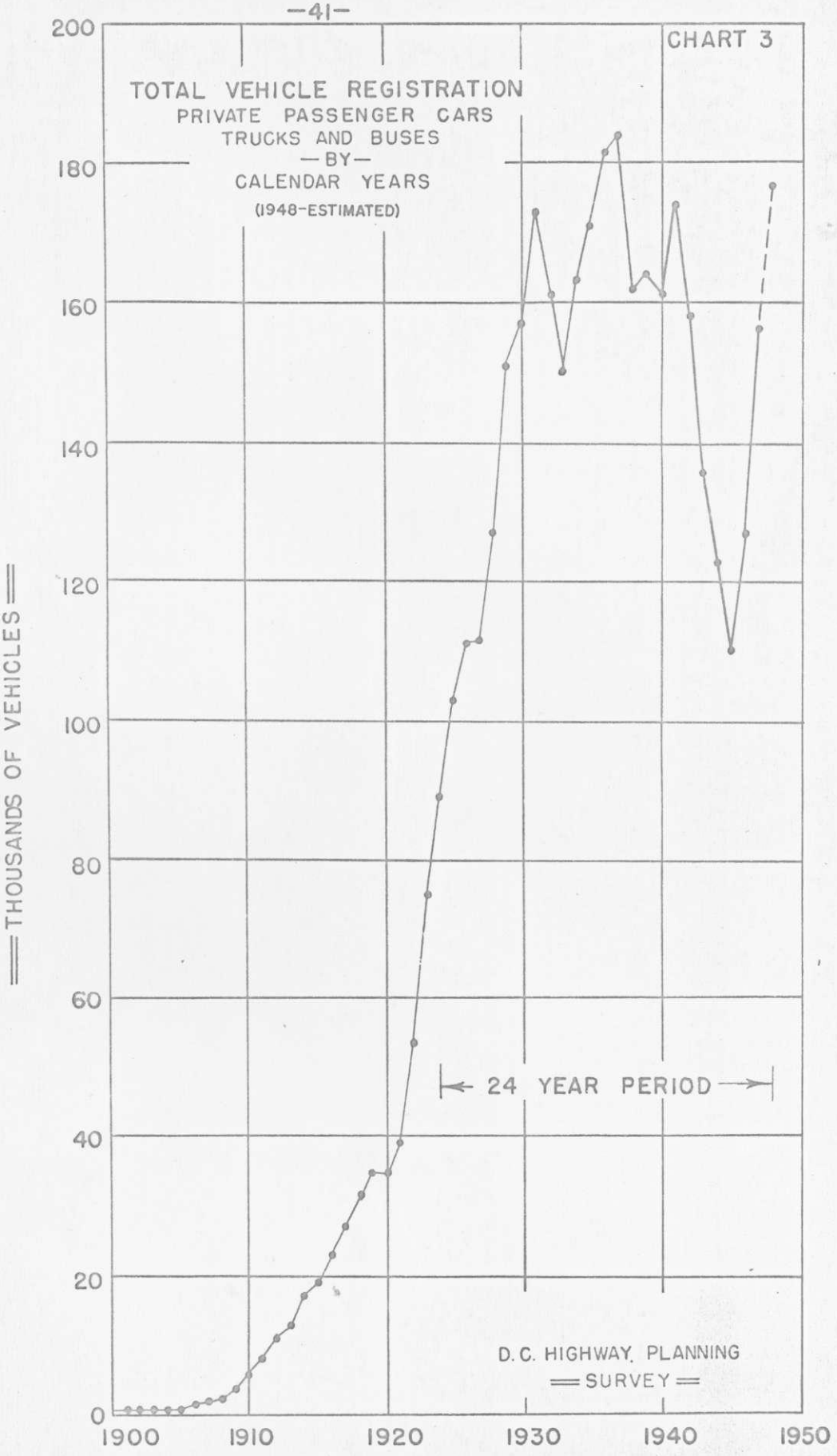


CHART 3
TOTAL VEHICLE REGISTRATION
PRIVATE PASSENGER CARS
TRUCKS AND BUSES
—BY—
CALENDAR YEARS
(1948-ESTIMATED)
THOUSANDS OF VEHICLES
200
180
160
140
120
100
80
60
40
20
0
1900
1910
1920
1930
1940
1950
24 YEAR PERIOD
D.C. HIGHWAY PLANNING
SURVEY

The reader will no doubt find it interesting to note that over 60% of the passenger cars were of the open type.

Net automobile registrations, consisting of private passenger cars, trucks and buses, continued to make spectacular gains until 1937 when 184,000 vehicles were registered by the end of the calendar year. This was followed by a short period of reduction to 162,000 (1940) and a subsequent recovery to 174,000 (1941).

The end of automobile production of private use in January 1942, following our entry in World War II, resulted in a steady decline to a low of 110,000 in 1945. With the resumption of production in 1946, there has been a steady gain, and by the end of 1947, there were 156,000 vehicles registered in the District. It is estimated that registrations will reach approximately 177,000 (1) by the end of the 1948 calendar year.

Another factor which intensifies the traffic problem is the trend toward increased use of the automobile. This has been a nation-wide trend, resulting from improved convenience and comfort provided by this means of transportation. In general, the local trend has followed the national trend. It is reflected in greater volumes of traffic, and it is in some measure related to local gasoline sales. For example, in 1925, gasoline consumption per registered vehicle of all types was approximately 460 gallons. In 1930, it increased to 540; in 1935 to 690; in 1940, to 1040; and, in 1946, it had risen to 1130 gallons. The corresponding figures on a Nation-wide scale are: 450,550,600,670,and 750. The actual increase of automobile use has been somewhat less than the local ratios indicate, but it is logical to assume that the national

(1) Based on normal production schedules in the automotive industry.

average increase since 1925, is a reasonable approximation of increased damands upon the District highway system, if adjusted to allow for the hundreds of thousands of motorists who come to Washington to visit our National Shrines.

This increased automobile ownership, together with consistent increases in the use of each of these vehicles, adds up to tremendous traffic burdens. Carefully planned highway improvements are necessary to promote orderly development of a rapidly growing community and to accomplish this objective with the least possible burden on the tax-payer.

(6) Growth of Suburban Traffic: Growth of population in the Metropolitan Area is another factor contributing substantial burdens upon the District of Columbia highway system. An indication of the magnitude of this increase is given in the following comparisons of vehicles crossing the District boundaries (both directions) between 7:00 A.M. and 10:00 P.M.:

Location	June 1925	June 1948	Increase
MacArthur Blvd.	2,172	4,191	93%
River Road	394	4,174	959%
Wisconsin Avenue	2,663	16,746	529%
Connecticut Avenue	10,423	13,920	33.5%
Georgia Avenue	4,469	20,074	349%
Riggs Road	753	2,155	186%
Sargent Road	181	1,638	805%
Queens Chapel Road	892	7,834	778.5%
Rhode Island Avenue	4,363	15,857	263.5%
Bladensburg Road	6,434	20,447	218%
Benning Road	2,480	2,582	4.1%

Location	June 1925	June 1948	Increase
Walker Road (Now Branch Avenue)	1,459	5,545	280%
Livingston Road (Now South Capitol St.)	909	5,335	487%
Total, Maryland.....	37,592	120,498	220.5%

	June 1925	June 1948	
Highway Bridge	11,683	47,787	309%
Memorial Bridge	Not built	42,292	
Key Bridge	7,599	27,594	263%
Chain Bridge	1,418	5,019	254%
Total, Virginia.....	20,700	122,692	492.7%
Grand Total	58,292	243,190	317.2%

It will be noted that traffic on Benning Road at the D. C. line has not increased appreciably. This is due to the fact that the heavy volume of traffic presently on Benning Road, west of Minnesota Avenue, is dispersed over routes which did not exist in 1924.

Thus, in 1925, about as many cars crossed into and out of the District on the 17 main roads across the District Line as now cross on Highway Bridge in one day, during the same hours.

This increase of travel into and out of the District serves to further increase the traffic load upon the District of Columbia highway system. A sample of how this affects the highway system may be illustrated by Wisconsin Avenue. At present this arterial is rapidly approaching capacity conditions. The suburban area served by this arterial continues to develop and the time is fast approaching when additional roadway capacity must be provided.

Further widening of Wisconsin Avenue is out of reason. There are no other alternate routes which can reasonably and economically be adapted to carry the overload. The only sound way to meet the growing needs of this sector of the City, and yet meet the demands of suburban traffic as well, is the development of the Arizona Parkway as proposed by the Highway Department.

Growth of suburban traffic into and out of the District also affects the highway system in another way. It increases demand for parking capacity. For example, a study by the Highway Planning Survey in 1940 revealed that out of 34,000 cars parked on the street, 15% had Maryland licenses and 14% had Virginia licenses. Out of 18,500 automobiles parked off street, 22% had Maryland licenses, and 19% had Virginia licenses.

(7) The Parking Problem: This problem which directly affects highway facilities has been a growing one for many years. Simultaneous with increased parking demand has come increased demand for movement of traffic. Provision of parking facilities in reasonable quantities is essential to safe, expeditious traffic movement. Such facilities must be adequate to serve the essential needs of business and governmental activities, which are the prime generators of traffic and parking demand in Washington. However, the provision of low cost, subsidized parking, as advocated by some, would impose such large burdens upon the highway system as to require rebuilding that would involve tremendous sums far in excess of anything yet considered, and would undoubtedly mean the virtual extinction of the public transit systems as we now know it. It is not sound economics to provide parking for all who want to use such facilities, for the simple reason that the resultant induced traffic burdens would over-

load the capacity of our street system. The problem is one of balance between parking supply and demand.

In all forms of transportation there are three physical requirements. These are: the vehicle, the roadway, and the terminal facility. History reveals that the terminal is the last to develop. The problem is one of stimulating orderly development of off-street terminal facilities, so that existing highways may serve their prime function which is traffic movement. To this end the Department played an important role in the creation of the District of Columbia Motor Vehicle Parking Agency. This established, for the first time in the United States, effective machinery for achieving a sound and lasting solution to the parking problem. The Department has maintained an active interest in this Agency and its activities, because how effectively this problem is solved has a direct bearing upon the highway needs.

(8) Meeting the Challenge of a Dynamic Problem: Many people are under the impression that the operations of the Department of Highways are simply routine tasks of repairing and replacing old roadways, and the building of a few new roadways and highway structures as demands increase. The problems are not as simple as that. The problem of keeping up with highway needs is characterized by routine tasks plus a large measure of creative effort. It requires a versatile organization having imagination, foresight and sound engineering skills, together with courage to face entirely new problems, and ingenuity to overcome the difficult obstacles which invariably accompany all major highway improvement projects. Let us examine briefly some of the changing aspects of the highway problem over the past 24 years, and how the organization has maintained

flexibility to modify its operations to meet changing needs.

Over the 24 year period covered by this report, the highway problem has passed through a series of changes geared to meet the changing needs of the times. The first phase of the problem was to "get'em out of the mud" with hard roads. The problem was one of converting earthen streets into paved streets, of converting cobblestone streets into smooth streets, and of building bridges and other structures strong enough to stand the weights which would be imposed upon them. The second phase came as a result of increased volumes of traffic. This called for traffic control measures and street widening. The third phase has been to improve the operating characteristics of our highway system from the standpoint of safety and capacity by improved alignment, channelization, grade separations and the like. The next phase will be the development of limited access roadways, where warranted, to "pipe-line" large volumes of traffic through or around congested points. The Rock Creek and Potomac Parkway is an example of this type facility now in place. The K Street elevated highway, now under construction, and the proposed construction of Arizona Avenue as a limited access highway facility are further examples of this technique.

During the course of evolutionary change over the past 24 years, the Department has recognized the fact that highway design must not only embrace the idea of building pavements and structures strong enough to carry the physical loads, which use these facilities, without premature deterioration; that they must be wide enough to carry the peak load volumes with safety and efficiency; and that they must be expanded so as to promote orderly city development. However, in addition to these things it should be pointed out that

the Department has long recognized the fact that highway safety requires that due allowance must also be made in roadway design for the vehicle operating characteristics and for the humal element - the shortcomings and limitations of the driver himself.

Let us review briefly some of the changes in the characteristics of the automobile of the past 24 years. At the beginning of this period the self-starter was comparatively new. The automobile was then primarily a man's vehicle. Few women had the agility and mechanical skill to reach the starter pedal, operate the choke, and manipulate the throttle and spark at the same time to start the car. Even when started, few had the strength necessary to use the mechanical two-wheel brakes or, on occasion, to use the emergency brake. High pressure tires of those days did not have the road-gripping characteristics of present day tires. Uncertainty of operation during the winter months restricted the use of the automobile. Putting cars in "dead storage" with wheels blocked up and radiators drained was a common practice in those days.

Improvements in automobile design came with amazing speed, and resulted in spectacular gains in registration and in use as previously discussed. Paralleling improvements in the design of the vehicle, there have been improvements in highway design and construction. For example, such improvements as reduction of high crowns, the elimination of barrel-type gutters, banking of curves, smoother grades, better alignment, removal of obstructions to vision, use of more stable and suitable materials, increased radius of corner curbing, channelization and other design features were effected to adapt the roadways to the operating characteristics

of the vehicles which use them. Use of more efficient road-building equipment and techniques has made it economically possible to hurtle the more difficult topographical barriers and thereby open up new areas for residential development.

Part II of this report deals with the specific construction improvements now in place. However, it must be pointed out that without a Congress having a full understanding of the need for these improvements, the legislation prerequisites to such improvements may not have been enacted in time to meet the highway needs, and greatly increased costs of local transportation together with chaotic traffic conditions could have been the result. Sound legislation has been enacted, and it is pertinent that we review briefly the more important public laws affecting revenues, appropriations and Federal Aid.

(C) Revenues and Appropriations: Prior to the fiscal year 1925 all expenses of the Department of Highways were paid for from appropriations made from the General Fund of the District of Columbia. The General Fund consisted of all taxes and fees collected by the District and deposited to its credit in the U.S. Treasury.

As we were entering the twenty-four year period under discussion, the demand for funds to maintain and expand public facilities in the rapidly growing city became so great that the Congress enacted legislation establishing a gasoline tax fund for the District of Columbia to be used exclusively for road and street improvement and repair. Thus the first gasoline tax was imposed in the District of Columbia. The Act was approved on April 23, 1924 and fixed the tax rate at two (2) cents per gallon.

The first appropriation made from this fund for the fiscal year 1925 paid only a small share of the operating and improvement costs of the Department of Highways. The balance of the necessary funds for carrying on highway activities came from the General Fund of District revenue.

Gradually, all items of the Street and Bridge Divisions of the Department of Highways, properly chargeable to the Gasoline Tax Fund, were transferred from the General Fund to the Gasoline Tax Fund. As a result, the 1937 Appropriation Act provided that all such activities would be payable from this fund. During the period from 1925 to 1933 inclusive, with a rapid increase in motor vehicle use, the revenue from the tax increased rapidly, making possible such a transfer, thereby relieving the General Fund of the District to the amount of the transfer. The transfer was gradual until 1933, and only to the extent of the increase in the revenue from the tax. However, in 1934, continuing until 1937, when all items were transferred, the changes were made regardless of revenue availability, resulting in a drastic reduction in the funds available for highway work. The annual return from the tax showed no material change during the fiscal years 1934 and 1936 inclusive, yet the transfer as an obligation of the Gasoline Tax Fund for the items covering maintenance, personnel, condemnation, sidewalks and alleys, representing an appropriation in excess of one and one-half million dollars, resulted in a material curtailment in other highway work payable from District funds.

Fortunately for the District and its highway activities, Congress included the District in Emergency Federal Aid under

the National Recovery Act. Strange as it may seem, the average of the amounts received during 1934 to 1936 inclusive, when added to District Gas Tax Appropriation, gave the Highway Department a total sum about equal to the average appropriation for highways during the period 1925 to 1933 inclusive.

An Act of Congress entitled "District of Columbia Revenue Act of 1937", approved on August 17, 1937, established the "Highway Fund, Gasoline Tax and Motor Vehicle Fees." This Act enlarged the scope of the fund to include, in addition to receipts from the Gasoline Tax, all funds collected from fees charged for the registration and titleing of motor vehicles, and fees charged for other motor vehicle licenses and permits to operate motor vehicles. The Act likewise enlarge the field of activities which could be properly supported from this new fund. The Act specifically limited the use of the Highway Fund solely and exclusively to (1) the construction, reconstruction, improvement and maintenance of public highways, including the necessary administrative expenses in connection therewith; (2) for the expenses of the office of the Director of Vehicles and Traffic incident to the regulation and control of traffic and the administration of the same; and (3) for the expenses necessarily involved in the police control, regulation and administration of traffic upon the highways, provided that the total amount to be expended under this latter item shall not exceed 15% of the total amount appropriated for pay of officers and members of the Metropolitan Police Force.

Pursuant to the provisions of this Act, subsequent appropriation acts carried items chargeable to the Highway Fund for

other than Street and Bridge Division activities. These items have increased during the years, as these other activities have expanded, to an estimated appropriation of $2,113,200 for the fiscal year 1949.

Subsequent to public Congressional hearings held during the fall of 1941, the original gasoline tax law of April 23, 1924 was amended to provide for an increase in the tax rate of one (1) cent per gallon. The new rate of three (3) cents per gallon became effective January 1, 1942 and was made to extend to and include June 30, 1951.

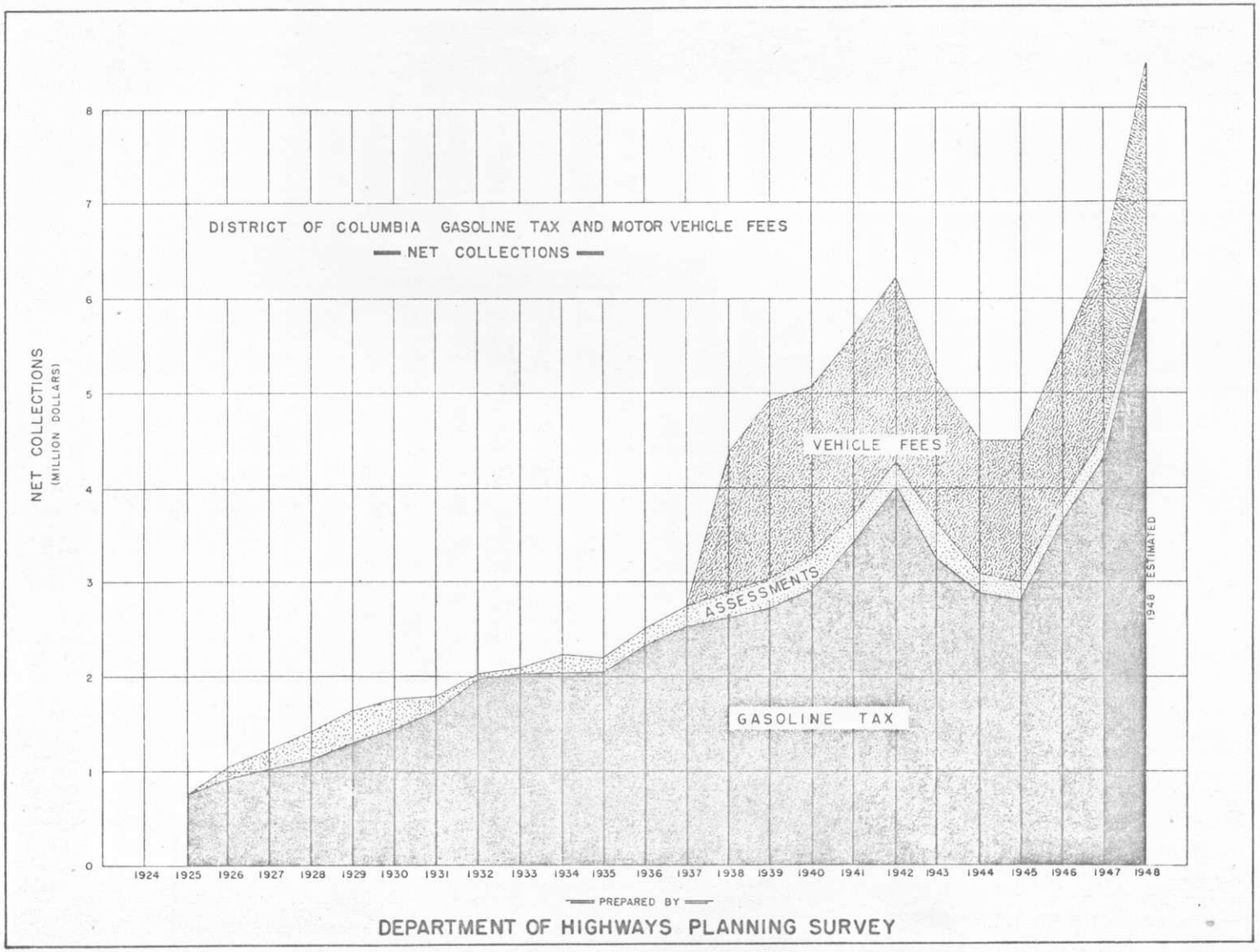
This gasoline tax rate increase was in response to the presentation of a well balanced program, and justification therefor to Congress by the Department, and was at the time considered sufficient to carry on the work. It is a matter of history that the war interrupted this program of street improvements and diverted our energies to furtherance of the war effort.

The war resulted in such an expansion of the city and such a great backlog of street improvement work, for which no funds were available in current revenues, that the Department was again forced to present our problem to Congress. The problem was twofold. The war effort decreased the use of automobiles to an extent which reduced the revenues derived from the three (3) cent gas tax to a figure below that of the former two (2) cent tax rate. This, coupled with the construction of urgent highway facilities in connection with the war effort, depleted the Highway Fund to a point where we came out of the war without any reserve. We were faced not only with a vast backlog of postponed street improvements but with the necessity for other work of a

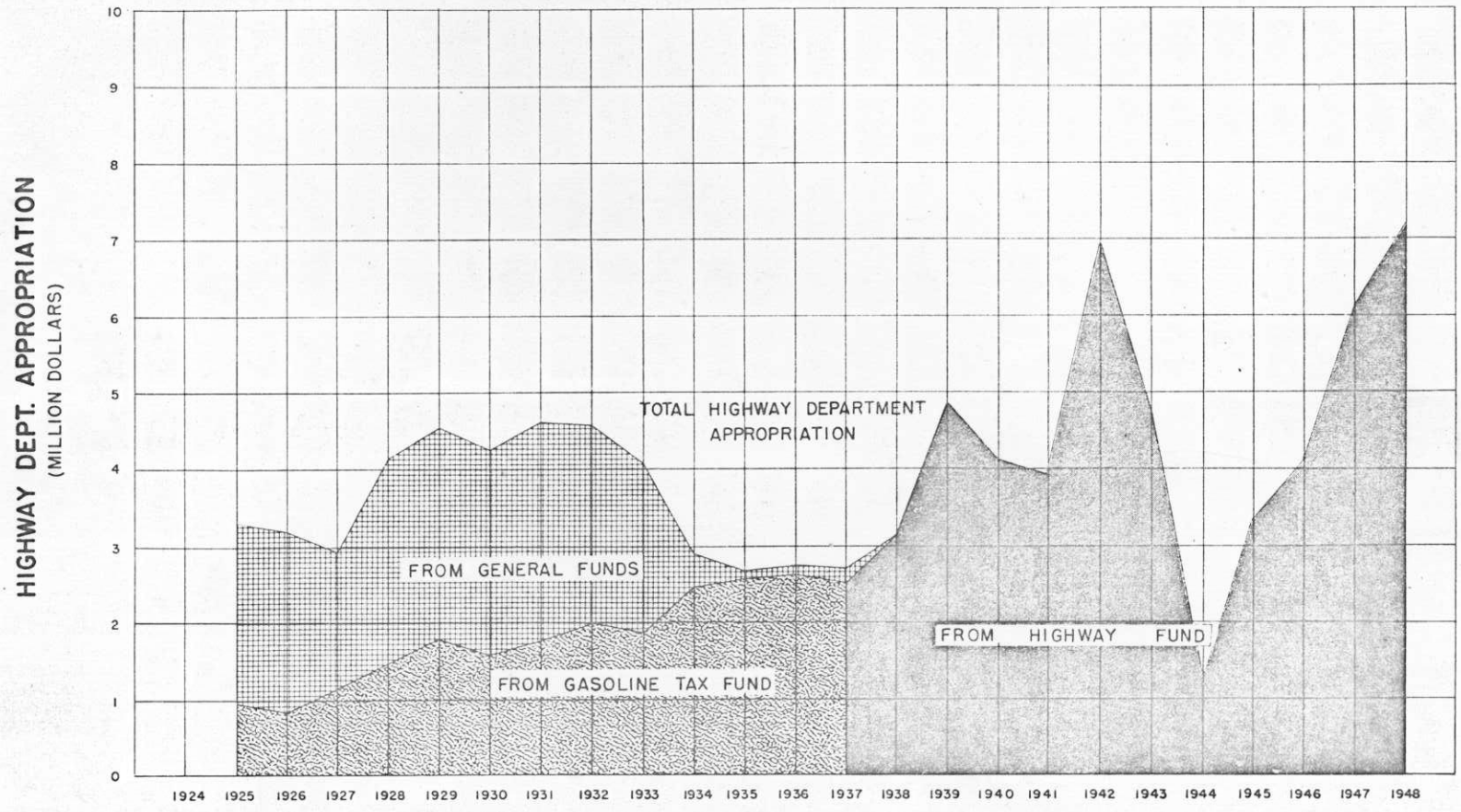
capital nature which was necessary due to the growth of the city and the increased volumes of traffic generated thereby.

Again, after a presentation of all the facts and justification therefor, the Congress increased the gasoline tax rate. By Act, approved July 16, 1947, the original gasoline tax law as amended and increased by the Act of December 16, 1941, was further amended and the rate increased to four (4) cents per gallon effective August 1, 1947, and extending to and including June 30,1952, after which it will revert to a permanent rate of three (3) cents per gallon.See appropriation and revenue charts on pages 54 and 55.

(D) Federal Aid: The District of Columbia was included in regular Federal aid under the Act approved June 8, 1940. Prior to the passage of this Act the District did share in some Federal funds in connection with NRA highway work and grade crossing elimination. In accordance with the Act of 1938 the District has regularly since 1940 been allocated its share, under the provisions of the Federal Aid Highway Acts for each and every year. Several special Bills during the war years were of benefit to the District and we shared in advanced engineering funds, access road funds and strategic highway funds. Also of benefit was the more important Federal Aid Highway Act of 1944 providing for Federal funds to be matched by the States during the three post-war years, which were later designated as the fiscal years 1946, 1947 and 1948. The original Act made these funds available for one year after the year for which allocation was made. Since passage of the Act Congress has, by Joint Resolution, extended the period of availability one additional year, allowing this additional time to place the projects under agreement and ulti-


DISTRICT OF COLUMBIA GASOLINE TAX AND MOTOR VEHICLE FEES
NET COLLECTIONS
NET COLLECTIONS
(MILLION DOLLARS)
0
1
2
3
4
5
6
7
8
1924
1925
1926
1927
1928
1929
1930
1931
1932
1933
1934
1935
1936
1937
1938
1939
1940
1941
1942
1943
1944
1945
1946
1947
1948
VEHICLE FEES
ASSESSMENTS
GASOLINE TAX
1948 ESTIMATED
PREPARED BY
DEPARTMENT OF HIGHWAYS PLANNING SURVEY

SOURCE AND AMOUNT OF HIGHWAY DEPARTMENT APPROPRIATION



PREPARED BY

DEPARTMENT OF HIGHWAYS PLANNING SURVEY

mately under construction. It is with some pride that we state that this additional time was not required by the District of Columbia. All of the projects embraced in the District of Columbia postwar program are fully prepared, insofar as plans and working drawings are concerned, and all have been placed under contract except for a few minor items. Construction work on the entire program, including the last of several large structures, will be completed during the latter part of 1949.

The funds that have been received from this source between 1940 (the first year the District was eligible) through 1948 are shown in tabular form on page 57.

The amount indicated in each column is the Federal allocation to the District and had to be matched by the District of Columbia on a 50/50 basis, except in the case of access and strategic highways, both of which carried a higher Federal contribution than the regular formula for matching. There were exceptions during the period in the nature of railroad grade separation structures which were assumed to be 100% Federal obligations.

There is in the process of passage new legislation by the Congress which will result in the allocation of additional Federal Aid funds to the District of Columbia which will assist in the construction of the many projects necessary to provide an adequate highway and bridge system.

Congress, in connection with the Defense Highway Act of 1941 approved November 19, 1941, authorized, in addition to other things, funds for advanced engineering studies. The District took advantage of this allocation and utilized it for two major projects, a preliminary report in one case, and allocated the

Federal Aid Funds Allocated

For Highway Improvements

	Primary	Secondary	Urban	Grade Crossing	Strategic	Access	Totals
1940	$ 490,070	$ 73,389	$ - - - -	$ 586,538	$ - - - -	$ - - - -	$ 1,149,997
1941	562,505	70,669	- - - -	152,100	- - - -	- - - -	785,274
1942	487,500	84,025	- - - -	97,500	170,625	2,185,250	3,024,900
1943	487,500	1,279	- - - -	7,800	- - - -	- - - -	496,579
1944	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
1945	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
1946	1,096,875	731,250	1,146,477	- - - -	- - - -	- - - -	2,974,602
1947	1,096,875	731,250	1,146,477	- - - -	- - - -	- - - -	2,974,602
1948	1,068,750	712,500	1,117,080	- - - -	- - - -	- - - -	2,898,330
Totals:	$5,290,075	$2,404,362	$3,410,034	$843,938	$170,625	$2,185,250	$14,304,284

balance of the funds available for the preparation of plans for Highway Bridge.

Congress, by the Act of July 15, 1943, authorized a reapportionment of Federal highway funds, then unexpended from prior balances, so as to permit advanced engineering studies both preliminary and final, on a matching basis. The District had available at that time in unexpended funds, sufficient moneys to take up the maximum amount that could be allotted to the District under the provisions of the Act referred to. It was from these funds and under the provisions of this Act that the District initiated projects with the Public Roads Administration for postwar planning. The operation of this Act enabled the Department of Highways to prepare practically all of its plans for the postwar period without securing any additional appropriation for that specific purpose. The funds remain available until one year after the end of the present emergency. That portion of the District matching fund is available until June 30, 1948. By that time all of the work originally contemplated will have been completed.

We have heretofore referred to the District's inclusion in the Federal Aid Highway Act of 1938, which provided for allotments to the States for 1940 and 1941.

The inclusion of the District, on the same basis as the States and Territories, in this Act was the result of a number of years of effort on the part of numerous organizations and persons. It may be said in this connection that, insofar as traffic and highway activities of the District are concerned, it is, even aside from the funds that result, the most valuable piece of legislation ever enacted in behalf of these interests. It is

proper that we should extend our sincere thanks to all who so effectively made our inclusion possible.

The improvements that have been made possible are extensive and will continue as time goes on. Working in cooperation and with the advice and counsel of the Public Roads Administration has resulted in great benefit to this community.

(E) Programs and Reports

(1) General Statement: At some time during the transition from its conception on the drawing board to its emplacement in the street system, a highway construction project is incorporated in a schedule and assigned a position of relative importance determined by the degree of intensity to which the need for the improvement has grown, by the type and nature of the improvement, and by certain other economic factors involving the amount of funds available and the state of the labor and commodities markets.

Programs are, at best, optimistic predictions of future accomplishments, but they are necessary if extensive construction activities are to be carried on in logical and orderly sequence. They constitute an effort on the part of highway officials to space out individual projects over a period of time -- usually 5 years -- so as to make two ends meet: appropriations and traffic requirements. They are the product of long-range analyses of population growth, accurate surveys of traffic habits in urban and suburban areas, and engineering investigations. They are susceptible of adjustment, either by extension or contraction, and vary with the general rise and fall of the national income from which are derived the funds necessary for their exe-

cution. They can be called construction time-tables which directly reflect the efficiency of the agencies which conceive them and the general economic conditions which affect the time of completion of the highway facilities included in such programs.

Formulated programs are the basic matter of formal reports prepared by the Department of Highways and submitted to the Commissioners and to other interested agencies for approval or comment. As a rule, the reports contain not only a listing of proposed activities to be undertaken during a specified period, but also present justification of the various projects embodied in the programs. This section of the present report, covering twenty-four (24) years of progress in highway development in the District of Columbia, is primarily concerned with the programs that have been developed and adopted during that time.

(2) The 1930,1934 and 1937 Programs: In 1930, the Department submitted its first definite program for the development of adequate improvements in its highway system to meet the demands of rapid advances in the design and use of private means of transportation. A tentative budget was prepared to accompany the report and, in it, provisions were made for the expenditure of funds on projects of the Streets and Bridges Divisions to extend over a period of approximately 5 years.

Strict adherence to the schedule of construction proposed in the program became impossible because of adverse economic conditions in the thirties. In 1934, a new program, based on an estimated drop in revenue, was drawn up for approval by the Commissioners. This revised program was carried out without further serious curtailment of operations through fiscal aid

received from the Public Roads Administration under provisions of the National Industrial Recovery Act of 1933.

Of necessity, the more extensive projects contained in the program for the five years, beginning with 1930, were laid aside until such time as the necessary funds could be levied without working a hardship on the taxpayer. The existing Gas Tax Fund was established to finance all the activities of the Department of Highways and, consequently, this additional load, coupled with the failure to provide funds in the Deficiency Acts of 1933 and 1934 for supplemental highway projects, forced the deferment of major improvements to future programming. It should be emphasized that retrenchment in construction during this period must not be construed as evidence of faulty planning. The programs had been developed on the assumption that the sum of approximately four (4) million dollars, which had heretofore been appropriated for highway improvements, would continue to be allocated annually for this purpose during the course of the 5-year program. The adjustment made in 1934 took into account the reduced revenues and the operations which had been scheduled for execution during the preceding years were allowed to remain dormant until such time as conditions more favorable to their accomplishment would prevail.

These did not come about until 1938, when the national economy showed definite signs of having improved permenently. During the previous year, the Department prepared a report which recapitulated the accomplishments and shortcomings of the programs of 1930 and 1934. The report also stressed the lack of sufficient revenues to underwrite extensive modernization of the highway system which had been retarded by the economic depresion. It further urged the adoption of a flexible program of highway improvements to per-

mit the execution of major projects over a period of years.

(3) 1939 - Highway Program: The facts disclosed in the report had an immediate effect. The District of Columbia Revenue Act of 1937, approved August 17, 1937, established the Highway Fund, referred to previously, into which all motor vehicle registration, fuel taxes and fees were paid. This Act also limited the expenditure of these monies solely and exclusively for highway purposes as defined in the Act. A new program of construction, based on the liberalizing aspects of the new fiscal policy, was formulated for the 5 years extending from 1939 to 1943. The budget set up in support of this program provided substantial amounts in excess of operating expenses to allow for general improvements and long-needed extensions of the Highway system.

New paving on major thoroughfares and local streets, roadway widening, bridge construction and repair, special major projects involving grade separation structures and limited-access highways, redesign of critical intersections, all these were projects which had been conceived during the preceding years and deferred until the passage of an adequate revenue measure to finance their construction. The 1939-1943 program revitalized them and, with minor changes, most of them were scheduled for construction during the five years embraced by the program.

(4) Organization of Highway Planning Survey: Highway Planning Survey Units were established in the 48 States, following the passage of the Hayden-Cartwright Act of 1934 by Congress, and began functioning in 1936. The language of the act specified that $1\frac{1}{2}$ percent of each state's annual highway allocation be spent in the development of "surveys, plans, engineering and economic in-

vestigations." The Public Roads Administration was largely responsible for the enactment of this legislation which created fact-finding bodies to operate as "pilots" for highway departments. This Agency of the Federal Government had long been aware of the need for a specialized instrument to conduct intensive research studies in the nation's travel habits on the highways. It meant the systematic and continues compilation of traffic volume counts at permanent and special stations, the evaluation of traffic-generating areas by conducting origin-destination surveys, the establishment of the parking demand in retail business districts and other related investigations designed to produce factual data on which an orderly and adequate program of highway improvements could be developed according to the nature and intensity of traffic requirements in urban areas.

As stated previously in 1938 the Federal Aid Highway Act was amended to recognize the District of Columbia as a civil entity equally eligible to participate in Federal Aid. This automatically included the District of Columbia in the National planning program. The task of assembling the required information, analyzing and interpreting traffic data, and presenting the findings in graphic form for further study by highway officials was entrusted in 1939, to a newly established unit of the Department which was designated as the Highway Planning Survey Unit.

(5) 1941 - The Highway Planning Survey Report: The newly organized research group had accumulated sufficient data and evidence, derived from a survey of the parking demand in the General Area of Washington, from a study of the use made of urban routes

in and about Rock Creek Park, from interviews with motorists on Trans-Washington trips, and from a study of the travel habits of all employees in the central business and governmental areas to issue a report, in 1941, on the more critical aspects of the problem of motor transportation in the Metropolitan Area.

The findings and recommendations of the Highway Planning Survey, which were detailed in the report, were of such significance that they were utilized by the Department of Highways to institute a long-range program of highway developments proposed for subsequent program years. Moreover, the report pointed up the critical nature of the parking situation in the business and Government districts, and led directly the creation of the Motor Vehicle Parking Agency by an Act of Congress, approved February 16, 1942. The Act conferred broad powers upon the Commissioners. It authorized the acquisition, creation and operation of public off-street parking facilities in the District, as a necessary measure to insure the free circulation of traffic in the public interest. The Parking Agency was activated in 1946 and published a report the following year. Its recommendations for the development of storage facilities by private enterprise were based on the results of the study conducted by the Highway Planning Survey in 1940, and on adjusted data revealed in a supplementary inventory of existing parking accommodations in the downtown area at the end of war.

The Department of Highways' Preliminary Report of 1941 contains a very careful analysis of the problem presented by the need for adequate terminal facilities in Washington. The recommendations which stemmed from this study are based on information ob-

tained from replies, furnished by 75,000 persons employed in the survey area, to Travel-Record questionnaires, and from a canvass, also by the questionnaire method, of persons parked in the area for a short period in order to shop, visit, pay professional calls, etc. They stress the necessity for tighter control of available "on-street" space for the benefit of transient of short-time parkers by means of wide-spread use of meters in the downtown area and other critical districts. The Department's recommendations also parallel those made by the Parking Agency in the matter of encouraging private business interests to establish customer parking facilities for the all-day parker near Federal Agencies by creating "fringe" parking lots on the outer periphery of the central district which could be serviced by mass transportation vehicles.

In addition to making specific recommendations for measures designed to improve the parking situation the Department published in the preliminary report of 1941, the results of engineering studies which were aimed directly at the preparation of Washington's highway system to bear the impact of vastly increased traffic pressures engendered by accelerated Federal activities in the approaching war.

The improvements which came about in the years immediately following publication of the 1941 Preliminary Report are listed elsewhere in this volume. Briefly, they consist of major thoroughfare reconstruction on radial truck highways connecting the central district to outlying residential and suburban areas in Maryland and Virginia. They also include such major projects as grade separation structures at congested, multiple intersections in

the general central area which encircles the business and Government districts. Where structures of this type were not feasible forone reason or another, the faulty intersections were redesigned and channelized on the surface. Narrow streets of the distributor type, which were considered essential to the proper dispersion of heavy traffic streams entering the central area via high-volume radial highways, were widened and repaved.

The scope and magnitude of the public works program formulated by the Department of Highways in 1941 necessitated certain other recommendations of a fiscal nature in order to insure the realization of capital projects within a reasonable length of time. Consequently, the report emphasized the need for immediate action in the interests of public safety. The argument was advanced that the only way in which the Department's extensive plans for modernizing the District of Columbia's system of permanent highways could be translated into actual improvements,over a period extending roughly over the next ten years, would be to implement the program by amending the fuel-tax Act of 1924, raising the impost on gasoline from 2 to 3 cents. This recommendation became law by an Act of Congress, approved December 26, 1941. As stated elsewhere, even with this increase, revenues declined during the war to an extent which necessited a further amendment to the fuel-tax Act of 1924, increasing the tax to four (4) cents on a temporary basis, in order to carry out our program of necessary improvements within the time required by sound planning.

(6) Preliminary Survey-Subways: Leaving no possibility unexplored in an effort to relieve the extremely severe condition of congestion in downtown Washington, officials of the Department

instituted in 1942, an engineering and economic investigation of lower-level street or tunnel systems, as a means of diverting excess traffic, particularly mass transportation vehicles, into underground channels.

The study was authorized by Congress in a Joint Resolution approved March 7, 1942, which directed the Commissioners of the District of Columbia to determine the feasibility of the construction of subways in the area under their jurisdiction. On March 13, 1942, the Director of highways was ordered to proceed with the survey and to prepare a report on the findings, accompanied by suitable conclusions and recommendations.

The urban region delimited by 17th Street on the west, 6th Street on the east, K Street on the north and Pennsylvania Avenue on the south, including short but densely populated sections extending outward from this area on certain arterials, was selected as the survey area. The cordon enclosed the critical retail business and Government districts, in which the streets, during peak hours, became over-saturated with bus and streetcar traffic. It was chosen with particular care because the transportation tangle within its borders had existed prior to 1941-42. Those were the years which witnessed the influx of new personnel to staff the expanded Federal establishment and the consequent increase in traffic movement. Any beneficial measures designed to alleviate the abnormal situation during the war would remain, therefore, to correct peacetime conditions.

On June 24, 1942, a report on the findings of the preliminary survey was prepared and submitted to the Commissioners. It contained an analysis of the transportation requirements of the dis-

trict surveyed, from which three basic conclusions were formed: (1) that rapid transit subway lines to the outlying sections of the District of Columbia are not warranted or necessary ; (2) that a system of streetcar tunnels and underpasses, including appropriate terminal facilities in the central congested area, is feasible and, in many cases, warranted; (3) that the construction of grade separation structures and depressed highways within and beyond the central area is necessary and logical.

These conclusions were embodied in a recommendation to the Commissioners and to Congress with a request for additional funds to conduct more detailed studies by Department engineers and consultants, in order to prepare definite plans as to projects, locations, costs and other factors. These recommendations were endorsed in part by the National Capital Park and Planning Commission in a companion report issued by that agency on the question of subways for Washington. The Commision expressed itself in favor of grade separation structures, or localized subways, in the heavily congested multiple intersections caused by the convergence of several arterial streets into overtaxed rotaries, such as Thomas and Scott Circles, and at 14th Street, S. W., and Maine Avenue.

(7) The K Street Trunk Highway Improvement: The need for an east-west limited-access highway across Washington, which would serve adequately as a high-speed dispersal artery during the morning rush period, and as an equally rapid means of egress from the central business and Government districts during the evening rush period, was recognized by the Department of Highways in its preliminary highway report of 1941.

By 1943, the strain exerted on the highway system by excessive

traffic movements generated by the war had reached the point where public safety and welfare were endangered unduly. As a result of this condition, the Director of Highways invited the J. E. Greiner Company, a consultant engineering firm of Baltimore, Maryland, to explore the possibility of creating such a through highway and to determine the feasibility of improving K Street along these lines.

The design of the proposed expressway was influenced by several factors based on the traffic situation as it existed in 1941, the last pre-war or normal year, in order to avoid any possible war-time distortion. Proceeding on the basis of this known quantity, the consultants projected a curve showing the population trend by years in the District of Columbia, in conjunction with the corollary yearly trend of persons-per-vehicle, and yearly vehicle registration increases. This combined indicator of probable normal traffic growth in the District of Columbia was adjusted to express induced and diverted traffic volumes, which would be generated by the improvements, and expanded to include a forecast of future traffic requirements by 1980.

The Department's choice of K Street as best suited for this type of development was endorsed by the consultants on account of width, straight line location and contiguity to the business district, and was recommended as essential to the relief of traffic pressure on congested parallel streets. On the basis of traffic data furnished to the consultants for analysis, it was computed that immediate construction of the improvement would effect an approximate reduction of 60% in the traffic carried by the adjacent streets and arterials serving this section of the city.

The westerly terminus of this facility, when considered to-

gether with other improvements recommended in the 1941 report, was to be located at the Francis Scott Key Bridge, an important highway crossing of the Potomac River. Construction of the elevated section is now in progress at this location. The eastern terminals at 6th Street, West Virginia Avenue and at 15th Street and H Street via Florida Avenue, connect with all important arterials in this section of the city, including a connection to the proposed Washington-Baltimore Freeway by way of West Virginia Avenue and New York Avenue extended. Other sections will be constructed at a later date during subsequent programs.

Engineering treatment of the highway lying between these points, consists of both underground and surface facilities. The underground work proposed takes the form of a depressed interchange at Mt. Vernon Square, a 4-lane depressed highway in the bed of K Street between Mt. Vernon Square and 6th Street, N.E., and underpasses at the intersection of K Street with Florida Avenue and in the vicinity of the intersection of Florida Avenue with Benning Road, 15th Street and H Streets, N.E.

The proposed surface improvements consist of widening roadway pavements on K Street, the construction of service roadways along certain highly developed sections of the highway, and the redesign of all intersections to permit entrance and exit from the trunk highway, via channelized connections.

The consultants declared that the trunk highway was entirely feasible from an engineering standpoint, and desirable as a much needed development for the relief of increasing traffic congestion on the present street system in the vicinity of K Street.

With the exception of the underpass treatment proposed at Mt. Vernon Square, decision has been reached by the Department to defer construction of the entire project, as recommended by the consultants, due to its great cost and the possibility of diverting traffic to other routes through surface improvements at a relatively minor cost, until the results of the Washington Metropolitan Area Transportation Study, now in progress are available.

(8) The 1944 Central Area Report: The traffic situation in the Central Area was reviewed again in a report submitted to the Commissioners, in October 1944, by the J. E. Greiner Company and De Leuw, Cather & Company, consulting engineers. Data relative to traffic volumes, employment, population trends and other statistical information of like nature, which reflected conditions existing prior to 1942, when gasoline and tire rationing became effective, were used as a basis for estimating future transportation needs.

The report is mainly concerned with a discussion of a master plan for the correction and the future development of transportation facilities in the Central Area of the District of Columbia. The plan is aimed directly at improving accessibility to the retail business and Federal districts located in the area and is given detailed consideration in the report.

In their analysis of conditions in the congested downtown district, the consultants again advanced the proposal of lower-level streets as the only positive means of reducing the conflicts between fixed-wheel mass transportation vehicles and free-wheel traffic on surface pavements. The contemplated relocation of streetcar lines, which now operate on Connecticut and Pennsylvania Avenues and Fourteenth Street, to underground tunnels in the critical

downtown area, is a project which appears to be amply justified. It was considered by the consultants that the proposed subway system would (1) serve the greatest number of people with the minimum mileage; (2) extend the benefits of rapid transit on lower-level streetcars to people living in all parts of the city; (3) remove streetcars from the surface of the most congested streets; (4) permit coordination with rail and bus routes remaining on the surface; (5) allow for future expansion. It was further pointed out that the flow of buses, after subways were built, would be reduced to the extent that patrons would be attracted to the faster underground routes.

The master plan evolved by the consultants and presented in the Central Area Report, involved extensive improvements in the existing street layout through the construction of grade separation structures and channelized connections, to form convenient inner and outer belt line distributor routes around the central portion of the city. K Street, situated on the northern rim of this area, was earmarked for further improvement as part of the inner belt route and as a surface distributing artery.

Underpasses to separate the heavy traffic flows were urged as remedial measures for the overloaded rotary at DuPont Circle and for the multiple intersection of Pennsylvania and Constitution Avenues and Fourth Street, N. W. Work on the underpass facility at Dupont Circle is curently in progress. Later studies and decision by the Capital Transit Company to remove its tracks from Pennsylvania Avenue, in the vicinity of 4th Street and Constitution Avenue have made it possible to redesign this intersection in order to serve traffic adequately at this point through surface

channelization without resort to expensive underpass construction.

The report noted, moreover, that existing parking facilities in the shopping district were entirely inadequate at present and that the creation of throughways leading into the heart of the city would be wasted effort, unless storage facilities were provided to accommodate the increased traffic which would be attracted by the improved highways. The consultants also suggested that certain obsolete buildings in this area be replaced gradually by a type of building more in keeping with the character of motorized transportation in this modern age -- buildings which would combine small shops and offices, centralized service, underground merchandise collection and delivery, and offer parking facilities for clients and customers. They further suggested that land in Government ownership be converted into suitably landscaped parking lots for the accommodation of Federal employees.

The program formulated by the J. E. Greiner Co., and De Leuw, Cather and Co., focuses anew the attention of citizens and Highway Department officials on the major improvements which have been recommended by engineers since the middle thirties, a period in the history of the Nation's Capital which saw the beginning of increased activity in the executive functions of Government. The population and traffic volume curves have been on the rise ever since, but without a corresponding expansion of the highway system to absorb excess traffic movements in the Central Area. Hazardous conditions, increased cost of motor vehicle operation, delay and inaccessibility of vital regions located in this area are the wasteful and unproductive results suffered each day by a large segment of the population. These facts were reiterated in the

Transportation Survey and Plan for the Central Area of Washington, D. C. and formed the basis for the recommendations made in the report of October 1944.

(9) The 1946 Transportation Report: After five years in the role of the world's war-time capital, Washington was bursting at the seams under the pressure of its swollen population. New groups of military and civilian personnel, engaged in the accelerated functions of a Government waging war on a global scale, had, by 1946, overflowed into the adjoining counties of Maryland and Virginia in such numbers that transportation problems were no longer limited to the city of Washington. A metropolitan area, composed of vast new housing developments, had sprung up to form a populous and exceedingly active fringe on all sides of the District of Columbia. Morning and evening periods of intense vehicular activity between suburban residential areas and the urban centers of employment were periods filled with danger and delay to the shuttling motorist, so that a revision of long-range highway programs to include expressways, was considered as essential to the solution of transportation problem.

The engineering firms of J. E. Greiner Company and De Leuw, Cather and Company, were again called in consultation with Department of Highways officials to study the new traffic trends and developments, and to recommend possible action. In December, 1946, they submitted a report containing broad recommendations which emphasized the necessity of consolidating and enlarging past proposals for improvements in the District of Columbia's highway system, to include a system of expressways serving all parts of the District and connecting with existing and proposed highways

of this type in Maryland and Virginia. A network of arterials, improved at irregular, multiple and high volume intersections through the construction of grade separation structures, channelization, and the use of effective signalization and other control measures were also recommended.

The most far reaching plan conceived by the consultants, and presented in their 1946 report, was a limited-access highway designed to relieve the shopping district of through traffic destined for the Federal Triangle, the Southwest Mall and other points beyond the Central Area. Tentatively designated as the "Mid-City Expressway", the proposed highway would extend from Canal Street in the vicinity of Independence Avenue across the Mall, along Third Street as a depressed highway, west of Griffith Stadium, under the hill north of Howard University, along the west edge of the Soldier's Home, through a hill east of Rock Creek Cemetery and thence northeast to the District Line. Justification for the high-cost heavy construction work necessary to the execution of this ambitious project was based on assumption that enormous volumes of traffic would be accommodated, to effect a welcome release in the pressure on other streets serving traffic destined for the Central Area, as well as that of a strictly local character.

Further extension of the expressway system involves certain modifications in the tentative plans for the K Street improvement prepared by the consultants in 1943. Redesigned to fit the new plan, this critical artery would start at third street, N.W., to connect with the Mid-City Expressway. Another important link in the system developed in the report of 1946, consists of a high-speed connection between the proposed Baltimore-Washington Parkway and the Anacostia River highway crossings and Seventeenth

Street, N. W. Designated as the Capitol Hill Expressway, this improvement calls for the construction of two one-way drives depressed east of Capitol Hill, through which they would be carried in tunnels, and merging in the Mall east of Third Street, from which point they would be carried at grade, on the approximate alignment of the present Madison and Jefferson Drives. Conflicts at all important intersections would be eliminated by grade separation structures.

Improvements of like nature, conceived on a somewhat lesser scale are also proposed for the Rock Creek Park drives which would be extended northward to the District line to connect with U.S. Route 240, and with the Northern Parkway as proposed by the Maryland National Capital Park and Planning Commission. Projects such as the K Street Elevated Highway, Canal Road widening, the opening up of the valley along Arizona Avenue as a parkway to connect Canal Road with Wisconsin Avenue, the Whitehaven Parkway as a high-speed artery to serve a densely populated area west of Wisconsin Avenue, and the Anacostia-Kenilworth Freeway as a section of the proposed circumferential route to provide for all by-passable traffic, on U. S. Route 1 on a throughway extending from points of entry in the Northeast to South Capitol Street along the east side of the Anacostia River, and thence to Alexandria on a proposed crossing across the Potomac River, all these are highway ameliorations discussed in the report as practicable engineering measures designed to further Washington's long-range transportation objectives.

Studies made by the consultants in connection with the operation of mass transportation vehicles on expressways, indicate

that maximum benefits will accrue to patrons of the transit company by inaugurating express schedules to attract and induce a greater portion of the population to use public transportation. The consultants stressed anew the advisability of the construction of off-street bus terminals in the central business and Government districts, to be built as integral parts of new groups of Federal buildings, and strongly recommended the vertical segregation of fixed-wheel vehicles in the downtown area through the construction of a system of depressed right-of-ways for streetcars.

PART II

CONSTRUCTION

(A) Structures:

(1) Procedures and Methods: The twenty-four year period covered by this report has been one of great progress in the Bridge Division of the Department of Highways. During this period we have seen all but a few of the major obsolete and inadequate bridges replaced with modern structures. In addition, the Bridge Division has undertaken and completed eight major grade separation structures, and at this time plans are complete for three additional structures. There is also in progress the construction of two major structures on new locations, which will provide additional traffic facilities, directly to areas of dense population, connecting with main city highways that have recently been developed.

This period saw the elimination of the last main-line railroad grade-crossings, with the construction of nineteen structures over or under main-line railroads. Plans for one additional crossing are ready so that, when the structure is completed, a new arterial highway to the Northeast will be opened. This latter is not an elimination project, but an addition to the system.

The Bridge Division has been called upon to design and construct numerous special projects, such as the Fourteenth Street Transit Terminal, and the Dupont Circle Underpass which includes facilities for an underground streetcar station. This latter work is now in progress.

In connection with the design of replacement and new structures, as well as grade separation projects, the District has utilized

the services of consulting engineers on some projects in order to speed up the work. The Design Unit of the Bridge Division, as heretofore stated, is unable to prepare plans in the volume required to carry out bridge programs of the magnitude with which we have been confronted during the past several years. During the period of this activity, the design of bridges and other structures has followed the modern trend. Provision has been made in all cases for increased loadings and accepted approved standards of design. In the main, bridge structures have been of the deck type. Added safety provisions have been incorporated in the designs and special lanes for heavy load traffic up to forty-five tons have been included.

Following is listed the major and minor bridge and structure work accomplished during the report period.

(2) Major Capital Outlay Structures:

(a) Bridges

Projects	Source of Funds	Completion Year
Connecticut Avenue Bridge over Klingle Road	D.C.	1932
Calvert Street Bridge over Rock Creek	D.C.	1935
P Street Bridge over Rock Creek	NRM	1935
M Street Bridge over Rock Creek	D.C.	1929
K Street Bridge over Rock Creek	D.C.	1940
Massachusetts Avenue Bridge over Rock Creek	D.C.	1941
Military Road Bridge over Rock Creek	D.C.	1929
Klingle Road Separation Structure over Rock Creek	FAS	1948
14th Street Bridge over Potomac River (East Bridge under construction)	FAP	1949 (1)
South Capitol Street Bridge over Anacostia River (under construction)	D.C.	1949 (1)
Pennsylvania Avenue Bridge over Anacostia (John Philip Sousa Bridge)	D.C.	1941
Benning Bridge over Anacostia River	D.C.	1934
Chain Bridge over Potomac River	D.C.	1938
Independence Avenue Bridge of Tidal Basin	FAP	1943
Tidal Basin Outlet Bridge	D.C.	1942
High Level Military Road Bridge over Rock Creek (plans completed)		

Projects	Source Of Funds	Completion Year
16th Street Bridge over Military Road (plans completed)	---	----
14th Street Bridge over Potomac River (West Bridge plans completed)	FAP	----
(b) Highway Grade Separation Structures		
Scott Circle Underpass	FAP	1942
Thomas Circle Underpass	D.C.	1940
Virginia Avenue Underpass	AW-FAP	1942
Portland Street Underpass	AW-FAP	1943
14th Street over Maine Avenue and Park Drive	DAWR	1943
Independence Avenue Overpass	FAP	1943
(c) Special Structures		
14th Street Transit Terminal	FAP	1943
Municipal Fish Wharf Pier #1 (superstructure)	D.C.	1937
Dupont Circle Underpass and Transit Station	FAP	1949 (1)
K Street Elevated Highway (in progress)	FAP	1948 (1)
K Street Depressed Highway (22nd Street to 27th Street - plans completed)	---	----
D.C. Fire Boat Wharves	D.C.	1942
(d) Railroad Grade Crossing Elimination Projects		
Van Buren Street under B. & O. Railroad	D.C.	1926
New Hampshire Avenue over B. & O. Railroad	NRS	1934
Piney Branch Road under B. & O. Railroad	D.C.	1934
Riggs Road under B. & O. Railroad	FAP	1948
Taylor Street over B. & O. Railroad	FAGM	1940
Michigan Avenue over B. & O. Railroad	WPGM	1937
Monroe Street over B. & O. Railroad	D.C.	1931
Franklin Street over B. & O. Railroad	D.C.	1937
Eastern Avenue over B. & O. Railroad	D.C.	1935
Montana Avenue under B. & O. Railroad	- -	---- (2)

(1) Anticipated completion year
(2) Constructed by railroad under Union Station Act

Key to Source of Funds:

D.C. - District of Columbia
FAS - Federal Aid Highway Act
FAP - Federal Aid Highway Act
NRS) NRM) - National Industrial Recovery Act of 1933
FAGM) WPGM) - Emergency Relief Act of 1935
DAWR - Defence Highway Act of 1941

(d) Railroad Grade Crossing Elimination Projects.	Source Of Funds	Completion Year
Eastern Avenue under Pennsylvania Railroad	D.C.	1937
Montana Avenue under Pennsylvania Railroad	---	---- (2)
Bladensburg Road under Pennsylvania Railroad	D.C.	1938
9th Street over Terminal Tracks	---	---- (2)
Queens Chapel Road over B. & O. Railroad	D. C.	1939
12th Street over Terminal Tracks	FAGM	1940
New York Avenue over Terminal Tracks	D. C.	1931
Maine Avenue under Terminal Tracks	FAGM	1942
Benning Biaduct over Pennsylvania Railroad	D. C.	1937

(3) Minor Capital Outlay

Small Bridges	Culverts
11	21

(B) Paving

(1) Procedures and Methods:

(a) General Statement: Many improvements have been made in the construction field during the past twenty-four (24) years, not only in the actual construction methods employed, but in the machinery used and in the pavement design as well. Many officials of the Department are members, and as such serve on committees of the American Association of State Highway Officials, the American Roadbuilders Association and other associations concerned with highway development. Through these contacts the Department is able to keep abreast of all progress in the industry. Specifications covering paving and structure construction in the District of Columbia have been revised and rewritten as often as necessary to take advantage of the great improvements made in equipment manufacture and by research agencies throughout the United States in improved roadway and structure design.

A word concerning paving methods in 1924, as compared with

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(2) Constructed by railroad under Union Station Act.

the methods employed today, will serve to illustrate the changes which have taken place during the years and will bring out very forcefully the fact that those changes were of necessity gradual, and the result of much research and effort, not only on the part of this Department, but also on the part of the whole highway industry. The changes themselves indicate, more clearly than words alone could, the fact that the Department must be alert to changes and improvements, no matter where or by whom developed, in order to operate efficiently and economically.

(b) Concrete Construction: To those who remember the twenties the present pace of construction work must indeed seem incredible. Back in 1924 the paving of a street of any considerable length was quite a project, judged not alone by the quantities involved but by the time consumed in completing the work. Excavation was by steam shovel and as often as not the excavated material was disposed of by wagon team as well as by truck. There was no such thing as batch-wagons or trucks, all aggregates being dumped on the sub-grade in stock piles, from which point they were rehandled by hand labor and dumped into the concrete mixer with wheel barrows. Volumetric measure was used. Field control was exercised by "striking-off" a level wheel barrow and measuring its cubic content by use of a one (1) cubic foot sample box. The amount of mixing water and time of mixing where determined by the mixer operator by experience only. The mixer itself was a vastly different machine from that used today, being of lesser capacity and with a manually-operated swiveled spout to discharge the concrete onto the sub-grade. All concrete was "struck-off" and finished by hand. The entire width of street was poured at one time and

no wire mesh reinforcement or joint materials were used to control cracking of the pavement. Hand sprinkled water was used for curing and the pavement was barricaded after completion for an arbitrary period of twenty-one (21) days before being opened to traffic. A good day's pour of six (6) inch concrete pavement consisted of approximately three hundred (300) square yards.

Compare the foregoing with the modern methods and procedures used today. Excavation is by a fast gasoline shovel or Keystone skimmer, and disposal of excavated material as well as hauling of aggregates are made by motor truck. The trucks used to haul aggregates are partitioned off into batches, each containing all of the ingredients necessary for one complete well designed concrete mixture. The proportion of materials in the mix is now controlled by weight at a central "batching plant" and the batch is dumped directly into the mixer from the truck. The amount of mixing water is determined by an automatic gauge attached to the mixer, and the mixing time is controlled by a counter on the mixer which is activated at the correct number of revolutions. There are some modern concrete mixers of the two-drum type. However, the mixer usually used on our work consists of one drum, one (1) cubic yard capacity, all power operated by one man, and with a boom and discharge bucket which swivels and extends twenty (20) feet ahead of the mixer. Although hand broomed, all concrete is now"struck-off" and finished by modern finishing machines. Instead of being poured in one slab, pavements are now constructed in longitudinal sections conforming to a pre-determined joint design. This often permits the maintenance of traffic on one side of the street during construction,

a very important factor today. Expansion and contraction joints, and wire-mesh reinforcement are used today to control cracking, and load-transfer devices are installed to distribute the load among slabs. Calcium chloride and water saturated burlap is now used to cure concrete, and due to improved methods of testing it is possible to open newly constructed pavements within four or five days after pouring. By the use of special cements or admixtures, even this time can be reduced at important intersections and on main arterials. A good day's pour of six (6) inch concrete pavement today measures approximately one thousand (1,000) square yards.

So-called "transit-mix" trucks are often used today on minor construction, such as curb and gutter, alleys, or sidewalks. These trucks, which transport as well as mix the concrete, have all the automatic devices necessary to control the production of good concrete.

(c) Bituminous Construction: The development of bituminous paving construction in the District of Columbia has paralleled the development of the industry. These developments may be classified as improvements in the equipment, materials, and methods of control and inspection.

The equipment manufacturers have made great strides in the designing of new equipment, bituminous plants, finishers, rollers and miscellaneous equipment.

The early bituminous plants consisted of a coal or wood-fired drier, some means of volumetric measuring of aggregates and bituminous material, and pits or tanks for storing the

bituminous materials. The capacity of coal or wood-fired driers was very low and irregular, and accurate control of the heat was impossible. With this type of drier in the plants producing sheet asphalt, it was necessary to dry the sand at night prior to the day's operations. The present day drier is heated by means of fuel-oil burners and a forced draft, in connection with the dust control unit, which directs the heat uniformly throughout the drum. A pyrometer or other type of recording thermometer is located in the discharge chute, thereby enabling the fireman to regulate and maintain the temperature of the aggregates as directed. The volumetric method of measuring the constituents of the bituminous mixture has been replaced by weighing. The modern plant is equipped with dial or beam-scales, with individual beams for each aggregate bin compartment, and a separate scale for weighing the bituminous material which insures accurate proportioning of the mixture. The storage of the bituminous material in open pits or tanks has been replaced by modern insulated tanks equipped with steam coils or electric heaters, capable of maintaining the bituminous material at the desired temperature. A thermometer is located in the bituminous line in order that the operator may have a constant check on the temperature of the material.

The transportation of the bituminous mixture to the paving projects in modern insulated dump trucks replaced the use of horse-drawn carts and dump-bottom wagons at about the same time that the modern truck came into general use.

The development of the modern finishing machine has been

perhaps the greatest advancement in the construction of bituminous pavements in the past ten to fifteen years. Previously the mixture was placed and finished entirely by hand which caused a very irregular thickness and grade. The modern finishing machine places and finishes the material to a uniform thickness and grade, and eliminates minor irregularities in the base course or old surface in the case of resurfacing work. The modern gasoline or diesel-operated rollers are an improvement over the old steam roller in that they prevent contamination of the surface by foreign materials such as coal, ashes, etc. There has been a definite swing from the use of three-wheel rollers to tandem rollers on bituminous work.

The early bituminous pavements in the District of Columbia were mixed with asphalt cements imported from Central or South America. This material was relatively hard, having a penetration of approximately 20, and was cooked and mixed with a heavy flux oil to the specified penetration at the bituminous plants. Improvements in the oil refining industry produced a petroleum asphalt cement from asphaltic base crude oil which compares very favorably with the imported asphalt cements. This domestic material was accepted for general use in the 1917-1919 period, and it's use has increased since that time to the exclusion of foreign asphalt cements for paving work. The petroleum asphalt cements are produced by the refineries at specified penetrations and require no further conditioning at the bituminous plants except heating.

The aggregates used in bituminous construction are basically

the same as have been used through the years. The aggregate sizes have been improved to secure a more uniform material and a denser pavement. The requirements on the quality of the aggregates have definitely been raised.

The methods of inspection and control of the bituminous mixtures have improved along with the progress in design of equipment and materials. The modern specifications are very thorough and strict, compared with those of past years. The present day design of bituminous mixtures is based on definite test results, rather than the trial-and-error methods used in the past. Modern methods for determining the stability of bituminous mixtures, surface area equivalents of the aggregates, and the characteristics of the bituminous material have improved and simplified the design of bituminous mixtures. The District of Columbia has maintained continuous inspection at the bituminous plants. The Department endeavors to keep it's inspectors abreast of new developments in the bituminous field.

(d) Concrete Materials and Design: Control of paving materials in the District of Columbia is not a new development. In 1888, there was established the Bureau of Asphalts and Cements for inspection and testing of these materials as they were being used in street paving. Control, however, extended only to asphalts and cements. As late as 1924, concrete materials for Portland cement concrete were still being proportioned by volume and little consideration was given to soundness or gradation of the aggregate.

The expansion of the concrete industry and the increased use of concrete during the period 1920 to 1930, led to a great amount

of research on concrete materials. This research established the value of exact proportioning of materials, the need for soundness in the aggregate, and the relation of mixing water to the ultimate strength. The facts established by this research led to the institution of a more rigid inspection system for concrete, and with the establishment of the Materials Section in 1930 there was developed the comprehensive system of inspection and testing of concrete materials which prevails today. All sources of sand and gravel are thoroughly investigated and all concrete mixes are accurately proportioned by weight. The aim has been to duplicate factory conditions as nearly as possible, so that each section of pavement consists of a uniform material. All concrete is mixed thoroughly in mechanical mixers. All cement is inspected by the U. S. Bureau of Standards. Specimens are made and tested for strength requirements before the pavement is opened to traffic.

In addition to closely controlling the quality of the materials in its concrete pavements, the Department has attempted constantly through improvements in its design and construction practices to increase the serviceability of its concrete pavements.

Early recognition was given to the fact that the temperature extremes, to which concrete pavements were subjected, necessitated some provision in design for expansion of concrete. During the period from 1924 to 1930, research conducted by the U.S. Public Roads Administration and State Highway agencies demonstrated the need for load-transfer devices at joints and a rational design of joint spacings. These findings together

with studies of local conditions led to the adoption of a basic design in 1932, which met the requirements of Federal Aid Primary systems. This design consisted of transverse expansion joints at intervals of 30 feet with load-transfer devices at each joint. The success of this apparently conservative practice has been demonstrated conclusively as structural failures, due either to wheel loads or expansion stresses, have been eliminated. Thorough sealing of the joints, a practice not commonly followed at that time, has been practiced since 1933, and has proven its worth in preventing failures due to infiltration of surface water.

Since concrete is used to a great extent as a base for sheet asphalt surfacing, it was necessary to develop a joint design which would be satisfactory for these asphalt surfaces. Recognizing the desirability of retaining the distinguishing characteristics of an asphalt surface, that is, its initially smooth, unbroken, and uniform appearance, and further appreciating that the major portion of irregular cracking of a bituminous surface could be attributed to an inadequately designed concrete base, a study was undertaken by the Department in an effort to develop a design and construction procedure whereby irregular cracking of bituminous surfaces at an early age, with subsequent premature failure and high maintenance cost, could be definitely controlled if not entirely eliminated.

These studies extended over a period of several years in which bases with different joint spacings were closely watched. In 1939 the Department adopted the present design of transverse joints spaced at 12-1/2 feet. By the use of this design it has

been possible to eliminate any large movement in the concrete base. As a result, asphalt surface cracking has been eliminated to a great extent, with a consequent reduction of maintenance costs.

The facts revealed by these studies were also applied to the design and construction of concrete pavements during the war years when steel priorities made it impossible to construct conventional type pavements.

(c) Soil Studies: Prior to 1930, highway engineers had made little attempt to treat soil as a material of construction. Its value as a supporting medium for pavements was not considered in design, and the characteristics of different soils were overlooked. It was about this time that first information on the behavior of soils under highway conditions became available. Although this early research information did not answer all of the many problems regarding highway soil mechanics, it did show that maintenance costs on pavements could be reduced by proper consideration of the capabilities of the soil foundation supporting the pavement.

In 1930 there was established, within the Materials Section, a soils unit which was to devote its time to the performance of soil inspection and investigation. Thus the Department was among the first to recognize the need for adequate soils investigations on construction projects, and among the first to devote full-time personnel to this type of work. By 1932 the duties of this unit included all soils field work for the Department. In addition its services were in constant demand by the various Departments of the Engineer Department. Its duties expanded to

include the performance of deep foundation borings, load bearing tests, sub-grade and drainage surveys, and the location and classification of sources of soil material for use in highway construction.

Because of the pioneer work of this unit the Department has become "soils conscious". Material for pavement foundations is no longer taken from the most accessible places, but is carefully inspected and tested before being used. The systematic location of suitable sources of material within the District has made it possible to obtain quality soil material for all projects. The accumulation of accurate information on local soils has made it possible to incorporate definite construction requirements into the standard specifications. In this manner, the advance in knowledge of soils has been reflected in actual construction practice and savings to the District of Columbia. Excavations for utilities in a city of this size are numerous, and the proper treatment of the backfill material in these utility cuts is maintained by constant inspection of utility projects.

An important part of the soils work has been the performance of deep earth borings and load bearing tests for major structures constructed by the District of Columbia. The first equipment used was hand operated and very laborious. By 1933, the demands for this work had become so great that motor-driven equipment was made available to eliminate some of the hand operations. Although this equipment was crude by present day standards, it made possible the thorough investigation of soil conditions of such major structures as the Blue Plains Sewage

Treatment Plant and the Klingle Bridge. It was possible to explore the foundation conditions at Blue Plains to a depth of one hundred and sixty feet below the surface, a record depth without precedent for this type of equipment.

This work has provided design engineers with accurate information on which to base reasonable design, and has eliminated to a large extent the once general practice of overbidding by contractors where large quantities of sub-surface construction was concerned.

Realizing the value of this type of soils work, in 1938 two (2) modern drill rigs were purchased and are in use today.

Following is listed the major and minor paving work accomplished during the report period.

(2) Major Capital Outlay Projects

(a) Major Paving Projects

Projects	Source Of Funds	Completion Year
Allison Street,N.E.,Rock Creek Church Road to Hawaii Avenue & Rock Creek Church Road Harewood Road to North Capitol Street	FAS	1946
Arkansas Avenue N.W., - 16th Street to Decatur Street	D.C.	1941
Alabama Avenue S.E. - 12th Street,21st Street	FAP	1947
Alabama Avenue & Bowen Road S.E. - Pennsylvania Avenue to D. C. Line	FAP	1947
Alabama Avenue S.E. 21st Street to Good Hope Road - 25th Street S.E. from Alabama Avenue to Good Hope Road	FAP	1947
Armory Plaza - 19th Street to 22nd Street	D.C.	1941
Blagden Avenue N.W. - 16th Street to Rock Creek Park	D.C.	1931
Blair Road N.W. - Peabody Street to Aspen Street	D.C.	1938
Benning Road N.E. - Minnesota Avenue to Central Avenue	NRM	1934
Bladensburg Road N.E. - H to D.C. Line	D.C.	1931
Brentwood Parkway, & 6th & 9th Streets,N.E. from Florida Avenue to Rhode Island Avenue	FAP	1942
Bunker Hill Road, Taylor Street and Randolph Street, N.E. 14th & 26th Streets.	FAP	1946

Projects	Source Of Funds	Completion Year
Branch Avenue S. E. - Pennsylvania Avenue to Alabama Avenue	NRS	1935
Branch Avenue S.E. - Alabama Avenue to D.C. Line	D.C.	1938
Canal Road N.W. - Weaver Place, to Chain Bridge	D.C.	1938
Central Avenue N.E. - Benning Road to D.C. Line	D.C.	1925
Dalecarlia Parkway N.W. - Loughboro Road to Massachusetts Avenue	FAP	1946
East Capitol Street - Central Avenue to 55th Street	D.C.	1942
Randolph Street and Eastern Avenue N.E. - 26th Street to Rhode Island Avenue	FAP	1940
Eastern Avenue N.E. - Bladensburg Road to Rhode Island Avenue	D.C.	1935
Foxhall Road N.W. - Canal Road to Reservoir Road	NRS	1936
Franklin Street, N.E. - Michigan Avenue to Lincoln Road	D.C.	1938
Franklin Street, N.E. - Rhode Island Avenue to 20th Street	D.C.	1941
Georgia Avenue, N.W. - Fern Street to D.C. Line	D.C.	1928
Good Hope Road S.E. - Nichols Avenue to Naylor Road	NRM	1934
Hawaii Avenue N.E. - North Capitol to Taylor- North Capitol Street - Farragut Place to Hawaii & Taylor between 7th and Hawaii	FAP	1940
Illinois Avenue - Grant Circle to 9th Street	D.C.	1934
Independence Avenue S.W. - 14th Street to 17th Street	DAWR	1943
Independence Avenue S.W. - 17th Street to Lincoln Memorial Circle	DAWR	1942
K Street, N.W. - 12th Street to Connecticut Avenue	D.C.	1938
K Street, N.W. 17th Street to 20th Street	D.C.	1933
K Street, N.W. 29th to Key Bridge (Low Level Roadway)	FAP	1946
Kennedy Street, N.W. Kansas Avenue to North Capitol Street	D.C.	1939
Kennedy Street, N.W. Kansas Avenue to 14th Street	D.C.	1938
Kennilworth Avenue Benning Road to Deane Avenue	WPMS	1936
Kennilworth Avenue - Deane Avenue to D.C.Line	WPMS	1936
Loughboro Road,N.W. - Indian Lane to Glenbrook Road	D.C.	1938
Loughboro Road, N.W. - Glenbrook Road to Mac- Arthur Boulevard.	D.C.	1939
MacArthur Boulevard N.W. - Foxhall Road to Reservoir Road.	NRS	1934

Projects	Source Of Funds	Completion Year
MacArthur Boulevard N.W. - Reservoir Road to D. C. Line	NRS	1935
Massachusetts Avenue N.W. - Nebraska Avenue to D. C. Line	FAP	1946
Montana Avenue N.E. 17th Street to Rhode Island Avenue	D.C.	1940
Montana Avenue N.E. and 17th Street N.E. New York Avenue to Douglas Street	D.C.	1937
Minnesota Avenue S.E. 18th Street to Pennsylvania Avenue	D.C.	1928
Minnesota Avenue S.E. Benning Road to 27th Street	FAP	1940
Mount Olivet Road, N.E. - New York Avenue to Bladensburg Road	FAS	1947
Maine Avenue S.W. (Roadways in connection with structures)	D.C.	1943
New Hampshire Avenue N.W. - Randolph Street to Grant Circle	NRS	1934
New Hampshire Avenue N.W. - Buchanan Street to North Capitol Street	D.C.	1937
New Hampshire Avenue N.W. - North Capitol Street to D.C. Line	NRS	1934
New Mexico Avenue & Tunlaw Road N.W. 39th Street to Nebraska Avenue	FAS	1947
North Capitol Street - Farragut Place to New Hampshire Avenue	FAP	1940
North Capitol Street & Blair Road between New Hampshire Avenue and Peabody Street	FAP	1941
New York Avenue N.E. - Florida Avenue to Bladensburg Road	D.C.	1931
Naylor Road S.E. - Good Hope Road to Texas Avenue	FAP	1940
Nichols Avenue S.E. - Upsal to South Capitol Street	D.C.	1939
Nichols Avenue S.E. 4th Street to Upsal Street	FAP	1939
Nichols Avenue S.E., Chesapeake Street to Joliet Street	FAS	1946
Nichols Avenue S.W. - South Capitol Street to Chesapeake Street	D.C.	1948
Nichols Avenue S.E. - Portland Street, northward 2800 feet.	D.C.	1923
Oklahoma Avenue N.E.-Benning Road to C Street	FWA	1943
Overlook Avenue S.W. - South Capitol to Chesapeake Street	FAS	1943
Piney Branch Road N.W. - Butternut Street to D. C. Line	D.C.	1932
Rock Creek & Potomac Parkway - K Street to Que Street.	NRS	1936
Scott Circle Underpass (Streets in connection with structure)	FAP	1942
Sherman Circle N.W.	D.C.	1933

Projects	Source Of Funds	Completion Year
South Capitol Street - Howard Road to Nichols Avenue	FAP	1943
South Capitol Street - Atlantic Street to D. C. Line	FAP	1942
Taylor Street, N.E. between Hawaii Avenue & Harewood Road	FAS	1940
Tilden Street, N.W. - Connecticut Avenue to Rock Creek Park	D.C.	1930
Union Station Plaza	D.C.	1931
Utah Avenue N.W. - Nebraska Avenue to Van Hazen Street	FAS	1941
Ward Circle N.W.	D.C.	1934
3rd Street, N.W. - Kennedy Street to Peabody Street	D.C.	1937
4th Street N.E. - Franklin Street to Michigan Avenue	D.C.	1933
12th Street, N.E. - Rhode Island Avenue - Monroe Street	D.C.	1927
16th Street,N.W. - Alaska Avenue to Kalmia Road	D.C.	1928
16th Street, N.W. - Kalmia Road to D.C.Line	D.C.	1929
17th Street, N.E. - Rhode Island Avenue to Douglas Street	D.C.	1930
18th Street, N.E. - Montana Avenue to Rhode Island Avenue	FAS	1940
42nd Street, N.W. - River Road to Wisconsin Avenue	D.C.	1947
49th Street, N.E. - Central Avenue to Grant Street	FAS	1940
49th Street, N.E. - Deane Avenue to Sheriff Road	FAS	1941
(b) Major Widening Projects		
Connecticut Avenue N.W. - M Street to Dupont Circle	D.C.	1928
Connecticut Avenue N.W. - Dupont Circle to Florida Avenue	D.C.	1927
Connecticut Avenue N.W. - (Taft Bridge)	D.C.	1936
Constitution Avenue N.W. - 2nd Street to Pennsylvania Avenue	D.C.	1932
C Street N.E. - 16th Street to 19th Street	D.C.	1938
E Street N.W. - 5th Street to 13th Street	D.C.	1926
E. Street N.W. - North Capitol to 5th Street	D.C.	1932
Florida Avenue N.E. - North Capitol Street to West Virginia Avenue	FAP	1940
H Street N.W. - Massachusetts Avenue to 7th Street	D.C.	1931
H Street N.W. - 7th Street to 13th Street	D.C.	1930
H Street N.W. - 17th Street to Pennsylvania Avenue	D.C.	1928
H Street N.E. - 2nd to 15th Streets	D.C.	1947
Harvard Street, N.W. - Entrance to "Zoo"	D.C.	1934

Major Widening Projects	Source Of Funds	Completion Year
Eye Street, N.W. - 13th Street to 15th Street	D.C.	1940
Independence Avenue S.W. 1st Street to Maryland Avenue	D.C.	1929
Independence Avenue S.W. 6th Street to 12th Street	D.C.	1942
Independence Avenue S.W. 12th Street to 14th Street	D.C.	1936
Independence Avenue and Maryland Avenue S.W. 1st Street to 7th Street	FAP	1941
M. Street, S.E. - 4th Street S.E. to Maine Avenue S.W.	FAP	1940
Pennsylvania Avenue S.E. - Fairlawn Avenue to 27th Street	FAP	1947
Pennsylvania Avenue S.E. - Branch Avenue to Alabama Avenue	FAP	1940
South Capitol Street - M Street, to Potomac Avenue	FAP	1947
Reno Road, N.W. - Quebec Street to Van Ness Street, and Yuma Street to Nebraska Avenue	FAP	1947
Reservoir Road, N.W. - 35th Street to Foxhall Road	D.C.	1932
Reservoir Road N.W. - MacArthur Boulevard to Foxhall Road	NRS	1933
You Street N.W. - 10th Street to 18th Street	FAP	1941
Wisconsin Avenue N.W. - R Street to 37th Street	D.C.	1942
West Virginia Avenue N.E.		
Florida Avenue to Penn Street	D.C.	1926
Penn Street to Holbrook Terrace	D.C.	1927
Holbrook Terrace to Mt. Olivet Road	D.C.	1932
West Virginia Avenue N.E. - Mt. Olivet Road to New York Avenue	FAP	1947
3rd Street N.W. - D Street to H Street	FAP	1939
3rd Street,N.W. - H Street to New York Avenue	FAP	1941
3rd Street,N.W. & S.W. Maryland Avenue to Pennsylvania Avenue	FAP	1941
6th Street,N.W. - D Street to M Street	D.C.	1941
6th Street N.W. - M Street to Rhode Island Avenue	FAP	1947
6th Street,N.W. - K Street to Florida Avenue N.W.	D.C.	1942
7th Street,S.W. - Constitution Avenue to Independence Avenue	D.C.	1939
9th Street,N.W. - G Street to K Street	D.C.	1938
9th Street N.W. - Rhode Island Avenue to You Street	D.C.	1938
10th Street,N.W. - Constitution Avenue to Pennsylvania Avenue	WPMS	1935
10th Street, N.W. - F Street to New York Avenue	D.C.	1929
11th Street, N.W. - Massachusetts Avenue to Rhode Island Avenue	D.C.	1938

Major Widening Projects	Source Of Funds	Completion Year
11th Street, N.W. - Rhode Island Avenue to Vermont Avenue	D.C.	1939
11th Street,S.E. - Pennsylvania Avenue to Anacostia Bridge	WPMH	1936
11th Street S.W. - Maryland Avenue to Water Street	D.C.	1935
12th Street,N.W. - New York Avenue to Massachusetts Avenue	D.C.	1939
12th Street N.W. & S.W. - Constitution Avenue to Independence Avenue	D.C.	1938
12th Street S.W. - Independence Avenue to D. Street	NRA	1934
13th Street, N.W. - You Street to Florida Avenue	D.C.	1939
13th Street,N.W. - Euclid Street to Spring Road	FAP	1940
13th Street,N.W. - Eye Street to Massachusetts Avenue	D.C.	1928
13th Street,N.W. - Massachusetts Avenue to Logan Circle	NRA	1934
14th Street,S.W. at Maine Avenue (In connection with 14th and Maine underpass)	D.C.	1943
14th Street,N.W. Constitution Avenue to Water Street	NRM	1934
14th Street S.W. Independence to Highway Bridge (in connection with 14th and Maine underpass).	D.C.	1942
15th Street,N.W. - Constitution Avenue to Pennsylvania Avenue	D.C.	1931
15th Street,N.W. - Pennsylvania Avenue to New York Avenue	D.C.	1929
15th Street N.W. - Eye Street to Massachusetts Avenue	D.C.	1927
15th Street,N.W. - Florida Avenue to Euclid Street	D.C.	1933
15th Street,N.W. - Massachusetts Avenue to Florida Avenue	D.C.	1947
17th Street,N.W. - K Street to Rhode Island Avenue	FAP	1939
17th Street,N.E. - E Street to K Street	FAP	1939
18th Street,N.W. - Florida Avenue to Columbia Road	D.C.	1935
19th Street,S.E. - B Street to E. Street	D.C.	1932
20th Street N.W. - Pennsylvania Avenue to New Hampshire Avenue	D.C.	1946
21st Street,N.W. - C Street to Virginia Avenue and E Street - 22nd Street to Virginia Avenue	D.C.	1941
23rd Street,N.W. - Constitution Avenue on Washington Circle	DAWR	1942
23rd Street,N.W. - N Street to Que Street and 22nd Street to Massachusetts Avenue	DAWR	1942
27th Street, N.W. & Utah Avenue - Military Road to Nebraska Avenue	FAS	1947

Major Widening Projects	Source Of Funds	Completion Year
34th Street, N.W. - Massachusetts Avenue to Cleveland Avenue	D.C.	1927
46th Street N.W. Massachusetts Avenue to River Road	D.C.	1938

(c) Major Replacement Projects

Benning Bridge over Anacostia - Kingman Lake to Viaduct	D.C.	1934
Connecticut Avenue N.W. - Calvert Street to Cathedral Avenue	D.C.	1927
Connecticut Avenue N.W. - Calvert Street to South end of Klingle Bridge	D.C.	1935
Connecticut Avenue N.W. - Newark Street to Fessenden Street	NRM	1936
Connecticut Avenue N.W. - Van Ness Street to Fessenden Street	NRM	1923
Connecticut Avenue N.W. - Fessenden Street to Chevy Chase Circle	WPMH	1936
Constitution Avenue N.W. - Pennsylvania Avenue to 14th Street	NRM	1934
Constitution Avenue N.W. - 14th Street to Virginia Avenue	D.C.	1931
Canal Street, S.W. - South Capitol Street to Independence Avenue	D.C.	1938
C Street, S.W. - 1st Street to 6th Street	D.C.	1940
Delaware Avenue N.E. - Constitution Avenue to Union Station	D.C.	1931
E Street,S.E. - 1st Street to 4th Street	D.C.	1939
F.Street N.W. - 9th Street to 14th Street	D.C.	1933
Florida Avenue N.W. - 1st Street to 7th Street	D.C.	1930
Florida Avenue N.W. - 16th Street to You Street.	D.C.	1933
Florida Avenue N.W. - 18th Street to Connecticut Avenue	D.C.	1928
G. Street N.W. - 17th Street to 22nd Street	D.C.	1931
Georgia Avenue N.W. (west-side) - Barry Street to Otis Place	D.C.	1933
Georgia Avenue N.W. - 100' South of Trumbull Street to Rock Creek Church Road	D.C.	1933
Georgia Avenue N.W. - Rock Creek Church Road to Buchanan Street	D.C.	1930
Highway Bridge - South Approach Roadway	D.C.	1931
K Street, N.W. - North Capitol Street to New Jersey Avenue	D.C.	1938
Louisiana Avenue N.W.- New Jersey Avenue to Union Station Plaza	D.C.	1931
K Street,N.W. - New Jersey Avenue to 7th Street	FAP	1939
M Street,N.W. - New Jersey Avenue to 11th Street	D.C.	1932
M Street N.W. - New Hampshire Avenue to 26th Street	FAP	1940
M Street,N.W. - Connecticut Avenue to New Hampshire Avenue	D.C.	1931

Major Replacement Projects	Source Of Funds	Completion Year
Massachusetts Avenue N.W. - Union Station Plaza to G. Street	D.C.	1930
Massachusetts Avenue N.W. - 9th Street to 13th Streets	FAP	1939
Massachusetts Avenue N.W. - Wisconsin Avenue to Nebraska Avenue	WPMH	1936
Massachusetts Avenue N.W. - Sheridan Circle to California Street	D.C.	1931
Massachusetts Avenue N.W. - California Street to Wisconsin Avenue	FAP	1941
Michigan Avenue N.W. - North Capitol Street to Columbia Road	NRS	1934
Missouri Avenue N.W. - 3rd Street to 8th Street	FAS	1939
Mt. Pleasant Street N.W. - 16th Street to Park Road	D.C.	1932
Michigan Avenue N.E. - North Capitol Street to Monroe Street	D.C.	1930
Maine Avenue S.W. - M Street to P Street	D.C.	1940
Maine Avenue S.W. - 12th Street to 14th Street	D.C.	1942
Maine Avenue S.W. - Independence to Highway Bridge	D.C.	1942
Maryland Avenue S.W. - 1st Street to 3rd Street	D.C.	1933
Nebraska Avenue N.W. - 45th Street to Indian Lane	D.C.	1937
New Hampshire Avenue N.W. - L Street to Dupont Circle	D.C.	1931
North Capitol Street - Massachusetts Avenue to Pierce Street	D.C.	1930
North Capitol Street - Truxton Circle to Rhode Island Avenue	D.C.	1930
North Capitol Street - V Street to Michigan Avenue	D.C.	1925
New Jersey Avenue S.E. - M Street to Eye Street	D.C.	1935
Nichols Avenue S.E.-Anacostia Bridge to Howard Road	D.C.	1937
Nichols Avenue S.E. - Sheridan Road North	D.C.	1933
Nichols Avenue S.E. - Portland Street to 4th Street	D.C.	1925
North Carolina Avenue S.E. - B Street to 11th Street	D.C.	1928
O Street N.W. - North Capitol Street to New Jersey Avenue	D.C.	1929
P Street N.W. - 6th Street to 13th Street	D.C.	1937
P Street,N.W. - Wisconsin Avenue to 28th Street	D.C.	1936
Pennsylvania Avenue S.E. - 11th Street to Barney Circle	FAP	1941
Randolph Street,N.W. - Georgia Avenue to Kansas Avenue	D.C.	1940
Rhode Island Avenue N.W. - 1st to 3rd Streets	D.C.	1935

Major Replacement Projects	Source Of Funds	Completion Year
Rhode Island Avenue N.W. - New Jersey Avenue to 7th Street	D.C.	1938
Rhode Island Avenue N.W. - 7th to 9th Streets and 10th Street to Logan Circle	FAP	1940
Rhode Island Avenue N.W. - Logan Circle to Scott Circle	D.C.	1934
Rock Creek and Potomac Parkway - under Massachusetts Avenue Bridge	D.C.	1941
Rhode Island Avenue N.E. - North Capitol Street to 4th Street	NRM	1934
Rhode Island Avenue N.E. - (SS) 14th Street to 16th Street	WPMH	1935
Rhode Island Avenue N.E. - (NS) 12th Street to 16th Street	WPMH	1935
South Capitol Street - K Street to Virginia Avenue	D.C.	1929
South Capitol Street - K Street to O Street	D.C.	1928
Vermont Avenue N.W. - Logan Circle to R Street	FAP	1940
Virginia Avenue N.W. - Constitution Avenue to 26th Street.	NRS	1935
1st Street, N.E. & S. E. - B Street North to B Street South	D.C.	1936
1st Street N.E. - B Street to Union Station Plaza	D.C.	1931
1st Street N.E. - H Street to New York Avenue	D.C.	1933
1st Street S.E. - North Carolina Avenue to Carroll Street	D.C.	1941
2nd Street, N.W. - Indiana Avenue to Massachusetts Avenue	D.C.	1931
2nd Street, N.W. - Florida Avenue to U Street	D.C.	1927
4th Street, S.W. - Pennsylvania Avenue to Maryland Avenue	NRS	1934
4½ Street S.W. - Maryland Avenue to P Street	D.C.	1934
5th Street, N.W. - M Street to Rhode Island Avenue	D.C.	1935
8th Street, S.E. - Pennsylvania Avenue to M Street	D.C.	1941
9th Street N.W. - Massachusetts Avenue to Rhode Island Avenue	D.C.	1939
11th Street S.E. - East Capitol Street to Pennsylvania Avenue	D.C.	1927
12th Street, N.W. - B Street North to B Street South	D.C.	1930
13th Street N.W. - Logan Circle to You Street	D.C.	1928
13th Street N.W. - Hamilton Street to Kennedy Street	D.C.	1937
14th Street, N.W. - Rhode Island Avenue to You Street (West-side)	WPMS	1936
14th Street, N.W. - Rhode Island Avenue to You Street (East-side)	D.C.	1939
14th Street N.W. - Florida Avenue to Monroe Street	D.C.	1940

Major Replacement Projects	Source Of Funds	Completion Year
14th Street,N.E. - Rhode Island Avenue to Kearney Street	D.C.	1944
14th Street,S.W. - Water Street to Highway Bridge	D.C.	1932
16th Street, N.W. - Scott Circle to You Street	D.C.	1928
16th Street,N.W. - Columbia Road to Tiger Bridge	NRM	1933
14th Street,N.W. - You Street to Florida Avenue	D.C.	1947
14th Street,N.W. - Rhode Island Avenue to You Street (East-Side)	D.C.	1939
17th Street, N.W.- Constitution Avenue to New York Avenue	FAP	1939
35th Street,N.W. - Prospect Street to Wisconsin Avenue	D.C.	1927

Summary:

(a)	Major Paving Project	1,752,280	Sq.Yards
(b)	Major Widening Projects	890,519	Sq.Yards
(c)	Major Replacement Projects	1,057,821	Sq.Yards
	Total	3,700,620	Sq.Yards

(3) Minor Capital Outlay Projects:

In addition to the major projects listed in 2-a,b and c, many residential street extensions were made, minor streets replaced or covered to prolong their life, macadam roadways reclaimed by construction of curbs and gutters, sidewalks and alleys constructed and other minor work performed to expand the highway system to accommodate the growing city. A summary of this work follows:

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Key to Source of Funds:

D.C.	District of Columbia.
FAS) FAP)	Federal Aid Highway Acts.
NRS) NRM)	National Industrial Recovery Act of 1933.
WPMS) MPMH)	Emergency Relief Act of 1935.
DAWR	Defense Highway Act of 1941.
FWA	Federal Works Agency (Lanham Act Funds).

(a)	New paving, concrete roadways	2,085,533 Sq.Yards
(b)	New paving, standard asphalt roadways.	946,042 Sq.Yards
(c)	Curb and Gutter, macadam reclamation.	2,464,000 Sq.Yards
(d)	Bituminous Roadways (low cost type)	816,875 Sq.Yards
(e)	Replacement	713,856 Sq.Yards
(f)	Asphalt cover of concrete roadways	1,822,104 Sq.Yards
(g)	Cement Sidewalks	1,312,027 Sq.Yards
(h)	Concrete alleys	1,157,139 Sq.Yards
(i)	Grading (heavy)	7,512,804 Cu.Yards

Totals

Paving	11,317,576 Sq.Yards
Grading	7,512,804 Cu.Yards

PART III

MAINTENANCE

(A) General Statement: The maintenance of our highway system, other than bridge and structure repair, falls into two general classes: repair of defective pavement areas, and repair of excavations made in pavements by public utilities, underground departments and plumbers or other individuals for the installation of subsurface work. The repair of defective areas is chargeable to appropriations made for maintenance, and the repair of excavated areas or "cuts" is chargeable to the corporation, department or individual making the excavation. The former is related to the extent and condition of our highway system while the latter is to a larger degree controlled by the growth of the city. The annual cost of work chargeable to corporations, departments and others making "cuts" in pavements has in some years amounted to as much as $600,000.

Reference was made in the first part of this report on Administration to the coordination which exists between sections within the Department. While it is true that the annual charges against utilities, plumbers and others for the repair of "cuts" in pavements have amounted to as much as $600,000 in a single year, such repairs have been held at a minimum through the adoption of office procedures to coordinate surface and subsurface work.

Briefly, here is the procedure followed. The Director of Highways, by vitue of a Commissioners' Order, acts in the dual capacity of Coordinator of Surface and Subsurface work. Through the Release Sub-Unit of the Street Division, complete information concerning future programs and sequence of projects is disseminated

to all departments and utilities concerned with underground installations. This information is also supplied to the owners of property abutting the street improvement projects, in order that the condition of underground service connections can be determined, and replacements made prior to the paving if found necessary. This information is furnished well in advance of the actual performance of the work, and permits all agencies and individuals to coordinate proposed sub-surface installations with our construction programs. All improvements of a permanent character are processed through this "release" channel prior to paving. This practice has, without doubt, encouraged the installation of all sub-surface work that can be foreseen, and has held the cutting of new street pavements to a minimum.

As stated heretofore expenditures for repair of defective areas is related to the extent and condition of the highway system. This relationship is, however, influenced by the standard of maintenance and by the design of the pavements under repair. It is a credit to the Department that the enforcement of a "high standard of maintenance", combined with the construction of properly designed pavements has resulted in lowered maintenance costs even in the face of a constantly growing highway system. This is illustrated by the fact that during the six (6) year period 1924-1929 an average of $810,416 was expended annually for maintenance of our highway system. The average pavement mileage for these six years was 581.34 miles of pavement. During the six year period 1942 - 1947, with an average roadway mileage of 969.67, there was an average annual expenditure of $1,066,666 for maintenance. This reflects an increase of 24.02% in expenditures for maintenance

purposes as compared with an increase of 40.04% in highway mileage. This very favorable record which has been attained despite rising labor and material costs is, we believe, due to three important factors: properly designed and constructed pavements, a high standard of maintenance and a constant effort to improve repair methods and techniques.

B. - Methods and Procedures: At the beginning of the period under discussion almost all repair processes were manual. One-half cubic yard portable concrete mixers were placed at strategic locations, and moved as necessary, depending upon the amount of repair work required in the various areas of the city. Aggregates were stock-piled, and measured and loaded into the mixer with wheelbarrows. Defective pavement sections were removed by hand, and the base or finished concrete repair was placed from crank hoist operated trucks and finished by hand. Asphalt mixtures for repair work were obtained from a municipally-owned plant located in line of New York Avenue N.E., just east of Florida Avenue. This plant was unique in that it utilized old asphalt, removed in connection with repair work, in the manufacture of asphaltic mixtures for use in making repairs. All handling of materials at the plant was by hand, and repair work in the street was also a manual operation, including compaction of the repaired area with a 1,200 pound hand-drawn roller.

The technique of street repair has of course benefited from all of the advancements in design and inspection of concrete and bituminous mixtures. Equipment manufacturers have made great strides in creating new and improved machines for this class of work which have been adopted and used to great advantage.

Two separate procedures which were adopted during this period have probably resulted in greater benefit to the city than any of the many improvements in repair work which have been adopted. These are respectively the "contract repair work" procedure and asphaltic repair by the "heater method".

Contract Repair: In 1929, coincident with the approval and issuance of the first edition of our "Standard Specifications for Pavements, Street, and Alley Improvements and Work Incidental Thereto" a definite decision was taken to let by contract repair work which was susceptible to unit measurement. As a result all repair work, including defective areas and cuts on hard-surfaced type pavements is performed by contract. This method of repair has proven most satisfactory and economical, and has resulted in considerable saving to the city.

Asphaltic Heater Repair: The Department's Maintenance Section is among the pioneers in the development of this type of bituminous repair. Prior to the perfection and adoption of the "heater repair" method the common proceedure in making surface repairs to asphaltic pavements was to cut and remove the affected surface down to the concrete base. After this trimming of the repair area, a binder course was placed and rolled or tamped, after which a sheet asphalt surface course was applied and also rolled. Due to the difficulty of securing sufficient compaction of the binder course, this method of repair more often than not resulted in cracks appearing around the edges of the repaired area. Such patches very seldom "ironed out" under traffic.

Asphaltic "heater repair" is performed by burning the asphalt surface with a specially designed oil-burning heater, the hood

of which is lowered to the surface and moved from place to place as the repair process requires. When the area has been heated sufficiently the burned top layer of asphalt is raked off to a depth of approximately one (1) inch and a new sheet asphalt surface mixture is raked over the area and thoroughly compacted. The resultant patch is not only by far more economical, but results in a repair which "irons out" under traffic and becomes an integral part of the original surface. This method of repair also lends itself to our contractual method of repair in that unit payment can be made by the ton of surface mixture, emplaced, including all burning and work incidental thereto.

C - Bridge Maintenance: In the field of bridge maintenance, progressive results have been obtained by the use of mobile pneumatic equipment providing for field operations consisting of sand blasting, guniting of concrete surfaces, pumping and for drilling and riveting, replacing the old method of hand operation.

The use of the portable electric arc welding machines has shown a decided improvement in flexibility and control over the old methods of acetylene gas welding with attendent hazards of operation.

The adoption of a standard color scheme for the painting of all District bridges and the use of a standard paint formula to accomplish this objective, represent a long period of experimental developments in this field. The results obtained from this activity have reflected economy of maintenance and a very favorable contrast between the combined elements of steel and masonry construction.

PART IV

LOOKING AHEAD

Advance planning in preparation for future action has become generally recognized as essential to the successful conduct of practically every kind of enterprise, public or private, of any size and complexity. In any well organized effort, it is the first and most important step taken toward the realization of aims and objectives, on schedule and according to predetermined procedures, with a minimum amount of waste in time, manpower and materials. It is a form of insurance against uncertainty, delay and costly experiments during the course of productive operations.

Municipalities are no exception. The increase in the number of services required of modern civil governments has necessitated a corresponding expansion in the functions performed by their departments. In turn, the gradual increase in expenditures to finance improvements urged by citizens has had to keep pace with costs. Betterment programs, today, involve vast amounts of public funds, particularly in the case of public works departments responsible for the construction of adequate highway facilities. Consequently highway departments have been led by the magnitude of their operations into fields of research usually reserved for the social sciences, rather than those concerned strictly with engineering and construction functions, in order to plan accurately and justify costly structures on the basis of economic necessity.

Highway engineers of the Department are technicians engaged in the actual design and construction of roadways, bridges and allied structures. As such, they can only be held responsible

for the structural worthiness of the facilities erected under their supervision. Their location, layout and capacities must be determined as precisely as possible by the Planning Survey Unit from pertinent, up-to-date data, derived from observation and factual studies.

In looking ahead, the Planning Survey Unit seeks to discover and plot the direction of trends, and to project these far enough into the future to establish the degree and intensity of the factors which enter into the transportation situation. The rise in the level of population in the whole urban area and in particular localities, housing, centers of mass employment, recreation areas, shopping centers, etc., are major forces which influence the selection of a design for a bridge, highway or other transportation facility.

(A) Present Construction:

1. The First Postwar Program: The accumulation of traffic data, the preparation of preliminary plans and other material resulting from engineering and economic investigations conducted by the Department had, for the most part, remained latent during the war years. The end of the war acted as a precipitating agent to solidify this mass of statistics and paper projects into the definite program formulated in 1946.

It was necessary to establish a priority list in order to make a logical beginning with those improvements which were critically needed, according to the nature and intensity of the need. The first post-war program consisted, therefore, of projects generally recognized as essential to the welfare of the community.

In its 1941 report on highway, parking and related traffic problems, the Department published the details of a long-range street improvement program. The need for such a program to extend the District of Columbia's major thoroughfares had, by that time, become a pressing one. The city had expanded to its statutory limits and its general pattern - the result of certain characteristics of topography which have fixed to some extent the form, rate and direction of growth - became readily apparent. The principal shaping forces were the rivers, valleys, railroads and other natural and man-made barriers which were instrumental in subdividing Pierre L'Enfant's geometric plan into smaller units.

The development of large residential areas in outlying sections of the District of Columbia, and beyond in several cases, during the war and post-war eras gave rise to a new and intense demand for adequate lines of highway communication between the so-called "dormitory " areas and the downtown centers of mass employment. Extensive reconstruction, in the form of widening, repaving and general overhauling of irregular intersections, was recommended in the report of 1941, so as to provide for the accommodations of heavier traffic loads.

The studies and investigations made by the Department's Highway Planning Survey Unit, in support of plans to modernize the highway system, were continued during the virtual suspension of construction activities which was enforced by war-time shortages of labor and materials. The results of such studies conducted on a continuing basis were especially valuable in keeping highway engineers informed on the changing needs of fluctuating

population groups. The metropolitan arterial system, which when completed will serve to connect the various residential areas, located on the outer periphery of the business and government district, with the heart of Washington, is the direct result of a realistic master plan, contrived principally to satisfy the demands of constant users of these facilities as revealed by traffic studies.

The basic plan is predicated upon a recognition of the fact that the city and the Metropolitan Area are geographically divided into segments all of which should be served by arterial highways leading to the central portion of the city. Roughly, these segments are the areas west of Rock Creek Park, Rock Creek Park to Soldiers' Home, Soldiers' Home to the Washington Terminal Yards and the B. & O. Railroad, the B. & O. Railroad to the Anacostia River, the northern section east of the Anacostia River, the central section east of the Anacostia River, the southern section east of the Anacostia River, and the several areas across the Potomac River in Virginia. To insure the proper flow of automobile and bus traffic to and from these segments it was found desirable to develop one or more through streets to each segment and to superimpose upon the network of "through streets" a system of major arterial highways with expressway characteristics to serve each of the geographical segments. Feeder streets from the "through streets" and the "major arterial highways" into each segment, and the improvement of residential streets within the segments located within our jurisdiction were also a part of the basic plan.

The basic plan was announced by this Department in the publication of the 1941 report hereinbefore referred to. Studies since

then have changed the plan to some extent, in that the Arizona Avenue Parkway has been approved as a substitute for the formerly proposed improvement of Foxhall Road as the "major arterial highway" to serve the area west of Connecticut Avenue, and the original plan has been implemented by the consultants' recommendations that the Mid-City and Capital Hill Expressways be constructed. The map on the last page of this report shows the "through street" and "major arterial highway" plan. By appropriate symbols the various portions of the "major arterial highway" system are indicated as either completed, under construction, programmed or under study.

The late war accelerated some phases of this plan. Notable among the projects that were constructed in furtherance of the overall plan are the Maine Avenue grade separation, the improvement of Independence Avenue, S. W., from 14th Street westward to the Lincoln Memorial Circle, the improvement of 23rd Street N.W. from Constitution Avenue to Massachusetts Avenue, including an underpass at Virginia Avenue, the paving of South Capitol Street and Overlook Avenue bordering Bolling Field and the construction of an underpass at Portland Street and South Capitol Street. Most of these projects were constructed as war measures to provide more suitable access to governmental establishments in the areas involved. The new bridge across the Anacostia River in the vicinity of South Capitol Street, now in progress, is another project which forms an important part of the major arterial plan.

The passage of the Federal Aid Highway Act of 1944, and appropriations made subsequent thereto, made it possible for the Department to program many more projects on the "through street and major arterial" systems for construction.

Following is a list of the projects included in this "First Postwar Program" as approved by the Public Roads Administration.

Project	Status
(a) Paving	
M Street S.E. 4th Street to 11th Street	Complete
West Virginia Avenue N.E., Mt. Olivet Road to New York Avenue	Complete
South Capitol Street, M. Street to Potomac Avenue	Complete
Massachusetts Avenue N.W., Nebraska Avenue to D.C.Line	Complete
Alabama Avenue S.E., 12th Street to 21st Street	Complete
Alabama Avenue S.E., 21st Street to Good Hope Road and 25th Street, S.E., Alabama Avenue to Good Hope Road.	Complete
6th Street, N.W., M. Street to Rhode Island Avenue	Complete
Taylor Street, Bunker Hill Road and Randolph Street N.E., 14th Street to 26th Street	Complete
Minnesota Avenue and Pennsylvania Avenue S.E. (channelization of intersection)	Complete
Alabama Avenue and Bowen Road, S.E., Pennsylvania Avenue to D. C. Line	Complete
49th Street, Quarles Street and Minnesota Avenue S.E., Sheriff Road to Eastern Avenue	In Progress
Utah Avenue and 27th Street, N.W. Military Road to Nebraska Avenue	Complete
Reno Road, N.W. Quebec Street to Van Ness Street and Yuma Street to Nebraska Avenue	Complete
Sheriff Road, N.E. Minnesota Avenue to D.C. Line	Complete
Dalecarlia Parkway, N.W., Loughboro Road to Massachusetts Avenue	Complete
Eastern Avenue N.E. and N.W., New Hampshire Avenue to Laurel Street	Complete
Nichols Avenue S.W., Chesapeake Street to Joliet Street	Complete
Rock Creek Church Road N.W., Harewood Road to North Capitol Street and Allison Street, Rock Creek Church Road to Hawaii Avenue	Complete
Tunlaw Road and New Mexico Avenue N.W., 39th Street to Nebraska Avenue	Complete
Porter Street, N.W., Connecticut Avenue to Klingle Bridge and Klingle Road, N.W., Klingle Bridge to Adams Mill Road	Complete
Riggs Road N.E., North Capitol Street to South Dakota Avenue	Complete
Riggs Road, N.E., South Dakota Avenue to D.C. Line	In Progress
Mt. Olivet Road, N.E., New York Avenue to Bladensburg Road	Complete
Weaver Street,N.W. Loughboro Road to MacArthur Boulevard	In Progress

Project	Status
Dupont Circle Underpass and Transit Terminal including approach and surface roadways	In Progress
Riggs Road, N.E., Grade Separation B. & O. Railroad	Complete
Highway Bridge over Potomac River, foot of 14th Street	In Progress
Klingle Road Bridges	Complete
K Street, N.W. Elevated Highway, 27th Street to Key Bridge	In Progress

The accomplishment of this first postwar program consisting of major capital outlay projects almost in its entirety, was carried out in spite of high construction costs, and the demands of repair and maintenance schedules, replacement work, street extensions, grading and sidewalk and alley construction to which the Department is committed by policy before undertaking any new major construction, no matter how urgently needed. That they became actualities is greatly due to careful, long-range planning, adequate fiscal management, and assistance in the form of funds and technical guidance extended by the Public Roads Administration.

2. The Second Postwar Program: The formulation of a "Second Postwar Program" to be undertaken upon completion of the current program also grants priority to projects located on the "through street" and"major arterial highway" systems. In addition the Department will continue to fulfill its maintenance obligations and follow its policy of supplying local improvements in the form of roadways, sidewalks and alleys to serve abutting properties in residential districts. These activities will be provided for before any funds can be allocated to the construction of capital improvements and long-range projects. At this writing the Federal Aid Highway Act of 1948 is pending in the Senate. The enactment

of this legislation will have a controling effect upon the time and sequence of this program. Following is a partial list of proposed projects from which the second post-war program may be formulated.

(a) Paving:

Military Road, N.W. (Fort Drive) 13th Street to 27th Street (including 16th Street Underpass and Rock Creek Bridge).
Division Avenue N.E., East Capitol Street to Sheriff Road.
Kansas Avenue N.W. and N.E. Madison Street to Eastern Avenue.
Harewood Road, N.E., Michigan Avenue to Taylor Street.
K Street N.W., Connecticut Avenue to 21st Street (paving and service roadways similar to mid-town section of K Street).
South Capitol Street, Howard Road to new bridge over Anacostia River.
South Capitol Street, M Street to Canal Street
11th Street, N.W., Vermont Avenue to Florida Avenue.
Massachusetts Avenue N.W., 1st Street to 7th Street.
Arizona Parkway, N.W. Canal Road to Wisconsin Avenue (including structures, channelization and other features).
South Dakota Avenue N.E., 12th Street to Riggs Road.
Ridge Road,S.E., C. Street to Bowen Road.
Benning Road, N.E., East Capitol Street to D. C. Line.
Michigan Avenue N.E., Varnum Street to D.C. Line.
Constitution Avenue and Pennsylvania Avenue N.W. (intersection channelization) (1)

(b) Structures:

Kansas Avenue railroad grade separation B. & O. Railroad.
K Street,N.W. 21st Street to 27th Street (including underpass at Washington Circle, depressed section and paving of service roadways).
Commodore Barney Circle (1).
Mt. Vernon Square (1).
Eckington Place, New York Avenue and Florida Avenue N.W.(intersection channelization including possible structure) (1).
Massachusetts Avenue over the Anacostia River (1).

(1) Although still in the planning stage, these projects are included in this list as definite possibilities for future programs.

It should be pointed out that the District of Columbia is not exclusively dependent upon the allocation of Federal monies in carrying out large-scale highway construction projects.

The Highway Fund, which consists largely of taxes paid locally on the gasoline consumed by citizens of Washington, is used to finance the construction of capital outlay projects. During the next year, these funds derived from the local taxpayers will be spent on such major improvements as Canal Road, N.W. from 36th Street to Foxhall Road, 4th Street, N.W. from College Street to Harvard Street, and Benning Road, N.E., from 16th Street to Kenilworth Avenue.

Although they are derived from a different source of funds, these improvements are nonetheless conceived and planned as integral parts of the arterial network of highways which has been and continues to be one of the principal aims of the Department. Development of this network of "through streets" on the circumferential, inner belt and distributor systems, is one of the outstanding achievements of sound, economic planning. Studies to determine the need for this expressway type of facility, which forms inner and outer belts around the central and metropolitan areas respectively, and which provides fast access routes from the heavily populated geographical sectors of the city to the inner core in the Government and retail business districts, have determined the selection of routes, and governed the engineering design of these roadways and the complementary structures which are needed to prevent conflicts at major intersections. Certain sections of the systems which have been constructed in recent years, or which are programmed within the foreseeable future

meet the requirements for high-standard highways capable of accommodating heavy traffic flows with little or no interruptions in "through" directions. Other sections consist of roadways which were constructed years ago when automobiles were still relatively scarce as a private means of transportation. As these obsolete sections become incorporated in the expressway systems their design standard will be raised to meet modern requirements. Whenever traffic conditions warrant grade separation structures, surface channelization and other means of engineering control will be placed in service. These conditions will be sampled and analyzed through procedures which have been developed during the last few years as the means for establishing precisely the intensity of demand for particular types of highway facilities in different localities. A brief description of Highway Planning Survey methods follows.

(B) Highway Development Planning: For the past ten years, there has been a growing tendency among the more progressively-minded highway engineers, who function at a policy-making level, to undertake major construction after exhaustive studies have been made of all factors, economic and engineering, which have a direct bearing on the type and design of the facility to be placed in service. This scientific approach to the problem of providing highways and bridges that will not be threatened with premature obsolescence, has long been urged by various private and public agencies as the only logical basis on which the spending of huge sums for improvements can be justified.

This principle is particularly applicable in large cities where the movement of traffic has crystallized over a period of

years into set patterns, which do not necessarily indicate that the users are operating under ideal conditions, but rather that they have been constrained by the rigidity of the street system into making compromises. The way in which most American cities have grown to the metropolitan level is best described by the word: haphazard. They just grew. This of course, is especially true in the case of those cities which have their origin in the colonial era. Many others, however, quickly reached economic maturity because they were founded on the banks of a navigable river, on the rim of a natural port or in the neighborhood of then unknown deposits of mineral resources, while remaining in the adolescant stage from a traffic engineering point of view. These are the population centers which require today, under the increasing pressure of motorized transportation, vast public works programs aimed at freeing their congested business and industrial centers from economic paralysis.

The Nation's Capital is a planned city. Its broad avenues and wide thoroughfares were laid out by L'Enfant, a man of talent and vision, who wished to impart some of the dignity and spaciousness of European capitals to the Capital of the new world. Unfortunately, the many squares and circles embodied in his design are focal points for the many important thoroughfares which empty their traffic loads into inadequate intersections. Highway engineers have long tried to remedy this situation by increasing the surface area of these facilities with corner "cut-backs", widening and other superficial measures. They have found that the only solution - one which does not involve the demolition of valuable property is to be found in the grade separation structure.

Elsewhere in this report, the rapid rate of increase in the population of Washington and its environs is treated. Briefly, the whole region has expanded into a metropolitan area to bring about an unexpected degree of vehicular activity which has overburdened the highway facilities to the danger point. L'Enfant's streets may be wide and spacious, but their capacities are limited by their intersections; the structural inadequacy of these crossings lies at the core of the urban traffic problem.

(1) Traffic Density: Volume studies conducted over a period of 10 years by this Department in cooperation with the Public Roads Administration have disclosed the fact that almost half of the total mileage performed by residents of the area is confined to the metropolitan region. Other cities have reached the same conclusions: that metropolitan centers exert a strong magnetic force on traffic movements within a 35 mile orbit. Intensive planning is therefore necessary to adjust the inadequate and constrictive urban street plan by designing facilities that can absorb this high degree of internal and external activity.

The Highway Planning Survey Unit has been compiling statistics for several years on the nature and characteristics of the traffic using the highway system in the District of Columbia. Traffic volumes have been and are being recorded automatically at 14 permanent stations located on the major highways and bridges which constitute the city's principal entrances and exists. The machine counts obtained can be compared by day, by season and by year with those tallied at the same points during previous years to 1939. Manual counts have also been made at some 150 intersections in order to establish the pattern of turning move-

ments as well as the volume of traffic using the facility. The results of these studies supplement other investigations and are extremely valuable in guiding highway engineers in the selection of a design which will be most effective in expediting the safe passage of large flows of vehicles through irregular intersections.

(2) Origin and Destination Studies: To observe and record the traffic patterns which are woven each day under conditions caused by the existing street layout is not sufficient. It is also necessary to determine desire routes and to estimate what the patterns would be under hypothetical conditions which would ensue if improved facilities were to be constructed elsewhere. Consequently, careful studies must be made before a long-range improvement program can be formulated on the basis of the findings derived from traffic studies.

The procedures followed in obtaining mass data concerning the travel habits of residents, in the various sections comprising the Metropolitan Area, vary to some extent with the nature of the information desired. The most accurate method consists in the application of the sampling formula originally developed by the U. S. Bureau of the Census in the conduct of population surveys, and adapted to the study of traffic phenomena by the U. S. Public Roads Administration. The technique involves the preselection of a sample on a percentage scale, and in expanding the sample by a factor which expresses the total sum of similar units in a pre-determined area. Contact is established directly with the sample, who then becomes respondent, and the replies to specific questions are considered as representative.

When applied to the planning of highways, this technique is used to study traffic movements within zones that correspond roughly to census tracts, enumeration districts and other subdivisions established by the Bureau of the Census. This permits the correlation of traffic data with population density and other factors existing within known limits. The means of conducting the survey are the same, but the ends differ in that this Department is concerned with mode, frequency and route of travel, and with points of origin and destination for trips performed within and between zones.

(3) Channelization: Generally speaking, there are three remedies available to highway engineers in the treatment of unusual or multiple intersections: (1) by signalization, the cheapest and most popular; (2) by channelization, which is more expensive and more efficient when combined with the first remedy; and (3) by a vertical separation of grades which involves the construction of expensive structures. Most difficult intersections encountered in the average street layout can be improved substantially by applying the first two remedies.

Channelization consists principally in establishing a geometric design for the logical and orderly passage of vehicles entering a common area from different points and seeking different exists. To prevent conflicts the path of each is defined by physical means and restricted by channels formed either by painted lines or low concrete strips, which conform to natural movement at a moderate rate of speed. Usually, special studies designed to reveal the predominant or normal turning pattern through the intersection are made before establishing travel lines.

(4) Road Life Study: Of great importance to economical highway development planning, because of the more accurate method of keeping a running inventory of existing pavements which it enforces, is the Road Life Study which was inaugurated by the Highway Planning Survey in 1940. The generally unfamiliar approach to the problem of taking physical stock of urban pavements by reducing these to basic block and intersection units has created some difficulty in the prosecution of this project. There is a strong tendency among highway personnel, caused by long association with previous routine methods, to rely for inventory purposes on the conventional contract concept of identification rather than on the rigid block and intersection system.

Briefly, the study consists in reducing the data available on the construction and performance of pavements, by units of blocks and intersections, to coded information on tabulating cards for greater ease in the preparation of reports. Information as to type, location, costs, age, function and other pertinent matter would, under this system, be condensed into a single record medium. Over a period of years, this record would assume greater value as a ready source of information on any phase of pavement history, from date of completion to date of retirement. It would lend itself more easily to analysis and to the subsequent formulation of future construction programs which would have the benefit of past experience in their shaping.

A preliminary Manual of Coding Procedure was prepared in 1946 and subsequently revised in the light of new procedures developed during a "pilot" study made on the Federal Aid System.

(C) Plans for the Future:

1. Projects Under Study: Looking toward new horizons, the Department of Highways has tentatively laid plans for the development of improvements to be undertaken in the period following completion of the postwar programs. The projects listed for the indeterminate future are of considerable importance, and it is quite conceivable that contingencies may arise at any time in the present traffic situation to force their construction at a definite and earlier date. Although they are not now recommended as part of any program, they are engineering items which have for some time been receiving the attention of the planning staff of the Department, and they will continue to be the subjects of further investigation.

Proposals for the erection of a new highway crossing over the Anacostia River in line with Massachusetts Avenue S.E., and another over the Potomac River to connect with Virginia via U.S. Route #1, in the vicinity of Alexandria, with southeast Washington, appear to have merit. The sustained rate of expansion in this densely populated suburb is expected to create a new and greater demand for such a link across the Potomac which would obviate the necessity of traversing the congested central area to reach either of the present crossings. The Massachusetts Avenue Bridge is also essential to complement extensive facilities of the expressway type which are in the discussion stage.

Construction of the Kenilworth-Anacostia Freeway is one of these improvements contemplated for construction in the future so as to provide an adequate connecting highway between the proposed Alexandria Bridge and the Washington-Baltimore Parkway

which is also in the planning stage. It's valley location makes it particularly susceptible to development as a circumferential route to accommodate by-passable traffic in the southeast section. Additional connections would be effected to attract traffic generated by the highway crossings over the Anacostia River. This would serve to release the overburdened local streets from the pressure of vehicles having external destinations, by diverting them to the belt highway planned to the west of the Anacostia River.

The extension of New York Avenue is another improvement of the limited-access type which would be developed to provide a suitable connection from Bladensburg Road to the proposed Washington-Baltimore Parkway. It would be urgently needed to effect rapid distribution of the heavy traffic flows attracted to the Parkway and, with suitable connections, it could be made to function as part of the belt route and expressway systems planned for the area west of the Anacostia River. The extension of Rock Creek and Potomac Parkway through the Zoo with appropriate connections to the east and west of Rock Creek Park is also considered as a necessary improvement even at the present time.

These projects, in whole or in part, have the endorsement of official bodies charged with the responsibility of directing and controlling certain phases of the construction programs prepared by the Department of Highways. They are based upon the results of traffic studies which reveal trends in population and use of privately-owned means of travel as factors pointing definately to the potential demand for highway facilities.

2. Expressways: Traffic engineers and highway departments concerned with the task of expediting the huge volumes of traffic through congested urban areas are turning to this admitedly expensive measure as the only one capable of achieving the desired results. The limited-access feature of this type of highway is particularly advantageous to a city like Washington, where the predominant traffic flow during the morning rush period is aimed directly at the central business and Government districts with no appreciable counter-flow into the suburbs. In metropolitan centers of like size, there is a certain amount of vacuum created in the central district by the outward movement of traffic destined to factory and warehouse areas located on the fringes of these cities. This compensates to some extent for the opposite movement which is focused on the downtown area.

The District of Columbia's major industry is the Federal Government. The big agencies with the exception of the Department of National Defense and the Bureau of the Census are situated in a region south of and contiguous to the retail business district. This condition has served to double the normal points of destination in the area and has further agravated the problem by increasing the demand,not only for means of access into the central district, but also for storage facilities. The provision of parking lots, although related to the problem of highway construction, is not a definite responsibility of this Department. A specific agency to study and recommend ways and means of furnishing adequate parking facilities in the congested central district was created by Congress in 1944. Its findings are pre-

sented briefly elsewhere in this report. This Department is, however, definitely concerned with moving traffic loads, with reasonable speed and safety, and with minimum friction and hazard, over the network of highways which it has constructed and for which it is responsible. It has reached the conclusion in consultation with several engineering firms, which were retained to study the traffic problem in Washington's Metropolitan Area, that a system of expressways will probably become necessary in the not too distant future. These high-speed traffic channels should be depressed in order to preserve as much of the remaining pavement area, which is already at a preminum, at grade level to serve local movements. Further studies and investigations are being made in this field.

Although the safe and rapid movement of vehicles into and through the critical central area is the prime concern of this Department, the construction of expressways would be beneficial in many ways other than as a means of achieving this end. It has been the experience of other large metropolitan centers, plagued with the same troubles, that expressways have had a revitalizing effect on run-down residential neighborhoods which usually form an exceedingly unattractive ring around the business area. It is a well known fact that rehabilitated slum areas have a tax potential far beyond the values which are placed upon them in their present condition.

Suitably interconnected with the street system at grade, expressways would also serve as protection for the valuable properties which occupy the retail business district by opening up new connecting arteries and speeding up the circulation of local surface

traffic. Although it is extremely doubtful for example, that F Street will ever be abandoned while the major federal installations with their thousands of highly-paid workers remain within walking distance of its shops, it is nevertheless essential and prudent to adopt measures which will forestall any further encroachment of the "downtown disease" upon its high tax-yield properties in the heart of the city. The slums can and should be eradicated before reaching unmanageable proportions. Highway facilities of the expressway type can very well mean the restoration of arteries through which new blood, in the form of healthier commercial activities, could be pumped to revive the stagnant neighborhoods.

(D) Conclusion: In the foreword, the question was asked: "What is being done to provide highway facilities adequate to meet future requirements." The obvious answer, of course, is that we have tried to build as many facilities as possible within the limits of our financial resources, for such is the mission of a Department of Highways. We have progressed with new and improved techniques in the road-building industry, and with the growth of Washington. We have been constrained to use great care in the selection of architectural designs by the fact that all structures must conform to specific standards in keeping with the dominating architectural motif of public buildings and monuments in the Nation's Capital.

But the obvious answer does not reveal, except to the eyes of the trained highway engineer and the map-maker, the thinking and the planning which determined the final design and location of each and every bridge and highway.

This report is an attempt not only to list the various highway facilities constructed by the Department during the past 24 years, but to show the reasons which shaped our decisions to build as we did, and which lie at the base of the plans we drew for a logical system of highways. The layman may think that highways are constructed on the basis of independent causes which flow from local conditions. That may be true for streets that serve residential districts, because most of these come about as a result of improvements in the properties which abut the roadway. There the local resident makes full use of curb, gutter and roadway. But such is not the case where major thoroughfares are concerned. The local resident's use of arterial highways is limited almost exclusively to the curb and gutter which serve to protect his property from erosion. The benefit which he derives is only incidental compared to the intense use made of it by the residents of other areas beyond, who must use this highway as the only way in which those regions can be reached.

In a large city, there are of necessity a large number of these arterials which radiate like the spokes of a wheel from the hub in which are concentrated the points of mass interest such as department stores, hotels, banks, theatres, restaurants, etc. Because so much depends upon their ability to furnish access into the areas with which they connect, these streets have been placed in a preferred class. They are designated as part of a system of highways which are treated as expressways in that all engineering as well as other means of control, such as "Stop" signs, traffic lights, etc. are installed on other minor streets which intersect these high-volume arteries, in order to provide greater sa

safety and prevent interference and conflict with heavy traffic streams. Where two major arterials intersect, the engineer is often forced to segregate equally important traffic streams by constructing a grade separation structure.

These considerations have guided us in the past, and will continue to do so until the planned network of arterials is complete within the Metropolitan Area, including interchanges at all important points. They have motivated the plan which has been gradually translated into concrete and asphalt during the past 24 years.

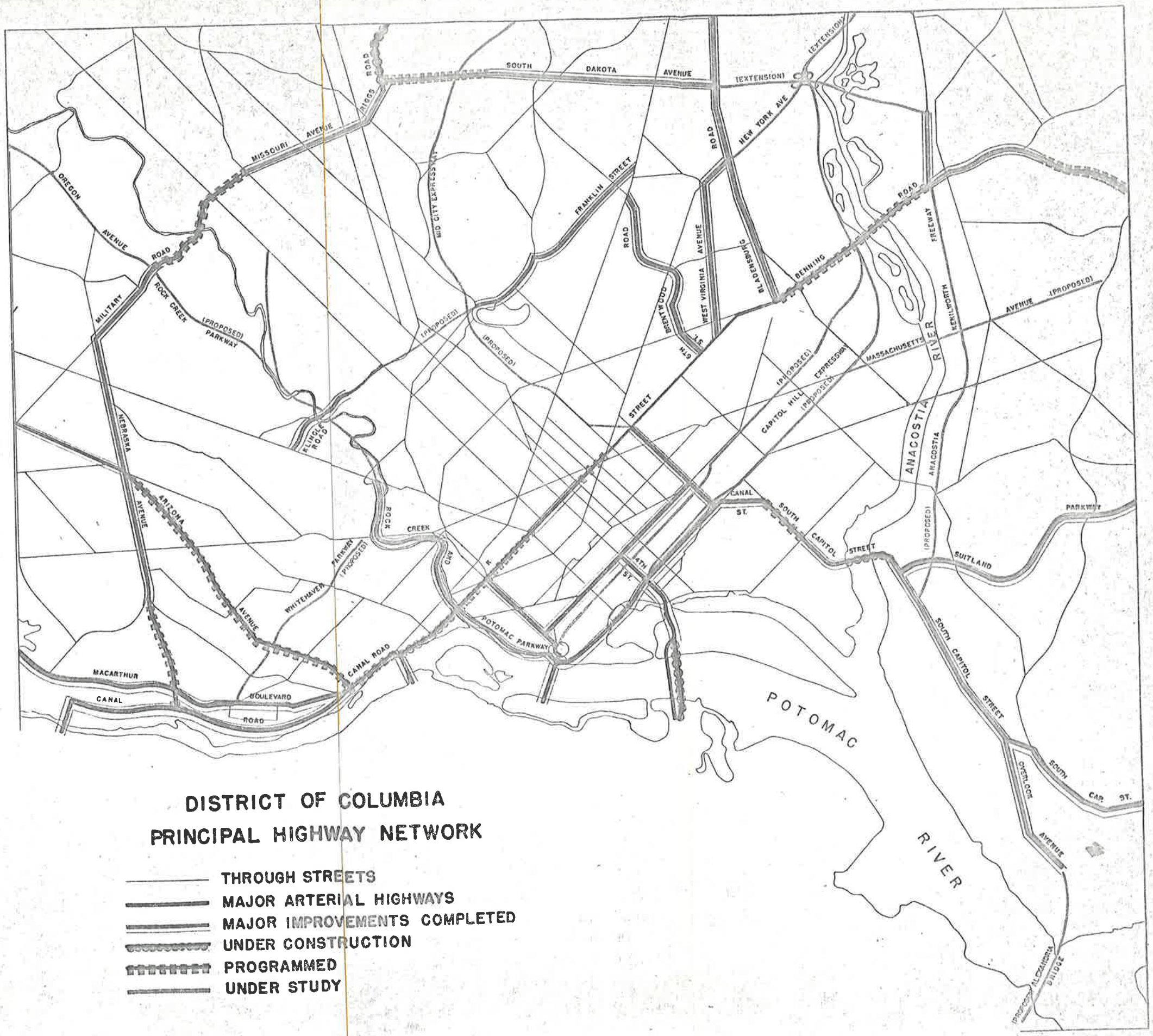
The success of this plan depends largely upon how wisely will be the use made of the facilities which were derived from its various features. Although it is expected that owners of private means of conveyance will make full use of present and future express highways, it should be understood that the advantages of safer, more comfortable and more economical travel on expressways must be put within reach of a larger percentage of the population than that now represented by private car-owners, if full return is to be realized from the investment. This condition, however, falls within the province of the transit utilities. The media of mass transportation must be made as attractive as possible in the form of rapid, frequent and comfortable service so that more people may be persauded to leave their automobiles at home during the work week.

It is our firm conviction that the system of "through streets" and "major arterial highways" that has been envisioned and planned to care for the transportation needs of our community, will prove to be adequate for a good many years to come when all sections

have been raised to the desired standard of design, providing the system as constructed is used by all to the greatest advantage. In this connection the importance of a vigorous program, designed to bring about an increase in the bus and streetcar riding habit cannot be overemphasized. It is our belief that a responsibility rests upon the transit industry to make full use of all components of the system as soon as possible after such a facility is opened to traffic. These improvements must be made available to all classes of travelers.

Much of this appeal would be enhanced by the construction of suitable storage facilities near the expressways suburban terminals where the transition from private to public modes of transportation could be made conveniently and quickly.

In essence, the problem of traffic is one of mechanics. Fluidity must be maintained on all parts of the system, for each member is inter-connected and inter-dependent. Failure on one section has repercussions on the whole system. It has been said that roads are movement and that movement is life. It should be remembered that the life of the community, therefore, depends in large measure on how well the highways can serve vehicular movement.



DISTRICT OF COLUMBIA
PRINCIPAL HIGHWAY NETWORK

- THROUGH STREETS
- MAJOR ARTERIAL HIGHWAYS
- MAJOR IMPROVEMENTS COMPLETED
- UNDER CONSTRUCTION
- PROGRAMMED
- UNDER STUDY