TRANSPORTATION STUDY

PREPARED FOR

NEW HAMPSHIRE DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS

IN COOPERATION WITH

U.S. DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION

BUREAU OF PUBLIC ROADS

CITIES OF DOVER AND SOMERSWORTH, N.H.

APRIL 1967

DOVER-SOMERSWORTH, NEW HAMPSHIRE

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Commissioner John O. Morton
Department of Public Works & Highways
State of New Hampshire
Concord, New Hampshire

Dear Commissioner Morton:

We submit herewith our report entitled, "Dover-Somersworth Transportation Study", prepared in accordance with our contract No. 7480-B, dated July 1, 1965.

This report summarizes data collected during various phases of the Study and presents our recommendations for both immediate and long term improvements to the highway system in the Dover-Somersworth area.

We gratefully acknowledge the assistance we received during the course of our work from staff members of your department, the U. S. Bureau of Public Roads, the cities of Dover and Somersworth and other public and private agencies.

Very truly yours,

TIPPETTS-ABBETT-McCARTHY-STRATTON

Thomas J. Fratar

ACKNOWLEDGEMENTS

The Dover-Somersworth Transportation Study could not have been accomplished without the cooperation of many individuals, business concerns, and governmental agencies. To name all who in one way or another contributed time and effort would be a formidable task. Sincere thanks is due them all.

Technical assistance was freely given by the New Hampshire State Department of Public Works and Highways and by the U.S. Department of Transportation through the Division office of the Bureau of Public Roads.

The Mayors, Councils, Planning Agencies, and operating departments of the Cities of Dover and Somersworth were most helpful. The support given by the City Manager of Dover, officials of the Dover Chamber of Commerce and Economic Commission, and the Mayor, City Clerk and City Engineer of Somersworth is especially appreciated. The Police Departments of both cities rendered special service and helped to insure a perfect safety record during operations at roadside interview stations during the summer of 1965.

A particular word of thanks is due the Public Service Company of New Hampshire for their cooperation in loaning records of meter locations to the Study. These records were of singular help in assuring a complete and accurate sampling of households throughout the Dover-Somersworth area. The cooperation of the State Department of Employment Security in furnishing employment data is also appreciated.

Even a short statement of acknowledgement would be incomplete without special mention of the many Study employees, hired in the Dover-Somersworth area during the summer of 1965, who, faced with demanding responsibilities of interviewing, coding and data processing, enthusiastically and loyally carried out their assigned duties. Finally, the cooperation of the people of the Dover-Somersworth area, in giving of their time to answer detailed travel questionnaires, is gratefully acknowledged.

TABLE OF CONTENTS

PAGE

CHAPTER I. INTRODUCTION
Study Area Description 1
Purpose of Study 3
Authority and Scope 3
Previous Studies 4
Dover 4
Somersworth 4

CHAPTER II. ORIGIN-DESTINATION SURVEY
Survey Design 7
Roadside Interviews 10
Home Interviews 11
Taxi Interviews 14
Traffic Zones 15
Coding and Processing of Interview Data 15
Survey Checks 16
Population Check 16
Screenline Check 17
Cordon Line Check 19
Employment Check 20

CHAPTER III. EXISTING CONDITIONS
Physical Features 21
Transportation Facilities 21
Railroads 22
Highways 22
Land Use 23
Population and Employment 31
Traffic Volumes 32
Travel Characteristics 34
Vehicle Trip Patterns 41

CHAPTER IV. AREA FORECASTS
Population and Employment Forecasts 43
Population and Dwelling Units 43
Family Income 45
Vehicle Ownership 45
Employment 46
Land Use Forecasts 47
Residential Land Use 49
Commercial Land Use 50

PAGE

Industrial Land Use. 51
Public and Semi-Public Land Use. 52
Travel Forecasts 53
Future Travel Desires 56
Future Traffic Volumes 57

CHAPTER V. RECOMMENDED ARTERIAL HIGHWAY IMPROVEMENTS
Analysis and Evaluation Procedure. 61
Immediate Action Program. 64
Central Avenue-Spaulding Turnpike Interchange-Mill Road-Durham Road-Back River Road, Dover 68
Silver Street-Central Avenue, Dover 70
Lower Square, Dover 72
Washington Street-Main Street, Dover 74
Upper Square, Dover 76
Portland Avenue-Portland Street, Dover. 78
Broadway Street-St. John Street, Dover 80
Central Avenue-Glenwood Avenue to Dover-Somersworth Traffic Circle, Dover 82
Market Street: Main and High Streets to Berwick Bridge, Somersworth. 87
High Street-Orange Street- Highland Street, Somersworth 88
High Street-West High Street-Washington Street-Hamilton Street, Somersworth. 90
High Street-Franklin Street, Somersworth 92
Main Street-Franklin Street and Main Street-Washington Street, Somersworth 94
Recommended Improvements to Meet Future Needs 96
Chestnut Street Bridge in Downtown Dover. 97
Fourth Street-Pierce Street-Broadway Connector, Dover 102
Arch Street-Washington Street Access to Downtown Dover. 102
Miracle Mile 103
Other Considerations. 104
Spaulding Turnpike, Dover Toll Station 104
Spaulding Turnpike-Washington Street Interchange, Dover 107
Garrison Road-Dover Point Connector, Dover 108
Realignment of Second and Third Streets at Upper Square, Dover. 109
Other Proposals 110
Construction Costs and Priorities. 111
Conclusion 113

LIST OF FIGURES

NO.	TITLE	PAGE
1	Location Map	2
2	Cordon Line and Screen Line	8-9
3	1965 Average Annual Weekday Traffic	
	A – Study Area	24-25
	B – Dover Central Area	26
	C – Somersworth Central Area	26
4	1964–1965 Average Annual Accidents	28
5	1965 Land Use	30
6	Traffic Zones and 1965 All Vehicle Trip Desire Lines	
	A – Study Area	38-39
	B – Dover Central Area (traffic zones only)	40
	C – Somersworth Central Area (traffic zones only)	40
7	1985 Land Use	48
8	Traffic Zones and 1985 All Vehicle Trip Desire Lines	58
9	1985 Average Annual Weekday Traffic	
	A – Study Area	63
	B – Dover Central Area	65
	C – Somersworth Central Area	65
10	Central Avenue-Spaulding Turnpike Interchange-Mill Road-Durham Road-Back River,Road, Dover	
	A – Existing Conditions	68
	B – Recommended Improvements	69
11	Silver Street-Central Avenue, Dover	
	A – Existing Conditions	70
	B – Recommended Improvements	71
12	Lower Square, Dover	
	A – Existing Conditions	72
	B – Recommended Improvements	73
13	Washington Street-Main Street, Dover	
	A – Existing Conditions	74
	B – Recommended Improvements	75
14	Upper Square, Dover	
	A – Existing Conditions	76
	B – Recommended Improvements	77
15	Portland Avenue-Portland Street, Dover	
	A – Existing Conditions	78
	B – Recommended Improvements	79
16	Broadway Street-St. John Street, Dover	
	A – Existing Conditions	80
	B – Recommended Improvements	81

NO.	TITLE	PAGE
17	Central Avenue-Glenwood Avenue to Dover-Somersworth Traffic Circle, Dover	
	A – Existing Conditions, Glenwood Avenue	82
	B – Recommended Improvements, Glenwood Avenue	83
	C – Recommended Improvements, Miracle Mile	84
	D – Recommended Improvements, Traffic Circle	85
18	Market Street: Main and High Streets to Berwick Bridge, Somersworth	
	A – Existing Conditions	86
	B – Recommended Improvements	87
19	High Street-Orange Street-Highland Street, Somersworth	
	A – Existing Conditions	88
	B – Recommended Improvements	89
20	High Street-West High Street-Washington Street-Hamilton Street, Somersworth	
	A – Existing Conditions	90
	B – Recommended Improvements	91
21	High Street-Franklin Street, Somersworth	
	A – Existing Conditions	92
	B – Recommended Improvements	93
22	Main Street-Franklin Street and Main Street-Washington Street, Somersworth	
	A – Existing Conditions	94
	B – Recommended Improvements	95
23	Downtown Dover, Recommended 1985 Improvements	
	A – Location Map	99
	B – Proposed Chestnut Street Bridge and Washington Street-Walnut Street	100
	C – Proposed Walnut Street Extension and Central Avenue-Pierce Street	101

LIST OF TABLES

NO.	TITLE	PAGE
1	Summary of Roadside Interviewing Activity	11
2	Home Interview Sample Selection Activity	12
3	Distribution of Home Interviews by Day of Week	13
4	Summary of Home Interviewing Activity	13
5	Population Check Summary	17
6	Ground Counts on Screenline	18
7	Internal Survey Area Land Use Acreages – 1965	27
8	Internal Survey Area Employment – 1965	31
9	Monthly Traffic Variations – 1964	33
10	Weekly Traffic Variations – July 1965	33
11	Summary of Survey Area Resident Trips by Mode of Travel	34
12	Summary of Survey Area Resident Person Trips by Mode of Travel and Destination Purpose	35
13	Summary of Survey Area Resident Vehicle Trips	35
14	Summary of Average Automobile Occupancy by Trip Purpose	36
15	Summary of Internal and External Vehicle Trips	37
16	External Vehicle Trips by Roadside Station	37
17	Distribution of External Trip Ends Outside Survey Area	42
18	National, State, County and City Population Growth Trends, 1920–1960	43
19	Internal Survey Area Population Growth Trends 1965–1985	44
20	Internal Survey Area Employment, 1965–1985	46
21	Internal Survey Area Land Use Acreages, 1965–1985	49
22	1965 and 1985 External Vehicle Trip Ends	55
23	1965 and 1985 Vehicle Trip End Summary	55
24	Comparison Between Traffic Using Spaulding Turnpike and Traffic Using Route 16	105
25	Spaulding Turnpike Time Difference Diversion	106
26	Effect of Toll Removal on Usage of Spaulding Turnpike and Route 16	106
27	Costs and Priorities – Recommended Immediate Action Program	112
28	Costs and Priorities – Recommended Future Improvements	112
A-1*	Total 1965 Vehicle Trips by Origin and Destination	114
A-2*	Total 1985 Vehicle Trips by Origin and Destination	115
A-3*	1965 and 1985 Traffic Volumes	116

*Appendix

CHAPTER I

INTRODUCTION

STUDY AREA DESCRIPTION

The Study Area includes portions of the cities of Dover and Somersworth, which are located in Strafford County in the northern portion of New Hampshire's Seacoast Region. The Area is about midway between Boston, Massachusetts and Portland, Maine, and is approximately 35 miles east of Concord, the State's capital, and 10 miles northwest of Portsmouth (Figure 1).

Dover was settled in 1623 and became a city in 1855. The city covers approximately 26 square miles of land and is bounded on the east by the Piscataqua and Salmon Falls River (which form the New Hampshire-Maine boundary), on the north by Rollinsford and Somersworth, on the west by Rochester and Barrington, and on the south by Madbury.

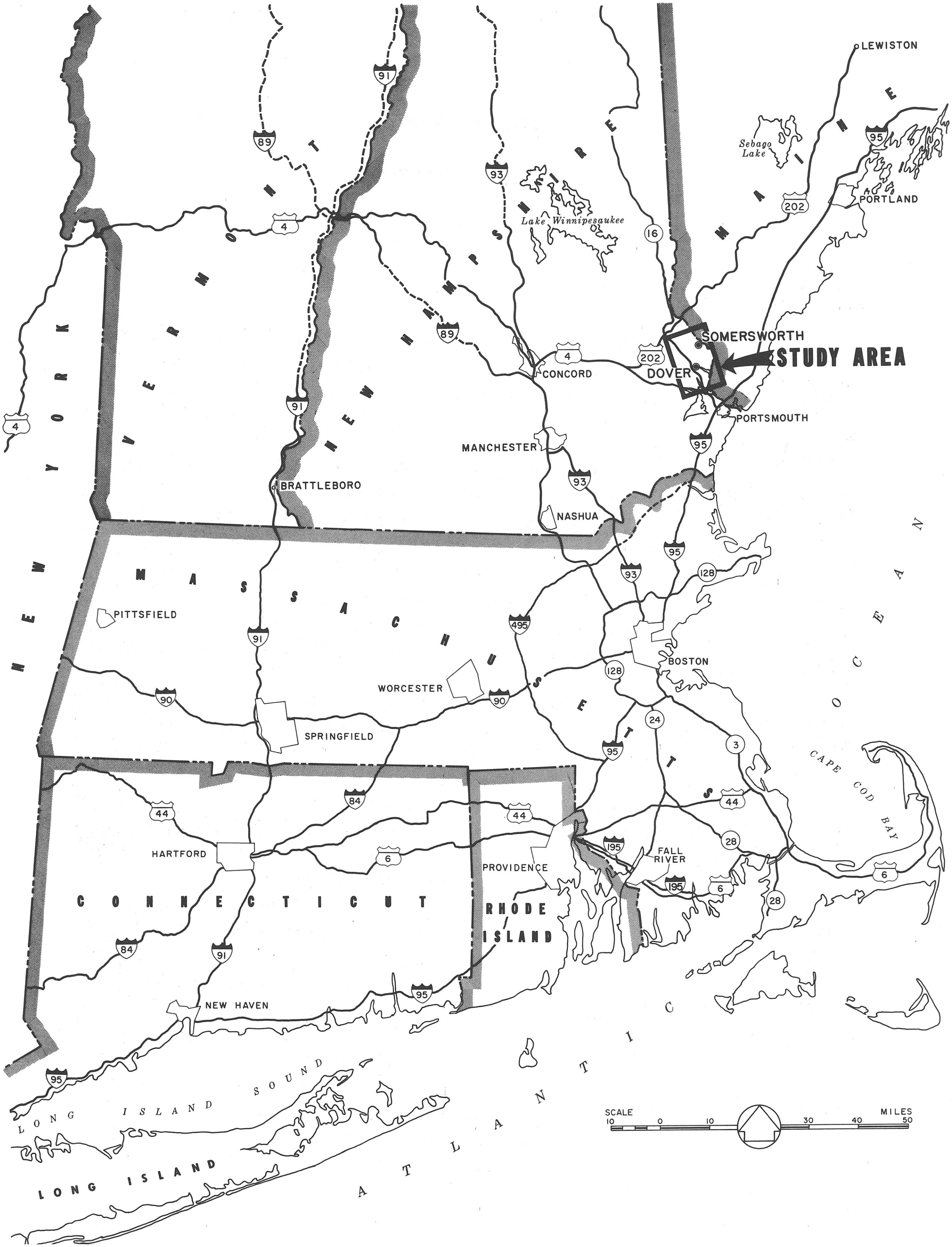
Somersworth was also settled in the 17th century. Under the name of Great Falls, it achieved city status in 1893. Covering approximately 10 square miles, Somersworth is bounded by the Salmon Falls River to the east, Rochester to the north, Dover to the west and Rollinsford to the south. The town of Berwick, Maine is directly across the river from Somersworth.

The 1960 U.S. Census reported a population of 19,131 in Dover and 8,529 in Somersworth. Between 1960 and 1965 it is estimated that the population increase in Dover was approximately 11 per cent, and in Somersworth 9 per cent, for a 1965 total of somewhat more than 30,000 in the two-city area.

Several major highways serve the area, notably the Spaulding Turnpike, a toll facility opened in 1957 connecting downtown Portsmouth and Rochester and passing within a mile of downtown Dover, and New Hampshire State Routes 4, 9, 16, 108 and 155. Boston and Maine Railroad lines pass through both Dover and Somersworth.

The Naval Shipyard in Portsmouth, Pease Air Force Base in Newington, and the University of New Hampshire in Durham are near the Study Area and have played significant roles in influencing its development. Many residents of Dover and Somersworth travel daily to these or other employment centers outside the area, while others who live outside the area travel to the industrial plants in Dover and Somersworth that contribute to the strength of the community's economic base. Dover is a retail center of regional significance as well, particularly to much of the rural territory to the north and east and to the smaller urban centers of Rochester and Somersworth. To a lesser extent Somersworth performs this function for some of the rural sections in the southern tip of Maine.

In recent years Dover and Somersworth have experienced a moderate rate of growth, with extensive new development occurring in the area between the two cities. It is anticipated that, as Dover and Somersworth continue to grow toward one another, the Study Area will become an integrated urban community.



LOCATION MAP

FIGURE 1

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NEW YORK

PURPOSE OF STUDY

With a few exceptions, the existing network of highway transportation facilities is adequate to meet the immediate needs of the area. However, as the pressures of the of the population explosion and changing patterns of life in urbanizing America become felt in the Dover-Somersworth area, traffic congestion will tend to become more of a problem unless steps are taken to meet growing transportation needs as they develop. Highway safety is another area of increasing concern.

Future transportation needs in the Study Area will be fashioned by changes in the patterns and intensities of everyday activity of the people dependent upon the area in one way or another – increasing income levels, more leisure time, higher per capita vehicle ownership, and other influences above and beyond mere increases in numbers of people living, working, shopping and pursuing their recreational, social and other personal interests in the area. Dover-Somersworth's "place on the map" will also have an influence in setting demands on local highway facilities. Located near the ocean beaches and other tourist attractions of the Atlantic coast, and sitting astride the gateway to the summer and winter playgrounds of central New Hampshire, the Dover-Somersworth area will feel the effects of the growing national pastime of traveling for recreation.

The purpose of the Dover-Somersworth Transportation Study is to develop a feasible plan and program to guide the staged development of a balanced highway transportation system which will accommodate present and future travel demands to the year 1985, and will encourage desirable land development patterns.

Growth and changes in the patterns of everyday living create a need for parallel growth and changes in transportation facilities. There is a complex interaction between land use, employment and population distribution, and transportation. Changes in land use patterns and redistribution of population and employment create a need for improved transportation facilities, while the completion of new transportation facilities accelerates population and economic growth in the areas they serve. The Dover-Somersworth Transportation Study was organized with recognition of this interaction to encompass the full scope of regional transportation and land use planning.

AUTHORITY AND SCOPE

The Dover-Somersworth Transportation Study was conducted by Tippetts-Abbett-McCarthy-Stratton for the New Hampshire Department of Public Works and Highways under the terms of an engineering agreement dated July 1, 1965. The Study is being financed by the State, with local matching funds from the cities of Dover and Somersworth, and with federal aid contributed by the United States Department of Transportation, Bureau of Public Roads.

With the ultimate objective of selecting a recommended transportation system which will best meet the future needs of the area, plus a series of recommendations for immediate action to meet current critical needs, the Study has encompassed a wide range of transportation and land use planning activities.

This report describes all phases of the Dover-Somersworth Transportation Study, including traffic engineering studies; collection of data pertaining to existing highway facilities; inventories and analyses of present travel patterns and trip generation factors; projections of population, employment, land use and travel demands; evaluation of alternative improvement proposals; and finally, selection of the recommended system. A separate report describing in more detail all of the technical aspects of the Study will be submitted to the New Hampshire State Department of Public Works and Highways.

PREVIOUS STUDIES

There have been no comprehensive urban transportation studies conducted in the Dover-Somersworth area in the past. However, a number of related studies have been made or are currently under way. Full consideration was given in the Dover-Somersworth Transportation Study to such studies made by others, many of which included proposals relating to the highway transportation network of the area. All of these proposals were evaluated and many are discussed in this report in the light of projected transportation demands.

DOVER

In 1950 the City Planning Board prepared a "Traffic Study Report of the City of Dover, New Hampshire", which included a number of proposals, many of which have come to pass in the ensuing years – notably the Spaulding Turnpike which provides a bypass around the central area of Dover for through traffic.

In a report dated March 1962 The Planning Services Group presented a study of traffic circulation and an analysis of parking needs in the City's central business area. This report, entitled "Traffic Circulation and Parking Plan", was prepared for the Dover Planning Board through a "701" urban planning assistance grant from the federal Housing and Home Finance Agency and includes many recommendations which were repeated in the more recent CRP report (see below), some of which are incorporated in the recommended plan presented herein.

In 1964 the City of Dover undertook a Community Renewal Program with the assistance of a federal grant from HHFA. The Dover Planning Board was designated by the City as the body responsible for preparation of the program, and in 1965 their final report, entitled "Dover, N.H. – A Program of Community Renewal", was published. This report included a section on transportation in which a number of specific proposals were made.

SOMERSWORTH

The essential elements of a master plan for the City of Somersworth were contained in a report entitled "General Development Plan", prepared for the Somersworth

Planning Board by Planning and Renewal Associates-Consultants in June 1960 through the assistance of a Federal "701" planning grant. Several specific street improvements recommended in the "General Development Plan" report were considered further in the Dover-Somersworth Transportation Study.

At the present time the firm of Desmond and Lord is acting as a consultant to Somersworth for the purpose of updating the City's master plan. Detailed information from the Dover-Somersworth Transportation Study has been furnished to them.

In 1963 the City gave approval to an extensive plan for urban renewal in the central area of Somersworth. This project, known as the Triangle Area Urban Renewal Project, will cover an area of 21.3 acres of which 12.6 acres are to be cleared for new construction. Detailed information from the Dover-Somersworth Transportation Study has been furnished to The Planning Services Group, who is consultant to the Somersworth Housing Authority for this project.

CHAPTER II

ORIGIN-DESTINATION SURVEY

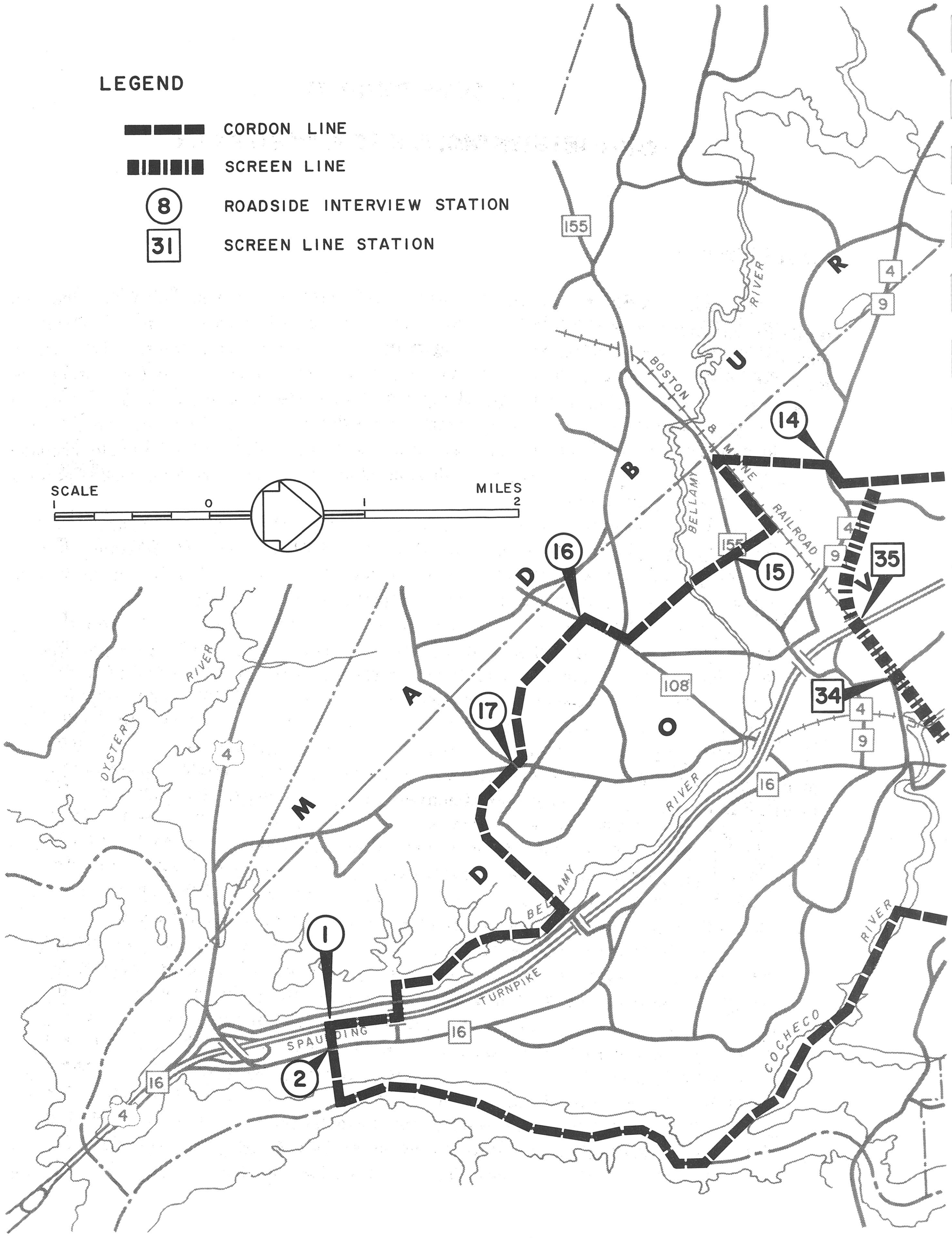
SURVEY DESIGN

The transportation planning process is based on the assumption that there is regularity and orderliness in the travel behavior of people. Because of this, a sampling technique can be employed in the gathering of facts concerning travel habits with a reliability consistent with the inevitable uncertainties inherent in the forecasting process. In other words, a properly designed representative sampling of area travelers to obtain travel information covering a representative brief period of time can be expected to yield information indicative of total area travel patterns. This is fortunate because the cost of interviewing all residents and other area highway users for extended periods of time would be prohibitive.

Using a sampling technique, an origin-destination survey was conducted in the Dover-Somersworth area during the summer of 1965 for the purpose of obtaining data on the travel habits and desires of the people using the highway facilities in the area to serve as the foundation for planning of future transportation facilities.

Early in the Study a cordon line was established to define the area within which interviews would be conducted to obtain origin-destination data. The cordon line was so located as to include areas of major existing development in Dover and Somersworth and areas in which the greatest growth is expected to occur in the next twenty years. Another important criterion used in establishing the cordon line was to minimize, insofar as possible, the number of major highways crossed where roadside interviews would have to be conducted, and to ensure that the points of crossing were suitable for operating roadside interview stations safely and effectively. A large portion of the cordon was defined by these considerations. Elsewhere the cordon line was located so as to follow city boundaries and areas zoned for uses other than agricultural. The cordon line is shown in Figure 2. The survey area enclosed thereby includes most of Dover, virtually all of Somersworth and a small portion of Rollinsford. It is estimated that about 94 per cent of the combined population of Dover and Somersworth reside inside the cordon line.

Roadside interviews were conducted on the major highways entering and leaving the area at points where they cross the cordon line. The purpose of the roadside interview survey was to obtain origin-destination information for vehicle trips made into, out of, or through the area. In the Dover-Somersworth area this type of travel is of far greater relative significance that it is in most larger urban areas because of the limited extent of the Study Area and the fact that it does not take in a region large enough to encompass all of the daily movements of persons, vehicles and goods oriented toward its hub – witness the large number of people residing in surrounding areas outside the cordon line (Rollinsford, Berwick, Madbury, Durham, etc. as well as the fringes of Dover and Somersworth) who look to Dover or Somersworth as their central city. Because of the greater


LEGEND
CORDON LINE
SCREEN LINE
8
ROADSIDE INTERVIEW STATION
31
SCREEN LINE STATION
SCALE
1
0
1
MILES
2
155
4
9
R
U
B
BOSTON & MAINE RAILROAD
BELLAMY RIVER
14
16
15
35
D
A
108
34
17
O
M
OYSTER RIVER
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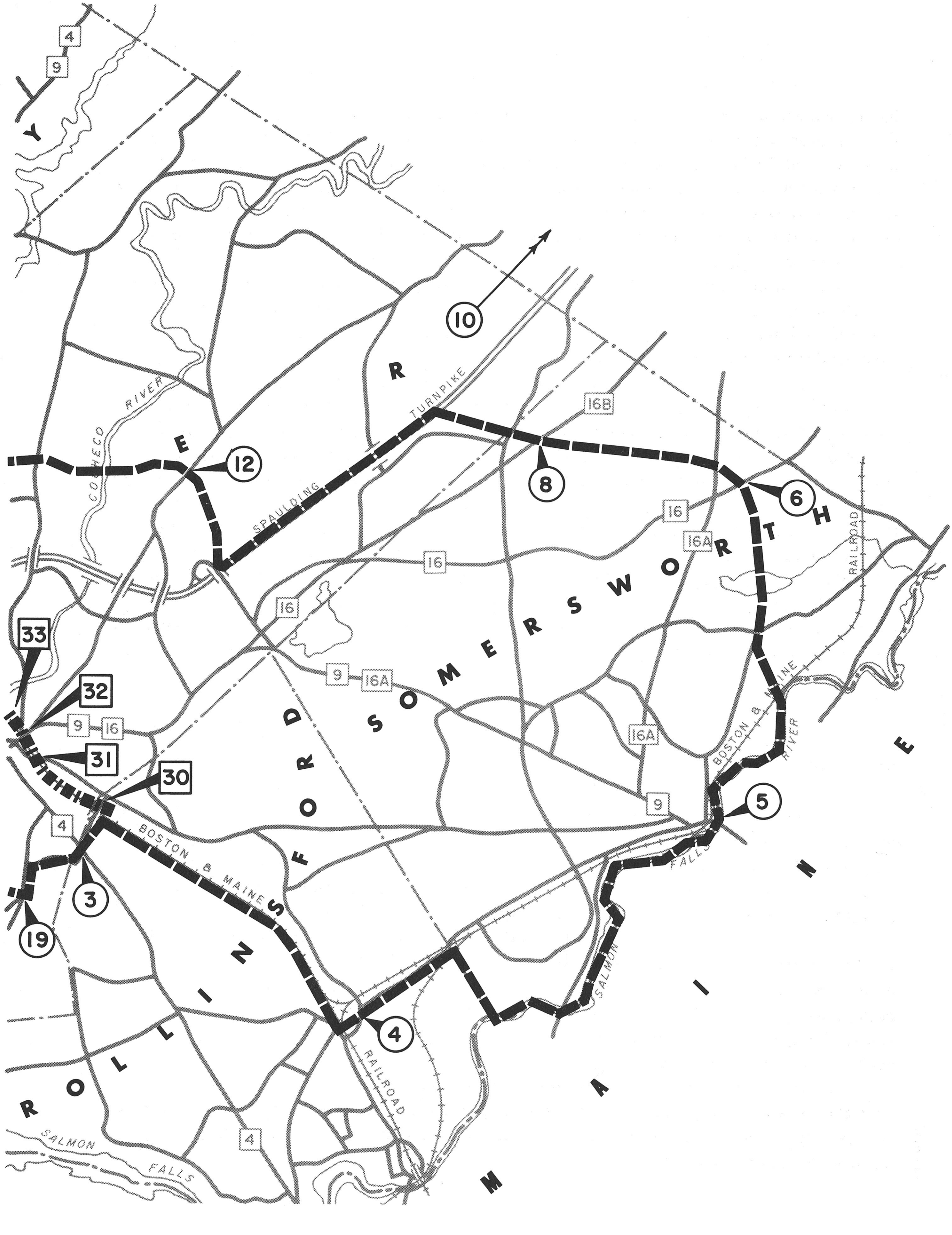


CORDON LINE AND SCREEN LINE
FIGURE 2

than normal significance of such traffic in the Study Area, a special adjustment was made to certain categories of internal travel data collected in the origin-destination survey to to account for the fact that external residents also make a large number of wholly internal trips – trips beginning and ending within the cordon line – that would not otherwise be accounted for in the design of the survey. Also, the volume of through traffic, trips with neither origin nor destination within the survey area, is quite heavy, particularly on the Spaulding Turnpike.

Within the cordon line, travel information for trips made by residents of the area either as a vehicle driver or as a passenger was collected in the home interview survey. A third interview survey was made of taxi operators to assemble current data on taxi travel within the Dover-Somersworth area.

In most urban transportation studies, data concerning truck travel within the internal survey area have been obtained through interviews with the drivers of selected trucks. In the Dover-Somersworth Transportation Study, origin-destination data for internal truck travel were obtained in conjunction with the home interview survey because of the difficulty of obtaining a complete and up-to-date listing of trucks to serve as the basis for a truck survey, and because the home interview sample size was sufficiently large to ensure statistical stability of data relating to truck travel (in a larger area a smaller home interview sample would be used and would provide stable person trip data but insufficient truck trip data). The procedure employed in the Dover-Somersworth Transportation Study adequately accounted for internal truck travel by residents. A special adjustment was made to account for similar travel by non-residents; for example, trips made by truck drivers who work in Dover or Somersworth but who live outside of the cordon line.

ROADSIDE INTERVIEWS

The cordon line intersects a total of 22 roads, 14 of which account for 95 per cent of the daily traffic entering and leaving the survey area. Roadside interview stations were established at points where these 14 highways cross the cordon line and interviews were conducted for periods of 8 hours, 16 hours, or 24 hours depending on the volume of traffic, as shown in Table 1. Station locations are shown in Figure 2.

A total of 25,179 interviews were obtained from all roadside interview stations; this represents 50 per cent of the 50,006 vehicles passing the stations during the hours of operation, or 45 per cent of the total average summer weekday traffic crossing the cordon line on the 14 major highways entering or leaving the area. With very few exceptions, interviews were obtained for a minimum of 25 per cent of the vehicles passing in each direction in each hourly period.

Information recorded in each interview included date and time of interview, vehicle type, number of persons in the vehicle, trip purpose, origin and destination of the trip, location where the vehicle driver lived, and route of entry or exit for trips passing through the survey area.

Table 1

SUMMARY OF ROADSIDE INTERVIEWING ACTIVITY

Station No.	Location	1965 Average Summer Weekday Traffic	No. of Hours in Operation	Traffic Passing During Hours of Operation	Interviews Obtained	Per cent Interviewed
1	Spaulding Turnpike at Dover Toll Station	6,587	24	6,174	2,825	46
2	N.H. 16 at Dover Point	5,553	24	5,666	2,999	53
3	N.H. 4 at Rollinsford line	3,622	16	3,774	1,964	52
4	RR overpass at Rollinsford	1,821	8	1,030	580	56
5	N.H. 9 on Somersworth-Berwick Bridge	9,507	24	8,088	3,932	49
6	N.H. 16 near Rochester line	6,210	24	6,565	2,372	36
8	N.H. 16B near Rochester line	1,909	8	889	482	61
10	Spaulding Turnpike at Rochester Toll Station	4,878	24	4,177	2,644	63
12	Sixth St., Dover, west of Spaulding Turnpike	1,138	8	581	416	72
14	N.H. 4/9 near Madbury line	2,898	16	2,632	1,261	48
15	N.H. 155 near Madbury line	3,156	16	2,810	1,362	49
16	N.H. 108 near Madbury line	4,825	24	4,963	2,956	60
17	Back River Road near Madbury line	1,088	8	532	382	72
19	Gulf Road near Rollinsford line	2,468	16	2,125	1,004	47
	Total	**55,660**		**50,006**	**25,179**	**50**

Manual traffic classification counts were made at each station for 24 hours including the period during which the station was in operation. Automatic traffic recorder counts were also made at each of the stations for a period of several days by the New Hampshire Department of Public Works and Highways. The manual counts and these automatic counts, plus data from the State's permanent counters in the area, served as the basis for expanding and adjusting roadside interview data to represent average weekday traffic.

HOME INTERVIEWS

A twenty per cent sample of all of the dwelling units inside the survey area cordon line was selected in accordance with standard procedures of the United States Bureau of Public Roads, and interviews were conducted at each of the selected dwelling units to obtain travel data for all of the residents for a particular weekday. The following definition of a dwelling unit as used in this Study corresponds to that employed by the

U.S. Bureau of the Census: A dwelling unit is a group of rooms or a single room, occupied or intended for occupancy as separate living quarters for a family or other groups of persons living together, or by a person living alone.

Selection of the majority of dwelling unit samples for home interview was by means of electric utility accounts, records of which were loaned to Tippetts-Abbett-McCarthy-Stratton for this specific purpose through the cooperation of the Public Service Company of New Hampshire. Records were in the form of printouts of meter service locations prepared in conjunction with the regular monthly billing cycle. Dwelling units in the portion of Rollinsford within the cordon line were field enumerated and samples were selected from the field listings. Samples were also selected in the field for four government housing projects in the Dover-Somersworth area which did not have individual electric meters for each dwelling unit. In addition, a comprehensive list of rooming houses, hotels, motels and institutions was prepared with the help of the local Chamber of Commerce and using the City Directory and similar references, and an interviewer was sent to each of these places to determine the number of dwelling units occupied or intended for occupancy by persons or groups of persons for periods of a week or more. Additional samples were selected for interview from this supplementary listing. Approximately 10,000 dwelling units were listed from these various sources, and 1,993 samples were selected on a one-in-five basis.(see Table 2)

Table 2

HOME INTERVIEW SAMPLE SELECTION ACTIVITY

Type	No. of Dwelling Units	No. of Samples Selected	Per Cent of Total
Electric Utility Accounts	9,090	1,818	91
Rollinsford Field Selected Samples	170	34	2
Government Housing Projects	324	64	3
Rooming Houses, Hotels, Motels, and Institutions	391	77	4
Total	9,975	1,993	100

Because of the short duration of the home interview survey, the fact that it did not extend into two seasons, and the limited geographic extent of the Study Area, no attempt was made to control the distribution of interviews by pre-assigning interview dates according to location. Interviewers worked more or less regular hours Tuesday through Saturday, collecting information concerning trips made on Monday through Friday, so that the distribution of completed interviews was fairly uniform for the several days of the week (see Table 3).

Table 3

DISTRIBUTION OF HOME INTERVIEWS BY DAY OF WEEK

Travel Day	No. of Completed Interviews	Per Cent of Total
Monday	320	20
Tuesday	365	23
Wednesday	375	23
Thursday	279	17
Friday	276	17
Total	**1,615**	**100**

As shown in Table 3, 1,615 interviews, which represented 81 per cent of the total, were completed successfully. The remainder could not be completed for one reason or another as shown in Table 4. The number of interviews that could not be completed because the residents were out of the area or because the interviewer was unable to contact anyone at the sample address after repeated attempts is somewhat higher than is normally experienced in surveys of this type conducted during other seasons of the year, and may be attributed to the fact that people spend more time away from home or are on vacation during the summer months. The refusal rate was also somewhat higher than normal but not enough to introduce serious bias into the survey.

Table 4

SUMMARY OF HOME INTERVIEWING ACTIVITY

	No. of Samples
Interviews Completed	1,615
Non-Interviews	378
Total	**1,993**

* * *

	Number	Percent of Total Samples
Reasons for Non-Interviews:		
Vacant	97	4.9
Residents Out of Area	87	4.4
Refusal	50	2.5
Unable to Contact	99	5.0
Other	45	2.2
Total	**378**	**19.0**

* * *

Trips from Completed Interviews	15,344
Trips per Completed Interview	9.5

Two basic types of data were obtained in the home interviews:

1. Information relative to the sample dwelling unit and the residents thereof – dwelling type, number of residents, number of employed persons, number of passenger vehicles garaged at the address, number of residents who drive a truck and where that truck is normally garaged, gross family income, and characteristics of the residents including sex, age, relation to head of household, occupation and industry.
2. Information concerning each trip made by each person at the sample address– occupation and industry of trip maker, location of and purpose at origin and destination, mode of travel, time of trip, number of passengers and type of parking at destination (driver trips only), and truck type, load and commodity (truck drivers only).

Travel information was collected only for weekdays, Monday through Friday, with the travel day chosen as being the 24-hour period from 4 AM to 4AM in order to minimize the possibility of a trip starting one day and ending the next.

Trips made by any of the following travel modes were recorded:

- automobile driver
- automobile passenger
- truck driver
- truck passenger
- taxi passenger
- bus passenger

In addition, walk trips or trips by other modes not included above (bicycle, horseback, etc.) were recorded for the first trip of the day to work only. The purpose of obtaining this information was to be able to make the employment accuracy check described subsequently in this chapter.

Complete trip data were recorded for 15,344 trips other than walk trips, or 9.5 trips per completed interview. This average compares very favorably with trip production rates obtained from studies conducted in similar areas in other parts of the country.

In expanding sample home interview data to provide information representative of the entire population of the survey area, account was taken of all of the non-interviews listed in Table 4. In sections of the area where all interviews were successfully completed the expansion factor was approximately five, equal to the reciprocal of the sampling rate. However, where there were non-interviews of the type for which trips were possible even though no data were obtained, adjustments were required in computing expansion factors. For example, where an interview could not be completed because the occupants refused to cooperate, data obtained from other interviews which were completed had to be expanded by an increased factor to account for what was not learned at the refusal household.

TAXI INTERVIEWS

In the summer of 1965 there were 20 taxis based in the Dover-Somersworth area, 17 in Dover and 3 in Somersworth. However, only 13 of these were operated during the summer months. Trip data for these taxis were obtained from the drivers and from manifests describing the travel performed by each vehicle on a particular weekday. A total of 909 trips was reported, equivalent to 70 trips per taxi per average weekday.

Information collected included the garage address of each taxi and the origin, destination and mid-point time of each trip made during a 24-hour period. As in the home interview survey, the 24-hour period was considered to run from 4 AM to 4 AM.

TRAFFIC ZONES

In order to handle the mass of trip data obtained in the surveys described in the preceding paragraphs, geographic traffic zones were established and given numerical codes. In the coding phase of the Study all home interview address locations, trip origins and destinations and garage locations of trucks and taxis were converted to the appropriate codes.

The cordon line, by definition, serves as the boundary between internal and external traffic zones. The internal survey area was divided into 50 zones – 35 in Dover, 13 in Somersworth, and 2 in Rollinsford – as illustrated in Figure 6, which appears later in this report. To make it possible to take maximum advantage of available sources of statistical data, the internal traffic zoning system recognized the boundaries of the 13 enumeration districts in Dover and the 6 in Somersworth, as used in the 1960 U.S. Census, to the maximum feasible extent. Further sub-division was accomplished by drawing traffic zone boundaries along major arterial highways or by following physical barriers such as rivers, railroads or the Spaulding Turnpike. Aside from these considerations, the area, shape, population, land use, trip generation and attraction potential, and practical considerations of trip data coding governed the manner in which the internal area was divided into traffic zones.

The portions of Dover, Somersworth, and Rollinsford outside the cordon line were sub-divided into eight external zones by following enumeration district boundaries, and trips were coded to these zones. Elsewhere in New Hampshire and in Vermont, Massachusetts, Connecticut and Rhode Island, trips were coded to town. In the remainder of the United States, except for York County, Maine, trips were coded to county and state. York County, due to the fact that it adjoins the Study, was sub-divided into six external zones. Trips to and from Canada were coded to province.

Traffic zones form the basic unit for all analysis and forecasting of travel in the survey area. Consequently, land use, population and economic data were developed on the basis of traffic zones as well as current travel data.

CODING AND PROCESSING OF INTERVIEW DATA

The manner in which both internal and external areas were broken up into workable geographic units for the purpose of data analysis has been described. A six-digit geographic coding system was established in such a manner that every traffic zone, internal and external, was uniquely identified and, moveover, identified in such a way as to facilitate machine sorting of coded data after they had been transferred to punched

IBM cards. External zone codes conformed to the maximum possible extent with IBM standard location codes and with the New England township coding schedule established in Massachusetts Informational Bulletin 3, "External Zoning System Manual," used throughout New Hampshire by the Department of Public Works and Highways.

A Coding Index was prepared which listed codes for prominent places within the Dover-Somersworth Study Area and included a listing of every street with codes given by house number. In addition, large-scale maps were prepared showing zone boundaries and codes. In practice, coders had to make use of both maps and Coding Index as well as other reference material to locate an address and to assign the appropriate geographic code.

In addition to geographic locations, numerous other items of information necessary to the transportation planning process were collected in the field surveys as noted in the preceding paragraphs. Each item of information had to be coded so that it could be represented by a minimum number of digits. Coding schedules were established for all of the non-geographic items of recorded data and a significant proportion of the total coding time was spent coding such information.

All coded origin-destination survey data were punched on IBM cards using standard card formats to facilitate subsequent processing and analysis.

SURVEY CHECKS

A series of checks of the origin-destination data collected in the field interview surveys was carried out to determine the completeness of sample data and to ensure its reliability within the statistical limits established by the design of the survey. These checks had two major objectives:

- to determine the adequacy of the home interview sample selection procedure, and
- to evaluate the completeness of all trip data obtained.

The population check related to the first of these objectives. The screenline and cordon line checks, and the employment check, were aimed at the second objective. These are described in subsequent paragraphs.

POPULATION CHECK

The population check was used to test the adequacy of the home interview sample selection by comparing the population obtained from expanded sample data with independently derived population figures updated from the 1960 U.S. Census by extending recent population trends in Somersworth and through the use of a special school census conducted recently in Dover. This comparison was made for 11 areas where groupings of enumeration districts coincide or nearly coincide with groupings of traffic zones. Where these boundaries did not exactly coincide, adjustments were made by counting dwelling units in the areas where the boundaries differed and applying factors to convert dwelling units to population. Table 5 summarizes the results of the population check for these areas which include, in the aggregate, more than 60 per cent of the population of the entire internal survey area and hence can be taken as a sufficient indicator of survey accuracy.

Table 5

POPULATION CHECK SUMMARY

Zones	Expanded Survey Data	Independent Estimate	Comparison Ratio*
8, 10, 11	1,912	1,968	0.97
12	1,104	1,272	0.87
13, 15, 17, 19, 20, 21	1,860	1,983	0.94
14, 27	1,324	1,170	1.13
18, 24	892	1,023	0.87
25, 33	1,923	1,790	1.07
26	1,270	1,161	1.09
28	993	1,012	0.98
38, 39, 46	2,815	3,011	0.93
40, 41, 45, 47, 50	2,899	2,956	0.98
44	1,063	1,185	0.90
Totals	18,055	18,531	0.97

* Expanded Survey Data/Independent Estimate

Comparison ratios for these groups of zones range from 0.87 to 1.13, with an overall average of 0.97. These ratios refer to areas with populations in the order of 1,000 to 3,000 persons. Standards established by the U.S. Bureau of Public Roads for population accuracy checks require that expanded survey population for a census tract (which usually has a population in the order of 4,000 persons) be within 15 percent of the population for the tract as obtained from independent sources. The difference would normally be expected to be greater for areas with less population; however, in the Dover-Somersworth Study, the 15 percent requirement was met for grouping of zones which are considerably smaller than census tracts. This fact, and the favorable overall comparison (97%), confirm the adequacy of sample selection and attest to the completeness of all household data collected in the home interview survey.

SCREENLINE CHECK

The best method for checking the completeness of trip data collected in an origin-destination survey is normally a screenline check in which the numbers of expanded survey vehicle trips with origin on one side of the screenline and destination on the other, and hence which must have to cross the screenline, are compared with ground counts on the screenline. To be most effective the screenline should completely bisect the survey area, following traffic zone boundaries and intercepting large volumes of traffic at a minimum number of points; it should be so oriented with respect to the highway network that potential double crossings of the screenline between origin and destination are minimized; and it should not pass too close to a downtown area where shuttling back and forth across the screenline while in search of a parking space or for other purposes is prevalent or where the nature of the parking supply-demand balance is such that drivers might park on one side of the screenline with a true destination on the other side.

For the Dover-Somersworth Transportation Study a screenline meeting all of the above criteria except, to some degree, the last was established along the Boston and Maine Railroad tracks from Oak Street on the Dover-Rollinsford line at the eastern boundary of the Study Area, to a point just northeast of Central Road (N.H. 4/9) near the western boundary of the Study Area, thence parallel to and north of Central Road to the cordon line near Columbus Avenue. The screenline, which is shown in Figure 2, divides the internal survey area into two sectors connected by six major roads. The southern sector contains 61 per cent of the survey area's population. Alternative screenline locations would have resulted in a more disproportionate splitting of the area and consequently would have been less valuable as an indicator of the completeness of survey trip data. The proximity of the screenline shown in Figure 2 to downtown Dover had to be accepted, therefore, and the screenline comparisons discounted accordingly.

Manual traffic classification counts were made at counting stations established on each of the six roads crossing the screenline for a period of 24 hours. Automatic traffic recorder counts were also made at each of the stations for a period of several days by the New Hampshire Department of Public Works and Highways. These counts, plus data from the State's permanent counters in the area, were used to adjust the manual counts to represent average summer weekday traffic. Adjusted ground counts at each of the screenline stations are tabulated in Table 6.

Table 6

GROUND COUNTS ON SCREENLINE

Station No.	Name of Road	1965 Average Summer Weekday Traffic
30	Oak Street	2,634
31	Broadway	4,781
32	Central Ave. (N.H. 9/16)	14,453
33	Chestnut St. – Third St.	3,619
34	Washington St.	4,404
35	Spaulding Turnpike	10,592
	Total	**40,483**

Initial comparisons made between expanded origin-destination survey data and the total adjusted ground count on the screenline were somewhat low and confirmed the need for the two adjustments described earlier in this chapter under the heading "Survey Design." The purpose of these adjustments was to account for the following two types of trips which were not sampled in the field interview surveys:

1) Internal Trips Made by External Residents – It was estimated that external Residents make approximately 8,000 internal vehicle trips within the survey area on an average summer weekday. Such trips by external residents are comparable to the non-home based trips made by residents of the internal survey area, data concerning which were obtained in the home interview and taxi surveys. Consequently, the adjustment was made by factoring internal non-home based survey trips upward to account for internal trips by external residents as well.

2) Internal Trips of Internally Garaged Trucks Made by External Residents – A special study was made to insure the adequacy of data collected in the home interview survey pertaining to trucks, since the usual kind of truck survey in which truck samples are selected from lists of registered vehicles was not conducted in the Dover-Somersworth Study Area. This special study involved a series of personal visits, made during the survey period, to all places within each of several selected zones where truck ownership was particularly significant, and the comparison of the data obtained with expanded survey data. It was found that about 22 per cent of the trucks normally garaged in the survey area are driven by external residents whose trips, except those crossing the cordon line, were not sampled. The adjustment was made by factoring upward all internal survey truck trip data obtained in the home interview survey.

Comparisons made between expanded origin-destination survey data, adjusted as described above, and the total adjusted ground count on the screenline showed excellent agreement during the morning peak period from 7 AM to 9 AM. The ratio of the number of screenline crossings from survey data to the total ground count was 104 per cent for automobiles and 98 per cent for trucks during this period. For the 16-hour period between 6 AM and 10 PM, the corresponding ratios for autos and trucks were 83 and 91 per cent respectively. In view of the proximity of the screenline to downtown Dover and other special circumstances influencing counts made on the screenline, these results were considered to be acceptable.

CORDON LINE CHECK

About 22 per cent of the total number of trips crossing the cordon line daily are made by residents of the internal area. Such trips were sampled both in the home and taxi interview surveys conducted in the internal survey area, and in the roadside interviews made on the cordon line.

Comparisons made between the numbers of cordon crossing trips by residents from these two types of interview surveys showed satisfactory agreement. The ratio of internal survey trips from expanded data recorded in the home and taxi interviews, to external survey trips from expanded data recorded in the roadside interviews, was 99 per cent for total 24-hour traffic.

EMPLOYMENT CHECK

Another method of testing the accuracy of survey trip data is through an employment check, whereby the number of home-to-work trip destinations in an area is compared with the number of persons employed in that area.

In order to make possible an employment comparison for the Dover-Somersworth Study, an effort was made to obtain complete data on trips from home to work by all modes including walking, and then to exclude from consideration trips where the work was not reflected in the employment figures (domestic workers are an example).

A number of factors make it impossible to achieve direct comparability between home-to-work trips and employment data, including:

1) Sickness, vacations and other forms of absenteeism tend to reduce person trips to work below the number of persons actually employed. This is particularly significant in the summer when 20 per cent or more of the work force may be on vacation during any given week.

2) Work trips to plants working on a six- or seven-day schedule are under-reported with respect to employment in a weekday origin-destination survey since employees on certain weekdays make no trips to work.

3) The place where a person works is not always where he is considered to be employed.

4) Since only home-to-work trip destinations were used, it is possible that some valid travel to work was not included in the comparisons, such as when intermediate stops were made between home and work.

For these reasons a "perfect" employment check would not be indicated by a 100 per cent comparison between home-to-work destinations and employment totals, but by something less.

Employment comparisons were made for eight portions of the Dover-Somersworth Area covering virtually all of the major employment centers and including 87 per cent of the total survey area employment. The ratios range from 86 to 115 per cent, with an overall weighted average of 94 per cent. These favorable comparisons attest to the adequacy of work trip reporting in the origin-destination survey and further verify the screenline comparison for AM peak hours described in the preceding paragraph, which indicated a satisfactory degree of accuracy with regard to travel during the time of day when most weekday trips to work are made.

CHAPTER III

EXISTING CONDITIONS

PHYSICAL FEATURES

The terrain in the Dover-Somersworth area is generally flat or gently sloping. The elevation varies from practically sea level at Dover Point which juts into the tidal waters of Little Bay, to a high of 250 feet above sea level in Somersworth, thereby giving that place the name Hilltop by which it is known colloquially.

A number of rivers follow a course through or near the Study Area. Indeed, much of the eastern boundary of the area is formed by the Salmon Falls and Piscataqua Rivers.

The southern portion of Dover is effectively bisected by the Bellamy River, a tidal estuary of considerable width at its mouth but which diminishes in width as it reaches north until it becomes a narrow stream north of N.H. Route 108.

The Cocheco River flows south from Rochester through the central area of Dover and into the Piscataqua River. East of the City the Cocheco River is quite wide and not crossed by any bridges.

Very little of the land area within Dover and Somersworth is unsuitable for development because of excessively steep slopes or swampy conditions. Much of the area is underlain by shallow bedrock, however, making extension of water and sanitary sewer lines prohibitively expensive in certain sections. Poorly drained soils are found in a few places also, further limiting the development potential of some areas due to the difficulty of achieving satisfactory operation of septic tanks.

All of these natural physical characteristics have played a role in determining the current form and nature of development in the area, and they will continue to exert an influence on the future growth and development. Man-made features too are major determinants in fashioning the direction, density, character and limits of future urban development. In the Dover-Somersworth area the railroads and especially the Spaulding Turnpike are important in this regard.

Consideration was given to the probable effects of all of these natural and man-made physical features in making projections of future land use and population distribution for the Dover-Somersworth Transportation Study as described in subsequent sections of this chapter.

TRANSPORTATION FACILITIES

The Dover-Somersworth area is quite well served by a network of railroad and highway facilities. The Piscataqua River, which flows south from the Dover area to the Atlantic Ocean at Portsmouth, is navigable for barge traffic about as far upstream as Newington, just south of Dover Point. But at the present time the rivers in the Study

Area are unsuitable for use as arteries of commercial transportation. There is, however, a great deal of pleasure boating and fishing on all of the area's rivers.

Public transit bus operations in the Study Area are of negligible significance and there are no airports in Dover or Somersworth. Railroads and particularly highways are the most important transportation facilities in Dover and Somersworth. These are described more fully below.

RAILROADS

The main line of the Boston and Maine Railroad passes through Dover in an east-west direction. As can be seen in Figure 2, the cordon line follows these tracks for some distance in Rollinsford and the screenline follows them through the survey area except near its western boundary. A spur line runs from central Dover southward to the Sawyer Mills area. Another B&M line runs north through Somersworth along the Salmon Falls River with a junction point in Rollinsford. Although service is not frequent, extensive delays to vehicular traffic on certain of the highways in the area occasionally occur. The Central Avenue crossing in Dover is a good example. In general, there are adequate safety devices at the more heavily traveled grade crossings.

HIGHWAYS

Figure 3 depicts the existing arterial highway network in the Dover-Somersworth area. These are the most important streets and highways in the area in terms of current traffic usage and service to the various sections of the Study Area. Three classifications are shown[1]:

- expressways, which are generally defined as divided highways with full or partial control of access and with most of the cross roads separated in grade;
- arterials, which with the expressways constitute the major network of highways in and through the area, and which are generally used primarily for traffic that is not originating at or destined to property abutting on the route; and
- collectors, which are intermediate in function between arterials and local streets (local street are all those not otherwise shown in Figure 3 and which are primarily for access to abutting property).

In the Dover-Somersworth area the only highway meeting the expressway definition given above is the Spaulding Turnpike which has full access control and no intersections at grade. Major arterial routes include New Hampshire State Route 16 which enters the Study Area from the south at Dover Point and continues directly through downtown Dover and northward to Rochester, splitting into three routes (16, 16A and 16B) near the Dover-Somersworth line; N.H. 4 and 9 which enter the Study Area from the west and proceed into the central area of Dover then split, with N.H. 4 continuing eastward on Portland Avenue and N.H. 9 following N.H. 16 and 16A to Somersworth then continuing through Somers-

1—Figure 9, which appears later in this report, illustrates and classifies the future arterial highway network in the same manner.

worth to Berwick; and N.H. Routes 108 and 155 which also enter the central area of Dover from the west.

Several field studies were conducted during the summer of 1965 for the purpose of acquiring a thorough knowledge of physical and operating characteristics of the existing street and highway network. These included:

- automatic traffic recorder counts made by the New Hampshire Department of of Public Works and Highways on the screenline and at roadside interview stations as described in Chapter II, and at numerous locations throughout the Study Area;
- manual peak period traffic classification counts, including intersection approach volume and turning movement counts, made at 20 critical intersections;
- inventories of physical features and dimensions, traffic control devices and traffic and parking regulations at each of the critical intersections where peak period traffic counts were made and at other critical points throughout the arterial highway system; and
- speed and delay runs made to determine average driving times on all major routes in the area during peak and off-peak hours.

In addition to the above, an accident location study was conducted to determine highway accident frequencies for specific locations throughout the Study Area. Records of all accidents occurring between August 1, 1963 and August 1, 1965 were obtained from the Police Departments of Dover and Somersworth and an accident spot map was prepared to illustrate accident frequency by location (see Figure 4). The average number of accidents reported for each of the two years was 600 in Dover and 290 in Somersworth. This represents a yearly loss to the public of close to one million dollars(1), entirely aside from non-monetary human costs associated with highway traffic accidents. Accident frequencies at certain locations are particularly high, as is graphically demonstrated in Figure 4. Recommendations for improvements at many of the worst locations, in order to reduce the accident toll and to improve traffic flow, are presented in Chapter V of this report.

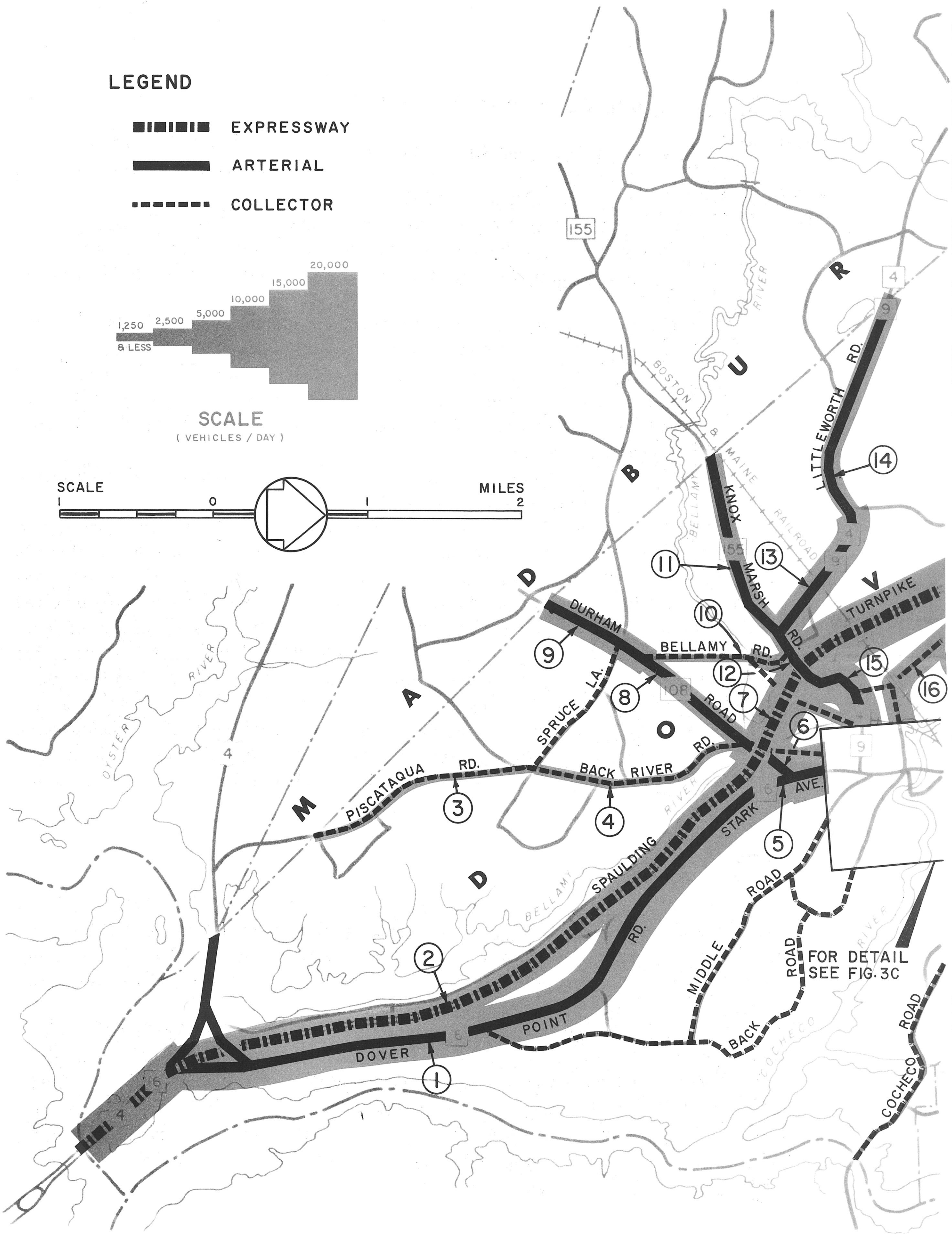
LAND USE

As part of the Dover-Somersworth Transportation Study an inventory of current land use within the cordon line was made in sufficient detail to provide an adequate basis for determining trip generation characteristics. Five classifications were used in the inventory of current land use: residential, commerical, industrial, public and semi-public (including parks and cemeteries), and vacant or other.

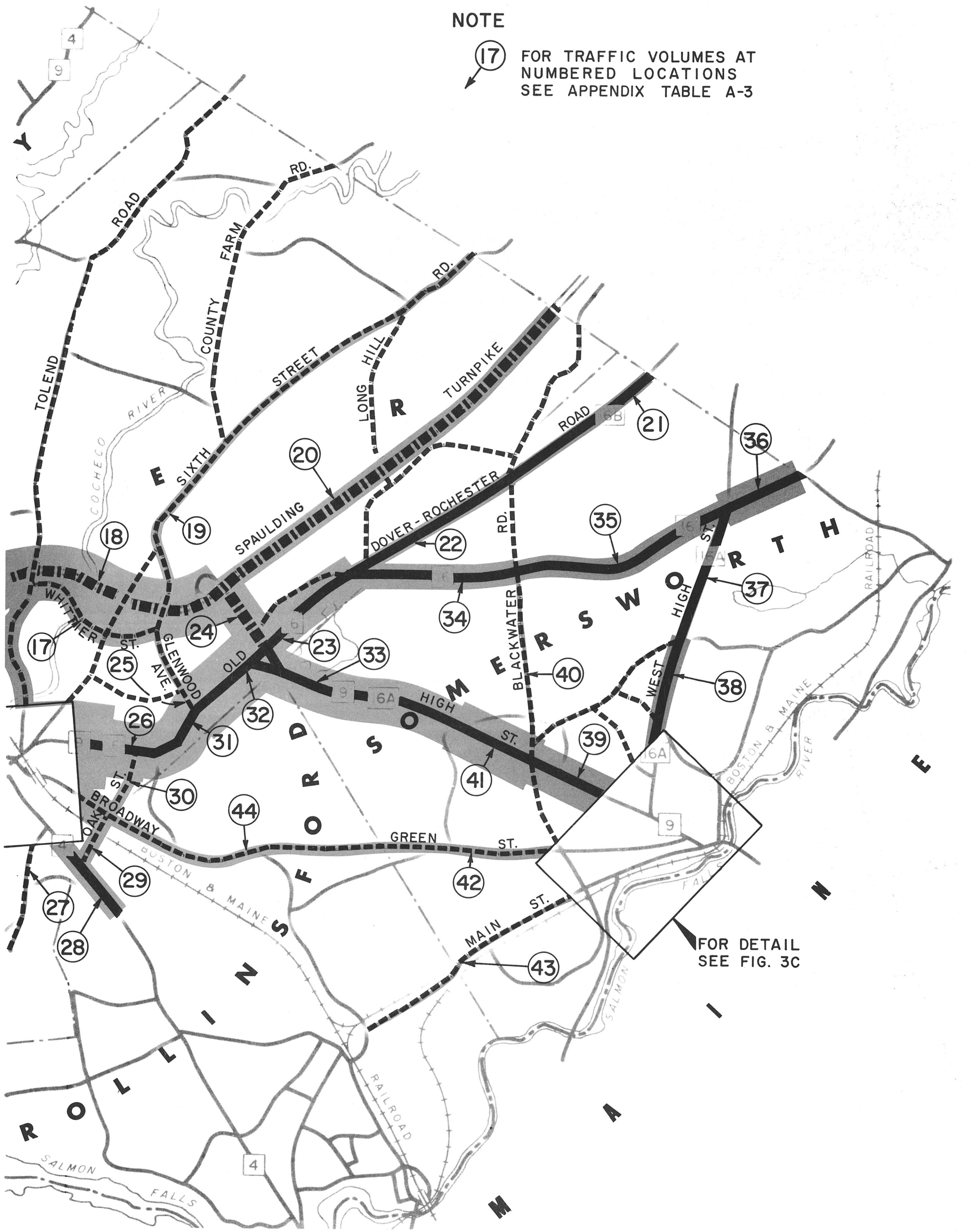
A land use map prepared by the Dover Planning Board in 1965 was reviewed in the field, with particular emphasis on the central business district, and corrections were made as necessary. Land use data for Somersworth and Rollinsford were collected in the field.

Figure 5 depicts current generalized land uses throughout the area. It is apparent that the most intensively developed areas are in the older, central portion of Dover east

1—Based on unit accident cost figures presented in the *Traffic Engineering Handbook*, Third Edition, 1965, Institute of Traffic Engineers.



TIPPETTS - ABBETT - McCARTHY - STRATTON
ENGINEERS AND ARCHITECTS NEW YORK



1965 AVERAGE ANNUAL WEEKDAY TRAFFIC

FIGURE 3A

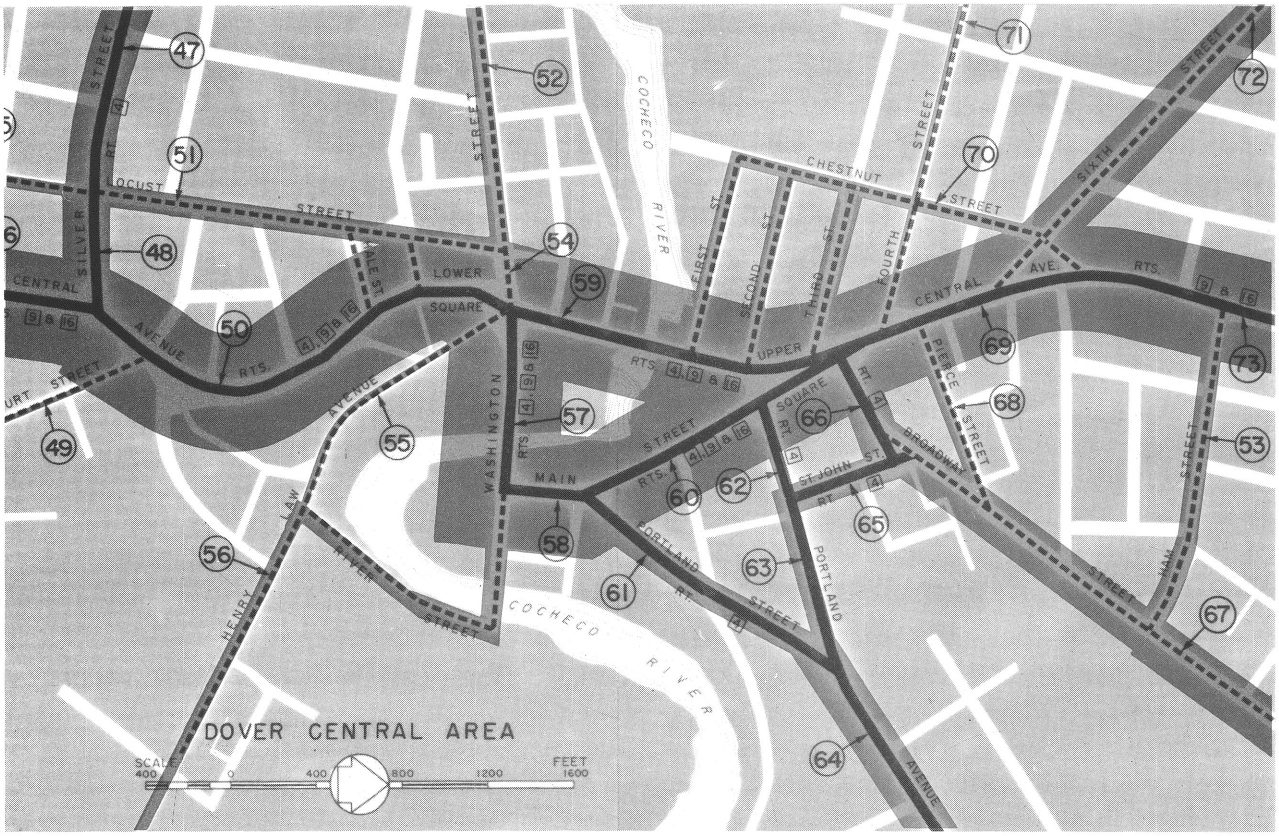
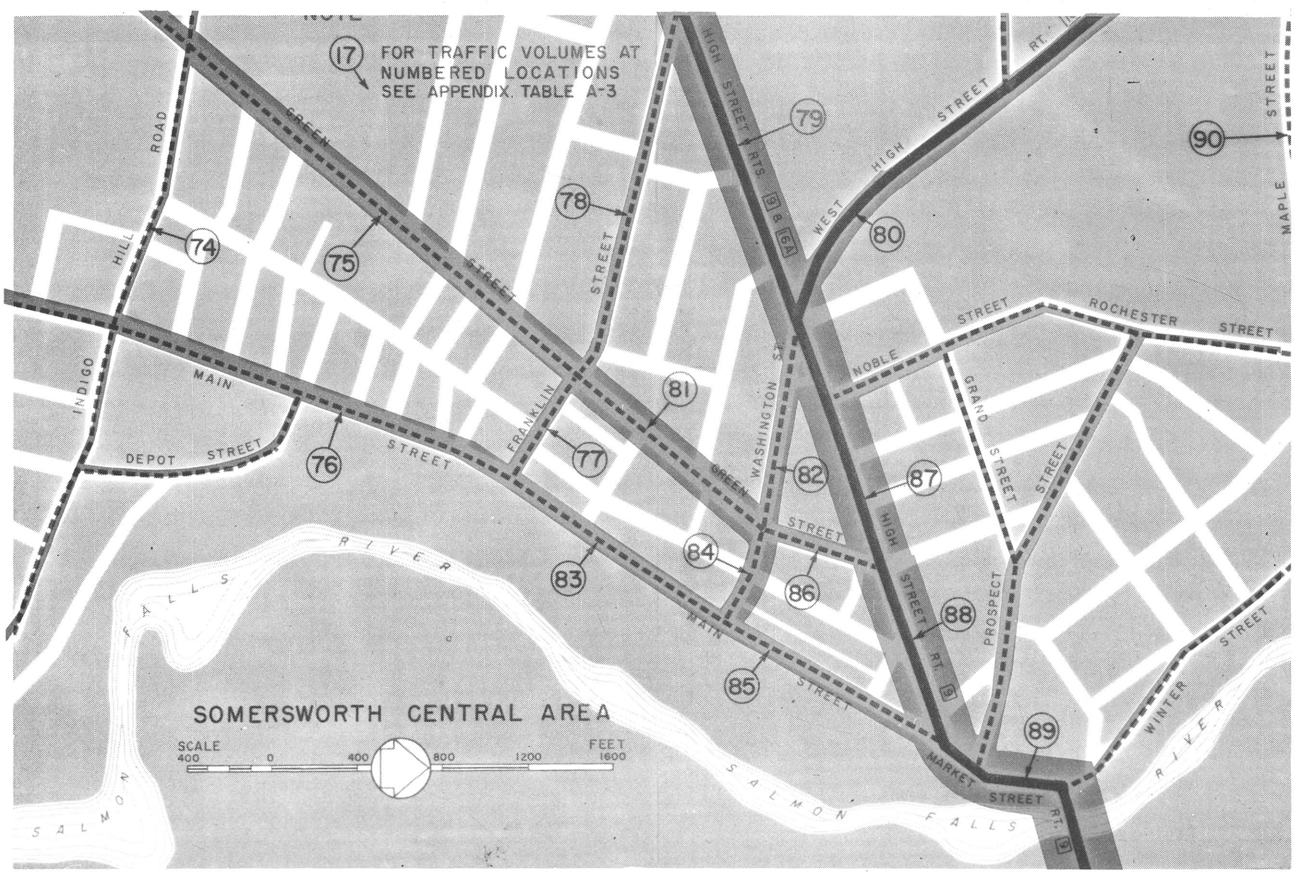


FIGURE **3B**

1965 AVERAGE WEEKDAY TRAFFIC

FIGURE **3C**



of the Spaulding Turnpike and in the northeastern section of Somersworth near the Salmon Falls River, although significant sub-concentrations are evident in the southern portion of Dover west of the Turnpike and along Routes 16 and 16A in Dover and Somersworth.

Residential land uses are scattered throughout central Dover with the two-family structure being the most common type of dwelling. About 74 per cent of the developed land in Dover is used for residential purposes. In Somersworth approximately half of the dwellings are detached, single family residences and the remainder are two-family and multi-family units; residential uses account for about 64 per cent of the developed land.

Downtown Dover contains a mixture of commercial, industrial, residential, and public uses. Retail stores extend along Central Avenue in the form of a strip development with the heaviest concentration on the west side of Central Avenue between Washington Street and Third Street. Retail uses also extend westward a short distance from Central Avenue on Washington Street and Third Street. The other major retail area in Dover, known as "Miracle Mile", is located on Central Avenue between Glenwood Avenue and the traffic circle at Rochester Road. This area is composed of various separated retail shopping facilities, particularly in the food and general merchandise line.

Somersworth does not have a well-defined central business district. Several business sections are scattered along Main, Green and High Streets, separated by residential and other non-commercial uses.

A number of large industrial plants in Dover border on, or are located close to the Cocheco River and the railroad in central Dover. Other Dover industry is located in an industrial park under development in the area west of the Spaulding Turnpike between Littleworth Road and the Boston and Maine Railroad. In Somersworth most of the industry is concentrated east of Main Street along the B&M Railroad and the Salmon Falls River.

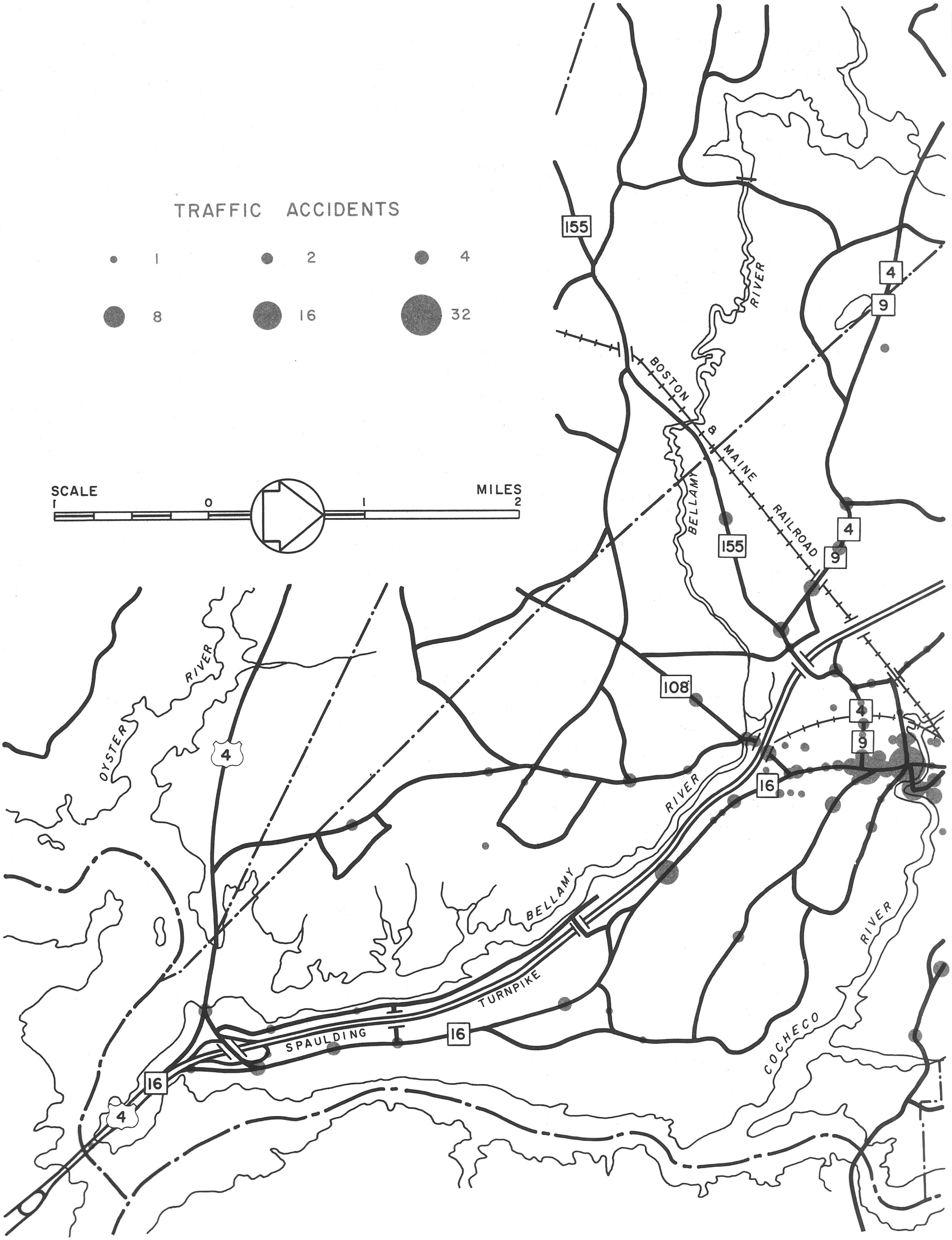
The outlying portions of both cities are largely devoted to agricultural uses or are vacant, with the exception of a few residential subdivisions and some strip development along certain of the major highways.

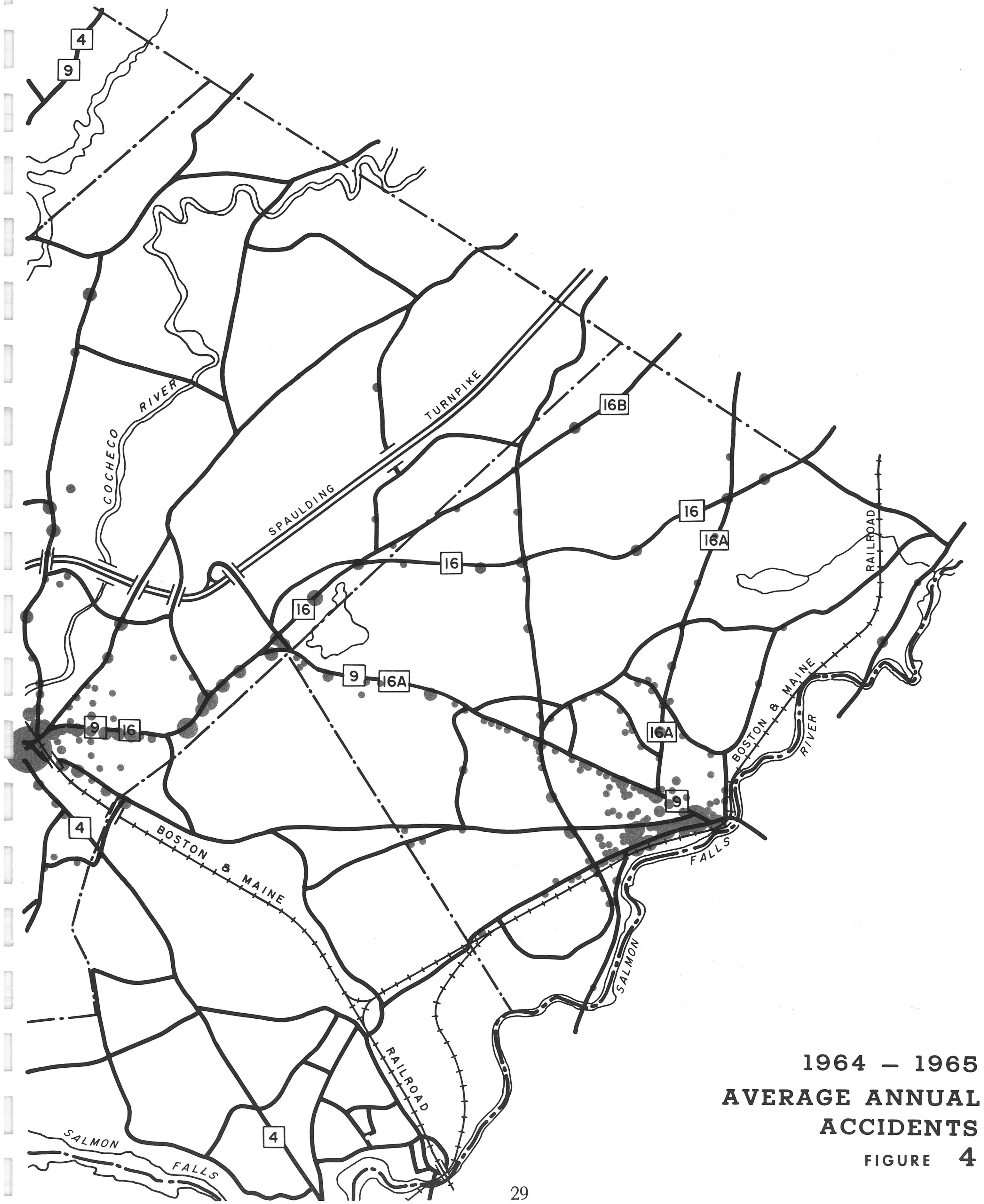
Measurements were made of acreages devoted to each of the five classifications of land use within each of the 50 traffic zones in the internal survey area. Gross acreages were used, with streets, parking areas, loading zones, and the like included with the contiguous land use. A summary of current land use acreages is presented in Table 7. It is of interest to note that almost 80 per cent of the total land area is undeveloped.

Table 7

INTERNAL SURVEY AREA LAND USE ACREAGES – 1965

Land Use Classification	Dover	Somersworth	Rollinsford	Total	Per Cent
Residential	1,688	581	74	2,343	14.7
Commercial	192	80	4	276	1.7
Industrial	140	59	2	201	1.3
Public & Semi-Public	259	195	0	454	2.8
Vacant & Other	6,951	4,357	1,379	12,687	79.5
Total	**9,230**	**5,272**	**1,459**	**15,961**	**100.0**


TRAFFIC ACCIDENTS
1
2
4
8
16
32
SCALE
MILES
1
0
1
2
155
4
9
RIVER
BOSTON
&
MAINE
RAILROAD
BELLAMY
108
OYSTER
RIVER
16
BELLAMY
RIVER
SPAULDING
TURNPIKE
COCHECO
RIVER



29

1964 — 1965
AVERAGE ANNUAL
ACCIDENTS
FIGURE 4

1965 LAND USE
FIGURE 5

1965 LAND USE

FIGURE 5

TIPPETTS - ABBETT - McCARTHY - STRATTON
ENGINEERS AND ARCHITECTS
NEW YORK

POPULATION AND EMPLOYMENT

Population, employment and other socio-economic data were also inventoried on a traffic zone basis, to be used in the traffic generation analysis. Data collected and tabulated for each of the 50 internal zones were as follows:

1. Population
2. Average family income
3. Dwelling units
4. Passenger vehicle ownership
5. Truck ownership
6. Number of employees classified into the following categories:
   a) Manufacturing and non-manufacturing industry, including transportation, utilities and construction
   b) Retail trade
   c) Other commercial activities, including wholesale trade, storage, personal services, and business and professional services
   d) Public and quasi-public activities

Estimates of current zonal population were derived from expanded home interview data having determined their adequacy for this purpose by means of the population check described in Chapter II. Average family income and numbers of dwelling units and vehicles owned for each zone were also determined from expansion of data obtained in the home interview survey.

Public and semi-public employment data were obtained by interviewing city, County, State and federal agencies in the Study Area. The New Hampshire Department of Employment Security cooperated with the Study by providing detailed data for employees of establishments with more than four employees. The Department also furnished estimates of the numbers of other employees that were covered by social security. With the assistance of Manning's Directory, adjustments were made to account for additional employment not otherwise accounted for.

A summary of current total employment is presented in Table 8. The industrial category takes the biggest share in all three sections of the area, accounting for 63 per cent of the employment listed in Dover and 79 per cent in Somersworth (68 per cent overall).

Table 8

INTERNAL SURVEY AREA EMPLOYMENT – 1965

Employment Category	Dover	Somersworth	Rollinsford	Total	Per Cent
Industrial	5,733	3,161	30	8,924	68.0
Retail Trade	1,493	405	6	1,904	14.5
Other Commercial	1,292	326	24	1,642	12.5
Public & Semi-Public	560	100	0	660	5.0
Total	**9,078**	**3,992**	**60**	**13,130**	**100.0**

TRAFFIC VOLUMES

A large amount of data pertaining to current usage of the arterial highway system in the Dover-Somersworth area was collected, or assembled from other sources, for use in the Study. Traffic volume data are required to analyze the general distribution of traffic flows throughout the highway network; to understand local patterns of seasonal, daily and hourly traffic variations; to evaluate current traffic demands; and to highlight problem areas where heavy volumes of traffic contribute to congestion and unsafe operation, or considered in a somewhat different way, to provide the kind of information that will justify expenditures to correct known deficiencies in the system where particularly inefficient or hazardous conditions exist. In addition, a number of technical purposes are served by collecting certain types of volume data. For example, as described more fully elsewhere in this report, traffic counts were made at roadside interview stations so that interview data collected on a sampling basis could be properly expanded; counts were made on the screenline to make it possible to check the completeness of origin-destination data; and scattered automatic traffic recorder counts were made throughout the system to facilitate the calibration of a simulation model developed for analyzing traffic flows in the area.

Current traffic volume data from all available sources – automatic recorder counts, manual counts, records of the State's permanent counters in the area, records of traffic passing the Spaulding Turnpike toll stations, and output data from the traffic simulation model described in Chapter IV – were compiled and adjusted as appropriate to produce the current traffic flow map shown earlier in this report in Figure 3. This figure illustrates by varying band widths the current traffic flow on the collectors, arterials and expressways in the area, and conveys a visual impression of the relative usage of available facilities. A tabulation of traffic volumes at 90 key locations in the Study Area is presented in Appendix Table A–3. The heaviest traffic volumes are on the Spaulding Turnpike south of the Somersworth interchange, on Route 16 between Dover Point and Somersworth, around the Central Avenue-Washington Street-Main Street triangle in downtown Dover, on Portland Avenue near central Dover, and on High Street (N.H. 9) through Somersworth.

Monthly traffic variations for three locations in the Study Area are shown in Table 9. The high peak reached during the summer months is indicative of the significance of recreational travel on highway usage in the Study Area. Analysis of the data summarized in Table 9, and similar data for other recent years, showed that, in general, summer weekday traffic volumes in the area are about 12 per cent higher than the annual weekday average. On the Spaulding Turnpike this same relationship holds except that there are many more trips which pass completely through the area on the Turnpike in the summer than during the other months of the year. Taking these factors into consideration, data obtained in the 1965 summer origin-destination survey were adjusted to represent average annual weekday traffic (AAWT) conditions. It is current AAWT that is depicted in Figure 3 and tabulated in Appendix Table A–3.

Table 9

MONTHLY TRAFFIC VARIATIONS – 1964

Month	Per Cent of Average Annual Weekday Traffic Spaulding Turnpike, Dover Point	N.H. 16 Dover Point	N.H. 16, Somersworth
January	76	90	82
February	85	87	94
March	80	87	103
April	86	100	92
May	98	101	95
June	108	102	108
July	139	110	105
August	137	107	115
September	113	108	107
October	99	106	102
November	88	102	98
December	88	95	97
Average Annual Weekday Traffic	**100**	**100**	**100**

Source: Records of continuous traffic counts made by NHDPW&H.

Weekly traffic variations are shown in Table 10. The impact of recreational travel is again clearly evident in the high percentages shown for Friday traffic. As noted earlier in this report, the origin-destination interview surveys were conducted so as to equalize the information gathered for any given weekday insofar as possible. Hence the data collected can be considered to represent average weekday conditions.

Table 10

WEEKLY TRAFFIC VARIATIONS – JULY 1965

Day of Week	Per Cent of Average July Weekday Traffic Spaulding Turnpike, Dover Point	N.H. 16, Dover Point	N.H. 16, Somersworth
Monday	99	92	96
Tuesday	91	100	97
Wednesday	88	99	95
Thursday	94	103	99
Friday	125	107	112
Average Weekday	**100**	**100**	**100**

Source: Records of continuous traffic count made by NHDPW&H.

An analysis was also made of hourly traffic variations in the Study Area. The most pronounced summer weekday traffic peak occurs in the late afternoon sometime between 4 and 6 PM. Data from the manual counts made at roadside interview and screenline stations and from the State's permanent counters in the area were processed to determine what proportion of the total daily traffic passed during the peak hour at each location. Peak hour percentages varied between about 8 per cent and 12 per cent, with an overall average of about 9 per cent.

TRAVEL CHARACTERISTICS

Information concerning current travel characteristics was obtained from the origin-destination survey described in Chapter II.

Residents of the internal survey area made approximately 84,000 person trips in the Dover-Somersworth area by private automobile or by truck on an average summer weekday in 1965. As shown in Table 11, about 62 per cent of these were made as drivers and the remainder as passengers. Over 88 per cent of the vehicle trips and almost 92 per cent of the person trips shown in Table 11 were made in private automobiles.

Table 11

SUMMARY OF SURVEY AREA RESIDENT TRIPS BY MODE OF TRAVEL
(Average Summer Weekday – 1965*)

Mode of Travel	Vehicle Trips Number	Vehicle Trips Per Cent	Person Trips Number	Person Trips Per Cent
Auto Driver	45,831	88.1	45,831	54.6
Auto Passenger			31,043	37.0
Truck Driver	6,180	11.9	6,180	7.4
Truck Passenger			856	1.0
Total	**52,011**	**100.0**	**83,910**	**100.0**

*original unadjusted data; includes internal-external trips

Table 12 contains a summary of the same trips by residents of the survey area according to purpose of the trip at the destination end as well as travel mode. For auto drivers and passengers the most frequently mentioned trip purpose was home. Most of the trips made by truck drivers and truck passengers were going to work. Almost 35 per cent of the trips by all four modes were homeward bound. A similar tabulation by origin purpose (not presented here) shows that another 35 per cent of the trips originated at home. Thus about 70 per cent of all resident person travel by auto and truck involved the home as either origin or destination. (This, incidentally, is one of the best reasons for obtaining trip data through a home interview survey.)

Table 12

SUMMARY OF SURVEY AREA RESIDENT PERSON TRIPS BY MODE OF TRAVEL AND DESTINATION PURPOSE
(Average Summer Weekday – 1965*)

Destination Purpose	Mode of Travel: Auto Driver	Auto Passenger	Truck Driver	Truck Passenger	Total	Per Cent
Home	15,970	12,436	643	156	29,205	34.8
Work	9,303	4,097	4,899	554	18,853	22.5
Personal Business	10,875	5,180	509	72	16,636	19.8
Recreation	1,719	2,787	22	50	4,578	5.5
School	162	106	6	–	274	0.3
Social	2,898	2,522	50	11	5,481	6.5
Shopping	4,904	3,916	50	11	8,881	10.6
Totals**	**45,831**	**31,043**	**6,180**	**856**	**83,910**	**100.0**

*original unadjusted survey data; includes internal-external trips
**actual column totals may vary slightly from those shown due to rounding.

After trips to home, work was the next most frequent reason for making trips, accounting for 22.5 per cent of the total internal person travel. Ranking next, in order, were personal business, shopping, social, recreation and school.

It was not within the scope of the Dover-Somersworth Transportation Study to exmine parking supply and demand. However, during the course of the home interviews information was recorded about the type of parking employed by auto and truck drivers at the destinations of their trips. Table 13 summarizes this information for these vehicle trips made by residents.

Table 13

SUMMARY OF SURVEY AREA RESIDENT VEHICLE TRIPS BY TYPE OF PARKING AT DESTINATION
(Average Summer Weekday – 1965*)

Type of Parking at Destination	Automobiles Number	Automobiles Per Cent	Trucks Number	Trucks Per Cent
Street Free	8,868	19.4	1,741	28.2
Street Meter	2,008	4.4	28	0.5
Lot Free	12,759	27.8	1,403	22.6
Lot Paid	518	1.1	11	0.2
Service or Repair	228	0.5	11	0.2
Residential Property	16,624	36.3	1,172	19.0
Not Parked	4,826	10.5	1,814	29.3
Totals	**45,831**	**100.0**	**6,180**	**100.0**

*original unadjusted survey data; includes internal-external trips

About 84 per cent of the automobile trips and 70 per cent of the truck trips parked free on the street, in a lot or on someone's residential property. About 10 per cent of the automobile trips and 29 per cent of the truck trips did not park at the destination; most of these were made to drop off or pick up passengers or goods. The remaining 6 per cent of the automobiles and 1 per cent of the trucks parked on the street at a parking meter, in a paid lot or at a service or repair station.

As shown in Table 11 there were approximately 46,000 auto driver trips made by residents of the internal survey area on an average summer weekday in 1965. A summary of the average number of persons in each automobile making these trips in terms of trip purposes is presented in Table 14 along with a similar tabulation for all automobile trips crossing the cordon line. The overall average occupancy is 1.7 persons for internal and external trips by residents and 2.0 persons for total external trips. The lowest average occupancies occur for trips to or from work and school, and for personal business trips by residents; the highest are for recreation trips.

Table 14

SUMMARY OF AVERAGE AUTOMOBILE OCCUPANCY BY TRIP PURPOSE
(Average Summer Weekday – 1965)

	Average Occupancy			
	Purpose at Origin		Purpose at Destination	
Purpose	Resident Trips*	Total External Trips	Resident Trips*	Total External Trips
Home	1.8	2.0	1.8	2.0
Work	1.5	1.5	1.4	1.5
Personal Business	1.5	2.1	1.5	2.0
Recreation	2.7	2.9	2.6	2.7
School	1.4	1.4	1.7	1.5
Social	1.9	2.4	1.9	2.3
Shopping	1.8	2.4	1.8	2.5
Average	**1.7**	**2.0**	**1.7**	**2.0**

*original unadjusted survey data; includes internal-external trips

In the travel forecasting phase of the Dover-Somersworth Transportation Study, vehicle trip data from the origin-destination survey were used. Almost 100,000 vehicle trips – approximately 82,000 automobile trips plus 15,000 truck trips – were made on highways in the survey area on an average weekday in the summer of 1965, as shown in Table 15. Of these, about 52 per cent began and ended within the Study Area. The rest were external trips, and of these, 20 per cent were through trips. Through trips accounted for about 10 per cent of all vehicle trips made in the survey area on an average weekday.

Table 15

SUMMARY OF INTERNAL AND EXTERNAL VEHICLE TRIPS
(Average Summer Weekday – 1965)

	Automobile*		Truck		Total	
	Number	Per Cent	Number	Per Cent	Number	Per Cent
Internal Trips	40,860	49.9	9,737	64.5	50,597	52.2
External Trips:						
Non-through	32,648	39.9	4,376	29.0	37,024	38.2
Through	8,338	10.2	980	6.5	9,318	9.6
Totals	**81,846**	**100.0**	**15,093**	**100.0**	**96,939**	**100.0**

*includes taxi trips

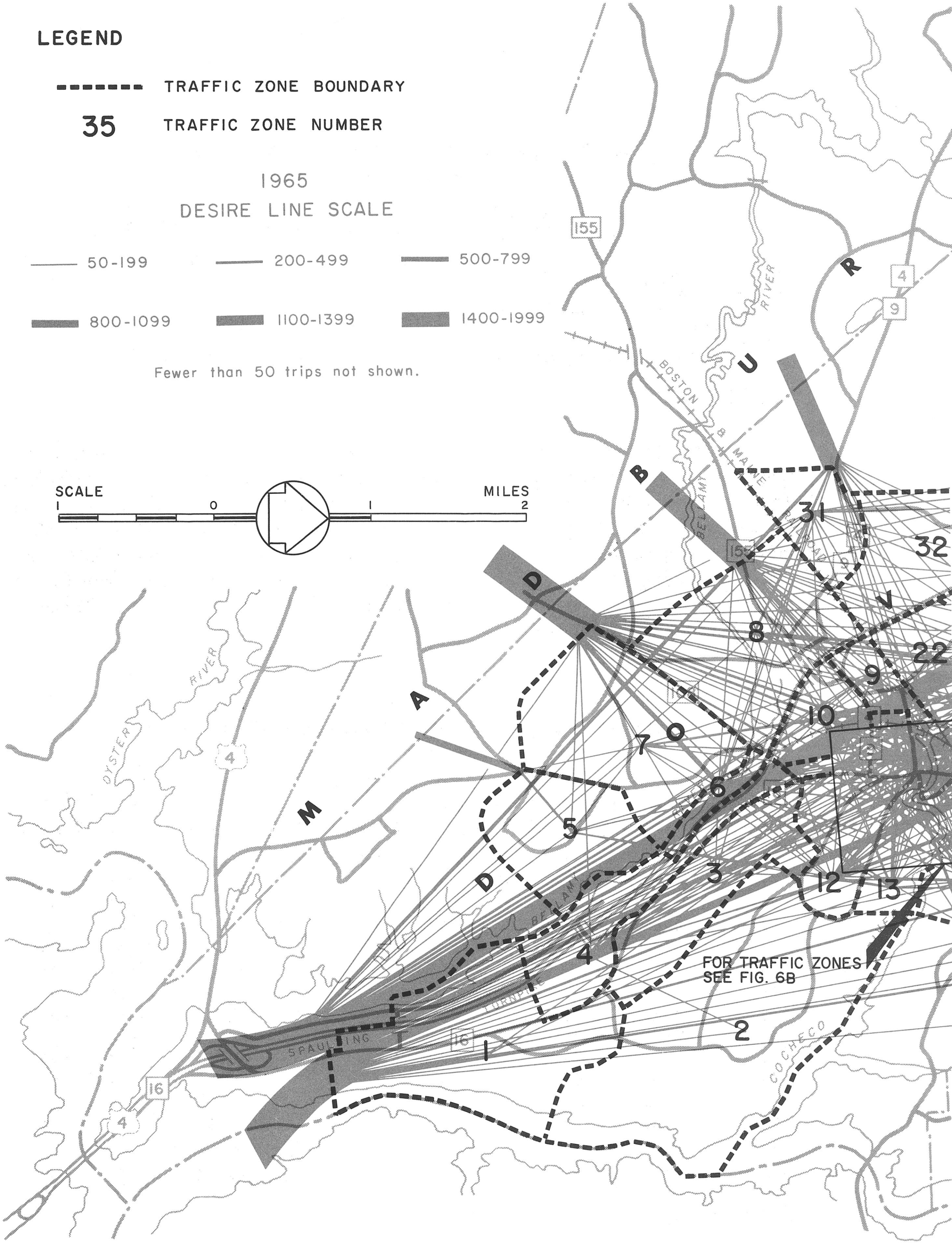
Table 16 shows a further breakdown of external trips by roadside interview stations. Here through trips are counted twice, one at each station through which they passed. This table shows that one-third of all the vehicles crossing the cordon line on an average summer weekday of 1965 were making through trips; that is, they had not or were not planning to stop inside the survey area. Almost half of the through trips entered and/or left via the Spaulding Turnpike. It is of interest to note that through traffic accounted for 76 per cent of the total traffic on the Spaulding Turnpike at Dover Point (Station 1) and 85 per cent on the Spaulding Turnpike toward Rochester.

Table 16

EXTERNAL VEHICLE TRIPS BY ROADSIDE INTERVIEW STATION
(Average Summer Weekday – 1965)

Roadside Interview Station No.	Automobiles* All Trips	Automobiles* Through Trips	Automobiles* PerCent Through	Trucks All Trips	Trucks Through Trips	Trucks PerCent Through	Total All Trips	Total Through Trips	Total PerCent Through
1	6,034	4,548	75	6 553	427	77	6,587	4,975	76
2	4,920	980	20	633	164	26	5,553	1,144	21
3	3.130	928	30	492	183	37	3,622	1,111	31
4	1,618	256	16	203	27	13	1,821	283	16
5	8,262	1,228	15	1,245	235	19	9,507	1,463	15
6	5,548	1,733	31	662	179	27	6,210	1,912	31
8	1,740	346	20	169	42	25	1,909	388	20
10	4,508	3,860	85	370	289	78	4,878	4,149	85
12	995	158	16	143	30	21	1,138	188	17
14	2,412	676	28	486	108	22	2,898	784	27
15	2,739	559	20	417	119	29	3,156	678	22
16	4,175	839	20	650	113	17	4,825	952	20
17	980	64	7	108	12	11	1,088	76	7
19	2,263	501	22	205	32	16	2,468	533	22
Totals	**49,324**	**16,676**	**34**	**6,336**	**1,960**	**31**	**55,660**	**18,636**	**33**

*includes taxi trips



TIPPETTS - ABBETT - McCARTHY - STRATTON
ENGINEERS AND ARCHITECTS NEW YORK

TRAFFIC ZONES AND 1965 ALL VEHICLE TRIP DESIRE LINES

FIGURE **6A**

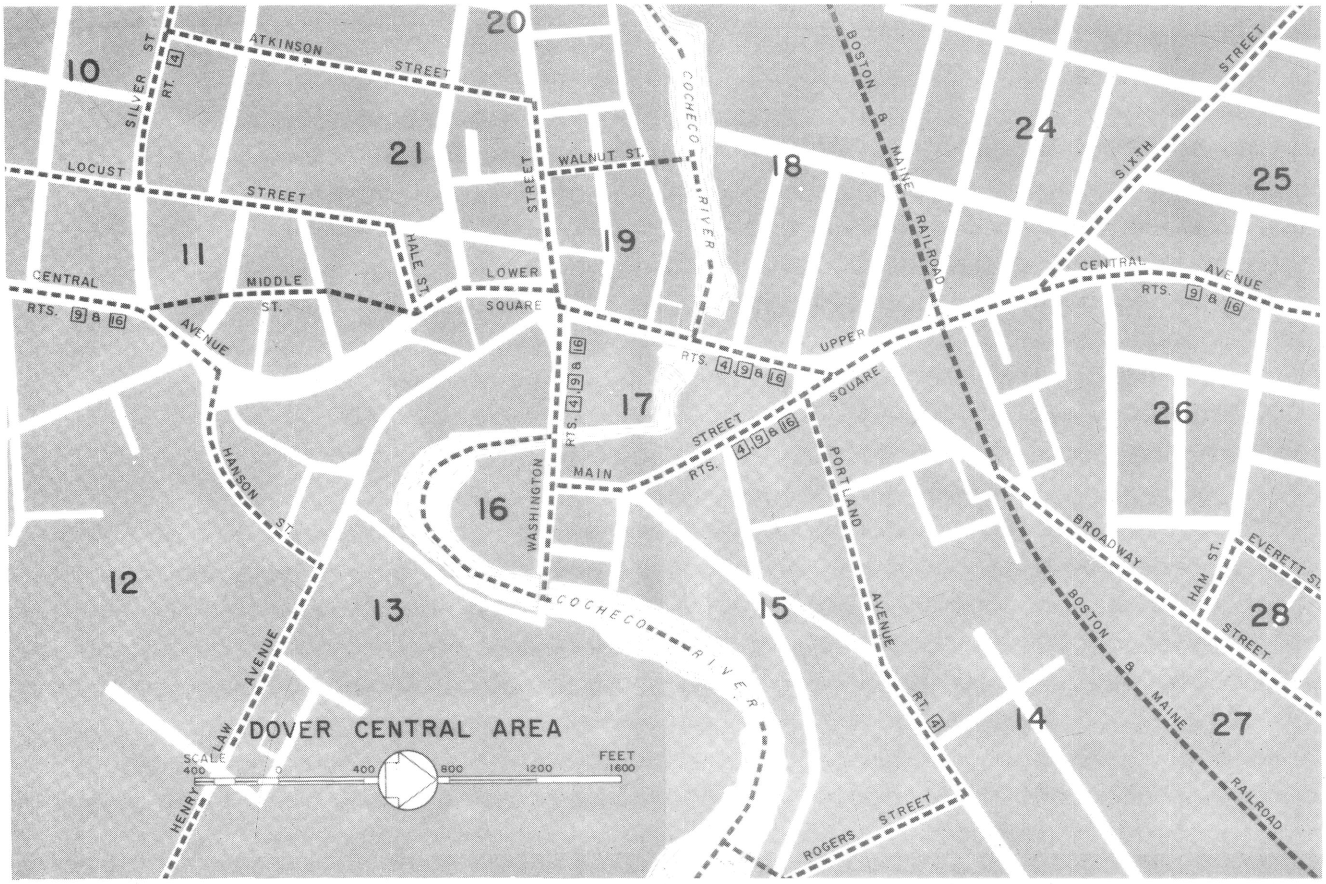
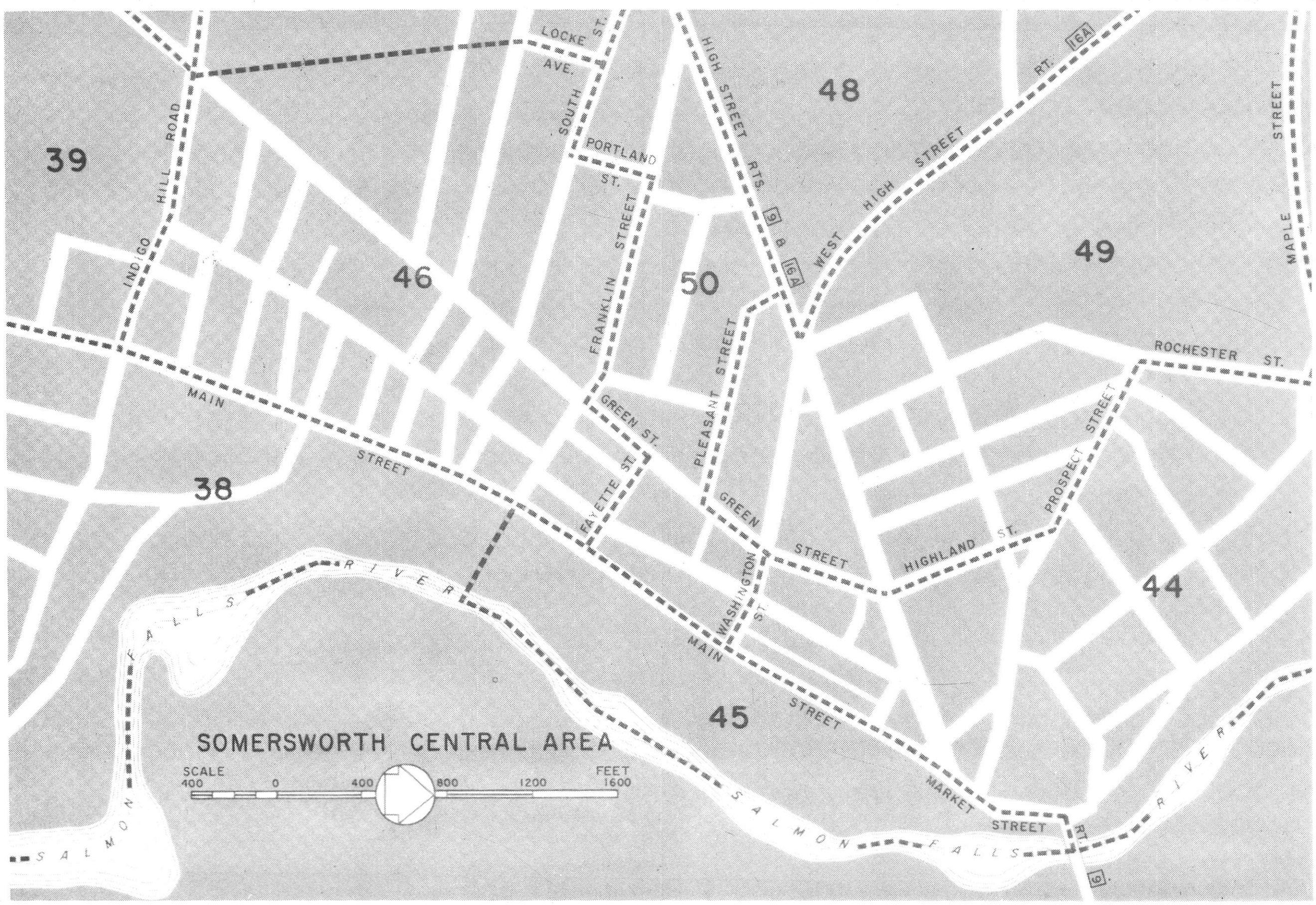


FIGURE 6B

TRAFFIC ZONES

FIGURE 6C



VEHICLE TRIP PATTERNS

A detailed zone-to-zone vehicle trip transfer table is included in Appendix Table A–1. Each entry in the table represents the number of trips from a specific origin zone or station to a specific destination zone or station; entries along the diagonal represent intra-zonal trips – that is, trips that began and ended in the same zone. Values shown in the table represent average annual weekday vehicle movements, having been converted from average summer weekday data obtained in the origin-destination survey as described earlier in this chapter under the heading "Traffic Volumes".

The data shown in Table A–1 have been plotted in Figure 6A in the form of "desire lines"(1). A desire line is simply a straight line from origin to destination, portraying graphically where the trip maker desires to begin his trip and where he wants to end it without regard to the route he must follow to get there. In Figure 6A the individual trip desire lines have been accumulated and drawn as bands having widths proportional to the total number of trips making the movement. The heavy concentration of trip desires to and from the central areas of Dover and Somersworth are clearly evident. The desire line display also indicates the large volume of traffic that flows between the two cities. The heavy through traffic movement along the Spaulding Turnpike can also be seen. This is the largest single interzonal movement in Table A–1, representing a two-directional volume of 2,067 trips.

The distribution of external trip ends to points outside the cordon line is summarized in Table 17 (this table shows average summer weekday volumes). On an overall basis 66 per cent of the trips crossing the cordon line originated in or were destined to points outside the cordon line in New Hampshire, 26 per cent in Maine, 7 per cent in Connecticut, Rhode Island, Massachusetts or Vermont, and less than 1 per cent outside of New England. Of the external trip ends in New Hampshire, 14 per cent were in the portions of Dover, Somersworth and Rollinsford outside the cordon line. Over 95 per cent of the external trip ends in Maine were in York County.

1–Figure 6A also shows traffic zones in the Study Area. Figures 6B and 6C show traffic zones in the central areas of Dover and Somersworth respectively.

Table 17

DISTRIBUTION OF EXTERNAL TRIP ENDS OUTSIDE SURVEY AREA
(Average Summer Weekday – 1965)

Roadside Interview Station No.	Trip End Location: New Hampshire	Maine	Remainder of New England	Remainder of U.S. and Canada	Total
1	4,376	477	1,611	123	6,587
2	4,533	446	548	26	5,553
3	1,308	2,219	77	18	3,622
4	1,043	773	3	3	1,821
5	1,619	7,753	106	29	9,507
6	5,613	484	105	8	6,210
8	1,817	73	20	–	1,909
10	3,484	219	1,134	40	4,878
12	1,095	42	1	–	1,138
14	2,703	134	47	15	2,898
15	2,795	179	164	18	3,156
16	4,479	221	115	11	4,826
17	1,056	16	17	–	1,088
19	902	1,555	9	3	2,468
Totals	**36,821**	**14,588**	**3,956**	**293**	**55,660**
Per Cent	**66.2**	**26.2**	**7.1**	**0.5**	**100.0**

Note: Actual column and row totals may vary slightly from those shown due to rounding.

CHAPTER IV

AREA FORECASTS

POPULATION AND EMPLOYMENT FORECASTS

The same items of population, employment and other socio-economic data that were inventoried on a traffic zone basis were forecasted to the year 1985 for each of the 50 internal zones in the survey area. These items included population and dwelling units, average family income, passenger vehicle and truck ownership, and employment by category.

POPULATION AND DWELLING UNITS

National, State, County, and local population figures for the decennial years 1920-1960 inclusive are presented in Table 18. The population of the United States increased by almost 70 per cent during this 50-year period. At the same time the population of the State of New Hampshire increased by 37 per cent and the cities of Dover and Somersworth increased by 47 per cent and 28 per cent respectively. These statistics indicate that the growth of the Study Area over the long term has been slow compared

Table 18

NATIONAL, STATE, COUNTY AND CITY POPULATION GROWTH TRENDS
1920-1960

Year	United States	New Hampshire	Strafford County	Dover	Somersworth
1920	106,022,000	443,000	38,546	13,029	6,688
1930	123,203,000	465,000	38,580	13,573	5,680
1940	132,165,000	492,000	43,553	14,990	6,136
1950	151,326,000	533,000	51,567	15,874	6,927
1960	179,323,000	609,000	59,799	19,131	8,529
Per Cent Increase					
1920-1960	69	37	55	47	28
1950-1960	19	14	16	21	23

Source: 1920-1940, "Population of New Hampshire," N.H. State Planning and Development Commission, 1946
1950-1960, "Population of New Hampshire," The State Planning Project, 1964

with national trends. A look at the population increases in the 1950-1960 decade presents a different picture, however. During this period the United States registered a 19 per cent increase in population and New Hampshire, a 14 per cent increase while Dover and Somersworth had increases of 21 and 23 per cent respectively, surpassing both national and State growth rates. This is in line with the national trend which shows proportionally greater increases in urban centers. As a result, whereas Dover and Somersworth in 1950 contained 31 per cent and 13 per cent respectively of the population of Strafford County, these proportions increased to 32 per cent and 14 per cent by 1960.

Forecasts of 1970 population growth in Strafford County and the City of Dover made by the New Hampshire State Planning Project and the Dover Planning Board indicate that the 1950-1960 trend is expected to continue. These references, plus information from a recent special school census in Dover, were used to update 1960 Census figures to 1965.

By 1985, it is estimated that the population of Strafford County will be 87,000. Dover is expected to account for an increasing share of the County population, and by 1985 should contain 35 per cent of the total. Somersworth should retain its 14 per cent share of the County population. By 1985, therefore, the population of the City of Dover is expected to reach 29,000, while the City of Somersworth should achieve a population of 12,000. Current and forecasted population within the Study Area cordon line are summarized in Table 19.

Table 19

INTERNAL SURVEY AREA POPULATION GROWTH TRENDS, 1965-1985

	1965	1985	Total Per Cent Increase
Dover	20,043	27,415	37
Somersworth	8,640	11,308	31
Rollinsford	465	700	50
Internal Survey Area	29,148	39,423	35

Note: Figures shown do not include population outside the cordon line.

To accommodate the expected population increases described above, a total of 3,200 new dwelling units would be required – 2,330 in Dover, 800 in Somersworth, and 70 in Rollinsford. In addition, an estimated 316 dwelling units in Dover and 300 dwelling units in Somersworth are expected to be displaced by construction and require replacement.

Distribution of area forecasts of population and dwelling units to individual traffic zones was accomplished in conjunction with the development of a future generalized land use plan, as discussed in a succeeding section of this report.

FAMILY INCOME

In the period 1950 to 1960, median family income in the State of New Hampshire increased from $2,875 to $5,636, a gain of 96 per cent. During the same period median family income in the City of Dover increased 104 per cent from $3,006 to $6,142. An analysis of changes in the Consumer Price Index and the Gross National Product Deflator in the 1950-1960 period indicates that about one-quarter of the 1950-1960 gain can be attributed to inflation, while the remaining three-quarters represented an increase in purchasing power.

In the period 1965 to 1985, it is expected that family purchasing power (real income) in the Dover-Somersworth Study Area will increase by about 60 per cent. This percentage increase in twenty years is equivalent to the average annual increase in real income in the 1950-1960 period. Actual family income in 1985 (in terms of 1985 dollars) will be greater than this percentage increase in purchasing power would indicate since inflation is expected to continue; the rate of future inflation cannot be predicted since it depends on governmental policies.

In estimating 1985 family income by traffic zone, consideration was given to the average increase in income levels for the Study Area as a whole and to specific changes in residential land use and occupancy within each zone, such as will occur as areas which now have a high percentage of substandard dwellings are redeveloped.

VEHICLE OWNERSHIP

The 1965 summer origin-destination survey showed a total of 9,529 passenger vehicles owned by the residents of the internal survey area, or about 0.327 automobiles per person. This is somewhat below the New Hampshire and national averages.

In forecasting 1985 passenger vehicle ownership in the survey area, comparisons were made of national, State and local trends. The number of automobiles per person in the United States as a whole is currently about 0.39 and is expected to reach 0.41 by 1985. Historically, the ownership rate in New Hampshire has been less than the national average but has been increasing at a faster rate and is probably close to that of the United States at the current time. It is anticipated that by 1985 automobile ownership in the survey area as well as in the State will reach about the same level as is expected for the United States. Thus the total number of passenger vehicles owned by residents of the internal survey area is expected to increase to about 15,700 (a percentage increase of almost 65 per cent).

An analysis was made to determine the relationship between automobile ownership and family income level in the Dover-Somersworth area. This relationship was used in conjunction with zonal forecasts of population and family income to allocate total forecasted passenger vehicle ownership to the 50 traffic zones in the internal survey area.

Truck registration in the United States as a per cent of total vehicle registration has decreased since 1950 from about 20 per cent to about 17 per cent. The percentage of trucks in recent years appears to be stabilizing at a level of about 17 per cent, and national forecasts indicate that by 1985 one out of six vehicles in the United States will be a truck. Total truck registration in New Hampshire as a per cent of total vehicle registration has been consistently below the national average since 1950 by two to three percentage points. In 1965, close to one out of seven vehicles in the State was a truck.

It is estimated that by 1985 the proportion of total vehicles represented by trucks in New Hampshire will be about 15 per cent, and that the same relationship will apply in the Dover-Somersworth Area. This projection produces an anticipated 1985 total of approximately 2,770 trucks in the internal survey area.

Zonal forecasts of truck ownership were obtained by distributing projected total truck ownership among the 50 internal zones in proportion to current ownership.

EMPLOYMENT

From 1955 to 1964, the Department of Employment Security covered employment in the Dover area increased by about 15.8 per cent. Although industry remained the dominant employer, this category actually experienced the smallest percentage gain at 8.9 per cent while commercial employment other than retail experienced the largest gain at 70.6 per cent. This trend is typical of maturing urban areas which place increasing reliance on commercial services of all types and less on manufacturing.

It is expected that total employment in these categories in the Dover-Somersworth area will continue to grow in the future at about the same rate as during the past ten years. Such a rate of growth is consistent with the expected population increase in the area. Increasing population will generate a need for additional public and semi-public facilities of all types, including schools, churches, offices of public agencies, hospitals, parks and the like. These types of facilities were considered individually in arriving at forecasts of 1985 employment in public and semi-public activities.

As shown in Table 20, total employment in the internal survey area is expected to increase from 13,130 in 1965 to 17,682 in 1985, an overall increase of 35 per cent. The expected increase in industrial employment is the greatest of the four categories shown (1,560), but its percentage increase is the least (17 per cent over the 20-year

Table 20

INTERNAL SURVEY AREA EMPLOYMENT, 1965-1985

	1965		1985		Change 1985-1965	
Employment Category	Number	Per Cent of Total	Number	Per Cent of Total	Number	Ratio*
Industrial	8,924	68.0	10,484	59.2	1,560	1.17
Retail Trade	1,904	14.5	3,174	18.0	1,270	1.67
Other Commercial	1,642	12.5	2,892	16.4	1,250	1.76
Public & Semi-Public	660	5.0	1,132	6.4	472	1.72
Total	**13,130**	**100.0**	**17,682**	**100.0**	**4,552**	**1.35**

* Number of Employees in 1985/Number of Employees in 1965

forecast period). The rate of growth is expected to be greatest for commercial employment other than retail trade, followed closely by public and semi-public employment, and retail trade.

The resulting changes in the employment mix of the Dover-Somersworth area are also summarized in Table 20. Industrial employment as a per cent of total employment is expected to drop from 68 to about 59 per cent, with all other categories increasing.

Distribution of area employment forecasts to individual traffic zones was accomplished in conjunction with the development of a future generalized land use plan, as discussed below.

LAND USE FORECASTS

In Chapter III the current inventories of land use and of population and employment data were described. The same items of data that were inventoried were forecasted on a zonal basis to the year 1985 as discussed in this chapter. However, the order of discussing these two categories of data is reversed in this chapter. This is done intentionally, to emphasize the planning approach taken in the Dover-Somersworth Transportation Study.

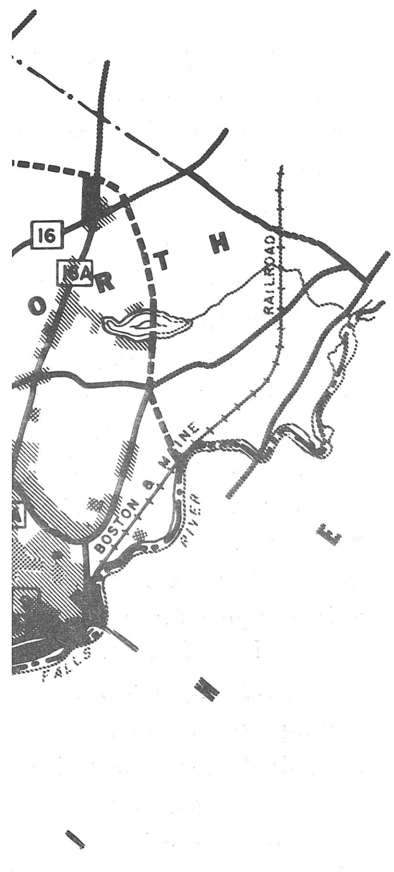
In Chapter III the current land use inventory was described first because acreages now devoted to various land uses at differing levels of intensity are indicative of the population distribution in the area and of the locations of employment centers. Thus current population, for example, is arrived at by adding up the numbers of people living in all of the various portions of the area (this, of course, is what the U.S. Census does).

In forecasting, the process is reversed; and to emphasize that fact, the order of discussion is reversed too. Although forecasts of data for individual traffic zones are required, it is extremely difficult to accurately forecast directly on this basis. This is because small areas are subject to sudden and extensive change which cannot be predicted. A basic principle in forecasting is that the smaller the areal unit, the less reliable the projection.

Therefore, in accordance with accepted procedures, overall areawide forecasts of population, dwelling units and employment were made first as described in the preceding section, and then these totals were distributed to traffic zones. This process is described in more detail below for each of the classifications of land use.

A summary of forecasted land use acreages is presented in Table 21. About 1,000 acres of presently vacant land are expected to be developed by 1985, the greatest part of which (61 per cent) will be for new residential construction. The greatest relative increase is expected to be for industrial purposes, which will require 62 per cent more land in 1985 than in 1965. It should be recognized, of course, that these are gross acreage figures and do not account for changing land uses.

Forecasted 1985 generalized land use throughout the area is depicted in Figure 7. Comparison with Figure 5 indicates where major new development and changing land uses are expected to occur.



1985 LAND USE

FIGURE 7

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TECTS
NEW YORK

Table 21

INTERNAL SURVEY AREA LAND USE ACREAGES, 1965-1985

Land Use Classification	1965 Acres	1965 Per Cent of Total	1985 Acres	1985 Per Cent of Total	Net Change 1985-1965 Acres	Net Change 1985-1965 Ratio
Residential	2,343	14.7	2,953	18.5	610	1.26
Commercial	276	1.7	421	2.6	145	1.53
Industrial	201	1.3	326	2.0	125	1.62
Public & Semi-Public	454	2.8	573	3.6	119	1.26
Vacant & Other	12,687	79.5	11,688	73.3	(–) 999	0.92
Total	**15,961**	**100.0**	**15,961**	**100.0**	**0**	**1.00**

RESIDENTIAL LAND USE

Present residential development in the Dover-Somersworth area consists of multi-family dwellings, two-family dwellings, single family developments in built-up areas and single-family developments in rural areas. It is expected that the most intensive future residential development in the Dover-Somersworth area will be in the form of garden apartments, similar to the housing currently under construction in the Washington Street and Bartlett Avenue projects in Somersworth, or town houses, rather than high-rise apartments. Density of this type of housing is in the order of 16 dwelling units per acre. In areas where two-family dwellings prevail, the density averages 8 dwelling units per acre. Single-family dwellings in built-up areas yield an average density of 4 dwelling units per acre, while single-family dwellings in rural areas usually have a density of one dwelling unit per acre.

In the United States, the proportion of various dwelling types in cities with population of less than 50,000 is generally as follows; multi-family, 5%; two-family, 9%; and single family, 86%. Forecasted population growth was distributed throughout the area in approximately these proportions. It was assumed that approximately 17 per cent of the new single family development will occur in rural areas.

In assigning areas for development or redevelopment, consideration was given to existing land uses, desirable mixtures of land uses and other environmental factors, physical condition of existing buildings, topography (with particular attention to steep grades and drainage conditions), accessibility, and availability of utilities. Selections were based on field inspections, review of maps and other physical data, study of previous planning reports prepared for the area and discussions with the city engineers, planning officials, and other public officials of the communities within the Study Area.

In existing built-up areas, additional development is expected to take place through the utilization of vacant parcels and through redevelopment of sub-standard areas to a higher density. In selecting redevelopment areas, considerable reliance was placed on the recommendations in the Community Renewal Plan prepared by the Dover Planning Board and on the proposals of the Triangle Urban Renewal Project in Somersworth.

Most two-family development is expected to take place on numerous small parcels close to the core areas where existing development consists of sub-standard, single-family housing. Most single-family urban development is expected to be in the form of extensions to existing development in areas already served by utilities or where extension of utility mains could be accomplished economically. A large part of the future single-family rural development is expected to take place outside the cordon line.

COMMERCIAL LAND USE

Additional land will be required for commercial uses by 1985 to accommodate expected economic growth and to meet the need to modernize existing facilities which, in many cases, are now housed in structurally unsatisfactory or functionally obsolescent buildings. The largest portion of new land will be required in the Central Business Districts of Dover and Somersworth which form the core of the region's commercial activity, but other new land, largely for convenient retail and service commercial uses, will be needed in outlying areas as well.

As shown in Table 20, the increase in retail trade employment in the internal survey area by 1985 is estimated to be 1,270 workers, of whom 960 would be in Dover, 200 in Somersworth and 10 in Rollinsford. Employment in other commercial activities is estimated to increase by 1,250 workers by 1985, of whom 1,020 would be in Dover, 220 in Somersworth and 10 in Rollinsford. Based upon an economic life of 40 years for commercial buildings, it is estimated that 50 per cent of existing commercial land will undergo major renovation or replacement over the next 20 years.

There is a marked difference between existing employment densities of commercial areas in the Central Business Districts and outlying areas. The existing average density for all commercial activities in both Central Business Districts is 45 employees per acre. Density of non-retail commercial activities, about 50 employees per acre, is somewhat higher than that of retail activities, which is in the order of 40 employees per acre. In rural areas, commercial employment densities are in the order of 10 employees per acre or less.

Although it is expected that there will be new multi-story construction in the Central Business Districts in the future, a net decrease in commercial densities should result due to the amount of land allocated for off-street parking facilities. In Dover the density of non-retail commercial functions in 1985 is expected to continue to be somewhat higher than retail densities; these are estimated at 40 and 35 employees per net acre respectively. In Somersworth the estimated density for all commercial employment is 35 workers per acre. In outlying areas in both communities the density of all commercial activities is estimated to remain at 10 workers per acre.

Based upon these average densities, it is estimated that 27 acres of new commercial land will be required in the Dover Central Business District by 1985. Recommendations contained in the Community Renewal Plan prepared by the Dover Planning Board were considered in allocating this requirement for new land to traffic zones in the central areas of Dover.

It is estimated that an additional 92 acres of new commercial land will be required in areas outside the Dover central area, 50 acres of which would be located principally at the intersections of major roads or as extensions to existing commercial developments. The remaining 42 acres, for neighborhood commercial establishments, were distributed throughout the area in proportion to expected population increases.

In Somersworth the proposed Triangle Urban Renewal Project provides for a major commercial redevelopment in the area bounded by High, Pleasant and Main Streets. It is assumed that seven acres of this redeveloped project will be devoted to commercial uses and will thereby satisfy the need for additional downtown commercial land to 1985. In distributing the 16 acres of new commercial land required in the portions of Somersworth outside the central area, it was assumed that seven acres would be at strategic highway locations or adjacent to existing commercial areas while the remaining nine acres would serve neighborhood functions and would be distributed among traffic zones in accordance with anticipated population increases.

Retail trade and other commercial employment expected by 1985 in each traffic zone were obtained by applying appropriate employment densities to the proposed new and redeveloped commercial areas.

INDUSTRIAL LAND USE

Many of the existing industrial plants in the Dover-Somersworth area were built around the turn of the century and located close to the rivers in order to satisfy their needs for power and disposal of wastes. The surrounding areas were subsequently densely built up, and the industrial facilities were left without adequate room for expansion and modernization. Many industries in the area are now operating in obsolescent, multistory buildings with inadequate off-street parking and loading facilities. Adequate land must be provided to accommodate the future industrial growth of the area and to satisfy the needs of existing industries seeking to modernize and expand.

With the advent of low-cost electrical power and efficient waste disposal systems, industries are no longer dependent upon riverside locations. There is now considerably greater flexibility in selecting appropriate sites for industrial development, and communities throughout the country are finding that the most efficient way to provide these sites is through the development of industrial parks such as the Dover Industrial Park being developed west of the Spaulding Turnpike between Littleworth Road and the B&M Railroad. Modern plants are generally constructed on one level and provide ample space for parking, loading, landscaping and future expansion. These can best be provided through unified developments outside of built-up areas where it becomes practicable to provide the necessary highway and rail access and utility services. It is also possible to arrange and shield facilities so as to minimize objectionable effects upon surrounding land uses.

The amount of land needed to satisfy industrial growth is estimated by applying an appropriate density for development to the expected employment growth. Although employee density in existing industrial areas averages 46 workers per acre, it is estimated that an employment density of 25 workers per acre for future growth would be appropriate. The amount of land needed by industries seeking to expand and modernize is based on the estimate that an average of 2 per cent of the existing industrial areas will be renewed annually. On this basis 40 per cent of existing industrial land will require redevelopment by 1985. It is estimated that this land will also be developed at an average density of 25 workers per acre.

Based on these considerations, it is estimated that 77 acres of new industrial land will be needed in Dover by 1985. Of this amount, 10 acres would be distributed in relatively small parcels at various locations beyond the boundary of the urbanized portions of the city for small industries including contractors, 53 acres would be developed by expanding the existing Dover Industrial Park, and 14 acres would be developed in downtown Dover to provide necessary parking area and other expanded facilities for industries now located there.

In Somersworth, it is estimated that 48 acres of new industrial land will be required. Five acres would be distributed in the outskirts of the built-up area in small parcels where they will be used by small industries. The proposed Triangle Area Urban Renewal Project is to be developed directly across the street from existing industrial plants which are badly in need of parking space, and it is assumed that two acres of the Triangle Project will be devoted to parking for these industries. The remaining 41 acres of new industrial land required in Somersworth are expected to be developed in areas zoned and otherwise suitable for industrial development in the western portion of the loop formed by the Indigo Hill Road and Main Street (14 acres), in the area between Routes 16 and 16B south of Gonic Road (22 acres), and in the area bounded by Depot Street, Indigo Hill Road and the railroad (4 acres).

PUBLIC AND SEMI-PUBLIC LAND USE

The City of Somersworth operates a 6–3–3 school system (elementary school, grades 1–6; junior high school, grades 7–9; and high school, grades 10–12). By 1985 it is estimated that 12 percent of the population will be in the elementary school age group, 6 percent in the junior high school age group and 6 percent in the high school age group. Therefore, it is estimated that there will be an additional 350 elementary school students, 175 junior high school students and 175 high school students in Somersworth. One new elementary school will be required, but it is expected that increased junior high and high school enrollment will be accommodated by additions to existing buildings.

In the past, Dover has operated on a 6–3–3 school system, but in the Fall of 1967 the City will change to a 6–2–4 system when a new high school will be opened for the four senior grades and the existing high school will become the junior high school for grades 7 and 8. It is estimated that 12 percent of the population will be in the elementary school age group, 4 percent in the 2-year junior high school age group and 8 percent in the 4-year high school age group by 1985. Therefore, it is estimated that there will be an additional 1,020 elementary school students, 340 junior high school students and 680 high school students in Dover. To accommodate these expected increases, three additional elementary schools and extensions to the new junior high and high schools will be required. Each new elementary school is estimated to require about 8 acres, other needs are expected to total 40 acres.

The Wentworth-Douglas Hospital in Dover, which serves the entire Study Area, is expected to increase its capacity from 96 beds to 180 beds, requiring an increase of 200 in its staff. No additional land acquisition is anticipated.

There is approximately one church for every 2,000 persons in the Dover-Somersworth area. Assuming that this proportion remains unchanged, there will be a need for an additional four new churches in Dover and one new church in Somersworth by 1985. Each new church is estimated to require two acres of land.

Because of the large amounts of open space in the Dover-Somersworth area and the major recreation facilities available at the seashore and mountain areas nearby, it is believed that a standard of two acres of park land per 1,000 population would be appropriate for the Study Area. On this basis, 16 additional acres of park land will be required in Dover and five acres in Somersworth by 1985.

It is anticipated that other public and semi-public employment, including policemen, firemen, postal clerks, and municipal, State and federal agency staffs, will increase in proportion to population increases in the Dover-Somersworth area. It is estimated that a total of 115 such new personnel will be needed in Dover and 22 in Somersworth, requiring four new acres of land for these activities in Dover and two acres in Somersworth.

TRAVEL FORECASTS

If it were possible to forecast future traffic volumes directly from current traffic volumes, the transportation planning process would be considerably simplified. But trip making, being a human activity, must be forecasted with consideration given to people and the use to which people put the land. Thus the trip forecasting process involves the following steps.

1 – Collection of data about present trips, the people making the trips, and the places from which and to which the trips are made. For the Dover-Somersworth Study, this was accomplished in the origin-destination survey described in Chaper II and in the population, employment and land use inventories described in Chapter III.

2 – A look ahead to estimate the degree and pattern of area development. This step has been described earlier in this chapter under the heading "Population and Employment Forecasts" and "Land Use Forecasts".

3 – An analysis of the ways in which the various items of current data (travel data, socio-economic data, and land use data) are inter-related and the development of travel forecasting tools; then use of these tools in conjunction with the area forecasts noted above to estimate future travel in the area. This process is described more fully below.

A multiple linear regression type of analysis was used to develop vehicle trip generation equations. In this analysis current socio-economic and land use data on a zonal basis were related to the numbers of vehicle trips currently produced or attracted by each zone, and regression equations that best fit the data were developed using a computer program to carry out the extensive mathematical computations that were required. In this equation development procedure, all of the parameters which appeared to influence trip generation were tested to determine those that actually do. Only those parameters which had a significant effect on the number of trips generated remained in the equation.

Six equations were developed in this manner, one for each of the following trip end categories:

(1) – home based work auto trip production
(2) – home based work auto trip attraction
(3) – other home based auto trip production
(4) – other home based auto trip attraction
(5) – non-home based auto trip origin and destination
(6) – truck trip origin and destination

Home based trips are those that begin or end at home. Regardless of the direction of the trip (that is, whether the trip is to home or from home), it is considered to be produced at the home end and attracted at the opposite end. The first two equations noted above pertain to trips between work and home. The dependent variable in the first equation is the number of such trips produced in a zone; the dependent variable in the second is the number of such trips attracted. Similarly, equations (3) and (4) are for trips having home as the purpose at one end any purpose other than work at the other end.

The final home based work auto trip production equation indicated that the number of work trips having home as one end was related to passenger vehicle ownership and number of residents. The attraction of home based work trips to an area was found to be, quite understandably, primarily affected by the employment in the area. Production of other home based auto trips was found to be dependent upon the same two parameters that affected home based work trip production; attraction of these trips was found to vary primarily with retail trade employment, number of dwelling units and average family income.

The non-home based auto trip equation, used to describe both the number of such trips originating in an area and the number of such trips destined to an area, contained the following independent variables: retail trade employment, number of dwelling units, average family income, and total employment. Truck trip origins and destinations were found to be primarily related to truck ownership, retail trade employment and number of dwelling units.

Forecasts of 1985 vehicle trip ends in each of the 50 internal traffic zones were made by introducing into the generation equations the forecasted values of the particular socio-economic and land use parameters which were the dependent variables in the equations.

Since detailed planning data were not available for areas beyond the cordon line, a different method was employed to forecast external trip ends. This included the determination of average annual per cent increases for each of the roadside interview station locations, giving consideration to the type of route, the location of the station, the distribution of current external trip ends for trips passing through the station, available data pertaining to past and projected traffic growth on similar routes in the area, and anticipated changes in regional accessibility brought about by plans for new highway construction in nearby areas. Estimates of 1985 average annual weekday traffic crossing the cordon line are presented in Table 22. The greatest absolute increase in traffic volume is expected to occur on the Somersworth-Berwick bridge (Station 5). The greatest relative volume increase is expected on the Spaulding Turnpike at Dover Point (Station 1), where projections show that traffic will more than double by 1985, assuming that the current toll structure remains essentially as it now is on the Turnpike.

Table 22

1965 AND 1985 EXTERNAL VEHICLE TRIP ENDS

Roadside Interview Station	Average Annual Weekday Traffic 1965	1985	Difference (1985–1965)	Per Cent Increase
1	4,520	9,910	5,390	119
2	4,950	8,960	4,010	81
3	3,220	5,290	2,070	64
4	1,620	2,410	790	49
5	8,460	16,880	8,420	99
6	5,530	10,000	4,470	81
8	1,700	3,080	1,380	81
10	3,010	5,710	2,700	90
12	1,010	1,660	650	664
14	2,580	4,670	2,090	81
15	2,810	4,610	1,800	64
16	4,300	8,570	4,270	99
17	970	1,450	480	49
19	2,200	3,610	1,410	64
Total	**46,880**	**86,810**	**39,930**	**85**

Note: Figures shown differ slightly from those shown in Appendix Tables A-1 and A-2 due to rounding.

An overall increase in traffic crossing the cordon line of 85 per cent is projected. This is equivalent to a compound annual traffic growth of 3.1 per cent.

Whereas external trip making is expected to increase by 85 per cent by 1985, a 62 per cent increase is projected for internal trips, as shown in Table 23. The overall increase in trip ends in the survey area by 1985 – both internal and external – is expected to be 74 per cent. This is in contrast to the projected population increase of 35 per cent.

Table 23

1965 AND 1985 VEHICLE TRIP END SUMMARY

Type of Trip End	Average Annual Weekday Trip Ends 1965	1985	Ratio (1985/1965)
Internal	46,004	74,678	1.62
External*	46,880	86,810	1.85
Total	**92,884**	**161,488**	**1.74**

*Figures shown differ slightly from those shown in Appendix Tables A-1 and A-2 due to rounding

FUTURE TRAVEL DESIRES

If areas grew uniformly the prediction of future travel would be simple, because current zone-to-zone trips could be multiplied by the single growth factor applicable to the entire area. However, urban growth is never uniform; zones will grow at different rates, some will remain static and some may decline in trip generating potential. Because of this unequal growth, the problem of forecasting travel is only partly solved when estimates of trips generated by each zone are completed. The isolated trip ends must be paired up before a picture of future travel desires can start to emerge. This process is known as trip distribution.

Two different trip distribution procedures were employed in the Dover-Somersworth Transportation Study; namely, the Fratar method of successive approximations and the gravity model method. The Fratar method was used to distribute truck trips; it was also used to distribute external through trips by passenger vehicle. The gravity model procedure was used to distribute all other passenger vehicle trips. A three-purpose breakdown was employed; that is, three gravity model distributions were made – for home based work trips, other home based trips, and non-home based trips – all for passenger vehicles only.

In the Fratar method, future trip ends in each zone are distributed to all zones in accordance with a measure of the relative trip attractiveness of each zone. The future movement between two zones is considered to be a function of present attractiveness, measured by the present interzonal or intrazonal movement, modified by the zones' future growth factors. Although different procedures were used to forecast trip ends in the internal traffic zones and at the external roadside interview stations on the cordon line, the distribution process for total truck trips was applied to both internal zones and external stations. For passenger vehicle through trips, of course, trips were distributed among the 14 external stations only. The growth factors required for the Fratar method are simply the ratios of 1985 to 1965 trip ends at the various zones or stations for the particular types of trips that are being distributed.

The gravity model is a means for simulating the movements of people through analogy to the law of gravity. Its mathematical formulation states that the trip interchange between two zones is directly proportional to the attractive power of each of the zones, as measured by the number of trips of a particular purpose produced and attracted at either end, and inversely proportional to some function of the spatial separation between the zones. Application of the gravity model in an urban area requires that it first be calibrated to fit the peculiar conditions of that area. Thus, in the Dover-Somersworth Transportation Study, three gravity trip distribution models for the three purposes noted above, were calibrated against current trip distribution patterns observed and quantified in the origin-destination survey, by empirically deriving travel time factors expressive of the average areawide effect of spatial separation on zonal trip interchanges.

After the gravity model calibration process was completed, 1985 passenger vehicle trip distribution in the survey area (except for through trips) was forecasted for each of the three purpose groupings – home based work trips, other home based trips, and non-home based trips. These forecasted trip patterns were then merged with trip distribution forecasts for truck trips and through passenger vehicle trips made by the Fratar method, to produce the zone-to-zone trip transfer table for total 1985 average annual weekday vehicle trips shown in Appendix Table A–2. This table is similar to Appendix Table A–1 which shows 1965 vehicle trip transfers.

The data shown in Table A–2 have been plotted in Figure 8 as desire lines, similar to the visual display of current trip patterns presented in Figure 6. The same scale has been used in both figures to facilitate comparison of trip patterns and changes in the overall density of travel desires between 1965 and 1985.

FUTURE TRAFFIC VOLUMES

The result of the trip distribution process described in the preceding section is a complete set of interzonal and intrazonal movements, representing the forecasted vehicular travel for the year 1985. The process used to translate these data to forecasted volumes on segments of the highway network is known as traffic assignment.

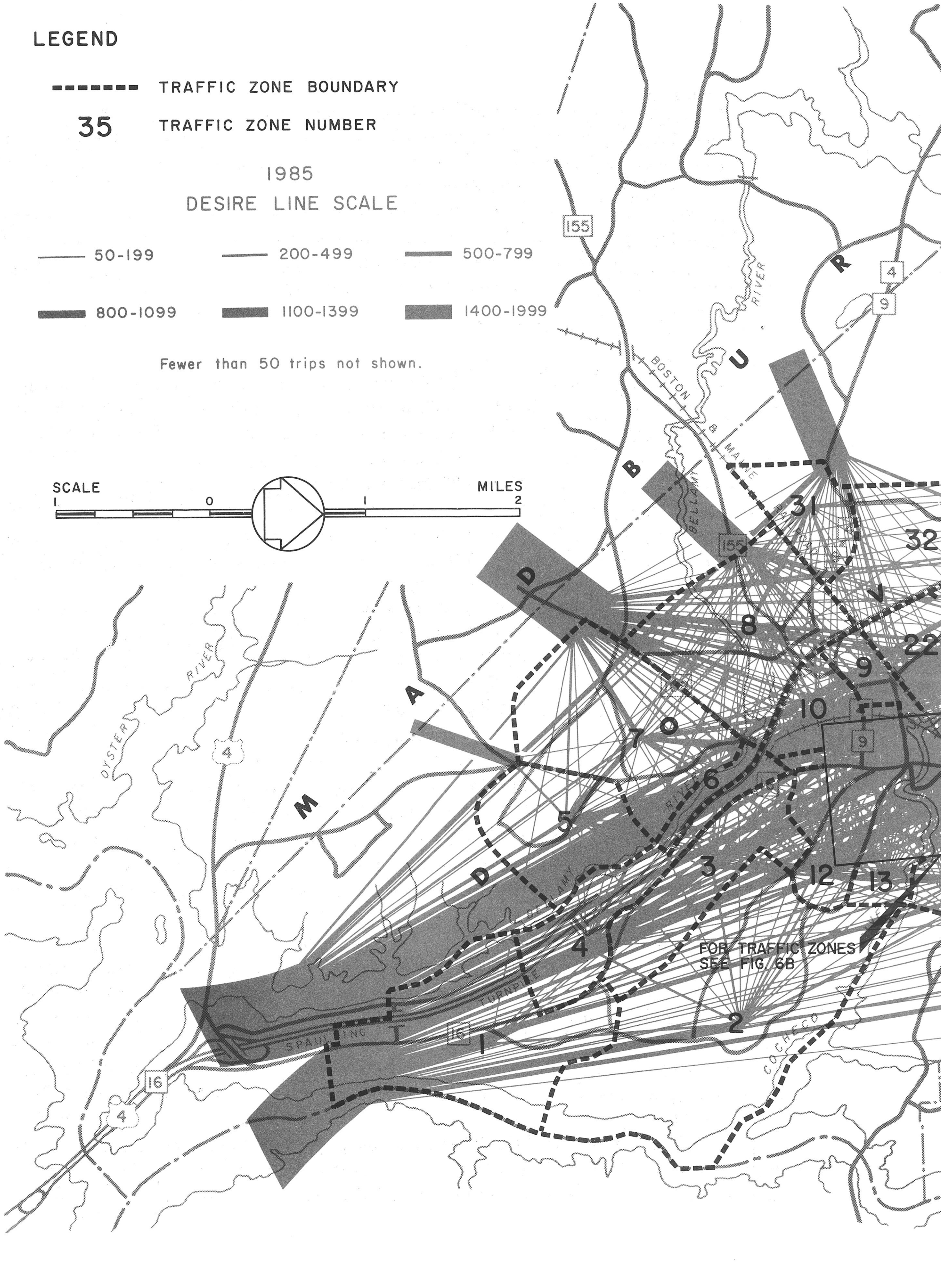
The traffic assignment process involves the schematic representation of the highway network, the determination of minimum paths through the network between all zones and external stations in the survey area, the assignment of interzonal movements to these paths, and the accumulation of traffic volumes on the various links and turning movements at the various nodes making up the network.

The arterial highway network in the Dover-Somersworth area was coded by a standard system of link and node numbering. Major streets and highways were included as well as additional actual and fictitious links required to provide access to and from all zones. Coded network description data included node numbers, lengths, and speeds or travel times. Approximately 270 links and 200 nodes were used to describe the existing 1965 highway network in the Dover-Somersworth area.

For any interzonal movement, there are usually a number of alternative routes, each with its own characteristics including distance, travel time or average speed, and travel costs. These are evaluated by a driver in selecting the route he will travel. For the Dover-Somersworth Study travel time was used as the measure of travel resistance and the traffic assignment process therefore assigned trips to minimum time paths.

A battery of standard computer programs was used to make traffic assignments for the Dover-Somersworth Transportation Study. As a first step, total current (1965) average summer weekday traffic obtained from the origin-destination survey was assigned to the existing system and assigned volumes throughout the system were investigated for reasonableness and compared with actual counted volumes where such were available at screenline crossing points and other locations throughout the arterial highway system. Unsatisfactory agreement in some instances suggested desirable revisions to the network coding to adjust minimum time path routings. This process was repeated twice; the third assignment of current trips to the existing network produced results which were considered to be acceptable.

Following this calibration process an assignment of forecasted traffic was made to the existing network, modified only to the extent of incorporating certain low-cost improvements deemed to be necessary and justified at the present time and therefore cer-



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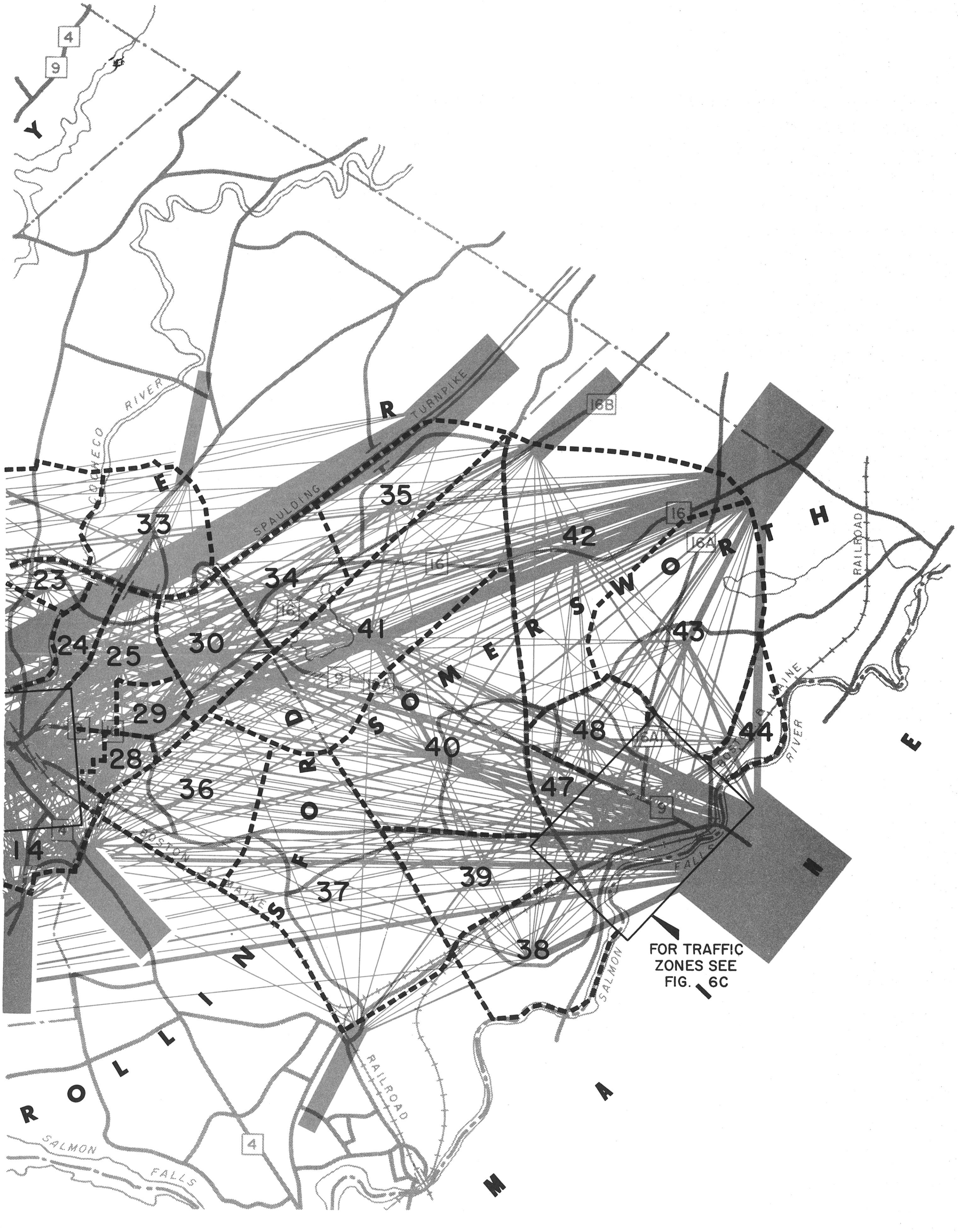


TRAFFIC ZONES AND 1985 ALL VEHICLE TRIP DESIRE LINES

FIGURE 8

tainly likely to be implemented by 1985, in order to ascertain where additional or improved highway transportation facilities would be required to accommodate forecasted travel demands. Results of this assignment, and a further assignment made to evaluate alternative improvement schemes, are discussed in Chapter V.

It would be well to point out at this point that traffic assignment is only a tool used to simulate the flow of traffic over a highway system. Due to certain technical shortcomings of the traffic assignment process, assigned volumes often require adjustment before they can be considered reasonable. For example, although vehicle movements have actual origins and destinations spread geographically throughout the zones into which the area has been divided, in the traffic assignment process all movements into or out of a zone are considered as having origin or destination at a single point located at the centroid of the zone. In the immediate vicinity of a zone centroid, therefore, assigned volumes may demonstrate unreasonable discontinuities. Similarly, the fact that not all streets in the area were included on the coded assignment network, and the fact that intrazonal movements were not assigned at all, even though such trips contribute to actual traffic flow, must be considered in interpreting and evaluating traffic assignment results. Adjustments of this type have been made as appropriate and traffic volumes discussed subsequently in this report and depicted on traffic flow maps (Figures 3 and 9) and in Appendix Table A–3 therefore represent actual volumes.

CHAPTER V

RECOMMENDED ARTERIAL HIGHWAY IMPROVEMENTS

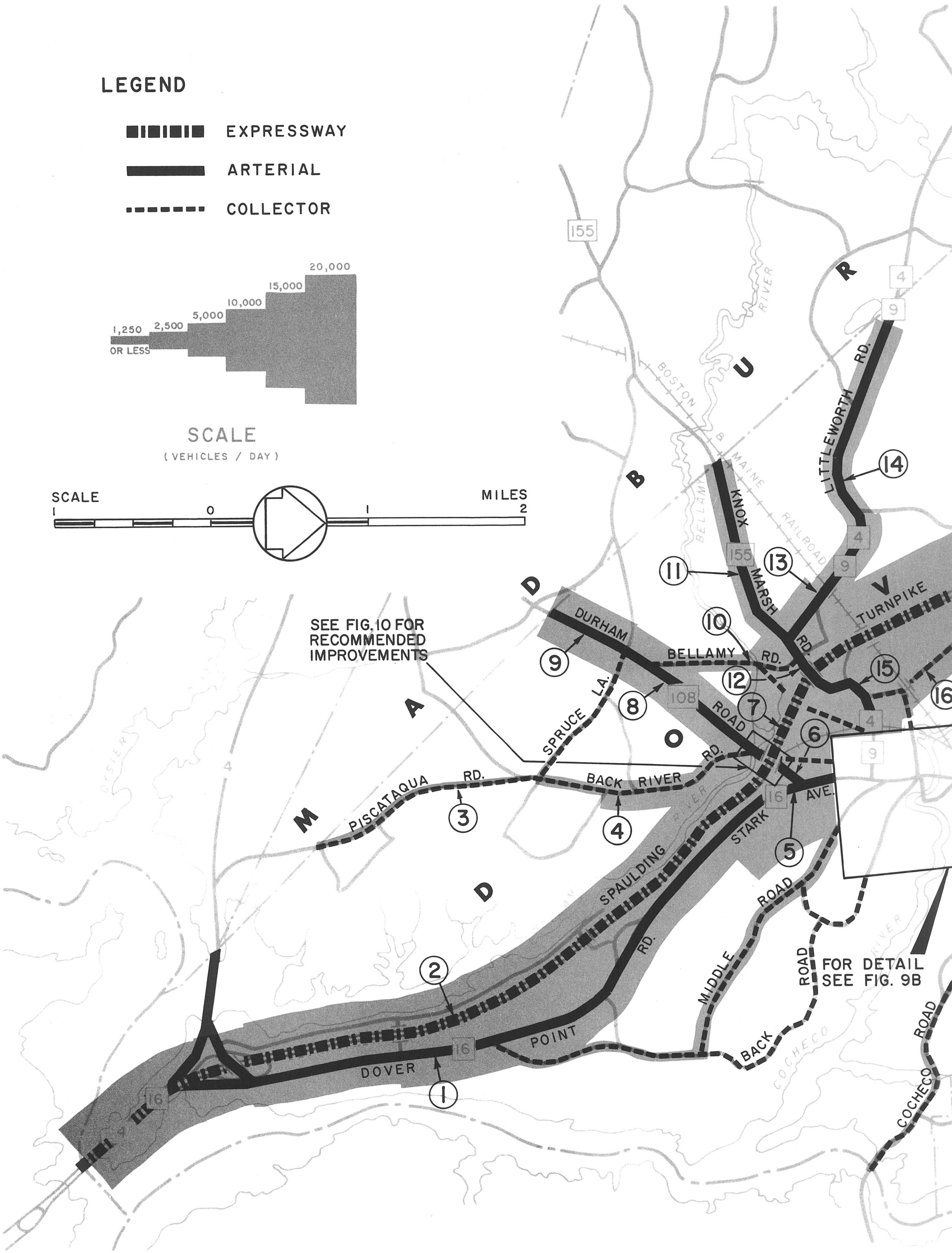
ANALYSIS AND EVALUATION PROCEDURE

The Dover-Somersworth Transportation Study was designed to provide an evaluation of arterial highway needs for two points in time – now and in 1985.

Early in the Study, local officials in Dover and Somersworth were consulted and field investigations were made to identify locations in the two-city area where traffic flow was unduly hazardous or congested – in other words, locations on the arterial highway system most in need of immediate attention. At these locations, manual peak period counts were made, as described earlier in this report, and data relating to accident frequency were compiled. From this analysis, recommendations were prepared for a series of improvements which should be made at critical locations on the existing arterial system so that these streets and highways can better and more safely serve current traffic demands.

Earlier chapters in this report have described the collection and analyses of data, the forecasting of future travel demands, and the procedures for translating these forecasted demands into estimates of future traffic volumes on streets and highways in the area. The first step in the determination of improvements required to meet future needs was to assign forecasted 1985 traffic to the existing arterial system, modified by incorporation of the improvements recommended for immediate implementation. The results of this assignment were carefully analyzed to identify areas where deficiencies might be expected to occur by 1985. In making this analysis the increased traffic carrying capability of the arterial system resulting from implementation of the immediate action proposals was taken into account. After deficiencies had been identified, a trial system of arterial highways was formulated, incorporating additional improvements to the extent that they appeared to be required to accommodate future travel demands.

The assignment of 1985 traffic to the trial system produced the traffic usage data required for evaluation of alternative improvement proposals. Consideration of these data along with approximate improvement cost information, anticipated benefits to the road users and others that would result from the various improvements, and impact on land use and community value factors led to selection of the components of the recommended arterial highway system. Locations where improvements have been recommended in subsequent sections of this chapter – both immediate action proposals and recommendations to meet future needs – are shown in Figure 9.



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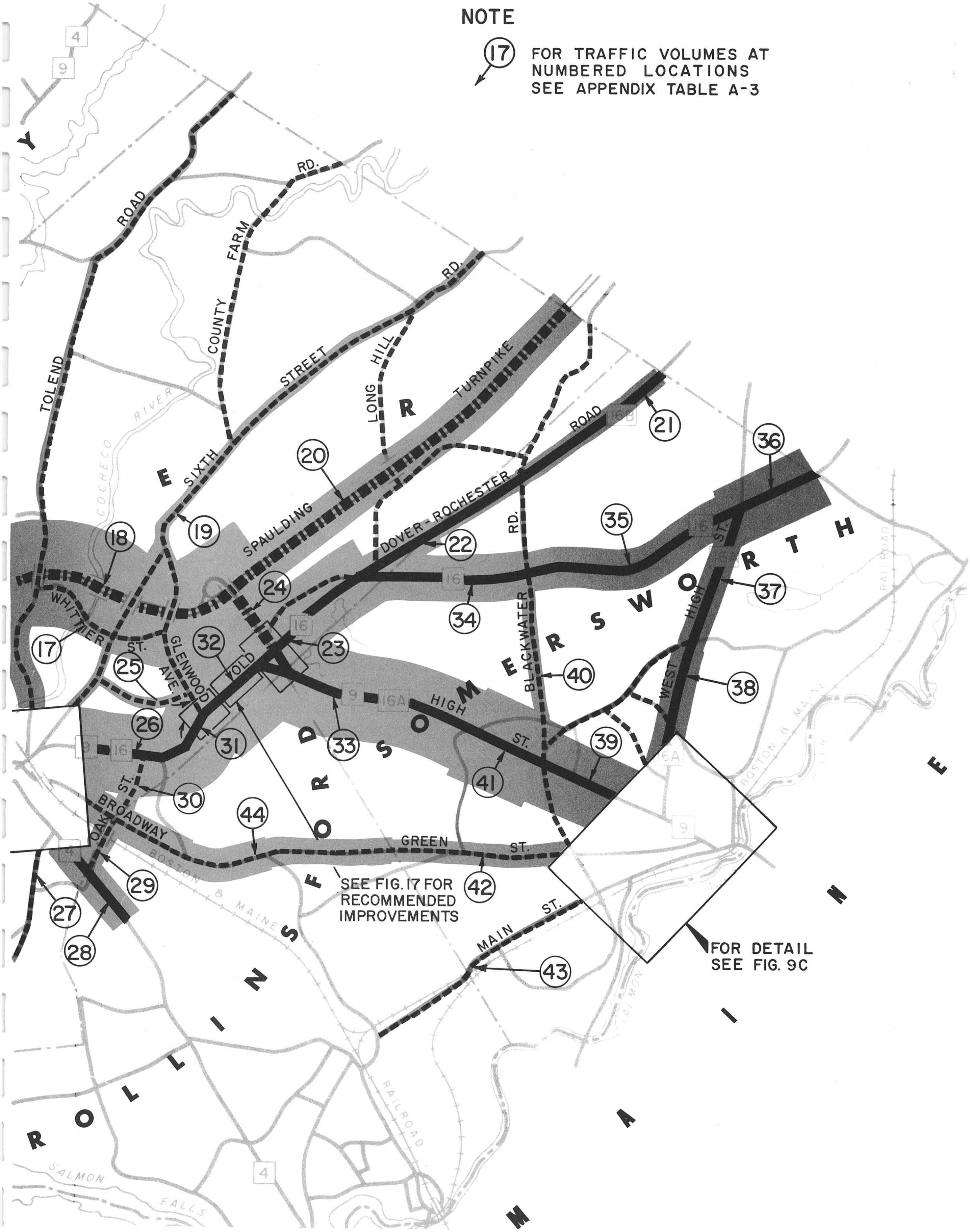


1985 AVERAGE ANNUAL WEEKDAY TRAFFIC

FIGURE 9A

Figure 9 also illustrates by varying band widths the anticipated traffic flow on the recommended arterial highway system – that is, the existing system with all recommended improvements. This figure conveys a visual impression of the relative usage of available and proposed facilities in 1985, and can be compared directly with Figure 3 which is drawn to the same volume scale and depicts current average annual weekday traffic. Additional traffic volume data are tabulated in Appendix Table A-3.

IMMEDIATE ACTION PROGRAM

The principal population and commercial developments in the Study Area are, to a considerable extent, concentrated along major arterial highways. These developments generate large volumes of traffic, but their use of land along existing highways precludes extensive reconstruction. This is especially true at locations in the central urban areas where peak period traffic congestion is most prevalent. Therefore, the immediate action improvements recommended in this report are designed to be accomplished within existing rights-of-way insofar as possible.

In general, the existing arterial system in the Dover-Somersworth area has adequate basic roadway capacity to handle current traffic demands and does not require major improvements such as widening beyond existing rights-of-way or construction of new facilities. However, at certain locations, particularly in business and commercial districts, the number of reported accidents appears to be excessive in comparison with traffic volumes. At most of these locations, pedestrian and vehicular safety could be improved immediately by the application of relatively low cost measures including channelizing islands, pavement markings, stop and yield signs, turning movement regulations, curbside parking controls and modernization of obsolete traffic signal installations.

Due to restricted widths, the use of arterial city streets for parking of vehicles is often at variance with their essential purpose of providing for the flow of vehicular traffic in and through the city. As a desirable standard it is recommended that no parking be permitted on either side of an arterial city street less than 30 feet in width. Between 30 and 38 feet, parallel parking may be permitted on one side. Parallel parking may be permitted on both sides of arterial city streets wider than 38 feet. Angle parking should not be allowed on arterial streets regardless of width due to the greater incidence of accidents that is characteristic of this type of on-street parking. It should be noted that these desirable standards pertain to arterial streets (see Figure 9 and discussion in

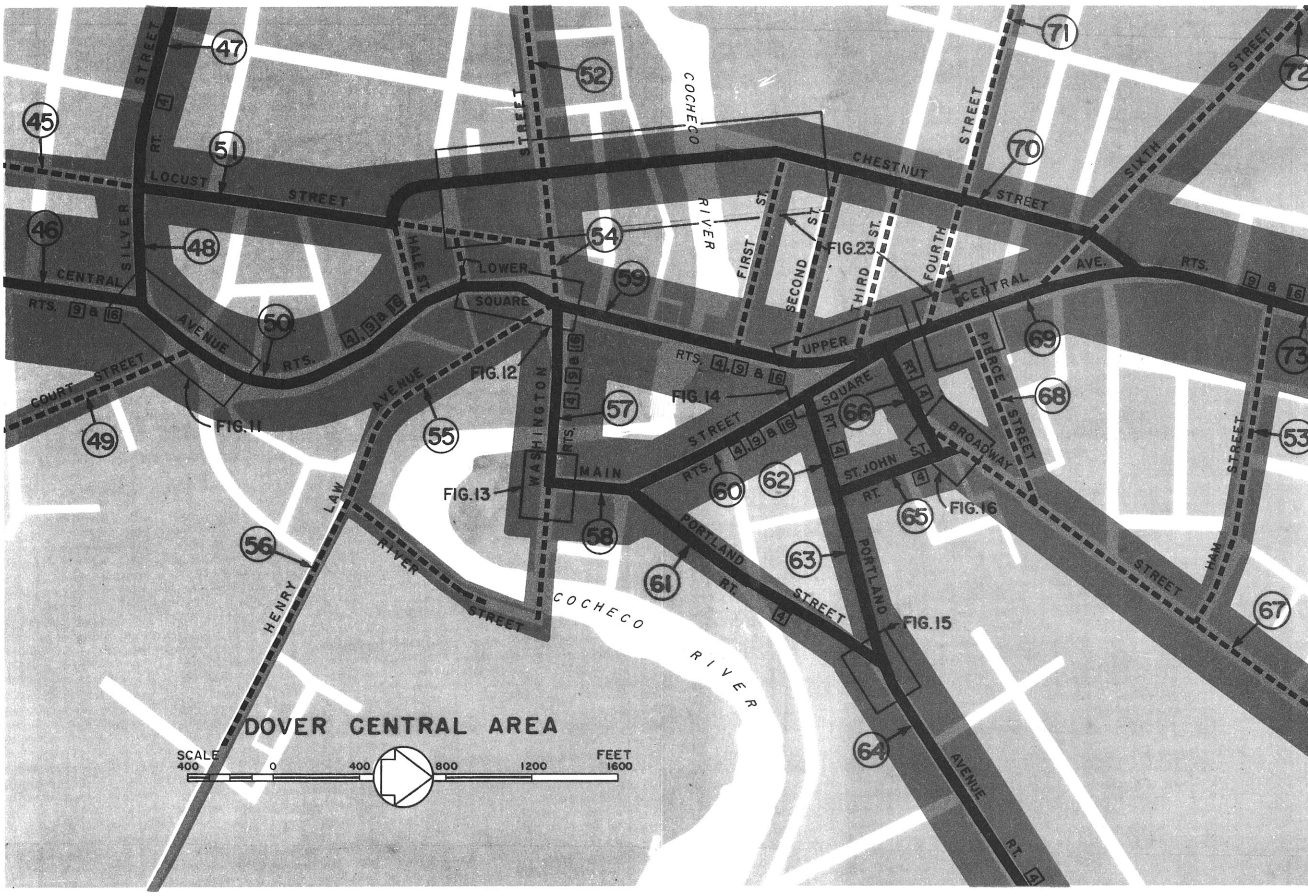
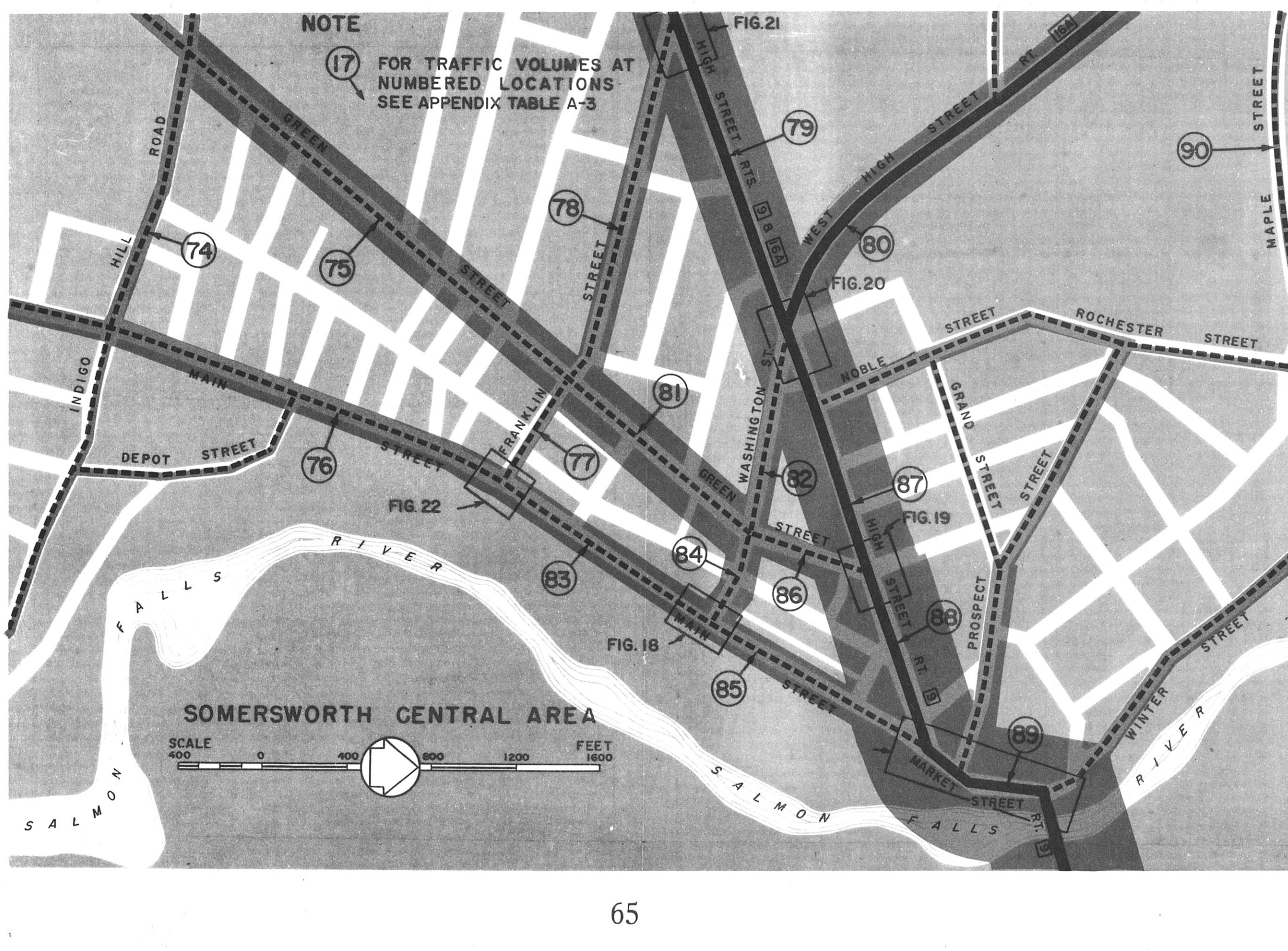


FIGURE 9B

1985 AVERAGE ANNUAL WEEKDAY TRAFFIC

FIGURE 9C



Chapter III under "Transportation Facilities – Highways"); for collector and local streets, these requirements may be reduced depending upon traffic volumes. It is recognized that the immediate action proposals discussed in the following paragraphs involve the elimination of an appreciable number of existing on-street parking spaces in Dover and Somersworth. The further elimination of on-street parking spaces to meet the desirable standards noted above may not be considered to be immediately practicable due to the general inadequacy of the total parking supply in the downtown areas. However, it is recommended that regulations in conformance with these standards be implemented as soon as practicable.

Detailed proposals for immediate action have been prepared for 13 locations, 8 in Dover(1) and 5 in Somersworth. These proposals are discussed below and illustrated in figures which depict current conditions – pavement widths, curbs, traffic controls, channelizing islands, 1965 summer peak hour traffic counts, and numbers of traffic accidents reported for the average year during the two-year period ending August 1, 1965 – as well as recommended modifications. Estimated 1985 peak hour traffic volumes are also indicated.(2)

1–One further location in Dover – namely, the Central Avenue-Stark Avenue intersection – was given extensive study and a possible channelization scheme was shown in the draft version of this report submitted July 28, 1966. However, it was agreed by all concerned that it would not effectively improve the flow of traffic or operational safety of the intersection. Therefore, it was subsequently depleted from the report with the concurrence of the U.S. Bureau of Public Roads, the State Department of Public Works and Highways, and the City of Dover. The Central Avenue-Stark Avenue intersection cannot be effectively and significantly improved through low-cost measures.

2–For reasons discussed in the final paragraph of Chapter IV, the computer traffic assignment process cannot be expected to yield detailed information concerning turning movements at all intersections. So as to provide some indication of the order of magnitude of future turning movements at each of the locations where immediate action proposals were made, an alternative procedure was used whereby current unadjusted manual turning movement counts (where such were made) have each been factored by the ratio of appropriate future to current assigned volumes to produce a rough estimate of future turning volumes. Future turning volumes have then been added as appropriate to obtain intersection approach volumes. It should be recognized that approach volumes so determined do not represent design hour volumes as tabulated in Appendix Table A–3.

The recommendations for immediate improvements presented below were developed using the following criteria:

1. Geometric design standards for lane widths and channelizing islands were established commensurate with the needs of passenger cars and single unit trucks. Because the number of large semi-trailer combinations in the area is relatively small, it would be impractical and uneconomical to design all movements at all intersections to accommodate these vehicles within the designated roadway area. However, it is recommended that all curbed islands be constructed with mountable curbs to permit passage of large trucks as required.

2. The designs attempt to reduce conflicting and hazardous traffic movements to simple diverging and merging maneuvers. This would make it possible to control traffic at most locations with stop and yield signs, rather than expensive traffic signal installations.

3. The designs provide for the retention of virtually all curbside parking except where it is absolutely necessary to prohibit parking to insure optimum traffic flow and maximum pedestrian safety.

4. The designs are of such nature that construction costs are relatively low and most improvements could be handled by the cities' own forces.

CENTRAL AVENUE-SPAULDING TURNPIKE INTERCHANGE-
MILL ROAD-DURHAM ROAD-BACK RIVER ROAD, DOVER

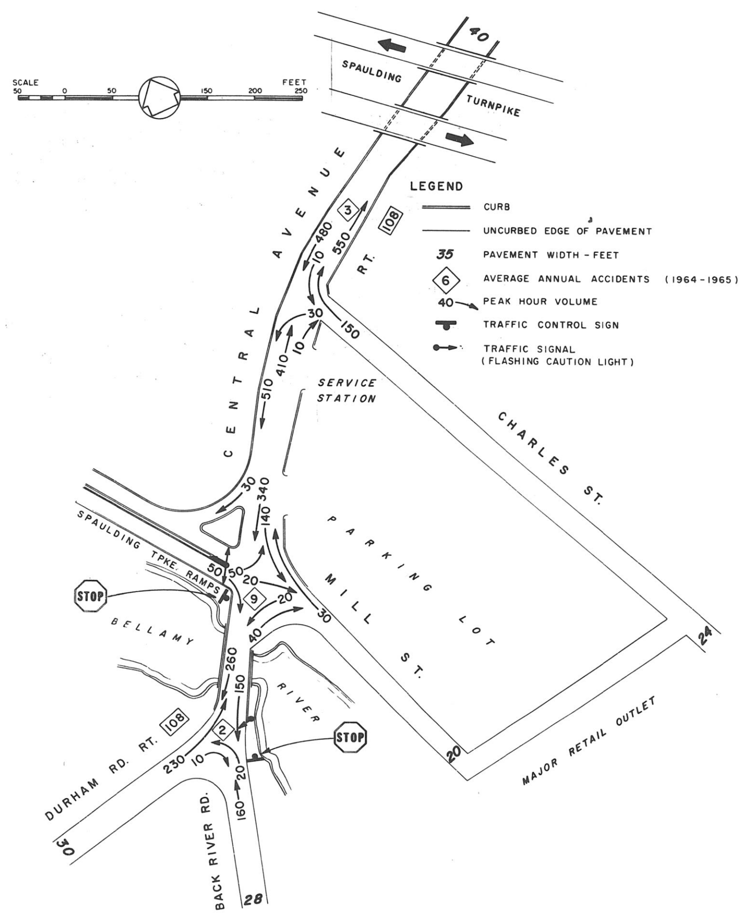
This location encompasses three separate, but interrelated intersections: (1) Durham Road (Route 108) and Back River Road; (2) Spaulding Turnpike ramps, Central Avenue (Route 108) and Mill Street; and (3) Central Avenue and Charles Street.

Regulatory traffic control devices consist of a stop sign and flashing red beacon on the Turnpike exit ramp at Central Avenue and a stop sign on Back River Road at Durham Road. Warning devices include flashing amber caution beacons on Central Avenue at the Turnpike ramps and on Durham Road at Back River Road. There are no other existing traffic controls or parking regulations and all turning movements are permitted.

It is recommended that the intersection of Durham Road and Back River Road be channelized with curbed islands. Mill Street would be made one-way southbound and the wide expanse of pavement on Mill Street at Central Avenue narrowed with curbing and a channelizing island. It is also recommended that dividing islands be marked on Central Avenue and separate left turn holding lanes designated on Central Avenue at Mill Street and Charles Street. Stop signs are recommended for controlling Back River Road traffic at the Durham Road – Back River Road intersection; Charles Street traffic at Central Avenue; and traffic on the Spaulding Turnpike exit ramp. The existing caution lights would be removed.

These measures would enable the heavy left turning movements on Central Avenue to operate safely without interfering with through movements and would provide well defined travel paths on Central Avenue from Back River Road and Durham Road to east of Charles Street.

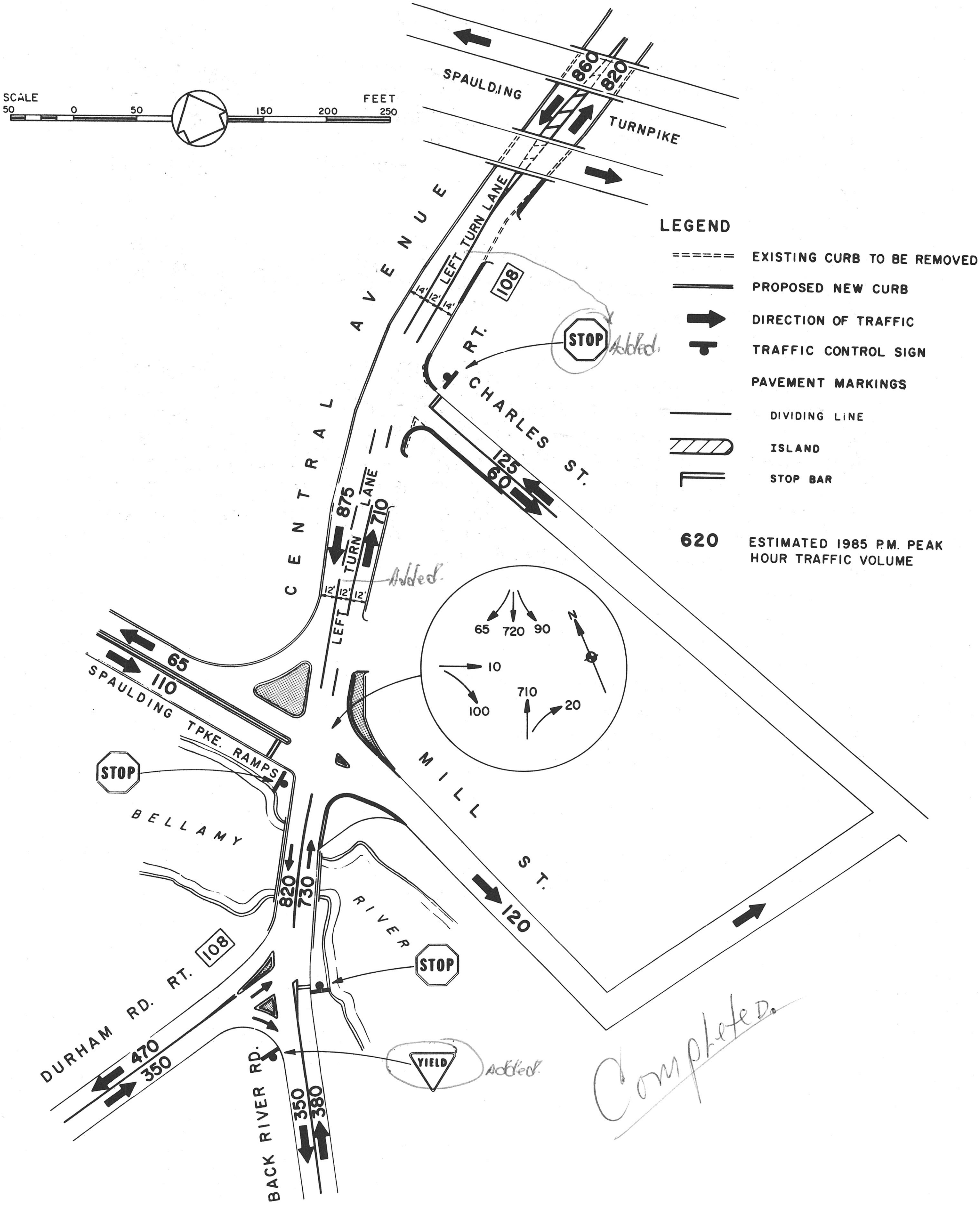
The total cost of the recommended improvements is estimated at $6,600. The current annual cost of accidents at this location is estimated to be $16,800.



TIPPETTS - ABBETT - McCARTHY - STRATTON
ENGINEERS AND ARCHITECTS NEW YORK

EXISTING CONDITIONS

FIGURE **10A**



RECOMMENDED IMPROVEMENTS

FIGURE 10B

CENTRAL AVE.-SPAULDING TPKE. INTERCHANGE-
MILL RD - DURHAM RD.- BACK RIVER RD., DOVER

SILVER STREET-CENTRAL AVENUE, DOVER

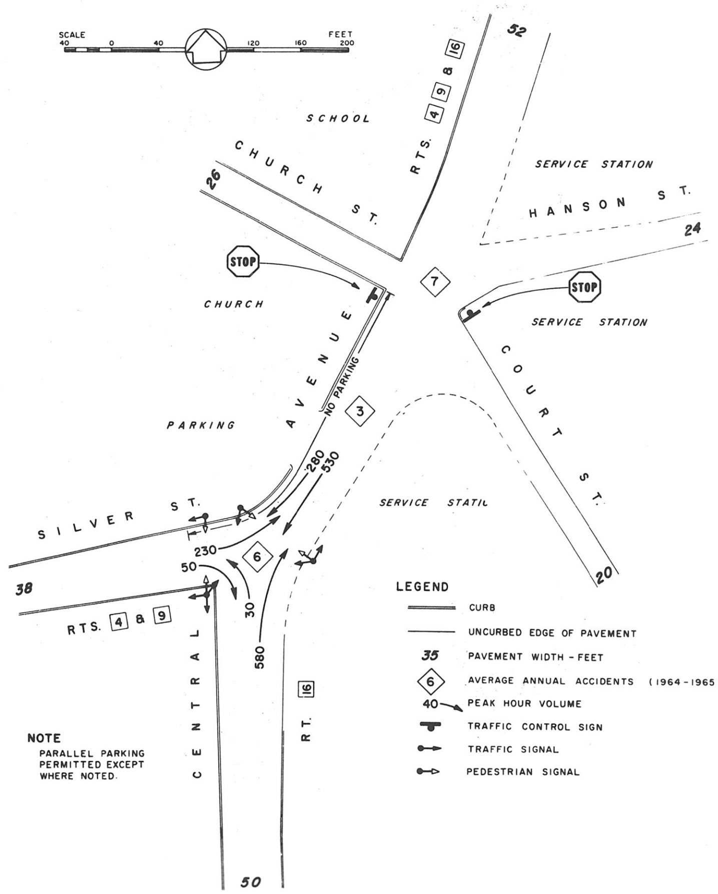
Movements at the intersection of Silver Street and Central Avenue are controlled with a two-phase fixed time traffic signal. Movements from Church Street and Court Street are regulated with stop signs. There are no curbside parking restrictions, except for the no-parking zone along the west side of Central Avenue, from Silver Street to Church Street. The centerlines on Silver Street and Central Avenue are the only existing pavement markings.

It is recommended that a separate left turn lane be marked on Central Avenue at Silver Street, and a dividing island marked on Central Avenue from Silver Street to Church Street. These measures are designed to enable left turning vehicles to wait safely without impeding the flow of through traffic.

It is recommended that the width of Silver Street at Central Avenue be reduced to 38 feet and curbs installed on the east side of Central Avenue and on the south side of Hanson Street for a distance of 200 feet from Central Avenue. It is recommended that the existing traffic signal be modernized, including the installation of "Walk – Don't Walk" signals, and pedestrian crosswalks be added. A stop sign would be installed to control Hanson Street traffic and the existing stop signs on Church Street and Court Street would be retained. Other improvements would include enlarged corner radii at the Church Street-Hanson Street-Court Street-Central Avenue intersection; and stop lines and centerlines on Church Street, Hanson Street and Court Street.

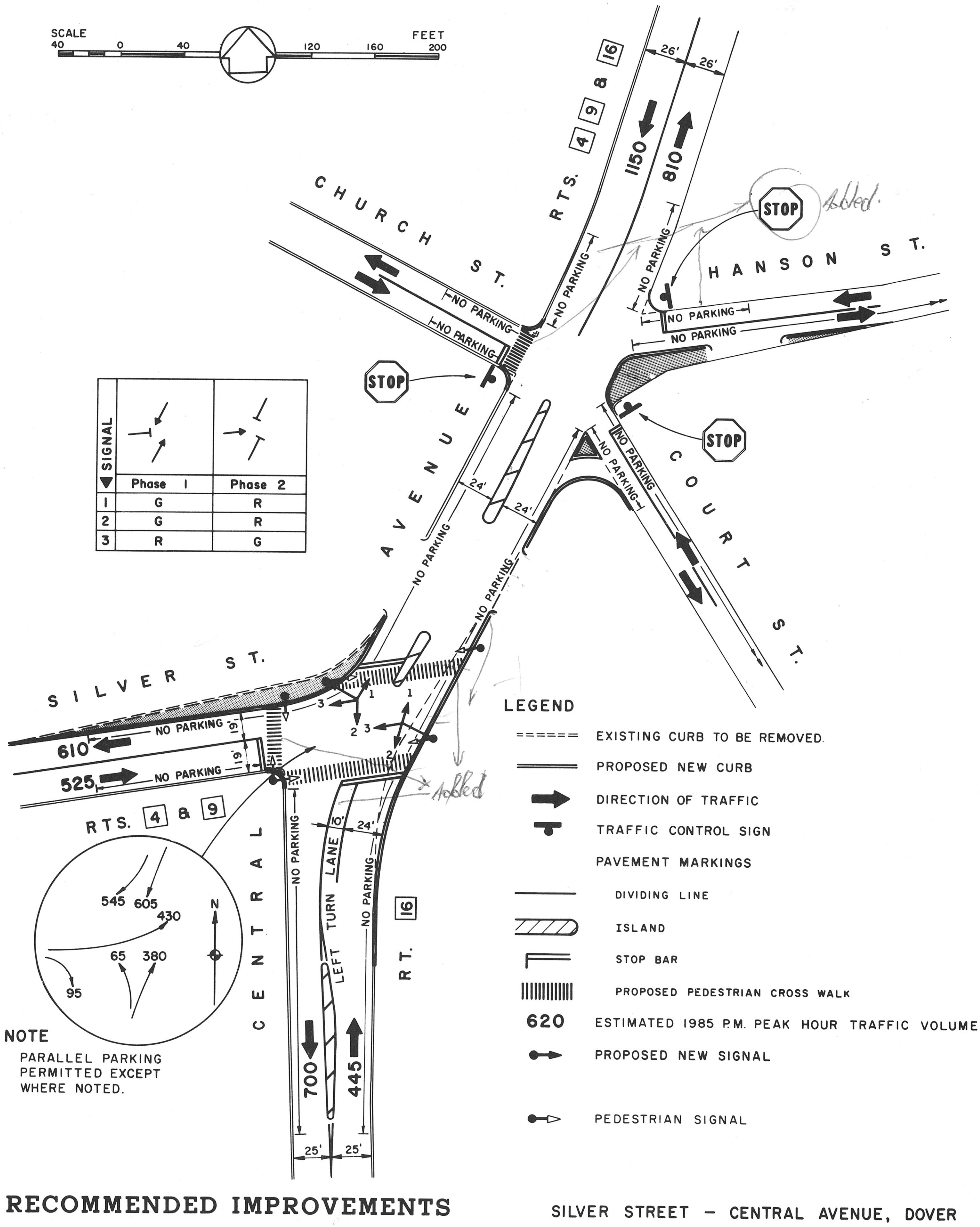
Implementation of these suggested improvements would result in the loss of approximately 33 currently used, on-street parking spaces, not including those that would be lost on Hanson Street and Court Street as a result of imposing the recommended one-side restriction on parking.

The estimated cost of the recommended improvements is $13,200, of which the signal modernization would account for nearly $4,400. The current cost of accidents at this location is estimated to be $19,200 per year.



EXISTING CONDITIONS

FIGURE 11A



RECOMMENDED IMPROVEMENTS SILVER STREET – CENTRAL AVENUE, DOVER

FIGURE **11B**

All possible turning movements, except the left turn from Henry Law Avenue, are permitted. The only existing traffic control devices are non-uniform signs requiring vehicles to stop for pedestrians on Central Avenue just north of Washington Street.

Central Avenue is one-way southbound north of Washington Street and two-way south of Washington Street. Washington Street is one-way eastbound from Central Avenue to Main Street, and two-way west of Central Avenue. Henry Law Avenue is two-way.

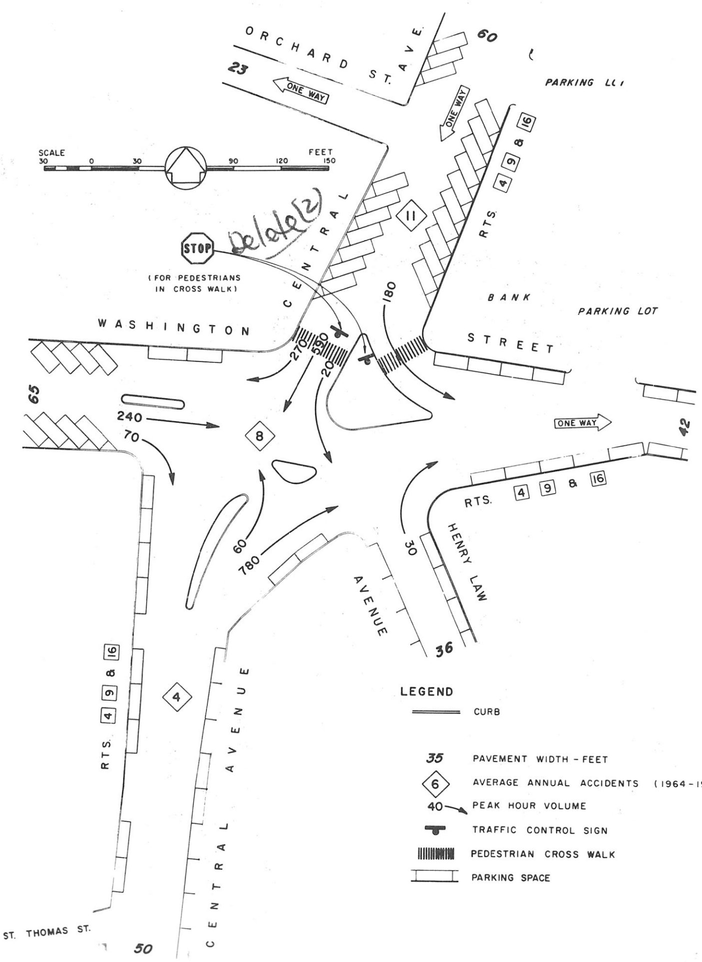
Lower Square and all intersecting streets are curbed. There are two curbed channelizing islands and two narrow curbed dividers; nevertheless, vehicular travel paths are poorly defined and there are relatively large areas of uncontrolled pavement. There are no curbside parking restrictions. Most parking spaces are metered and some are angled to the curb.

It is recommended that new channelizing islands be installed, which would provide better definition of traffic lanes, eliminate unneeded pavement area, and provide pedestrian safety zones. All existing permissible turning movements would be retained except the left turn from southbound Central Avenue to Henry Law Avenue. This turn would not be allowed, due to the very small proportion of drivers wishing to make it (about 2% in the peak hour, as shown in Figure 12A) and because adequate alternative routes to Henry Law Avenue are available via Washington Street and River Street and via Central Avenue and Hanson Street.

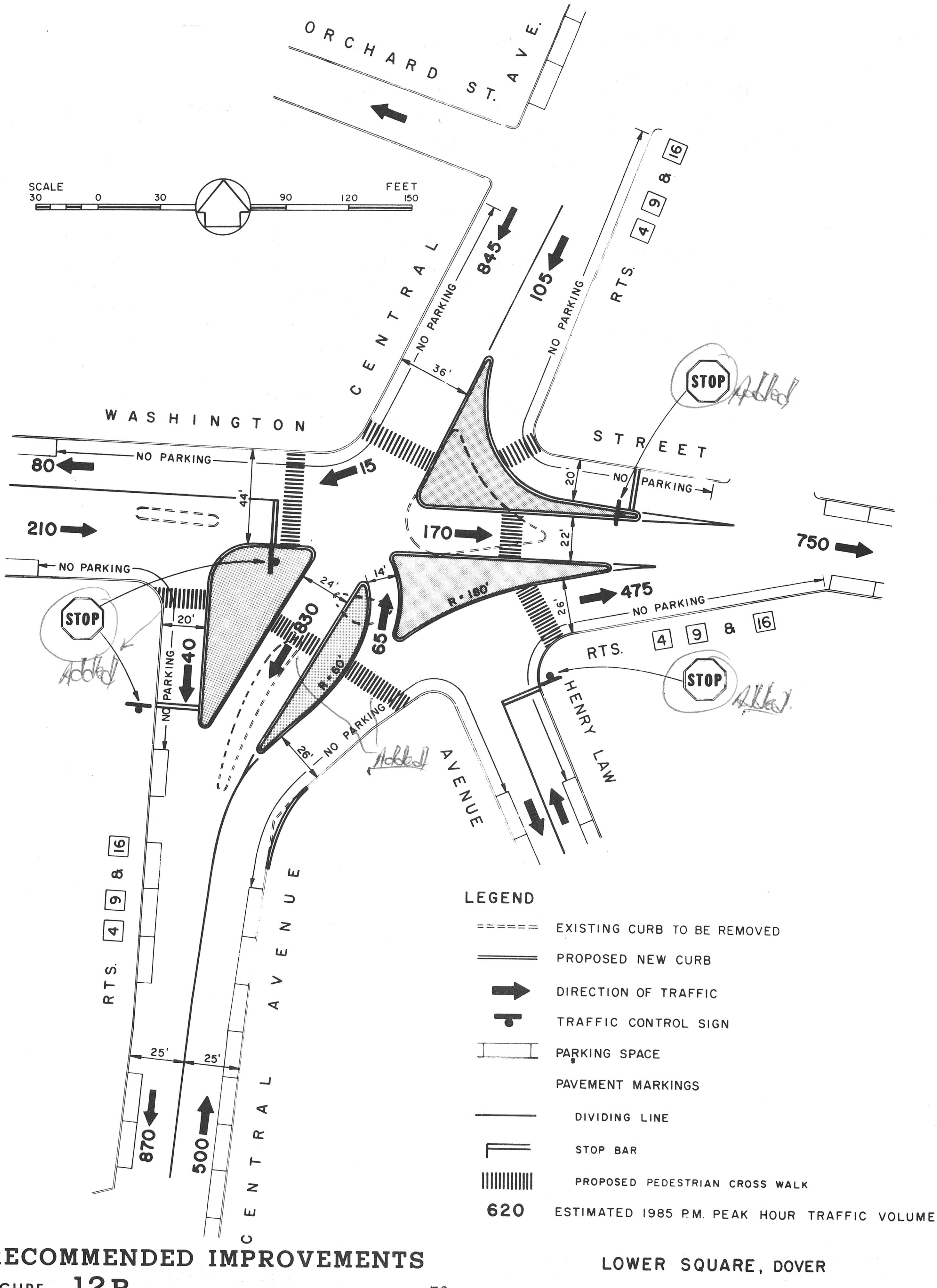
Stop sign control is recommended for eastbound Washington Street traffic; northbound Henry Law Avenue traffic; and southbound Central Avenue – eastbound Washington Avenue traffic. The existing pedestrian crosswalk stop signs would be removed. Parking would be prohibited on all approaches and within the confines of the intersection; elsewhere, parallel parking would be permitted.

Within the limits of the area depicted in Figure 12, approximately 46 existing on-street parking spaces would be eliminated as a result of implementing these suggestions.

The estimated total cost of the recommended improvements is $10,300. The current annual cost of accidents at this location is estimated at $27,600.



EXISTING CONDITIONS
FIGURE 12A



RECOMMENDED IMPROVEMENTS

FIGURE **12B**

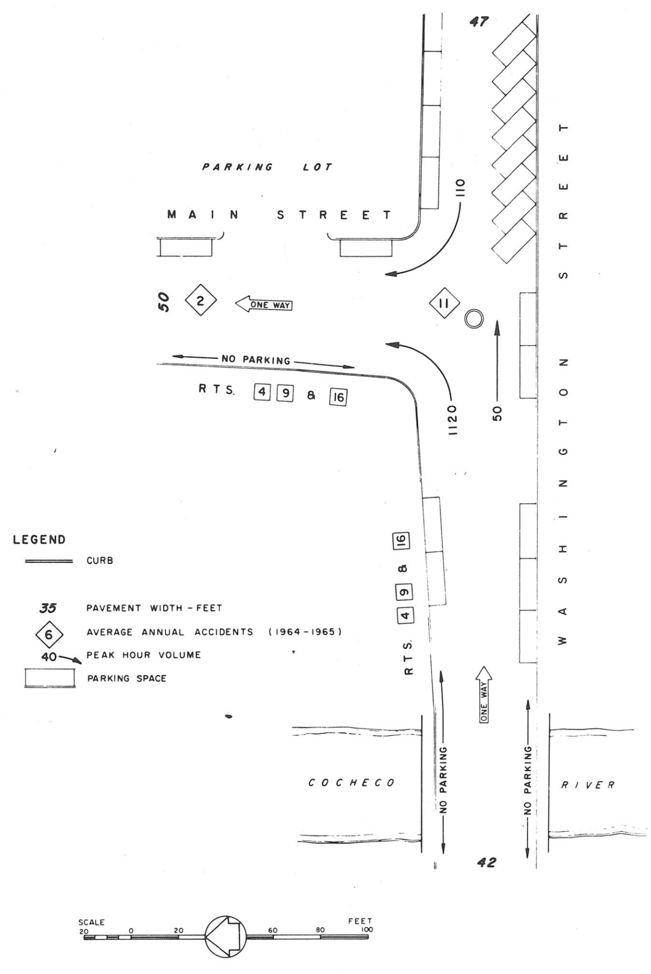
LOWER SQUARE, DOVER

WASHINGTON STREET-MAIN STREET, DOVER

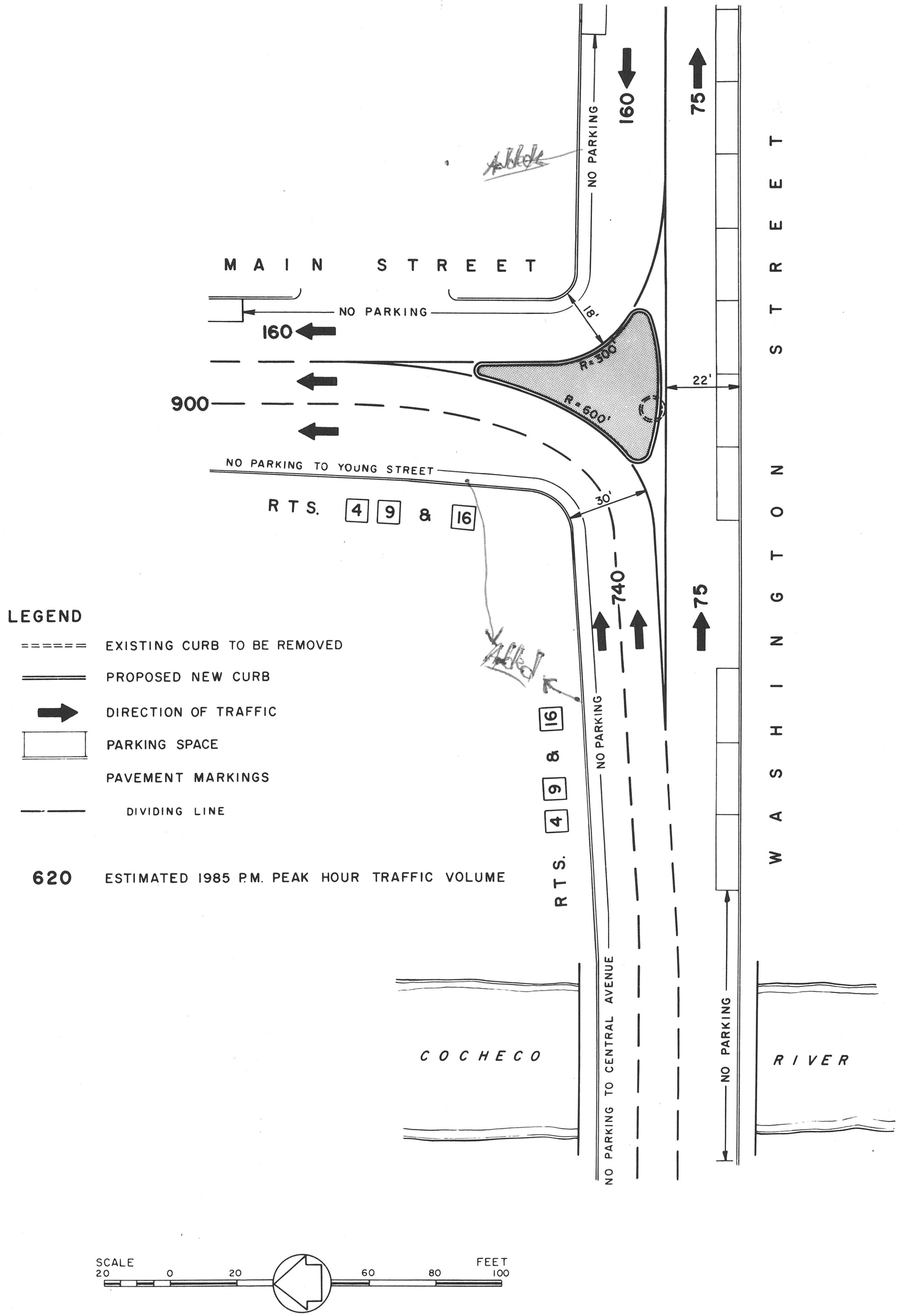
A curbed island at the intersection of Washington Street and Main Street is the only existing channelizing device. There are no existing traffic controls or guide signs. Curbside parking is generally permitted, except along the west of Main Street and on the bridge over the Cocheco River.

It is recommended that a curbed channelizing island be installed which would provide a safe transition between one-way and two-way operations on Washington Street. Curbside parking would be prohibited on the north side of Washington Street, and on both sides of Main Street; parallel parking would be permitted along the south side of Washington Street. Approximately 9 on-street parking spaces would be lost as a result of making the recommended improvements at this location.

The total cost of the recommended improvements is estimated at $2,200. The current cost of accidents at this location is estimated at $13,200 annually.



EXISTING CONDITIONS
FIGURE 13A



RECOMMENDED IMPROVEMENTS WASHINGTON STREET – MAIN STREET, DOVER

FIGURE 13B

UPPER SQUARE, DOVER

Movements at the intersections of Broadway Street-Central Avenue-Third Street and Main Street-Portland Avenue are controlled with fixed time traffic signals. Stop signs control movements at Second Street and Central Avenue.

Central Avenue, south of Second Street, is one-way southbound. Main Street is one-way northbound and Portland Avenue is one-way eastbound. In general, all turns, including "U" turns, are permitted except left turns from Central Avenue to Broadway and from Third Street to Central Avenue. Extensive curbside parking is permitted in the Square and on Central and Main Streets. Nearly all of these parking spaces are metered and most stalls are angled to the curbs.

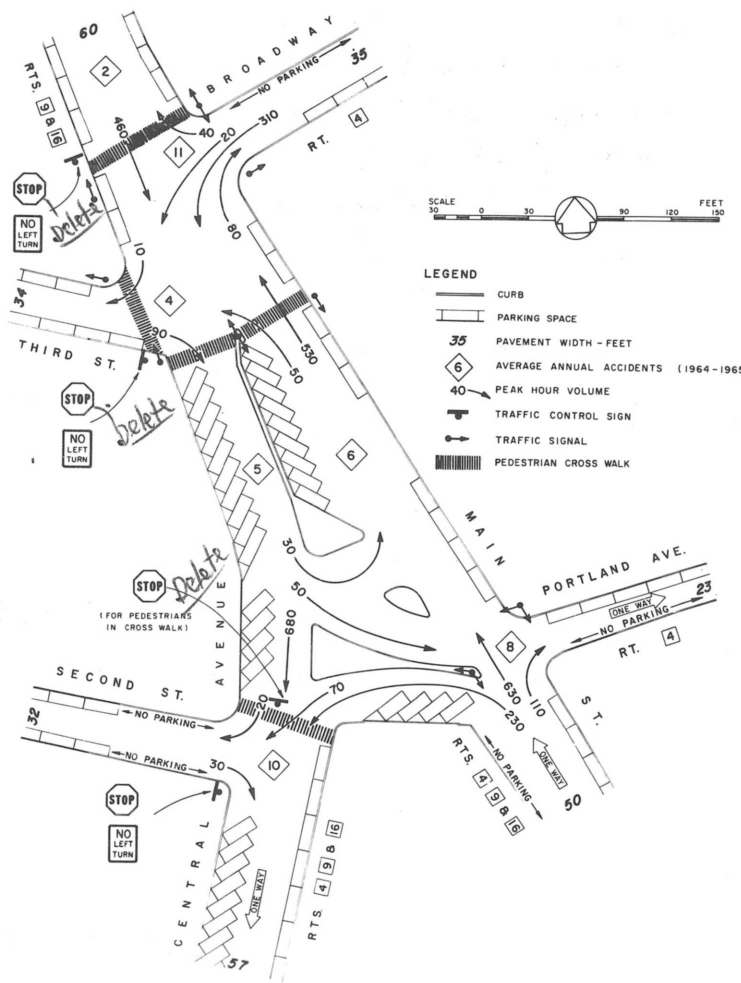
It is recommended that the existing channelizing islands be enlarged and additional islands installed to define vehicular and pedestrian travel ways. The proposed channelization scheme would retain all existing permissible turning movements and would not require modifications to the existing one-way street operations, except that Broadway would be made one-way westbound between Central Avenue and the Dover Fire Station (see recommendation pertaining to Broadway Street-St. John Street, Dover).

It is recommended that the existing signal installation at Broadway Street-Central Avenue-Third Street be replaced with a modern three-phase system, which would provide a separate phase for left turning vehicles. The existing signal at Portland Avenue and Main Street would be replaced with a pedestrian-actuated signal. Signal heads would be mounted on overhead mast arms and pedestal-mounted "Walk" – "Don't Walk" signals would be installed.

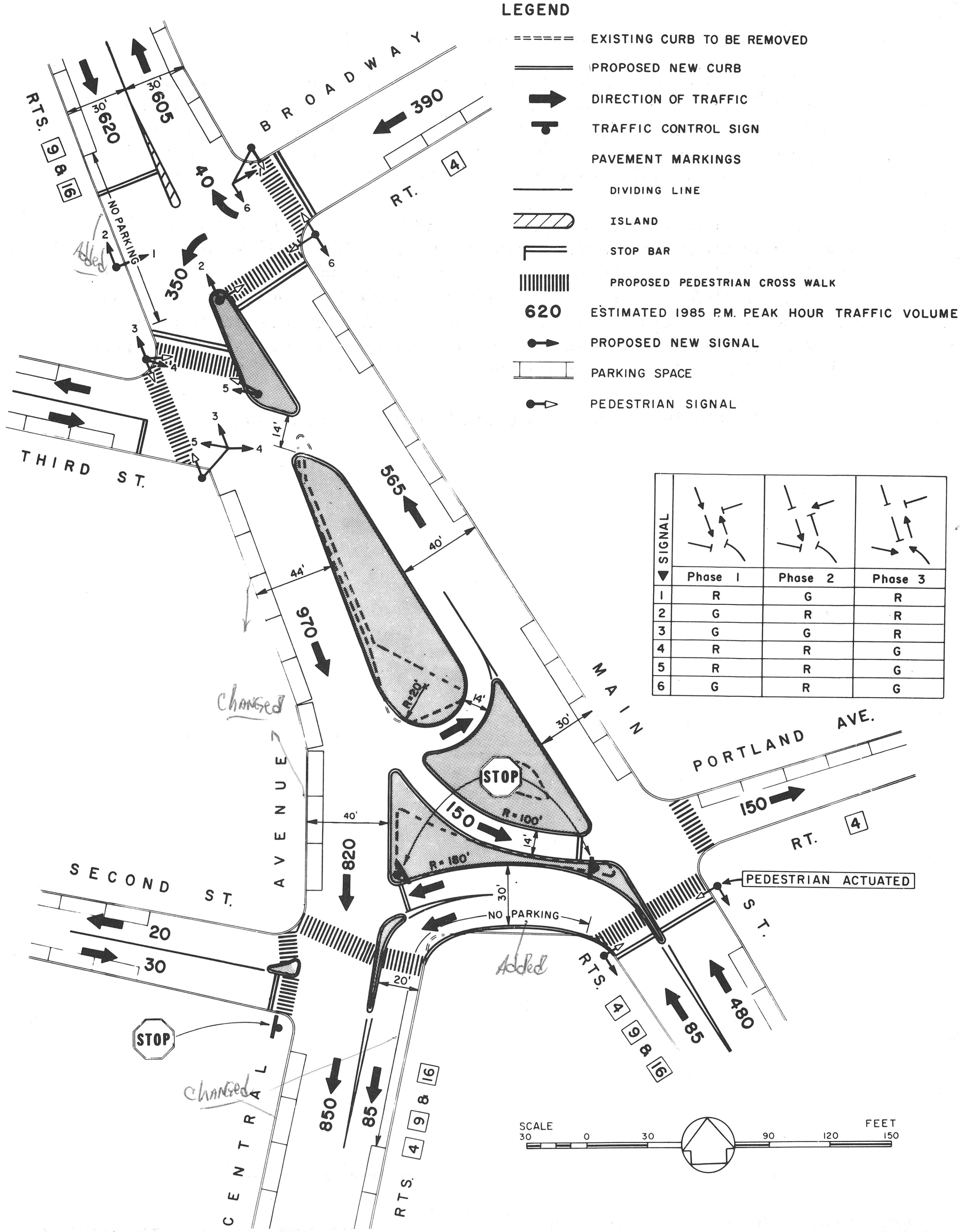
It is also recommended that the existing angle parking stalls on the west side of Central Avenue from Third Street to Second Street be replaced with parallel stalls and the existing parking stalls in the center of the Square be removed; all other existing parking spaces would be unaltered.

Within the limits of the area depicted in Figure 14, approximately 31 existing on-street parking spaces would be eliminated as a result of implementing these suggestions.

The estimated total cost of the recommended improvements is $22,000, of which the new signals would account for nearly $8,000. The current annual cost of accidents at this location is estimated at $55,000.



EXISTING CONDITIONS
FIGURE 14A



SIGNAL	Phase 1	Phase 2	Phase 3
1	R	G	R
2	G	R	R
3	G	G	R
4	R	R	G
5	R	R	G
6	G	R	G

RECOMMENDED IMPROVEMENTS

UPPER SQUARE, DOVER

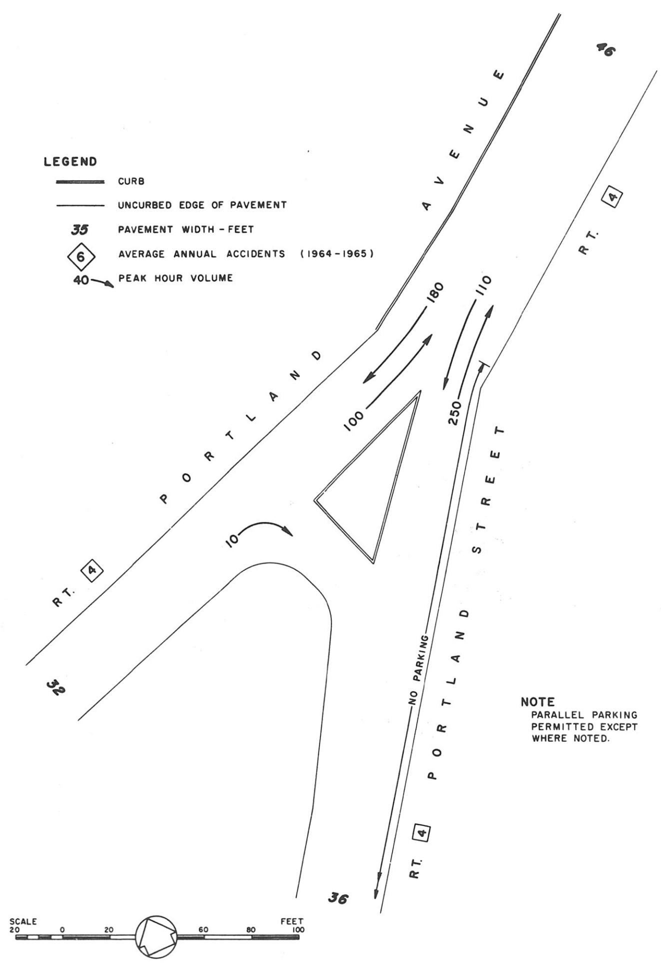
FIGURE 14B

PORTLAND AVENUE-PORTLAND STREET, DOVER

At the Portland Avenue-Portland Street intersection there are no existing traffic controls and all possible turning movements are permitted. Curbside parking is permitted, except along the east side of Portland Street. The configuration of the intersection and the unregulated turning movements create safety hazards, particularly for eastbound Portland Avenue traffic and westbound Portland Avenue – Portland Street traffic.

It is recommended that centerlines be marked on all approaches and a separate left turn holding lane be designated on the east approach of Portland Avenue. It is also recommended that the centerline on Portland Avenue west of the intersection, between Portland Street and St. John Street, be offset by 4 feet in order to establish a 12-foot eastbound lane and a 20-foot westbound lane. Parking would be permitted at the westbound curb and prohibited in the eastbound lane. Parking would be allowed on the west side of Portland Street south of the channelization area.

The estimated cost of the recommended improvements plan is $2,300.



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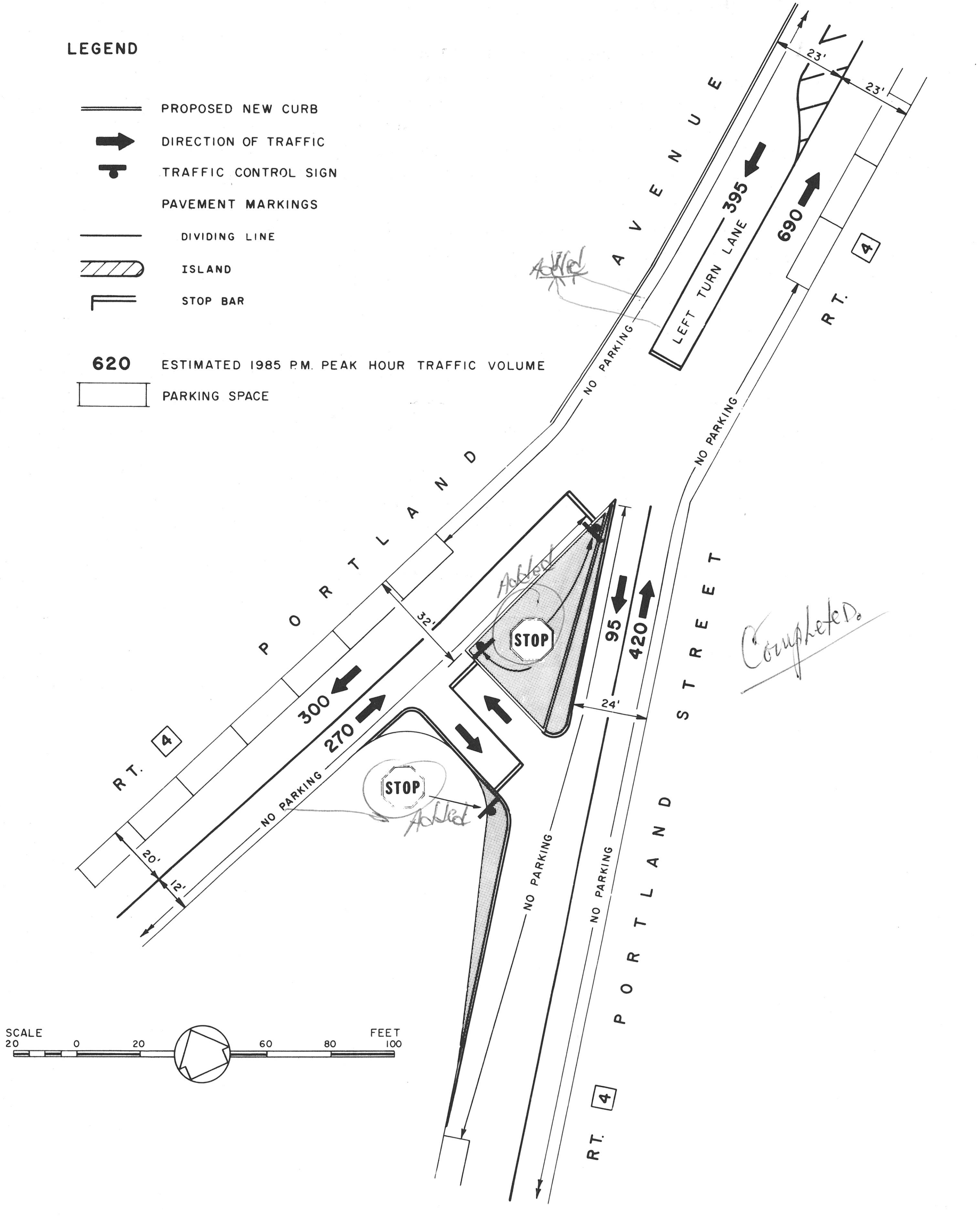
ENGINEERS AND ARCHITECTS NEW YORK

EXISTING CONDITIONS

FIGURE 15A



RECOMMENDED IMPROVEMENTS PORTLAND AVENUE - PORTLAND STREET, DOVER

FIGURE 15B

BROADWAY STREET-ST. JOHN STREET, DOVER

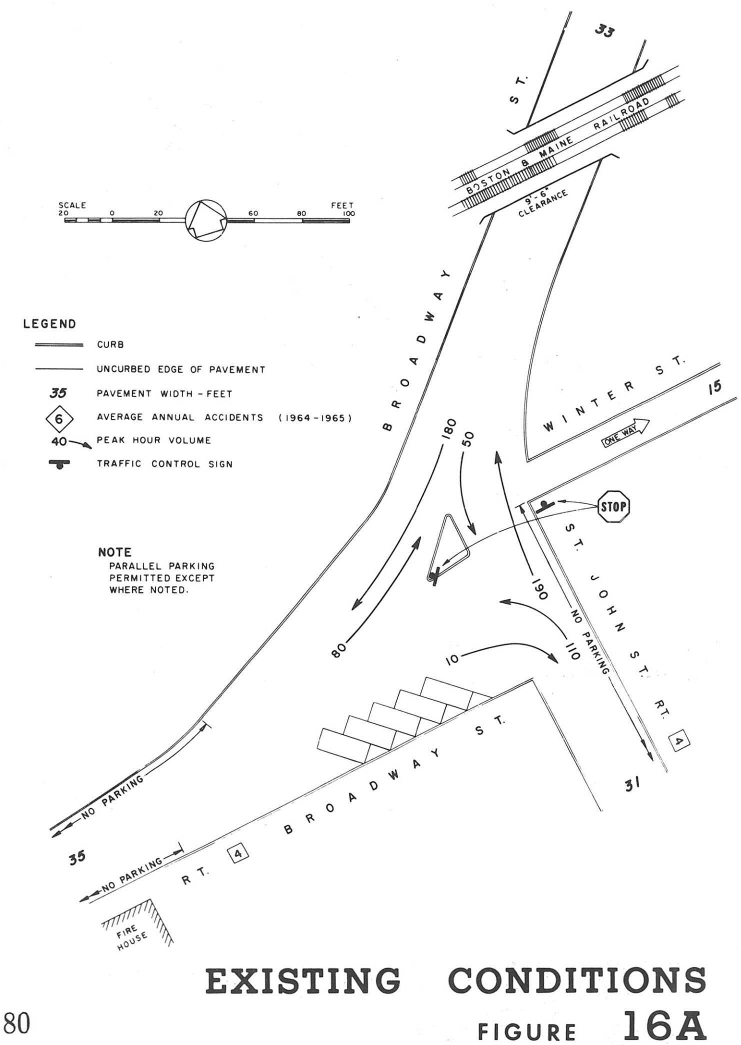
The wide expanse of uncontrolled pavement on Broadway Street at St. John Street and the lack of turn controls presents safety hazards to both vehicular and pedestrian traffic. The two stop signs at Broadway Street and St. John Street, which control northbound St. John Street traffic, are the only existing regulatory control devices. All possible turns, including "U" turns around the channelizing island, are permitted. Curbside parking is permitted, except on the east side of St. John Street and on Broadway Street at the City Fire Station.

It is recommended that the existing channelizing island be replaced with a larger island to control the turning movement from St. John Street to Broadway, which would be one-way westbound between the Fire Station and Central Avenue. The channelization would provide a separate eastbound lane for fire trucks.

It is recommended that the centerline on St. John Street be offset by 3.5 feet to develop a 12-foot northbound lane and a 19-foot southbound lane. Parking on St. John Street would continue to be permitted only at the southbound curb. Parking would be prohibited in and adjacent to the channelization area, but elsewhere all existing parking regulations would be retained. Approximately 15 on-street parking spaces would be lost as a result of making the recommended improvements at this location.

The existing stop sign at the corner of St. John Street and Winter Street would be retained and a stop sign would be installed to control right turns from Broadway Street to St. John Street. Curb radii at these corners would be increased to at least 15 feet.

The estimated cost of the recommended improvements is $4,400.



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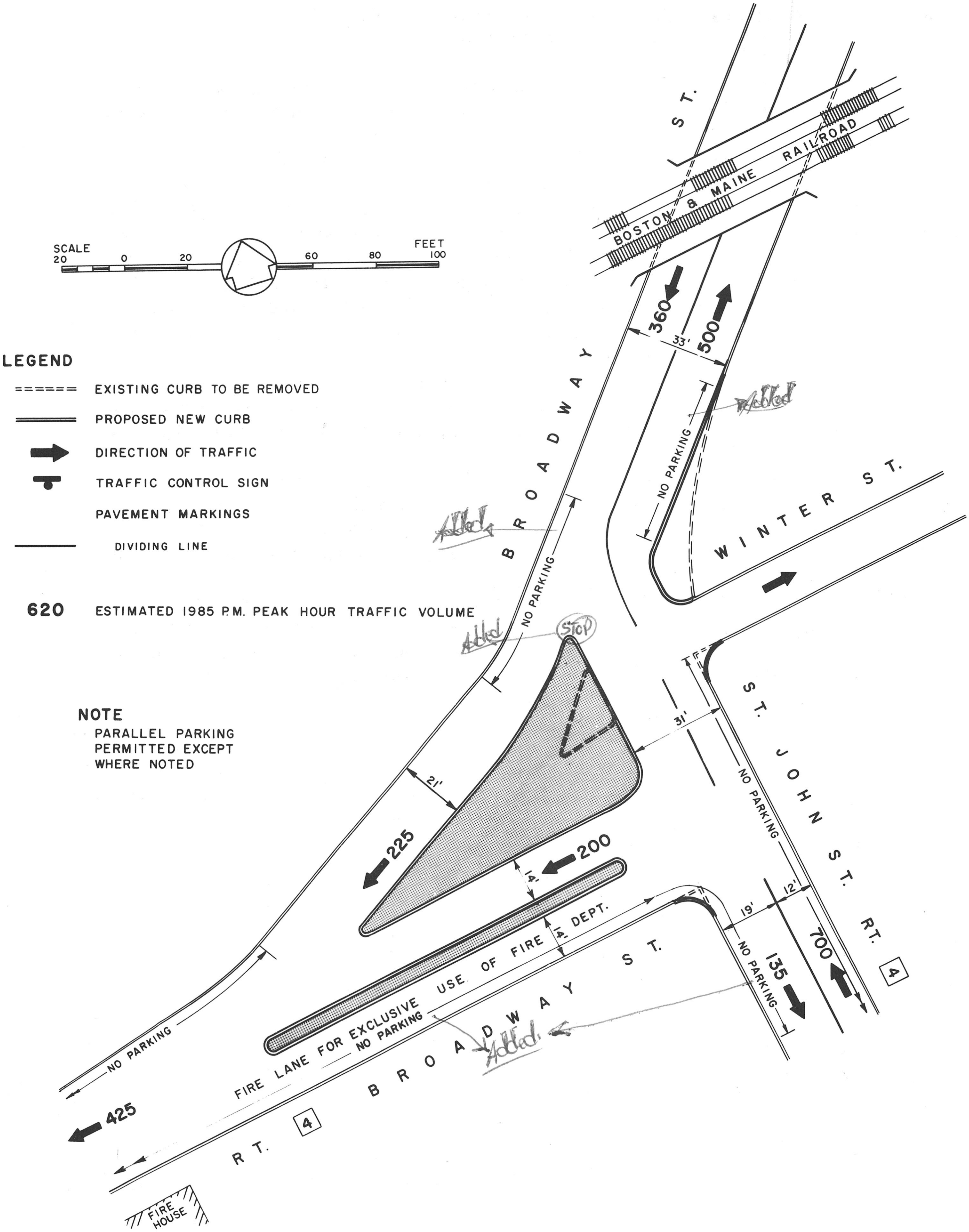
EXISTING CONDITIONS
FIGURE 16A



RECOMMENDED IMPROVEMENTS BROADWAY STREET — ST. JOHN STREET, DOVER

FIGURE **16B**

CENTRAL AVENUE-GLENWOOD AVENUE TO DOVER-SOMERSWORTH TRAFFIC CIRCLE, DOVER

At the Central Avenue-Glenwood Avenue intersection, all possible movements and turns are permitted; stop signs control movements from Glenwood Avenue. There are no posted curbside parking regulations.

It is recommended that the through pavement on Central Avenue at Glenwood Avenue be widened and divided into three 12-foot lanes, consisting of one through lane in each direction and a separate left turn holding lane, as shown in Figure 17B. Curbed channelizing islands and a partially-actuated traffic signal are also recommended. The channelization would provide four separate one-way roadways for turning movements to and from Glenwood Avenue. The traffic signal would have two fixed phases for Central Avenue traffic and an actuated phase for left turns from Glenwood Avenue to Central Avenue. Curbside parking would be prohibited on both sides of Central Avenue and within the four turning roadways.

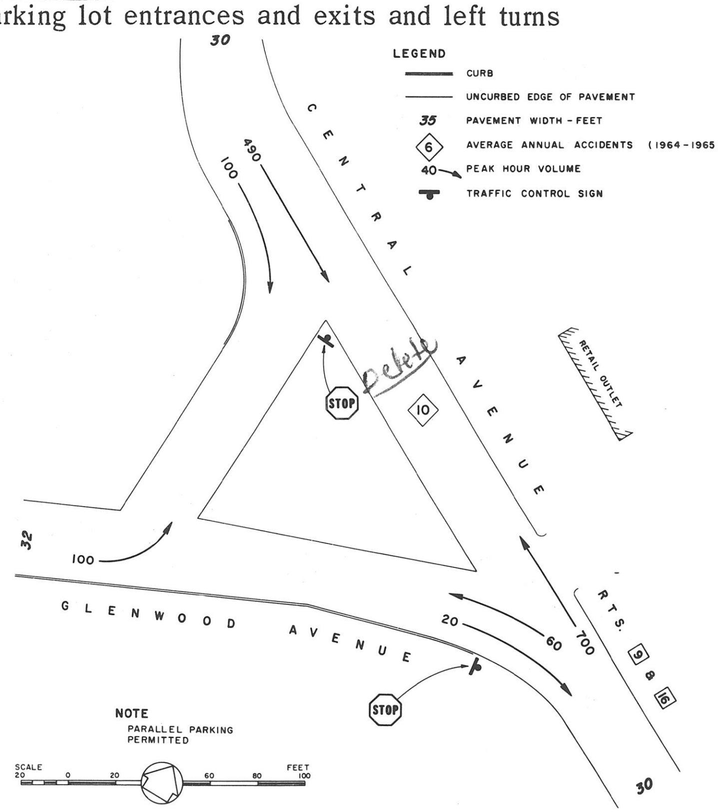
The 3,000-foot long stretch of Central Avenue (Routes 9 and 16) shown in Figure 17C is popularly known as Dover's "Miracle Mile". In recent years, several large retail outlets and recreational centers have been built along this heavily travelled arterial route.

The existing Central Avenue roadway consists of an undivided pavement 21.5 feet wide, flanked by unimproved shoulders with an average width of 10 feet. There are no existing access controls and the roadway is curbed only for relatively short segments. As a result, entrances and exits at most parking lots are unmarked and vehicles can enter or leave the roadway at virtually any point.

It is recommended that the Central Avenue roadway from south of Glenwood Avenue to the Dover-Somersworth Traffic Circle, be widened to a curb-to-curb width of 40 feet, and generally subdivided into two 12-foot through lanes, separated by a 16-foot median. The median would be opened at parking lot entrances and exits and left turns from central Avenue would be made from a separate lane located within the median area. Parking lot entrances and exits would be consolidated and delineated with drop curbs. In order to keep construction costs to a minimum, the median would be delineated with pavement markings and curbs would be used only at and adjacent to the auxiliary left turn lanes.

At the Dover-Somersworth traffic circle it is recommended that pavement restrictions be applied as shown in Figure 17D to improve the definition of travel paths.

The total cost of the recommended improvements, including the channelization at Glenwood Avenue and the pavement markings at the traffic circle, is estimated at $78,000. The current annual cost of accidents at this location is estimated at $48,000.



TIPPETTS - ABBETT - McCARTHY - STRATTON
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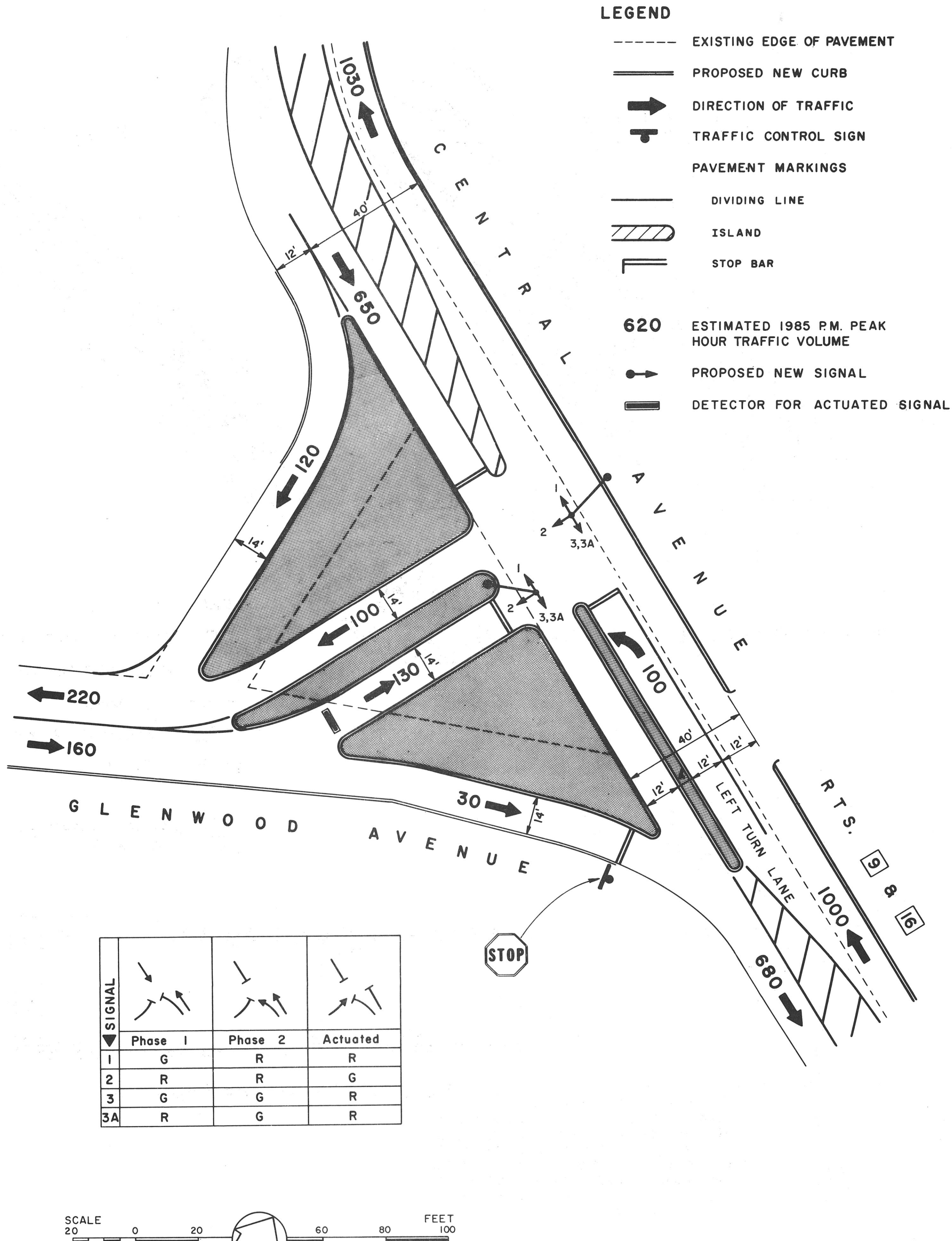
EXISTING CONDITIONS

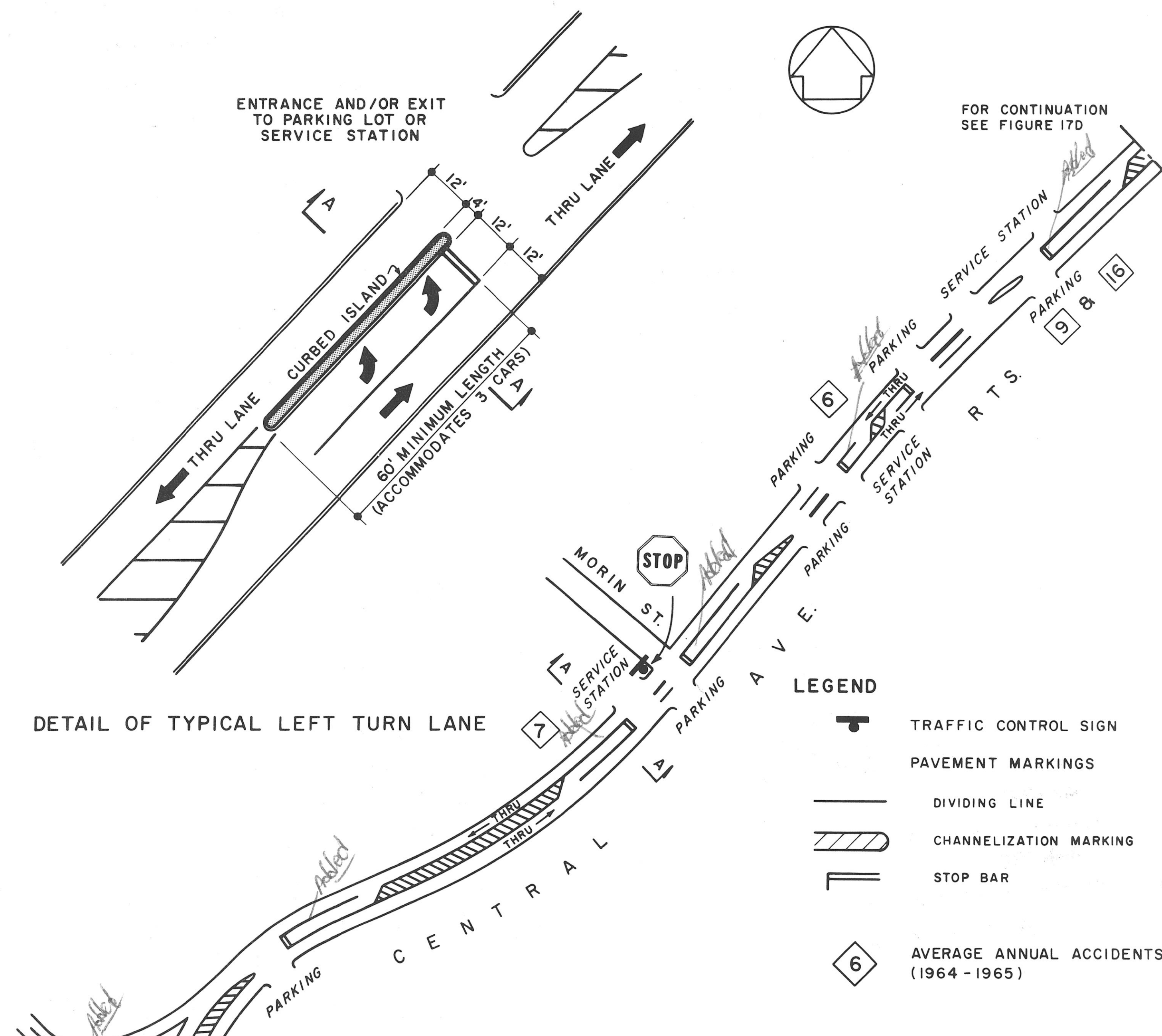
FIGURE **17A**

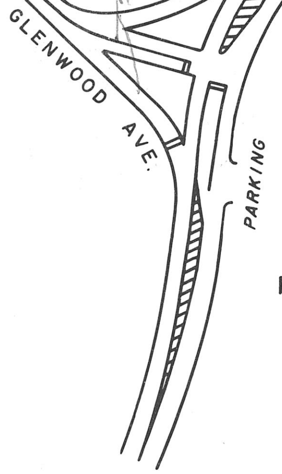


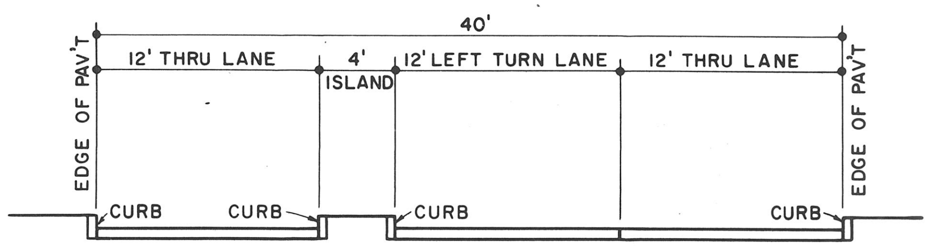
SIGNAL	Phase 1	Phase 2	Actuated
1	G	R	R
2	R	R	G
3	G	G	R
3A	R	G	R

RECOMMENDED IMPROVEMENTS CENTRAL AVENUE - GLENWOOD AVENUE, DOVER

FIGURE **17B**







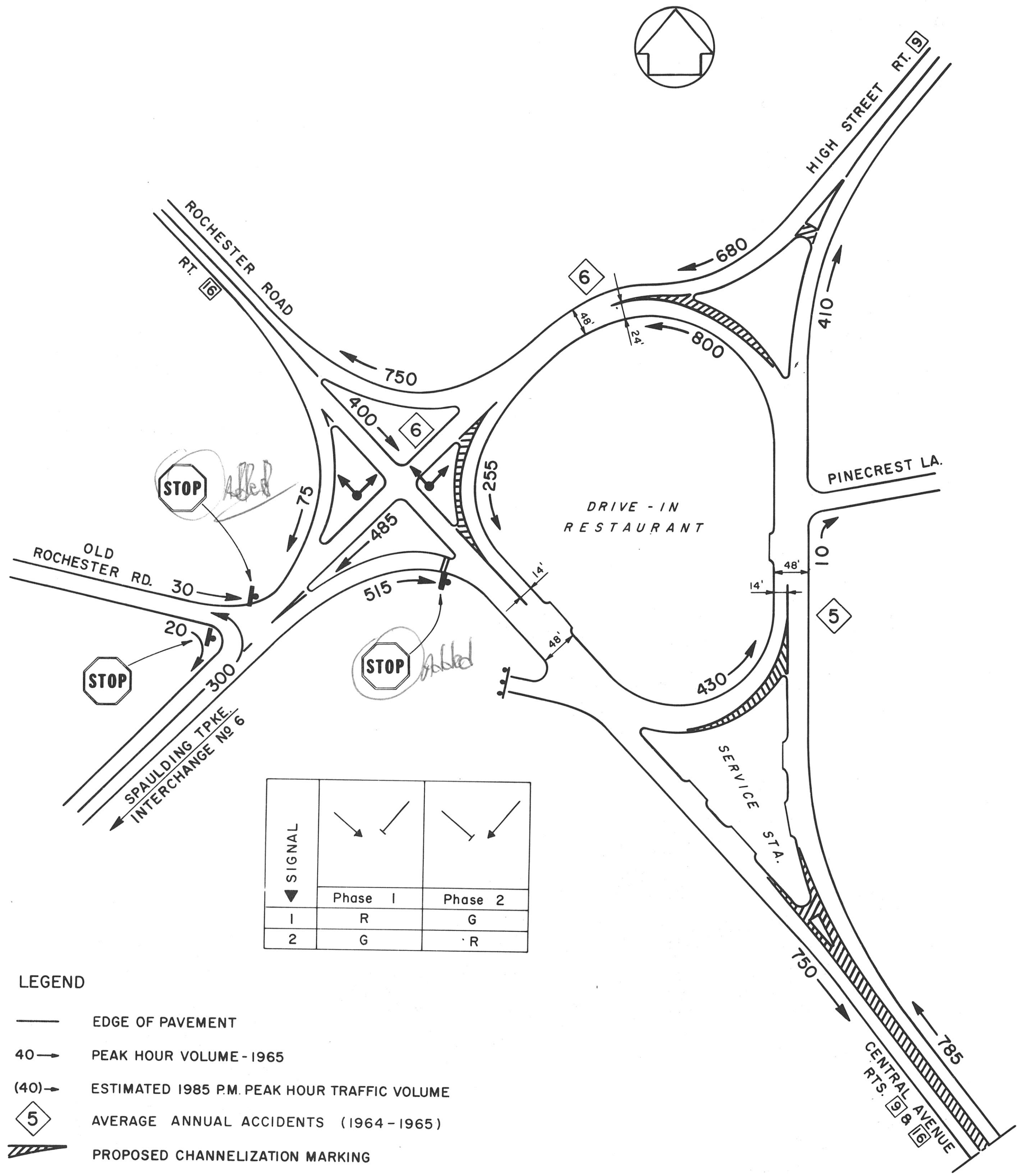
TYPICAL SECTION WITH LEFT TURN LANE

NOTE

THE PLAN SHOWN ABOVE IS SCHEMATIC AND IS NOT TO SCALE. THE LOCATIONS OF EXISTING PARKING FACILITIES AND SERVICE STATIONS ARE APPROXIMATE. CHANNELIZATION SHOWN IS TYPICAL FOR CENTRAL AVE. BETWEEN GLENWOOD AVE. AND THE DOVER-SOMERSWORTH TRAFFIC CIRCLE.

RECOMMENDED IMPROVEMENTS • MIRACLE MILE, DOVER

FIGURE **17C**



SIGNAL	Phase 1	Phase 2
1	R	G
2	G	R

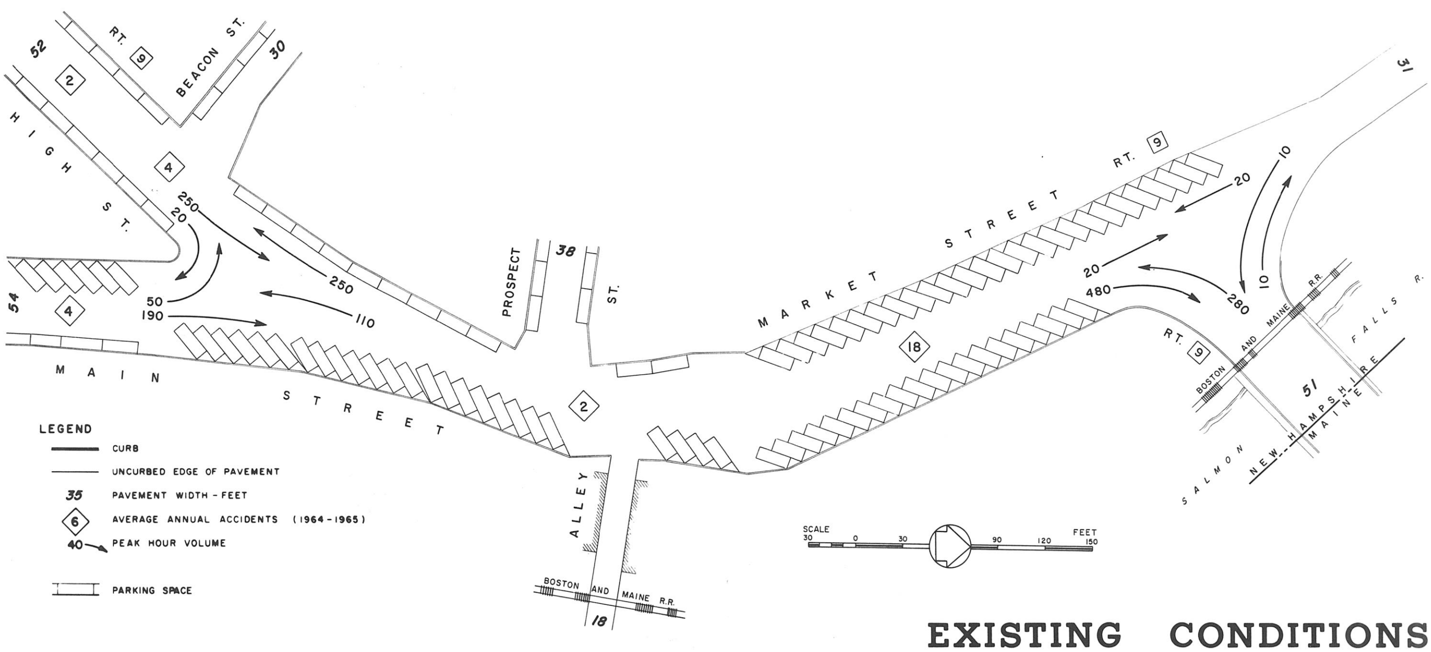
LEGEND

- EDGE OF PAVEMENT
- 40→ PEAK HOUR VOLUME - 1965
- (40)→ ESTIMATED 1985 P.M. PEAK HOUR TRAFFIC VOLUME
- ◇5 AVERAGE ANNUAL ACCIDENTS (1964 - 1965)
- PROPOSED CHANNELIZATION MARKING
- TRAFFIC CONTROL SIGN
- EXISTING TRAFFIC SIGNAL

FOR CONTINUATION
SEE FIGURE 17C

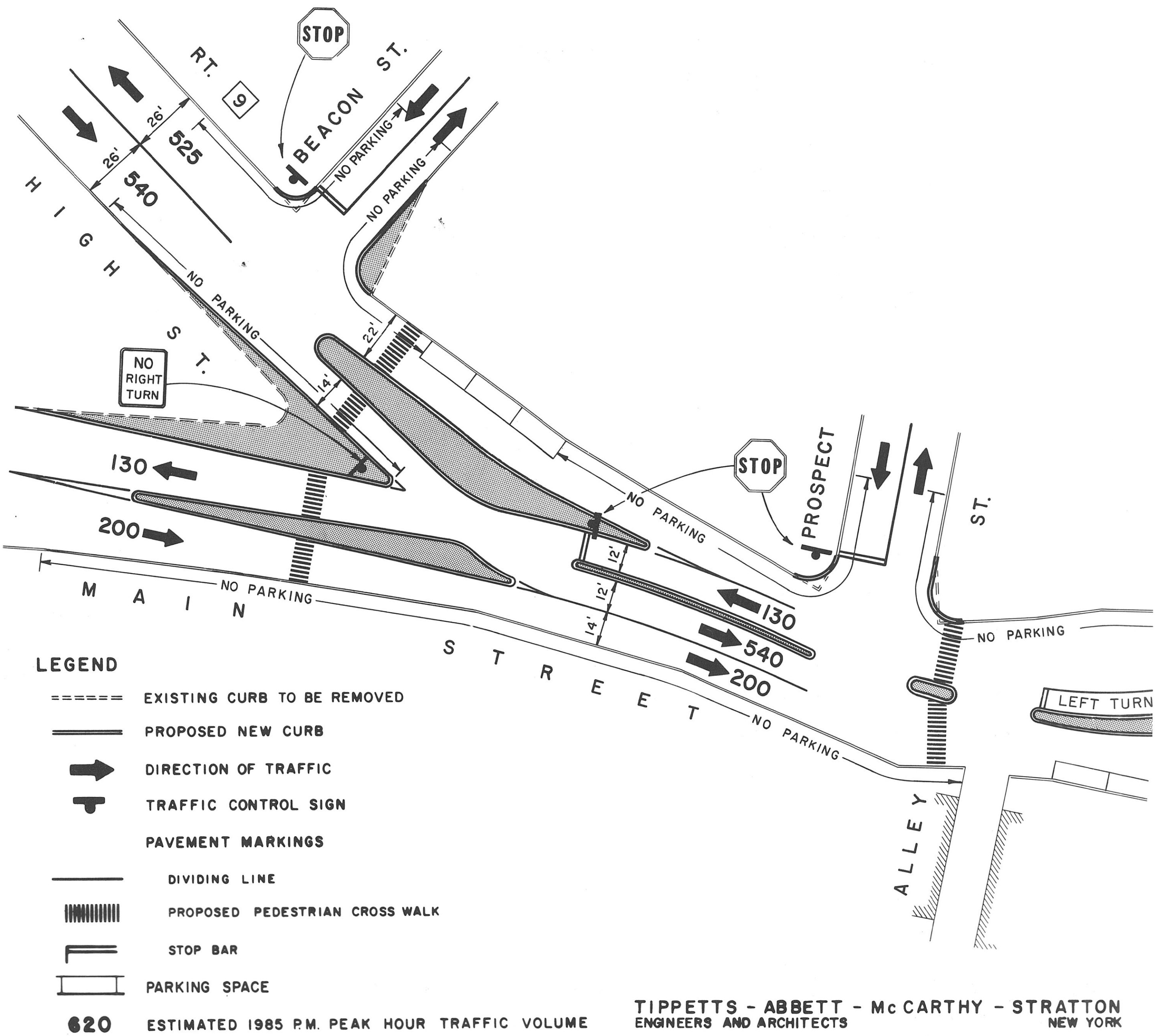
RECOMMENDED IMPROVEMENTS DOVER - SOMERSWORTH TRAFFIC CIRCLE

FIGURE 17D



EXISTING CONDITIONS

FIGURE 18A



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MARKET STREET: MAIN AND HIGH STREETS TO BERWICK, BRIDGE, SOMERSWORTH

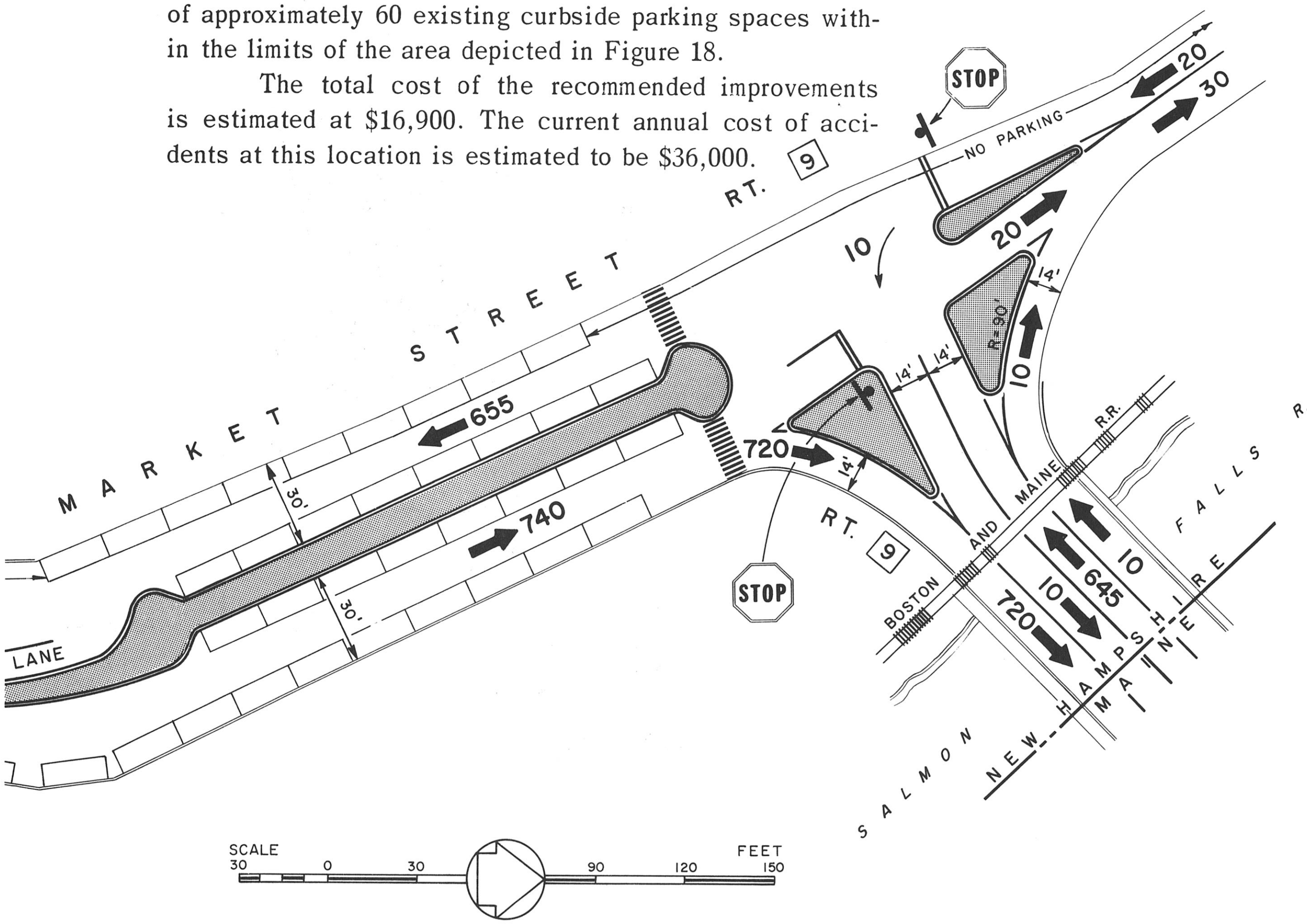
At this location there are no existing traffic controls, parking regulations or pavement markings, and all possible turning movements including "U" turns are permitted. Parking is unrestricted and most spaces are angled to the curb.

There is considerable congestion several times a day on Market Street at the privately owned alley leading to an industrial plant parking lot on the east bank of the power company canal via a one-lane bridge. Extensive right-of-way acquisition and construction would be required for any improvement at this location. Police officer control during periods when large numbers of vehicles are entering or leaving the parking lot can insure safe operation.

It is recommended that curbed channelizing islands be installed at the intersection of Market Street, Main Street, and High Street and at the end of the Berwick Bridge. These islands would provide well defined travel paths and also serve as pedestrian safety zones. Potential conflicting movements at these locations would be controlled with stop signs. It is also recommended that a median island be constructed on Market Street between Prospect Street and the Berwick Bridge; centerlines be marked on Main Street and High Street; a centerline and lane lines marked on the Berwick Bridge; and stop lines marked in conjunction with stop signs. Stop signs would be installed on Prospect Street and Beacon Street and corner radii at these intersections would be increased to 15 feet.

These improvements would require the elimination of approximately 60 existing curbside parking spaces within the limits of the area depicted in Figure 18.

The total cost of the recommended improvements is estimated at $16,900. The current annual cost of accidents at this location is estimated to be $36,000.



RECOMMENDED IMPROVEMENTS

FIGURE 18B

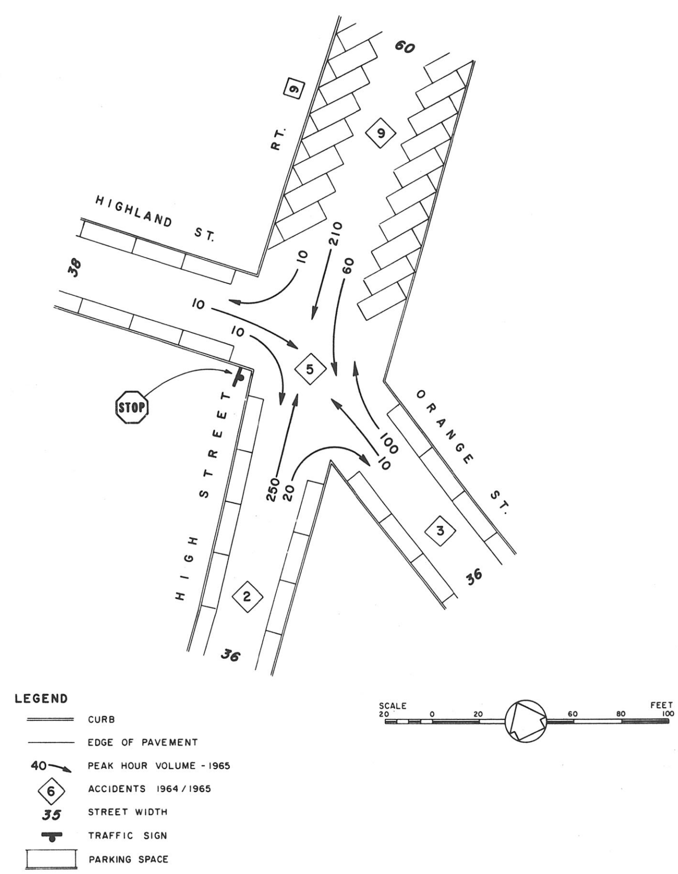
MARKET STREET - MAIN & HIGH STREETS TO BERWICK BRIDGE, SOMERSWORTH

HIGH STREET-ORANGE STREET-HIGHLAND STREET, SOMERSWORTH

All possible turning movements are permitted at this intersection. The stop sign regulating Highland Street traffic is the only existing traffic control device. There are no parking regulations or pavement markings.

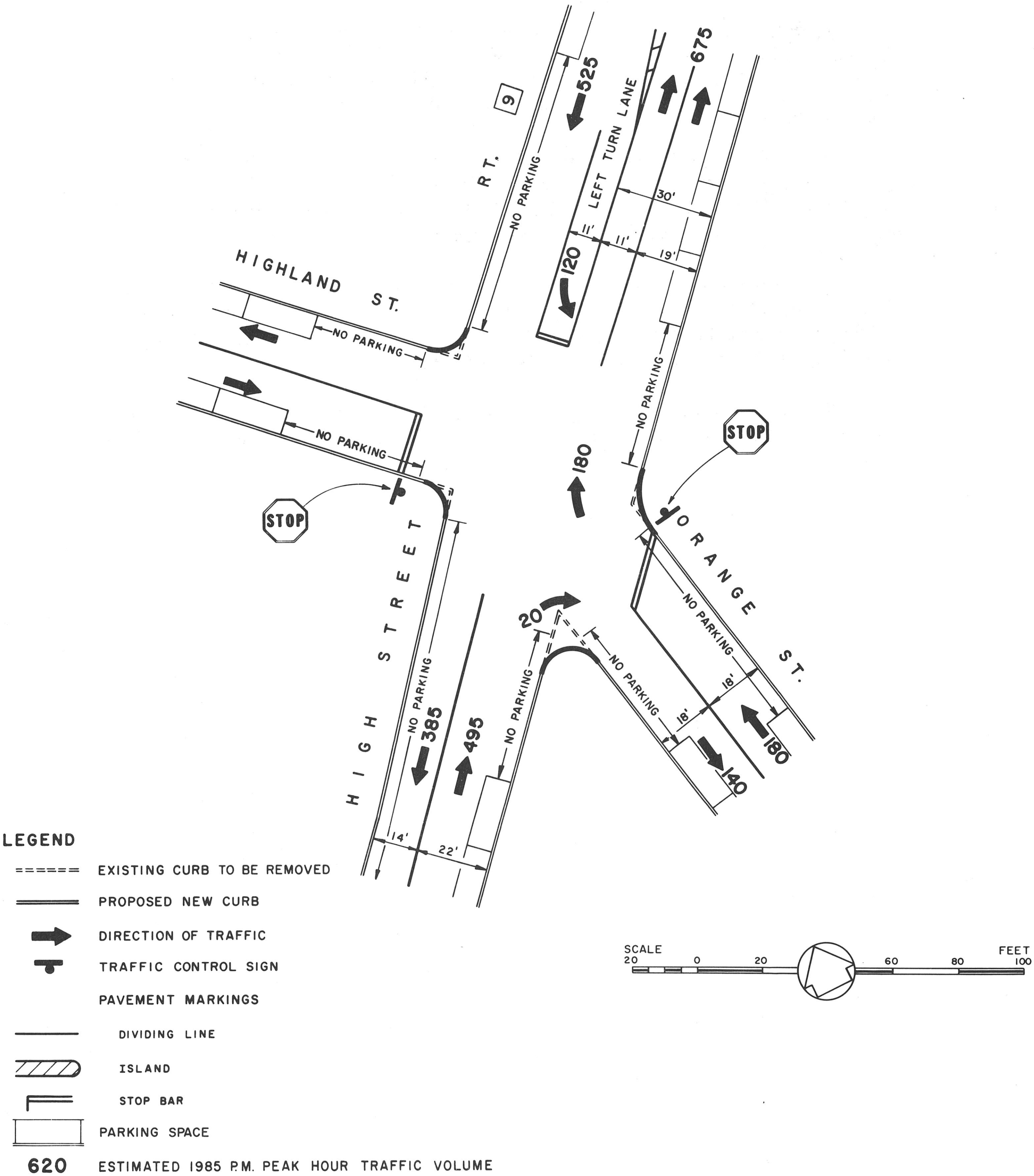
It is recommended that centerlines be marked on all approaches and a separate left turn holding lane be designated on the east approach of High Street. It is also recommended that traffic on Highland Street and Orange Street be controlled with stop signs; stop lines would be marked in conjunction with these signs, and corner radii would be enlarged to at least 15 feet. Parking would be restricted on the intersection approaches; elsewhere, parallel parking would be permitted. Within the limits of the area shown in Figure 19 approximately 29 existing on-street parking spaces would be lost as a result of implementing these proposals.

The estimated cost of the recommended improvements is $1,400. The current cost of accidents at this location is estimated at $19,200 annually.



TIPPETTS - ABBETT - McCARTHY - STRATTON
ENGINEERS AND ARCHITECTS NEW YORK

EXISTING CONDITIONS
FIGURE 19A



HIGH STREET - ORANGE STREET
HIGHLAND STREET, SOMERSWORTH

RECOMMENDED IMPROVEMENTS
FIGURE 19B

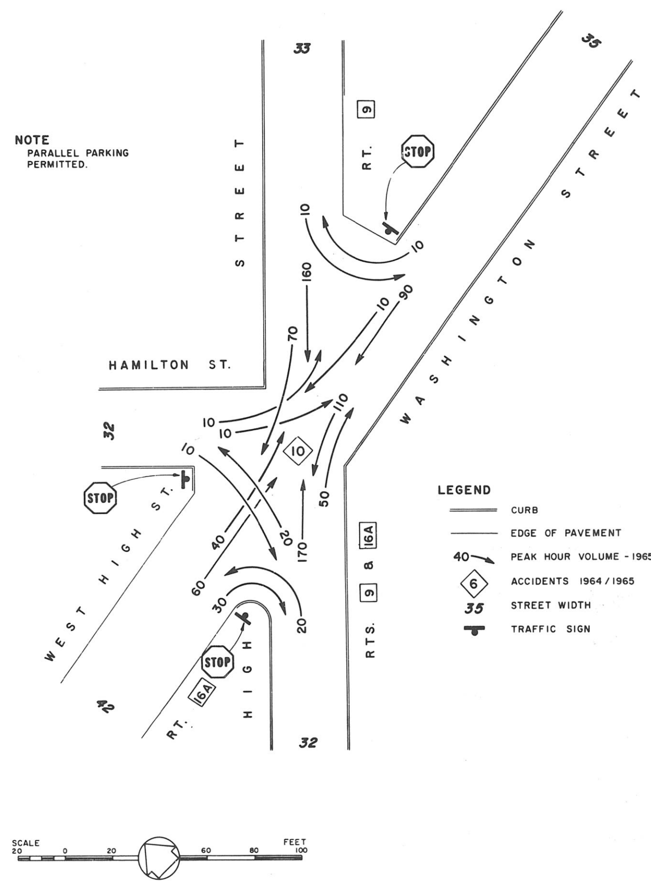
HIGH STREET-WEST HIGH STREET-WASHINGTON STREET-HAMILTON STREET, SOMERSWORTH

At this location all possible turning movements are permitted and there are no curbside parking restrictions. Traffic on Washington Street, West High Street and Hamilton Street is controlled by stop signs. However, sight distances are restricted by abutting buildings and stop signs cannot effectively control movements.

It is recommended that a traffic signal, centerlines and stop lines be installed. Washington Street, West High Street and High Street traffic would operate on fixed time phases. Hamilton Street traffic would operate on a separate actuated phase because the relatively low volumes do not warrant a regular phase.

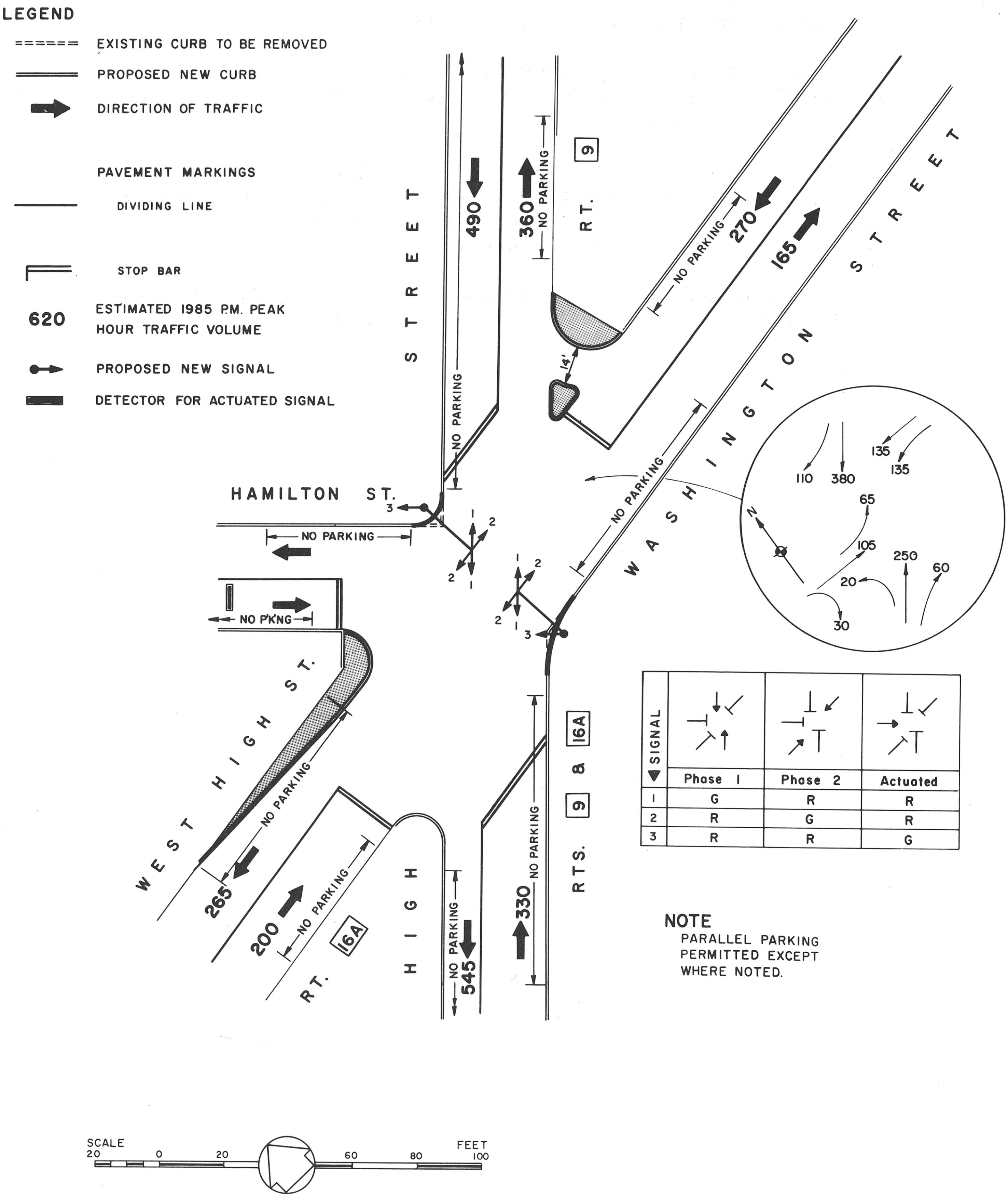
It is recommended that curbside parking be prohibited on the west side of High Street and on all approaches for 50 feet on either side of the intersection; elsewhere, curbside parking would be permitted. Within the limits of the area depicted in Figure 20 approximately 25 curbside spaces would be eliminated.

The estimated cost of the improvements is $8,700 of which the signal would account for $5,600. The current cost of accidents at this location is estimated at $12,000 per year.



TIPPETTS - ABBETT - McCARTHY - STRATTON
ENGINEERS AND ARCHITECTS NEW YORK

EXISTING CONDITIONS
FIGURE 20A



SIGNAL	Phase 1	Phase 2	Actuated
1	G	R	R
2	R	G	R
3	R	R	G

HIGH STREET - WEST HIGH STREET - WASHINGTON STREET - HAMILTON STREET, SOMERSWORTH

RECOMMENDED IMPROVEMENTS

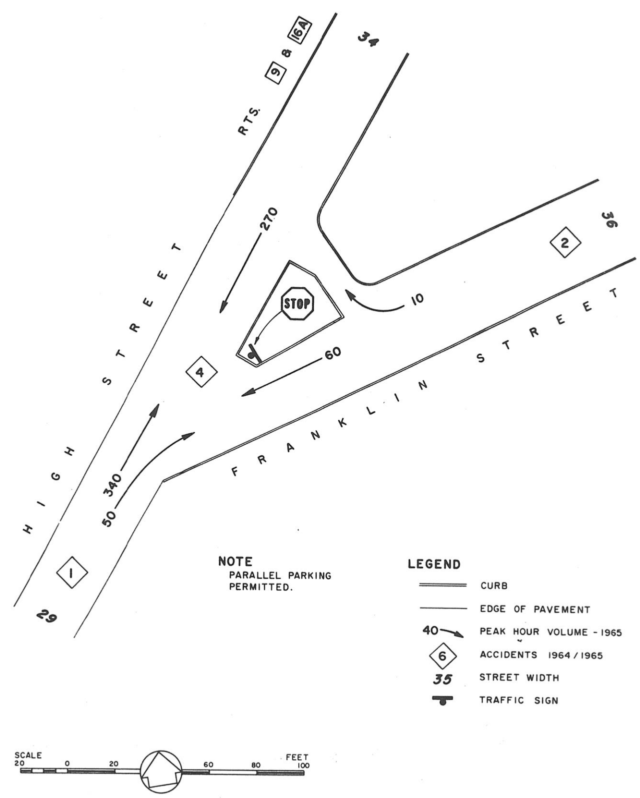
FIGURE 20B

HIGH STREET-FRANKLIN STREET, SOMERSWORTH

The non-uniform stop sign on Franklin Street is the only existing traffic control device, there are no pavement markings or curbside parking restrictions, and all possible turning movements are permitted.

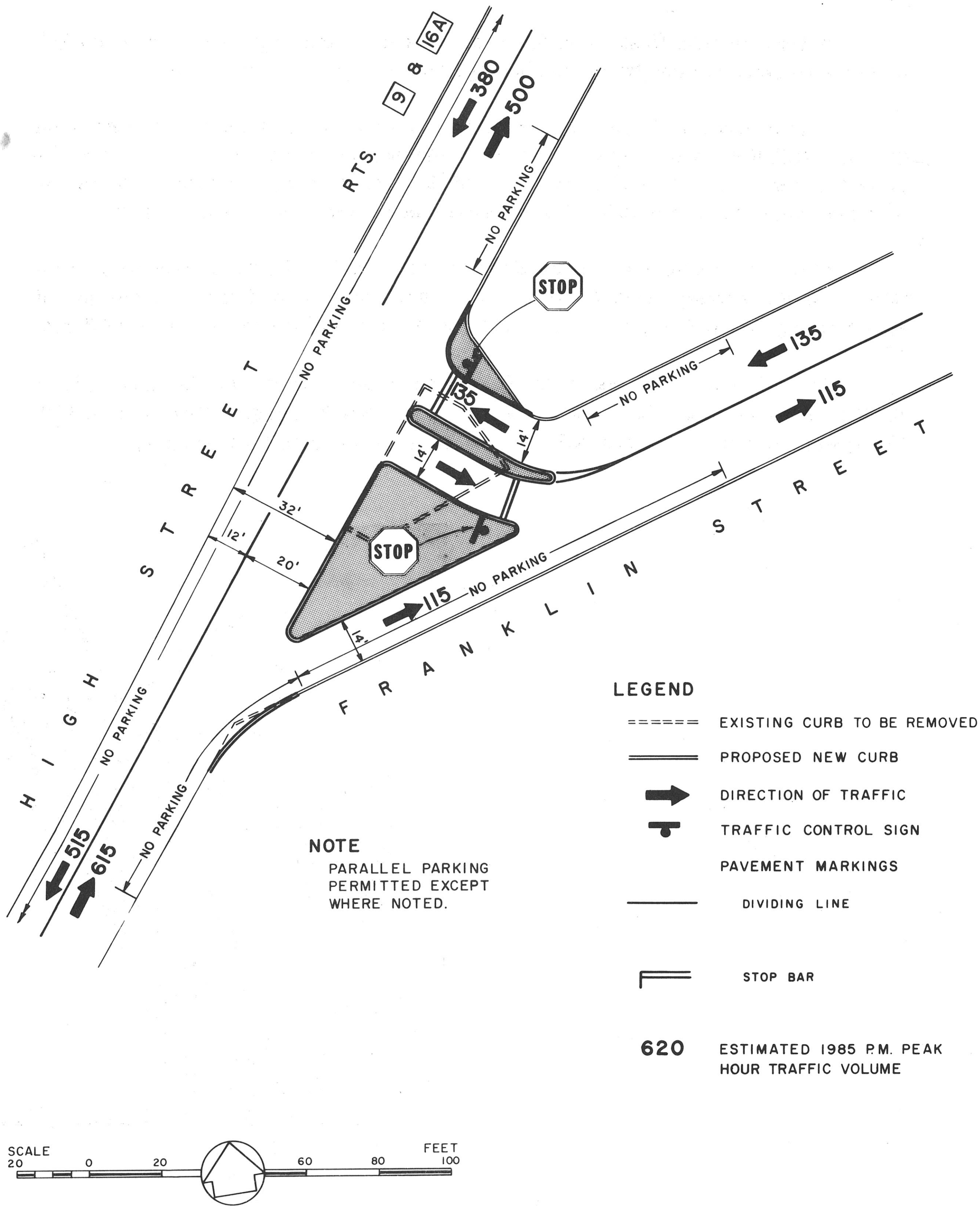
It is recommended that the existing channelization be replaced with the standard channelization and traffic controls for "T" intersections. It is also recommended that center and stop lines be marked and curbside parking be restricted within the channelization area; elsewhere, parking would be permitted.

The estimated cost of the recommended improvements is $3,100. The current annual cost of accidents at this location is estimated at $8,400.



TIPPETTS - ABBETT - McCARTHY - STRATTON
ENGINEERS AND ARCHITECTS NEW YORK

EXISTING CONDITIONS
FIGURE 21A



RECOMMENDED IMPROVEMENTS HIGH STREET - FRANKLIN STREET, SOMERSWORTH

FIGURE 21B

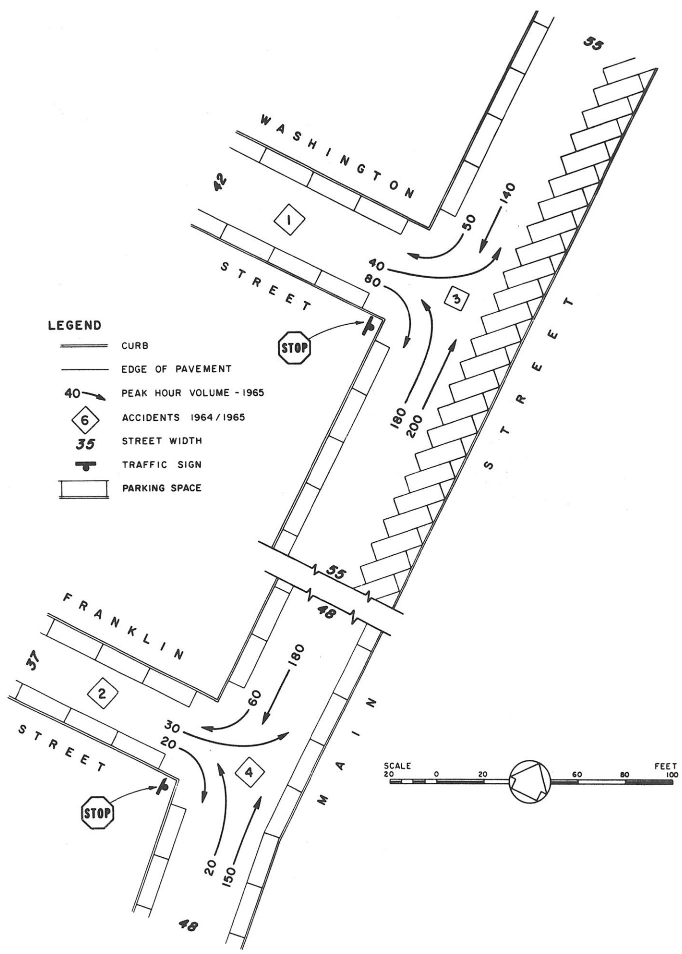
MAIN STREET-FRANKLIN STREET AND MAIN STREET-
WASHINGTON STREET, SOMERSWORTH

Movements from Washington Street and Franklin Street are stop sign controlled; there are no other existing traffic parking regulations or pavement markings.

It is recommended that a centerline be marked on Main Street from Market Street to Indigo Hill Road and a separate left turn holding lane be designated at the more important intersections. It is also recommended that traffic on cross streets be controlled with stop signs and corner radii at intersections be increased to at least 15 feet.

Curbside parking would be prohibited in the vicinity of both intersections; elsewhere parallel parking would be permitted. These changes will result in the loss of approximately 35 existing parking spaces within the limits of the area depicted in Figure 22.

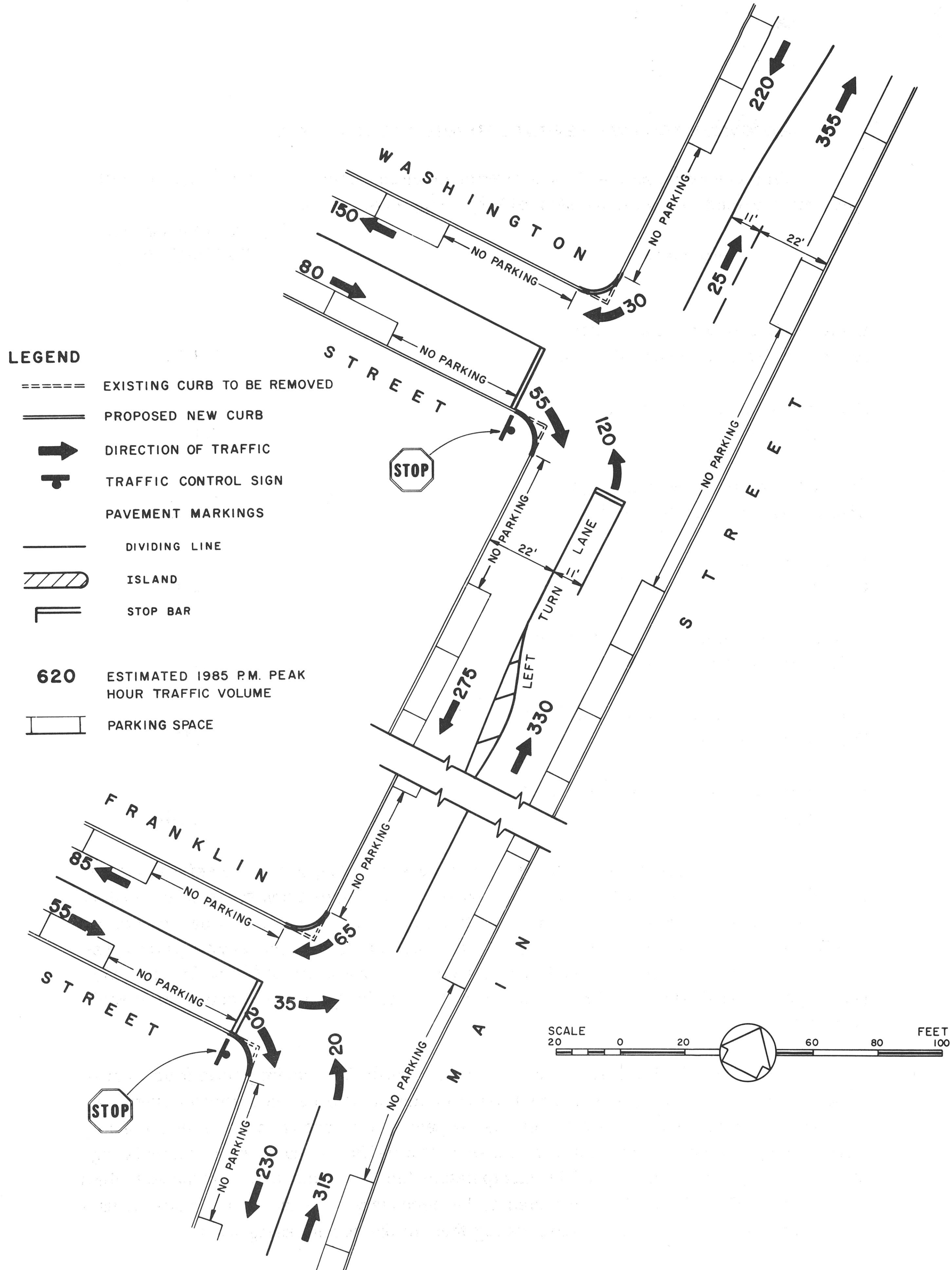
The estimated total cost of the improvements recommended for the intersections of Main Street and Franklin Street, and Main Street and Washington Street, is $1,900. The current cost of accidents at this location is estimated at $12,000 annually.



TIPPETTS – ABBETT – Mc CARTHY – STRATTON
ENGINEERS AND ARCHITECTS NEW YORK

EXISTING CONDITIONS

FIGURE 22A



MAIN STREET - FRANKLIN STREET AND MAIN STREET - WASHINGTON STREET, SOMERSWORTH

RECOMMENDED IMPROVEMENTS

FIGURE 22B

RECOMMENDED IMPROVEMENTS TO MEET FUTURE NEEDS

Traffic volumes on most of the arterial route corridors in the Dover-Somersworth area are expected to increase substantially by 1985, as shown below:

Location	Ratio of 1985 Traffic To 1965 Traffic
Entering Central Dover from East: Broadway Street and Portland Avenue	1.74
Entering Central Dover from North: Central Avenue	1.37
Entering Central Dover from West: Washington Street and Silver Street	1.60
Entering Central Dover from South: Central Avenue	1.43
Entering Central Somersworth from South: Main Street and Green Street	1.56
Entering Central Somersworth from West: High Street	1.67
Entering Central Somersworth from North: West High Street	1.74

As noted earlier, forecasted 1985 traffic was first assigned to the existing arterial highway system modified by incorporation of the 13 improvements recommended for immediate implementation to meet current traffic demands. An evaluation of the results of this assignment indicated that, except in the Central Dover area, existing highways and intersections as improved would be adequate to accommodate 1985 traffic with only minor modifications such as elimination of on-street parking and modifications in signal control.

In the Central Dover area, more elaborate measures including certain new construction and changes in one-way street patterns appeared to be necessary to overcome deficiencies in the existing street network to permit it to accommodate future traffic. Accordingly, a second assignment of forecasted 1985 traffic was made using the existing arterial highway network updated by incorporating the immediate action proposals plus additional modifications which appeared to be necessary. Certain other types of improvements were also tested by incorporating them in the second assignment.

The recommendations described below for improvements required to meet future needs were based on analyses of the results of the traffic assignment. In a later section of this chapter some of the proposals that were also considered but which are not recommended are discussed. Estimated construction costs of the recommended improvements are summarized and a suggested priority schedule is presented.

CHESTNUT STREET BRIDGE IN DOWNTOWN DOVER

The assignment of 1985 traffic to the existing system updated by the immediate action proposals showed that the Central Avenue and Washington Street crossings of the Cocheco River would be required to accommodate 42% more traffic in 1985 than they actually handled in 1965, unless a new crossing were provided. On Central Avenue, Main Street, and Washington Street in downtown Dover and through Upper and Lower Squares anticipated increases in traffic would cause serious problems unless steps were taken to provide additional street capacity. Much of the on-street parking would have to be eliminated, at least during peak periods, on Central Avenue, Washington Street and Main Street to accommodate the heavy movement of traffic. Additional signalization would be required at Lower Square. Considerable congestion would still be expected during peak periods, particularly at the intersection of Broadway and Central Avenue and at Lower Square.

While the cost of the signal controls required at Lower Square is not large, the cost of providing off-street parking facilities to make up for the elimination of on-street spaces must also be taken into consideration. A detailed study of potential sites would be required to accurately determine the cost of replacing existing parking facilities. Even with the replacement of on-street parking by off-street facilities, the excessive volume of traffic which Central Avenue, Main Street, and Washington Street would be required to accommodate would cause congestion and increase accident potentials.

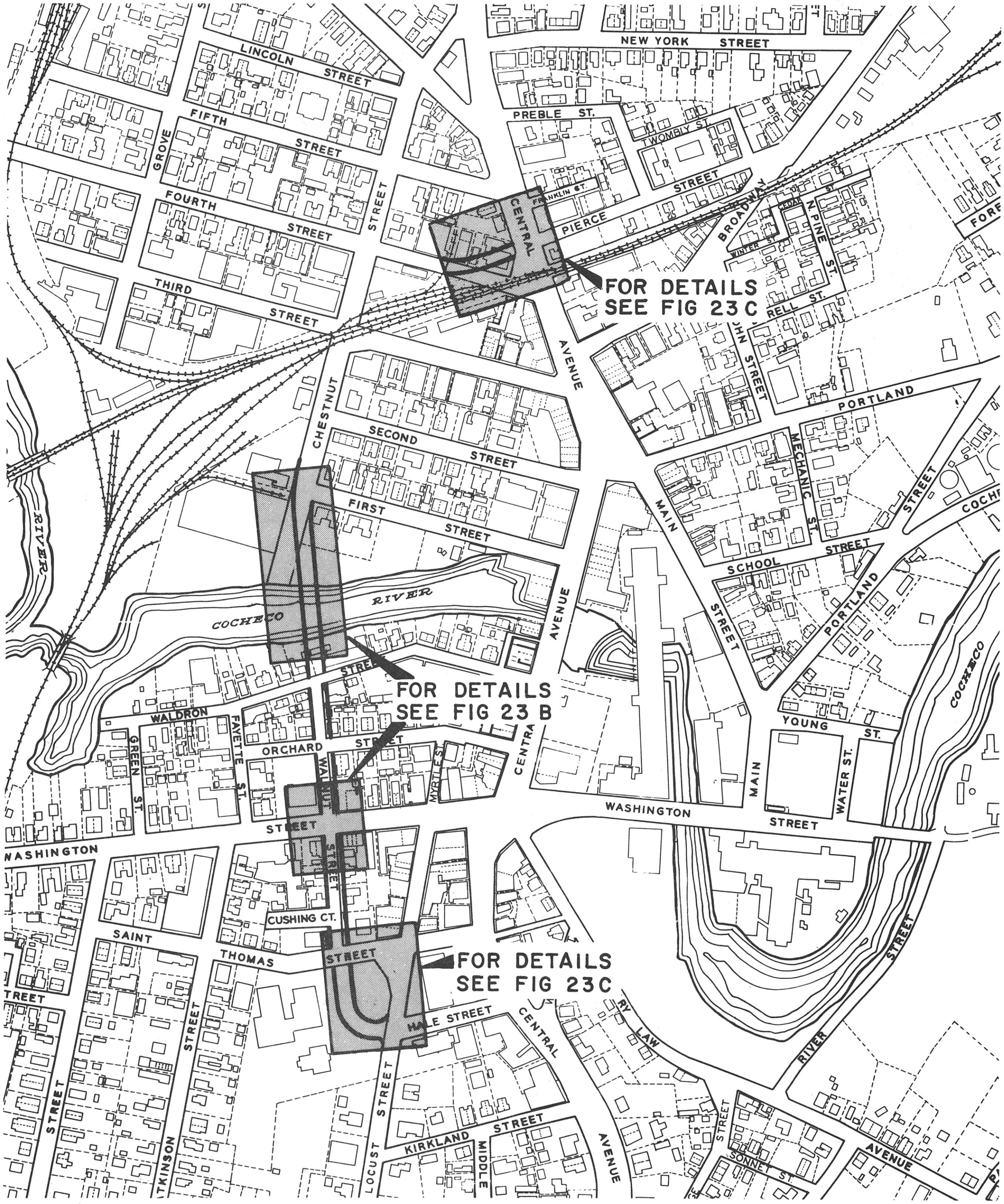
The recommended solution to the traffic problem in downtown Dover involves the construction of a new two-lane bridge (one lane in each direction) across the Cocheco River. The bridge would connect Chestnut Street on the north with Washington Street and Locust Street on the south. A similar bridge connection was proposed in the Dover Community Renewal Program. The bridge would accommodate about 10,000 vehicles per day in 1985 and would relieve considerably the existing river crossings. With the proposed bridge, the existing crossings on Central Avenue and Washington Street would be required to accommodate in 1985 about the same volume they handle today. With the other improvements discussed subsequently, the proposed bridge would provide an effective bypass of downtown Dover for through movements between the north (Central Avenue) and the west (Washington and Silver Streets) and would also serve the portion of the through east-west movements using Broadway Street.

The Cocheco River Bridge is shown in Figure 23. The proposed alignment extends from Chestnut Street at First Street, across the Cocheco River, and along the alignment of Walnut Street to Washington Street. South of Washington Street, Walnut Street would be extended to Locust Street to provide for movement of traffic to Silver Street via Locust Street and to Central Avenue via Hale Street. The estimated cost for the bridge connection and approaches is approximately $500,000, as shown below:

Item	Total Cost
Bridge Structure and Chestnut Street Approach to First Street	$310,000
Widening of Walnut Street North of Washington Street	10,000
Widening and Extension of Walnut Street to Locust Street	30,000
Right-of-way Acquisition Between First Street and Washington Street	90,000
Right-of-way Acquisition South of Washington Street	50,000
Traffic Control Devices	10,000
Total	**$500,000**

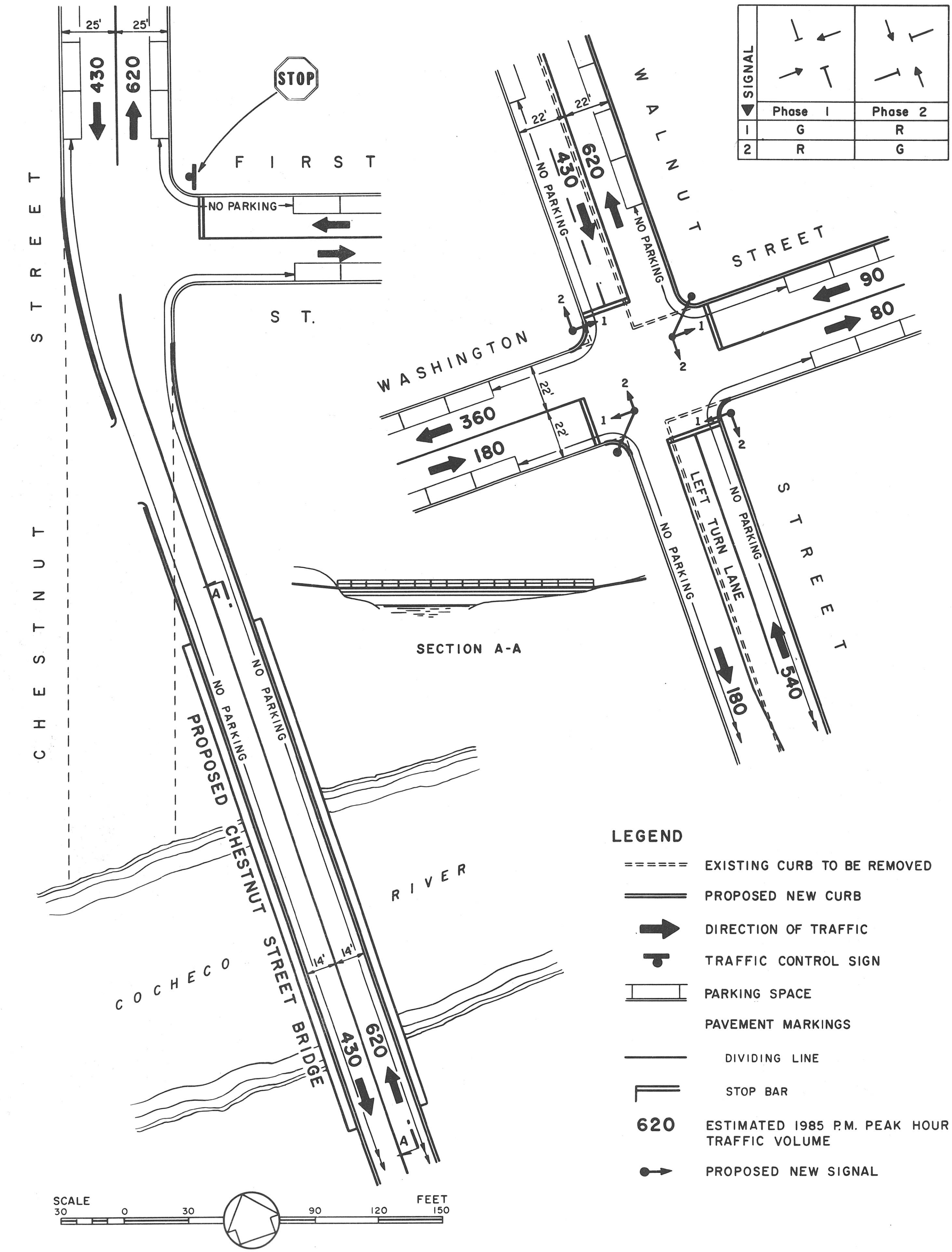
With the proposed bridge connection, anticipated peak hour volumes at Lower Square, Upper Square and other intersections in downtown Dover are shown in Figures 12B and 14B. Under the proposed scheme, traffic would flow relatively freely throughout downtown Dover. As a result of diverting some of the heavy through traffic away from Central Avenue and the indirect benefits that would accrue to merchants in the area, the proposed scheme would provide appreciable benefits to the road users. These would come primarily as a result of reducing traffic accident frequency and cutting down on the number of stops required by drivers in downtown Dover, thereby saving drivers time as well as vehicle operating costs.

Alternative alignments would require detailed study in the preliminary design stage. It is understood that the area bounded by Central Avenue, First Street, the railroad spur line and Washington Street is currently under application for an urban renewal project, and, of course, the location of the proposed connection must be carefully studied in relation to the nature and extent of the proposed redevelopment of this area. With respect to accessibility, it is likely that any location for the intersection of the proposed connection with Washington Street that lies between Locust Street and Atkinson Street will be essentially equal in attractiveness as an alternate to Central Avenue, if a suitable connection to Locust Street is provided south of Washington Street to minimize the necessity for vehicles using the proposed connection to pass through the Lower Square area. The proposed connection could, of course, tie directly into Locust Street at Wash-



RECOMMENDED 1985 IMPROVEMENTS

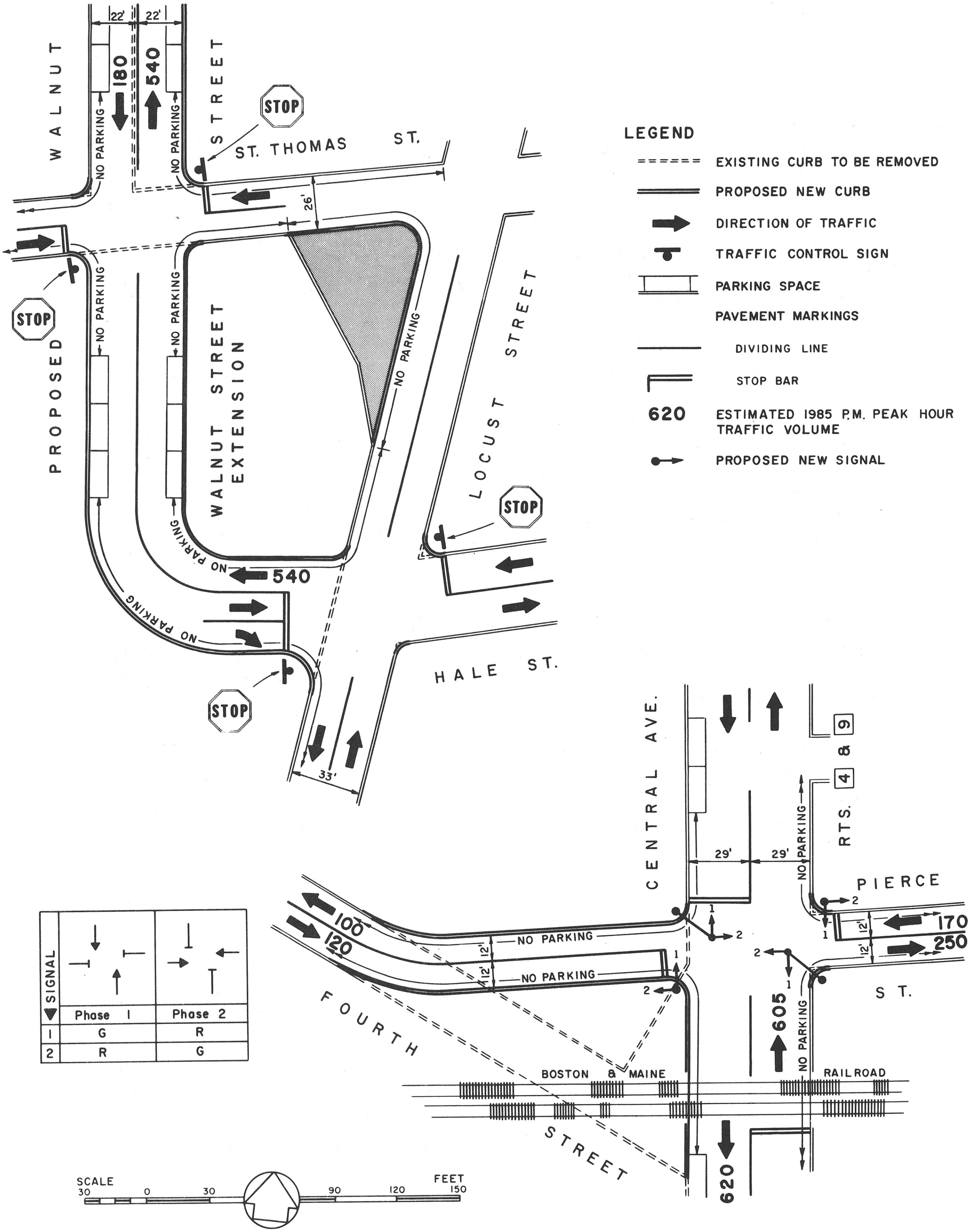
FIGURE 23A



RECOMMENDED 1985 IMPROVEMENTS

FIGURE **23B**

PROPOSED CHESTNUT STREET BRIDGE
WASHINGTON STREET - WALNUT STREET



RECOMMENDED IMPROVEMENTS

FIGURE 23C

PROPOSED WALNUT STREET EXTENSION
CENTRAL AVENUE - PIERCE STREET

ington Street and this alignment would probably serve traffic demands to 1985. However, a connection to Washington Street close to Lower Square would not handle traffic as efficiently as a connection further from the Square, since space is needed between the two intersections for queues of vehicles. The connection at Walnut Street is proposed in lieu of that at Atkinson Street in view of the greater ease with which a suitable connection can be developed south of Washington Street. Other alternative alignments are possible, of course, dependent upon plans for the proposed urban renewal area and longer range plans for redevelopment of areas south of Washington Street.

FOURTH STREET-PIERCE STREET-BROADWAY CONNECTOR, DOVER

It is recommended that Fourth Street west of Central Avenue be realigned to intersect Central Avenue opposite Pierce Street and be operated as a two-way street. It is also recommended that Pierce Street between Central Avenue and Broadway be improved by minor widening within the existing right-of-way, repaving and installation of curbing. A signal would be required at the Central Avenue intersection and would be integrated with the signalization of Upper Square. The proposed improvement is depicted in Figure 23C.

This proposal, which was also included in the Dover Community Renewal Program, would provide a better connection for east-west traffic between Broadway to the east, and Fourth Street and the proposed Chestnut Street bridge to the west. From the assignment of 1985 traffic to the trial future network, it was found that the volume of traffic that would cross Central on the proposed realigned Fourth Street-Pierce Street connector would be approximately 4,000 vehicles daily. Without the connector this traffic would have to turn on to Central Avenue and then off again a block or two away. Not only will the proposed straight-through connection speed up the movement of east-west traffic, but it will remove this traffic from Central Avenue, thereby relieving congestion on that route as well.

The total estimated cost of the recommended improvements is $108,000, including $70,000 for right-of-way.

ARCH STREET-WASHINGTON STREET ACCESS TO DOWNTOWN DOVER

Dover's Community Renewal Program contains a proposal for a new road between the Washington Street-Arch Street intersection and Silver Street at its junction with the northbound on-ramp to the Spaulding Turnpike. The connection would be approximately 0.4 miles in length, which is almost the same as the distance between the two points via existing Silver and Arch Streets. The objective of the proposal is to enhance the attractiveness of Washington Street as an access route between the Silver Street interchange and downtown Dover.

Currently the Silver Street route is favored by drivers traveling between downtown Dover and the Silver Street interchange of the Spaulding Turnpike, although the Arch Street-Washington Street route is approximately the same length. As traffic in this corridor increases it will become desirable to divert some drivers away from Silver Street to Washington Street. With the addition of the proposed new bridge across the Cocheco River, the Washington Street route would provide excellent service for drivers desiring to travel between the Silver Street interchange and the northern portion of central Dover or to the areas to the east served by Broadway Street.

The Community Renewal Program proposal for a new connection parallel to Arch Street was evaluated by adding a link to the traffic assignment network to represent the proposed connection. Travel speeds on Washington Street were increased somewhat to account for the fact that Washington Street would be improved between Arch Street and Belknap Street to a uniform curb-to-curb width and to a surface condition matching that which exists on Washington Street east of Belknap.

Approximately 4,400 vehicles would use the new connection on an average weekday in 1985. However, this traffic could be accommodated on existing Silver Street and on Arch Street if Arch Street were improved to a uniform well-graded cross-section, paved and curbed.

The proposed new connection would provide no added advantage to the road users since it would be essentially the same length as the existing alternative route via Silver and Arch Street. A serious disadvantage of the proposed new connection is that four-way intersections would be required on both ends, creating traffic control problems that would not exist using existing intersections at each end of Arch Street. The most significant factor favoring upgrading of Arch Street as an alternative to constructing a new road is initial cost. The estimated cost of necessary improvements to Arch Street is $20,000, a fraction of what the new road would cost. Washington Street improvements between Arch Street and Belknap Street are estimated at $25,000.

These improvements on existing alignment are recommended as being the most feasible means of increasing the attractiveness of the Arch Street-Washington Street access to downtown Dover and to the proposed Cocheco River Bridge.

MIRACLE MILE

Evaluation of assigned 1985 traffic volumes along the upper Central Avenue in Dover, in the area known as "Miracle Mile", indicates that the improvement proposed would be capable of meeting the demands of 1985 traffic as well. Depending on the locations of entrances and exits for the developments along Central Avenue, actuated signals may be required where vehicle movements are concentrated.

OTHER CONSIDERATIONS

Some of the alternative highway improvement schemes and proposals made by others that were considered in the Dover-Somersworth Transportation Study, but which have not been included in the recommended plan, are discussed below.

SPAULDING TURNPIKE, DOVER TOLL STATION

One of the proposals contained in the Dover Community Renewal Program is that the existing toll station on the Spaulding Turnpike at Dover Point be removed or relocated to the Newington side of the General Sullivan Bridge. This proposal was based on the belief that by so doing a considerable amount of traffic now contributing to congestion along Central Avenue in Dover would begin to use the Turnpike instead. While clearly beyond the scope of the Dover-Somersworth Transportation Study to make a recommendation on this question, an analysis was made of the impact of present tolls on current and forecasted 1985 traffic using the Turnpike and alternative routes, and the effect of toll removal.

Drivers approaching Dover from the direction of Portsmouth or on U.S. Route 4 from the direction of Concord are faced with a choice of route at Dover Point. They can either pay a small toll and travel north for part of their trip on the Spaulding Turnpike, or they can drive on N.H. Route 16. Drivers traveling in the opposite direction are faced with the same sort of decision.

Roadside interviews made at Dover Point on the Turnpike (Station 1) and on Route 16 (Station 2) provided information regarding this decision. In Table 24 the trips passing each of these stations on an average summer weekday are broken down according to origin or destination within, or at a roadside interview station on the opposite side of, the survey area. This table shows that the largest proportion of traffic on the Spaulding Turnpike at Dover Point (almost 58 per cent) was traveling through the area, 15 per cent had origin or destination in Somersworth or at a roadside interview station in Somersworth, and the remainder (27 per cent) had origin or destination in Dover or Rollinsford or at one of the roadside interview stations in Dover or Rollinsford. Of the traffic on Route 16 at Dover Point, less than 1 per cent was traveling to or from the Spaulding Turnpike in the direction of Rochester, 15 per cent to or from Somersworth, and 84 per cent to or from the remainder of the area. The last column in Table 24 indicates the proportion of drivers who selected Route 16. Understandably, only about 1 per cent of

Table 24

COMPARISON BETWEEN TRAFFIC USING SPAULDING TURNPIKE AND TRAFFIC USING ROUTE 16

Description of Sub-area	Traffic Zones*	Average Summer Weekday Trips (1965) to or from Indicated Traffic Zones Via: Spaulding Turnpike Number	Spaulding Turnpike Per Cent of Total	N.H. Route 16 Number	N.H. Route 16 Per Cent of Total	Per Cent of Combined Trips Via Route 16
Dover Point	1–4	39	0.6	1,132	20.4	97
Dover, west of Spaulding Turnpike	5–8, 31–33	710	10.8	604	10.9	46
Central Dover, east of Turnpike, south of RR	9–21	574	8.7	1,688	30.3	75
Central Dover & Rollinsford, north of RR	22–29,36–37	218	3.3	970	17.5	82
Dover, northern portion east of Turnpike	30,34,35	243	3.7	284	5.1	54
Somersworth	38–50	991	15.1	831	15.0	46
Spaulding Turnpike toward Rochester	Station 10	3,812	57.8	44	0.8	1
Total		**6,587**	**100.0**	**5,553**	**100.0**	**46**

*includes roadside interview stations on boundaries of zones indicated (except for Station 10 which is shown separately)

the drivers heading to or from the north on the Spaulding Turnpike elected to use Route 16; but 97 per cent of the drivers heading to or from Dover Point used Route 16.

Travel times via each route to the destination or from the origin within, or at a roadside interview station on the opposite side of the survey area were computed and a time-difference diversion curve was plotted. That is, for each traffic movement, the potential time saving via the Turnpike route was plotted against the proportion of traffic making the movement who elected to use the non-toll route (Route 16). Values picked from the smooth curve drawn through the plotted points are shown in Table 25. This table shows that no one used the Turnpike to save 1 minute and that virtually everyone used it when they could save 7 minutes. The range between these extremes demonstrates the fact that different drivers place different values upon their time. For a 5¾ minute time saving, about half of the drivers selected the toll route and half selected the non-toll route.

Assuming that this value of time remains fairly constant, it is possible to draw some conclusions about the probable effect of increasing or decreasing tolls. For example, a 50 per cent increase or decrease would have the effect of translating the diver-

Table 25

SPAULDING TURNPIKE TIME DIFFERENCE DIVERSION
(Average Summer Weekday – 1965)

Time Saving Via Turnpike (minutes)	Per Cent Using Turnpike
1	0
2	3
3	9
4	18
5	33
6	57
7	99

sion curve by about 3 minutes so that, of trips to and from zones having a 4-minute time difference, 0 per cent rather than 18 per cent would use the Turnpike if the tolls were increased by 50 per cent. Since the travel time difference for almost all points in the survey area lies between 4 and 7 minutes, it would appear that a 50 per cent increase in tolls would have the effect of diverting almost all Turnpike traffic except through traffic to Route 16. Similarly, a 50 per cent reduction would theoretically have the effect of attracting to the Turnpike most of the external trips now using Route 16 at Dover Point, the same as the effect that would be obtained from complete removal of tolls. Actually, the value placed on time is not constant, particularly where low toll rates are concerned, and some drivers would still choose the longer non-toll route regardless of how small a toll was charged.

The final step in the analysis of Spaulding Turnpike tolls was to determine the traffic that might be expected to be diverted from Route 16 to the Turnpike if tolls were removed completely at Dover Point. Results of this analysis are summarized in Table 26 for 1965 and 1985 average annual weekday traffic. It is estimated that removal of tolls would have the effect of diverting 4,500 vehicles on an average weekday from Route 16 to the Turnpike at Dover Point. However, the diversion would be much less north of the Central Avenue interchange, and through the central portion of Dover the effect would be very small (500 vehicles per day in 1965, 900 in 1985). It would appear from this analysis that the Spaulding Turnpike is bypassing a great deal of traffic around downtown Dover and that most of the traffic passing through Dover has an origin or destination such that it would be there even if tolls were removed.

Table 26

EFFECT OF TOLL REMOVAL ON USAGE OF SPAULDING TURNPIKE AND ROUTE 16

	Anticipated Change in Average Annual Weekday Traffic			
	1965		1985	
Section	Turnpike	Route 16	Turnpike	Route 16
Dover Point to Central Avenue	+4,500	-4,500	+8,200	-8,200
Central Avenue to Silver Street	+1,500	-1,500	+2,700	-2,700
Silver Street to Somersworth Traffic Circle	+ 500	- 500	+ 900	- 900

SPAULDING TURNPIKE-WASHINGTON STREET INTERCHANGE, DOVER

It has been suggested by others that traffic congestion in the vicinity of Dover's Industrial Park might be substantially eased by the addition of a half-diamond interchange at Washington Street, where an existing bridge carries Tolend Road (the extension of Washington Street) over the Turnpike. Such an interchange would provide ramp connections to the Turnpike to and from the north only. Drivers desiring to leave the Turnpike from the north would exit to Tolend Road and travel to the Industrial Park on Columbus Avenue, an existing unimproved road which would have to be widened and paved as part of the proposed improvement. In the reverse direction, drivers would use Columbus Avenue and Tolend Road, cross over the Turnpike, and enter the Turnpike from Washington Street via the northbound ramp. The distance over the road saved by these drivers would be about one-half mile in comparison to using the Silver Street interchange.

To evaluate this suggestion, ramps were added at Washington Street as part of the trial network described earlier in this chapter and 1985 forecasted traffic was assigned. It was found that approximately 2,000 vehicles would use improved Columbus Avenue on an average weekday in 1985, two-thirds of which would enter or leave the Spaulding Turnpike via the proposed ramps at Washington Street and travel from or to the Industrial Park or points outside the Study area cordon line via Littleworth Road (N.H. 4/9). The other one-third of the traffic using Columbus Avenue would have origin or destination in the eastern portion of central Dover. All of this traffic can be adequately served by existing highway facilities – Littleworth Road to Knox Marsh Road, the Silver Street interchange with Spaulding Turnpike, and the Arch Street connection to Washington Street.

Traffic on Littleworth Road between the Industrial Park and Knox Marsh Road is forecasted to be 7,000 vehicles per day in 1985, without improving Columbus Avenue and adding ramps at Washington Street. Even with the proposed improvements, the volume on this section of Littleworth Road would drop by only 2,000 vehicles per day.

Since the Columbus Avenue improvement is not required to relieve existing Littleworth Road, and because drivers using Columbus Avenue would save very little if any time by doing so, this part of the proposal cannot be economically justified and is therefore not recommended.

Without Columbus Avenue traffic, the proposed ramps would carry no more than 1,000 vehicles per day. Vehicles that would use the ramps could find alternative routes that would be no more than 2 or 3 miles longer via the Silver Street interchange. It is apparent that the interchange could not be justified on the basis of such insignificant savings for so few drivers. Hence it is not recommended.

It is understood that a strip of land 1,600 feet in depth and parallel to the Spaulding Turnpike, from the B&M Railroad to Tolend Road, has been recently rezoned for industrial purposes. Development of this area to the fullest possible extent could well change the situation and provide justification for the suggested half-diamond interchange with the Turnpike.

GARRISON ROAD-DOVER POINT CONNECTOR, DOVER

The Dover Community Renewal Program recommended that a new bridge be built across the Bellamy River about 1.6 miles south of Route 108 and in line with the existing Spaulding Turnpike overpass connecting Cushing Road and Spur Road on Dover Point.

The cost of a bridge spanning the Bellamy River, which at this point is several hundred feet wide, would probably be on the order of $500,000. In addition, a new road would be required from the bridge to Garrison Road, a distance of about 2,000 feet. One of the purposes of the proposed connection would be to divert traffic from Route 108.

A Garrison Road-Dover Point connector was built into the trial network and it was found, by assigning 1985 traffic, that approximately 2,000 vehicles per day would use it. This comparatively low assigned volume reflects the fact that such a connection, although saving some distance for traffic desiring to travel between the Garrison Road area and Dover Point, would not be preferred by most drivers wishing to travel between Garrison Road and downtown Dover since existing Back River Road would be quicker. Likewise many drivers traveling between Garrison Road and the General Sullivan Bridge to Newington would elect to use existing Piscataqua Road and U.S. 4 rather than the longer route via the proposed connector and N.H. 16.

Approximately two-thirds of the traffic that would use the proposed connection would be traveling to or from the section of Dover Point between Cushing Road and Central Avenue. For these drivers the potential time and distance saved in comparison to using the Back River Road-Central Avenue route would be very small. The remaining one-third of the drivers using the proposed connection would have to travel an extra two miles to reach their destinations via existing routes.

Back River Road, Route 108 through the Sawyer Mills area, and Route 16 on Dover Point can adequately handle projected 1985 traffic, assuming the immediate action program is implemented. In view of this fact and the small potential road user cost savings, it is obvious that the very great initial expense required for the proposed connection cannot be justified solely on the basis of meeting future traffic needs.

It is understood that the City is contemplating the building of a new fire station to better serve Dover Point and if it can cover the Garrison Road area as well, it would not be necessary to later construct another fire station in that rapidly developing area. This represents another potential benefit that can be considered in evaluating this proposal, but on the basis of traffic needs the proposed Bellamy River crossing and connection to Garrison Road cannot be recommended.

REALIGNMENT OF SECOND AND THIRD STREETS AT UPPER SQUARE, DOVER

In conjunction with the proposed Chestnut Street bridge over the Cocheco River, consideration was given to realigning Third Street just west of Central Avenue and modifying the channelizing islands at Upper Square to facilitate flow of westbound traffic from Broadway. Under this scheme Broadway would continue to be operated one-way westbound just east of Central, in accordance with the immediate action proposals shown in Figures 14B and 16B, and Third Street would be operated one-way westbound between Upper Square and Chestnut Street. This would provide a direct connection for traffic from Broadway and Portland Avenue across Central Avenue to the proposed Chestnut Street Bridge.

Consideration was also given to realigning Second Street just west of Central Avenue and further modifying the channelizing islands at Upper Square to facilitate flow of eastbound traffic between the proposed Chestnut Street bridge and Portland Avenue. Under this scheme Second Street would be operated one-way eastbound from Chestnut Street to Central Avenue and provision would be made for eastbound traffic to continue through Upper Square to Portland Avenue. Portland Avenue would be operated one-way eastbound to St. John Street, as it is currently operated.

In addition to extensive revisions to the channelization scheme and signal installation proposed for immediate implementation at Upper Square as shown in Figure 14B, realignment of Second and Third Streets at Central Avenue would require expensive right-of-way takings on the northwest corners of both intersections.

Assignment of 1985 traffic to the arterial highway system incorporating these improvements as well as the proposed Chestnut Street bridge showed that approximately 3,000 vehicles per day would travel straight through Upper Square on the westbound Broadway-Third Street connection and 2,000 vehicles per day would make the reverse movement on the Second Street-Portland Avenue connection.

There is no doubt that these two improvements would help to smooth the flow of east-west traffic through central Dover. However, they are not included with the recommendations for improvement required by 1985 because, in view of the traffic relief to Central Avenue afforded by the proposed Chestnut Street bridge and improved Fourth Street-Pierce Street connection, forecasted east-west traffic movements can be adequately accommodated through Dover if the immediate action proposals, particularly as regards Upper Square, are put into effect.

OTHER PROPOSALS

In addition to the proposals that have been discussed heretofore in this report, there have been a number of other suggestions made at various times that were considered in the Dover-Somersworth Study.

The Dover Community Renewal Program contained a recommendation that a new road be built parallel to Central Avenue between Glenwood Avenue and the Somersworth traffic circle. Such an improvement would be vastly more expensive than the relatively minor modifications recommended for the improvement of traffic flow along "Miracle Mile" (Figure 17C), and it would leave unsolved what is inherently an unsatisfactory and unsafe situation now existing along that highway. Since it was found that the recommended improvement would be adequate to meet the demands of 1985 traffic, the proposal that a parallel route be constructed was not considered further.

Another suggestion contained in the Dover Community Renewal Program, and identified therein as a "long-term proposal", was that consideration be given to building a limited access connector roadway between the Sawyer Mills area and central Dover along the alignment of the existing Boston and Maine Railroad spur track. Entirely aside from the question of whether the right-of-way could be purchased for this purpose, it was evident after observing the results of the assignment of forecasted 1985 traffic to the existing highway network that such a facility could not be justified.

One of the problems that has plagued downtown Somersworth is related to the general inadequacy of the parking lots provided for employees by the industries concentrated east of Main Street along the B&M Railroad and the Salmon Falls River. Traffic in parts of the City come to a standstill at those times of day when factory shifts are changed, as workers stream in and out of the narrow shoe-shop exit alley and ramp from the General Electric Plant to these lots. Implementation of immediate action proposals will reduce the existing supply of spaces used by these workers, particularly along the east side of Main Street where it is recommended that angle parking be replaced by parallel parking. To alleviate this situation the industries and the City should search out ways of providing more adequate employee parking facilities with better access to the existing downtown street system. It is hoped that some of the area within the proposed Triangle Urban Renewal Project will be devoted to alleviating this problem.

Another suggested location for additional off-street parking that is worthy of consideration is the wedge-shaped space running from Washington Street to Fore Street, between the east side of Main Street and the B&M Railroad. Development of this property for parking would be relatively expensive since a retaining wall would be needed for the entire length to accommodate the difference in elevation (up to 10 feet) between Main Street and the railroad. It is believed that this space could accommodate up to 50 cars with an entrance from Main Street approximately 200 feet north of Washington Street and an exit near Fore Street.

If extensive parking area continues to be required immediately adjacent to the industrial plants, consideration should be given to providing a new improved access connection somewhere between the shoe-shop alley and the GE plant ramp, at least two lanes in width and intersecting Main Street at approximately right angles with grades such that adequate sight distance will be provided at the intersection. As land becomes more valuable in the central area of Somersworth it may become feasible to cover the existing canal and use the top for parking. Detailed consideration of these alternatives is beyond the scope of the Dover-Somersworth Transportation Study.

CONSTRUCTION COSTS AND PRIORITIES

Estimated costs for the 13 immediate action proposals are listed in Table 27 in order of suggested priority within each city. Construction costs were estimated using unit costs furnished by the New Hampshire Department of Public Works and Highways and similar data obtained from other New England States. Right-of-way costs were determined from tabulations of assessed values prepared by the Dover City Assessor. The total initial cost for proposed improvements at the eight locations in Dover is $139,000; the total initial cost for proposed improvements at the five locations in Somersworth is $32,000.

Accidents occurring at the eight locations in Dover and the five locations in Somersworth accounted for 25 per cent of the total number of accidents in each of the two cities during the two-year period ending August 1, 1965. Savings to the public resulting from reduction in the number of accidents at these locations would alone pay for the recommended improvements within a very few years.

It is highly recommended that all 13 of the proposals be implemented as soon as possible. Suggested priorities are indicated in Table 27 in case it is not feasible to complete the entire program at one time. These priorities indicate the ranking of proposals with respect to return on the initial investment in the form of anticipated road user cost savings, particularly from accident reduction.

The existing arterial system in Somersworth will be adequate to meet the demands of 1985 traffic if all of the immediate action proposals are implemented. In Dover other measures are required in addition to the immediate action proposals.

Table 27

COSTS AND PRIORITIES – RECOMMENDED IMMEDIATE ACTION PROGRAM

Proposals in Order of Priority	Initial Cost
DOVER	
Washington Street-Main Street	$ 2,200
Lower Square	10,300
Upper Square	22,000
Central Avenue-Glenwood Avenue to Dover-Somersworth Traffic Circle	78,000
Central Avenue-Spaulding Turnpike Interchange-Mill Road-Durham Road-Back River Road	6,600
Silver Street-Central Avenue	13,200 if possible (study)
Portland Avenue-Portland Street	2,300
Broadway Street-St. John Street	4,400
Subtotal, Dover	**$139,000**
SOMERSWORTH	
High Street-Orange Street-Highland Street	$ 1,400
Main Street-Franklin Street and Main Street-Washington Street	1,900
Market Street: Main Street and High Streets to Berwick Bridge	16,900
High Street-West High Street-Washington Street-Hamilton Street	8,700
High Street-Franklin Street	3,100
Subtotal, Somersworth	**$ 32,000**
Grand total, Study Area	**$171,000**

Estimated construction costs for these other features of the recommended arterial highway plan for the Dover-Somersworth area required by 1985 are listed in Table 28 in order of suggested priority. The total estimated cost is $653,000.

Table 28

COSTS AND PRIORITIES – RECOMMENDED FUTURE IMPROVEMENTS

Proposals in Order of Priority	Initial Cost
Chestnut Street Bridge in Downtown Dover	$500,000
Arch Street-Washington Street Access to Downtown Dover	45,000
Fourth Street-Pierce Street-Broadway Connector, Dover	108,000
	$653,000

As noted earlier in this report, 1985 traffic could be handled – with difficulty and subject to periodic congestion – without providing relief to existing streets through downtown Dover in the form of a new bridge connection across the Cocheco River; but it would require virtually complete elimination of on-street parking in much of the downtown area. Between now and 1985, traffic volumes will gradually rise, calling for the progressive elimination of on-street parking – first near intersections, then perhaps peak period parking restrictions on one side only, followed by complete elimination on one side, and so forth – until relief is provided by completion of the proposed Chestnut Street Bridge.

The Arch Street-Washington Street improvement will be required by 1985 to provide an acceptable alternative to Silver Street for drivers traveling between the Silver Street interchange of the Spaulding Turnpike and downtown Dover. This route will be particularly attractive after completion of the Chestnut Street bridge and is therefore listed next in priority. However, in view of the relatively low cost of this improvement, it may be considered desirable to complete it before it becomes essential, in order to divert traffic from Silver Street.

Similarly, although the Fourth Street-Pierce Street-Broadway connector is listed next in priority order, it may be desirable to complete the Pierce Street portion of this improvement in the nearer future in view of the heavy use of this street by trucks unable to get under the railroad bridge on Broadway.

CONCLUSION

Localized problems will undoubtedly arise between now and 1985, calling for application of traffic engineering measures and/or minor construction of the sort illustrated by the immediate action proposals contained in this report. But it is believed that completion of the 13 improvements recommended for immediate implementation, coupled with a vigorous signing and pavement marking program on the local level in accordance with standards of the National Manual for Uniform Traffic Control Devices, and followed by construction of the recommended future improvements, will provide the Dover-Somersworth area with an arterial highway system adequate to safely and efficiently meet the demands put upon it to the year 1985.

APPENDIX

TABLE A-1

TOTAL 1965 VEHICLE TRIPS[c] BY ORIGIN AND DESTINATION

DESTINATIONS — INTERNAL ZONES[a] 1–27

Origins	Zone	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Internal Zones[a]	1	21	9	6	7	—	5	—	—	—	11	20	49	9	14	—	15	7	16	22	24	31	2	2	15	5	21	—
	2	—	—	12	29	7	—	5	—	12	—	10	—	22	22	—	—	5	—	2	—	5	—	—	13	—	9	9
	3	—	24	92	34	27	48	—	15	9	20	32	17	33	29	2	—	46	13	4	23	19	10	7	18	32	19	5
	4	34	29	62	102	—	37	5	10	—	31	30	44	22	19	19	10	29	16	28	10	18	5	14	27	30	—	51
	5	—	7	20	22	203	54	61	15	14	7	15	33	29	19	15	2	10	12	13	5	49	—	—	24	12	5	—
	6	14	—	62	47	40	5	59	51	25	15	66	54	37	25	—	12	44	33	14	16	14	5	19	24	44	15	5
	7	—	5	14	18	102	41	61	22	14	10	24	35	5	22	—	7	22	25	31	5	31	5	—	11	32	5	14
	8	3	—	27	10	10	48	17	27	44	12	22	28	5	33	2	5	16	7	8	27	24	5	14	23	36	16	5
	9	—	—	10	9	5	34	5	61	43	46	19	14	28	17	5	—	31	44	29	29	42	23	16	54	18	42	5
	10	14	2	20	20	14	19	37	12	46	153	37	13	82	40	3	7	58	48	39	46	20	22	—	16	33	17	40
	11	17	5	29	44	29	54	18	27	31	19	89	72	46	22	21	14	24	8	42	46	14	—	5	42	6	42	24
	12	49	—	7	36	27	45	39	37	14	—	61	139	100	48	6	49	46	40	84	23	62	2	7	12	53	31	9
	13	9	22	14	39	31	32	21	5	14	81	46	85	65	75	14	5	22	31	13	39	187	32	23	22	21	5	14
	14	7	—	28	22	25	40	9	21	27	32	28	40	91	466	62	48	44	62	93	72	46	14	6	84	147	62	33
	15	—	—	14	19	5	2	—	—	5	3	19	7	14	62	44	—	5	28	24	—	3	2	6	9	19	13	5
	16	20	—	9	19	—	29	5	—	—	24	27	34	5	75	—	—	7	11	4	16	—	5	2	9	32	9	9
	17	5	5	34	42	19	40	28	9	19	15	9	45	29	58	19	7	21	17	34	49	31	—	11	28	102	37	9
	18	16	—	22	34	13	34	13	7	44	64	32	52	3	33	18	—	45	43	49	50	74	22	31	57	67	58	37
	19	19	—	3	28	13	34	37	22	45	43	65	84	38	55	30	10	19	41	32	94	18	15	8	31	19	73	—
	20	19	2	28	12	15	19	—	19	84	66	49	15	15	124	17	5	31	33	32	62	60	27	4	22	32	36	36
	21	35	5	11	5	29	56	52	24	37	62	14	50	159	49	24	12	26	40	18	83	43	27	4	20	52	29	19
	22	—	12	12	10	—	5	5	12	17	29	14	—	29	13	—	5	—	13	16	24	14	12	32	27	7	9	2
	23	—	—	7	14	5	11	—	5	30	—	—	6	22	11	2	2	19	38	24	14	4	10	16	51	15	4	28
	24	15	10	17	31	19	42	5	44	51	19	27	15	29	87	2	5	20	57	57	32	—	—	49	188	205	98	4
	25	7	—	23	12	13	29	24	32	5	59	3	44	16	138	30	32	108	48	22	34	53	19	11	164	301	81	68
	26	10	—	13	10	10	32	22	9	31	18	30	25	14	66	17	19	31	50	77	40	18	28	3	109	31	93	29
	27	—	9	5	42	—	14	22	—	—	31	31	—	5	5	5	—	17	26	11	31	17	12	28	10	78	21	49
	28	—	—	12	2	—	20	21	24	—	12	17	104	24	41	24	21	62	22	19	19	10	19	9	22	92	95	5
	29	—	7	35	2	20	14	2	—	20	17	14	30	23	46	13	19	26	75	13	13	59	34	15	46	139	33	22
	30	—	9	41	15	15	80	9	46	32	32	22	29	51	164	18	22	46	89	47	36	35	27	31	76	213	88	34
	31	22	—	37	9	22	32	10	34	5	32	—	10	14	22	—	5	—	10	19	17	14	13	25	5	63	29	—
	32	—	—	5	—	—	—	5	—	5	—	5	—	—	—	—	—	5	10	10	—	10	—	—	—	5	—	—
	33	—	9	—	5	—	5	—	—	—	—	5	—	5	—	5	—	10	10	11	—	10	10	—	10	27	19	22
	34	—	5	5	5	—	17	21	12	26	16	9	31	15	44	—	5	38	41	20	5	40	10	9	30	21	22	14
	35	—	—	9	—	—	5	—	—	—	15	5	—	5	7	5	5	—	2	19	5	10	—	—	15	16	14	33
	36	—	—	—	—	—	—	—	—	—	5	—	—	—	2	4	—	—	—	2	—	—	—	—	4	10	31	13
	37	—	—	—	—	—	—	5	—	—	9	—	—	—	5	—	4	—	10	—	—	—	4	—	—	23	5	47
	38	—	—	—	—	—	20	5	—	—	5	—	—	9	—	—	5	5	9	5	—	—	—	—	9	5	10	—
	39	—	—	5	—	—	5	—	—	—	—	—	—	—	—	—	5	14	—	—	—	—	—	—	—	—	2	1
	40	—	—	5	—	—	20	—	—	—	5	1	—	—	17	—	5	32	14	15	5	10	—	—	10	5	5	15
	41	—	4	10	—	15	—	24	15	—	19	5	17	10	20	5	—	22	17	19	19	—	18	—	5	10	19	19
	42	—	—	—	—	—	—	—	1	—	37	—	5	—	—	—	7	14	—	9	—	—	5	—	9	—	5	—
	43	—	—	—	—	—	5	—	—	5	—	—	—	—	10	—	5	5	5	—	9	13	—	—	—	—	—	—
	44	1	—	9	2	—	—	—	—	5	—	2	—	—	—	—	—	49	9	19	9	17	—	—	—	13	29	—
	45	—	—	—	—	5	1	5	5	9	5	5	21	9	10	8	—	—	17	17	9	9	10	9	—	26	10	9
	46	—	—	5	—	5	19	—	9	—	—	9	5	—	11	—	5	24	22	9	5	5	10	—	22	29	10	5
	47	—	—	5	5	5	—	—	—	—	—	—	—	—	—	5	—	5	22	—	—	—	—	9	—	—	15	—
	48	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	9	5	—	—	—	—	—	5	14	—	—
	49	14	—	5	—	—	5	5	—	—	5	—	20	—	7	—	—	—	9	—	13	—	—	—	26	—	5	14
	50	—	—	—	—	—	9	—	—	—	—	5	—	5	10	—	5	—	9	—	5	—	—	—	—	14	5	—
	SUB-TOTAL	351	180	789	762	748	1,066	662	632	768	1,084	923	1,272	1,122	2,043	444	389	1,119	1,207	1,075	1,063	1,139	464	425	1,404	2,154	1,301	762
External Stations[b]	1	—	—	5	2	7	78	10	17	31	44	22	22	6	10	6	14	32	21	17	8	19	9	8	35	9	18	8
	2	130	40	161	168	36	84	23	28	18	57	35	75	58	73	29	36	49	75	44	22	76	13	31	103	62	58	49
	3	7	—	13	22	13	56	10	12	7	30	40	19	34	70	28	40	96	50	51	13	59	7	2	65	32	46	62
	4	—	—	—	—	—	8	—	—	—	3	—	—	—	7	—	—	4	3	3	—	3	—	—	4	4	3	—
	5	13	4	13	7	8	18	19	10	13	18	16	13	22	35	—	15	41	28	26	34	40	11	13	48	30	28	23
	6	2	—	22	20	3	62	8	4	8	16	22	18	13	46	12	41	58	43	55	13	73	9	15	61	40	43	24
	7																											
	8	4	—	3	4	6	5	3	6	8	5	5	7	7	28	3	3	17	19	16	3	24	7	13	36	13	13	6
	9																											
	10	14	2	8	6	13	34	4	9	18	16	—	6	8	6	2	16	13	18	3	4	23	5	6	23	18	9	3
	11																											
	12	—	—	6	4	—	7	4	8	—	7	—	8	5	13	6	6	13	29	—	17	18	—	3	42	25	14	8
	13																											
	14	2	—	13	13	5	49	16	65	17	21	18	16	16	37	2	32	18	37	21	11	44	9	6	35	29	17	30
	15	3	2	13	19	10	24	7	39	42	40	25	16	23	49	8	21	38	65	38	24	91	11	16	28	39	43	16
	16	13	15	39	22	75	285	58	63	11	51	38	34	23	55	22	19	64	84	58	22	93	10	22	28	36	46	19
	17	—	—	3	2	233	11	83	5	3	—	3	3	—	12	5	—	11	5	13	4	4	5	—	4	2	3	—
	18																											
	19	8	3	14	12	17	42	6	4	13	16	14	21	16	24	9	22	46	49	17	13	36	12	3	18	62	30	41
	SUB-TOTAL	196	66	313	301	426	763	251	270	189	324	238	258	231	465	132	265	500	526	362	188	603	108	138	530	401	371	289
TOTAL		547	246	1,102	1,063	1,174	1,829	913	902	957	1,408	1,161	1,530	1,353	2,508	576	654	1,619	1,733	1,437	1,251	1,742	572	563	1,934	2,555	1,672	1,051

DESTINATIONS — INTERNAL ZONES[a] 28–50 and SUB-TOTAL

Origins	Zone	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	SUB-TOTAL
Internal Zones[a]	1	—	—	6	22	—	—	—	—	—	5	—	—	—	—	—	—	—	—	—	9	—	5	—	358
	2	—	9	—	—	—	5	5	—	—	1	—	—	—	4	—	—	—	—	—	—	—	5	—	191
	3	12	32	75	24	5	—	19	14	—	—	—	—	15	12	—	—	—	2	5	5	—	5	9	812
	4	7	2	37	—	—	5	5	—	—	—	5	—	—	—	5	5	7	—	10	5	—	—	5	780
	5	5	20	20	19	—	—	—	5	—	—	—	—	—	5	—	—	—	5	5	10	—	—	—	740
	6	22	22	53	49	5	5	22	10	—	—	15	10	15	—	—	—	5	—	19	—	—	5	9	1,011
	7	17	—	—	12	5	—	—	—	—	—	—	—	—	29	—	—	—	5	9	—	—	—	—	638
	8	29	10	29	35	—	—	15	—	—	—	—	1	—	15	—	—	—	14	5	—	—	—	—	627
	9	2	32	27	22	—	—	15	—	—	—	—	—	—	—	—	5	5	9	—	—	—	—	—	746
	10	5	19	49	26	—	—	30	10	5	1	—	—	5	—	29	—	5	5	—	—	—	5	5	1,057
	11	14	5	58	—	5	—	10	14	—	—	—	—	—	14	—	—	2	14	—	—	—	—	5	931
	12	108	22	68	5	—	—	36	—	—	—	—	—	—	24	10	—	—	21	—	—	—	5	—	1,325
	13	13	50	54	31	—	5	10	—	—	—	—	—	—	5	—	—	—	22	—	—	—	—	10	1,167
	14	61	64	146	14	—	—	21	9	—	5	2	10	9	19	—	10	2	10	16	—	—	11	5	2,023
	15	31	24	19	—	—	5	—	5	4	—	—	—	—	5	—	—	—	—	—	—	—	—	—	401
	16	14	14	22	5	—	—	—	5	—	—	5	—	7	—	—	5	—	—	10	—	—	—	5	443
	17	67	36	82	9	—	20	28	9	12	4	5	9	32	17	5	19	9	8	32	14	9	9	14	1,171
	18	34	56	52	36	5	10	43	—	—	—	17	5	5	9	—	5	8	26	14	5	5	—	—	1,253
	19	41	13	40	11	—	10	10	12	6	—	5	—	10	21	—	—	5	—	—	—	—	—	5	1,065
	20	5	5	43	14	5	—	5	5	—	7	1	—	12	19	5	—	—	14	5	—	—	14	—	1,023
	21	27	23	49	31	5	—	15	5	—	—	—	—	10	5	—	5	—	17	5	—	—	—	—	1,182
	22	22	5	39	13	—	10	5	—	—	4	5	—	—	18	—	—	—	10	10	—	—	—	—	460
	23	18	8	34	15	—	—	4	5	—	—	—	—	—	—	—	—	—	9	—	—	—	—	—	431
	24	49	48	44	26	—	10	29	9	—	—	9	—	10	5	9	—	8	—	14	9	—	26	—	1,433
	25	62	126	192	61	10	10	28	33	12	48	5	—	9	12	9	—	5	15	49	—	14	—	14	2,090
	26	105	52	66	9	—	19	29	—	20	14	10	—	10	19	—	—	17	19	15	10	—	5	10	1,264
	27	2	7	41	17	5	13	26	36	13	51	9	—	24	14	—	5	—	9	—	—	—	14	—	755
	28	205	93	61	9	—	10	33	—	—	—	—	5	—	12	9	—	—	5	5	—	—	—	—	1,143
	29	40	239	84	14	—	31	39	9	—	—	—	—	5	5	—	—	26	15	—	—	—	19	—	1,263
	30	61	76	551	5	—	29	134	44	10	20	10	15	40	119	5	5	57	17	74	9	15	75	37	2,715
	31	9	14	22	1	—	—	—	14	4	—	—	—	25	13	—	—	32	1	10	—	—	5	7	606
	32	—	—	14	—	—	—	—	—	—	—	5	—	—	—	—	—	—	—	—	—	—	—	—	79
	33	12	10	15	—	—	—	—	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	205
	34	29	42	102	—	5	—	183	32	—	12	10	—	—	14	10	5	14	29	10	5	5	5	—	973
	35	—	2	44	14	—	—	32	66	4	—	—	—	—	29	—	—	—	5	—	—	5	—	—	371
	36	—	—	4	4	—	—	—	—	10	10	—	—	—	—	—	4	—	—	5	—	—	—	5	113
	37	12	—	14	—	—	—	—	—	10	83	12	—	—	4	—	—	10	13	—	5	—	—	4	279
	38	—	—	10	—	5	—	5	—	—	—	111	22	44	—	5	—	105	87	75	17	5	26	77	681
	39	—	—	20	—	—	—	—	—	—	—	10	49	31	—	—	—	44	52	40	5	—	22	—	305
	40	—	14	31	20	—	—	5	—	—	—	53	31	393	102	40	31	143	122	75	93	5	77	36	1,435
	41	—	19	110	13	—	2	10	20	—	4	—	—	83	187	22	5	31	59	59	10	34	24	15	999
	42	—	—	10	—	—	—	21	—	—	—	5	—	46	—	110	10	—	19	13	—	26	9	14	375
	43	—	—	23	5	—	4	5	5	—	—	—	1	19	5	22	330	95	78	25	50	36	19	31	810
	44	—	5	70	24	—	—	—	—	5	5	64	31	150	13	—	87	401	228	151	88	97	183	122	1,888
	45	5	15	38	—	—	—	17	—	—	9	92	44	124	51	22	67	210	85	209	14	57	149	62	1,469
	46	5	—	58	22	—	—	19	—	—	9	92	48	93	62	17	31	183	160	402	61	79	45	129	1,724
	47	—	—	26	—	—	—	5	—	—	—	13	5	92	5	—	45	58	22	83	48	14	47	71	605
	48	—	—	15	—	—	—	—	—	—	—	8	5	—	48	14	44	110	52	54	15	233	60	41	732
	49	—	19	49	5	—	—	10	—	—	4	24	5	67	24	—	36	165	109	87	38	47	95	58	970
	50	—	—	15	7	—	—	9	—	5	10	72	—	39	19	19	31	140	68	125	43	62	53	103	887
	SUB-TOTAL	1,150	1,252	2,731	649	60	203	937	381	120	306	674	296	1,424	983	367	790	1,902	1,460	1,725	568	748	1,022	908	46,004
External Stations[b]	1	4	20	44	64	2	4	31	22	—	—	13	2	10	19	6	5	13	40	17	4	4	19	—	801
	2	33	42	78	24	6	2	24	21	—	22	6	2	5	23	—	5	13	14	22	5	6	7	4	1,997
	3	26	40	93	77	1	1	31	6	—	4	—	2	17	22	2	6	1	3	1	—	—	—	—	1,217
	4	13	13	27	5	—	—	—	—	4	58	36	24	33	25	5	12	62	47	108	35	17	21	19	606
	5	21	37	160	83	2	11	40	2	—	14	228	44	151	47	40	93	709	537	290	72	56	202	160	3,545
	6	21	44	171	69	4	2	73	4	4	6	74	22	70	188	66	30	60	189	72	22	52	42	45	2,061
	7																								
	8	—	22	58	60	4	—	49	29	8	2	—	3	2	13	—	—	—	—	7	5	6	—	3	535
	9																								
	10	7	4	27	45	—	—	3	—	—	2	—	2	—	5	2	—	2	2	—	—	—	2	—	390
	11																								
	12	8	14	24	4	5	16	—	—	—	3	3	—	4	—	—	—	—	3	6	3	—	3	3	342
	13																								
	14	8	20	120	169	2	—	12	6	—	3	—	2	2	17	3	—	8	16	3	3	2	2	—	977
	15	32	29	77	37	—	5	29	9	—	12	8	2	22	15	—	6	14	21	10	8	12	13	4	1,115
	16	39	35	88	24	6	5	25	10	3	5	5	3	14	43	—	6	13	14	7	7	6	15	—	1,678
	17	4	8	17	4	—	—	2	—	—	—	—	—	3	3	—	—	—	—	—	—	4	—	—	459
	18																								
	19	32	37	57	27	7	—	10	4	4	2	—	—	14	16	13	7	9	2	11	4	4	4	—	832
	SUB-TOTAL	248	365	1,041	692	39	46	329	113	23	133	373	108	347	436	137	170	904	888	554	168	169	330	238	16,555
TOTAL		1,398	1,617	3,772	1,341	99	249	1,266	494	143	439	1,047	404	1,771	1,419	504	960	2,806	2,348	2,279	736	917	1,352	1,146	62,559

DESTINATIONS — EXTERNAL STATIONS[b] and TOTAL

Origins	Zone	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	SUB-TOTAL	TOTAL
Internal Zones[a]	1	—	139	13	—	—	9		4		4		—		3	4	4	—		3	183	541
	2	4	24	—	—	5	5		3		2		—		2	—	7	—		2	54	245
	3	8	148	5	—	17	11		21		19		—		13	4	40	2		10	298	1,110
	4	10	161	25	—	11	12		—		3		11		—	9	29	3		13	287	1,067
	5	4	22	11	—	13	—		—		7		3		7	4	89	171		14	345	1,085
	6	45	63	50	2	35	53		22		30		21		62	30	273	23		24	733	1,744
	7	8	27	18	—	14	2		10		5		—		10	5	53	64		4	220	858
	8	27	24	4	—	7	4		3		15		8		118	47	84	9		4	354	981
	9	32	23	10	—	4	12		13		28		4		13	46	21	4		20	230	976
	10	29	52	14	5	7	24		10		17		—		28	46	43	7		26	308	1,365
	11	13	44	42	4	13	11		16		11		10		21	23	48	10		18	284	1,215
	12	9	53	21	4	18	24		—		8		5		8	22	40	5		14	231	1,556
	13	13	44	18	—	18	23		23		13		4		13	26	38	9		6	248	1,415
	14	18	65	75	14	23	34		17		8		24		19	30	65	2		37	431	2,454
	15	13	25	17	—	5	3		4		4		6		7	3	13	—		23	123	524
	16	12	29	45	—	24	38		57		12		15		17	28	13	—		4	294	737
	17	15	40	61	4	53	82		31		12		45		35	14	49	7		40	488	1,659
	18	12	68	56	—	31	27		33		7		25		32	41	75	12		43	462	1,715
	19	13	34	49	6	22	49		32		13		16		29	27	45	7		22	364	1,429
	20	13	40	13	—	18	26		11		3		19		14	43	29	10		19	258	1,281
	21	19	65	55	4	49	71		23		23		7		32	55	96	9		47	555	1,737
	22	11	16	7	3	12	4		7		9		6		—	18	14	—		19	126	586
	23	7	13	4	—	6	13		7		4		9		1	11	11	—		4	90	521
	24	9	84	55	12	55	62		31		17		78		40	50	43	11		27	574	2,007
	25	23	86	49	5	37	37		21		18		44		39	35	68	—		31	493	2,583
	26	12	73	38	12	30	42		31		8		20		18	16	28	4		13	345	1,609
	27	7	50	21	15	19	38		25		12		12		30	21	28	—		24	302	1,057
	28	9	60	34	11	36	36		8		8		15		7	26	35	10		29	324	1,467
	29	22	42	44	3	26	45		6		4		24		26	26	28	3		43	342	1,605
	30	79	72	120	15	155	200		70		17		35		59	72	87	14		73	1,068	3,783
	31	90	29	84	7	92	55		40		38		3		192	40	30	3		34	737	1,343
	32	4	4	2	—	—	—		—		—		—		4	4	3	—		—	21	100
	33	—	—	—	—	7	3		—		—		19		3	5	3	—		—	40	245
	34	31	39	23	8	37	75		24		3		11		10	27	32	4		13	337	1,310
	35	30	16	7	—	9	6		25		1		3		2	19	6	3		8	135	506
	36	—	1	—	8	9	—		—		—		—		4	2	-	—		3	27	140
	37	—	11	2	65	13	3		—		—		3		—	6	4	—		4	111	390
	38	25	6	—	34	244	92		—		—		—		4	15	14	4		—	438	1,119
	39	2	4	—	18	44	23		—		—		—		2	5	3	—		3	104	409
	40	23	4	36	22	130	93		8		2		—		8	20	21	—		22	389	1,824
	41	26	14	13	33	63	192		12		9		4		14	25	58	4		12	479	1,478
	42	4	4	3	5	37	64		—		—		—		—	—	6	—		3	126	501
	43	7	4	2	11	63	40		—		—		—		—	8	8	—		4	147	957
	44	13	6	4	62	579	78		—		—		3		3	18	19	—		3	788	2,676
	45	52	8	—	122	634	147		4		2		3		13	15	9	5		—	1,014	2,483
	46	16	22	—	56	250	77		4		—		3		13	21	10	—		12	484	2,208
	47	9	11	1	20	84	33		4		—		—		3	5	7	2		6	185	790
	48	13	2	—	18	72	36		—		2		3		—	2	7	—		8	163	895
	49	16	—	—	21	210	61		4		4		—		3	4	11	—		2	336	1,306
	50	7	8	3	42	123	62		—		—		—		—	5	4	—		3	257	1,144
	SUB-TOTAL	864	1,879	1,154	671	3,463	2,137		664		402		521		981	1,028	1,751	421		796	16,732	62,736
External Stations[b]	1	—	4	40	2	116	130		53		1,048		6		106	19	35	3		4	1,566	2,367
	2	—	—	113	2	35	197		62		21		19		52	4	19	2		5	531	2,528
	3	58	132	—	1	17	18		7		4		13		41	83	102	2		15	493	1,710
	4	—	2	3	—	52	90		1		1		1		1	4	4	—		—	159	765
	5	120	38	18	34	—	245		9		10		9		38	49	55	—		2	627	4,172
	6	138	184	29	46	241	—		4		—		5		10	18	55	7		76	813	2,874
	7																					
	8	31	18	4	2	11	—		—		—		7		4	12	14	1		31	135	670
	9																					
	10	1,019	18	9	1	9	—		—		—		—		11	25	69	1		7	1,169	1,559
	11																					
	12	3	15	16	—	8	2		4		—		—		4	10	8	—		6	76	418
	13																					
	14	111	29	38	—	71	11		6		6		1		—	31	14	9		26	353	1,330
	15	25	4	83	2	54	31		12		32		10		31	—	1	4		26	315	1,430
	16	24	14	119	6	58	60		31		67		9		18	4	—	9		22	441	2,119
	17	—	4	2	—	—	4		3		3		—		3	2	4	—		2	27	486
	18																					
	19	8	12	16	1	10	102		8		7		11		22	31	23	3		—	254	1,086
	SUB-TOTAL	1,537	474	490	97	682	890		200		1,199		91		341	292	403	41		222	6,959	23,514
TOTAL		2,401	2,353	1,644	768	4,145	3,027		864		1,601		612		1,322	1,320	2,154	462		1,018	23,691	86,250

a For location of internal traffic zones see Figure 4
b For location of external roadside interview stations see Figure 2
c Average annual weekday traffic

DOVER - SOMERSWORTH, NEW HAMPSHIRE TRANSPORTATION STUDY

TIPPETTS - ABBETT - McCARTHY - STRATTON ENGINEERS AND ARCHITECTS NEW YORK

TABLE A-2

TOTAL 1985 VEHICLE TRIPS[c] BY ORIGIN AND DESTINATION

DESTINATIONS — INTERNAL ZONES[a] 1–25 (rows: ORIGINS)

Origin	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
INTERNAL ZONES[a]																									
1	208	112	35	67	13	12	17	8	15	14	67	205	13	18	8	2	7	16	29	11	21	3	3	6	9
2	112	226	101	108	49	13	21	19	57	22	23	159	67	42	14	6	15	36	28	28	21	10	6	40	19
3	35	146	90	92	41	38	52	44	68	57	52	138	105	63	25	6	16	40	32	45	28	15	13	23	41
4	68	107	167	131	31	40	44	41	62	68	53	112	98	62	25	7	19	42	47	42	31	14	10	43	54
5	13	56	40	51	525	31	256	28	37	31	34	81	28	34	17	7	18	34	26	23	24	16	7	14	17
6	12	13	39	64	39	22	51	28	43	38	32	56	26	33	12	3	9	29	13	30	16	13	8	10	18
7	17	21	52	84	292	51	355	59	51	42	45	110	35	47	19	7	28	36	56	35	40	15	10	19	77
8	8	14	44	41	27	28	59	45	69	45	25	53	38	52	18	4	11	27	23	42	19	21	20	16	31
9	15	27	68	62	38	43	51	79	131	96	57	107	73	91	42	9	26	65	56	112	43	65	107	47	57
10	14	22	56	49	30	38	42	45	96	168	94	83	65	78	35	7	29	74	50	86	40	44	15	30	44
11	67	23	52	94	34	32	45	25	81	56	133	129	76	69	21	7	19	47	40	52	29	19	15	29	48
12	205	159	103	112	86	50	110	53	109	83	128	611	213	186	89	30	71	139	88	99	85	32	25	64	96
13	13	67	55	98	52	26	69	28	60	52	101	184	98	132	35	7	24	69	39	80	59	35	17	29	54
14	19	41	63	60	35	32	47	53	106	78	69	185	133	514	233	16	72	199	70	115	57	42	24	120	209
15	8	15	24	26	18	12	18	18	42	35	22	88	35	235	129	5	23	101	32	26	21	19	12	50	84
16	3	6	5	8	5	3	7	9	10	8	7	30	7	20	7	1	9	8	4	8	5	5	4	8	14
17	7	15	16	18	19	9	28	11	26	24	19	71	24	91	23	3	15	31	17	39	16	13	9	25	51
18	16	36	86	49	34	29	35	28	65	74	47	149	47	175	74	7	31	165	60	113	35	41	37	111	183
19	29	28	32	37	26	13	56	23	64	56	40	95	39	91	31	5	17	45	33	92	31	37	17	36	71
20	11	28	45	42	22	36	35	43	159	72	51	100	57	215	59	8	23	58	64	178	69	29	17	32	35
21	21	21	29	32	24	24	40	19	43	50	29	77	46	56	38	4	11	26	31	60	16	23	14	22	42
22	3	65	15	13	10	13	15	21	65	25	19	32	21	59	19	5	13	42	28	28	23	53	148	66	28
23	3	7	12	11	8	9	10	19	108	14	16	24	17	26	12	3	9	36	17	17	14	25	20	24	24
24	7	17	53	43	14	21	16	17	47	29	29	61	29	103	48	7	25	110	47	70	22	26	23	216	186
25	9	19	40	34	17	18	51	30	57	55	48	96	54	209	83	14	51	164	71	36	42	50	25	211	389
26	10	19	30	29	20	22	47	22	61	40	58	108	56	241	61	9	35	136	64	94	40	63	23	107	157
27	4	8	13	15	11	5	10	9	20	17	15	46	15	55	22	2	11	36	16	12	9	27	8	27	96
28	5	11	17	13	9	11	35	11	23	19	19	121	31	103	33	7	32	68	28	38	25	13	9	44	82
29	5	20	15	13	10	7	11	11	22	18	13	39	34	64	31	5	21	68	29	15	15	20	10	51	125
30	13	28	26	29	30	15	37	32	69	34	29	70	42	124	36	5	27	60	29	57	20	47	60	88	162
31	22	18	26	30	28	15	35	46	44	39	24	52	18	26	12	2	5	15	11	27	11	21	13	13	36
32	1	2	2	3	3	3	3	4	8	4	3	5	4	8	4	1	3	9	6	6	4	8	6	7	5
33	2	4	9	6	6	4	8	11	21	10	7	16	11	29	11	4	9	28	11	9	13	15	15	36	130
34	4	9	10	8	10	19	59	22	20	24	8	39	15	38	19	4	19	41	19	15	22	8	10	40	35
35	2	6	7	8	5	10	9	12	6	6	14	7	20	9	4	6	19	8	10	5	7	[illegible]	6	18	27
36	2	5	3	3	3	4	3	6	4	5	5	6	3	6	9	2	7	16	9	5	6	2	2	12	16
37	1	3	4	3	2	3	3	3	5	3	5	8	6	27	8	1	5	14	6	4	5	2	1	8	12
38	1	4	4	4	7	2	6	5	4	5	4	12	6	23	6	3	5	19	8	6	4	3	4	7	14
39	1	3	3	2	2	4	1	3	2	3	4	9	2	5	4	1	3	11	4	4	4	1	—	6	6
40	4	8	11	8	9	9	13	14	18	11	8	18	14	36	13	6	15	39	15	11	13	8	9	22	29
41	6	11	12	11	14	9	17	15	23	15	8	25	15	40	14	3	19	36	25	13	9	12	12	26	40
42	3	5	6	7	1	7	5	7	5	3	12	4	12	6	—	3	10	3	6	4	4	7	4	7	12
43	3	2	3	3	3	5	4	4	2	2	5	3	9	5	1	5	10	6	3	2	3	6	3	6	6
44	4	6	5	4	7	4	6	6	5	5	5	10	6	16	5	3	13	13	7	6	5	4	4	9	19
45	2	6	4	5	7	2	6	3	6	5	2	15	9	13	9	1	3	6	4	5	2	3	3	6	9
46	3	8	6	6	7	4	10	8	9	6	16	12	33	11	5	10	25	13	9	10	4	5	5	14	17
47	1	2	3	3	2	3	4	4	3	2	2	4	4	8	5	1	2	10	5	3	2	1	2	5	6
48	2	3	4	2	3	3	4	7	6	4	4	9	5	11	7	2	6	14	7	6	5	3	4	6	10
49	—	2	3	2	4	3	5	3	5	3	1	4	4	9	4	2	3	9	4	5	2	2	2	19	6
50	1	2	3	3	3	2	3	2	3	2	5	4	9	3	2	3	7	4	2	3	1	2	2	5	6
SUB-TOTAL	1,021	1,977	1,542	1,639	1,709	802	1,879	1,044	3,075	1,561	1,477	3,554	1,974	3,255	1,449	260	853	3,347	1,352	1,838	1,045	934	823	1,880	2,944
EXTERNAL STATIONS[b]																									
1	32	49	47	44	70	34	74	48	51	49	34	83	50	61	30	19	38	55	44	46	35	22	20	35	44
2	575	310	134	117	121	50	129	49	67	72	45	146	74	99	44	15	36	83	56	70	49	29	30	76	85
3	19	29	31	24	23	23	30	30	33	36	35	61	46	199	56	22	61	108	59	37	42	14	14	59	59
4	6	11	8	7	11	5	12	9	9	13	6	20	16	42	12	7	12	27	13	12	11	5	6	17	20
5	21	37	32	25	36	28	65	43	43	37	49	58	50	108	45	30	62	129	52	55	51	16	22	80	69
6	22	43	30	27	43	31	61	39	35	31	21	62	47	117	36	25	46	104	55	52	46	19	23	61	62
7																									
8	28	12	10	9	12	9	15	16	12	10	8	19	27	27	15	11	19	38	17	19	14	19	5	36	20
9																									
10	7	12	10	14	16	13	16	18	15	13	6	19	20	19	9	8	13	26	12	13	11	6	5	25	17
11																									
12	4	8	9	7	9	5	10	11	16	8	7	17	11	26	10	6	13	34	11	10	11	9	12	29	29
13																									
14	15	27	36	27	33	34	69	116	64	49	35	65	49	60	26	18	39	62	47	51	98	25	17	31	24
15	23	38	43	41	50	32	58	76	70	47	29	77	52	82	22	12	26	55	43	65	38	32	22	42	49
16	50	79	98	80	160	97	311	103	90	80	69	137	101	132	52	16	44	131	92	97	67	32	32	76	80
17	8	12	17	18	126	10	93	14	16	17	8	33	12	15	11	2	6	13	10	14	7	16	6	13	15
18																									
19	13	26	19	19	37	19	24	17	26	27	17	59	29	11	38	10	37	75	26	33	25	13	12	36	46
SUB-TOTAL	818	693	524	459	747	385	967	589	649	489	369	856	584	1,100	406	201	447	939	539	569	460	245	226	616	619
TOTAL	1,839	2,670	2,066	2,098	2,456	1,187	2,846	1,633	3,724	2,050	1,846	4,410	2,558	4,355	1,855	461	1,300	4,286	1,891	2,407	1,505	1,179	1,049	2,496	3,563

DESTINATIONS — INTERNAL ZONES[a] 26–50 and SUB-TOTAL (rows: ORIGINS)

Origin	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	SUB-TOTAL
INTERNAL ZONES[a]																										
1	10	4	5	4	13	22	1	2	4	2	—	1	1	1	3	6	2	—	3	2	3	1	2	—	1	1,012
2	19	8	11	21	28	18	2	4	9	6	2	3	4	2	9	11	6	2	6	6	8	2	3	2	2	1,431
3	30	12	18	13	27	25	3	8	60	6	5	4	5	2	12	11	4	3	5	9	5	3	4	3	3	1,580
4	29	15	23	13	30	29	3	7	8	7	3	2	5	1	8	12	5	2	15	4	7	2	3	2	2	1,655
5	21	10	10	11	30	28	2	6	11	8	3	2	6	2	10	14	6	3	7	7	7	3	3	3	3	1,659
6	22	5	11	7	14	15	3	4	19	5	3	2	2	3	9	9	1	3	4	2	4	3	3	3	2	808
7	26	10	35	11	37	35	3	8	13	10	4	3	6	3	12	17	8	4	7	8	10	4	4	5	3	1,889
8	22	9	11	10	32	46	4	11	22	9	3	3	5	1	14	15	5	5	6	3	8	4	7	3	3	1,031
9	74	20	23	22	69	50	8	21	20	12	6	5	4	3	18	23	7	3	7	6	9	3	6	5	2	1,990
10	40	22	19	18	34	28	4	10	24	6	4	3	5	3	11	15	5	3	5	5	6	2	4	3	3	1,613
11	58	15	19	13	29	29	3	7	8	6	5	5	9	3	8	8	3	2	6	2	6	2	4	1	2	1,534
12	131	46	115	39	100	52	5	16	50	14	9	8	12	4	18	37	11	5	9	15	16	4	9	4	5	3,750
13	56	15	31	42	27	18	4	11	15	7	6	6	6	4	14	14	5	3	7	4	12	4	5	4	4	1,812
14	234	74	102	75	110	25	8	29	38	21	35	27	23	15	36	41	12	8	16	13	33	7	12	8	10	3,674
15	60	23	33	41	36	11	4	12	18	9	9	9	6	3	14	14	4	4	6	4	10	6	6	4	4	1,448
16	8	2	7	5	6	1	2	3	5	3	3	1	2	2	5	3	2	2	1	2	4	1	3	2	1	267
17	35	11	25	16	18	5	3	9	14	6	50	5	5	3	16	19	3	4	5	2	10	2	6	3	3	898
18	111	36	69	58	59	15	10	27	42	19	16	13	15	10	39	36	9	11	14	6	24	10	14	9	8	2,396
19	64	16	28	23	29	11	6	11	14	8	9	6	8	4	16	14	3	5	7	4	13	5	7	4	4	1,357
20	69	13	20	15	57	27	6	10	15	10	4	5	8	4	28	14	5	5	6	6	9	3	6	4	2	1,833
21	40	9	35	12	20	11	4	8	11	5	6	5	4	4	13	9	4	3	5	2	10	2	5	2	3	1,022
22	52	13	13	12	47	21	8	13	8	7	2	2	3	1	7	9	4	2	3	2	4	1	3	2	1	1,069
23	23	9	72	11	60	14	6	14	10	7	2	1	4	1	9	12	4	2	4	4	5	2	3	2	2	770
24	107	28	56	56	76	19	8	36	49	18	12	7	8	5	23	25	8	5	9	7	14	4	7	19	5	1,877
25	206	96	71	104	162	36	5	29	35	27	16	30	14	6	29	40	12	5	14	9	30	6	10	6	6	2,877
26	232	63	143	104	115	16	6	25	48	24	22	25	14	8	27	33	11	8	10	8	20	8	12	7	6	2,547
27	63	35	44	26	26	4	3	51	33	63	17	11	8	6	24	16	4	3	6	4	14	3	6	4	3	986
28	131	44	178	83	78	9	2	16	49	17	22	13	11	6	17	36	9	5	8	8	17	4	7	4	6	1,587
29	87	25	62	120	127	16	4	78	53	25	9	9	8	5	27	31	8	7	13	7	14	7	11	6	5	1,425
30	99	34	78	120	443	19	15	98	267	86	19	17	30	14	169	176	34	31	42	21	59	30	46	26	21	3,158
31	25	4	9	11	19	42	6	10	20	8	4	2	5	3	22	15	5	5	9	2	12	4	8	5	11	850
32	6	3	2	3	15	6	4	2	3	3	—	—	2	—	1	3	2	1	—	2	1	2	—	—	1	174
33	25	51	16	24	98	10	2	40	16	14	2	3	6	1	13	18	7	2	5	5	7	3	6	3	4	799
34	78	18	31	45	225	20	3	16	373	110	5	36	14	5	74	101	32	15	21	21	23	14	18	10	10	1,825
35	24	58	17	24	86	8	3	14	110	275	5	3	12	3	46	106	30	17	11	9	16	8	11	7	8	1,149
36	102	17	22	9	19	4	—	2	5	5	6	10	8	6	4	6	3	1	7	3	59	2	3	2	2	475
37	25	11	28	10	17	2	—	3	5	3	10	85	48	13	18	8	5	5	10	8	28	4	5	6	7	505
38	14	8	11	8	30	5	2	6	14	12	8	13	218	61	58	37	30	30	88	49	182	57	42	41	53	1,238
39	10	6	7	4	15	2	—	2	5	2	6	13	41	52	36	16	11	8	20	17	66	10	14	9	16	481
40	28	23	17	27	170	21	2	13	74	46	3	18	58	37	302	313	100	55	89	49	129	86	85	63	56	2,225
41	33	16	23	31	189	15	3	18	101	106	6	8	37	15	305	398	55	33	74	30	69	46	87	55	27	2,207
42	10	4	9	7	35	5	2	7	31	31	2	6	30	11	100	42	164	63	32	15	73	31	49	20	25	943
43	7	3	5	7	31	6	—	25	14	17	1	5	31	7	47	32	71	283	116	47	77	23	71	47	61	1,134
44	25	6	7	10	51	9	—	5	21	12	29	11	66	22	97	51	32	108	289	91	223	101	105	142	137	1,830
45	8	4	8	6	25	2	2	5	15	9	3	8	55	16	50	30	14	47	83	34	120	31	43	44	45	832
46	20	14	17	15	59	23	1	7	23	16	9	28	182	49	118	94	73	77	226	120	709	105	146	99	170	2,657
47	8	3	4	7	30	4	2	3	14	8	2	4	57	10	97	46	31	23	87	31	74	24	47	53	84	840
48	12	6	7	10	46	8	—	6	18	11	3	5	42	15	85	87	39	62	134	43	117	47	287	78	59	1,364
49	7	4	4	7	26	5	—	3	10	7	2	6	41	9	52	55	21	57	131	40	120	53	66	125	98	1,055
50	6	3	6	5	21	11	1	4	10	8	2	7	53	16	75	27	24	61	137	45	170	51	79	78	157	1,140
SUB-TOTAL	2,632	984	1,617	1,375	3,141	852	178	775	1,854	1,156	414	504	1,242	480	2,245	2,205	953	1,101	1,825	838	2,661	840	1,393	1,037	1,156	74,678
EXTERNAL STATIONS[b]																										
1	35	20	20	26	77	73	7	18	44	21	7	9	26	9	38	34	22	15	25	31	33	12	20	16	13	1,765
2	73	28	41	36	95	51	12	28	52	27	12	22	46	18	52	52	21	27	34	27	71	20	35	22	16	3,479
3	79	63	38	46	88	46	6	12	30	16	13	15	29	11	45	36	17	10	22	30	31	7	10	9	9	1,858
4	23	16	19	15	35	14	1	8	11	8	26	43	78	30	32	21	17	17	33	39	80	17	20	22	19	961
5	73	58	42	65	297	92	8	29	98	60	21	52	516	83	311	230	182	271	759	509	692	224	261	271	366	6,868
6	57	36	35	56	209	78	8	29	152	83	11	34	116	32	126	137	231	194	181	195	177	48	136	88	85	3,672
7																										
8	22	14	13	22	77	34	4	9	37	44	3	5	28	6	26	55	51	17	26	35	30	10	18	14	12	1,028
9																										
10	17	11	12	18	50	30	3	9	24	17	3	4	17	5	25	27	14	9	19	19	17	6	11	12	6	723
11																										
12	19	12	12	20	63	16	79	55	15	12	3	3	9	3	14	18	8	5	8	11	11	4	6	3	4	735
13																										
14	40	22	21	20	78	225	11	13	20	13	5	11	12	5	18	44	15	6	15	19	13	4	12	6	6	1,716
15	49	17	28	21	60	74	9	16	32	17	5	11	19	7	39	31	14	11	18	17	21	16	20	14	8	1,698
16	81	30	47	34	137	63	12	48	52	56	11	16	27	12	51	77	25	18	41	24	41	13	26	19	16	3,283
17	10	3	8	5	14	12	1	4	9	4	3	3	6	2	9	11	4	4	5	3	8	3	5	4	2	654
18																										
19	51	33	35	30	47	24	6	12	19	13	10	11	18	9	19	20	22	14	14	15	25	6	11	9	7	1,271
SUB-TOTAL	629	363	371	414	1,327	832	167	290	595	391	133	239	947	232	805	793	643	618	1,190	974	1,250	390	591	509	569	29,651
TOTAL	3,261	1,347	1,988	1,789	4,468	1,684	345	1,065	2,449	1,547	547	743	2,189	712	3,050	2,998	1,596	1,719	3,015	1,812	3,911	1,230	1,984	1,546	1,725	104,329

DESTINATIONS — EXTERNAL STATIONS[b] and TOTAL (rows: ORIGINS)

Origin	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	SUB-TOTAL	TOTAL
INTERNAL ZONES[a]																					
1	32	587	13	6	21	22		7		7		3		14	23	50	8		13	806	1,818
2	57	295	29	11	61	42		13		11		9		27	37	79	12		25	708	2,139
3	48	122	27	8	31	31		45		11		8		36	40	98	17		19	541	2,121
4	44	108	22	9	40	27		8		9		8		29	42	80	19		20	465	2,120
5	66	121	24	10	41	42		13		18		10		28	49	198	126		30	776	2,435
6	36	40	18	6	29	40		14		13		5		42	34	92	12		12	393	1,201
7	75	117	29	11	57	49		16		15		9		43	65	324	75		29	909	2,798
8	47	45	28	9	48	39		15		19		12		139	76	111	13		17	613	1,644
9	47	67	36	10	43	36		13		17		16		61	71	90	15		26	548	2,538
10	49	69	35	9	31	31		10		11		8		51	49	74	19		37	483	2,096
11	29	45	36	6	33	20		8		7		11		31	29	84	9		17	365	1,799
12	80	138	65	21	75	69		18		20		16		53	80	141	29		59	864	4,614
13	45	84	47	15	52	53		30		27		11		45	47	97	13		30	596	2,408
14	58	100	200	36	104	91		28		18		28		66	59	143	16		108	1,055	4,729
15	38	42	60	12	46	37		22		13		10		24	22	55	6		38	425	1,873
16	20	16	22	6	30	23		12		8		7		19	11	17	3		10	204	471
17	34	45	59	12	59	47		19		12		15		34	26	46	6		32	446	1,344
18	55	88	123	27	141	103		63		22		28		49	54	149	13		67	982	3,378
19	43	55	61	18	57	62		26		11		11		52	44	92	9		32	573	1,930
20	48	78	37	11	44	64		15		14		15		50	59	96	14		30	575	2,408
21	36	48	43	11	51	47		18		11		11		41	32	70	8		31	458	1,420
22	22	33	18	5	29	19		6		5		8		19	26	32	6		13	241	1,310
23	21	31	13	6	21	23		7		5		12		18	22	33	7		12	231	1,001
24	35	64	75	17	74	95		27		16		23		42	47	85	12		46	658	2,535
25	43	91	55	21	69	62		19		18		25		29	39	107	16		46	640	3,517
26	39	93	78	22	73	71		23		19		24		30	41	70	13		41	637	3,184
27	19	28	58	17	56	55		19		10		10		17	23	34	3		22	371	1,357
28	21	46	39	20	51	38		13		11		12		21	25	39	7		29	372	1,959
29	26	36	47	15	64	57		23		19		20		19	23	32	5		26	412	1,837
30	73	93	89	36	292	215		76		49		67		65	60	132	14		64	1,325	4,483
31	80	54	45	13	97	67		28		31		16		229	77	63	10		26	836	1,686
32	74	12	5	1	8	8		4		3		2		10	9	12	2		6	156	330
33	17	28	13	8	40	29		10		9		70		14	16	48	3		13	318	1,117
34	36	62	27	11	96	114		57		24		24		20	31	64	9		18	593	2,418
35	21	41	32	9	60	114		43		21		11		13	44	42	15		14	480	1,629
36	7	12	13	10	21	10		4		3		3		4	6	11	2		10	116	591
37	9	22	16	29	58	20		4		5		6		4	14	16	4		10	217	722
38	27	31	28	54	510	129		28		17		10		27	22	39	5		18	945	2,183
39	9	19	11	33	88	37		6		4		2		3	7	12	3		10	244	725
40	42	53	67	29	294	135		25		24		16		18	35	68	10		30	846	3,071
41	35	49	36	38	250	137		49		27		18		34	40	70	11		19	813	3,020
42	21	24	17	16	181	230		49		15		8		15	12	34	3		11	636	1,579
43	22	27	9	18	263	194		18		8		5		6	16	18	4		8	616	1,750
44	26	34	25	35	760	191		27		14		9		14	20	41	6		14	1,216	3,046
45	28	24	29	37	516	179		35		19		10		20	13	23	4		16	953	1,785
46	33	58	31	63	652	192		29		16		11		21	22	41	7		35	1,211	3,868
47	11	16	9	17	185	63		10		7		5		13	16	17	3		7	379	1,219
48	19	32	10	20	274	110		19		11		6		7	14	28	6		17	573	1,937
49	15	22	9	22	283	107		13		8		3		6	10	16	3		9	526	1,581
50	12	18	10	16	353	76		12		7		4		6	19	21	3		8	560	1,700
SUB-TOTAL	1,830	3,463	1,928	902	6,812	3,752		1,096		719		691		1,673	1,693	3,434	638		1,275	29,906	104,584
EXTERNAL STATIONS[b]																					
1	9	11	82	3	294	287		113		2,252		13		235	44	101	4		8	3,456	5,221
2	1	29	194	3	74	368		110		23		30		100	6	46	4		10	998	4,477
3	117	223	9	1	28	27		14		3		18		60	132	204	3		25	864	2,722
4	—	3	3	—	84	126		1		1		1		1	4	6	—		2	232	1,193
5	307	80	33	55	4	478		15		11		17		82	101	137	—		5	1,325	8,133
6	303	343	43	63	466	8		9		—		9		20	31	118	10		125	1,548	5,220
7																					
8	63	33	7	3	18	—		10		—		11		7	20	32	1		47	252	1,280
9																					
10	2,213	19	8	1	9	—		—		—		—		10	27	92	1		10	2,390	3,113
11																					
12	4	29	23	—	15	2		7		—		1		6	15	16	—		11	124	859
13																					
14	243	54	60	—	152	18		12		6		2		6	60	37	12		42	704	2,920
15	58	8	135	3	112	54		20		33		13		60	1	2	5		47	551	2,249
16	67	39	236	11	146	129		63		88		16		36	11	9	16		47	914	4,197
17	—	7	3	—	—	7		4		4		—		6	3	7	2		5	48	702
18																					
19	18	22	26	2	21	163		14		10		17		40	55	52	5		3	448	1,719
SUB-TOTAL	3,403	895	862	145	1,423	1,667		392		2,431		148		669	510	859	63		387	13,859	43,505
TOTAL	5,233	4,358	2,790	1,047	8,235	5,419		1,488		3,150		839		2,342	2,203	4,293	701		1,662	43,760	148,089

a For location of internal traffic zones see Figure 4
b For location of external roadside interview stations see Figure 2
c Average annual weekday traffic

DOVER - SOMERSWORTH, NEW HAMPSHIRE
TRANSPORTATION STUDY

TIPPETTS - ABBETT - McCARTHY - STRATTON
ENGINEERS AND ARCHITECTS
NEW YORK

APPENDIX TABLE A-3

1965 AND 1985 TRAFFIC VOLUMES

Location No.	1965 AAWT	1965 DHV	1965 Directional Distribution (%)	1985 AAWT	1985 DHV	1985 Directional Distribution (%)
1	6,700	670	66–34	12,100	1,210	66–34
2	4,500	450	60–40	9,900	990	60–40
3	1,000	100	60–40	1,500	150	60–40
4	1,900	190	60–40	5,000	500	60–40
5	7,600	760	66–34	16,700	1,670	66–34
6	7,600	760	66–34	13,000	1,300	66–34
7	7,400	740	66–34	15,800	1,580	66–34
8	3,500	350	64–36	7,300	730	64–36
9	4,300	430	64–36	8,600	860	64–36
10	1,000	100	66–34	2,400	240	66–34
11	2,800	280	60–40	4,600	460	60–40
12	7,700	770	66–34	12,700	1,270	66–34
13	4,400	440	66–34	6,800	680	66–34
14	2,600	260	66–34	4,700	470	66–34
15	6,400	640	60–40	10,900	1,090	60–40
16	3,900	390	66–34	5,500	550	66–34
17	2,700	270	66–34	3,200	320	66–34
18	9,400	940	66–34	16,800	1,680	66–34
19	1,000	100	66–34	1,700	170	66–34
20	3,000	300	60–40	5,700	570	60–40
21	1,700	170	68–32	3,100	310	66–34
22	2,200	220	68–32	4,600	460	66–34
23	6,500	650	66–34	11,600	1,160	66–34
24	6,400	640	66–34	13,500	1,350	66–34
25	2,100	210	66–34	3,100	310	66–34
26	9,100	910	60–40	12,500	1,250	60–40
27	400	40	66–34	1,100	110	66–34
28	3,200	320	66–34	5,300	530	66–34
29	2,300	230	67–33	4,300	430	67–33
30	1,900	190	66–34	2,800	280	66–34
31	9,600	960	60–40	15,200	1,520	60–40
32	11,400	1,140	60–40	17,900	1,610	60–40
33	7,100	710	60–40	14,700	1,470	60–40
34	4,000	400	66–34	7,500	750	66–34
35	3,600	360	68–32	6,400	640	68–32
36	5,500	550	66–34	10,000	1,000	66–34
37	2,100	210	66–34	4,200	420	66–34
38	2,700	270	66–34	4,900	490	66–34
39	7,100	710	60–40	13,700	1,370	60–40
40	600	60	66–34	2,700	270	66–34
41	8,400	840	60–40	15,600	1,560	60–40
42	1,800	180	66–34	3,800	380	66–34
43	1,400	140	66–34	1,400	140	66–34
44	2,100	210	66–34	5,000	500	66–34
45	1,200	120	60–40	4,000	400	60–40
46	12,600	1,260	60–40	18,000	1,800	60–40

APPENDIX TABLE A-3 – 1965 and 1985 TRAFFIC VOLUMES (continued)

Location No.	1965 AAWT	1965 DHV	1965 Directional Distribution (%)	1985 AAWT	1985 DHV	1985 Directional Distribution (%)
47	5,300	530	60–40	7,000	700	60–40
48	5,500	550	60–40	7,800	780	60–40
49	900	90	60–40	3,200	320	60–40
50	13,200	1,320	60–40	11,800	1,180	60–40
51	2,500	250	60–40	9,000	900	60–40
52	1,900	190	60–40	4,500	450	60–40
53	1,900	190	60–40	3,900	390	60–40
54	5,600	560	60–40	4,000	400	60–40
55	1,000	100	60–40	2,100	210	60–40
56	1,100	110	60–40	1,300	130	60–40
57	13,500	1,350	one way	9,900	990	one way
58	14,000	1,400	one way	11,200	1,120	one way
59	13,800	1,380	one way	12,300	1,230	one way
60	12,100	1,210	one way	9,700	970	one way
61	2,900	290	60–40	4,800	480	60–40
62	1,100	110	one way	1,700	170	one way
63	2,400	240	60–40	4,700	470	60–40
64	5,300	530	60–40	9,500	950	60–40
65	3,300	330	60–40	6,900	690	60–40
66	5,000	500	60–40	6,900	690	one way
67	5,200	520	60–40	8,700	870	60–40
68	1,200	120	60–40	4,200	420	60–40
69	12,700	1,270	60–40	10,400	1,040	60–40
70	1,500	150	60–40	7,900	790	60–40
71	700	70	60–40	1,500	150	60–40
72	4,900	490	60–40	7,000	700	60–40
73	12,700	1,270	60–40	18,100	1,810	60–40
74	900	90	66–34	2,000	200	66–34
75	3,000	300	60–40	5,200	520	60–40
76	2,400	240	66–34	3,200	320	60–40
77	1,100	110	60–40	1,300	130	60–40
78	1,200	120	60–40	3,000	300	60–40
79	6,300	630	60–40	10,500	1,050	60–40
80	2,700	270	60–40	4,700	470	60–40
81	3,900	390	60–40	7,000	700	60–40
82	2,200	220	60–40	3,000	300	60–40
83	2,900	290	60–40	3,300	330	60–40
84	3,200	320	60–40	4,400	440	60–40
85	3,300	330	60–40	3,400	340	60–40
86	2,000	200	60–40	3,100	310	60–40
87	6,600	660	60–40	11,700	1,170	60–40
88	6,800	680	60–40	13,200	1,320	60–40
89	7,000	700	63–37	14,800	1,480	63–37
90	500	50	66–34	900	90	66–34

NOTES:

(1) Tabulated volumes are taken from the output of computer traffic assignment programs and adjusted as required to represent average annual weekday traffic. In using this information, the approximations introduced by this adjustment procedure and the limitations of the computer traffic assignment process itself as discussed in the final paragraph of Chapter IV of the report, should be kept in mind.

(2) AAWT = average annual weekday traffic; DHV = design hour volume (generally taken as 10% of AAWT)

(3) See Figure 3 or Figure 9 for Location Nos.