1962

Interstate Route 95 : Location and Economic Study : Portsmouth, New Hampshire-Kittery, Maine (Full Report)

Wilbur Smith and Associates

INTERSTATE ROUTE 95

LOCATION AND ECONOMIC STUDY

PORTSMOUTH - KITTERY

NEW HAMPSHIRE MAINE

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NEW HAMPSHIRE MAINE

Prepared For

THE NEW HAMPSHIRE DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS

and

THE MAINE STATE HIGHWAY COMMISSION

In Cooperation With

THE U. S. DEPARTMENT OF COMMERCE BUREAU OF PUBLIC ROADS

by

Wilbur Smith and Associates

NEW HAVEN, CONNECTICUT

NOVEMBER, 1962

Wilbur Smith and Associates

TRAFFIC • PARKING • TRANSIT • HIGHWAYS

495 ORANGE STREET

New Haven, Conn.

November 6, 1962

Mr. John O. Morton
Commissioner
Department of Public Works and Highways
State House Annex
Concord, New Hampshire

Mr. David H. Stevens
Chairman
Maine State Highway Commission
State House
Augusta, Maine

Gentlemen:

We are pleased to submit our location and economic study for Interstate Route 95 in the Portsmouth-Kittery area. The study was made in accord with our agreements of November, 1961, and was undertaken jointly for the Maine State Highway Commission and the New Hampshire Department of Public Works and Highways, in cooperation with the U. S. Bureau of Public Roads.

Throughout the study, conferences were held with city, state and federal officials to coordinate the route location with over-all planning for the Portsmouth-Kittery area. Particular consideration was given to the impact of the proposed Interstate highway location on roadside businesses concentrated along the approaches to the existing Interstate Bridge in both Maine and New Hampshire.

The recommended route location, designed to accommodate 1985 traffic needs, was based on comprehensive roadside origin-destination surveys conducted in 1961, and interviews in the spring and summer of 1962 of patrons of the service stations, motels and restaurants that would be affected. Traffic services, economic impact, location, construction and right-of-way costs have been developed in detail for three alternate locations. The alternate providing the optimum balance in these criteria is recommended.

Valuable assistance was rendered by city, town, state and federal agencies. We wish to particularly acknowledge the cooperation of the owners and operators of the commercial facilities along the Interstate Bridge approaches.

A special note of acknowledgement is due the bridge consultants, Hardesty and Hanover, who were responsible for developing the details of location, design and costs for alternate Piscataqua River bridge sites.

We appreciate the opportunity of undertaking this interesting and important study and believe that the information developed will be valuable to you and the legislative committees in resolving this Interstate route location problem.

Respectfully submitted,

Wilbur S. Smith

Registered Prof. Eng.
State of Maine 1453
State of New Hampshire 1147

Wilbur S. Smith

ACKNOWLEDGEMENT OF TECHNICAL ASSISTANCE

In addition to the assistance and cooperation given by federal, state and city officials, and other public bodies, acknowledgement is made of the technical advice and assistance of the following:

Hardesty and Hanover
Consulting Engineers
101 Park Avenue
New York, New York

Mr. John L. Hyde
Appraiser
6 Columbus Avenue
Concord, New Hampshire

Mr. Jerome Knowles, Jr.
Appraiser
Jerome Knowles Junior Associates
Northeast Harbor, Maine

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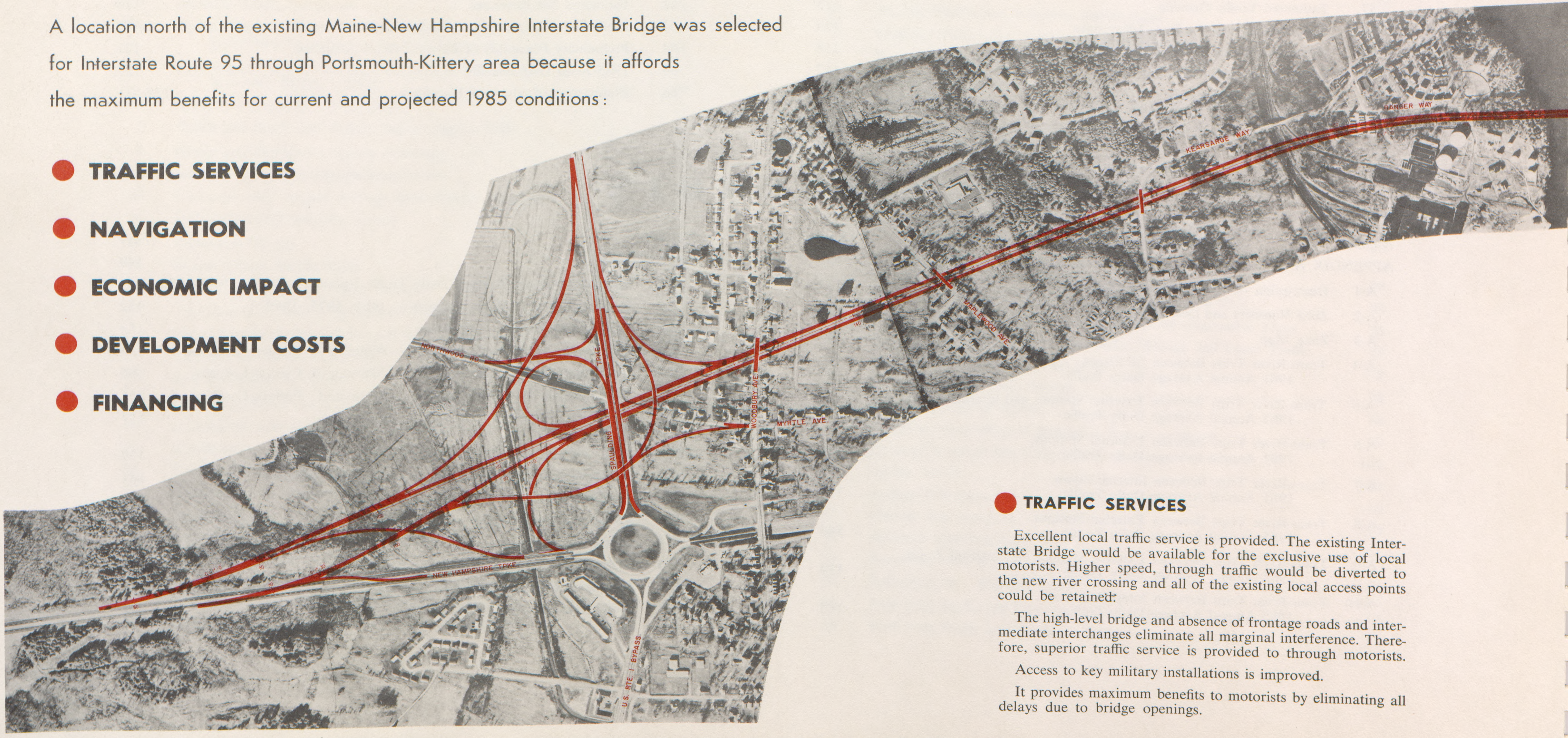
THE RECOMMENDED ROUTE

A location north of the existing Maine-New Hampshire Interstate Bridge was selected for Interstate Route 95 through Portsmouth-Kittery area because it affords the maximum benefits for current and projected 1985 conditions:

- **TRAFFIC SERVICES**
- **NAVIGATION**
- **ECONOMIC IMPACT**
- **DEVELOPMENT COSTS**
- **FINANCING**



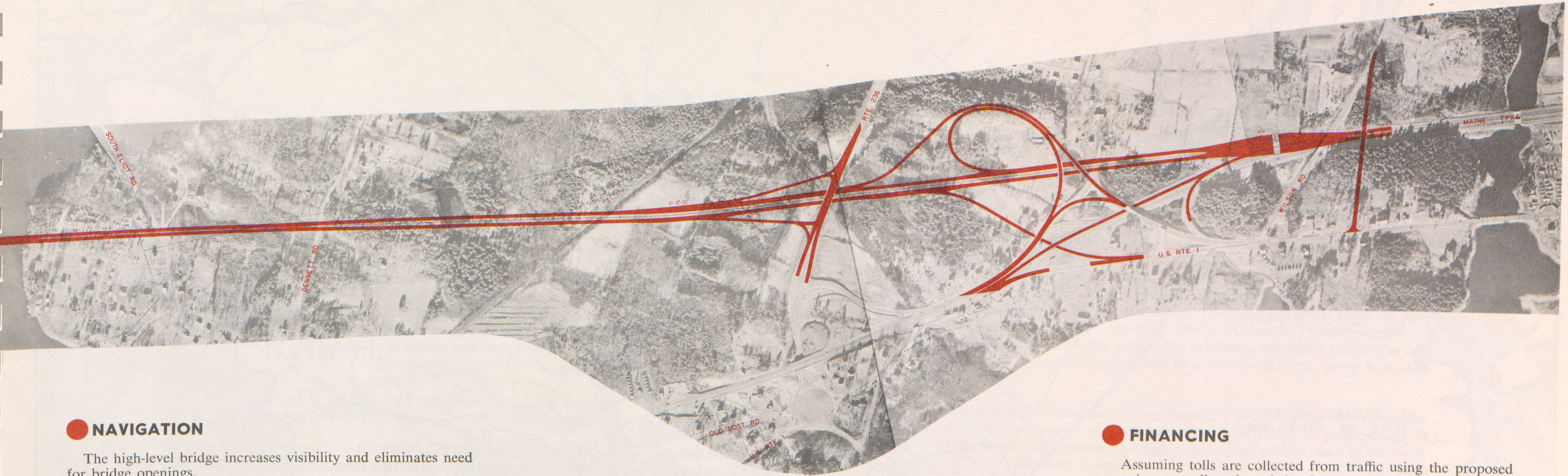
TRAFFIC SERVICES

Excellent local traffic service is provided. The existing Interstate Bridge would be available for the exclusive use of local motorists. Higher speed, through traffic would be diverted to the new river crossing and all of the existing local access points could be retained.

The high-level bridge and absence of frontage roads and intermediate interchanges eliminate all marginal interference. Therefore, superior traffic service is provided to through motorists.

Access to key military installations is improved.

It provides maximum benefits to motorists by eliminating all delays due to bridge openings.



NAVIGATION

The high-level bridge increases visibility and eliminates need for bridge openings.

The distance between the high-level bridge and the existing Interstate Bridge facilitates maneuvering of ships and navigation of the channel.

ECONOMIC IMPACT

A minimum amount of developed property is removed from the tax rolls.

The plan requires acquisition of the fewest number of service stations and other commercial buildings. While more business would be diverted from existing service stations along the Interstate Bridge approaches, this effect would be small over the long run and would likely be offset by a favorable re-orientation of the existing businesses and land use toward filling local needs.

During the construction period of the new route, the influx of workers and expenditures for materials and transportation will add to the business potentials for motels, restaurants and service stations.

The elimination of heavy through traffic volumes would favor relocation of local auto-oriented business establishments to the present Interstate Bridge approaches.

Accessibility to the Portsmouth-Kittery area will be improved; this should increase the development of customer markets and make the area inviting for commercial industrial growth.

The proposed route permits the maximum utilization of land along the existing Interstate Route approaches for business and commercial expansion.

It provides greatest long-range advantages for favorable land use developments, including location of small business and industrial parks.

The plan provides most favorable long-range community impact.

DEVELOPMENT COSTS

Preliminary right-of-way acquisition costs are estimated at $715,000, about 18 per cent lower than on the other locations studied.

The estimated total development costs of $13,587,000 are about 30 per cent less than for the alternates evaluated.

FINANCING

Assuming tolls are collected from traffic using the proposed crossing, as well as the existing Interstate Bridge, revenue bond financing of the bridge and its approaches is entirely feasible.

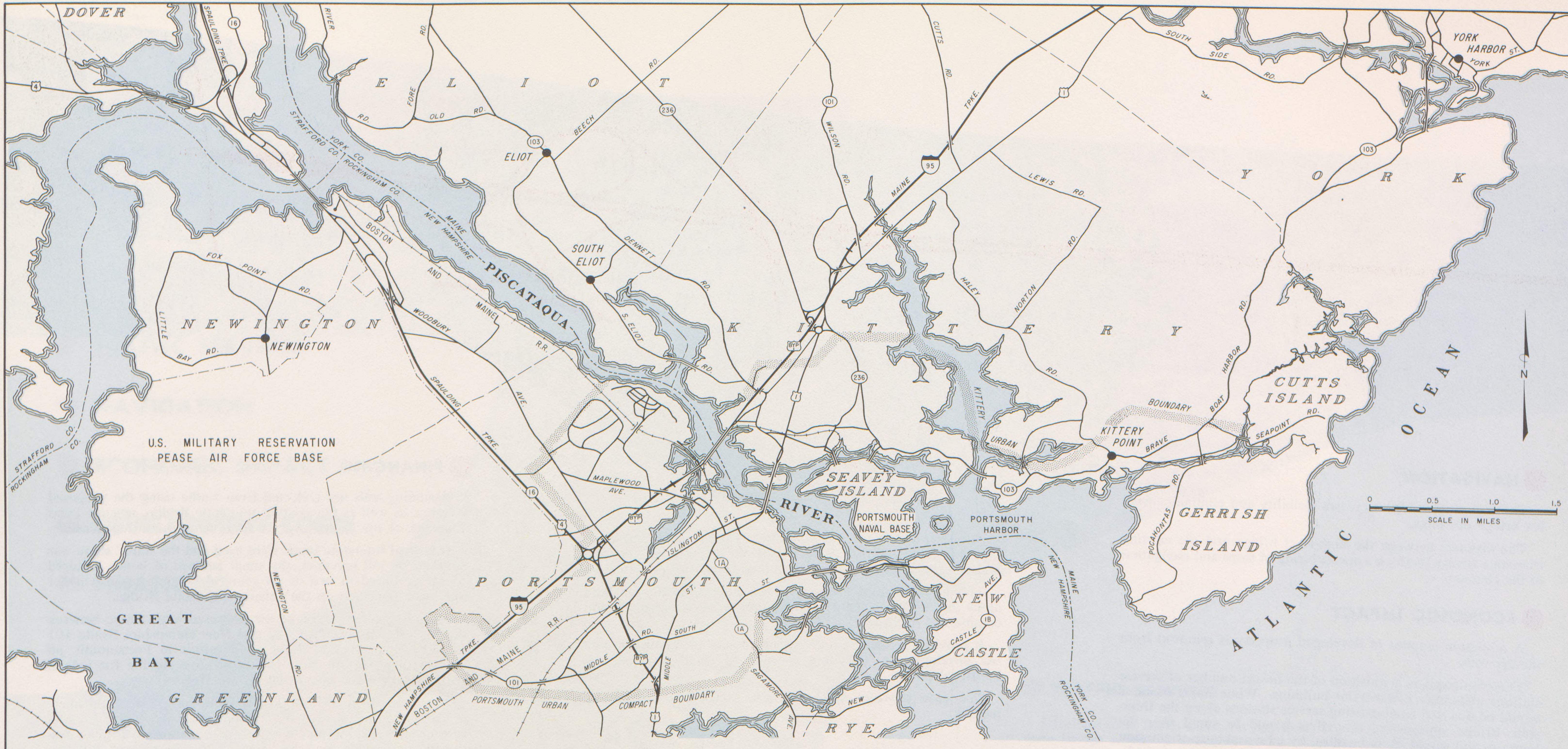
If federal Interstate funds were used and the states' share was financed by toll revenues, the small amount of bonds required could be retired in two to six years, depending upon whether tolls were collected on the existing Interstate Bridge.

Assuming construction of the proposed interchange between the New Hampshire Turnpike and New Hampshire Route 101 (Middle Road) south of the traffic circle in Portsmouth, all construction costs in New Hampshire are eligible for federal participation if the new bridge is toll free.

In Maine about $975,000 of construction costs would likely be ineligible for federal participation unless the Maine Legislature amends the statutes relating to the Maine Turnpike Authority, to provide that the Maine Turnpike become toll free after payment of Turnpike indebtedness.

If a toll free facility is constructed, New Hampshire's share of construction costs would approximate $750,000.

Maine's share of construction costs would vary between $620,000 and $1,500,000, depending upon the eligibility of constructing the approaches to the Maine Turnpike with federal Interstate funds.



REGIONAL MAP

Wilbur Smith and Associates

FIGURE 1

INTRODUCTION

The Portsmouth-Kittery area, centered in the principal coastal traffic corridor to upper New England and Canada, is facing increasing traffic problems because of its role as the gateway to a broad, fast growing, recreational region. Traffic volumes in the area show substantial growths.

More leisure time, longer vacations, and a generally higher standard of living, have stimulated vacation travel in the nation, and in New England, particularly. The opening of new express highways and the improvement of existing highway networks have given the motoring public easy access to the historic and recreational areas of this region. However, it is not only recreational traffic that is growing; commercial, industrial and general business travel are also increasing in Maine and New Hampshire.

Study Area Characteristics

Located at the mouth of the Piscataqua River, approximately halfway between Boston, Massachusetts and Portland, Maine, the Portsmouth-Kittery area has a population of about 37,000 persons. In addition to its importance in relation to beach and mountain recreation areas, the Portsmouth-Kittery area is the trade center for about 100,000 persons living in Strafford and Rockingham Counties, New Hampshire, and York County, Maine. The study area is defined in Figure 1.

Heavy volumes of traffic are funnelled through the Portsmouth-Kittery area via U. S. Routes 1 and 4 and, principally, Interstate Route 95 (New Hampshire and Maine Turnpikes). The Portsmouth Naval Shipyard, Pease Air Force Base, and, especially in the summer months, recreational areas add heavy volumes of traffic to the highway corridor.

At present, the Portsmouth area is linked with Kittery, Maine, across the Piscataqua River, by two bridges. Memorial Bridge, a toll-free two-lane structure built in the early 1920's, is designated U. S. Route 1. The Maine-New Hampshire Interstate Toll Bridge, built in 1940, links the New Hampshire and Maine Turnpikes (both designated as Interstate Route 95).

Traffic over Interstate Route 95 via the Interstate Bridge has shown marked growth in recent years, especially during the summer months. Summer traffic on the Interstate Bridge is about 75 per cent higher than the annual average daily traffic, as compared with only a 16 per cent increase on the Memorial Bridge. Average daily traffic during July, 1962 was almost 24,000 vehicles on the Interstate Bridge and 19,400 vehicles on the Memorial Bridge.

The New Hampshire Turnpike now ends at a traffic circle approximately one mile south of the Interstate Bridge, and the Maine Turnpike begins about a mile north of the bridge. The connecting roadway between these two turnpikes, except for the Piscataqua River bridge, is a four-lane divided highway with partial control of access under the jurisdiction of the Maine-New Hampshire Interstate Bridge Authority.[1] Numerous gasoline stations, motels, restaurants, and other automotive orientated businesses, catering to both through and local traffic, have been established in a commercial strip along both sides of the bridge approaches.

During periods of peak traffic, the existing Interstate Bridge carries heavy volumes. Only 30 feet wide, it is sometimes operated as a three-lane facility at peak periods. A single track of the Boston and Maine Railroad is carried on a lower deck of the structure. Because of the low clearance created by the lower railroad span (10.2 feet at mean high tide), the lift bridge must be opened frequently for passing boats. Such operations cause serious interferences with normal highway traffic flows. Often vehicles are backed-up for more than a mile in each direction on the bridge approaches.

Authority for Study

As automobile travel increases, and longer sections of Interstate Route 95 are constructed, traffic through the Portsmouth-Kittery area will grow considerably. To determine present and future highway needs for the area, the Department of Public Works and Highways of New Hampshire and the Maine State Highway Commission, in cooperation with the U. S. Bureau of Public Roads, authorized Wilbur Smith and Associates to undertake an engineering and economic study of the problems of locating, constructing, and financing the Interstate Route 95 bridge crossing the Piscataqua River between Portsmouth, New Hampshire and Kittery, Maine. This comprehensive study, taking into account traffic services, physical and topographic conditions, construction and right-of-way costs, and community impacts was authorized on November 30, 1961.

[1] See Part IV, Chapter XIII for description of the Authority.

Scope

Two solutions to the problem of constructing Interstate Route 95 through the Portsmouth-Kittery area were considered:

1. Expanding the capacity of the existing toll bridge, including construction of a parallel bridge.
2. Constructing a high-level bridge and approaches on a new location.

All plans connect the northern terminus of the New Hampshire Turnpike to the southern terminus of the Maine Turnpike and also provide for connections to other principal routes. The two turnpikes have been designated as segments of Interstate Route 95, the major north-south route between Maine and Florida.

The study includes a comparative analysis of toll financing versus financing through a 90 per cent contribution of Federal highway funds, as provided by the Federal Highway Act of 1956.

Traffic Studies—The comprehensive origin-destination data on traffic crossing the Piscataqua River, collected by the Maine State Highway Commission in October, 1961 and by Wilbur Smith and Associates in July, 1961, were carefully analyzed. This information was supplemented by additional traffic volume data collected by the New Hampshire and Maine highway agencies throughout the study area by automatic recorders during other periods of the year. Field reconnaissance was undertaken to examine the physical features of the existing highway network and to observe traffic operations under normal and peak travel periods.

Analyses were made of the amount of road capacity required to handle traffic volumes in the study corridor, and to provide additional river-crossing capacity as needed. Suitable means of interchange with other routes and traffic service to local business and industrial functions have been determined, and all routes are coordinated with plans for local highways in Portsmouth and Kittery.[2]

Location Studies—All physical factors affecting the feasibility of location and construction of the proposed routes were carefully observed.

The three most feasible locations were determined and functional plans showing alignments, approximate grades, plan and profiles, bridge locations, interchanges, basic drainage requirements, and other factors were prepared. Design criteria prescribed by the U. S. Bureau of Public Roads and the highway departments of Maine and New Hampshire were followed.

[2] *Comprehensive Transportation Plan, Portsmouth, New Hampshire*, Wilbur Smith and Associates, 1962.
Comprehensive Transportation Plan, Kittery, Maine, Wilbur Smith and Associates, 1962.

Cost estimates were made for the recommended routes, including costs of right-of-way as estimated by qualified appraisers.

Economic Impact Study—This phase of the study involved detailed economic impact investigations of the alternative route and bridge solutions. Complete economic comparisons, including conventional benefit-cost studies, comparative cost estimates, and impact on land use were made.

Characteristics of customers were related to origin and destination data and other basic traffic information. Through and local traffic were considered separately in relating traffic characteristics to businesses. Trends in roadside business were evaluated, and the market areas of typical businesses determined.

Extensive field investigations were conducted as part of the economic study. Interviews were conducted with customers of motels, restaurants, and service stations to determine buying habits, trip origins and destinations, and how they would be affected by the various alternate route locations under consideration. The impact on all land uses, residential, commercial and industrial, was evaluated.

Benefit comparisons were made, together with a summary of relative traffic relief afforded existing roads and streets and the improvements in accessibility which the recommended route would provide.

Cooperative Action

Throughout the study, a close working relationship was maintained with the U. S. Bureau of Public Roads, the Maine State Highway Commission, the New Hampshire Department of Public Works and Highways, the Maine-New Hampshire Interstate Bridge Authority, the Maine Turnpike Authority, the New Hampshire Port Authority, the Federal Housing and Home Finance Agency, the U. S. Corps of Engineers, and other official bodies concerned with transportation in the area.

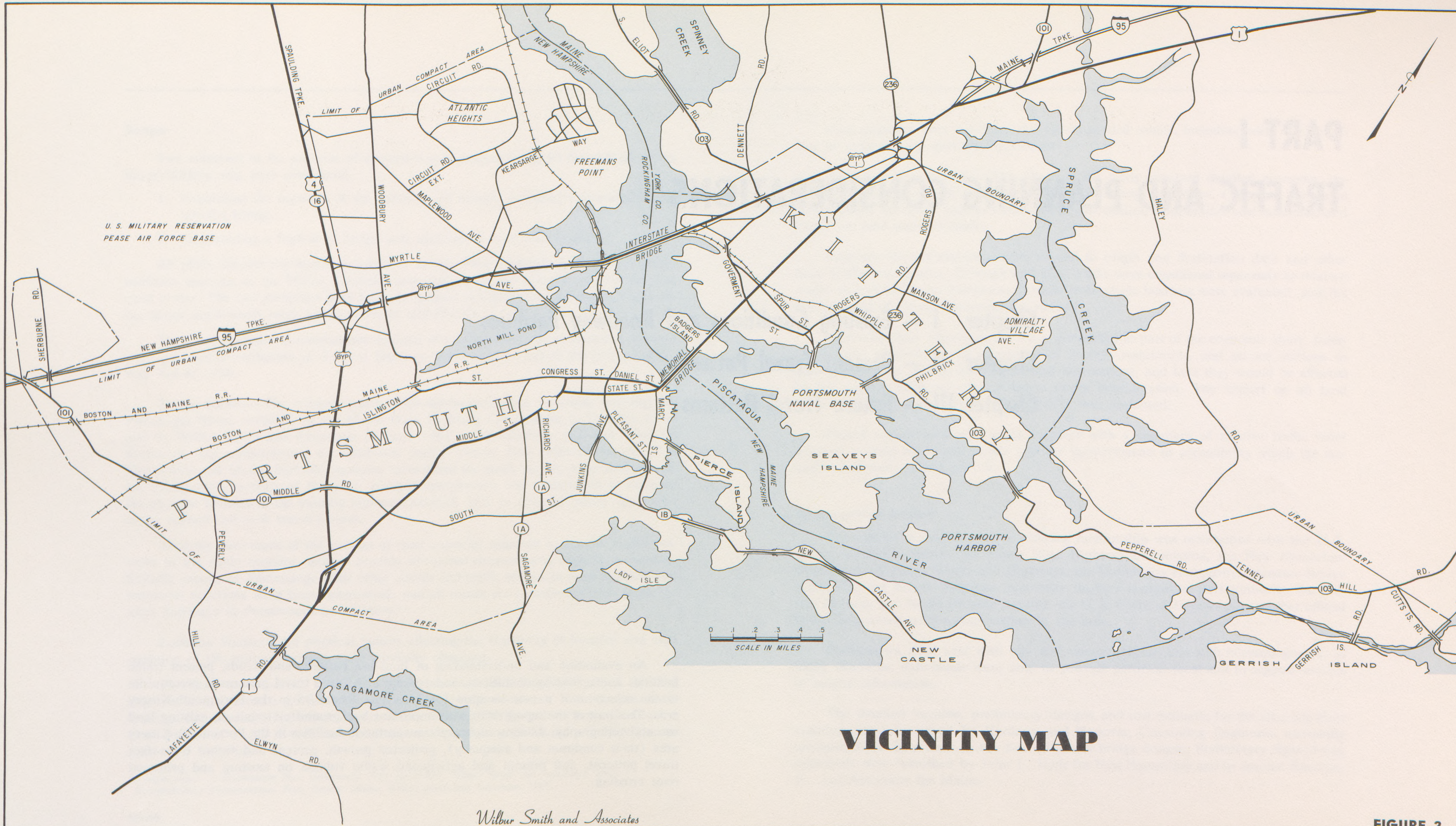
Conferences were held with city and county officials and with business groups. In many instances, individuals were able to provide pertinent facts and to suggest sources of helpful information.

The detailed location, preliminary designs, and cost estimates for the alternate river crossings were developed by Hardesty and Hanover, Consulting Engineers, nationally recognized for their work in the field of major bridge designs. Preliminary right-of-way appraisals were furnished by John L. Hyde for New Hampshire and by Jerome Knowles, Jr., and Associates for Maine.

PART I

TRAFFIC AND PLANNING CONSIDERATIONS

An evaluation and understanding of land use patterns and trends, present traffic facilities and operating conditions, and present and future travel patterns is prerequisite to the selection of a new location for Interstate Route 95 in the Portsmouth-Kittery area. This part of the report deals with important background materials on existing land use and topography, existing highway transportation facilities in the Portsmouth-Kittery area (their condition and adequacy), projected growth, present and future trans-river travel patterns, and present and anticipated traffic volume on existing and proposed river crossing.



VICINITY MAP

Wilbur Smith and Associates

FIGURE 2

Chapter I

EXISTING CONDITIONS AND ROADWAY FACILITIES

A thorough knowledge of existing roadway facilities and operating conditions is necessary to insure that the proposed Interstate Route 95 improvement will be well integrated with highway transportation improvements in the Portsmouth-Kittery area.

Street System and Land Use Pattern

The existing street system in the Portsmouth-Kittery area and immediate environs is shown in Figure 2. The effects of topographic and landscape features are quite apparent. Bays, rivers, and inlets have, to a large extent, controlled land development and roadway patterns. The street network is irregular, and in many cases discontinuous. To a large extent, the Piscataqua River forms a barrier to north-south travel.

The land use patterns, are further complicated by the existence of two military installations, Pease Air Force Base and the Portsmouth Naval Base.

Land Use—Distribution of land use in the City of Portsmouth is given in Table 1. The land area in Portsmouth approximates 15 square miles—9,704 acres, of which the Pease Air Force Base occupies 1,719 acres. Approximately 43 per cent of the existing land is developed, 57 per cent is vacant, thereby reflecting potential areas for new growth.

The largest single land use in Portsmouth is for residential purposes—over 40 per cent of all developed land. About 80 per cent of the residential land is occupied by single family dwelling units. Residential areas are interspaced throughout the city. Several concentrations in the western section of Portsmouth were built as World War I and II housing projects. More recently, residential construction has taken place on large tracts located in the southern sections of Portsmouth.

Industrial land use amounts to 331 acres, or about ten per cent of all developed land. Most manufacturing plants are located near the Boston and Maine Railroad tracks east of North Mill Pond and at Freeman's Point. The principal manufacturing products include gypsum, shoe board, fiber tufting, buttons, and shoes.

Business and commercial land uses, about four per cent of the developed land, are heavily concentrated in the central business district, which serves the entire Portsmouth-Kittery area.

TABLE 1

EXISTING LAND USE

Portsmouth, New Hampshire

July, 1960

Type	*Acres*	*Per Cent of Total Land*	*Per Cent of Developed Land*
Residential			
Single Family	1,118	14.0	32.6
Two-Family	110	1.4	3.2
Multi-Family	167	2.1	4.9
Commercial	146	1.8	4.3
Industrial	331	4.1	9.7
Railroad	93	1.2	2.7
Utility	277	3.5	8.1
Public & Semi-Public	608	7.6	17.7
Street	574	7.2	16.8
Total developed	3,424	42.9	100.0
Vacant[1]	4,561	57.1	
Total land[2]	7,985	100.0	

[1] About 3,500 acres, 44 per cent of total land area, is economically developable.
[2] This table excludes the 1,719 acres occupied by Pease Air Force Base.

Source: Planning Department, Portsmouth, New Hampshire

Most land in Kittery is presently vacant and undeveloped. Residential development is scattered throughout the town along major town roads, and also in Admiralty Village, a 600 unit defense housing installation composed of two and four family structures, east of Maine Route 236 near Spruce Creek. Commercial uses concentrated along Alternate U. S. Route 1, north approach to the present Interstate Bridge, cater primarily to the needs of the highway travelers, and represent an important part of Kittery's economic base. In addition, retail areas located around the town center provide convenience goods shopping. The Portsmouth Naval Shipyard, located along Kittery's coastline on the Piscataqua River is the major employment center in the region.

Topography

The terrain in Portsmouth is mostly level to gently rolling with elevations varying between 20 and 40 feet above sea level. Approximately 800 acres of land have poor surface drainage, mainly tidal marshlands located along Sagamore Creek and several fresh water swamps in the south portions of the city. Most of the land located north of Spaulding Turnpike appears to be generally suitable for development.

TABLE 2

MAJOR ROADWAYS IN THE PORTSMOUTH-KITTERY AREA

		Route Description				
Name	*Route Number*	*Access Control*	*Median Divider*	*No. of Traffic Lanes*	*Pavement Width (ft.)*	*AADT*[1]
New Hampshire Turnpike	Interstate 95	Full	Yes	4	48 (Shoulders)	14,500
Maine-New Hampshire Interstate Bridge						
New Hampshire Approach	Bypass U. S. 1	Some	Yes	4	48 (Shoulders)	15,000
Interstate Bridge	....	....	None	3	30 (Curbed)	13,600
Maine Approach	Bypass U. S. 1	Some	Yes	4	48 (Shoulders)	11,800
Maine Turnpike	Interstate 95	Full	Yes	4	48 (Shoulders)	7,800
Spaulding Turnpike	U. S. 4-N. H. 16	Some	Yes	4	48 (Shoulders)	10,200
Memorial Bridge						
Portsmouth Approach	U. S. 1	None	None	4	34 & 44 (Curbed)[2]	18,600
Memorial Bridge	U. S. 1	....	None	2	28 (Curbed)	16,800
Kittery Approach	U. S. 1	None	None	4	20 & 20 (Curbed)[2]	17,500
Sagamore Avenue	N. H. 1A	None	None	2	24 (Shoulders)	3,500
New Castle Avenue	N. H. 1B	None	None	2	22 (Shoulders)	1,800
Middle Road	N. H. 101	None	None	2	24 (Curbed)	6,700
—	Me. 103	None	None	2	20 (Shoulders)	4,500
Rogers Road	Me. 236	None	None	2	22 (Shoulders)	5,400

[1] Annual Average Daily Traffic, 1961
[2] Pair of one-way streets

In Kittery, most of the land is classified as rolling terrain with very few prominent high spots. Throughout the town, the depth of soil is fairly shallow, and much of Kittery appears to be underlain by ledge or bedrock. The "Soil Map" of York County, (prepared by the U. S. Department of Agriculture and the University of Maine) indicates that a major portion of the land west of the Maine Turnpike and the Interstate Bridge approaches is suitable for building construction and agricultural production.

Existing Highways

The major routes converging on the study area are shown in Figure 2. The New Hampshire and Maine Turnpikes are linked by the partially-controlled access approaches of the Interstate Toll Bridge. The Spaulding Turnpike begins at its junction with the New Hampshire Turnpike and extends northwesterly into upper New Hampshire. U. S. Route 1 is routed via Middle, State, Daniel and Congress Streets in Portsmouth over the Memorial Bridge into Maine. Other principal highways include New Hampshire Routes 1A (Sagamore Avenue), 1B (New Castle Avenue), and 101 (Middle Road); and Maine Routes 103 and 236. General physical and traffic characteristics of these roadways are shown in Table 2, and a detailed description of each route is given in Appendix A-1.

Piscataqua River Crossings

Over 30,000 vehicles crossed the Piscataqua River bridges each day in 1961. The Memorial Bridge carries slightly less than 17,000 vehicles daily, and the Interstate Toll Bridge, a combined highway and railway structure, carries almost 14,000 vehicles daily.

Interstate Bridge—The Interstate highway and railway bridge, opened to traffic in November, 1940, crosses the Piscataqua River about 4.0 miles above its mouth. Its vertical lift span provides a horizontal clearance of 200 feet and a vertical clearance of 135 feet above mean high water when opened, and 10.2 feet when closed. A 30 foot roadway is provided between safety-walks.

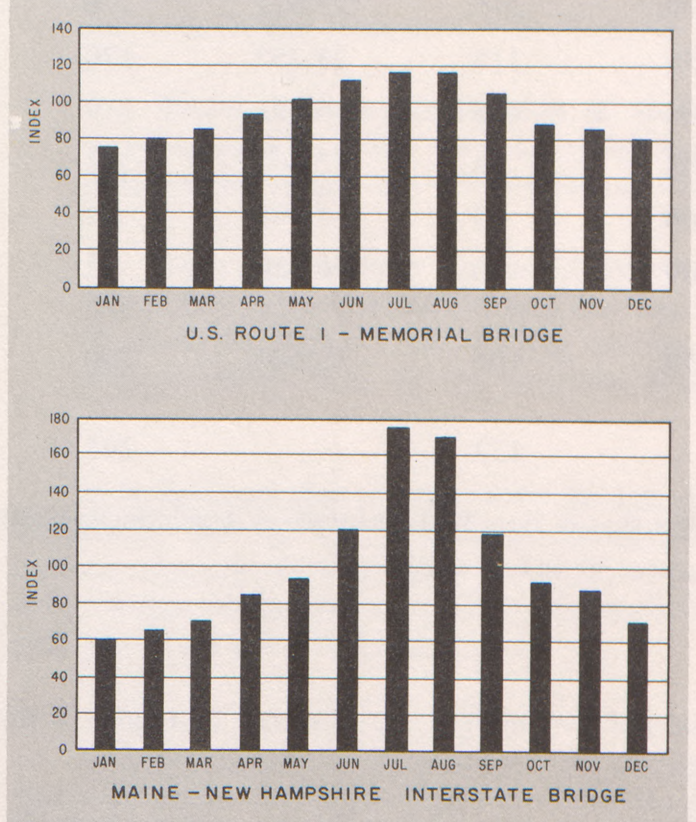
Memorial Bridge—The Memorial Bridge crosses the Piscataqua River about 3.5 miles above its mouth and links the downtown area of Portsmouth with Kittery. Constructed in the early 1920's, the bridge incorporates a vertical lift span with a horizontal clearance of 260 feet and a vertical clearance of 150 feet above mean high water when opened, and 19.1 feet when closed. The roadway is 28 feet, thus permitting one travel lane in each direction.

Traffic Variations

Interstate Route 95 and U. S. Route 1 both serve as links to the vast recreational areas of Maine and New Hampshire. As a result, there are pronounced variations in seasonal, daily and hourly traffic flows.

Seasonal—The monthly traffic variations on the Memorial and Maine-New Hampshire Interstate Bridges are shown in Figure 3 and Table 3. These patterns clearly indicate the strong impact of recreational traffic on trans-river volumes.

The peak traffic months on both bridges are July and August. However, seasonal traffic variations are much more pronounced on the Maine-New Hampshire Interstate Bridge which predominantly serves long distance traffic. Traffic volumes on the Interstate Bridge during the summer months are 70 to 75 per cent higher than the annual average daily traffic, 24,000 vehicles per day as compared with an average daily traffic of about 14,000.



MONTHLY TRAFFIC VARIATIONS – 1961

Wilbur Smith and Associates — FIGURE 3

The summer volumes on the Memorial Bridge are only about 15 per cent greater than the average daily traffic — about 19,000 vehicles as compared with 17,000.

The lowest volume month on both bridges occurred in January when average daily traffic approximated 12,600 vehicles on the Memorial Bridge and 8,100 vehicles on the Interstate Bridge, 75 and 60 per cent of the annual average daily traffic, respectively. The extreme peaks in traffic levels on the Interstate Bridge clearly reflect the high summer vacation and tourist travel in contrast to the more locally oriented travel on the Memorial Bridge.

TABLE 3

MONTHLY TRAFFIC VARIATIONS

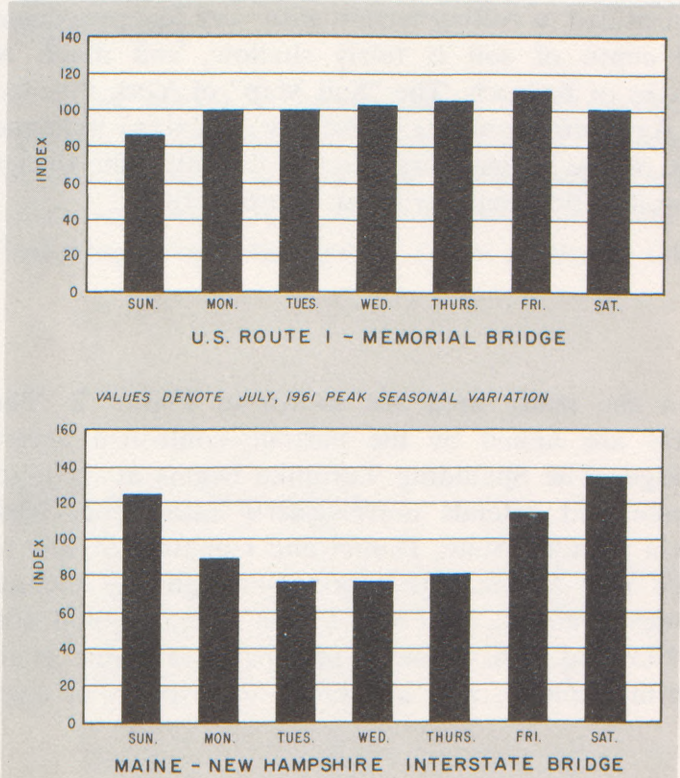
Memorial and Maine-New Hampshire Interstate Bridges[1]

Month	Memorial Bridge ADT[2,3]	Memorial Bridge Per Cent of AADT[4]	Maine-New Hampshire Interstate Bridge ADT[3]	Maine-New Hampshire Interstate Bridge Per Cent of AADT[4]
January	12,600	75	8,137	60
February	13,400	80	8,878	65
March	14,200	85	9,585	70
April	15,507	93	11,524	84
May	17,172	102	12,767	94
June	18,834	112	16,318	120
July	19,336	115	23,971	176
August	19,336	115	23,252	170
September	17,600	105	16,181	119
October	14,708	88	12,607	92
November	14,200	85	11,999	88
December	13,400	80	9,849	72
Annual Average Daily Traffic (AADT)	16,750	100	13,640	100
Maximum Month as Per Cent of Minimum Month	....	153	....	295

[1] Source: Maine Highway Commission, New Hampshire Dept. of Public Works and Highways, Maine-New Hampshire Interstate Bridge Authority
[2] Actual counts—April through July and October; estimates for all other months
[3] Average Daily Traffic, 1961
[4] Annual Average Daily Traffic, 1961

Daily—Daily traffic variations for the two bridges are depicted in Figure 4 for July, 1961.

On the Memorial Bridge, daily volumes were at a low on Sunday and gradually increased to a peak on Friday. The peak day, Friday, was 16 per cent of the total week's travel, while Sunday represented only 13 per cent of the total week's travel. The pattern found on the Memorial Bridge is typical for an urban area and conforms to variations in commercial and retail activity found in downtown Portsmouth.



DAILY TRAFFIC VARIATIONS

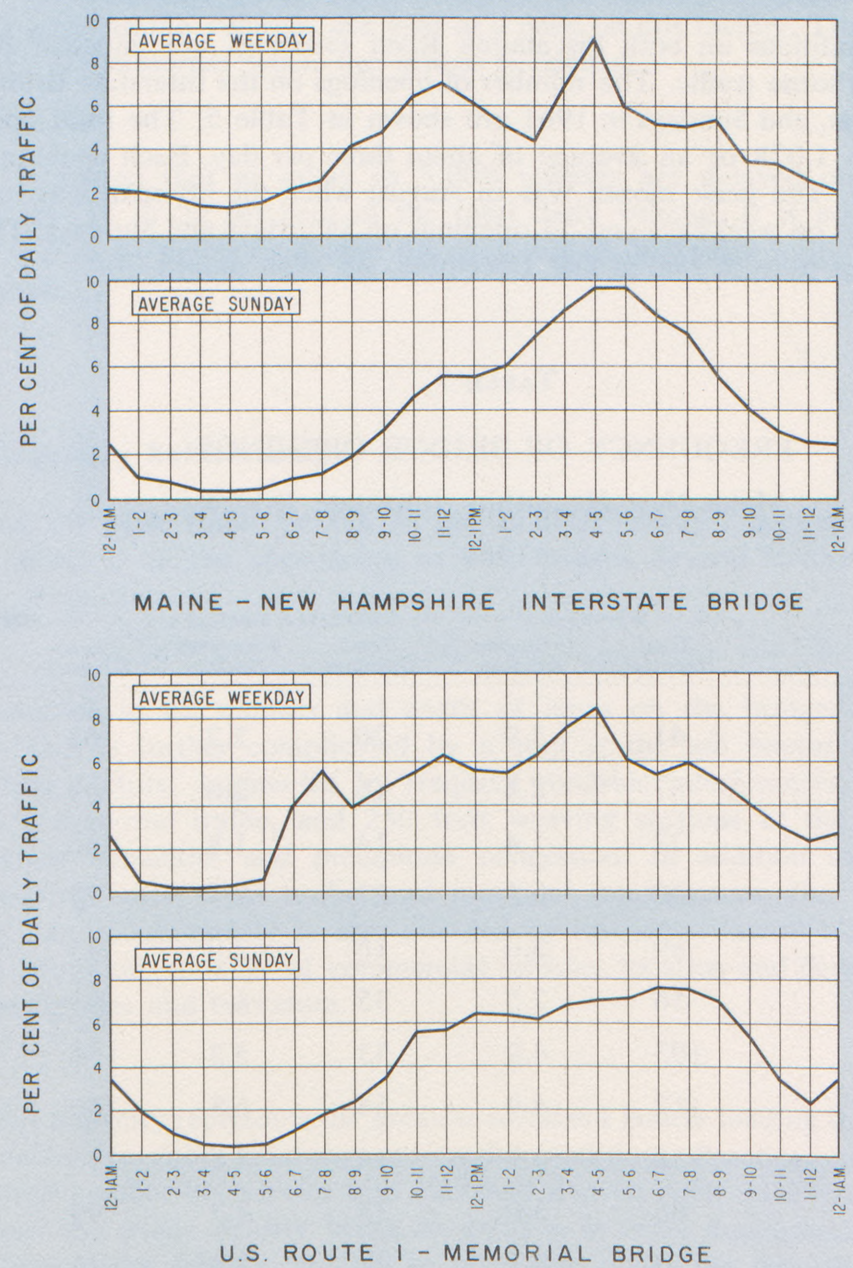
FIGURE 4

Daily traffic volumes on the Interstate Bridge follow a different variation pattern and more closely reflect rural or suburban travel. The peak daily volume on Saturday was followed by a secondary peak on Sunday. Monday-through-Thursday daily volumes remained about level, while somewhat higher volumes were recorded on Friday. The peak day, Saturday, represented 20 per cent of the total week's travel while Tuesday, the most lightly traveled day, accounted for 11 per cent of the total week's travel. Saturday travel was nearly 40 per cent greater than on an average day, Sunday about 25 per cent greater.

Hourly—Hourly traffic variations for an average weekday and Sunday during July, 1961 are depicted in Figure 5.

On the Maine-New Hampshire Interstate Bridge, the peak hour on an average weekday occurred between 4:00 P.M. and 5:00 P.M. when 9.2 per cent of total day's traffic was observed. The second highest hour was between 11:00 A.M. and 12 Noon, with 7.1 per cent of the day's traffic. No distinct morning peak was observed on this bridge. The Sunday pattern on the Interstate Bridge is typical of a vacation and tourist route. The peak hour on Sunday occurred between 4:00 P.M. and 5:00 P.M. when 9.9 per cent of the day's travel was recorded. The six hours between 2:00 P.M. and 8:00 P.M. accounted for over 50 per cent of the 24-hour traffic volume.

On the Memorial Bridge the peak hour occurred between 4:00 P.M. and 5:00 P.M. amounting to 8.5 per cent of the 24-hour volume. On Sunday, the peak hour, occurring between 6:00 P.M. - 7:00 P.M., accounted for 7.6 per cent of the day's traffic.



HOURLY TRAFFIC VARIATIONS – JULY, 1961

Wilbur Smith and Associates FIGURE 5

Comparative Travel Times

The traffic volume characteristics become especially significant when related to operations and capacities. Accordingly, speed and delay studies were conducted during both peak and off-peak periods.

The travel times and distances for various trans-river trips are shown in Table 4. The time-distance comparisons are based on data obtained in the route reconnaissance investigations. Comparative travel times and distances over the Interstate and Memorial Bridges are as follows:

For the heavy through movement between the junction of the New Hampshire and Spaulding Turnpikes and points north via U. S. Route 1 or the Maine Turnpike, the routing via the Interstate Bridge is 1.1 miles and 5.3 minutes shorter than via the Memorial Bridge. Average travel speeds of 36 m.p.h. were attained via the Interstate Bridge compared with 24 m.p.h. via the Memorial Bridge.

Travel between the junction of U. S. Route 1 and U. S. Route 1 Bypass in Portsmouth to points north in Maine via U. S. Route 1 or the Maine Turnpike is 0.2 miles longer, but 2.9 minutes shorter via the Interstate Bridge.

Time and distance are saved by motorists using the Memorial Bridge between downtown Portsmouth and the Junction of U. S. Route 1 and the Maine Turnpike in Kittery. The routing via the Memorial Bridge is 0.5 miles and 0.4 minutes shorter than via the Interstate Bridge.

It is apparent that the Interstate Bridge offers the greatest savings in time and distance for through traffic while the Memorial Bridge, situated closer to the central business districts of Portsmouth and Kittery, provides a better routing for traffic having either origin or destination in these downtown areas. These relationships are consistent with the actual use of the two bridges.

It is also significant to note that the average speed of 36 miles per hour via the Interstate Bridge is substantially lower than the 60 m.p.h. operating speeds on the Maine and New Hampshire Turnpikes. Thus, this section of roadway constitutes a "bottleneck" for high speed through traffic.

TABLE 4

TYPICAL TIME-DISTANCE RELATIONSHIPS

Maine-New Hampshire Interstate and Memorial Bridges

Movement Between	Distance in Miles	Travel Time in Minutes	Avg. Speed in m.p.h.
Junction of New Hampshire—Spaulding Turnpikes and Junction of U. S. Route 1—Maine Turnpike			
via Interstate Bridge	2.9	4.8	36
via Memorial Bridge	4.0	10.1	24
Savings via Interstate Bridge	1.1	5.3	....
Junction of New Hampshire—Spaulding Turnpikes and downtown Kittery			
via Interstate Bridge	2.6	5.7	27
via Memorial Bridge	2.9	8.2	21
Savings via Interstate Bridge	0.3	2.5	.....
Junction of Maine Turnpike—U. S. Route 1 and downtown Portsmouth			
via Interstate Bridge	2.9	5.8	30
via Memorial Bridge	2.4	5.4	27
Savings via Interstate Bridge	−0.5	−0.4	....
Junction of U. S. Route 1—U. S. Route 1 Bypass and Junction of Maine Turnpike—U. S. Route 1			
via Interstate Bridge	4.2	7.0	36
via Memorial Bridge	4.0	9.9	24
Savings via Interstate Bridge	−0.2	2.9	....
Junction of U. S. Route 1—U. S. Route 1 Bypass and downtown Kittery			
via Interstate Bridge	3.9	7.9	30
via Memorial Bridge	2.9	8.0	22
Savings via Interstate Bridge	−1.0	0.1	....

Bridge Openings

Operating conditions on both Piscataqua River crossings are impeded by bridge openings for waterborne traffic. The number of openings on the Interstate Bridge during weekdays, Saturdays, and Sundays in 1961 are shown in Table 5. The total openings in 1961 amounted to 1,078 or an average of about three per day. Each opening lasts for about ten minutes. The peak month was in August when the lift span was raised 166 times, 112 openings on weekdays and 54 openings on Saturdays and Sundays. The fewest number of openings were in March and December, 46 each month.

TABLE 5

FREQUENCY OF BRIDGE OPENINGS

Maine-New Hampshire Interstate Bridge

1961

Month	Weekdays		Saturdays & Sundays		All Days	
	Total Openings	Frequency Per Day	Total Openings	Frequency Per Day	Total Openings	Frequency Per Day
January	41	1.9	20	2.2	61	2.0
February	47	2.4	16	2.0	63	2.2
March	32	1.4	14	1.8	46	1.5
April	50	2.5	27	2.7	77	2.6
May	69	3.0	16	2.0	85	2.7
June	56	2.5	35	4.4	91	3.0
July	103	4.9	53	5.3	156	5.0
August	112	4.9	54	6.8	166	5.4
September	82	3.9	34	3.8	116	3.9
October	66	3.0	33	3.7	99	3.2
November	50	2.3	22	2.8	72	2.4
December	32	1.5	14	1.4	46	1.5
TOTAL	740	2.8	338	3.2	1,078	3.0

Source: Maine-New Hampshire Interstate Bridge Authority

The high frequency of bridge openings during the summer months coincides with the period when traffic volumes are also at a peak on this facility. This results in severe traffic delays to motorists when the bridge is opened.

It is estimated that as many as 5,000 vehicles are delayed on a busy summer weekend day—15 to 20 per cent of the total daily volume. It is not unusual to find traffic backed-up as much as a mile on each side of the bridge waiting for the lift span to be lowered.

Volume-Capacity Relationships

During the peak traffic periods in the summer months, backups and congestion frequently develop on the approaches to both bridges. Several factors contribute to the delay and congestion.

A reduction in the number and width of lanes on the bridges tends to restrict capacities. This is further complicated by a stop at the toll booths on the Interstate Bridge. These factors, augmented by frequent roadside interferences, openings of the bridges to waterborne traffic, and 250 foot weaving sections at the rotary in Portsmouth, reduce capacities and precipitate congestion. In addition to roadway width, effective moving lanes, cross traffic, and marginal interferences, the volume of traffic a roadway can accommodate is also affected by restrictive lateral clearance, shoulder width and condition, number of commercial vehicles, location and design of interchange connections, grades and curvature.

Possible capacity represents the greatest sustained hourly loading that can be accommodated under prevailing roadway and traffic conditions. Practical capacity represents the maximum number of vehicles that can pass a given point on a roadway during one hour without the traffic density being so great as to cause unreasonable delay, hazard, or restrictions to the driver's freedom to maneuver under the prevailing roadway and traffic conditions.[3]

[3] *Highway Capacity Manual*, Practical Applications of Research, By the Committee on Highway Capacity, Department of Traffic and Operations, Highway Research Board, published by U.S. Department of Commerce, Bureau of Public Roads, 1950.

Existing peak hour volumes are compared with practical capacities in Table 6. Capacity calculations for the bridges assume urban conditions—for rural conditions, capacities would be somewhat lower. Both bridges adequately serve peak hour volumes during average mid-week periods. However, both bridges operate beyond their practical capacities during peak hours in the summer months. During these periods, the influx of tourist and vacation traffic cause frequent delays and congestion.

It is clear that there is little capacity reserve on the existing bridges. As growth in the Portsmouth-Kittery area continues, capacities will become taxed for an increasing number of hours each day. The need for improved trans-river crossings to serve existing and future traffic—becomes more evident.

TABLE 6

VOLUME-CAPACITY COMPARISON

Piscataqua River Crossings

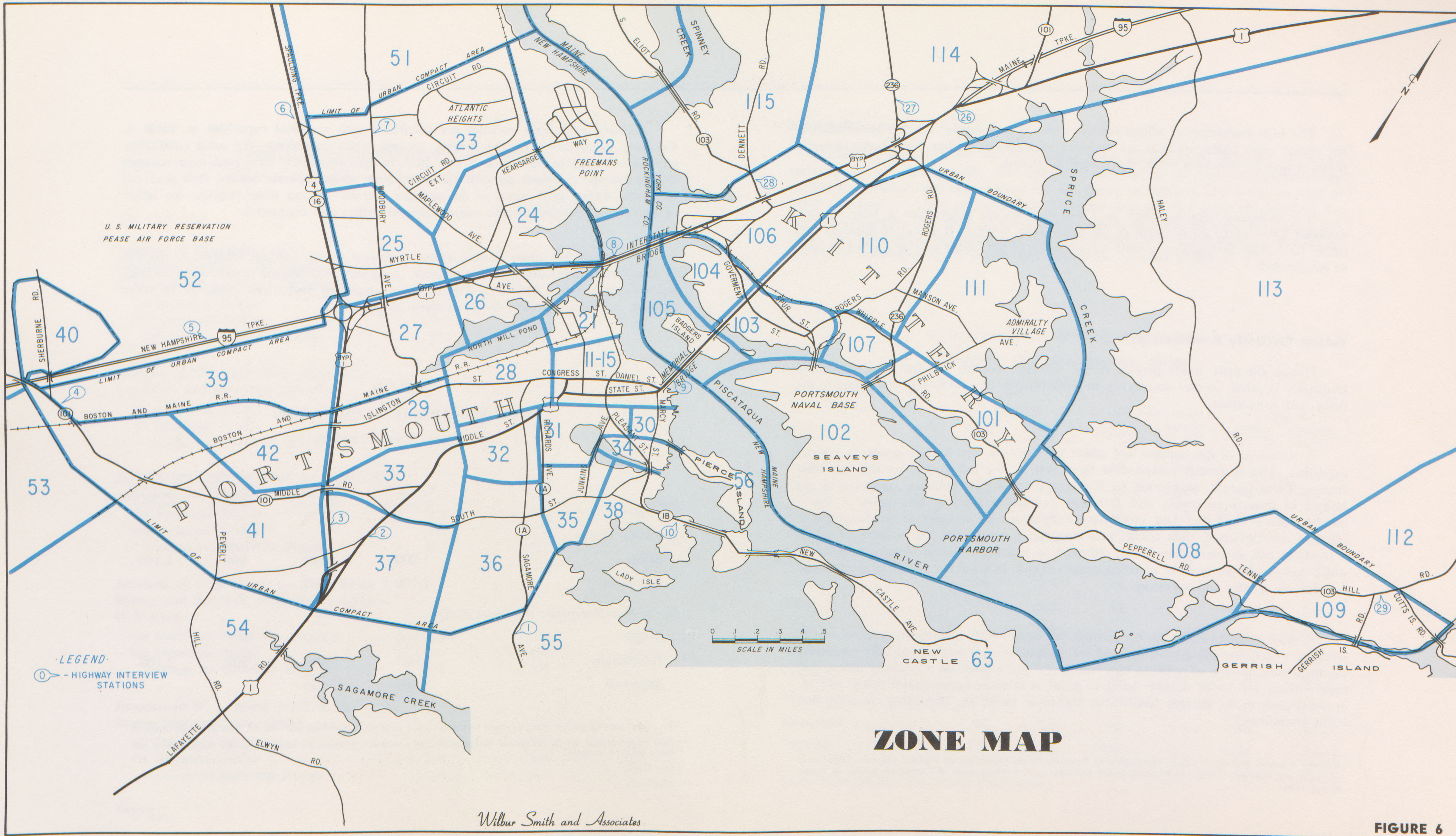
Facility	Practical Capacity[1]		Summer Peak Hour Volume[2]	
	Northbound (Light Direction)	*Southbound (Heavy Direction)*	*Northbound (Light Direction)*	*Southbound (Heavy Direction)*
Memorial Bridge				
Bridge	1,000	1,000	800	1,100
Approach	1,200	1,200	....	....
Maine-New Hampshire Interstate Bridge				
Bridge	900	1,800[3]	....	....
Toll Station	900	1,800[4]	900	2,100
Approach	2,400	2,400	....	....

[1] To permit passing, bridge capacity would be reduced to a total of 1,500 vehicle per hour for both directions of travel.

[2] Peak hour volumes on the Memorial Bridge occur on a weekday while on the Interstate Bridge the peak hour volumes are on a weekend.

[3] Two lanes

[4] Four lanes



ZONE MAP

FIGURE 6

Chapter II

PRESENT TRAVEL PATTERNS

Present travel patterns in the Portsmouth-Kittery area were determined from detailed origin-destination surveys conducted during July and October, 1961. Vehicle classification counts were also obtained. As previously indicated, field reconnaissance studies were made of the physical features of the existing highway network, and of traffic operations during normal and peak hour conditions.

Origin and Destination Surveys

Motorists were interviewed relative to their trip origin and destination at the study area boundary on all major routes entering the Portsmouth-Kittery area. The 12 survey stations, as depicted in Figure 6, formed an external cordon of the urban area, and were generally located along the urban boundaries. In addition, survey stations were established on the Memorial and Maine-New Hampshire Interstate Bridges.

The locations and periods of operations of the origin-destination survey stations are shown in Table 7. The stations in New Hampshire, including those on the two bridges, were operated during July, 1961 in conjunction with the Portsmouth arterial highway study.[4] The four stations in Maine were operated by the Maine State Highway Commission during October, 1961.

At all stations, motorists were questioned as to their trip origin and destination, purpose and frequency. The time of interview, vehicle type and vehicle occupancy were also recorded. In addition, the route of entry for each "through" trip was obtained for stations 1 through 10.

Interviews were obtained in the outbound direction between 7 A.M. and 7 P.M. at stations 1 through 10. The four stations in Kittery, 26-29, were operated between 6 A.M. and 6 P.M., and interviews were gathered from a sampling of traffic in both directions.

[4] *Comprehensive Transportation Plan*, Portsmouth, New Hampshire, Wilbur Smith and Associates 1962.

TABLE 7

ORIGIN AND DESTINATION SURVEY STATION DATA

1961

Station Number	When Operated: Date	When Operated: Day	Location
1	July 10	Monday	N. H. Route 1A, south of Little Harbor Road
2	July 11	Tuesday	U. S. Route 1, north of Alumni Drive
3	July 11	Tuesday	U. S. Route 1 Bypass, north of Greenleaf Avenue
4	July 10	Monday	N. H. Route 101, east of Sherbourne Road
5	July 13	Thursday	N. H. Turnpike, south of traffic circle
6	July 12	Wednesday	U. S. Route 4 and N. H. 16, west of Echo Avenue
7	July 12	Wednesday	Woodbury Avenue, west of Maplewood Avenue
8	July 18	Tuesday	Interstate Toll Bridge, Piscataqua River
9	July 20	Thursday	Memorial Bridge, Piscataqua River
10	July 11	Tuesday	N. H. Route 1B, between Portsmouth and New Castle
26	Oct. 10-13	Tues.-Fri.	U. S. Route 1, north of Maine Route 236
27	Oct. 16-17	Mon.-Tues.	Maine Route 236, west of U. S. Route 1
28	Oct. 18-19	Wed.-Thurs.	Maine Route 103, west of Valles Road
29	Oct. 20	Friday	Maine Route 103, east of Cutts Island Road

The sample size and survey coverage of the origin-destination survey are shown in Table 8. This table indicates the total number of interviews, total vehicle count in the direction of interviewing, and the per cent of vehicles interviewed. Of the 56,289 vehicles passing through the survey stations during the interviewing period, 57 per cent, or 32,059 motorists, were interviewed. This sample size compares favorably with that attained in similar studies and provides good statistical accuracy.

TABLE 8

ORIGIN AND DESTINATION SURVEY COVERAGE

Station[1] Number	Period of Operation	Total Vehicles in Direction of Interviews During Study Hours	Total Interviewed	Per Cent Interviewed
1	7 A.M. - 7 P.M.	2,028	1,515	75
2	7 A.M. - 7 P.M.	2,506	1,420	57
3	7 A.M. - 7 P.M.	3,365	1,851	55
4	7 A.M. - 7 P.M.	3,158	1,609	51
5	7 A.M. - 7 P.M.	6,327	3,419	54
6	7 A.M. - 7 P.M.	4,203	2,311	55
7	7 A.M. - 7 P.M.	3,628	2,198	61
8	7 A.M. - 7 P.M.	6,010	3,686	61
9	7 A.M. - 7 P.M.	6,113	4,558	75
10	7 A.M. - 7 P.M.	892	713	80
26	6 A.M. - 6 P.M.	11,813	4,324	37
27	6 A.M. - 6 P.M.	2,819	1,893	67
28	6 A.M. - 6 P.M.	2,858	2,181	76
29	6 A.M. - 6 P.M.	569	381	67
	Total	56,289	32,059	57

[1] See Table 7 for survey station location.

Vehicle Classification Counts

A summary of the vehicle classification counts at the origin-destination survey stations is shown in Table 9.

A total of 131,042 vehicles passed through the survey stations during a 24-hour period. Approximately 95 per cent—or 124,288 vehicles—were passenger cars and two-axle light trucks; the remaining five per cent, 6,754 vehicles, were heavy trucks. Station 9, the Memorial Bridge, was the busiest station, with 18,482 vehicles. Station 26, U. S. Route 1 in Kittery, had the highest percentage of commercial vehicles—over eight per cent of the total volume.

The Memorial Bridge carried 18,482 vehicles on a weekday in July, 1961, of which 526 vehicles (three per cent) were trucks. Of the 16,756 vehicles on the Interstate Bridge, 1,042 (six per cent) were trucks.

It is significant to note that truck traffic in the Portsmouth-Kittery area is considerably below that in most urban areas. This again clearly reflects the unique character of the area, as a terminus and corridor for recreational travel.

Annual Average Daily Traffic

Based upon the traffic records of the New Hampshire Department of Public Works and Highways, the Maine State Highway Commission, the Maine-New Hampshire Interstate Bridge Authority, and counts made for this study, the survey data were adjusted to an estimated 1961 annual average daily traffic (AADT).

TABLE 9

SUMMARY OF VEHICLE CLASSIFICATION COUNTS

24-Hour Period

July and October, 1961

Station Number[1]	Route	Vehicle Type: Passenger Cars and Light Trucks	Vehicle Type: Heavy Trucks	Total Vehicles
1	N. H. Route 1A	5,542	133	5,675
2	U. S. Route 1, Portsmouth	7,036	272	7,308
3	U. S. Route 1 Bypass	8,570	717	9,287
4	N. H. Route 101	7,027	374	7,401
5	N. H. Turnpike	15,300	1,115	16,415
6	U. S. Route 4 and N. H. Route 16	11,048	455	11,503
7	Woodbury Avenue	9,696	429	10,125
8	Interstate Toll Bridge	15,714	1,042	16,756
9	Memorial Bridge	17,956	526	18,482
10	N. H. Route 1B	2,457	83	2,540
26	U. S. Route 1, Kittery	15,561	1,365	16,926
27	Maine Route 236	3,655	94	3,749
28	Maine Route 103, West Kittery	3,979	114	4,093
29	Maine Route 103, East Kittery	747	35	782
	TOTAL	124,288	6,754	131,042
Per Cent		94.8	5.2	100.0

[1] See Table 7 for survey station location.

At many stations, counts were taken for an extended period and related to the State's automatic traffic recorders to permit adjustments for seasonal traffic variations. Toll station statistics of the Interstate Toll Bridge and New Hampshire Turnpike were used to establish the AADT on these facilities.

The 1961 AADT volumes of the survey stations are given in Table 10. The 1961 AADT at the 14 stations is estimated at 114,100 vehicles, as compared with the 131,042 vehicles found at the time of the origin-destination survey.

TABLE 10

ESTIMATED 1961 ANNUAL AVERAGE DAILY TRAFFIC VOLUMES

Origin-Destination Survey Stations

Stations[1]	*Location*	*1961 AADT*[2]
1	N. H. Route 1A	3,500
2	U. S. Route 1, Portsmouth	6,300
3	U. S. Route 1 Bypass	5,800
4	N. H. Route 101	6,400
5	New Hampshire Turnpike	14,500
6	U. S. Route 4 and N. H. Route 16	10,200
7	Woodbury Avenue	8,100
8	Interstate Toll Bridge	13,640
9	Memorial Bridge	16,800
10	N. H. Route 1B	1,800
26	U. S. Route 1, Kittery	18,700[3]
27	Maine Route 236	3,000[3]
28	Maine Route 103, West Kittery	4,500[3]
29	Maine Route 103, East Kittery	860[3]
	TOTAL	114,100

[1] See Table 7 for survey station locations.
[2] Annual average daily traffic.
[3] Estimated by Maine Highway Commission.

Analysis of Origin-Destination Data

The origin-destination data were coded to numerical zones. The zones into which the study area were sub-divided are shown in Figure 6.

Kittery was sub-divided into 11 zones within the urban boundary, and four additional zones between the urban and town boundaries. Other communities in York County were also delineated as individual zones. Five of the neighboring counties in Maine were given separate zone numbers.

In New Hampshire, the central business district of Portsmouth was divided into five zones and the remaining portion of the urban compact area into 21 zones. The remaining portions of Rockingham County were divided into 17 individual zones. The other nine New Hampshire counties and the cities of Manchester and Nashua were given separate zone numbers.

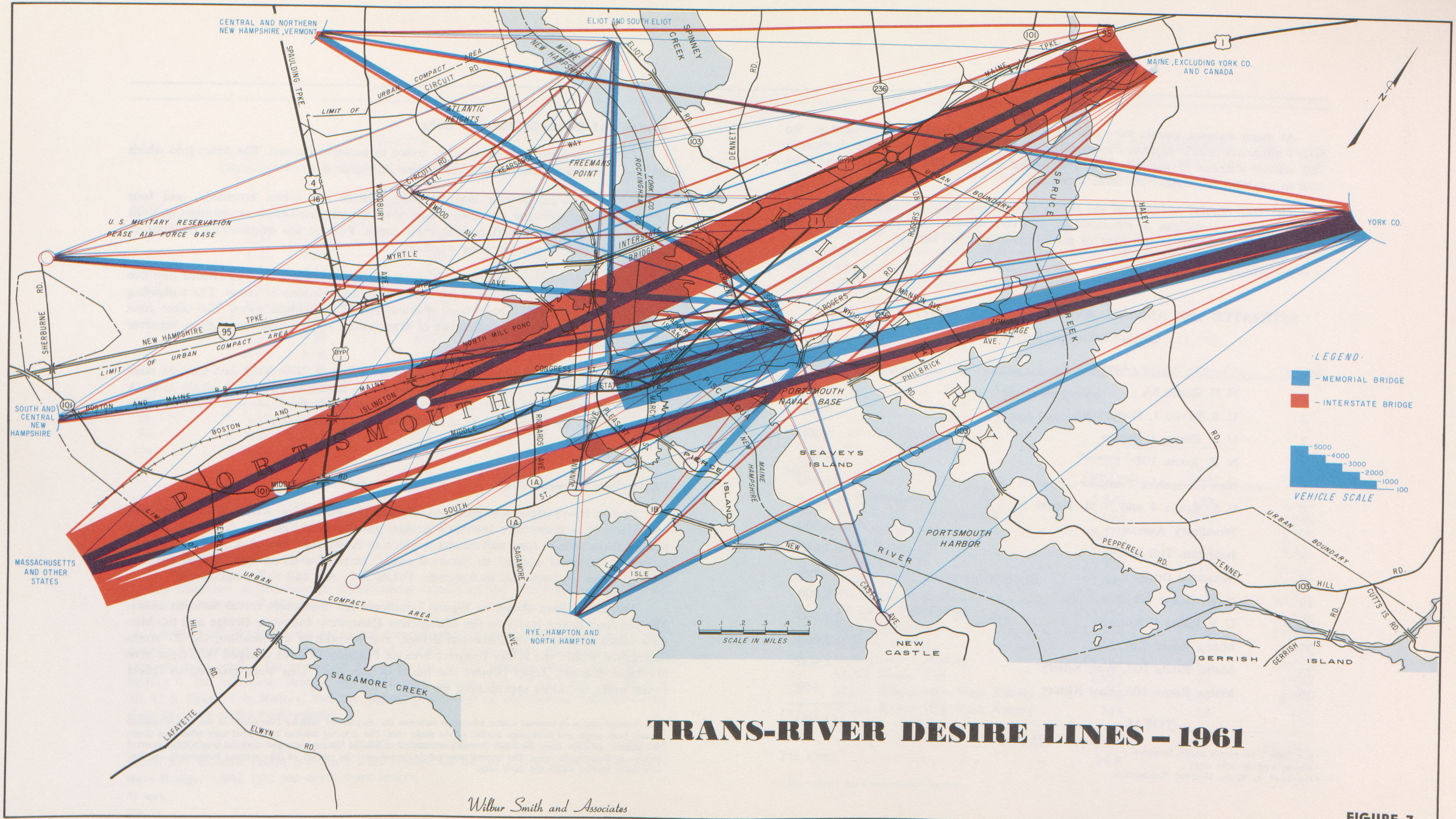
Vermont, Massachusetts, Connecticut-Rhode Island, New York and Canada were assigned individual zone numbers. All other states were grouped into a single zone. A listing of the zones used in this study are shown in Appendix Table A-2. Appendix Figure A-3 depicts the zones outside of the Portsmouth-Kittery area.

Trans-river Travel—1961

Present travel patterns of motorists crossing the Piscataqua River on the Memorial and Maine-New Hampshire Interstate Bridges are shown in Figure 7. A detailed tabulation of these zone-to-zone movements is given in Appendix Table A-4. Additional tabulations of "external station" to "internal zone," between external stations and between internal zones are contained in Appendix Tables A-5, A-6 and A-7, respectively.[5]

The desire lines shown in Figure 7 indicate the trans-river travel between zones. The red lines depict travel on the Maine-New Hampshire Interstate Bridge and the blue lines indicate travel on the Memorial Bridge. For purpose of clarification, the 27 zones established within the urban compact area of Portsmouth were grouped into eight geographical districts. Zones beyond the limits of the study area were grouped to reflect broad traffic corridors approaching the area.

[5] The external station to external station tabulation indicates the number of vehicles intercepted at the survey stations having both origin and destination outside of the study area. The external stations to internal zone tabulation shows the number of trips from the eight Portsmouth external stations to Kittery zones and from the four Kittery external stations to Portsmouth zones. The internal zone tabulation indicates the number of trips between Portsmouth and Kittery zones located within the study area.



TRANS-RIVER DESIRE LINES – 1961

Maine-New Hampshire Interstate Bridge—The largest desire line in 1961 was from Massachusetts and points south to points north of York County, approximately 7,050 vehicles. This "through" traffic accounted for about 50 per cent of annual average daily traffic—13,640 vehicles used this facility in 1961. This heavy movement primarily uses U. S. Route 1 and the New Hampshire Turnpike on the south, and U. S. Route 1 and the Maine Turnpike on the north. The second largest movement was the 2,200 vehicles from points in Rockingham County and adjacent New Hampshire areas (south of the study area) to places in York County north of the study area.

The bridge does not provide attractive traffic service between Portsmouth and Kittery because of its location west of the Portsmouth central business district and the Naval Yard in Kittery, both served more directly by the Memorial Bridge. This is reaffirmed by the travel patterns. The total volume between these two areas using the Interstate Bridge amounted to only 925 vehicles daily in 1961, seven per cent of the total bridge volume. About half of this travel was generated from the central business district of Portsmouth to places situated near the ramp connections in Kittery.

Memorial Bridge—The Memorial Bridge is located in close proximity to the Portsmouth central business district and the more densely populated areas of Kittery. Accordingly, it primarily serves local inter-community travel. Of the 16,800 vehicles traversing the bridge daily in 1961, about 6,500 (39 per cent) traveled between the two communities. The largest zone-to-zone movement was 4,300 vehicles, between the Portsmouth central business district and Kittery.

The second largest travel desire line reflects the 1,800 vehicles moving between the central business district of Portsmouth and the area beyond Kittery in York County. Through traffic, or traffic with both origin and destination outside of the study area, comprised about 3,400 vehicles or 20 per cent of the total bridge usage. Of these "through" trips, the major movements included about 900 vehicles daily traveling between Massachusetts and points south to all of Maine, north of York County. A second through movement of equal magnitude was found between Massachusetts and points south to York County, excluding Kittery.

Distribution—The relative proportions of through, local, and semi-local traffic on the two river crossings are shown in Table 11. Through traffic, vehicles with neither origin or destination within Portsmouth or Kittery, comprised 48 per cent of the total trans-river movement; semi-local (*i.e.,* local-external) traffic 31 per cent, and local traffic 21 per cent.

TABLE 11

DISTRIBUTION OF TRANS-RIVER TRAVEL

Memorial and Maine-New Hampshire Interstate Bridges

1961 Annual Average Daily Traffic[1]

Travel Between	*Interstate Bridge*		*Memorial Bridge*		*Total Trans-River*	
	Vehicles	*Per Cent*	*Vehicles*	*Per Cent*	*Vehicles*	*Per Cent*
Local Zones	606	10	5,676	90	6,282	100
Local and External Zones	2,064	23	6,957	77	9,021	100
External Zones	10,723	76	3,349	24	14,072	100
Total	13,393	46	15,982	54	29,375	100

[1] From Appendix Table A-4.

As previously indicated, the majority of through trips use the Interstate Bridge while the Memorial Bridge serves the bulk of local traffic. Thus, each bridge serves a somewhat different function.

Chapter III
FUTURE TRAVEL PATTERNS

Future travel patterns for the Portsmouth-Kittery area have been developed from projections of existing travel patterns, land uses, population and motor vehicle registrations. Internal travel patterns have been synthesized using relationships derived from studies of comparable areas in conjunction with land-use forecasts. External travel patterns have been developed from existing patterns using growth factors and diversion formulas at external stations, and a distribution technique for those trips with an origin or destination in the study area.

Historical Trends

Present land use and development provide a nucleus for future growth and hence a basis for estimating anticipated changes in population, travel, commercial and industrial development. Many parts of Portsmouth and Kittery are only partially developed; hence opportunities exist for growth. Growths in population will be accompanied by increases in motor vehicle registrations and travel.

Population—Population trends for the Portsmouth-Kittery study area and environs are tabulated in Table 12. The 1960 population of Portsmouth was 26,900, an increase of 43 per cent since 1950 and 81 per cent since 1940. The establishment of Pease Air Force Base in 1955 was the principal reason for the large increase in population between 1950 and 1960.

In 1960, the population of Kittery was 10,689, an increase of 27.6 per cent over 1950 and 98 per cent over 1940. The population and economy of the community is heavily dependent upon the Portsmouth Naval Shipyard. This government installation indicated an increase of civilian employees from about 4,000 in 1950 to 9,000 in 1960.

As shown in Figure 8, population growth in Portsmouth and Kittery was only moderate from 1900 to 1940 with accelerated growth taking place in the last two decades. Assuming that both governmental installations in the area are operating at a level that will remain constant, it is estimated that the 1985 population of Portsmouth and Kittery will probably approach 28,600 and 14,100, respectively.

TABLE 12

POPULATION TRENDS

Portsmouth-Kittery and Environs

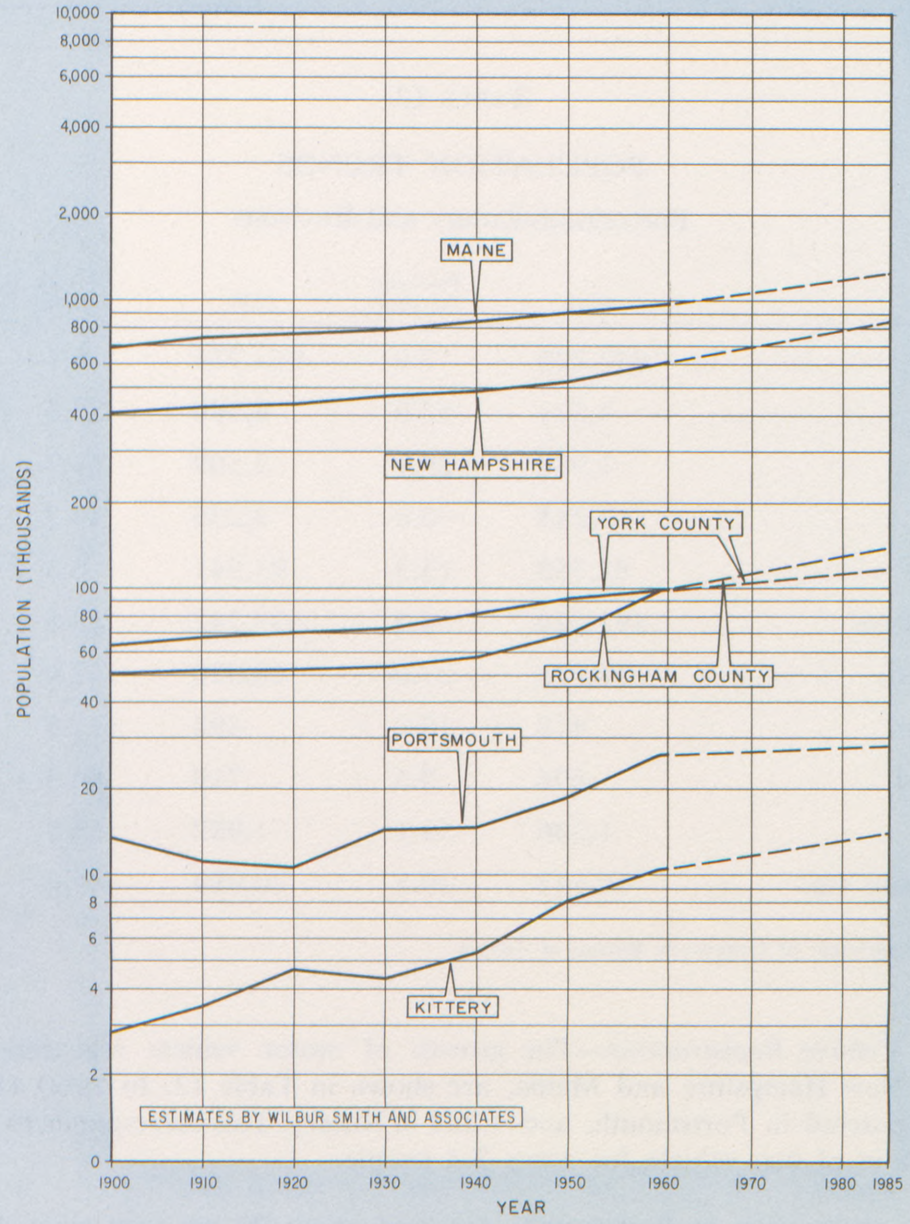
Area	*1940*	*Per Cent Increase*	*1950*	*Per Cent Increase*	*1960*
Maine	847,226	7.9	913,774	6.1	969,265
Kittery	5,374	55.9	8,380	27.6	10,689
Eliot	1,932	29.9	2,509	24.9	3,133
York	3,283	−0.8	3,256	43.2	4,663
York Co.	82,550	13.3	93,541	6.3	99,402
New Hampshire	491,524	8.5	533,242	13.8	606,921
Portsmouth	14,821	27.0	18,830	42.9	26,900
Newington	418	18.2	494	111.5	1,045
Greenland	696	3.3	719	66.3	1,196
Rye	1,246	59.1	1,982	63.7	3,244
Rockingham Co.	58,142	20.5	70,059	41.4	99,029

Source: U.S. Department of Commerce, Bureau of Census

Motor Vehicle Registrations—The growth of motor vehicle registrations in the study area, New Hampshire and Maine, are shown in Table 13. In 1960 11,343 vehicles were registered in Portsmouth, and 4,228 in Kittery. This corresponds to an average ownership ratio of one vehicle for every 2.4 people.

Vehicle registration in Portsmouth increased about 90 per cent since 1950, compared with a 43 per cent increase in population.

Traffic Volumes—Increases in travel have accompanied the growth in people and vehicle registrations. Traffic growths are readily apparent from the annual average daily traffic trends on major highway facilities, as shown in Figure 9 and Table 14.



POPULATION TRENDS

Wilbur Smith and Associates FIGURE 8

TABLE 13

MOTOR VEHICLE REGISTRATIONS

Area	*1950*	*Per Cent Increase*	*1955*	*Per Cent Increase*	*1960*
Portsmouth	5,949	44.6	8,601	31.9	11,343
Kittery	N.A.[1]	....	N.A.	....	4,228
New Hampshire	172,339	23.3	212,452	20.7	256,343
Maine	276,421	16.7	322,674	16.0	374,318

[1] N.A.—Data not available

Source: U.S. Bureau of Public Roads
Tax Collector—Portsmouth, New Hampshire and Kittery, Maine

TABLE 14

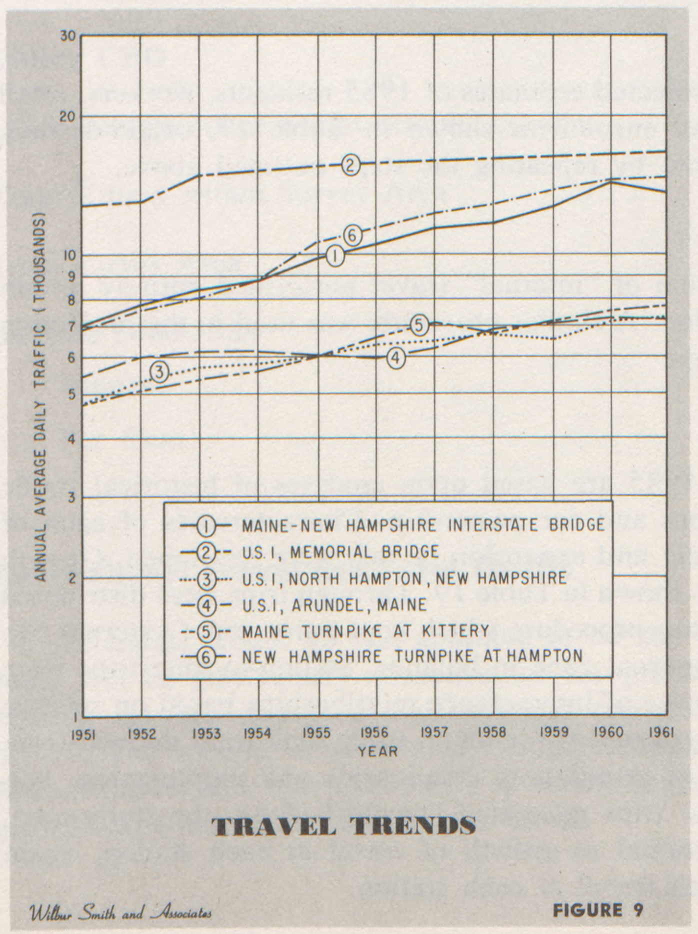
ANNUAL AVERAGE DAILY TRAFFIC TRENDS

Year	*Interstate Bridge*	*Memorial Bridge*	*U.S. Route 1 North Hampton, N.H.*	*U.S. Route 1 Arundel, Maine*	*Maine Turnpike at Kittery*	*New Hampshire Turnpike*
1951	7,063	12,825	4,897	5,551	4,808	6,999
1952	7,795	13,000	5,341	6,039	5,155	7,618
1953	8,397	14,915	5,725	6,222	5,422	8,088
1954	8,766	N.A.	5,821	6,228	5,642	8,943
1955	9,852	15,520	6,031	6,139	6,037	10,722
1956	10,547	N.A.	6,420	6,006	6,661	11,545
1957	11,471	16,075	6,530	6,399	7,104	12,295
1958	11,699	N.A.	6,818	6,911	6,876	12,739
1959	12,627	N.A.	6,680	7,114	7,248	13,945
1960	14,438	16,500	7,289	7,353	7,618	14,529
1961	13,640	16,750	7,322	7,224	7,809	14,776
Per Cent Increase —						
1951-1961	93	31	50	30	62	111
1957-1961	19	4	12	13	10	20

Source: Maine Highway Commission, New Hampshire Department of Public Works and Highways, Maine-New Hampshire Interstate Bridge Authority.

The New Hampshire Turnpike shows the largest increase, 114 per cent from 1951 to 1961 and 20 per cent in the last four years. Traffic on the Interstate Bridge increased 93 per cent between 1951 and 1961, and 19 per cent in the last four years. In contrast, traffic on the Memorial Bridge increased only 31 per cent in the 1951-1961 period, and only four per cent between 1957 and 1961. In Kittery, traffic usage of the Maine Turnpike increased 63 per cent between 1951 and 1961, and 10 per cent between 1957 and 1961.

Traffic Projections—Future travel patterns for the Portsmouth-Kittery study area were developed from projections of land uses, population, employment, retail sales, vehicle registrations, income levels, and school enrollments. From these data, it is feasible to establish the rates of travel (trips per person) generated at the Memorial and Interstate Bridges by the populations in various parts of the area. The present travel patterns will change, however, as populations increase and new land-uses take place according to expected development of the Portsmouth-Kittery areas.



TRAVEL TRENDS

FIGURE 9

The interactance of travel patterns between various urban land uses has been explored in detail in recent years and has shown rather remarkable consistency from one community to another. In practice, average rates of travel, derived from communities of similar type, are applied to an area that is to be studied and a pattern of "relative" movements "synthesized" for travel between parts of the area. An origin-destination survey that intercepts travel between any two parts of the area can then be used to calibrate the synthetic values, thus converting the average trip rates to values that are precise for the study area.

In the Portsmouth-Kittery area, average rates of trip-generation were applied to the population in a series of zones in each community, based on median family income of the residents in each zone. Residents of the study area were estimated to produce about 63,000 trips on the average day in 1960, or about 2.6 trips per resident. The estimated trips were then classed according to probable purpose, also related to income level. Eight categories of travel were recognized, seven of them representing trips with either origin or destination at place of residence (Tables 15 and 16).

Non-residential land-uses were next identified (Table 17) and trips for the several purposes prorated to each use according to its relative importance in each zone. By this means two exactly equal sets of trip-ends were prepared for each of the "home-based" classes of travel. For example, the number of work trips generated in all of the zones by the residents were, at this point in the study, accounted for by an equal number of trips generated at the places of work.

TABLE 15

TRIP ENDS GENERATED IN THE CENTRAL BUSINESS DISTRICT
1960-1985

Trip Purpose	*1960*	*1985*	*Growth Factor*
Work	4,338	4,749	1.09
Business	2,836	3,568	1.26
Shopping[1] (conv.)	2,810	3,548	1.26
Shopping[2] (GAF)	2,147	3,071	1.43
Social	275	289	1.05
Recreation	3,067	4,398	1.43
School	119	128	1.08
Miscellaneous	5,696	7,730	1.36
Total Trip Ends	26,984	35,211	1.30
Trucks	1,795	2,345	1.31

[1] Convenience, i.e.—Food stores, drug stores, eating and drinking places.
[2] General merchandise, apparel, furniture, appliances, and furnishings.

TABLE 16

PERSON AND TRUCK TRIPS GENERATED WITHIN STUDY AREA

1960-1985

Purpose	*1960*	*1985*	*Growth Factor*
Work	15,260	15,288	1.00
Business	5,193	6,680	1.29
Shopping[1] (conv.)	8,573	10,774	1.26
Shopping[2] (GAF)	2,372	3,320	1.40
Social	9,060	11,409	1.26
Recreational	6,133	8,798	1.43
School	5,674	7,104	1.25
Miscellaneous	10,433	14,477	1.39
Total Person Trips	62,698	77,850	1.24
Trucks	7,900	9,809	1.24

[1] Convenience, i.e.—Food stores, drug stores, eating and drinking places.

[2] General merchandise, apparel, furniture, appliances and furnishings.

Following preparation of the "trip-end" estimates, a series of interactance relationships ("gravity curves") were applied, independently, to each class of travel. By this technique the work trips were proportioned to places of employment; shopping and business trips to retail centers; school trips between homes and schools; social trips to homes of other residents; and recreational travel to appropriate places of attraction. Miscellaneous trips, with neither end at home, were appropriately distributed between places of work, business and shopping.

Next, average car occupancy rates were applied to each class of traffic to determine the number of car trips that were generated between pairs of zones.

The tentative distribution of trips at the river crossings was next compared with the origin-destination survey data and calibrating factors prepared to modify the average trip rates so that they would represent the unique characteristics of the Portsmouth-Kittery area. Relatively little adjustment was needed for most classes of travel.

The trip-generation rates derived for 1960 travel are shown in Table 18. These rates were then modified to represent changes that would reasonably be expected to occur by 1985, based on higher expected rates of car ownership in the several income classes. The new rates, together with estimates of 1985 population in each income class, are also shown in Table 18.

Using the new trip rates and projected estimates of 1985 residents, workers, retail activity, vehicle registration and school enrollment shown in Table 17, origin-destination patterns for 1985 were synthesized by repeating the steps outlined above.

This work completed the projection of "internal" travel performed entirely within the study area by its resident population. A similar procedure was used in the projection of commercial (truck) trips in the area.

Estimated external trip ends for 1985 are based upon analyses of historical traffic growths, population, vehicle registrations and car ownership. Characteristics of each of the 12 stations were analyzed separately and expansion factors were developed. Growth factors developed for each station are shown in Table 19. Through trips were distributed between stations by use of an averaging procedure which kept estimates of external trip volume at each external station and internal zone in balance. Station-to-zone trips were distributed among the internal zones by use of interactance relationships based on relative travel times. The estimates of future external trip ends in each zone were derived from a composite factor, reflecting growth in population, retail sales and employment, balanced to the total estimate of external trips generated "locally" within the study area. Through trips were estimated proportional to growth of travel at each station, again maintaining control of the total of such travel at each station.

TABLE 17

EXPECTED SURVEY AREA GROWTHS

1960-1985

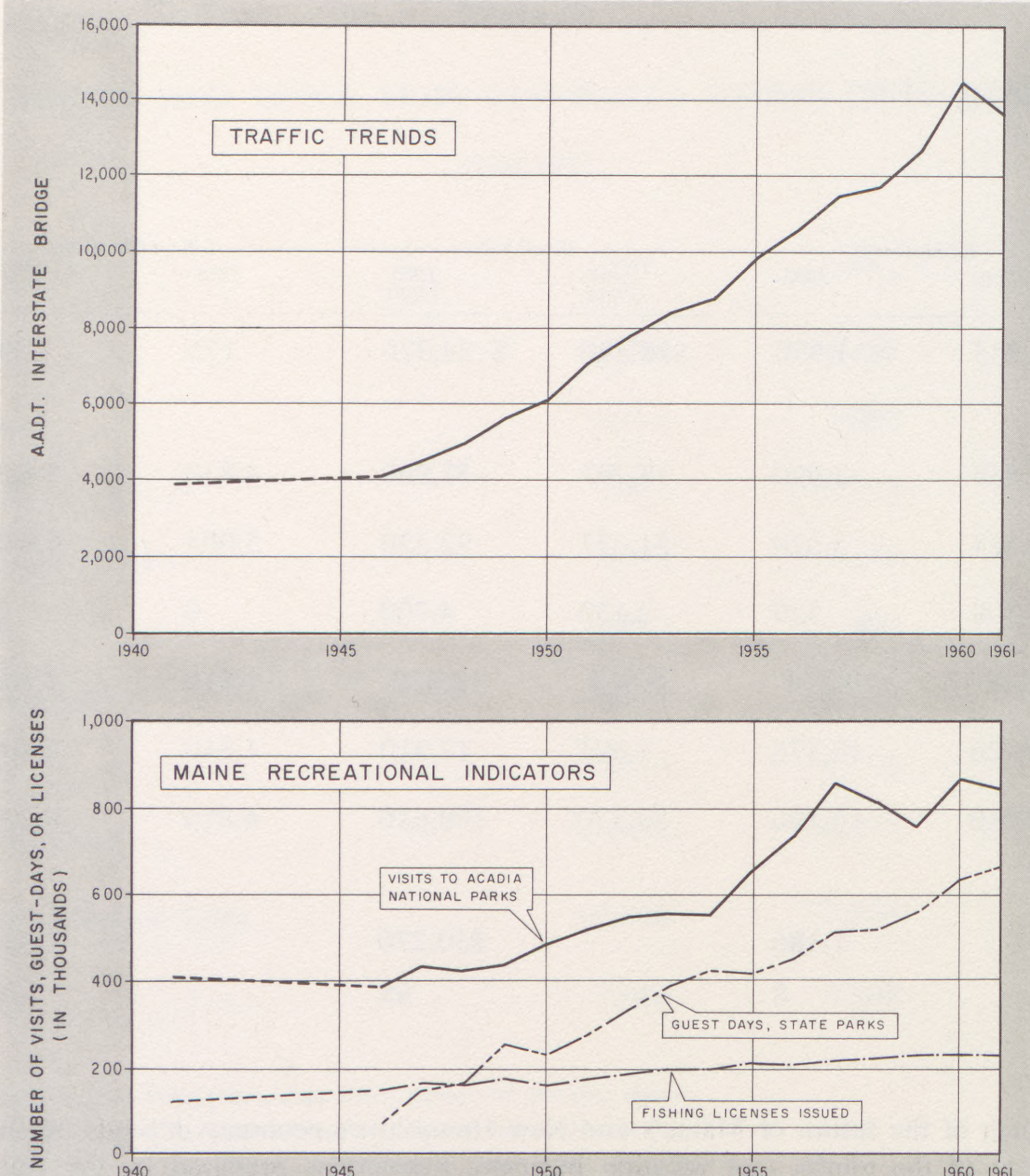
Area	Population 1960	Population 1985	Vehicles Registered 1960	Vehicles Registered 1985	Employment 1960	Employment 1985	Retail Sales 1960 (000)	Retail Sales 1985 (000)	School Enrollment 1960	School Enrollment 1985
Portsmouth CBD	1,186	1,130	380	470	1,745	1,930	$18,380	$ 34,370	175	180
Other Portsmouth zones within external cordon line	15,197	15,160	5,701	7,410	2,839	3,690	33,297	57,960	4,830	5,650
Total Portsmouth	16,383	16,290	6,081	7,880	4,584	5,620	51,677	92,330	5,005	5,830
Kittery CBD	300	500	91	208	308	350	2,130	4,700	0	0
Other Kittery Zones within external cordon	8,566	10,000	3,281	4,903	10,118	10,226	5,563	12,610	1,810	2,400
Total Kittery within Survey Area	8,866	10,500	3,372	5,111	10,426	10,576	7,693	17,310	1,810	2,400
Total Survey Area	25,249	26,790	9,453	12,991	15,010	16,196	59,370	109,640	6,815	8,230
Increase 1960-1985										
Number	....	1,541	....	3,538	....	1,186	....	$50,270	....	1,415
Per Cent	....	6	....	37	....	8	....	85	....	21

Recreational Travel and Total Traffic

Interstate Route 95 will continue to be the principal gateway into Maine. The route will be particularly attractive for fast-growing recreational travel. The general relation between improved highways and recreational travel in Maine is shown in Figure 10. The opening of the Maine Turnpike and the new highways through Connecticut, Massachusetts and New Hampshire in recent years has helped make possible the large growth experienced in recreational travel.

Much of the future of Maine's and New Hampshire's economy depends on the development of the tourist and vacation business. Projections prepared by the National Planning Association for the Outdoor Recreation Resources Review Commission[6] indicates that most of the increase in employment and income is expected to occur in the trade, service and construction industries which are closely geared to serving the expected rapid growth in recreation. The expansion in these industries projected through 1976 equals the total growth expected in Maine's employment, because increases and declines in other industries offset each other.

[6] Volume 23 of the Commission's Studies *Projections to the Years 1976 and 2000; Economic Growth, Population, Labor Force and Leisure, and Transportation,* Government Printing Office, 1962.



TRAFFIC AND RECREATIONAL INDICATORS

Wilbur Smith and Associates

FIGURE 10

TABLE 18

TRIP GENERATION ESTIMATES

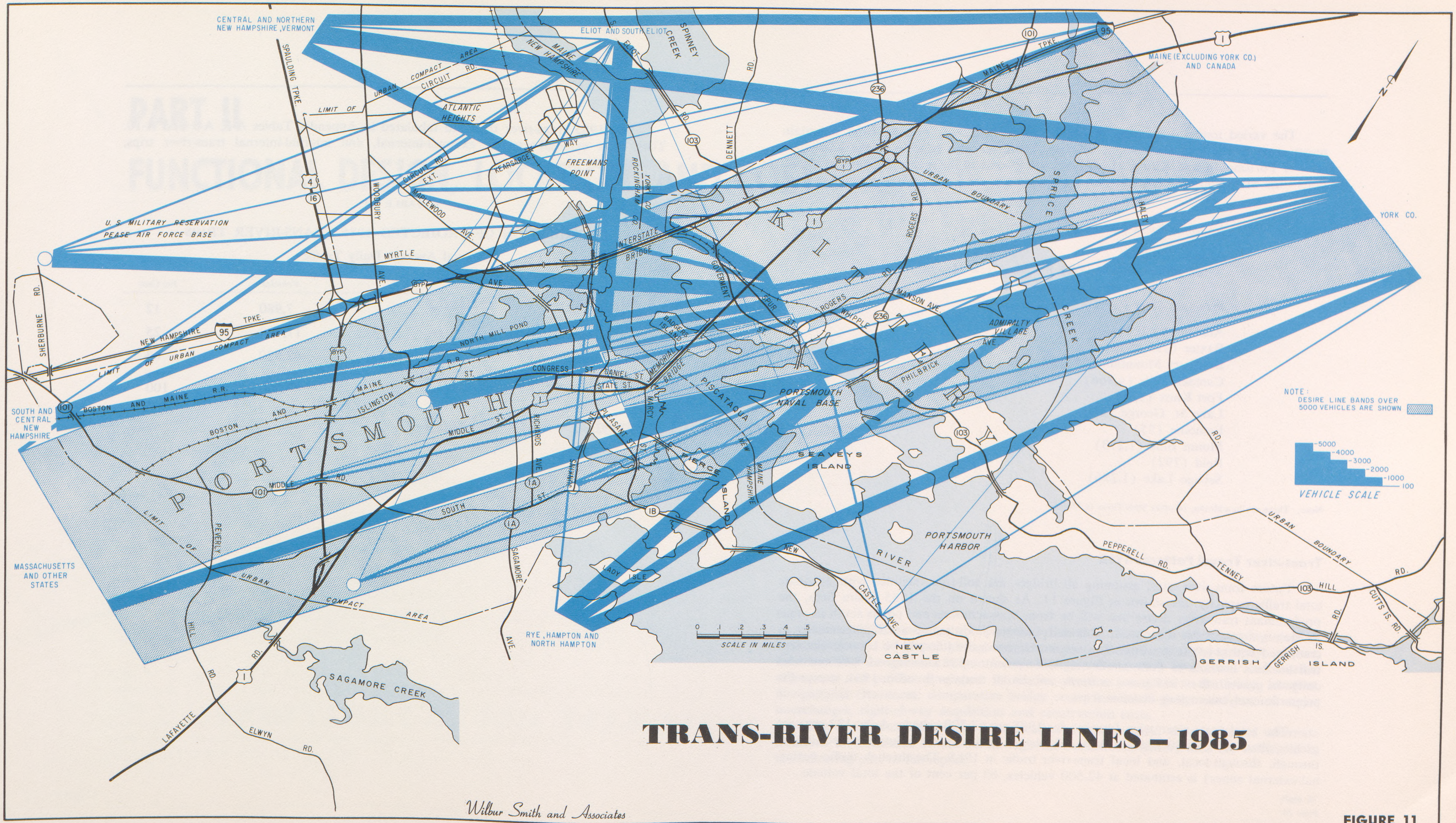
1960-1985

Income Group	Range	Area Population 1960	Area Population 1985	Trips/Person 1960	Trips/Person 1985
1	Under $4,500	3,402	1,080	1.20	1.77
2	$4,500-5,100	2,821	2,230	1.77	2.49
3	$5,100-5,700	6,407	9,660	2.49	2.98
4	$5,700-6,300	10,395	11,370	2.98	3.01
5	Over $6,300	2,224	2,450	3.01	3.01
		25,249	26,790		

TABLE 19

1985 EXPANSION FACTORS — EXTERNAL STATIONS

Station	Annual Average Daily Traffic 1961	Annual Average Daily Traffic 1985	Average Annual Increase (Per Cent)	Growth Factor
1	3,500	6,300	2.5	1.80
2	6,300	11,600	2.6	1.84
3	5,800	11,200	2.8	1.93
4	6,400	12,700	2.9	1.98
5	14,500	39,800	4.3	2.74
6	10,200	21,700	3.2	2.13
7	8,100	14,600	2.5	1.80
10	1,800	3,300	2.6	1.83
26	18,700	46,700	3.9	2.50
27	3,000	5,300	2.4	1.77
28	4,500	8,100	2.5	1.80
29	860	1,600	2.6	1.86



TRANS-RIVER DESIRE LINES – 1985

FIGURE 11

The varied tourist attractions of Maine are well known, ranging from mountain resort areas to the long stretches of beaches. There are also beaches in the immediate area of Portsmouth and Kittery. Listed below are some of the major recreational attractions—the State and the National Parks (figures in parentheses are the acreage of each area):

National Parks and Forests

Acadia (30,686)
White Mountain (41,004) includes New Hampshire

Principal State Parks

Aroostook (577)
Baxter (193,254)
Bradbury Mountain (271)
Camden Hills (4,966)
Fort Knox (124)
Lake St. George (360)
Lamoine (55)
Mount Blue (1,273)
Reid (792)
Sebago Lake (1,296)

Note: There are in addition, 14 other State Parks in Maine.

Trans-river Travel Patterns-1985

Future trans-river trips, assuming all bridges are toll-free facilities with adequate total traffic capacity, are shown in Figure 11. As shown on the 1985 desire lines, the predominant trans-river desire line will be from Massachusetts and points south to areas in Maine, north of the study area. This daily volume is estimated at 28,500 vehicles as compared with 11,000 in 1961. The second largest desire line will be between the central business districts of Portsmouth and Kittery, with a 1985 volume of 5,400 vehicles daily. In general, the 1985 travel patterns are similar to those found in 1961, except for proportionately more long-distance trips.

The total trans-river trips forecast for 1985 are 67,500 vehicles daily, 122 per cent greater than the 30,440 trips in 1961. Table 20 indicates the relative proportion of through, through-local, and local trans-river traffic in 1985. The through traffic (external-external zones) is estimated at 42,500 vehicles, 63 per cent of the total volume.

The 1985 trans-river trips are tabulated in Appendix Tables A-8, A-9 and A-10. They show external-external, external-internal, and internal-internal trans-river trips, respectively.

TABLE 20

DISTRIBUTION OF PROJECTED 1985 TRANS-RIVER TRIPS

Annual Average Daily Traffic

Between	*Vehicles*	*Per Cent*
Local Zones	7,980	12
Local and External Zones	17,000	25
External Zones	42,520	63
Total	67,500	100

PART II

FUNCTIONAL DESIGN, LOCATION, AND COST

Chapter IV — Design Considerations

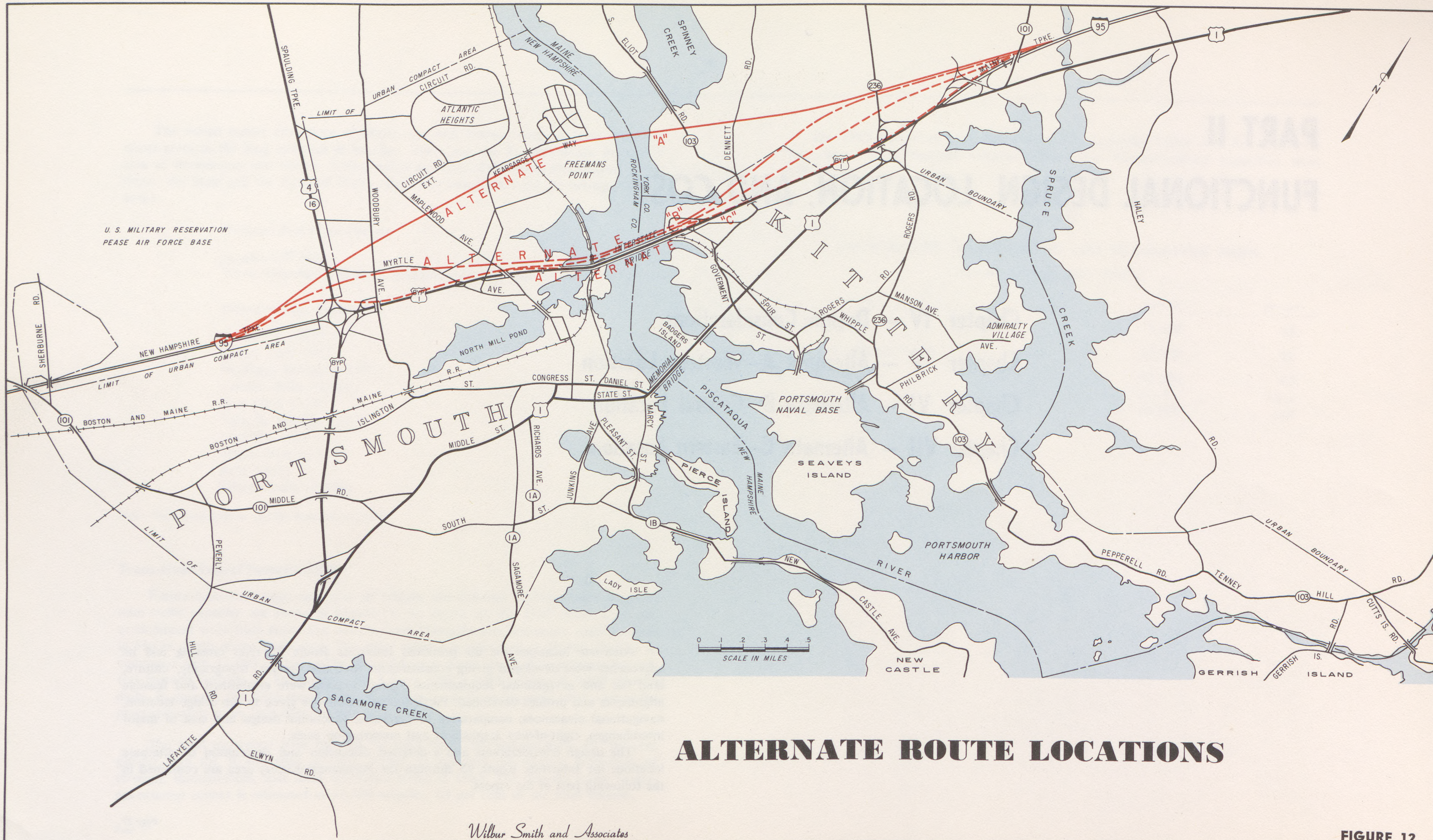
Chapter V — Alternate A—Western Location

Chapter VI — Alternate B—Central Location

Chapter VII — Alternate C—Eastern Location

Alternate locations for the proposed Interstate Route 95 river crossing and its approaches were developed giving consideration to traffic service, topography, culture, land use and navigational requirements. Design criteria were established and feasible alignments and profiles developed. Particular attention was given to the bridge location, navigational clearances, comparative bridge costs, functional design and cost of major interchanges, right-of-way acquisition and construction costs.

The design considerations and a detailed discussion and description of alternate locations for Interstate Route 95 through the Portsmouth-Kittery area are contained in the following part of the report.



ALTERNATE ROUTE LOCATIONS

FIGURE 12

Chapter IV
DESIGN CONSIDERATIONS

In the Portsmouth-Kittery area, Interstate Route 95 is complete to the southern boundary of Portsmouth and to the northern boundary of Kittery. South of Portsmouth, Interstate Route 95 consists of the New Hampshire Turnpike; north of Kittery, it is the Maine Turnpike. The purpose of this report is to develop the most desirable location through the Portsmouth-Kittery area, recognizing that the location must tie these two facilities together.

East of the present Interstate Bridge approaches, both Portsmouth and Kittery are densely developed. These developments, the greater expanse of river crossing to the east, and the alignments of the New Hampshire and Maine Turnpikes favor a route location along or west of the present Interstate Bridge.

Alternate Locations Studied

Three feasible locations between the New Hampshire and Maine Turnpikes have been developed. Alternate A extends from the New Hampshire Turnpike south of its present terminus in a northerly and northeasterly direction, west of the present Interstate Bridge approaches and south of Kearsarge Way to a proposed interchange with the Maine Turnpike and U. S. Route 1 in Kittery, as indicated in Figure 12. Major interchanges are proposed with U. S. Route 4 (Spaulding Turnpike) and Bypass U. S. Route 1 (present Interstate Bridge) in Portsmouth, Maine Route 236 and U. S. Route 1 in Kittery.

A second location for the Interstate connector, Alternate B, proposes interchanges at the same locations as on Alternate A. The approaches to and the main span over the Piscataqua River would, however, be immediately west of and closely parallel to the present Interstate Bridge, see Figure 12.

The third location, Alternate C, also shown in Figure 12, utilizes the present Interstate Bridge right-of-way in New Hampshire. Northbound traffic would use the existing right-of-way in Maine and southbound traffic would use a separate right-of-way immediately west of the present Interstate Bridge alignment. Since this location pre-empts the present location of Bypass U. S. Route 1, additional interchanges with the local street system would be required between the major interchanges near the southern and northern extremities of the route section.

Traffic Assignments

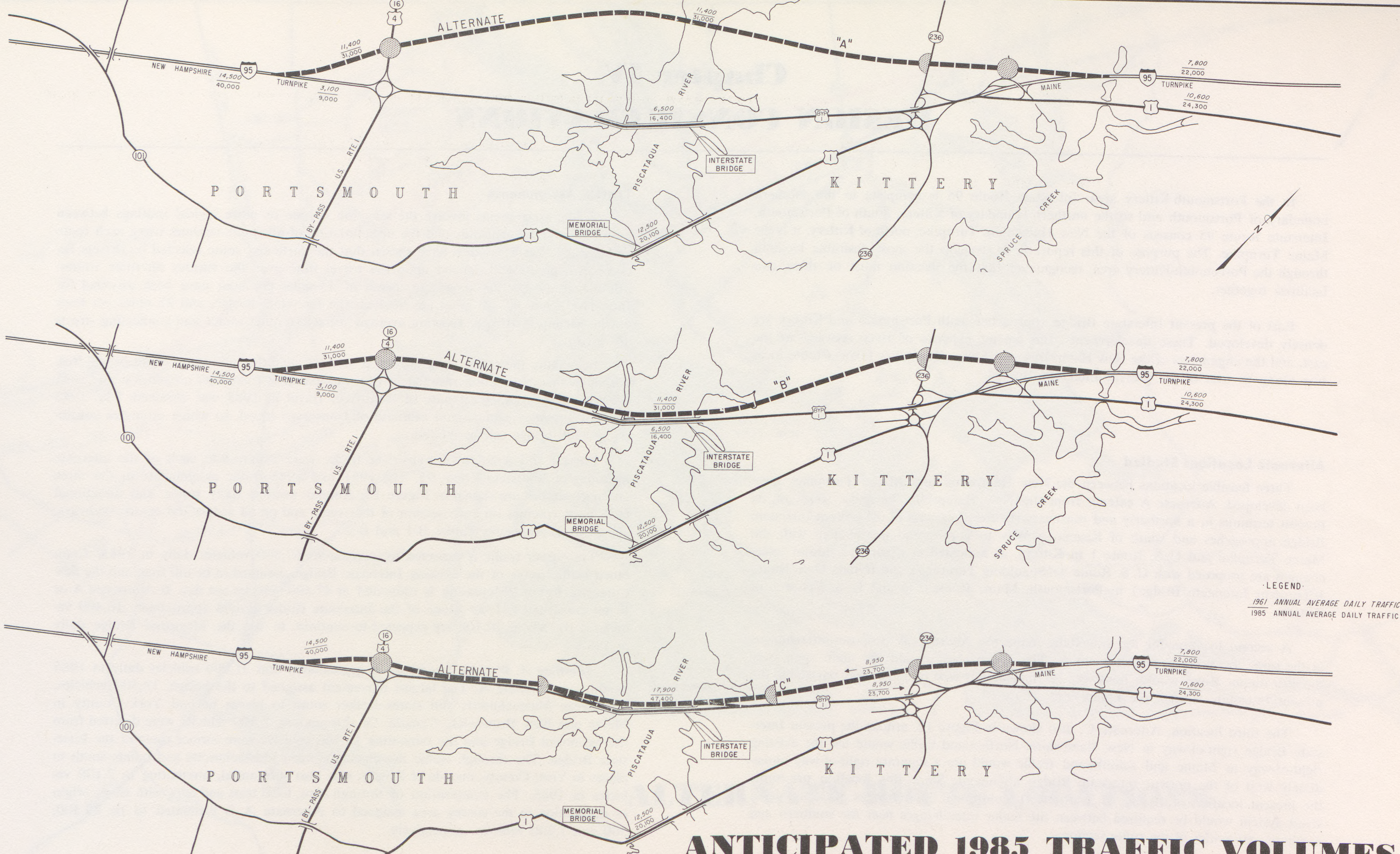
Traffic assignments involve the selection of one or more logical routings between each pair of zone centroids and the accumulation of all traffic volumes using each route under study. Traffic studies have shown that the particular route selected by drivers between two points will depend upon the travel time over the various alternate routes. For this study, average operating speeds of 55 miles per hour have been assumed for Interstate Route 95, 40 miles per hour on the Interstate Bridge, and 25 miles per hour on the Memorial Bridge. Existing average speeds on other major and connecting streets are used.

In making the traffic assignments, it was assumed that all routes would be toll-free. Although this assumption resulted in over-estimation of trans-river crossings in the 1961 projections, a sounder estimate of trans-river travel in 1985 was obtained. The 1985 estimate provides a maximum estimate of trans-river travel, to which estimates considering a toll bridge can be related.

Present and anticipated trans-river traffic were assigned to each of the alternate locations of Interstate Route 95. The 1961 and 1985 traffic assignments to the three alternate studies are shown in Figure 13. Annual average daily traffic and directional peak hour volumes on each section of the route, and on all access and egress roadways, are given in Appendix Tables B-1 and B-2.

Trans-river traffic is expected to increase to 67,500 vehicles daily in 1985. Combined traffic usage of the existing Interstate Bridge, assumed to be toll free, and the new Interstate Route 95 crossing is estimated at 47,400 vehicles per day. If Alternates A or B are constructed, 1985 usage of the Interstate Bridge should approximate 16,400 vehicles daily. About 20,100 are expected to continue to use the Memorial Bridge daily in 1985.

Alternate A, Western Location—It is estimated that 31,000 vehicles daily in 1985 would use Alternate A. The largest movement assigned to the bridge, 18,500 vehicles, is between Massachusetts and states farther south to places beyond York County in Maine and New Brunswick, Canada. Of this amount, 2,400 vehicles were diverted from the Memorial Bridge and the remaining 16,100 vehicles were former users of the Interstate Bridge. The through traffic movement between Massachusetts and points south to places in York County, outside of Kittery, was also substantial, amounting to 7,100 vehicles in 1985. The composition of through trips, local trips and trips with either origin or destination in the survey area assigned to Alternate A is estimated to be 29,500, 300 and 1,200 vehicles, respectively.



ANTICIPATED 1985 TRAFFIC VOLUMES

FIGURE 13

Alternate B, Central Location— The same traffic levels are estimated for Alternate B and Alternate A. Although the bridge and its approaches are at different locations, the interchange locations and traffic service provided are identical.

Alternate C, Eastern Location—It is estimated that 47,400 vehicles daily in 1985 would use the proposed Piscataqua River Bridge at this location. Since Alternate C incorporates the Interstate Bridge as a part of the plan, the assigned traffic is composed of two parts—traffic already using the Interstate Bridge and traffic diverted from the Memorial Bridge. About 9,900 vehicles were diverted from the Memorial Bridge to Alternate C, assuming the new bridge and the Interstate Bridge were both toll free.

Design Criteria

Functional plans for the three alternate locations for Interstate Route 95 have all been developed to the same design standards. Standards developed by the state highway departments and published by the American Association of State Highway Officials and U. S. Bureau of Public Roads have been used as a guide in determining the design criteria for the Interstate Route location in the Portsmouth-Kittery area.[7]

Requirements of the U. S. Army Corps of Engineers govern navigational clearances of the Piscataqua River. The relative availability and cost of highway construction materials, local design and maintenance practices, and weather conditions are recognized.

Specific design criteria for the alternates are as follows:

a. *Control of Access*—Full control of access is maintained. Access and egress will be permitted only at designated points where on and off ramps are provided to insure maximum safety to the traveling public and preserve the necessary high capacity of the proposed route.

b. *Right-of-way—A* variable right-of-way width is used to keep right-of-way takings to a minimum. The required right-of-way varies, depending upon land developments, topography and construction considerations. Alternate A right-of-way varies from 250 feet in New Hampshire to 150 feet at the high level bridge. A 300 foot right-of-way will be required in Maine. Alternate B requires a 250 foot and 300 foot right-of-way in New Hampshire and Maine, respectively, except at the bridge location where a 150 foot right-of-way is needed. For Alternate C in New Hampshire, 94 feet of right-of-way will be needed in addition to the existing 100 feet. Required right-of-way is 150 feet for the southbound roadway on Alternate C in Maine. It will be necessary to acquire 16 feet of right-of-way in Maine for the northbound lanes in addition to the existing 100 foot right-of-way.

c. *Design Speed*—The design speed for the expressway is 60 miles per hour, including the major river crossing of the Piscataqua River.

d. *Curvature*—The maximum horizontal curvature used is two degrees and 45 minutes, a radius of 2,080 feet, on Alternate C at the south approach to the Piscataqua River crossing. The maximum degree of curvature on Alternate A is one degree and 30 minutes, on Alternate B, two degrees and 30 minutes.

e. *Grades*—The maximum grade, four per cent, is used on Alternate A at the high-level Piscataqua River crossing. On Alternates B and C, a maximum grade of three per cent is used. The maximum grades on exit ramps are 3.8 per cent downgrade and 4.2 per cent upgrade. The maximum grades on access ramps are 3.5 per cent upgrade and 4.3 per cent downgrade.

f. *Capacity*—The lane capacity of the proposed Interstate Route in the Portsmouth-Kittery area is based upon a design capacity of 1,500 vehicles per lane per hour. Based upon detailed analyses of the relationship of peak hour traffic volumes to annual average daily traffic and the directional distribution of traffic during peak travel periods in this area, the design hourly volume is estimated at 17 per cent of the estimated annual average daily traffic volumes. The directional distribution is 70 per cent in the heavier direction of travel and the per cent of trucks during the design hour is negligible. Peak travel in this area is restricted to weekend summer periods. Because of this, a practical capacity of 1,800 vehicles per lane per hour has been recognized.

g. *Lane Width*—Through traffic lanes are 12 feet wide. Three-foot curb offsets are used on the major river crossing. Major turning roadways and ramp widths at interchanges are in accord with AASHO standards.

h. *Shoulders*—Ten foot paved shoulders to the right of the through traffic lanes are recommended. To the left of the through traffic lanes, paved shoulders four feet and three feet wide are proposed for Maine and New Hampshire, respectively. The paved shoulder areas provide lateral support for base and surface courses and reduce hazards to both motorists and maintenance personnel.

[7] *A Policy on Geometric Design of Rural Highways* (1954); *A Policy on Arterial Highways in Urban Areas* (1957); *Geometric Design Standards for the National System of Interstate and Defense Highways* Adopted by AASHO and Approved by the Secretary of Commerce; *Instruction Manual for Preparation and Submission of Revised Estimate of Cost for Completing Interstate System* in Accordance with Section 104(b) 5, Title 23, United States Code, Highways (1960).

i. *Median*—Where right-of-way acquisition permits, a 40-foot median is provided in New Hampshire and 36-foot median in Maine. Where right-of-way is restricted in New Hampshire, a minimum 16-foot median is provided. Topography, land development and the high cost of the major river crossing dictate the use of a four-foot raised median with ten inch non-mountable curb and three-foot curb offsets from the travel lanes on the Piscataqua River bridge and its approaches.

j. *Frontage Roads*—Frontage roads are provided where required to give access to otherwise land-locked properties and to maintain continuity in existing highways intercepted by the Interstate Route. Minimum twenty-foot frontage roads are provided for land service; where the frontage road is used by traffic exiting or gaining access to the Interstate Route, a 24-foot minimum pavement is used.

k. *Grade Separation Structures*—Highway grade separation structures are provided where required to maintain continuity and essential traffic services. A minimum vertical clearance of 14.25 feet is provided at all local, city and state highways. A vertical clearance of 16.5 feet is provided for the Interstate.

At railroad crossings, a minimum vertical clearance of 22.5 feet has been maintained above the top of rails.

l. *Interchange Spacing*—The major interchanges in New Hampshire and Maine are about three miles apart. In Alternate C, where the existing Interstate Bridge right-of-way would be used, intermediate ramp connections are provided so that local traffic service will not be impaired.

m. *Interchanges*—The geometric designs of the major interchanges between the proposed Interstate Route and U. S. Route 4 and Bypass Route 1 in Portsmouth and U. S. Route I and Maine Route 236 in Kittery are based upon estimated turning movements and required lane capacity derived from the traffic projections and assignments.

The section of the Interstate Route under study is about 4.5 miles in length. The proposed major interchanges are only three miles apart and the Piscataqua River crossing is located about midway between the two interchanges. Due to the proximity of the major interchanges and the elevation required for the high level bridge crossing, it is not possible to provide intermediate interchanges to the local street system on Alternate A. Since the present Interstate Bridge and its approaches are retained as a separate two-way facility immediately to the east, intermediate ramp connections are not feasible for Alternate B. Alternate C, which utilizes the existing right-of-way of the present Interstate Bridge crossing, would require construction of frontage roads. In connection with the frontage road designs, it is possible to provide intermediate local ramp connections to the existing street systems in both Portsmouth and Kittery. Since the Interstate Route on this location would be constructed with full control of access, these ramp connections are essential to maintain local traffic service now provided by the Interstate Bridge and its approaches.

n. *Lighting*—It is recommended that the interchanges on Alternates A and B be lighted. Due to the proximity of other light sources, it is required that Alternate C be lighted for its entire length.

o. *Signing*—To maintain maximum operational efficiency and safety, illuminated overhead signs are recommended.

p. *Structures*—In the design, it is assumed that the grade separation structures would be steel beam bridges of composite, or continuous, design dependent upon foundation conditions. Open end spans have been assumed with stub abutments and piles through the end embankments.

q. *Navigation Requirements*—Preliminary discussions with the U. S. Corps of Engineers indicate that they will require a minimum 200 foot channel clearance and 135 foot clearance above mean high water for a bridge closely paralleling the existing Interstate Bridge. The required horizontal navigational clearances in the vicinity of the proposed high level bridge vary from about 450 feet downstream to 475 feet upstream of the proposed structure. A 130 foot clearance above mean high water will probably be required at the latter location.

On January 31, 1962 the U. S. Army Engineer Division, New England, issued an "Interim Report on Commercial Channel" for Portsmouth Harbor and Piscataqua River. The proposed channel lines, soundings in the river, and most of the data on the waterway were taken from this report. The report recommends an improvement of the channel to provide widening at bends, and extension of the 35-foot Federal project channel to Newington, New Hampshire. The recommended improvement will be made as soon as funds are released under a current Federal appropriation.

Data on navigation requirements were also obtained from the Department of Commerce publication "Navigational Clearance Requirements for Highway and Railroad Bridges" reprinted June, 1960; and, from discussions with the U. S. Army Engineer Division, New England, the American Merchant Marine Institute, and the New Hampshire Port Authority.

The Piscataqua River is about 13 miles long, beginning at the confluence of the Salmon Falls and Cocheo Rivers and flowing southerly for about four miles to a point where it joins a large tidal basin consisting of Great Bay and its tributary rivers. The tidal basin produces severe tidal currents which limit navigation to slack water periods. Tide ranges in the harbor are 7.8 feet (mean) and 9.0 feet (spring). Rapid tidal currents exist throughout the river; the average velocity at full strength of the current varies from about 2.6 knots to 4.0 knots.

Below the juncture with Great Bay, the river swings southeast for about 2.5 miles to Boiling Rock, where it narrows in width, and then winds to Portsmouth Harbor, passing under the Interstate and Memorial Bridges.

The river is characterized by rapid tidal currents, hazardous cross-currents, abrupt directional changes, and submerged rock ledges. The bed of the river is solid rock, either exposed or overlaid by a thin layer of gravel, resulting in poor holding ground for anchoring vessels. All these hazards limit navigation by deep-draft vessels to a three-hour period, between one and one-half hours before and after slack water.

Petroleum products, gypsum, electrical cable and coal constitute the principal items of waterborne traffic, which had a gross tonnage of 1,400,000 short tons in 1960. This was carried in a total of about 800 one-way vessel trips.

The size of vessel using the navigable channel determines the clearance requirements for any structure over the waterway. The existing Federal navigation project was completed in 1956, and since that time the size of tankers using the river has increased from 16,170 to 35,000 deadweight tons. The current Federal project is designed to permit the use of a 35,000-DWT supertanker (length 715 feet, beam 93 feet, draft 35 feet). Any new river crossing must be designed to accommodate the size of vessel used in the Federal project, otherwise the investment in channel improvement would be wasted. All such improvements are based fundamentally on consumer benefits realized through the more economic delivery of materials by the use of larger vessels. The Corps of Engineers and the Merchant Marine Institute both advise that the size of vessel governing bridge clearances must be of the ocean-going 35,000-DWT class.

The Department of Commerce report on Navigation Clearances shows that a vertical clearance of 130 feet would accommodate 96 per cent of all active vessels in the American Merchant Marine fleet, and 100 per cent of the tankers in that fleet. It would be reasonable then to fix the vertical underclearance of any new structure at 130 feet above mean high water to permit the use of the supertankers which are expected to use the channel. Any reduction below that height rapidly decreases the number of vessels capable of clearing the bridge; for example, 36 per cent of the tankers have a highest fixed point between 120 and 130 feet above the water line.

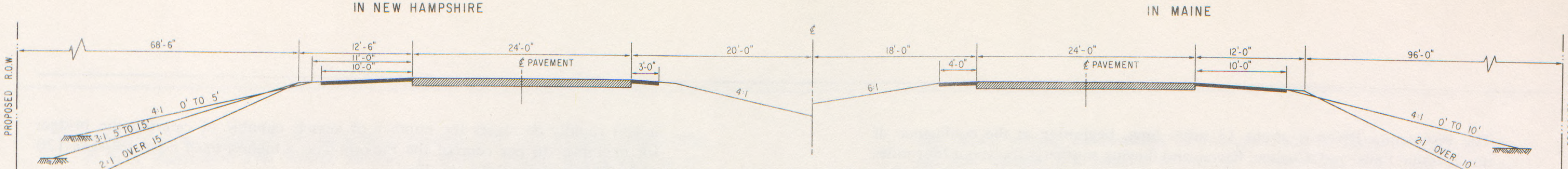
Because the existing Interstate Bridge has a vertical underclearance of 135 feet, and Memorial Bridge of 150 feet, it is reasonable to use 135 feet for any new bridge adjacent to or downstream from the Interstate Bridge, otherwise the new bridge would set a new limit of reduced clearance for all upstream reaches of the navigable channel. The horizontal clearance requirements for a new bridge are intimately related to the location and type of structure proposed.

r. *Typical Cross Sections*—In Figure 14, the typical roadway and structure cross sections recommended for the alternate designs are indicated. The four-lane divided roadway sections in New Hampshire and Maine recommended for Alternate A are indicated. The six-lane divided section with frontage roads is used in New Hampshire on Alternate C. The directional three-lane and two-lane highway sections with frontage roads are also used in Maine on the Alternate C design.

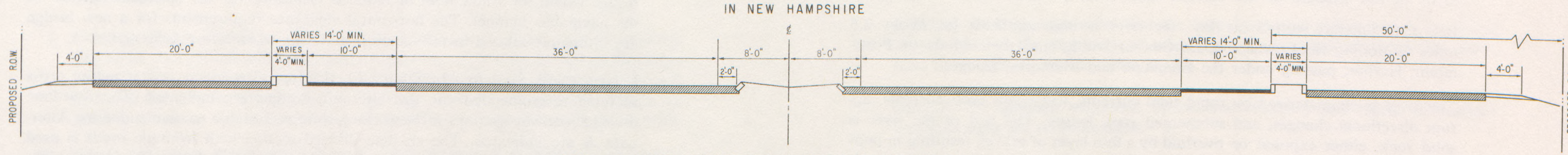
On Figure 15, the recommended cross sections for the various structures are shown. A design with two 30-foot roadways separated by a four-foot raised median is suggested for the Piscataqua River Bridge. Barrier curbs are proposed on both sides of the divided roadways. A safety walk 1.5 feet wide from face of barrier curb to face of parapet is provided on each side of the structure. In accord with good current practice, a barrier is proposed in the median to prevent cross-overs by vehicles and head-on collisions.

On the typical highway grade separation carrying the Interstate Route over an intersecting road, a six-foot left shoulder and ten foot right shoulder are recommended.

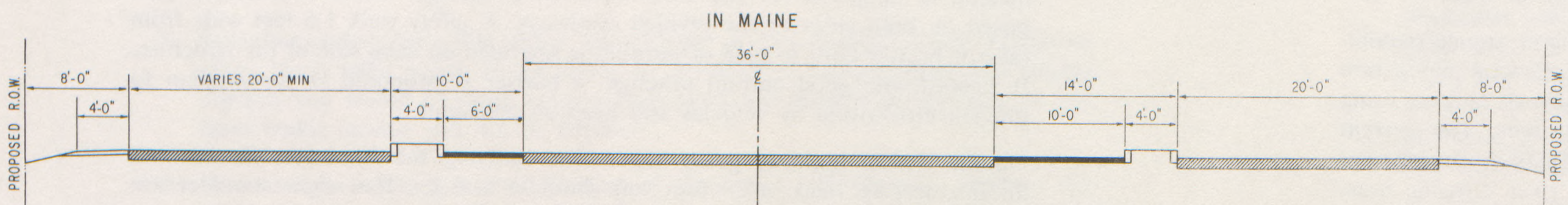
The prescribed design standards provide a high speed, high capacity highway facility engineered to the standards required to provide adequate traffic service and minimum hazards to motorists.



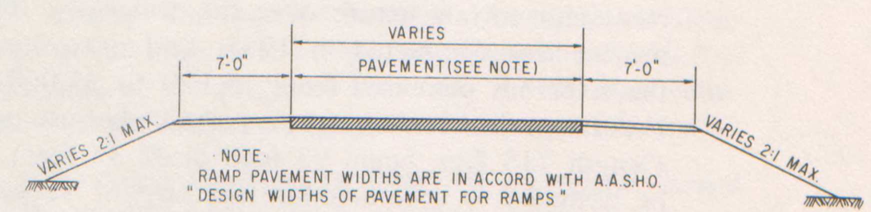
FOUR-LANE DIVIDED HIGHWAY HALF SECTIONS



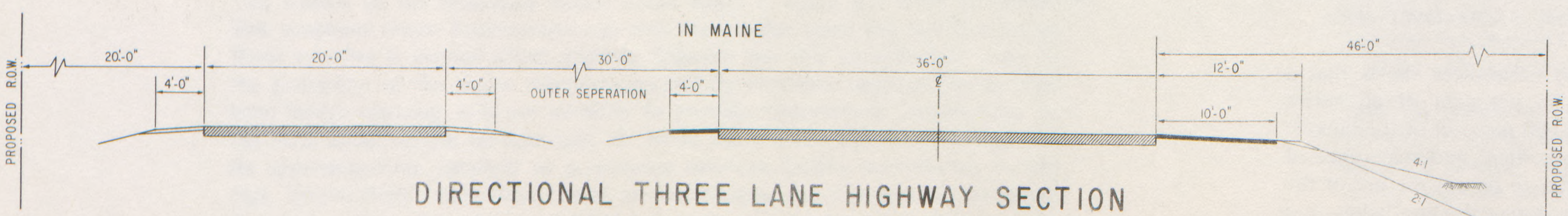
SIX - LANE DIVIDED HIGHWAY SECTION
WITH FRONTAGE ROADS



DIRECTIONAL THREE LANE HIGHWAY SECTION
WITH FRONTAGE ROADS



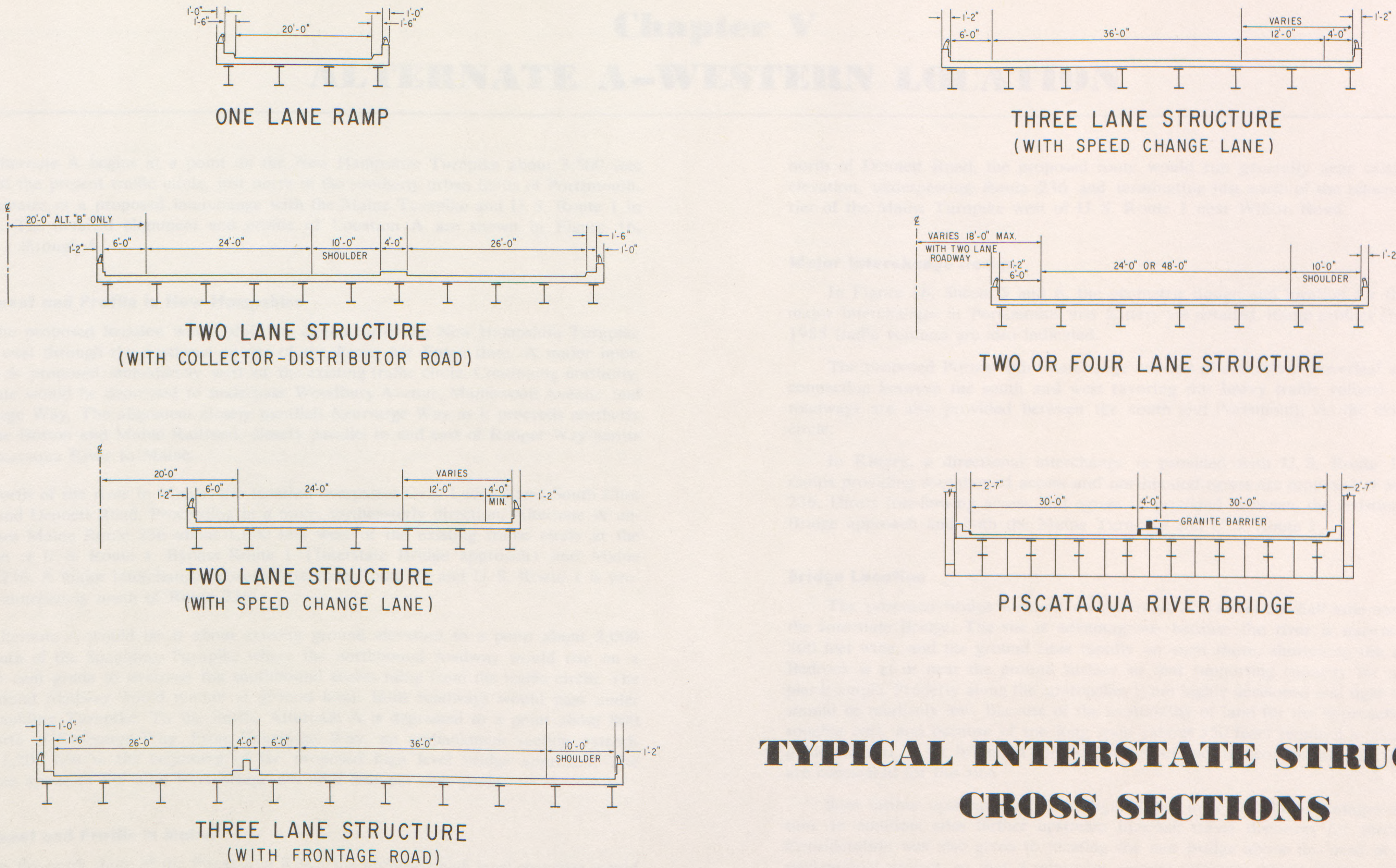
TYPICAL RAMP SECTION



DIRECTIONAL THREE LANE HIGHWAY SECTION
WITH FRONTAGE ROAD

TYPICAL HIGHWAY CROSS SECTIONS

FIGURE 14



TYPICAL INTERSTATE STRUCTURE CROSS SECTIONS

Wilbur Smith and Associates

FIGURE 15

Chapter V
ALTERNATE A–WESTERN LOCATION

Alternate A begins at a point on the New Hampshire Turnpike about 3,500 feet south of the present traffic circle, just north of the southerly urban limits of Portsmouth. It terminates at a proposed interchange with the Maine Turnpike and U. S. Route 1 in Kittery. The detailed alignment and profile of Location A are shown in Figure 16, Sheets 1 through 6.

Alignment and Profile in New Hampshire

The proposed location would shift the alignment of the New Hampshire Turnpike to the west through the northeast corner of the Pease Air Force Base. A major interchange is proposed immediately west of the existing traffic circle. Continuing northerly, the route would be depressed to underpass Woodbury Avenue, Maplewood Avenue, and Kearsarge Way. The alignment closely parallels Kearsarge Way as it proceeds northerly over the Boston and Maine Railroad, closely parallel to and east of Ranger Way across the Piscataqua River to Maine.

North of the river in Maine, the location overpasses Gray Lodge Lane, South Eliot Road and Dennett Road. Proceeding in a more northeasterly direction, Alternate A underpasses Maine Route 236 about 1,800 feet west of the existing traffic circle at the junction of U. S. Route 1, Bypass Route 1 (Interstate Bridge approach) and Maine Route 236. A major interchange between Interstate Route 95 and U. S. Route 1 is provided immediately north of Route 236.

Alternate A would be at about existing ground elevation to a point about 3,000 feet south of the Spaulding Turnpike where the northbound roadway would rise on a 1.4 per cent grade to overpass the southbound access ramp from the traffic circle. The southbound roadway would remain at ground level. Both roadways would pass under the Spaulding Turnpike. To the north, Alternate A is depressed to a point about 800 feet north of Kearsarge Way. From Kearsarge Way, an embankment section extends about 1,200 feet to the beginning of the proposed high level bridge approach. The approach spans to the high level bridge are on a four per cent grade.

Alignment and Profile in Maine

On the north shore of the Piscataqua River, the proposed high level structure would be about 97 feet above normal ground elevation. Dropping on a four per cent grade, the route would overpass Eliot Road and Dennett Road. From a point about 700 feet north of Dennett Road, the proposed route would run generally near existing ground elevation, underpassing Route 236 and terminating just north of the relocated toll barrier of the Maine Turnpike west of U. S. Route 1 near Wilson Road.

Major Interchange Design

In Figure 16, Sheets 5 and 6, the geometric design and location for the proposed major interchanges in Portsmouth and Kittery are detailed. Ramp profiles and estimated 1985 traffic volumes are also indicated.

The proposed Portsmouth interchange consists of a modified cloverleaf with a direct connection between the south and west favoring this heavy traffic volume. Directional roadways are also provided between the south and Portsmouth via the existing traffic circle.

In Kittery, a directional interchange is provided with U. S. Route 1. Diagonal ramps providing southbound access and northbound egress are proposed at Maine Route 236. Direct free-flowing access and egress is provided between the existing Interstate Bridge approach and both the Maine Turnpike and U. S. Route 1.

Bridge Location

The proposed bridge location on Alternate A is about one-half mile upstream from the Interstate Bridge. The site is advantageous because the river is narrow, less than 800 feet wide, and the ground rises rapidly on each shore, shortening the approaches. Bedrock is at or near the ground surface so that supporting capacity for any type of pier is ample. Property along the approaches is not highly developed and right-of-way costs should be relatively low. Because of the availability of land for the approaches at a reasonable cost, and because of the long span (about 550 feet) required to clear the navigable channel, a lift bridge at this location would not be economical; only fixed bridges are considered for this site.

Sites farther upstream were investigated, but none had the advantages of this location. In addition, sites farther upstream increase travel distances for through traffic. Consideration was also given to locating the new bridge above the head of the federal navigational project, so that a minimum vertical clearance, about 50 feet, could be used and the cost greatly reduced. Due to the six additional miles of highway construction and travel distance, the site was considered impractical and uneconomical.

At the selected site, the water reaches a depth of 76 feet near the New Hampshire shore. The river bottom slopes down from the New Hampshire shore very rapidly reaching a depth of 35 feet only 20 feet from the shore. In Maine, the river bottom slopes down much more gradually, reaching a depth of 35 feet about 180 feet from shore. Because of the constriction in width, accompanied by only a nominal increase in depth, currents are much faster at this location than further downstream.

The minimum structure length to span the entire waterway is 760 feet. The high ground on each riverbank reduces the length required for the approach spans. The steep bank on the New Hampshire side prevents the construction of a main pier in the river on that side. The more gradual river bottom on the Maine side will permit construction of river piers on that side. Thus, topographic limitations indicates a main span between 590 feet and 850 feet. The span cannot be reduced below the lower limit without encroaching upon the federal river channel project and it need not be increased above the upper limit to span the entire river.

The river bottom at this site also has little overburden on top of the rock. This condition combined with the swift current and the required navigation clearance prevents the use of falsework bents for erection of the span. Of necessity, erection must be either by cantilever or suspension methods. For cantilever erection, those types of structure using permanent side spans, which can assist in the erection of the main span, are advantageous.

Navigation Clearances

The horizontal clearance required at Location A varies on the two sides of the bridge because of the flare in the channel. The required upstream clearance is 475 feet and the downstream clearance is 450 feet; a vertical clearance of 130 feet will probably be required by the Corps of Engineers.

The pier for the New Hampshire end of the main span must of necessity be located on the shore. In such a position, no allowance will be necessary for pier protection. Unless the pier at the Maine end is located near the north shore and the length of the main span increased, this pier will be in the navigable water adjacent to the channel line. A conventional timber pile fender is not feasible at this location because of lack of overburden to anchor the piles. There are several methods of protecting this pier. One is to build a stone-filled sheet pile cofferdam around it similar to the one proposed for the lift bridge. A second is to move the pier back an arbitrary distance from the channel line and dump rip-rap around it so that the rip-rap will limit the draft and size of vessel that can hit the pier. The least costly solution, but also the one involving the greatest risks would be to place the north pier adjacent to the channel line and leave it unprotected.

Suitable Types of Bridges

The four types of bridges studied for Alternate A are illustrated in Figure 17.

The Semi-Through Cantilever Truss Bridge requires that the river pier be set back from the channel line as far as the New Hampshire main pier is set back from the channel line. Such a combination of set-back piers produces a main span length of 670 feet. Erection can be accomplished by cantilevering out from the anchor spans. The haunched bottom chords over the main piers as well as the deck truss construction at the extremities of the anchor spans keep pier heights relatively low while underclearance over the river channel remains high. Reasonable protection is afforded the river pier because of its set-back position.

The Through Cantilever Truss Bridge permits a minimum length of main span because the river pier can be placed at the channel line. Erection can easily be accomplished by cantilevering out over the river, using the side spans as anchors. Fabrication of such a structure is routine and should result in a favorable unit price for steel. The structure can be made less subject to damage by vessels by moving the river pier back from the channel line as described above. However, such a shift increases the length of the main structure and consequently increases the over-all cost.

The Tied Arch Bridge requires a minimum amount of expensive deep structure since it is a single span. Conditions are basically suited to such a structure were it not for the erection difficulties. The tied arch will span the river channel and optimum use of short-span approach structure is possible. However, the practical necessity of eliminating falsework in the river channel requires a cantilever erection scheme for the arch rib. This requires a cable tie-back system involving elaborate temporary structures. The cost of such an erection scheme more than offsets any possible saving in approach structure.

The Suspension Bridge has certain definite advantages for this site. Good foundation conditions, high ground on both banks, and difficult conditions for river pier construction all favor the suspension bridge. The span length required is somewhat short for a suspension bridge, but numerous shorter examples can be cited. The suspension bridge shown has straight backstays and truss side spans to match the stiffening trusses for appearance. Elimination of river piers prevents any hazard to river traffic and the basic erection methods for suspension bridges do not require falsework.

Comparative Bridge Costs

The estimated construction costs of the various types of pier bridges at Location A are shown in Table 21.

TABLE 21

COMPARATIVE COST ANALYSIS

ALTERNATE HIGH-LEVEL BRIDGE DESIGNS

Alternate A, Western Location

Bridge Type	*Over-all Length (feet)*	*Estimated Cost of Structures* *Main Spans*	*Approach Spans*	*Total*
Semi-Through Cantilever	3,910	$3,140,000	$2,010,000	$5,150,000
Through Cantilever	3,850	3,500,000	2,050,000	5,550,000
Tied Arch	3,910	3,240,000	2,440,000	5,680,000
Suspension	3,915	5,470,000	1,940,000	7,410,000

The preliminary bridge costs indicate that the Semi-Through Cantilever, Through Cantilever and Tied Arch Bridges are competitive. The final decision as to choice of structure should be based on more refined and detailed preliminary engineering studies. In the cost estimates developed for Alternate A, the cost for the Semi-Through Cantilever structure, $5,150,000 was used.

Cost Estimates

Preliminary estimates of construction and right-of-way acquisition costs have been developed based upon unit costs for similar type construction in Maine and New Hampshire, see Appendix Table B-3, and preliminary right-of-way estimates by qualified local appraisers.[8]

The cost estimates for Alternate A in New Hampshire have been divided into two parts:

1. The approaches to the high-level structure.
2. The high-level structure itself.

A similar breakdown has been developed for Maine. Construction costs are also broken down into 12 separate items including utility adjustment, grading, drainage, pavement, grade separation structures, interchanges and the major river bridge, as shown in Appendix Table B-4. Engineering and right-of-way costs are shown.

[8] In New Hampshire, John L. Hyde; in Maine, Jerome Knowles, Jr. and Associates.

In Table 22, the major cost items are summarized for New Hampshire, Maine and the entire route section. Totals are given for preliminary engineering, right-of-way acquisition, and construction.

TABLE 22

ESTIMATED COSTS

Alternate A, Western Location

Description	*Route Section* *New Hampshire*	*Maine*	*Total*
	(Thousands of Dollars)		
Length, miles	2.34	2.09	4.43
Preliminary Engineering	$ 271	$ 235	$ 506
Right-of-Way	550	165	715
Construction Costs			
Bridge and Approaches	2,117	3,033	5,150
Other	3,899	2,192	6,091
Subtotal	$6,016	$5,225	$11,241
Engineering and Contingencies	602	523	1,125
Total Estimated Cost	$7,439	$6,148	$13,587

The construction costs for the Piscataqua River Bridge are almost 46 per cent of the total construction costs of $11,241,000. Based upon the actual length of bridge in each state, about $2,117,000 of the total bridge construction costs are assigned to New Hampshire; the remaining $3,033,000 to Maine.

The preliminary cost estimates indicate that total costs for the 2.34 miles of route in New Hampshire will approximate $7,439,000. Costs in Maine are estimated at $6,148,000 for 2.09 miles of construction. Total costs for Alternate A are estimated at $13,587,000 for the entire 4.43 miles, including right-of-way acquisition costs of $715,000.

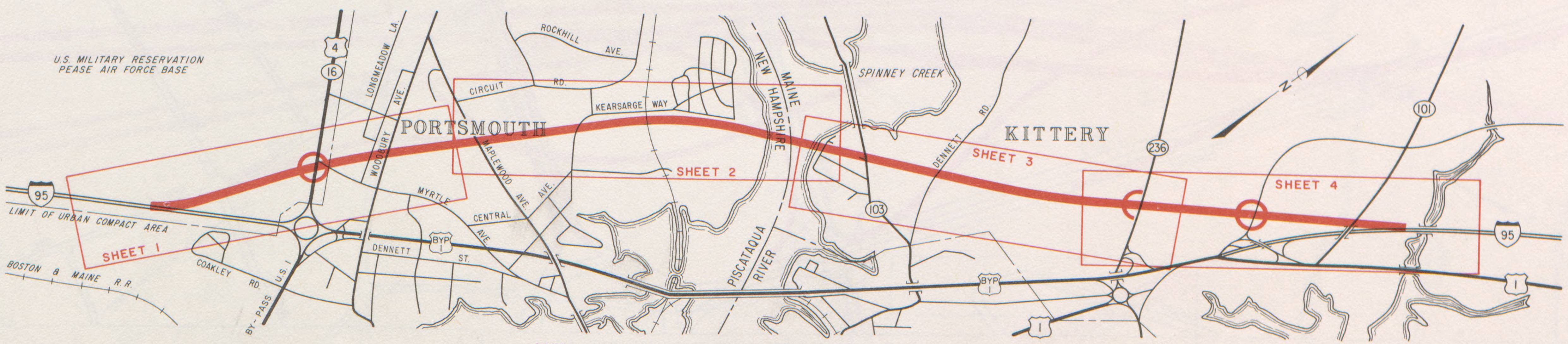
Non-Participating Costs—Federal legislation does not permit the use of Interstate funds for construction of access roadways to toll facilities, unless certain requirements are met. Assuming construction of the proposed interchange between the New Hampshire Turnpike and New Hampshire Route 101 (Middle Road) south of the traffic circle in Portsmouth, all construction costs in New Hampshire would be eligible for federal participation, if the new bridge is toll free. In Maine, about $975,000 of construction costs likely would be ineligible for federal participation at the major interchange on the Maine Turnpike, as shown in Appendix Table B-7. It is possible that some of the non-participating costs could be made participating if the Maine Legislature amended the statutes relating to the Maine Turnpike Authority, to provide that the turnpike become toll free after payment of the turnpike indebtedness.

Functional Plan

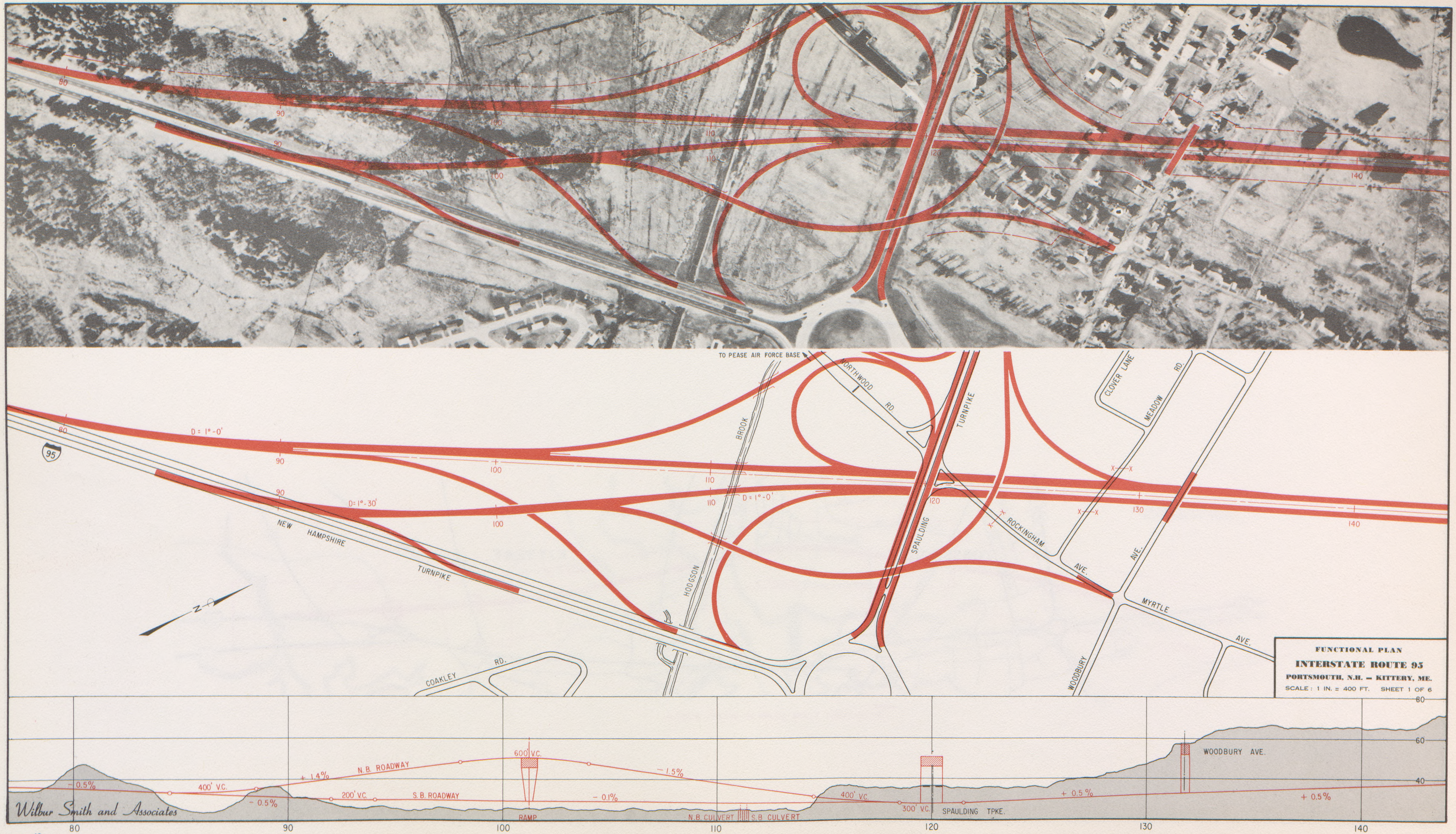
INTERSTATE ROUTE 95

Alternate A

SCALE: 1 IN. = 400 FT. FIGURE 16 SHEETS 1 TO 6

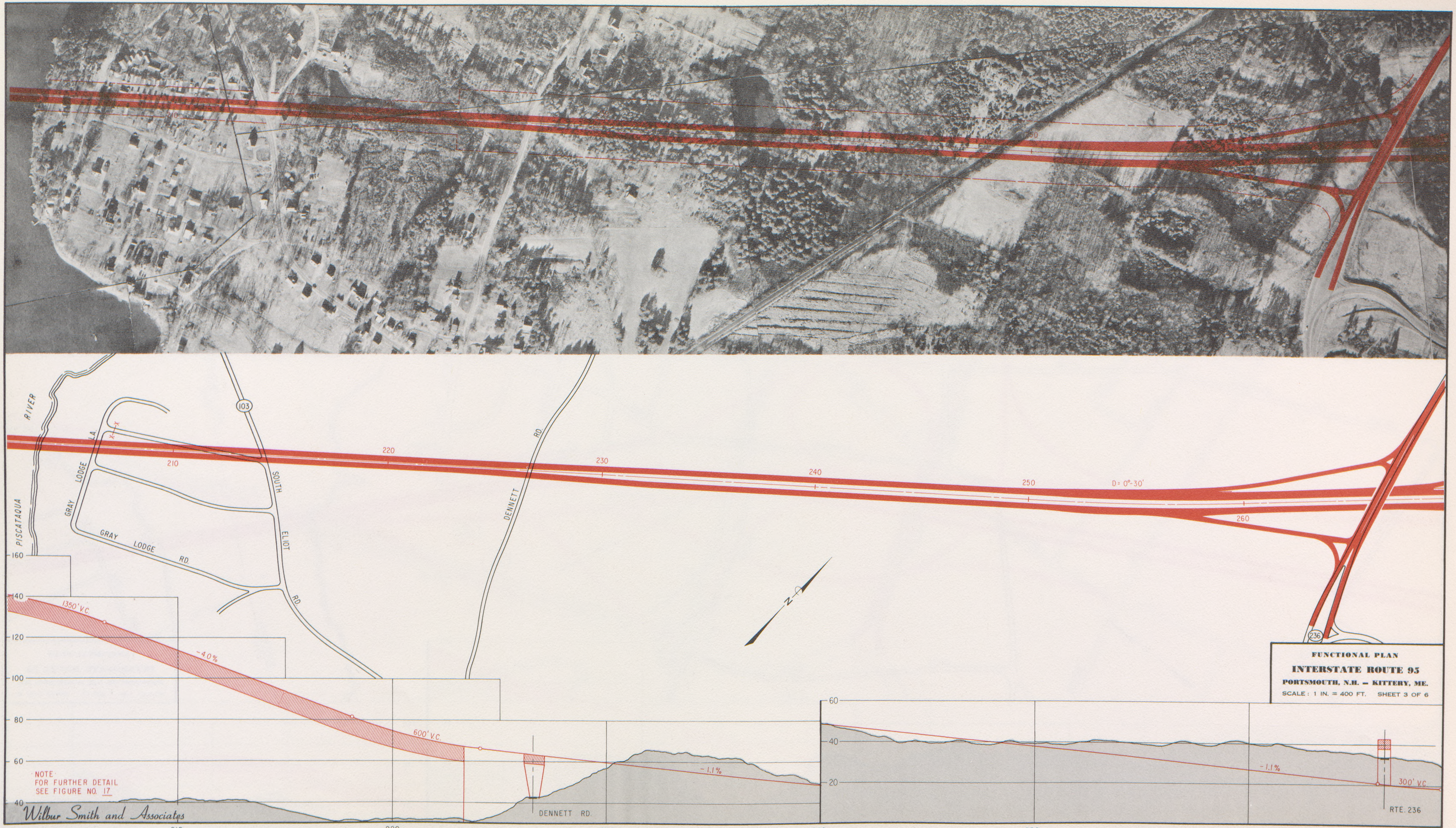


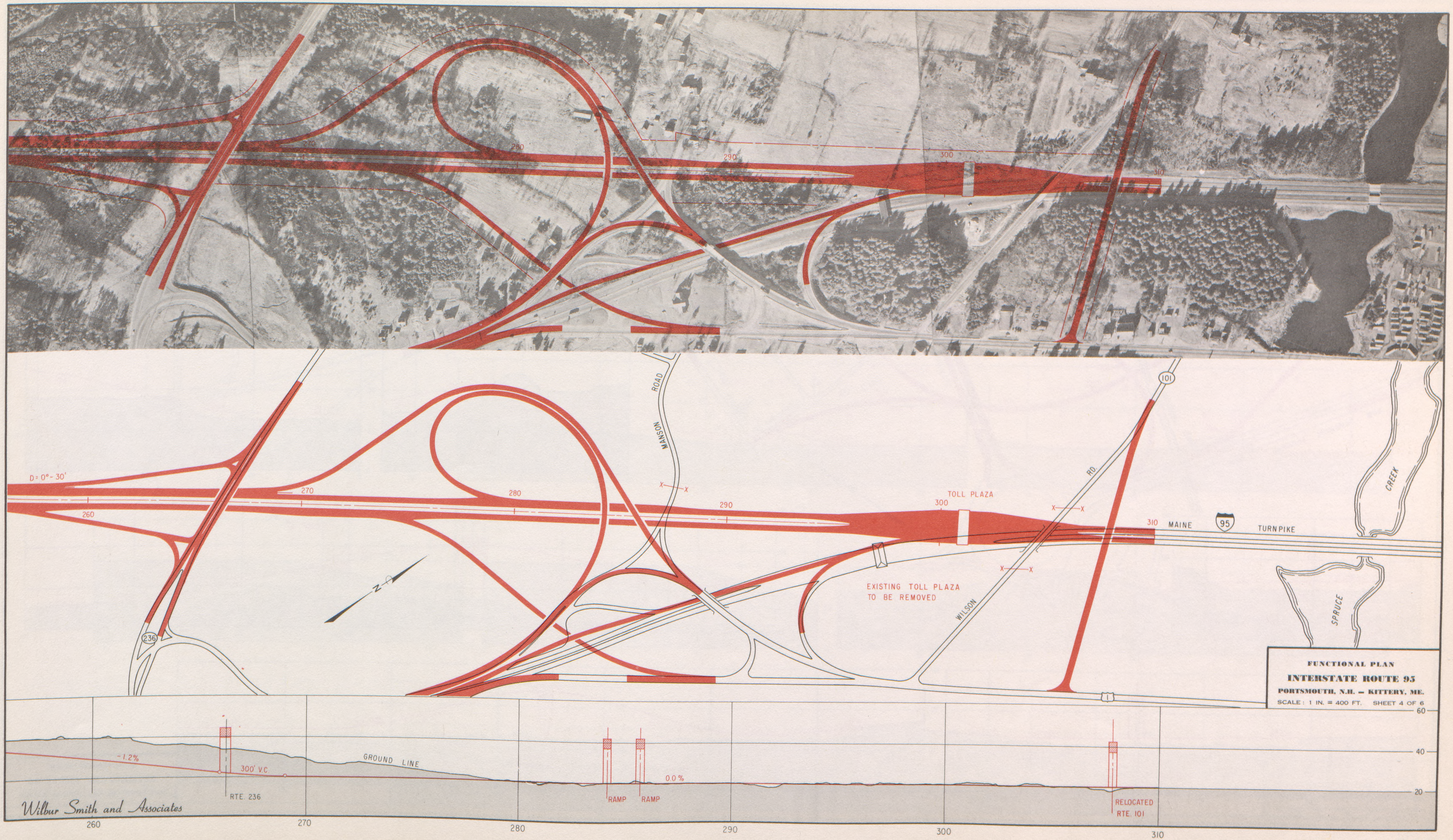
NOTE:
INTERCHANGE PLANS SHOWN ON SHEETS 5 AND 6

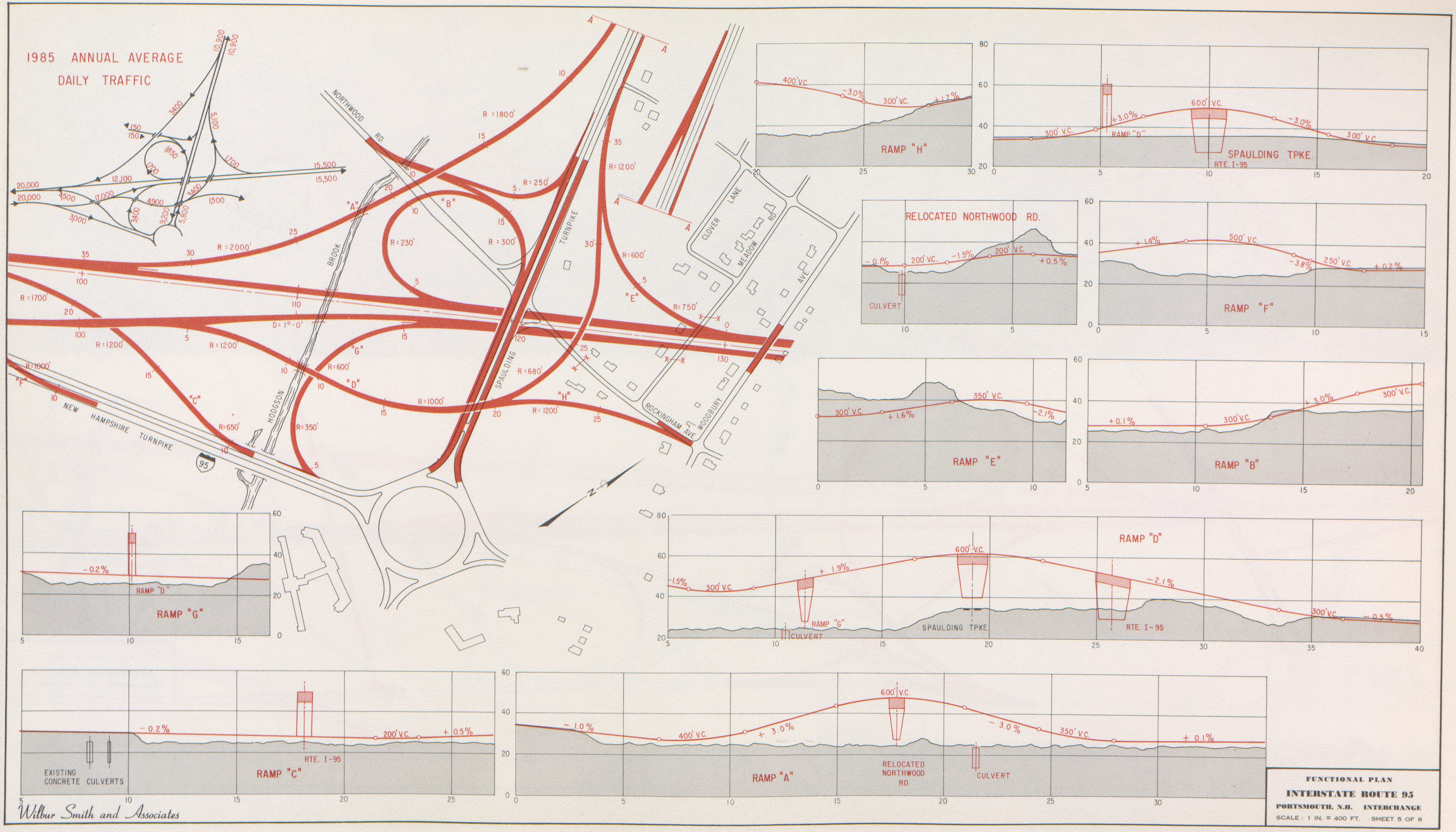


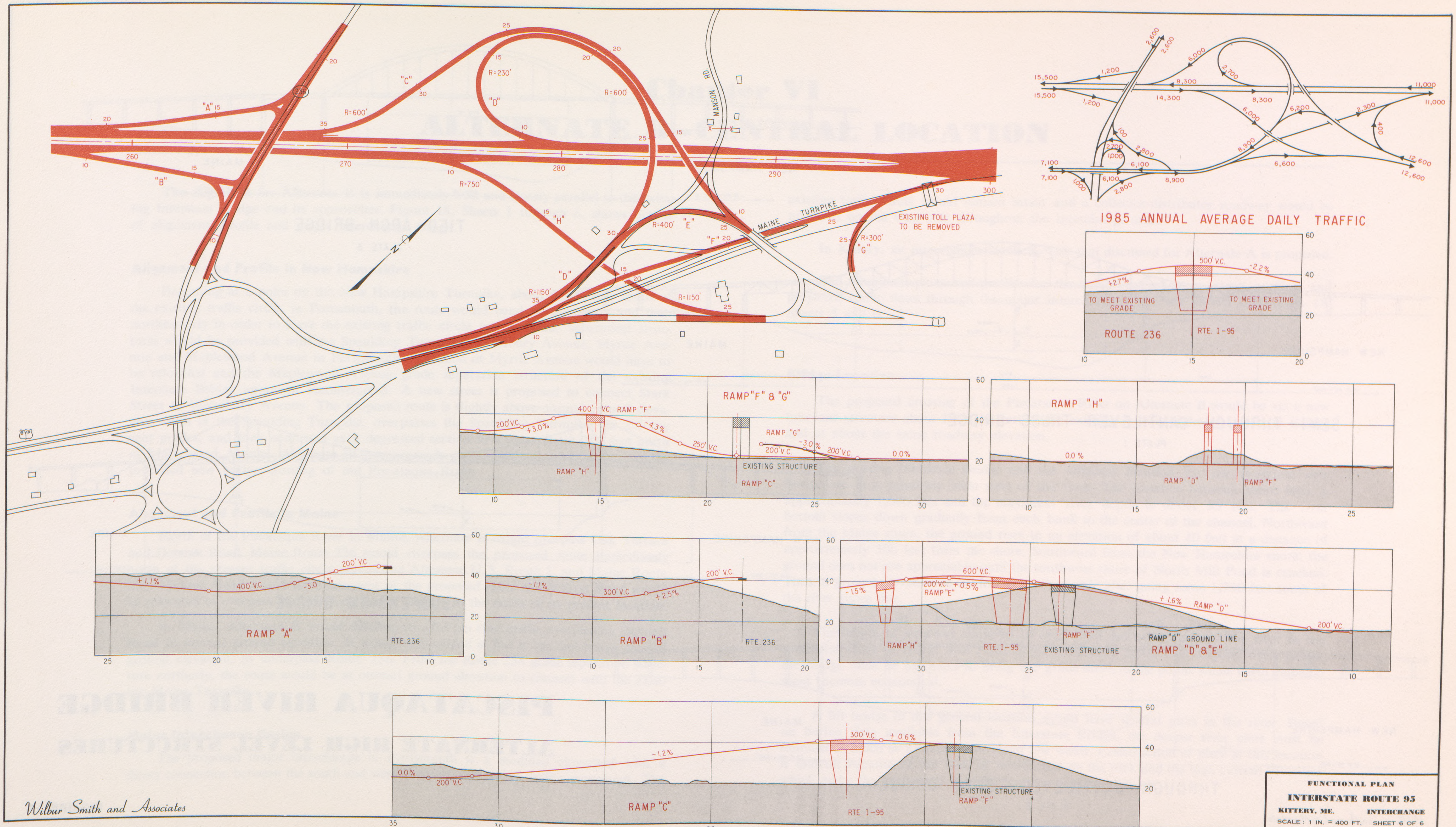
TO PEASE AIR FORCE BASE
NORTHWOOD RD.
TURNPIKE
CLOVER LANE
MEADOW RD.
BROOK
HODGSON
SPAULDING
ROCKINGHAM AVE.
WOODBURY AVE.
MYRTLE AVE.
NEW HAMPSHIRE TURNPIKE
COAKLEY RD.
D = 1°-0'
D = 1°-30'
95
N
FUNCTIONAL PLAN
INTERSTATE ROUTE 95
PORTSMOUTH, N.H. – KITTERY, ME.
SCALE: 1 IN. = 400 FT. SHEET 1 OF 6
N. B. ROADWAY
S. B. ROADWAY
600' V.C.
400' V.C.
200' V.C.
300' V.C.
+ 1.4%
– 1.5%
– 0.5%
– 0.1%
+ 0.5%
RAMP
N.B. CULVERT
S.B. CULVERT
SPAULDING TPKE.
WOODBURY AVE.
80
90
100
110
120
130
140
40
60
Wilbur Smith and Associates

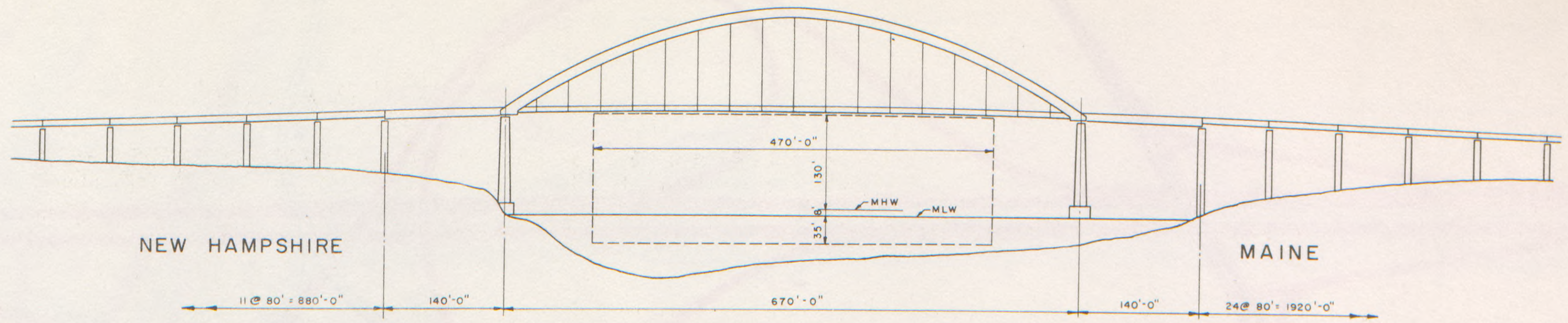

FUNCTIONAL PLAN
INTERSTATE ROUTE 95
PORTSMOUTH, N.H. – KITTERY, ME.
SCALE: 1 IN. = 400 FT.
SHEET 2 OF 6
CIRCUIT RD. EXTENSION
CIRCUIT RD.
MANGROVE ST.
KEARSARGE
WAY
RALEIGH WAY
PREBLE WAY
RANGER WAY
BASEBALL FIELD
WATER TOWER
D=1°-15'
OIL TANK
OIL TANK
MAPLEWOOD AVE.
FAIRVIEW AVE.
CUTTS AVE.
BOSTON & MAINE R.R.
PISCATAQUA RIVER
NEW HAMPSHIRE
MAINE
PORTSMOUTH
KITTERY
GRAY LODGE LANE
N
MAPLEWOOD AVE.
GROUND LINE
KEARSARGE WAY
R.R.
R.R.
+0.5%
600' V.C.
+2.7%
300' V.C.
+4.0%
1350' V.C.
+4.0%
-4.0%
CLEARANCE LINE
NOTE:
FOR FURTHER DETAIL
SEE FIGURE NO. 17
Wilbur Smith and Associates


FUNCTIONAL PLAN
INTERSTATE ROUTE 95
PORTSMOUTH, N.H. – KITTERY, ME.
SCALE : 1 IN. = 400 FT. SHEET 3 OF 6
PISCATAQUA
RIVER
GRAY LODGE LA
GRAY LODGE RD
103
SOUTH ELIOT RD.
DENNETT RD
210
220
230
240
250
260
D = 0°-30'
N
236
160
140
120
100
80
60
40
20
1350' V.C.
-4.0%
600' V.C.
-1.1%
300' V.C.
NOTE:
FOR FURTHER DETAIL
SEE FIGURE NO. 17
DENNETT RD.
RTE. 236
Wilbur Smith and Associates


D = 0° - 30'
260
270
280
290
300
310
TOLL PLAZA
MAINE TURNPIKE
95
MANSON ROAD
WILSON RD
101
CREEK
SPRUCE
EXISTING TOLL PLAZA TO BE REMOVED
236
FUNCTIONAL PLAN
INTERSTATE ROUTE 95
PORTSMOUTH, N.H. – KITTERY, ME.
SCALE: 1 IN. = 400 FT. SHEET 4 OF 6
60
40
20
-1.2%
300' V.C.
GROUND LINE
0.0%
RTE. 236
RAMP
RAMP
RELOCATED RTE. 101
Wilbur Smith and Associates

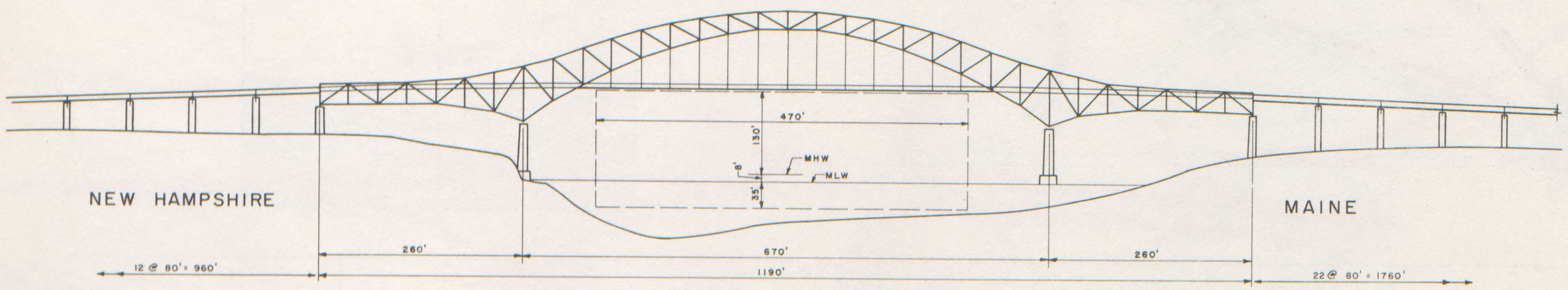

1985 ANNUAL AVERAGE DAILY TRAFFIC
NORTHWOOD RD.
TURNPIKE
SPAULDING
BROOK
HODGSON
NEW HAMPSHIRE TURNPIKE
95
CLOVER LANE
MEADOW RD.
WOODBURY AVE.
ROCKINGHAM AVE.
RAMP "H"
SPAULDING TPKE.
RTE. I-95
RELOCATED NORTHWOOD RD.
CULVERT
RAMP "F"
RAMP "E"
RAMP "B"
RAMP "G"
RAMP "D"
RAMP "C"
EXISTING CONCRETE CULVERTS
RAMP "A"
RELOCATED NORTHWOOD RD.
FUNCTIONAL PLAN
INTERSTATE ROUTE 95
PORTSMOUTH, N.H. INTERCHANGE
SCALE: 1 IN. = 400 FT. SHEET 5 OF 6
Wilbur Smith and Associates


MAINE TURNPIKE
MANSON RD.
EXISTING TOLL PLAZA TO BE REMOVED
"A"
"B"
"C"
"D"
"E"
"F"
"G"
"H"
R=230'
R=600'
R=750'
R=400'
R=1150'
R=300'
1985 ANNUAL AVERAGE DAILY TRAFFIC
TO MEET EXISTING GRADE
ROUTE 236
RTE. I-95
RAMP "F" & "G"
EXISTING STRUCTURE
RAMP "H"
RAMP "D"
RAMP "F"
RAMP "C"
RAMP "A"
RTE. 236
RAMP "B"
RAMP "D" GROUND LINE
RAMP "D" & "E"
RAMP "E"
Wilbur Smith and Associates
FUNCTIONAL PLAN
INTERSTATE ROUTE 95
KITTERY, ME. INTERCHANGE
SCALE: 1 IN. = 400 FT. SHEET 6 OF 6



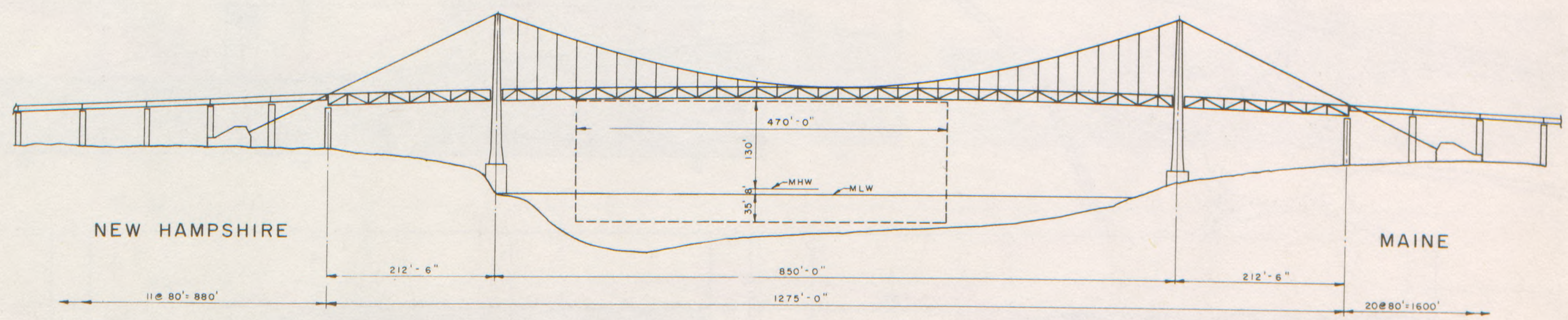
TIED ARCH BRIDGE

PLATE 3



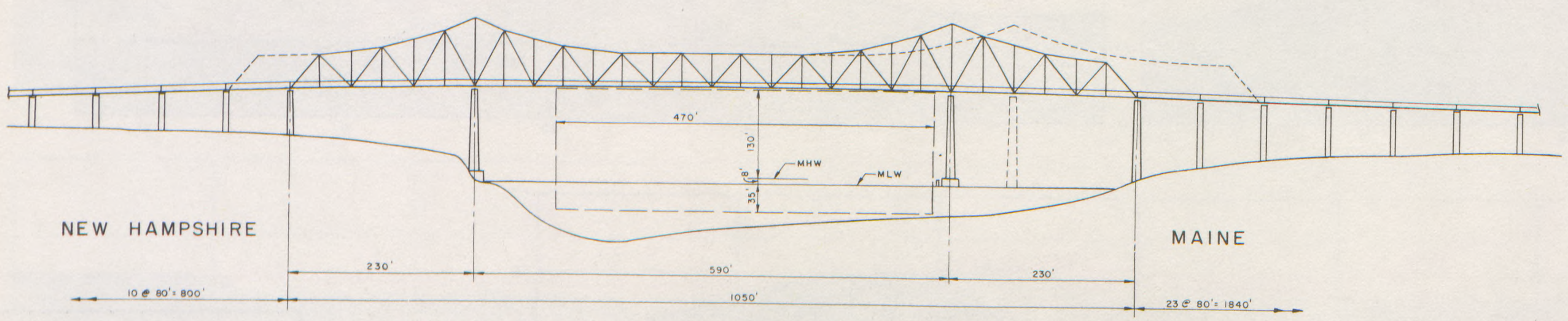
SEMI-THROUGH CANTILEVER TRUSS BRIDGE

PLATE 1



SUSPENSION BRIDGE

PLATE 4



THROUGH CANTILEVER TRUSS BRIDGE

PLATE 2

PISCATAQUA RIVER BRIDGE

ALTERNATE HIGH LEVEL STRUCTURES

FIGURE 17

Chapter VI
ALTERNATE B—CENTRAL LOCATION

The alignment for Alternate B is immediately west and closely parallel to the existing Interstate Bridge and its approaches. Figure 18, Sheets 1 through 6, shows details of alignment, profile and major interchange design.

Alignment and Profile in New Hampshire

Beginning at a point on the New Hampshire Turnpike, about 3,500 feet south of the existing traffic circle, in Portsmouth, the route would bend northwesterly and then northeasterly in order to leave the existing traffic circle intact. Grade separation structures would be provided with the Spaulding Turnpike, Woodbury Avenue, Myrtle Avenue and Maplewood Avenue in Portsmouth. A section of Myrtle Avenue would have to be relocated and the Maplewood Avenue grade separation structure of the existing Interstate Bridge approach reconstructed. A new street is proposed to connect Stark Street to Woodbury Avenue. The proposed route is slightly above normal ground elevation south of the Spaulding Turnpike, overpasses the Spaulding Turnpike via 2.4 per cent grades, and then continues as a depressed section to a point about 700 feet north of Maplewood Avenue. Alternate B then proceeds on an embankment section to the proposed new bridge crossing of the Piscataqua River.

Alignment and Profile in Maine

North of the Piscataqua River in Maine, Alternate B would overpass Oak Terrace and Dennett Road. Maine Route 236 would overpass the proposed route immediately north of the present traffic circle connecting Alternate U. S. Route 1, and Maine Route 236. Manson Road would terminate west of the proposed route and Wilson Road would be relocated to overpass the Interstate Route slightly to the north of its present location.

In Maine, Alternate B would descend on a 0.4 per cent grade, overpassing Dennett Road to normal ground elevation. It would then extend at five to ten feet below general ground elevation, to underpass Route 236. From the Route 236 grade separation structure northerly, the route would be at normal ground elevation to connect with the existing Maine Turnpike.

Major Interchange Design

The proposed major interchange in Portsmouth is a modified cloverleaf with a direct connection between the south and west favoring this heavy traffic movement. The existing traffic circle would remain intact and a collector-distributor roadway would be provided on the west side throughout the interchange area.

In Kittery, an interchange identical with that discussed for Alternate A is proposed.

The functional plans and profiles for the major interchanges, ramp profiles, and projected traffic flows through the major interchange areas are shown on Figure 18, Sheets 5 and 6.

Bridge Location

The proposed crossing of the Piscataqua River on Alternate B would be via a new four-lane structure about 100 feet west of the existing railway-highway Interstate Bridge and at about the same roadway elevation.

The existing Interstate Bridge and the adjacent location for the proposed new bridge are in a relatively wide part of the river. The distance between shore lines is approximately 1,600 feet and the maximum river depth is about 55 feet. The river bottom slopes down gradually from each bank to the center of the channel. Northward from the Maine shore, the ground rises to an elevation of about 40 feet at a distance of approximately 300 feet from the shore. Southward from the New Hampshire shore, the ground does not rise appreciably until the southwest shore of North Mill Pond is reached. Thus, a ground elevation of 20 feet is reached only after going some 1,700 feet south of the river shore line.

The length of structure required to span from the north shore of the river to the southwest shore of North Mill Pond is approximately 2,500 feet. Beyond these points, the bridge must be extended to bring the grade down to the points where earth embankment becomes economical.

A lift bridge in this general location would have several piers in the river. Based on boring data available from the Interstate Bridge, the deeper river piers must be founded as much as 83 feet below mean low water. Construction of piers at this location is difficult because of the lack of overburden on the rock and the high current velocities which make the anchorage of cofferdams or caissons difficult.

Sound rock is generally available within ten feet of the ground surface, except in the river bed. In the river, sound rock exists at depths varying from five feet to 30 feet below the river bottom. The shallow depth to rock occurs in the center part of the river, while the deeper depths occur along the sides. The deepest rock is on the New Hampshire side of the river bed.

Navigation Clearances

Navigation clearances at the site are severely limited by the existing Interstate Bridge. This vertical lift bridge provides a horizontal clearance between main piers of 200 feet and a vertical clearance of 135 feet above mean high water with the lift span fully open. The effective horizontal clearance is actually somewhat less than 200 feet because the bridge alignment is skewed about 25 degrees relative to the general alignment of the river channel. The existing bridge piers have no fender protection.

The 200-foot horizontal clearance through the existing bridge is inadequate to accommodate a supertanker of about 93-foot beam, 715 feet long, and with a draft of 35 feet for which the present Federal navigational project is now designed.[9] To prolongate this same channel width through a new bridge would make navigation of the supertankers through the draw impossible. The investment in the Federal improvement of the channel would be wasted, and the growth of upstream commerce halted.

To insure that the present navigation problem is not aggravated, it is necessary to step the new lift span piers back from those of the existing bridge. The arrangement of piers shown on Figure 19 results. Also, to protect the new structure from damage or destruction by the large 35,000-ton tankers the piers must be protected by substantial fenders.

A conventional timber fender system would be ineffective because of the depth of the water and the lack of overburden material for anchoring the timber piles. Some type of cofferdam protection must be used, and the cofferdam must have considerable mass and good stability. A cofferdam arrangement which incorporates these features and at the same time is shaped to lead the vessels in and out of the draw is also shown on Figure 19. The shape of the cofferdam is such that the existing piers are also protected on the upstream side. The protection consists of a double-walled, stone-filled cofferdam with a tremie-concrete base which also serves as the pier base. The pier protection, as shown, adds about $1,000,000 to the cost of the bridge.

[9] *Interim Report on Commercial Channel, Portsmouth Harbor and Piscataqua River,* U.S. Army Engineers, January 13, 1962.

The arrangement of the new piers and their cofferdam protection is generally acceptable to the Corps of Engineers. Discussions with representatives of the American Merchant Marine Institute indicate that shippers may demand a wider opening through the drawspans, and suggest that they may request that the existing bridge be replaced under the Truman-Hobbs Act[10] with a new and longer lift span providing as much as 400-foot horizontal clearance.

Type of Bridge

The proposed vertical-lift bridge is a four-lane structure with a through-truss tower-drive lift span, through-truss side spans, and stringer approach spans as shown on Plate 2 of Figure 19. The through-truss lift span will provide approximately 36 feet underclearance with the span down and will eliminate the necessity of opening the span for barges, most pleasure craft, and tugs. The additional underclearance will not greatly increase the cost of the bridge because the south approach has to be kept high to overpass the tracks of the Boston and Maine Railroad and most of the north approach is a water crossing which requires structure in any case.

All piers will be supported on solid rock, and will be protected within the tide range by granite facing.

The cost of operation for the new span and the existing lift span will be minimized by providing operation of both spans from a common control center on the new structure. Such a scheme raises the initial cost by the amount necessary to relocate the controls for the existing bridge, but saves the recurring annual cost of a complete second set of bridge operators.

Bridge Cost

The estimated total cost for 2,868 linear feet of construction, including the lift span, side spans and approach spans is $10,650,000, of which $6,560,000 is for the lift span and towers and $4,090,000 for the approach spans.

Cost Estimates

In Table 23, the estimated costs of Alternate B are summarized. A more detailed cost breakdown is presented in Appendix B-5.

[10] The Truman-Hobbs Act provides funds for the replacement of structures causing channel restrictions and hazards to shipping.

It is estimated that the total cost of the 4.33 mile section of Interstate Route 95 through the Portsmouth-Kittery area on this location would approximate $20,235,000 of which $873,000 is for right-of-way acquisition and $16,911,000 for construction. Construction costs of the low-level lift bridge and its approaches are estimated at $10,650,000. Of this amount, about $5,900,000 is allocated to New Hampshire, $4,750,-000 to Maine.

Total costs for the 2.08 mile section in New Hampshire is estimated at $11,647,000. Construction, right-of-way acquisition and engineering costs for the 2.25 mile route section in Maine are estimated at $8,588,000.

Non-participating Costs—As previously described in Chapter V, Interstate financing will probably not be available for construction of the roadway connecting directly to the Maine Turnpike, since it is a toll road. These non-participating costs, estimated at about $975,000 are detailed in Appendix Table B-7. Since the same interchange design is used as with Alternate A, the costs are identical.

TABLE 23

ESTIMATED COSTS

Alternate B, Central Location

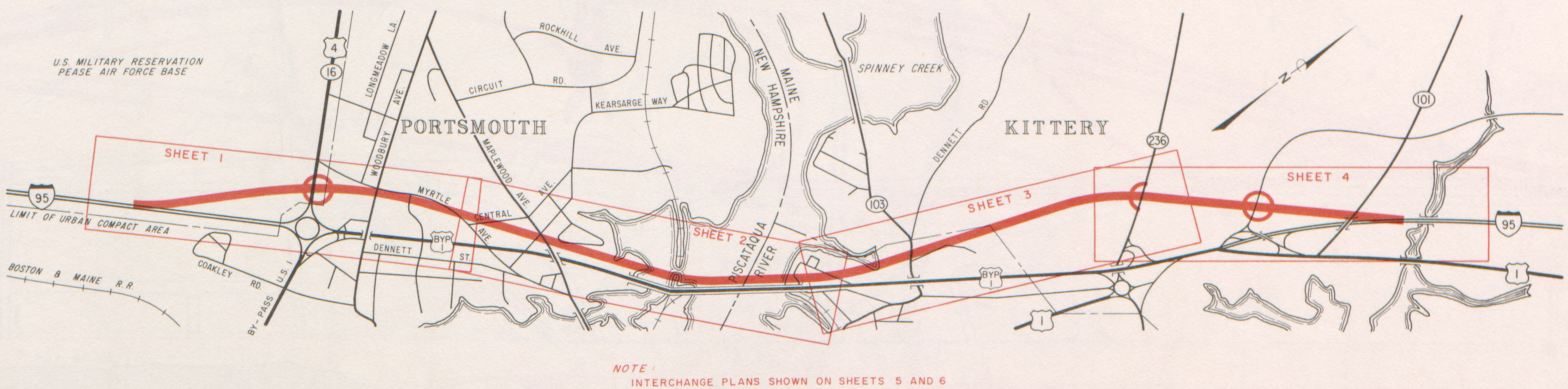
Description	Route Section: New Hampshire	Maine	Total
	(Thousands of Dollars)		
Length, miles	2.08	2.25	4.33
Preliminary Engineering	$ 432	$ 328	$ 760
Right-of-Way	644	229	873
Construction Costs			
Bridge and Approaches	5,900	4,750	10,650
Other	3,710	2,551	6,261
Subtotal	$ 9,610	$7,301	$16,911
Engineering and Contingencies	961	730	1,691
Total Estimated Cost	$11,647	$8,588	$20,235

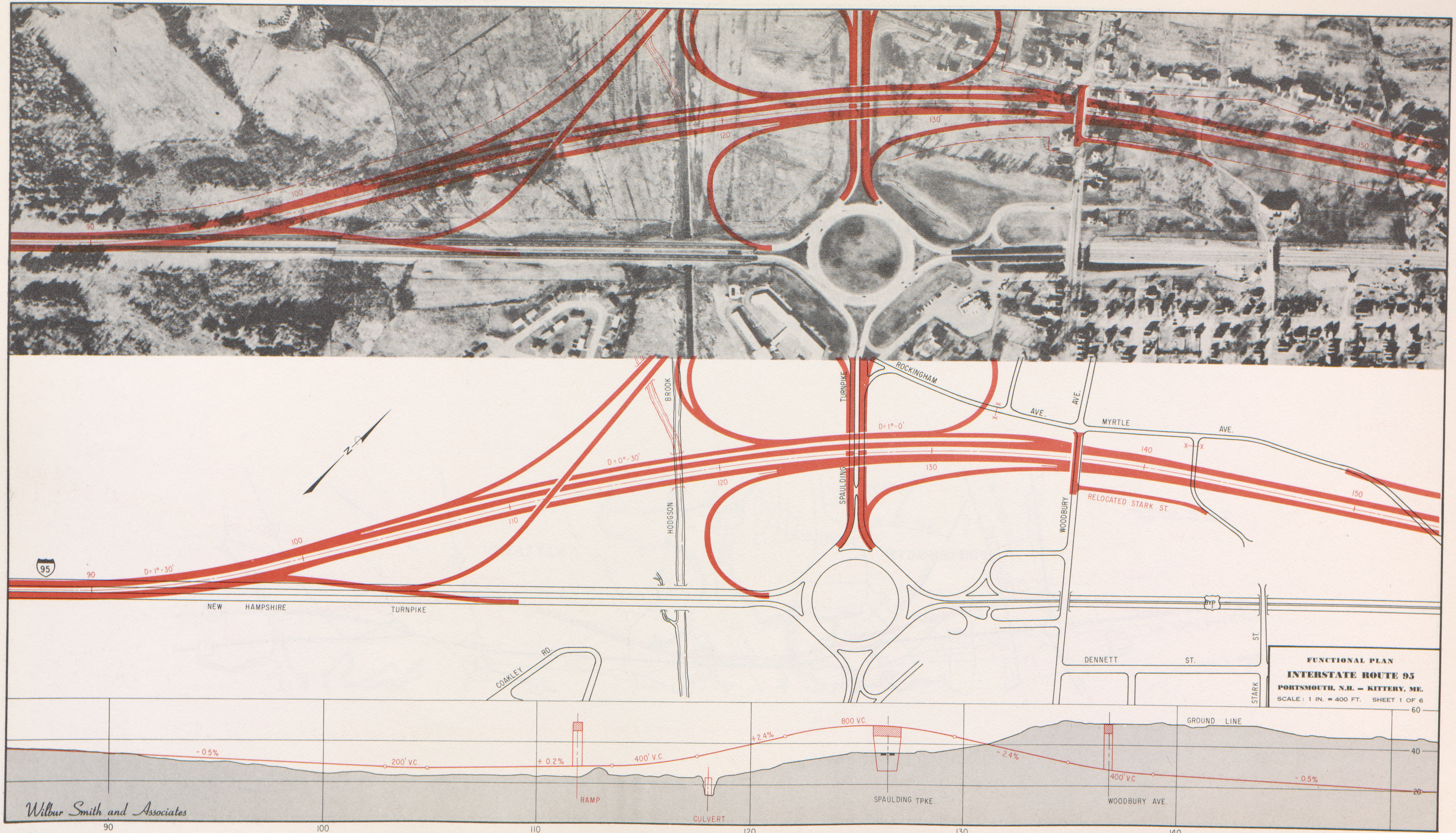
Functional Plan

INTERSTATE ROUTE 95

Alternate B

SCALE: 1 IN. = 400 FT. FIGURE 18 SHEETS 1 TO 6




FUNCTIONAL PLAN
INTERSTATE ROUTE 95
PORTSMOUTH, N.H. – KITTERY, ME.
SCALE: 1 IN. = 400 FT. SHEET 1 OF 6
95
D = 1°-30'
D = 0°-30'
D = 1°-0'
NEW HAMPSHIRE TURNPIKE
COAKLEY RD.
HODGSON BROOK
SPAULDING TURNPIKE
ROCKINGHAM AVE.
WOODBURY AVE.
MYRTLE AVE.
RELOCATED STARK ST.
DENNETT ST.
STARK ST.
BYP
GROUND LINE
-0.5%
200' V.C.
+0.2%
400' V.C.
+2.4%
800' V.C.
-2.4%
400' V.C.
-0.5%
RAMP
CULVERT
SPAULDING TPKE.
WOODBURY AVE.
60
40
20
90
100
110
120
130
140
150
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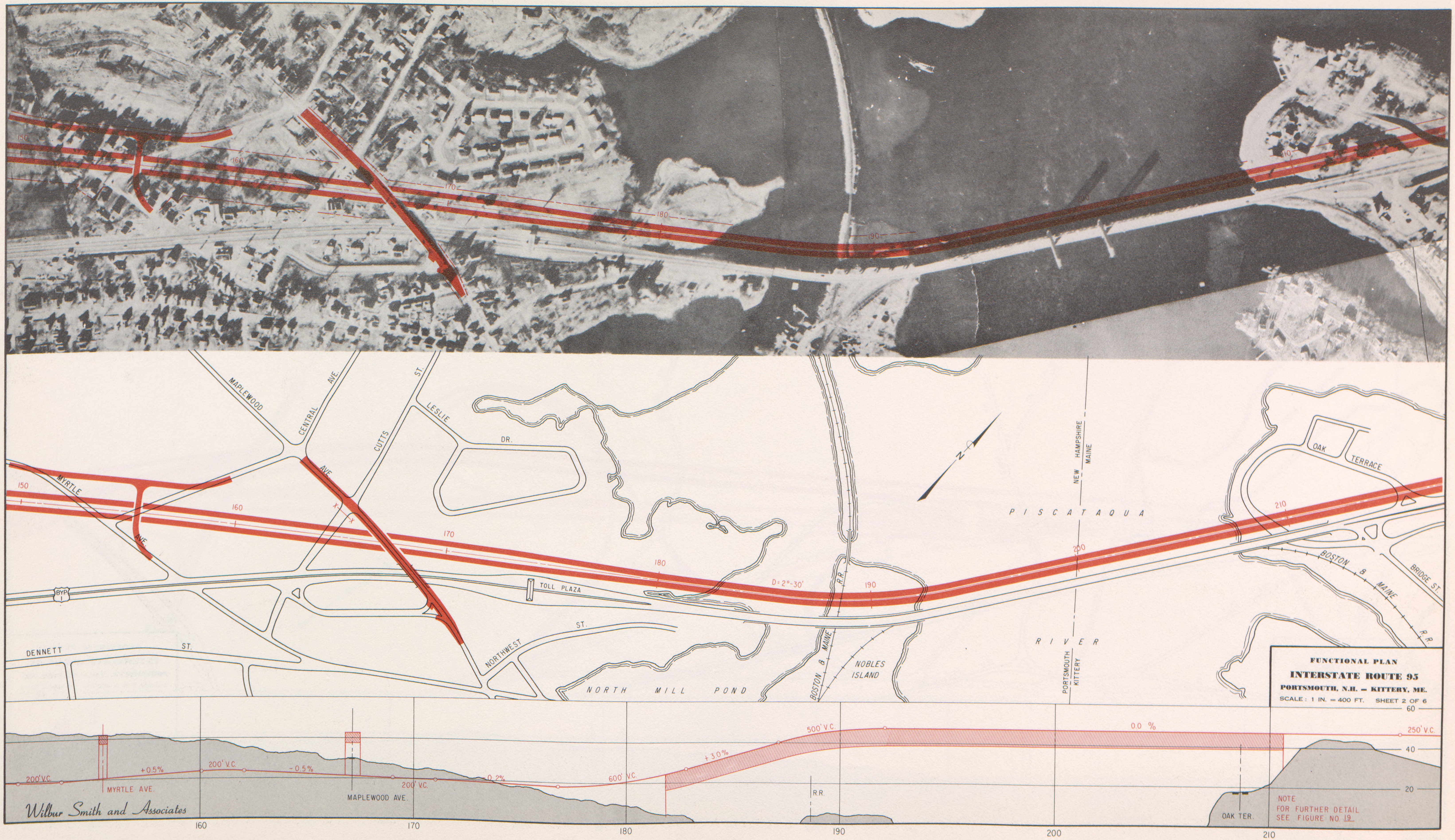
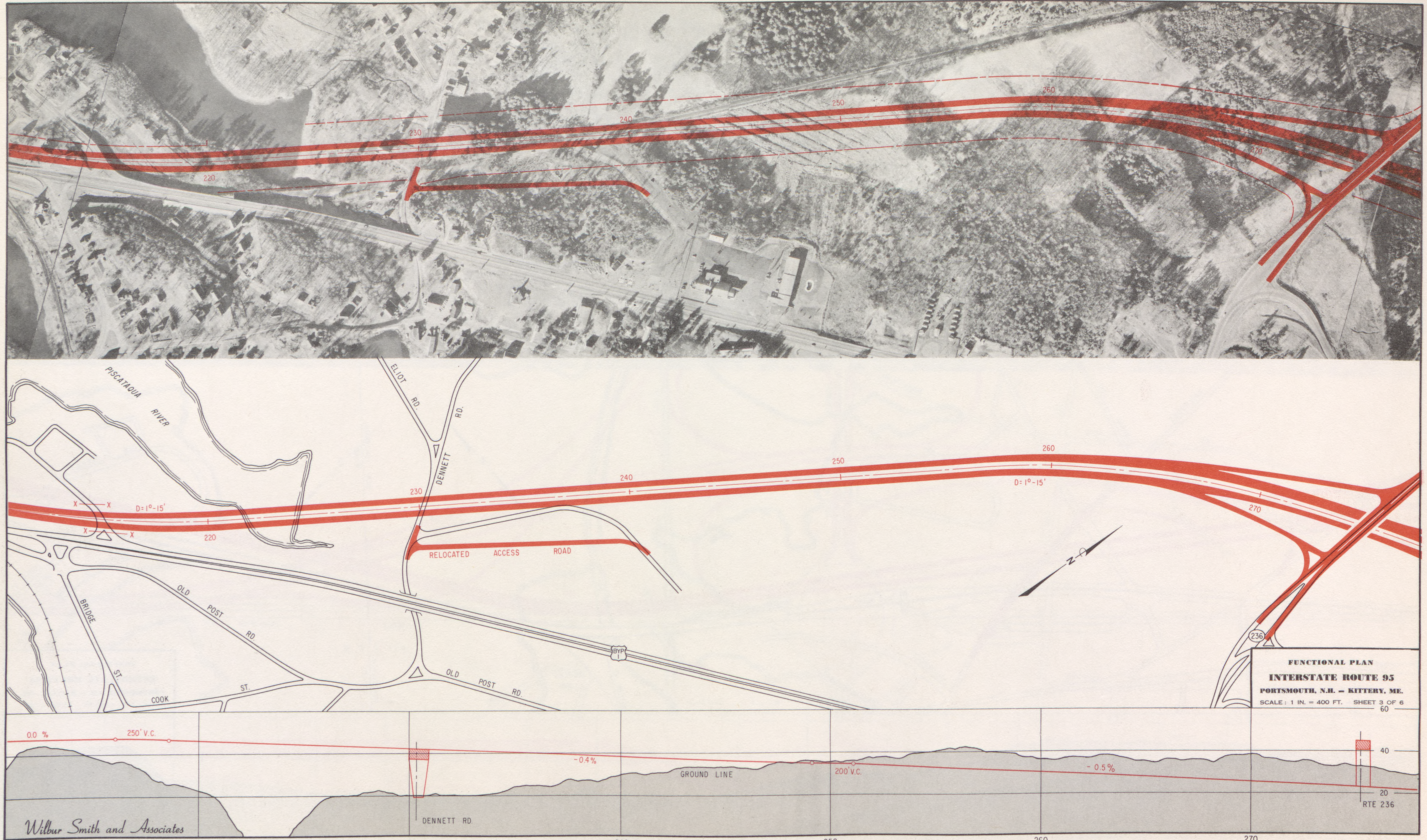
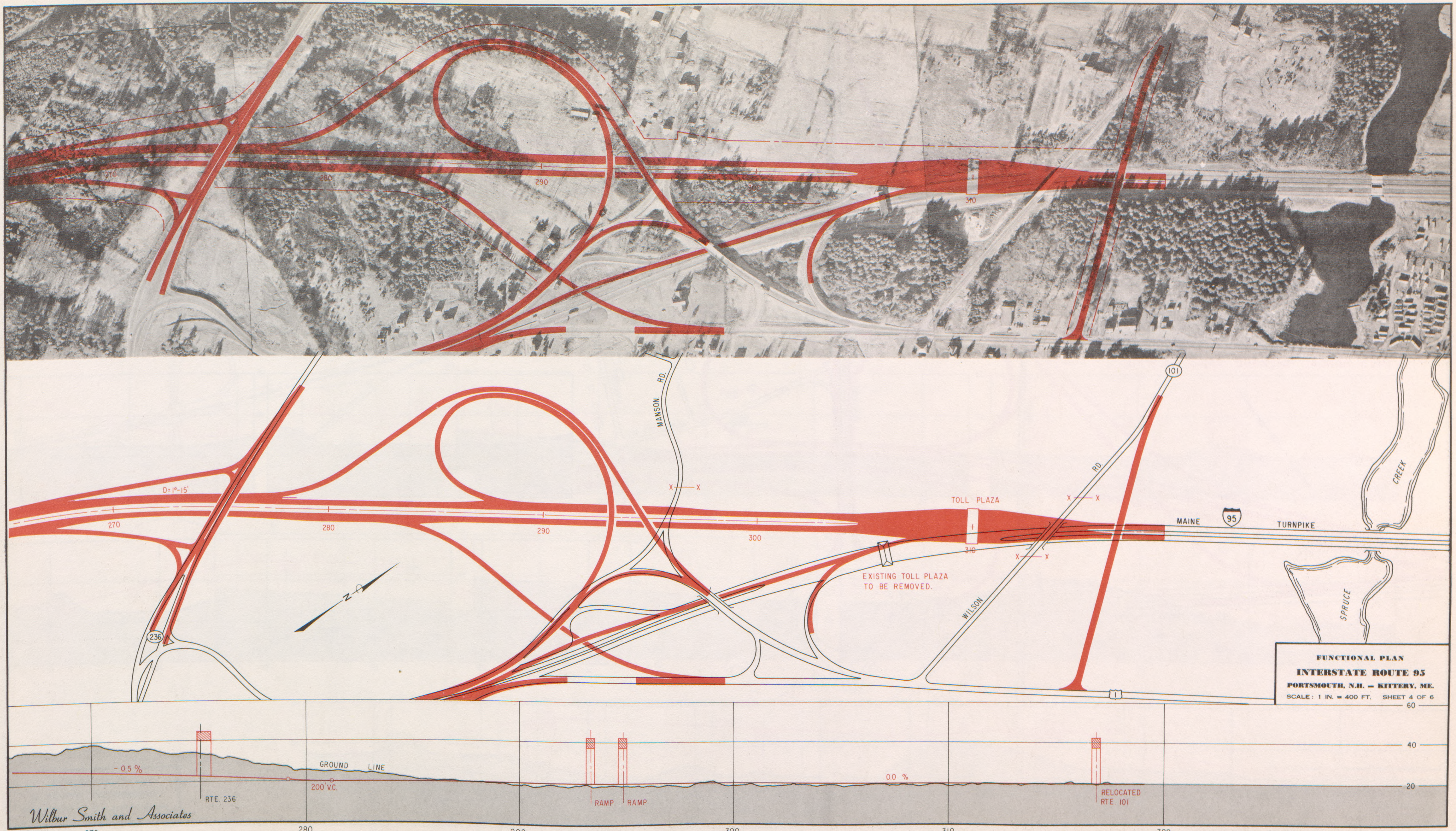
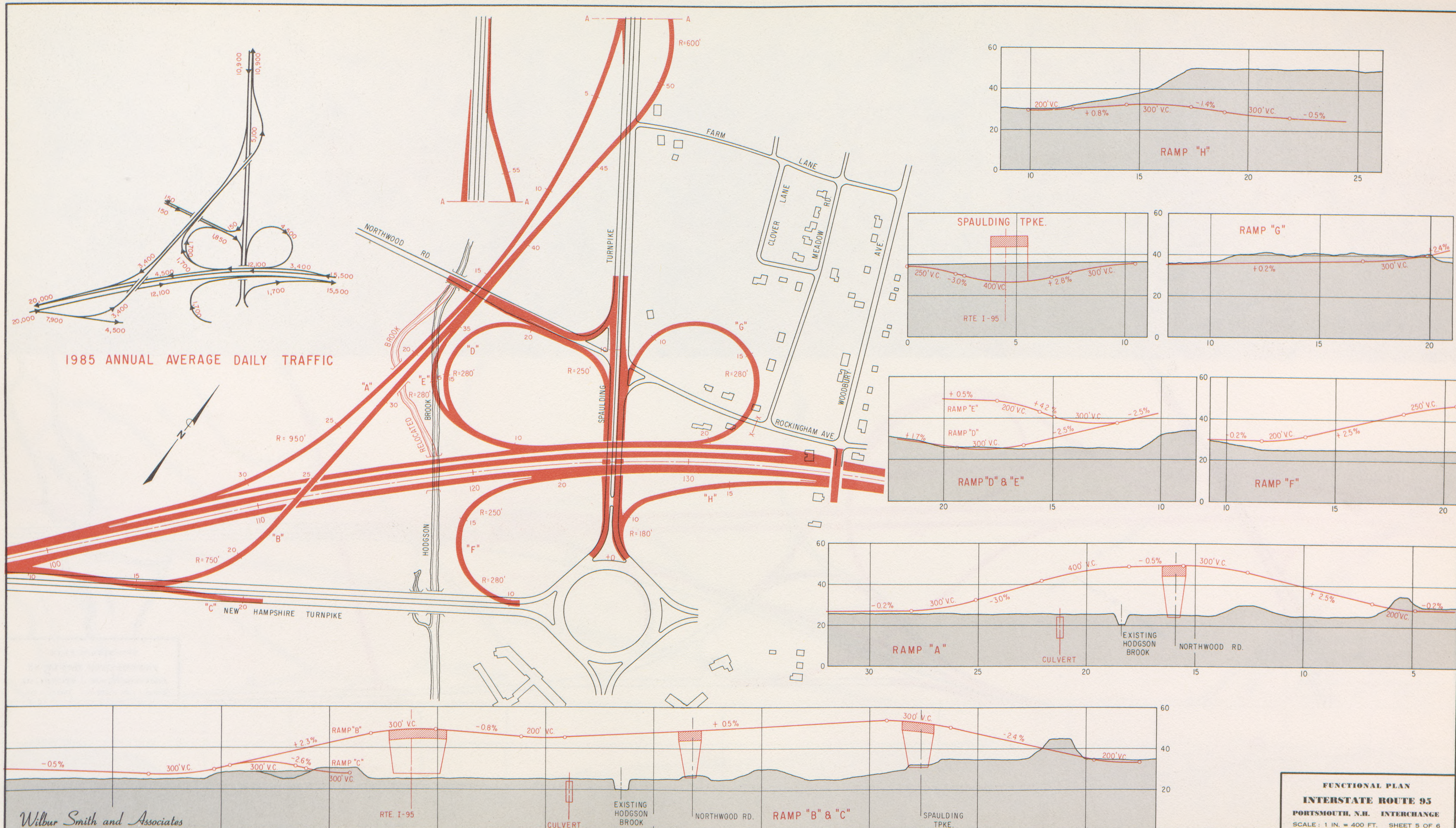
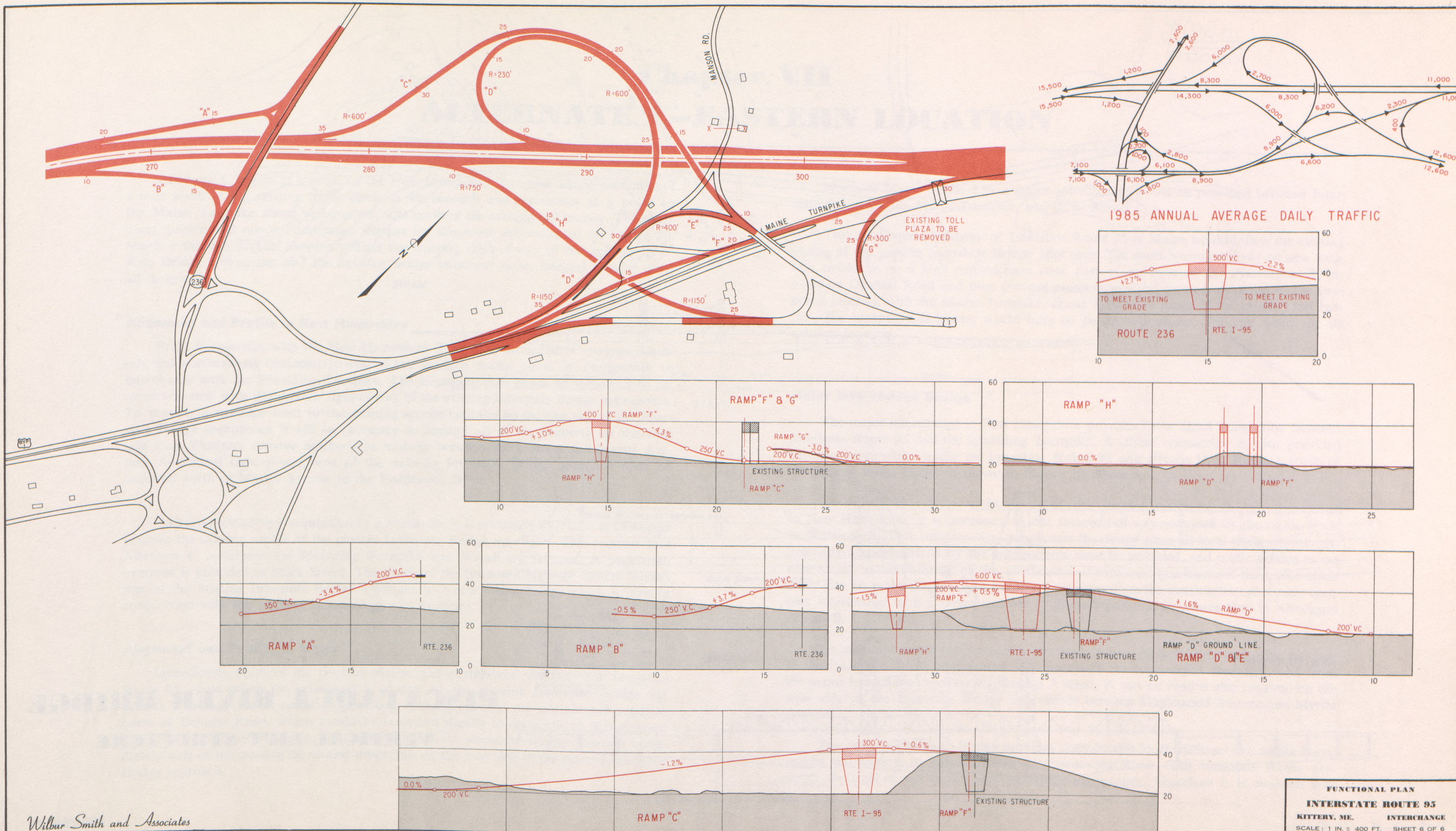

FUNCTIONAL PLAN
INTERSTATE ROUTE 95
PORTSMOUTH, N.H. – KITTERY, ME.
SCALE: 1 IN. = 400 FT. SHEET 2 OF 6
MAPLEWOOD
CENTRAL AVE.
CUTTS ST.
LESLIE DR.
MYRTLE AVE.
OAK TERRACE
PISCATAQUA
RIVER
NEW HAMPSHIRE
MAINE
PORTSMOUTH
KITTERY
BOSTON & MAINE R.R.
BRIDGE ST.
TOLL PLAZA
BYP 1
D=2°-30'
DENNETT ST.
NORTHWEST ST.
NORTH MILL POND
NOBLES ISLAND
150
160
170
180
190
200
210
200' V.C.
+0.5%
200' V.C.
-0.5%
200' V.C.
0.2%
600' V.C.
+3.0%
500' V.C.
0.0 %
250' V.C.
MYRTLE AVE.
MAPLEWOOD AVE.
R.R.
OAK TER.
NOTE
FOR FURTHER DETAIL
SEE FIGURE NO. 19
60
40
20
Wilbur Smith and Associates


FUNCTIONAL PLAN
INTERSTATE ROUTE 95
PORTSMOUTH, N.H. — KITTERY, ME.
SCALE: 1 IN. = 400 FT. SHEET 3 OF 6
PISCATAQUA RIVER
ELIOT RD.
DENNETT RD.
RELOCATED ACCESS ROAD
BRIDGE ST.
OLD POST RD.
COOK ST.
D=1°-15'
BYP 1
236
220
230
240
250
260
270
0.0 %
250' V.C.
-0.4%
GROUND LINE
200' V.C.
- 0.5%
DENNETT RD.
RTE 236
60
40
20
Wilbur Smith and Associates

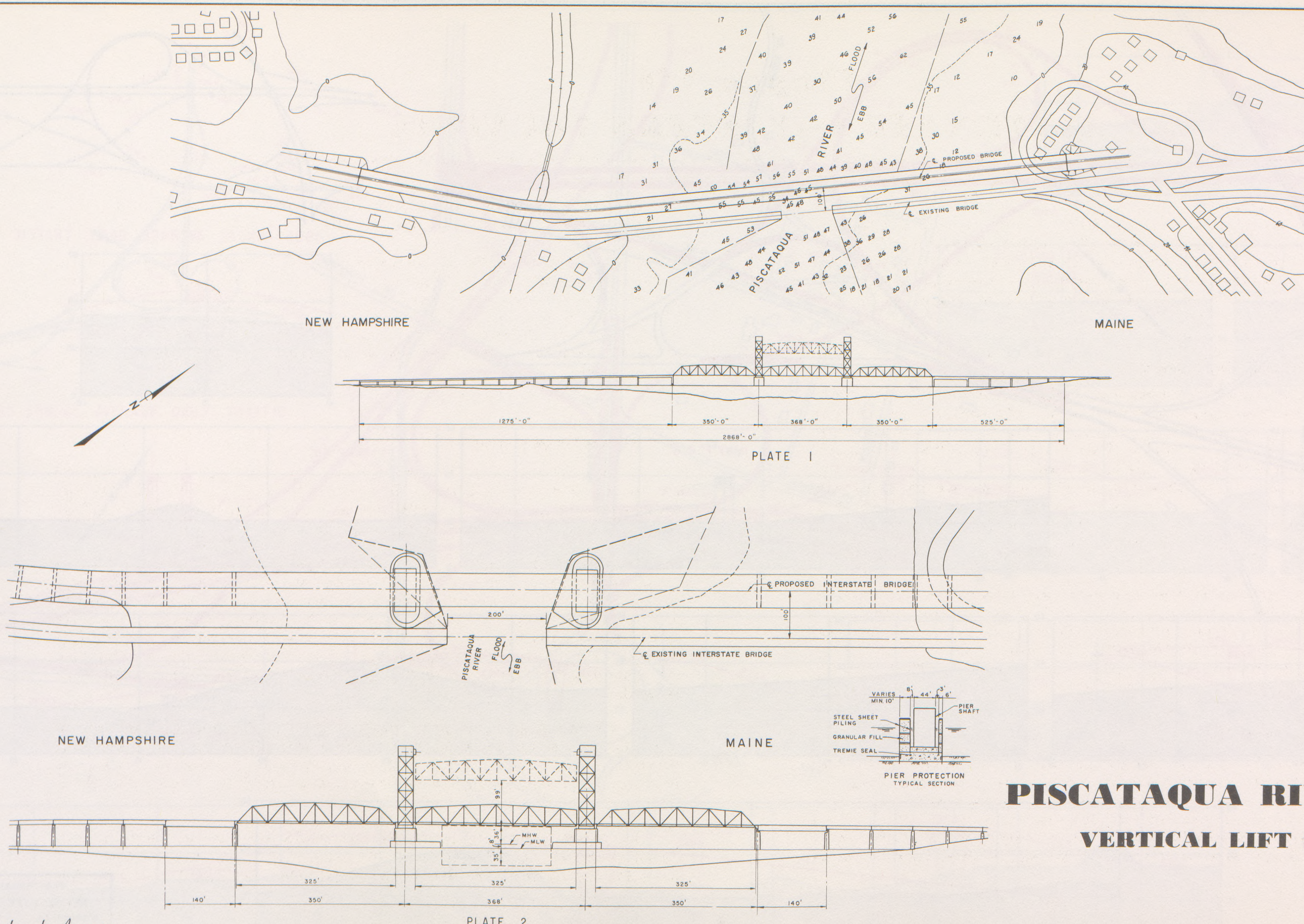


FUNCTIONAL PLAN
INTERSTATE ROUTE 95
PORTSMOUTH, N.H. – KITTERY, ME.
SCALE : 1 IN. = 400 FT. SHEET 4 OF 6
D=1°-15'
270
280
290
300
310
MANSON RD.
TOLL PLAZA
EXISTING TOLL PLAZA
TO BE REMOVED.
WILSON RD.
101
236
1
MAINE
95
TURNPIKE
CREEK
SPRUCE
- 0.5 %
GROUND LINE
200' V.C.
RTE. 236
0.0 %
RAMP
RAMP
RELOCATED
RTE. 101
60
40
20
320
Wilbur Smith and Associates


1985 ANNUAL AVERAGE DAILY TRAFFIC
NORTHWOOD RD.
FARM LANE
CLOVER LANE
MEADOW RD.
WOODBURY AVE.
ROCKINGHAM AVE.
SPAULDING TURNPIKE
HODGSON BROOK
RELOCATED BROOK
NEW HAMPSHIRE TURNPIKE
R=600'
R=950'
R=750'
R=280'
R=250'
R=180'
RAMP "H"
SPAULDING TPKE.
RTE I-95
RAMP "G"
RAMP "D" & "E"
RAMP "F"
RAMP "A"
CULVERT
EXISTING HODGSON BROOK
NORTHWOOD RD.
RAMP "B" & "C"
SPAULDING TPKE.
Wilbur Smith and Associates
FUNCTIONAL PLAN
INTERSTATE ROUTE 95
PORTSMOUTH, N.H. INTERCHANGE
SCALE: 1 IN. = 400 FT. SHEET 5 OF 6



1985 ANNUAL AVERAGE DAILY TRAFFIC
MANSON RD.
MAINE TURNPIKE
EXISTING TOLL PLAZA TO BE REMOVED
"A"
"B"
"C"
"D"
"E"
"F"
"G"
"H"
R=600'
R=230'
R=750'
R=400'
R=300'
R=1150'
270
280
290
300
236
ROUTE 236
RTE. I-95
TO MEET EXISTING GRADE
500' VC
+2.7%
-2.2%
RAMP "F" & "G"
400' VC RAMP "F"
200' V.C.
+3.0%
-4.3%
250' V.C.
RAMP "G"
-3.0%
0.0%
EXISTING STRUCTURE
RAMP "H"
RAMP "C"
RAMP "D"
RAMP "F"
RAMP "A"
350' V.C.
-3.4%
RTE. 236
RAMP "B"
-0.5%
250' V.C.
+3.7%
-1.5%
600' V.C.
+0.5%
RAMP "E"
+1.6%
RAMP "D" GROUND LINE
RAMP "D" & "E"
RTE. I-95
300' V.C.
+0.6%
-1.2%
Wilbur Smith and Associates
FUNCTIONAL PLAN
INTERSTATE ROUTE 95
KITTERY, ME. INTERCHANGE
SCALE: 1 IN. = 400 FT. SHEET 6 OF 6



PISCATAQUA RIVER BRIDGE

VERTICAL LIFT STRUCTURE

Wilbur Smith and Associates

FIGURE 19

Chapter VII
ALTERNATE C—EASTERN LOCATION

Alternate C begins at a point on the New Hampshire Turnpike about six-tenths of a mile south of the existing traffic circle in Portsmouth and terminates at a point on the Maine Turnpike about one-quarter mile north of the existing toll barrier. The alignment, profile and major interchange designs for this route are indicated on Figure 20, Sheets 1 through 7. This location utilizes the existing right-of-way of the present Interstate Bridge approaches and the existing bridge structure as an integral part of overall design.

Alignment and Profile in New Hampshire

From its junction with the New Hampshire Turnpike, Alternate C swings northerly and northeasterly immediately west of the existing traffic circle in Portsmouth to interchange with the Spaulding Turnpike. The alignment then bends northeasterly to become common with the present right-of-way of the existing Interstate Bridge approaches. To provide a frontage road to the existing service facilities on the east side of the Interstate Bridge approaches, it will be necessary to acquire all of the property on the west side from Woobury Avenue northerly to midway between Stark Street and Myrtle Avenue. Additional right-of-way west of the existing Interstate Bridge approach must be acquired north of Myrtle Avenue to the Piscataqua River.

To keep right-of-way acquisition to a minimum, it is necessary to follow as closely as possible the existing profile of the present Interstate Bridge approach. This requires that Alternate C underpass the Spaulding Turnpike and Woodbury Avenue. A pedestrian overpass is provided at Stark Street. The grade of the proposed highway closely follows that of the existing Interstate Bridge approach to a new 4-lane bridge which is used in conjunction with the existing railway-highway structure.

Alignment and Profile in Maine

Immediately north of the river in Maine, the northbound roadway for Interstate Route 95 would follow the existing right-of-way of the present Interstate Bridge approach. Frontage roads would be provided on both sides of the northbound roadway north of Dennett Road, which would be relocated slightly to the north, to Maine Route 236. The southbound roadways of Interstate Route 95 would be on new location immediately west of the existing developed properties on the west side of the present Interstate Bridge approach.

North of Maine Route 236 a major interchange would be provided between Interstate Route 95, the Maine Turnpike, and U. S. Route 1.

The northbound roadway of Interstate Route 95 in Maine would follow the existing profile of the present Interstate Bridge approach. The southbound roadway on new location would be on a high embankment over part of an inlet of the Piscataqua River, overpass Dennett Road and then proceed at about natural ground elevation to the proposed junction with the Maine Turnpike, about 1,300 feet north of the existing toll barrier. The turnpike toll barrier would have to be moved about 200 feet north of its existing location.

Major Interchange Design

The major interchange in New Hampshire provides for a direct connection between Interstate Route 95 and the Spaulding Turnpike. A direct connection is also provided between southbound traffic on Interstate Route 95 and Bypass U. S. Route 1 south of the present traffic circle, as shown in Figure 20, Sheet 5.

To utilize the existing right-of-way of the present Interstate Bridge approaches in New Hampshire, it is necessary to use the right-of-way occupied by the traffic circle in Portsmouth. This substantially complicates the design since all local traffic movements presently accommodated by the traffic circle must be provided, and traffic service to the commercial establishments in the northeast and southeast quadrants of the traffic circle must also be maintained. These requirements necessitate the construction of a more complex interchange with a larger number of grade separation structures than in Alternates A and B.

To maintain traffic service to the existing commercial developments on the east side of the Interstate Bridge approaches, it is necessary to construct a frontage road from the major interchange area to Maplewood Avenue. A service road is also required on the west side of the Interstate Bridge approaches between Maplewood Avenue and Myrtle Avenue.

The present Interstate Bridge provides considerable local traffic service within Portsmouth and Kittery, as well as across the Piscataqua River. The Interstate Route preempts the right-of-way of the existing bridge approaches. Therefore it is essential that

intermediate interchanges be provided between the proposed highway and the local street network in this area. By utilizing the service roads in the vicinity of Maplewood Avenue, a full interchange is provided between the local street system and the proposed Interstate Route.

To maintain local trans-river service, an exit ramp for northbound traffic and access ramp for southbound traffic are provided with Old Post Road and Dennett Road in Maine immediately north of the river crossing. Local traffic is provided with access to the fronttage roads in the service area enclosed by the northbound and southbound roadways of Interstate Route 95 by ramp connections at Dennett Road. These ramps would also be used by Interstate traffic leaving the mainline roadways to use the service facilities.

The major interchange in Maine consists of widely divided northbound and southbound roadways with direct southbound access and northbound egress to Maine Route 236 and direct interchange between U. S. Route 1 and Interstate Route 95, as shown in Figure 20, Sheets 6 and 7.

Feasibility of Widening Existing Bridge

Consideration was given to the possibility of using the Interstate Bridge as a three-lane, one-way facility. If such a scheme were feasible, three adequate lanes on the existing bridge plus three lanes on a new lift bridge would provide adequate capacity for projected and assigned trans-river traffic volumes.

Examination of the inherent structural limitations shows that the lifting-girder hangers are the structural members that limit the roadway width. The clear distance between these hangers is 36 feet. Immediately beyond the hangers are the tower columns with a clear horizontal distance of 38.5 feet.

Because the hangers are between the tower columns, it would be difficult to gain any appreciable increase in width between hangers without a major reconstruction of the ends of the lift span and the adjacent parts of the towers. Thus, the existing bridge is limited to a clear width between structural members of 36 feet.

In order to gain some increase in width by moving only the lifting-girder hangers it would be necessary to relocate these hangers in front of the tower columns. This major structural change would require refabricating the end panels of the lift span, and in order to do so, the lift span would have to be temporarily supported from the towers. In addition some unorthodox type of framing would have to be devised so that the lifting girders could be reconnected to the counterweight ropes in their present location.

The reconstruction required to relocate the lifting-girder hangers would be extremely expensive and would gain only another 2.5 feet in overall clearacne for the roadway because the towers themselves present the next obstruction and are only 38.5 feet apart. Therefore it does not seem reasonable to make the considerable investment required to move the lifting-girder hangers and gain only a small additional clearance.

Due to economic considerations, shoulders are often omitted when constructing long, expensive structures. However, in these instances, the lateral clearance from the edge of traffic lane to the curb should be not less than two, and preferably three feet, with an additional minimum width of 1.5 feet between the curb and the parapet or railing. On modern high-speed, heavily used highways, these minimum clearances are premised upon 12-foot traffic lanes.

To provide necessary safety, comfort, ease of operation, and maintain the required roadway capacity, the minimum acceptable roadway width on a modern three-lane bridge would be 40 feet between curbs, 43 feet between vertical obstructions. This would indicate that to reconstruct the existing Interstate Bridge to adequate standards as a three-lane, one-way facility, it would be necessary to provide 43 feet between hangers. Since a clear distance of only 36 feet is available, it would be necessary to virtually reconstruct the bridge to provide a more adequate clearance.

If a full 43-foot roadway section is used, the traffic lanes would cantilever far beyond the approach girders which are only 18.5 feet apart. The existing brackets would have to be replaced with much stronger brackets, and in order to do so, the existing deck would have to be partially demolished and rebuilt. In addition, once this had been done, the added dead load plus the cantilever live load would over-stress the main girders of the approach spans.

Based on the 36-foot dimension and allowing 1.5 foot emergency walks, three 11-foot lanes could be provided if the full curb-to-curb width were utilized for lanes, thus making the outside lane lines and the curb lines coincident.

While it is recognized that the existing bridge is sometimes used as a three-lane facility, two lanes in the heavier direction of travel during peak travel periods, traffic operations are not satisfactory. The limited lateral clearances require reduced operating speeds, increase driver tension and accident potentials. The quality of traffic service provided certainly cannot be recommended for a new highway facility that will be used by substantially greater traffic volumes and require expenditures of large sums of money.

It is not considered feasible to use the existing bridge as an adequate three-lane, one-way facility. If the existing bridge is to be used at all, it should be used as a two-lane facility.

Bridge Location

In this design a new four-lane, low-level lift-span structure is proposed in the same location as in Alternate B, closely parallel to and immediately west of the existing river crossing. In this scheme, it is proposed that the existing Interstate Bridge be used as a two-lane northbound roadway for Interstate Route 95. The westerly roadway on the new four-lane crossing would be used as the southbound roadway of Interstate Route 95.

To accommodate peak hour traffic volumes in the design year, 1985, the easterly roadway on the new river crossing would be operated northbound or southbound dependent upon the traffic flow. For example, on Friday evenings in the summer, this roadway would be operated northbound and Sunday evenings, southbound. The design provides for such contingencies.

In all other respects, the bridge location and navigational clearances are identical to that proposed in Alternate B, as shown in Figure 19 and described in Chapter VI of this report.

Bridge Costs

The cost of the river crossing on Alternate C would be identical with that of Alternate B, $10,650,000—$6,560,000 for the main lift-span and towers, and $4,090,000 for the approaches. This includes $1,000,000 for necessary protection of the main piers on either side of the channel.

Cost Estimates

Cost of the 4.36 miles of Alternate C is estimated at $20,820,000 of which $875,000 is for right-of-way acquisition, $17,420,000 for construction, and $2,525,000 for engineering and contingencies. In Table 24 estimated costs for the route section in New Hampshire and Maine are summarized. In Appendix Table B-6, a detailed breakdown is given for the highway sections and major river crossing in Maine and New Hampshire.

Total costs for the sections of Alternate C in New Hampshire and Maine are $11,960,000 and $8,860,000, respectively. Of these amounts, the bridge and its approaches comprise $10,650,000—$5,900,000 in New Hampshire and $4,750,000 in Maine.

Non-Participating Costs—As previously discussed in Chapter V relative to Alternate A, it is likely that Interstate funds would not be available for construction of roadways providing access and egress directly to the Maine Turnpike, since it is a toll facility. As indicated in Appendix Table B-7, these non-participating costs are estimated at more than $700,000.

TABLE 24

ESTIMATED COSTS

Alternate C, Eastern Location

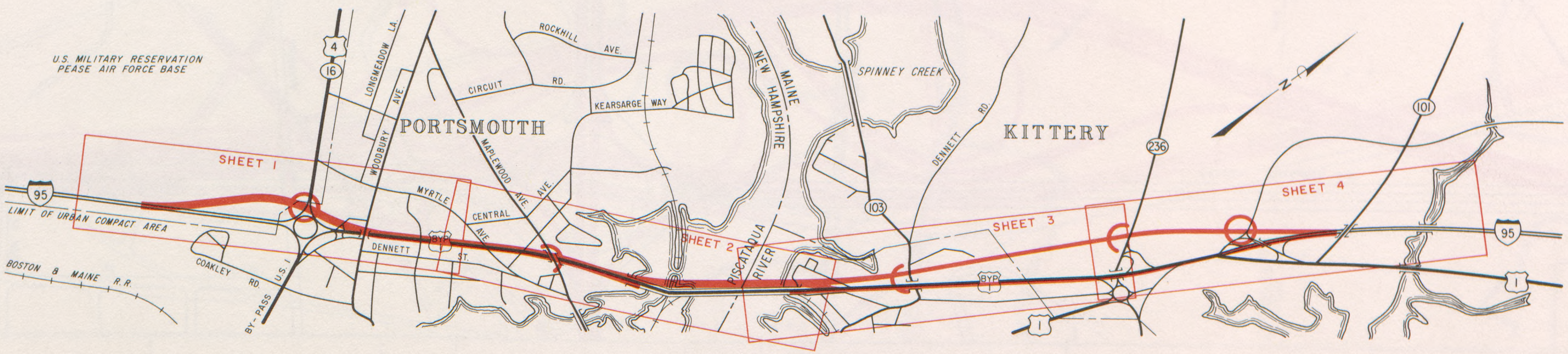
Description	Route Section New Hampshire	Route Section Maine	Route Section Total
	(Thousands of Dollars)		
Length, miles	2.12	2.24	4.36
Preliminary Engineering	$ 449	$ 334	$ 783
Right-of-Way	522	353	875
Construction Costs			
Bridge and Approaches	5,900	4,750	10,650
Other	4,090	2,680	6,770
Sub-Total	$ 9,990	$7,430	$17,420
Engineering and Contingencies	999	743	1,742
Total Estimated Cost	$11,960	$8,860	$20,820

Functional Plan

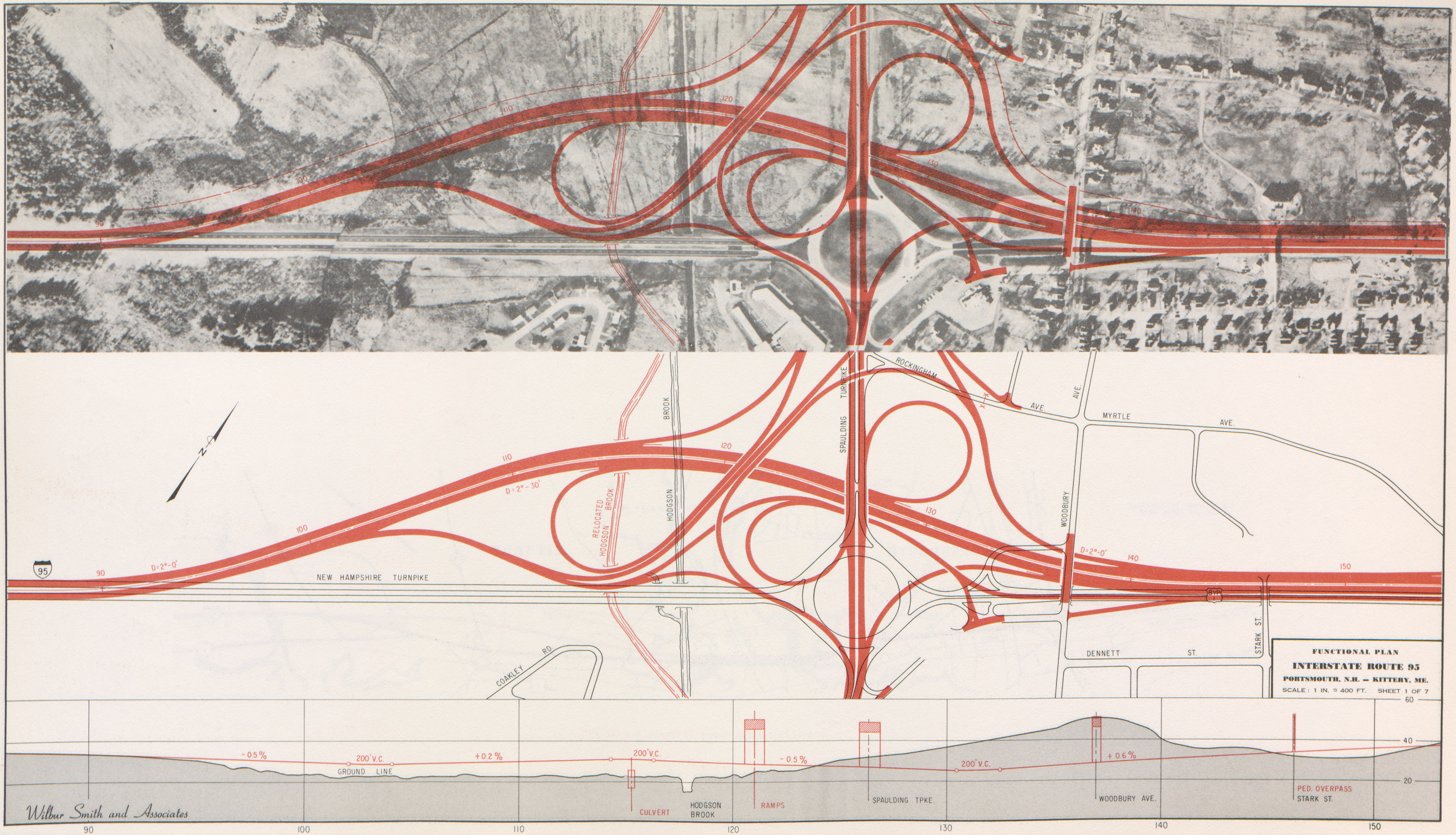
INTERSTATE ROUTE 95

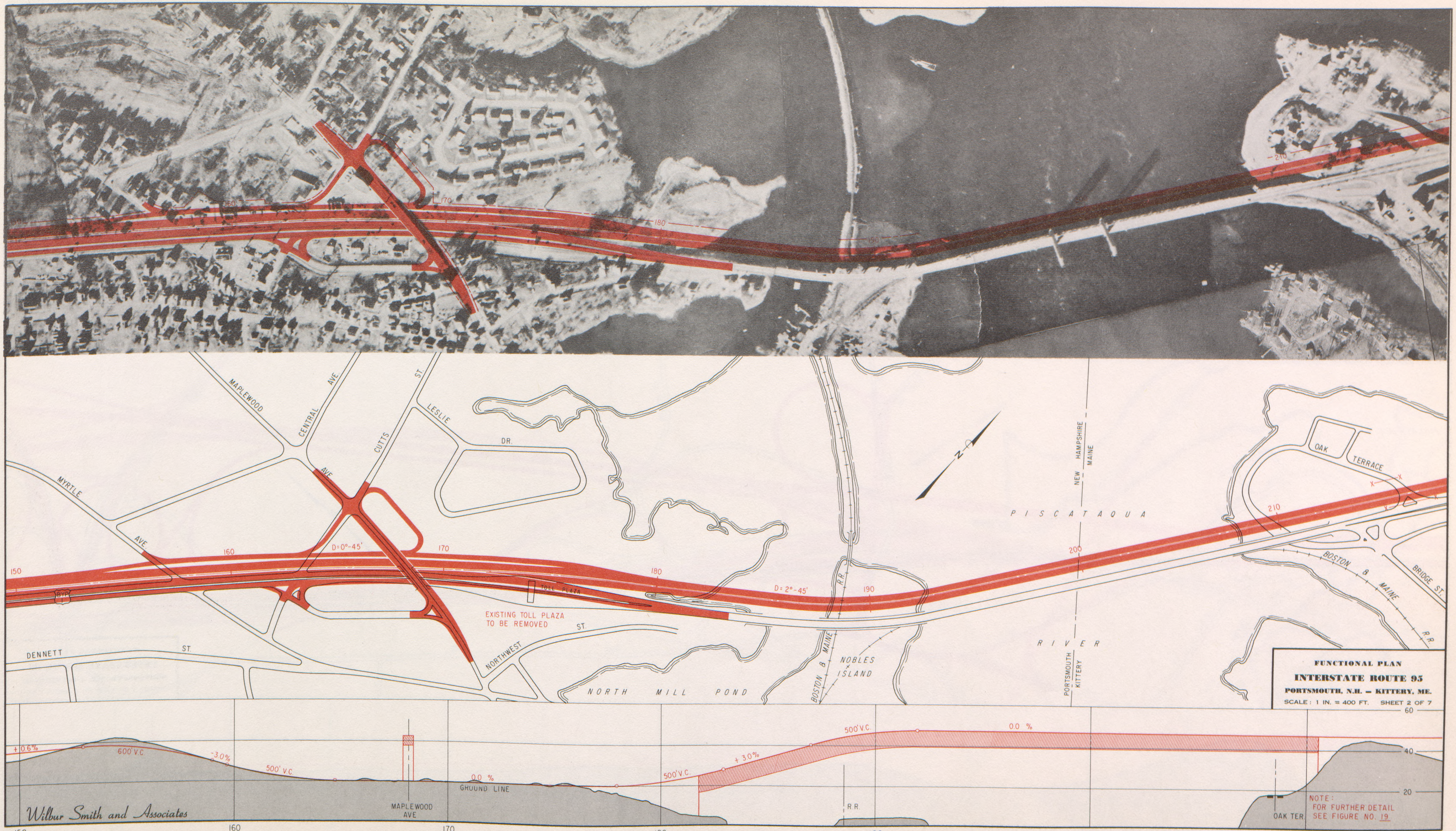
Alternate C

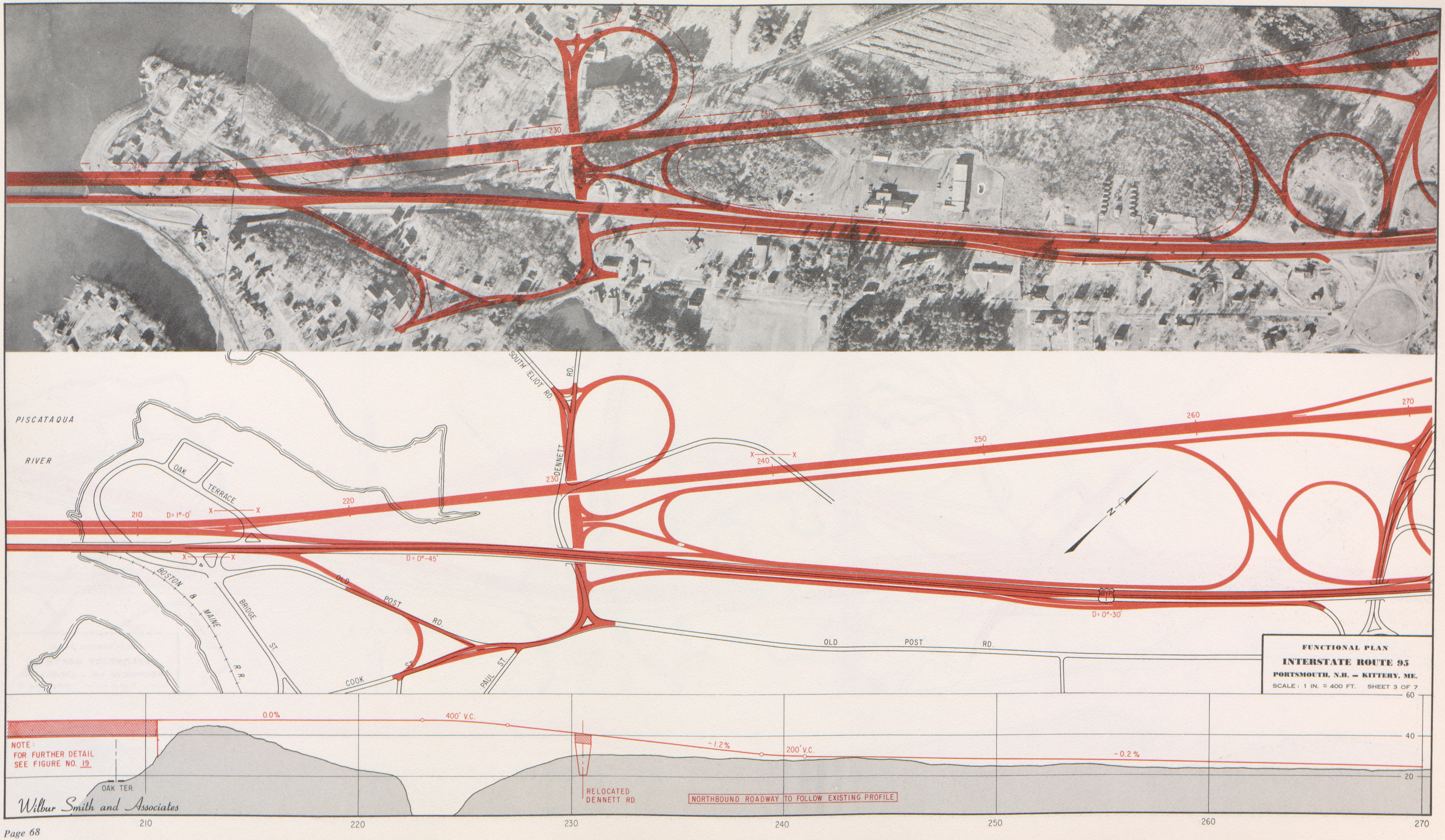
SCALE: 1 IN. = 400 FT.   FIGURE 20 SHEETS 1 TO 7

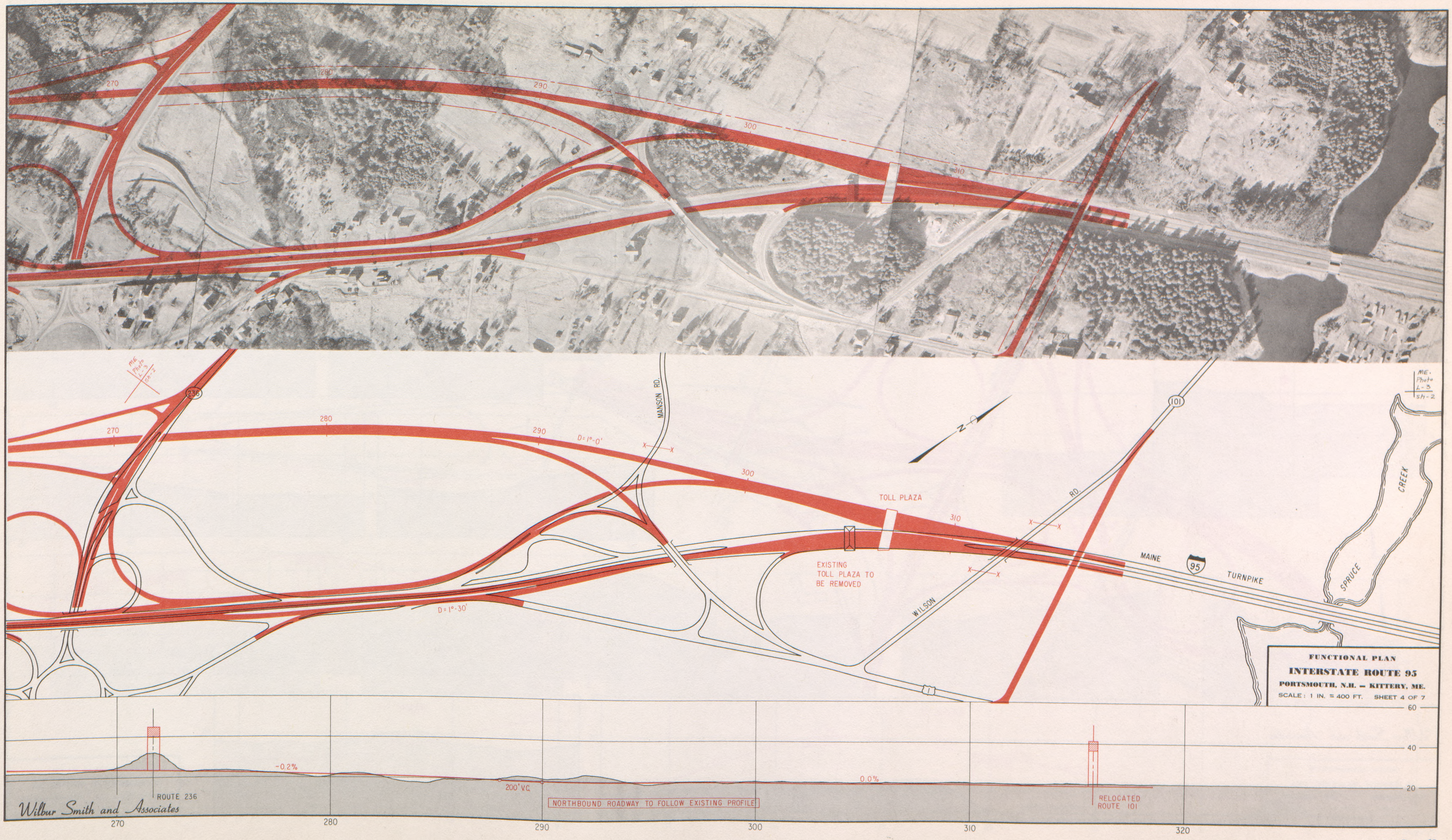


NOTE:
INTERCHANGE PLANS SHOWN ON SHEETS 5,6 AND 7


FUNCTIONAL PLAN
INTERSTATE ROUTE 95
PORTSMOUTH, N.H. – KITTERY, ME.
SCALE: 1 IN. = 400 FT.
SHEET 1 OF 7
NEW HAMPSHIRE TURNPIKE
SPAULDING TURNPIKE
ROCKINGHAM AVE.
MYRTLE AVE.
WOODBURY AVE.
DENNETT ST.
STARK ST.
COAKLEY RD.
HODGSON BROOK
RELOCATED HODGSON BROOK
D=2°-0'
D=2°-30'
-0.5%
+0.2%
+0.6%
200' V.C.
GROUND LINE
CULVERT
RAMPS
SPAULDING TPKE.
WOODBURY AVE.
PED. OVERPASS
STARK ST.
Wilbur Smith and Associates


FUNCTIONAL PLAN
INTERSTATE ROUTE 95
PORTSMOUTH, N.H. – KITTERY, ME.
SCALE: 1 IN. = 400 FT.   SHEET 2 OF 7
MAPLEWOOD
CENTRAL AVE
CUTTS ST.
LESLIE DR.
MYRTLE AVE
DENNETT ST.
NORTHWEST ST.
EXISTING TOLL PLAZA TO BE REMOVED
TOLL PLAZA
D=0°-45'
D=2°-45'
NORTH MILL POND
BOSTON & MAINE R.R.
NOBLES ISLAND
PISCATAQUA RIVER
NEW HAMPSHIRE
MAINE
PORTSMOUTH
KITTERY
OAK TERRACE
BRIDGE ST.
N
150
160
170
180
190
200
210
+0.6%
600' V.C.
-3.0%
500' V.C.
0.0 %
GROUND LINE
MAPLEWOOD AVE
500' V.C.
+3.0%
500' V.C.
0.0 %
R.R.
OAK TER
NOTE: FOR FURTHER DETAIL SEE FIGURE NO. 19
60
40
20
Wilbur Smith and Associates


FUNCTIONAL PLAN
INTERSTATE ROUTE 95
PORTSMOUTH, N.H. – KITTERY, ME.
SCALE: 1 IN. = 400 FT. SHEET 3 OF 7
PISCATAQUA
RIVER
OAK
TERRACE
SOUTH ELIOT RD.
DENNETT RD.
BOSTON & MAINE R.R.
BRIDGE ST.
OLD POST RD.
COOK ST.
PAUL ST.
D = 1°-0'
D = 0°-45'
D = 0°-30'
210
220
230
240
250
260
270
0.0%
400' V.C.
-1.2%
200' V.C.
-0.2%
NOTE:
FOR FURTHER DETAIL
SEE FIGURE NO. 19
OAK TER.
RELOCATED
DENNETT RD.
NORTHBOUND ROADWAY TO FOLLOW EXISTING PROFILE
60
40
20
Wilbur Smith and Associates

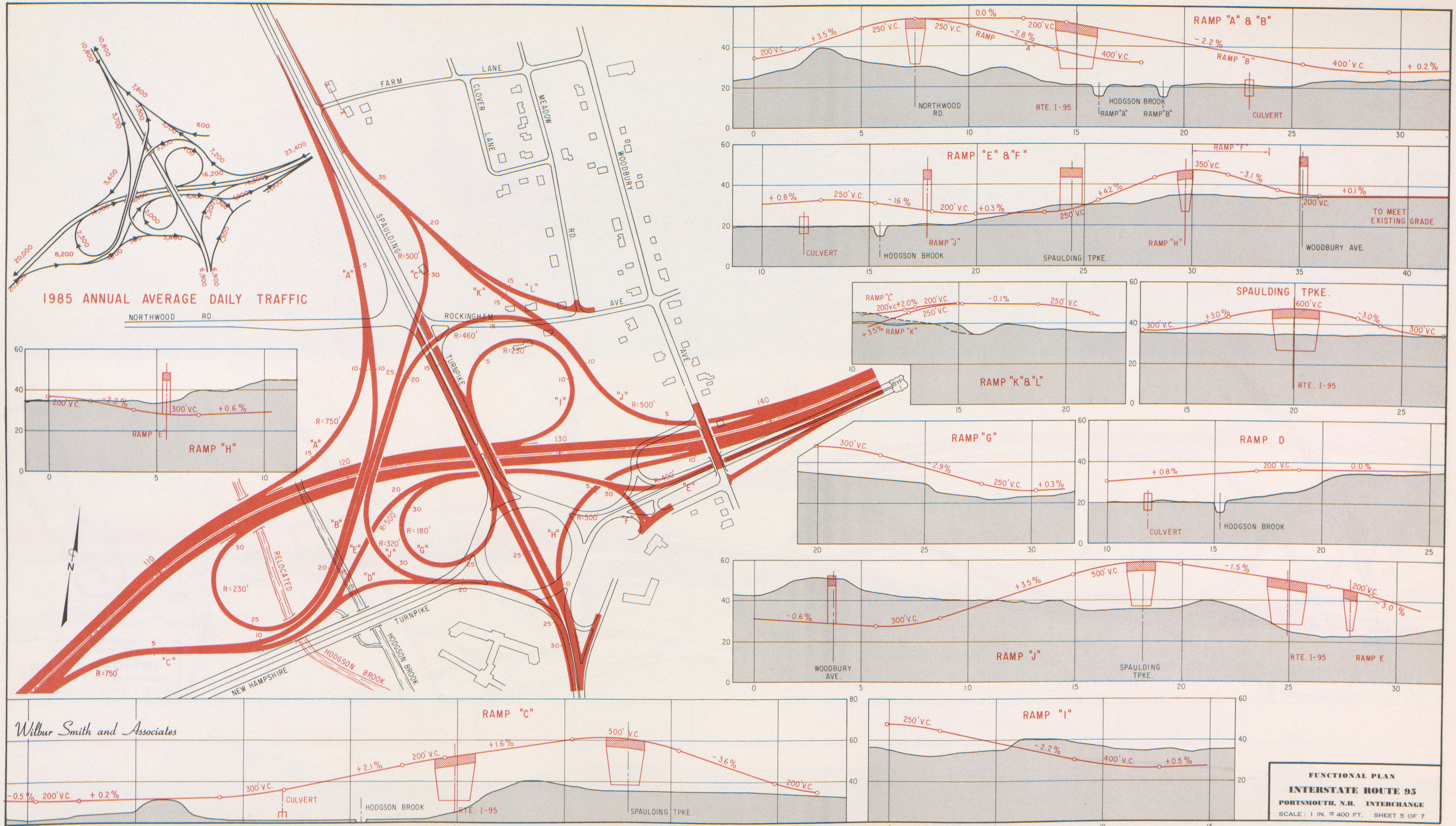


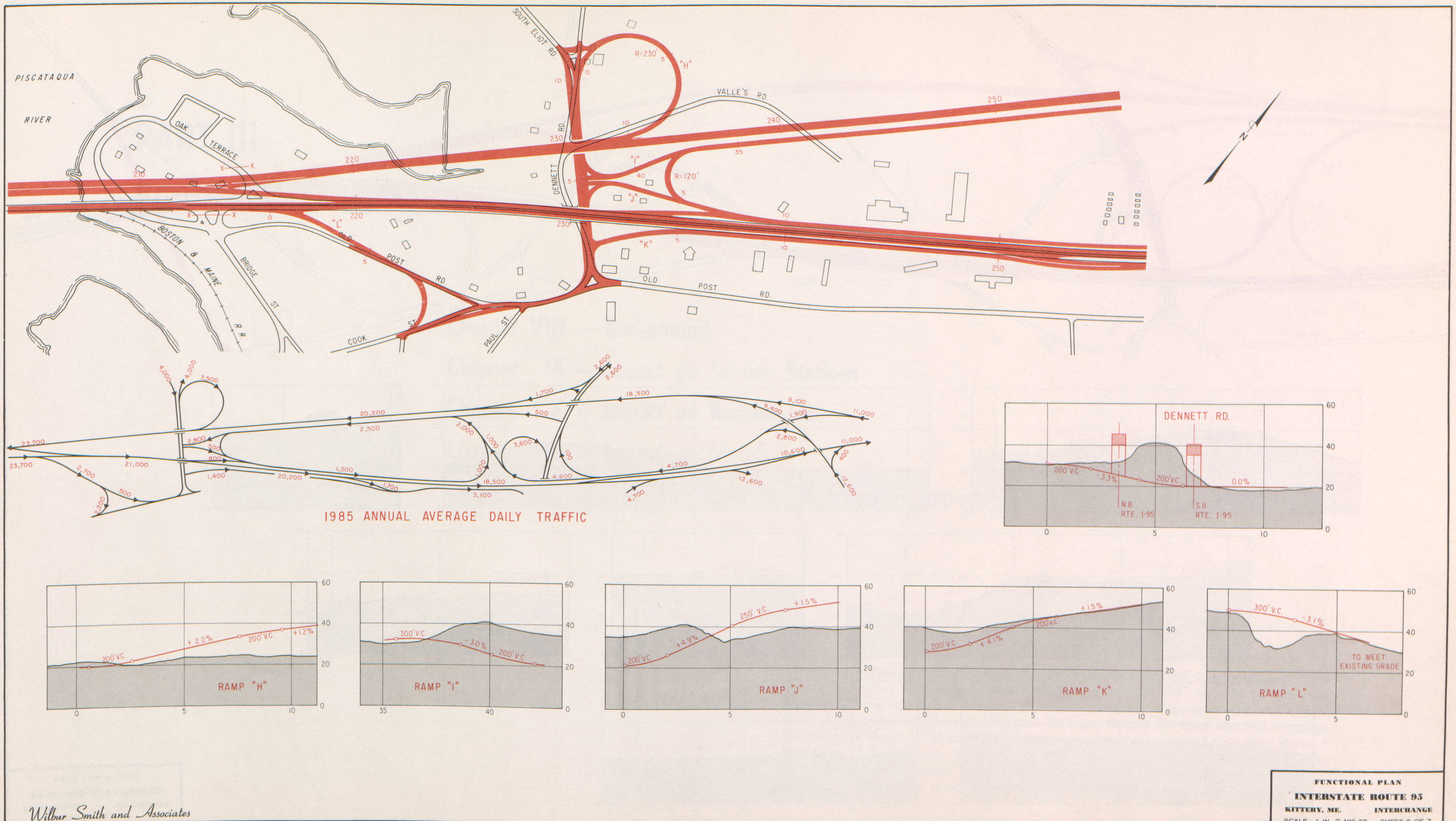
FUNCTIONAL PLAN

INTERSTATE ROUTE 95

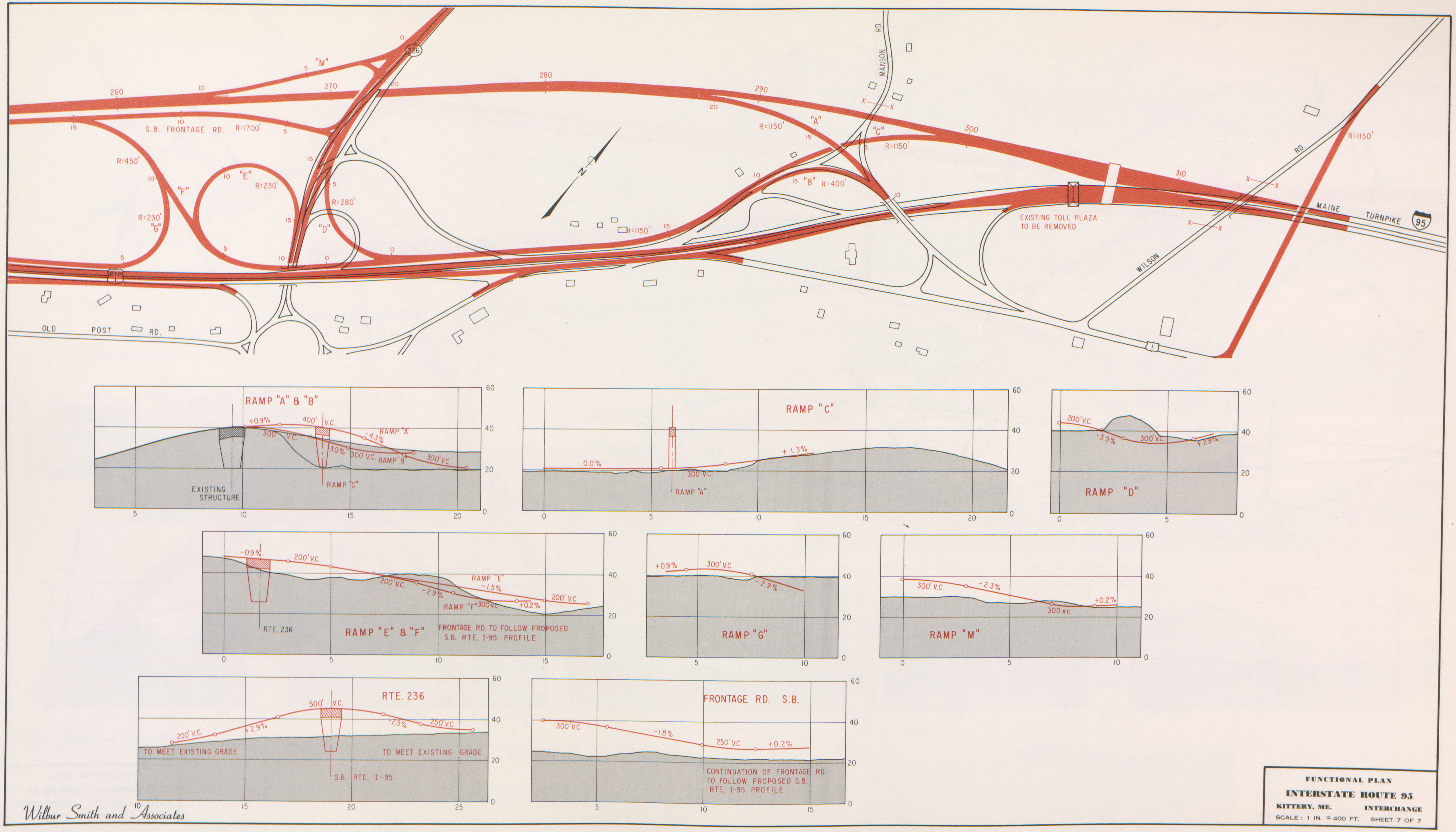
PORTSMOUTH, N.H. – KITTERY, ME.

SCALE: 1 IN. = 400 FT. SHEET 4 OF 7


1985 ANNUAL AVERAGE DAILY TRAFFIC
NORTHWOOD RD.
FARM LANE
CLOVER LANE
MEADOW RD.
WOODBURY AVE.
ROCKINGHAM AVE.
SPAULDING TURNPIKE
NEW HAMPSHIRE TURNPIKE
HODGSON BROOK
RELOCATED
BYP.
RAMP "A" & "B"
NORTHWOOD RD.
RTE. I-95
HODGSON BROOK
CULVERT
RAMP "E" & "F"
TO MEET EXISTING GRADE
WOODBURY AVE.
SPAULDING TPKE.
RAMP "K" & "L"
SPAULDING TPKE.
RAMP "H"
RAMP "G"
RAMP D
RAMP "J"
WOODBURY AVE.
RAMP E
RAMP "C"
RAMP "I"
Wilbur Smith and Associates
FUNCTIONAL PLAN
INTERSTATE ROUTE 95
PORTSMOUTH, N.H. INTERCHANGE
SCALE: 1 IN. = 400 FT. SHEET 5 OF 7



PISCATAQUA RIVER
OAK TERRACE
BOSTON & MAINE R.R.
BRIDGE ST.
COOK ST.
PAUL ST.
OLD POST RD.
SOUTH ELIOT RD.
DENNETT RD.
VALLE'S RD.
R=230'
R=120'
"H"
"I"
"J"
"K"
"L"
N
1985 ANNUAL AVERAGE DAILY TRAFFIC
DENNETT RD.
N.B. RTE. I-95
S.B. RTE. I-95
RAMP "H"
RAMP "I"
RAMP "J"
RAMP "K"
RAMP "L"
TO MEET EXISTING GRADE
Wilbur Smith and Associates
FUNCTIONAL PLAN
INTERSTATE ROUTE 95
KITTERY, ME. INTERCHANGE
SCALE: 1 IN. = 400 FT. SHEET 6 OF 7



S.B. FRONTAGE RD.
R=1700'
R=450'
"F"
"E"
R=230'
R=230'
"G"
"M"
236
R=280'
"D"
R=1150'
MANSON RD.
"A"
"C"
R=1150'
"B"
R=400'
EXISTING TOLL PLAZA TO BE REMOVED
MAINE TURNPIKE
95
WILSON RD.
R=1150'
OLD POST RD.
RAMP "A" & "B"
EXISTING STRUCTURE
RAMP "C"
RAMP "A"
RAMP "D"
RAMP "E" & "F"
RTE. 236
FRONTAGE RD. TO FOLLOW PROPOSED S.B. RTE. I-95 PROFILE
RAMP "G"
RAMP "M"
RTE. 236
TO MEET EXISTING GRADE
TO MEET EXISTING GRADE
S.B. RTE. I-95
FRONTAGE RD. S.B.
CONTINUATION OF FRONTAGE RD. TO FOLLOW PROPOSED S.B. RTE. I-95 PROFILE
Wilbur Smith and Associates
FUNCTIONAL PLAN
INTERSTATE ROUTE 95
KITTERY, ME.
INTERCHANGE
SCALE: 1 IN. = 400 FT.
SHEET 7 OF 7

PART III

ECONOMIC IMPACT

Major highway improvements in an area have been found to have profound effects in changing travel patterns and in determining the location and character of economic activities. These effects are reflected in changes in work, shopping, social and recreational travel and in revisions of land use. To help evaluate the three alternate locations for Interstate Route 95 through the Portsmouth-Kittery area, studies have been made of the impact of each plan on the patronage at the service stations, restaurants and motels along the Interstate Bridge approaches, and on community-wide land use and business reorientation. This part presents the principal findings of these studies.

Chapter VIII
BACKGROUND

Since the Interstate Bridge and the Portsmouth-Kittery Bypass were opened in 1940, many highway-oriented businesses have been established along both the Maine and New Hampshire approaches. The bridge approaches consist of a four-lane divided roadway with a narrow median. No openings are provided in the median and left turns can only be made through interchanges. However, there is no restriction on roadway access, and all of the businesses have direct access and egress to the roadway.

Regional Setting

The Interstate Bridge approaches in the Portsmouth-Kittery area comprise the only section of highway in the Interstate Route 95 corridor between Danvers, Massachusetts and Waterville, Maine without full control of access. The commercial establishments along the bridge approaches are the only road-side businesses with direct access to Interstate 95 traffic from 40 miles south to 130 miles north, as shown in Figure 21.

Presently, there are three sections of highway without control of access that can be patronized by long-distance north-south travelers using Interstate routes or turnpikes. These are the only locations where motorists traveling between New York City and Waterville, Maine can obtain lodging and a choice of restaurants and service stations without leaving the main highway. One is located just south of Hartford, Connecticut on Route 15, a second just north of Route 128 outside of Boston, at Danvers, and the third is on the route under study.

Interstate highways now planned would permit the by-passing of the first two groups of roadside businesses. With completion of Interstate Route 95 in Massachusetts, the direct access to roadside businesses at Danvers will be by-passed. Also, the completion of Interstate Route 91, will permit the by-passing of the commercial strip on the Berlin Turnpike south of Hartford.

South of the Portsmouth-Kittery area in New Hampshire, the first service station on Interstate 95 is approximately 29 miles away with a restaurant and service station provided on each side of the highway. However, as is the case on new Interstate highways and turnpikes, motorists have no choice in brands of gasoline or among different restaurant facilities. Heading north, the first service area in Maine is about 23 miles above the entrance to the Maine Turnpike. A two-bay service station is provided on each side of the highway. On the west side of the Maine Turnpike, a restaurant with

ROADSIDE BUSINESS "OASES"

I-95 AND CONNECTIONS

Wilbur Smith and Associates

FIGURE 21

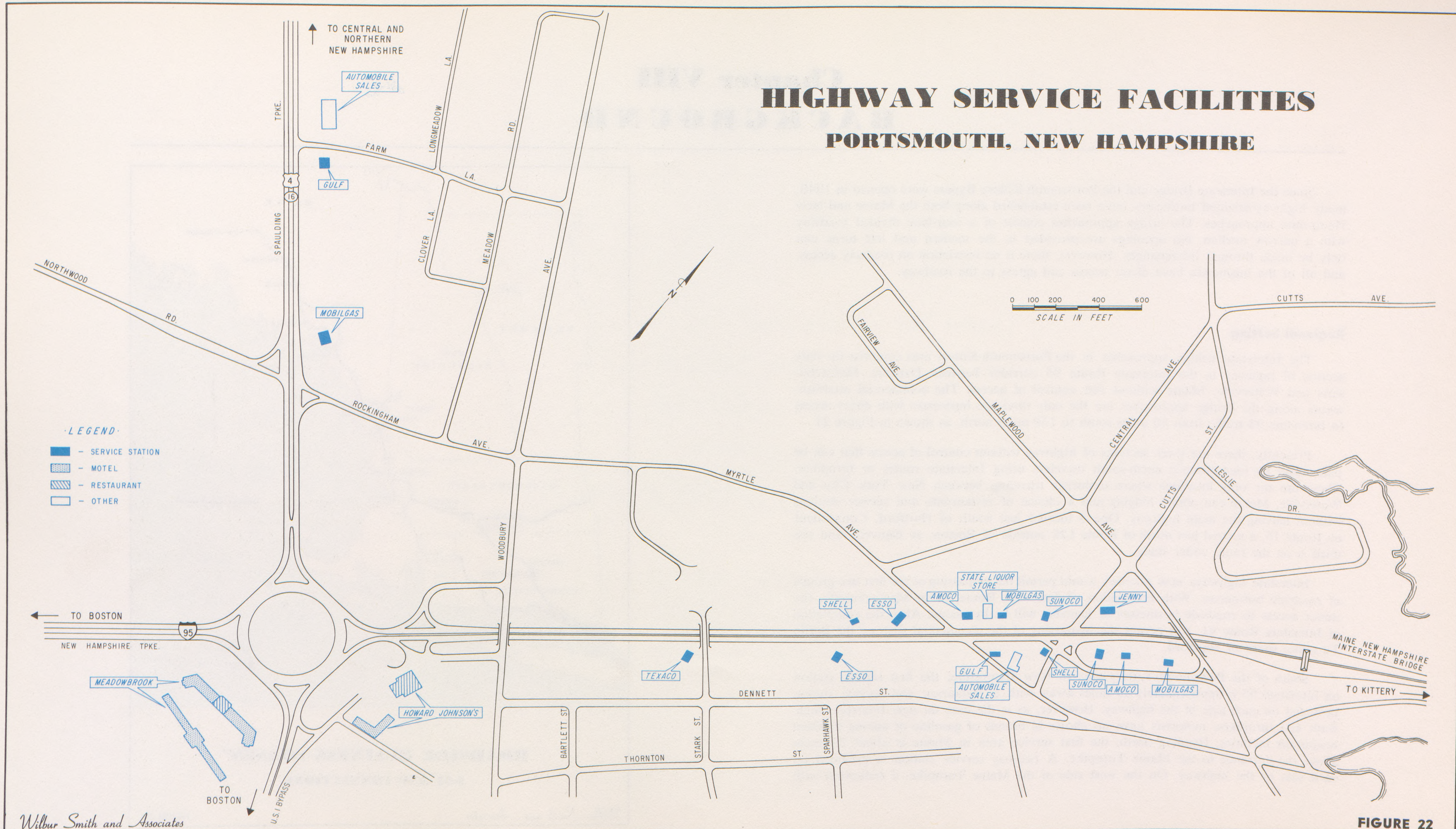

HIGHWAY SERVICE FACILITIES
PORTSMOUTH, NEW HAMPSHIRE
TO CENTRAL AND NORTHERN NEW HAMPSHIRE
AUTOMOBILE SALES
GULF
MOBILGAS
SPAULDING TPKE.
FARM LA.
LONGMEADOW LA.
RD.
CLOVER LA.
MEADOW
AVE.
NORTHWOOD RD.
ROCKINGHAM AVE.
MYRTLE AVE.
WOODBURY
FAIRVIEW AVE.
MAPLEWOOD AVE.
CENTRAL AVE.
CUTTS AVE.
CUTTS ST.
LESLIE DR.
0 100 200 400 600
SCALE IN FEET
LEGEND
- SERVICE STATION
- MOTEL
- RESTAURANT
- OTHER
TO BOSTON
NEW HAMPSHIRE TPKE.
95
4
16
SHELL
ESSO
AMOCO
STATE LIQUOR STORE
MOBILGAS
SUNOCO
JENNY
TEXACO
ESSO
GULF
AUTOMOBILE SALES
SHELL
SUNOCO
AMOCO
MOBILGAS
MAINE NEW HAMPSHIRE INTERSTATE BRIDGE
TO KITTERY
MEADOWBROOK
HOWARD JOHNSON'S
DENNETT ST.
BARTLETT ST.
STARK ST.
SPARHAWK ST.
THORNTON ST.
TO BOSTON
U.S.1 BYPASS
Wilbur Smith and Associates

FIGURE 22

a snack bar for 31 persons and two dining rooms, one with a capacity of approximately 100 persons and the other with a capacity of about 80, are provided. On the east side of the Turnpike, a stand-up snack bar is available during the hours of 7:30 A.M. to 7:30 P.M. Access to the restaurant for northbound motorists is via a pedestrian tunnel.

Revisions in Access to Roadside Businesses

Completion of Interstate Route 95 through the Portsmouth-Kittery area will inevitably have some impact on the roadside businesses along the Interstate Bridge approaches because the present direct access would be modified. To assess the impact that full control of access would have on traffic patterns and patronage of the roadside businesses along the Interstate Bridge approaches, extensive field surveys and investigations were undertaken. These provide the basis for analyses of the anticipated effects on roadside businesses of the three alternate route locations appraised in this report.

The three alternate plans developed for study seemed most feasible in light of traffic services, land use developments, topography, construction and right-of-way costs. These are shown schematically in Figure 12. All three alternates begin at a point on the New Hampshire Turnpike about 0.7 miles south of the existing traffic circle and terminate at a major interchange with the Maine Turnpike and U. S. Route 1 near the southern terminus of the present Maine Turnpike in Kittery.

Alternate A, the most westerly location, would cross the Piscataqua River about one-half mile west of the present Interstate Bridge. A high-level bridge crossing is proposed. Traffic desiring to use the service facilities along the present routes would have to leave Interstate 95 south of the traffic circle in Portsmouth, or at the major interchange with U. S. Route 1 and the Maine Turnpike in Kittery. However, the route would be depressed below normal ground elevation in New Hampshire and carried across the Piscataqua River on a high-level structure. The present roadside businesses will not, therefore, be seen readily by motorists and character of the signs approaching the major interchanges would be especially important in determining the attraction of the present roadside businesses for travelers.

Alternate B, the central location, would closely parallel the existing Interstate Bridge approaches, but would leave the existing roadway, including the traffic circles in Portsmouth and Kittery, intact. Due to its physical proximity to the present Interstate Bridge, as well as land use and topographic considerations, a low-level lift bridge across the Piscataqua River is indicated about 100 feet west of the existing crossing. With this scheme, motorists would again have to leave Interstate Route 95 south of the Portsmouth traffic circle, or at the major interchange with the Maine Turnpike and U. S. Route 1 in Kittery, to gain access to the service facilities. However, motorists would be very close to, and within sight of, the existing service facilities. This would provide an opportunity for some evaluation of the extent and type of services provided. Accordingly, motorists would be in a position to leave the Interstate route at the nearby interchange in order to patronize the facilities on their present trip, or to plan their return trip so as to take advantage of the services provided.

Alternate C, the easterly location, would utilize the existing right-of-way of the present Interstate Bridge approaches. In New Hampshire, the present traffic circle would be taken and frontage roads provided for those businesses that remain after reconstruction. In Maine, the existing Interstate Bridge approach would be used for northbound traffic, a new roadway and necessary frontage roads would be constructed for southbound traffic just west of the existing development on the present bridge approach. Relatively good access to the remaining businesses would be provided by this alternative.

Existing Roadside Development

There are 18 service stations, five eating establishments, and seven motels along the Interstate Bridge approaches in Portsmouth and Kittery. As shown in Figure 22, 13 service stations are located in Portsmouth; seven serve northbound traffic, six provide service to the southbound roadway. Two large combination restaurant-motels are located immediately southeast and northeast of the present traffic circle. Two service stations along the Spaulding Turnpike that will be affected by the proposed construction are also shown. Other businesses that will be affected consist of an automobile sales outlet and a state liquor store.

In Kittery, service facilities consist of five motels, three eating establishments and five service stations. These service facilities are almost evenly divided on the west and east sides of the present bridge approach. However, the establishments serving southbound traffic are considerably larger. As shown in Figure 23, the roadside businesses are concentrated in the area north of Dennett Road and south of Maine Route 236 and the existing traffic circle in Kittery.

Contribution to Local Economy

As shown in Table 25, 18 of the 49 service stations in the entire Portsmouth-Kittery study area are located on the existing Interstate Bridge approaches. These comprise about 35 per cent of all stations, about the same percentage of the totals in both Portsmouth and Kittery. The five eating establishments along the Interstate Bridge approaches comprise less than six per cent of the total in the study area. The two restaurants in Portsmouth are only three per cent of the total eating establishments in the Portsmouth area; the three restaurants in Kittery comprise almost 18 per cent of the total in the Kittery area. Over half of the commercial overnight establishments in the total study area are located along the Interstate Bridge approaches.

HIGHWAY SERVICE FACILITIES
KITTERY, MAINE

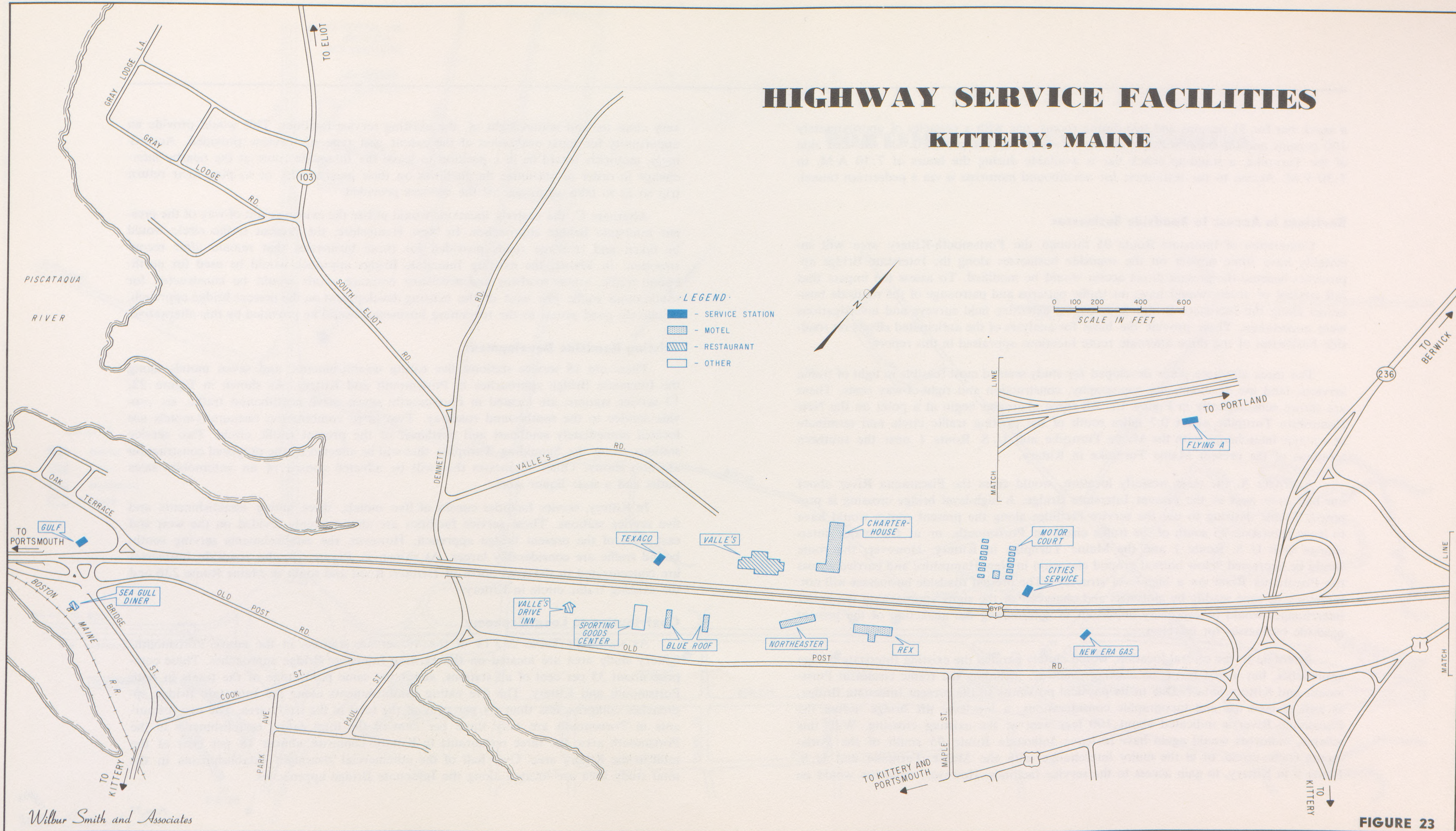


FIGURE 23

TABLE 25

LOCATION OF SELECTED BUSINESS ESTABLISHMENTS

Portsmouth-Kittery Area

Type of Establishment	Portsmouth Total	Portsmouth On Interstate Highway	Kittery Total	Kittery On Interstate Highway	Study Area Total	Study Area On Interstate Highway
Service Stations	34	13	15	5	49	18
Eating & Drinking Establishments	60	2	17	3	77	5
Motels and Hotels	7	3	6	5	13	7

A better measure of importance than the number of outlets is the relative volume of sales that accrue from these roadside businesses. In Table 26, the distribution of selected retail services in the Portsmouth-Kittery area and along the Interstate Bridge approaches are shown. From data collected in this investigation, it is estimated that throughout the study area annual retail sales approximate $66,250,000, of which 87 per cent are in Portsmouth and 13 per cent are in Kittery.

Sales at eating and drinking establishments comprise approximately eight per cent of this total. About 59 per cent of the sales in this category are in Portsmouth, 41 per cent in Kittery. Of the total restaurant sales in the study area, almost one third are made along the Interstate Bridge approaches.

Gasoline service station sales amount to almost ten per cent of the total retail sales in the Portsmouth-Kittery area. About 51 per cent of these are made along the approaches to the present Interstate Bridge. Almost 80 per cent of all the service station sales in the area are made in Portsmouth, with the sales along the Portsmouth Bridge approach also amounting to about 80 per cent of total service station sales to Interstate Bridge traffic.

Seasonal Variations in Patronage and Sales

As previously discussed, traffic use of the Interstate Bridge varies from a low during the winter months to a seasonal peak during July and August. Analyses were made of patronage of the service stations, restaurants and motels along the Interstate Bridge approaches to ascertain the seasonal variations in business volume. A comparison of monthly changes in gross receipts and traffic usage of the Interstate Bridge is illustrated in Figure 24 and shown in Table 27.

TABLE 26

SALES VOLUME—SELECTED RETAIL SERVICES—1960

Portsmouth, Kittery and Interstate Bridge Approaches

Location	Eating & Drinking Establish. Sales Amount	Eating & Drinking Establish. Sales Per Cent	Service Station Sales Amount	Service Station Sales Per Cent	Total Retail Sales Amount	Total Retail Sales Per Cent
Portsmouth-Kittery Area:	(Dollar amounts in Thousands)					
Grand Total	$5,240	100	$6,330	100	$66,250	100
Along Interstate Bridge Approaches	1,650	31	3,200	51	N.A.	......
Portsmouth:						
Total	3,115	59	5,030	79	57,470	87
Along Interstate Bridge Approaches	*	*	2,540	40	N.A.	......
Kittery:						
Total	2,125	41	1,300	21	8,780	13
Along Interstate Bridge Approaches	*	*	660	10	N.A.	......

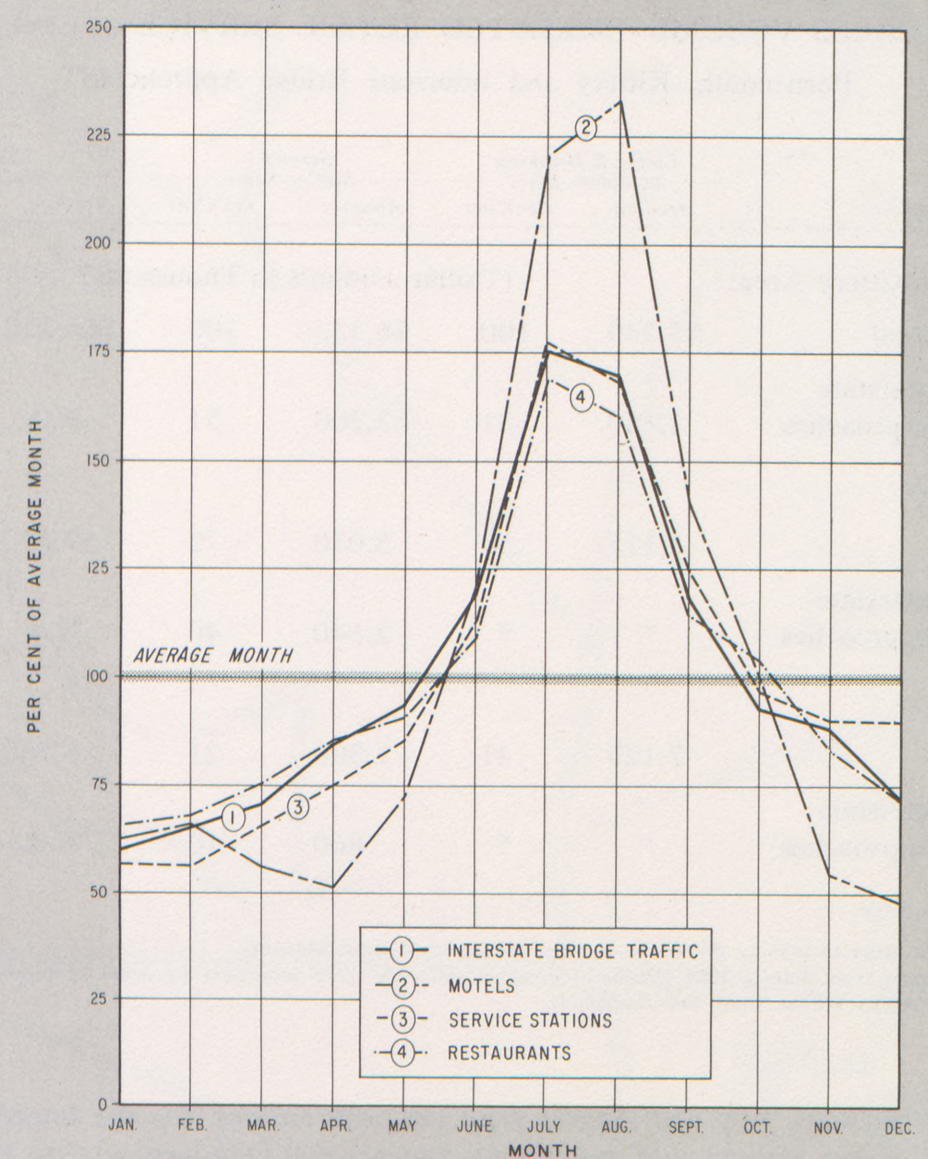
N.A.—Not Available.

* Not shown in order to prevent disclosure of sales of individual establishments.

Sources: Estimates from data in 1958 Census of Business, data for 1960 published by *Sales Management Magazine* and data collected by Wilbur Smith and Associates.

At all facilities, July and August were the peak months. On the Interstate Bridge and at the service stations and restaurants, January and February were the low months. At the motel facilities, however, April and December were the low months.

The motels show the widest variation in usage; the restaurants the least. As would be expected, the service station sales follow very closely traffic usage of the Interstate Bridge. In all instances, activity during June, July, August and September were greater than during the average months. During all other months of the year, patronage was less than during the annual average month.



MONTHLY VARIATIONS GROSS RECEIPTS AND TRAFFIC

Wilbur Smith and Associates FIGURE 24

TABLE 27

MONTHLY VARIATIONS IN GROSS RECEIPTS AND TRAFFIC VOLUMES ON INTERSTATE BRIDGE APPROACHES—1961

Month	Per Cent of Annual Average Month: Traffic Volume	Service Stations	Eating and Drinking Establishments	Motels
January	60	56	65	62
February	65	56	68	66
March	70	66	75	56
April	85	75	86	51
May	94	86	91	73
June	120	113	109	121
July	176	178	169	221
August	171	168	161	234
September	119	124	115	115
October	92	97	105	99
November	88	90	83	55
December	72	90	73	48
Average Month	100	100	100	100

Traffic usage of the Interstate Bridge and service station sales are about three times larger in July than in January. Restaurant patronage is about two and one-half times as great during the peak summer months than the seasonal low in January; motel activity is over four times greater during the summer than during the low months of usage in the winter months and early spring.

The traffic corridor served by the present Interstate Bridge and Interstate Route 95 connects the metropolitan areas of Southern New England and the Eastern Seaboard with the resort areas in New Hampshire and Maine. As a result there are marked seasonal variations in traffic volumes and patronage of the roadside businesses. Over half of the total business of the establishments studied is transacted during the four months from June through September. Some of the motels close entirely during the winter season.

Survey Procedures

Discussions were held with operators of each type of business located along the Interstate Bridge approaches from the traffic circle in New Hampshire to the entrance to the Maine Turnpike, relative to availability of sales records and permission to interview customers. As a result of these conversations, it was decided that a letter advising the businessmen of the purpose of the study would be desirable. Accordingly, duplicates of the letter shown in Appendix C-1 were mailed to the operators of each business.

Study Design for Customer Interviews—Customers at each of the businesses can be divided into two broad groups, local and through traffic. A local trip has either origin and/or destination in the study area; most of these trips would continue to use the present Interstate Bridge regardless of the location selected for Interstate Route 95. A through trip has neither origin nor destination in the Portsmouth-Kittery area. The major proportion of these through trips are currently using the New Hampshire and Maine Turnpikes and to a large extent will be diverted to the planned, controlled access highway. Thus, it is important to learn the origin and destination, route of entry and exit, and amounts spent by through and local traffic. Related information on state of registration, trip frequency and purpose are also valuable in developing customer traffic characteristics. The detailed information was obtained through personal interviews of the patrons of the roadside businesses.

Seasonal variations in the volume and characteristics of traffic on the bridge approaches clearly indicated the desirability of obtaining patronage patterns representative of the spring, winter, fall and summer months. Accordingly, interviews were conducted in March, April and July as shown in Tables 28 and 29. Interviews were taken on both weekdays and weekend days because of significant traffic and business variations on these days. To permit ready comparison of highway and customer traffic, the same zones were used for coding both the economic and the traffic study information.

Forms used in the first cycle of interviews are shown in Appendix C-2, 3, and 4. These were revised for the second cycle by the addition of questions relating to frequency of trip as shown in Appendix C-5, 6 and 7.

Service Station—Interviews were conducted at ten of the 18 service stations during the first cycle as shown in Table 28. The sample consisted of five stations on each side of the road, representative of the small, medium and large service station operations, diversity of brands, and varying locations and designs with respect to accessibility and attractiveness for through and local traffic. Two stations, one on each side of the road, were selected for the purposes of establishing statistical controls and to provide the basis for estimates of total sales of all stations. Simultaneous interviews were conducted for seven consecutive days. A total of 30 service station interview days were obtained in the first cycle.

Table 28

INVENTORY AND INTERVIEW SCHEDULE OF SERVICE STATIONS

	East Side of Highway				West Side of Highway		
	Period of Survey				Period of Survey		
Brands	*Date*	*Day*	*No. of Interviews*	*Brands*	*Date*	*Day*	*No. of Interviews*
Texaco	......	......	......	Shell	....	......	......
Esso	3/29	Thu.	83	Esso	3/30	Fri.	107
	4/3	Tue.	101		3/31	Sat.	94
	4/4	Wed.	106				
	4/5	Thu.	97	Amoco	3/30	Fri.	120
	4/6	Fri.	130		3/31	Sat.	99
	4/7	Sat.	132				
	4/8	Sun.	170	Mobilgas	4/3	Tue.	78
	4/9	Mon.	114		4/4	Wed.	93
	7/12	Thu.	141		4/5	Thu.	75
	7/14	Sat.	281		4/6	Fri.	102
	7/15	Sun.	193		4/7	Sat.	63
					4/8	Sun.	111
Gulf	3/30	Fri.	90		4/9	Mon.	83
	3/31	Sat.	78				
				Sunoco	3/29	Thu.	67
Shell	7/11	Wed.	62		7/12	Thu.	156
	7/14	Sat.	123		7/14	Sat.	281
	7/15	Sun.	81		7/15	Sun.	193
Sunoco	....	......	......	Jenney	....	......	......
Amoco	....	......	......	Gulf	4/2	Mon.	31
Mobilgas	3/30	Fri.	39	Texaco	4/2	Mon.	46
	4/3	Tue.	68		4/8	Sun.	109
					7/11	Wed.	105
New Era	....	......	......		7/14	Sat.	176
					7/15	Sun.	221
Flying A	4/2	Mon.	63				
	4/8	Sun.	70	Cities Service	......	......	......
						Total	4,632
		Off-Interstate Highway					
Mobilgas	4/3	Wed.	34	Atlantic	7/12	Thu.	39
					7/14	Fri.	62
Gulf	7/12	Thu.	112		7/15	Sat.	56
	7/14	Fri.	116				
	7/15	Sat.	87	Esso	7/12	Thu.	142
					7/14	Fri.	153
					7/15	Sat.	177
						Total	978

The hours of operation of the service stations varied somewhat during the two study cycles. Some stations are open 24 hours a day all year round, others during the summer period only. Most stations are open 7:00 A.M. each day throughout the year and close between 10:00 and 11:00 P.M. Interviews were initiated at 7:00 A.M. or opening time whichever was later, and continued to 11:00 P.M. or closing time, whichever was earlier.

Analyses of the first cycle data guided the selection of the two stations on each side of the highway that were interviewed on a weekday and on weekend days during the second cycle. Three additional service stations on major arterials in Portsmouth were surveyed for the same days during July. A total of 21 service station interview days were obtained during the summer interview period.

Restaurants—Because of the small number of restaurants in the study area, five, and the differences in the nature of customer attraction of each, interviews were conducted at all restaurants with the exception of the Meadowbrook Motel, for a weekday and weekend day during the first cycle as shown in Table 29. Only open for a limited number of hours at breakfast, lunch and dinner, the Meadowbrook Restaurant customers are drawn almost completely from people who are staying overnight in the area, or residents of the area. Analyses of the first cycle interviews indicated the desirability of interviewing for another weekday and weekend day during the summer at each of the restaurants except the Drive-In and Meadowbrook.

Motels—Because occupancy is low at motels in the area during the spring, it was found desirable to interview at each of the three major motels for at least three days. The motel schedule of interviewing is shown in Table 29.

The Blue Roof Motel is the only motel open the year round at which no interviews were conducted. During the summer months, three small motels containing an additional 36 units are open. Their operation is completely oriented toward families traveling together—largely on vacation travel. Second cycle interviews were conducted for three days at the Howard Johnson and Meadowbrook Motels, and for one day at the Charterhouse.

Other Data Collected

During the two cycles of interviewing, personal calls were made on almost all of the operators or managers of businesses along the Bridge approaches. As described, permission was sought, and usually granted, to interview at the selected businesses.

In addition, detailed sales information was requested at all businesses (except the State liquor store) and obtained for 21 of them. Information as to gross receipts was obtained at a sufficient number of each type of business to permit reasonably accurate estimates to be made for those at which this information was lacking. At four businesses which did not supply income data, customer interviews were obtained which were of assistance in making estimates of total income. The resulting gross income estimates provide order-of-magnitude data which are regarded as useful for the purposes of the present study, especially for making comparisons. They are, however, subject to a number of qualifications and should not be utilized for other purposes.

TABLE 29

INVENTORY AND INTERVIEW SCHEDULE OF RESTAURANTS AND MOTELS

Restaurants				Motels			
Name	*Date*	*Day*	*No. of Interviews*	*Name*	*Date*	*Day*	*No. of Interviews*
Meadowbrook	....	......	......	Meadowbrook	4/5	Thu.	19
					4/6	Fri.	22
Howard Johnson's	4/12	Thu.	371		4/7	Sat.	19
	4/14	Sat.	405		7/12	Thu.	35
	7/11	Wed.	566		7/14	Sat.	34
	7/14	Sat.	507		7/15	Sun.	28
Sea Gull	4/15	Sun.	96	Howard Johnson's	4/5	Thu.	21
	4/16	Mon.	159		4/6	Fri.	17
	7/12	Thu.	112		4/7	Sat.	14
	7/14	Sat.	119		7/11	Wed.	38
					7/14	Sat.	33
Valle's Drive-In	4/17	Tue.	190		7/15	Sun.	36
	4/18	Wed.	196				
				Blue Roof	....	......	......
Valle's Steak House	4/15	Sun.	262				
	4/16	Mon.	196	Northeaster	....	......	......
	4/17	Tue.	194				
	7/12	Thu.	278	Rex	....	......	......
	7/15	Sun.	418				
				Charterhouse	4/5	Thu.	10
Off Interstate Highway					4/6	Fri.	6
					4/7	Sat.	9
Warren's	7/12	Thu.	66		4/17	Tue.	10
	7/15	Sun.	77		4/19	Thu.	23
					4/20	Fri.	9
		Total	4,212		7/11	Wed.	28
				Motor Court	....	......	......
						Total	411

Chapter IX
IMPACT ON SERVICE STATIONS

To evaluate the impact of constructing Interstate Route 95 as a controlled access highway through the Portsmouth-Kittery study area, detailed analyses were made of service station patronage along the Interstate Bridge approaches.

Volume of Service Station Sales

Annual gross sales at the service stations along the approaches to the Interstate Bridge in New Hampshire and Maine were placed at approximately $3,200,000. Cigarette sales amount to about 28 per cent of the total. Almost all of cigarette sales are in New Hampshire, due to a favorable sales tax situation. Service station sales other than cigarettes are estimated at $2,300,000 annually. About 80 per cent of this is from gasoline sales with the remaining 20 per cent from parts, accessories, tires, batteries and other miscellaneous items.

In Table 30, annual service stations sales are given. It is interesting to note that gasoline sales on the east side of the New Hampshire approach, northbound traffic, are considerably higher than on the west side approach which services southbound traffic. The opposite condition exists in Maine: west side sales are considerably higher than east side sales. This demonstrates the "oasis" condition that exists at the approaches. The service stations at this location are the first encountered, where gasoline can be purchased without driving off of the highway, for a long distance in either direction.

Through vs. Local Sales

On an average weekday, June through September, about 85 per cent of gasoline and auto accessory sales are to through traffic. On a weekend day, this increases to 93 per cent. During the months October through May, a lower percentage of sales are to through traffic, 75 per cent on weekdays and 88 per cent on weekend days.

In the summer months, 65 per cent of gross sales are made on the five weekdays, Monday through Friday; 35 per cent on Saturdays and Sundays. During the eight months period October through May, 69 per cent of gross sales are on weekdays and only 31 per cent on the weekend.

The variations in service station sales between the weekday and weekend day for the summer period and the other eight months of the year are summarized in Table 31.

TABLE 30

SERVICE STATION SALES

Interstate Bridge Approaches—New Hampshire and Maine

1961

Location	*Gasoline*	*Other*[1]	*Sub-Total*	*Cigarettes*[2]	*Total*
New Hampshire	(In Thousands of Dollars)				
West Side	$ 530	$110	$ 640	$450	$1,090
East Side	840	160	1,000	450	1,450
Total	1,370	270	1,640	900	2,540
Maine[3]	470	190	660	*	660
Grand Total	$1,840	$460	$2,300	$900	$3,200

* Negligible.
[1] Includes parts and accessories, tires and batteries, miscellaneous.
[2] Cigarette sales are a major activity in New Hampshire due to a lower state sales tax.
[3] Sales of stations on east and west sides combined to prevent disclosure of sales of individual businesses.

TABLE 31

WEEKLY DISTRIBUTION OF SERVICE STATION SALES[1]

Period	*Through (Per Cent)*	*Local (Per Cent)*	*Sales as Per Cent of Weekly Total*
June-September			
Weekdays	85	15	65
Weekend	93	7	35
October-May			
Weekdays	75	25	69
Weekend	88	12	31

[1] Exclusive of cigarette sales.

In Table 32, the seasonal distribution of service station sales between through and local traffic is indicated. On an average day during the period June through September, inclusive, 88 per cent of gasoline and auto accessory sales are to through traffic, 12 per cent to local traffic. During the eight months, October through May, 79 per cent of gasoline and accessory sales are to through traffic and 21 per cent to local traffic. A much higher percentage of cigarette sales are to through traffic, 97 per cent during the peak four months and 94 per cent during the eight months, October through May, inclusive. On an annual average basis, 83 per cent of all automotive sales are to through traffic, as are 96 per cent of cigarette sales.

TABLE 32

SEASONAL DISTRIBUTION OF SERVICE STATION SALES

Period	Gasoline and Auto Accessories Through (Per Cent)	Gasoline and Auto Accessories Local (Per Cent)	Cigarettes Through (Per Cent)	Cigarettes Local
June-September	88	12	97	3
October-May	79	21	94	6
Annual Average	83	17	96	4

Repeat Patronage

A majority of the customers interviewed at service stations indicated that they had previously patronized service stations in this section of highway, as shown in Table 33. Motorists passing through the area in the October to May period were most likely to be repeat customers. Many are salesmen with regular routes. In summer months, when recreational drivers predominate, the proportion of "repeaters" is not quite so high. It would appear, however, that more than half of the recreational drivers travel the route at least once a year. This proportion is less than observed at restaurants and motels.

Trip Purpose

Trip purposes of service station patrons were found to vary considerably for through and local traffic, as well as on different days of the week. During both periods of study, social and recreational trips were dominant for through traffic, except on weekdays during the eight months, October through May. Work and business trips were a substantially higher percentage of local traffic than through traffic, and shopping and school trips were the dominant trip purpose for local traffic on weekdays during the period October through May.

TABLE 33

REPEAT BUSINESS AT SERVICE STATIONS

Period	Time of Last Purchase: 1-7 days	1-4 wks.	1-6 mo.	7 mo.-1 yr.	1 yr.-5 yr.	Total Repeat Business	Total Business
June-September			(Per Cent Distribution)				
Weekday:							
Through	14	15	7	8	19	63	100
Local	49	7	4	3	7	70	100
Weekend:							
Through	23	18	12	11	25	90	100
Local	42	9	4	2	5	62	100
October-May							
Weekday:							
Through	41	15	25	4	5	90	100
Local	53	11	6	1	1	72	100
Weekend:							
Through	40	16	24	6	6	92	100
Local	69	7	6	2	0	84	100

As expected, the percentage of work and business trips decreased substantially on Saturdays and Sundays, except for local traffic during the off-season. During this period, the decided decrease in shopping, school, and miscellaneous trips on Saturdays results in a percentage increase in work and business trips. In Table 34, the distribution by trip purpose of through and local traffic for the two periods of survey is summarized.

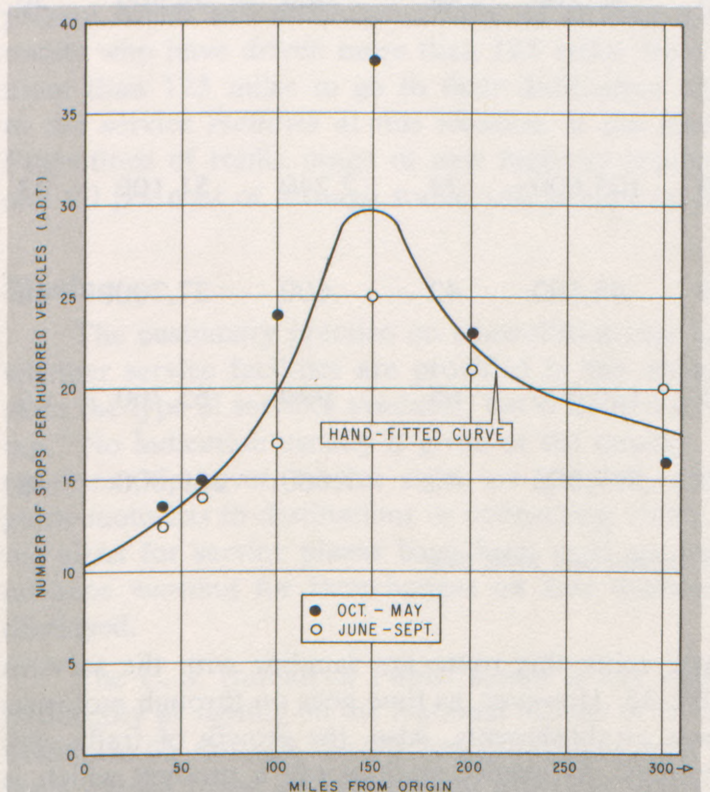
Stops Related to Trip Length

The origin and destination data obtained at the service stations were expanded to an average daily patronage level for the two periods of interview. To relate stops for service to trip length and origin and destination, the number of drivers from each traffic zone who stopped at the service stations along the approaches to the Interstate Bridge was divided by the total number of drivers originating from that zone using the Interstate Bridge crossing.

Table 34

TRIP PURPOSE OF SERVICE STATION PATRONS

Period	Through Traffic: Work and Business	Through Traffic: Social or Recreation	Through Traffic: Shopping, School Misc.	Local Traffic: Work and Business	Local Traffic: Social or Recreation	Local Traffic: Shopping, School Misc.
June-September			(Per Cent Distribution)			
Weekday	27	70	3	51	33	16
Saturday	12	87	1	26	55	19
Sunday	7	91	2	18	73	9
October-May						
Weekday	62	29	9	30	15	55
Saturday	25	63	12	48	35	17
Sunday	21	66	13	20	60	20



SERVICE STATION STOPS PER HUNDRED VEHICLES

Wilbur Smith and Associates FIGURE 25

Table 35 summarizes stops per 100 vehicles by area or origin for northbound and southbound trips. In Figure 25, an empirical curve developed from these data is illustrated.

Patronage at the service stations appears to be highest by those motorists about 150 miles from their basic origin. A close similarity was found in the number of stops per 100 vehicles during the two periods of interview. The increase in stops was in direct proportion to the increase in motorists making the particular trip.

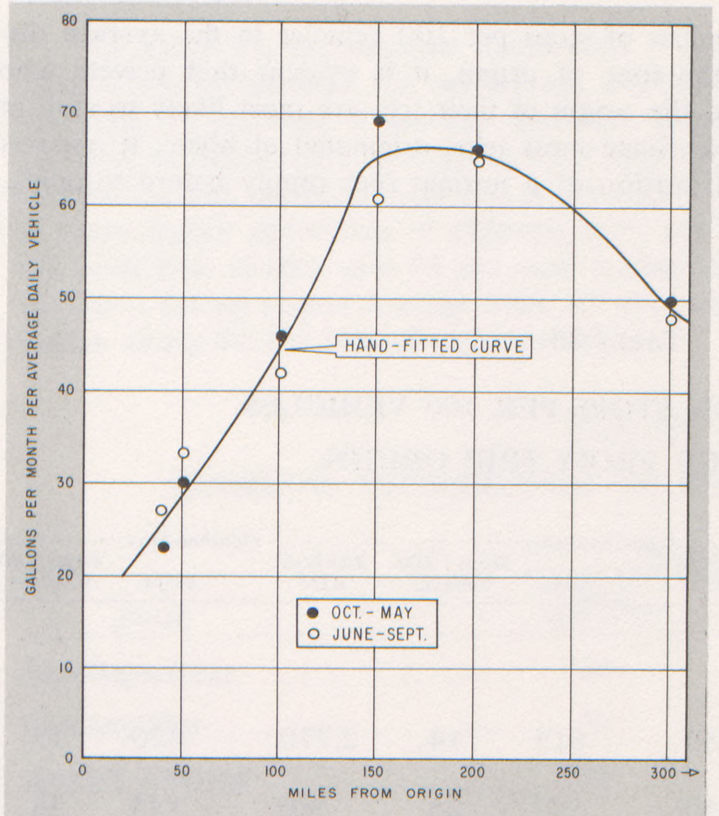
From the relationship of the number of stops per 100 vehicles to the average distance from the center of gravity of the zone of origin, it is evident that drivers who have traveled 100 to 200 miles from the origin of their trip are most likely to stop at the service stations in the study area. Since most trips originated at home, it appears that most motorists use a substantial portion of a normal fuel supply before stopping.

Table 35

SERVICE STATION STOPS PER 100 VEHICLES BY DISTANCE FROM TRIP ORIGIN

Area of Origin	Average Distance from Area	June-September: Through ADT*	June-September: Stops	June-September: Stops / 100 Vehicles	October-May: Through ADT	October-May: Stops	October-May: Stops/100 Vehicles
Northbound	(miles)						
Mass.	50	4,450	615	14	2,770	420	15
R.I. & Conn.	150	750	187	25	380	143	38
Rest of U. S. Outside Me. & Vt.	300	1,900	383	20	680	112	16
Southbound							
York & Cumberland Counties	40	3,970	527	13	2,240	317	14
Augusta-Bath, Lewiston Area	100	1,140	193	17	600	146	24
Rest of Maine & Canada	200	1,990	465	23	990	212	21
TOTAL		14,200	2,370	17	7,660	1,350	18

* Through average daily traffic, vehicles with neither origin or destination in the Portsmouth-Kittery Study Area.



MARKET PENETRATION OF SERVICE STATIONS

FIGURE 26

Market Penetration

In evaluating the market potential of service stations, the term "penetration" is frequently used. Penetration is expressed in gallons per month per vehicle of average daily traffic flow. It is an indication of the amount of business likely to be done by any service station in relation to the traffic passing the station on the highway. Table 36 shows penetration by zone of origin for all the filling stations combined. Figure 26 shows how this penetration of through traffic varies according to distance traveled between the origin of the trip and the service stop. Penetration does not decline as rapidly with increasing distance as stops per 100 vehicles (Figure 25). The indicated market penetration is much higher than normally found. This again substantiates the "oasis effect" of the concentrated service facilities along this highway.

Impact of New Highway

Studies of retail trade show that competitive businesses usually help each other by combining to attract patronage from a larger service area than they could draw from individually. The possibility of choosing among competing products, of having a wider selection of goods, or of making several purchases with only one stop has a strong attraction. This "law of cumulative attraction" has been long applied in the location of stores in downtown business districts and more recently by developers of shopping centers. It also applies to concentrations of automobile oriented businesses, such as those found on the Interstate Bridge approaches.

Studies have brought to light the interesting fact that business firms located in communities which cannot be seen from the bypass route have been adversely affected to a greater extent than those that are visible from the highway.

TABLE 36

PENETRATION OF SERVICE STATIONS
THROUGH TRAFFIC INTERSTATE BRIDGE APPROACHES

Area of Origin	Average Distance	June-September Through ADT	June-September Gal./Mo. to Through Traffic	June-September Pene.[1]	October-May Through ADT	October-May Gal./Mo. to Through Traffic	October-May Pene.[1]
Northbound							
Mass.	50	4,450	146,000	33	2,770	83,500	30
R.I. & Conn.	150	750	45,600	61	380	26,100	69
Other U. S. Outside of Me. & Vt.	300	1,900	92,200	48	680	34,900	50
Southbound							
York & Cumberland Counties	40	3,970	105,600	27	2,240	51,100	23
Augusta-Bath Lewiston Area	100	1,140	48,100	42	600	27,700	46
Rest of Maine & Canada	200	1,990	130,000	65	990	65,700	66
TOTAL		14,200	567,500	40	7,660	289,000	38

[1] "Penetration"—gallons per month per vehicle of average daily traffic flow.

That most of the drivers presently using this route are familiar with the services on the approaches is evident from Table 33. However, as time goes on through motorists will tend to forget the existence of these establishments. Also, the growth of traffic will reduce the proportion of present customers. As service stations sell a product which is widely marketed, previous experience and personal contacts are not as important for them as for other types of automotive sales. Service stations, therefore, are more likely to be hurt by a route location with poor visibility of the existing developments.

In developing the impact of the alternate route locations on patronage of the service stations, consideration was given to the cumulative attraction of these facilities, visibility from the new highway, adequacy of signing, familiarity of motorists with the area, and opportunity to exit and return to the new highway without adverse travel. Consideration was also given to the reluctance of motorists to leave the road for this type of service, as measured in other studies, and the receding proportion of repeat business in the traffic stream. No allowance was made in these tables for the probable increase in local usage of the Interstate Bridge after diversion of through traffic and removal of tolls.

Studies of the patronage of service stations along uncontrolled access highways and at interchanges of controlled access highways, indicate that as much as two-thirds of the through traffic patronage can be lost by bypass construction. These values vary considerably, depending upon visibility, the cumulative attraction of the bypassed facilities and the individual operator of the service facility.

It is expected that when the new route is constructed the service stations along the present routes will retain practically all of their local customers. It is expected that motorists who have driven more than 125 miles from their point of origin and who have more than 125 miles to go to their destination will be willing to leave the main route to use service facilities at this location, if the routing is clear, direct, and well-signed. Projections of traffic usage of new highway improvements also indicate that between ten and 20 per cent of through traffic will remain on the existing route.

Signing

The customary practice on controlled-access highways is to indicate at interchanges whether service facilities are provided in the immediate environs. The usual sign indicates the type of services available, but is limited to "Food," "Phone," "Gas," and "Lodging." No indication usually is given of the quality, variety, or hours of operation of the facilities. Moreover, service signs are generally smaller than the directional signs used to guide motorists to destinations or connecting routes. Although prominent advanced warning signs for service plazas have been used successfully on toll roads for many years, advance warning for interchanges on free expressways are usually not as prominently displayed.

The U. S. Bureau of Public Roads is the official agency responsible for insuring uniformity of signing on the National System of Interstate and Defense Highways of which Interstate 95 through the Portsmouth-Kittery area is an integral part. A system of uniform signing based on best current practices has been developed by the American Association of State Highway Officials and concurred in by the U. S. Department of Commerce Bureau of Public Roads.[11]

[11] *Manual for Signing and Pavement Marking on the National System of Interstate and Defense Highways, December 6, 1960*, The American Association of State Highway Officials.

It is recognized that additional experience and study of motorists needs and desires are needed to determine proper signing for special services. Therefore, a detailed signing practice for motorists services has not been prescribed for the Interstate system. It is anticipated that experience with the opening of additional mileage of Interstate highways to traffic will determine the most effective method of advising Interstate highway users of what services are provided at specific locations, and how these facilities should be identified on the signs. Federal law prohibits any sign that may be interpreted as commercial from occupying the Interstate right-of-way.

Special signing might be provided at the toll barriers and information centers along the existing turnpikes. Signing at rest areas and off the right-of-way of the highway approaches might also be used. The special signing should give particular attention to advising motorists of the availability of roadside services, particularly the type and number. It is not, however, proposed that the use of signs or signing practices be adopted that would not be in accord with the manual for signing of the National System of Interstate Highways.

Economic Impact on Service Stations

This evaluation is made on the basis of the following general assumptions which apply to all three plans for new bridge construction:

1. The bridge will be completed by the close of 1965; and, 1966 will be the first full year of operation.

2. Through traffic is estimated to increase by 25 per cent between 1961 and 1966. An additional increase in traffic of 10 per cent is assumed for 1966 which is attributable to the opening of the new bridge facility. This additional induced traffic volume is continued through 1967 at a lower rate of 5 per cent.

3. This "normal" growth rate of 4.5 per cent per year is projected through 1968 and an annual growth rate of 4.0 per cent through 1971.

4. Thereafter the annual rate of growth is assumed to decline gradually, reaching 2.5 per cent by 1978.

5. Local traffic is expected to increase by slightly over ten per cent by 1966 and business from this source is related directly to the increase in traffic.

In the tables summarizing the expected volume of business in 1966 (in this and in the immediately following chapters on restaurants and motels) the volume of future potential business is related directly to the anticipated increase in traffic volumes. This method is in accord with experience in similar situations. Downward adjustments in the proportion of traffic patronizing the roadside businesses are made to reflect the results expected from the changes in access to, and visibility of the businesses located on the approaches to the bridge as provided by the alternate plans.

Table 37 presents an initial approximation of the effects of the alternate locations of Interstate Route 95 on the volume of business at existing service stations. The top line shows the estimated volume of business in 1961. For each of the alternatives, estimated service station sales are given for the first full year of operation of the proposed alternate facilities (1966).

Comparison of the situation in 1966 with that in 1961 provides the first basis for evaluating effects of each alternate plan. This comparison is indicated for the following reasons:

1. The volume of business of the establishments on the Interstate Bridge approaches during the years while the new bridge and approaches are under construction will be affected by the influx of workers and related activity. This construction activity will have the short-term effect of somewhat increasing business.

2. The growth of through traffic during the interim construction period will tend to be restricted to some degree by the limited capacity of the present Interstate Bridge.

TABLE 37

APPROXIMATION OF INITIAL ECONOMIC IMPACT OF ALTERNATIVE PLANS

Service Stations

Time and Alternates	*New Hampshire*						*Maine*		*Maine and New Hampshire Combined*			
	Gas and Related Sales		*Cigarettes*		*Total Station Sales*		*Total Station Sales*		*Gas and Related Sales*		*Total Station Sales*	
	Dollars	*Per Cent*	*Dollars*	*Per Cent*	*Dollars*	*Per Cent*	*Dollars*	*Per Cent*	*Dollars*	*Per Cent*	*Dollars*	*Per Cent*
	(Dollar Amounts in Thousands)											
1961	$1,640	100	$900	100	$2,540	100	$ 660	100	$2,300	100	$3,200	100
1966	(Assumed as first full year after completion of new river crossing)											
Construction of Alternate A												
Minimum	900	55	400	44	1,300	51	350	53	1,250	54	1,650	52
Expected	1,350	82	700	78	2,050	81	550	83	1,900	83	2,600	81
Construction of Alternate B												
Minimum	1,350	82	750	83	2,100	83	600	91	2,000	87	2,700	84
Expected	1,550	95	850	94	2,400	94	650	98	2,200	96	3,050	95
Construction of Alternate C	1,150	70	500	56	1,650	65	1,150	174	2,300	100	2,800	88

The net effect of these considerations is that comparison of business volume in 1966 with that experienced in 1961 provides a firm basis for evaluating the economic impact of alternate routes.

The estimates are presented as initial approximations of gross business volume for several reasons. The impact data given in this chapter are designed to provide the basis for considering the effects of additional developments that will be set in motion by the new highway facilities. Economic impact analyses consist of a series of steps in which each set of influences is taken successively. The prospect for the early completion of the new road facilities will tend to create a dynamic situation which opens the way for a series of new developments. The calculations in this chapter are limited to what are usually termed the "direct" and "immediate" effects. Other effects such as the development of new businesses, or the change in the character of existing businesses are discussed later.

Alternate A—Western Location—Alternate A will not provide good visibility of existing service station facilities. Motorists will have to leave the new highway south of the existing traffic circle in Portsmouth, or north of the existing traffic circle and Route 1 interchange in Kittery.

Estimates were prepared of the proportion of through traffic that would no longer use the existing station facilities on the approaches to the bridge. The estimates of revenues from local traffic make no allowance for redevelopment of this area because of the diversion of through traffic to the new route as well as the removal of tolls from the present bridge. As is described later in Chapter XII, the typical effect of freeing local streets from through traffic has been to increase the business potential from local sources.

The estimates of gross business volume in 1966 are given in the form of a range described in Table 37 as the "minimum" and "expected" levels. Any forecast of future business volume necessarily involves elements of uncertainty largely deriving from actions and events yet to occur. In the present case, a quite new set of conditions are introduced by the proposed new bridge. The "minimum" estimates reflect the most unfavorable set of impacts that can be contemplated. On the other hand, the "expected" levels are regarded as the more realistic volumes of business that will be realized.

Among the considerations underlying the estimates of expected business are the following: a greater degree of initiative on the part of the affected businessmen in meeting the new situation; better signing notifying travelers of the existence of these facilities, wholly apart from any changes that may be introduced in the standards for the National System of Interstate Highways; and somewhat greater allowances for the retention of business from through traffic.

The net effect of these calculations is given in Table 37. With minimum business conditions it is expected that total business volume of the 18 service stations in the area in 1966 could be as low as 50 to 55 per cent of the 1961 level. However, under more likely conditions, business volume in 1966 is estimated at about 80 per cent of the 1961 level. In the latter case and with anticipated traffic growths, it could take about four years for business volumes to return to 1961 levels.

Alternate B—Central Location— While motorists would have to leave the new highway south of the traffic circle in Portsmouth, or north of the traffic circle and U. S. Route 1 interchange in Kittery, Alternate B provides good visibility of the existing service facilities. Motorists would have ample opportunity while driving on this closely parallel facility and using the new low-level river bridge to observe the extent and quality of the roadside businesses. This, coupled with the direct routing to the present Interstate Bridge approaches from the major interchanges in Portsmouth and Kittery, should encourage patronage of the service stations. It has, therefore, been estimated that the amount of patronage retained would be higher than with Alternate A.

If Interstate Route 95 through the Portsmouth-Kittery area follows Alternate B, it is anticipated that 1966 service station sales will be about 85 per cent of the 1961 level for minimum conditions, and 95 per cent for the conditions that seem likely to develop. The impact in Maine would be less: about 90 per cent of the recent patronage would be retained in 1966 under the most unfavorable conditions and virtually no loss would be experienced for more favorable conditions expected.

In New Hampshire, sales volume in 1966 would not be as close to the 1961 volume, but the differences would be slight. The estimates indicate that 1966 service station sales will approximate, at a minimum, about 85 per cent of 1961 levels; but the volume is more likely to approximate 95 per cent of the base year level.

Alternate C—Eastern Location—The alignment of Alternate C follows the existing right-of-way of the Interstate Bridge approaches. Motorists would not only be in close proximity to existing service facilities, but intermediate ramp connections to frontage roads servicing the roadside businesses would be provided between the major interchanges south of the traffic circle in Portsmouth and north of the traffic circle and U. S. 1 interchange in Kittery. With the extensive frontage roads provided, virtually no change in gas and related sales is anticipated. Largely because of the good accessibility to stations on the bridge approaches provided by this alternative, no range in the estimated future business volume is given.

The construction of Interstate 95 along the present Interstate Bridge approaches will necessitate the acquisition of all of the service stations on the west side of the present Interstate Bridge approach in New Hampshire. While it is expected that patronage of the remaining service stations on the east side of the Interstate Bridge in New Hampshire would increase due to a gain in patronage from both local traffic and through traffic, the over-all effect would be a reduction in service station sales by 1966 in New Hampshire to about 65 per cent of the recent level. Gas and auto accessory sales would approximate 70 per cent of present dollar volumes, cigarette sales, 55 per cent.

In Maine, a considerable increase in sales is anticipated. The service facilities on the west side of the present Interstate Bridge approaches would benefit considerably from the acquisition of the service stations on the west side of the Interstate Bridge in New Hampshire. Moreover, the frontage roads and traffic circulation provided in Maine would encourage construction of additional service stations, since considerable land areas are available for development. Therefore, it is anticipated that service station sales in Maine would increase about 75 per cent if Interstate 95 is built along the alignment of Alternate C.

The combined station sales for Maine and New Hampshire in 1966 would approximate 90 per cent of the 1961 level if the Alternate C location is used. Gas and auto accessory sales, however, are estimated at about the dollar volumes realized in 1961.

Summary

Due to the high percentage of through traffic patronage at the existing service stations, construction of a highway on new location would have some adverse effects on service station sales.

Considering the impact on all service stations in both states, Alternate A, the western location for Interstate Route 95, would cause the greatest reduction in total station sales, ranging from about 50 to 20 per cent of present volumes. The impact of Alternate B, the central location, is expected to be minor. Gas and related sales, assuming Alternate C which follows the present Interstate Bridge approaches is constructed, are anticipated to be about the same in 1966 as in 1961. On Alternates A and C, a sizeable decline is, however, expected in cigarette sales owing to the necessary removal of stations in New Hampshire which enjoys lower cigarette taxes.

The impact on the service station facilities in each of the states is significantly different only for Alternate C. As noted, due to the necessity of acquiring several of the service stations for construction purposes in New Hampshire, Alternate C would result in a loss of service station sales in that State. For Maine, Alternate C is much more attractive, as service station sales in 1966 are expected to be about 75 per cent higher than in 1961.

Chapter X
IMPACT ON RESTAURANTS

There are five restaurants on the Interstate Bridge approaches which may be affected by the location of a new river crossing. Two are located in New Hampshire and three in Maine. All the restaurants are of good quality.

The restaurants share a common characteristic in that they are located in an area which attracts both long distance travelers and local patrons. Among the principal factors which influence the volume of business at these restaurants, and the potential effects of new highway construction, are the following:

1. The attraction of certain well-known restaurants.
2. The "oasis" effect caused by the location of the study area in relation to other restaurants enroute to the major generators of traffic.
3. The stability of local patronage.
4. The degree of "repeat" business enjoyed by all restaurants in this area.

Characteristics of Patronage

In this section, relationships are established to determine the revenue generation of each type of customer. The variance among seasons, facilities, and customers is presented. By knowing the characteristics of the clientele, the impact of route plans on future patronage can be evaluated.

Average purchase, total income and reliance upon through and local patronage vary considerably during different days of the week. One restaurant caters more to local patrons by providing special banquet facilities. Another restaurant does not have the similarity of the other four restaurants in relation of through to local sales.

Two restaurants have a wide drawing attraction which substantially affects percentage of sales attributable to through and local traffic. These will be termed restaurants A and B. Most of the following analyses are concerned with these two restaurants. They typify the two basic types of establishments in relation to trip purpose, volume of through and local traffic in terms of trips, customers and dollars. They account for the bulk of the business of all restaurants.

Of the three remaining facilities, one is similar to restaurant A, one is comparable to restaurant B, and the remaining restaurant is highly oriented to through traffic during both the winter and summer.

The principal difference between the two restaurants is that A is more oriented toward local patrons. For example, A receives a larger proportion of sales volume during the summer from local patrons than B. Another important difference is shown in Table 38. Weekend sales to local patrons both during the summer season and during the October-May period are a higher proportion of total sales in the case of restaurant A. Local patrons account for 45 and 62 per cent of weekend sales volume during the two seasons compared with 25 and 56 per cent for restaurant B. While both restaurants do the same percentage of their business on weekdays and weekend days, 60 and 40 per cent, respectively, during the eight month period October through May, restaurant A does a larger percentage of its business on weekdays during the June through September period.

It is interesting to note that both during the week and on the weekends for both periods of the year, the average dollar sales per auto stop or per person is less for through traffic than local traffic.

The analyses indicated that the number of occupants per car increased during the week as did the average purchase. Car occupancy during the week averaged 2.4 persons during the eight month period. Occupancy rose to 3.6 persons on an average summer weekday. Local occupancy also increased, but not to this extent. Average occupancy increased from 2.2 persons per car during the October through May period to 3.1 persons per car during the June through September period. This is the basic reason why each auto yielded more income during the summer.

Trip Purpose

From analyses of trip purpose, a clear and broad understanding of the nature of the restaurant clientele was determined. Certain trip purposes are a clue to whether or not a customer is a potential patron that will be lost because of an alternate highway routing. Study of the relationship between through and local trip purposes indicated that a substantial market can be retained depending upon which alternate route plan is constructed. Probably one of the more significant findings is that restaurants because of reputation and drawing power can continue to capture a significant market.

Table 38

SEASONAL AND DAILY VARIATIONS IN AUTO STOPS PATRONAGE AND SALES FOR TWO RESTAURANTS

Period	Restaurant A Through	Restaurant A Local	Per Cent of Weekly Volume	Restaurant B Through	Restaurant B Local	Per Cent of Weekly Volume
	(Per Cent Distribution)					
June-September						
Weekday			63			55
Auto Stops	66	34		68	32	
Patrons	58	42		53	47	
Sales	54	46		49	51	
Weekend			37			45
Auto Stops	62	38		79	21	
Patrons	63	37		84	16	
Sales	55	45		75	25	
October-May						
Weekday			60			60
Auto Stops	70	30		55	45	
Patrons	75	25		57	43	
Sales	63	37		53	47	
Weekend			40			40
Auto Stops	42	58		56	44	
Patrons	46	54		44	56	
Sales	38	62		44	56	

One restaurant has an orientation toward through traffic during the week. However, on weekends the proportion of local patronage increases considerably. Significantly, the increase in local patrons consisted of motorists from outside the study area who use the restaurant as their destination. The main purpose of the trip was to eat at this particular restaurant.

The trip purpose comparison indicated in Table 39 shows a similarity between the two restaurants. The predominant trip purpose for through traffic is social and recreational on both weekdays and weekend days during the period June through September. During the period October through May, work and business trips are dominant on weekdays although social and recreational trips are again dominant on weekends. As shown in the lower section of Table 39, social-recreational trips are also dominant for local traffic during the summer months, although not to the same extent as for through traffic. During the period October through May social-recreational trips are the dominant trip purpose on weekends for local traffic, although a very high percentage of restaurant patronage is just for the purpose of going out to eat at restaurant A. On weekdays during the eight month period, the predominant trip purpose of restaurant patrons was work and business.

In Table 40 the percentage distribution of restaurant sales by trip purpose is summarized. The weekday and weekend patterns for both seasons of the year are quite similar for the two restaurants. On a typical weekday during the four month summer period, over 60 per cent of restaurant sales are to customers who gave social and recreation as their trip purpose. About 25 per cent of these patrons were from local traffic, 75 per cent were through motorists. During the eight-month period, October through May, social-recreational trips account for about 30 per cent of restaurant sales. Two-thirds of these sales are to through traffic, about one-third to local traffic.

Work and business trips account for 40 to 50 per cent of restaurant sales on an average weekday during the period October through May. Through customers account for over half of the sales to patrons giving work or business as their trip purpose.

Repeat Business

The interview data clearly indicate the importance of repeat customers. In Table 41, the distribution of repeat business between local and through traffic for both weekdays and weekends during both seasons of interview are indicated. Of important significance is the fact that over 85 per cent of the motorists indicated that they had previously eaten at the restaurant within the last five years. About one third of the through traffic customers, and over 50 per cent of the local customers had eaten at the same restaurant within the last month.

The high percentage of repeat business is a favorable factor as far as retaining patronage after the construction of an alternate highway facility.

Table 39

SEASONAL AND DAILY VARIATION IN SALES—TWO RESTAURANTS BY TRIP PURPOSE FOR THROUGH AND LOCAL TRANSACTIONS

(Per Cent Distribution of Purchases)

Period	Restaurant A					Restaurant B				
	Work Business	Social Recreation	Eat	Shopping, School, Misc.	Total	Work Business	Social Recreation	Eat	Shopping, School, Misc.	Total
					Through Customers					
June-September										
Weekday	28	68	1	3	100	23	74	......	3	100
Saturday	......	......	......	......	......	5	93	1	1	100
Sunday	8	91	......	1	100	......	......	......	......	......
October-May										
Weekday	41	41	6	12	100	51	38	4	7	100
Saturday	......	......	......	......	......	13	71	5	11	100
Sunday	15	72	5	8	100	......	......	......	......	......
					Local Customers					
June-September										
Weekday	27	46	25	2	100	30	54	9	7	100
Saturday	......	......	......	......	......	9	67	19	5	100
Sunday	5	52	43	0	100	......	......	......	......	......
October-May										
Weekday	42	27	26	5	100	50	15	12	23	100
Saturday	......	......	......	......	......	14	33	39	14	100
Sunday	3	53	41	3	100	......	......	......	......	......

Economic Impact of Alternative Plans

The statements in the similar section of the preceding chapter on service stations relative to 1) the restricted scope of the impact analyses in this chapter; 2) the projected growth of travel; and 3) the basis for comparison of 1961 and 1966 business volumes are equally applicable here.

Table 42 presents the initial approximations of the economic impact of the three plans on the sales volume of the existing restaurants located on the present bridge approaches. Comparison is made of sales volume in 1961 with the expected sales during 1966, the assumed first full year during which the new highway facilities will be in operation.

On the basis of the evidence reviewed above, it is expected that the alternate bridge plans would have only a moderate effect in reducing patronage that would otherwise be obtained from "through" travelers, particularly under Plans A and B. As in the chapter on service stations, calculations were carried out to show the volume of business under pessimistic and optimistic assumptions regarding the relevant determining factors.

In the case of restaurants, these projections yielded quite small differences and it was decided that presentation of these separate estimates would give misleading impressions as to the accuracy possible in forecasts of business volume. Hence, the "minimum" and "expected" projections were averaged and these averages are given in Table 42.

Table 40

SEASONAL AND DAILY VARIATIONS IN TRANSACTIONS BY TRIP PURPOSE—TWO RESTAURANTS

Period	Through Customers				Local Customers				
	Work/ Business	Social Recreation	Eat	Other	Work/ Business	Social Recreation	Eat	Other	Total
	(Per Cent Distribution)								
	Restaurant A								
June-September									
Weekday	18	45	0	3	9	15	9	1	100
Weekend	5	57	1	0	2	19	16	0	100
October-May									
Weekday	24	25	4	8	16	11	10	2	100
Weekend	5	27	1	4	2	32	26	3	100
	Restaurant B								
June-September									
Weekday	16	50	0	2	10	17	3	2	100
Weekend	4	73	0	2	2	14	4	1	100
October-May									
Weekday	27	19	1	5	24	8	12	4	100
Weekend	5	32	1	5	8	18	22	9	100

Table 41

REPEAT BUSINESS AT ALL RESTAURANTS AND TIME OF LAST VISIT

Period	Same Day	1-7 days	1-4 wks.	5 wks. - 6 mo.	7 mo. - 1 yr.	1-5 yrs.	Total Repeat
	(Per Cent Distribution)						
June-September							
Weekday							
Through	1	16	17	14	14	25	87
Local	5	35	12	11	6	16	85
Weekend							
Through	1	14	18	15	16	23	87
Local	3	29	17	12	9	17	87
October-September							
Weekday							
Through	2	16	16	32	10	7	83
Local	16	31	13	14	6	6	86
Weekend							
Through	5	11	13	33	8	17	87
Local	7	27	17	23	5	8	87

Nonetheless, five-year forecasts of business volume need to provide for some range because of uncertainties that necessarily prevail. Hence, although a single forecast is presented for each plan, a possible variation of few percentage points, plus and minus, needs to be recognized. However, the general order-of-magnitude of the differential effects among the three plans is considered valid.

Under all plans, sales in 1966 are above the current level by amounts varying from 6 to 14 per cent. The foregoing review of the characteristics of the restaurants—their drawing power, the distant location of competing restaurants available to long-distance travelers, the importance of local and repeat sales—figures importantly in the favorable impact expected.

TABLE 42

APPROXIMATION OF INITIAL ECONOMIC IMPACT
OF ALTERNATIVE PLANS

Eating and Drinking Establishments
(Dollar Amounts in Thousands)

	Gross Sales	*Per Cent of 1961*
1961	$1,700	100
1966 (Assumed as first full year after completion of new river crossing)		
Construction of Alternate A	1,810	106
Construction of Alternate B	1,840	108
Construction of Alternate C	1,930	114

Summary

Alternate A—the high level bridge at the westerly location—by removing most of the through traffic would have greatest adverse effect on restaurants. However, this would make the restaurants more accessible and attractive to local patrons and would permit further development of the immediate areas for local and other businesses. These new businesses would attract additional restaurant patronage. Removal of the present toll on the existing bridge would accelerate these developments.

Similar developments in the immediate area would be realized with Alternate B—the separate low-level bridge adjacent to the present bridge. In consequence, the estimates shown in Table 42 for sales volume impact for Alternates A and B would be increased because of this type of change, particularly in the years following the opening of the new bridge facility. How soon these developments would occur depends, in part, on the actions of business people, particularly the extent to which they move forward in anticipating the effects of the alternate plans.

With respect to Alternate C, the present bridge is part of the proposed design. Additional development of highway-oriented business catering primarily to through traffic is likely in the limited area in Maine where frontage roads are provided. This plan requires the removal of the State liquor store as well as six additional service stations in New Hampshire. Consequently net additional development in the area would be limited.

The effects of the developments listed above would probably serve to virtually eliminate the differences in volume of business activity at restaurants shown in Table 42, and could well result in a somewhat higher volume of business under Alternate A, for example.

Chapter XI
IMPACT ON MOTELS

Motel businesses in the study area enjoy a favorable position in relation to traffic flow and location between major points of trip generation. At the present time there are seven motels, or tourist facilities catering to the motoring public. The two motels in New Hampshire are located at the traffic circle connecting the New Hampshire Turnpike, Interstate Bridge and Spaulding Turnpike. Both motels are open all year with a combined capacity of 144 units.

There are five motels on the Maine approaches to the Interstate Bridge. Only two are open all year. The others which provide an additional 20 motel units and sixteen cabin units are open during the summer season.

Characteristics

First cycle interview data revealed general similarities among the various motels in the study area with respect to weekday and weekend customer patterns and purpose of trip, as shown in Table 43.

Weekday revenues comprise 65 per cent of total weekly receipts during the eight month period, October-May, 70 per cent during the period June-September. In this discussion of motel business, a local trip or customer is defined as one that has a specific destination or trip purpose in the study area. A through trip, as suggested, is one that is enroute to its major destination, or purpose and is stopping enroute. At all motels the proportion of through traffic revenues exceeded local traffic revenues. Through traffic revenues were a lower percentage of the total on weekdays, during the eight-month period.

Motel Activity

In Table 44, the distribution of motel receipts between through and local traffic for the two periods of the year is indicated. The relative importance of through and local traffic is shown.

On an annual basis, about 85 per cent of motel receipts are from through traffic, 15 per cent from local traffic. During the summer months, about 90 per cent of motel income is from through traffic, only ten per cent from local traffic. During the period October through May, 80 per cent of motel receipts are derived from through traffic, 20 per cent from local traffic.

TABLE 43

AVERAGE DAILY VARIATION IN MOTEL SALES
THROUGH AND LOCAL TRAFFIC

Period	Per Cent of Week	Per Cent Distribution Through	Local
June-September			
Weekday	70		
Trips		90	10
Patrons		90	10
Sales		90	10
Weekend	30		
Trips		95	5
Patrons		95	5
Sales		95	5
October-May			
Weekday	65		
Trips		70	30
Patrons		75	25
Sales		75	25
Weekend	35		
Trips		90	10
Patrons		95	5
Sales		95	5

Based on data collected, it is estimated that the five motels along the Interstate Bridge approaches do an annual volume of business approximating $500,000. About 58 per cent of this volume is realized during the four summer months, 42 per cent during the remaining eight months of the year. This distribution varies for local and through traffic. About 60 per cent of annual sales are made to through traffic during the summer months compared with 40 per cent to local traffic during these four months.

TABLE 44

SEASONAL DISTRIBUTION OF MOTEL SALES

Period	Through Traffic (Per Cent)	Local Traffic (Per Cent)	Total Traffic (Per Cent)
June-September	90	10	100
October-May	80	20	100
Annual Average	85	15	100

Trip Purpose

The percentage distribution of motel customers by trip purpose is given in Table 45.

During the summer months, social and recreational trips comprise over 85 per cent of through traffic patronage. During the period October through May, weekend patronage is primarily for social and recreational purposes, but on the average weekday, 75 per cent of the motel stops by through traffic are for business or work purposes.

The trip purposes of local traffic are quite similar during the summer months. In the winter months, however, business and work comprise a much higher percentage of local traffic motel patronage.

TABLE 45

TRIP PURPOSE OF MOTEL PATRONS

	Per Cent Distribution by Trip Purpose							
	Through Traffic				Local Traffic			
Period	Business Work	Social Recreational	Other	Total	Business Work	Social Recreational	Other	Total
June-September								
Weekday	12	85	3	100	14	75	11	100
Friday	9	88	3	100	12	80	8	100
Saturday	8	90	2	100	11	85	4	100
October-May								
Weekday	75	18	7	100	90	6	4	100
Friday	14	80	6	100	30	60	10	100
Saturday	8	90	2	100	22	66	12	100

Repeat Business

Motel patrons were questioned as to when they last stayed overnight in the area. As indicated in Table 46, about 75 per cent of the motel customers indicated that they had stopped previously.

The similarity of patterns between local and through traffic are significant. About 35 per cent of the motel customers indicated that they had stopped in the same area less than a month ago. As expected, repeat business was somewhat higher on the weekday than on the weekend, due to the increased number of business and work trips.

TABLE 46

REPEAT BUSINESS AT MOTELS

	Per Cent Distribution—Prior Visits				
Period	1-4 Wks.	1-6 Mos.	7 Mo.-1 Yr.	1-5 Yrs.	Total Repeat
June-September					
Weekday					
Through	42	9	7	18	76
Local	39	26	19	0	84
Weekend					
Through	43	12	2	21	78
Local	18	33	1	31	83
October-May					
Weekday					
Through	33	38	2	4	77
Local	37	22	12	1	72
Weekend					
Through	42	8	8	16	74
Local	33	49	18	0	100

Economic Impact of Alternative Plans

The statements in the similar section of the chapter on service stations relative to: 1) the restricted scope of the impact analysis in this chapter; 2) the projected growth of travel; and 3) the basis for comparison of 1961 and 1966 business volumes are equally applicable here. These matters and the descriptions of the alternative locations for Interstate Route 95 need not be repeated.

On the basis of the evidence reviewed above, it is expected that the alternate bridge plans would have only a moderate effect in reducing patronage that would otherwise be obtained from "through" travelers, particularly under Plans A and B. As in the chapter on service stations, calculations were carried out to show the volume of business under pessimistic and optimistic assumptions regarding the relevant determining factors.

In the case of motels, these projections yielded quite small differences and it was decided that presentation of these separate estimates would give misleading impressions as to the accuracy possible in forecasts of business volume. Hence, the "minimum" and "expected" projections were averaged and these averages are given in Table 47.

Nonetheless, five-year forecasts of business volume need to provide for some range because of uncertainties that necessarily prevail. Hence, although a single forecast is presented for each plan, a possible variation of a few percentage points plus, and minus, needs to be recognized. The general order-of-magnitude of the differential effects among the three plans is, however, valid.

Table 47 presents the initial approximation of the anticipated impact of the three plans on activities of the seven existing motels. Comparisons of gross sales volume in 1961 with those anticipated in 1966, the assumed first full year that the new crossing will be open, indicate that all plans would have a moderate effect on the volume of motel business.

The level of business expected in 1966 as a percentage of that realized in 1961 varies from 110 per cent in the case of Alternate A, the high-level bridge, to 120 per cent in the case of Alternate C, a new low-level bridge integrated with the existing Interstate Bridge. As described later in Chapter XII, the activity in connection with the construction of the bridge would have the effect of raising the patronage of the motels during the construction period. In consequence, the motel operators would reap temporary benefits. It should also be noted that the motels along the the existing bridge approaches operate at close to capacity during July and August. There is, therefore, an unsatisfied demand during this period.

TABLE 47

INITIAL APPROXIMATION OF ECONOMIC IMPACT—MOTELS

	Gross Sales	
	Dollars (In Thousands)	*Per Cent of 1961*
1961	500	100
1966 (Assumed as first full year after completion of new river crossing)		
Construction of Alternate A	550	110
Construction of Alternate B	570	114
Construction of Alternate C	600	120

It seems clear that any of the bridge plans would not have any significant adverse effect on the business of existing motels. The growth in business volume, however, would likely be somewhat greater under Alternate C than under the other plans. A California study[12] presents the following relevant conclusion:

> "There has been no indication that a group of financially sound and well-managed motels will be affected detrimentally by an access-controlled bypass. Some new motels will locate near the freeway if it is possible to find a reasonable site. Any growing industry such as the motel business will be continually attracting new investors. Those businesses which are established must maintain a high level of public service in order to compete with the constant change taking place."

Other studies in California show that attractiveness, service, cleanliness, and managerial ability have more effect on motel operations than the presence or absence of a freeway.[13]

There is a possibility that additional motels may be located in the immediate environs of major interchanges in both Portsmouth and Kittery. Another possible source of competition is new motel facilities at the beaches outside of the study area. However, the competitive position of the existing motels is strong because of their reputation and established clientele. In any event, the expected growth of traffic in the years ahead indicates a need for additional motel facilities in the general area of Portsmouth and Kittery.

[12] "Motels and Freeways," by J. F. Kelly, *California Highways and Public Works*, January-February, 1954.

[13] "North Sacramento Study"—*California Highways and Public Works* and *Location and Economic Study for Interstate Route.* Tallahassee, Florida, Wilbur Smith and Associates, 1957—page 57.

Chapter XII

OVER-ALL EVALUATION OF ECONOMIC IMPACTS

This chapter is devoted to an over-all summary of the economic impacts on the new route facility. Special attention is given to the general impact on the businesses located on the approaches to the present Interstate Bridge, but other impacts are also discussed. The scope of analysis goes beyond that in the last three chapters in that developments not previously considered are evaluated.

Effect of Construction Activity

General economic influences will be set in motion by the decisions to build the new highway facility. These effects are common to all plans, differing only in that Alternates B and C would require larger construction outlays than A.

The influx of workers and the expenditures for materials and transportation will add to the business potentials for motels, restaurants and service stations. The construction activity is expected to enhance business volume to an extent that will go far toward compensating for any adverse effects that the completion of an alternate route might have during the initial years after completion of the new river crossing.

Changes in Land Use and Business Orientation

Another point that needs to be made is the prospect for changes in the character and location of business, or more generally in land use. The businesses and development of the area would be much influenced by completion of a new river crossing. For example, if the alternate with most adverse immediate effects on service stations is selected, some service stations may diversify their activity in an effort to secure more local patronage. Some may rely more heavily on the quality of their mechanics and subsidiary automobile services to attract customers. Such business adaptations are constantly occurring in the nation's economy. A few service station properties may well be converted to other automobile oriented activities, such as drive-in restaurants, ice cream stands, or used car agencies. Other establishments may cater to the heavy late evening and early morning truck traffic, much of which may stay on the present route to secure services.

Both Alternates A and B would remove much through traffic from the Interstate Bridge. This would favor relocation of auto-oriented local business establishments to the present route. Among the establishments which might advantageously locate on the old route over a period of years are: automobile sales businesses, boat sales and service establishments, sports equipment stores, bowling alleys, additional motels and restaurants, large supermarkets and discount stores.

Businessmen desiring to serve the entire Portsmouth trading area are likely to find that land on the existing Interstate Bridge approaches is more accessible than the areas on the edge of the downtown business districts of Portsmouth and Kittery, which are presently devoted to these uses. Removal of auto-oriented businesses from the central areas would make land available for parking, or other appropriate uses accessory to the pedestrian-oriented shopping district in the central business districts. Furthermore, the diversion of high speed, heavy, through traffic from the present Interstate Bridge may permit state and local officials to relax some of the restrictions presently imposed on traffic movements along the present approaches.

Changes in highway alignments, capacity, and quality of service are a powerful long-range influence on land development. Each roadside business establishment on the present Interstate Bridge approach has come into being in the last 20 years, largely because of the completion of the Maine and New Hampshire Turnpikes. Further changes may be expected as a result of plans presently under consideration. In this connection, it should be recalled that accessibility to markets, rather than exposure to traffic, frequently determines business potentials.

Location A would make available almost the full capacity of the existing Interstate Bridge for local travel. The high traffic volumes which presently occur during the summer season tax the capacity of the existing bridge, even though it is being operated with two lanes in the predominant direction of travel. Furthermore, it is likely that tolls may be removed from the present bridge before the new river crossing is opened. The Memorial Bridge, which provides a direct connection from the central part of Portsmouth to the central part of Kittery, is operating at close to practical capacity. The combination of the toll on the Interstate Bridge and capacity restraints on the Memorial Bridge has the effect of discouraging traffic between Portsmouth and Kittery. If through traffic were diverted from the Interstate Bridge and tolls were removed, it is likely that local traffic crossing the Piscataqua River would increase substantially, and many motorists who now use the Memorial Bridge would shift to the Interstate Bridge.

This consideration should carry considerable weight, as many studies—some of which are cited below—have demonstrated the beneficial effects of bypasses in stimulating local businesses. The present approach roads to the Interstate Bridge are strategically located. If through traffic is re-routed via a new bypass, as envisaged in Alternate A, the opportunity is created for an expansion of business activity on the approach roads. The extent of this potential development depends, in large part, on the enterprise of the area's businessmen.

Alternate C, which utilizes the existing roadway and provides frontage roads with direct access to the through traffic lanes at several locations, would cause the least change from the present patterns of land use. The existing pattern of roadside business, heavily dependent on the ebb and flow of seasonal recreational traffic, would probably continue. Yet, all of the service stations on the west side of the Interstate Bridge approach in New Hampshire would be taken to provide right-of-way for the new southbound lanes. However, it is assumed that construction of new service stations in Maine to serve this traffic would partially off-set their loss. Automobile-oriented businesses would try to find locations elsewhere in the area. However, alternate locations do not appear to be as centrally located with respect to the trading area of the community as the frontage on the Interstate Bridge approaches.

The conflict between high speed through traffic and vehicles entering or leaving driveways along the present route poses a continuing traffic hazard. All of the proposals presented in this report contemplate elimination of direct access to roadside developments. Alternates A and B would further reduce driving hazards by eliminating the existing mixture of high-speed, long haul, through traffic and relatively slower local traffic, which would be retained with Alternate C. Studies have shown that controlled access highways have approximately one half the accident rate of highways with partial control of access. The number of accidents on the existing Interstate Bridge approaches should also be reduced, because of the removal of conflicts between through and local traffic provided by Alternates A and B.

Some widespread benefits to the local community may also be anticipated from Alternates A and B in the form of free circulation of local traffic.

Other Economic Considerations

Thus far, the discussions have dealt mainly with the data collected and the conditions observed in this study. There are many other important economic considerations gleaned from other studies and reports that have applications to this project.

Since two of the proposed alternate routes by their limited access characteristics are in effect bypasses of the existing strip-urban development, the findings of numerous bypass impact studies are relevant.

Bypass Effects—Bypasses do not generally affect business activity negatively. They can, in fact, be positive, progressive and strong influences. The effects of a limited-access facility on existing businesses will certainly be at a minimum, because no highway oriented facility can be located on the new roadway. The design standards for the Interstate route, providing a controlled-access facility, will not allow business devolpments directly on the route. Motorists will be required to leave the road for all services—gasoline, food, lodging, etc.

"Before" and "after" studies of the effects of bypasses on existing business districts demonstrate that even negative initial impacts are almost always quickly overcome when controlled-access bypasses are constructed. California has made many such studies.[14]

The excellent studies made in California on the effects of bypasses are summarized in Table 48.

TABLE 48

BUSINESS VOLUMES AFTER CONSTRUCTION OF BYPASS FREEWAYS

California Cities	*Year Bypass Was Constructed*	*Pop. of Town or City*	*Per Cent Change* Business	Eating Places	Service Stations	All Others
Templeton	1952-3	600	+ 24	− 9	− 2	+20
Folsom	1949	1,700	+ 36	+ 7	+ 5	− 1
Imperial	1949	1,700	+ 21	+ 2	+ 3	+ 1
Anderson	1950	2,200	+ 21	+132	−31	+22
Auburn	1947	4,600	+ 74	+ 5	+21	0
Fairfield	1949	5,000	+109	+ 14	−12	+ 7
Escondido	1949	6,600	+ 67	+ 12	+26	+13
N. Sacramento	1947	6,000	+224	+ 12	+26	+22

Source: *California Highways and Public Works*

[14] "Four Years After," by John F. Kelly, *California Highway and Public Works*, 1953.
"Bypass Effects, U.S. Highway 50," (Falsom and Imperial) *California Highways and Public Works*, 1951.

In a special report made to Congress in 1961[15], the results of studies in several states were reported. The report states:

"Of the 76 bypassed areas for which information about retail trade activity is available, 50 experienced either a greater increase or a smaller decrease than occurred in a comparable area which was not bypassed. . . . Service stations in bypassed areas registered gains exceeding those for the control group in approximately half of the 46 cases where information is available. . . . Also, since most of the modern bypassed routes are limited-access facilities prohibiting the construction of abutting business establishments, through travelers desiring to make purchase must ordinarily leave the highway and enter the bypass area if they wish to make a purchase. As a result, through travelers on local streets of bypassed areas are more likely to have a shopping purpose than was formerly the case when all travelers were routed over local streets."

The report continues:

"In Illinois, for example, the volume of retail trade in four towns bypassed by a major highway increased or remain unaffected. . . . In Tyndall, South Dakota, retail business was found to be better in 1957, after construction of a bypass route, than in the county in which Tyndall is located. . . . Areas experiencing rapid economic growth and high traffic volumes experience little adverse effects from traffic diversion. . . . One of the most common adjustments attempted by businesses in bypassed areas is to attract more local customers. For example, restaurants may emphasize service to families rather than truckers; a souvenir gift store may evolve into a variety store or hardware store; and service stations may shift their emphasis from selling gas to automobile lubrication or other minor servicing."

Extensive studies were made of the effects of bypasses on communities in Kansas.[16] The following conclusions may be drawn from this report:

1. Comparison of the sales performance of firms selling highway oriented goods with that of all other firms revealed no significant decrease in highway oriented sales that could be attributed directly to a possible loss in through traffic. . . .

4. For the city, as a whole, highway oriented sales have continued on their upward trend throughout this entire period of highway relocation.

7. The stability of the highway oriented share of total sales indicates that the installation of the bypass highway did not cause any relative disservice in the aggregate to firms selling these types of retail goods.

Many other citations could be given, but the pattern appears to be the same: controlled-access bypasses rarely have a sustained negative effect on bypassed business, even those heavily auto-oriented.

General Observations on Land Values—Based on other studies, the development of a new Interstate route should have a positive effect in land values. In both Portsmouth and Kittery, the entire community becomes more accessible and this accessibility will increase the area of the labor market and the development of customer markets. This, in turn, will make the area more inviting for commercial and industrial growth. Land adjacent to the freeway will tend to be favored over other land for purposes of industrial and commercial expansion. Increases in truck transportation and trends in dispersion of industries will be important factors in the area's development.

The freeway will tend to appreciate adjoining property; it will provide important advertising impacts, it will constitute a convenience to employees and business associates, and will help develop additional business.

The importance of freeways as a factor in industrial location has been well described in an article by William M. Barker.[17] He mentions five reasons:

1. The movement of the people to the suburbs requires good highways for plant employees. Some workers travel up to 40 miles.

2. Truck transportation's availability to the plant is an important consideration, especially in less than car load shipments.

3. Advertising benefits accrue as a result of proximity to the highway. The name of the firm on the building as well as the fact that the plant is within sight of the motorist, engender much of this benefit.

4. Big plant investments should be in places that are easily reached.

5. The thruways help make economical a system of satellite plants.

Many other studies have shown how freeways increase land values, particularly within the zone of influence in urbanized area, far more rapidly than other land in the

[15] *Final Report of the Highway Cost Allocation Study,* Part VI, House Document No. 72, 87th Congress 1st Session, 1961, p. 37.

[16] *The Economic Effects of Bypass Highways and Selected Kansas Communities,* by Hulse Wagner, Center for Research in Business, University of Kansas, Lawrence, Kansas, 1958.

[17] *The Thruways as an Industrial Location Factor,* William M. Barker.

region. As these land values increased and as new businesses developed, the communities enjoyed direct benefits in terms of increases in assessments and, thereby, increased tax collections. Ratios of the percentage increases in a somewhat similar condition have been found to range from 0.7 to over 10. The values of land adjacent to the new route can increase from 1.1 to 3.5 times as fast as other land in the area.[18]

Throughout the country experiences have been similar: freeways have encouraged land development, intensified land use and strengthened the communities' tax bases.

Integrated Planning—State and local officials recognize the importance of developing the new Interstate route in a manner that will best fit long-range plans for both Portsmouth and Kittery. Comprehensive street and highway planning has been in process in each of the communities concurrently with this study. Interchanges, important roadway connectors and other components of the over-all planning will be closely attuned to the new Interstate route. However, the proposed route will require a minimum development of feeder and service streets. Rather than upsetting long range plans, the route can have a marked influence in stabilizing highway plans for the entire area.

Local planning bodies are certain to take this important transportation artery into full account in their over-all land use planning. Maximum social and economic benefits will thereby result.

The routes under study are designed for the future needs of Portsmouth and Kittery as well as for the rapid movement of interstate and defense traffic. They will improve transportation services, access to key military installations and will not have an adverse effect on navigation.

Summary of Impact Factors

The construction of the new Interstate route will occur at a very favorable period in the growth and development of both Portsmouth and Kittery. Each of these cities is growing slowly but soundly. They are now arriving at a point in size where local business transactions will become increasingly larger in relation to transactions by transients.

To promote as much year-round business stability as is possible, most businesmen will be anxious to develop these local potentials which will become of increasing importance as the two cities grow.

The economic and business studies carried out for this report, permit comparisons among the relative impacts of the three proposed alternate route alignments:

[18] *Future Highways and Urban Growth,* Wilbur Smith and Associates, New Haven, Connecticut, 1961, Page 308.

Residential Development—Alternate A will require the removal of approximately 26 dwellings and 70 house trailers. Plan B also will require the removal of approximately 26 dwellings. Plan C will affect only 21 dwellings.

The removal of a limited number of dwellings from the areas to be traversed, while creating the need for individual adjustments, is usually not a serious matter over the long-run because of the tendency frequently observed for residential uses to give way to other community land uses.

Commercial Development—Alternate A will produce some adverse effects on service station businesses along the present route, but this condition should be temporary. Construction of this alternate will require the removal of two existing service stations. Construction of Alternate B will require the removal of three service stations and would have about the same effects on service station businesses as Alternate A.

To construct Alternate C, nine service stations will be removed. Some adverse effects will be created on service station businesses initially but in the future, the "saturation effect" would retard total service station expansion in the entire area.

It is not believed that either of the three highway plans will have appreciable adverse impacts on restaurants or motels. Alternate A should produce the maximum values in commercial development. It will open up a much greater area of land for development than either of the other two routes, and it will permit the maximum utilization of land along the existing routes for business and commercial expansion.

As has been pointed out, the Portsmouth-Kittery urbanized area enjoys a very favorable geographic position along the north-south travel corridor. Approaching from the north or south, the area provides the first opportunity in many miles for motorists to avail themselves of a choice of services—service stations, motels and restaurants. Because of the design characteristics of Interstate highways, the growth of additional business in the Portsmouth-Kittery area will be encouraged rather than discouraged.

Motorists seek out high-type businesses, such as those located on the approaches to the Interstate Bridge for their principal transactions. They will, therefore, continue to plan their stops so as to make maximum use of these businesses.

Industrial Development—Alternates A and B will be much better for encouraging industrial development than Alternate C. Small businesses, industrial plants and industrial parks can be developed readily with either construction of Alternates A or B. Again, the advantage will be slightly in favor of Plan A. Because of the land restrictions created, Alternate C offers the least opportunity for industrial development, particularly for small plants.

Public and Institutional Land Uses—Alternate A will interfere with a water tower. Line B would take a portion of the site of Franklin School, but will not disturb the school building. Plan C will also encroach on the Franklin School property. When the costs of remedies for these encroachments are considered, it appears that the least cost will be incurred in the construction of Alternate A.

Right-of-way Costs—Part III has presented these costs in some detail. In connection with the summary of impacts given here, it should be noted that—according to the preliminary estimates—the value of the property that needs to be acquired is of the same magnitude for all three plans. However, the costs for Alternate A are less by approximately 15 to 20 per cent.

Conclusion

A new Interstate route to the west of the present Portsmouth-Kittery urbanized area, with proper signing and feeder roads, will increase total economic potentials. New travel will be induced, thereby increasing the number of stopovers and business purchases by motorists. New land uses will develop and present land values will increase. The new highway will serve to stimulate the business economy in both Maine and New Hampshire.

The impact studies indicate that the alternate route locations evaluated in this report will not produce significant adverse effects on the general economy of Portsmouth and Kittery. While the immediate effects for Alternate A will be somewhat more negative than the other lines, its long-range advantages will be greater. Through its construction, some businesses along the present route will suffer initially, but these losses will be limited almost entirely to service stations. Increases in local patronage and accelerated growth in traffic, which the new route will induce, should quickly compensate for the small amount of business lost immediately after completion of the new river crossing.

PART IV

TRAFFIC AND REVENUES

Traffic usage and toll revenues have been developed for the alternate bridge locations assuming that they were constructed as toll facilities. By relating toll revenues, maintenance and operation costs, and capital costs, the feasibility of revenue bond financing is indicated.

Chapter XIII
TOLL IMPLICATIONS

Construction of the National System of Interstate and Defense Highways, of which Interstate Route 95 through the Portsmouth-Kittery area is a part, is to be financed jointly by the Federal government and the respective states. Generally, the Federal government is responsible for 90 per cent of the construction costs; the states provide the remaining 10 per cent. The Federal construction money is drawn from a highway trust fund and the amounts apportioned to each state are related to the estimated cost of completing the Interstate highway system in each state.

To expedite Interstate highway construction and complete the system prior to the programed completion date in 1972, many states have sold general obligation bonds. Arrangements have been made with the Bureau of Public Roads by these states to receive reimbursement for the actual construction costs as highway trust funds become available. Other states have financed construction of Interstate highways by the sale of revenue bonds. In these instances, the security of the bonds is the tolls collected from motorists using the facilities, or a combination of tolls and pledges of gas tax and/or other highway department revenues.

This latter method of financing routes, now designated as part of the Interstate highway system, has been used in both Maine and New Hampshire as well as Massachusetts, New York, Connecticut, Pennsylvania, New Jersey and several of the midwestern states.

Purpose

A basic consideration of this study was to evaluate the feasibility of financing the construction of Interstate Route 95 through the Portsmouth-Kittery area with tolls. Consideration was given to revenue bond financing for the construction items that would not be eligible for federal participation if a toll were collected for use of the river crossing. Analyses were also made assuming Interstate financing and that only the 10 per cent states share of the construction costs would be financed by tolls.

Existing Interstate Bridge

The present direct connection between the New Hampshire and Maine Turnpikes is via the Piscataqua River bridge operated by the Maine-New Hampshire Interstate Bridge Authority. The present bridge is essentially a two-lane facility although special traffic operational techniques permit three-lane operation during peak travel periods. Present traffic demands exceed the capacity of the bridge.

The Maine-New Hampshire Interstate Bridge Authority

The Maine-New Hampshire Interstate Bridge Authority was created by acts of the Maine and New Hampshire Legislatures in 1936-1937. The compact between the two states was approved by the Congress on June 16, 1938. The Trust Indenture, dated February 1, 1955 under which the Authority has operated, was terminated on February 1, 1962, following the redemption of all outstanding bonded indebtedness.

The enabling legislation provides for the continuance of toll charges to accumulate a trust fund for the operation and maintenance of the bridge in future years. Present revenues from the bridge are accumulating in the trust fund.

Traffic and Revenue Growth—Existing Interstate Bridge

The present bridge operated by the Maine-New Hampshire Interstate Bridge Authority has enjoyed good growths in traffic and revenues. In Table 49, traffic trends are indicated for the period 1951 through 1961.

TABLE 49

TRAFFIC TRENDS

Maine-New Hampshire Interstate Bridge

	Passenger Cars		Trucks	
Year	*Number*	*Per Cent Change From Previous Year*	*Number*	*Per Cent Change From Previous Year*
1951	2,310,015	18	276,848	10
1952	2,670,784	16	304,179	10
1953	2,767,907	4	323,651	6
1954	2,885,505	4	344,878	7
1955	3,233,567	12	393,527	14
1956	3,460,717	7	387,430	− 2
1957	3,805,087	10	358,140	− 8
1958	3,888,721	2	352,642	− 2
1959	4,186,594	8	390,905	11
1960	4,814,939	15	429,909	10
1961	4,581,880	−5	414,195	− 4

Source: The Maine-New Hampshire Interstate Bridge Authority.

Annual traffic usage of the Interstate Bridge has increased from over 2,310,000 passenger cars in 1951 to 4,582,000 passenger cars in 1961, over 98 per cent. This is equivalent to an annual growth rate of over seven per cent per year compounded. Growth in truck usage in the same ten-year period was somewhat less, slightly under 50 per cent or at an average rate of over four per cent per year compounded. During the first seven months of 1962 passenger car usage increased 3.4 per cent and truck usage increased 7.0 per cent as compared to the same period in 1961.

While annual traffic growths have varied considerably due to economic conditions and other factors, the overall growth during the last few years indicates a normal growth pattern of between four and five per cent per year.

Annual toll revenues and the per cent change over the previous year are shown in Table 50 for the period 1951 through 1961. Revenues have increased from about $279,000 in 1951 to over $564,000 annually in 1961. In this ten-year period revenues have increased by over 100 per cent. This is equal to an average annual growth rate of almost 7.3 per cent per year compounded.

TABLE 50

ANNUAL TOLL REVENUES

Maine-New Hampshire Interstate Bridge

Year	*Revenues*	*Per Cent Change Over Previous Year*
1951	$278,775	16
1952	307,506	10
1953	328,192	7
1954	352,867	8
1955	394,084	12
1956	425,347	8
1957	459,829	8
1958	473,685	3
1959	515,757	9
1960	589,251	14
1961	564,494	−4

Source: Maine-New Hampshire Interstate Bridge Authority.

During the last five years, revenues have increased almost 33 per cent from $425,000 to $564,000 annually. This is an average annual increase of over 5.8 per cent per year. During the first seven months of 1962, gross revenues increased about 4.7 per cent over the comparable period in 1961.

The decrease in tolls and traffic usage in 1961 reflects the closing of the Memorial Bridge to traffic for an extended period during 1960 and the temporary diversion of this traffic to the Interstate Bridge.

Toll Schedule

A fairly nominal toll structure is used on the present Interstate Bridge. As shown in Table 51, passenger cars are charged ten cents. The toll for three and four-axle semi-trailer vehicles is 25 and 35 cents, respectively. Commutation books are available which reduce the toll rate to 15 cents for three-axle semi-trailer vehicles and 25 cents for four-axle semi-trailer trucks.

TABLE 51

PRESENT TOLL SCHEDULE

Maine-New Hampshire Interstate Bridge

Vehicle Toll Class	*Number of Axles*	*Toll Rate*
Passenger Car Light Delivery Truck Motorcycles	2	10¢
Passenger Car and Single Axle Trailer (also House Trailer)	3	25¢
Passenger Car and Double Axle Trailer (also House Trailer)	4	35¢
Truck—Medium (Single or Dual Rear Tires)	2	20¢
Truck—Heavy (Semi-tractor Trailer)	3	25¢
Truck—Heavy Tractor Trailer (four axles)	4	35¢
Truck with five axles or over (Semi-tractor—heavy equipment)	5 or over	50¢
Bus with two axles	2	20¢
Bus with three axles	3	25¢
Commutation Book Busses or Trucks under four axles—40 trips	2 and 3	15¢
Commutation Book Trucks of four axles—50 trips	4	25¢

Source: The Maine-New Hampshire Interstate Bridge Authority.

Chapter XIV

ESTIMATED TRAFFIC USAGE AND REVENUES

Traffic assignments were made to each of the three alternates studied to establish traffic usage and earnings assuming that tolls would be collected from motorists. Diverted traffic levels were projected to the first full year of operation of the proposed toll facility and for a thirty-seven year earning period.

Alternate Toll Schedules

Two basic toll schedules were considered in assigning traffic to the proposed river crossings assuming that they would be built as toll facilities. As shown in Table 52, the toll schedules assume a five cent or ten cent per axle toll rate.

A toll schedule embodying a per axle toll charge is easy to apply, more readily understood by motorists, and facilitates audit and accounting control. As indicated, passenger cars would pay either 10 cents or 20 cents; a four-axle semi-trailer either 20 cents or 40 cents. A commutation rate is not recommended, although it might be considered if tolls are retained on the existing Interstate Bridge or Alternate C is constructed, since a large number of local motorists would be required to pay tolls.

Estimated 1961 Diverted Traffic

Traffic assignments were made to Alternates A, B, and C assuming that tolls would be collected from motorists. Since Alternate C includes the existing Interstate Bridge as part of the design, computations were also made assuming that tolls would continue to be collected on the existing Interstate Bridge if Alternates A or B were constructed. In Table 53, assigned traffic volumes at 1961 levels are indicated for Alternates A and B assuming that the existing Interstate Bridge would be toll free. In Table 54, estimated 1961 traffic volumes using the proposed bridges as well as the existing Interstate Bridge are shown assuming that Alternate C were constructed, or tolls were continued on the existing Interstate Bridge and Alternates A or B were constructed.

It is estimated that about 10,579 vehicles would use the proposed bridge on new location (Alternates A and B) if the toll structure was five cents per axle. About 9,224 vehicles per day are anticipated with a 10 cent per axle toll rate. It is anticipated that the higher per axle toll charge would have a greater impact on the commercial traffic than the two-axle vehicles which are primarily passenger cars. With a five cent per axle toll rate, it is expected that about 5.5 per cent of the traffic would be three and four-axle trucks; with a ten cent per axle toll rate, it is anticipated that only 4.7 per cent of the traffic would be the larger commercial vehicles.

TABLE 52

ASSUMED TOLL SCHEDULES

Proposed Piscataqua River Bridge

Vehicle Toll Class Number	Vehicle Toll Class Description	Assumed Toll Rate 5 Cents Per Axle	Assumed Toll Rate 10 Cents Per Axle
1	Two-Axle Vehicle:	$0.10	$0.20
	Passenger Car Pickup and Panel Truck Two-axle 6-Tire Truck		
2	Three-Axle Vehicle:	0.15	0.30
	Three-Axle Truck Two-Axle Vehicle Pulling Single-Axle Trailer		
3	Four-Axle Vehicle:	0.20	0.40
	Two-Axle Vehicle Pulling Two-Axle Trailer Three-Axle Vehicle Pulling Single-Axle Trailer		
4	Five-Axle Vehicle:	0.25	0.50
	Three-Axle Vehicle Pulling Two-Axle Trailer Two-Axle Vehicle Pulling Three-Axle Trailer		
5	Special and Oversize Vehicles, Per Axle	0.05	0.10

TABLE 53

ESTIMATED 1961 DIVERTED TRAFFIC

Assuming Tolls on Alternates A or B—
Existing Interstate Bridge Toll Free

Vehicle Toll Class		Average Daily Traffic With			
		5 Cent Per Axle Toll Rate		10 Cent Per Axle Toll Rate	
Number	Description	Number	Per Cent	Number	Per Cent
1	Two-Axle Vehicle	9,998	94.5	8,789	95.3
2	Three-Axle Vehicle	262	2.5	196	2.1
3	Four or more Axle Vehicles	319	3.0	239	2.6
	Total	10,579	100.0	9,224	100.0

In Table 54, estimated 1961 diverted traffic is indicated, assuming tolls on the proposed bridge and existing Interstate Bridge. If tolls are continued on the existing Interstate Bridge, some traffic which would use it as a free facility would continue to use the Memorial Bridge. Even with this redistribution of traffic, the number of toll paying vehicles would be about 52 per cent greater with a five cent per axle toll rate, 68 per cent greater with a 10 cent per axle toll rate.

TABLE 54

ESTIMATED 1961 DIVERTED TRAFFIC

Assuming Tolls on Proposed Bridge and
Existing Interstate Bridge[1]

Vehicle Toll Class		Average Daily Traffic With			
		5 Cents Per Axle Toll Rate		10 Cents Per Axle Toll Rate	
Number	Description	Number	Per Cent	Number	Per Cent
1	Two-Axle Vehicle	15,208	94.5	14,721	94.8
2	Three-Axle Vehicle	402	2.5	369	2.4
3	Four or more Axle Vehicles	483	3.0	443	2.8
	Total	16,093	100.0	15,533	100.0

[1] Traffic usage of Alternates A, B, and C would be identical.

First Year Traffic and Revenues

It has been assumed that the proposed new bridge and its approaches could be opened to traffic by January, 1966. Based upon present traffic trends, in particular usage of the existing Interstate Bridge and New Hampshire and Maine Turnpikes, it is anticipated that the normal traffic growth from 1961 through 1966 will be about 4.5 per cent per year. It is also assumed that the opening of the new, high capacity connector between the Maine and New Hampshire Turnpikes will induce generated and development traffic equal to about 10 per cent of the previous year traffic level.

In Table 55, first year traffic and revenues for the proposed Piscataqua River Bridge with five and ten cent per axle toll rates are indicated.

TABLE 55

FIRST YEAR TRAFFIC AND REVENUES (1966)

Assuming Tolls on Alternates A or B—
Existing Interstate Bridge Toll Free

Vehicle Toll Class		5 Cents Per Axle Toll Rate		10 Cents Per Axle Toll Rate	
Number	Description	AADT	Revenue	AADT	Revenue
1	Two-Axle Vehicle	13,705	$500,200	12,048	$879,500
2	Three-Axle Vehicle	359	19,700	269	29,500
3	Four or more Axle Vehicles	437	31,900	328	47,900
	Total	14,501	$551,800	12,645	$956,900

With the assumed five cent per axle toll rate, it is estimated that 14,501 vehicles will use the proposed new river crossing on an annual average day in 1966, if it is constructed on the Alternate A or B locations and the existing Interstate Bridge becomes toll free. With the ten cent per axle toll, it is expected that the annual average traffic level will be reduced to 12,645 vehicles daily. First year revenues, assuming that the bridge and its approaches are opened to traffic in 1966, are estimated at $551,800 with a five cent per axle toll rate, $956,900 with a 10 cent per axle toll.

With the five cent per axle toll schedule, it is anticipated that about 9.4 per cent of the tolls would be collected from three and four axle vehicles; with the ten cent per axle toll rate, it is estimated that only 8.1 per cent of revenues will be from the larger commercial vehicles.

If the tolls are collected at the existing bridge and on the bridges proposed by Alternates A and B, first year traffic and revenues for the combined facilities and for Alternate C would be identical. Annual average daily traffic and annual toll revenues for first year of operation (1966) are indicated in Table 56 for both the five cent per axle and 10 cent per axle toll schedules. The first year toll revenues are estimated to be $839,400 with the five cent per axle toll rate, about 52 per cent higher than if tolls were collected from the proposed bridge on new location alone and the Interstate Bridge were toll free. First year toll revenues of about $1,617,000 are estimated with the ten cent per axle toll rate assuming that tolls are collected on both the existing Interstate Bridge and the proposed new river crossing. These revenues are about 69 per cent higher than would be realized if the tolls were collected from the new bridges proposed in Alternates A or B alone.

TABLE 56

FIRST YEAR TRAFFIC AND REVENUES (1966)

Assuming Tolls on Proposed Bridge and Existing Interstate Bridge

Vehicle Toll Class		*5 Cents Per Axle Toll Rate*		*10 Cents Per Axle Toll Rate*	
Number	*Description*	*AADT*	*Revenue*	*AADT*	*Revenue*
1	Two-Axle Vehicle	20,846	$760,900	20,178	$1,473,000
2	Three-Axle Vehicle	551	30,200	506	55,400
3	Four or more Axle Vehicles	662	48,300	607	88,600
	Total	22,059	$839,400	21,291	$1,617,000

Annual Traffic Growth

Normal traffic growths in the travel corridor served by the present Interstate Bridge are estimated at 4.5 per cent per year as shown in Table 57. In the traffic and revenue projections, a 4.0 per cent annual growth rate is estimated between 1969 and 1971, decreasing to 3.5 per cent annually between 1972 and 1974. During the period 1975 through 1977, a 3.0 per cent per year growth rate has been used; from 1978 to 1980, a 2.5 per cent annual growth is indicated. No traffic growth is shown after 1980 although all growth indices and the traffic projections assuming toll free river crossings, indicate a continued moderate traffic growth through 1985.

TABLE 57

ESTIMATED TRAFFIC GROWTHS

Proposed Piscataqua River Bridge

Year	*Per Cent Growth Over Previous Year* — *Generated and Development*	*Normal*
1962		4.5
1963		4.5
1964		4.5
1965		4.5
1966	10	4.5
1967	5	4.5
1968		4.5
1969		4.0
1970		4.0
1971		4.0
1972		3.5
1973		3.5
1974		3.5
1975		3.0
1976		3.0
1977		3.0
1978		2.5
1979		2.5
1980		2.5

When new highway facilties greatly improving the quality of traffic service are opened, experience demonstrates that traffic growths are much higher than normal. This additional traffic consists of new travel generated by the attractiveness of the new facility and the accelerated development of areas served by the new highway. Since a large part of the traffic in this corridor is long distance travel, presently well served by the New

Hampshire and Maine Turnpikes, a very conservative amount of generated and development traffic is anticipated. Generated and development traffic equal to 10 per cent of the previous year traffic level has been estimated during the first year the new river crossing and its approaches are opened to traffic, five per cent during the second year of operation.

Annual Traffic and Revenues

In Table 58, estimated annual traffic and revenues are indicated for the proposed Piscataqua River bridge with the assumed five and ten cent per axle toll rates if it is constructed on the Alternate A or B locations and the existing Interstate Bridge is toll free. Table 59 shows estimated annual traffic and revenues if the Alternate C location is used, or if the tolls are collected on the existing Interstate Bridge as well as on the proposed Alternate A or B structures.

It is anticipated that first year traffic levels will increase from about 14,501 vehicles per day in 1966 to 24,400 vehicles per day in 1980 if a five cent per axle toll is levied and Alternates A or B are constructed as toll facilities. With the ten cent per axle toll rate, it is expected that first year traffic of 12,645 vehicles will increase to 21,280 vehicles in 1980. Gross tolls are anticipated to increase from about $552,000 in 1966 to $929,000 in 1980, with the five cent per axle toll. Gross tolls with the ten cent per axle toll schedule are expected to be almost 74 per cent greater, $957,000 in 1966 increasing to $1,610,000 in 1980.

In the interests of conservatism, no growth in traffic usage and revenues is indicated after 1980 although a continued moderate increase is anticipated.

As shown in Table 59, estimated annual traffic revenues would be considerably higher if tolls were collected on the existing Interstate Bridge as well as the proposed new river crossings. Annual toll revenues would increase from about $839,000 in 1966 to about $1,411,000 in 1980 with the five cent per axle toll rate. If the 10 cent per axle toll schedule were used, annual revenues of $1,617,000 in 1966 are expected to increase to about $2,720,000 in 1980. Average annual revenues for the first 37 years of operation are estimated at $1,306,000 with the five cent per axle toll rate, $2,517,000 annually with the 10 cent per axle toll rate.

TABLE 58

ESTIMATED ANNUAL TRAFFIC AND REVENUES

Assuming Tolls on Alternates A or B—
Existing Interstate Bridge Toll Free

Year	With 5 Cents Per Axle Toll Rate: AADT[1]	With 5 Cents Per Axle Toll Rate: Annual Gross Tolls (000)	With 10 Cents Per Axle Toll Rate: AADT[1]	With 10 Cents Per Axle Toll Rate: Annual Gross Tolls (000)
1966	14,501	$552	12,645	$ 957
1967	15,910	605	13,870	1,050
1968	16,630	633	14,500	1,097
1969	17,300	658	15,080	1,141
1970	17,990	684	15,680	1,187
1971	18,710	712	16,310	1,234
1972	19,360	737	16,880	1,277
1973	20,040	762	17,470	1,322
1974	20,740	789	18,080	1,368
1975	21,360	813	18,620	1,409
1976	22,000	837	19,180	1,452
1977	22,660	862	19,760	1,495
1978	23,230	884	20,250	1,533
1979	23,810	906	20,760	1,571
1980	24,400	929	21,280	1,610
Next 22 Years Annually		929		1,610
Average Annual Gross Revenues				
First Five Years		$626		$1,086
First Ten Years		$694		$1,204
First 37 Years		$859		$1,490

[1] Annual Average Daily Traffic

TABLE 59

ESTIMATED ANNUAL TRAFFIC AND REVENUES

Assuming Tolls on Proposed Bridge and Existing Interstate Bridge[1]

Year	With 5 Cents Per Axle Toll Rate AADT[2]	With 5 Cents Per Axle Toll Rate Annual Gross Tolls (000)	With 10 Cents Per Axle Toll Rate AADT[2]	With 10 Cents Per Axle Toll Rate Annual Gross Tolls (000)
1966	22,059	$ 839	21,291	$1,617
1967	24,200	920	23,360	1,774
1968	25,290	961	24,410	1,854
1969	26,300	999	25,390	1,928
1970	27,350	1,039	26,410	2,005
1971	28,440	1,081	27,470	2,085
1972	29,440	1,119	28,430	2,158
1973	30,470	1,158	29,430	2,234
1974	31,540	1,199	30,460	2,312
1975	32,490	1,235	31,370	2,381
1976	33,460	1,272	32,310	2,452
1977	34,460	1,310	33,280	2,526
1978	35,320	1,343	34,110	2,589
1979	36,200	1,377	34,960	2,654
1980	37,100	1,411	35,830	2,720
Next 22 Years Annual		$1,411		$2,720
Average Annual Gross Revenues				
First Five Years		$ 952		$1,836
First Ten Years		$1,055		$2,035
First 37 Years		$1,306		$2,517

1 Traffic usage of Alternates A, B and C would be identical.

2 Annual Average Daily Traffic

NOTE: Tolls collected on the two bridges are combined in this tabulation.

Chapter XV
FEASIBILITY OF REVENUE BOND FINANCING

Annual maintenance and operation costs of the proposed high-level bridge and its approaches if operated as a toll facility have been estimated. Operating costs for the Interstate Bridge, recognizing the substantial change in traffic usage, were also determined. By relating net revenues to debt service requirements, based upon an estimated bond issue and assumed interest rate, the feasibility of revenue bond financing is established.

Annual Maintenance and Operation Costs

Operating costs are indicated in Table 60 for the alternates studied. If the existing Interstate Bridge becomes toll free, personnel costs are estimated at $70,000 annually, related toll collection expenses at $35,000. Maintenance of the bridge, including a painting reserve fund, is estimated at $25,000 annually; other operating and miscellaneous expenses are expected to approximate $20,000. If maintenance costs for the approaches are also included, a total operating budget of $175,000 per year appears reasonable.

If the new bridge and the existing Interstate Bridge are both operated as toll facilities, salaries of operating personnel are estimated at $120,000 and operating expenses at $60,000. Bridge maintenance costs would increase to $75,000 due to the necessity of paying the salaries of bridge tenders on the lift span and higher mechanical and electrical maintenance costs for the lift bridge. Insurance costs would also be somewhat higher for the existing Interstate Bridge, thereby increasing other operating expenses to about $45,000. The total operating budget for the bridges is estimated at $350,000, if maintenance costs for the approaches are also included.

Annual Net Revenues—Alternates A or B

In Table 61 annual net revenues assuming the Alternates A or B bridges operated as a toll facility are indicated.

With Five Cent Per Axle Toll Rate—First year net revenues of $377,000 are indicated assuming that the bridge and approaches will be financed through the sale of revenue bonds. Assuming a three-year construction period and 40-year revenue bonds, it is estimated that average annual net revenues for the 37-year earnings period will approximate $661,000 per year.

TABLE 60

ESTIMATED ANNUAL OPERATING BUDGETS

Fiscal Years 1966-1970

Item	*Annual Expenses* — *Alternates A orB - Existing Interstate Bridge Toll Free*[1]	*Annual Expenses* — *Alternates A, B, or C With Tolls On Interstate Bridge*
Bridges		
Operating Personnel—		
Toll Collectors and Supervisors	$ 70,000	$120,000
Operating Expenses—		
Supplies, Utilities, Office Equip., Travel, Toll Equipment Rental and Maintenance, Misc.	35,000	60,000
Maintenance—		
Lighting, Normal Bridge Maintenance, Painting Reserve	25,000	75,000
Other Operating Expenses—		
Insurance, Consulting Engineer, Trustee and Legal Fees	20,000	45,000
Approach Roadway		
Maintenance	25,000	50,000
Total	$175,000	$350,000

[1] In these preliminary estimates, identical costs are used for Alternate B since the lift span would be operated by the same bridge tenders employed to operate the lift span of the existing Interstate Bridge.

Table 61

ESTIMATED NET REVENUES

Assuming Tolls on Alternates A or B—Existing Interstate Bridge Toll Free
(Thousands of Dollars)

Year	With 5 Cents Per Axle Toll Rate: Gross Revenues	M & O[1] Expenses	Net Revenues	With 10 Cents Per Axle Toll Rate: Gross Revenues	M & O[1] Expenses	Net Revenues
1966	$552	$175	$377	$ 957	$175	$782
1967	605	175	430	1,050	175	875
1968	633	175	458	1,097	175	922
1969	658	175	483	1,141	175	966
1970	684	175	509	1,187	175	1,012
1971	712	190	522	1,234	190	1,044
1972	737	190	547	1,277	190	1,087
1973	762	190	572	1,322	190	1,132
1974	789	190	599	1,368	190	1,178
1975	813	190	623	1,410	190	1,220
1976	837	205	632	1,452	205	1,247
1977	862	205	657	1,495	205	1,290
1978	884	205	679	1,533	205	1,328
1979	906	205	701	1,571	205	1,366
1980	929	205	724	1,610	205	1,405
Next 22 Years Annually			$724			$1,405
AVERAGE ANNUAL NET REVENUES						
First Five Years			$451			$ 911
First Ten Years			$512			$1,022
First 37 Years			$661			$1,291

[1] Maintenance and operating expenses, including toll collection.

With Ten Cents Per Axle Toll Rate—Net revenues are substantially higher with the higher toll schedule. First year net revenues are estimated at $782,000 for the bridge project. For a 37-year earning period, assuming 40-year bonds and a three-year construction period, average annual net revenues of $1,291,000 should be realized.

Annual Net Revenues—Tolls on Proposed Bridge and Existing Interstate Bridge

Table 62 shows annual net revenues, assuming toll collection on the proposed bridge and the existing Interstate Bridge.

Table 62

ESTIMATED NET REVENUES

Assuming Tolls on Proposed Bridge and Existing Interstate Bridge[1]
(Thousands of Dollars)

Year	With 5 Cents Per Axle Toll Rate: Gross Revenues	M & O Expenses[2]	Net Revenues	With 10 Cents Per Axle Toll Rate: Gross Revenues	M & O Expenses[2]	Net Revenues
1966	$ 839	$350	$ 489	$1,617	$350	$1,267
1967	920	350	570	1,774	350	1,424
1968	961	350	611	1,854	350	1,504
1969	999	350	649	1,928	350	1,578
1970	1,039	350	689	2,005	350	1,655
1971	1,081	380	701	2,085	380	1,705
1972	1,119	380	739	2,158	380	1,778
1973	1,158	380	778	2,234	380	1,854
1974	1,199	380	819	2,312	380	1,932
1975	1,235	380	855	2,381	380	2,001
1976	1,272	410	862	2,452	410	2,042
1977	1,310	410	900	2,526	410	2,116
1978	1,343	410	933	2,589	410	2,179
1979	1,377	410	967	2,654	410	2,244
1980	1,411	410	1,001	2,720	410	2,310
Next 22 Years Annually			$1,001			$2,310
AVERAGE ANNUAL NET REVENUES						
First Five Years			$ 602			$1,486
First Ten Years			$ 690			$1,670
Thirty-Seven Years			$ 908			$2,119

[1] Traffic usage of Alternates A, B and C would be identical.
[2] Maintenance and operating expenses, including toll collection.

With Five-Cent Per-Axle Toll Rate—First year net revenues of $489,000 are estimated, assuming that revenue bonds are marketed for construction of the proposed bridge and its approaches. It is estimated that average annual net revenues for a 37-year earnings period, assuming a three-year construction period and 40-year revenue bonds, would approximate $908,000.

With Ten-Cent Per-Axle Toll Rate—Net revenues are more than 150 per cent greater with the higher toll rate. First year net revenues are estimated at $1,267,000 for the two bridges if both the proposed bridge and its approaches are financed by revenue bonds. Assuming a three-year construction period and 40-year revenue bonds, it is estimated that average annual net revenues for the 37-year earnings period would approximate $2,119,000 if the new bridge and its approaches are financed by the sale of revenue bonds and tolls are also collected on the existing Interstate Bridge.

Debt Coverage

The feasibility of revenue bond financing was investigated assuming the costs of constructing the bridge and its approaches on each of the alternates was financed entirely from revenue bonds. Analyses were also made assuming that revenue bonds would be sold for the states' 10 per cent share of construction costs, assuming that the facilities would become toll free after the debt was retired and, therefore, that Interstate funds would be available for the remaining 90 per cent of construction costs.

In Alternate C, the present Interstate Bridge is incorporated into the design and local trans-river traffic would have to pay a toll. Therefore, computations were made assuming that tolls would be collected on the existing Interstate Bridge and these revenues combined with earnings from Alternates A and B. Debt coverages were computed assuming both the five cent and ten cent per axle toll rates.

For the purpose of these preliminary analyses, it is anticipated that 40-year revenue bonds with an interest rate of 4.75 per cent could be marketed. Assuming capitalized interest for three years during construction and the first year of operation, maximum interest requirements and level debt service were computed. In all instances, the approximate size of the bond issue has been estimated conservatively on the high side. Care was taken to exclude construction cost items that would not be eligible for federal participation, such as toll collection appurtenances and roadways providing access and egress to the toll facility only.

The approximate size of the bond issue, maximum interest and debt service requirements are shown in Table 63 for each of these variations. In Table 64, approximate coverage of first year interest, second year interest and level debt service is indicated for each of the alternate revenue bond projects with the ten cent per axle toll rate. Debt service coverages were not adequate for revenue bond financing with a five cent per axle toll rate.

Tolls on Alternate A, Existing Interstate Bridge Toll Free—Assuming Federal funds are used where permissible south of the Portsmouth interchange and within the interchange area, a bond issue of about $15,800,000 would be required. Net revenues with a ten cent per axle toll would provide coverage of first year interest of 1.04 and coverage of level debt service of 1.41.

Interest coverage of about 1.2 in the early years, and level debt service coverage greater than 1.5 over the life of the bonds, is usually required to make a revenue bond project saleable. Assuming the present Interstate Bridge is toll free, it appears that the sale of revenue bonds is marginal for construction of the proposed high level bridge on Alternate A.

Tolls on Alternate B, Existing Interstate Bridge Toll Free—A bond issue of about $24,000,000 would be required to construct Alternate B as a toll facility. First year interest coverage is estimated at about 0.69, level debt service at 0.93. The relationship of debt service requirements to net income indicates that revenue bonds could not be sold for Alternate B, assuming a ten cent per axle toll.

Tolls on Alternate C—Since the present Interstate Bridge is an integral part of this design, local trans-river traffic using this crossing would pay a toll. This additional traffic would substantially increase revenues and, assuming that tolls would be collected on the Interstate Bridge during the construction period, would reduce capitalized interest requirements, thereby decreasing the size of the bond issue. Based on these assumptions, an assumed bond issue of $21,400,000 is indicated.

A first year interest coverage of 1.25 and level debt service coverage of 1.71 over the life of the bonds are indicated in Table 64. Based on these relationships, it would appear that revenue bonds could be sold for Alternate C.

Tolls on Alternate A and Existing Interstate Bridge—Net revenues from the Interstate Bridge would permit reduction of the amount of capitalized interest and the size of the bond issue. Therefore, an estimated b$3,250,000 on Alternate A and $4,100,000 less than if the Interstate Bridge were toll free, is anticipated. The very high coverage of first year interest, 1.84, and level debt service, 2.52, indicate that the project could be financed easily by the sale of revenue bonds.

TABLE 63

PRELIMINARY ESTIMATES OF DEBT SERVICE REQUIREMENTS

Assuming 10 Cents Per Axle Toll

Item	*Alternate A*[1]	*Alternate B*[1]	*Alternate C*[2]	*Alternate A and Existing Interstate Bridge*[2]	*Alternate B and Existing Interstate Bridge*[2]
Assuming Bridge and Approaches Financed Entirely by Toll Revenue Bonds			(Thousands of Dollars)		
Project Costs	$ 600	$ 690	$ 710	$ 600	$ 690
Right-of-way	10,310	15,880	15,000	10,310	15,880
Construction[3]	1,500	2,300	2,170	1,500	2,300
Engineering & Contingencies					
Total	$12,410	$18,870	$17,880	$12,410	$18,870
Assumed Bond Issue	15,800	24,000	21,400	14,500	22,700
Maximum Interest	750	1,140	1,016	689	1,078
Level Debt Service Requirements	915	1,390	1,239	840	1,315
Assuming States' 10 Per Cent Share of Bridge and Approaches Financed by Toll Revenue Bonds					
Project Costs	100	110	100	100	110
Right-of-way	2,130	2,700	2,670	2,130	2,700
Construction[3]	310	390	390	310	390
Engineering & Contingencies					
Total	$ 2,540	$ 3,200	$ 3,160	$ 2,540	$ 3,200
Assumed Bond Issue	3,250	4,100	2,750	1,950	2,800
Maximum Interest	154	195	131	93	133
Level Debt Service Requirements	188	237	159	113	162

1 Traffic usage and revenues of Alternates A and B are identical.

2 Traffic usage and revenues of Alternate C and Alternates A and B, assuming tolls are collected on the Interstate Bridge, are identical. Bond Issue reduced $1,300,000 to reflect net earnings of the Interstate Bridge during the three-year construction period.

3 The toll booths and additional costs of grading, paving, signing and lighting of the toll plaza are estimated at $262,000, $261,000 and $393,400 for Alternates A, B and C, respectively.

Tolls on Alternate B and Existing Interstate Bridge—With the decrease in size of bond issue made possible by earnings from the Interstate Bridge during the construction period, and the additional revenues from Interstate Bridge traffic, a first year interest coverage of 1.18 and level debt service of 1.61 is estimated. These coverages would indicate that the sale of about $22,700,000 in revenue bonds would likely be possible dependent upon market conditions.

Summary—Assuming the existing Interstate Bridge toll free and a ten cent per axle toll on the proposed bridge, debt service coverages indicate that the feasibility of marketing revenue bonds for the construction of Alternate A is marginal and that Alternate B could not be financed by the sale of revenue bonds. The preliminary feasibility studies indicate that revenue bonds could be sold for the construction of Alternate C as a toll facility.

Assuming that tolls are collected on the existing Interstate Bridge as well as on Alternates A and B, the combined revenues would make revenue bond financing of Alternate A quite attractive and the financing of Alternate B possible.

Interstate Financing, Assuming States' Share Obtained from Tolls

Existing federal-aid legislation permits federal participation in the costs of major river crossings which are operated as toll facilities if the enabling legislation provides that the facility will become toll free when the state has recaptured its share of construction costs from tolls. If this method of financing were followed, the states of Maine and New Hampshire would have to finance only ten per cent of the construction costs for the bridge and its approaches, and the entire cost of those construction items necessary for toll collection purposes. The approximate size of bond issue and debt service requirements are shown in Table 63. In Table 64, estimated coverages of interest and level debt service are given.

Assuming a toll free Interstate Bridge, the required bond issue would approximate $3,250,000 on Alternate A and $4,100,000 on Alternate B, if the states' share was financed by toll revenues and the remaining 90 per cent of construction costs obtained from federal Interstate funds. The relationship of net revenues to amortization costs indicate that the relatively small amount of bonds required would be retired in about five years with Alternate A and six years with Alternate B, assuming a ten cent per axle toll. The debt retirement period would be about twice as long if a five cent per axle toll was levied.

With Alternate C, or assuming that tolls would be collected on the Interstate Bridge and Alternates A or B, the size of the needed bond issue would be less since toll income would be available during the three year construction period. The size of bond issue required would vary from about $2,800,000 with Alternate B to $1,950,000 with Alternate A. This amount of debt could be retired within two to three years after the new bridge was opened to traffic.

* * * * *

For financing purposes, it will probably be necessary to obtain origin-destination data on weekends and during different seasons of the year. It will also be necessary to have specialists in the sale of this type security establish with greater preciseness the magnitude of financing costs and the interest rate that the market will require. The values indicated can only be viewed as approximate guides.

TABLE 64

PRELIMINARY FEASIBILITY OF REVENUE BOND FINANCING

Approximate Coverages By Net Toll Revenues

Assuming 10 Cents Per Axle Toll

Item	*Alternate A*[1]	*Alternate B*[1]	*Alternate C*[2]	*Alternate A & Existing Interstate Bridge*[2]	*Alternate B & Existing Interstate Bridge*[2]
Assuming Bridge and Approaches Financed Entirely By Toll Revenue Bonds					
First Year Interest	1.04	0.69	1.25	1.84	1.18
Second Year Interest	1.17	0.77	1.40	2.07	1.32
Level Debt Service	1.41	0.93	1.71	2.52	1.61
Assuming States' 10 Per Cent Share of Bridge and Approaches Costs Financed by Toll Revenue Bonds					
First Year Interest	5.08	4.01	9.67	13.62	9.53
Second Year Interest	5.68	4.49	10.87	15.31	10.71
Level Debt Service	6.87	5.45	13.33	18.75	13.08

Note: Assuming 40-Year Revenue Bonds at 4.75 Per Cent Interest, three year construction period and capitalized interest for four years.

[1] Traffic usage and revenues of Alternates A and B are identical.

[2] Traffic usage and revenues of Alternate C and Alternates A and B, assuming tolls are collected on the Interstate Bridge, are identical.

PART V

FINDINGS AND CONCLUSIONS

Chapter XVI — Services

Chapter XVII — Comparison of Alternates

Alternate route locations for Interstate Route 95 through the Portsmouth-Kittery area have been studied in detail. Three feasible alternates have been developed and described. In the following part of the report, comparative analyses are made of traffic usage, the quality of traffic service, economic impacts, effect on river and harbor development, functional design, right-of-way acquisition considerations, and construction costs. The feasibility of revenue bond financing for each of the alternates is reviewed. From study of the relative advantages and disadvantages of the alternates, recommendations are made as to the best location for Interstate Route 95 between the existing New Hampshire and Maine Turnpikes.

Chapter XVI

SERVICES

Perhaps the most important criteria for the selection of the Interstate route location through the Portsmouth-Kittery area is the quality of traffic service provided the communities and the large volume of through traffic passing through the area. This may be evaluated by comparing relative traffic usage, service to through and local traffic, relief to existing facilities, effect on river traffic, road user benefits, and the return on the highway investment as measured from benefit-cost analyses.

Traffic Usage

Estimated 1985 traffic volumes on Alternates A and B vary from 40,000 vehicles per day south of the major interchange with the Spaulding Turnpike in Portsmouth, to 31,000 vehicles per day at the Piscataqua River Bridge, and 22,000 vehicles per day at its northerly terminus with the Maine Turnpike. Local traffic service is nominal since no intermediate interchanges are provided between the major interchanges with the Spaulding and New Hampshire Turnpikes in Portsmouth and U. S. Route 1 and the Maine Turnpike in Kittery.

If Alternate A or B are constructed, it is estimated that 16,400 vehicles will use the present Interstate Bridge daily in 1985, assuming it is toll free. Although traffic usage will be about 20 per cent greater than present, daily and seasonal traffic variations will resemble more closely those on the Memorial Bridge; peak hour traffic will be a much smaller percentage of the daily average. The present bridge will be able to accommodate these reduced peak hour traffic volumes satisfactorily.

If Alternate C, the most easterly location, is constructed, 1985 traffic volumes are estimated to vary from 40,000 vehicles daily south of the Portsmouth traffic circle to 47,400 vehicles daily at the Piscataqua River Bridge, and 22,000 at the Maine Turnpike. Since the present Interstate Bridge is an integral part of the design, the combined volume of through and local traffic is equivalent to that assigned to the proposed bridge and the existing Interstate Bridge with Alternates A and B.

Traffic usage of the Memorial Bridge is estimated at 20,100 vehicles daily in 1985, about 20 per cent higher than existing levels, regardless of which alternate is constructed. The aforementioned traffic assignments assume all river crossings toll free, therefore, some traffic was diverted from the Memorial Bridge to the toll free Interstate Bridge. If tolls were continued on the Interstate Bridge, traffic usage of the Memorial Bridge would be greater and considerable congestion would result.

Local Traffic Service

The location of the Piscataqua River about midway between the two major terminal interchanges, and the relatively short distance between the river and each interchange, make it difficult to provide intermediate ramp connections for local traffic. The high-level crossing on Alternate A precludes consideration of additional access and egress points for local traffic. The topography and land developments along Alternate B make the provision of additional access and egress points prohibitively costly and disruptive to existing land developments.

Alternate C, the eastern location, includes the present Interstate Bridge and its approaches as part of the basic design. To maintain essential local traffic service, intermediate access and egress ramps are provided to the local street system, immediately south and north of the river. Local traffic movements at the intermediate ramp connections to the frontage roads would have to merge with through traffic. This marignal interference would also be aggravated by the close proximity of the frontage roads and the distractions of diverse light at night.

Alternates A and B provide four traffic lanes for through traffic in addition to the four traffic lanes which would be available for local traffic along the present Interstate Bridge approaches. The Alternate C design provides a total of six traffic lanes for local and through traffic combined. It is not feasible to provide additional traffic lanes on Alternate C without incurring additional costs and severely disrupting existing roadside development.

Superior local traffic service of comparable quality is provided by Alternates A and B. The existing Interstate Bridge would be available for the exclusive use of local motorists. Higher speed, through traffic would be diverted to the new river crossing and all of the existing local access points could be maintained. If the Alternate C location were constructed, a number of the existing access and egress ramps for local traffic would have to be eliminated and local traffic would be intermixed with higher speed through traffic.

Through Traffic Service

Each of the alternate route locations would provide a direct free flowing connection between the existing New Hampshire and Maine Turnpikes. The high-level bridge and absence of frontage roads and intermediate interchanges eliminate all marginal interference on Alternate A. Therefore, excellent traffic service is provided to through

motorists. While there will be no marginal interference at intermediate interchanges on Alternate B, the proposed low-level lift bridge will cause some delays to through traffic during bridge openings. The extensive frontage roads and intermediate ramp connections necessary to maintain local traffic service and access to the roadside businesses, combined with delays for river traffic at the low-level bridge, indicate a much lower quality of traffic service for through motorists on Alternate C.

Road User Benefits—Alternate Routes

A controlled access highway provides significant economic benefits to motorists, as contrasted to divided highways without control of access. Higher operating speeds are realized and roadside interferences are eliminated. These tangible benefits result in time savings, reduced operating expenses, and fewer accidents. Equally important, but of a less tangible nature, are the indirect benefits resulting from the lessening of fatigue.

Time Savings—Use of the proposed improvements will result in considerable time savings.[19] It is estimated that vehicles using the alternates in 1985 will maintain average speeds of 52 miles per hour, compared to speeds of 20 to 28 miles per hour on the Interstate Bridge.

Operating Savings—Unit cost values for vehicle operation on various types of roadway surfaces and with varying degrees of "stop-and-go" operation have been developed by extensive studies.[19]

Average gasoline cost has been estimated at $0.32 per gallon, oil at $0.45 per quart, and tires at $100 initial cost per set. The per-vehicle-mile cost of automobile repairs has been estimated at $0.012 on good pavement and depreciation was established as $0.015 per vehicle mile. For example, the operating cost on a four-lane divided highway in good condition, assuming free traffic operation and an average speed of 52 miles per hour, approximates $0.088 to $0.090 per vehicle mile depending on the topography or grades.

The operating costs for heavy trucks average approximately three times those of passenger cars. These values represent only direct operating expenses incurred by motorists, primarily gasoline costs and those expenses accrued through the maintenance and repair necessary by stop-and-go operation.

[19] Road User Benefit Analyses for Highway Improvement. American Association of State Highway Officials, 1960.

Indirect Benefits—Of a less tangible nature, but also important, are the benefits which accrue to motorists through reduction of fatigue and tension caused by restricted traffic flow. On paved highways, with restricted operating conditions, comfort and convenience costs have been estimated at $0.01 per vehicle mile. For highways with normal operating characteristics, a cost of $0.005 per mile has been established, while no per-vehicle-mile cost has been developed for paved highways with free-flowing operation.

Benefits-Cost Analyses

The 1985 road user costs for the existing condition and the three alternates are shown in Table 65. Annual road user benefits have been developed by comparing road-user costs for each alternate with the existing condition and are also indicated in the table.

Since the proposed improvement encompasses a major river crossing with a useful life in excess of 40 years, 1985 annual average daily traffic volumes have been used as representative of the annual average daily traffic volume for the period of analysis. Annual road user costs for the basic condition, no additional river crossings, assume a road user cost of 13.71 cents per mile due to the restricted operation and low operating speeds that would prevail.

Recognizing the free unimpeded flow of traffic on Alternate A, a road user cost of 9.01 cents per mile was used. Since through traffic would be diverted from the present Interstate Bridge, the elimination of congestion would reduce road user costs on this facility to about 11.56 cents per mile. On Alternate B, a road user cost of 8.78 cents per mile was used; a slightly lower value than on Alternate A due to the lighter grades at the approaches to the low-level bridge. The same per mile costs were used on Alternate C.

The total road user costs for each alternate also include the costs for stopping delays on the approaches to the Interstate Bridge due to navigational openings on the low-level lift bridges.

Annual road user costs for Alternate A and B are quite similar. The lower per mile costs on Alternate B due to the lower grades are to a large extent off-set by the increased motorist costs due to the delays for river traffic. Road user costs for Alternate C are lowest, since local traffic using the facility would benefit to the same extent as the through motorist.

Annual road user benefits of over $3,000,000 annually at 1985 traffic levels are anticipated for Alternate A and B. User benefits of over $3,800,000 annually are estimated for Alternate C.

The benefit-cost ratio is a measure of the return on the highway investment. It relates capital costs and maintenance and operation expenses to road user benefits. If the annual difference or savings in road user costs is equal to, or greater than, the annual cost of the improvement including maintenance and operation of the highway, the benefit ratio will be greater than one.

The maintenance and operating expenses include roadway maintenance and bridge maintenance including maintenance and operation of the lift spans on the low-level bridges. Interest and amortization costs were estimated using the construction costs previously described and assuming a useful life of 20 years for pavement and appurtenances, 60 years for right-of-way, and 40 years for grading, drainage and structures.

As shown in Table 65, annual highway costs for Alternate A are appreciably lower than for Alternates B and C primarily due to the lower cost of the river bridge. By relating road user savings to annual highway costs, benefit-cost ratios were computed for each of the alternates. Alternate A has a benefit-cost ratio of 4.72; Alternate B, 3.22; Alternate C, 3.96. The benefit-cost ratios indicate that each of the alternates would be worthwhile improvement. However the much higher benefit ratio for Alternate A demonstrates that it provides a greater return on the highway investment.

TABLE 65

1985 ROAD USER BENEFITS

Conditions	Annual Road User Costs	Annual Road User Benefits	Annual Highway Costs: Maintenance and Operation	Annual Highway Costs: Interest and Amortization	Annual Highway Costs: Total	Benefit-Cost Ratio
Existing Interstate Bridge	$10,757,000	$........	$ 77,700	$	$ 77,700	....
ALTERNATE A						
New high-level fixed bridge	4,536,700	....	41,900	616,200	658,100	....
Existing Interstate Bridge	3,170,700	....	65,700	....	65,700	....
Total	$ 7,707,400	$3,049,600	$107,600	$616,200	$ 723,800	4.72
ALTERNATE B						
New low-level lift bridge	4,522,500	....	51,600	911,000	962,600	....
Existing Interstate Bridge	3,170,700	....	65,700	....	65,700	....
Total	$ 7,693,200	$3,063,800	$117,300[1]	$911,000	$1,028,300	3.22
ALTERNATE C						
New low-level bridge combined with Existing Interstate Bridge	$ 6,900,300	$3,856,700	$103,600[1]	$947,100	$1,050,700	3.96

[1] Assume both lift spans operated by same personnel.

Chapter XVII
COMPARISON OF ALTERNATES

The three alternate locations for Interstate Route 95 through the Portsmouth-Kittery area were evaluated in terms of traffic service characteristics, functional design, construction and right-of-way costs, road user benefits, and economic impact on the roadside businesses and the communities. The relative advantages and disadvantages of the alternate route locations are reviewed in the following discussion and detailed in Table 66. Each of the alternates provide a direct routing for through traffic between the New Hampshire and Maine Turnpikes. They are almost of identical length. Alternate A is 4.46 miles long, Alternate B, 4.49 miles, and Alternate C, 4.48 miles in length.

Traffic Service

Excellent traffic service will be provided to through motorists on Alternate A. There will be no delays for river traffic on the proposed high-level bridge and there will be no marginal interference due to intermediate interchanges or service roads between the major interchanges proposed in Portsmouth and Kittery.

Through traffic service on Alternate B will be very good due to the absence of intermediate interchanges and service roads. However, there will be some delays for river traffic because of the low-level lift bridge.

TABLE 66

COMPARISON OF ALTERNATE LOCATIONS

Interstate Route 95—Portsmouth, New Hampshire and Kittery, Maine

Item	Alternate A, Western Location			Alternate B, Central Location			Alternate C, Eastern Location		
	New Hampshire	*Maine*	*Total*	*New Hampshire*	*Maine*	*Total*	*New Hampshire*	*Maine*	*Total*
Approximate Length (miles)									
Between common points	2.37	2.09	4.46	2.24	2.25	4.49	2.24	2.24	4.48
Actual construction project	2.34	2.09	4.43	2.08	2.25	4.33	2.12	2.24	4.36
Traffic Usage									
Estimated 1985 Annual Average Daily Traffic									
Highest Volume Section	40,000	31,000	....	40,000	31,000	....	47,500	47,400	....
Piscataqua River Bridge	31,000	31,000	....	31,000	31,000	....	47,400	47,400	....
Lowest Volume Section	24,200	16,600	....	24,200	16,600	....	30,300	22,000	....
Estimated 1985 Directional Design Hour Volumes									
Piscataqua River Bridge	3,690	3,690	....	3,690	3,690	....	5,640	5,640	....
Traffic Service									
Through Traffic	Excellent: No marginal interference from frontage roads or intermediate ramp connections; no delays due to bridge openings.			Very Good: no marginal interference from frontage roads or intermediate ramp connections; some delays due to bridge openings.			Good: Some marginal interference due to extensive frontage roads and some intermediate ramp connections; some delays due to bridge openings.		
Local Traffic	Good: Through traffic diverted to new bridge; Interstate Bridge available for local motorists; no decrease in access points to Interstate Bridge required.			Good: Through traffic diverted to new bridge; Interstate Bridge available for local motorists; no decrease in access points to Interstate Bridge required.			Fair: Local traffic intermixed with through traffic; number of present access points to Interstate Bridge eliminated.		

TABLE 66 (Cont.)

Item	Alternate A, Western Location: New Hampshire	Maine	Total	Alternate B, Central Location: New Hampshire	Maine	Total	Alternate C, Eastern Location: New Hampshire	Maine	Total
Effect on River and Harbor Development									
Channel Clearances	Preferred: High-level fixed bridge design provides liberal horizontal (470 ft. min.) and adequate vertical (130 ft.) clearances.			Adequate: Low-level lift bridge provides adequate horizontal (225 ft. min.) and vertical (135 ft. open; 36 ft. closed) clearances.			Adequate: Low-level lift bridge provides adequate horizontal (225 ft. min.) and vertical (135 ft. open; 36 ft. closed) clearances.		
Navigation	Preferred: Greater distance from Interstate Bridge and wider channel facilitate maneuvering of ships.			Undesirable: Prolongates narrow channel of present Interstate Bridge; close proximity to Interstate Bridge makes navigation difficult.			Undesirable: Prolongates narrow channel of present Interstate Bridge; close proximity to Interstate Bridge makes navigation difficult.		
Functional Design									
Mainline Roadways									
Maximum Curvature	1° −30′	0 −30′	....	2 −30′	1 −15′	....	2 −45′	1 −30′	....
Maximum Grade	4.0%	4.0%	....	3.0%	0.5%	....	3.0%	1.2%	....
Major Interchange									
Maximum Curvature	230′R	230′R	....	250′R	230′R	....	230′R	230′R	....
Maximum Grade	−3.8%	−4.3%	....	+4.2%	−4.3%	....	+4.2%	−4.3%	....
Estimated Costs (Thousands of Dollars)									
Right-of-way	$ 550	$ 165	$ 715	$ 644	$ 229	$ 873	$ 522	$ 353	$ 875
Construction									
Piscataqua River Bridge	2,117	3,033	5,150	5,900	4,750	10,650	5,900	4,750	10,650
Major Interchanges	1,404	1,313	2,717	1,581	1,314	2,895	2,503	1,627	4,130
Other	3,368	1,637	5,005	3,522	2,295	5,817	3,035	2,130	5,165
Sub-Total	$6,889	$5,983	$12,872	$11,003	$8,359	$19,362	$11,438	$8,507	$19,945
TOTAL	$7,439	$6,148	$13,587	$11,647	$8,588	$20,235	$11,960	$8,860	$20,820

Alternate C will provide good traffic service for through traffic, but there will be delays due to navigation and some marginal interference because of the extensive frontage roads and intermediate access and egress ramps provided between the proposed major interchanges.

Alternates A and B will provide good service to local traffic since they would leave the existing Interstate Bridge available for the almost exclusive use of local motorists by diverting through traffic to the new route. Local trans-river traffic would not have to compete with the higher speed, through traffic on the existing Interstate Bridge. Moreover, all existing access to the Interstate Bridge approaches could be maintained.

With Alternate C, the Interstate Bridge and its approaches would be incorporated into the new route. Many of the present access points would have to be eliminated, thereby decreasing traffic service to local motorists. Moreover, since local traffic would have to mix with the higher speed, through traffic, during periods when through traffic was heavy, local motorists would be inconvenienced.

Effect on River and Harbor Development

The river crossings on each of the alternates have been designed to provide horizontal and vertical clearances that recognize the channel improvements proposed by the U. S. Corps of Engineers. However, the design characteristics and actual location of the

TABLE 66 (Cont.)

Item	Alternate A, Western Location: New Hampshire	Alternate A: Maine	Alternate A: Total	Alternate B, Central Location: New Hampshire	Alternate B: Maine	Alternate B: Total	Alternate C, Eastern Location: New Hampshire	Alternate C: Maine	Alternate C: Total
Benefit-Cost Ratio			4.72			3.22			3.96
Economic Factors									
Acquisition of Buildings									
Residential	21	5	26	19	7	26	9	12	21
Commercial, Misc.	2	1	3	3	....	3	....	....	....
Service Stations	2	....	2	2	1	3	8	1	9
TOTAL	25	6	31	24	8	32	17	13	30
Impact on Roadside Businesses (1966 Gross Sales as per cent of present)									
Service Stations		50-80			85-95			90	
Restaurants		106			108			114	
Motels		110			114			120	
Community Impact									
Short-range		Fair			Good			Good	
Long-range		Good			Fair			Fair	
Feasibility of Revenue Bond Financing (with 10 Cent per Axle Toll)[1]									
Estimated Bond Issue for—									
Entire Bond Project		$14,560,000	(15,800,000)		$22,700,000	(24,000,000)			$21,400,000
States' 10 Per Cent Share of Construction Costs		1,950,000	(3,250,000)		2,800,000	(4,100,000)			2,750,000
Estimated Coverage By Net Revenues[1 2]									
First Year Interest			1.84 (1.04)			1.18 (0.69)			1.25
Second Year Interest			2.07 (1.17)			1.32 (0.77)			1.40
Level Debt Service			2.52 (1.41)			1.61 (0.93)			1.71
Number of Years to Pay Out Bond Issue for States' 10 Per Cent Share of Construction Costs			2 (5)			3 (6)			3

[1] (000)—With existing Interstate Bridge toll free
[2] Bond issue for entire project.

alternate crossings will have some effect on future river and harbor developments and the ease of navigation.

Because of inherent design features, it is possible to economically provide a horizontal channel clearance in excess of 470 feet on the high-level bridge. The absence of a lift span would also increase visibility and eliminate the necessity of signaling for a bridge opening.

With Alternates B and C, horizontal clearances are slightly greater than those provided by the existing Interstate Bridge and vertical clearances are equal. However, the close proximity of the proposed bridge and the existing Interstate Bridge tends to elongate the present narrow channel which the large tankers now find difficult to navigate. The extension of this restrictive channel by a new low-level bridge would be undesirable.

The much greater distance between the existing Interstate Bridge and high-level bridge proposed with Alternate A would facilitate maneuvering of ships and navigation of the river channel.

Functional Design

All three alternates have been designed to accommodate projected traffic volumes. However, the pattern of interchange roadways, location of ramps, and relation of through roadways to frontage roads vary among the alternates and favor some designs.

The maximum curvature on Alternate A is one degree and 30 minutes. Maximum curves of two degrees and 30 minutes and two degrees and 45 minutes are used on Alternates B and C, respectively. The maximum grade on Alternate A is four per cent at the high-level bridge crossing. Maximum grades on Alternates B and C are three per cent at the south approach to the proposed low-level lift bridge.

No intermediate interchanges are provided between the major interchanges in Portsmouth and Kittery on Alternates A and B. This reduces marginal interference and simplifies signing. The absence of frontage roads parallel to the mainline roadways also improves traffic flow and operating characteristics of these two schemes.

In the Alternate C design, extensive frontage roads are necessary to maintain traffic service to the roadside businesses along the present Interstate Bridge approaches. Moreover, intermediate connections to the local street system are required between the two major interchanges so that local traffic service presently provided can be maintained. If this were not done, all the local traffic would either have to use the Memorial Bridge or back-track to the major interchanges at the Spaulding Turnpike in New Hampshire, or to Route 236 access points in Maine. This would impose traffic demands on the Memorial Bridge far in excess of its capacity. Considerable congestion would result daily and local trans-river traffic would be penalized year-round to provide a satisfactory traffic service for the through traffic which peaks during the summer.

Major Interchanges—Alternates A and B permit the retention of the traffic circle in Portsmouth. This greatly reduces the number of local traffic movements that must be accommodated at the major interchange with the Spaulding and New Hampshire Turnpikes, thereby greatly simplifying the design of the major interchange. The maximum ramp grade on Alternate A is 3.8 per cent. A short 4.2 per cent grade is used on Alternate B.

Alternate C encroaches upon the existing traffic circle in Portsmouth. Therefore, the major interchange must accommodate all local turning movements that previously used the circle, in addition to through traffic movements. The additional complexity of design is apparent from the drawings. Not only is the cost materially increased, but signing is more difficult and traffic operations are somewhat impaired. A maximum grade of 4.2 per cent is used in the design.

The functional design of the major interchange in Maine is the same for Alternates A and B. High speed, free flowing connections are provided between Interstate Route 95 and U. S. Route 1, as well as between the Maine Turnpike and the present Interstate Bridge. In the Alternate C design, extensive frontage roads are required to maintain service to the existing roadside developments and to facilitate access to these establishments from the mainline roadway. The close proximity of the frontage roads to the mainline roadways and the diverting influence of the roadside businesses somewhat impairs traffic operations and may result in an increased number of accidents. Maximum ramp grades are 4.3 per cent in all the designs.

While the reversible center roadway on the Interstate Bridge crossing of Alternate C permits a more effective use of the six travel lanes across the river during periods of peak travel, the mechanics of directing traffic to and from the roadway is cumbersome and will be quite confusing to transient traffic. Since a very high percentage of the motorists during peak travel periods will be occasional users of the bridge crossing, this is particularly disadvantageous.

Estimated Costs

Preliminary right-of-way acquisition costs are estimated at $715,000 for Alternate A, $873,000 for Alternate B, and $875,000 for Alternate C. Total right-of-way acquisition costs are about 18 per cent lower on Alternate A than on Alternates B and C.

Estimated construction costs for the Piscataqua River bridge, major interchanges and other items are also indicated in Table 66. Estimated construction costs for Alternate A are $12,872,000; for Alternate B, $19,362,000; for Alternate C, $19,945,000. Construction costs for Alternates B and C are over 50 per cent greater than for Alternate A, primarily due to higher bridge costs. While the high-level structure can be constructed for about $5,150,000, the low-level lift bridge will cost about $10,650,000. Estimated construction costs of the major interchanges in New Hampshire and Maine are comparable for Alternates A and B. Due to the encroachment on the Portsmouth traffic circle, a more complex and expensive interchange is required in New Hampshire with Alternate C.

The total cost for Alternate A, including right-of-way, is estimated at $13,587,000, about $6,648,000 less than Alternate B and $7,233,000 less than Alternate C.

Benefit-Cost Relationships

As previously indicated, the benefit-cost ratio is a measure of the return on investments for highway purposes. A ratio of one indicates that the annual savings in road user costs is equal to the annual costs of the improvement including amortization, maintenance, and operation of the highway. The benefit-cost indices for the several alternates indicate their relative merit.

Benefit-cost ratios of 4.72 for Alternate A, 3.22 for Alternate B and 3.96 for Alternate C have been computed. Each of the alternates shows a good return on the highway investment; Alternate A, the highest.

The cost ratios are somewhat conservative since they do not fully recognize physical improvements required for continued operation of the existing Interstate Bridge. Thus, the benefit-cost ratios will be larger if the annual highway costs for improving the existing Interstate Bridge are included in the calculations, and if operating speeds on the existing bridge reflected the extreme congestion that would occur in future years if additional trans-river capacity is not provided.

Economic Factors

Economic considerations involve the number of residential and commercial buildings that will be required for construction of the proposed highway facilities, the impact on roadside businesses—service stations, motels, and restaurants, and community impact as measured by land use changes.

Alternate A will displace about 26 families, two service stations and three commercial buildings. About the same number of families will be displaced with Alternate B, and 21 with Alternate C. However, a greater number of service stations and other commercial properties are affected by the latter two designs, six and nine, respectively compared with five on Alternate A. To construct Alternate C, it would be necessary to acquire nine service stations, all but one in New Hampshire; only three service stations are affected by Alternate B, two by Alternate A.

The economic impact studies demonstrate that a large percentage of the patronage of service stations is from through traffic. Because of this, service stations will be affected to a larger extent than motels or restaurants. While the immediate impact of constructing Interstate Route 95 on new location would be disadvantageous to existing roadside businesses, this is largely overcome by normal traffic growth expected during the period while the bridge is being designed and is under construction.

If Alternate A is constructed and opened to traffic in 1966, business volume at service stations should be at least 50 to 80 per cent of present levels, restaurant sales about six per cent higher and motel receipts about 10 per cent higher than in 1961.

Alternate B has less impact on service station sales; 1966 sales volume is estimated at 85 to 95 per cent of 1961 sales. Restaurant and motel receipts are estimated to be slightly higher than with Alternate A.

If Alternate C is selected and opened to traffic in 1966, service stations sales are estimated at about the same level as with Alternate B. Estimated restaurant and motel receipts are higher than with the other two plans, but not significantly.

It is important to note that the preceding impacts are estimated for the first year that the new river crossing would be in operation. Normal traffic growth, additional travel generated by improved access, and anticipated increases in population, employment and retail activity throughout the area would soon be reflected in higher levels of business at all establishments. While Alternate A would tend to divert somewhat more business from the existing service stations along the Interstate Bridge approaches, this effect would be small over the long-run, and is likely to be offset by a favorable re-orientation of the existing businesses and land use toward local needs.

Feasibility of Revenue Bond Financing

The approximate size of bond issue has been computed assuming that the entire bond project would be financed from tolls and assuming that only the states' 10 per cent share of construction costs would be financed by tolls. A minimum interest coverage of about 1.2 in the initial years, and level debt service coverage over the life of the bonds greater than 1.5 would likely be required. As indicated in Table 66, with the existing Interstate Bridge toll free and a 10 cent per axle toll, it would be difficult to finance Alternate A and impossible to finance Alternate B with revenue bonds. Assuming tolls are collected from traffic using the proposed river crossing as well as the existing Interstate Bridge, Alternate A would make an attractive bond issue and revenue bonds could likely be sold for Alternates B and C.

The much smaller bond issue required to recapture the states' 10 per cent share of construction costs, assuming Interstate financing, could be paid off in two to six years depending upon the alternate selected and whether tolls were collected on the existing Interstate Bridge. The states' 10 per cent share of construction costs on a toll free facility would vary between $2,200,000 and $2,900,000 depending on which alternate is selected.

Summary

Alternate A is the shortest of the three studied. Its estimated cost is over $6,600,000 less than the two alternate schemes.

Traffic service for through traffic is better with Alternate A than Alternate B since there will be no delays for bridge openings. The quality of traffic service provided by Alternate A is definitely superior to that provided by Alternate C because of the absence of extensive frontage roads and intermediate ramp connections between the major interchanges in Portsmouth and Kittery. Local traffic service with Alternate A is identical with that provided by Alternate B, and considerably more favorable than that provided by Alternate C. The Interstate Bridge approaches are an integral part of the Alternate C design and the number of local access points is reduced. This impairs local trans-river traffic service. It also requires the local traffic to intermix with the higher speed through traffic which is disadvantageous to both.

All alternates are adequately designed to provide a 60-mile per hour operating speed. The maximum curvature on mainline roadways is somewhat less for Alternate A; however, the maximum grade of four per cent for the high-level bridge is greater than the three per cent grade necessary for the low-level lift span on Alternates B and C.

Considering the design controls of route termini, topography, and the present development of the area—a very moderate displacement of existing dwellings and businesses is required. While Alternate A requires the taking of more residential dwellings, it is less disruptive to service stations and other commercial buildings.

The impact on restaurant and motel sales is slight with all alternates. While service station sales are affected more by Alternate A than Alternates B or C, the volume of sales will be equivalent to present levels within five years after the highway improvement is completed and opened to traffic. In subsequent years, normal traffic growth and new land use developments will result in substantial increases in sales at all business establishments along the Interstate Bridge approaches.

Alternate A provides a higher quality of traffic service for both through and local motorists, can be constructed at considerably less cost, and will not have a significant adverse impact upon the roadside businesses presently located along the Interstate Bridge approaches.

It is recommended that Interstate Route 95 through the Portsmouth-Kittery area be constructed on the Alternate A location.

APPENDIX A

APPENDIX A-1

DESCRIPTION OF EXISTING MAJOR HIGHWAYS

Maine-New Hampshire Interstate Bridge Study

Spaulding Turnpike—The Spaulding Turnpike, constructed and operated by the New Hampshire Department of Public Works and Highways, was opened to traffic in September, 1957. Designated as U. S. Route 4 and State Route 16, this 22.8 mile, four-lane, partially controlled-access facility connects Portsmouth with Rochester, New Hampshire. It is one of the major highways leading to the popular recreational areas located in central and northern New Hampshire. The southern terminus is located at the traffic circle in the northwest section of Portsmouth, where it intersects the southern approach to the Interstate Bridge and the New Hampshire Turnpike. At this location, the 1961 AADT was 10,200 vehicles.

New Hampshire Turnpike—The New Hampshire Turnpike, opened to traffic in June, 1950, extends from Seabrook to Portsmouth, New Hampshire, a distance of 14.7 miles. Designated as Interstate Route 95, it provides regional access between Southern New England, the Middle Atlantic States and Southeastern states—and New Hampshire, Maine and Canada.

The turnpike, constructed and operated by the New Hampshire Department of Public Works and Highways, is a four-lane controlled access highway, with interchanges located in Hampton and Portsmouth. In Portsmouth, the turnpike terminates at the traffic circle located northwest of the city where connections are made with the Spaulding Turnpike, Maine-New Hampshire Interstate Bridge approach and U. S. Route 1 Bypass. At its northern terminus in Portsmouth the 1961 annual average daily traffic (AADT) approximated 14,500 vehicles.

Maine Turnpike—The Maine Turnpike is a four-lane divided controlled-access expressway designated as Interstate Route 95 between Kittery and Portland, Maine and operated by the Maine Turnpike Authority. The section from Kittery to Portland, Maine, a distance of 47 miles was opened to traffic in 1947; the 59-mile Portland-Augusta extension was constructed in 1955. At its southern terminus in Kittery, the 1961 annual average daily traffic volumes approximated 7,800 vehicles.

The Maine-New Hampshire Interstate Bridge—This toll bridge and its approaches, connecting the Maine and New Hampshire Turnpikes, is designated as part of the U. S. Route 1 Bypass in New Hampshire and Maine.

Both bridge approaches are four-lane divided highways. Access is controlled by use of an unbroken median divider and extensive frontage roads. During peak travel periods, the bridge is operated as a three-lane facility by using directional lane signals. Normally it is used as a two-lane bridge.

Although an unbroken median separates opposing streams of traffic, and prohibits direct crossings, frequent access from abutting property seriously impairs the effectiveness of this route. Marginal interference from vehicles entering and leaving the numerous commercial developments along the route, and the narrow Piscataqua River Bridge restrict traffic operations.

The New Hampshire bridge approach provides interchange connections to Maplewood, Myrtle, and Woodbury Avenues in Portsmouth. However, it intersects Cottage Street and Greenleaf Avenue at-grade. The 1961 AADT exceeded 15,000 vehicles on the west approach of the Interstate Bridge.

The Interstate Bridge approach in Maine interchanges with Maine Route 236 and Oak Terrace; a grade separation is provided at Maine Route 103. The 1961 AADT approximated 13,640 at the Interstate Bridge and 11,800 south of Route 236.

U. S. Route 1—U. S. Route 1 is the principal north-south highway serving Portsmouth, Rye, North Hampton, and Hampton in New Hampshire, and Kittery, Portland and Bangor in Maine. In Portsmouth it follows Lafayette Road, Middle, State and Congress Streets and is essentially a two-lane facility with curb parking permitted on some sections. To provide greater traffic capacity in the central business district, State and Congress Streets are operated as one-way streets.

Through Kittery, U. S. Route 1 follows Hunter and Newmarch Streets, and New State Road. Hunter and Newmarch Streets, located at the north bridgehead of the Memorial Bridge, form a traffic rotary and provides two lanes in each direction of travel. The remaining sections of U. S. Route 1 within the Kittery urban area vary in width from two to four lanes.

The 1961 average annual daily traffic on this route ranges from 6,000 vehicles on the outskirts of Portsmouth and Kittery to over 18,000 vehicles per day in central Portsmouth.

New Hampshire Route 1A—This north-south highway closely follows the Atlantic shoreline. It primarily serves the beach areas and other summer recreational facilities in Hampton, North Hampton, and Rye, and enters the Portsmouth area from the south via Sagamore Avenue as a two-lane highway. Its 1961 AADT along Sagamore Avenue was 3,500 vehicles.

New Hampshire Route 1B—This roadway connects Portsmouth with New Castle, a well developed residential community located on an island off the New Hampshire coastline. It is a two-lane highway, with its northern terminus situated in Portsmouth on Pleasant Street, and its southern terminus at the south city limits of Portsmouth at the junction of Wentworth House Road and Sagamore Avenue, New Hampshire Route 1A. The 1961 AADT on State Route 1B approximated 1,800 vehicles.

New Hampshire Route 101—This important east-west highway serves southern New Hampshire. From its western terminus at Keene, it links Peterborough, Wilton, Milford, Manchester, Exeter and Portsmouth. A section of this route, located immediately to the west of Portsmouth, was recently constructed on new location as a high-standard two-lane highway. In Portsmouth, it is routed over Middle Road and intersects U. S. Route 1, Lafayette Road, in the southern section of the city. The 1961 AADT at the western urban compact boundary of Portsmouth was 6,700 vehicles.

Maine Route 103—This two-lane east-west route serves Eliot, South Eliot, Kittery, Kittery Point and York Harbor. In the Kittery area, it follows Eliot Road, Cook Street, Walker Street, Wentworth Street and Whipple, Pepperell and Tenny Hill Roads. The 1961 AADT approximated 4,550 and 780 vehicles respectively at the west and east urban boundaries of Kittery.

Maine Route 236—This two-lane highway extends northerly from Kittery (via Rogers Road) to South Berwick and Berwick. The 1961 AADT at the north urban boundary of Kittery approximated 3,000 vehicles.

Appendix Table A-2

ZONE NUMBERS AND DESCRIPTION

Maine-New Hampshire Interstate Bridge Study

New Hampshire Zones

Portsmouth Central Business District
Zones 11-15

Within Urban Compact Limits of Portsmouth
Zones 21-39, 41, 42, 56

Within City Limits of Portsmouth
Zones 40, 51-55

Within Rockingham County
Zone 60 N. Newington
Zone 61 S. Newington
Zone 62 Greenland, Stratham
Zone 63 New Castle
Zone 64 N. Hampton
Zone 65 Hampton, Hampton Falls, Seabrook
Zone 66 Newmarket, Newfields
Zone 67 Exeter, Kensington, E. Kingston, Newton, S. Hampton
Zone 68 Kingston, Danville, Sandown, Derry, Londonderry, Windham, Salem, Atkinson, Hampstead and Plaistow
Zone 69 Epping, Brentwood, Fremont, Raymond, Chester, Auburn, Candia, Deerfield, Nottingham, Northwood
Zone 70 Rye
Zone 71 Rye Beach, Jenness Beach, Rye Ledge, Bass Beach
Zone 72 West Rye
Zone 73 Langs Corner, Rye North Beach
Zone 74 Foss Beach, Rye Harbor State Park
Zone 75 Wallis Sands, Concord Point
Zone 76 Foyes Corner, Odiornes Point, Fort Dearborn

Other
Zone 78 Coos Co.
Zone 79 Grafton Co.
Zone 80 Hillsborough Co., excluding Nashua and Manchester
Zone 81 City of Manchester
Zone 82 City of Nashua

Appendix Table A-2 (Cont.)

Zone 83 Merrimack Co.
Zone 84 Strafford Co.
Zone 85 Belknap Co.
Zone 86 Cheshire Co.
Zone 87 Sullivan Co.
Zone 88 Carroll Co.

Maine Zones

Within Urban Portion of Kittery

Zones 101-111

Elsewhere in Kittery

Zones 112-115

Within York County

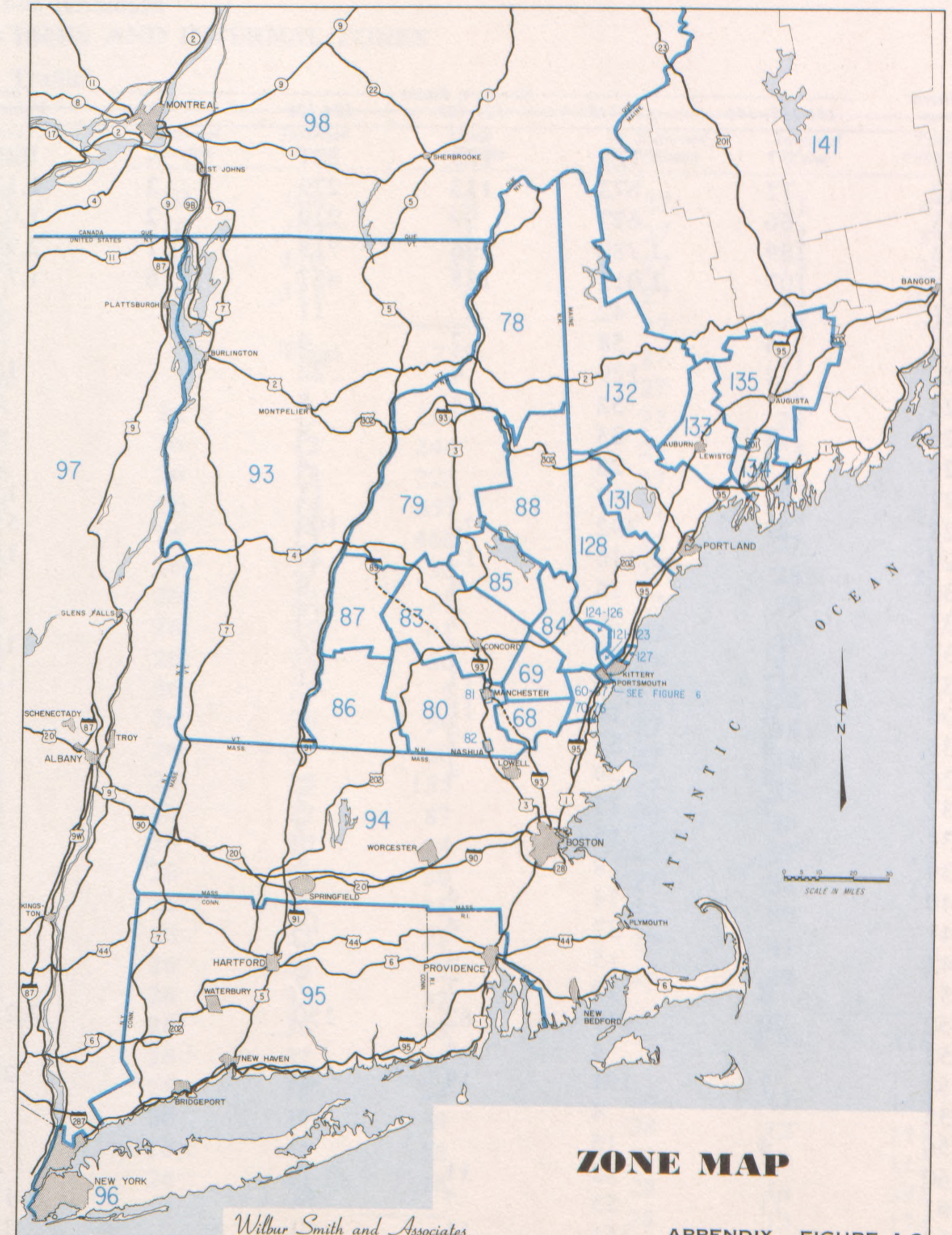
Zones 121-123 Eliot
Zones 124 S. Berwick
Zone 125 Berwick
Zone 126 N. Berwick
Zone 127 York
Zone 128 Elsewhere in York Co.

Other

Zone 131 Cumberland Co.
Zone 132 Oxford Co.
Zone 133 Androscroggin Co.
Zone 134 Sagadahoc Co.
Zone 135 Kennebec Co.
Zone 141 Rest of Maine

Other States

Zone 93 Vermont
Zone 94 Massachusetts
Zone 95 Connecticut and Rhode Island
Zone 96 New York City
Zone 97 Rest of New York
Zone 98 Quebec, Canada
Zone 99 Other States
Zone 151 New Brunswick, Canada



ZONE MAP

Wilbur Smith and Associates

APPENDIX FIGURE A-3

Appendix Table A-4

TRANS-RIVER TRIPS BETWEEN ALL ZONES

Memorial and Maine-New Hampshire Interstate Bridge

1961 Annual Average Daily Traffic[1]

Southern Zones	Northern Zones 131-135, 141	101-115	121-123	124-128	151	Total Vehicles
11	77	722	128	321	4	1,252
12	72	673	113	279	2	1,139
13	66	627	99	219	2	1,013
14	189	1,780	296	718	11	2,994
15	107	1,015	188	457	6	1,773
21	....	42	....	11	....	53
22	4	58	7	4	....	73
23	4	129	4	22	....	159
24	....	52	4	8	....	64
25	8	33	....	8	....	49
26	....	26	....	4	....	30
27	22	97	4	11	....	134
28	27	392	24	109	....	552
29	....	116	15	20	....	151
30	....	15	4	9	....	28
31	7	26	7	15	....	55
32	11	141	4	26	....	182
33	11	122	11	31	....	175
34	4	19	11	....	....	34
35	4	33	7	4	....	48
36	4	59	4	....	....	67
37	7	15	....	7	....	29
38	....	15	....	7	....	22
39	....	8	....	4	4	16
40	....	74	4	....	....	78
41	....	37	4	19	....	60
42	....	15	4	7	....	26
51	8	19	7	7	....	41
52	70	949	82	150	....	1,251
53	....	4	4	....	....	8
54	7	191	14	26	....	238
55	....	4	....	....	....	4
56	4	15	....	....	....	19
60	....	22	11	4	....	37
61	11	55	7	38	....	111
62	....	151	11	30	....	192
63	11	171	26	56	....	264
64	22	133	11	30	18	214
65	181	381	26	347	62	997
66	7	92	4	11	....	114
67	48	145	11	58	4	266
68	37	15	....	34	....	86
69	18	60	4	11	....	93
70	18	355	8	96	4	481
71	18	48	4	23	4	97
72	....	....	4	....	....	4
73	....	....	....	....	....	....
74	....	....	....	....	....	....
75	....	7	8	....	....	15
76	4	7	4	4	....	19
77	....	....	....	....	....	....
78	....	4	....	....	....	4
79	....	....	....	22	....	22
80	36	4	....	7	4	51
81	103	68	4	54	11	240
82	11	11	....	19	4	45
83	54	48	....	87	8	197
84	217	694	51	331	21	1,314
85	11	4	....	18	....	33
86	4	11	4	29	....	48
87	7	4	....	....	....	11
88	4	4	....	4	....	12
93	29	33	....	48	4	114
94	4,361	1,009	87	2,173	401	8,031
95	733	77	11	228	108	1,139
96	131	4	4	22	36	197
97	629	106	4	245	97	1,081
99	1,213	142	22	337	297	2,011
Total	8,631	11,388	1,375	6,869	1,112	29,375

[1] Station 8 and 9 (refer to Figure 6) operated on July 18 and 20, 1962, respectively. Does not equal estimated AADT due to factoring, rounding and deletion of faulty interviews.

Appendix Table A-5

TRANS-RIVER TRIPS BETWEEN EXTERNAL STATIONS AND INTERNAL ZONES

1961 Annual Average Daily Traffic[1]

External Station	Internal Zone	Total Vehicles
1	101	5
1	102	154
1	103	33
1	104	3
1	105	3
1	106	16
1	107	10
1	108	13
1	109	1
1	110	43
1	111	5
	Total	286
2	101	18
2	102	566
2	103	120
2	104	12
2	105	11
2	106	58
2	107	37
2	108	46
2	109	5
2	110	158
2	111	18
	Total	1,049
3	101	8
3	102	247
3	103	52
3	104	5
3	105	6
3	106	25
3	107	16

External Station	Internal Zone	Total Vehicles
3	108	20
3	109	2
3	110	69
3	111	8
	Total	458
4	101	14
4	102	448
4	103	94
4	104	9
4	105	8
4	106	46
4	107	29
4	108	36
4	109	4
4	110	125
4	111	14
	Total	827
5	101	13
5	102	413
5	103	87
5	104	8
5	105	8
5	106	42
5	107	27
5	108	34
5	109	4
5	110	115
5	111	13
	Total	764

External Station	Internal Zone	Total Vehicles
6	101	18
6	102	558
6	103	118
6	104	11
6	105	10
6	106	57
6	107	36
6	108	45
6	109	5
6	110	156
6	111	18
	Total	1,032
7	101	17
7	102	534
7	103	113
7	104	11
7	105	10
7	106	54
7	107	35
7	108	43
7	109	5
7	110	149
7	111	17
	Total	988
10	101	4
10	102	126
10	103	27
10	104	3
10	105	2
10	106	13
10	107	8

External Station	Internal Zone	Total Vehicles
10	108	10
10	109	1
10	110	35
10	111	4
	Total	233
26	11	282
26	12	244
26	13	225
26	14	657
26	15	468
26	21	52
26	22	36
26	23	41
26	24	36
26	25	5
26	26	59
26	27	60
26	28	135
26	29	87
26	30	14
26	31	39
26	32	36
26	33	23
26	34	9
26	35	32
26	36	23
26	37	45
26	38	23
26	39	9
26	41	18
26	42	18
	Total	2,676

External Station	Internal Zone	Total Vehicles
27	11	45
27	12	39
27	13	36
27	14	105
27	15	76
27	21	15
27	22	3
27	23	19
27	24	3
27	25	....
27	26	11
27	27	10
27	28	29
27	29	2
27	30	2
27	31	2
27	32	8
27	33	....
27	34	2
27	35	3
27	36	3
27	37	14
27	38	11
27	39	....
27	41	....
27	42	....
	Total	438
28	11	143
28	12	113
28	13	112
28	14	331
28	15	174
28	21	52

Appendix Table A-5 (Cont.)

External Station	Total Vehicles	Internal Zone
28	22	21
28	23	12
28	24	14
28	25	4
28	26	22
28	27	12
28	28	62
28	29	32
28	30	4
28	31	4
28	32	16
28	33	18
28	34	4
28	35	28
28	36	10
28	37	36
28	38	28
28	39	....
28	41	4
28	42	10
	Total	1,266
29	11	22
29	12	16
29	13	17
29	14	51
29	15	31
29	21	12
29	22	....
29	23	....
29	24	2
29	25	....
29	26	2
29	27	11
29	28	7
29	29	....
29	30	....

External Station	Internal Zone	Total Vehicles
29	31	4
29	32	....
29	33	....
29	34	....
29	35	2
29	36	....
29	37	....
29	38	2
29	39	....
29	41	....
29	42	....
	Total	179

SUMMARY

External Station	Total Vehicles Internal Zone
1	286
2	1,049
3	458
4	827
5	764
6	1,032
7	988
10	466
26	2,676
27	438
28	1,266
29	179
Total	9,665

[1] Station 1-10 and 26-29 (refer to Figure 6) operated during July and October, 1961.

Appendix Table A-6

TRANS-RIVER TRIPS BETWEEN EXTERNAL STATIONS

1961 Annual Average Daily Traffic[1]

External Station	External Station 26			External Station 27		
	Cars	Trucks	Total	Cars	Trucks	Total
1	237	2	239	30	1	31
2	1,001	10	1,011	50	3	53
3	697	90	787	100	6	106
4	580	12	592	103	4	107
5	8,719	786	9,505	70	10	80
6	1,020	2	1,022	120	1	121
7	140	1	141	150	0	150
10	90	0	90	10	0	10
Total	12,484	903	13,387	633	25	658

External Station	External Station 28			External Station 29		
	Cars	Trucks	Total	Cars	Trucks	Total
1	60	1	61	20	0	20
2	100	4	104	20	1	21
3	200	6	206	0	0	0
4	200	8	208	20	0	20
5	150	6	156	10	5	15
6	242	1	243	10	0	10
7	300	0	300	9	0	9
10	28	0	28	10	0	10
Total	1,280	26	1,306	99	6	105

Total, All Stations 15,456

[1] Station 1-10 and 26-29 (refer to Figure 6) operated during July and October, 1961.

Appendix Table A-7

TRANS-RIVER TRIPS BETWEEN INTERNAL ZONES

1961 Annual Average Daily Traffic

Internal Zone	*Internal Zone*	*Total Vehicles*
11	101-111	668
12	101-111	623
13	101-111	580
14	101-111	1,646
15	101-111	939
21	101-111	39
22	101-111	54
23	101-111	119
24	101-111	48
25	101-111	31
26	101-111	24
27	101-111	90
28	101-111	363
29	101-111	107
30	101-111	14
31	101-111	24
32	101-111	130
33	101-111	113
34	101-111	18
35	101-111	31
36	101-111	55
37	101-111	14
38	101-111	14
39	101-111	7
41	101-111	34
42	101-111	14
56	101-111	14
TOTAL		5,813

Appendix Table A-8

TRANS-RIVER TRIPS BETWEEN EXTERNAL STATIONS

1985 Annual Average Daily Traffic

External Station	*Ext. Sta. 26 Total*	*Ext. Sta. 27 Total*	*Ext. Sta. 28 Total*	*Ext. Sta. 29 Total*	*Total*
1	616	56	116	52	840
2	2,228	84	172	48	2,532
3	1,740	164	340	0	2,244
4	1,780	228	464	64	2,536
5	28,140	164	344	48	28,696
6	3,076	256	540	32	3,904
7	436	324	684	28	1,472
10	208	16	48	24	296
Total	38,224	1,292	2,708	296	42,520

Appendix Table A-9

TRANS-RIVER TRIPS BETWEEN EXTERNAL STATIONS AND INTERNAL ZONES

1985 Annual Average Daily Traffic

Station	Zone	Total Vehicles
1	101	6
1	102	210
1	103	80
1	104	6
1	105	....
1	106	40
1	107	22
1	108	13
1	109	....
1	110	87
1	111	6
		470
2	101	16
2	102	526
2	103	205
2	104	16
2	105	....
2	106	104
2	107	52
2	108	28
2	109	....
2	110	217
2	111	16
		1,180
3	101	8
3	102	286
3	103	108
3	104	12
3	105	....
3	106	72
3	107	28
3	108	16
3	109	....
3	110	132
3	111	8
		670
4	101	12
4	102	440
4	103	192
4	104	16
4	105	....
4	106	84
4	107	44
4	108	20
4	109	....
4	110	180
4	111	12
		1,000
5	101	12
5	102	372
5	103	160
5	104	12
5	105	12
5	106	96
5	107	50
5	108	25
5	109	....
5	110	199
5	111	12
		950
6	101	17
6	102	523
6	103	203
6	104	17
6	105	17
6	106	129
6	107	56
6	108	34
6	109	6
6	110	281
6	111	17
		1,300
7	101	20
7	102	721
7	103	315
7	104	24
7	105	20
7	106	179
7	107	68
7	108	40
7	109	4
7	110	339
7	111	20
		1,750
10	101	7
10	102	343
10	103	127
10	104	7
10	105	....
10	106	67
10	107	37
10	108	23
10	109	....
10	110	142
10	111	7
		760
26	11	457
26	12	381
26	13	372
26	14	1,078
26	15	760
26	21	54
26	22	41
26	23	120
26	24	54
26	25	85
26	26	57
26	27	82
26	28	211
26	29	154
26	30	19
26	31	161
26	32	72
26	33	72
26	34	13
26	35	22
26	36	53
26	37	44
26	38	31
26	39	72
26	41	19
26	42	16
		4,500
27	11	133
27	12	111
27	13	108
27	14	316
27	15	221
27	21	16
27	22	12
27	23	30
27	24	16
27	25	21
27	26	16
27	27	23
27	28	63
27	29	50
27	30	5
27	31	4
27	32	21
27	33	23
27	34	4
27	35	5
27	36	16
27	37	16
27	38	9
27	39	21
27	41	5
27	42	5
		1,270
28	11	315
28	12	259
28	13	253
28	14	745
28	15	397

Appendix Table A-9 (Cont.)

Station	Zone	Total Vehicles
28	21	29
28	22	21
28	23	56
28	24	29
28	25	44
28	26	32
28	27	38
28	28	127
28	29	83
28	30	12
28	31	9
28	32	50
28	33	50
28	34	9
28	35	15
28	36	35
28	37	32
28	38	21
28	39	18
28	41	12
28	42	9
		2,700
29	11	50
29	12	40
29	13	40
29	14	118
29	15	73
29	21	5
29	22	3
29	23	10
29	24	5
29	25	7
29	26	5
29	27	7
29	28	20
29	29	13
29	30	3
29	31	3
29	32	7
29	33	7
29	34	3
29	35	3
29	36	7
29	37	5
29	38	3
29	39	7
29	41	3
29	42	3
		450

SUMMARY

External Station	Total Vehicles Internal Zone
1	470
2	1,180
3	670
4	1,000
5	950
6	1,300
7	1,750
10	760
26	4,500
27	1,270
28	2,700
29	450
TOTAL	17,000

Appendix Table A-10

TRANS-RIVER TRIPS BETWEEN INTERNAL ZONES

Internal Zone	Internal Zone	Total Vehicles
11	101	52
	102	164
	103	44
	104	76
	105	....
	106	68
	107	44
	108	52
	109	36
	110	100
	111	164
		800
12	101	60
	102	152
	103	52
	104	88
	105	....
	106	84
	107	44
	108	52
	109	36
	110	100
	111	164
		832
13	101	76
	102	164
	103	60
	104	96
	105	....
	106	96
	107	48
	108	44
	109	36
	110	92
	111	148
		860
14	101	144
	102	352
	103	100
	104	192
	105	....
	106	164
	107	112
	108	132
	109	88
	110	256
	111	436
		1,976
15	101	76
	102	204
	103	56
	104	104
	105	....
	106	92
	107	60
	108	60
	109	44
	110	140
	111	156
		992

Appendix Table A-10 (Cont.)

Internal Zone	Internal Zone	Total Vehicles	Internal Zone	Internal Zone	Total Vehicles	Internal Zone	Internal Zone	Total Vehicles	Internal Zone	Internal Zone	Total Vehicles	Internal Zone	Internal Zone	Total Vehicles
21	101	3	24	101	3	27	101	6	30	101	3	33	101	6
	102	17		102	23		102	57		102	6		102	78
	103	4		103	5		103	14		103	3		103	18
	104	6		104	7		104	10		104	3		104	15
	105	2		105	1		105	....		105	....		105	....
	106	6		106	11		106	15		106	3		106	11
	107	3		107	3		107	4		107	1		107	6
	108	3		108	2		108	4		108	2		108	6
	109	3		109	2		109	4		109	1		109	2
	110	6		110	6		110	13		110	3		110	13
	111	9		111	7		111	13		111	5		111	15
		62			70			140			30			170
22	101	3	25	101	2	28	101	41	31	101	1	34	101	2
	102	41		102	18		102	166		102	12		102	21
	103	7		103	4		103	48		103	3		103	5
	104	8		104	5		104	79		104	5		104	5
	105	....		105	1		105	....		105	....		105	....
	106	12		106	6		106	54		106	3		106	5
	107	3		107	2		107	32		107	1		107	2
	108	3		108	2		108	34		108	1		108	2
	109	3		109	2		109	23		109	1		109	1
	110	8		110	4		110	73		110	3		110	6
	111	10		111	4		111	100		111	5		111	6
		98			50			650			35			55
23	101	7	26	101	3	29	101	15	32	101	7	35	101	1
	102	85		102	16		102	53		102	73		102	18
	103	19		103	4		103	19		103	17		103	4
	104	15		104	6		104	22		104	19		104	3
	105	2		105	....		105	....		105	....		105	....
	106	22		106	10		106	20		106	15		106	4
	107	7		107	3		107	11		107	7		107	1
	108	7		108	3		108	13		108	6		108	1
	109	4		109	2		109	9		109	3		109	1
	110	17		110	6		110	24		110	16		110	3
	111	15		111	7		111	39		111	17		111	4
		200			60			225			180			40

Appendix Table A-10 (Cont.)

Internal Zone	*Internal Zone*	*Total Vehicles*
36	101	4
	102	31
	103	6
	104	6
	105	....
	106	6
	107	2
	108	4
	109	2
	110	8
	111	11
		80
37	101	3
	102	19
	103	4
	104	5
	105	....
	106	6
	107	3
	108	2
	109	1
	110	7
	111	10
		60
38	101	3
	102	14
	103	4
	104	5
	105	....
	106	4
	107	2
	108	2
	109	1
	110	6
	111	9
		50

Internal Zone	*Internal Zone*	*Total Vehicles*
39	101	2
	102	13
	103	2
	104	2
	105	....
	106	2
	107	2
	108	2
	109	....
	110	....
	111	....
		25
41	101	2
	102	56
	103	10
	104	5
	105	....
	106	8
	107	2
	108	2
	109	2
	110	8
	111	5
		100
42	101	2
	102	55
	103	10
	104	8
	105	....
	106	8
	107	2
	108	2
	109	....
	110	8
	111	5
		100

Internal Zone	*Internal Zone*	*Total Vehicles*
56	101	3
	102	7
	103	2
	104	5
	105	....
	106	3
	107	2
	108	3
	109	3
	110	5
	111	7
		40

GRAND TOTAL 7,980

SUMMARY

Internal Zone	*Total Vehicles Internal Zone*
11	800
12	832
13	860
14	1,976
15	992
21	62
22	98
23	200
24	70
25	50
26	60
27	140
28	650
29	225
30	30
31	35
32	180
33	170
34	55
35	40
36	80
37	60
38	50
39	25
41	100
42	100
56	40
TOTAL	7,980

APPENDIX B

Appendix Table B-1

ESTIMATED ANNUAL AVERAGE DAILY TRAFFIC VOLUMES—1961, 1975, 1985
ALTERNATES A, B and C

New Hampshire Interchange

Ramp	*Alternate Line A* 1961	1975	1985	*Alternate Line B* 1961	1975	1985	*Alternate Line C* 1961	1975	1985
A	1,260	2,640	3,400	1,260	2,640	3,400	2,110	4,420	5,700
B	630	1,320	1,700	1,260-1,890	2,640-3,950	3,400-5,100	850	1,780	2,300
C	1,660	3,490	4,500	1,660	3,490	4,500	1,300	2,710	3,500
D	1,260-1,890	2,690-3,950	3,400-5,100	630	1,320	1,700	1,410	2,940	3,800
E	630	1,320	1,700	630	1,320	1,700	1,630-2,370	3,410-4,960	4,400-6,400
F	1,660	3,490	4,500	630	1,320	1,700	560	1,160	1,500
G	630	1,320	1,700	1,660	3,490	4,500	740	1,550	2,000
H	630	1,320	1,700	630	1,320	1,700	810	1,700	2,200
I	....	....	....	....	....	....	150	310	400
J	....	....	....	....	....	....	1,300	2,710	3,500
K	....	....	....	....	....	....	....	....	....
L	....	....	....	....	....	....	....	....	....
M	....	....	....	....	....	....	....	....	....
Piscataqua River Bridge	11,400	24,000	31,000	11,400	24,000	31,000	17,900	37,000	47,400

Maine Interchange

Ramp	*Alternate Line A* 1961	1975	1985	*Alternate Line B* 1961	1975	1985	*Alternate Line C* 1961	1975	1985
A	440	930	1,200	440	930	1,200	3,480	7,280	9,400
B	440	930	1,200	440	930	1,200	1,040	2,170	2,800
C	2,220	4,650	6,000	2,220	4,650	6,000	700-1,740	1,470-3,640	1,900-4,700
D	1,000-3,290	2,090-6,900	2,700-8,900	1,000-3,290	2,090-6,900	2,700-8,900	40	80	100
E	2,290	4,800	6,200	2,290	4,800	6,200	1,330	2,790	3,600
F	1,000	2,090	2,700	1,000	2,090	2,700	370-740	770-1,550	1,000-2,000
G	150	310	400	150	310	400	370	780	1,000
H	2,220	4,650	6,000	2,220	4,650	6,000	1,300	2,710	3,500
I	....	....	....	....	....	....	1,040	2,170	2,800
J	....	....	....	....	....	....	300	620	800
K	....	....	....	....	....	....	520	1,080	1,400
L	....	....	....	....	....	....	1,000	2,090	2,700
M	....	....	....	....	....	....	630	1,320	1,700
N	....	....	....	....	....	....	630	1,320	1,700
Piscataqua River Bridge	11,400	24,000	31,000	11,400	24,000	31,000	17,900	37,000	47,400

Note: Refer to functional plan of interchanges for ramp designation.

APPENDIX TABLE B-2

ESTIMATED DESIGN HOUR VOLUMES—1961, 1975, 1985
ALTERNATES A, B, and C

	New Hampshire Interchange								
	Alternate Line A			Alternate Line B			Alternate Line C		
Ramp	1961	1975	1985	1961	1975	1985	1961	1975	1985
A	300	630	810	300	630	810	500	1,050	1,360
B	150	310	400	300-450	630-940	810-1,210	200	420	550
C	390	830	1,070	400	830	1,070	310	640	830
D	300-450	640-940	810-1,210	150	310	400	340	700	900
E	150	310	400	150	310	400	390-560	810-1,180	1,050-1,520
F	390	830	1,070	150	310	400	130	280	360
G	150	310	400	400	830	1,070	180	370	480
H	150	310	400	150	310	400	190	400	520
I	....	....	....	....	....	....	40	70	100
J	....	....	....	....	....	....	310	640	830
K	....	....	....	....	....	....	....	....	....
L	....	....	....	....	....	....	....	....	....
M	....	....	....	....	....	....	....	....	....
Piscataqua River Bridge	1,360	2,860	3,690	1,360	2,860	3,690	2,130	4,400	5,640

	Maine Interchange								
	Alternate Line A			Alternate Line B			Alternate Line C		
Ramp	1961	1975	1985	1961	1975	1985	1961	1975	1985
A	100	220	290	100	220	290	830	1,730	2,240
B	100	220	290	100	220	290	250	520	670
C	530	1,110	1,430	530	1,110	1,430	170-410	350-870	450-1,120
D	240-780	500-1,640	640-2,120	240-780	500-1,640	640-2,120	10	20	25
E	550	1,140	1,480	550	1,140	1,480	320	660	860
F	240	500	640	240	500	640	90-180	180-370	240-480
G	40	70	100	40	70	100	90	190	240
H	530	1,110	1,430	530	1,110	1,430	310	640	830
I	....	....	....	....	....	....	250	520	670
J	....	....	....	....	....	....	70	150	190
K	....	....	....	....	....	....	120	260	330
L	....	....	....	....	....	....	240	500	640
M	....	....	....	....	....	....	150	310	400
N	....	....	....	....	....	....	150	310	400
Piscataqua River Bridge	1,360	2,860	3,690	1,360	2,860	3,690	2,130	4,400	5,640

Note: Refer to functional plan of interchanges for ramp designation.

Appendix Table B-3

TYPICAL CONSTRUCTION UNIT PRICES

Interstate Route 95

Portsmouth, New Hampshire and Kittery, Maine

Item	*Unit*	*New Hampshire*[1]	*Maine*[2]
Clearing and Grubbing	Acre	$430.00	$290.00
Earth Excavation	C.Y.	.45	.42
Ledge Excavation	C.Y.	3.00	4.00
Earth Borrow	C.Y.	.54	.46
Sand	C.Y.	.68	....
Gravel	C.Y.	1.05	....
Crushed Gravel	C.Y.	1.80	....
Type I-1 Hot Asphaltic Concrete Pavement	Ton	7.00	....
Type I-1 Hot Asphaltic Concrete Pavement Base	Ton	7.10	....
Gravel Base Course in Place	C.Y.	....	.86
Crushed Gravel Base Course In Place	C.Y.	....	1.88
Bituminous Macadam Base Course	Ton	....	4.25
Bituminous Concrete Surface Course Type A	Ton	....	7.66
Highway Structure[3]	S.F.	16.00	16.00
Guard Rail, Type E	L.F.	....	2.63
Three Cable Guard Rail	L.F.	2.00	....
Chain Link Fence	L.F.	3.40	3.50
Lighting, per luminaire[3]	Each	700.00	700.00
Signing[3]			
Mainline	Mile	2,000.00	2,000.00
Interchange	Each	60,000.00	60,000.00

[1] 1960 Weighted Average Unit Prices, Interstate Projects, New Hampshire Department of Public Works and Highways.

[2] 1961 Weighted Average Unit Prices, Interstate Projects, Maine Highway Commission.

[3] Estimated by Wilbur Smith and Associates.

Appendix Table B-4

COST ESTIMATE BY ROUTE SECTIONS—ALTERNATE A, WESTERN LOCATION

Interstate Route 95, Portsmouth, New Hampshire and Kittery, Maine

	New Hampshire	New Hampshire	Maine	Maine	Total For Route
Route Section	A1-A2	A2-A3	A3-A4	A4-A5	....
Section Length, Miles	2.05	0.29	0.45	1.64	4.43
No. of lanes to be constructed	4	4	4	4	....
No. of through lanes	4	4	4	4	....
Work Classification			(Thousands of Dollars)		
1. Preliminary Engineering	175	96	137	98	506
2. Right-of-Way	541	9	91	74	715
3. Clear & grub; demolition	26	....	....	18	44
4. Utility Adjustments	206	....	....	33	239
5. Grade & drain; minor structures	875	....	....	203	1,078
6. Base; surfacing; shoulders	269	....	....	208	477
7. R. R. grade separations	497	....	....	....	497
8. Highway grade separations without ramps	451	....	....	325	776
9. Interchanges, complete	1,404	....	....	1,313	2,717
10. Other bridges; tunnels	....	2,117	3,033	....	5,150
11. Walls	8	....	....	....	8
12. Guard rail; fencing; lighting; traffic control devices	55	11	16	22	104
13. Roadside improvement	21	....	....	11	32
14. All other items	76	....	....	43	119
15. Sub-Total, Lines 3 to 14	3,888	2,128	3,049	2,176	11,241
16. Constructing Engineering & Contingencies, Ten Per Cent of Line 15	389	213	305	218	1,125
17. Total Estimated Cost	4,993	2,446	3,582	2,566	13,587

Appendix Table B-5

COST ESTIMATE BY ROUTE SECTIONS—ALTERNATE B, CENTRAL LOCATION

Interstate Route 95, Portsmouth, New Hampshire and Kittery, Maine

	New Hampshire	*New Hampshire*	*Maine*	*Maine*	*Total For Route*
Route Section	B1-B2	B2-B3	B3-B4	B4-B5	....
Section Length, Miles	1.74	.34	.20	2.05	4.33
No. of lanes to be constructed	4	4	4	4	....
No. of through lanes	4	4	4	4	....
Work Classification			(Thousands of Dollars)		
1. Preliminary Engineering	166	266	214	114	760
2. Right-of-Way	643	1	20	209	873
3. Clear & grub; demolition	23	....	....	22	45
4. Utility Adjustments	169	....	....	41	210
5. Grade & drain; minor structures	639	....	....	424	1,063
6. Base; surfacing; shoulders	248	....	....	261	509
7. R. R. grade separations	....	....	....	....	....
8. Highway grade separations without ramps	862	....	....	357	1,219
9. Interchanges, complete	1,581	....	....	1,314	2,895
10. Other bridges; tunnels	....	5,900	4,750	....	10,650
11. Walls	30	....	....	....	30
12. Guard rail; fencing; lighting; traffic control devices	49	13	7	56	125
13. Roadside improvement	24	....	....	19	43
14. All other items	72	....	....	50	122
15. Sub-Total, Lines 3 to 14	3,697	5,913	4,757	2,544	16,911
16. Constructing Engineering & Contingencies, Ten Per Cent of Line 15	370	591	476	254	1,691
17. Total Estimated Cost	4,876	6,771	5,467	3,121	20,235

Appendix Table B-6

COST ESTIMATE BY ROUTE SECTIONS—ALTERNATE C, EASTERN LOCATION

Interstate Route 95, Portsmouth, New Hampshire and Kittery, Maine

	New Hampshire	*New Hampshire*	*Maine*	*Maine*	*Total For Route*
Route Section	C1-C2	C2-C3	C3-C4	C4-C5	....
Section Length, Miles	1.78	.34	.20	2.04	4.36
No. of lanes to be constructed	6	4	4	6	....
No. of through lanes	6	4	4	6	....
Work Classification			(Thousands of Dollars)		
1. Preliminary Engineering	183	266	214	120	783
2. Right-of-Way	521	1	20	333	875
3. Clear & grub; demolition	23	....	....	19	42
4. Utility Adjustments	185	....	....	41	226
5. Grade & drain; minor structures	344	....	....	258	602
6. Base; surfacing; shoulders	390	....	....	362	752
7. R. R. grade separations	....	....	....	....	....
8. Highway grade separations without ramps	369	....	....	160	529
9. Interchanges, complete	2,503	....	....	1,627	4,130
10. Other bridges; tunnels	....	5,900	4,750	....	10,650
11. Walls	....	....	....	....	....
12. Guard rail; fencing; lighting; traffic control devices	116	13	7	135	271
13. Roadside improvement	20	....	....	19	39
14. All other items	127	....	....	52	179
15. Sub-Total, Lines 3 to 14	4,077	5,913	4,757	2,673	17,420
16. Constructing Engineering & Contingencies, Ten Per Cent of Line 15	408	591	476	267	1,742
17. Total Estimated Cost	5,189	6,771	5,467	3,393	20,820

Appendix Table B-7

PRELIMINARY ESTIMATE OF NON-PARTICIPATING COSTS

Interstate Route 95, Kittery, Maine

Work Classification	*Alternate A*	*Alternate B*	*Alternate C*
	Estimated Costs (1,000 Dollars)		
1. Preliminary Engineering	37	37	27
2. Right-of-Way	26	26	17
3. Clear & grub; demolition	6	6	3
4. Utility Adjustments	11	11	11
5. Grade & drain; minor structures	39	39	31
6. Base; surfacing; shoulders	73	73	73
7. R. R. grade separations	....	....	....
8. Highway grade separations without ramps	160	160	160
9. Interchanges, complete	524	524	308
10. Other bridges; tunnels	....	....	....
11. Walls	....	....	....
12. Guard rail; fencing; lighting; traffic control devices	....	....	....
13. Roadside improvement	....	....	....
14. All other items	16	16	12
15. Sub-Total, Lines 3 to 14	829	829	598
16. Constructing Engineering & Contingencies, Ten Per Cent of Line 15	83	83	60
17. Total Estimated Cost	975	975	702

Note: Non-participating costs include $300,000 for toll booths and additional costs of grading, paving, signing and lighting of a new toll plaza for the Maine Turnpike.

APPENDIX C

Appendix C-1

INFORMATIONAL LETTER TO OPERATORS OF ROADSIDE BUSINESSES

Wilbur Smith and Associates

TRAFFIC • PARKING • TRANSIT • HIGHWAYS

495 ORANGE STREET

New Haven, Conn.

March 20, 1962

Individually Addressed To Each Operator Of
A Business Along The Interstate Highway:

As you are perhaps aware the states of New Hampshire and Maine are studying the best way of providing additional bridge capacity over the Piscataqua River in the Portsmouth-Kittery area.

One of the considerations in evaluating alternate solutions to this problem is to measure the impact alternate bridge locations would have upon business in the area.

Acting as consultants for the States, we plan to collect information regarding customer purchases, origin and travel patterns. At some establishments, customer interviews would be conducted on a weekday and a weekend day in the latter part of March and again in July.

A representative of our firm will be contacting you soon with further information. We would like to enlist your support in the conduct of this important study. Your cooperation will be of great assistance to us and help insure that any additional bridge capacity will be properly located.

Yours very truly,

Wilbur S. Smith

Wilbur S. Smith

WSS/bjk

Appendix C-2

SERVICE STATION QUESTIONNAIRE—FIRST CYCLE

PORTSMOUTH-KITTERY ECONOMIC IMPACT STUDY

Service Station Customer Interview — Facility Code ____________

Station name ____________ Day ________ Date ________ Time ________

1. Passenger Car Liscense Plate
   - ☐ New Hampshire ☐ Maine ☐ Mass. ☐ Other ____________
   - ☐ Standard ☐ Compact ☐ Small
2. Description of car: Make ____________ Model ____________ Year ________
3. Number of occupants ________ 4. Sex of driver ☐ Male ☐ Female
5. Truck ☐ Panel or Pickup ☐ 2-axle, six-tire ☐ 3-axle, single unit ☐ Tractor-trailer
   - ☐ New Hampshire ☐ Maine ☐ Other ____________ ☐ Bus
6. What does your gas indicator read?

E - 1/4	1/4	1/4 - 1/2	1/2	1/2 - 3/4	3/4	3/4 - F	no indicator or broken
☐	☐	☐	☐	☐	☐	☐	☐

7. Where did this trip start? ____________
8. Where will this trip end? ____________
9. Where is your car usually garaged? ☐ at origin ☐ at destination ☐ elsewhere ________
10. Route used getting here?

Northbound

U.S. 1	N.H. Tpk.	U.S. 1A	U.S. 4	N.H. 101	Other
☐	☐	☐	☐	☐	☐

Southbound

U.S. 1	Me. Tpk.	Me. 103	Me. 236	Me. 101	Other
☐	☐	☐	☐	☐	☐

11. What route will you continue trip on?

Northbound

U.S. 1	Me. Tpk.	Me. 103	Me. 236	Me. 101	Other
☐	☐	☐	☐	☐	☐

Southbound

U.S. 1	N.H. Tpk.	U.S. 1A	U.S. 4	N.H. 101	Other
☐	☐	☐	☐	☐	☐

12. Which bridge did you (will you) use? ☐ Interstate ☐ Memorial ☐ Neither
13. When was the last time you drove by here? ☐ earlier today ☐ yesterday
    - ☐ days ago ☐ 2-3 weeks ago ☐ mos. ago ☐ years ago ☐ first time
14. What is the purpose of this trip?
    - ☐ Work ☐ Business ☐ Shopping ☐ Social ☐ Recreational ☐ School ☐ Other
15. Purchases

		Gal.	$		$		$
Gas	(Reg.	______	______	Car Service, lube	______	Cigarettes	______
	(Prem.	______	______	Wash., oil change		Food	______
	(Other	______	______	Etc.		List Others	______
	Diesel	______	______			______	______
						______	______

APPENDIX C-3

RESTAURANT QUESTIONNAIRE—FIRST CYCLE

PORTSMOUTH-KITTERY ECONOMIC IMPACT STUDY

Restaurant Customer Interview   Facility Code______

Restaurant__________ Day______ Date______ Time______

1. Number in party______ Adults______ Children under 12______
2. Where is your car registered? ☐ Maine ☐ New Hampshire ☐ Mass. Other______
3. Where did this trip start?______
4. Where will this trip end?______
5. Where is your car usually garaged? ☐ at origin ☐ at destination elsewhere______
6. Route used getting here?

Northbound

U.S. 1	N.H. Tpk.	U.S. 1A	U.S. 4	N.H. 101	Other
☐	☐	☐	☐	☐	☐

Southbound

U.S. 1	Me. Tpk.	Me. 103	Me. 236	Me. 101	Other
☐	☐	☐	☐	☐	☐

7. What route will you continue trip on?

Northbound

U.S. 1	Me. Tpk.	Me. 103	Me. 236	Me. 101	Other
☐	☐	☐	☐	☐	☐

Southbound

U.S. 1	N.H. Tpk.	U.S. 1A	U.S. 4	N.H. 101	Other
☐	☐	☐	☐	☐	☐

8. What bridge did you (will you) use? ☐ Interstate ☐ Memorial ☐ Neither
9. Have you been by here before? ☐ Yes ☐ No 10. When was the last time?
   ☐ earlier today ☐ yesterday ☐ days ago ☐ 2-3 weeks ago ☐ mos. ago
   ☐ years ago ☐ first time
11. Have you ever eaten here before? ☐ Yes ☐ No 12. When was the last time?
   ☐ earlier today ☐ yesterday ☐ days ago ☐ 2-3 weeks ago ☐ mos. ago
   ☐ years ago ☐ first time
13. What is the purpose of this trip?
   ☐ Work ☐ Business ☐ Shopping ☐ Social ☐ Recreational ☐ School ☐ Eat ☐ Other
14. Total food and beverage check $______Other______ $______

APPENDIX C-4

MOTEL QUESTIONNAIRE—FIRST CYCLE

PORTSMOUTH-KITTERY ECONOMIC IMPACT STUDY

Motel Customer Interview Form   Facility Code______

	Day	*Date*	*Time*	
1. Arrival	______	______	______	2. Room No. (s)______
Departure	______	______	______	3. State license plate______

M F C

4. Resident City______State______ 5. No. in group______
6. Room bill $______Other charges $______ 7. Reservations? ☐ Yes ☐ No
8. Where did this trip start?______
9. What was the purpose of that trip?
   ______Business______Recreation______Other______
   A. Where is that located?______
10. If the answer to A is not in the Portsmouth-Kittery area ask:
   Why did you decide to stop in this area?______
   If answer can be identified geographically: where?______
11. Route used getting here?______
12. Where are you going now?______
13. What route will you continue trip on?______
14. Which bridge did you (will you) use?______Interstate______Memorial______Neither
15. Have you been by here before? ___Yes ___No 16. When was the last time?
   ___days ago ___wks ago ___mos. ago ___yrs. ago ___first time
17. Have you stayed overnight in the Portsmouth-Kittery area before? ___Yes ___No
18. How long ago was that? ___wks. ago ___months ago ___years ago

APPENDIX C-5

SERVICE STATION QUESTIONNAIRE—SECOND CYCLE

PORTSMOUTH-KITTERY ECONOMIC IMPACT STUDY

Service Station Customer Interview Facility Code__________

Station name____________________Day_______Date_______Time________

1. Passenger Car Liscense Plate
   ☐ New Hampshire ☐ Maine ☐ Mass. ☐ Other__________
   ☐ Standard ☐ Compact ☐ Small
2. Description of car: Make__________Model__________Year________
3. Number of occupants________ 4. Sex of driver ☐ Male ☐ Female
5. Truck ☐ Panel or Pickup ☐ 2-axle, six-tire ☐ 3-axle, single unit ☐ Tractor-trailer
   ☐ New Hampshire ☐ Maine ☐ Other__________ ☐ Bus
6. What does your gas indicator read?

E - 1/4	1/4	1/4 - 1/2	1/2	1/2 - 3/4	3/4	3/4 - F	no indicator or broken
☐	☐	☐	☐	☐	☐	☐	☐

7. Where did this trip start?____________________
8. Where will this trip end?____________________
9. Where is your car usually garaged? ☐ at origin ☐ at destination ☐ elsewhere______
10. Route used getting here?

Northbound

U.S. 1	N.H. Tpk.	U.S. 1A	U.S. 4	N.H. 101	Other
☐	☐	☐	☐	☐	☐

Southbound

U.S. 1	Me. Tpk.	Me. 103	Me. 236	Me. 101	Other
☐	☐	☐	☐	☐	☐

11. What route will you continue trip on?

Northbound

U.S. 1	Me. Tpk.	Me. 103	Me. 236	Me. 101	Other
☐	☐	☐	☐	☐	☐

Southbound

U.S. 1	N.H. Tpk.	U.S. 1A	U.S. 4	N.H. 101	Other
☐	☐	☐	☐	☐	☐

12. Which bridge did you (will you) use? ☐ Interstate ☐ Memorial ☐ Neither
13. When was the last time you drove by here? ☐ earlier today ☐ yesterday
    ☐ days ago ☐ 2-3 weeks ago ☐ mos. ago ☐ years ago ☐ first time
14. What is the purpose of this trip?
    ☐ Work ☐ Business ☐ Shopping ☐ Social ☐ Recreational ☐ School ☐ Other
15. Purchases

		Gal.	$		$		$
Gas	(Reg.	____	____	Car Service, lube	____	Cigarettes	____
	(Prem.	____	____	Wash., oil change		Food	____
	(Other	____	____	Etc.		List Others	____
	Diesel	____	____			____	____
						____	____

16. How long have you been coming by here?
    ☐ 1st time ☐ Less than a year ☐ 1 Year ☐ 2 Years ☐ 3 Years ☐ 4 Years
    ☐ 5 Years ☐ 6-10 Years ☐ Other________
17. How often do you come by here?
    ☐ Times a-week ☐ Times 2-month ☐ Times 2-Year

APPENDIX C-6

RESTAURANT QUESTIONNAIRE—SECOND CYCLE
PORTSMOUTH-KITTERY ECONOMIC IMPACT STUDY

Restaurant Customer Interview Facility Code________

Restaurant________________ Day________ Date________ Time________

1. Number in party________ Adults________ Children under 12________
2. Where is your car registered? ☐ Maine ☐ New Hampshire ☐ Mass. Other______
3. Where did this trip start? ________________
4. Where will this trip end? ________________
5. Where is your car usually garaged? ☐ at origin ☐ at destination elsewhere______
6. Route used getting here?

Northbound

U.S. 1	N.H. Tpk.	U.S. 1A	U.S. 4	N.H. 101	Other
☐	☐	☐	☐	☐	☐

Southbound

U.S. 1	Me. Tpk.	Me. 103	Me. 236	Me. 101	Other
☐	☐	☐	☐	☐	☐

7. What route will you continue trip on?

Northbound

U.S. 1	Me. Tpk.	Me. 103	Me. 236	Me. 101	Other
☐	☐	☐	☐	☐	☐

Southbound

U.S. 1	N.H. Tpk.	U.S. 1A	U.S. 4	N.H. 101	Other
☐	☐	☐	☐	☐	☐

8. What bridge did you (will you) use? ☐ Interstate ☐ Memorial ☐ Neither
9. Have you been by here before? ☐ Yes ☐ No 10. When was the last time?
   ☐ earlier today ☐ yesterday ☐ days ago ☐ 2-3 weeks ago ☐ mos. ago
   ☐ years ago ☐ first time
11. Have you ever eaten here before? ☐ Yes ☐ No 12. When was the last time?
   ☐ earlier today ☐ yesterday ☐ days ago ☐ 2-3 weeks ago ☐ mos. ago
   ☐ years ago ☐ first time
13. What is the purpose of this trip?
   ☐ Work ☐ Business ☐ Shopping ☐ Social ☐ Recreational ☐ School ☐ Eat ☐ Other
14. Total food and beverage check $__________Other__________ $__________
15. How long have you been coming by here?
   ____1st Time ____Less than a year ____1 Year ____2 Years ____3 Years
   ____4 Years ____5 Years ____6-10 Years ____Other__________
16. How often do you come by here?
   ____Times a week ____Times a month ____Times a year

APPENDIX C-7

MOTEL QUESTIONNAIRE—SECOND CYCLE
PORTSMOUTH-KITTERY ECONOMIC IMPACT STUDY

Motel Customer Interview Form Facility Code________

	Day	*Date*	*Time*	
1. Arrival	______	______	______	2. Room No. (s)________
Departure	______	______	______	3. State license plate________

M F C

4. Resident City__________State__________ 5. No. in group__________
6. Room bill $__________Other charges $__________ 7. Reservations? ☐ Yes ☐ No
8. Where did this trip start?________________
9. What was the purpose of that trip?
   ________Business________Recreation________Other________
   A. Where is that located?________________
10. If the answer to A is not in the Portsmouth-Kittery area ask:
   Why did you decide to stop in this area?________________
   If answer can be identified geographically: where?________________
11. Route used getting here?________________
12. Where are you going now?________________
13. What route will you continue trip on?________________
14. Which bridge did you (will you) use?_____Interstate_____Memorial_____Neither
15. Have you been by here before? ____Yes ____No 16. When was the last time?
   ____days ago ____wks ago ____mos. ago ____yrs. ago ____first time
17. Have you stayed overnight in the Portsmouth-Kittery area before? ____Yes ____No
18. How long ago was that? ____wks. ago ____months ago ____years ago
19. How long have you been coming by here? ____1st Time ____Less than a year
   ____1 Year ____ 2 Years____ 3 Years____ 4 Years____ 5 Years____6-10 Years
   ________Other________________.
20. How often do you come by here? ____Times a week ____Times a month
   ________Times a year.

____

____

WILBUR SMITH
AND ASSOCIATES