REPORT OF THE DEPARTMENT OF HIGHWAYS AND TRANSPORTATION ON THE

VIRGINIA COMMUTER STUDY

TO THE GOVERNOR AND THE GENERAL ASSEMBLY OF VIRGINIA

- Northern Virginia Case Study

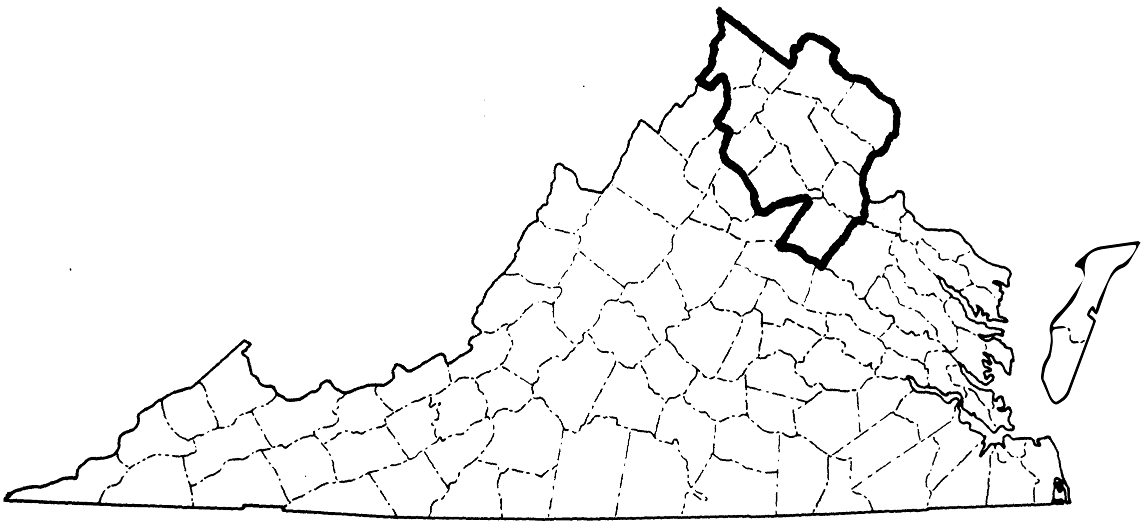
(See Also House Document 7)

HOUSE DOCUMENT NO. 7B

COMMONWEALTH OF VIRGINIA
RICHMOND
1983

VIRGINIA COMMUTER STUDY

An Analysis of Commuting Conditions in Three Case Study Areas



NORTHERN VIRGINIA CASE STUDY

PREPARED FOR
THE VIRGINIA
DEPARTMENT OF HIGHWAYS
AND TRANSPORTATION
BY
BARTON-ASCHMAN ASSOCIATES, INC.

VIRGINIA COMMUTER STUDY

Phase 3 Report
An Analysis of Commuting Conditions in Three Case Study Areas

Northern Virginia

June 1982

Prepared for
The Virginia Department of
Highways and Transportation

Prepared by
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Washington, D.C.

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INTRODUCTION

The purpose of the Virginia Commuting Study is to assess the feasibility of alternative transportation modes for commuters working in metropolitan centers, while residing in outlying communities. The study was prompted by the General Assembly's concern over the problems facing such commuters in a state and national climate of declining transportation revenues, high costs of building and operating transportation facilities, and an uncertain energy future. Of particular concern is the desire to identify more cost- and energy-efficient modal alternatives to the single-occupant auto, which characterizes much of today's commuting in Virginia.

Study Approach

The approach to this study has followed three broad phases:

1. The identification of problems and issues associated with commuting in Virginia (with an emphasis upon longer-distance commuting from outlying suburbs and exurban areas) and the development of policy, program, and legislative options to address these issues.

2. The identification of available modal options for such commuting (as drawn from national experience) and the development of a planning methodology through which the applicability of these options can be determined for urban areas in Virginia.

3. A detailed analysis of three case study areas--Northern Virginia, Roanoke, and Martinsville--in which the methodology developed in the second phase will be applied to determine the viability of various commuter options in these areas. The case study areas were chosen by the Virginia Department of Highways and Transportation (VDH&T) to provide a cross-section of urban area size and commuting problems that is somewhat representative of commuting conditions across the state.

An important feature of the study is the definition in Phase I of three future scenarios for commuter transportation in the 1980s and beyond, which reflect the uncertainties that exist with regard to energy availability and costs and financial resources for transportation improvements. The viability of alternative transportation actions in the case study areas (Phase 3) and alternative policy and program actions (Phase 1) is considered within the context of the scenarios to define actions which appear appropriate under any of the scenarios (and thus, represent high-priority actions for implementation).

Organization of this Report

This report documents one of the three case studies in Phase 3. Other reports describe the analyses and results of Phase 1 (Commuting Problems, Issues, and Policy/Program Response) and Phase 2 (A Methodology for Evaluating Commuter Travel Options in Virginia Cities). An Executive Summary provides an overview of the entire study and highlights principal conclusions and recommendations.

The presentation of case study analyses and conclusions basically follows the principal steps of the planning methodology that is detailed in the Phase 2 report. The case studies have the dual objectives of identifying actions that can be taken to improve commuting in each area and demonstrating the use of the planning methodology in a variety of commuting environments. The second objective requires that each step of the analysis be documented in detail so that subsequent users of the methodology can achieve maximum benefit from application in the case studies. Thus, the report contains more extensive tables, sample calculations, and description of assumptions than would ordinarily be found in a typical project feasibility study.

While each case study report follows the general outline of the major steps in the planning methodology, there are important differences in the way in which material is presented and in the level and type of analysis for each case study. This results primarily from the vast differences in commuting conditions between a large urban region such as Northern Virginia, that is part of an even larger metropolitan area, and a smaller, free-standing urban area, such as Martinsville. The types and level of problems in two such contrasting areas obviously demand different planning and analytical techniques, and the resulting transportation solutions are likely to be quite different in form, cost, and impact.

Finally, some of the variation in the case study discussions is the result of different analysts working on each area. While there was extensive communication between the three principal analysts during the study, each was given considerable flexibility in adapting and applying the basic methodology to conditions in his respective study areas. This had the benefit of producing three fairly independent tests of the planning methodology, reflecting not only differences among study areas, but differences in interpretation of the methodology, as well.

CASE STUDY AREA DEFINITION

The Northern Virginia Case Study area is shown in Figure 1.1. The area includes the counties of Fairfax, Prince William, Loudoun, Fauquier, Clarke, Frederick, Warren, Rappahannock, Culpeper, Stafford, and Spotsylvania, and the independent cities of Falls Church, Manassas, Manassas Park, Fairfax, Winchester, and Fredericksburg. Arlington County and the city of Alexandria are included in parts of the analysis, but are not part of the primary study area because work trips from these areas are fairly short, and their commuters already have and use a wide variety of alternative travel modes.

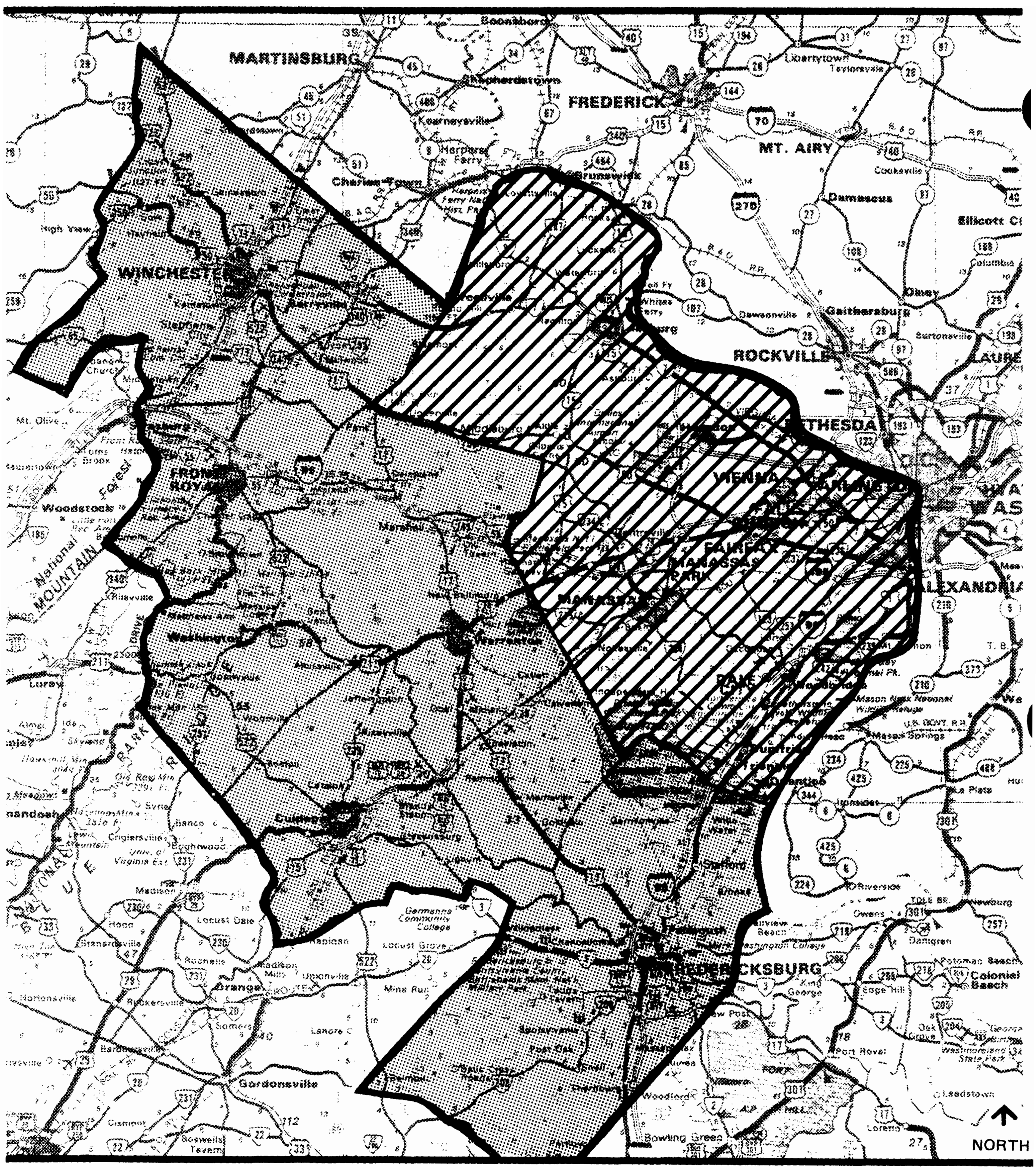
The major destination for study area work trips is the central D.C. area (see Figure 1.2). This includes the District's downtown employment core, but also extends into Arlington County to include Rosslyn, Fort Myer, the Pentagon, Crystal City, and National Airport. This will henceforth be referred to as the "central area".

The recent growth in suburban employment has made suburban work destinations grow in importance. For this study, suburban destinations include Fairfax County, Fairfax City, Falls Church, Alexandria and that portion of Arlington County outside the central area.

Another geographic stratification is at the boundary of the Washington, D.C. SMSA. The SMSA includes Loudoun and Prince William Counties and the closer-in jurisdictions (see Figure 1.1). Although travel from the outlying counties is included, it should be noted that available data limits much of the analysis detail to the SMSA jurisdictions.

CORRIDOR DEFINITION

The study area is divided into three main corridors, with one of these being further divided into two sub-corridors in the outlying areas (see Figure 1.3). Each corridor represents a shed of commuters using one or more major radial highways as shown in Table 1.1. Because of the geography of Northern Virginia, the corridors gradually merge and lose their individual "identities" near the Capital Beltway. At the border between Arlington and Fairfax Counties, the corridors are largely indistinguishable. Therefore, Arlington County and Alexandria are not split into corridors and are generally analyzed separately from the corridor areas. The corridor boundaries require a judgement as to the "area of influence" of each major corridor highway facility. This judgement was also tempered with the need to maintain compatibility with existing Census geographic areas and the Metropolitan Washington Council of Governments (MWCOG) zone and district definitions.



SCALE: 1" = APPROX 13.3 MILES

Figure 1.1
STUDY AREA

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STUDY AREA BOUNDARY
AREA OUTSIDE THE SMSA
AREA INSIDE THE SMSA

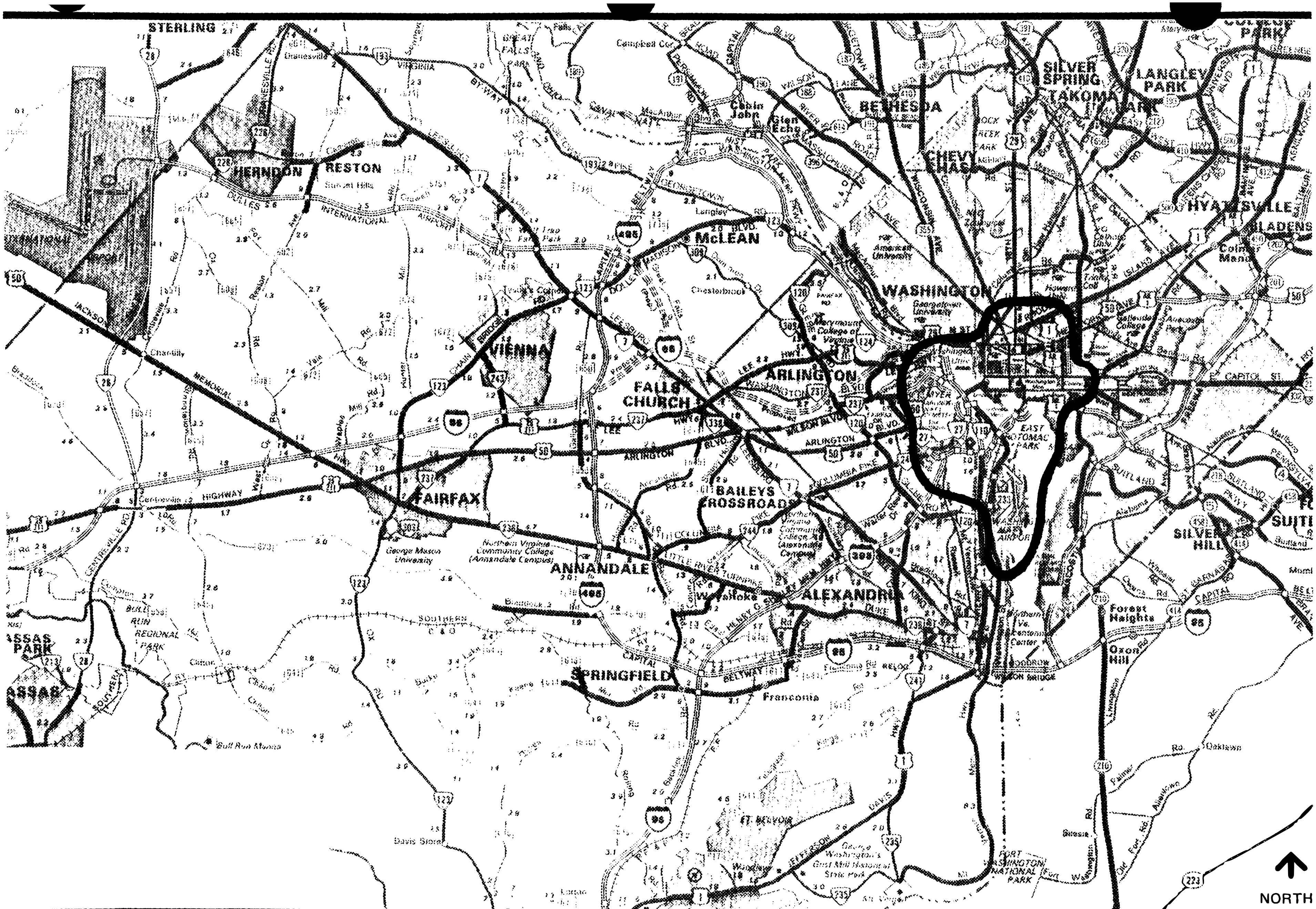

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Figure 1.2
D.C. CENTRAL AREA BOUNDARY
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Virginia Commuting Study

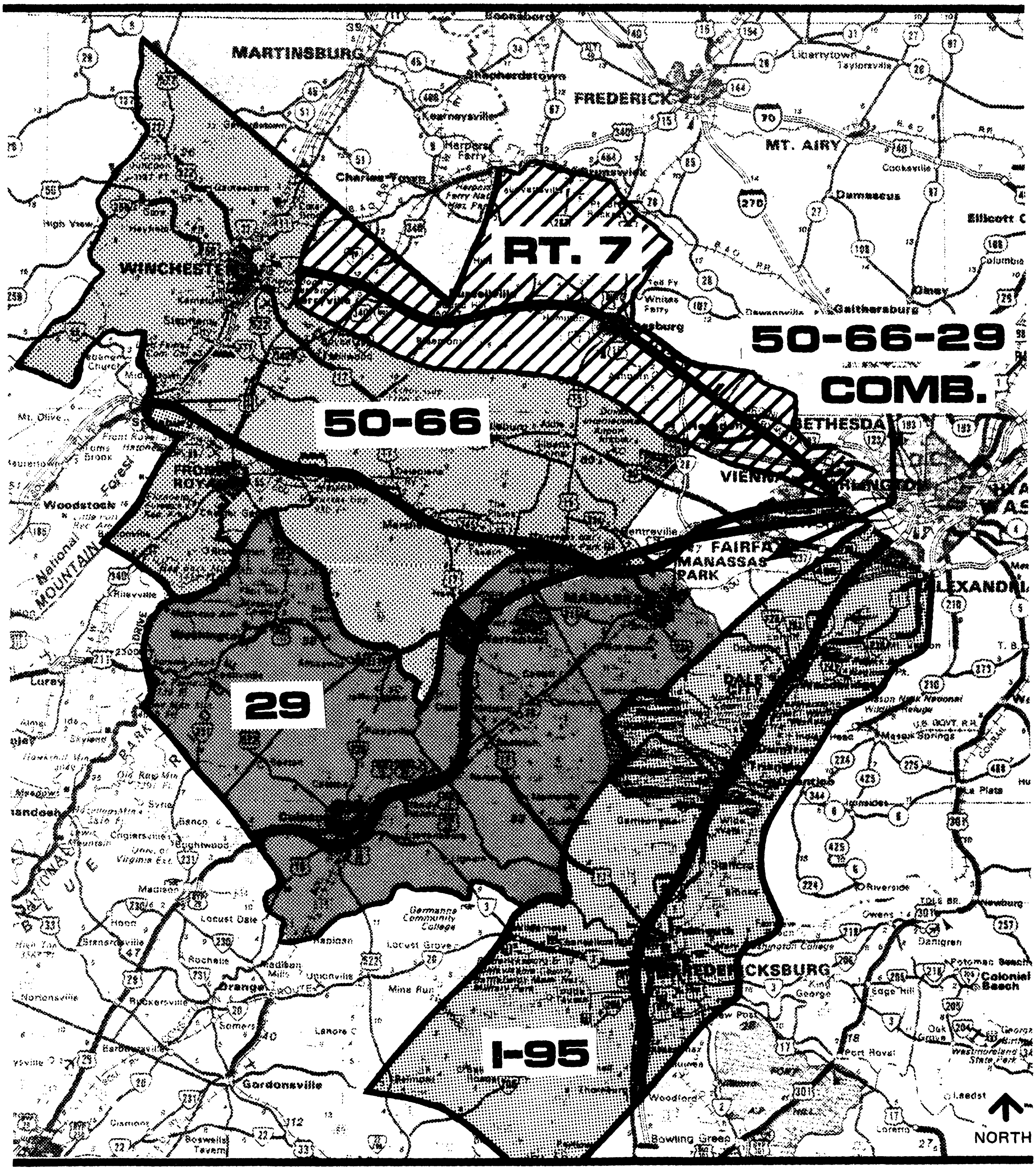

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Figure 1.3
CORRIDOR DEFINITIONS

MAJOR HIGHWAY CORRIDOR FACILITIES
CORRIDOR BOUNDARY

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MAJOR CORRIDORS

Corridor	Highways	Counties	Urban Areas
Virginia Route 7	Route 7 George Washington Memorial Parkway Dulles Airport Access Road	Fairfax Loudoun Warren	McLean Reston Herndon Berryville
U.S. 50 - I-66	U.S. 50 I-66 U.S. 17 Virginia Route 55	Fairfax Loudoun Warren Frederick Prince William Fauquier	Falls Church Fairfax City Vienna Manassas Manassas Park Front Royal Winchester
U.S. 29	U.S. 29 U.S. 15	Fairfax Prince William Fauquier Culpeper Rappahannock	Falls Church Fairfax City Manassas Manassas Park Warrenton Culpeper Washington, Va.
I-95	I-95 U.S. 1 George Washington Memorial Parkway	Fairfax Prince William Stafford Spotsylvania	Springfield Dale City Woodbridge Quantico Fredericksburg

The 50-66 and 29 corridors (i.e., U.S. 50, I-66, and U.S. 29) are combined within Fairfax County and have a separate identity only outside Fairfax County. In this analysis, data is sometimes presented separately for the three areas (50-66 outside Fairfax, 29 outside Fairfax, and 50-66-29 inside Fairfax) and sometimes for all three areas combined.

Table 1.2 presents the basic demographic data for the SMSA and outlying portions of the corridors. The I-95 corridor stands out as being the most populous, both inside and outside the SMSA boundary. The 50-66 corridor has the largest share of its population outside the SMSA, reflecting primarily the Front Royal and Winchester areas. Also of interest is the distribution of employment: there are almost as many jobs outside the central area as within it.

The study area contains the entire spectrum of land uses to be found in Virginia, from the intensity of Rosslyn to the vast farmlands of Rappahannock County. Within this range, there are four main levels of development. Arlington County and Alexandria are essentially fully developed urban communities, with a substantial base of housing and employment. Fairfax County, Falls Church, and Fairfax City represent a suburban region that is rapidly becoming very urbanized, especially in areas with good accessibility to the central area. Prince William County and, to a lesser degree, Loudoun County are the third tier: areas which in many respects have been and continue to be rural in character, but which are now becoming home to many commuters seeking a lifestyle even more "suburban" than that of Fairfax County. The final group is made up of the outlying counties, which are substantially rural but with significant "pockets" of residential, and sometimes commercial, land use, such as Winchester, Front Royal, Leesburg, Warrenton, and Fredericksburg.

An important study area travel characteristic is trip length distribution, as shown in Table 1.3. The I-95 and Rt. 7 distributions are similar, although the former has more long trips. The combined 50-66-29 corridor has the longest average trip length and the greatest proportion of trips over 30 miles. This probably reflects circuitous path-taking in addition to long airline distances.

Table 1.3 defines the magnitude of the long-distance commuter market, in Northern Virginia. For example, trips over 30 miles comprise about 10 to 20% of total central area-destined work trips in each corridor. Even though long commuting trips represent a small share of total central area work trips, they represent a much greater share of total person-miles of work travel because of their longer distance. The share of central area -- destined work trips over 30 miles long by corridor is as follows. Rte. 7 = 10.3%, 50-66-29 = 22.8%, I-95 = 11.2%. However, such trips represent the following shares of person-miles travelled in each corridor: Rte. 7 = 22.5%, 50-66-29 = 38.8%, I-95 = 26.7%. Therefore, long trips become more significant when viewed in the context of total time and distance spent in travel. This context is important in estimating and evaluating the costs and impacts of long-distance commuting.

Table 1.2

1980 CORRIDOR DEMOGRAPHIC DATA

Corridor		Population	Households	Employment
Rt. 7	1/ SMSA:	195,500	65,700	73,250
	2/ outlying areas:	12,400	4,900	5,200
50-66	1/ SMSA:	16,500	5,000	8,250
	2/ outlying areas:	88,500	35,300	32,600
29	1/ SMSA:	67,100	18,900	19,800
	2/ outlying areas:	49,200	18,000	13,500
50-66 and 29 combined	1/, 3/ SMSA:	181,000	59,800	70,060
I-95	1/ SMSA:	450,800	141,500	110,440
	2/ outlying areas:	90,200	31,500	19,800
Central Area 1/		122,300	61,600	519,800
Rest of Arlington County and Alexandria 1/		258,700	114,700	101,400

Notes:

1/ Source: 1980 Round II estimates by MWCOG, for the SMSA portion.
2/ Source: 1980 Census and various data sources for outlying areas (outside the Washington SMSA).
3/ Fairfax County portion only.

Table 1.3

1980 TRIP LENGTH DISTRIBUTIONS

Distance (Miles)[1/]	Rt. 7		50-66-29[2/]		I-95	
	%	Cum. %	%	Cum. %	%	Cum. %
10 or less	18.5	18.5	12.1	12.1	19.6	19.6
11-20	46.0	64.5	27.5	39.6	56.7	76.3
21-30	25.2	89.7	37.6	77.2	12.5	88.8
31-40	2.9	92.6	10.2	87.4	6.7	95.5
41-50	7.3	99.9	10.6	98.0	2.3	97.8
51 and over	0.1	100.0	2.0	100.0	2.2	100.0
Average trip length (miles)[3/]		19.4		24.6		17.6
Median trip length (miles)[3/]		15.7		24.1		14.5
Daily work trips (both directions)[3/]		28,774		29,993		83,839

Corridor: Rt. 7, 50-66-29, I-95

Notes:

1/ Distance is measured over-the-road, based on the AM peak hour minimum paths from districts in each corridor to the central area. Only trips which originate from Fairfax, Loudoun, and Prince William Counties and the outlying areas, and are destined to the central area are included. Source of 1980 work person trip and highway distance data is MWCOG.

2/ Includes Fairfax, Prince William, and Loudoun Counties and outlying portions of the combined corridor.

3/ To central area only.

TRANSPORTATION SYSTEM

The Northern Virginia suburbs of the Washington Metropolitan Area enjoy the largest variety of commuting modes of any urban area in Virginia. Several different types of highway facilities are available, including some freeway and arterial HOV facilities. Transit is represented by Metrorail, Metrobus, and several private commuter bus operations. There are a variety of ridesharing assistance programs covering various parts of the area. Finally, the region has an active TSM program to improve the use of the existing transportation system.

Highway System

The major corridor highway facilities are shown in Figure 1.3. These are radial routes, some of which are only two lanes wide in outlying areas, but most of which are four to eight lanes wide through at least Fairfax and Arlington Counties. Since the focus of this study is on peak hour commuting, more emphasis is placed on the radial routes than the non-radial roads. However, circumferential and lateral, cross-country routes, such as the Beltway, Rt. 28, U.S. 17, Rt. 123, and Rt. 236, play important roles in distributing traffic among radial routes.

A special characteristic of the Northern Virginia highway system is the availability of several special facilities for HOVs. These include the well-publicized separate bus/pool lanes on the Shirley Highway (including special priority ramps), arterial bus lanes ("diamond lanes") on U.S. 50 in Fairfax and Arlington Counties, and the Dulles Airport Access Road, which allows peak hour commuter access by HOVs from the Reston area (see Figure 1.4). These facilities permit buses and other vehicles with at least four persons to save about 0.5 to 1.5 minutes per mile. The U.S. 50 diamond lanes are shoulder lanes that are not physically separated from other traffic. (Unfortunately, these lanes are terminated about five miles short of downtown Washington because of a narrowed pavement through an older, built-up area.) Use of the Dulles Airport Access Road is facilitated by special inbound entry and outbound exit ramps that are operated by police. It should be noted that the FAA currently plans to prohibit HOV use of this road by about 1985 (although VDH&T plans construction of a toll facility in the Dulles Access Route right-of-way).

Transit System

Public transit service is operated by the Washington Metropolitan Area Transit Authority (WMATA). This includes the Metrorail system, with the Blue Line presently operating to National Airport and the Orange Line to Ballston. Metrobus service is provided throughout most of Alexandria, and Arlington and Fairfax Counties, as shown in Figure 1.5. As of 1979, there

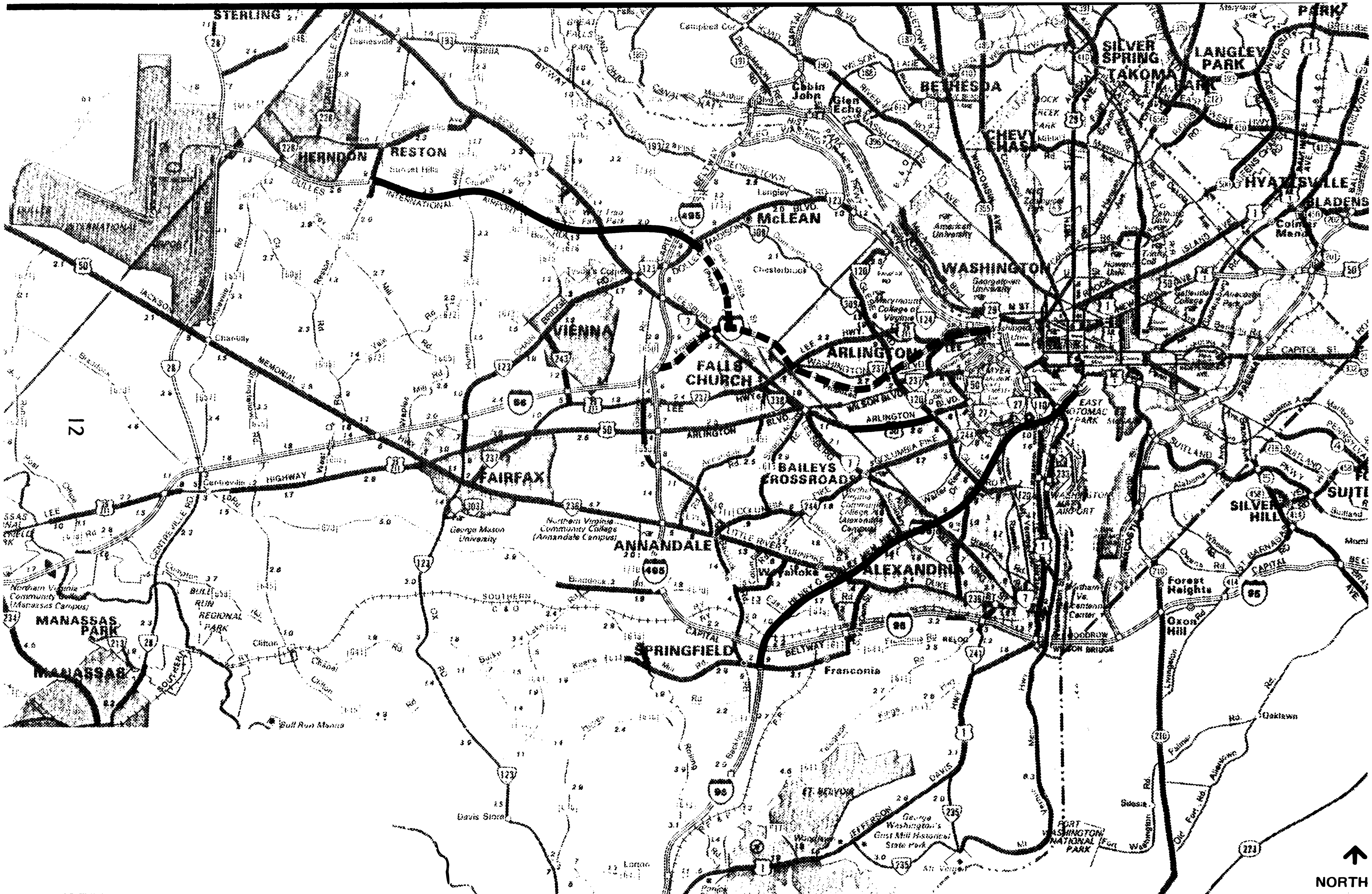

Figure 1.4
EXISTING HIGH OCCUPANCY VEHICLE FACILITIES

SCALE: 1" = APPROX 3 MILES

▬ EXISTING
▬ ▬ UNDER CONSTRUCTION

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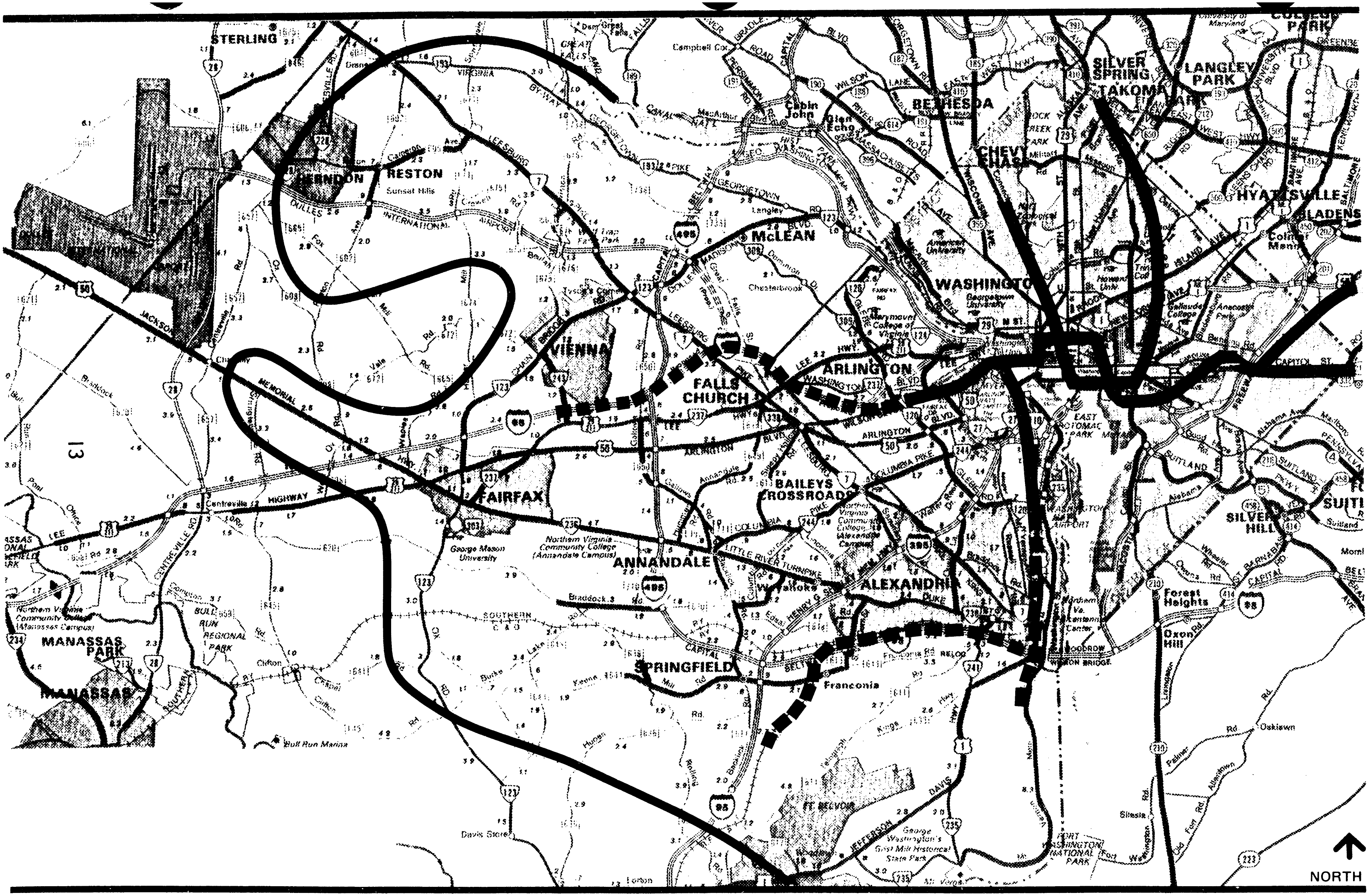

Figure 1.5
LIMITS OF WMATA TRANSIT SERVICE IN VIRGINIA (1980)

SCALE: 1" = APPROX 3 MILES

SERVICE LIMITS
EXISTING METRORAIL
PROPOSED METRORAIL

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were 79 local routes with 165 peak hour bus trips, and 117 express routes with 286 peak hour bus trips. Several indicators of the extent of WMATA service are shown in Table 1.4. The magnitude of just the Virginia portion of WMATA service can be appreciated by noting that in terms of passengers, revenue capacity miles, revenues, and operating expenses, this service exceeds the total of all other public transit systems in Virginia.

Private commuter bus service is also extensive in Northern Virginia. A total of 91 inbound bus trips are made daily by seven different operators, as described in Table 1.5 and Figure 1.6. Over 75% of the trips are in the I-95 corridor, probably reflecting the relatively long and narrow shape of this corridor, its two major highway facilities, the presence of HOV lanes that speed bus operations, and fairly dense, linear development, with several urban and suburban centers along the route from Fredericksburg to Washington. Accurate ridership and financial data are generally unavailable for most of these carriers, but it has been observed in other studies that many of the private operators are only able to stay in business through the use of part-time drivers, charter service cross-subsidies, and/or old and sometimes ill-maintained equipment. General ridership and service level trends seem to have stabilized somewhat after declining in recent years.

Fringe parking lots are another important component of the transportation system, especially for long-distance commuters. Figures 1.7a and 1.7b indicate the locations of the more important commuter parking lots in the study area. These include carpool/vanpool staging areas as well as established lots for switching to public and private transit routes. They represent mainly those areas formally identified for commuter parking, whether a separate lot or part of a shopping center, for example.

Ridesharing

Perhaps the fastest growing aspect of the Northern Virginia commuter transportation system is the ongoing formal effort to encourage ridesharing. This actually consists of several different programs around the region, each with a slightly different focus, as described in Table 1.6. MWCOG's Commuter Club is the largest and most experienced, concentrating on providing match lists to prospective carpoolers and vanpoolers. The Federal government, primarily through the General Services Administration, has an active program which includes administrative assistance and parking cost and location incentives. Alexandria and the Counties of Fairfax and Prince William also have jurisdiction - based ridesharing coordinators to assist in various ways in pool formation (usually for residents of their jurisdiction). Northern Virginia is also very fortunate (and somewhat unique) to have a relatively large private sector involvement in ridesharing. Tyson's Transportation Associates provides personalized matching for many of the employees at Tyson's Corner. The Virginia Vanpool Association (VVPA), a non-profit organization, and a few for-profit firms such as Vanpool Services, Inc., provide several types of supportive actions for vanpool formation and vehicle acquisition.

Table 1.4

PUBLIC TRANSIT SERVICE CHARACTERISTICS

Indicator	1980 Data for WMATA 1/ Bus System		1980 Data for WMATA 1/ Rail System
Estimated Service Area Population 4/		828,900	
Estimated Service Area (square miles) 4/		452.7	
Number of Active Transit Vehicles	494		79
Miles of Transit Route	476		10
Daily Hours of Service (weekdays)	24		14
Annual Revenue Vehicle Miles 2/	12,454.1		4,411.3 5/
Annual Revenue Capacity Miles 3/	543.5		772.0
Total Annual Unlinked Passenger Trips 2/	33,935.1		28,489.0
Employees 4/		1,233	
Average Vehicle Age (years)	9.0		5.5
Total Annual Revenue 2/	$ 8,191.9		$11,887.5
Total Annual Operating Expenses 2/	$23,769.8		$19,530.1
Revenue/Cost Ratio	0.34		0.61

Notes:

1/ Source: Public Transportation in Virginia - Service, Operations, Costs, and Revenue During Fiscal Year 1980, prepared by VDH&T Public Transportation Division, October, 1981. Data is based on information supplied by WMATA and relates only to that portion of WMATA service in Northern Virginia.

2/ In thousands

3/ In millions

4/ Not reported by transit mode.

5/ Presumably car-miles.

Table I.5

COMMUTER BUS SERVICE LEVELS

Origin	Peak Hour Travel Time (Minutes)	Operator	AM Inbound Bus Trips by Corridor Route 7	50 - 66	29	I-95
Sterling/Reston	50	Gold Line	4			
Leesburg	65	Greyhound	1			
Centreville Area	55	Goldline		8		
Manassas Area	65	Trailways		4		
		Colonial Transit		2		
Gainesville	70	Colonial Transit			1	
Nokesville	70	Trailways			1	
Prince William	50	Colonial Transit				42
Fredericksburg Area	80	Colonial Transit				4
		D&J				7
		Kube				6
		Tara				5
		Greyhound				2
		Trailways				4
Totals			5	14	2	70

Note:

Sources:
- The 1979 Zone Level Washington Transit Network (Phase III Metrorail), Technical Report No. 16, prepared by MWCOG, January, 1980.
- Intercity Bus Service in Virginia, prepared by Virginia Highway & Transportation Research Council, August, 1981.
- Extending the Shirley Highway HOV Lanes, prepared by JHK & Associates for VDH&T, March, 1982.
- Peak hour travel times estimated by Barton-Aschman Associates, Inc.

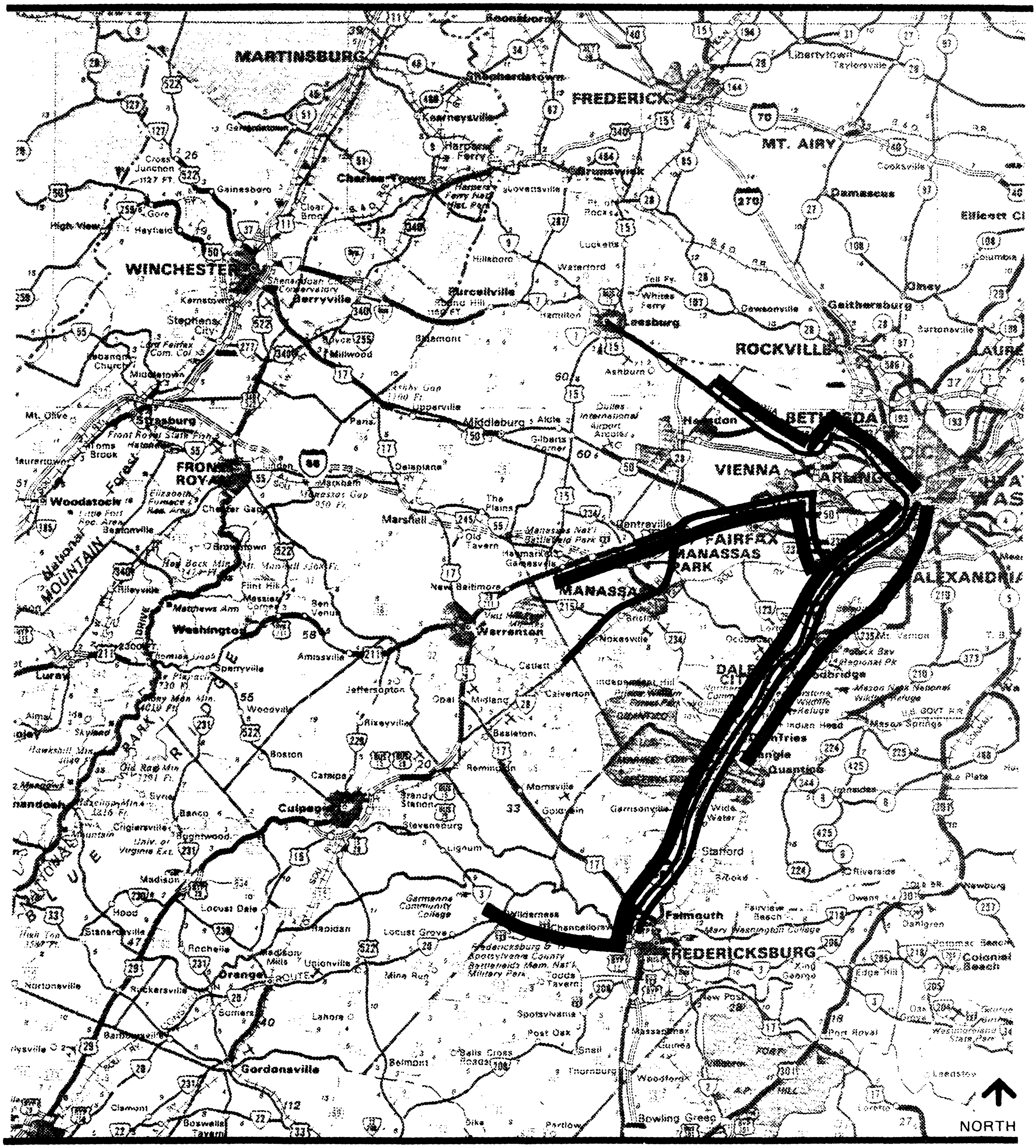

Figure 1.6
EXISTING PRIVATE COMMUTER BUS SERVICE

SCALE: 1" = APPROX 13.3 MILES

GREYHOUND
TRAILWAYS
OTHER CARRIERS

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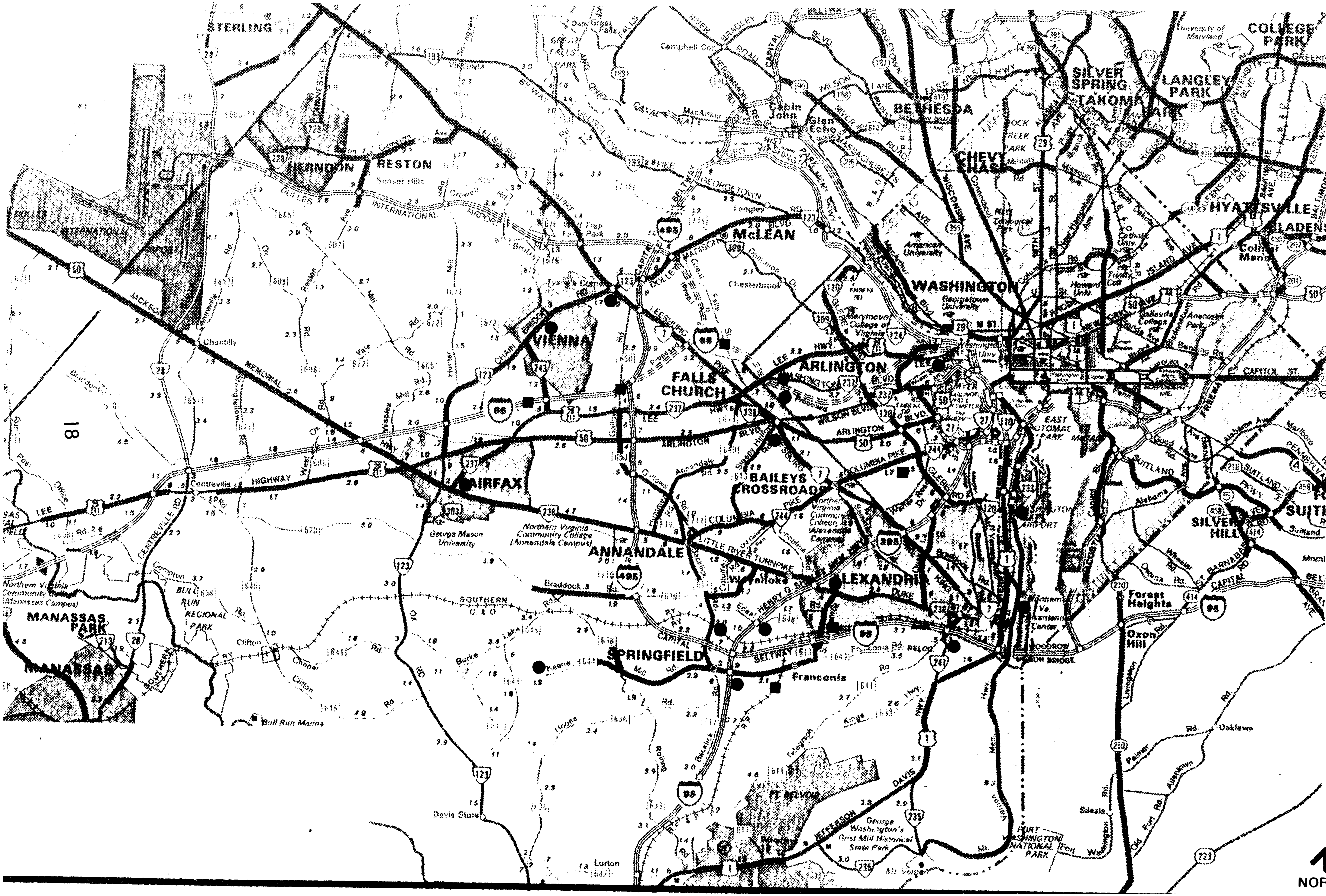

SCALE: 1" = APPROX 3 MILES

Figure 1.7a
COMMUTER PARKING FACILITIES

● EXISTING
■ PLANNED OR PROPOSED

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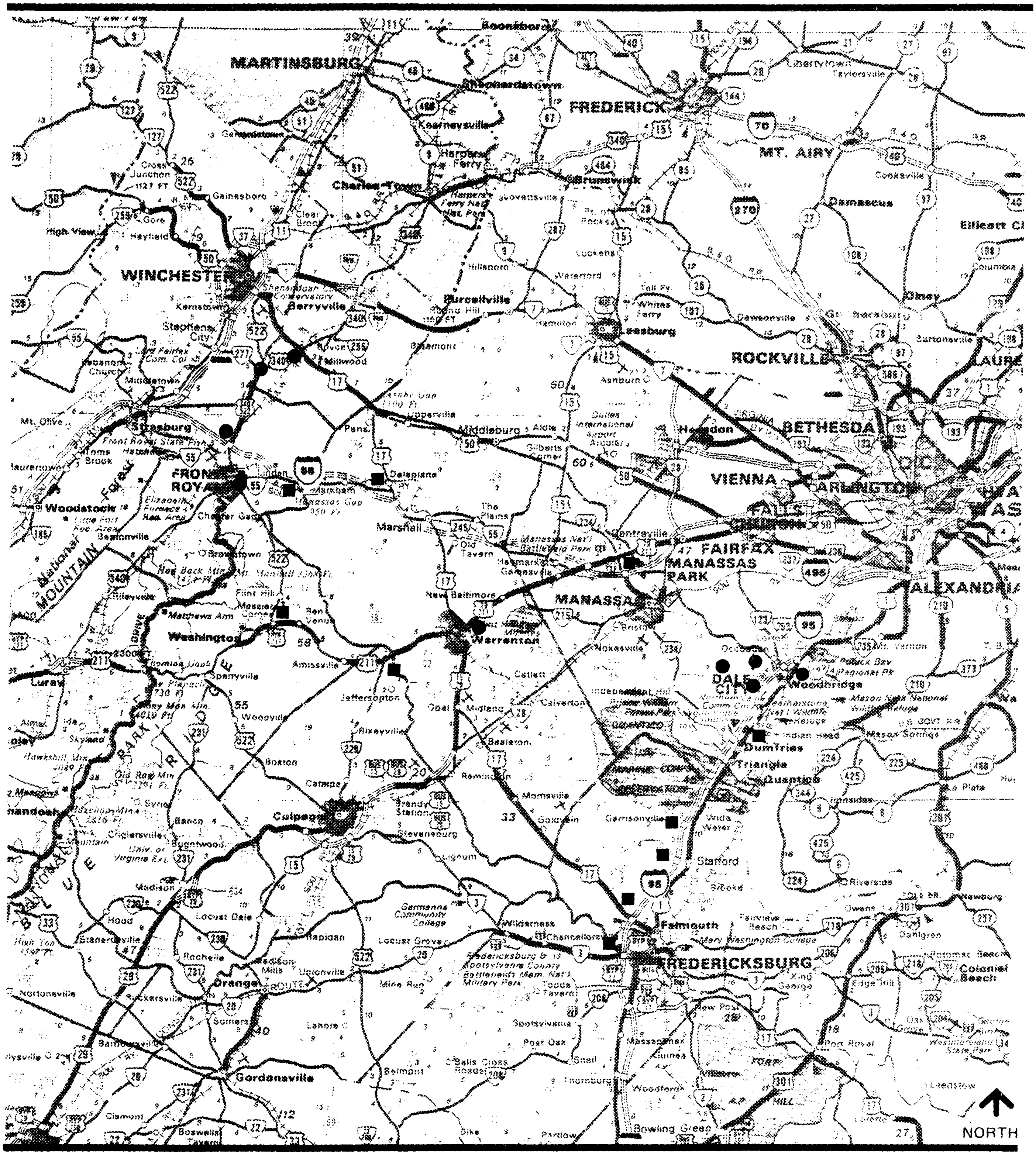

Figure 1.7b
COMMUTER PARKING FACILITIES

SCALE: 1" = APPROX 13.3 MILES

● EXISTING
■ PLANNED OR PROPOSED

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Table 1.6
RIDESHARING PROGRAMS

Organization and Program	1980 Service Area Population	Program Orientation 1/	Staff	1981 Funding	Services Offered: Carpool Matching	Vanpool Matching	Transit Information	Promotion	Other	Comments
MWCOG Commuter Club	1,105,714 2/	GP, EB Universities	3	$135,000 3/	X	X			Vanpool consumer information	33% of 1982 funding from VDH&T
Alexandria Ridesharing Service	103,217 4/	EB	1	15,000	X	X	X			
Prince William County	166,665 4/ 6/	GP	1	30,000 3/	X	X	X	X	Vanpool loan financing	Started out as demonstration program, may be continued.
Fairfax County	616,291 4/ 6/	GP, EB	1	18,000 3/	X	X		X		Program started February, 1982
NVTC	1,105,714 2/ 4/	GP, EB	2	137,166 7/				X		I-66 and ridesharing marketing projects
RADCO PDC	118,674	GP	2	15,000	X	X	X			
Tyson's Transportation Associates 8/	1,105,714 2/ 4/	EB	1	10,000	X	X				Non-profit organization by Tyson's Corner businesses
Virginia Vanpool Association 9/	---	GP	---	---		X			Van purchase/ lease information	Non-profit association of vanpool operators

Notes:

1/ Key to abbreviations: GP = general public; EB = employer based.
2/ Northern Virginia population.
3/ 1982 budget.
4/ Population figures included in those for MWCOG.
5/ Includes Manassas and Manassas Park.
6/ Includes Fairfax City.
7/ Projects funded in fiscal years 1982, 1983, and 1984.
8/ This organization evolved from VANGO of Virginia.
9/ Volunteer organization without full time staff or budget.

Source: Ridesharing Programs in Virginia: Services, Operations, and Costs for Fiscal Year 1981, prepared by VDH&T Public Transportation Division, January, 1982. Supplemented by written and verbal communication with Northern Virginia ridesharing personnel.

Transportation Systems Management (TSM) Actions

The final regional transportation component is the program of TSM actions. This consists of several relatively low-cost strategies to improve the use and productivity of the existing highway transit systems. The HOV facilities described earlier are often considered part of TSM. Other recently implemented TSM actions include:

- Computerized control and coordination of groups of arterial traffic signals and ridesharing encouragement activities provided by Arlington County and Alexandria for their municipal employees.

- Federal Executive Order (13 August 1979) on parking facilities for government employees (OMB Circular A-118) which mandated increased parking charges and preferential treatment for pool vehicles (although this has since been challenged in court).

- Residential parking permit programs in Arlington County and Alexandria.

These actions are significant in the context of supportive measures to encourage the use of transit and ridesharing, and to discourage driving alone, for all Northern Virginia commuters.

Summary

Northern Virginia commuters are fortunate in having a number of commuting options available to them. No other part of the state has this diversity of travel modes, facilities, and services for work trips. However, even this rosy picture has its limitations. Because of physical limits of accessibility and financial constraints of providers, some of these travel options are not readily available to many commuters, particularly long-distance commuters in Prince William, Loudoun, and the outlying counties. Moreover, further improvements and service innovations are needed to meet current travel demands and provide for expected growth in all corridors.

PLANS AND PROPOSALS

MWCOG is the Metropolitan Planning Organization (MPO) responsible for transportation planning in the Washington area. MWCOG's Transportation Planning Board (TPB) prepares the transportation plan for the region, which includes a Long Range Element, a Transportation System Management (TSM) Element, and a Policy Element. This section will review the main features of the first two elements as they relate to commuting in Northern Virginia, especially by long-distance commuters. The other sources of information on plans and proposals are the Status Reports for the Statewide Transportation Facilities Inventory and Local Transportation Issues, prepared in 1981 by VDH&T for each Planning District Commission. Part or all of PDCs 7, 8, 9, and 16 are in the study area. These reports identify transportation deficiencies and make broad level recommendations about their resolution.

Highway System

Two main types of highway plans affect commuters: building new roads and increasing the capacity of existing roads. Both improvements tend to reduce travel time and in some cases, slightly reduce auto operating costs by decreasing vehicle wear and tear. Because of the focus on the central area, radial routes are most important to long-distance commuters, but the importance of circumferential routes increases as the radial routes become congested and as suburban employment grows.

Figures 1.8a and 1.8b illustrate a selected group of highway improvements that have been proposed by MWCOG, VDH&T, and others. These roads include those radial and circumferential lateral routes judged to be particularly important to commuters. Only significant capacity increases, such as new lanes or new roadways, are shown (road upgrading and resurfacing are excluded). Most of these improvements reflect increases in the number of lanes from two to four or from four to six. The two major new roadways are the Dulles Toll Road and the Springfield Bypass. The Toll Road would consist of two lanes on each side of the existing Dulles Airport Access Road, from Route 28 to Rt. 123, initially, and then ultimately continuing on to I-66. The most recently identified toll would be $0.50 for the main line, $0.35 at Rt. 28, and $0.25 at all other ramps. The Springfield Bypass would serve as a lateral or cross-county route through Fairfax County to interconnect several radial highway corridors and collect and distribute traffic between these routes.

These proposed improvements are included in this report since they represent a benefit to commuters, primarily in terms of time savings, and perhaps, reduced driving frustration. However, this benefit is shared more or less equally by almost all commuters, whether they use a bus, ride in a carpool or vanpool, or drive alone. These improvements are not presumed to offer any new travel choices to commuters (except possibly a choice of route), and are not presumed to have any effect on inducing mode shifts to HOVs. Therefore, highway capacity improvements represent only part of the solution to commuting problems.

In terms of HOV facilities, the opening of the I-66 peak period HOV roadway is now planned for December, 1982. This will represent the most significant change in Northern Virginia transportation service since the opening of the Metrorail Blue Line in 1978. This highway will be of tremendous benefit to commuters in the 50-66-29 and Rt. 7 corridors and has the potential to

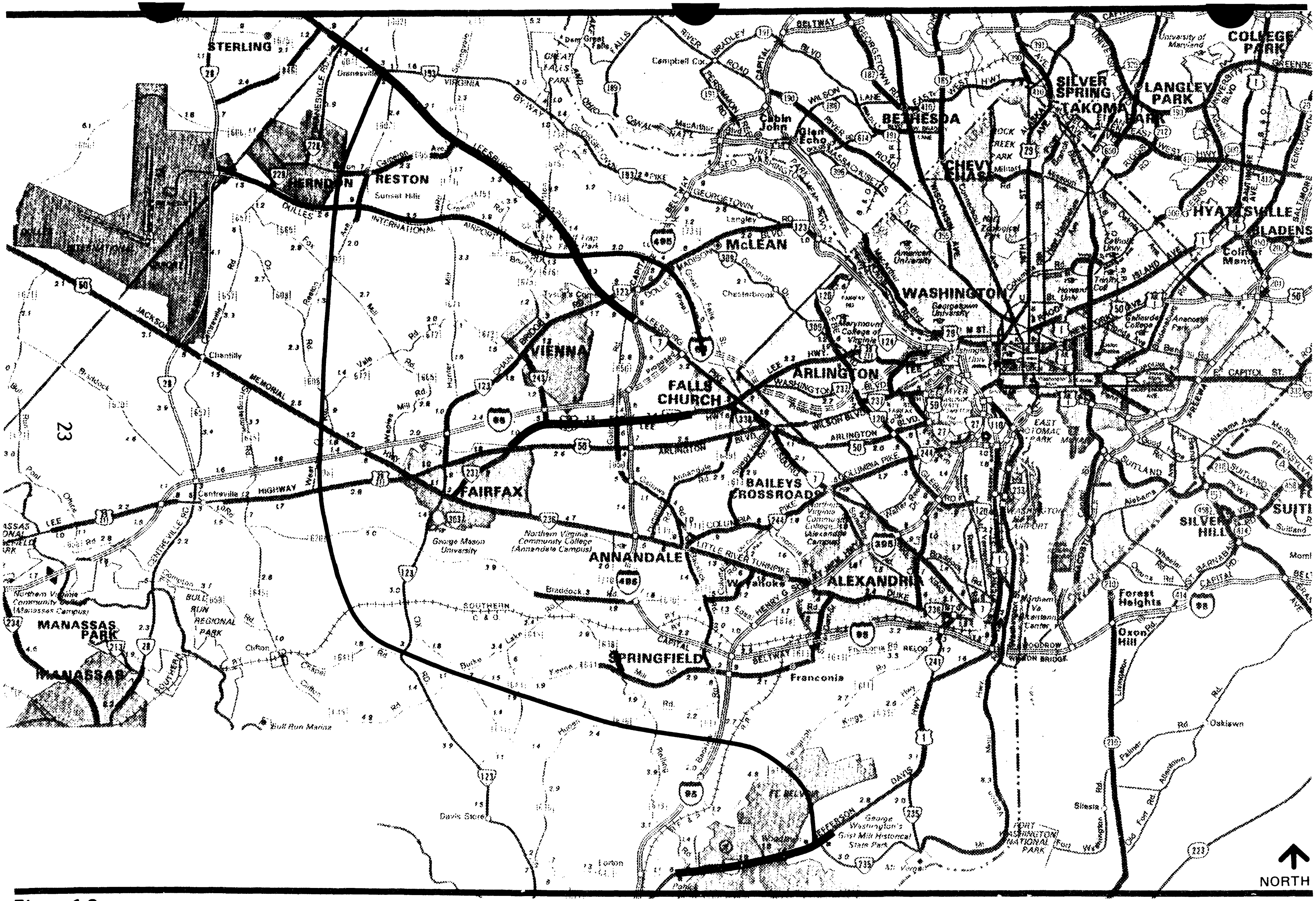
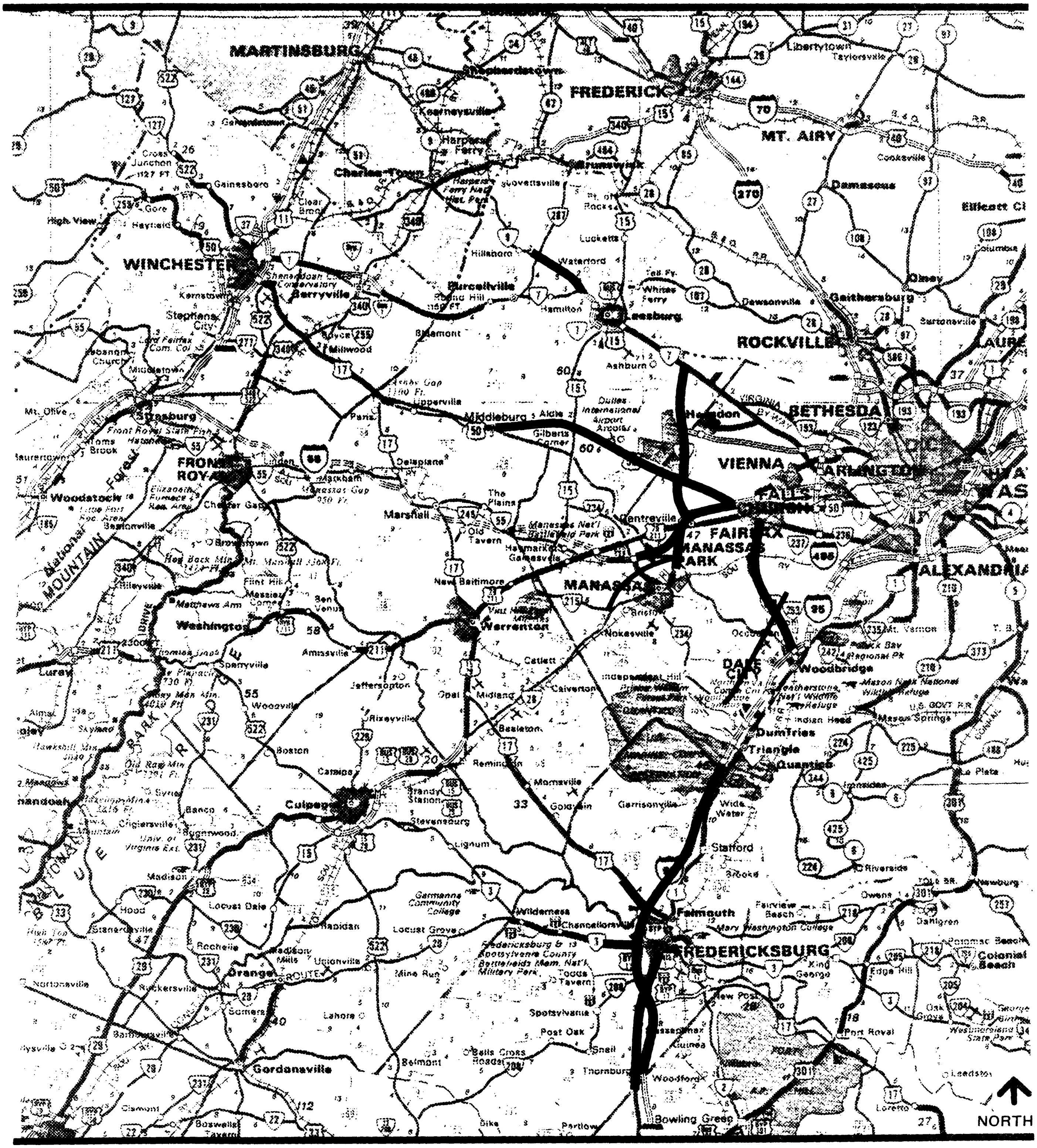


Figure 1.8a
PREVIOUSLY PROPOSED HIGHWAY IMPROVEMENTS

SCALE: 1" = APPROX 3 MILES

WIDEN EXISTING ROAD
CONSTRUCT NEW ROAD

NORTHERN VIRGINIA CASE STUDY
Virginia Commuting Study



SCALE: 1" = APPROX 13.3 MILES

Figure 1.8b
PREVIOUSLY PROPOSED HIGHWAY IMPROVEMENTS

WIDEN EXISTING ROAD
CONSTRUCT NEW ROAD

NORTHERN VIRGINIA CASE STUDY
Virginia Commuting Study

strongly reshape commuting patterns in those areas. Another improvement, the Dulles Airport Access Road Extension from Rt. 123 to I-66, is considered an HOV-related improvement, since it will facilitate HOV access to I-66 from the Reston area (where HOVs are presently allowed onto the Dulles road during peak hours). Recent estimates call for this segment to be completed by Spring, 1983. The final, major proposed HOV action is the extension of the Shirley Highway HOV lanes from Franconia to Dale City (Rt. 642). A 1982 study performed for VDH&T indicated that this option is feasible from operational, design, and demand points of view. These HOV proposals are described in more detail in a later section.

Transit System

The most significant planned transit improvement is the completion of Metrorail. These include the K Route to Vienna and the J/H Route to Huntington and Franconia. These route sections have been the subject of numerous studies, but the major question of a stable and reliable source of funding for construction and operation has still not been completely resolved. Another transit option receiving much attention is the idea of a rail line to Dulles Airport. This could be a branch of the Metrorail K Route and might have one or more local stops to provide service to the Rt. 7 corridor. The question of the relative roles of Dulles and National Airports tends to cloud the consideration of this proposal as a commuter facility. Another plan which has been subjected to intense scrutiny is the suggested commuter rail service on the Southern Railway route to Gainesville and on the RF&P line to Fredericksburg. The availability of existing track and a suitable terminal station in Alexandria make this a seemingly straightforward proposal, but there are institutional and funding issues that pose a significant problem to its implementation.

In the private sector, Prince William County is currently proposing a public-private cooperative venture to purchase buses to be leased to one or more private bus operators. Although public funds would be used to buy the buses, they would be operated in long-distance commuter service without operating subsidy. This is viewed as one means of maintaining adequate commuter bus service without a continuing public subsidy.

Ridesharing

Numerous ridesharing assistance and promotional activities are planned by Washington area agencies. MWCOG is in the process of upgrading its matching system by making it more responsive and more useful to a wider range of prospective poolers. This includes the use of interactive matching to greatly reduce the time required to provide match lists. NVTC has just started two multi-year projects to perform market research and promote ridesharing: one focuses on encouraging use of the I-66 HOV lanes, and the other involves promoting ridesharing at the employment centers of Rosslyn and Crystal City. Some of the other recently-initiated ridesharing programs, such as Fairfax County's, will be getting into full swing within the next year.

In general, the Washington area is moving away from the early forms of ridesharing assistance, such as simple matching, to the more advanced stages, which include employer targeting, parking strategies, personalized assistance in pool formation, assistance in van acquisition, and formal pool staging areas.

TSM Actions

Some of the more significant projects on MWCOG's list of TSM actions in the planning, proposal, and/or implementation stages include:

-- additional lanes and ramp widening on I-395
-- sophisticated freeway traffic management and control systems for I-66 and Shirley Highway (I-395)
-- additional fringe parking facilities, using shopping centers and lots at Metrorail stations which are not yet in service

The VDH&T Statewide Transportation Facilities Inventory Reports also suggest several locations for commuter parking lots. The proposed sites compiled from several sources are also shown in Figures 1.7a and 1.7b.

Summary

There are several different types of transportation proposals presently outstanding in Northern Virginia. Most of these proposals have a beneficial impact on commuters. Since a major purpose of this study is to analyze alternative transportation concepts for Northern Virginia, it will make maximum use of these previously identified proposals. In the context of this study, those concepts which have the greatest effect on shifts to HOV modes, especially for long-distance commuters, are the most important. Therefore, six previously identified transit and HOV options will be carried into the analysis of modal alternatives, as described in a later section. Table 1.7 and Figure 1.9 display these projects and the reports which document them. This study will make maximum use of the analyses contained in these reports.

PROBLEMS AND ISSUES

The major problems facing Northern Virginia commuters are increasing congestion in major commuting corridors, limited funds to mount an effective response to this congestion, and increasing transportation needs brought on by

Table 1.7
PREVIOUSLY IDENTIFIED COMMUTING ALTERNATIVES

Alternative	Study	Sponsor	Date	Status[1/]
Rapid Rail	Traffic, Revenue, and Operating Costs (for the Metrorail Adopted Regional System)	WMATA	1969	A
Rapid Rail	Dulles Airport Rapid Transit Service	FRA	1971	B
HOV Facility	Secretary's Decision on Interstate Highway 66, Fairfax and Arlington Counties, Virginia	USDOT	1977	C
HOV Facility	Draft Environmental Impact Statement, Dulles Access Highway Extension to I-66 and Other Parallel Roadways from Route 7 to I-495	FAA	1978	D
Commuter Rail	Northern Virginia Commuter Rail Study	MWCOG	1981	E
HOV Facility	Extending the Shirley Highway HOV Lanes	VDH&T	1982	F

Note:

1/ Status codes are as follows:

A. Metrorail Route to Huntington (Blue Line) scheduled to open late in 1982. Yellow Line to Franconia under final design to Van Dorn Street station, scheduled to open to Franconia in 1989. K Route (Orange Line) is under construction to Dunn Loring, under final design to Vienna, and is scheduled to open to Vienna in 1986.

B. Proposed (engineering feasibility study done).

C. Scheduled to open December, 1982.

D. Committed for construction; planned to open by early 1983.

E. Proposed (planning and operations feasibility study done).

F. Proposed (planning and design feasibility study done).

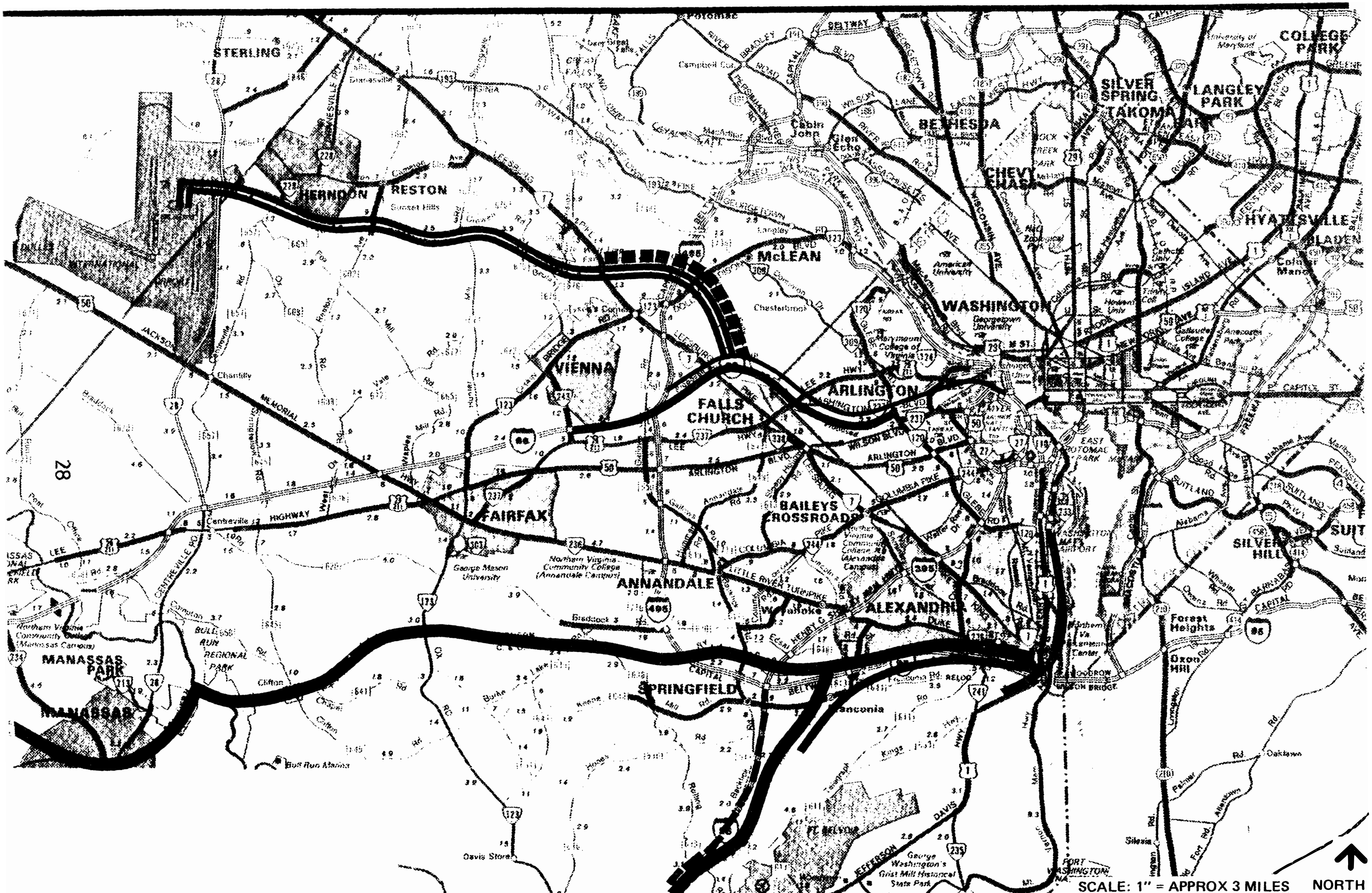


Figure 1.9
PREVIOUSLY PROPOSED ALTERNATIVES

METRORAIL
HOV LANE EXTENSION ON I - 95
COMMUTER RAIL
DULLES AIRPORT ACCESS ROAD EXTENSION
METRORAIL EXTENSION TO DULLES AIRPORT
I - 66 HOV/TRANSIT FACILITY

rapid suburban population and employment growth. During the 1970s, Fairfax County was by far the most rapidly growing jurisdiction in the Washington region, with its population growing by nearly 140,000, or about 44% over the decade. Prince William and Loudoun Counties registered population growth rates of approximately 50%, but with smaller absolute change in population. Providing transportation facilities and services to meet expected continued growth in the 1980s, as well as addressing the problems that already exist, will be an exceedingly difficult task, given state and national constraints on transportation revenues.

Congestion in Major Commuting Corridors

Congestion is chronic in many locations in Northern Virginia, even with a variety of routes available to most commuters. As roadways reach their capacity, the effect has been to extend "peak hour" congestion over a longer period of time each day --typically two to three hours each morning and afternoon for the principal commuting corridors.

VDH&T recently issued a series of Statewide Transportation Facilities Inventory and Local Transportation Issues report, one for each planning district, as part of its development of a statewide transportation plan. These reports identify highway deficiencies based on congestion, substandard design, and safety conditions. The major radial highway problems in Planning Districts 7, 8, 9, and 16 are noted in Table 1.8 and Figures 1.10a and 1.10b. Table 1.8 also indicates the number of lanes and 1980 average daily traffic volumes for each deficient highway section. As this information shows, there are congested facilities in each of the major commuting corridors identified in the previous section.

This list does not include special cases of congestion. For example, I-395 is frequently congested between Glebe Road and the Pentagon, but commuters can avoid much of this by forming carpools and using the high-occupancy vehicle (HOV) lanes in the median of the expressway. I-66 is often backed-up for miles west of the Beltway, primarily because of the present termination of I-66 at the Beltway, and the necessity for all traffic to exit and merge with Beltway traffic. The opening of I-66 east of the Beltway as a peak period HOV facility should improve this situation. A third special case is the George Washington Memorial Parkway, both northwest of Key Bridge and southeast of the 14th Street Bridge. Peak period delays are a regular occurrence north to Spout Run Parkway and south to National Airport. Expansion of this facility's capacity to accommodate more commuter traffic would destroy its park setting and is contrary to policy of the National Park Service, which owns and maintains the route.

Other special cases are the Potomac River bridges. The Woodrow Wilson Bridge and the bridges into D.C. -- Key, Memorial, 14th Street, Theodore Roosevelt -- are frequently major points of congestion. The Woodrow Wilson Bridge is also in need of major repairs; its poor deck condition is a daily cause

Table 1.8

MAJOR HIGHWAY DEFICIENCIES 1/

Different Route Sections By Corridor 4/	1980 ADT 2/	Number of Lanes	Peak Hour Peak Direction Vehicles per Lane 3/
Route 7			
A1. Route 7, Round Hill to Leesburg (Loudoun)	7,295	2	440
A2. Route 7, Route 228 to Route 50 (Fairfax, Falls Church)	50,820	4	1,520
A3. Route 193, Capital Beltway to George Washington Memorial Parkway (Fairfax)	8,355	2	500
A4. Route 123, Route 243 to George Washington Memorial Parkway (Fairfax)	59,790	4	1,790
Routes 50-66			
B1. Route 50, Route 120 to Route 27 (Arlington)	48,625	4	1,460
B2. Route 50, Fairfax City to Route 7 (Fairfax)	50,320	4	1,510
B3. Route 50, Middleburg to Arcola (Loudoun)	6,125	2	370
B4. Routes 29 Fairfax City to Falls Church (Fairfax)	23,960	2	1,440
Route 29			
C1. Route 29, I-66 to Fairfax line (Prince William)	20,690	2	1,240
C2. Route 28, Remington to Manassas City (Prince William and Fauquier)	21,905	2	1,310
I-95			
D1. I-95, Rolling Road to Keene Mill Road (Fairfax)	87,200	6	1,740
D2. U.S. 1, Alexandria to I-395 (Arlington)	31,240	4	940
D3. U.S. 1, Rolling Road to Route 235 (Fairfax)	24,900	2	1,490
D4. I-95, Dale City to Woodbridge (Prince William)	67,490	6	1,350
D5. I-95, Quantico to Dumfries (Prince William)	46,010	6	920

Notes:

1/ Source: Status Report, Statewide Transportation Facilities Inventory and Local Transportation Issues report for Planning Districts 7, 8, 9, and 16, prepared by VDH&T.

2/ Source: Average Daily Traffic (ADT) Volume on Interstate, Arterial and Primary Routes, 1980, prepared by VDH&T. (Volumes shown are the highest volumes along each portion of route.)

3/ Calculated assuming 60% split in the peak direction and 10% of daily traffic in the peak hour.

4/ Designations of congested areas refer to Figures 1.10a and 1.10b.

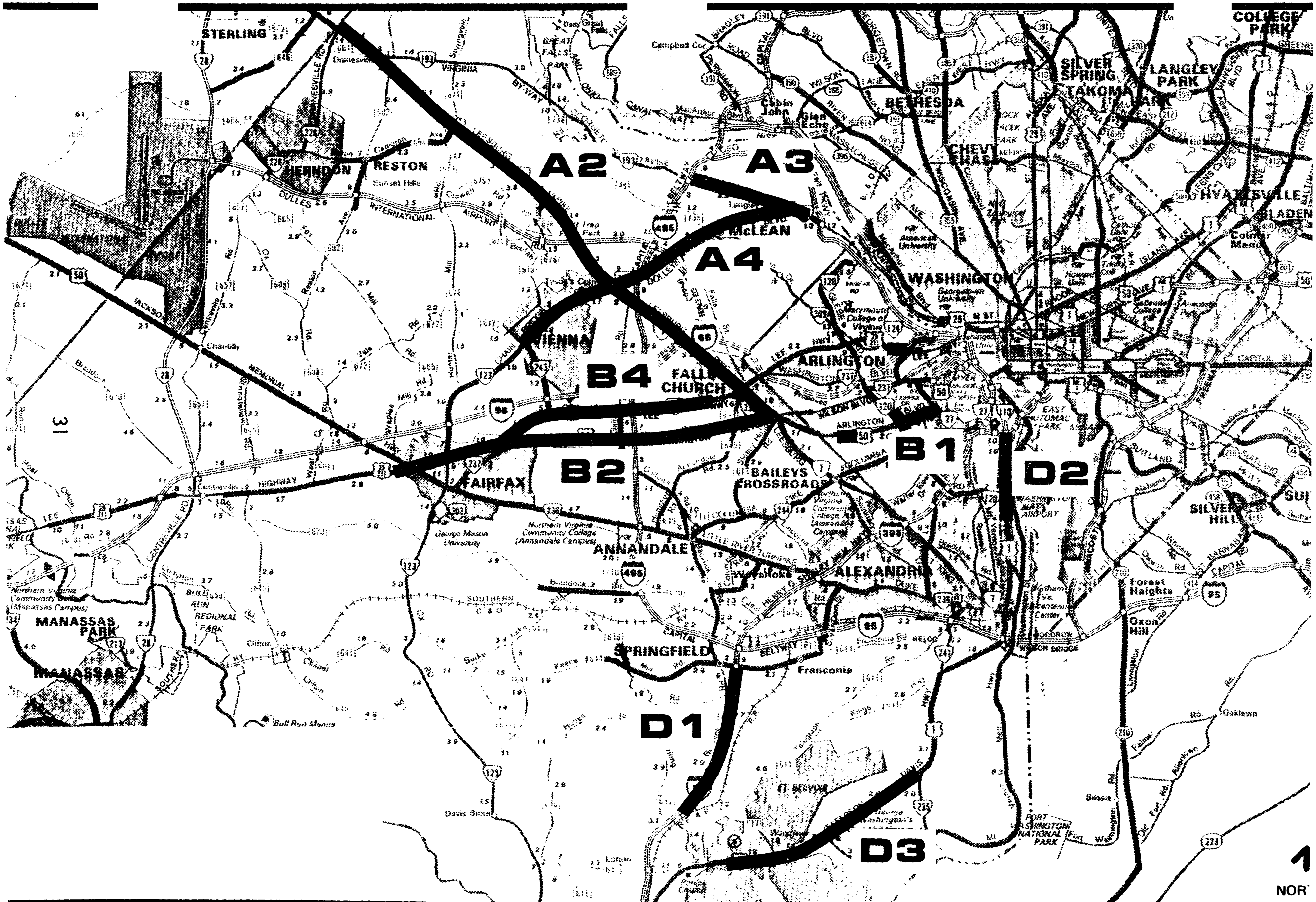


Figure 1.10a
MAJOR HIGHWAY DEFICIENCIES
NORTHERN VIRGINIA CASE STUDY
Virginia Commuting Study

B2 REFERENCE CODE (SEE TABLE 1.8)

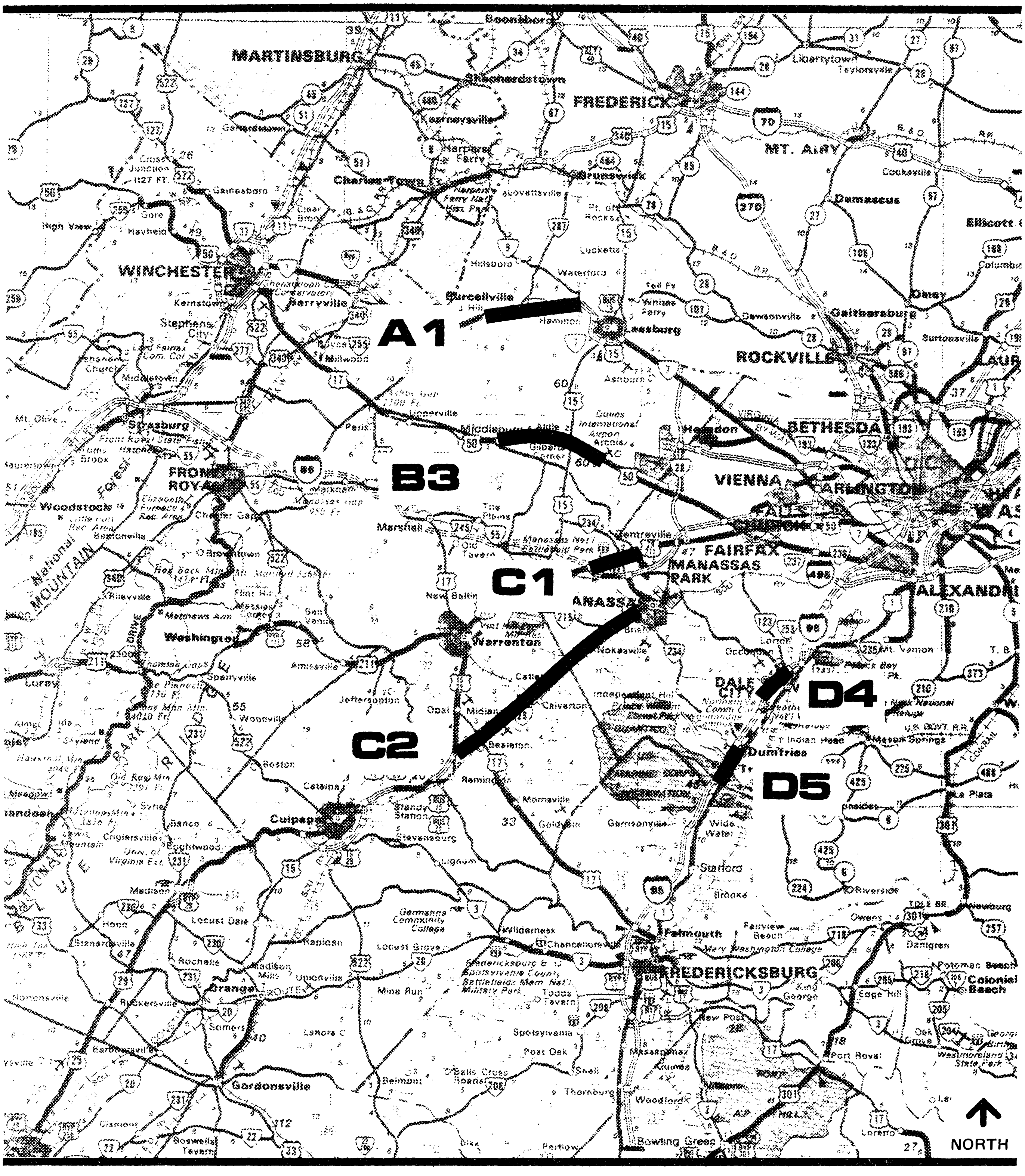


Figure 1.10b

SCALE: 1" = APPROX 13.3 MILES

MAJOR HIGHWAY DEFICIENCIES

NORTHERN VIRGINIA CASE STUDY
Virginia Commuting Study

D4 REFERENCE CODE (SEE TABLE 1.8)

of delay. These are special cases because none of them are completely within the jurisdiction of VDH&T. The Woodrow Wilson Bridge is subject to a multi-jurisdictional agreement between Virginia, Maryland, and D.C., and the other bridges are under the jurisdiction of Maryland, D.C. or the federal government.

Another factor which is contributing significantly to congestion in major commuting corridors is the growth of several major suburban activity centers which lie within these corridors. The rapid growth of office and retail developments in such activity centers as Tyson's Corner, Springfield, Bailey's Crossroads, and other smaller development centers has brought increased traffic and congestion to these areas, which in turn further congests longer-distance commuters desiring to pass through these areas on their way to downtown Washington or closer-in suburban destinations.

With this growth in suburban employment centers and the general growth in population throughout the Virginia suburbs has come the need for better lateral or cross-county highway facilities. Traditionally, the major highway pattern in Northern Virginia has been predominantly radial, deriving from major highways which focused upon the Washington central area. Only a few highways, such as Routes 123 and 28 offer lateral connections between these radial facilities. Increasing suburban land development has created the demand for additional highway capacity, particularly for these cross-county or lateral routes, but it has also made construction of such facilities increasingly difficult because of citizen resistance to highway construction in general. Thus, a controversial project, such as the Springfield Bypass, has required years for planning and design and has been gradually scaled back from a freeway facility to a more modest arterial project. Lacking adequate capacity on lateral routes, more traffic is forced onto the higher-capacity radial facilities, often resulting in longer, more circuitous trips and more congestion.

Despite the growing pressures being made upon the transportation system, it should be recognized that major improvements are under construction and are being planned in principal commuting corridors to provide additional capacity for person travel (for example, see the earlier discussion on the I-66 extension). With the possible exception of Route 1 (I-595) in the Crystal City area, there is unlikely to be any major expansion of highway capacity in most commuting corridors of Fairfax and Arlington Counties and the City of Alexandria. Rather, more advantage must be taken of the ability of existing highway facilities to move increased numbers of people by greater use of the HOV facilities in the I-95 and I-66 corridors, which are essentially the two major commuting routes inside the Beltway. In the outer suburban counties, there are opportunities (and plans) to increase the capacity of major commuting routes, such as Route 50, through roadway widening. However, with increasing growth in these areas, the capacity gained through current projects will have to be preserved through future actions such as HOV lanes and stronger efforts in ridesharing and public transportation service.

Transportation Financial Constraints

State and local governments across the country are facing a financial crisis in transportation, and Virginia is no exception. The problems of declining transportation revenues and the escalating cost of building and operating transportation facilities and services has been documented in many reports and is discussed in the Problems and Issues paper elsewhere in this study. Despite the recent action by the General Assembly to increase transportation revenues through a 3% tax on the wholesale price of gasoline and a revamping of the state licensing and fee structure, state funds, coupled with an uncertain federal funding source, will fall far short of Virginia's projected needs, both in highways and public transportation.

As the most populous region in the state and as an integral part of the Washington Metropolitan Area, Northern Virginia faces a truly unique set of problems and needs with financial implications that are relatively large, compared to other parts of the state. This is not to say that the transportation needs of other communities and regions are not important or severe; it is simply a recognition of the magnitude of investment that must be made in Northern Virginia as a result of the greater population that is served and the larger and more complex concentrations of traffic that must be accommodated. At the same time, higher development densities and larger population concentrations create opportunities for meeting much of this travel demand with modal alternatives such as public transportation and ridesharing that help to conserve the investment already made in major highway facilities and reduce the necessity for building further costly and disruptive highway projects in the heavily developed suburban areas. Nevertheless, as can be seen from the preceding discussion on congestion in Northern Virginia, major future investments in new highway facilities will be required, just as major expenditures will be warranted, and indeed essential, in expanding and upgrading public transportation.

The problem which Northern Virginia faces is in insuring that adequate financial resources from state and federal sources are directed to its needs, in the face of strong competition for these funds from other areas of the state. This is certainly true in considering the allocation of highway funding for various parts of the state, and there has been a particular problem for Northern Virginia relative to the funding of costly public transportation facilities and services -- particularly the construction of the Metrorail system. Public transportation presents a unique funding dilemma for Northern Virginia because it is inexorably tied to the total regional transit system and bound by multi-jurisdictional compacts to uphold its share of system capital and operating costs. In effect, decisions concerning public transportation that are made in suburban Maryland and the District of Columbia affect public transportation service and cost in Virginia. Decisions must be made jointly. For example, it is impossible to operate one level of service on the Metrorail system in D.C. and Maryland and a different level of service as the system crosses the river into Virginia.

Perhaps the most serious transportation funding issue concerns development of a stable and reliable funding source to cover escalating transit operating costs. Given Virginia's posture of not participating in transit operating costs, this costly burden has fallen upon the local communities of Northern Virginia, supplemented by federal operating assistance programs. However, the federal government has demanded that state and local jurisdictions in the Washington Metropolitan Area develop stable and reliable funding sources to support the operating costs of public transportation before some $1.7 billion in federal funds will be released to complete construction of the Metrorail system. Thus far, the question of whether Virginia has met its obligations in this regard is an unresolved issue between the state and the federal government. The state contends that the 2% tax on the retail price of gasoline now in effect in Northern Virginia, and whose proceeds may be used for transit operating support, represents an adequate state response to this need. The recent revenue package enacted by the General Assembly in March, 1982, also provided additional state funding for Metrorail construction. However, it remains to be seen whether the federal government will accept the present funding sources as meeting its demand for a stable and reliable funding source.

Ironically, if current national administration proposals for eliminating public transportation operating assistance programs by 1986 are enacted, the whole issue of local and state funding for operating assistance will be magnified since new state and local sources must be found to replace federal funds. In fiscal year 1980, this would have meant that local jurisdictions in Northern Virginia would have had to provide an additional $5.4 million in operating and administrative assistance, or a 23% increase in the local assistance actually provided that year. The alternative to providing these funds would be a cutback in service, which would only exacerbate the congested commuting conditions that were described earlier.

Long-distance commuters coming from outlying counties in the Washington region have an important stake in these funding problems. Metrorail and express bus facilities offer opportunities for transfer from the private auto at the outskirts of the urban area, and provide an alternative to the auto for the most congested part of the commuting trip. Moreover, public investments in Metrorail, HOV facilities, and other commuter transit service remove autos from the highways and free up capacity for those who must drive.

Other Insights into Commuting Issues and Problems

An interesting source of information on the attitudes of Northern Virginia residents concerning commuting conditions is a central area employment survey performed by MWCOG in 1978. The responses to this survey are particularly interesting because they reflect how the users feel toward the transportation service which they are receiving. One particularly interesting question was "How would you describe your travel to and from work?", the responses to which are shown in Table 1.9, stratified by major commuting

Table 1.9
CONVENIENCE OF COMMUTING[1/]

Response	Rt. 7 3/	50-66 3/	Corridor 29 3/	I-95 3/	All Commuters 2/
Very Convenient	17%	21%	26%	24%	33%
Convenient	48%	50%	53%	51%	50%
Inconvenient	26%	22%	17%	18%	13%
Very Inconvenient	8%	7%	4%	6%	4%
No Response	0%	0%	0%	1%	0%

Notes:

1/ Responses to the question "How would you describe your travel to and from work?" asked in an MWCOG November, 1978 survey of central area employees.

2/ Includes all Washington, D.C. central area commuters for comparative purposes.

3/ Includes commuters from Fairfax, Prince William, and Loudoun Counties only.

corridors. These responses indicate that, on the whole, Virginia commuters are less satisfied with their work travel than all central area commuters (i.e., including Maryland and D.C. commuters to downtown Washington). Commuters in the Route 29 corridor seem most satisfied with their commuting conditions, followed by the I-95 and 50-66 corridors. Route 7 commuters were by far the least satisfied.

It is useful to note some of the circumstances which could have contributed to the nature of these responses. In the year prior to the survey, the Metrorail Red Line was extended to Silver Spring, and the Blue Line was opened between National Airport and RFK Stadium. This was accompanied by major shifts in Virginia's Metrobus service. Also, at about the same time, Reston was starting to experience reliability and equipment problems with its express service as provided by a private operator. In addition, VDH&T had recently completed major construction on I-495 south of the Cabin John Bridge. These conditions may explain the unhappiness of Route 7 commuters, 34% of whom responded with "inconvenient" or "very inconvenient", twice the rate of the entire sample.

These data clearly show that there are slight but noticable differences in the way people in each corridor perceive their trip to work. These reactions can be related to specific conditions (facilities or services) that affect commuting.

The MWCOG survey also asked: "What are the most important things that could be done to improve your trip to work?" Respondents could identify up to three improvements. A tablulation of the first response is shown in Table 1.10, (assuming that respondents answer first with the improvement they consider most important). The results indicate a strong desire for more transit service at a lower fare. Over 50% of the respondents in each corridor would like to have lower fares and completion of the Metrorail system. Those in the Routes 7 and 50-66 corridors emphasized completing Metrorail (presumably referring to the K Route to Vienna), while the other two corridors, having access to the Shirley Highway and the Blue Line at National Airport, gave lower transit fares as their primary preference. Increasing express bus service scored third, while providing more HOV lanes was fourth (except in the Route 7 corridor, where increasing feeder bus service was fourth). About 7 to 9% favored improving highway and general traffic operations.

The responses to the MWCOG survey all point to one issue which is frequently noted in discussions with local officials and in reviewing the plans and policies of local jurisdictions: the need for adequate and improved commuting alternatives to the single-occupant auto. Actions to improve transit service and HOV facilities tend to reduce both the number of vehicles on the road and the costs of the individual traveler. Particularly for the long-distance commuter who typically lives well beyond the urban transit service area, ridesharing may offer the only reasonable alternative to driving alone.

Table 1.10
IMPROVEMENTS SUGGESTED BY COMMUTERS[1/]

	Percentage Response by Corridor			
	Rt. 7	50-66	29	I-95
Improve pedestrian ways	1.1	1.5	2.0	1.8
Provide or expand bike storage facilities downtown and at Metrorail stations	1.1	0.7	1.2	1.2
Build more bikeways	0.8	1.4	1.0	1.0
Lower transit fare	13.6	21.3	33.4	30.1
Increase express bus service	14.7	11.2	14.6	12.4
Increase feeder bus service	5.0	3.9	2.7	4.4
Complete the 100-mile Metrorail system	34.5	33.2	18.6	23.6
Construct and designate more express bus and carpool lanes	4.9	5.2	6.6	8.2
Stricter enforcement of traffic regulations	1.6	1.7	2.4	1.0
Improve traffic signalization	2.4	2.0	2.7	2.1
Provide more parking space in downtown areas	2.2	1.2	1.5	1.0
Widen or improve existing highways	2.9	2.1	3.4	3.0
Build major new highways	0.7	0.8	0.4	0.5
Reduce commuting by auto to downtown areas	0.4	0.8	0.2	0.6
Provide more parking spaces at Metrorail stations	0.4	0.3	0.1	--
Provide more bus service in the District	--	--	--	--
Improve Metrorail operations	0.4	0.3	--	--
Other	3.8	3.1	1.6	1.9
No Response	9.5	9.3	7.6	7.2

Note:

1/ Responses to the question "What are the most important things that could be done to improve your trip to work?" asked in an MWCOG November, 1978 survey of central area employees. Figures shown include commuters from Fairfax, Prince William, and Loudoun Counties only.

One issue which has been identified as important in the other case studies, but which may be less of an issue in Northern Virginia, is the cost of travel for long-distance commuters. Given the virtual dependence of long-distance commuters upon the automobile (i.e., lacking other available modes), their travel costs are obviously very sensitive to the cost of gasoline, which represents a lare share of total driving costs and is most subject to sudden and drastic change. Increases in gas prices in recent years have sharply escalated commuting costs, particularly for long work trips. However, in Northern Virginia, this effect is offset by the differential in housing costs between outlying communities and the closer-in suburbs of Washington.

Housing prices in the Washington area decline with increasing distance from the central area. A recent study by MWCOG has concluded that this decline is sufficient to offset fairly high commuting costs. For example, for a person driving to work alone in downtown Washington, gas costs would have to reach $2.88 per gallon to equal the housing cost savings of living in Frederick, a 45-mile commute, versus living in Gaithersburg, a 21-mile commute. A long-distance commuter could make this even more attractive economically by ridesharing and spreading the cost of travel among several people.

The high housing costs of the Washington area probably make this a somewhat unique situation in Virginia commuting. Certainly, in medium- and small-sized urban areas, there should be little or no differential in housing costs between central cities and outlying communities. In such areas, travel costs assume much greater importance for long-distance commuters.

DATA BASE

The MWCOG transportation planning data base is the primary source of information for this case study. MWCOG has provided the following data for 1980 for its system of 1,313 internal zones:

- Work person trips
- Daily parking costs
- Highway terminal times
- Highway distance
- Highway time
- Transit fare
- Households
- Employees
- Residential, commercial, and total land area
- Transit service level

Population, employment, and household data for MWCOG's 200 districts are available for 1980, as well as forecasts for each 5 years up to and including

2000 in the MWCOG Cooperative Forecasting Round II Summary Report (1979). Characteristics of central area commuters were derived from two MWCOG central area employment surveys. These surveys were taken in conjunction with the Metrorail "Before and After" study and represent a sample of about 4% of central area employment performed in May and June, 1977 (just after the Red Line was extended to Dupont Circle) and October and November, 1978 (just before the Orange Line was opened to New Carrollton). Characteristics of auto commuters from outlying areas were taken from a 1980 survey of trips at external stations performed by VDH&T for MWCOG (the external stations were located at the SMSA boundary). Employment characteristics came from the MWCOG report "An Economic Profile of the Washington Region, 1980". Peak hour auto and transit passenger volumes were taken from the MWCOG Beltway Cordon Count for 1980 and the Core Cordon Counts for 1980 and 1981. Private sector employment by employer size was derived from 1979 Census Bureau reports on County Business Patterns for Virginia, D.C., and Maryland. Federal employment by employer size was estimated from MWCOG documentation of the employment survey mentioned above.

Existing and projected data for the outlying areas came primarily from the 1980 Census, the Bureau of Economic Analysis (1979), the above-mentioned Planning District reports (1981), and an MWCOG draft of the In-Commuting and Fringe Growth Discussion Paper (June, 1981).

One of the largest problems in data manipulation involved compressing the MWCOG data from 1,313 zones to a manageable (and less expensive to process) district level. This was accomplished using standard UTPS programs, but at considerable expense. Another problem was the general issue of level of detail for some data: for example, the availability of labor force breakdowns by employer size of 250-500 instead of the desired 100-500. The third major problem was one of general geographic compatibility. Many data items were only available for the entire Washington, D.C. SMSA, or for political jurisdictions. This complicates analyses based on corridors. These problems were resolved by obtaining more detailed data or by using the available data with reasonable assumptions to produce the desired format.

INITIAL SCREENING OF MODAL OPTIONS

The initial screening of computer options to the single-occupant auto (also called the "Drive Alone" mode) employs the criteria described in the Methodology report. As discussed previously, data were collected on employment, dwelling units, residential land area, work trip lengths, and peak hour person trip movements.

The key criteria used in the initial screening of commuter options for each corridor are summarized in Table 1.11. A brief discussion of the development of each data item is appropriate:

Peak Volume: This was developed from a daily, two-way, work person trip table (i.e., desire line volumes), using an inbound peak hour-to-daily factor from a 1980 MWCOG cordon survey. Trips originating inside the central area, Arlington County, and Alexandria are excluded. Actual ground counts could not be used because the location of major highway facilities with respect to the Beltway caused some "warping" of trip patterns, such as people from Reston coming around the Beltway to use I-395 to approach the central area. Also, the exact trip purpose, origin, and destination are not known for ground count data. Peak corridor volume should reflect known travel patterns as much as possible.

Employment: This is the 1980 MWCOG employment estimate for the central area.

Corridor Length: This is defined in conjunction with the trip length distribution in each corridor. It was established as the over-the-road distance outward from the central area at which the cumulative person trip volume drops below 3,000 peak hour trips (the minimum warrant for express bus service). Therefore, this should be considered the approximate maximum distance over which capital-intensive options appear feasible.

Residential Density: For this analysis, it is not sufficient to describe density as a single value for each corridor. Density must be viewed in the context of location within the corridor. The density figure shown is the cumulative net residential density from the Arlington County border out to the distance specified in the "Corridor Length" column. This represents the density of the area served by the major part of the corridor. This is also displayed in Figure 1.11, which shows the cumulative density by distance in each corridor, in conjunction with the cumulative trip length distributions. Figures 1.12a and 1.12b show the net residential density by MWCOG zone. These figures show that overall, densities are low to moderate outside the Beltway, but that significant concentrations of housing do occur in each corridor, particularly near the major corridor highway facilities.

Table 1.11

APPLICATION OF INITIAL SCREENING CRITERIA FOR MODAL OPTIONS

	Criteria			
Corridor	Peak Volume 1/	CBD Employment 2/	Corridor Length 3/	Residential Density 4/
Va. Route 7	8,800	519,800	12	2.60
Routes 50, 66, 29 5/	9,200	519,800	26	3.05
I-95	25,800	519,800	23	3.39

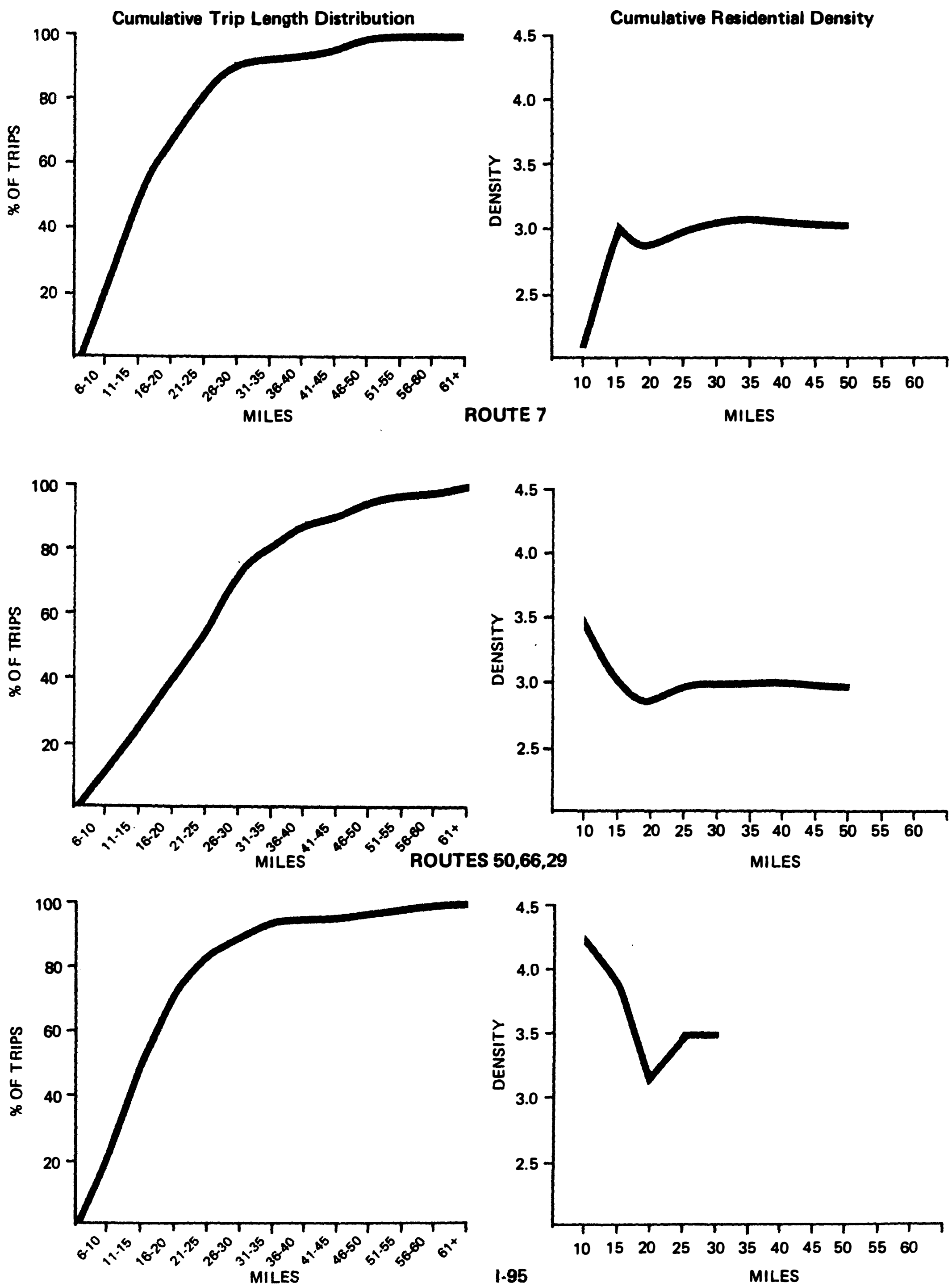
1/ Based on MWCOG 1980 work person trip table and MWCOG 1980 core cordon count of auto and transit passengers; rounded to the nearest 100. Peak 1 hour (7:30-8:30 a.m.), inbound flow of persons. Excludes trips originating inside the central area, Arlington County, Alexandria, and outside Virginia.

2/ MWCOG 1980 central area employment estimate.

3/ In miles measured over-the-road. This represents the distance along the corridor from the core area that is travelled by at least 3,000 inbound persons in the peak hour, from that part of the corridor outside Arlington County and Alexandria.

4/ This represents the approximate cumulative net residential density (in housing units per net residential acre) along the corridor outside Arlington County and Alexandria, up to the distance listed in the "corridor length" column. This value is to be used in conjunction with data on net residential density by MWCOG zone.

5/ Includes Fairfax, Prince William, and Loudoun Counties and outlying portions of this corridor.



NOTES:

MILES ARE TOTAL OVER-THE-ROAD DISTANCE FROM THE D.C. CENTRAL AREA WHICH INCLUDES ROSSLYN AND CRYSTAL CITY.

TRIP LENGTH DISTRIBUTION INCLUDES ONLY TRIPS DESTINED TO THE D.C. CENTRAL AREA (AS DEFINED ABOVE) AND EXCLUDES TRIPS FROM ARLINGTON CO. AND ALEXANDRIA.

RESIDENTIAL DENSITY(HOUSEHOLDS PER NET RESIDENTIAL ACRE) IS CALCULATED ON A DISTRICT BASIS AND INCLUDES DATA FOR FAIRFAX, LOUDOUN, AND PRINCE WILLIAM COUNTIES ONLY.

DATA SOURCES: MWCOG 1980 WORK PERSON TRIP TABLE, A.M. PEAK HIGHWAY DISTANCE, HOUSEHOLDS, AND RESIDENTIAL AREA.

Figure 1.11
CORRIDOR TRIP LENGTH AND DENSITY CHARACTERISTICS

Figure 1.12a
1980 NET RESIDENTIAL DENSITY BY ZONE (INSIDE BELTWAY)

NORTHERN VIRGINIA CASE STUDY
Virginia Commuting Study

HOUSEHOLDS PER NET RESIDENTIAL ACRE
0 - 3
3 - 6
6 - +
MAJOR CORRIDOR HIGHWAYS

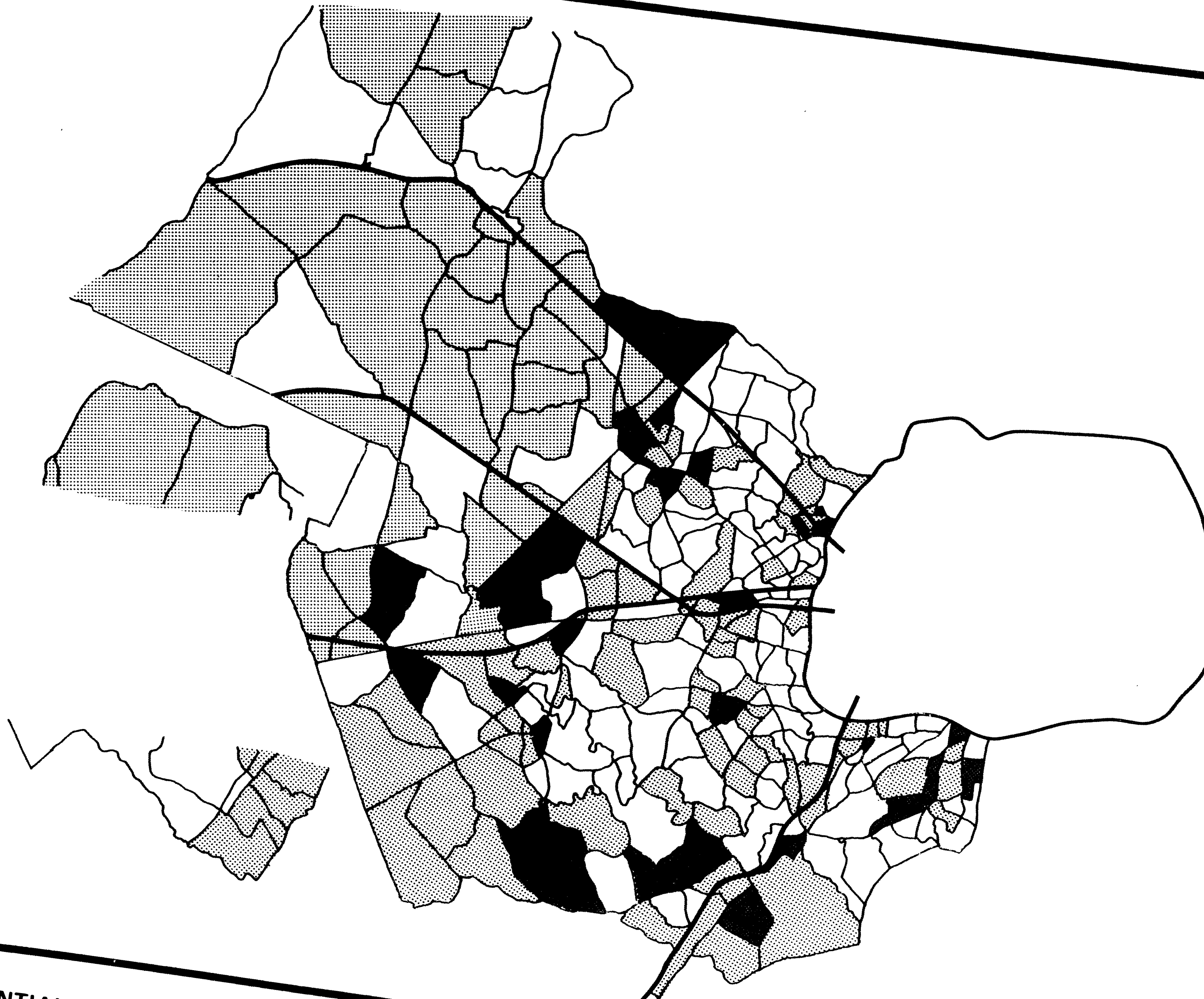


Figure 1.12b
1980 NET RESIDENTIAL DENSITY BY ZONE
(OUTSIDE BELTWAY)

NORTHERN VIRGINIA CASE STUDY
Virginia Commuting Study

The criteria for screening modal options are shown in Table 1.12, which is reproduced from the Methodology report. This table illustrates the minimum corridor volumes that are required in order to further consider each commuting mode. The results of applying the initial screening criteria in the three study corridors are summarized in Table 1.13. The major conclusion is that some type of exclusive bus lane or busway may be warranted in all corridors, but rail options are likely to be viable only in the I-95 corridor. This conclusion will help guide the consideration of alternatives in the next screening phase. "Viable" in this context refers only to the potential to sustain a minimum level of ridership. It does not imply anything about physical, institutional, or economic viability. Those issues are discussed in a later section.

APPLICATION OF MODAL SUMMARY TABLES

The modal summary tables from the Methodology report are used in the next level of testing and screening of alternatives. The purpose of using these tables is to develop initial estimates of mode usage and to help determine whether further consideration of specific options is worthwhile. This initial application of the tables to the existing (1980) commuter travel markets in each corridor will also test the methodology and compare estimated with observed results.

Table 1.14 shows the distributions of socioeconomic data for the Washington, D.C. SMSA that are used in the corridor travel analyses. Compared to the typical (nationally-derived) distributions shown in the Methodology report, the Washington area is more affluent and has a higher proportion of jobs concentrated in large employers. However, it is fairly typical with respect to employment type and work trip length. In this case study, the only characteristic for which corridor-specific values were available was trip length.

Applications of the modal summary tables for all three Northern Virginia corridors are shown in Appendix Tables 1A.1 through 1A.5. Mode shares are estimated for all modes which currently exist in Northern Virginia: Carpool, Vanpool, Express Bus, Busway, and Rapid Rail. The tables for a Large Urban Area are used. In each case, an initial modal share is selected, socioeconomic adjustment factors are computed (based on the distributions in Table 1.14) and a revised modal share is calculated. At this point, the only factor that distinguishes among corridors is the trip length factor.

Using the procedures in the Methodology report, these shares are rationalized in Table 1.15. The ridesharing modes are combined and the transit share is selected as the largest of the shares of the three transit modes. In determining the share by corridor, one must consider the availability of

Table 1.12
INITIAL SCREENING CRITERIA FOR MODAL OPTIONS

Mode	Corridor Volume (one-way, peak hour, peak direction Person trips)1/	Employment	Residential Density (DUS/acre)	Corridor Length (miles)
Express Bus	3,000	25,000 2/	3	5 4/
Light Rail/Busway	8,000	50,000 2/	9	5 4/
Rapid Rail	17,000	70,000 2/	12	7 4/
Commuter Rail	17,000	100,000 2/	1	10 4/
Carpool	--	100 3/	1	3 5/
Vanpool	--	300 3/	1	7 5/
Buspool	--	300 3/	2	7 5/

1/ At maximum load point in corridor for design year.

2/ Central area total employment for design year.

3/ Individual employers or contínguous employers with simlar shifts and employee characteristics.

4/ Facility length.

5/ Trip length.

Table 1.13

RESULTS OF INITIAL SCREENING FOR MODAL OPTIONS

1. Further consideration of express bus in mixed traffic is warranted in all corridors.
2. Further consideration of LRT/busway is warranted in all corridors.
3. Further consideration of rapid rail or commuter rail is warranted only in the I-95 corridor.
4. Further consideration of ridesharing modes is warranted in all corridors.
5. CBD employment is large enough to support any of the modes.
6. Corridor lengths are sufficient to support implementation of any of the modes.
7. Aggregate net residential density values are low, but significant concentrations of housing exist near key highway facilities in each corridor.

Table 1.14

SOCIOECONOMIC DISTRIBUTION OF COMMUTER MARKET

		NOTES
Net Residential Density		
Low (less than 3 DU/acre)	37.0%	Households in Fairfax, Prince William, and Loudoun Counties; 1980 MWCOG data
Medium (3.01-6.00 DU/acre)	55.6%	
High (over 6 DU/acre)	7.4%	
Household Income		
Low (Less than $10,000)	13.5%	1977 Census data for the Washington SMSA
Medium ($10,001-25,000)	43.2%	
High (over $25,000)	43.3%	
Employment Concentration		
1-100 employees	39.6%	SMSA totals 1977 MWCOG employment survey data and 1979 Census report on County Business Patterns
101-500	18.4%	
501-1000	8.2%	
over 1000	33.8%	
Type of Employment		
Office	67.9%	SMSA totals; 1977 MWCOG employment data
Retail	18.8%	
Blue Collar	13.3%	

Work Trip Length (by corridor)	Rt. 7	50-66-29	I-95	
0-5 miles	0%	0%	0%	1980 MWCOG work person trips and highway distances to the central area; VDH&T survey of external station auto trips (data shown includes only Fairfax, Loudoun, and Prince William Counties, and the outlying areas)
6-10	18%	12%	20%	
11-15	30%	13%	33%	
16-20	16%	15%	24%	
21-25	16%	15%	8%	
26 or more	20%	45%	15%	

Table 1.15

RATIONALIZATION OF MODAL SUMMARY TABLE RESULTS

	To Central Area			To Suburbs		
	Rt. 7	50-66-29	I-95	Rt. 7	50-66-29	I-95
Ridesharing Modes						
Carpool	.331	.373	.320	.303	.343	.294
Vanpool	.033	.049	.028	.033	.049	.028
(Percent Vanpool of Total)	(9%)	(12%)	(8%)	(10%)	(12%)	(9%)
Transit Modes						
Express Bus	.185	.184	.185	.024	.024	.024
Busway/LRT	.383	.380	.384	.051	.050	.051
Rapid Rail	.133	.090	.145	.017	.012	.019

Initial Mode Shares

Corridor	Destination Area	Transit 1/	Ridesharing 2/	Drive Alone
Rt. 7	Central Area	.225	.364	.411
	Suburban	.029	.336	.635
50-66-29	Central Area	.185	.422	.393
	Suburban	.024	.372	.640
I-95	Central Area	.384	.348	.268
	Suburban	.051	.322	.627

Notes:

1/ The available transit modes vary by corridor: I-95 has a busway which almost all commuters can use; the 50-66-29 corridor has only express bus in mixed traffic, and Rt. 7 has the Dulles Airport Access Road "busway" that Reston/Herndon transit and ridesharing commuters can use (20% of the corridor's households), while the other 80% only have express bus in mixed traffic available.

2/ Of the total ridesharing share, carpooling represents about 88%-92% and vanpooling about 8%-12%.

transit service (ridesharing is assumed to be available everywhere). For example, I -95 has a busway available to essentially all commuters, Rt. 7 has a busway of limited use, and 50-66-29 has only express bus service in mixed traffic.

The initial mode shares are then modified to account for the time savings to ridesharing and transit passengers resulting from the two busways (because traffic is so sparse on the Dulles Airport Access Road, it is assumed to operate somewhat like the I-395 HOV lanes). Note also that in this case, both busways also allow carpools and vanpools. Table 1.16 shows the mode shifts that are estimated using Tables 15, 16, and 18 from the Methodology report.

Table 1.17 compares the final estimated mode shares with observed data by corridor. There is no clear pattern of over- or under-estimating the transit share. It is overestimated in the I-95 corridor and underestimated everywhere else, particularly in the Rt. 29 corridor. Transit is estimated fairly well in the Rt. 7 corridor, ridesharing in Rt. 29, and drive alone in Rts. 50-66. Only the I-95 corridor is poorly estimated in all three categories. These comparisons suggest that the base mode share in the modal summary table may be slightly low for express bus in mixed traffic, and slightly high for busway/LRT. There may also be some bias in the observed data, since transit users sometimes respond more readily to surveys than auto users.

Another test of the modal summary tables was performed to check the estimated mode shares for long trips -- in this case, trips from the outlying counties to the central area. The tables are applied in the same manner as before, except that the Trip Length factor for 25+ miles is used for all trips from the outlying counties. Table 1.18 shows the new net factor by mode for this case, as well as the rationalization, modification, and validation of mode shares by corridor. The observed and estimated shares are reasonably close in the Rt. 7 and 29 corridors (which have no transit service). However, the transit share is underestimated in the 50-66 corridor and overestimated in the I-95 corridor.

The next step in the application of the modal summary tables is applying the modal share to the corridor person trip volumes to estimate total trips by mode. Table 1.19 presents the 1980 base travel data, for trips originating outside Alexandria and Arlington County and destined to the central area and close-in suburbs. This data confirms the dominance of the suburban work destinations for trips originating outside Arlington County and Alexandria. Even though the central area has more employment than the suburbs, the Virginia suburbs obviously have a much higher proportion of employees living in Virginia than does the central area. Table 1.20 shows the results of multiplying the estimated modal shares by corridor person trips to get absolute daily person trip volumes by mode. I-95 is, of course, the dominant corridor in terms of absolute numbers of non-single occupant auto travellers (i.e., transit and ridesharing). Table 1.21 converts these daily person trips into inbound peak hour vehicle trips using occupancies of 40 for transit, 12 for vanpool, and 2.5 for carpool. Daily volumes are divided by 2 to represent inbound flow and then multiplied by 0.36 to represent the peak hour.

Table 1.16

APPLICATION OF ADJUSTMENT FACTORS TO MODAL SUMMARY TABLES

Ridesharing and Transit shares to be adjusted based on major HOV facilities as shown:

Corridor	Facility	Location	Distance (mi.)	Average Time Saved 1/ (minutes) Pools	Buses
Rt. 7	Dulles Airport Access Road	Reston to I-495	10	5.1	7.3
I-95	I-95/I-395	Franconia to Potomac River	11	5.6	8.0

Revised Mode Shares

Corridor	Destination Area	Transit	Ridesharing	Drive Alone
Rt. 7	Central Area	.236	.375	.389
	Suburbs	.029	.336	.635
50-66-29	Central Area	.185	.422	.393
	Suburbs	.024	.372	.640
I-95	Central Area	.462	.397	.141
	Suburbs	.051	.322	.627

Note:

1/ Time savings assumed to apply only to central area - destined trips.

Table 1.17

VALIDATION OF MODAL SUMMARY TABLES

Mode Shares by Corridor for Work Trips To Central Area

	Transit		Ridesharing 1/		Drive Alone	
	Est	Obs 2/	Est	Obs 2/	Est	Obs 2/
Rt. 7	.236	.254	.375	.282	.389	.464
50-66	.185	.258	.422	.366	.393	.376
29	.185	.310	.422	.428	.393	.262
I-95	.462	.307	.397	.461	.141	.232

Notes:

1/ "Ridesharing" includes autos with two or more persons, vanpools, and buspools.

2/ Observed data is from a 1978 MWCOG survey of central area employees, and excludes trips originating in the central area, Arlington County, or Alexandria.

Table 1.18
SPECIAL APPLICATION OF MODAL SUMMARY TABLES TO LONG DISTANCE TRIPS

Use same data as initial application, except that in this case, 100% of the trips in all corridors are in the "Trip Length 25+" category.

Mode	Net Factor	Net Modal Share To Central Area	To Suburbs
Carpool	2.066	.430	.395
Vanpool	5.131	.082	.103
Express Bus	1.291	.181	.023
Busway/LRT	1.498	.374	.049
Rapid Rail	0.069	.017	.002

Rationalization

Corridor	Destination Area	Initial Mode Shares Transit	Ridesharing	Drive Alone
Rt. 7	Central Area	—	.512	.488
	Suburbs	—	.498	.502
50-66	Central Area	.181	.512	.307
	Suburbs	.023	.498	.479
29	Central Area	—	.512	.488
	Suburbs	—	.498	.502
I-95	Central Area	.374	.512	.114
	Suburbs	.049	.498	.453

(Continued on next page)

Table 1.18 (Con'd)

Modify I-95 Shares Due to HOV Lanes 2/

		Revised Mode Shares		
		Transit	Ridesharing	Drive Alone
I-95	Central Area	.411	.553	.036
	Suburbs	.049	.498	.453

Validation — Mode Shares by Corridor for Work Trips to the Central Area

	Transit		Ridesharing		Drive Alone	
Corridor	Est	Obs 1/	Est	Obs 1/	Est	Obs 1/
Rt. 7	0	0	.512	.494	.488	.506
50-66	.181	.364	.512	.324	.307	.312
29	0	0	.512	.477	.488	.523
I-95	.411	.328	.553	.344	.036	.328

Note:

1/ Source: 1980 external station cordon survey by VDH&T, plus commuter bus ridership data from MWCOG and 1982 JHK & Associates study of the extension of the I-95 HOV lanes.

2/ Long distance HOV commuters in Rt. 7 corridor assumed not to use the Dulles Airport Access Road.

Table 1.19

EXISTING WORK TRAVEL MARKETS

Corridor	1980 Daily Person Trips by Destination (home to work and work to home) 6/ Central Area 1/	Suburbs 2/
Rt. 7	28,774	36,179
50-66 3/	2,008	2,025
29 4/	5,206	7,373
50-66-29 combined 5/	22,779	44,030
I-95	83,839	94,905
Total	142,606	184,512

Notes:

1/ D.C. core area, Rosslyn, Crystal City, Pentagon, and National Airport.
2/ Remainder of Arlington County, Alexandria, and Fairfax County.
3/ Portion in Loudoun County and beyond.
4/ Portion in Prince William County and beyond.
5/ Fairfax County portion only.
6/ Excludes trips originating in Alexandria or Arlington County.

Source: MWCOG 1980 work person trip table, 1980 VDH&T external survey, and MWCOG commuter bus ridership data.

Table 1.20

STIMATED 1980 MODAL VOLUMES FROM MODAL SUMMARY TABLES

	Daily Person Trips by Mode 6/ 7/					
	Central Area 1/			Suburbs 2/		
Corridor	Transit	Carpool	Vanpool	Transit	Carpool	Vanpool
Rt. 7	6,800	9,800	970	1,000	11,100	1,090
50-66 3/	400	700	100	0	700	90
29 4/	1,000	1,900	260	200	2,400	330
50-66-29 combined 5/	5,500	11,100	1,520	1,100	14,400	1,960
I-95	38,700	30,600	2,660	4,800	27,800	2,750
Total	52,400	54,100	5,510	7,100	56,400	6,220

Notes:

1/ D.C. core area, Rosslyn, Crystal City, Pentagon, and National Airport.
2/ Remainder of Arlington County, Alexandria, and Fairfax County.
3/ Portion in Loudoun County and beyond.
4/ Portion in Prince William County and beyond.
5/ Fairfax County portion only.
6/ Excludes trips originating in Alexandria or Arlington County.
7/ Estimates rounded to nearest 100 for transit and carpool, nearest 10 for vanpool.

Table 1.21

ESTIMATED PEAK HOUR INBOUND VEHICULAR VOLUMES FROM MODAL SUMMARY TABLES

	Peak Hour Inbound Vehicle Trips 6/ 7/					
	Central Area 1/			Suburbs 2/		
Corridor	Transit	Carpool	Vanpool	Transit	Carpool	Vanpool
Rt. 7	31	735	15	5	835	16
50-66 3/	2	55	2	0	55	1
29 4/	5	145	4	1	180	5
50-66-29 combined 5/	25	835	23	5	1,080	29
I-95	174	2,295	40	22	2,085	41
Total	237	4,065	84	33	4,235	92

Notes:

1/ D.C. core area, Rosslyn, Crystal City, Pentagon, and National Airport.
2/ Remainder of Arlington County, Alexandria, and Fairfax County.
3/ Portion in Loudoun County and beyond.
4/ Portion in Prince William County and beyond.
5/ Fairfax County portion only.
6/ Excludes trips originating in Alexandria or Arlington County.
7/ Estimates rounded to the nearest 5 for carpool.

Comparison of the volumes in Table I.21 with the modal usage warrants in Table 23 in the Methodology report verifies that further consideration of express bus in mixed traffic and the ridesharing modes is warranted in all corridors. A busway or other fixed guideway facility appears viable only in the I-95 corridor. However, the combined bus volumes of the Rt. 7 and 50-66-29 corridors is 63, which just exceeds the minimum warrant of 60 buses for a busway.

The principal conclusion from the application of the modal summary tables is that they replicate existing conditions reasonably well for a simple sketch planning tool. The tables have indicated that (a) alternatives which encourage carpool and vanpool use are of value in all corridors, (b) that increased express bus service has potential in all corridors, and (c) a major fixed guideway facility is viable in the I-95 corridor. The evidence presented by the application of these tables is sufficient to warrant the use of a more detailed planning technique, the corridor sketch planning program. Alternatively, in an actual application, the analyst could stop at this point in the methodology and use the modal volumes already developed.

CORRIDOR SKETCH PLANNING PROGRAM

As described in the Methodology report, the corridor sketch planning program is a UTPS program designed to perform mode split and auto occupancy analysis on a zone-to-zone basis. The basic inputs are person trips, highway system characteristics, income distribution of commuters, Cartesian coordinates of the zone centroids, transit fare, and transit out-of-vehicle time by service type. Other input parameters are used to define the characteristics of the guideway being tested. The program calculates transit in-vehicle times directly from the coordinates. Coefficients are applied to each item of impedance (time, cost, etc.) to determine the total "disutility" that commuters attach to each mode. A multi-modal logit model is then applied to determine mode shares by zonal interchange. This program is described in more detail in a separate document prepared as part of this project.

This model is very useful for policy sketch planning. The variables it is sensitive to include:

- Transit service coverage and frequency, by service type (express, local radial, local non-radial, and guideway)
- Transit fare
- Transit operating speed, by service type

-- Characteristics of a fixed guideway facility (busway or light rail)

-- Highway speed and terminal time

-- Auto operating cost and parking cost

-- Special carpool parking cost

-- Characteristics of an HOV facility

-- Income distribution of commuters

Using 1980 data from MWCOG, the model was applied to an 80-zone system in Northern Virginia. These zones have similar boundaries as MWCOG's 200 district system. The zone system covered the Virginia portion of the Washington, D.C. SMSA, plus the D.C. central area. The outlying areas were represented by four external stations. Figures 1.13 and 1.14 illustrate the zone and district system used. The zone boundaries correspond to those of the MWCOG regional 200-district system, while the district boundaries generally reflect corridor and jurisdictional boundaries.

Travel data was developed from the MWCOG 1980 work person trip table. This table was revised to contain only those trip patterns of interest, including trips from the external stations. In this case, external station trips represent only central area and suburban-destined travel from the outlying counties in the study area (see Table 1.22).

A zone-level trip end summary for 1980 is shown in Table 1A.6. The 80 zones are also compressed into 13 districts for clarity. The district-to-district trip table is shown in Table 1.23. Both tables are in production-attraction format (both home-to-work and work-to-home trips are shown as being produced from the home end and attracted to the work end). Through trips and trips outside the study area are excluded.

In addition to person trips, the model requires zone-to-zone data on highway distance, highway time, and transit fare, all of which were developed from existing MWCOG skim trees. Zonal data on other transportation characteristics are presented in Appendix Tables 1A.7 - 1A.9 of this report, and the basic user-definable parameters for the base run are shown in Table 1.24. It should be noted that the base case situation includes the existing HOV facility on the Shirley Highway.

The original coefficients of the model were taken from previously calibrated logit models in Minneapolis, New Orleans, and Seattle. These coefficients were adjusted in successive iterations until the model's results were reasonably close to observed data for Northern Virginia. The observed data came from a 1978 MWCOG survey of central area employees and 1980 MWCOG Beltway and core area cordon counts. As Table 1.25 shows, the model

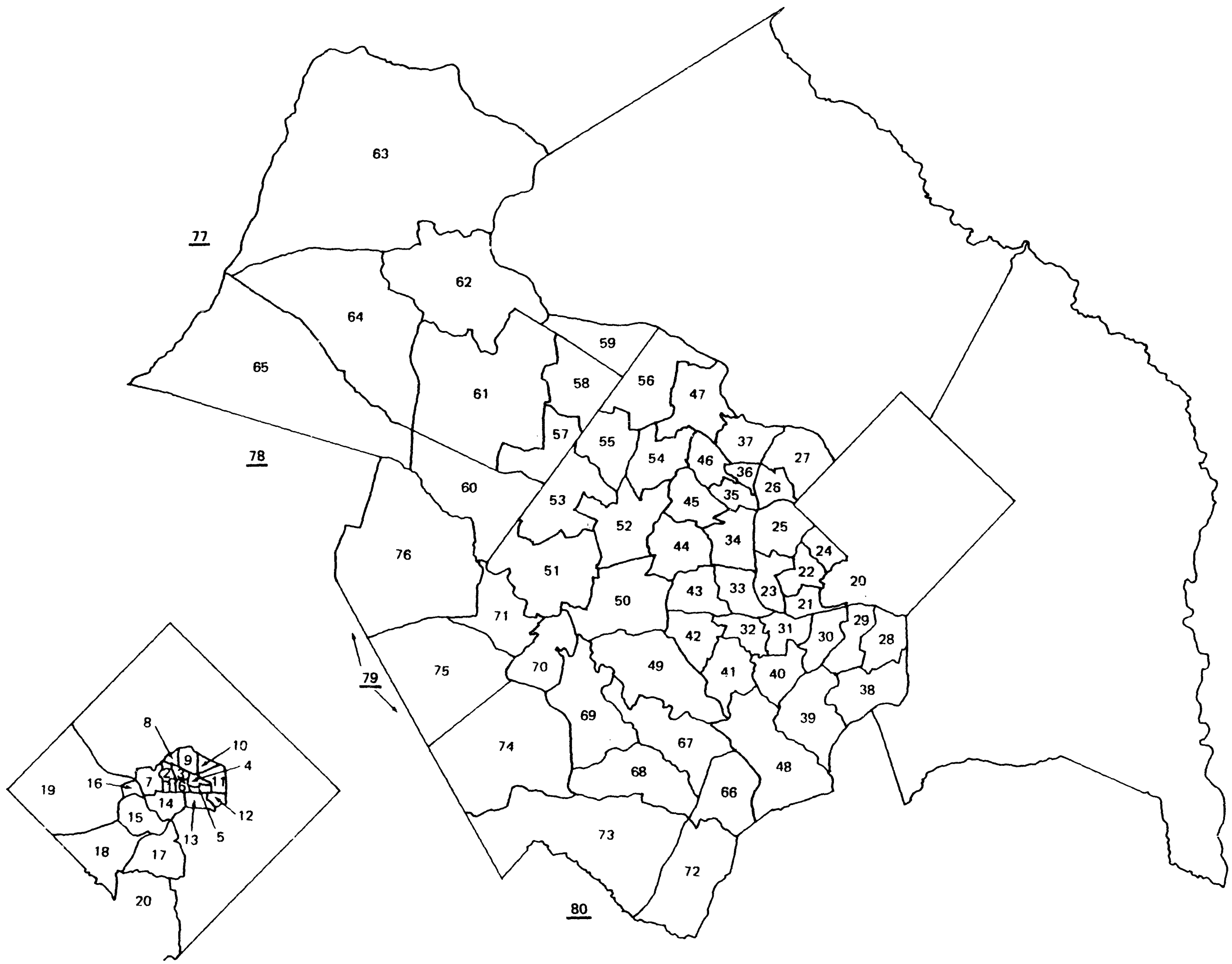


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Figure 1.13
SKETCH PLANNING ZONE SYSTEM
NORTHERN VIRGINIA CASE STUDY
Virginia Commuting Study

78 ZONE NUMBER
<u>78</u> EXTERNAL STATION

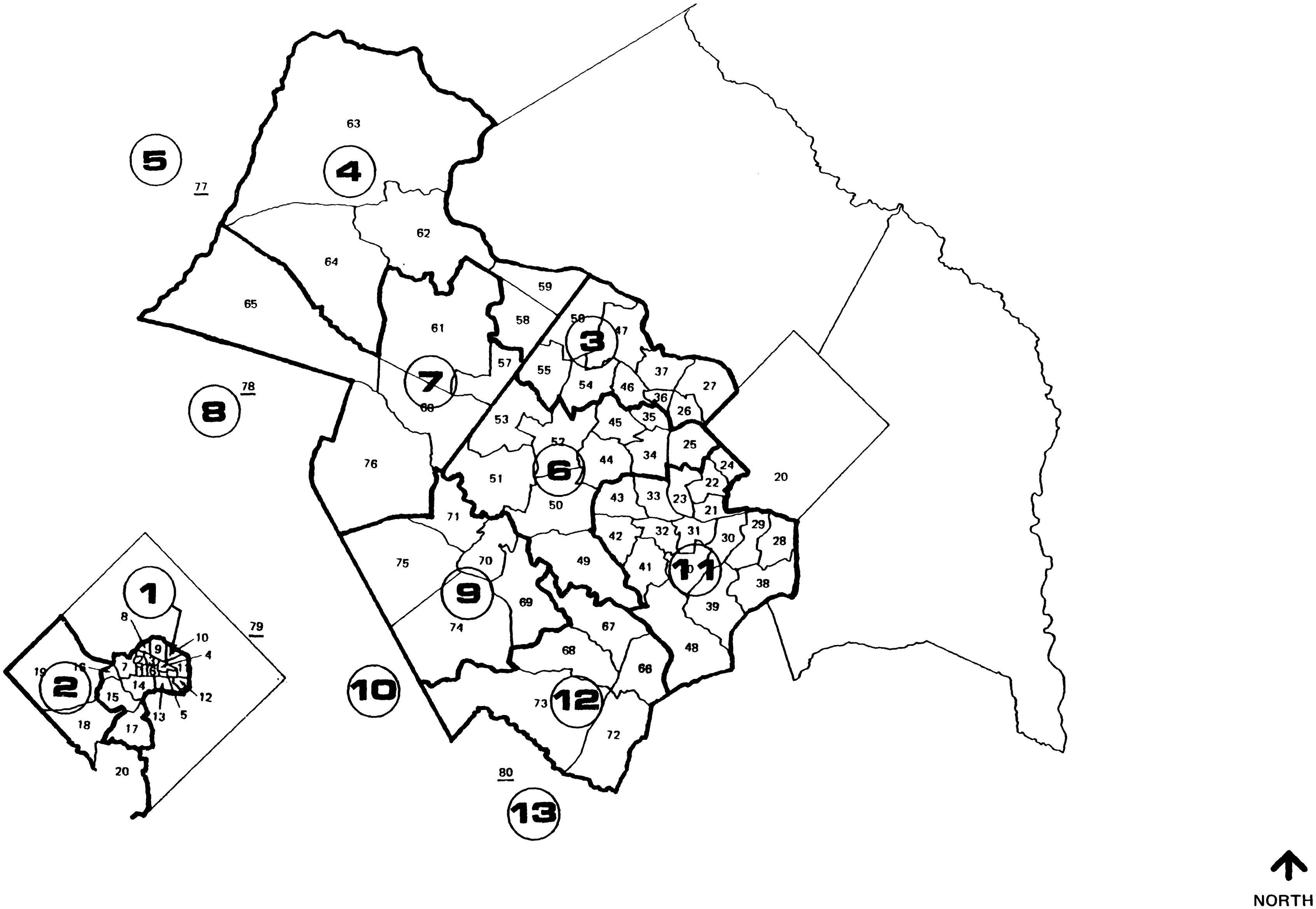

Figure 1.14
SKETCH PLANNING DISTRICT BOUNDARIES
NORTHERN VIRGINIA CASE STUDY
Virginia [redacted]uting Study

78 ZONE NUMBER
78 EXTERNAL STATION
13 DISTRICT NUMBER
DISTRICT BOUNDARY

Table 1.22
EXTERNAL STATION DEFINITIONS

External Station 2/	District 2/	Corridor	Areas Included
77	5	Rt. 7	Clarke Co. (64%) 1/ Frederick Co. and Winchester (11%)
78	6	50-66	Clarke Co. (36%) Frederick Co. and Winchester (89%) Warren Co. (100%) Fauquier Co. (39%) Rappahannock Co. (21%)
79	7	29	Fauquier Co. (61%) Rappahannock Co. (79%) Culpeper Co. (100%)
80	8	I-95	Spotsylvania Co. and Fredericksburg (100%) Stafford Co. (100%)

Note:

1/ Figures in parentheses represent percentage of candidate commuter trips in each county assigned to each corridor.

2/ External station and district numbers refer to Figures 1.13 and 1.14.

Table 1.23

REVISED COG 1980 WORK TRIPS BY MAJOR MOVEMENT (13 DISTRICTS)

10MAR82 9.50.13 UFMTR REPORT 4 PAGE 7

WKTRIPS DATA SET J1 TABLE 1

I/J	1	2	3	4	5	6	7	8	9	10	11	12	13	ROW TOTAL
1	43483	4747	1041	28	2	535	41	1	36	8	1142	63	11	51138
2	100752	50042	8406	146	6	7385	289	32	366	72	15034	636	122	183288
3	21830	5929	24592	1462	58	11758	2521	109	1062	178	5045	336	70	74950
4	6876	1130	4487	11848	1125	2384	1717	123	391	104	1060	98	23	31366
5	68	12	29	128	0	20	43	0	5	0	9	2	0	316
6	22779	10244	14467	642	34	33786	1898	231	2896	459	13037	894	167	101534
7	1288	349	669	510	151	993	1773	228	651	329	404	70	18	7433
8	720	170	291	134	0	513	281	0	392	0	207	38	0	2746
9	4196	1539	2271	212	11	4771	984	328	14527	1356	2267	1012	222	33696
10	1010	267	399	68	0	796	298	0	1257	0	345	100	0	4540
11	67301	32616	10582	348	22	22089	799	113	1832	260	46623	3694	669	186948
12	12750	4713	1783	115	10	3456	362	85	2724	269	9329	15212	3679	54487
13	3788	570	216	12	0	391	33	0	228	0	1054	1846	0	8138
	286841	112328	69233	15653	1419	88877	11039	1250	26367	3035	95556	24001	4981	740580

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Table 1.24
USER-CODED SYSTEM PARAMETERS FOR THE
CORRIDOR SKETCH PLANNING PROGRAM
BASE YEAR (1980) APPLICATION
EXISTING CONDITIONS

Corridor Length 1/	11.4	mi.
Guideway Express Transit Headway 1/	8	min.
Guideway Express Transit Speed 1/	45	mph
Non-Access Length of Guideway Express Corridor 1/	4.2	mi.
Local Transit Speed	12	mph
Minimum Carpool Occupancy 1/	4	persons
Average Occupancy of 4 + Person Vehicle	4.61	persons
HOV Lane Speed 1/	50	mph
Auto Operating Cost per Mile 2/	4.0	cents

Notes:

1/ Relates to the existing Shirley Highway HOV facility.

2/ In 1968 dollars. Since MWCOG's mode choice model was calibrated using 1968 data, the MWCOG transportation cost data base (transit fares and parking costs) is always expressed in 1968 dollars. Since the transit fare and parking cost data provided by MWCOG for this study were 1980 values expressed in 1968 dollars, the auto operating cost value also had to be converted to 1968 dollars. The logit coefficient on travel cost in the sketch planning model has been adjusted accordingly.

Table 1.25
CORRIDOR SKETCH PLANNING MODEL VALIDATION

	Observed	Estimated
Mode Shares to the Central Area 1/		
Transit	0.357	0.395
Auto Driver	0.433	0.408
Auto Passenger	0.210	0.197
Auto Occupancy	1.49	1.48
Percent Transit by Household Income (all trips) 2/		
Low 25%		0.371
Middle 50%		0.223
High 25%		0.148
Total		0.216
Percent Auto Person Trips by Occupancy (all trips) 3/		
One person per auto	0.590	0.614
Two	0.261	0.233
Three	0.060	0.087
Four or more	0.089	0.065

Mode Shares by Corridor for Work Trips to Central Area

Corridor	Transit		Ridesharing		Drive Alone	
	Est	Obs 1/	Est	Obs 1/	Est	Obs 1/
Route 7	.185	.265	.499	.299	.316	.436
50-66-29 4/ combined	.219	.312	.507	.377	.274	.311
I-95	.425	.409	.385	.368	.190	.223

Notes:

1/ Observed data is from a 1978 MWCOG survey of central area employees. Both observed and estimated figures exclude trips originating in the central area.

2/ No observed data available.

3/ Observed data is from 1980 MWCOG Beltway Cordon Count.

4/ Fairfax, Loudoun, and Prince William Counties and beyond.

replicates the observed data fairly well. In the Rt. 7 and 50-66-29 corridors, transit is underestimated and ridesharing overestimated, but the I-95 corridor is estimated somewhat better.

The corridor sketch planning program is shown to be an effective and useful tool for quickly and inexpensively estimating the effect of quantitative changes in traveller or system characteristics. Based on the initial results of the modal summary tables and the corridor sketch planning program, it is suggested that in this case study, the former be used to analyze qualitative ridesharing assistance actions and the latter be used to analyze specific time and cost related alternatives.

MODAL ALTERNATIVES

The development of alternatives is based on the definition of problems and issues and consideration of the present and possible future travel conditions in each corridor. For the Northern Virginia case study, this is complicated by the fact that there are already several actions designed to induce mode shifts that are in various stages of study and implementation, as discussed earlier in the section on "Plans and Proposals". The effects of these actions (as estimated by past studies) are summarized in Table 1.26. This case study will incorporate the estimated impacts from these previous studies and will not attempt to duplicate that work.

The so-called "new" alternatives to be investigated in this study are identified in Table 1.27 and Figures 1.15 and 1.16. These include policy options, as well as major capital improvements and some relatively low-cost actions. The different zonal input data for each alternative involving new service levels are shown in Appendix Tables 1A.10 - 1A.12.

The alternatives and the effects which they would have on mode shares in the study corridors are described below:

Alternative #1

This would simply change the current definition of an HOV from "4 or more" to "3 or more" persons on the existing Shirley Highway HOV lanes (see Table 1.28). The purpose is to make the lanes available to more people and thereby encourage more carpooling. Table 1.29 shows the existing mode shares, and the new mode shares estimated to result from this action. There would be a slight drop in daily transit ridership, and a net gain in ridesharing. Since the second column of Table 1.29 includes only trips originating in Fairfax County and beyond, it can be seen that this action would generate more HOV trips from Fairfax and beyond than from Alexandria and lower Arlington County.

Table 1.26

ESTIMATED EFFECTS OF PREVIOUSLY IDENTIFIED ALTERNATIVES

Daily Person Trips Shifted to the Indicated Mode by Corridor

Previously Identified Alternative	Forecast Year	Route 7 Transit	Route 7 Ridesharing	50-66-29 Transit	50-66-29 Ridesharing	I-95 Transit	I-95 Ridesharing
Metrorail J, H, and K Routes	1990	10,350	--	10,830	--	31,890	--
Rapid Rail to Dulles	1976	8,040	--	--	--	--	--
I-66 inside Beltway	1983	2/	8,510 1/	2/	17,420 1/	--	--
Dulles Access Road Extension	(mode shifts not reported; reported effect limited to re-assignment of traffic volumes)						
Commuter Rail	1982	--	--	2,800	--	3,200	--
Shirley Highway HOV Extension	1990	--	--	--	--	900	11,380

1/ Includes four or more person pools only.

2/ Mode shift not reported.

Source: Studies cited in Table 1.7, adjusted to represent daily trips. Figures rounded to nearest 10, and include trips from all Northern Virginia jurisdictions. Some of these figures may include non-work trips — the extent of this cannot be determined.

Table 1.27
NEW ALTERNATIVES

Corridor		Alternative
I-95	#1	Allow vehicles with 3 or more persons to use existing Shirley Highway HOV lanes.
50-66-29 combined	#2	Extend I-66 HOV lanes from I-495 to U.S. 50.
all	#3	Increase commuter bus service coverage area by 25% and service frequency by 50% outside Fairfax County.
all	#4	Major increase in scope, coverage, and effectiveness of existing regional carpool matching program.
all	#5	New program of countywide vanpool coordinators.

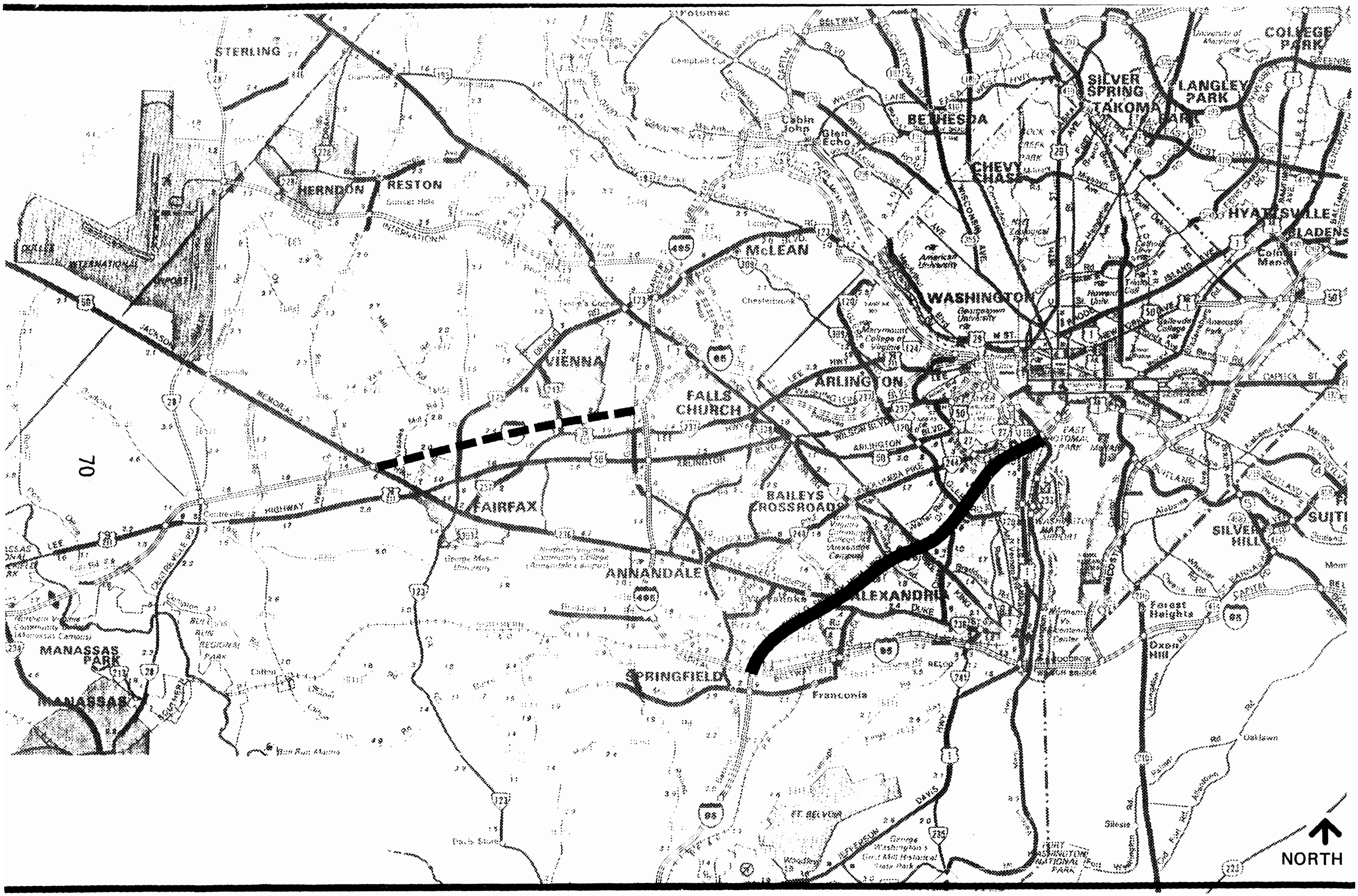

Figure 1.15
NEW ALTERNATIVES (FIXED GUIDEWAY FACILITIES)

SCALE: 1" = APPROX. 3 MILES

NORTHERN VIRGINIA CASE STUDY
Virginia Commuting Study

3+ HOVs On I-395
I-66 HOV Lane Extension

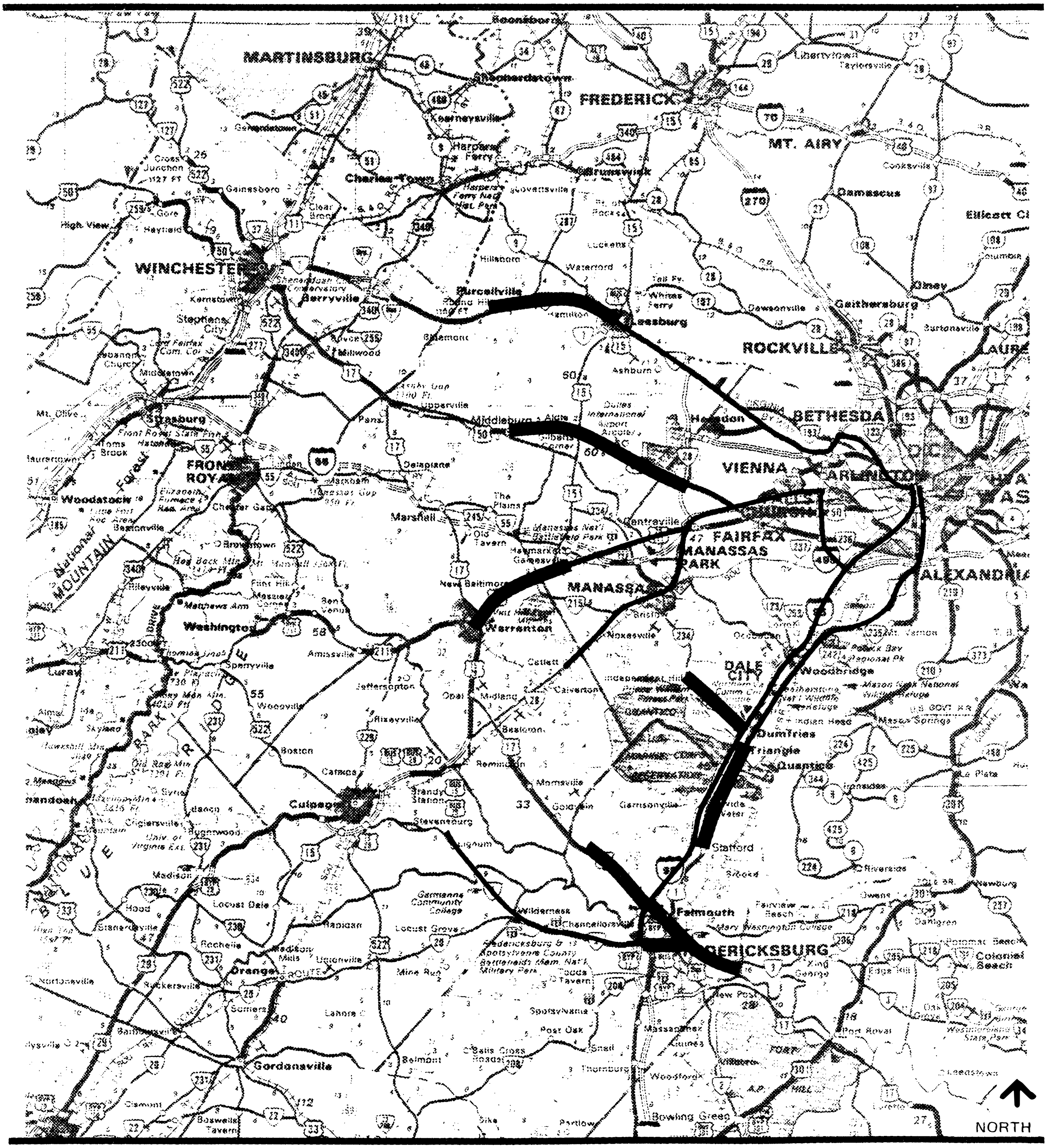

Figure 1.16
ALTERNATIVE NUMBER 3
(EXPAND COMMUTER BUS ROUTE)

NORTHERN VIRGINIA CASE STUDY
Virginia Commuting Study

Table 1.28
USER-CODED SYSTEM PARAMETERS FOR THE
CORRIDOR SKETCH PLANNING PROGRAM
BASE YEAR (1980) APPLICATION
ALTERNATIVE #1 - 3+ HOVs ON SHIRLEY HIGHWAY

Corridor Length 1/	11.4	mi.
Guideway Express Transit Headway 1/	8	min.
Guideway Express Transit Speed 1/	45	mph
Non-Access Length of Guideway Express Corridor 1/	4.2	mi.
Local Transit Speed	12	mph
Minimum Carpool Occupancy 1/	3	persons
Average Occupancy of 4+ Person Vehicle	4.61	persons
HOV Lane Speed 1/	50	mph
Auto Operating Cost per Mile 2/	4.0	cents

Notes:

1/ Relates to the existing Shirley HOV facility.

2/ In 1968 dollars. Since MWCOG's mode choice model was calibrated using 1968 data, the MWCOG transportation cost data base (transit fares and parking costs) is always expressed in 1968 dollars. Since the transit fare and parking cost data provided by MWCOG for this study were 1980 values expressed in 1968 dollars, the auto operating cost value also had to be converted to 1968 dollars. The logit coefficient on travel cost in the sketch planning model has been adjusted accordingly.

Table 1.29
ANALYSIS OF ALTERNATIVE #1 - 3+ HOV's ON SHIRLEY HIGHWAY
1980 CONDITIONS

	All Trips to Central Area 1/ 2/	I-95 Trips to Central Area 2/ 3/	I-95 Trips to Suburbs 3/ 4/
Existing Modal Share			
Transit	.357	.307	.117
Ridesharing	.366	.461	.296
Existing Daily Trips			
Transit	86,880	25,740	11,100
Ridesharing	89,070	38,650	28,090
Total Person Trips	243,358	83,839	94,905
New Modal Share 5/			
Transit	.355	.305	.117
Ridesharing	.369	.468	.296
New Daily Trips			
Transit	86,390	25,570	11,100
Ridesharing	89,800	39,230	28,090
Change in Daily Trips			
Transit	-490	-170	0
Ridesharing	+730	+580	0

Notes:

1/ Includes trips originating in Alexandria and Arlington County, outside the central area.

2/ Existing values are observed data.

3/ Excludes trips originating in the central area, Alexandria and Arlington County.

4/ Existing values are estimated data for the base case (estimated by the sketch planning program).

5/ New modal share derived by applying the relative mode shift estimated by the sketch planning program to the observed data.

Therefore, most of the effect of this option would be on long-distance trips. The effects of this option would be limited to central area-destined trips, which are most able to make full use of the HOV lanes. This analysis does not address the issue of 4-person carpools "breaking down" into 3-person pools, only the creation of new carpools.

Alternative #2

This would extend the I-66 HOV facility 7 miles west of the Beltway to US 50 (see Table I.30 and Figure I.15). The cross-section would be similar to that on the Shirley Highway, with new reserved lanes for HOVs. The HOV lanes would end at the Beltway, at which point HOVs would continue on I-66 to Rosslyn. (The location of Metrorail in the I-66 median from Vienna to the Beltway would pose a significant design challenge to enable HOV lanes to exist in that same segment. This option may be physically feasible only if Metrorail is not extended beyond the Beltway.) This option would save time for ridesharing and transit commuters from the Fairfax City/Manassas areas and beyond, and may lead to less congestion on I-66 at I-495. The analysis in this case tests what the incremental effect of extending this facility would be (over and above the effect of that portion of I-66 under construction). Table I.31 indicates there would be a slight increase in transit trips and a slight drop in ridesharing trips. Basically, the rationale is that for longer trips, transit has a lower cost and, therefore, "looks" better to the traveller. The time savings to carpools, in this case, does not offset the time savings to buses. Obviously this option has its greatest impact on the 50-66-29 corridor, but the effect on Rt. 7 trips to the central area is not insignificant. Again, it should be noted that these figures represent net changes in mode volumes, not trips diverted to a specific facility.

Alternative #3

This involves major increases in commuter bus service in the outlying areas beyond Fairfax County. The route network would be increased so that the coverage area would expand by about 25%, and frequency would be increased by 50%, resulting in a 33% drop in average wait time. Figure I.16 illustrated one representative expanded commuter bus network, although there may be other routings which could represent this option. As Table I.32 shows, this would increase daily transit trips from all corridors (outside Fairfax County) by about 1,900. The largest absolute increase would be in the 29 corridor. The I-95 corridor would gain the fewest trips, primarily because service in that area is good at present, and the absolute gain in service quality is not that large. Essentially, no increase is shown in trips to the suburbs, since the vast majority of commuter bus service is oriented to the central area. Also, the central area displays more auto disincentives such as congestion and parking cost than the suburbs.

Table 1.30
USER-CODED SYSTEM PARAMETERS FOR THE CORRIDOR SKETCH PLANNING PROGRAM
BASE YEAR (1980) APPLICATION
ALTERNATIVE #2 - EXTEND I-66 HOV FACILITY

Corridor Length 1/	17.3	mi.
Guideway Express Transit Headway 1/	20	min.
Guideway Express Transit Speed 1/	35	mph
Non-Access Length of Guideway Express Corridor 1/	3.0	mi.
Local Transit Speed	12	mph
Minimum Carpool Occupancy 1/	4	persons
Average Occupancy of 4+ Person Vehicle	4.61	persons
HOV Lane Speed 1/	50	mph
Auto Operating Cost per Mile 2/	4.0	cents

Notes:

1/ Relates to the proposed extended I-66 HOV facility.

2/ In 1968 dollars. Since MWCOG's mode choice model was calibrated using 1968 data, the MWCOG transportation cost data base (transit fares and parking costs) is always expressed in 1968 dollars. Since the transit fare and parking cost data provided by MWCOG for this study were 1980 values expressed in 1968 dollars, the auto operating cost value also had to be converted to 1968 dollars. The logit coefficient on travel cost in the sketch planning model has been adjusted accordingly.

Table 1.31
ANALYSIS OF ALTERNATIVE #2 -- EXTEND I-66 HOV FACILITY
1980 CONDITIONS

	Route 7 Trips to Central Area 1/ 2/	50-66-29 Trips to Central Area 1/ 5/	Route 7 Trips to Suburbs 1/ 3/	50-66-29 Trips to Suburbs 1/ 3/ 5/
Existing Modal Share				
Transit	.254	.275	.035	.070
Ridesharing	.282	.410	.324	.321
Existing Daily Trips				
Transit	7,310	8,250	1,270	3,740
Ridesharing	8,110	12,300	11,720	17,150
Total Person Trips	28,774	29,993	36,179	53,428
New Modal Share 4/				
Transit	.266	.319	.037	.077
Ridesharing	.277	.378	.323	.317
New Daily Trips				
Transit	7,650	9,570	1,340	4,110
Ridesharing	7,970	11,340	11,680	16,940
Change in Daily Trips				
Transit	+340	+1,320	+70	+370
Ridesharing	-140	-960	-40	-210

Notes:

1/ Excludes trips originating in the central area, Arlington County or Alexandria.

2/ Existing values are observed data.

3/ Existing values are estimated data for the base case (estimated by the sketch planning program).

4/ New modal share derived by applying the relative mode shift estimated by the sketch planning program to the observed data.

5/ Includes both Fairfax County and outlying portions of this corridor.

Table 1.32
ANALYSIS OF ALTERNATIVE #3 -- EXPAND COMMUTER BUS SERVICE
1980 CONDITIONS

	Corridor			
	Route 7 1/	50-66 1/	29 1/	I-95 1/
Existing Transit Share				
to Central Area 2/	.124	.364	.251	.264
to Suburbs 3/	.004	.002	.002	.060
Existing Daily Transit Trips				
to Central Area 2/	860	730	1,310	4,370
to Suburbs 3/	25	5	15	945
New Transit Share 4/				
to Central Area	.191	.535	.371	.273
to Suburbs	.007	.003	.003	.061
New Daily Transit Trips				
to Central Area	1,330	1,080	1,930	4,500
to Suburbs	40	5	20	950
Change in Daily Transit Trips				
to Central Area	+470	+350	+620	+130
to Suburbs	+15	0	+5	+5

Notes:

1/ Excludes trips originating in the central area, Alexandria, Falls Church, Fairfax City, and Fairfax and Arlington Counties.

2/ Observed data based on 1978 MWCOG central area survey and 1980 VDH&T external station survey.

3/ Existing values are estimated data for the base case (estimated by the sketch planning program).

4/ New modal share derived by applying the relative mode shift estimated by the sketch planning program to the observed data.

Alternative #4

This involves a major increase in the scope, coverage, and effectiveness of the existing regional carpool matching program. This would include expanded marketing and advertising, better coverage of outlying areas, more personalized matching efforts, more contacts with major employers, and an increased follow-up effort. Table 1.33 illustrates the use of the modal summary tables in estimating the effect of such actions and displays the estimated results. This action has the potential for a moderate increase in ridesharing person trips. The effect is most pronounced in the I-95 corridor and least significant in the Route 7 corridor. It is interesting that the effect is more pronounced for suburban destinations in the Rt. 7 and 50-66-29 corridors. This may reflect the influence of work sites such as Tyson's Corner and Fairfax City.

Alternative #5

This would consist of a program of countywide vanpool coordinators, similar to the Maryland program, which includes VANGO and active county-level vanpool support. The state could participate by providing technical, financial, and administrative support and coordination for the county staffs. The county staffs would actively assist in vanpool formation via administrative assistance, promotion, employer contacts, personalized matching, and technical support to vanpoolers. Table 1.34 shows the use of the modal summary tables in estimating the effects of this program. The effect is similar to, but not as pronounced as in, Alternative #4.

In general, this review of new alternatives has shown that transit and ridesharing in Northern Virginia can be increased by 2 to 5% by a variety of options. This limited sensitivity is due in part to the fact that most Northern Virginia commuters already have several commuting options available and currently enjoy a relatively high level of transportation service. Many commuters in the highly urbanized areas are current transit users, and a fairly high proportion of the long-distance commuters from outlying areas are ridesharers. Aside from major regional programs such as Metrorail, severe central area constraints (such as parking availability) or other major external influences (such as another gasoline shortage) opportunities to induce more substantial mode shifts may be limited.

The I-95 corridor has the greatest potential for net absolute increases in transit and ridesharing. Next comes the 50-66-29 corridor, followed by the Route 7 corridor. The improved carpool program has the largest effect on ridesharing, while extending the I-66 HOV lanes has the largest impact on transit use of those new alternatives studied.

In comparing the results of the analysis of "new" alternatives with the figures cited by other studies for the "old" alternatives, the values tend to be about one order of magnitude apart. This is due, in part, to the fact that the "old"

Table 1.33
ANALYSIS OF ALTERNATIVE #4 -- IMPROVED CARPOOL PROGRAM
1980 CONDITIONS

From Carpool Modal Summary Table: Instead of "Normal" Carpooling Encouragement Factor (1.007), use "High" Factor (1.042). The difference is 1.042/1.007 = 1.038, or a 3.8% increase in carpooling (which is 88%-92% of all ridesharing).

	Corridor		
	Route 7	50-66-29 combined 4/	I-95
Existing Ridesharing Share			
to Central Area 1/	.282	.410	.461
to Suburbs 2/	.336	.372	.322
Existing Daily Ridesharing Trips			
to Central Area	8,110	12,300	38,650
to Suburbs	12,160	19,880	30,560
New Ridesharing Share			
to Central Area	.292	.424	.477
to Suburbs	.347	.384	.333
New Daily Ridesharing Trips			
to Central Area	8,400	12,720	39,990
to Suburbs	12,560	20,520	31,600
Change in Daily Ridesharing Trips 3/			
to Central Area	+290	+420	+1,340
to Suburbs	+400	+640	+1,040

Notes:

1/ Existing values are observed data.

2/ Existing values are estimated data (estimated via the modal summary tables).

3/ Represents change in carpool person trips.

4/ Includes both Fairfax County and outlying portions of this corridor.

Table 1.34
ANALYSIS OF ALTERNATIVE #5 -- VANPOOL ASSISTANCE PROGRAM
1980 CONDITIONS

From Vanpool Modal Summary Table: Add a factor of 1.25 to 8%-12% of ridesharing trips to represent net increase in vanpooling.

	Corridor		
	Route 7	50-66-29 combined 4/	I-95
Existing Ridesharing Share			
to Central Area 1/	.282	.410	.461
to Suburbs 2/	.336	.372	.322
Existing Daily Ridesharing Trips			
to Central Area	8,110	12,300	38,650
to Suburbs	12,160	19,880	30,560
New Ridesharing Share			
to Central Area	.288	.422	.470
to Suburbs	.344	.383	.329
New Daily Ridesharing Trips			
to Central Area	8,290	12,660	39,400
to Suburbs	12,440	20,460	31,220
Change in Daily Ridesharing Trips 3/			
to Central Area	+180	+360	+750
to Suburbs	+280	+580	+660

Notes:

1/ Existing values are observed data.

2/ Existing values are estimated data (estimated via the modal summary tables).

3/ Represents change in vanpool person trips.

4/ Includes both Fairfax County and outlying portions of this corridor.

alternatives are all very expensive, capital-intensive projects, designed to have major impacts on commuters' travel time. Also, in most of these studies, more detailed analysis techniques were used, which may have displayed a greater sensitivity to system changes. Finally, the forecasts in Table 1.26 were prepared for different target years (none of them being 1980). These considerations require that caution be used in assessing the results of these prior studies and comparing them with the results of this study.

The initial screening also helped to define the feasible commuting modes in each corridor. Modes that are obviously not viable in certain corridors, such as commuter rail, can be quickly identified and excluded from further analysis. The conclusion to analyze express bus and ridesharing actions in all corridors, while limiting the analysis of busway and rapid rail, is a very important step in the process.

Another part of this effort was to test the modal summary tables and sketch planning model. On the whole, they proved to be effective in allowing the analyst to quickly analyze a variety of commuting options. The comparison of the initial application results with existing conditions confirmed the general accuracy of the techniques. However, the modal summary tables do tend to slightly underestimate transit, and the sketch planning model probably slightly overstates the effect of a fixed guideway/HOV facility on transit ridership. In a sketch planning context, these differences are not significant.

FUTURE TRAVEL CONDITIONS

The analyses in the previous section are based on 1980 trip volumes. This section documents the estimation of year 2000 person trips, and the results of applying the estimated mode shares to these trips for each alternative.

The basic demographic projections for 2000 are shown in Table 1.35. Comparing this data with Table 1.2 shows that suburban areas are expected to grow much faster in households and employment than the central area. The future year trip table was developed by applying growth factors by zone to the 1980 trip table. Trip productions (the rows of the trip table) were factored by the ratio of 2000 to 1980 households and trip attractions (the columns) were factored by the ratio of 2000 to 1980 employment. Household and employment forecasts for the SMSA were developed by MWCOG. Forecasts for the outlying areas were estimated primarily by extrapolating trends from 1970-1980. The growth factors by zone are shown in Appendix Table 1A.9.

Table 1.35
2000 CORRIDOR DEMOGRAPHIC DATA

Corridor		Population	Households	Employment
Rt. 7	(1) SMSA:	339,200	117,700	155,000
	(2) outlying areas:	14,600	6,800	7,600
50-66	(1) SMSA:	35,300	11,600	26,600
	(2) outlying areas:	111,000	51,800	45,900
29	(1) SMSA:	112,700	32,300	33,200
	(2) outlying areas:	62,500	27,500	19,400
50-66 and 29 combined	(1) (3) SMSA:	315,200	110,900	178,100
I-95	(1) SMSA:	661,600	219,000	159,400
	(2) outlying areas:	111,500	47,000	38,000
Central Area (1)		142,200	77,600	595,100
Rest of Arlington County and Alexandria (1)		296,300	137,100	144,300

Notes:

(1) Source: 2000 Round II estimates by MWCOG, for the SMSA portion.

(2) Source: Barton-Aschman Associates projections based on 1980 Census and various data sources for outlying areas (outside the Washington SMSA).

(3) Fairfax County portion only.

Table 1.36
ESTIMATED Person TRIPS BY 13 DISTRICTS — BASE00 -- NULL

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PER TRP DATA SET J1 TABLE 7

I/J	1	2	3	4	5	6	7	8	9	10	11	12	13	ROW TOTAL
1	59754	9464	2506	84	6	1890	129	0	154	9	1893	2	0	75891
2	110416	66169	13969	297	11	15118	642	27	784	78	17788	184	0	225483
3	22286	7687	45452	3968	74	25209	5691	118	1530	196	5216	49	0	117476
4	9176	2157	13217	34863	1609	8940	5992	176	819	155	1542	0	0	78646
5	50	13	50	213	0	53	73	0	7	1	9	1	0	470
6	25066	14183	29983	1880	60	90443	6558	393	6211	820	15838	711	42	192188
7	1720	653	1991	1483	226	4725	6276	361	1496	548	617	44	10	20150
8	566	182	489	229	1	1361	603	0	534	3	180	22	0	4170
9	4462	2187	4933	573	20	15720	2760	423	20358	1727	2756	1510	250	57679
10	885	312	710	137	1	2157	737	1	1774	4	329	103	0	7150
11	82463	48023	22153	888	44	49177	2229	140	3594	380	69561	8267	1273	288192
12	16944	7860	5094	449	32	11713	1319	142	5552	474	15340	32280	8071	105270
13	4539	876	577	58	1	1197	148	3	478	7	1576	3077	0	12537
	338327	159766	141124	45122	2085	227703	33157	1784	43291	4402	132645	46250	9646	1185302

SINOFF 6700 (INFORMATION): UFMTR ENDED AT 15.20.36 (RETURN CODE= 0)

The factoring procedure achieved the desired production and attraction totals, while leaving the basic trip patterns largely intact. This procedure is implemented as part of the corridor sketch planning program and is documented more fully in Appendix B of the Methodology report. The new zonal trip ends are shown in Appendix Table 1A.13 and the new district trip matrix is shown in Table 1.36. These future trip patterns reflect the fact that suburban employment is projected to grow much faster than central area employment. Also, the relative household growth is higher in the outer Fairfax and close-in Prince William/Loudoun suburbs than in other areas. The total growth in trips is estimated at about 60% over 20 years, which equates to a compound annual growth rate of 2.38%. The difference in growth by area can be seen from Table 1.37, which is directly comparable to Table 1.19 shown previously. Trips to the central area grow by only 18%, while trips to the suburbs grow by 86%.

The corridor sketch planning program was used to apply the mode choice model to the estimated future trips, using the existing transportation system, to establish a year 2000 base case. None of the system or traveller characteristics were changed. The results of this base application are shown in Table 1.38, compared with the results of the base 1980 application. The slight change in modal shares is due to the difference between projected trip patterns and existing transit service levels. That is, high growth in areas having poor transit service will result in a higher lower future percent transit, if all else is equal.

Table 1.39 compares the absolute modal volumes estimated for 1980 and 2000. I-95 has the largest total growth in transit trips and in HOV trips to the central area. Rte. 7 exhibits a large total growth in ridesharing trips to the suburbs. The 50-66-29 corridor is unusual in that it is estimated to actually lose transit trips to the central area, but have a massive gain in suburban-destined ridesharing trips. These values are presented as a "null case" against which the estimated future changes in modal usage can be compared.

In the I-95 corridor, it is projected that people will tend to take advantage of the existing high level of service provided by the transit/HOV lanes by orienting their work trip patterns with respect to that service. Therefore, the transit share to the central area should increase slightly, even with no change in service level. In the other two corridors, present transit service levels are lower, and thus, the transit share may decline in these areas, as more people tend to live and work in areas not well served by transit. This phenomenon is also related to the large increase in suburban-destined work trips. The I-95 corridor has relatively good transit service to suburban areas, (i.e., Arlington, Alexandria) but the other corridors do not. This results in a major decrease in transit share for those trips.

The other interesting result of Table 1.38 is that transit and ridesharing appear to draw from each other: as one mode's share goes up, the other's goes down. This indicates that in some cases, these two modes may be appealing to largely the same market. These figures further imply that the

Table 1.37
FORECASTED WORK TRAVEL MARKETS

Corridor	2000 Daily Person Trips by Destination (home to work and work to home) (6, 7) Central Area (1)	Suburbs (2)
Rt. 7	31,511	68,585
50-66 (3)	2,287	6,921
29 (4)	5,344	20,383
50-66-29 combined (5)	25,069	104,625
I-95	103,949	143,242
Total	168,160	343,756

Notes:

(1) D.C. core area, Rosslyn, Crystal City, Pentagon, and National Airport.
(2) Remainder of Arlington County, Alexandria, and Fairfax County.
(3) Portion in Loudoun County and beyond.
(4) Portion in Prince William County and beyond.
(5) Fairfax County portion only.
(6) Excludes trips originating in Alexandria or Arlington County.
(7) Travel forecast made by Barton-Aschman Associates based on socioeconomic forecasts by MWCOG.

Table 1.38
COMPARISON OF BASE YEAR 2000
RUN WITH BASE 1980 RUN OF
SKETCH PLANNING PROGRAM

Corridor	Destination	1980 Base Estimate (1)		2000 Base Estimate (1)		Net Change	
		% transit	% ridesharing	% transit	% ridesharing	% transit	% ridesharing
Rt. 7	Central Area	.185	.499	.175	.506	-5.4%	+1.4%
	Suburbs	.035	.324	.021	.325	-40.0%	+0.3%
50-66-29	Central Area	.219	.507	.193	.527	-11.9%	+3.9%
	Suburbs	.070	.321	.038	.324	-45.7%	+0.9%
I-95	Central Area	.425	.332	.428	.330	+0.7%	-0.6%
	Suburbs	.117	.296	.111	.301	-5.1%	+1.7%
Total	Central Area	.333	.402	.335	.402	+0.6%	0
	Suburbs	.087	.309	.065	.314	-25.3%	+1.6%

Notes:

(1) Excludes trips originating in the central area, Alexandria, and Arlington County. Values represent unadjusted results of the corridor sketch planning program.

Table 1.39
ESTIMATED CHANGE IN MODAL TRIPS

Trip Length	Rt. 7	Corridor 50-66-29	I-95
Base 1980 Daily Transit Trips			
to Central Area	7,310	8,250	25,740
to Suburbs	1,270	3,740	11,100
Base 2000 Daily Transit Trips			
to Central Area	7,560	7,910	32,120
to Suburbs	1,440	5,010	15,900
Change in Daily Transit Trips			
to Central Area	250	-340	6,380
to Suburbs	170	1,270	4,800
Base 1980 Daily Ridesharing Trips			
to Central Area	8,110	12,300	38,650
to Suburbs	11,720	17,150	28,090
Base 2000 Daily Ridesharing Trips			
to Central Area	9,010	13,140	47,610
to Suburbs	22,290	42,740	43,120
Base 2000 Daily Ridesharing Trips			
to Central Area	9,010	13,140	47,610
Change in Daily Ridesharing Trips			
to Central Area	900	840	8,960
to Suburbs	10,570	25,590	15,030

demographic trends of the next 20 years, by themselves, will tend to create a slight increase in the share of drive alone work trips to the suburbs and essentially no change in the combined transit and ridesharing share. (This observation ignores the effect of costs and service levels, both of which could change radically in the next few years.)

Another effect of the travel forecast is on trip length. Table 1.40 shows the estimated 2000 trip length distribution and can be compared with the 1980 distribution in Table 1.14. Very slight but noticeable increases in trip length are indicated, especially in the "26 miles or more" category. Since this table is based on the 1980 highway system, these changes come entirely from the forecasted re-distribution of households and employment within the study area. Thus, compared to present travel patterns, long-distance commuting comprises a larger share of total work trips in the future.

Each of the five "new" alternatives was analyzed using the forecasted person trips. The results are summarized as follows.

Alternative #1 (3+ HOVs on Shirley Highway)

(See Table 1.41). The effects on transit and ridesharing trips are similar to, but slightly more pronounced than in 1980. The net effect between the new 2000 trips and the existing base 1980 trips is substantial, however, especially in terms of ridesharing trips to the suburbs.

Alternative #2 (Extend I-66 HOV Lanes)

(See Table 1.42). The effects are similar to the base 1980 application, with a stronger impact in the 50-66-29 corridor. The net effect between 1980 and 2000 shows a huge shift in suburban ridesharing trips and a minimal effect on central area transit trips.

Alternative #3 (Expand Commuter Bus Service)

(See Table 1.43). The effects are similar to the base 1980 application, with a stronger impact in the Route 7 corridor. The base 2000 transit share declines in all corridors except 50-66. The net effect between base 1980 and 2000 is largest in the Rt. 7 and I-95 corridors in absolute terms, but largest in the 50-66 and 29 corridors in relative terms. It should be noted that the effects of this alternative are limited (by definition) to the areas outside Fairfax County.

Table 1.40
2000 WORK TRIP LENGTH DISTRIBUTIONS BY CORRIDOR

	percent of work trips by corridor		
Trip Length	Rt. 7	50-66-29	I-95
0-5 miles	0%	0%	0%
6-10	19%	11%	18%
11-15	26%	12%	31%
16-20	12%	14%	26%
21-25	20%	12%	8%
26 or more	23%	51%	17%
Average Trip Length (miles)	20.1	25.3	18.0

Source: 1980 network highway distance from MWCOG, 2000 person trip estimates by Barton-Aschman Associates based on MWCOG forecasts.

Table 1.41
ANALYSIS OF ALTERNATIVE #1 - 3+ HOV's ON SHIRLEY HIGHWAY
2000 CONDITIONS

	All Trips to Central Area (1)	I-95 Trips to Central Area (2)	I-95 Trips to Suburbs (2)
Base 2000 Modal Share (3)			
Transit	.353	.309	.111
Ridesharing	.368	.458	.301
Base 2000 Daily Trips			
Transit	98,340	32,120	15,900
Ridesharing	102,510	47,610	43,120
Total Person Trips	278,573	103,949	143,242
New Modal Share (3)			
Transit	.351	.306	.111
Ridesharing	.372	.466	.301
New Daily Trips			
Transit	97,780	31,810	15,900
Ridesharing	103,630	48,440	43,120
Change in Daily Trips (from Base 2000)			
Transit	-560	-310	0
Ridesharing	+1,120	+830	0
Change in Daily Trips (from Existing 1980)			
Transit	+10,900	+6,070	+4,800
Ridesharing	+14,560	+9,790	+15,030

Notes:

(1) Includes trips originating in Alexandria and Arlington County, outside the central area.

(2) Excludes trips originating in the central area, Alexandria and Arlington County.

(3) Base 2000 and new modal shares derived by applying the relative mode shift estimated by the sketch planning program to the observed data.

Table 1.42
ANALYSIS OF ALTERNATIVE #2 -- EXTEND I-66 HOV FACILITY
2000 CONDITIONS

	Route 7 Trips to Central Area (1)	50-66-29 Trips to Central Area (1, 3)	Route 7 Trips to Suburbs (1)	50-66-29 Trips to Suburbs (1, 3)
Base 2000 Modal Share (2)				
Transit	**.240**	**.242**	**.021**	**.038**
Ridesharing	**.286**	**.402**	**.325**	**.324**
Base 2000 Daily Trips				
Transit	7,560	7,910	1,440	5,010
Ridesharing	9,010	13,140	22,290	42,740
Total	31,511	32,700	68,585	131,929
New Modal Share (2)				
Transit	.250	.290	.022	.043
Ridesharing	.282	.366	.325	.321
New Daily Trips				
Transit	7,880	9,480	1,510	5,670
Ridesharing	8,890	11,970	22,290	42,350
Change in Daily Trips (from Base 2000)				
Transit	+320	+1,570	+70	+660
Ridesharing	-120	-1,170	0	-390
Change in Daily Trips (from Existing 1980)				
Transit	+570	+1,230	+240	+1,930
Ridesharing	+900	+360	+10,570	+25,200

Notes:

(1) Excludes trips originating in the central area, Arlington County or Alexandria.

(2) Base 2000 and modal shares derived by applying the relative mode shift estimated by the sketch planning program to the observed data.

(3) Includes both Fairfax County and outlying portions of this corridor.

Table 1.43
ANALYSIS OF ALTERNATIVE #3 -- EXPAND COMMUTER BUS SERVICE
2000 CONDITIONS

	Corridor			
	Route 7 (1)	50-66 (1)	29 (1)	I-95 (1)
Base 2000 Transit Share (2)				
to Central Area	.122	.382	.237	.263
to Suburbs	.003	.001	.001	.061
Base 2000 Daily Transit Trips				
to Central Area	1,120	880	1,270	5,650
to Suburbs	50	10	20	1,560
New Transit Share (2)				
to Central Area	.188	.557	.340	.270
to Suburbs	.005	.001	.002	.061
New Daily Transit Trips				
to Central Area	1,730	1,280	1,820	5,800
to Suburbs	80	10	40	1,560
Change in Daily Transit Trips (from Base 2000)				
to Central Area	+610	+400	+550	+150
to Suburbs	+30	0	+20	0
Change in Daily Transit Trips (from Existing 1980)				
to Central Area	+870	+550	+510	+1,430
to Suburbs	+55	+5	+25	+615

Notes:

(1) Excludes trips originating in the central area, Alexandria, Falls Church, Fairfax City, and Fairfax and Arlington Counties.

(2) Base 2000 and modal shares derived by applying the relative mode shift estimated by the sketch planning program to the observed data.

Alternative #4 (Improved Carpool Program)

This option (and Alternative #5) required the re-calculation of year 2000 modal shares using the modal summary tables. This process is shown in Appendix Tables IA.14 through IA.16, and the results for Alternative #4 are shown in Table 1.44. Again, the results are similar to the base 1980 application, except for a greater net effect on suburban trips. Comparison of the 2000 and base 1980 data indicates substantial increases in carpooling, especially for suburban trips.

Alternative #5 (Vanpool Assistance Program)

(See Table 1.45). Just as in the 1980 case, Alternative #5, has a similar effect as Alternative #4, but not as substantial.

The major conclusion of the analysis of alternatives under future travel conditions is that there is a small change in the transit and ridesharing modal shares due to demographic trends, but a fairly large change in absolute volumes due to the projected growth of suburban employment. All alternatives except #3 (Expand Commuter Bus Service) indicate large absolute increases in the alternative modes, particularly to suburban destinations, compared to existing conditions. However, these changes are considerably more modest when compared to base 2000 conditions.

ESTIMATION OF CAPITAL AND OPERATING COSTS AND REVENUES

In this section, the operating and capital costs of each alternative are estimated. These estimates are prepared for both new and previously identified alternatives, using a combination of techniques from the Methodology report and the various studies documenting the previously identified alternatives. The cost analysis is consistent with the ridership analysis in that it is performed at a sketch level of detail. All costs are expressed in terms of present year dollars, which for this study relates to a time frame of about 1980-82.

Tolls and fare revenues which may offset part or all of the cost of some alternatives are not included. In general, the transit options involve the cost of rail cars or buses; the construction of track, station, and yards, major purchases of right-of-way (where necessary), and the cost to operate the trains or buses in normal service. The highway options involve road construction, major purchases of right-of-way (where necessary), operations, maintenance, toll operations, and traffic monitoring and control. Specific techniques and assumptions used in the cost estimation process are described below. Where feasible for the "old" alternatives, every attempt was made to

Table 1.44
ANALYSIS OF ALTERNATIVE #4 -- IMPROVED CARPOOL PROGRAM
2000 CONDITIONS

From Carpool Modal Summary Table: Instead of "Normal" Carpooling Encouragement Factor (1.007), use "High" Factor (1.042). The difference is 1.042/1.007 = 1.038, or a 3.8% increase in carpooling (which is 88%-92% of all ridesharing).

	Corridor		
	Route 7	50-66-29 combined (4)	I-95
Base 2000 Ridesharing Share			
to Central Area (1)	.279	.521	.476
to Suburbs (2)	.344	.400	.330
Base 2000 Daily Ridesharing Trips			
to Central Area	8,790	17,040	49,480
to Suburbs	23,590	52,770	47,270
New Ridesharing Share (1)			
to Central Area	.289	.538	.493
to Suburbs	.356	.413	.341
New Daily Ridesharing Trips			
to Central Area	9,110	17,590	51,250
to Suburbs	24,420	54,490	48,840
Change in Daily Ridesharing Trips (from Base 2000)(3)			
to Central Area	+320	+550	+1,770
to Suburbs	+830	+1,720	+1,570
Change in Daily Ridesharing Trips (from Existing 1980)(3)			
to Central Area	+1,000	+5,290	+12,600
to Suburbs	+12,260	+34,610	+18,280

Notes:

(1) Base 2000 and new modal shares derived by applying the relative mode shift estimated by the modal summary tables to the observed data.

(2) Base 2000 modal share from the modal summary table.

(3) Represents change in carpool person trips.

(4) Includes both Fairfax County and outlying portions of this corridor.

Table 1.45
ANALYSIS OF ALTERNATIVE #5 -- VANPOOL ASSISTANCE PROGRAM
2000 CONDITIONS

From Vanpool Modal Summary Table: Add a factor of 1.25 to 8%-12% of ridesharing trips to represent net increase in vanpooling.

	Corridor		
	Route 7	50-66-29 combined (4)	I-95
Base 2000 Ridesharing Share			
to Central Area (1)	.279	.521	.476
to Suburbs (2)	.344	.400	.330
Base 2000 Daily Ridesharing Trips			
to Central Area	8,790	17,040	49,480
to Suburbs	23,590	52,770	47,270
New Ridesharing Share			
to Central Area	.285	.537	.486
to Suburbs	.353	.413	.337
New Daily Ridesharing Trips			
to Central Area	8,980	17,560	50,520
to Suburbs	24,210	54,490	48,270
Change in Daily Ridesharing Trips (from Base 2000)(3)			
to Central Area	+190	+520	+1,040
to Suburbs	+620	+1,720	+1,000
Change in Daily Ridesharing Trips (from Base 1980)(3)			
to Central Area	+870	+5,260	+11,120
to Suburbs	+12,050	+34,610	+17,710

Notes:

(1) Base 2000 and new modal shares derived by applying the relative mode shift estimated by the modal summary tables to the observed data.

(2) Base 2000 modal share from the modal summary table.

(3) Represents change in vanpool person trips.

(4) Includes both Fairfax County and outlying portions of this corridor.

estimate costs for as close to 1982 as possible. This was done for the sake of consistency, even though the alternatives would be actually implemented in different years. For the most part, the available documentation of the "old" alternatives is not sufficiently detailed to allow precise re-estimation of costs and revenues on a truly consistent basis.

Costs for Alternatives Defined in Previous Studies

Basic sources for the Metrorail Routes include: Detailed Financial Analysis of the Selected Metrorail System: Patronage, Revenue and Operating Cost Estimates, prepared for WMATA by Peat, Marwick, Mitchell & Co., 9 August 1978, and Traffic, Revenue, and Operating Costs, prepared for WMATA by W.C. Gilman & Co., and Alan M. Voorhees & Associates, February, 1969. Costs obtained from these studies include the increments of capital cost of rail construction and rail cars, and annual rail operating costs for J, H and K routes from Ballston to the Vienna stations, and from National Airport to the Huntington and Franconia stations.

Basic sources for Rapid Rail to Dulles include: Dulles Airport Rapid Transit Service Feasibility Study, prepared for Federal Railroad Administration by Day and Zimmerman Consulting Services, April, 1971, and the Peat, Marwick, Mitchell & Co. report cited above. Costs are based on the recommended system and service level with through service to D.C., integrated with Metrorail, providing two local stops at Reston and Route 7. Unit costs are taken from the 1978 Peat, Marwick, Mitchell & Co. report and recent reported WMATA rail car bids.

Basic sources for I-66 Inside Beltway include: Secretary's Decision on Interstate Highway 66, Fairfax and Arlington Counties, Virginia, prepared by USDOT, 5 January 1977, and Traffic Management Concepts for Interstate 66, prepared for VDH&T by JHK & Associates, 28 February 1977. As of May 1982, most of the costs for this road had already been incurred, but the full estimated cost is shown for comparative purposes.

The basic source for the Dulles Access Road Extension was the Draft Environmental Impact Statement (DEIS), Dulles Access Highway Extension to I-66 and Outer Parallel Roadways from Route 7 to I-495, prepared by FHWA Region 15 for the Federal Aviation Administration, December, 1978. Costs include operation and maintenance of the FAA's center lanes as well as VDH&T's outer toll lanes.

The basic source for Commuter Rail was the Northern Virginia Commuter Rail Study, prepared for VDH&T by MWCOG, December, 1981.

The basic source for the Shirley Highway HOV Extension was Extending the Shirley Highway HOV Lanes, prepared for VDH&T by JHK & Associates, March, 1982. Costs include the recommended 12-mile extension of the HOV lanes to Route 642.

Costs for New Alternatives

3+ HOVs on Shirley Highway: Basically, the one-time cost of changing the signs along the highway to read "3 Person Pools."

Extend I-66 HOV Facility: Unit costs were taken from the JHK & Associates report on extending the Shirley Highway HOV lanes.

Expand Commuter Bus Service: The existing level of commuter bus service was increased by extending routes as shown in Figure 1.16 and by increasing bus trips on these routes by 50%. Operating cost data was taken from Intercity Bus Service in Virginia, prepared by the Virginia Highway and Transportation Research Council, August, 1981.

Improved Carpool Program: Costs were based on required funding for "Level 3" county and regional ridesharing programs (from the Methodology Report) for Fairfax, Prince William, and Loudoun counties, and Planning Districts 7, 9, and 16, plus increased funding for MWCOG's Commuter Club matching program.

Vanpool Assistance Program: This alternative assumed the same cost as Improved Carpool Program, except without the increased funding for MWCOG (since this is mainly a county-level effort, using only existing resources from MWCOG).

Capital and operating cost estimates are shown in Tables 1.46 through 1.49. The previously identified transit options are the most expensive, both in terms of initial capital and annual operating costs. The "new" alternatives are the least costly, although expanding commuter bus service in the I-95 corridor has a fairly high operating cost. Allowing 3+ HOVs on Shirley Highway is the least cost option, since only sign changes are required. The carpool and vanpool cost estimates include only administrative costs: staff time and miscellaneous expenses for ridesharing marketing materials and services.

The annualized capital cost is determined by applying a capital recovery factor to the capital cost. An interest rate of 10% was assumed, with useful life spans ranging from 5 years for highway signs to 40 years for commuter rail cars. These life spans were taken largely from the handbook Characteristics of Urban Transportation Systems, prepared for UMTA by DeLeuw, Cather & Co., May, 1974. The annualized capital cost does not represent an actual periodic cost or cash flow, but is merely a technique to allow one-time costs and recurring costs to be compared on the same basis. Table 1.50 and 1.51 indicate the annualized capital cost for each alternative.

Revenues for Alternatives Defined in Previous Studies

A critical financial aspect of each alternative is its potential to generate revenue. Certain options return part or all of their costs through user fees

Table 1.46
ESTIMATED CAPITAL COST OF PREVIOUSLY IDENTIFIED ALTERNATIVES

Previously Identified Alternative	Capital Cost in Millions			
	Route 7	50-66-29	I-95	Total
Metrorail J, H, and K Routes	162.5	162.5	530.3	855.3
Rapid Rail to Dulles	444.2	--	--	444.2
I-66 inside Beltway (1)	72.6	147.3	--	219.9
Dulles Access Road Extension	35.0	--	--	35.0
Commuter Rail	--	24.2	22.3	46.5
Shirley Highway HOV Extension	--	--	77.2	77.2

Notes:

Source: Studies cited in Table 1.7 with costs re-estimated for 1982 as necessary.

Figures rounded to nearest 0.1 million and are expressed in approximate 1982 dollars.

(1) Costs allocated based on person trips shifted.

Table 1.47
ESTIMATED ANNUAL OPERATING AND MAINTENANCE COSTS OF PREVIOUSLY IDENTIFIED ALTERNATIVES

Previously Identified Alternative	Annual Operating and Maintenance Cost in Thousands			
	Route 7	50-66-29	I-95	Total
Metrorail J, H, and K Routes	6,250	6,250	13,700	26,200
Rapid Rail to Dulles	18,700	--	--	18,700
I-66 inside Beltway (1)	294	596	--	890
Dulles Access Road Extension	644	--	--	644
Commuter Rail	--	1,980	2,460	4,440
Shirley Highway HOV Extension	--	--	240	240

Source: Studies cited in Table 1.7 with costs re-estimated for 1982 as necessary.

Figures rounded to nearest 0.1 million and are expressed in approximate 1982 dollars.

(1) Costs allocated based on person trips shifted.

Table 1.48
ESTIMATED CAPITAL COSTS OF NEW ALTERNATIVES

New Alternative	Capital Cost in Millions Rt. 7	50-66-29	I-95	Total
#1 3+ HOVs on Shirley Highway	--	--	0.001	0.001
#2 Extend I-66 HOV Facility (1)	16.4	23.6	--	40.0
#3 Expand Commuter Bus Service	0.3	0.8	3.5	4.6
#4 Improved Carpool Program	--	--	--	--
#5 Vanpool Assistance Program	--	--	--	--

Note: Figures rounded to nearest 0.1 million and are expressed in approximate 1982 dollars.

(1) Costs allocated based on person trips affected.

Table 1.49
ESTIMATED ANNUAL OPERATING AND MAINTENANCE COSTS OF NEW ALTERNATIVES

New Alternative	Annual Operating and Maintenance Cost in Thousands Rt. 7	50-66-29	I-95	Total
#1 3+ HOVs on Shirley Highway	--	--	--	--
#2 Extend I-66 HOV Facility (2)	57	83	--	140
#3 Expand Commuter Bus Service	75	300	1,125	1,500
#4 Improved Carpool Program (1,2)	57	87	191	335
#5 Vanpool Assistance Program (1)	51	78	171	300

Notes: Figures rounded to nearest thousand and are expressed in approximate 1982 dollars.

(1) Administrative Costs

(2) Costs allocated based on person trips affected.

Table 1.50
ESTIMATED ANNUALIZED CAPITAL COSTS OF PREVIOUSLY IDENTIFIED ALTERNATIVES

Previously Identified Alternative	Annualized Capital Cost in Thousands			
	Route 7	50-66-29	I-95	Total
Metrorail J, H, and K Routes	17,300	17,300	56,700	91,300
Rapid Rail to Dulles	47,200	--	--	47,200
I-66 inside Beltway	8,600	17,500	--	26,100
Dulles Access Road Extension	3,700	--	--	3,700
Commuter Rail	--	2,600	2,300	4,900
Shirley Highway HOV Extension	--	--	8,200	8,200

Source: Studies cited in Table 1.7, adjusted for inflation.

Figures rounded to nearest hundred thousand and are expressed in approximate 1982 dollars.

For options serving more than one corridor, costs are allocated based on person trips shifted (except for commuter rail, for which the corridor split was estiamted by MWCOG).

An annual interest rate of 10% is assumed.

Table 1.51
ESTIMATED ANNUALIZED CAPITAL COSTS OF NEW ALTERNATIVES

New Alternative	Annualized Capital Cost in Thousands Rt. 7	50-66-29	I-95	Total
#1 3+ HOVs on Shirley Highway	--	--	0.3	0.3
#2 Extend I-66 HOV Facility (1)	1,900	2,800	--	4,700
#3 Expand Commuter Bus Service	56	150	656	862
#4 Improved Carpool Program	--	--	--	--
#5 Vanpool Assistance Program	--	--	--	--

Note: Figures rounded to nearest thousand and are expressed in approximate 1982 dollars.

An annual interest rate of 10% is assumed.

Costs allocated based on person trips affected.

(fares and tolls). Revenue estimates are shown in Tables 1.52 for alternatives defined in previous studies. Key assumptions for these alternatives are summarized below:

Metrorail Routes J, H, and K. A rail revenue/operating cost ratio of 0.50 was used, based on the present Metrorail value of 0.55 to 0.60 and the fact that the extended Metrorail routes are assumed to be slightly less productive than the existing core system.

Rapid Rail to Dulles. The assumed revenue/operating cost ratio was similar to the Metrorail assumption, except that it is expected that higher fares would be charged for this premium service. A revenue/cost ratio of 0.70 was used.

I-66 Inside Beltway: No revenues.

Dulles Access Road Extension. The DEIS for this project assumed (as has this study) that VDH&T would set the tolls on the outer toll lanes to cover all operating and capital costs.

Commuter Rail. This analysis used revenue estimates developed by MWCOG which were based on the present Maryland DOT commuter rail fares increased by 50 percent.

Shirley Highway HOV Extension: No revenues.

Revenues for New Alternatives

Revenue estimates for the new alternatives are presented in Table 1.53, and key assumptions in estimating revenue are summarized below:

3+ HOVs on Shirley Highway: No revenues.

Extend I-66 HOV Facility: No revenues.

Expand Commuter Bus: Revenues were estimated by multiplying the estimated number of additional passengers by an estimated average fare of $3.00 per one-way trip. This fare is approximately what is currently being charged from areas such as Fredericksburg to downtown D.C.

Improved Carpool Program: No revenues.

Vanpool Assistance Program: No revenues.

Net Costs of Alternatives

Table 1.54 combines the cost and revenue estimates into a summary table showing the net annual cost for each alternative. The rapid rail options are

Table 1.52
ESTIMATED ANNUAL REVENUES OF PREVIOUSLY IDENTIFIED ALTERNATIVES

Previously Identified Alternative	Forecast Year	Annual Revenue in Thousands: Route 7	50-66-29	I-95	Total
Metrorail J, H, and K Routes	1990	3,100	3,100	6,900	13,100
Rapid Rail to Dulles	1976	13,100	--	--	13,100
I-66 inside Beltway	1983	--	--	--	--
Dulles Access Road Extension	1985	2,000	--	--	2,000
Commuter Rail	1982	--	1,500	1,800	3,300
Shirley Highway HOV Extension	1990	--	--	--	--

Source: Studies cited in Table 1.7.

Figures rounded to nearest hundred thousand and are expressed in approximate 1982 dollars.

The estimated revenues in this table are based on modal usage and cost information which does not necessarily reflect 1982 conditions. The "Forecast Year" indicates that year for which the originally documented revenue estimates apply, but this study attempted to revise these estimates to more closely reflect 1982 conditions.

Table 1.53
ESTIMATED ANNUAL REVENUES OF NEW ALTERNATIVES

New Alternative	Annual Revenue In Thousands			
	Rt. 7	50-66-29	I-95	Total
#1 3+ HOVs on Shirley Highway	--	--	--	--
#2 Extend I-66 HOV Facility	--	--	--	--
#3 Expand Commuter Bus Service	$ 60	$ 240	$ 900	$1,200
#4 Improved Carpool Program	--	--	--	--
#5 Vanpool Assistance Program	--	--	--	--

Note: Figures rounded to nearest thousand and are expressed in approximate 1982 dollars.

TABLE 1.54
ESTIMATED NET ANNUAL COST OF ALTERNATIVES

	Net Annual Cost in Thousands			
Alternative	Route 7	50-66-29	I-95	Total
Metrorail	$20,450	$20,450	$63,500	$104,400
Rapid Rail to Dulles	52,800	--	--	52,800
I-66 Inside Beltway (2)	8,894	18,096	--	26,990
Dulles Access Road Extension	2,344(1)	--	--	2,344
Commuter Rail	--	3,080	2,960	6,040
Shirley HOV Extension	--	--	8,440	8,440
3+ HOVs on Shirley	--	--	0.3	0.3
Extend I-66 HOV (2)	1,957	2,883	--	4,840
Expand Commuter Bus	71	210	881	1,162
Improved Carpool Program (2)	57	87	191	335
Vanpool Assistance Program (2)	51	78	171	300

Notes

Figures rounded to nearest thousand and are expressed in approximate 1982 dollars.

(1) This is the net cost to the FAA of operation, maintenance, and construction of the inner lanes of this facility.

(2) Costs revenues are allocated based on person trips affected.

still the most costly, while the ridesharing programs are the least costly. The commuter rail and HOV facilities are somewhere in the middle. Approximately one order of magnitude (i.e., power of 10) separates the low from the middle cost options, which are in turn separated by another order of magnitude or so from the highest cost options.

Not all of the net costs in Table 1.54 would be borne by VDH&T, if these alternatives are implemented. Generally, VDH&T would pay for the roadway HOV and ridesharing options, while the rapid rail options could presumably be covered by a combination of UMTA, VDH&T, and local funds. The expansion of commuter bus raises a question of funding source, since revenues are projected to cover about 80% of operating costs and none of the capital costs. Funding sources will be discussed later in the implementation sections of this report.

IMPACT ASSESSMENT

Estimates of usage and costs for each alternative must be assembled with estimates of other impacts to enable a comparison to be made among commuting options. Presenting the results of the impact analysis in a tabular format facilitates the evaluation of relative costs and effectiveness of each alternative. Impacts for each alternative are calculated in terms of modal usage, capital and operating costs, user benefits, and effects on society at large.

For the previously studied alternatives, the ridership information presented in this analysis is simply that which has been reported in the previous studies. No attempt was made to adjust these forecasts to 1980 travel conditions. Most of the cost information has also been taken from these studies, although some adjustments were made to identify separately segments of certain options and to put all costs into the same approximate 1982 time frame.

For the "new" alternatives, all modal usage estimates relate to 1980 and all costs relate to 1982. For these options, it was feasible to forecast modal usage for 2000, and this is shown in the tables in comparison with 1980 results. It should also be kept in mind that this is an incremental analysis, which investigates the net additional impacts of the options, beyond the base conditions.

Assessment Methodology And Assumptions

Much of the methodology used to calculate impacts was discussed in the Methodology Report, but special features of the analysis will be discussed in this section as documentation of additional assumptions and procedures. The method of calculating each impact is as follows:

Annual Modal Usage. Incremental daily modal usage (for trips to the central area and suburbs) multiplied by 250 working days per year.

Peak Hour Modal Usage. Incremental daily modal usage, factored by 0.18 to represent peak hour, peak direction trips.

Percent Modal Share. Net change in daily modal usage divided by total daily work trips in the market area of each corridor (calculated only for the "new" alternatives.)

Total Annual Travel Time Saved. Annual modal usage factored by the following time savings:

Rapid Rail = 5.18 minutes per trip (based on Metrorail "Before and After" survey)

Bus/Pool Lanes = 1.0 minute per mile of facility, factored by 50% to represent an average trip length

Commuter Bus and Ridesharing Programs = no time savings assumed

Capital and Operating Cost. Described in the previous section. Costs relate to increments of new service (such as the extensions of Metrorail).

Change in Annual VMT. Reduction in auto driver (vehicle) trips, factored by an average trip length (see Table 1.55). Reduction in vehicle trips estimated as follows:

Rapid Rail = 24% of rail users assumed to be former auto drivers (based on Metrorail "Before and After" survey)

Bus/Pool Lanes = change in average auto occupancy from 1.32 (average for central area and suburban trips) to 4.5

Commuter Rail = 80% of rail users assumed to be former auto drivers

Commuter Bus = 65-69% (depending on corridor) of bus users assumed to be former auto drivers; trip length of 30 miles assumed

Ridesharing Programs = change in average auto occupancy from 1.32 to 2.5 (for carpools) or to 12 (for vanpools)

Change in Annual Gasoline Usage. Change in Annual VMT divided by 16.4 mpg for 1980 and 22.5 mpg for 2000.

Change in Annual Emissions. Change in Annual VMT multiplied by the following emissions rates in grams/mile:

Table 1.55
IMPACT ASSESSMENT PARAMETERS

Parameter	Corridor: Route 7	Corridor: 50-66-29	Corridor: I-95
Average Combined Auto Occupancy for Central Area and Suburban Work Trips	1.32	1.32	1.32
Average Combined Trip Length (miles) -- 1980	12.9	13.9	11.2
Average Combined Trip Length (miles) -- 2000	11.3	12.1	11.3
Total Daily Work Trip Market -- 1980	64,953	83,421	178,744
Total Daily Work Trip Market -- 2000	100,096	164,629	247,191

Source: Barton-Aschman analysis of MWCOG base data.

	1980	2000
CO	5.0	1.4
HC	44.0	15.0
NO_x	4.0	1.9

These rates reflect low altitude conditions, an average speed of 30 mph, and an ambient temperature of 60^{o} F. They were estimated using the EPA MOBILE2 program.

Change in Peak Hour Vehicles. Calculated the same way as Change in Annual VMT.

Change in Average Daily User Cost. Calculated for each alternative and compared to the cost of driving alone, which is 11.3 cents per mile times the average trip length, plus $1.25 per day for parking (estimated central area value based on Metrorail "Before and After" survey, factored for inflation). User costs for each alternative are as follows:

Rapid Rail = transit fare is approximately 10.8 cents/mile (based on Metrorail "Before and After" survey, factored for inflation)

Bus/Pool Lanes and Carpool Assistance = "drive alone" cost divided by "new" auto occupancy (2.5 for carpools, 4.5 for pool vehicles on HOV lane)

Vanpool Assistance Program = 5 cents per passenger-mile

Commuter Rail = daily average round trip fare of $4.14 on the Southern route, $4.31 on the RF&P route (based on the MWCOG Commuter Rail study).

Commuter Bus = average daily round trip fare of $6.00 (approximate current fare from Fredericksburg area).

Land Acquisition/Dislocation. Qualitative assessment (i.e., substantial, minimal, none) based on projected station area, parking, and right-of-way needs.

Having described the impact calculation assumptions, it should be noted that there are several basic limitations inherent in the comparisons of alternatives which must be kept in mind when reviewing the results of the impact assessment. First, the analyses and assessments have been done at a sketch planning level of detail, intended to provide a broad-based assessment of several transportation service concepts. Estimates of modal shares and impact assessments relate more to the corridor level than to any specific route or jurisdiction.

Second, there are other impacts and considerations that are not included, primarily due to the commuting focus of this study. This especially affects the capital-intensive options such as Metrorail and I-66, which will both be used by significant volumes of non-work trips during off-peak hours.

In several cases, data pertain to an option which is only part of a larger system (for example, both the rapid rail and HOV-on-freeway facilities). Although it is valuable to look at extensions of system elements, the fact that they are part of a larger whole cannot be ignored. For example, leaving Ballston as a permanent end-of-line station would have a general negative operational impact on the rest of the Metrorail system, because of the need for auto parking and rail yard facilities, among other things.

Fourth, it should be noted that not all of the alternatives are necessarily independent options. A Dulles rail line, for example, may be somewhat less feasible if Metrorail is not extended as far as the West Falls Church station.

Fifth, the fact that data for previously identified alternatives were taken from different reports, based on different analysis procedures, and with travel estimates for different target years complicates their comparison with each other and with the "new" alternatives. Therefore, caution should be used in interpreting these comparisons. Finally, it should be noted that in some cases, the cost and other data for one facility have been allocated to two corridors. This further complicates the comparison of an alternative which serves two corridors with an alternative which serves only one corridor.

Impact Assessment For Previously Studied Alternatives

Because they are taken from other studies which used a variety of analysis techniques and target years, assessment of previously studied alternatives is presented separately from that of the new alternatives developed in this study. The results of this assessment are shown in Tables 1.56-1.58. These options are all in the moderate-to-high range of costs and impacts, although they have different rates of cost-effectiveness. The main observations from this analysis are noted below:

Route 7 (Table 1.56)

1. Although the I-66 HOV facility is not located in this corridor, it is still estimated to have a major influence on this corridor. The new I-66 HOV facility inside the Beltway will be a tremendous incentive to ridesharing. An earlier study has estimated it will generate over 2 million new ridesharing person trips annually in this corridor. Reserving the two inbound lanes for HOVs during the peak hour should prove an attractive time savings for HOVs, which will induce many commuters to form pools or ride transit, which in turn will reduce their commuting cost. Its immediate impact on ridesharing will be far greater than any ridesharing promotional or assistance efforts. This represents a rare opportunity for a major, one-time boost for ridesharing in a corridor,

Table 1.56
SUMMARY OF IMPACT ASSESSMENT OF PREVIOUSLY STUDIED ALTERNATIVES
ROUTE 7 CORRIDOR

	Alternatives		
Estimated Impacts (5)	Metrorail (2,10)	Dulles Rapid Rail (3)	I-66 Inside Beltway (4,10)
Annual Transit Ridership	2,587,500	2,010,000	--
Annual Ridesharing Usage	--	--	2,127,500
Peak Hour Transit Ridership (1)	1,860	1,450	--
Peak Hour Ridesharing Usage (1)	--	--	1,530
Total Annual Travel Time Saved (hours)	223,200	173,500	170,200
Capital Cost ($ millions)	$ 162.5	$ 444.2	$ 72.6 (8)
Annual Operating Cost ($000)	$ 6,250	$ 18,700	$ 294 (8)
Net Total Annualized Cost ($000)	$ 20,450	$ 52,800	$ 8,894 (8)
Capital Cost Per Annual Transit Rider	$ 63	$ 221	--
Capital Cost per Annual Ridesharing User	--	--	$ 34
Annual Operating Cost per Annual Transit Rider	$ 2.40	$ 9.30	--
Annual Operating Cost per Annual Ridesharing User	--	--	$ 0.14
Net Total Annualized Cost per Annual Transit Rider	$ 7.90	$ 26.30	--
Net Total Annualized Cost per Annual Ridesharing User	--	--	$ 4.18
Change in Annual VMT (000)	-8,011	-6,223	-14,693
Change in Annual Gasoline Usage (000 gallons)	-488	-379	-896
Change in Annual Emissions (tons)			
HC	-44	-34	-81
CO	-388	-302	-712
NO_x	-35	-27	-65
Change in Peak Hour Vehicles (1)	-450	-350	-820
Change in Average Daily User Cost (6)			
Drive Alone to Transit	$ -1.38	$ -1.38	--
Drive Alone to Ridesharing	--	--	$ -3.24
Land Acquisition/Dislocation	none (5)	minimal	none (9)

Notes to Table 1.56:

(1) Peak one hour, peak direction flow.

(2) Relates only to K Route (Orange Line) section from Ballston to Vienna. Ridership and basic costs pertain to a forecast year of 1990, althrough all costs are expressed in 1982 dollars. Estimates reflect no rapid rail service in Dulles corridor.

(3) Ridership and basic costs pertain to a forecast year of 1976, although all costs are expressed in 1982 dollars.

(4) Ridesharing usage and basic costs pertain to a forecast year of 1984, although all costs are expressed in 1982 dollars. All figures reflect only the increment of modal shifts to ridesharing caused by the facility. Most of the capital costs and land acquisition for this option have already been incurred as of May, 1982.

(5) Work trips only (except that the data for some of the previously identified alternatives may include some impacts related to non-work trips as well). Impacts are based on the estimated change in transit or ridesharing usage estimated to result from each alternative.

(6) Change in the daily commuting cost for the average trip to and from work for each commuter making the shift from driving alone to transit and/or ridesharing.

(7) Includes 4+ person pools only.

(8) Includes only highway operating, maintenance, and capital costs; excludes bus operating and capital costs.

(9) The land acquisition impact of this option affects another corridor.

(10) All cost and ridership figures have been apportioned to two corridors for this option based on the location of the facility (if appropriate) or the relative effect on modal volumes by corridor. The values for each corridor sharing this option must be added to determine the total value.

and subsequent modal shifts (after the initial impact) are likely to be small in comparison to the initial impact. This option has a moderate net cost per ridesharing user, and a very favorable potential savings for those who presently drive alone, but this is achieved with a substantial amount of land acquisition (most of which affects only the 50-66-29 corridor).

2. The Metrorail K Route will draw almost as many annual riders from the Route 7 corridor as it will from the 50-66-29 corridor in which it is located (assuming the Dulles rail line is not built). The total number and share of commuters changing modes are greatest for Metrorail, and it has minimal land requirements (being largely in the I-66 median) and a modest user cost savings. However, its cost-effectiveness is fairly low, due to the high capital and annual operating costs.

3. The Dulles rail line is shown as being very expensive, even though it would also attract over 2 million commuters annually. It is presumed that most of those riders would otherwise use the K Route (i.e., there is a considerable overlap between the two estimates). The high relative cost of this option is due to the fact that it serves only the Rt. 7 corridor and that it covers a relatively long distance (almost 17 miles) with only three stations. The feasibility of the Dulles rail line is strongly related to the intended role of Dulles Airport in the Washington region, which in turn, is dependent upon federal policy decisions on airport usage.

50-66-29 (Table 1.57)

1. Similar to the Rt. 7 case, I-66 inside the Beltway has a major estimated impact on ridesharing usage (over 4.3 million trips annually in this corridor). These estimates are shown to result in some very significant potential reductions in VMT and peak hour vehicles. The net annual cost and change in mode share are also large, and result in a moderate cost-effectivenss. However, the negative effort of I-66 on land acquisition is most strongly felt in this corridor.

2. Metrorail (also the K Route) has a similar net annualized cost as I-66 , but is estimated to affect "only" about 2.7 million commuters annually. The ridership and impacts of Metrorail in the corridor are similar to those in the Rt. 7 corridor, and the costs have been equally divided between both corridors. Also, despite the sizeable impacts related to Metrorail, the relative cost-effectiveness is fairly low.

3. Commuter rail is projected to have a much smaller impact than either of the other two alternatives. Its total cost is lower than the other two and its cost-effectiveness is comparable to that of I-66, but it offers only minimal time and (particularly) cost savings to the average rider. Commuter rail is also somewhat more limited in scope, since it does not serve other kinds of trips at other hours, as do Metrorail and I-66.

Table 1.57
SUMMARY OF IMPACT ASSESSMENT OF PREVIOUSLY STUDIED ALTERNATIVES
50-66-29 CORRIDOR

Estimated Impacts (5)	Alternatives: Metrorail (2,9)	Alternatives: I-66 Inside Beltway (3,7,9)	Alternatives: Commuter Rail (4,9)
Annual Transit Ridership	2,707,500	--	700,000
Annual Ridesharing Usage	--	4,355,000	--
Peak Hour Transit Ridership (1)	1,950	--	500
Peak Hour Ridesharing Usage (1)	--	3,140	--
Total Annual Travel Time Saved (hours)	233,700	348,400	116,700
Capital Cost ($ millions)	$ 162.5	$ 147.3 (8)	$ 24.2
Annual Operating Cost ($000)	$ 6,250	$ 596 (8)	$ 1,980
Net Total Annualized Cost ($000)	$ 20,450	$ 18,096 (8)	$ 3,080
Capital Cost Per Annual Transit Rider	$ 60	--	$ 35
Capital Cost per Annual Ridesharing User	--	$ 34	--
Annual Operating Cost per Annual Transit Rider	$ 2.41	--	$ 2.83
Annual Operating Cost per Annual Ridesharing User	--	$ 0.14	--
Net Total Annualized Cost per Annual Transit Rider	$ 7.90	--	$ 4.40
Net Total Annualized Cost per Annual Ridesharing User	--	$ 4.16	--
Change in Annual VMT (000)	-9,032	-32,407	-5,897
Change in Annual Gasoline Usage (000 gallons)	-551	-1,976	-360
Change in Annual Emissions (tons)			
HC	-50	-178	-32
CO	-438	-1,570	-286
NO_x	-40	-143	-26
Change in Peak Hour Vehicles (1)	-470	-1,680	-300
Change in Average Daily User Cost (6)			
Drive Alone to Transit	$ -1.39	--	$ -0.25
Drive Alone to Ridesharing	--	$ -3.41	--
Land Acquisition/Dislocation	moderate	substantial	minimal

Notes to Table 1.57:

(1) Peak one hour, peak direction flow.

(2) Relates only to K Route (Orange Line) section from Ballston to Vienna. Ridership and basic costs pertain to a forecast year of 1990, although all costs are expressed in 1982 dollars. Estimates reflect no rapid rail service in Dulles corridor.

(3) Ridesharing usage and basic costs pertain to a forecast year of 1984, although all costs are expressed in 1982 dollars. All figures reflect only the increment of modal shifts to ridesharing caused by the facility. Most of the capital costs and land acquisition for this option have already been incurred as of May, 1982.

(4) Transit ridership and basic costs pertain to a forecast year of 1982, and all costs are expressed in 1982 dollars.

(5) Work trips only (except that the data for some of the previously identified alternatives may include some impacts related to non-work trips as well). Impacts are based on the estimated change in transit or ridesharing usage estimated to result from each alternative.

(6) Change in the daily commuting cost for the average trip to and from work for each commuter making the shift from driving alone to transit and/or ridesharing.

(7) Includes 4+ person pools only.

(8) Includes only highway operating, maintenance, and capital costs; excludes bus operating and capital costs.

(9) All cost and ridership figures have been apportioned to two corridors for this option based on the location of the facility (if appropriate) or the relative effect on modal volumes by corridor. The values for each corridor sharing this option must be added to determine the total value.

I-95 (Table 1.58)

1. Metrorail (Blue/Yellow Lines) is estimated to have a major impact on mode usage, but at a very high net cost. Its cost-effectiveness is similar to Metrorail in other corridors. Its impacts in terms of reduced VMT, pollution emission, and gasoline consumption are substantial.

2. Extending the Shirley Highway HOV lanes is estimated to have a modest impact on new transit trips, but a large effect on ridesharing. This option affects many fewer commuters than Metrorail, but is estimated to have comparable VMT-related impacts, primarily because it will serve longer trips. This option is moderately expensive in total (even though transit-related costs are excluded), but is very cost-effective for ridesharers and also provides an attractive cost savings for both transit and pool vehicle riders.

3. Commuter rail is more cost-effective than in the 50-66-29 corridor, and is mid-way between Metrorail and the Shirley HOV extension in the I-95 corridor. However, due to the high fares, it may actually cost the average commuter more than driving alone.

In summary, of the options previously studied, the HOV facility options provide more positive impacts at a greater cost-effectiveness than do the transit options. However, both types of strategies are extremely capital cost intensive and tend to have impacts that extend far beyond their effect on peak period commuting. Therefore, comparisons of these alternatives must be made with extreme care.

Impact Assessment For New Alternatives

The "new" alternatives are generally less capital-intensive actions, which also have less of a modal shift impact than those options discussed above. However, the relative cost-effectiveness of these "new" options is high, and some of them have little or no capital costs. The comparability of the "new" options with each other is enhanced by the fact that they have all been analyzed in a consistent fashion, for 1980 conditions. Tables 1.59-1.61 describe these strategies, with a discussion for each corridor presented below:

Route 7 (Table 1.59)

1. Extension of the I-66 HOV lanes outside the Beltway is not expected to be an important incentive to ridesharing or transit use, over and above the incentive to be provided by the I-66 HOV lanes inside the Beltway. Under current traffic conditions, not enough time would be saved to significantly benefit pool vehicles. The estimated modest increase in transit trips comes from the increased attractiveness of park-and-ride

Table I.58
SUMMARY OF IMPACT ASSESSMENT OF PREVIOUSLY STUDIED ALTERNATIVES
I-95 CORRIDOR

Estimated Impacts (5)	Alternatives		
	Metrorail (2)	Commuter Rail (3,9)	Extend I-95 HOV Lanes (4, 7)
Annual Transit Ridership	7,972,500	800,000	225,000
Annual Ridesharing Usage	—	—	2,845,000
Peak Hour Transit Ridership (1)	5,740	580	160
Peak Hour Ridesharing Usage (1)	—	—	2,050
Total Annual Travel Time Saved (hours)	688,300	133,300	307,000
Capital Cost ($ millions)	$ 530.3	$ 22.3	$ 77.2 (8)
Annual Operating Cost ($000)	$ 13,700	$ 2,460	$ 240 (8)
Net Total Annualized Cost ($000)	$ 63,500	$ 2,960	$ 8,440 (8)
Capital Cost Per Annual Transit Rider	$ 67	$ 28	$ 343
Capital Cost per Annual Ridesharing User	—	—	$ 27
Annual Operating Cost per Annual Transit Rider	$ 1.72	$ 3.08	$ 1.07
Annual Operating Cost per Annual Ridesharing User	—		$ 0.08
Net Total Annualized Cost per Annual Transit Rider	$ 7.96	$ 3.70	$ 38
Net Total Annualized Cost per Annual Ridesharing User	—	—	$ 2.97
Change in Annual VMT (000)	-21,430	-5,430	-18,796
Change in Annual Gasoline Usage (000 gallons)	-1,307	-331	-1,146
Change in Annual Emissions (tons)			
HC	-118	-30	-104
CO	-1,038	-263	-911
NO_x	-94	-24	-83
Change in Peak Hour Vehicles (1)	-1,380	-350	-1,210
Change in Average Daily User Cost (6)			
Drive Alone to Transit	$ -1.36	$ +0.53	$ -2.03
Drive Alone to Ridesharing	—		$ -2.94
Land Acquisition/Dislocation	moderate	minimal	moderate

Notes to Tables 1.58:

(1) Peak one hour, peak direction flow.

(2) Relates only to J/H Route (Blue and Yellow Lines) section from National Airport to Huntington and Franconia. Ridership and basic costs pertain to a forecast year of 1990, although all costs are expressed in 1982 dollars.

(3) Transit ridership and basic costs pertain to a forecast year of 1982 and all costs are expressed in 1982 dollars.

(4) Transit and ridesharing usage and basic costs pertain to a point in time when this improvement could be expected to be completed, assumed to be approximately 1987. Costs are expressed in 1981 dollars.

(5) Work trips only (except that the data for some of the previously identified alternatives may include some impacts related to non-work trips as well). Impacts are based on the estimated <u>change</u> in transit or ridesharing usage estimated to result from each alternative.

(6) Change in the daily commuting cost for the average trip to and from work for each commuter making the shift from driving alone to transit and/or ridesharing.

(7) Includes 4+ person pools only.

(8) Includes only highway operating, maintenance, and capital costs; excludes bus operating and capital costs.

(9) All cost and ridership figures have been apportioned to two corridors for this option based on the location of the facility (if appropriate) or the relative effect on modal volumes by corridor. The values for each corridor sharing this option must be added to determine the total value.

Table 1.59
SUMMARY OF 1980 IMPACT ASSESSMENT OF NEW ALTERNATIVES
ROUTE 7 CORRIDOR

	Alternatives			
Estimated Impacts (5)	I-66 HOV Lane Extension (2,7,8)	Expanded Commuter Bus (8)	Improved Carpool Program (8)	Vanpool Assistance Program (8)
Annual Transit Ridership	102,500	121,300	—	—
Annual Ridesharing Usage	—	—	172,500	115,000
Peak Hour Transit Ridership (1)	80	90	—	—
Peak Hour Ridesharing Usage (1)	—	—	120	80
Percent Transit Share (3)	.006	.007	—	—
Percent Ridesharing Share (3)	—	—	.011	.007
Total Annual Travel Time Saved (hours)	6,400	0	0	0
Capital Cost ($ millions)	$ 16.4 (4)	$ 0.3	$ 0	$ 0
Annual Operating Cost ($000)	$ 57 (4)	$ 75	$ 57	$ 51
Net Total Annualized Cost ($000)	$ 1,957 (4)	$ 71	$ 57	$ 51
Capital Cost Per Annual Transit Rider	160	$ 2	—	—
Capital Cost per Annual Ridesharing User	—	—	$ 0	$ 0
Annual Operating Cost per Annual Transit Rider	$ 0.56	$ 0.62	—	—
Annual Operating Cost per Annual Ridesharing User	—	—	$ 0.33	$ 0.44
Net Total Annualized Cost per Annual Transit Rider	$ 19.09	$ 0.59	—	—
Net Total Annualized Cost per Annual Ridesharing User	—	—	$ 0.33	$ 0.44
Change in Annual VMT (000)	-317	-2,426	-796	-1,000
Change in Annual Gasoline Usage (000 gallons)	-19	-148	-49	-61
Change in Annual Emissions (tons)				
HC	-2	-13	-4	-6
CO	-15	-118	-39	-48
NO_x	-1	-11	-4	-4
Change in Peak Hour Vehicles (1)	-20	-60	-40	-50
Change in Average Daily User Cost (6)				
Drive Alone to Transit	$ -1.38	$ -2.03	—	—
Drive Alone to Ridesharing	—	—	$ -2.50	$ -2.90
Land Acquisition/Dislocation	minimal	none	none	none

Notes to Tables 1.59:

(1) Peak one hour, peak direction flow.

(2) Includes only incremental impacts for the extension of the I-66 HOV lanes beyond the Beltway.

(3) This modal share represents incremental daily modal trips divided by central area and suburban corridor person trips. It is expressed as a proportion (i.e., .159=15.9%).

(4) Includes only highway operating, maintenance, and capital costs; excludes bus operating and capital costs.

(5) Work trips only. Impacts are based on the estimated change in transit or ridesharing usage estimated to result from each alternative. Transit ridership, ridesharing usage, and basic costs pertain to a forecast year of 1980, although all costs are expressed in 1982 dollars.

(6) Change in the daily commuting cost for the average trip to and from work for each commuter making the shift from driving alone to transit and/or ridesharing.

(7) Includes 4+ person pools only.

(8) All cost and ridership figures have been apportioned to two or more corridors for this option based on the location of the facility (if appropriate) or the relative effect on modal volumes by corridor. The values for each corridor sharing this option must be added to determine the total value.

service for those living in western Fairfax County, near Centreville and Chantilly. The cost-effectiveness of this option is very low, especially in light of its capital cost. This option only becomes worthy of future consideration if the Metrorail K Route is not extended to Vienna, both because of duplication of line-haul service and physical incompatibility in the I-66 median.

2. The alternative of expanding commuter bus service is fairly attractive. It has a low capital cost and good cost-effectivenss and user cost savings. However, the absolute change in modal usage is also fairly modest.

3. Both ridesharing assistance programs (carpool and vanpool) are extremely cost-effective. Their modest impact on modal usage is compensated for by their low administrative cost, lack of any capital cost, and high user cost savings. However, neither ridesharing nor commuter bus options are expected to result in any net time savings for commuters. The impacts of these programs relate to this corridor's share of the impacts of a regional ridesharing effort.

<u>50-66-29 (Table I.60)</u>

1. Extending the I-66 HOV lanes exhibits much more favorable impacts and cost-effectiveness than for the Rt. 7 corridor, but it still suffers from low cost-effectiveness and only modest user cost savings. If the cost of operating transit service were to be included, the viability of this strategy would be further reduced.

2. Expanded commuter bus service exhibits fairly good cost and impact characteristics. The total impact is twice that in the Rt. 7 corridor, although the relative cost-effectiveness is not as good. However, this option is still far more cost-effective than any of the capital-intensive options.

3. The ridesharing assistance options continue to be the most cost-effective actions. The effects on modal share and impacts are much greater than in the Rt. 7 corridor, but are still modest compared to other options in the 50-66-29 corridor. In this corridor, the vanpool option improves to the point of being essentially equivalent to the carpool option. The greater impact of ridesharing in this corridor is due to longer trip lengths and a larger existing ridesharing base.

<u>I-95 (Table I.61)</u>

1. Allowing 3+ person pools on the Shirley Highway HOV lanes has a modest impact, but its minimal cost makes it very cost-effective. In this case it may, in fact, be too successful. Near the Pentagon, the HOV lanes currently operate at level of service C during the AM peak hour, and reach level of service D during the most congested part of the

Table 1.60
SUMMARY OF 1980 IMPACT ASSESSMENT OF NEW ALTERNATIVES
50-66-29 CORRIDOR

Estimated Impacts (5)	Alternatives: I-66 HOV Lane Extension (2,7,8)	Expanded Commuter Bus (8)	Improved Carpool Program (8)	Vanpool Assistance Program (8)
Annual Transit Ridership	422,500	243,800	—	—
Annual Ridesharing Usage	—	—	265,000	235,000
Peak Hour Transit Ridership (1)	300	170	—	—
Peak Hour Ridesharing Usage (1)	—	—	190	170
Percent Transit Share (3)	.020	.012	—	—
Percent Ridesharing Share (3)	—	—	.013	.011
Total Annual Travel Time Saved (hours)	26,100	0	0	0
Capital Cost ($ millions)	$ 23.6 (4)	$ 0.8	$ 0	$ 0
Annual Operating Cost ($000)	$ 84 (4)	$ 300	$ 87	$ 78
Net Total Annualized Cost ($000)	$ 2,883 (4)	$ 210	$ 87	$ 78
Capital Cost Per Annual Transit Rider	$ 56	$ 3	—	—
Capital Cost per Annual Ridesharing User	—		$ 0	$ 0
Annual Operating Cost per Annual Transit Rider	$ 0.20	$ 1.23	—	—
Annual Operating Cost per Annual Ridesharing User	—	—	$ 0.33	$ 0.33
Net Total Annualized Cost per Annual Transit Rider	$ 6.82	$ 0.86	—	—
Net Total Annualized Cost per Annual Ridesharing User	—	—	$ 0.33	$ 0.33
Change in Annual VMT (000)	-1,409	-4,719	-1,317	-2,202
Change in Annual Gasoline Usage (000 gallons)	-86	-288	-80	-134
Change in Annual Emissions (tons)				
HC	-8	-26	-7	-12
CO	-68	-229	-64	-107
NO_x	-6	-21	-6	-10
Change in Peak Hour Vehicles (1)	-70	-110	-70	-110
Change in Average Daily User Cost (6)				
Drive Alone to Transit	$ -1.39	$ -2.03	—	—
Drive Alone to Ridesharing	—	—	$ -2.63	$ -3.00
Land Acquisition/Dislocation	minimal	none	none	none

Notes to Table 1.60:

(1) Peak one hour, peak direction flow.

(2) Includes only incremental impacts for the extension of the I-66 HOV lanes beyond the Beltway.

(3) This modal share represents incremental daily modal trips divided by central area and suburban corridor person trips. It is expressed as a proportion (i.e., .159=15.9%).

(4) Includes only highway operating, maintenance, and capital costs; excludes bus operating and capital costs.

(5) Work trips only. Impacts are based on the estimated change in transit or ridesharing usage estimated to result from each alternative. Transit ridership, ridesharing usage, and basic costs pertain to a forecast year of 1980, although all costs are expressed in 1982 dollars.

(6) Change in the daily commuting cost for the average trip to and from work for each commuter making the shift from driving alone to transit and/or ridesharing.

(7) Includes 4+ person pools only.

(8) All cost and ridership figures have been apportioned to two or more corridors for this option based on the location of the facility (if appropriate) or the relative effect on modal volumes by corridor. The values for each corridor sharing this option must be added to determine the total value.

Table I.61
SUMMARY OF 1980 IMPACT ASSESSMENT OF NEW ALTERNATIVES
I-95 CORRIDOR

Estimated Impacts (2)	Alternatives: 3 + HOVs	Expanded Commuter Bus (5)	Improved Carpool Program (5)	Vanpool Assistance Program (5)
Annual Transit Ridership	—	33,800	—	—
Annual Ridesharing Usage	145,000	—	595,000	352,500
Peak Hour Transit Ridership (1)	—	30	—	—
Peak Hour Ridesharing Usage (1)	100	—	430	250
Percent Transit Share (4)	—	.001	—	—
Percent Ridesharing Share (4)	.003	—	.013	.008
Total Annual Travel Time Saved (hours)	14,500	0	0	0
Capital Cost ($ millions)	$ .001	$ 3.5	$ 0	$ 0
Annual Operating Cost ($000)	$ 0	$ 1,125	$ 191	$ 171
Net Total Annualized Cost ($000)	$ 0.3	$ 881	$ 191	$ 171
Capital Cost Per Annual Transit Rider	—	$ 104	—	—
Capital Cost per Annual Ridesharing User	$ 0.01	—	$ 0	$ 0
Annual Operating Cost per Annual Transit Rider	—	$ 33	—	—
Annual Operating Cost per Annual Ridesharing User	$ 0	—	$ 0.32	$ 0.49
Net Total Annualized Cost per Annual Transit Rider	—	$ 26	—	—
Net Total Annualized Cost per Annual Ridesharing User	$ .002	—	$ 0.32	$ 0.49
Change in Annual VMT (000)	-191	-698	-2,404	-2,686
Change in Annual Gasoline Usage (000 gallons)	-12	-43	-147	-164
Change in Annual Emissions (tons)				
HC	-1	-4	-13	-15
CO	-9	-34	-117	-130
NO_x	-1	-3	-11	-12
Change in Peak Hour Vehicles (1)	-20	-20	-150	-170
Change in Average Daily User Cost (3)				
Drive Alone to Transit	—	$ 2.03	—	—
Drive Alone to Ridesharing	-2.76	—	$ 2.27	$ -2.65
Land Acquisition/Dislocation	none	none	none	none

Notes to Table 1.61:

(1) Peak one hour, peak direction flow.

(2) Work trips only. Impacts are based on the estimated <u>change</u> in transit or ridesharing usage estimated to result from each alternative. Transit ridership, ridesharing usage, and basic costs pertain to a forecast year of 1980, although all costs are expressed in 1982 dollars.

(3) Change in the daily commuting cost for the average trip to and from work for each commuter making the shift from driving alone to transit and/or ridesharing.

(4) This modal share represents incremental daily modal trips divided by central area and suburban corridor person trips. It is expressed as a proportion (i.e., .159=15.9%).

(5) All cost and ridership figures have been apportioned to two or more corridors for this option based on the location of the facility (if appropriate) or the relative effect on modal volumes by corridor. The values for each corridor sharing this option must be added to determine the total value.

peak hour. If as many as 20% of the present 4-person pools were to break down into 3-person pools, the additional traffic would push the HOV lanes into level of service D, which begins to diminish the priority treatment that the HOV lanes are supposed to provide. This situation greatly diminishes the attractiveness of this option.

2. Expanding commuter bus service yields the striking result of having minimal effect on mode shift and impacts, and poor cost-effectiveness. This is because commuter bus service is already very good in this corridor, at least in terms of coverage and frequency. The levels of increased service studied under this option would require a fairly large number of buses and would still not make a significant change in the commuter bus mode share.

3. The ridesharing options have a very sizeable total modal usage and impact in this corridor, approaching that of the capital-intensive options. The cost-effectiveness results are comparable to those for Rt. 7, in that a carpool program is more cost-effective than a vanpool program.

Of the "new" alternatives, the ridesharing assistance programs result in the most favorable impacts and cost-effectiveness, followed by expanded commuter bus service (except in the I-95 corridor). These options are the most cost-effective of all those studied in all corridors. The favorable cost-effectiveness of the 3+ HOV on I-95 option is overshadowed by the excessive congestion that would be created near the Pentagon during the peak hour.

Impact Assessment For Future Conditions

An impact assessment was also performed for estimated year 2000 conditions, to determine if the forecasted growth in travel and the resulting change in travel patterns have any effect on the results described in the preceding section. A quantitative future analysis could only be performed for the "new" alternatives (see Tables 1.62-1.64), but a qualitative assessment is also made for the previously studied options. For the "new" options, different gasoline consumption and emissions rates were used, reflecting the advanced state of engine technology assumed to exist in 2000. Also, the 2000 figure represents the incremental change in mode usage over the base 2000 (null alternative) estimate.

Route 7 (Table 1.62)

Ridesharing has a moderate increase in mode shift and cost-effectiveness relative to 1980. Commuter bus improves by a smaller amount, while extending the I-66 HOV lanes actually has a lower total impact than in 1980, due to changing travel patterns. The previously studied options are all expected to have slightly higher modal volumes in 2000, but little or no improvement in cost-effectiveness.

Table 1.62
SUMMARY OF 2000 IMPACT ASSESSMENT OF NEW ALTERNATIVES
ROUTE 7 CORRIDOR

Estimated Impacts (5)	Alternatives: I-66 HOV Lane Extension (2,7,8)	Alternatives: Expanded Commuter Bus (8)	Alternatives: Improved Carpool Program (8)	Alternatives: Vanpool Assistance Program (8)
Annual Transit Ridership	97,500	160,000	—	—
Annual Ridesharing Usage	—	00	287,500	202,500
Peak Hour Transit Ridership (1)	70	120	—	—
Peak Hour Ridesharing Usage (1)	—	—	200	150
Percent Transit Share (3)	.004	.006	—	—
Percent Ridesharing Share (3)	—	—	.011	.008
Total Annual Travel Time Saved (hours)	6,000	0	0	0
Capital Cost ($ millions)	$ 16.4 (4)	$ 0.3	$ 0	$ 0
Annual Operating Cost ($000)	$ 57 (4)	$ 75	$ 57	$ 51
Net Total Annualized Cost ($000)	$ 1,957 (4)	$ 71	$ 57	$ 51
Capital Cost Per Annual Transit Rider	$ 168	$ 2	—	—
Capital Cost per Annual Ridesharing User	—	—	$ 0	$ 0
Annual Operating Cost per Annual Transit Rider	$ 0.59	$ 0.47	—	—
Annual Operating Cost per Annual Ridesharing User	—	—	$ 0.20	$ 0.25
Net Total Annualized Cost per Annual Transit Rider	$ 20.07	$ 0.44	—	—
Net Total Annualized Cost per Annual Ridesharing User	—		$ 0.20	$ 0.25
Change in Annual VMT (000)	-264	-3,200	-1,162	$ 1,543
Change in Annual Gasoline Usage (000 gallons)	-12	-142	-52	-69
Change in Annual Emissions (tons)				
HC	-0.4	-5	-2	-2
CO	-4	-53	-19	-25
NO_x	-1	-7	-2	-3
Change in Peak Hour Vehicles (1)	-15	-80	-70	-100
Change in Average Daily User Cost (6)				
Drive Alone to Transit	$ -1.36	$ -2.03	—	—
Drive Alone to Ridesharing	—	—	$ -2.27	$ -2.67
Land Acquisition/Dislocation	minimal	none	none	none

Notes to Table 1.62:

(1) Peak one hour, peak direction flow.

(2) Includes only incremental impacts for the extension of the I-66 HOV lanes beyond the Beltway.

(3) This modal share represents incremental daily modal trips divided by central area and suburban corridor person trips. It is expressed as a proportion (i.e., .159=15.9%).

(4) Includes only highway operating, maintenance, and capital costs; excludes bus operating and capital costs.

(5) Work trips only. Impacts are based on the estimated change in transit or ridesharing usage estimated to result from each alternative, compared to base 2000 conditions. Transit ridership and ridesharing usage pertain to a forecast year of 2000, although this assessment still uses costs expressed in 1982 dollars.

(6) Change in the daily commuting cost for the average trip to and from work for each commuter making the shift from driving alone to transit and/or ridesharing.

(7) Includes 4+ person pools only.

(8) All cost and ridership figures have been apportioned to two or more corridors for this option based on the location of the facility (if appropriate) or the relative effect on modal volumes by corridor. The values for each corridor sharing this option must be added to determine the total value.

50-66-29 (Table 1.63)

Ridesharing reflects a much better performance than in 1980. However, the extension of I-66 looks only slightly better, and the commuter bus option indicates a lower response than in 1980. The previously studied options are expected to have much higher modal volumes and slightly better cost-effectiveness in 2000.

I-95 (Table 1.64)

Commuter bus shows a small increase in travel over 1980, and the other options exhibit a larger, but still moderate improvement in modal volumes and cost-effectiveness. The previously studied options should improve slightly in performance.

All options still show positive impacts in 2000, but some alternatives exhibit a smaller net improvement than in 1980. This is due in large measure to the change in travel orientation described earlier. Since future trips are projected to be more "suburban-destined", those modes which are more flexible with respect to travel patterns should perform better than those which are primarily central area-oriented by nature.

Of all options, Metrorail and I-66 inside the Beltway will probably have the largest absolute gain in modal trips over the base case. Only expanded commuter bus and the extension of I-66 indicate little or no relative increase over base 1980 conditions. Most of the other alternatives experience similar relative increases in mode shares.

Summary

This assessment of impacts has allowed the comparison of alternative commuting actions in each corridor. This makes it possible to identify options which relate to one of the main objectives of this study, which is to improve travel to work by making available modal options which save time and money for commuters. From the above analysis, the following conclusions can be reached regarding the most appropriate commuting actions for each corridor:

Route 7 and 50-66-29. Improved ridesharing assistance is the most cost-effective action that can be taken in either of the corridors. This could be in the form of a major program for assistance in vanpool formation, possibly including carpool matching assistance as a secondary focus. The imminent opening of I-66 as a peak period HOV roadway will also be of tremendous significance in inducing shifts to HOV modes. Increased commuter bus service in outlying areas is also a very viable alternative, and will be

Table 1.63
SUMMARY OF 2000 IMPACT ASSESSMENT OF NEW ALTERNATIVES
50-66-29 CORRIDOR

Estimated Impacts (5)	Alternatives: I-66 HOV Lane Extension (2,7,8)	Expanded Commuter Bus (8)	Improved Carpool Program (8)	Vanpool Assistance Program (8)
Annual Transit Ridership	557,500	242,500	—	—
Annual Ridesharing Usage	—	—	567,500	560,000
Peak Hour Transit Ridership (1)	400	170	—	—
Peak Hour Ridesharing Usage (1)	—	—	410	400
Percent Transit Share (3)	.014	.006	—	—
Percent Ridesharing Share (3)	—	—	.014	.014
Total Annual Travel Time Saved (hours)	34,000	0	0	0
Capital Cost ($ millions)	$ 23.6 (4)	$ 0.8	$ 0	$ 0
Annual Operating Cost ($000)	$ 83 (4)	$ 300	$ 87	$ 78
Net Total Annualized Cost ($000)	$ 2,883 (4)	$ 210	$ 87	$ 78
Capital Cost Per Annual Transit Rider	$ 42	$ 3	—	—
Capital Cost per Annual Ridesharing User	—	—	$ 0	$ 0
Annual Operating Cost per Annual Transit Rider	$ 0.15	$ 1.24	—	—
Annual Operating Cost per Annual Ridesharing User	—	—	$ 0.15	$ 0.14
Net Total Annualized Cost per Annual Transit Rider	$ 5.17	$ 0.87	—	—
Net Total Annualized Cost per Annual Ridesharing User	—	—	$ 0.15	$ 0.14
Change in Annual VMT (000)	-1,619	-4,694	-2,455	-4,569
Change in Annual Gasoline Usage (000 gallons)	-72	-209	-109	-203
Change in Annual Emissions (tons)				
HC	-2	-7	-4	-7
CO	-27	-78	-41	-75
NO_x	-3	-10	-5	-10
Change in Peak Hour Vehicles (1)	-100	-110	-150	-270
Change in Average Daily User Cost (6)				
Drive Alone to Transit	$ -1.37	$ -2.03	—	—
Drive Alone to Ridesharing	—	—	$ -2.39	$ -2.77
Land Acquisition/Dislocation	minimal	none	none	none

Notes to Tables 1.63:

(1) Peak one hour, peak direction flow.

(2) Includes only incremental daily impacts for the extension of the I-66 HOV lanes beyond the Beltway.

(3) This modal share represents incremental modal trips divided by central area and suburban corridor person trips. It is expressed as a proportion (i.e., .159=15.9%).

(4) Includes only highway operating, maintenance, and capital costs; excludes bus operating and capital costs.

(5) Work trips only (except that the data for some of the previously identified alternatives may include some impacts related to non-work trips as well). Impacts are based on the estimated change in transit or ridesharing usage estimated to result from each alternative, compared to base 2000 conditions. Transit ridership and ridesharing usage pertain to a forecast year of 2000, although this assessment still uses costs expressed in 1982 dollars.

(6) Change in the daily commuting cost for the average trip to and from work for each commuter making the shift from driving alone to transit and/or ridesharing.

(7) Includes 4+ person pools only.

(8) All cost and ridership figures have been apportioned to two or more corridors for this option based on the location of the facility (if appropriate) or the relative effect on modal volumes by corridor. The values for each corridor sharing this option must be added to determine the total value.

Table 1.64
SUMMARY OF 2000 IMPACT ASSESSMENT OF NEW ALTERNATIVES
I-95 CORRIDOR

Estimated Impacts (2)	Alternatives			
	3 + HOVs	Expanded Commuter Bus (5)	Improved Carpool Program (5)	Vanpool Assistance Program (5)
Annual Transit Ridership	—	37,500	—	—
Annual Ridesharing Usage	207,500	—	835,000	510,000
Peak Hour Transit Ridership (1)	—	30	—	—
Peak Hour Ridesharing Usage (1)	150	—	600	370
Percent Transit Share (4)	—	.001	—	—
Percent Ridesharing Share (4)	.003	—	.014	.008
Total Annual Travel Time Saved (hours)	0	0	0	0
Capital Cost ($ millions)	$ .001	$ 3.50	$ 0	$ 0
Annual Operating Cost ($000)	$ 0	$ 1,125	$ 191	$ 171
Net Total Annualized Cost ($000)	$ 0.3	$ 881	$ 191	$ 171
Capital Cost Per Annual Transit Rider	—	$ 93	—	—
Capital Cost per Annual Ridesharing User	$ 0.01	—	$ 0	$ 0
Annual Operating Cost per Annual Transit Rider	—	$ 30	—	—
Annual Operating Cost per Annual Ridesharing User	$ 0	—	$ 0.23	$ 0.34
Net Total Annualized Cost per Annual Transit Rider	—	$ 23	—	—
Net Total Annualized Cost per Annual Ridesharing User	$ 0.001	—	$ 0.23	$ 0.34
Change in Annual VMT (000)	-273	-776	-3,374	-3,886
Change in Annual Gasoline Usage (000 gallons)	-12	-34	-150	-173
Change in Annual Emissions (tons)				
HC	-0.4	-1	-5	-6
CO	-5	-13	-56	-64
NO_x	-1	-2	-7	-8
Change in Peak Hour Vehicles (1)	-30	-20	-210	-250
Change in Average Daily User Cost (3)				
Drive Alone to Transit	—	$ 2.03	—	—
Drive Alone to Ridesharing	$ -2.77	—	$ -2.28	$ -2.66
Land Acquisition/Dislocation	none	none	none	none

Notes to Table 1.64:

(1) Peak one hour, peak direction flow.

(2) Work trips only. Impacts are based on the estimated change in transit or ridesharing usage estimated to result from each alternative, compared to base 2000 conditions. Transit ridership and ridesharing usage pertain to a forecast year of 2000, although this assessment still uses costs expressed in 1982 dollars.

(3) Change in the daily commuting cost for the average trip to and from work for each commuter making the shift from driving alone to transit and/or ridesharing.

(4) This modal share represents incremental daily modal trips divided by central area and suburban corridor person trips. It is expressed as a proportion (i.e., .159=15.9%).

(5) All cost and ridership figures have been apportioned to two or more corridors for this option based on the location of the facility (if appropriate) or the relative effect on modal volumes by corridor. The values for each corridor sharing this option must be added to determine the total value.

enhanced by the I-66 HOV facility. None of the rail options performed favorably in comparison with the ridesharing alternatives.

I-95. Improved ridesharing programs are also beneficial for this corridor, focusing on vanpools first, then carpools. Extending the Shirley Highway HOV lanes is also a worthwhile proposal and would produce significant benefits. As with the other corridors, ridesharing appears more viable than the rail options, both in terms of public cost and cost to the individual commuter.

At this point, the viability of Metrorail as a commuting option should be discussed. The remaining Metrorail segments in Northern Virginia were estimated to have a large impact on modal shifts and VMT-related impacts, but also exhibit a high net cost per trip. However, this result should not be interpreted to mean that the Metrorail system should not be completed in Northern Virginia. Among the benefits of Metrorail not counted in Tables 1.56-1.58 are service to a substantial non-work trip market, land development impacts, reductions in bus operating cost, improved regional accessibility, and improved operational efficiency for the rest of the Metrorail system. It is the conclusion of this study's analysts that the completion of Metrorail serves several of the Washington region's transportation goals and is therefore a viable option. However, in the context of benefitting commuters, especially long-distance commuters, the alternatives identified above should receive priority in implementation. The issue of implementation is addressed further in a later section.

SCENARIO ANALYSIS

The preceding sections presented analyses of commuter options under roughly today's conditions (1980) and under future (2000) conditions. In the latter case, transportation system characteristics were assumed to remain stable (i.e., not changed from 1980). Given the present uncertain technical, environmental, political, and financial situation in which urban transportation (especially in Northern Virginia) exists, it is necessary to perform another level of analysis which investigates the effects of possible, basic system changes under different scenarios of the future.

The method of this scenario analysis is to hypothesize alternative transportation futures based on recent and anticipated trends, translate these futures into potential changes in system characteristics, and estimate the effects of these changes on mode choice. The purpose is to determine how commuters will likely respond to such changes, and to ascertain how this, in turn, affects the viability of certain commuting actions such as those discussed in the previous section.

Three scenarios of the future have been defined elsewhere in this study. These scenarios relate changes in fuel cost and transportation funding to relative changes in travel time and cost by auto and transit. Based on commuter trip length distributions, three trip lengths have been chosen as representative of Northern Virginia commuting. These typical trips are 10, 25, and 50 miles in length, and for the sake of this analysis, are assumed to be destined to the central employment area.

Table 1.65 illustrates the general time and cost characteristics of these three trips. This information was derived from network data, transit schedules, and fare tables. A base gasoline cost of \$1.20 per gallon is used, which represents the 1980 average cost for all grades of gasoline and includes all taxes. These system characteristics represent inbound trips during the AM peak period.

The effects of the scenarios on these trip characteristics are described in Table 1.66. An important feature of this table is that although the change in fuel cost per <u>gallon</u> is constant for all trips, the effect on total fuel cost per <u>trip</u> obviously varies directly with trip length. All of the other parameters in this table reflect a constant percentage (for each scenario and variable) applied to the base data. For example, changes in transit fare under the "Constrained" scenario all reflect a 30% increase in fares over the existing condition. The percentage changes for each scenario are described in the Scenario report and Table 1.67. The system changes shown do not take into account institutional considerations. For example, there may be a vast difference in policy decisions and implementation of service and fare changes by WMATA (which would provide transit service for short trips) and by private bus operators (who would serve medium and long trips).

Table 1.65
REPRESENTATIVE TRIP CHARACTERISTICS[1/]

Characteristic	Characteristics for by Length of Trip		
	Short	Medium	Long
Typical Origin	Springfield	Dale City	Fredericksburg
Distance (miles)	10	25	50
Highway Run Time (min)	20	45	70
Gasoline Cost (cents/gallon)[2/]	120	120	120
Transit Run Time (min)[3/]	25	60	80
Transit Wait Time (min)[3/]	5	15	20
Transit Fare (cents)[3/]	190	230	300

1/ One-way trips destined to Washington central employment area.

2/ Average 1980 cost; includes all taxes.

3/ Express service.

Table 1.66
EFFECTS OF SCENARIOS ON CHARACTERISTICS OF REPRESENTATIVE TRIPS

Characteristics	Scenarios	Change in Characteristics by Length of Trip		
		Short	Medium	Long
Highway Run Time (min)	Constrained	+6	+14	+21
	Expected	+1	+2	+3.5
	Unconstrained	-1	-2	-3.5
Gasoline Cost (cents/gallon)	Constrained	+60	+60	+60
	Expected	+12	+12	+12
	Unconstrained	-24	-24	-24
Transit Run Time (min)	Constrained	+6	+15	+20
	Expected	+1	+3	+4
	Unconstrained	-1	-3	-4
Transit Wait Time (min)	Constrained	+1	+3	+4
	Expected	+0.5	+1.5	+2
	Unconstrained	-0.5	-1.5	-2
Transit Fare (cents)	Constrained	+57	+69	+90
	Expected	+48	+58	+75
	Unconstrained	+38	+46	+60

Table 1.67

SCENARIO DESCRIPTORS FOR SENSITIVITY ANALYSES[1/]

Descriptor	Scenario: Constrained	Scenario: Expected	Scenario: Unconstrained
Fuel Cost	+50%	+10%	-20%[2/]
Highway Service Levels	o 30% increase in peak-hour travel time.	o 5% increase in peak-hour travel time.	o 5% decrease in peak-hour travel time.
Transit Service Levels	o 20% increase in peak-hour headways.	o 10% increase in peak-hour headways.	o 10% decrease in peak-hour headways.
	o 20% decrease in speed.	o 5% decrease in speed.	o 5% increase in speed.
	o 30% increase in fares.	o 25% increase in fares.	o 20% increase in fares.

1/ Impacts above and beyond recently enacted 3% tax on wholesale price of gas in Virginia.

2/ Net effect of an increase in gas tax partially offsetting a larger decrease in non-tax gas cost.

The technique used to estimate the modal shifts resulting from the hypothesized system changes is called "incremental logit analysis". Given a known original mode share, the absolute change in the system variables, and coefficients describing the relative sensitivity of travellers to each variable, a new mode share can be estimated. The method is described in more detail in an Appendix to the Methodology report.

The results of the scenario analysis are shown in Table 1.68. In general, these figures imply that future time and cost changes under all three scenarios will result in lower transit shares and higher ridesharing shares than the present.

Short Trips

The "Expected" scenario shows a 28% drop in transit share over existing conditions, as well as a 15% increase in ridesharing share. There is little variation in the transit share among scenarios, with "Constrained" indicating a slightly higher share, and "Unconstrained" having the same share as "Existing". The significance of ridesharing increases under all scenarios, with the largest change in the "Constrained" scenario and the smallest in the "Unconstrained" scenario. Only in the "Constrained" case does the drive alone share decrease over the existing case, indicating that some transit users can, in fact, be induced to driving alone, if fares are high enough. Short trips, of course, have the smallest absolute change in service level, but the fare increase still outweighs the modest rise in fuel cost per trip.

Medium Trips

Medium-length trips exhibit similar modal shift characteristics as short trips, but to a slightly greater degree. The "Expected" case shows a 34% drop in transit share and a 20% increase in ridesharing share. The spread of both transit and ridesharing shares across scenarios is slightly greater than for short trips. Also as with short trips, the drive alone share increases over existing conditions for every scenario except "Constrained". The "Constrained" scenario has a greater impact on medium than short trips, which is reflected in the fact that in that case the drive alone share becomes smaller for medium trips than for short ones. This not only reflects the interaction between transit fare and fuel cost increases, but also that the absolute decline in transit service levels would become a more important factor for medium trips.

Long Trips

The representative long trip illustrates a different pattern of response to the scenarios than the other two trip lengths. The transit share actually increases slightly and the ridesharing share increases dramatically in the "Constrained" case. However, the mode shares vary considerably for the

Table 1.68
EFFECTS OF SCENARIOS ON MODAL SHARES

Scenarios	Mode	Modal Shares for Representative Trips to the Central Area		
		Short	Medium	Long
Existing Conditions[1/]	Transit	.309	.290	.116
	Ridesharing	.417	.393	.485
	Drive Alone	.274	.317	.399
Constrained	Transit	.233	.236	.121
	Ridesharing	.502	.521	.690
	Drive Alone	.265	.243	.189
Expected	Transit	.221	.190	.066
	Ridesharing	.478	.470	.562
	Drive Alone	.301	.340	.372
Unconstrained	Transit	.221	.181	.046
	Ridesharing	.453	.408	.419
	Drive Alone	.326	.411	.535

Note:

1/ Based on 1978 MWCOG Metrorail "Before and After" survey and 1980 VDH&T external station survey.

other two scenarios. The transit share drops by 43% over existing conditions in the "Expected" case and by 60% in the "Unconstrained" case. The drive-alone share is estimated to drop slightly in the "Expected" case, substantially (53%) in the "Constrained" case, but increase by 34% in the "Unconstrained" case. The long trip reflects the extreme case of high transit fares not being counteracted by improved service, and that a decline in fuel costs particularly induces long-distance commuters to drive alone.

Summary

The impact of the hypothesized future conditions on mode shares tends to be a reduction in transit share and a small-to-moderate gain in ridesharing. This results primarily from the interaction of fuel cost and transit fare, both of which tend to overshadow changes in travel time. This is because the scenario characteristic which increases travel time--roadway capacity and service level--tends to affect buses, pool vehicles, and single-occupant autos all more or less the same. On the other hand, changes in the cost variables affect each mode quite differently because of higher auto occupancies in the case of carpools and vanpools, and because of the expense of providing peak hour service in the case of transit.

These results have serious implications for the viability of commuting alternatives. Under the hypothetical situations analyzed, transit will attract a declining share of the commuting market, while ridesharing will generally increase in importance. In addition, the mode shares of medium and long trips are more sensitive than short trips to the variability of the two extreme scenarios. This indicates that extensive, high-capital transit options are expected to be less viable in the future for trips of 25 miles or more. Such options will still be feasible for shorter trips, due to the larger total volume of such trips and the lesser variability they exhibit with respect to extremes of system characteristics. Commuting options which encourage ridesharing, on the other hand, will be enhanced under all scenarios.

The scenario analysis has confirmed the logical view that transit options are and will likely continue to be more suitable for trip lengths of 25 miles or less, while ridesharing options will continue to be applicable for all types of trips, but particularly so for long-distance commuting.

IMPLEMENTATION

This section describes how the commuter travel options receiving a favorable assessment in the Impact Assessment section can be implemented. This includes discussions of combining options, priorities, supportive actions, responsibility, financing, and monitoring. This is not intended to be the final statement on these actions, but is a conceptual planning tool, to begin the process of implementing the activities.

Combining Options

As stated previously, the options being studied are not all independent alternatives. In fact, some clearly relate to others and there are certain groups of actions which tend to mutually reinforce each other, such that the whole net effect is greater than the sum of the parts. In this study, the major combinations of options involve ridesharing, commuter bus, and HOV facilities.

Carpool/Vanpool Assistance. Throughout this analysis, the improved carpool program and the vanpool assistance program have been treated as separate actions. Estimation of their costs and impacts assumed separate staffs and activities. Experience with similar programs suggests that a more acceptable plan is to have both functions carried out by the same staff. There are numerous elements common to both programs, such as matching and promotion. Also, experience in several Maryland counties, indicates that the efficiency (use of resources) and effectiveness (net results) of both carpool and vanpool assistance are enhanced by a combined effort. At the most basic level (simple matching and promotion, for example), carpool and vanpool assistance are basically the same thing. It is only where assistance is offered in van acquisition, driver licensing and insurance, etc., that vanpool assistance becomes substantially more involved and time-consuming. In this context, it is very likely that the estimated annual cost for the improved carpool program could also include a moderate level of vanpool assistance (perhaps at "Level 3.5").

Ridesharing Assistance/HOV Lanes. Ridesharing encouragement programs are most effective when there is a "hard" time savings that they can "sell." The existing Shirley Highway HOV lanes provide such savings, the benefits of which are obvious to some and less apparent to others. The imminent opening of the I-66 HOV roadway and the proposed extension of the Shirley HOV lanes should encourage more ridesharing from outside the Beltway, particularly in Prince William County, which is served by both I-66 and I-95. NVTC is already planning a major ridesharing promotional effort in conjunction with the opening of I-66 late in 1982.

Expanded Commuter Bus/HOV Lanes. One factor contributing to the relatively high level of commuter bus service in the I-95 corridor is the presence of the Shirley HOV lanes. Time savings for buses are significant enough to encourage inbound Metrobuses and private buses on U.S. 50 to travel seven extra miles around the Beltway in order to use the Shirley HOV lanes to downtown Washington. On this basis, it is apparent that the I-66 HOV facility is consistent with, and supportive of, the expansion of commuter bus service in the Rt. 7 and 50-66-29 corridors.

Priorities

Priorities are basically set according to greatest need or benefit, tempered by cost and political considerations. Large capital projects are often preceded by smaller, low-cost projects, especially if such projects are highly cost-effective. Politically, it is usually necessary to "spread" projects so that one corridor or area does not receive (or appear to receive) favorable treatment.

Table 1.69 lists the commuter actions proposed as a result of this study, in order of priority. Figure 1.17 also illustrates these actions in the general context of where certain commuting modes work best.

First Priority. A ridesharing assistance program should receive first priority, since it requires no major capital funding, has a short lead time, is very cost-effective, and affects all corridors. This option can be further broken down into areas of emphasis. In the closer-in areas (inside the Beltway), the emphasis should first be placed on employer-based ridesharing promotion. This relatively dense area contains the majority of the area's employment and peak hour congestion, so that attempts to induce pool formation at the employment end of the commuting trip are most likely to be successful. Outside the Beltway, and particularly in the outlying counties, the focus should initially be on ridesharing assistance at the residential end.

In a sense, this is already happening in Northern Virginia. The ridesharing programs of Alexandria, Tyson's Corner, Fairfax County, and NVTC all focus more (if not totally) on the employment end, while the Prince William program's emphasis is on commuting residents of that county.

Second Priority. The expansion of commuter bus service, combined with the opening of the I-66 HOV facility, can provide a quick enhancement of commuter service in the I-66 and Route 7 corridors. Service would be provided by private carriers with public involvement coming through the purchase of new or reconditioned buses and leasing them to operators. This is the basic premise of Project Move, currently being proposed jointly by Prince William County and VDH&T. The financial condition of most private commuter bus operators makes it difficult for them to purchase and operate buses at fares that commuters can afford. The bus companies react by operating vehicles well past their useful life, which reduces reliability and comfort, as Reston and Prince William County commuters can attest. If the public sector could provide buses with a minimum of "strings" attached, this could induce operators to provide service that would otherwise not be profitable. In the case of Prince William County, this type of program will probably be necessary just to ensure the continuation of existing commuter bus service in the county.

Third Priority. Next in priority are two projects to assist HOVs in the Rt. 7 corridor: the Dulles access road extension to I-66 and the Dulles toll road. Since HOVs are now allowed on the Dulles access road, the extension to I-66

Table 1.69
PRIORITIZATION OF COMMUTING ACTIONS

Priority	Action	Affected Corridor(s)	Approximate Year of Implementation
1/	I-66 inside Beltway	Rt. 7 and 50-66-29	late 1982
3/	Extend Metrorail to Huntington	I-95	late 1983
1	Ridesharing assistance programs	all	1982
2	Expanded commuter bus service	Rt. 7 and 50-66-29	1983
3	Dulles access road extension to I-66	Rt. 7	1983
4	Dulles toll road	Rt. 7	1985
5	Extend Shirley HOV lanes to Dale City	I-95	1988
6	Extend Metrorail K Route to Vienna	Rt. 7 and 50-66-29	1986 2/
7	Extend Metrorail J Route to Franconia-Springfield	I-95	1989 2/

Notes:

1/ Under construction, with opening to occur in late 1982.

2/ Estimated by WMATA as of May, 1982.

3/ Station and track work are essentially complete; opening of this line has been delayed until late 1983 or early 1984 due to reported delays in rail car construction.

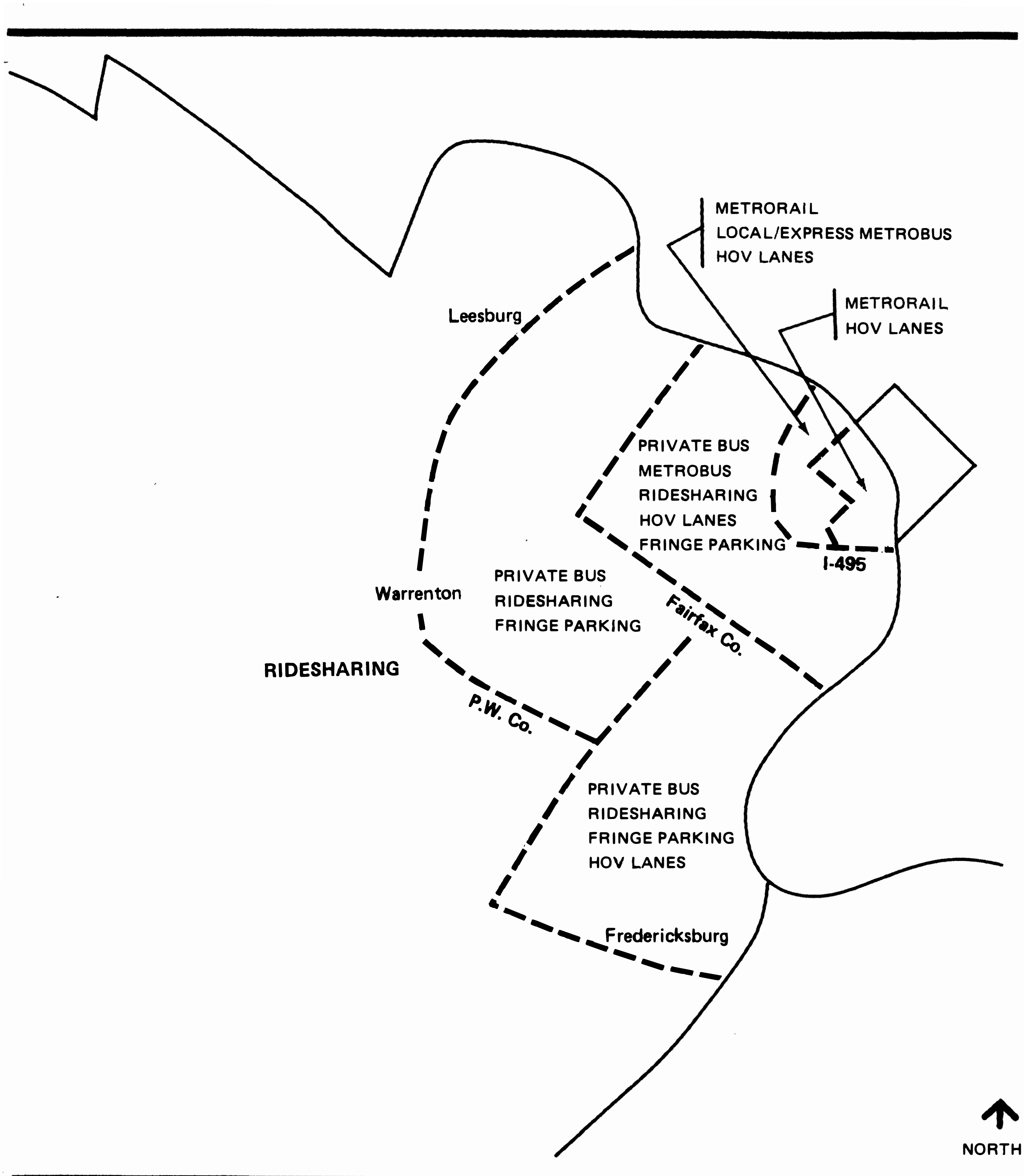

Figure 1.17
RECOMMENDED COMMUTER TRANSPORTATION SERVICE CONCEPTS

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is a logical and important means of continuing this priority treatment into the central area. If the FAA prohibits HOV use of the Dulles access road by 1985, as has been discussed, construction of the Dulles toll road should become a priority project. HOVs could then use the Dulles toll road and the Dulles access road extension to reach I-66.

Fourth Priority. This action involves the extension of the Shirley Highway HOV lanes to Dale City. By the late 1980's (which is the earliest this option could be implemented), severe congestion on I-95 will probably extend as far south as Occoquan. Given such conditions, the proposed extension of the HOV lanes to Rt. 642 will offer enough time savings to HOVs to be justifiable beyond question. This option will particularly benefit long-distance I-95 commuters.

Other Actions. The final proposed options are to complete the 101-mile Metrorail system in Northern Virginia; first, the K Route to Vienna and second, the J Route to Franconia-Springfield. The low priority of these lines stems as much from realistic construction schedules and funding as anything else. That is, there is probably very little that could be done to implement Metrorail much sooner than currently planned. However, it also reflects the modest impact of Metrorail on inducing work trip mode shifts relative to its costs. If Metrorail is to be moved up in priority, it must be for other reasons, in addition to benefitting commuters.

Supportive TSM Actions

In addition to the major modal options discussed throughout this report, a number of transportation system management (TSM) actions have been identified that are supportive of the major alternatives. These actions improve the efficiency (and therefore enhance the attractiveness to the commuter) of one or more modal options. The two principal TSM supportive actions identified as most beneficial to long-distance commuters in this study are fringe parking and traffic management.

Fringe Parking. Fringe parking facilities are a vital part of any transit or ridesharing option. In areas outside the Beltway, the auto is and always will be the predominant mode of arrival to transit. In the outlying counties, development densities are so low that commuters must meet at selected areas in order to form carpools. Fringe parking includes parking lots and structures at Metrorail stations, along express bus routes, and near major highway intersections in outlying areas. It includes park-ride and kiss-ride lots for transit and pool staging areas for carpool and vanpool formation. Shopping center and church parking lots, as well as road shoulders and vacant land near interchanges, may also function as fringe parking facilities.

The need for increased and improved commuter parking has been expressed in several previous studies, and numerous potential sites have been identified, as was noted in Figures I.7a and I.7b and shown in Table I.70. An important problem in fringe parking implementation is coordination with the private

Table 1.70
PREVIOUSLY PROPOSED FRINGE PARKING FACILITIES

Location	Number of Spaces	Use	Estimated Construction Cost	Comments
Columbia Pike	NA	Metrobus	$ 65,000	under construction in FY 81; cost estimated by Arlington County
Bailey's Crossroads	500	Metrobus	750,000	proposed by WMATA
Annandale	500	Metrobus	750,000	proposed by WMATA
East Falls Church	1,240	Metrorail	4,652,000	includes supplemental garage
Franconia	3,355	Metrorail	5,033,000	surface lot
Dunn Loring	1,000	Metrorail	1,500,000	surface lot
West Falls Church	3,153	Metrorail	10,730,000	includes supplemental garage
Vienna	3,445	Metrorail	9,068,000	includes supplemental garage
Huntington	2,565	Metrorail	3,848,000	includes supplemental surface parking
I-66 and Rt. 234	NA	commuter bus and ridesharing	--	--
U.S. 1 and Rt. 1330	345	commuter bus and ridesharing	518,000	--
Rt. 675 and Rt. 828	NA	Metrobus and ridesharing	--	--
U.S. 17 and I-95	800	commuter bus and ridesharing	1,200,000	ultimate capacity
Rt. 630 and I-95	400	commuter bus and ridesharing	600,000	ultimate capacity
Rt. 610 and I-95	600	commuter bus and ridesharing	900,000	ultimate capacity
Rt. 3 and I-95	600	commuter bus and ridesharing	900,000	ultimate capacity
U.S. 522/340 and I-66	125	ridesharing	188,000	expansion from 25 to 150 spaces
Rt. 79 and I-66	100	ridesharing	150,000	--
Front Royal	100	ridesharing	150,000	probably located near Rt. 55 and U.S. 522
Rt. 55 and U.S. 17	NA	ridesharing	--	
U.S. 211 and Rt. 229	NA	ridesharing		
Rt. 211 and U.S. 522	NA	ridesharing	--	

Notes:

NA = Not Available

1/ Estimated by Barton-Aschman except as noted.

sector: securing permission to use existing parking at service stations, shopping centers, churches, and other similar sites. Numerous spaces exist which are underutilized, and this is obviously the least costly means of providing commuter parking capacity. As an alternative, small gravel or paved lots can be constructed on public land, or other underutilized land near major commuting routes. Such facilities, properly located, designed, and identified, are an important factor in the encouragement of ridesharing, and are essential to commuter bus service.

There should be a formal program for fringe parking, consisting of two elements. The first is the construction of new facilities and the improved use of existing facilities for pool formation and transferring to express bus service. This would include those sites described in Figures 1.7a and 1.7b, and listed in Table 1.70. The second element is expansion of parking at existing and proposed Metrorail stations.

Virtually every analysis of Metrorail ridership has indicated that the demand for parking will exceed the planned supply. A 1977 WMATA analysis, for example, calculated that the estimated Metrorail parking demand from Fairfax County is about twice the planned supply. This particularly affects long-distance commuters, who have no other practical means of arriving at a Metrorail station, except by auto. MWCOG is currently performing a detailed analysis of access to Metrorail, which should more accurately determine the demand for parking at stations, as well as the impacts of not providing sufficient spaces.

Traffic Management. There are several aspects to traffic management. The first is a strategy of using sophisticated equipment to monitor freeway use, detect vehicle location, control access at on-ramps, and warn motorists of traffic conditions downstream. This type of equipment has already been proposed for installation on I-66 and on the Shirley Highway. These systems are worthy of implementation because they have the potential for improving traffic flow, and hence, reducing travel time for commuters. This will be particularly true in the future, when such systems will be the only available method of improving roadway capacity.

Another element of traffic management is enforcement. The value of HOV lanes is undermined if they are used by non-HOVs. State and local police will have to work with area traffic engineers to ensure that HOV facility violation rates do not become excessive. One particular example of this is the proposal to improve enforcement at Dulles Airport to reduce "backtracking" by Reston and Herndon commuters. The completion of the Dulles access road extension to I-66 will tempt the drivers of low-occupancy vehicles to try to use both facilities during the peak period.

The third aspect of traffic management is additional priority treatment for HOVs. In addition to reserved lanes, HOVs can also be provided with special freeway ramps, bypass of ramp metering, and other such techniques to avoid traffic bottlenecks. If the Dulles toll road is built, provision should be made for special treatment of HOVs at the toll facilities. HOVs could be assigned separate toll gates or lanes to reduce delay and/or be charged a lower toll, or could be allowed to bypass the toll facilities altogether. Future development in the Rt. 7 corridor will make continued HOV priority treatment viable, and possibly necessary. If HOVs are to be removed from the existing Dulles access road, they should be accommodated on the toll lanes.

Implementation Responsibility

One of the most important considerations in implementation is determining which agencies will participate, and how. Almost every agency having jurisdiction in Northern Virginia is currently pursuing actions to assist commuters. The challenge of this study is to recognize these existing institutional relationships and to tailor this study's program of commuting options to the capabilities and limitations of each participant.

A discussion of implementation roles for each type of action follows. Ridesharing. It is proposed that any new ridesharing assistance efforts be "decentralized," with staffing primarily at the county level, as opposed to a major MWCOG staff increase. The combined carpool/vanpool program would use staff in three counties, three Planning District Commissions, NVTC, and MWCOG as shown in Table I.71. Prince William and Loudoun Counties and the three PDCs would initially concentrate on ridesharing market analysis and promotion from the residential end, distributing information, and assisting in implementing fringe parking sites. Eventually, they would assist in vanpool formation (as Prince William County has already started), and possibly, provide ridesharing assistance to major employers. Fairfax County would first concentrate on major employment centers, such as Springfield, Fairfax City, Fort Belvoir, and Tyson's Corner (where it would work with Tyson's Transportation Associates). Its staff would actively promote ridesharing at employment sites, and would gradually become involved with residential-based ridesharing encouragement, as well. MWCOG would continue its emphasis on regional computerized matching and would have one person dedicated full-time to assisting the matching process in Northern Virginia. NVTC would play a smaller, but special role of performing special projects in conjunction with other jurisdictions (such as the I-66 promotional project). NVTC is also well suited as a sub-regional coordinating agency, because it is already multi-jurisdictional and it serves as the Northern Virginia clearinghouse for public transportation funding. The private sector will continue to have an important role in working with major private sector employers and in providing vanpool assistance.

Staffing levels are also identified in Table I.71. Full-time personnel must be well-qualified, highly capable, and strongly motivated, and hence may earn moderate-to-high salaries. Since these people are expected to "sell" ridesharing, their abilities are very important to the success of the program. Part-time staff should preferably be full-time, permanent employees who spend only half of their time working on ridesharing.

Table 1.71
STAFFING FOR RIDESHARING ASSISTANCE PROGRAM

Agency	Additional Staff Full-Time	Additional Staff Part-Time	Annual Staff Cost[1/]	Annual Total Cost[1/]
Fairfax County Office of Transportation	2	0	$60,000	$75,000
Prince William County Planning Department	1	1	47,000	57,000
Loudoun County Planning Department	1	0	30,000	35,000
RADCO Planning District Commission	1	0	30,000	35,000
Lord Fairfax Planning District Commission	0	1	15,000	17,000
Rappahannock-Rapidan Planning District Commission	0	1	15,000	17,000
Northern Virginia Transportation Commission	1	0	35,000	45,000
Metropolitan Washington Council of Governments	1	0	35,000	35,000

1/ In addition to currently programmed staff and costs.

HOV Facilities. Implementation of HOV lanes on freeways would be the responsibility of VDH&T. Planning for these facilities would be performed in conjunction with MWCOG, but design and construction would be solely a state function. Enforcement of HOV lane usage would be a joint effort of state and county police, as is the current practice. Traffic management techniques on freeways would be implemented by VDH&T. Fringe parking faciities would be implemented by WMATA (rail stations), local jurisdictions (express bus lots), and by VDH&T in the more distant areas, with planning support from the PDCs and outlying counties. The design, construction, and operation of the Dulles toll road would also be a function of VDH&T.

Commuter Bus Service. As mentioned above, expansion of commuter bus service into outlying areas would be a joint effort by the counties, the state, and private bus operators, much along the lines of Prince William County's Project Move. A county (with assistance from the state) would purchase new or reconditioned buses and lease them to private operators. The lease would contain provisions to allow the county to recoup its initial investment, provide some minimal administrative oversight, and ensure that the buses would be used as intended. No operating assistance would be involved. The bus operators would agree to maintain the buses, accept all liability for their use, and operate the buses in regular commuting service.

Metrorail and Local Bus. WMATA obviously is the implementing agency for Metrorail and Metrobus service, but NVTC also provides some administrative and fiscal oversight. However, there is an increasing question as to future responsibility for much of the bus service in Northern Virginia. Both Fairfax County and Alexandria are strongly considering starting their own bus systems, similar to that of the Ride-On system in Montgomery County, Maryland. This involves small-to-medium sized buses (generally fewer than 35 seats) operating local service from residential areas to major employment centers and Metrorail stations.

Increased feeder bus service is very important to the viability of Metrorail, due to limited parking (mentioned above) and the need to serve persons without access to an automobile. The primary rationale for a locally-operated system is that it can operate with lower unit costs than what the jurisdictions pay to WMATA for Metrobus service. This has resulted in cost savings in Montgomery County, even considering the fact that the system is financed totally by county funds. Other factors include increased local control over service and less perceived negative impacts, which results from the use of smaller buses. In any case WMATA is still likely to operate major line-haul routes and routes which cross jurisdictional boundaries.

Locally-run bus systems require a substantial commitment of staff time and local funds, as well as a potentially separate infrastructure for purchasing, maintenance, accounting, and other functions involved in operating transit service. On-going feasibility studies in Fairfax County and Alexandria should indicate whether or not this is a reasonable course of action in these jurisdictions.

Funding Sources

Funding for the commuting options identified above will come from a variety of sources. VDH&T, UMTA, FHWA, and local governments are expected to be the main contributors, with some participation by the private sector as well. The potential funding sources are described below.

Ridesharing. Current ridesharing programs in Northern Virginia are funded through a mix of sources: local, Highway Planning and Research (FHWA funding of VDH&T), VDH&T demonstration grants, and state energy conservation funds. Some of these funds are provided on a matching basis and the local match can range from "hard" funding to "soft" in-kind services and support.

The total estimated annual cost of the ridesharing program as described in Table 1.71 is $316,000. This would be in addition to the $45,000 in VDH&T funds presently provided to MWCOG for its Commuter Club activities. The additional funds should first be drawn from Paragraph 13(b) of the Financial Assistance for Mass Transit section of the appropriations bill recently passed by the General Assembly. This fund allows up to an 80% state share of the cost of continuing ridesharing programs. However, this fund has only $200,000 for FY 83 for the entire state, and, therefore, will not go very far in meeting Northern Virginia's needs. Additional funds can be made available through Paragraph 1, which is the allocation to NVTC for public transportation in Northern Virginia. This program provides up to 50% of the administrative costs of a ridesharing program. The total funding for this project is about $21 million per year, but this amount also includes funding for Metrorail and Metrobus capital costs and administrative costs.

Federal funds for ridesharing will still be available in the near future. Current proposals call for a reduction in the FY 83 FHWA budget, but increased flexibility in the use of these funds. The present federal share of ridesharing projects is 75%. State energy conservation funds will likely become less of a factor in the future. The VDH&T demonstration program of experimental projects is expected to focus more on totally new concepts and ideas rather than the re-application of previously tested service concepts.

HOV Facilities. Funds for HOV facilities, including traffic management equipment and operations on I-95 and I-66, would come mainly from the Interstate highway program, with some minor additional funding potentially available from UMTA Section 3 (discretionary capital assistance). Dulles toll road financing (capital and operating) would come from revenue bonds and tolls. VDH&T currently finances fringe parking lots in outlying areas from general highway funds, and this practice is expected to continue. Parking facilities for Metrorail would be funded as part of Metrorail capital costs, while express bus parking facilities would be funded by VDH&T and the local jurisdictions.

Commuter Bus. Prince William County and VDH&T are currently working on an agreement for a 95% state share of the purchase of 20 refurbished commuter buses (Project Move), involving $1.33 million in state funds. These funds would come from state transit appropriations not allocated to any specific area. However, this fund is very limited (about $1.6 million for FY 1983) and will not go very far in supporting additional projects of this type. The expanded commuter bus option in the Rt. 7 and 50-66-29 corridors would require 11 buses, estimated to cost $100,000 each. The other possible source of funds would be the public transportation appropriation to NVTC, mentioned above. However, the 50% local match requirement may prevent some jurisdictions from using these funds. The local share for this alternative would be funded by the affected counties, primarily Prince William, Loudoun, and Fauquier.

Federal funding may be available through Section 18 (for small urban and rural areas--proposed to be re-designated Section 21 in the new transportation bill) for 80% funding of capital equipment, but this has not been finalized by Congress.

Metrorail. The major Metrorail funding issue is whether or not the current 2% wholesale gasoline tax represents Virginia's required share of a "stable and reliable" funding source for operating assistance to transit in the Washington area. The federal government has made this a requirement for continued federal participation in Metrorail funding. These funds come from Section 3 and special Congressional appropriations for WMATA.

Section 5 formula assistance is available from UMTA for operating and capital assistance on a 50% matching basis. About $7.7 million is available in FY 82 for the Virginia portion of WMATA funding. State funds for transit are limited to capital and administrative costs and are passed through NVTC. About $21 million is available in the FY 83 state budget.

If any locally-operated bus systems are initiated, they will probably rely heavily on county funds, although the state transit funds mentioned above are a potential source of assistance.

Monitoring

The monitoring user and operating response is a critical aspect of implementing any transportation action. Feedback on what actually happens, as compared to what was predicted, is necessary to adjust the analysis methodology and to evaluate program effectiveness. Northern Virginia currently has a considerable amount of activity in monitoring travel patterns. Several of these existing monitoring programs are listed below, along with suggestions for expanding these programs to incorporate some of the concerns raised in this study:

1. Metrorail "Before and After" Program--MWCOG. This program includes detailed surveys of travellers in areas affected by Metrorail implementation to determine how the system changes regional travel habits. It is suggested that these surveys be used to identify more accurately characteristics of park-ride and kiss-ride rail trips, particularly on the basis of trip length.

2. Annual Metrobus and Metrorail Surveys-WMATA. These surveys are used to help determine the allocation of revenues and costs among local jurisdictions. Specific attention should be paid to trips originating outside the SMSA, especially after the opening of Metrorail service to Huntington station in Fairfax County.

3. Annual Beltway Cordon Count and Metro Core Cordon Count-MWCOG. This activity consists of detailed counts taken annually of auto, bus, and taxi vehicle and passenger volumes for 13 hours taken at major cordon locations around the Beltway and the central area. More effort should be applied to classifying counts of private buses and vans, and checking their occupancy. Consideration should also be given to establishing count locations just outside the Beltway so that the distributive effect of the Beltway can be estimated.

4. External Station Cordon Count-VDH&T. This was a roadside interview performed at the outer boundaries of Prince William and Loudoun Counties in 1980. It is suggested that this become a regular survey, performed every 3-5 years, and that it include transit vehicles and passengers. More consideration should also be given to detailed geocoding of trip origins.

5. Statewide Traffic Counts-VDH&T. These are annual ADT classification counts on major roads throughout the state. It would be helpful to include a breakdown of passenger cars by occupancy.

6. NVTC Ridesharing Program. NVTC's two projects to encourage ridesharing in connection with I-66 and at major employment sites will include a significant follow-up effort, using surveys and counts to evaluate project effectiveness. It will be particularly interesting to see how the results of that effort relate to data used in the modal summary tables of this project.

7. Various Reports of Transportation Providers. Both UMTA and VDH&T collect and publish annual operating and financial statistics from WMATA, which provide a useful base for performing trend studies. VDH&T also surveys ridesharing programs statewide and publishes their characteristics. These are very helpful in assessing the relative performance of transportation services. It is suggested that a similar, although more limited, effort be performed for private bus operators, perhaps using data already reported to other agencies.

8. Ridesharing Follow-up. MWCOG does some surveying of its Commuter Club subscribers as to pool formation and satisfaction with the program. This should be expanded to a regular event, and other ridesharing programs should also include efforts to survey their users. Similar surveys could also be performed at fringe parking lots. Private sector programs, such as VVPA, should also be contacted regarding user surveys.

CONCLUSIONS

The purpose of the Northern Virginia case study was to develop conclusions regarding the usefulness of the methodology described in the Methodology Report for analyzing commuter options and to identify the most appropriate options to be pursued in this area.

Methodology

The application of the methodology was considered successful in that it proved to be a stern test of the technique, but yielded reasonable results. Specific observations from this case study regarding the methodology are as follows:

1. It is generally worth the effort to develop a sound base of observed data on modal usage and characteristics of commuters and the transportation system. Also, this information must be compatible with the analysis areas and level of detail under consideration.

2. In this case study, much of the information in the modal summary tables was of limited use. The most significant (and very valuable) data were the factors in the Ridesharing Assistance Section.

3. The corridor sketch planning program was very useful in this case study, allowing the quick and inexpensive testing of a variety of system changes and providing for the estimation of future trips. In general, its accuracy was quite reasonable, although it tended to underestimate transit use in poor service areas, and overestimate it in good service areas. Ridesharing was slightly overestimated in all corridors. Among the main criticisms of the program are its lack of sensitivity to incremental highway congestion and its tendency to overestimate transit impact and underestimate ridesharing impact of HOV facilities. The inability of the program to analyze more than one fixed guideway facility in a corridor at one time is not viewed as a major limitation, particularly since there are probably only two corridors in the state in which this is likely to be an issue.

4. Future analyses of commuting options should avoid attempting to "mix" newly analyzed actions with the results of previous studies. This process added inconsistency to the comparison of alternatives in this study. The preferred technique would be to re-analyze "old" alternatives in the same travel and cost context as the "new" ones. Results performed for different years, at different levels of detail, and using different analysis techniques, cannot readily be made consistent with each other, especially if documentation of the earlier studies is limited.

5. This case study demonstrated the problem of assessing options which are only part of a system, or which serve only work trips, in comparison with options which may stand alone or which may serve a very broad trip market. Considerable attention must be given to avoiding the "apples vs. oranges" types of evaluation.

Commuting Actions

This case study identified several commuting actions which hold promise for addressing the problems of Northern Virginia's commuters, especially long-distance commuters:

1. A major increase in the area's programs to encourage, assist, and promote ridesharing is warranted. This is a fairly low-cost action which is highly cost-effective, especially in conjunction with other supportive actions. The programs must be operated primarily at the local (county) level, with coordination and technical assistance provided at the regional and state levels. Employer-based programs are likely to produce the best results.

2. The present proposals for HOV priority treatment on ramps and freeway should be vigorously pursued. Special traffic management systems are necessary to develop the full beneficial effect of such facilities. HOV lanes are a relatively costly action, but they do have a significant impact on mode shifts to ridesharing and transit.

3. A major supportive action of the above two options is the expansion of fringe parking capacity. Park-Ride lots provide flexibility in the formation of pools and access to line-haul transit.

4. Maintenance of existing transit services is a valuable goal. A limited public effort will probably have to be made to keep some private transit service in operation. A substantial financial effort is required just to keep the present WMATA bus and rail system going.

5. Commuter bus service can be expanded into outlying areas if public support is available for private operators. The cost of public subsidy must be balanced against the flexibility that bus sevice offers the commuter.

SUMMARY

The principal conclusion derived from the case study analyses is that, regardless of urban area size or characteristics, ridesharing modes (carpooling, vanpooling, and buspooling) offer virtually the only feasible modal alternatives to the single-occupant (i.e., drive alone) auto for long-distance commuters. This conclusion applies generally to work trips of more than 5 miles in length for most medium-sized urban areas and all small urban areas, and to work trips of more than 10 miles for large urban areas. Exceptions to this conclusion are limited to major commuting corridors in Northern Virginia, where the extent of suburban development and the volume of commuter traffic generated by Washington area employment are sufficient to warrant transit service (primarily, bus) for trips longer than 10 miles.

The high costs of transit service (bus or rail), coupled with the modest volumes of long-distance commuters in most corridors, render transit infeasible or a poor public investment for serving this portion of the total commuting market. In corridors where long-distance commuting volumes approach transit service warrants, the most cost-effective approach to a financially marginal proposition is to seek private sector provision of the service, or to bolster private operators who may already be running bus service in the corridors. Public transportation plays an essential role in meeting the demands of shorter commuting trips, primarily within medium-sized and large urban areas. The Northern Virginia case study has underscored this fact through its assessment of Metrorail's positive impact on commuting conditions in that area.

Fortunately for the commuters and taxpayers of Virginia, the most feasible modal alternatives (ridesharing) for long-distance commuting are also the most cost-effective in terms of low user costs and very low public investments required. More efficient use is made of the vast existing fleet of private vehicles, while public costs for expensive new buses and trains is minimized.

However, a major question associated with ridesharing in the future is whether further substantial shifts to that mode can be attained, unless drastic increases in commuting costs and congestion force commuters in that direction. Under the expected future of fairly stable gasoline prices and a continuing federal role at least in capital funding for highways and transit, there may be insufficient incentive for significant growth in ridesharing, even under an aggressive program of public encouragement. Estimated results of attractive ridesharing programs in the case study areas range from a maximum shift to ridesharing of 12% in Martinsville to a maximum shift of 6% in Northern Virginia.

Although small as a percentage of total commuting, these modal shifts are not insignificant in their impacts in reducing vehicle-miles of travel, pollution emissions, and gasoline consumption, because they are drawing strongly from the longer work trips. Moreover, they are additions to an already strong base of ridesharing. For example, about 30% of all workers in the Martinsville area are already ridesharing.

In Northern Virginia the projected growth of suburban employment at a rate several times faster than that of the Washington central area will bring about major changes in commuter travel patterns in that area. One immediate implication is that scattered suburban employment sites will be difficult to serve with conventional transit, and local congestion around these sites is likely to grow. Ridesharing programs focused upon major employers may be a critical element in future transportation planning for such areas.

In summary, while the absolute shift in modal share of commuter travel to ridesharing may be modest even under an active promotional program, the state should pursue a strong ridesharing program because (1) it is very cost-effective as a mode of travel in terms of public costs per ridesharer served or vehicle removed from the road, (2) the beneficial, incremental impacts are important, and on top of an already significant ridesharing base, replacement of major factor in holding down congestion, pollution emissions, and energy consumption, and (3) it is the only feasible modal alternative for most long-distance commuters.

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APPENDIX

NORTHERN VIRGINIA CASE STUDY

Table IA.1
INITIAL APPLICATION AND VALIDATION OF MODAL SUMMARY TABLES

CARPOOL - Large Urban Area

to Central Area, use High Share: .208
(high parking costs and
Federal ridesharing encouragement)
to Suburbs, use Normal Share: .191

ocioeconomic Adjustment Factors

ncome:		1.248	*	.135	+	0.832	*	.432	+	0.996	*	.433	=	0.959
mployment Con-		0.665	*	.396	+	0.991	*	.184	+	0.991	*	.082		
entration:	+	1.982	*	.338										1.197
mployment Type:		1.035	*	.679	+	1.035	*	.188	+	.787	*	.133	=	1.002
rip Length (Rt. 7):		0.593	*	0	+	0.988	*	.18	+	1.032	*	.30		
	+	1.619	*	.16	+	1.680	*	.16	+	1.784	*	.20	=	1.372
rip Length (50-66-29):		0.593	*	0	+	0.988	*	.12	+	1.032	*	.13		
	+	1.619	*	.15	+	1.680	*	.15	+	1.784	*	.45	=	1.550
rip Length (I-95):		0.593	*	0	+	0.988	*	.20	+	1.032	*	.33		
	+	1.619	*	.24	+	1.680	*	.08	+	1.784	*	.15	=	1.329

idesharing Assistance Factor
Areawide Matching (existing), use Normal Factor: 1.007
let Factor

Rt.7):	0.959	*	1.197	*	1.002	*	1.372	*	1.007	=	1.589
50-66-29):	0.959	*	1.197	*	1.002	*	1.550	*	1.007	=	1.795
-95):	0.959	*	1.197	*	1.002	*	1.329	*	1.007	=	1.539

entral Area Share

Rt. 7):	1.589	*	.208	=	0.331
50-66-29):	1.795	*	.208	=	0.373
-95):	1.539	*	.208	=	0.320

uburban Share

Rt.7):	1.589	*	.191	=	0.303
50-66-29):	1.795	*	.191	=	0.343
-95):	1.539	*	.191	=	0.294

Table 1A.2
INITIAL APPLICATION AND VALIDATION OF MODAL SUMMARY TABLES

VANPOOL - Large Urban Area

to Central Area, use Normal share: .016
to Suburbs, use Normal share: .016

Socioeconomic Adjustment Factors

Employment Concentration:		0.405	*	.396	+	2.164	*	.184	+	2.085	*	.082			
	+	0.811	*	.338										=	1.004
Employment Type:		1.066	*	.679	+	1.066	*	.188	+	0.593	*	.133		=	1.003
Trip Length (Rt. 7):		0.176	*	0	+	0.694	*	.18	+	1.204	*	.30			
	+	1.251	*	.16	+	1.992	*	.16	+	5.095	*	.20		=	2.024
Trip Length (50-66-29):		0.176	*	0	+	0.694	*	.12	+	1.204	*	.13			
	+	1.251	*	.15	+	1.992	*	.15	+	5.095	*	.45		=	3.019
Trip Length (I-95):		0.176	*	0	+	0.694	*	.20	+	1.204	*	.33			
	+	1.251	*	.24	+	1.992	*	.08	+	5.095	*	.15		=	1.760

Net Factor

(Rt. 7):	1.004	*	1.003	*	2.024	=	2.038
(50-66-29):	1.004	*	1.003	*	3.019	=	3.040
(I-95):	1.004	*	1.003	*	1.760	=	1.772

Central Area Share

(Rt. 7):	2.038	*	0.16	=	.033
(50-66-29):	3.040	*	.016	=	.049
(I-95):	1.772	*	.016	=	.028

Suburban Share

(Rt. 7):	2.038	*	.016	=	.033
(50-66-29):	3.040	*	.016	=	.049
(I-95):	1.772	*	.016	=	.028

Table IA.3
INITIAL APPLICATION AND VALIDATION OF MODAL SUMMARY TABLES

EXPRESS BUS IN MIXED TRAFFIC - Large Urban Area

to Central Area, use High Share: .140
(several private operators plus extensive WMATA service)

to Suburbs, use High Share: .018

Socioeconomic Adjustment Factors

Income:	0.858 *	.135	+	1.055 *	.432	+	1.065	*	.433	=	1.033
Employment Type:	1.058 *	.679	+	1.058 *	.188	+	0.641	*	.133	=	1.003
Trip Length (Rt. 7):	0.516 *	0	+	1.401 *	.18	+	1.246	*	.30		
+	1.246 *	.16	+	1.246 *	.16	+	1.246	*	.20	=	1.274
Trip Length (50-66-29):	0.516 *	0	+	1.401 *	.12	+	1.246	*	.13		
+	1.246 *	.15	+	1.246 *	.15	+	1.246	*	.45	=	1.265
Trip Length (I-95):	0.516 *	0	+	1.401 *	.20	+	1.246	*	.33		
+	1.246 *	.24	+	1.246 *	.08	+	1.246	*	.15	=	1.277

Net Factor

(Rt. 7):	1.033 *	1.003 *	1.274	=	1.320
(50-66-29):	1.033 *	1.003 *	1.265	=	1.311
(I-95):	1.033 *	1.003 *	1.277	=	1.323

Central Area Share

(Rt. 7):	1.320 *	.140	=	.185
(50-66-29):	1.311 *	.140	=	.184
(I-95):	1.323 *	.140	=	.185

Suburban Share

(Rt. 7):	1.320 *	.018	=	.024
(50-66-29):	1.311 *	.018	=	.024
(I-95):	1.323 *	.018	=	.024

Table 1A.4
INITIAL APPLICATION AND VALIDATION OF MODAL SUMMARY TABLES

EXPRESS BUS ON BUSWAY/LRT

to Central Area, use Normal Share: .250
to Suburbs, use Normal Share: .033

Socioeconomic Adjustment Factors

Income:	0.968	*	.135	+	1.224	*	.432	+	0.688	*	.433	=	0.957
Employment Type:	1.082	*	.679	+	1.082	*	.188	+	0.498	*	.133	=	1.004
Trip Length (Rt. 7):	0.646	*	0	+	1.754	*	.18	+	1.559	*	.30		
+	1.559	*	.16	+	1.559	*	.16	+	1.559	*	.20	=	1.594
Trip Length (50-66-29):	0.646	*	0	+	1.754	*	.12	+	1.559	*	.13		
+	1.559	*	.15	+	1.559	*	.15	+	1.559	*	.45	=	1.582
Trip Length (I-95):	0.646	*	0	+	1.754	*	.20	+	1.559	*	.33		
+	1.559	*	.24	+	1.559	*	.08	+	1.559	*	.15	=	1.598

Net Factor

(Rt. 7):	0.957	*	1.004	*	1.594	=	1.532
(50-66-29):	0.957	*	1.004	*	1.582	=	1.520
(I-95):	0.957	*	1.004	*	1.598	=	1.535

Central Area Share

(Rt. 7):	1.532	*	.250	=	.383
(50-66-29):	1.520	*	.250	=	.380
(I-95):	1.535	*	.250	=	.384

Suburban Share

(Rt. 7):	1.532	*	.033	=	.051
(50-66-29):	1.520	*	.033	=	.050
(I-95):	1.535	*	.033	=	.051

Table 1A.5
INITIAL APPLICATION AND VALIDATION OF MODAL SUMMARY TABLES

RAPID RAIL
to Central Area, use Normal share: .250
to Suburbs, use Normal share: .033

Socioeconomic Adjustment Factors

Density:	0.91	*	.370	+	0.94	*	.556	+	1.00	*	.074	=	0.933
Income:	1.1444	*	.135	+	1.0623	*	.432	+	0.7547	*	.433	=	0.940
Trip Length	1.393	*	0	+	1.065	*	.18	+	0.836	*	.30		
(Rt. 7): +	0.544	*	.16	+	0.368	*	.16	+	0.079	*	.20	=	0.604
Trip Length													
(50-66-29):	1.393	*	0	+	1.065	*	.12	+	0.836	*	.13		
+	0.544	*	.15	+	0.368	*	.15	+	0.079	*	.45	=	0.409
Trip Length													
(I-95):	1.393	*	0	+	1.065	*	.20	+	0.836	*	.33		
+	0.544	*	.24	+	0.368	*	.08	+	0.079	*	.15	=	0.661

Net Factor

(Rt. 7):	0.933	*	0.940	*	0.604	=	0.530
(50-66-29):	0.933	*	0.940	*	0.409	=	0.359
(I-95):	0.933	*	0.940	*	0.661	=	0.580

Central Area Share

(Rt. 7):	0.530	*	.250	=	.133
(50-66-29):	0.359	*	.250	=	.090
(I-95):	0.580	*	.250	=	.145

Suburban Share:

(Rt. 7):	0.530	*	.033	=	.017
(50-66-29):	0.359	*	.033	=	.012
(I-95):	0.580	*	.033	=	.019

Table 1A.6
1980 Trip End Summary
TRIP END SUMMARY ON 1980 AND 2000 PERSON TRIPS -- NO. VA. 80

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TRIP END SUMMARY

WKTRIPS = TABLE 1001

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ZONE	INS	OUTS	INTRA	(1+2)	(3+4)	(3+5)	(2+3)	(1+3)
1	20285	1411	110	21696	21806	21916	1521	20395
2	34534	2498	383	37032	37415	37798	2881	34917
3	29027	1126	144	30153	30297	30441	1270	29171
4	11615	502	26	12117	12143	12169	528	11641
5	19198	0	0	19198	19198	19198	0	19198
6	14896	0	0	14896	14896	14896	0	14896
7	8291	4690	144	12981	13125	13269	4834	8435
8	3070	4500	89	7570	7659	7748	4589	3159
9	2930	6987	128	9917	10045	10173	7115	3058
10	813	1992	12	2805	2817	2829	2004	825
11	13811	2112	163	15923	16086	16249	2275	13974
12	7394	1097	55	8491	8546	8601	1152	7449
13	32091	726	95	32817	32912	33007	821	32186
14	1782	0	0	1782	1782	1782	0	1782
15	33467	2165	418	35632	36050	36468	2583	33885
16	14003	3971	411	17974	18385	18796	4382	14414
17	34897	12624	2559	47521	50080	52639	15183	37456
18	13315	36772	3039	50087	53126	56165	39811	16354
19	24352	46715	9388	71067	80455	89843	56103	33740
20	42696	67836	19538	110532	130070	149608	87374	62234
21	12405	4971	637	17376	18013	18650	5608	13042
22	4479	9874	426	14353	14779	15205	10300	4905
23	5156	18970	963	24126	25089	26052	19933	6119
24	13863	16650	2156	30513	32669	34825	18806	16019
25	21921	23791	3912	45712	49624	53536	27703	25833
26	8962	13252	1349	22214	23563	24912	14601	10311
27	19744	9203	4278	28947	33225	37503	13481	24022
28	5578	22890	2268	28468	30736	33004	25158	7846
29	1761	9574	191	11335	11526	11717	9765	1952
30	2358	5510	144	7868	8012	8156	5654	2502
31	9462	7766	1096	17228	18324	19420	8862	10558
32	2275	12070	449	14345	14794	15243	12519	2724
33	7155	11104	1041	18259	19300	20341	12145	8196
34	18662	16383	2837	35045	37882	40719	19220	21499
35	4710	4367	278	9077	9355	9633	4645	4988

Table 1A.6
1980 Trip End Summary (Continued)
TRIP END SUMMARY ON 1980 AND 1000 PERSON TRIPS -- NO. VA. 80

TRIP END SUMMARY

WKTRIPS = TABLE 1001

ZONE	(1) INS	(2) OUTS	(3) INTRA	(4) (1+2)	(5) (3+4)	(6) (3+5)	(7) (2+3)	(8) (1+3)
36	14810	2033	389	16843	17232	17621	2422	15199
37	938	2681	55	3619	3674	3729	2736	993
38	3145	20108	1631	23253	24884	26515	21739	4776
39	3928	1508	134	5436	5570	5704	1642	4062
40	5847	4534	366	10381	10747	11113	4900	6213
41	297	7124	42	7421	7463	7505	7166	339
42	368	7159	33	7527	7560	7593	7192	401
43	3113	11880	363	14993	15356	15719	12243	3476
44	22786	15423	2734	38209	40943	43677	18157	25520
45	4384	10135	455	14519	14974	15429	10590	4839
46	1080	3776	99	4856	4955	5054	3875	1179
47	2074	4466	290	6540	6830	7120	4756	2364
48	2258	3148	168	5406	5574	5742	3316	2426
49	121	1812	2	1933	1935	1937	1814	123
50	583	2920	34	3503	3537	3571	2954	617
51	1203	5453	108	6656	6764	6872	5561	1311
52	2351	7059	207	9410	9617	9824	7266	2558
53	1470	3505	119	4975	5094	5213	3624	1589
54	3427	14419	1746	17846	19592	21338	16165	5173
55	6263	10833	2833	17096	19929	22762	13666	9096
56	810	3162	86	3972	4058	4144	3248	896
57	6286	0	0	6286	6286	6286	0	6286
58	2330	7965	1170	10295	11465	12635	9135	3500
59	556	5582	153	6138	6291	6444	5735	709
60	395	613	26	1008	1034	1060	639	421
61	1465	1468	353	2933	3286	3639	1821	1818
62	3970	2578	4017	6548	10565	14582	6595	7987
63	803	3424	2183	4227	6410	8593	5607	2986
64	118	3941	353	4059	4412	4765	4294	471
65	388	1202	513	1590	2103	2616	1715	901
66	6981	11110	3153	18091	21244	24397	14263	10134
67	2578	8432	481	11010	11491	11972	8913	3059
68	1665	15894	1120	17559	18679	19799	17014	2785
69	387	1679	19	2066	2085	2104	1698	406
70	9541	8853	6169	18394	24563	30732	15022	15710

Table 1A.6
1980 Trip End Summary (Continued)
TRIP END SUMMARY ON 1980 AND 2000 PERSON TRIPS -- NO. VA. 80

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TRIP END SUMMARY

WKTRIPS = TABLE 1001

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ZONE	INS	OUTS	INTRA	(1+2)	(3+4)	(3+5)	(2+3)	(1+3)
71	4009	7366	1670	11375	13045	14715	9036	5679
72	5205	10253	2292	15458	17750	20042	12545	7497
73	469	1695	57	2164	2221	2278	1752	526
74	1237	4707	584	5944	6528	7112	5291	1821
75	2395	2293	356	4688	5044	5400	2649	2751
76	1089	2734	524	3823	4347	4871	3258	1613
77	1419	316	0	1735	1735	1735	316	1419
78	1250	2746	0	3996	3996	3996	2746	1250
79	3035	4540	0	7575	7575	7575	4540	3035
80	4981	8138	0	13119	13119	13119	8138	4981
	644766		95814		1385346		740580	
		644766		1289532		1481160		740580

Table 1A.7

1980 ZONAL SYSTEM AND TRAVELLER CHARACTERISTICS FOR CORRIDOR SKETCH PLANNING PROGRAM

ZONE	COMM-ERCIAL ACRES	RESI-DENTIAL ACRES	TOTAL ACRES	TOTAL EMPLOY-MENT	HIGHWAY TERM. TIME	DAILY PARKING COST	HOUSEHOLDS BY INCOME LOW	LOW-MID	HIGH-MID	HIGH
1	22	189	225	38846	7	218	195	430	430	568
2	119	85	230	58526	7	231	819	1144	1144	982
3	105	82	212	62428	7	228	232	342	842	018
4	52	59	192	27499	5	205	476	159	159	014
5	0	92	147	43127	5	229	0	0	0	000
6	0	138	186	29492	7	215	0	0	0	000
7	227	115	461	16671	4	168	1544	2134	2134	1541
8	167	40	224	9725	4	170	3385	2199	2199	677
9	363	93	518	7880	4	134	6702	2437	2437	607
10	169	71	269	2659	4	20	1879	696	696	207
11	239	215	538	38235	4	185	1798	758	758	478
12	10	145	173	13019	4	194	196	130	130	121
13	70	398	609	69101	7	201	788	626	626	604
14	0	11	703	3455	4	185	0	0	0	000
15	40	290	1466	38975	5	155	633	410	410	257
16	52	58	288	17060	6	154	721	976	976	331
17	640	792	2355	40990	3	143	2784	2335	2335	2211
18	2218	709	3602	14435	3	31	7463	6791	6791	3921
19	5793	1099	8798	30540	3	56	7654	9976	9976	8649
20	4665	3596	9696	56500	3	37	17323	13871	13871	8435
21	614	2029	5752	10741	3	7	590	1000	1000	689
22	2331	400	3622	3955	3	0	898	1646	1646	1796
23	3337	329	4409	4883	3	0	1647	3233	3233	3647
24	1714	715	2797	13252	3	8	1536	3017	3017	3401
25	4765	1464	7568	20804	3	8	2639	4371	4371	5110
26	1665	455	2848	8582	3	28	1371	2193	2193	3381
27	4069	305	7572	23117	3	27	881	1452	1452	5030
28	2778	850	5005	7057	2	0	2354	3376	3376	6595
29	1827	423	4352	1761	2	0	1201	1861	1861	1079
30	1421	441	4538	2075	2	0	674	1043	1043	603
31	2272	1140	5184	8520	2	0	779	1531	1531	1350
32	2270	444	4077	2160	2	0	811	2100	2100	2357
33	3426	413	4692	6429	2	0	646	1613	1613	3297
34	4433	2790	10361	16894	2	0	1016	2713	2713	4860
35	1648	283	2451	4057	2	0	317	836	836	898
36	172	717	1402	12838	2	43	219	431	431	487
37	780	223	6401	853	2	0	167	457	457	784
38	4768	1210	7848	4099	2	0	2020	2830	2830	5795
39	226	2167	8608	8212	2	0	50	55	55	088
40	1134	916	6950	4988	2	0	460	847	847	717
41	1137	25	5927	259	2	0	289	1261	1261	1324
42	615	57	5588	305	2	0	464	1202	1202	1350
43	2674	652	5242	2696	2	0	864	1979	1779	2373
44	2356	1161	8460	19759	2	5	1918	2665	2665	3416
45	2485	250	5247	3740	2	0	631	1639	1639	2394
46	1203	102	3757	943	2	0	270	602	602	982
47	1810	199	10202	2013	2	0	169	323	323	1545
48	417	647	18003	1868	2	0	142	365	365	712
49	500	14	16345	99	2	0	42	297	297	424
50	946	82	14284	484	2	0	88	448	448	768
51	758	246	16076	1020	2	0	195	913	913	1244
52	2515	621	11551	1960	2	0	299	1090	1090	1795
53	460	139	12217	1233	2	0	128	562	562	867
54	2827	324	7265	3948	2	0	776	2325	2325	4264
55	1443	484	7935	6988	2	0	488	2191	2191	3248
56	818	160	11930	713	2	0	152	615	615	775
57	0	3003	7648	5025	2	0	0	0	0	000
58	1278	330	10316	2756	2	0	890	1805	1805	1420
59	467	82	8877	572	2	0	563	1144	1144	899
60	117	46	19968	330	2	0	110	92	92	086
61	357	573	40947	1466	2	0	281	285	285	229
62	1073	923	31090	6544	2	0	913	965	965	797
63	1328	355	110208	2446	2	0	868	800	300	742
64	532	108	44128	418	2	0	734	645	645	506
65	306	236	57806	843	2	0	287	243	243	217
66	1566	1052	7457	7706	2	0	2177	2258	2258	1370
67	1199	697	12179	2293	2	0	908	1387	1387	1366
68	2790	381	13869	2092	2	0	1723	2630	2630	2581
69	421	54	11570	307	2	0	173	265	265	262
70	3427	1025	12102	11673	2	0	1571	2397	2397	1901
71	1214	487	8889	4258	2	0	965	1548	1548	1015
72	1870	1633	18700	14441	2	0	1641	1707	1707	1509
73	412	65	37126	404	2	0	120	244	244	389
74	672	387	32102	1394	2	0	449	762	762	1018
75	430	475	27598	2144	2	0	329	373	373	417
76	649	164	43680	1288	2	0	357	495	495	527
77	0	0	0	0	2	0	25	25	25	025
78	0	0	0	0	2	0	25	25	25	025
79	0	0	0	0	2	0	25	25	25	025
80	0	0	0	0	2	0	25	25	25	025

Table 1A.8
BASE 1980 ZONAL SERVICE LEVEL
FOR CORRIDOR SKETCH PLANNING PROGRAM

	REGULAR EXPRESS			LOCAL RADIAL		LOCAL NON-RADIAL			GUIDEWAY EXPRESS		
ZONE	WALK TIME	WAIT TIME	AUTO CONN FLAG	WALK TIME	WAIT TIME	WALK TIME	WAIT TIME	AUTO CONN FLAG	WALK TIME	WAIT TIME	AUTO CONN FLAG
1	99	99	0	2	1	2	1	0	99	99	0
2	99	99	0	2	1	2	1	0	99	99	0
3	99	99	0	2	1	2	1	0	99	99	0
4	99	99	0	2	1	2	1	0	99	99	0
5	99	99	0	2	1	2	1	0	99	99	0
6	99	99	0	2	1	2	1	0	99	99	0
7	99	99	0	2	1	2	1	0	99	99	0
8	99	99	0	2	1	2	1	0	99	99	0
9	99	99	0	2	1	2	1	0	99	99	0
10	99	99	0	2	1	2	1	0	99	99	0
11	99	99	0	2	1	2	1	0	99	99	0
12	99	99	0	2	1	2	1	0	99	99	0
13	99	99	0	2	1	2	1	0	99	99	0
14	99	99	0	2	1	2	1	0	99	99	0
15	4	3	0	4	2	4	3	0	6	4	0
16	4	3	0	4	2	4	5	0	99	99	0
17	4	3	0	4	2	6	5	0	6	4	0
18	4	4	1	10	4	10	5	0	6	4	0
19	4	4	1	10	4	10	5	0	99	99	0
20	7	4	0	7	4	12	4	0	10	4	0
21	9	3	0	4	30	4	30	1	12	3	0
22	9	2	0	8	8	12	30	0	12	2	0
23	9	4	0	8	4	12	30	0	12	4	0
24	9	3	0	4	3	4	3	0	12	8	0
25	9	3	0	8	3	8	5	0	99	99	0
26	6	2	1	10	2	10	2	0	99	99	0
27	4	5	1	4	4	4	4	1	99	99	0
28	10	3	0	10	3	99	99	0	21	0	1
29	12	5	0	3	6	99	99	1	17	0	1
30	10	5	0	10	8	99	99	0	10	4	0
31	4	5	0	4	8	99	99	0	4	5	0
32	12	5	0	6	8	99	99	0	12	5	0
33	3	3	1	12	8	12	8	0	17	0	1
34	8	4	0	4	3	99	99	1	99	99	0
35	4	2	1	2	15	2	15	1	99	99	0
36	2	2	1	2	4	2	6	1	99	99	0
37	6	8	1	8	4	8	6	1	99	99	0
38	12	6	0	3	6	99	99	1	25	0	1
39	4	8	1	4	10	99	99	1	23	0	1
40	2	10	1	2	15	99	99	1	11	0	1
41	7	5	1	7	15	99	99	1	19	0	1
42	3	8	1	5	15	99	99	1	23	0	1
43	2	10	1	2	8	99	99	1	26	0	1
44	6	5	0	6	5	6	5	0	99	99	0
45	3	10	1	3	10	99	99	1	99	99	0
46	99	99	0	3	15	99	99	1	99	99	0
47	99	99	0	3	15	99	99	1	99	99	0
48	7	15	1	99	99	99	99	0	30	0	1
49	20	15	1	99	99	99	99	0	99	99	0
50	14	10	1	14	15	99	99	1	99	99	0
51	25	10	1	25	15	99	99	1	99	99	0
52	16	10	1	16	15	99	99	1	99	99	0
53	4	30	1	12	5	99	99	0	99	99	0
54	12	5	0	12	5	99	99	0	99	99	0
55	4	5	1	3	5	99	99	1	99	99	0
56	4	30	1	4	30	99	99	1	99	99	0
57	20	5	1	99	99	99	99	0	99	99	0
58	21	5	1	99	99	99	99	0	99	99	0
59	24	5	1	99	99	99	99	0	99	99	0
60	25	5	1	99	99	99	99	0	99	99	0
61	25	5	1	99	99	99	99	0	99	99	0
62	12	30	1	99	99	99	99	0	99	99	0
63	25	30	1	99	99	99	99	0	99	99	0
64	25	30	1	99	99	99	99	0	99	99	0
65	25	30	1	99	99	99	99	0	99	99	0
66	9	3	1	99	99	99	99	0	40	0	1
67	15	3	1	99	99	99	99	0	39	0	1
68	19	4	1	99	99	99	99	0	55	0	1
69	25	10	1	99	99	99	99	0	99	99	0
70	10	10	1	99	99	99	99	0	99	99	0
71	18	10	1	99	99	99	99	0	99	99	0
72	9	15	1	99	99	99	99	0	60	0	1
73	25	15	1	99	99	99	99	0	60	0	1
74	25	30	1	99	99	99	99	0	99	99	0
75	25	30	1	99	99	99	99	0	99	99	0
76	25	30	1	99	99	99	99	0	99	99	0
77	99	99	0	99	99	99	99	0	99	99	0
78	30	30	1	99	99	99	99	0	99	99	0
79	99	99	0	99	99	99	99	0	99	99	0
80	20	20	1	99	99	99	99	0	60	0	1

NOTES: THERE IS ONLY ONE AUTO CONNECT FLAG FOR LOCAL TRANSIT SERVICE; THE SAME FLAG APPLIES TO RADIAL AS WELL AS NON-RADIAL SERVICE.
A VALUE OF '99' MEANS THAT THE SERVICE DOES NOT EXIST.

Table 1A.9
MISCELLANEOUS ZONAL DATA FOR
CORRIDOR SKETCH PLANNING PROGRAM

ZONE	CBD FLAG	X COORD	Y COORD	PROD FACTOR	ATTR FACTOR
1	1	2712	1753	1.063	1.085
2	1	2702	1782	1.000	1.091
3	1	2733	1783	1.053	1.135
4	1	2768	1764	1.750	1.113
5	1	2783	1745	1.000	1.095
6	1	2737	1754	1.000	1.078
7	1	2654	1764	1.000	1.078
8	1	2715	1815	1.000	1.082
9	1	2744	1813	1.016	1.081
10	1	2786	1802	1.143	1.185
11	1	2808	1777	1.250	1.068
12	1	2809	1721	1.000	1.122
13	1	2761	1723	1.083	1.059
14	1	2693	1710	1.000	1.029
15	1	2670	1669	1.235	1.013
16	1	2617	1748	1.533	1.550
17	1	2694	1605	2.175	1.651
18	1	2559	1631	1.132	1.083
19	1	2498	1752	1.210	1.600
20	1	2594	1468	1.215	1.414
21		2343	1413	1.485	1.252
22		2325	1498	1.150	1.000
23		2238	1548	1.076	1.020
24		2428	1600	1.136	1.218
25		2266	1639	1.170	1.740
26		2259	1836	1.187	1.093
27		2355	1890	1.364	1.199
28		2640	1337	1.185	1.141
29		2534	1334	1.400	1.056
30		2430	1337	3.500	4.143
31		2296	1336	1.212	1.576
32		2153	1336	1.459	1.136
33		2131	1471	1.069	1.016
34		2127	1621	1.531	1.864
35		2130	1789	1.931	1.829
36		2182	1857	1.063	2.938
37		2179	1969	1.421	1.444
38		2567	1130	1.304	1.098
39		2348	1071	4.000	1.024
40		2262	1194	1.931	2.060
41		2095	1233	2.220	3.000
42		1979	1320	2.071	10.000
43		1985	1472	1.694	1.296
44		1931	1623	1.196	1.606
45		1971	1793	1.381	1.378
46		2034	1892	1.280	1.000
47		1996	2152	1.382	2.950
48		2162	990	4.688	1.632
49		1816	1241	2.000	2.000
50		1724	1474	3.278	1.600
51		1473	1576	7.030	26.600
52		1734	1696	2.372	14.700
53		1562	1836	2.714	7.500
54		1854	1895	1.505	1.564
55		1696	2002	1.876	3.857
56		1855	2207	3.182	3.714
57		1547	2005	1.000	2.560
58		1597	2206	2.644	3.107
59		1740	2306	2.421	5.000
60		1226	1841	3.750	3.333
61		1170	2217	2.909	4.333
62		1210	2472	2.222	2.569
63		1026	2881	2.844	2.667
64		829	2474	1.800	3.500
65		533	2217	2.000	2.000
66		2073	790	1.259	1.727
67		1906	994	2.500	3.391
68		1756	881	1.875	2.476
69		1621	1079	2.300	2.333
70		1467	1271	1.446	1.444
71		1339	1408	1.961	1.674
72		1966	566	1.894	1.264
73		1621	674	3.600	3.750
74		1374	933	1.417	1.174
75		1092	1299	1.933	2.857
76		1052	1577	2.579	3.615
77		417	2564	1.406	1.452
78		668	2027	1.470	1.406
79		954	1145	1.527	1.440
80		1759	388	1.494	1.921

Table 1A.10

ZONAL SERVICE LEVEL FOR NEW ALTERNATIVE #2 (Part 1)

EXTEND I-66 HOV LANES

	REGULAR EXPRESS			LOCAL RADIAL		LOCAL NON-RADIAL			GUIDEWAY EXPRESS		
ZONE	WALK TIME	WAIT TIME	AUTO CONN FLAG	WALK TIME	WAIT TIME	WALK TIME	WAIT TIME	AUTO CONN FLAG	WALK TIME	WAIT TIME	AUTO CONN FLAG
1	99	99	0	2	1	2	1	0	99	99	0
2	99	99	0	2	1	2	1	0	99	99	0
3	99	99	0	2	1	2	1	0	99	99	0
4	99	99	0	2	1	2	1	0	99	99	0
5	99	99	0	2	1	2	1	0	99	99	0
6	99	99	0	2	1	2	1	0	99	99	0
7	99	99	0	2	1	2	1	0	99	99	0
8	99	99	0	2	1	2	1	0	99	99	0
9	99	99	0	2	1	2	1	0	99	99	0
10	99	99	0	2	1	2	1	0	99	99	0
11	99	99	0	2	1	2	1	0	99	99	0
12	99	99	0	2	1	2	1	0	99	99	0
13	99	99	0	2	1	2	1	0	99	99	0
14	99	99	0	2	1	2	1	0	99	99	0
15	4	3	0	4	2	4	3	0	6	5	0
16	4	3	0	4	2	4	5	0	4	5	0
17	4	3	0	4	2	6	5	0	99	99	0
18	4	4	1	10	4	10	5	0	99	99	0
19	4	4	1	10	4	10	5	0	8	5	0
20	7	4	0	7	4	12	4	0	99	99	0
21	9	3	0	4	30	4	30	1	99	99	0
22	9	2	0	8	8	12	30	0	99	99	0
23	9	4	0	8	4	12	30	0	99	99	0
24	9	3	0	4	3	4	3	0	99	99	0
25	9	3	0	8	3	8	5	0	12	8	0
26	6	2	1	10	2	10	2	0	12	8	0
27	4	5	1	4	4	4	4	1	99	99	0
28	10	3	0	10	3	99	99	0	99	99	0
29	12	5	0	3	6	99	99	1	99	99	0
30	10	5	0	10	8	99	99	0	99	99	0
31	4	5	0	4	8	99	99	0	99	99	0
32	12	5	0	6	8	99	99	0	99	99	0
33	3	3	1	12	8	12	8	0	99	99	0
34	8	4	0	4	3	99	99	1	8	4	0
35	4	2	1	2	15	2	15	1	8	4	0
36	2	2	1	2	4	2	6	1	8	4	0
37	6	8	1	8	4	8	6	1	99	99	0
38	12	6	0	3	6	99	99	1	99	99	0
39	4	8	1	4	10	99	99	1	99	99	0
40	2	10	1	2	15	99	99	1	99	99	0
41	7	5	1	7	15	99	99	1	99	99	0
42	3	8	1	5	15	99	99	1	99	99	0
43	2	10	1	2	8	99	99	1	19	0	1
44	6	5	0	6	5	6	5	0	19	0	1
45	3	10	1	3	10	99	99	1	12	8	0
46	99	99	0	3	15	99	99	1	12	8	0
47	99	99	0	3	15	99	99	1	99	99	0
48	7	15	1	99	99	99	99	0	99	99	0
49	20	15	1	99	99	99	99	0	35	0	1
50	14	10	1	14	15	99	99	1	35	0	1
51	25	10	1	25	15	99	99	1	40	0	1
52	16	10	1	16	15	99	99	1	35	0	1
53	4	30	1	12	5	99	99	0	40	0	1
54	12	5	0	12	5	99	99	0	30	0	1
55	4	5	1	3	5	99	99	1	35	0	1
56	4	30	1	4	30	99	99	1	99	99	0
57	20	5	1	99	99	99	99	0	99	99	0
58	21	5	1	99	99	99	99	0	99	99	0
59	24	5	1	99	99	99	99	0	99	99	0
60	25	5	1	99	99	99	99	0	45	0	1
61	25	5	1	99	99	99	99	0	99	99	0
62	12	30	1	99	99	99	99	0	99	99	0
63	25	30	1	99	99	99	99	0	99	99	0
64	25	30	1	99	99	99	99	0	99	99	0
65	25	30	1	99	99	99	99	0	60	0	1
66	9	3	1	99	99	99	99	0	99	99	0
67	15	3	1	99	99	99	99	0	99	99	0
68	19	4	1	99	99	99	99	0	99	99	0
69	25	10	1	99	99	99	99	0	50	0	1
70	10	10	1	99	99	99	99	0	40	0	1
71	18	10	1	99	99	99	99	0	40	0	1
72	9	15	1	99	99	99	99	0	99	99	0
73	25	15	1	99	99	99	99	0	99	99	0
74	25	30	1	99	99	99	99	0	99	99	0
75	25	30	1	99	99	99	99	0	45	0	1
76	25	30	1	99	99	99	99	0	45	0	1
77	99	99	0	99	99	99	99	0	99	99	0
78	30	30	1	99	99	99	99	0	60	0	1
79	99	99	0	99	99	99	99	0	50	0	1
80	20	20	1	99	99	99	99	0	99	99	0

NOTES: THERE IS ONLY ONE AUTO CONNECT FLAG FOR LOCAL TRANSIT SERVICE; THE SAME FLAG APPLIES TO RADIAL AS WELL AS NON-RADIAL SERVICE.
A VALUE OF '99' MEANS THAT THE SERVICE DOES NOT EXIST.

Table 1A.11

ZONAL SERVICE LEVEL FOR NEW ALTERNATIVE #2 (PART 2)

EXTEND I-66 HOV LANES

	REGULAR EXPRESS			LOCAL RADIAL		LOCAL NON-RADIAL			GUIDEWAY EXPRESS		
ZONE	WALK TIME	WAIT TIME	AUTO CONN FLAG	WALK TIME	WAIT TIME	WALK TIME	WAIT TIME	AUTO CONN FLAG	WALK TIME	WAIT TIME	AUTO CONN FLAG
1	99	99	0	2	1	2	1	0	99	99	0
2	99	99	0	2	1	2	1	0	99	99	0
3	99	99	0	2	1	2	1	0	99	99	0
4	99	99	0	2	1	2	1	0	99	99	0
5	99	99	0	2	1	2	1	0	99	99	0
6	99	99	0	2	1	2	1	0	99	99	0
7	99	99	0	2	1	2	1	0	99	99	0
8	99	99	0	2	1	2	1	0	99	99	0
9	99	99	0	2	1	2	1	0	99	99	0
10	99	99	0	2	1	2	1	0	99	99	0
11	99	99	0	2	1	2	1	0	99	99	0
12	99	99	0	2	1	2	1	0	99	99	0
13	99	99	0	2	1	2	1	0	99	99	0
14	99	99	0	2	1	2	1	0	99	99	0
15	4	3	0	4	2	4	3	0	6	5	0
16	4	3	0	4	2	4	5	0	4	5	0
17	4	3	0	4	2	6	5	0	99	99	0
18	4	4	1	10	4	10	5	0	99	99	0
19	4	4	1	10	4	10	5	0	8	5	0
20	7	4	0	7	4	12	4	0	99	99	0
21	9	3	0	4	30	4	30	1	99	99	0
22	9	2	0	8	8	12	30	0	99	99	0
23	9	4	0	8	4	12	30	0	99	99	0
24	9	3	0	4	3	4	3	0	99	99	0
25	9	3	0	8	3	8	5	0	12	8	0
26	6	2	1	10	2	10	2	0	12	8	0
27	4	5	1	4	4	4	4	1	99	99	0
28	10	3	0	10	3	99	99	0	99	99	0
29	12	5	0	3	6	99	99	1	99	99	0
30	10	5	0	10	8	99	99	0	99	99	0
31	4	5	0	4	8	99	99	0	99	99	0
32	12	5	0	6	8	99	99	0	99	99	0
33	3	3	1	12	8	12	8	0	99	99	0
34	8	4	0	4	3	99	99	1	8	4	0
35	4	2	1	2	15	2	15	1	8	4	0
36	2	2	1	2	4	2	6	1	8	4	0
37	6	8	1	8	4	8	6	1	99	99	0
38	12	6	0	3	6	99	99	1	99	99	0
39	4	8	1	4	10	99	99	1	99	99	0
40	2	10	1	2	15	99	99	1	99	99	0
41	7	5	1	7	15	99	99	1	99	99	0
42	3	8	1	5	15	99	99	1	99	99	0
43	2	10	1	2	8	99	99	1	19	0	1
44	6	5	0	6	5	6	5	0	19	0	1
45	3	10	1	3	10	99	99	1	12	8	0
46	99	99	0	3	15	99	99	1	12	8	0
47	99	99	0	3	15	99	99	1	99	99	0
48	7	15	1	99	99	99	99	0	99	99	0
49	20	15	1	99	99	99	99	0	30	0	1
50	14	10	1	14	15	99	99	1	25	0	1
51	25	10	1	25	15	99	99	1	27	0	1
52	16	10	1	16	15	99	99	1	13	0	1
53	4	30	1	12	5	99	99	0	27	0	1
54	12	5	0	12	5	99	99	0	25	0	1
55	4	5	1	3	5	99	99	1	35	0	1
56	4	30	1	4	30	99	99	1	99	99	0
57	20	5	1	99	99	99	99	0	99	99	0
58	21	5	1	99	99	99	99	0	99	99	0
59	24	5	1	99	99	99	99	0	99	99	0
60	25	5	1	99	99	99	99	0	28	0	1
61	25	5	1	99	99	99	99	0	99	99	0
62	12	30	1	99	99	99	99	0	99	99	0
63	25	30	1	99	99	99	99	0	99	99	0
64	25	30	1	99	99	99	99	0	99	99	0
65	25	30	1	99	99	99	99	0	40	0	1
66	9	3	1	99	99	99	99	0	99	99	0
67	15	3	1	99	99	99	99	0	99	99	0
68	19	4	1	99	99	99	99	0	99	99	0
69	25	10	1	99	99	99	99	0	30	0	1
70	10	10	1	99	99	99	99	0	26	0	1
71	18	10	1	99	99	99	99	0	26	0	1
72	9	15	1	99	99	99	99	0	99	99	0
73	25	15	1	99	99	99	99	0	99	99	0
74	25	30	1	99	99	99	99	0	99	99	0
75	25	30	1	99	99	99	99	0	28	0	1
76	25	30	1	99	99	99	99	0	28	0	1
77	99	99	0	99	99	99	99	0	99	99	0
78	30	30	1	99	99	99	99	0	43	0	1
79	99	99	0	99	99	99	99	0	33	0	1
80	20	20	1	99	99	99	99	0	99	99	0

NOTES: THERE IS ONLY ONE AUTO CONNECT FLAG FOR LOCAL TRANSIT SERVICE; THE SAME FLAG APPLIES TO RADIAL AS WELL AS NON-RADIAL SERVICE.

A VALUE OF '99' MEANS THAT THE SERVICE DOES NOT EXIST.

Table 1A.12

ZONAL SERVICE LEVEL FOR NEW ALTERNATIVE #3

EXPAND COMMUTER BUS SERVICE

	REGULAR EXPRESS			LOCAL RADIAL		LOCAL NON-RADIAL			GUIDEWAY EXPRESS		
ZONE	WALK TIME	WAIT TIME	AUTO CONN FLAG	WALK TIME	WAIT TIME	WALK TIME	WAIT TIME	AUTO CONN FLAG	WALK TIME	WAIT TIME	AUTO CONN FLAG
1	99	99	0	2	1	2	1	0	99	99	0
2	99	99	0	2	1	2	1	0	99	99	0
3	99	99	0	2	1	2	1	0	99	99	0
4	99	99	0	2	1	2	1	0	99	99	0
5	99	99	0	2	1	2	1	0	99	99	0
6	99	99	0	2	1	2	1	0	99	99	0
7	99	99	0	2	1	2	1	0	99	99	0
8	99	99	0	2	1	2	1	0	99	99	0
9	99	99	0	2	1	2	1	0	99	99	0
10	99	99	0	2	1	2	1	0	99	99	0
11	99	99	0	2	1	2	1	0	99	99	0
12	99	99	0	2	1	2	1	0	99	99	0
13	99	99	0	2	1	2	1	0	99	99	0
14	99	99	0	2	1	2	1	0	99	99	0
15	4	3	0	4	2	4	3	0	6	4	0
16	4	3	0	4	2	4	5	0	99	99	0
17	4	3	0	4	2	6	5	0	6	4	0
18	4	4	1	10	4	10	5	0	6	4	0
19	4	4	1	10	4	10	5	0	99	99	0
20	7	4	0	7	4	12	4	0	10	4	0
21	9	3	0	4	30	4	30	1	12	3	0
22	9	2	0	8	8	12	30	0	12	2	0
23	9	4	0	8	4	12	30	0	12	4	0
24	9	3	0	4	3	4	3	0	12	8	0
25	9	3	0	8	3	8	5	0	99	99	0
26	6	2	1	10	2	10	2	0	99	99	0
27	4	5	1	4	4	4	4	1	99	99	0
28	10	3	0	10	3	99	99	0	21	0	1
29	12	5	0	3	6	99	99	1	17	0	1
30	10	5	0	10	8	99	99	0	10	4	0
31	4	5	0	4	8	99	99	0	4	5	0
32	12	5	0	6	8	99	99	0	12	5	0
33	3	3	1	12	8	12	8	0	17	0	1
34	8	4	0	4	3	99	99	1	99	99	0
35	4	2	1	2	15	2	15	1	99	99	0
36	2	2	1	2	4	2	6	1	99	99	0
37	6	8	1	8	4	8	6	1	99	99	0
38	12	6	0	3	6	99	99	1	25	0	1
39	4	8	1	4	10	99	99	1	23	0	1
40	2	10	1	2	15	99	99	1	11	0	1
41	7	5	1	7	15	99	99	1	19	0	1
42	3	8	1	5	15	99	99	1	23	0	1
43	2	10	1	2	8	99	99	1	26	0	1
44	6	5	0	6	5	6	5	0	99	99	0
45	3	10	1	3	10	99	99	1	99	99	0
46	99	99	0	3	15	99	99	1	99	99	0
47	99	99	0	3	15	99	99	1	99	99	0
48	7	15	1	99	99	99	99	0	30	0	1
49	20	15	1	99	99	99	99	0	99	99	0
50	14	10	1	14	15	99	99	1	99	99	0
51	25	10	1	25	15	99	99	1	99	99	0
52	16	10	1	16	15	99	99	1	99	99	0
53	4	30	1	12	5	99	99	0	99	99	0
54	12	5	0	12	5	99	99	0	99	99	0
55	4	5	1	3	5	99	99	1	99	99	0
56	4	30	1	4	30	99	99	1	99	99	0
57	15	3	1	99	99	99	99	0	99	99	0
58	10	3	1	99	99	99	99	0	99	99	0
59	10	3	1	99	99	99	99	0	99	99	0
60	12	3	1	99	99	99	99	0	99	99	0
61	15	3	1	99	99	99	99	0	99	99	0
62	8	20	1	99	99	99	99	0	99	99	0
63	15	20	1	99	99	99	99	0	99	99	0
64	15	20	1	99	99	99	99	0	99	99	0
65	20	20	1	99	99	99	99	0	99	99	0
66	9	3	1	99	99	99	99	0	40	0	1
67	15	3	1	99	99	99	99	0	39	0	1
68	15	3	1	99	99	99	99	0	55	0	1
69	20	7	1	99	99	99	99	0	99	99	0
70	8	7	1	99	99	99	99	0	99	99	0
71	10	7	1	99	99	99	99	0	99	99	0
72	7	10	1	99	99	99	99	0	60	0	1
73	20	10	1	99	99	99	99	0	60	0	1
74	20	20	1	99	99	99	99	0	99	99	0
75	20	20	1	99	99	99	99	0	99	99	0
76	20	20	1	99	99	99	99	0	99	99	0
77	20	20	1	99	99	99	99	0	99	99	0
78	20	20	1	99	99	99	99	0	99	99	0
79	20	20	1	99	99	99	99	0	99	99	0
80	15	15	1	99	99	99	99	0	60	0	1

NOTES: THERE IS ONLY ONE AUTO CONNECT FLAG FOR LOCAL TRANSIT SERVICE; THE SAME FLAG APPLIES TO RADIAL AS WELL AS NON-RADIAL SERVICE.
A VALUE OF '99' MEANS THAT THE SERVICE DOES NOT EXIST.

Table 1A.13
2000 TRIP END SUMMARY
TRIP END SUMMARY ON 1980 AND 2000 PERSON TRIPS -- NO. VA. 80

TRIP END SUMMARY

PER TRP = TABLE 2007

ZONE	(1) INS	(2) OUTS	(3) INTRA	(4) (1+2)	(5) (3+4)	(6) (3+5)	(7) (2+3)	(8) (1+3)
1	22043	1567	110	23610	23720	23830	1677	22153
2	37749	2624	361	40373	40734	41095	2985	38110
3	32980	1238	150	34218	34368	34518	1388	33130
4	12940	918	45	13858	13903	13948	963	12985
5	21046	0	0	21046	21046	21046	0	21046
6	16091	0	0	16091	16091	16091	0	16091
7	8994	4862	133	13856	13989	14122	4995	9127
8	3370	4662	84	8032	8116	8200	4746	3454
9	3213	7336	122	10549	10671	10793	7458	3335
10	1003	2357	14	3360	3374	3388	2371	1017
11	14768	2755	189	17523	17712	17901	2944	14957
12	8341	1147	54	9488	9542	9596	1201	8395
13	33999	837	94	34836	34930	35024	931	34093
14	1874	0	0	1874	1874	1874	0	1874
15	33909	2872	432	36781	37213	37645	3304	34341
16	21559	6122	809	27681	28490	29299	6931	22368
17	54550	26696	7301	81246	88547	95848	33997	61851
18	14797	43438	2950	58235	61185	64135	46388	17747
19	40145	55988	13872	96133	110005	123877	69860	54017
20	61997	83230	26005	145227	171232	197237	109235	88002
21	15499	7733	863	23232	24095	24958	8596	16362
22	4592	11860	354	16452	16806	17160	12214	4946
23	5553	21377	714	26930	27644	28358	22091	6267
24	17314	19784	2227	37098	39325	41552	22011	19541
25	39694	28089	5280	67783	73063	78343	33369	44974
26	10159	16698	1152	26857	28009	29161	17850	11311
27	23484	13588	5357	37072	42429	47786	18945	28841
28	6608	28322	2375	34930	37305	39680	30697	8983
29	1885	13877	212	15762	15974	16186	14089	2097
30	8970	18959	1420	27929	29349	30769	20379	10390
31	15250	9654	1422	24904	26326	27748	11076	16672
32	2625	18314	505	20939	21444	21949	18819	3130
33	7625	12641	738	20266	21004	21742	13379	8363
34	35178	25369	4926	60547	65473	70399	30295	40104
35	8571	8664	585	17235	17820	18405	9249	9156

Table 1A.13 (Continued)
2000 TRIP END SUMMARY
TRIP END SUMMARY ON 1980 AND 2000 PERSON TRIPS -- NO. VA. 80

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TRIP END SUMMARY

PER TRP = TABLE 2007

ZONE	(1) INS	(2) OUTS	(3) INTRA	(4) (1+2)	(5) (3+4)	(6) (3+5)	(7) (2+3)	(8) (1+3)
36	43966	1946	720	45912	46632	47352	2666	44686
37	1409	3953	68	5362	5430	5498	4021	1477
38	3452	27368	1823	30820	32643	34466	29191	5275
39	3809	6397	385	10206	10591	10976	6782	4194
40	11849	8780	976	20629	21605	22581	9756	12825
41	874	16220	170	17094	17264	17434	16390	1044
42	3623	14934	413	18557	18970	19383	15347	4036
43	4078	20903	455	24981	25436	25891	21358	4533
44	38200	19546	2814	57746	60560	63374	22360	41014
45	6259	14622	443	20881	21324	21767	15065	6702
46	1144	5051	72	6195	6267	6339	5123	1216
47	6307	6091	692	12398	13090	13782	6783	6999
48	3142	15172	845	18314	19159	20004	16017	3987
49	255	3751	5	4006	4011	4016	3756	260
50	926	9892	90	10818	10908	10998	9982	1016
51	26714	32044	8190	58758	66948	75138	40234	34904
52	34446	14569	3177	49015	52192	55369	17746	37623
53	11049	9231	901	20280	21181	22082	10132	11950
54	6045	22967	2082	29012	31094	33176	25049	8127
55	26566	17849	8541	44415	52956	61497	26390	35107
56	2849	10138	511	12987	13498	14009	10649	3360
57	16133	0	0	16133	16133	16133	0	16133
58	6313	20277	4588	26590	31178	35766	24865	10901
59	2676	13407	895	16083	16978	17873	14302	3571
60	1298	2345	135	3643	3778	3913	2480	1433
61	6222	3778	1685	10000	11685	13370	5463	7907
62	10974	5509	9582	16483	26065	35647	15091	20556
63	1240	9221	7199	10461	17660	24859	16420	8439
64	638	6951	1017	7589	8606	9623	7968	1655
65	815	2537	1009	3352	4361	5370	3546	1824
66	13155	14148	4351	27303	31654	36005	18499	17506
67	7986	20543	2404	28529	30933	33337	22947	10390
68	3976	29914	2927	33890	36817	39744	32841	6903
69	926	3984	55	4910	4965	5020	4039	981
70	15644	15290	7078	30934	38012	45090	22368	22722

Table 1A.13 (Continued)
2000 TRIP END SUMMARY
TRIP END SUMMARY ON 1980 AND 2000 PERSON TRIPS -- NO. VA. 80

TRIP END SUMMARY

PER TRP = TABLE 2007

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ZONE	INS	OUTS	INTRA	(1+2)	(3+4)	(3+5)	(2+3)	(1+3)
71	6694	15407	2842	22101	24943	27785	18249	9536
72	6003	21015	3457	27018	30475	33932	24472	9460
73	1559	6079	432	7638	8070	8502	6511	1991
74	1639	7209	527	8848	[illegible]375	9902	7736	2166
75	6907	4308	979	11215	12194	13173	5287	7886
76	3674	6475	2186	10149	12335	14521	8661	5860
77	2085	470	0	2555	2555	2555	470	2085
78	1784	4170	0	5954	5954	5954	4170	1784
79	4398	7146	4	11544	11548	11552	7150	4402
80	9646	12537	0	22183	22183	22183	12537	9646
	1017722		167580		2203024		1185302	
		1017722		2035444		2370604		1185302
GRAND	1662488		263394		3588370		1925882	
TOTAL		1662488		3324976		3851764		1925882

SIGNOFF 6700 (INFORMATION): UFMTR ENDED AT 14.51.00 (RETURN CODE= 0)

Table 1A.14
2000 APPLICATION OF MODAL SUMMARY TABLES

CARPOOL - Large Urban Area

to Central Area, use High Share: .208
(high parking costs and
Federal ridesharing encouragement)
to Suburbs, use Normal Share: .191

Socioeconomic Adjustment Factors

Income:	1.248	*	.135 +	0.832	*	.432 +	0.996	*	.433	=	0.959
Employment Concentration:	0.665	*	.396 +	0.991	*	.184 +	0.991	*	.082		
+	1.982	*	.338								1.197
Employment Type:	1.035	*	.679 +	1.035	*	.188 +	.787	*	.133	=	1.002
Trip Length (Rt. 7):	0.593	*	0 +	0.988	*	.19 +	1.032	*	.26		
+	1.619	*	.12 +	1.680	*	.20 +	1.784	*	.23	=	1.397
Trip Length (50-66-29):	0.593	*	0 +	0.988	*	.11 +	1.032	*	.12		
+	1.619	*	.14 +	1.680	*	.12 +	1.784	*	.51	=	1.571
Trip Length (I-95):	0.593	*	0 +	0.988	*	.18 +	1.032	*	.31		
+	1.619	*	.26 +	1.680	*	.08 +	1.784	*	.17	=	1.356

Ridesharing Assistance Factor
Areawide Matching (existing), use Normal Factor: 1.007
Net Factor

(Rt.7):	0.959	*	1.197 *	1.002	*	1.397 *	1.007	=	1.618
(50-66-29):	0.959	*	1.197 *	1.002	*	1.571 *	1.007	=	1.820
(I-95):	0.959	*	1.197 *	1.002	*	1.356 *	1.007	=	1.571

Central Area Share

(Rt. 7):	1.618	*	.208 =	0.336
(50-66-29):	1.820	*	.208 =	0.378
(I-95):	1.571	*	.208 =	0.327

Suburban Share

(Rt.7):	1.618	*	.191 =	0.309
(50-66-29):	1.820	*	.191 =	0.348
(I-95):	1.571	*	.191 =	0.300

able 1A.15
000 APPLICATION OF MODAL SUMMARY TABLES

'ANPOOL - Large Urban Area

to Central Area, use Normal share: .016
to Suburbs, use Normal share: .016

·ocioeconomic Adjustment Factors

:mployment Concentration:		0.405	*	.396	+	2.164	*	.184	+	2.085	*	.082		
	+	0.811	*	.338									=	1.004
:mployment Type:		1.066	*	.679	+	1.066	*	.188	+	0.593	*	.133	=	1.003
'rip Length (Rt. 7):		0.176	*	0	+	0.694	*	.19	+	1.204	*	.26		
	+	1.251	*	.12	+	1.992	*	.20	+	5.095	*	.23	=	2.165
'rip Length (50-66-29):		0.176	*	0	+	0.694	*	.11	+	1.204	*	.12		
	+	1.251	*	.14	+	1.992	*	.12	+	5.095	*	.51	=	3.233
'rip Length (I-95):		0.176	*	0	+	0.694	*	.18	+	1.204	*	.31		
	+	1.251	*	.26	+	1.992	*	.08	+	5.095	*	.17	=	1.849

\let Factor

Rt. 7):	1.004	*	1.003	*	2.165	=	2.180
50-66-29):	1.004	*	1.003	*	3.233	=	3.256
I-95):	1.004	*	1.003	*	1.849	=	1.862

:entral Area Share

Rt. 7):	2.180	*	.016	=	.035
50-66-29):	3.256	*	.016	=	.052
I-95):	1.862	*	.016	=	.030

;uburban Share

Rt. 7):	2.180	*	.016	=	.035
50-66-29):	3.256	*	.016	=	.052
I-95):	1.862	*	.016	=	.030

Table 1A.16
RATIONALIZATION AND ADJUSTMENT OF 2000
APPLICATION OF RIDESHARING MODAL SUMMARY TABLES

	Initial Mode Share					
	To Central Area			To Suburbs		
Mode	Rt. 7	50-66-29	I-95	Rt. 7	50-66-29	I-95
Carpool	.336	.378	.327	.309	.348	.300
Vanpool	.035	.052	.030	.035	.052	.030
Total	.371	.430	.357	.344	.400	.330
(Percent Vanpool of Total)	(9%)	(12%)	(8%)	(10%)	(13%)	(9%)

Ridesharing and Transit shares to be adjusted based on major HOV facilities as shown:

				Average Time Saved (1) (minutes)	
Corridor (2)	Facility	Location	Distance (mi.)	Pools	Buses
50-66-29	I-66	I-495 to Rosslyn	9.5	4.8	6.9
I-95	I-95/I-395	Franconia to Potomac River	11	5.6	8.0

Revised Ridesharing Mode Share

	Rt. 7	50-66-29	I-95
To Central Area	.371	.536	.410
To Suburbs	.344	.400	.330

Notes:

(1) Time savings assumed to apply only to central area-destined trips.

(2) It is assumed that by 2000, the Dulles toll road will be in place and that the FAA will have prohibited use of the existing Dulles Airport Access Road by HOVs. Therefore, Rt. 7 commuters will not have direct access to an HOV facility.