

A FEASIBILITY STUDY
TO DEVELOP INTERIM EXPRESS BUS SERVICE
FROM THE MOUNT VERNON AREA
UTILIZING THE WMATA HUNTINGTON STATION SITE

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By
ALAN M. VOORHEES & ASSOCIATES, INC.
Westgate Research Park
McLean, Virginia 22101

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I. INTRODUCTION

The purpose of this study has been to determine the feasibility of new express transit services by bus between the proposed WMATA Huntington Station site and downtown Washington, the Pentagon, Crystal City, and other places of employment concentration. The proposed services would operate in the interim prior to the inauguration of Metro rapid rail service at Huntington Station.

Among the goals and objectives of the proposed services would be:

- The provision of new and improved transit facilities for those presently using bus service.
- The creation of an attractive alternative for those using private automobile.
- The establishment of the Huntington Station location as a focal point for access to the regional transit system.

This study has been designed to be the initial step toward the development of a practical demonstration project to meet such objectives.

The various elements of the study are listed in the sequence of their appearance in this report:

- Investigation of the characteristics of transit service presently available to potential users of the proposed new services.

- Examination of present and anticipated future conditions of street and highway traffic flow on potential express bus routes, and on automobile access routes to the Huntington Station site.
- Determination of potential travel demand through analysis of the results of a household survey conducted with the cooperation of the Mount Vernon Council of Citizens' Association, supplemented by analysis of available regional travel data.
- Identification of alternative express bus terminal points, routing, and characteristics of service.
- Analysis of a series of specific alternative routes and services in terms of patronage and revenue potential, operating costs, and other factors related to provision of the service.
- Recommendation of a demonstration program, with general specification of routes and services, estimation of patronage, revenue, and operating costs, and identification of facility and equipment requirements.

This study has been conducted with full cognizance of other transit studies, programs, and activity in the Washington area. In many respects the analyses and recommendations have been designed to provide flexible guidelines for the start of service and possible alteration or expansion once underway. The many other transportation activities of the region, including other projects in Northern Virginia that are proceeding concurrently with this work, make this general approach more desirable than the development of a less flexible plan.

II. INVENTORY OF SERVICE AND FACILITIES

The planning of new express bus services requires identification of the characteristics of presently available transit service, and of the street and highway system. The existing transit services are very likely to be affected by the new services. They will provide some feeder service to the proposed express routes, and some of the patronage on the new routes will be diverted from existing services.

The conditions of street and highway traffic flow must be known in order to estimate travel speeds on bus routes, and to evaluate highway access to the parking and terminal facilities at the Huntington Station site. Proposed schedules of highway improvement projects also must be considered in estimating the effects on an express bus program.

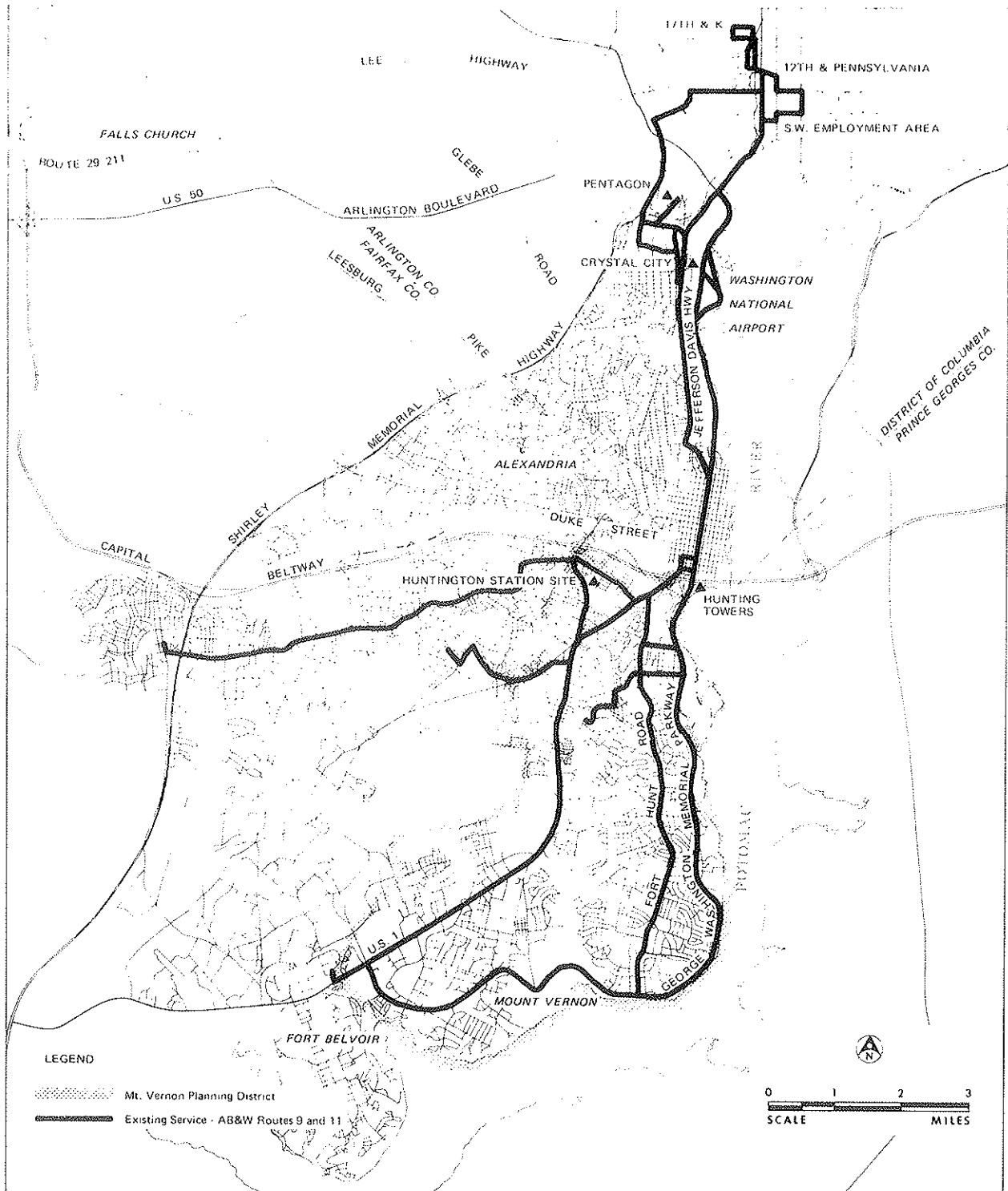
TRANSIT SERVICE

Virtually all of the significant transit service to the area to be served by the Huntington Station is presently supplied by the Alexandria, Barcroft, and Washington Transit Company (AB&W). Service is provided seven days a week to Alexandria, principal places of employment in Arlington County, and to downtown Washington.

Routes

AB&W Routes 9 and 11 are the principal ones providing service to the Mount Vernon area and nearby Fairfax County. The series of routes bearing these numbers are illustrated in Figure 1.

Figure 1
GENERAL LOCATION MAP



Route 9 -- The Route 9 series of services generally operate on the Jefferson Davis Highway (U.S. 1) between Fort Belvoir and the downtown terminal of AB&W at 12th Street and Pennsylvania Avenue. Most trips use the 14th Street Bridge, although some use Memorial Birdge. The outbound routing from the downtown terminal passes 7th Street and Independence Avenue and 12th and C Streets. Several peak period trips have the Pentagon as an inner terminal; a number of peak period trips have outer terminals at Hunting Towers (at Hunting Creek, south of Alexandria) or at other intermediate points in Fairfax County. The only Route 9 services that directly pass the Huntington Station site are some Saturday and Sunday trips that deviate from their U.S. 1 route to traverse North Kings Highway and Huntington Avenue.

Route 11 -- The Route 11 series generally uses the George Washington Parkway between various points in Alexandria and Fairfax County and downtown Washington. Fort Belvoir and several other points served by Route 9 are also reached by Route 11. Downtown routing is similar, although a substantial amount of peak period service goes to 17th and K Streets downtown. In peak periods there is now some partially express service operated between downtown Washington and Hunting Towers (at the south edge of Alexandria). At the present time there are one A.M. and two P.M. peak period trips that travel the entire length of the Mount Vernon Highway beyond Hunting Towers.

Route 11 service that passes the Huntington Station location is 11C (Rose Hill) using North Kings Highway and Huntington Avenue, and 11D (Springfield), using Huntington Avenue enroute to the Mount Vernon Highway at Belle Haven Road.

Connecting Routes -- Routes 9 and 11 provide direct service from the Mount Vernon area to downtown Washington, the Crystal City complex, the

Pentagon, and Navy facilities in Arlington. King and Washington Streets in Alexandria is a transfer point common to virtually all variations of these routes, expanding further the range of origin-destination possibilities in any specific time period. In addition, a number of other AB&W routes leave King and Washington to serve other points in Alexandria and Arlington. The only bus service from the Mount Vernon area to Rosslyn is that to be obtained by transferring to the Route 25 joint service of AB&W and the Washington, Virginia, and Maryland Coach Company (WV&M) between National Airport, Crystal City, Pentagon, and Rosslyn.

Fares -- In November 1970 AB&W established a four-zone system which effectively increased fares over those previously prevailing. Between downtown Washington and the third zone (including the Huntington Station site and other points beyond Hunting Creek) the fare is now 70 cents. Fares to the fourth zone (beyond Collingwood Road) are 80 cents. In general, fares between outer points and Crystal City are 20 cents less than to downtown; to the Pentagon, fares are 10 cents less than those to Washington.

Travel Times -- The fastest peak period scheduled running times (with limited stops) between Hunting Towers and 12th and Pennsylvania and 17th and K are 30 and 32 minutes, respectively. Other peak period trips are scheduled for up to 37 and 39 minutes between the same points. Limited stop service from Belle View and Ft. Hunt Road to 12th and Pennsylvania is scheduled for 42 minutes. Other peak period trips are listed at up to 50 and 52 minutes to 12th and Pennsylvania and 17th and K, respectively, from that point.

Equipment and Facilities -- All buses in service on Routes 9 and 11 are standard city transit coaches, with 40-50 seats per vehicle. Shops and offices of AB&W are located at 600 N. Royal Street, Alexandria, and additional garage facilities are located near the intersection of Jefferson Davis Highway (U.S. 1) and South Glebe Road in Arlington.

STREETS AND HIGHWAYS

Conditions of traffic flow on streets and highways have a considerable effect on the travel time potential of express bus routes. In a similar way conditions at intersections near the proposed Huntington Station site affect the accessibility of the site by automobile. In addition to travel time considerations, turning movement hazards have a great effect on acceptance of an access route by the public.

Major Highway Projects

There are three major projects which will affect corridor travel for transit vehicles between Huntington Station, Crystal City, the Pentagon, and downtown Washington:

- Completion of the express lanes for transit vehicles on Shirley Highway (I-95) on an interim basis, between their entrance point in Fairfax County and the 14th Street Bridge, will provide an express transit facility directly into downtown Washington.
- Subsequent completion of the entire Shirley Highway reconstruction project will permit even greater benefits from the express transit lanes, with grade-separated access to the transit lanes at the Pentagon.

- Proposed reconstruction of U.S. 1 between Alexandria and the Shirley Highway in Arlington will greatly affect bus travel in this corridor during the period of construction. Eventual completion of the project will improve access to the Crystal City complex in a substantial way. However, the project schedule is uncertain at this point.

Opening of the interim Shirley Highway express transit lanes could have an immediate impact on a proposed express bus demonstration from the Huntington site. There is little likelihood that the other construction projects will be underway soon enough to affect the demonstration. Progress of these projects should be monitored in order to anticipate changing conditions.

Huntington Station Access

There are three proposed highway improvement projects that are related to station access:

- Reconstruction of U.S. 1 from Penn Daw to the Capital Beltway
- Reconstruction of Huntington Avenue from North Kings Highway (Route 241) to Old Richmond Road (near U.S. 1 intersection).
- Reconstruction of Fort Hunt Road (Route 629) between U.S. 1 and Mount Vernon Boulevard.

The U.S. 1 project is close to the start of construction. The principal benefits of the completed project will result from the improved traffic flow at the U.S. 1-Huntington Avenue intersection, particularly for the cross movements between Huntington Avenue and Fort Hunt Road, and the left

turn from U. S. 1 south into Huntington Avenue. Probable scheduling of the project indicates that despite the eventual advantages to be derived, there may be some inconvenience to traffic in the early stages of an express bus demonstration project.

The Huntington Avenue and Fort Hunt Road improvement programs are expected to be complete or underway by 1976. The uncertainty of the scheduling makes it more likely that they will be ready for Metro rapid rail service to Huntington Station rather than for interim bus service.

Route Reconnaissance

As part of this study, a series of travel time investigations were made, over a period of three months, in peak and off-peak hours, between the Huntington Station location and check points along all principal travel routes to downtown Washington. The resulting data supplemented the running time information available for existing transit operations, in providing a basis for developing and evaluating alternative express bus routes.

The route reconnaissance additionally provided opportunities to observe and identify the nature of some of the impediments to traffic flow, both along bus routes, and on automobile approach routes to the Huntington Station site. All preliminary investigations considered both the upper Huntington site (on North Kings Highway) and the lower site (on Huntington Avenue) as possible interim terminal locations.

III. TRAVEL CHARACTERISTICS

Estimation of travel potential for proposed transit services requires knowledge of origin-destination characteristics of present travel, including present choice of travel mode. Although a wide range of travel data is available for the Washington area, estimation of patronage for a specific project to be planned in detail and financed at an early date requires data that are:

- As up-to-date as possible.
- Reliable for analysis on a small area basis.
- As comprehensive as possible for the study area.

As available data did not appear to meet all these requirements, a household survey was planned and undertaken in the service area of the proposed Huntington Avenue Metro Station. The survey results were used in conjunction with other available data in estimating patronage for alternative express bus services.

MOUNT VERNON SURVEY

A household travel survey was conducted in conjunction with the Mount Vernon Council of Citizens' Association. As part of this study, the consultant undertook survey planning, design, management, and data processing. Association volunteers organized and carried out the collection and distribution of questionnaires. The survey area encompassed an area generally having boundaries coinciding with those of the Mount Vernon Planning District of Fairfax County.

Survey Questionnaire

A single sheet questionnaire was designed for distribution to all households, with provision for response from up to two employed persons in each household. (A sample questionnaire is shown in Appendix A.)

Simplicity and brevity were the prime objectives of questionnaire design, and questions were limited to those essential for providing data for patronage estimation and demonstration program development. The questionnaire elements were:

- Place of employment.
- Usual travel mode to work.
- Time of arrival at work.
- Time of departure from work.

Distribution and Collection

Questionnaires were prepared for distribution to all households in each of the 76 citizens' association areas and identifiable apartment developments in the survey area. Preliminary estimates indicated that these "distribution groups" represented close to 20,000 households, or about 90 percent of all households in the survey area.

Questionnaires were delivered by volunteers in late July 1970, with a request for return by mail (with postage prepaid) by July 25. In some areas volunteers made door-to-door collections of the completed questionnaires.

Successful distribution was made to approximately 17,500 households. Approximately 5,000 useful questionnaires were returned (28 percent), representing responses from 6,500 employed persons.

Data Processing

Returned questionnaires were identified through a preprinted serial number as to their distribution group (citizens' association or apartment complex). The geographic identification of the distribution group was related to a survey zone system which was related, in turn, to the Council of Governments (COG) area system.

In most cases the questionnaires were factored by distribution group, i. e., the returned questionnaires for each group (association or apartment development) were expanded to represent the total households in that group. (In some cases where there was a very low rate of return, distribution groups were combined with adjacent ones for factoring.)

Factored responses totaled 21,500 employed persons residing in 16,200 households.

Time and budget constraints limited the opportunities to control the survey to the fullest degree, and to remove all possibilities for bias in the sample. However, the relatively large total sample (28 percent) compensates, to a large extent, for this, and the data has been judged suitable for the purpose intended -- that of estimating patronage preliminary design of service for a demonstration program.

As a conservative measure, the factored total of 21,200 employed persons has been held as the total for the survey area for planning purposes. Although this figure may represent only about 80 percent or

less of the survey area labor force, use of the lower figure will offset any possible bias resulting from the possible greater tendency of bus riders to respond to the survey.

Summary of Results

Approximately 66 percent of employed persons residing in the survey area work at or near one of the specific locations listed on the questionnaire. Table 1 shows the percentage distribution of places of employment. Fort Belvoir and the Pentagon are the largest individual employment locations.

Eighty-two percent of workers residing in the survey area travel to work by automobile (as a driver or passenger), with 12 percent using the bus. Table 2 lists the reported travel mode for three of the major employment locations. It may be observed that locations where parking problems and costs are greater, the tendency to use the bus and form car-pools is greatest. The greater amount of direct bus service to the 12th and Pennsylvania area may be a factor in the greater use of the bus to that point.

A breakdown of the 21,540 employed persons in the survey total by place of employment and travel mode (auto versus bus) is shown in Table 3.

OTHER TRAVEL DATA

Available travel data used to supplement and evaluate the Mount Vernon survey findings included the following regional studies:

- The 1966 regional on-board bus survey conducted by the National Capital Transportation Agency.

- The 1968 regional household survey conducted by the Washington Metropolitan Area Council of Governments.

Two recent studies have been specifically undertaken in connection with relocation of Federal offices to the Crystal City complex.^{1/} These studies have provided some additional insight into factors affecting choice of transit mode to that location.

As noted earlier in this section, the requirements for patronage estimation have led to major reliance on the new Mount Vernon survey data, with other sources used principally to verify and evaluate certain aspects of the survey findings.

^{1/} Staggering Work Hours to Improve Highway Transportation Service, C. R. Julian, Federal Highway Administration, U. S. Department of Transportation; and Traffic and Parking Impact Study, Main Navy Relocation, Arlington County, Virginia, U. S. Army Transportation Engineering Agency.

TABLE 1
MOUNT VERNON SURVEY
PLACE OF EMPLOYMENT
PERCENTAGE DISTRIBUTION

<u>Location</u>	<u>Percentage</u>
12th and Pennsylvania N. W.	5
Farragut Square	6
21st Street and Constitution	3
14th and Independence	3
Southwest Employment Area	4
Capitol Hill	3
Pentagon	9
Rosslyn	2
Crystal City	5
Downtown Alexandria	7
National Airport	4
Navy Annex	1
Fort Belvoir	14
Other Locations	<u>34</u>
Total	100%

TABLE 2
MOUNT VERNON SURVEY
TRAVEL MODE TO WORK
PERCENTAGE DISTRIBUTION

<u>Travel Mode</u>	<u>Conn. and K, N.W.</u>	<u>12th and Pa., N.W.</u>	<u>Pentagon</u>	<u>All Work Locations</u>
Drive every day	51	37	75	71
Passengers in car	7	12	7	7
Carpool	11	13	6	8
Walk to bus	17	27	6	8
Drive and park, then ride bus	10	7	3	2
Driven to bus	4	4	2	2
Other	<u>—</u>	<u>—</u>	<u>1</u>	<u>2</u>
All modes	100%	100%	100%	100%

TABLE 3
MOUNT VERNON SURVEY
TRAVEL MODE VERSUS WORK LOCATION

<u>Work Location</u>	<u>Drive Every Day</u>	<u>Car Pool or Passenger</u>	<u>Bus</u>	<u>Total*</u>
12th and Pennsylvania, N. W.	420	283	420	1, 123
Connecticut and K, N. W.	704	257	431	1, 392
21st and Constitution, N. W.	338	114	112	572
14th and Independence, N. W.	163	245	121	537
Southwest Employment Area	426	289	94	809
Capitol Hill	468	108	23	609
Pentagon	1, 422	248	203	1, 891
Rosslyn	373	72	39	489
Crystal City	595	251	243	1, 101
Downtown Alexandria	1, 108	156	244	1, 526
National Airport	647	115	127	894
Navy Annex	228	31	16	275
Fort Belvoir	2, 428	303	140	2, 958
Other	<u>6, 010</u>	<u>864</u>	<u>327</u>	<u>7, 364</u>
Total	15, 330	3, 336	2, 540	21, 540

*Includes "Other" mode of travel.

IV. ALTERNATIVE PLANS

In selecting alternative plans to be considered it is necessary to identify specific routing and service combinations that can be fully tested, evaluated and compared in order to select and develop a recommended program. The strategy of this analysis is to initiate and develop alternative small programs for service which might eventually be undertaken individually or in combination with others. Each will be evaluated in terms of patronage, revenue, and operating costs.

IDENTIFICATION OF ALTERNATIVES

In developing alternatives, the principal attributes to be identified are the type and frequency of service, the terminal locations, and the actual travel routes.

Service Concepts

The extent to which the proposed service is truly express is one point to be considered.

- Express service without stops has the advantage of optimizing running time. Even one or two stops which require very little time may diminish the "express" features of the service in the minds of some riders. Limited stop service, even with only one or two stops beyond the express portion of the route, provides more opportunity to fill the bus and improve the economics of the operation. A related consideration is the undesirable effect on riders who are passed by partially-filled express buses as they wait for their local bus. In a demonstration

project, however, there are often advantages in limiting the effect on other routes and services - particularly with respect to the diversion of patrons from existing routes. Limited stop service from Huntington Station would have a significantly greater effect on AB&W services than express service alone.

- Development of a proposed program must take into consideration the alternative objectives of (1) concentrating service to a limited number of locations with very frequent service, or (2) spreading service to many locations, with less frequency, but very selective scheduling. The concentration of service has the advantage of making the service available to a high percentage of potential users at the particular locations, permitting the results possibly to be somewhat more predictable. On the other hand, very selective scheduling to more destinations may create the opportunity for an eventually broader and stronger program.

Alternative Service Destinations

The potential demand for peak period transit service indicated in the survey findings, and reflected in the data in Tables 1 to 3, may be summarized as follows:

- Downtown Washington employees are those who tend to make greatest use of bus service and carpools. The particular incidence of these travel modes to the Connecticut and K, and 12th and Pennsylvania areas is indicative of greater highway congestion and higher parking costs there.

- The downtown locations farthest from the central areas seem to generate somewhat less transit usage, probably indicating somewhat lower parking costs and less congested access. In some cases, the lesser amounts of direct transit service provided is also a factor.
- The Pentagon, with its large number of employees, does generate a significant number of transit trips, although the percentage using transit is low. Obviously the free, but not always convenient, parking is a factor.
- Crystal City and Rosslyn, the principal commercial centers in Arlington County, generate and attract transit travel somewhat more than do the outlying Federal installations, again indicative of some degree of congested access and the prevalence of costs related to parking. Rosslyn does not now have direct bus service from the Mount Vernon area, and that may affect the amount of transit patronage indicated. Both areas are likely to become even more important employment locations for Mount Vernon than they are at present.

Routing Considerations

All major travel routes between the proposed Huntington site and the employment locations described were studied through vehicular surveys in peak periods, for purposes of assessing their potential as routes for express buses. The objective of the investigations was the identification of ways to provide transit services with travel times substantially better than those now scheduled. A summary of the route analysis follows:

- The George Washington Memorial Parkway from the north end of Washington Street in Alexandria to the 14th Street and Memorial Bridges is a very direct route from the Mount Vernon area to most of the locations considered. The present use of frontage roads to expand the capacity of intersections at the Alexandria end is a successful traffic engineering technique but does not fully alleviate the back-up of traffic entering northbound. No alternative routing appears to exist for buses to bypass the congestion with significant improvement in travel time. Further improvements would appear to have to be of a major nature and would have to improve total vehicular flow. The fact that there are major delays in the morning peak period on this route, and the fact that the Huntington Station site is not especially well located for access to the route, tend to diminish the potential of new express services on the Parkway from Huntington.

- The Jefferson Davis Highway (U.S. 1) has been examined primarily as a possible route to Crystal City and the Pentagon. Congestion and delay are prevalent at certain periods south of Crystal City, and there appears little opportunity for improvement for bus flow. Express buses would gain little time advantage over those presently scheduled.

- The Shirley Highway express transit lanes, when open on an interim basis to the 14th Street Bridge, will provide a route that is significantly faster than any other between the Huntington site and downtown Washington. There will be two access routes available between Shirley Highway and the Huntington site: (1) a route using Telegraph Road, Duke Street, Quaker Lane, and Seminary Road, with direct access

to the lanes at the Seminary Road interchange, and (2) a route using the Capital Beltway and the Shirley Highway, using the Turkeycock entrance ramp to the express lanes. Under free flow conditions, travel times via both routes are about the same. It would appear that the interim express lanes will be useful primarily for travel to downtown Washington. Ultimate completion of the project will provide grade-separated access to the lanes at the Pentagon and possibly improved access at other points.

- The proposed South Capitol Street Urban Corridor Demonstration Project in the District of Columbia may eventually have some potential bearing on routing from the Huntington site to points in downtown Washington via the Woodrow Wilson Bridge and Route I-295. This project involves future express transit lanes with preferential traffic signal controls across the Anacostia River into Washington. The progress of this project should be monitored, although there is little likelihood of the facilities being available during the early stage of the Huntington project.

ANALYSIS OF ALTERNATIVES

On the basis of the considerations outlined in the previous section, three alternative express service proposals were identified for further analysis. Techniques were developed for estimating patronage revenue and operating costs.

Alternative Routes and Services

- A. Huntington Station Site to 17th and K Street Area in Downtown Washington via the Shirley Highway Express Lanes. Service would be provided to points along 14th Street in Washington. Eight inbound trips in the A. M. period and eight outbound in the P. M. would be run.

- B. Huntington Station Site to the Southwest Employment Area in Washington via the Shirley Highway Express Lanes. Four inbound trips in the A. M. period, and four outbound in the P. M. would be operated.

- C. Huntington Station Site to Crystal City and the Pentagon via U. S. 1. Four inbound trips in the A. M. and four outbound in the P. M. would be run.

A summary of service characteristics of the three alternatives is shown in Table 4.

Patronage Estimates

Daily patronage (at the 1970 level) was estimated in the following manner, using the detailed Mount Vernon survey data as the primary source of information.

A series of "diversion" percentages were developed for estimating the switch from existing travel modes to express bus routes for each employment location. Principal points of consideration included the following:

- The changes in automobile-bus modal split that would result from improved transit travel times to the employment areas.
- Relative cost and convenience of parking in the vicinity of each employment location.
- Relative amounts of street and highway congestion and delay encountered on routes to each employment area.
- Quality and quantity of present transit service to each employment area.

For auto drivers these percentages varied from 4 percent for the Pentagon to 10 percent at 17th and K. For carpool users the corresponding range of diversion percentages was 2 to 5 percent. Persons who now walk to bus routes could be expected to divert at the 25 percent rate for all employment locations. Sixty percent of those who now are driven to the bus were judged potential, as were 85 percent of those who now drive and park to take a bus at all employment locations.

There was a further downward adjustment of diversion factors to reflect the degree to which the proposed services met the starting and leaving times of all employees at the particular terminal location. For example, even the most attractive service to any location could not be expected to serve more than 80 percent of employees there even if all were ready and willing to use transit service.

The final diversion factors were applied to the survey travel volumes for each present travel mode between the Mount Vernon area and the respective employment areas. The patronage estimates represent potential patronage. In addition to the levels of service assumed, the following conditions would have to be satisfied to reach the patronage potential:

- Active promotion of the proposed service.
- An attractive and safe environment at the Huntington site.
- Automobile access to the site not unreasonably hampered by highway construction or traffic congestion.

Revenue Estimates

For evaluating alternatives and for preparing preliminary estimates of revenue, an assumed fare of 70 cents between the Huntington site and downtown Washington has been used. For trips between the Huntington Station site and Crystal City and the Pentagon, an average fare of 55 cents has been assumed. These fares are generally representative of those in effect at the present time. Neither a premium fare nor a parking charge has been assumed. A premium fare is charged for express service in some cities, but such a fare would affect the patronage potential for the Huntington service.

Operating Cost Estimates

Operating costs, including the costs of vehicular equipment, have been estimated on the basis of that most likely to result if the present local operator (AB&W) were operating the service, but with no utilization of drivers or equipment assumed for anything other than the Huntington demonstration project. (Prior to implementation of any demonstration project, a detailed analysis of costs must be made. The estimates made as part of this study are only for evaluation purposes.)

Costs have been estimated as four unit measures:

- Mileage related costs (maintenance of equipment, fuel, etc.) have been estimated at 35 cents per bus mile.
- Hour-related costs (principally drivers' wages) have been estimated at the rate of \$9.50 per bus-hour of operation. (This high figure reflects the fact that the peak period demonstration service may not make efficient utilization of the drivers throughout the number of hours for which they must be paid.)
- Passenger-related costs (liability insurance, promotion of service, etc.) have been estimated at 10 cents per passenger. This higher than normal rate takes into consideration the fact that the demonstration service must be vigorously promoted.
- The costs of the equipment have been estimated at the rate of \$3200 per year per bus. (This is the approximate net annual cost of a 45-passenger bus, assuming a 12-year life.)

Operating costs have been estimated on the basis of 253 days of operation per year. No service has been assumed on weekends or holidays.

Revenue and cost estimates do not reflect any eventual compensatory payment arrangement with the local operator to counter lost revenues resulting from diversion of passengers to the demonstration program routes. The patronage forecasts indicate that up to 65 percent of the patronage on demonstration routes may be diverted from existing services. Estimate of such compensatory costs can only be made as part of the final cost analysis prior to implementation.

EVALUATION OF ALTERNATIVES

A summary of service characteristics for patronage, revenue and operating costs for the three alternatives is shown in Table 4. A summary of evaluation findings follows:

- Only the Shirley Highway Express Lanes offer the time savings potential to form the basis for a significant demonstration of new attractive express services.
- Only downtown Washington offers the patronage potential for frequent direct service throughout the peak period.
- To avoid the many problems that might result from too much effect on existing services, the proposed service should be fully express, and every attempt made to attract as many patrons as possible from the automobile mode.
- Patronage estimates indicate that express service which can serve several points in downtown Washington has the potential to meet its operating costs. (Although it must be reiterated that the likely cost structure for a demonstration project would most likely have to consider the loss to the local operator resulting from diversion of patrons.)

TERMINAL CONSIDERATIONS

Both the upper (North Kings Highway) and lower (Huntington Avenue) portions of the Huntington Station site have been considered as alternative terminal locations for the interim express bus service. The staff of the

TABLE 4
 ALTERNATIVE TRANSIT SERVICES
 SERVICE CHARACTERISTICS AND ESTIMATED
 PATRONAGE, REVENUE, AND OPERATING COSTS

	Alternative		
	<u>A</u>	<u>B</u>	<u>C</u>
Route - Miles (one way)	13.1	12.1	7.9
Running Time - Minutes (one way)	32	26	30
Round Trips Each Peak Period	8	4	4
Buses Required	5	2	2
Assumed One-Way Fare	70¢	70¢	55¢
Daily Passengers (one way)	746	124	230
Annual Passengers	189,000	30,400	58,200
Annual Bus Miles	100,000	43,100	31,800
Annual Bus Hours	5,430	1,820	2,200
Annual Passenger Revenue*	\$132,500	\$21,300	\$32,000
Annual Operating and Equipment Costs*	\$121,400	\$41,200	\$42,200
Revenue/Cost Ratio	1.09	0.52	0.76

*Revenues are based on assumed fare listed; costs represent those reasonably expected during 1971-1972 period. Costs for developing and maintaining the terminal facilities at the Huntington site have not been included.

A - Service to 17th and K; 12th and Pennsylvania.

B - Service to Southwest Employment Area.

C - Service to Crystal City and the Pentagon.

Washington Metropolitan Area Transportation Authority (WMATA) and its consultants have undertaken investigation of the various aspects of site development and highway access as part of their effort to plan and design the future Metro station. The following summary generally reflects their findings.

The principal considerations related to use of the upper (North Kings Highway) location for the interim terminal are as follows:

- The site is generally level and no major problems related to improvement might be expected.
- Use of the site as an interim bus terminal would not interfere significantly with construction of the Metro line and station.
- The principal automobile access route from the Mount Vernon area would be North Kings Highway. Most traffic bound for the site would be forced to make the already-heavy left turn movement on U.S. 1 at the Penn Daw intersection.
- Automobile access from the Belle Haven area would tend to be indirect.

Corresponding aspects of development of the lower site on Huntington Avenue are as follows:

- A large amount of grading at the site would be necessary for development of the interim bus terminal.
- Use of the site as an interim bus terminal might interfere with construction of the Metro line and station.

- Improvement of U.S. 1 between Penn Daw and the Capital Beltway will result in improved traffic flow at the U.S. 1 intersections at Fort Hunt Road and Huntington Avenue.
- Automobile access to the station would not use the Penn Daw intersection. Relatively direct access from the Belle Haven area would be possible. (It should be noted, however, that a direct connection between Fort Hunt Road and Huntington Avenue would improve access even more; such a connection is not a part of the present plans for improvement.)
- Although existing transit routes would provide very limited service to the interim terminal, more of this service passes the lower site than the upper. The lower site would also be more accessible in the event of any future diversion of other routes to the site. (Although not included in the scope of this study, the possibility exists that some express bus trips might actually terminate at other points, e. g. , the Sherwood Hall Lane area, and make local stops between these points and the Huntington site. This might be especially advisable if highway construction activity hindered access to the site to any great extent.)

In summary, access considerations tend to favor the lower (Huntington Avenue) site, although it should be noted that bus access to Telegraph Road would be about the same from either location. However, the service appears to be feasible from either site. The relative time schedules of the demonstration and the various construction projects will be a major consideration in the eventual selection of a site.

V. RECOMMENDED PROGRAM

On the basis of the evaluation of the alternative proposals, a program is recommended that includes Alternative A as studied, and supplements it with a part of Alternative B. The proposed program is outlined in Table 5 and schematically illustrated in Figure 2.

PROPOSED SERVICE

It is proposed that the demonstration program consist of ten peak-period inbound trips in the morning and ten outbound in the evening between the Huntington site and downtown Washington.

Routing would be via the Shirley Highway Express Lanes with entrance gained at the Seminary Road interchange. An alternative access route would entail use of the Capital Beltway (I-495) and the Shirley Highway to the Turkeycock entrance to the express lanes. (The alternative routing is substantially longer but results in travel times about the same as the recommended route.)

It is proposed that six or seven of the ten peak trips terminate in the area of 17th and K Streets, serving all points along 14th Street enroute. It is proposed that at least three trips directly serve the D Street terminal in the Southwest employment area, and that these and possibly some of the other trips also serve the 12th and Pennsylvania Avenue terminal. As far as possible, routing and stops in downtown Washington should conform with existing practice of AB&W Routes 9 and 11 and that proposed for the Shirley Highway express lane demonstration project.

Figure 2
RECOMMENDED EXPRESS BUS ROUTES FROM HUNTINGTON STATION SITE

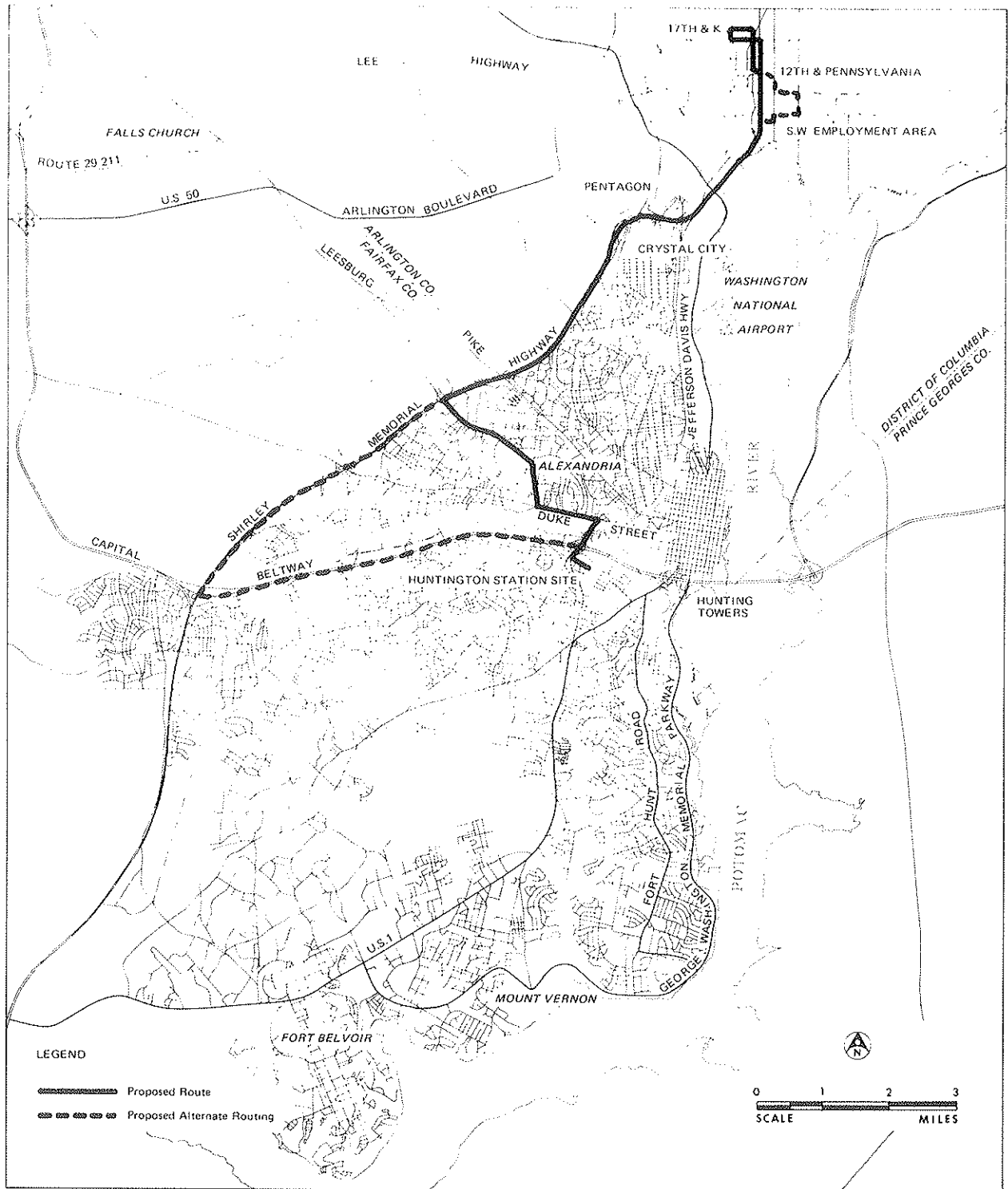


TABLE 5
 RECOMMENDED DEMONSTRATION PROGRAM
 SERVICE CHARACTERISTICS AND ESTIMATED
 PATRONAGE, REVENUE AND OPERATING COSTS

Route - Miles (one way) ^{1/}	13.1
Running Time - Minutes (one way)	32
Round Trips Each Peak Period	10
Buses Required	6
Assumed One-Way Fare	70¢
Daily Passengers (one way)	830
Annual Passengers	210,000
Annual Bus Miles ^{1/}	125,100
Annual Bus Hours	6,400
Annual Passenger Revenue ^{2/}	\$147,000
Annual Operating and Equipment Costs ^{2/}	\$149,000
Revenue/Cost Ratio	0.98

^{1/} Cost estimates assume use of the Shirley Highway Express Lanes; however, in practice it may be desirable to route some trips near the beginning and end of the peak period over more direct routes.

^{2/} Revenues are based on assumed fare listed; costs represent those to be reasonably expected in the 1971-1972 period. Costs for developing and maintaining the terminal facilities at the Huntington Station site are not included.

PATRONAGE

Patronage estimates indicate a high potential load factor on most of the ten trips. No patronage or passenger revenue has been assumed for the reverse trips in each peak period.

REVENUES AND OPERATING COSTS

Revenues have been estimated on the basis of the assumed 70 cent fare. Without consideration of special costs related to diverted passengers, there is indication that revenues can approximately meet operating costs.

IMPLEMENTATION

It is proposed that implementation of the proposed demonstration be accomplished as part of, or in coordination with, the overall Shirley Highway express bus demonstration project. The type of equipment used should be the same as that selected for use in that project.

SITE REQUIREMENTS

The following are the anticipated maximum requirements at the Huntington site during the interim demonstration period:

- Two Bus Bays.
- Twenty-five Kiss-Ride Spaces.
- Five Hundred Parking Spaces.

These facilities could be expected to accommodate a passenger volume approximately 20 percent greater than that estimated.

PROJECT COSTS

Operating costs estimated represent those that might reasonably be expected in the first year of operation, without any utilization of drivers and equipment for other than demonstration services. Estimated revenues for the first year of operation should approximately equal the direct costs estimated. However, the fact that there will be an impact on existing transit services, with costs resulting from the diversion of passengers, does indicate that there will be a significant net project cost. Cost of developing and maintaining the terminal facilities at the Huntington site have not been included in this analysis.

In anticipating the outlook throughout a demonstration period ending in December 1974, the following additional factors will have to be considered:

- Unit operating costs will increase but not at a rate which can be predicted with accuracy.
- There should be some opportunity to increase operating efficiency, with greater utilization of drivers and equipment, if project operations cannot be combined with other services.
- Patronage may be expected to increase beyond that estimated, but, on the other hand, some time will elapse after the start of operations and before even the estimated patronage level is reached.
- It is reasonable to expect that higher fare levels may be appropriate at later stages of the project.

APPENDIX A
MOUNT VERNON
SURVEY QUESTIONNAIRE

MAY WE ASK YOUR HELP ?

The Northern Virginia Transportation Commission is interested in improving commuter transportation from the Mt. Vernon Area. The Commission is co-operating with the Mt. Vernon Council of Citizens Associations in this effort. Would you help us by answering the questions inside this form?

In some areas your local civic association block captain will arrange to pick up your completed questionnaire. If your questionnaire is not picked up, please drop it in the mail, no later than Saturday, July 25, 1970.

Thank you

Northern Virginia Transportation Commission
and
Mount Vernon Council of Citizens Associations

COMMUTER TRANSPORTATION SURVEY

Nº 19296

YOUR ADDRESS _____

How many persons in this household are employed. (Do not include students employed for the summer)

- 1 One
- 2 Two
- 3 Three
- 4 Four or more

1 Please fill out this section for the principal wage earner in the household.

A. Please check the location which best describes the general area where you work.

- 1 12th & Pennsylvania, N.W.
- 2 Farragut Sq. (Conn & K, N.W.)
- 3 21st & Constitution, N.W.
- 4 14th & Independence, N.W.
- 5 South West Employment Area
- 6 Capitol Hill
- 7 Pentagon
- 8 Rosslyn
- 9 Crystal City
- 10 King & Washington, Alexandria
- 11 National Airport
- 12 Navy Annex
- 13 Ft. Belvoir
- 14 Other. _____

B. Please check the way which best describes the way you now get to work

- 1 Drive every day
- 2 Passenger in a car
- 3 Carpool
- 4 Walk to bus
- 5 Drive & park, then ride bus
- 6 Driven to bus
- 7 Other. _____

C. Please check the time most representative of when you arrive and leave work.

Arrive		Leave	
1 <input type="checkbox"/> Before 7:15 AM	1 <input type="checkbox"/> Before 4:15 PM		
2 <input type="checkbox"/> 7:15 AM	2 <input type="checkbox"/> 4:15 PM		
3 <input type="checkbox"/> 7:30 AM	3 <input type="checkbox"/> 4:30 PM		
4 <input type="checkbox"/> 7:45 AM	4 <input type="checkbox"/> 4:45 PM		
5 <input type="checkbox"/> 8:00 AM	5 <input type="checkbox"/> 5:00 PM		
6 <input type="checkbox"/> 8:15 AM	6 <input type="checkbox"/> 5:15 PM		
7 <input type="checkbox"/> 8:30 AM	7 <input type="checkbox"/> 5:30 PM		
8 <input type="checkbox"/> 8:45 AM	8 <input type="checkbox"/> 5:45 PM		
9 <input type="checkbox"/> 9:00 AM	9 <input type="checkbox"/> 6:00 PM		
0 <input type="checkbox"/> After 9:00 AM	0 <input type="checkbox"/> After 6:00 PM		

2 If there is another wage earner in the household have him or her also fill out this section.

A. Please check the location which best describes the general area where you work.

- 1 12th & Pennsylvania, N.W.
- 2 Farragut Sq. (Conn & K, N.W.)
- 3 21st & Constitution, N.W.
- 4 14th & Independence, N.W.
- 5 South West Employment Area
- 6 Capitol Hill
- 7 Pentagon
- 8 Rosslyn
- 9 Crystal City
- 10 King & Washington, Alexandria
- 11 National Airport
- 12 Navy Annex
- 13 Ft. Belvoir
- 14 Other. _____

B. Please check the way which best describes the way you now get to work

- 1 Drive every day
- 2 Passenger in a car
- 3 Carpool
- 4 Walk to bus
- 5 Drive & park, then ride bus
- 6 Driven to bus
- 7 Other. _____

C. Please check the time most representative of when you arrive and leave work.

Arrive		Leave	
1 <input type="checkbox"/> Before 7:15 AM	1 <input type="checkbox"/> Before 4:15 PM		
2 <input type="checkbox"/> 7:15 AM	2 <input type="checkbox"/> 4:15 PM		
3 <input type="checkbox"/> 7:30 AM	3 <input type="checkbox"/> 4:30 PM		
4 <input type="checkbox"/> 7:45 AM	4 <input type="checkbox"/> 4:45 PM		
5 <input type="checkbox"/> 8:00 AM	5 <input type="checkbox"/> 5:00 PM		
6 <input type="checkbox"/> 8:15 AM	6 <input type="checkbox"/> 5:15 PM		
7 <input type="checkbox"/> 8:30 AM	7 <input type="checkbox"/> 5:30 PM		
8 <input type="checkbox"/> 8:45 AM	8 <input type="checkbox"/> 5:45 PM		
9 <input type="checkbox"/> 9:00 AM	9 <input type="checkbox"/> 6:00 PM		
0 <input type="checkbox"/> After 9:00 AM	0 <input type="checkbox"/> After 6:00 PM		

A REMINDER —

If this questionnaire is not picked up, please place in the mail—no postage required—by July 25, 1970.

Thank You For Your Cooperation

APPENDIX B
MOUNT VERNON
SURVEY DATA

TABLE B-1
MOUNT VERNON SURVEY
TRAVEL MODE TO WORK LOCATION

<u>Work Location</u>	<u>Drive Every Day</u>	<u>Passenger In Car</u>		<u>Car Pool</u>	<u>Walk To Bus</u>		<u>Drive and Park, Then Ride Bus</u>		<u>Driven To Bus</u>		<u>Other</u>	<u>Total</u>	<u>Percent</u>
		<u>Car</u>	<u>Car</u>		<u>Bus</u>	<u>Bus</u>	<u>Bus</u>	<u>Bus</u>	<u>Other</u>				
12th and Pennsylvania, N. W.	420	139	144	297	83	40	0	1,123	5				5
Connecticut and K, N. W.	704	100	157	236	136	59	0	1,392	6				6
21st and Constitution, N. W.	338	49	65	62	32	18	8	572	3				3
14th and Independence, N. W.	163	50	195	68	35	18	8	537	3				3
Southwest Employment Area	426	68	221	65	12	17	0	809	4				4
Capitol Hill	468	50	58	23	0	0	10	609	3				3
Pentagon	1,422	127	121	116	53	34	18	1,891	9				9
Rosslyn	373	12	60	17	1	21	5	489	2				2
Crystal City	595	109	142	167	15	61	12	1,101	5				5
Downtown Alexandria	1,108	110	46	218	14	12	18	1,526	7				7
National Airport	647	44	71	119	8	0	5	894	4				4
Navy Annex	228	8	23	15	0	1	0	275	1				1
Fort Belvoir	2,428	207	96	125	0	15	87	2,958	14				14
Other	<u>6,010</u>	<u>427</u>	<u>437</u>	<u>249</u>	<u>36</u>	<u>42</u>	<u>163</u>	<u>7,364</u>	<u>34</u>				<u>34</u>
TOTAL	15,330	1,500	1,836	1,777	425	338	334	21,540	100				100
Percent	71	7	8	8	2	2	2	100					

TABLE B-2
MOUNT VERNON SURVEY
ARRIVAL TIME AT WORK LOCATION

Work Location	Before			7:30			7:45			8:00			8:15			8:30			8:45			9:00			Total						
	7:15 AM	7:30 AM	7:45 AM	7:15 AM	7:30 AM	7:45 AM	7:15 AM	7:30 AM	7:45 AM	7:15 AM	7:30 AM	7:45 AM	7:15 AM	7:30 AM	7:45 AM	7:15 AM	7:30 AM	7:45 AM	7:15 AM	7:30 AM	7:45 AM	7:15 AM	7:30 AM	7:45 AM		7:15 AM	7:30 AM	7:45 AM	7:15 AM	7:30 AM	7:45 AM
12th and Pennsylvania, N. W.	144	51	66	98	140	113	176	124	118	93	1,123																				
Connecticut and K, N. W.	77	36	130	104	136	95	228	200	231	155	1,392																				
21st and Constitution, N. W.	62	7	45	27	55	76	101	103	70	24	572																				
14th and Independence, N. W.	68	48	64	68	90	65	88	15	6	20	537																				
Southwest Employment Area	103	89	103	86	117	76	97	53	54	28	809																				
Capitol Hill	68	27	32	28	75	40	71	33	138	82	609																				
Pentagon	464	177	339	252	322	161	141	9	3	15	1,891																				
Rosslyn	67	33	72	52	77	26	71	18	24	45	489																				
Crystal City	225	164	107	119	161	57	120	36	68	45	1,101																				
Downtown Alexandria	197	28	70	94	259	195	257	92	155	179	1,526																				
National Airport	286	74	82	31	138	71	36	10	18	113	894																				
Navy Annex	69	7	51	72	55	4	5	0	8	0	275																				
Fort Belvoir	520	260	667	448	728	54	94	20	41	108	2,958																				
Other	<u>1,239</u>	<u>419</u>	<u>884</u>	<u>681</u>	<u>1,459</u>	<u>410</u>	<u>802</u>	<u>367</u>	<u>446</u>	<u>615</u>	<u>7,364</u>																				
TOTAL	3,589	1,420	2,713	2,160	3,813	1,444	2,286	1,079	1,381	1,522	21,540																				
Percent	17	7	12	10	18	7	11	5	6	7	100																				

NOTE: Totals may differ from sum of entries due to rounding.

TABLE B-3
MOUNT VERNON SURVEY
DEPARTURE FROM WORK LOCATION

Work Location	Before								After				Total
	4:15 PM	4:15 PM	4:30 PM	4:45 PM	5:00 PM	5:15 PM	5:30 PM	5:45 PM	6:00 PM	6:00 PM	6:00 PM	6:00 PM	
12th and Pennsylvania, N.W.	117	37	81	98	215	124	219	46	84	100	100	1,123	
Connecticut and K, N.W.	97	37	129	61	291	118	245	92	140	176	176	1,392	
21st and Constitution, N.W.	41	29	50	22	93	53	118	47	41	70	70	572	
14th and Independence, N.W.	55	79	48	91	162	38	12	6	5	34	34	537	
Southwest Employment Area	76	121	140	50	104	84	94	42	38	47	47	809	
Capitol Hill	82	10	69	16	100	30	66	30	55	136	136	609	
Pentagon	101	42	208	124	419	259	235	70	99	297	297	1,891	
Rosslyn	54	32	51	58	119	29	46	15	28	52	52	489	
Crystal City	233	126	228	37	223	12	54	24	43	95	95	1,101	
Downtown Alexandria	247	37	120	116	440	95	117	38	109	197	197	1,526	
National Airport	234	5	48	114	182	19	49	0	19	164	164	894	
Navy Annex	9	10	100	25	22	17	22	14	21	30	30	275	
Fort Belvoir	295	355	497	304	880	142	112	20	79	190	190	2,938	
Other	<u>1,740</u>	<u>576</u>	<u>1,145</u>	<u>414</u>	<u>1,205</u>	<u>303</u>	<u>473</u>	<u>139</u>	<u>378</u>	<u>840</u>	<u>840</u>	<u>7,364</u>	
TOTAL	3,381	1,498	2,915	1,531	4,455	1,323	1,861	584	1,141	2,429	2,429	21,540	
Percent	16	7	14	7	21	6	9	3	6	11	11	100	

NOTE: Totals may differ from sum of entries due to rounding.