

# APPENDIX

## METRO

### A RAPID RAIL TRANSIT SYSTEM FOR THE NATIONAL CAPITAL REGION (MAR. 1, 1968; REVISED FEB. 7, 1969)

PREPARED BY WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

Metro is ready. A regional rapid rail transit plan has been adopted. A program for financing the plan has been approved. The initial responsibilities assigned by Congress to the Washington Metropolitan Area Transit Authority have been fulfilled. The way is clear for construction to begin. And construction will begin following appropriation by Congress of District of Columbia funds for this purpose. The stage is set for activation of the federal-local enterprise envisioned by Congress in 1960 as the instrument for development of rapid rail transit in the National Capital region. This partnership requires Congressional authorization of federal participation in the regional program. Local political leaders have responded fully to the Congressional mandate to agree on a regional system that transcends the boundaries of the District of Columbia. So, too, have the people. On November 5, 1968, in all area jurisdictions where bond referenda were required, the voters authorized bond issuances to finance local shares of the cost of constructing and equipping the system. Seventy-two percent of the local area voters expressed their willingness to tax themselves to bring rapid rail to the region. The plan and program was adopted on March 1, 1968. The original estimates of costs and revenues underwent extensive analysis during the ensuing months at an approximate cost of \$1.5 million, borne totally by local governments, to ensure development of the best possible estimates for presentation to Congress.

#### INTRODUCTION

Among the studies was an independent economic analysis which attests to the financial soundness of the program. It projects cumulative benefits three times greater than the combined federal-local investment in the program. The detailed refinements of costs and revenues were presented to the WMATA Board of Directors on February 7, 1969. They are contained in two technical documents entitled "Preliminary Design and Capital Costs" and "Traffic, Revenues and Operating Costs." Based on these refined data, the Board adopted unanimously a revised plan and program. This is the revised plan and program, and these are the representatives of the District of Columbia, Northern Virginia and suburban Maryland who have developed and approved it as directed by Congress:

#### Directors

Frederick A. Babson, *chairman*; Walter E. Fauntroy, *1st vice chairman*; Carlton R. Sickles, *2nd vice chairman*; Ned R. Thomas; Thomas W. Fletcher; James P. Gleason.

#### Alternates

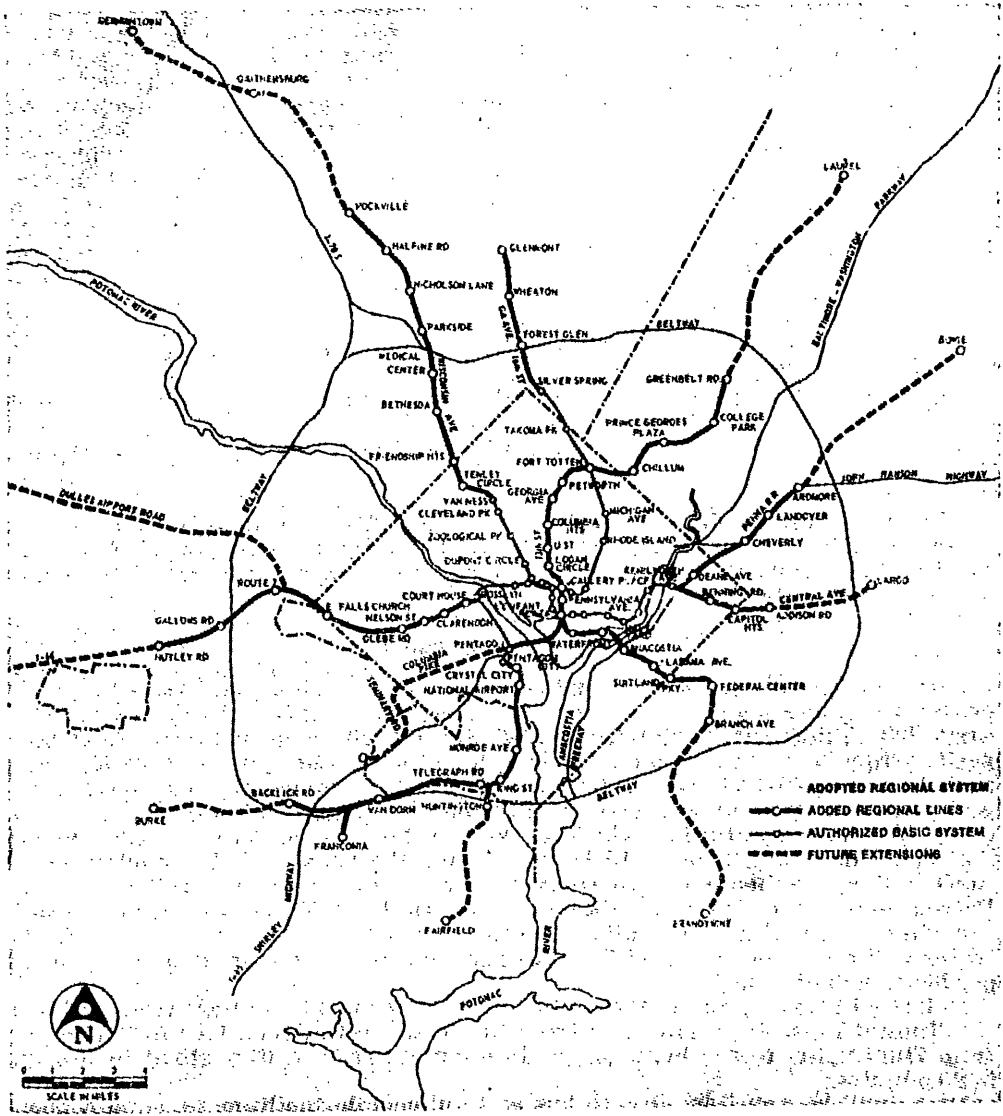
Lee M. Rhoads; Joseph P. Yeldell; Gladys Noon Spellman; Nicholas Colasanto; Polly Shackleton; Rose C. Kramer.

These Board members are chosen by the Northern Virginia Transportation Commission, representing the Counties of Fairfax and Arlington and the cities of Alexandria, Fairfax and Falls Church; the Washington Suburban Transit Commission, representing Montgomery and Prince Georges Counties; and the District of Columbia Council, which selects its representatives from among the D.C. Commissioner, Assistant to the Commissioner, and nine-member Council.

## BACKGROUND

The revised plan and program is the result of two years of intensive deliberation by the Washington Metropolitan Area Transit Authority involving more than 100 formal Board meetings, countless hours of informal workshops, scores of public briefings and hearings, over a million man-hours of work by staff and consultants and the investment of millions of dollars of non-Federal funds. In the broader sense, it is the product of nearly two decades of Congressional concern over oppressive traffic congestion and its negative effects on the physical character, economic growth and social well-being of the Nation's Capital. This concern, in constant evidence since 1952 when Congress authorized major studies into the transportation problems of metropolitan Washington, resulted in development of a wealth of basic data for the WMATA when it became an official body on February 20, 1967.

Available to the Transit Authority was the product of seven years of effort by the national Capital Transportation Agency, a temporary federal body established by Congress to work on rapid rail transit until the interstate compact body came into being. During those seven years, NCTA developed the 25 miles of routes that form the heart of the regional system. Congress approved these routes in 1965 and authorized \$150 million of federal and District of Columbia funds to get construction underway. Congress has since appropriated \$66.5 million of these funds but has restricted the use to non-construction activities. Construction can and will begin approximately 75 days after the lifting of that restriction by Congress. Rapid rail transit service will begin approximately three years after removal of the restriction. The already authorized 25-mile heart of the system will be in full operation some two years thereafter along with some other elements of Metro. The entire Metro system—97.7 miles of service covering the Nation's Capital and its immediate environs—can be operating in late 1979. To do so requires early release of construction money and timely authorization by Congress of Federal participation in the Metro system.



**The Metro System.**—Adopted March 1, 1968; revised February 7, 1969; by the Board of Directors, Washington Metropolitan Area Transit Authority.

## DESCRIPTION OF FACILITIES

Metro is a 97.7-mile network of rapid rail transit facilities serving the nation's capital and the nearby areas of Maryland and Virginia. It includes 37.7 miles of service in the District of Columbia, 29.9 miles in Maryland and 30.1 miles in Virginia. The system has 86 stations. Forty-four stations are in the District of Columbia. Twenty-two are in Maryland and the remaining 20 are in Virginia. Fifty-three stations will be in subway. The remaining 33 will be at surface or on aerial structures. Metro will operate entirely on exclusive rights-of-way uninterrupted by other rail vehicles or at-grade traffic crossings. Forty-seven miles of the system, mostly in the highly developed central portion, will be constructed below surface. Forty-two miles will be on surface utilizing, wherever feasible, existing rights-of-way along established rail lines or in the medians of highways. The remaining eight miles will be on aerial structure, mostly for the purpose of grade separation. Metro contains three principal through routes. All three traverse the District of Columbia. In certain instances, the routes branch as they reach into suburban areas to permit broader coverage of the region. Convenient transfer points linking the three independent lines are provided at four double-level stations: Metro Center at 12th and G Streets, N.W.; Gallery Place at 7th and G Streets, N.W.; L'Enfant Plaza at 7th and D Streets, S.W.; and Fort Totten at Riggs Road and the B&O Railroad. Transfer will also be possible by means of a walkway connecting the two stations at Farragut Square.

Facilities for parking 30,000 automobiles will be provided at 37 Metro stations. Spaces will be available for 5,000 vehicles in the District of Columbia, 11,000 in Virginia and 14,000 in Maryland.

The revised plan adopted by the Board involves three station changes on which public hearings were held in January. On the Rockville Route in Montgomery County, the Pooks Hill Station near the Beltway was shifted a mile south along Wisconsin Avenue and renamed Medical Center Station. In the District of Columbia, on the Anacostia-Branch Avenue Line, a station was shifted four blocks from South Capitol and M Streets to 4th and M Streets, S.W. and renamed Waterfront Station. In Fairfax County, the Huntington Route was shifted westward and the Huntington Station relocated in the vicinity of North Kings Highway and Farmington Drive.

## SCHEDULES OF SERVICE

Service will be fast, frequent and comfortable. Air-conditioned trains will run every two minutes on the main lines during peak hours. The system is expected to carry 293 million riders annually by 1990. Service will be provided over a 20-hour period from 5 a.m. to 1 a.m. Train schedules during typical weekday peak periods will consist of two- to four-minute service. During the base day, trains will run every six minutes and, during the early morning and late evening hours, every 10 minutes. Saturday schedules will be the same as on a weekday except that "base day" operations will be run during the peak periods. Sunday operations will approximate the weekday "early morning-late evening" operations. Patrons entering trains will walk on at platform level. Three wide doors on each car will open simultaneously allowing easy access for those getting on or off. The trains will reach top speeds of 75 miles per hour and will average about 35 miles per hour, including stops.

Riders will travel from Bethesda to Metro Center in 14 minutes; from Ardmore to L'Enfant Plaza in 19 minutes; from Anacostia to Gallery Place in 8 minutes; from Huntington to the Pentagon in 13 minutes; from Nutley Road to Rosslyn in 20 minutes.

Metro will be coordinated with bus and automobile facilities to serve communities for miles on both sides of rapid rail lines. Feeder buses with frequent service, special drop-off lanes and wide neighborhood coverage will be so convenient that a majority of the system's riders will use the combined system. For those who drive to Metro stations, 30,000 parking places will be provided at key stations, and "kiss-and-ride" lanes will be built for motorists dropping off passengers.

## Typical Peak Period Travel Times

	Metro Center	Gallery Place	L'Enfant Plaza	Dupont Circle	Rosslyn	Pentagon	Capitol South
Rockville	26	27	31	23	29	35	33
Parkside	19	20	24	16	22	28	26
Bethesda	14	16	19	11	18	24	22
Tenley Circle	10	11	15	7	12	19	17
Glenmont	22	20	24	25	29	28	28
Silver Spring	15	13	17	16	22	21	21
Fort Totten	10	9	12	14	18	17	16
Greenbelt Road	22	20	22	25	30	28	26
Prince Georges Plaza	17	15	17	20	25	22	21
Columbia Heights	7	5	7	11	15	11	11
Ardmore	23	23	19	27	29	28	17
Deane Avenue	18	16	12	20	22	18	10
Addison Road	20	20	16	24	26	23	14
Kenilworth Avenue	14	14	10	13	20	17	8
Potomac Avenue	9	9	5	13	15	12	3
Branch Avenue	19	16	14	23	28	21	16
Federal Center	16	14	11	20	23	18	15
Anacostia	10	8	5	14	17	12	9
Franconia	29	26	24	32	26	20	28
Backlick Road	30	27	25	33	27	21	29
Huntington	22	22	19	22	16	13	23
Crystal City	12	9	7	13	6	3	11
Nutley Road	26	29	30	26	20	26	33
East Falls Church	15	18	10	15	9	15	22
Clarendon	9	12	13	9	2	9	15
Rosslyn	6	9	10	6	--	6	12



## DESCRIPTIONS OF ROUTES

## Rockville Route

This route begins at the Metro Center Station (12th and G Streets, Northwest) and extends westward in subway under G Street, thence northwestward under Lafayette Park and Farragut Square, continuing under Connecticut Avenue to Yuma Street. From this point the route proceeds westward in subway under Yuma Street to Tenley Circle, thence northward under Wisconsin Avenue to the District of Columbia-Maryland boundary. The route continues northward under Wisconsin Avenue, through Bethesda, to a point south of the Capital Beltway. The route crosses over the Capital Beltway along the east side of Rockville Pike, thence northward in subway along Rockville Pike to a point south of Randolph Road, thence proceeds under private property in subway to the Baltimore and Ohio Railroad. The route continues northwestward on the surface along the B&O Railroad to a terminal at Rockville. The following stations are provided: Metro Center, Farragut North, Dupont Circle, Zoological Park, Cleveland Park, Van Ness, Tenley Circle, Friendship Heights, Bethesda, Medical Center, Parkside, Nicholson Lane, Halpine Road, and Rockville. Storage tracks and inspection facilities are provided north of the Rockville terminal. A future extension is planned extending northward to Germantown, alignment to be determined.

## Glenmont Route

This route begins at the Metro Center Station and extends eastward in subway under G Street to 6th Street, thence southeastward under Judiciary Square, eastward under D Street, and northward under Union Station. The route then proceeds northward on the surface along the B&O Railroad to the District of Columbia-Maryland boundary. The route continues northward through Silver Spring along the B&O Railroad, thence in subway under 16th Street and Georgia Avenue to a terminal at Glenmont. The following stations are provided: Gallery Place, Judiciary Square, Union Station, Rhode Island, Michigan Avenue, Fort Totten, Takoma Park, Silver Spring, Forest Glen, Wheaton, and Glenmont. The main maintenance yard is provided south of the Rhode Island Station. Storage and inspection facilities are provided north of the Glenmont Station.

## Huntington Route

This route begins at the Metro Center Station and proceeds northward in subway under 12th Street, thence westward under Eye Street. The route continues westward in subway under the Potomac River, crossing the District of Columbia-Virginia boundary into Rosslyn, thence southward under Lynn Street in subway to a point south of Arlington Boulevard. From this point the route continues southward on the surface along the east side of the Jefferson Davis Highway, then curves southwestward, in subway, south of the Pentagon and continues in subway under Hayes Street, thence eastward under 18th Street to the National Airport. The route then turns southward and proceeds through National Airport on an aerial structure, crosses over the George Washington Memorial Parkway and proceeds southward on the surface along the east side of the Richmond, Fredericksburg and Potomac Railroad. The route continues along the east side of the RF&P Railroad through Alexandria to a point south of Duke Street. The route then proceeds southward over private property, crossing over the Capital Beltway and Huntington Avenue to a terminal at the Huntington Station. The following stations are provided: Metro Center, McPherson Square, Farragut West, Foggy Bottom, Rosslyn, Pentagon, Pentagon City, Crystal City, National Airport, Monroe Avenue, King Street, and Huntington. A future extension is planned southward to Fairfield, alignment to be determined.

## Ardmore Route

This route begins at the Metro Center Station and proceeds southward in subway under 12th Street to the Southwest Mall area, turning eastward under D Street, S.W., thence to Pennsylvania Avenue. The route continues in subway southeastward under Pennsylvania Avenue, eastward under G Street, S.E., northeastward under Potomac Avenue, northward under 19th Street, and northeast on the surface across the D.C. Stadium parking lot east of Oklahoma Avenue.

The route then turns eastward, crossing over Benning Road, the Anacostia River and Kenilworth Avenue north of Benning Road, thence northeastward on surface along the Penn Central Railroad to the District of Columbia-Maryland boundary and continues to a terminal at Ardmore. The following stations are provided: Federal Triangle, Independence Avenue, L'Enfant Plaza, Voice of America, Capitol South, Marine Barracks, Potomac Avenue, Stadium-Armory, Oklahoma Avenue, Kenilworth Avenue, Deane Avenue, Cheverly, Landover, and Ardmore. Storage and inspection facilities are provided immediately east of the Kenilworth Avenue Station. A future extension is planned to Bowie, alignment to be determined.

#### Greenbelt Route

This route begins at the Gallery Place Station (7th and G Streets, Northwest) and proceeds northward in subway under 7th Street, thence northwestward under Massachusetts Avenue to 13th Street. The route continues northward in subway under 13th Street to Kansas Avenue, thence northeastward under Kansas Avenue, thence eastward under Farragut Street and Fort Totten, passing under the Glenmont Route in subway at the Fort Totten Station. The route then continues eastward on the surface in the median of the proposed Interstate Route 95 to the District of Columbia-Maryland boundary. In Maryland the route continues northeastward along the median of the proposed Interstate 95, thence on the surface, eastward generally parallel to and south of East-West Highway. After crossing under Belerest Road, the route proceeds eastward in subway passing under East-West Highway. The route continues in subway northeastward under Queens Chapel Road, thence eastward crossing under U.S. Route 1 south of Albion Road. From this point the route continues eastward, south of Albion Road, and crosses over the Baltimore and Ohio Railroad and proceeds northward on the surface along the east side of the Railroad. The route continues northward along the east side of the B&O Railroad to the terminal at Greenbelt Road. The following stations are provided: Gallery Place, Logan Circle, U Street, Columbia Heights, Georgia Avenue, Petworth, Fort Totten, Chillum, Prince Georges Plaza, College Park, and Greenbelt Road. Storage and inspection facilities are provided north of the Greenbelt terminal. A future extension is planned to Laurel, alignment to be determined.

Under study is an alternate routing for the mid-city portion of the Greenbelt Route. This alternate route would proceed northward in subway under 7th Street, thence westward under U Street, thence northward under 14th Street to the vicinity of Park Road, thence northeastward in subway and under Kansas Avenue as with the adopted route. Stations would be provided in the vicinity of 7th and M Streets, 7th and Rhode Island, 12th and U, and 14th and Park Road.

#### Branch Route

This route begins at the Gallery Place Station and proceeds southward in subway under 7th Street to Maine Avenue, S.W. From Maine Avenue the route proceeds eastward in subway under M Street to the vicinity of 6th Street, S.E., thence southeastward to pass under the Washington Navy Yard and the Anacostia River in subway to Nichols Avenue, thence eastward under Good Hope Road to Fort Stanton Park. The route then proceeds in subway first under a portion of Fort Stanton Park, then under private property to Naylor Road. Continuing southeastward the route proceeds in subway under Naylor Road to a portal south of 30th Street, S.E. The route then continues on the surface along the east side of Naylor Road, then crosses over Naylor Road to the District of Columbia-Maryland boundary. In Maryland the route continues, crossing over Suitland Parkway and Naylor Road, and proceeds eastward along the south side of Suitland Parkway crossing over Branch Avenue. From this point the route continues eastward on the surface and passes under Suitland Parkway, thence eastward on the surface generally parallel to Suitland Parkway. The route continues southeastward on the surface passing under Silver Hill Road, and then under Suitland Parkway, and proceeds on the surface across private property southward to a terminal at Branch Avenue. The following stations are provided: Pennsylvania Avenue, L'Enfant Plaza, Waterfront, Navy Yard, Anacostia, Alabama Avenue, Suitland Parkway, Federal Center, and Branch Avenue. A future extension is planned to Brandywine, alignment to be determined.



### Addison Route

This route begins at a junction with the Ardmore Route immediately east of the Kenilworth Avenue Station. From the junction the route proceeds eastward parallel to and north of Benning Road, over the Penn Central Railroad, the B&O Railroad and Minnesota Avenue to Fort Mahon Park. The route continues in subway under Fort Mahon Park to 42nd Street, N.E., then proceeds in subway generally under Benning Road and East Capitol Street to Central Avenue, thence southeastward in subway under Central Avenue to the District of Columbia-Maryland boundary. In Maryland the route continues eastward in subway under Central Avenue to a terminal at Addison Road. The following stations are provided: Benning Road, Capitol Heights, and Addison Road. A future extension is planned eastward to Largo, alignment to be determined.

### Franconia Route

This route begins at a junction with the Backlick Route, west of the Van Dorn Station and proceeds southward along the west side of the RF&P Railroad on the surface, passing under the Capital Beltway and continuing to a terminal at Franconia. The following station is provided: Franconia.

### Backlick Route

This route begins at a junction with the Huntington Route south of Duke Street and proceeds westward crossing under the Southern Railway and continues on the surface along the south side of the Southern Railway. The route then crosses over Cameron Run and continues westward on the surface parallel to and north of the Capital Beltway. The route then crosses over the RF&P Railroad and continues westward on the surface, first along the north side of the RF&P Railroad, and then along the north side of the Capital Beltway, thence under the Shirley Highway to a terminal at the Backlick Station located along the south side of the Southern Railway. The following stations are provided: Telegraph Road, Van Dorn, and Backlick Road. Storage and inspection facilities are provided west of Telegraph Road serving the Huntington and Franconia Routes in addition to this route. A future extension is planned to Burke, alignment to be determined.

### I-66 Route

This route begins at a junction with the Huntington Route south of the Rosslyn Station and proceeds westward in subway under 16th Street and Wilson Boulevard to Fairfax Drive. The route continues in subway under Fairfax Drive to a point west of Glebe Road where it enters the median of the proposed Interstate Route 66. The route continues westward on the surface on the median of interstate Route 66 to a terminal at Nutley Road. The following stations are provided: Court House, Clarendon, Nelson Street, Glebe Road, East Falls Church, Route 7, Gallows Road, and Nutley Road. Storage and inspection facilities are provided in the median of I-66 east of Route 7. A future extension is planned to Centreville, alignment to be determined.

### L'Enfant-Pentagon River Crossing

This route begins at a junction with the Branch Route, south of the L'Enfant Plaza Station and proceeds in subway under the Washington Channel to East Potomac Park. The route portals along the south side of the Penn Central Railroad and crosses over the Potomac River, on a bridge southeast of and adjacent to the Long Bridge, to the District of Columbia-Virginia boundary. The route then passes under the RF&P Railroad and proceeds in subway to a junction with the Huntington Route northeast of the Pentagon Station. No stations are provided on this route. A future extension is planned southwestward to Lincolnia alignment to be determined.

**Number of Stations, Route Miles and Parking Spaces  
by Route and Jurisdiction**

Route and Jurisdiction	Number of Stations	Miles Route	Parking Spaces
<b>Rockville</b>			
District of Columbia	7½	6.0	350
Montgomery County	6½	9.5	3,500
Total	14	15.5	3,850
<b>Glenmont</b>			
District of Columbia	7	7.2	2,450
Montgomery County	4	6.5	2,550
Total	11	13.7	5,000
<b>Greenbelt</b>			
District of Columbia	7	5.9	—
Prince George's County	4	5.1	2,000
Total	11	11.0	2,000
<b>Ardmore</b>			
District of Columbia	12	7.7	1,500
Prince George's County	3	4.5	3,000
Total	15	12.2	4,500
<b>Addison</b>			
District of Columbia	1½	1.8	25
Prince George's County	1½	1.2	625
Total	3	3.0	750
<b>Branch</b>			
District of Columbia	6	5.4	500
Prince George's County	3	3.1	2,500
Total	9	8.5	3,000
<b>L'Enfant</b>			
District of Columbia	—	1.4	—
Arlington	—	0.8	—
Total	—	2.2	—
<b>Huntington</b>			
District of Columbia	3	2.3	—
Arlington County	5	5.5	—
Alexandria	2	3.6	—
Fairfax County	1	0.4	2,000
Total	11	11.8	2,000
<b>Franconia</b>			
Fairfax County	1	1.2	1,000
Total	1	1.2	1,000
<b>Backlick</b>			
Alexandria	1½	1.5	1,500
Fairfax County	1½	5.1	2,500
Total	3	6.6	4,000
<b>I-66</b>			
Arlington County	5	5.9	500
Fairfax County	3	6.1	3,500
Total	8	12.0	4,000
<b>Total by Jurisdiction</b>			
District of Columbia	44	37.7	4,925
Montgomery County	10½	16.0	6,050
Prince George's County	11½	13.9	8,125
Arlington County	10	12.2	500
Fairfax County	6½	12.8	9,000
Alexandria	3½	5.1	1,500
Grand Totals	86	97.7	30,100

## TYPE OF EQUIPMENT

The Metro passenger car will be a comfortable, reliable, high-performance vehicle. Incorporated into the cars will be the latest proven engineering advances of equipment introduced recently in Chicago, Cleveland and Toronto and designed for use in San Francisco. A total of 658 vehicles will be required for full operation of the 97.7-mile system. Initial operations anticipated for 1972 will require 32 vehicles and the number will increase to 158 to provide service in 1974 when the 25-mile heart of the system is fully operative along with other elements of Metro. The cars will be 75 feet long, 10 feet wide, and 10 feet-8 inches high. Each will weigh approximately 75,000 pounds. They will rest on steel wheels, 28 inches in diameter, on standard gauge tracks. Top speed of the vehicles will be approximately 75 miles-per-hour with an acceleration-deceleration of 3 miles-per-hour-per-second. Cars will have a passenger capacity of 175. Seats will be provided for 81 and there will be ample room for standees. Except during rush hours, there will be sufficient seating for all patrons. Cars will be paired back-to-back with capability of reversing direction at ends of lines, omitting the requirement for turnaround loops. Maximum train length will be eight cars.

To test citizen reaction to the industrial design, the WMATA has transported a prototype vehicle throughout the region. More than 150,000 persons inspected the prototype, many of whom completed questionnaires designed to test individual reactions. The response was highly favorable. The prototype is air-conditioned, as will be the revenue vehicles. Louvered vents running the length of the ceiling permit conditioned air to flow across the top of the car and down the windows to maintain even temperatures without drafts. Six 50-inch-wide double doors permit ease of movement into and out of the car. Sculptured vinyl seats, two abreast, are installed. Other styles and shapes of seats will be tested as well as materials to ensure maximum comfort and durability and minimum maintenance requirements. Windows of the vehicle are 56 inches wide by 36 inches high. The glass is tinted for glare reduction and double-glazed for thermal and acoustical insulation. The car is evenly lighted by fluorescent fixtures hidden in recessed troughs. The carpeting, like the seats, will undergo testing for long wear under heavy duty circumstances.

The train control and communications system will reflect the ultimate proven techniques of the state of the art. Automatic train controls will permit the trains to operate with high precision and efficiency. Each train will be attended by an operator who can override the electronics when necessary. The capability for automatic operation will permit the operator to answer questions and supervise passenger activity. The operator will be able to communicate by radio with the train control supervisor. The automatic train control and communications systems will have three subsystems: (1) automatic train protection which guarantees the safety of passengers and equipment by regulating train speed and spacing, (2) automatic train operation which starts and stops trains and opens doors, and (3) automatic train supervision which monitors train performance throughout the system. The automatic fare collection systems will have fare vending equipment, money changers, fare gates, and agent encoders as basic equipment.

Commuters will be able to use a card containing stored values of fares or rides. Each gate will have capability to read and write on the cards allowing 40 patrons per minute to enter the system. Single-ride tickets, tokens or coins will also be accepted. Ticket vending machines will be provided at each station in the free area. Within the system will be vending machines capable of updating tickets that lack sufficient value to allow passengers to exit the system. Each station agent will have agent encoders to interpret tickets and issue new tickets automatically where needed. Still under study is a fare system that can relate the cards used on Metro to available low-unit-cost-bus fare collection equipment.

## DESIGN OF FACILITIES

Metro will be a visual asset to the National Capital region. All elements of the system will be designed so as to enhance the appearance of the area. The architectural concept has received the endorsement of the Commission of Fine Arts. It calls for station design in the District of Columbia to be in keeping with the classic public architecture of the federal city. A design goal is for optimum service and efficiency in a pleasant atmosphere. Platforms of all stations will be 600 feet long to accommodate eight-car trains. Approximately half of the stations will have side platforms while the other half will have center platforms. Sta-

tions will be spacious to facilitate the movement of large numbers of people swiftly and comfortably.

Within the vaulted subway stations, mezzanines and platforms will stand free of the gracefully-arched, coffered walls to avoid direct contact by patrons and for ease of maintenance. Fare collection and passenger services will be located on the mezzanines which will be cantilevered above the platforms. The mezzanines will provide a clear view of activity within stations at all times. There will be no hidden passageways. Escalators will transport passengers from surface to mezzanine and then to platform for boarding. Durable materials will be used throughout. Subsurface stations will be air-conditioned and extensive acoustical treatment will dampen the sounds of trains and patrons. Indirect lighting will emphasize the spaciousness of the facilities and provide a high level of brightness without harsh glare. Access facilities for the downtown portion of Metro will be situated in parks and squares and arcaded in buildings, wherever possible. In suburban areas, transit lines and stations will be designed to complement the distinguishing features of their environment. A site plan is being developed for each station with strong weight given to local community objectives as well as regional land use and development plans. Also being developed are special landscaping plans for each station and all support facilities. Stations will have convenient means for bus-rail transfer with special lanes provided for buses and taxis, where appropriate. Many stations will have large parking facilities to allow ease of transfer from private automobile to public transit.

#### TIMETABLE FOR PROVISION OF FACILITIES

Construction will begin approximately 75 days after Congressional appropriation of District of Columbia funds for this purpose. Two contracts for final engineering and architectural design have been concluded and are ready to be advertised for bids. Several others are nearing completion. Given the timely availability of construction money, initial operations will begin during the latter part of 1972 along the segment from Dupont Circle to Rhode Island Avenue via G Street, Union Station and the B&O Railroad. It is anticipated that the entire 97.7-mile system will be in full operation by 1980. Following is the schedule for phasing of operations of the Metro system:

Phase 1, December 1972. From north of the Dupont Circle Station on the Rockville Route to north of Rhode Island Avenue Station on the Glenmont Route.

Phase 2, December 1973. From north of Rhode Island Avenue Station to north of Silver Spring Station on the Glenmont Route and from south of the 12th and Independence Station to the Pentagon City Station on the Huntington Route.

Phase 3, December 1974. The Huntington Route south of Pentagon City including the Telegraph Rd. Yard; The I-66 Route from Rosslyn to the Court House Station; The Rockville Route between Dupont Circle and Parkside and the entire Ardmore Route.

Phase 4, December 1976. From the Court House Station to the Route 7 Station on the I-66 Route and from Chillum Station on the Greenbelt Route to Pentagon Station (2nd River Crossing included) and from L'Enfant Plaza to Waterfront Station.








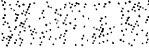
Phase 5, December 1978. From the Waterfront Station to Branch Avenue on the Branch Route, from Parkside Station to Rockville on the Rockville Route and from Route 7 Station to Nutley Station on the I-66 Route.

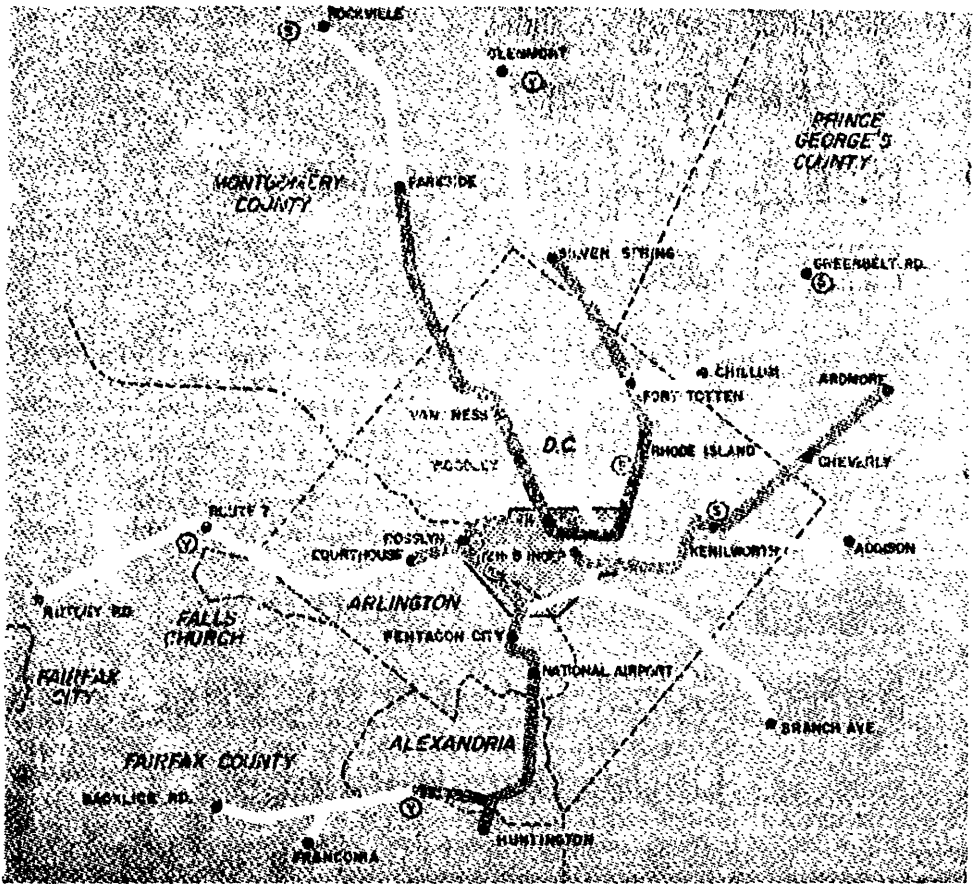
Phase 6, December 1979. From Chillum to Greenbelt Station on the Greenbelt Route, from north of Silver Spring to Glenmont Station on the Glenmont Route, from Kenilworth to Addison Road Station on the Addison Route, from the Telegraph Road Yard to Backlick Road Station on the Backlick Route and the Franconia Route.

## PROVISION OF FACILITIES

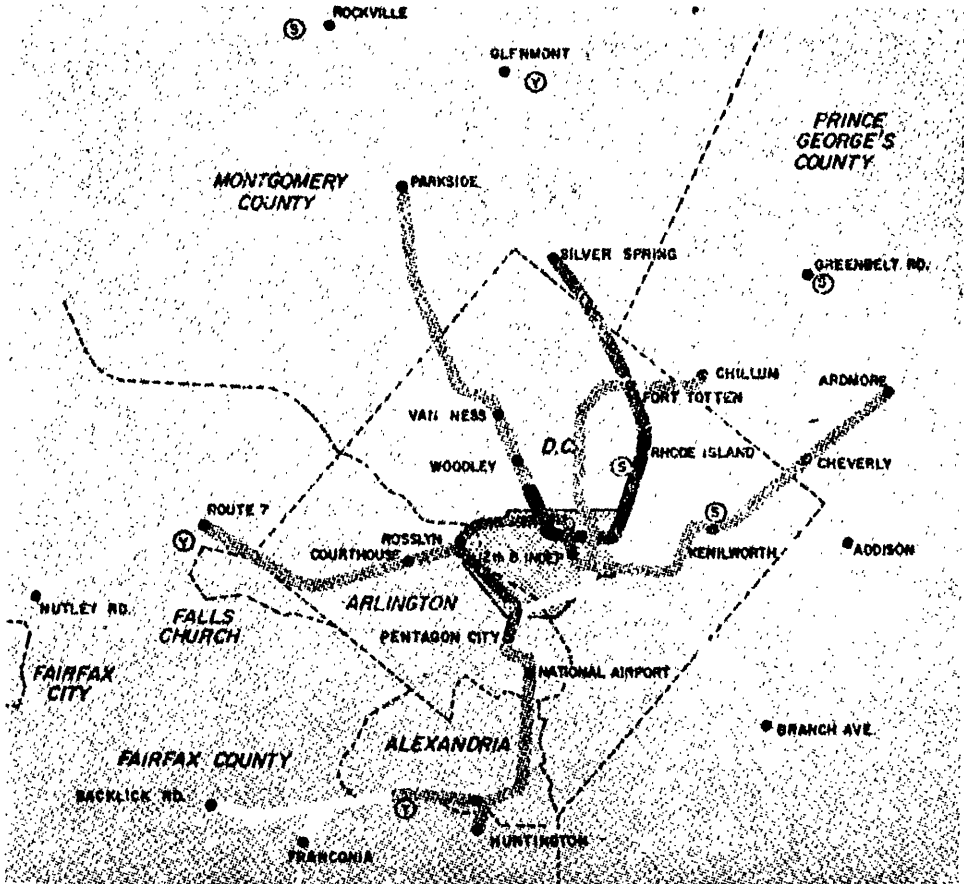
Substantial progress has been made in acquiring property, securing easements, and concluding agreements to permit the Transit Authority to construct the Metro in accordance with the adopted plan. To the maximum extent possible, public rights-of-way are utilized. When private property is needed, it is acquired by negotiated purchase or lease, as appropriate, or by condemnation, if necessary. A number of properties have been purchased by the Authority at a cost in excess of \$3 million. Agreements have been reached with other government agencies granting the Authority interests in real property. Businesses, individuals and families have been relocated from properties acquired by WMATA for construction of Metro. Negotiations are under way with private and governmental interests involving surface, sub-surface and aerial property rights and for the relocation of structures and other facilities, where necessary.

## Legend for Maps

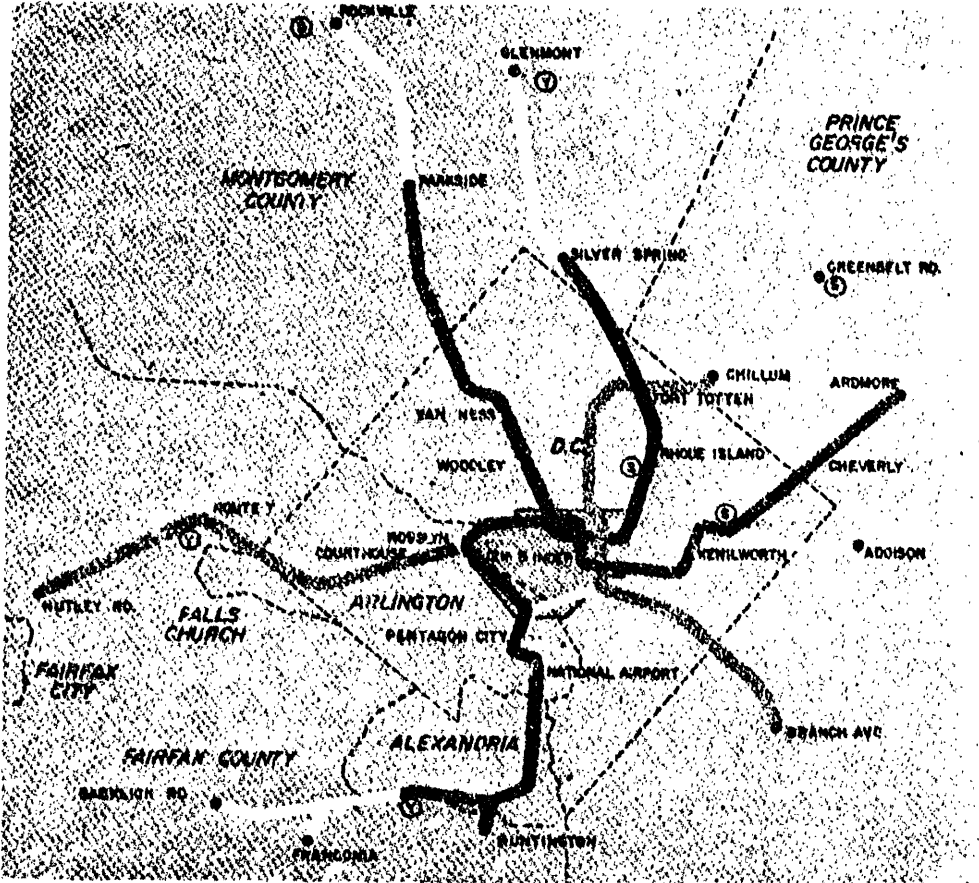
-  Modified Sector Zero
-  Metro
-  Station
-  Vehicle Storage
-  Maintenance Shop
-  Previously Constructed
-  Constructed in this Phase
-  Under Construction



Phase 1, 1972

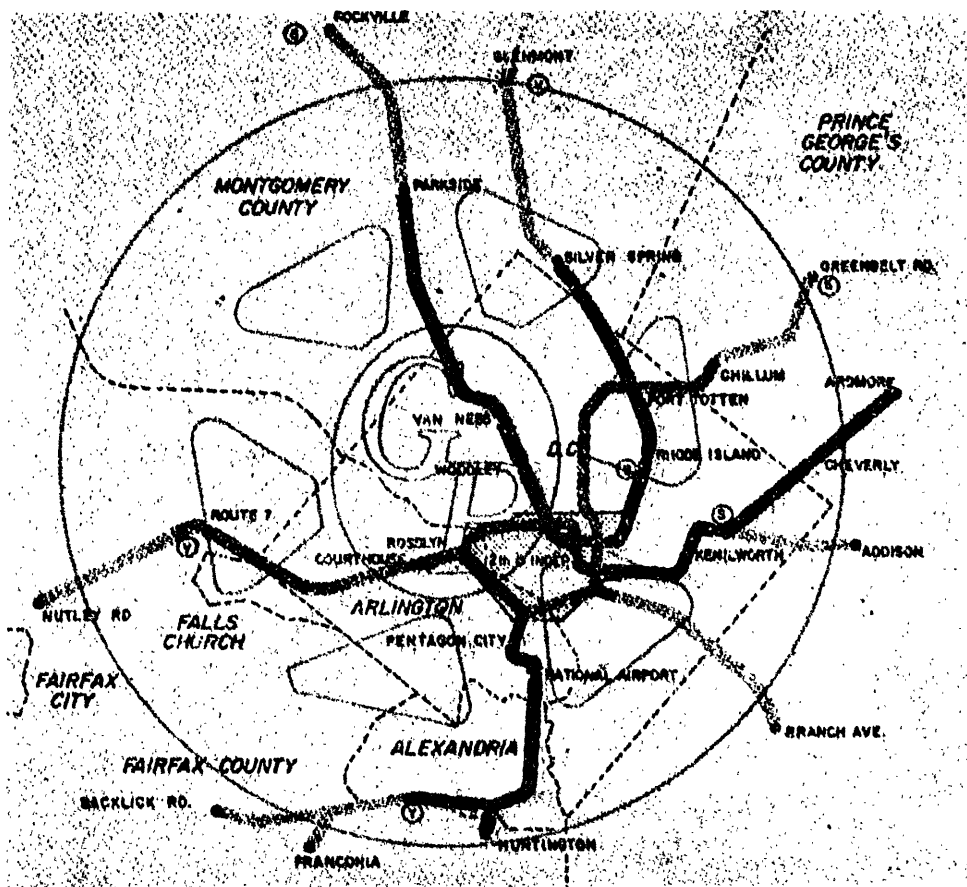


Phase 2, 1973

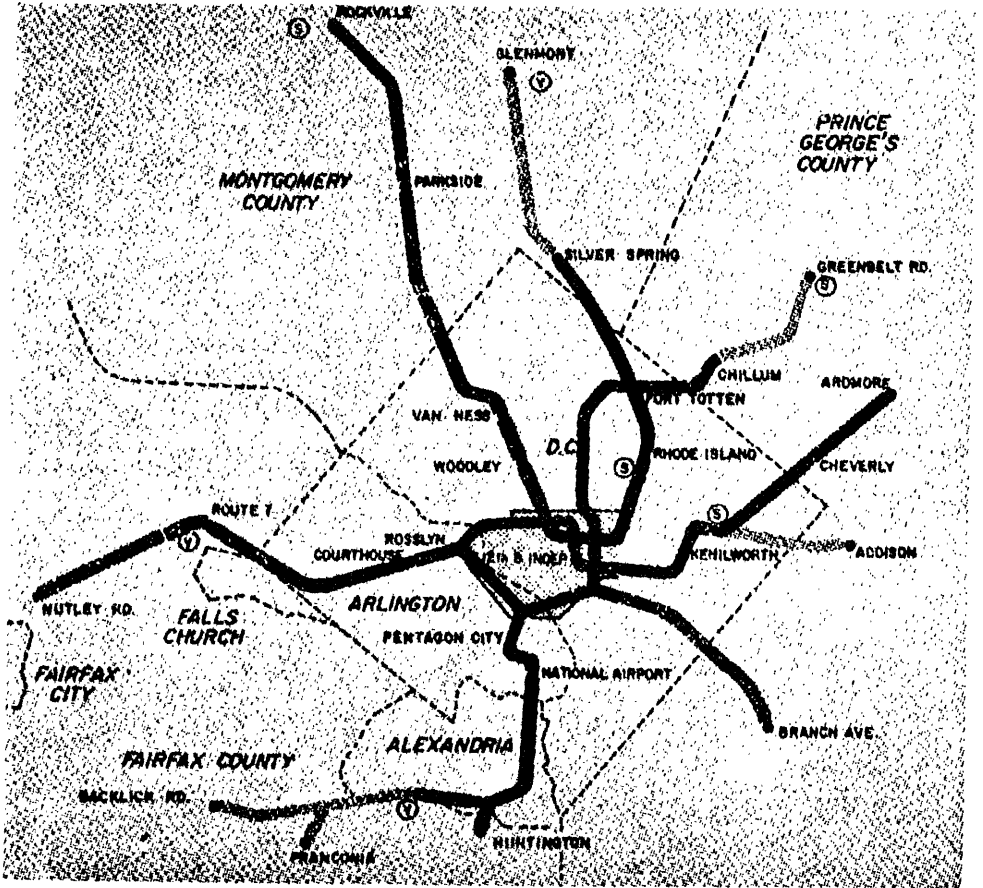


Phase 3, 1974

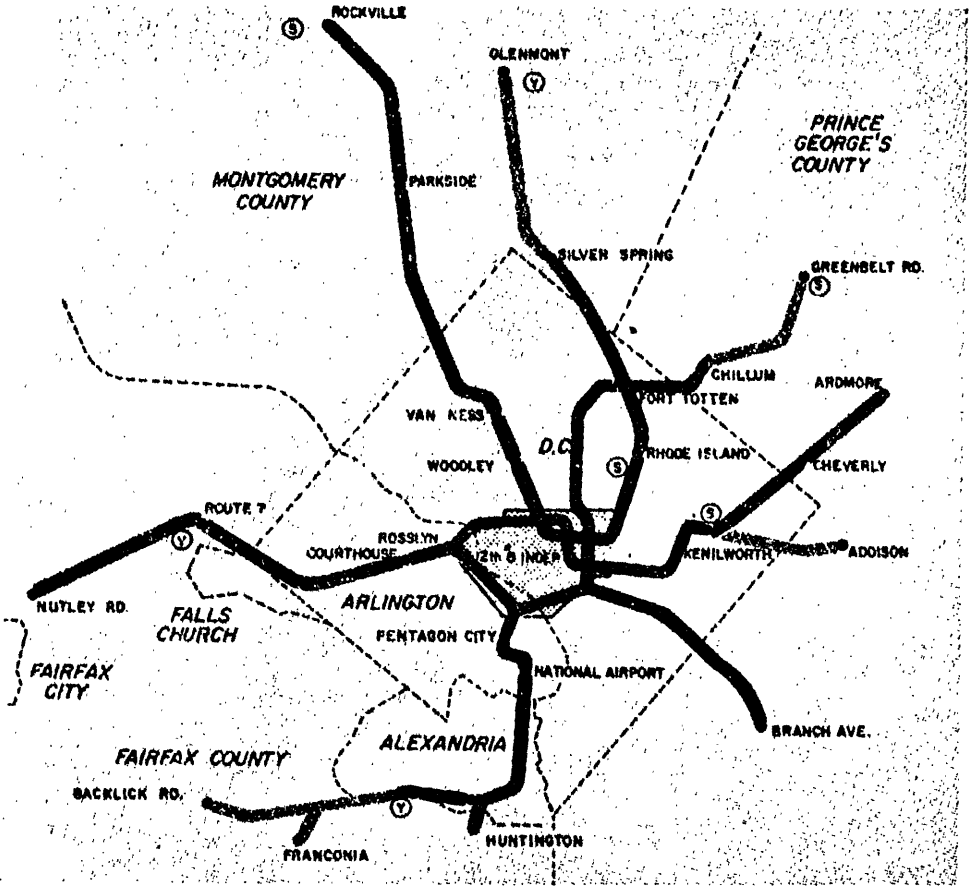




Phase 4, 1976



Phase 5, 1978



Phase 6, 1979



*Metro Subway Station*

## CAPITAL COST ESTIMATE

The cost of constructing and equipping the entire Metro system, based on detailed engineering analyses just concluded, is estimated as \$2.495 billion. The estimate was prepared using January, 1969, prices as the base cost. A sum equal to 14 per cent of the cost of all construction and equipment, excepting vehicles, was added to account for engineering and administrative services. A contingency factor equal to 10 percent of the cost of all structures and equipment was added. To anticipate future price increases, the total cost of the project was distributed over a 10-year construction period and escalated at a rate of five per cent, compounded annually. The result is an addition of \$535.4 million to the base year 1969 cost for escalation alone. In selecting the escalation factor to apply to the base year cost, each of the contributing elements were considered. The present upward trend in the cost of goods and services, the recent escalation of construction costs, rising interest rates and similar factors were weighed against the deflationary effect of such items as improved construction methods and machines and higher worker productivity. To determine base year construction costs of the principal items of major structures, quantities were taken from the plans and priced on the basis of the complete design.

Cost estimates for miscellaneous structures and facilities were developed for prototypes from preliminary plans and adjusted for variations in size, depth and site conditions. Linear foot costs developed for normal conditions were used in pricing some special construction activities where detailed costs were not attainable. Rights-of-way estimates for property acquisition were prepared by professional appraisers. Provision was made in the estimate for relocation costs and a 16 per cent factor was applied to cover such matters as title work, court costs and excess awards. For purposes of computing the estimates of construction costs, it was concluded that the optimum size of the construction contract should be in the range of \$10-to-\$20 million. This was done to generate maximum interest and competition among proficient and qualified contractors. Some contracts will be larger or smaller but most will be within this range. The structural contracts will include activities in the construction of heavy civil engineering works such as tunnels, sub-aqueous structures, elevated structures, bridges, embankments, underpinning, public and private utilities, maintenance and relocation of streets and highways, and hydraulic works. Preparatory work such as alterations to existing facilities is included in the structural contracts.

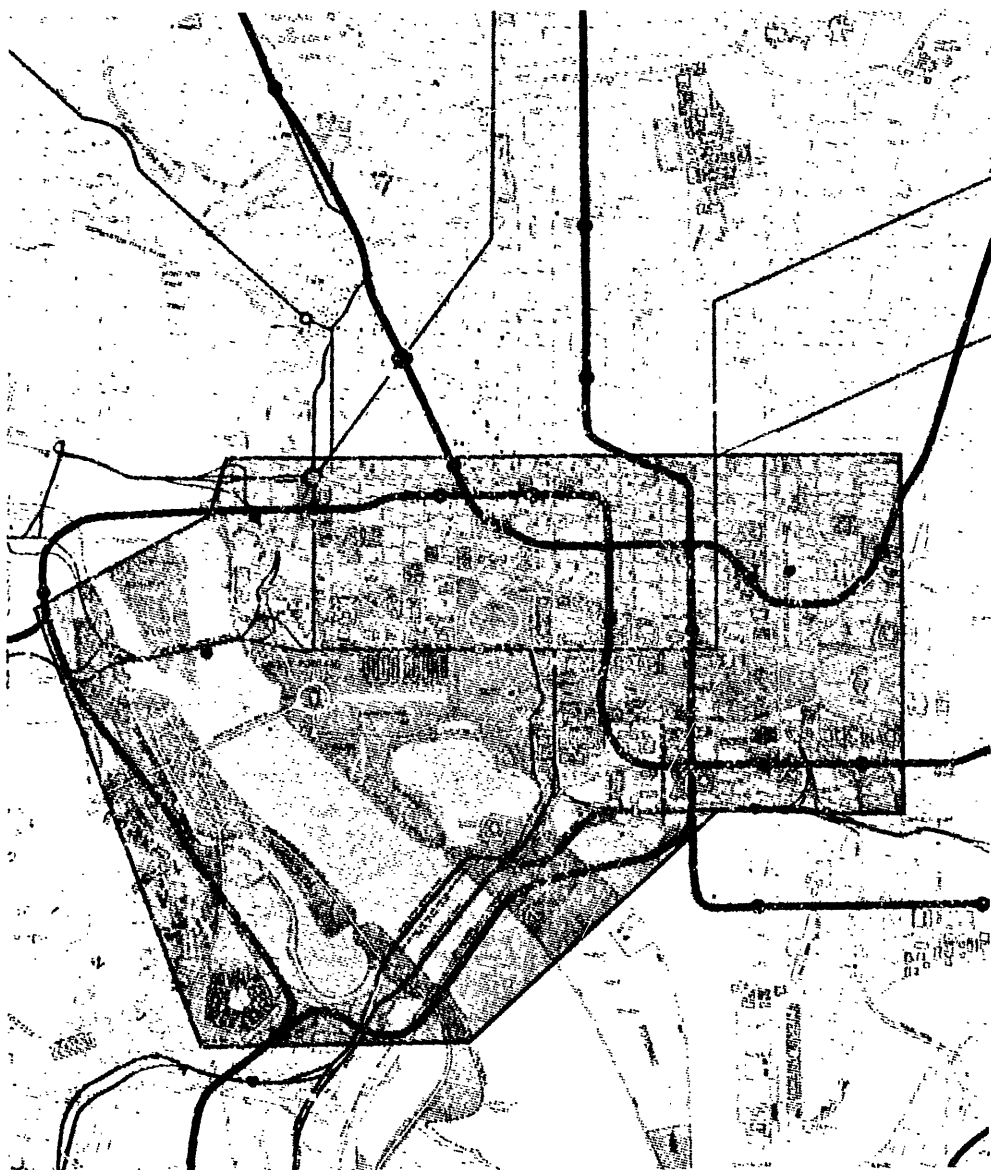
The finish contracts will involve installation of finish materials for floors and walls, equipment for electrical and mechanical facilities, service and connections, surface restoration and off-street paving after completion of structural contracts. Specialized finish contracts for such items as escalators, fare collection equipment and signing were considered separately, as were contracts for shops, vehicle service and yard facilities. Equipment contracts involve the supply and installation of major equipment items such as trackwork, traction power, train and supervisory control and communications, service and inspection, shop equipment and revenue and service vehicles. These are considered individually. Unit costs were developed to include the cost of labor, material, and equipment, as well as other contractor burdens such as payroll, insurance, taxes, overhead, and fee. Labor rates used are the preferred rates in current agreements between the trade unions and contractor associations. Material costs used are the prevailing costs in the area, or, in those instances where there are no prevailing costs, the best information available. In certain instances, the cost estimate for Metro facilities as planned is dependent upon construction of non-Metro facilities currently planned by other agencies. Prime examples are on the Greenbelt Route from Fort Totten Station to west of Prince Georges Plaza where Metro facilities are assumed to be in the median of I-95, and the I-66 route from a point west of Glebe Road Station where the Metro will be constructed in the median of I-66.

The mechanical engineering systems portion of the Metro will include ventilation, heating, air-conditioning, structural drainage, plumbing, fire protection, and escalators. These elements have been costed individually. The cost estimates provide for development and installation of train and supervisory control and communications systems and subsystems, including train operation, train protection and train supervision, two-way voice communications, closed-circuit television, safety fire and burglar systems and other elements such as track cross-overs and yard and terminal switches as will be required. Trackwork will com-

ply with appropriate standards consisting of continuous-welded rail for normal operations and heat-treated rail for short radius curves and special circumstances. The electrical systems are designed for safe, efficient, and continuous operation of the entire system with primary power supplied by the local electrical power companies. Electrical traction power will be supplied to the cars by means of a contact rail installed parallel to the running track. Spacing and capacity of traction power substations have been dictated by the demand of the operating schedules during peak periods. They are designed for an operating headway of 90 seconds even though the planned minimum headway is 120 seconds. These are the elements that were analyzed in detail in determining the estimate of total capital cost of Metro.

## Capital Cost by Type of Construction Route and Jurisdiction

Dollars (Millions)					
Route and Jurisdiction	Subway	Surface	Aerial	Other	Total
<b>Rockville</b>					
District of Columbia	101.9	—	—	20.1	122.0
Montgomery County	102.9	16.5	2.6	40.4	162.4
<b>Total</b>	<b>204.8</b>	<b>16.5</b>	<b>2.6</b>	<b>60.5</b>	<b>284.4</b>
<b>Glenmont</b>					
District of Columbia	10.1	23.9	5.4	35.3	74.7
Montgomery County	73.6	8.1	—	25.0	106.7
<b>Total</b>	<b>83.7</b>	<b>32.0</b>	<b>5.4</b>	<b>60.3</b>	<b>181.4</b>
<b>Greenbelt</b>					
District of Columbia	107.9	3.0	1.8	16.8	129.5
Prince Georges County	15.8	20.2	5.2	14.6	55.8
<b>Total</b>	<b>123.7</b>	<b>23.2</b>	<b>7.0</b>	<b>31.4</b>	<b>185.3</b>
<b>Ardmore</b>					
District of Columbia	46.4	6.9	10.9	15.3	79.5
Prince Georges County	—	19.3	3.7	10.1	33.1
<b>Total</b>	<b>46.4</b>	<b>26.2</b>	<b>14.6</b>	<b>25.4</b>	<b>112.6</b>
<b>Addison</b>					
District of Columbia	36.3	0.4	—	7.4	44.1
Prince Georges County	27.6	—	—	5.7	33.3
<b>Total</b>	<b>63.9</b>	<b>0.4</b>	<b>—</b>	<b>13.1</b>	<b>77.4</b>
<b>Branch</b>					
District of Columbia	96.4	0.5	0.3	18.2	115.4
Prince Georges County	3.6	14.3	3.8	8.9	30.6
<b>Total</b>	<b>100.0</b>	<b>14.8</b>	<b>4.1</b>	<b>27.1</b>	<b>146.0</b>
<b>L'Enfant</b>					
District of Columbia	—	—	—	—	—
Arlington County	—	—	—	—	—
<b>Total</b>	<b>—</b>	<b>—</b>	<b>—</b>	<b>—</b>	<b>—</b>
<b>Huntington</b>					
District of Columbia	5.1	—	—	0.4	5.5
Arlington County	48.5	3.0	6.9	12.5	70.9
Alexandria	—	13.5	4.8	9.5	27.8
Fairfax County	—	3.5	1.4	7.8	12.7
<b>Total</b>	<b>53.6</b>	<b>20.0</b>	<b>19.1</b>	<b>30.2</b>	<b>116.2</b>
<b>Franconia</b>					
Fairfax County	—	6.1	—	3.0	9.1
<b>Total</b>	<b>—</b>	<b>6.1</b>	<b>—</b>	<b>3.0</b>	<b>9.1</b>
<b>Backlick</b>					
Alexandria	1.9	7.4	—	6.8	16.1
Fairfax County	—	18.7	2.1	10.4	31.2
<b>Total</b>	<b>1.9</b>	<b>26.1</b>	<b>2.1</b>	<b>17.2</b>	<b>47.3</b>
<b>J-86</b>					
Arlington County	86.5	11.6	—	22.7	120.8
Fairfax County	—	30.7	—	14.7	45.4
<b>Total</b>	<b>86.5</b>	<b>42.3</b>	<b>—</b>	<b>37.4</b>	<b>166.2</b>
<b>Sector "Q"</b>					
District of Columbia	291.8	1.0	6.3	50.3	349.5
Arlington County	32.7	6.1	0.7	10.8	49.3
<b>Total</b>	<b>324.6</b>	<b>6.1</b>	<b>7.0</b>	<b>61.1</b>	<b>398.8</b>
<b>Total by Jurisdiction</b>					
District of Columbia	404.1	34.7	18.4	119.5	576.7
Montgomery County	178.5	24.6	2.6	65.4	269.1
Prince Georges County	47.0	53.6	12.7	39.3	152.6
Arlington County	135.0	14.6	6.9	35.2	191.7
Alexandria	1.9	20.9	4.8	16.3	43.9
Fairfax County	—	59.0	3.5	35.9	98.4
Sector "Q"	324.6	6.1	7.0	61.1	398.8
<b>Grand Total</b>	<b>1089.1</b>	<b>219.7</b>	<b>55.9</b>	<b>366.7</b>	<b>1725.4</b>
<b>Vehicle and Non Revenue Facilities</b>					<b>233.8</b>
<b>Escalation</b>					<b>538.4</b>
<b>Regional System Total</b>					<b>2498.6</b>



*Modified Sector Zero (Central Employment Area)*



## ESTIMATED RIDERSHIP

To measure Metro's revenue potential, an extensive analysis of ridership was undertaken utilizing the latest available regional data and most up-to-date proven computer techniques. To estimate ridership, certain basic assumptions were necessary regarding population and employment growth and levels of income. The following data developed by the Metropolitan Washington Council of Governments were utilized in the study:

Population of this area will increase from 2.0 million in 1960 to 3.5 million in 1980, and to 4.2 million in 1990. Most of this growth will be in the suburbs. The District of Columbia, Arlington County, Alexandria and Falls Church will continue to grow, but at a more modest rate.

Employment in the metropolitan area will increase from 1.0 million in 1965 to 1.4 million in 1975 and to 1.9 million in 1990.

Employment in the system's downtown area will increase from 273,000 in 1965 to 343,000 in 1975 and to over 500,000 in 1990.

The median income of the Washington area worker, set at \$4,050 in 1960, will increase by 40 per cent by 1990 to \$5,637 in 1960 constant dollars.

Also for study purposes, it was assumed that by 1975 a freeway system will be in place involving the complete inner loop network of the North, South, East and Center Legs, completion of I-66 and the Three Sisters Bridge across the Potomac, completion of the North Central Freeway, I-95 and a portion of the Northern Parkway in Maryland. By 1990, the assumed highway system will include the Outer Beltway, Monticello Freeway, extensions of the Indian Head Highway, Southeast Expressway and Central Avenue.

This basic information for 1990 was utilized in the traffic forecasting procedure to establish three categories of 1990 ridership estimates.

First: the volume of all 1990 trips that would be made to and from each of the 680 zones into which the metropolitan area is divided for the purpose of traffic analysis.

Second: the proportion of these trips that would be made by more than one mode of transportation (bus and rail, car and rail).

Third: the number of public transportation trips using the rapid rail transit system.

It was estimated that the percentage of persons using public transportation to downtown Washington in peak hours would be raised from an estimated 40 per cent in 1965 to 60 per cent of a larger population once the new system is introduced. This estimate is comparable to the percentages that prevail in other cities with rail transit systems. During the peak period, 86 per cent of all 1990 transit trips would use rail services for at least part of the trip, and 90 to 97 per cent of all trips originating in individual Maryland and Virginia suburbs would use the rail service. The analysis of total traffic demands in 1990 included data on passenger volumes for peak hours and for the average weekday as well as annual volumes. Total Metro ridership for the year 1990 is estimated at 292,610,000. Average weekday patronage amounts to 959,000 and the average for a peak two-hour morning period is 252,500. A clear majority of these patrons will use the combined bus-rail system. Total transit trips for the year 1990, including trips by bus only, is estimated at 348,830,000.

## PROBABLE FARES

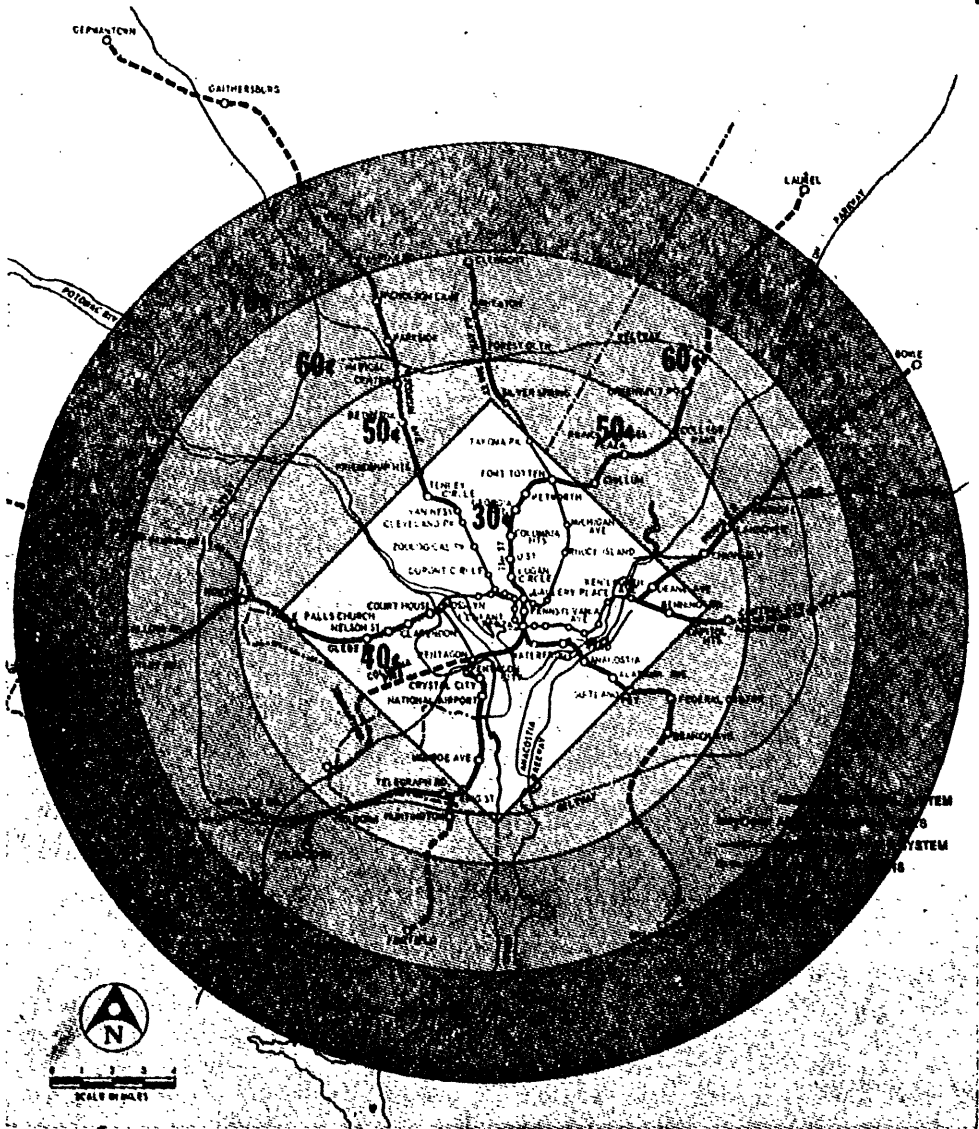
Three possible fare systems were analyzed: zone fare, flat fare, and mileage fare. To determine estimated revenue for Metro, a zone fare system was assumed. Concentric rings extending from the center of the 10-mile square were established for the purpose of assuming additional fare zones. The first ring has a radius of 8 $\frac{1}{4}$  miles from the center of the square. Additional rings are 3 $\frac{1}{3}$  miles apart. This fare structure was used in estimating passenger movements and in determining gross passenger revenues for 1990. The zone-fare system used in the study was assumed to apply to feeder buses as well as the rail system. Free transfer between bus and rail was also assumed. In all cases the base fare will be shared between the bus company and rail system when the rider uses both modes to complete a trip. Where zone boundaries are crossed, the incremental fare increase will be retained by the mode used to cross the zone. The base fare was assumed to be 30 cents with an incremental 10-cent fare per zone. Between the District of Columbia and Maryland the incremental fare was set at 20 cents.

The Potomac River was established as a 10-cent zone boundary except for retention of Rosslyn and the Pentagon within the central 30-cent fare zone. This fare system is comparable to the existing bus fares.

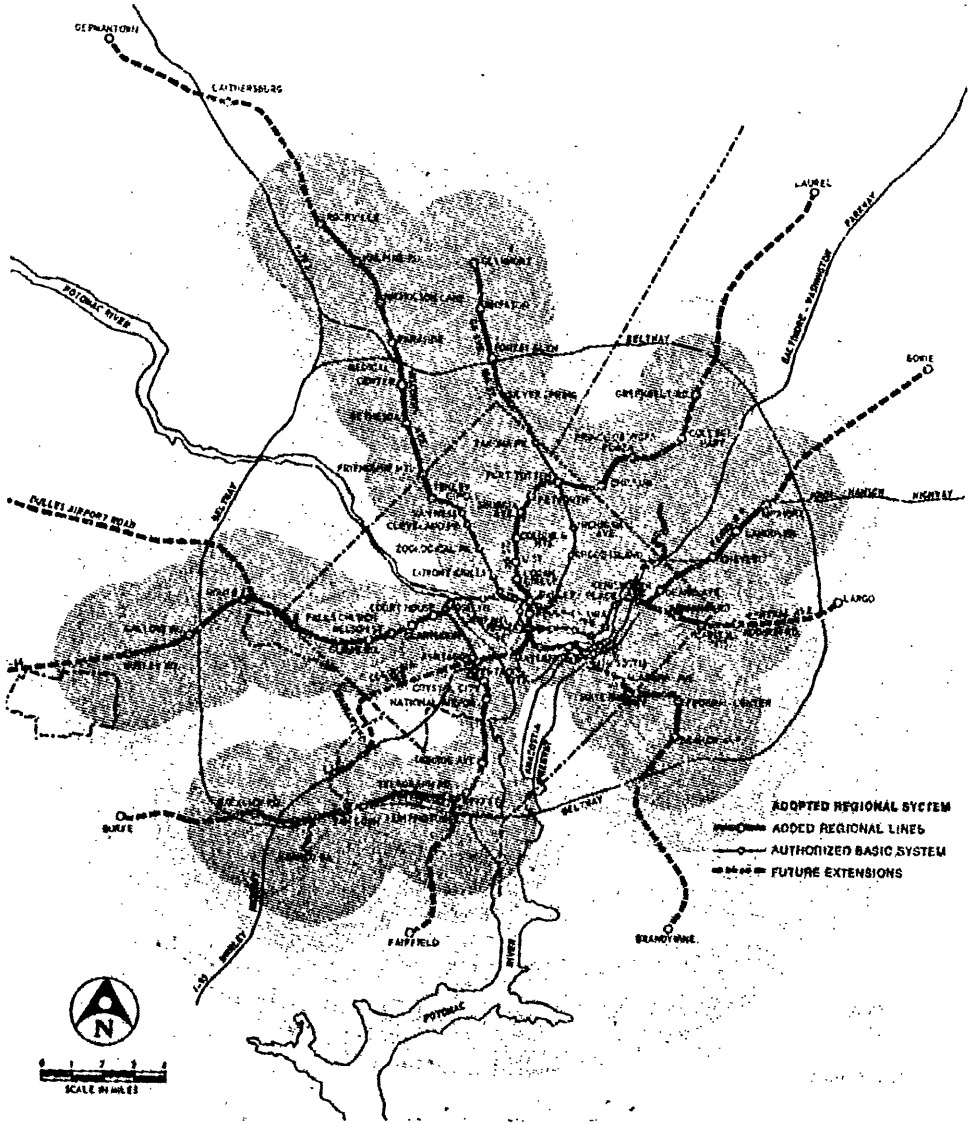
#### FEEDER BUS SERVICE

Metro patrons will have the added convenience of extensive feeder bus service, closely coordinated with rapid rail, providing wide coverage of the entire metropolitan area. Feeder bus routes will radiate to Metro stations from all sectors of the transit zone including remote areas not presently served by buses. The bus service will be sufficiently frequent and convenient that approximately 70 per cent of Metro's riders will arrive or depart from stations by feeder bus. Most Metro patrons will be within a 10-minute feeder bus ride of a rapid transit station. Because of the impact of rapid rail on the region's bus operations, and because coordination of the two modes is so vital to efficient transportation, extensive redesign of the present all-bus system was undertaken by WMATA for study purposes. Emphasis of the redesign was on altering the primary function of the buses from trunk line operations to feeder and local service operations with much greater attention given to cross-town and cross-county routes. The redesigned bus system was developed with the cooperation and assistance of the four local bus companies and the Washington Metropolitan Area Transit Commission.

Operating costs of the redesigned bus operations were analyzed in depth on the basis of vehicle hours, vehicle miles, vehicle requirements, and revenue passengers, utilizing latest available data on wages and other factors. Bus revenue estimates were developed on the basis of a zone fare structure involving a 50/50 split of base fares. The analysis projected operating revenues for the bus companies at a level of about 6 per cent above operating expenses. Current levels are about 4 per cent.



*Assumed Zone Fare System*



10-Minute Feeder Bus Service

## ESTIMATED OPERATING EXPENSES

Estimated operating costs are based on the physical characteristics of the system, the plan of operation, the standards of the Authority and practices of other systems. Cost estimates are broken down into separate categories: maintenance of way, maintenance of equipment, electrical and controls, transportation, power, general and administrative, and parking lots and landscaping. To obtain realistic estimates of operating costs, train operations were simulated for the entire Metro system. Personnel requirements based on safety and operating practices of the rapid transit industry were determined. Working rules and conditions as they affect operating costs were assumed to be those stated in the Agreement between D.C. Transit System, Inc., and Division 689 of the Amalgamated Transit Union. Employee benefits were assumed to be comparable with those of D.C. Transit. Proposed salaries were based on general salary levels in the transit industry and related to the level of responsibility and authority held. Wage rates were estimated using as a base point the wage rate in effect May 1, 1968, for bus operators of D.C. Transit. This rate was used for train operators. Where there were no comparable job classifications, wage rates were estimated on the basis of existing differentials on other rapid transit systems.

Material costs were estimated at mid-1968 price levels. The Authority anticipates that operation of the Metro system will be conducted by private enterprise under contract. A contingency factor of 5 per cent was added to computed operating costs. On power costs, a 10 per cent contingency was added. Both operating costs and fares were based upon comparable prices with the assumption that escalation would thus be neutralized. For purposes of the estimate, annual depreciation expense was calculated on the basis of 7.5 per cent of system gross revenues. This allowance covers replacement of vehicles as well as other depreciation expenses such as turnstiles, escalators, ticket booths and wiring. Total annual depreciation expenses are estimated to amount to \$6.7 million for 1990. Given all cost-of-operation factors, total annual operating expenses by 1990 are projected at \$32 million. Including depreciation, total operating expenses for 1990 will approximate \$38.7 million.

## Financial Forecasts: 1973-2030

Year	Gross Revenue	Operating Expenses	Net Revenue Before Depreciation (Thousands of Dollars)	Depreciation	Net Revenue After Depreciation
1973	2,700	3,700	(1,000)	—	(1,000)
74	15,100	8,800	6,300	1,132	5,168
75	39,700	15,300	24,400	2,978	21,422
76	44,400	15,300	29,100	3,330	25,770
77	53,000	20,500	32,500	3,975	28,525
78	60,800	23,600	37,200	4,560	32,640
79	65,400	24,600	40,800	4,905	35,895
1980	75,000	30,700	44,300	5,625	38,675
81	77,500	30,900	46,600	5,812	40,788
82	75,800	31,000	47,800	5,910	41,890
83	80,100	31,100	49,000	6,007	42,993
84	81,400	31,200	50,200	6,105	44,095
85	82,800	31,300	51,500	6,210	45,290
86	84,100	31,500	52,600	6,307	46,293
87	85,400	31,600	53,800	6,405	47,395
88	86,800	31,700	55,100	6,510	48,590
89	88,100	31,800	56,300	6,608	49,692
1990	89,400	32,000	57,400	6,705	50,695
91	90,300	32,100	58,200	6,772	51,428
92	91,200	32,200	59,000	6,840	52,160
93	92,000	32,300	59,700	6,900	52,800
94	92,900	32,300	60,600	6,968	53,632
95	93,800	32,400	61,400	7,035	54,365
96	94,700	32,500	62,200	7,102	55,098
97	95,600	32,600	63,000	7,170	55,830
98	96,500	32,700	63,800	7,238	56,562
99	97,400	32,700	64,700	7,305	57,395
2000	98,300	32,800	65,500	7,372	58,128
1	98,800	32,800	66,000	7,410	58,590
2	99,200	32,900	66,300	7,440	58,860
3	99,600	32,900	66,700	7,470	59,230
4	100,100	32,900	67,200	7,508	59,692
5	100,500	33,000	67,500	7,538	59,962
6	101,000	33,000	68,000	7,575	60,425
7	101,400	33,100	68,300	7,605	60,695
8	101,900	33,100	68,800	7,642	61,158
9	102,300	33,100	69,200	7,672	61,528
2010	102,800	33,200	69,600	7,710	61,890
11	103,200	33,200	70,000	7,740	62,260
12	103,700	33,300	70,400	7,778	62,622
13	104,100	33,300	70,800	7,808	62,992
14	104,600	33,400	71,200	7,845	63,355
15	105,000	33,400	71,600	7,875	63,725
16	105,400	33,400	72,000	7,905	64,095
17	105,900	33,500	72,400	7,943	64,457
18	106,300	33,500	72,800	7,973	64,827
19	106,800	33,600	73,200	8,010	65,190
2020	107,200	33,600	73,600	8,040	65,560
21	107,600	33,600	74,000	8,070	65,930
22	108,100	33,700	74,400	8,107	66,293
23	108,500	33,700	74,800	8,138	66,662
24	109,000	33,700	75,300	8,175	67,125
25	109,400	33,800	75,600	8,205	67,395
26	109,900	33,800	76,100	8,242	67,858
27	110,300	33,900	76,400	8,273	68,127
28	110,800	33,900	76,900	8,310	68,590
29	111,200	33,900	77,300	8,340	68,960
2030	111,700	34,000	77,700	8,378	69,322
<b>Total</b>	<b>5,289,500</b>	<b>1,783,400</b>	<b>3,506,100</b>	<b>396,511</b>	<b>3,109,589</b>

## ESTIMATED REVENUE

Total fare box revenue for the year 1990 is estimated at \$124.2 million. Anticipated allocation to the private bus companies for their share of bus-rail joint fares is \$37.9 million, resulting in net fare box revenue of \$86.3 million. It is estimated that revenue accruing from parking, concession leases and similar activities will amount to \$3.1 million for an adjusted gross revenue of \$89.4 million. Operating and maintenance expenses of \$32 million reduces the net revenue before depreciation to \$57.4 million. Net revenue after allowance for depreciation of \$6.7 million is \$50.7 million.

*Estimated income statement for year 1990*

[Millions of dollars]	
Total fare box revenue.....	124.2
Less bus fare split.....	37.9
	86.3
Net fare box revenue.....	86.3
Nonfare box revenue.....	3.1
	89.4
Adjusted gross revenue.....	89.4
Operating and maintenance expense.....	32.0
	57.4
Net revenue before depreciation.....	57.4
Depreciation expenses:	
Vehicles.....	5.4
Other.....	1.3
	6.7
Total.....	6.7
	6.7
Net revenue after depreciation.....	50.7

## FINANCIAL PLAN

The Metro financial program calls for capital costs to be financed, to the extent possible, through revenues from the operation of the system. The remaining costs are to be shared among the federal government and the local jurisdictions within the Washington Metropolitan Area Transit Zone. Cost of the system is estimated at \$2,494.6 million. Net interest during construction will amount to \$60.9 million, increasing the total project cost to \$2,555.5 million. Approximately one-third of the total project cost will be financed through system revenues. The Authority's financial consultants anticipate that net revenues of Metro will support issuance of revenue bonds during the construction period amounting to \$835 million. Revenue bonds issued by the Authority will have a maturity of less than 50 years and will be secured by a pledge of the gross revenues of the system. These bonds will have a coverage factor of 1.2 times net revenue before depreciation.

*Bond issue and grants needed to meet total project cost*

[Millions of dollars]	
Total cost of system.....	2,494.6
Net interest during construction.....	60.9
	2,555.5
Total project cost.....	2,555.5
Revenue bond issue.....	835.0
Net project cost.....	1,720.5
Federal share.....	1,147.0
Local share.....	573.5

A reserve for debt service will be built out of revenues during the period prior to the start of the sinking fund until such reserve equals one year's maximum debt service on all bonds outstanding. An average interest rate of five per cent for these tax-exempt revenue bonds has been assumed by the Authority's financial advisors. A sinking fund will be established to provide for the repayment of bonds. This fund will be in an amount sufficient to retire all bonds within 50 years of issue. Because revenue bonds are secured by a pledge of the gross revenues of the transit operations, provisions are made for meeting operating expenses in

the event of a deficiency in revenues to pay both debt service and operating costs. To provide for such contingency, long-term service contracts will be entered into with suburban transit commissions or local units of government under which each entity will contract with the Authority for transit services in and for its area. In return for such services, the compact members will pay an allocated share of any deficiency occurring in revenue available for operating expenses after paying interest and sinking fund obligations on the bonds. However the Authority's revenue and operating expense estimates indicate that these service contracts will not require any local funding.

The remaining net project cost—that amount not covered by revenue bonds—is to be shared by governments. It amounts to \$1,720.5 million. Under the Congressionally authorized federal-local matching formula for grants to construct the 25-mile basic system, the federal share is two-thirds of the net project cost. Extension of this formula to the Metro system would result in a total federal contribution of \$1,147 million or about 45 per cent of the total project cost. Legislation has been introduced in Congress to authorize federal participation in this financial plan. The legislation would authorize the Secretary of Transportation to contract with WMATA to allow the Authority to issue federal share bonds in the principal amount of \$1,047 million. This sum represents the total federal share, less the \$100 million already authorized and partially appropriated. These bonds, like the revenue bonds, would be issued during the construction period. Debt service would be provided through annual contributions by the federal government. The bonds, to mature in 30 years, would be issued in annual amounts not exceeding \$200 million and the interest yield would be subject to federal taxation as gross income. The matching formula for federal and local grants charges local governments with responsibility for \$573.5 million. The Authority has adopted a cost-allocation formula for sharing this local net project cost among the District of Columbia, Maryland and Virginia.

This formula grows out of four weighted considerations :

1. Proportion that the estimated construction cost within each signatory's area bears to the total estimated construction cost (40 per cent of the \$573.5 million of local net project cost is allocated to the three major jurisdictions on this basis).
2. Proportion that service provided—as measured by train miles and number of stations within each signatory's area—bears to the total service provided (30 per cent of the \$573.5 million of local net project cost is allocated to the three major jurisdictions on this basis).
3. Proportion that the estimated 1990 ridership originating in each signatory's area bears to the total system ridership (15 per cent of the \$573.5 million of local net project cost is allocated to the three major jurisdictions on this basis).
4. Proportion that the estimated 1990 population of each signatory's area bears to the total population of the Transit Zone (15 per cent of the \$573.5 million of local net project cost is allocated to the three major jurisdictions on this basis).

#### *Allocation of required member grants*

[Millions of dollars]		
Required grants.....		573.5
District of Columbia.....		208.7
Virginia.....		149.9
Alexandria.....	30.6	
Arlington County.....	54.0	
Fairfax County.....	61.9	
Fairfax City.....	2.6	
Falls Church.....	0.8	
Maryland.....		197.0
Montgomery County.....	110.4	
Prince Georges County.....	86.6	
Future allocation.....		17.9

For the purpose of computing the ratios in the first two factors, costs attributable to the central employment area, or Modified Sector Zero portion of the System, were separated from the total costs and redistributed among the three jurisdictions. This, in effect, permits Maryland and Virginia and the District of



Columbia to share equitably the costs of the essential central employment portion of the system which serves heavy volumes from all three jurisdictions.

Modified Sector Zero, the central employment area, is bounded on the north by L Street, N.W. and N.E.; on the east by First Street, N.E. and S.E.; on the south by the Southwest Freeway to the vicinity of Sixth Street, S.W.; thence southwesterly across the Potomac River to the D.C.-Virginia boundary; thence westerly to and including the Pentagon; on the west by a line from the Pentagon to the intersection of Wilson Boulevard and Fort Myer Drive; thence easterly across the Potomac River to Rock Creek; thence northerly along Rock Creek to L Street, N.W.

Sub-allocation formulae were adopted by the suburban transit commissions for distributing the Maryland and Virginia shares among the local jurisdictions in each transit district. No sub-allocation formula was needed in the District of Columbia.

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This analysis showed a decline in the total system cost resulting in a reduction of both federal and local grant requirements. It also resulted in variations in the amounts of local shares. Based on these refined data, the shares for Montgomery and Prince Georges Counties and the cities of Alexandria and Falls Church would be reduced. The shares for the District of Columbia, Fairfax and Arlington Counties and the City of Fairfax would be increased. In order to avoid delay at a daily escalation fee of about \$250,000, it was agreed that the financial plan should provide for each jurisdiction to enter into a commitment for the lesser amount of the two estimates. These commitments would guarantee 97 per cent of the required local grants, provide a satisfactory base for the sale of the Authority's revenue bonds and avoid penalizing the program in terms of lost time and added escalation costs.

Five years after the start of construction, or by July 1, 1974—whichever is later—further analysis of program costs will be undertaken. Net project costs then will be recomputed on the basis of the adopted formulae, utilizing latest available data. If, as a result of this analysis, the local net project cost exceeds \$555.6 million, the excess will be distributed among the jurisdictions in proportion that the increase in any jurisdiction bears to the total increase. Under this arrangement, each local jurisdiction will be legally committed to a minimum contribution and a procedure is provided for equitable allocation among jurisdictions of additional costs when they can be more definitively determined midway through the construction period. Thus, the legal commitment by each jurisdiction does not exceed the amount for which it has appropriate authorization thereby avoiding costly delay. With respect to any increase above these minimum amounts, each jurisdiction would pledge its faithful cooperation and best efforts to satisfy any increased allocation. Recomputation of cost estimates midway through the construction period will allow sufficient time for any additional local authorizations in the event they are required. Obligation of these funds would not be required until 1977. If delay were encountered for reasons now unforeseeable, temporary or short-term borrowings against accrued reserve fund revenues could be utilized to keep the construction program on schedule.

**WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY**  
**Calculation of Revenue Bonds and Capital Contribution Required to Finance Adopted Regional System**  
(000's omitted)

Fiscal year ending June 30	Financed by						Bond service			Net revenues before depreciation and bond service	5½% earned on bond reserve fund	Total available for bond service before depreciation
	Construction obligation	Capital contributions	Revenue Bonds (net) (a)	Interest earned on construction funds	System net revenues	Bonds outstanding	Interest at 5% (b)	Sinking fund	Total			
1969 and prior years	\$ 83,100	\$ 83,100										
1970	193,700	193,700										
1971	377,300	375,525		\$ 1,775								
1972	392,400	282,016	\$106,925	3,459		\$130,000						
1973	371,800	257,357	106,925	7,518		260,000				\$ (1,000)	\$ (1,000)	
1974	305,900	196,771	102,800	7,329	\$ (1,000)	385,000				6,300	6,300	
1975	250,100	135,540	102,800	6,592	5,168	510,000				24,400	24,400	
1976	225,900	102,036	102,800	6,080	14,984	635,000	\$ 6,500		\$ 6,500	29,100	\$ 358	29,458
1977	216,000	93,988	102,800	5,858	13,354	760,000	13,000		13,000	32,500	715	33,215
1978	78,400	533	61,700	5,768	10,399	835,000	19,250		19,250	37,200	1,059	38,259
1979						835,000	25,500		25,500	40,800	1,403	42,203
1980						835,000	31,750		31,750	44,300	1,746	46,046
1981						835,000	38,000		38,000	46,600	2,090	48,690
1982						835,000	41,750		41,750	47,800	2,296	50,096
1983						835,000	41,750	\$ 1,045	42,795	49,000	2,354	51,354
1984						833,955	41,698	2,145	43,843	50,200	2,411	52,611
1985						831,810	41,591	3,387	44,978	51,500	2,474	53,974
1986						828,423	41,421	4,518	45,939	52,600	2,527	55,127
1987						823,905	41,195	5,792	46,987	53,800	2,584	56,384
1988						818,113	40,906	7,216	48,122	55,100	2,647	57,747
1989						810,897	40,545	8,616	49,161	56,300	2,704	59,004
1990						802,281	40,114	9,047	49,161	57,400	2,704	60,104
1991						793,234	39,662	9,499	49,161	58,200	2,704	60,904
1992						783,735	39,187	9,974	49,161	59,000	2,704	61,704
1993						773,761	38,688	10,473	49,161	59,700	2,704	62,404
1994						763,288	38,164	10,997	49,161	60,600	2,704	63,304
1995						752,291	37,615	11,546	49,161	61,400	2,704	64,104
1996						740,745	37,037	12,124	49,161	62,200	2,704	64,904
1997						728,621	36,431	12,730	49,161	63,000	2,704	65,704
1998						715,891	35,795	13,366	49,161	63,800	2,704	66,504
1999						702,525	35,126	14,035	49,161	64,700	2,704	67,404
2000						688,490	34,425	14,736	49,161	65,500	2,704	68,204
2001						673,754	33,688	15,473	49,161	66,000	2,704	68,704
2002						658,281	32,914	16,247	49,161	66,300	2,704	69,004
2003						642,034	32,102	17,059	49,161	66,700	2,704	69,404
2004						624,975	31,249	17,912	49,161	67,200	2,704	69,904
2005						607,063	30,353	18,808	49,161	67,500	2,704	70,204
2006						588,255	29,413	19,748	49,161	68,000	2,704	70,704
2007						568,507	28,425	20,736	49,161	68,300	2,704	71,004
2008						547,771	27,389	21,772	49,161	68,800	2,704	71,504
2009						525,999	26,300	22,861	49,161	69,200	2,704	71,904
2010						503,138	25,157	24,004	49,161	69,600	2,704	72,304
2011						479,134	23,957	25,204	49,161	70,000	2,704	72,704
2012						453,930	22,697	26,464	49,161	70,400	2,704	73,104
2013						427,466	21,373	27,788	49,161	70,800	2,704	73,504
2014						399,678	19,984	29,177	49,161	71,200	2,704	73,904
2015						370,501	18,525	30,636	49,161	71,600	2,704	74,304
2016						339,865	16,993	32,168	49,161	72,000	2,704	74,704
2017						307,697	15,385	33,776	49,161	72,400	2,704	75,104
2018						273,921	13,696	35,465	49,161	72,800	2,704	75,504
2019						238,456	11,923	37,238	49,161	73,200	2,704	75,904
2020						201,218	10,061	39,100	49,161	73,600	2,704	76,304
2021						162,118	8,106	41,033	49,139	74,000	2,703	76,703
2022						121,085	6,054	35,399	41,453	74,400	2,280	76,680
2023						85,686	4,284	29,530	33,814	74,800	1,860	76,660
2024						56,156	2,808	23,585	26,393	75,300	1,452	76,752
2025						32,571	1,629	17,440	19,069	75,600	1,049	76,649
2026						15,131	757	10,999	11,756	76,100	647	76,747
2027						4,132	207	4,339	4,339	76,400	239	76,639
<b>Totals</b>	<b>\$2,494,600</b>	<b>\$1,720,566</b>	<b>\$686,750</b>	<b>\$44,379</b>	<b>\$42,905</b>		<b>\$1,372,529</b>	<b>\$835,000</b>	<b>\$2,207,529</b>	<b>\$3,274,200</b>	<b>\$121,422</b>	<b>\$3,395,622</b>

Notes: (a) Bond proceeds assumed to be available to meet obligations during last quarter of preceding fiscal year indicated.  
(b) Interest is paid from bond proceeds for first four years of each issue.  
(c) Includes interest earned at 5½% on accumulated depreciation reserve.  
(d) Equals bond service in following year.  
(e) Applied to meet a portion of construction obligations in following year.

Interest at 5% (b)	Bond service		Net revenues before depreciation and bond service	5½% earned on bond reserve fund	Total available for bond service before depreciation	Times bond service earned	Total available for bond service after depreciation (c)	Times bond service earned	Bond reserve fund		Balance available for replacements & improvements		Fiscal Year ending June 30
	Sinking fund	Total							Current payment	Cumulative total (d)	Current	Cumulative	
			\$ (1,000)		\$ (1,000)		\$ (1,000)		\$6,500	\$ 6,500	\$ (1,000)		1969 and prior years 1970
			6,300		6,300		5,168				5,168 (e)		1971
			24,400		24,400		21,484				14,984 (e)		1972
\$ 6,500		\$ 6,500	29,100	\$ 358	29,458		26,354		6,500	13,000	13,354 (e)		1973
13,000		13,000	32,500	715	33,215		29,649		6,250	19,250	10,399 (e)		1974
19,250		19,250	37,200	1,059	38,259		34,327		6,250	25,500	8,827	\$ 8,827	1975
25,500		25,500	40,800	1,403	42,203		38,177		6,250	31,750	6,427	15,254	1976
31,750		31,750	44,300	1,746	46,046		41,569		6,250	38,000	3,569	18,823	1977
38,000		38,000	46,600	2,090	48,690		44,336		3,750	41,750	2,586	21,409	1978
41,750		41,750	47,800	2,296	50,096	1.20x	45,963	1.10x	1,045	42,795	3,168	24,577	1979
41,750	\$ 1,045	42,795	49,000	2,354	51,354	1.20	47,449	1.11	1,048	43,843	3,606	28,183	1980
41,698	2,145	43,843	50,200	2,411	52,611	1.20	47,998	1.09	1,135	44,978	3,020	31,203	1981
41,591	3,387	44,978	51,500	2,474	53,974	1.20	49,580	1.10	961	45,939	3,641	34,844	1982
41,421	4,518	45,939	52,600	2,527	55,127	1.20	50,944	1.11	1,048	46,987	3,957	38,801	1983
41,195	5,792	46,987	53,800	2,584	56,384	1.20	52,414	1.12	1,135	48,122	4,292	43,093	1984
40,906	7,216	48,122	55,100	2,647	57,747	1.20	53,906	1.12	1,039	49,161	4,745	47,838	1985
40,545	8,616	49,161	56,300	2,704	59,004	1.20	55,120	1.12	—	49,161	5,959	53,797	1986
40,114	9,047	49,161	57,400	2,704	60,104	1.22	55,938	1.14	—	49,161	6,777	60,574	1987
39,662	9,499	49,161	58,200	2,704	60,904	1.24	56,978	1.16	—	49,161	7,817	68,391	1988
39,187	9,974	49,161	59,000	2,704	61,704	1.26	57,895	1.18	—	49,161	8,734	77,125	1989
38,688	10,473	49,161	59,700	2,704	62,404	1.27	58,485	1.19	—	49,161	9,324	86,449	1990
38,164	10,997	49,161	60,600	2,704	63,304	1.29	59,630	1.21	—	49,161	10,469	96,918	1991
37,615	11,546	49,161	61,400	2,704	64,104	1.30	60,545	1.23	—	49,161	11,384	108,302	1992
37,037	12,124	49,161	62,200	2,704	64,904	1.32	61,597	1.25	—	49,161	12,436	120,738	1993
36,431	12,730	49,161	63,000	2,704	65,704	1.34	62,650	1.27	—	49,161	13,489	134,227	1994
35,795	13,366	49,161	63,800	2,704	66,504	1.35	63,518	1.29	—	49,161	14,357	148,584	1995
35,126	14,035	49,161	64,700	2,704	67,404	1.37	64,678	1.32	—	49,161	15,517	164,101	1996
34,425	14,736	49,161	65,500	2,704	68,204	1.39	65,740	1.34	—	49,161	16,579	180,680	1997
33,688	15,473	49,161	66,000	2,704	68,704	1.40	66,533	1.35	—	49,161	17,372	198,052	1998
32,914	16,247	49,161	66,300	2,704	69,004	1.40	67,136	1.37	—	49,161	17,975	216,027	1999
32,102	17,059	49,161	66,700	2,704	69,404	1.41	67,469	1.37	—	49,161	18,308	234,335	2000
31,249	17,912	49,161	67,200	2,704	69,904	1.42	67,004	1.36	—	49,161	17,843	252,178	2001
30,353	18,808	49,161	67,500	2,704	70,204	1.43	65,135	1.32	—	49,161	15,974	268,152	2002
29,413	19,748	49,161	68,000	2,704	70,704	1.44	65,935	1.34	—	49,161	16,774	284,926	2003
28,425	20,736	49,161	68,300	2,704	71,004	1.44	65,925	1.34	—	49,161	16,764	301,690	2004
27,389	21,772	49,161	68,800	2,704	71,504	1.45	64,921	1.32	—	49,161	15,760	317,450	2005
26,300	22,861	49,161	69,200	2,704	71,904	1.46	65,631	1.34	—	49,161	16,470	333,920	2006
25,157	24,004	49,161	69,600	2,704	72,304	1.47	65,667	1.34	—	49,161	16,506	350,426	2007
23,957	25,204	49,161	70,000	2,704	72,704	1.48	66,380	1.35	—	49,161	17,219	367,645	2008
22,697	26,464	49,161	70,400	2,704	73,104	1.49	67,086	1.36	—	49,161	17,925	385,570	2009
21,373	27,788	49,161	70,800	2,704	73,504	1.50	66,861	1.36	—	49,161	17,700	403,270	2010
19,984	29,177	49,161	71,200	2,704	73,904	1.50	67,572	1.37	—	49,161	18,411	421,681	2011
18,525	30,636	49,161	71,600	2,704	74,304	1.51	68,290	1.39	—	49,161	19,129	440,810	2012
16,993	32,168	49,161	72,000	2,704	74,704	1.52	69,011	1.40	—	49,161	19,850	460,660	2013
15,385	33,776	49,161	72,400	2,704	75,104	1.53	69,650	1.42	—	49,161	20,489	481,149	2014
13,696	35,465	49,161	72,800	2,704	75,504	1.54	70,121	1.43	—	49,161	20,960	502,109	2015
11,923	37,238	49,161	73,200	2,704	75,904	1.54	70,343	1.43	—	49,161	21,182	523,291	2016
10,061	39,100	49,161	73,600	2,704	76,304	1.55	71,069	1.45	(22)	49,139	21,930	545,221	2017
8,106	41,033	49,139	74,000	2,703	76,703	1.56	71,672	1.46	(7,686)	41,453	30,219	575,440	2018
6,054	35,399	41,453	74,400	2,280	76,680	1.85	71,609	1.73	(7,639)	33,814	37,795	613,235	2019
4,284	29,530	33,814	74,800	1,860	76,660	2.27	71,919	2.13	(7,421)	26,393	45,526	658,761	2020
2,808	23,585	26,393	75,300	1,452	76,752	2.91	72,202	2.74	(7,324)	19,069	53,133	711,894	2021
1,629	17,440	19,069	75,600	1,049	76,649	4.02	72,432	3.80	(7,313)	11,756	60,676	772,570	2022
757	10,999	11,756	76,100	647	76,747	6.53	72,858	6.20	(7,417)	4,339	68,519	841,089	2023
207	4,132	4,339	76,400	239	76,639	17.66	72,897	16.80	(4,339)	—	72,897	913,986	2024
\$1,372,529	\$835,000	\$2,207,529	\$3,274,200	\$121,422	\$3,395,622		\$3,165,420				\$913,986		

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Modified Sector Zero, the central employment area, is bounded on the north by L Street, N.W. and N.E.; on the east by First Street, N.E. and S.E.; on the south by the Southwest Freeway to the vicinity of Sixth Street, S.W.; thence southwesterly across the Potomac River to the D.C.-Virginia boundary; thence westerly to and including the Pentagon; on the west by a line from the Pentagon to the intersection of Wilson Boulevard and Fort Myer Drive; thence easterly across the Potomac River to Rock Creek; thence northerly along Rock Creek to L Street, N.W.

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Five years after the start of construction, or by July 1, 1974—whichever is later—further analysis of program costs will be undertaken. Net project costs then will be recomputed on the basis of the adopted formulae, utilizing latest available data. If, as a result of this analysis, the local net project cost exceeds \$555.6 million, the excess will be distributed among the jurisdictions in proportion that the increase in any jurisdiction bears to the total increase. Under this arrangement, each local jurisdiction will be legally committed to a minimum contribution and a procedure is provided for equitable allocation among jurisdictions of additional costs when they can be more definitively determined midway through the construction period. Thus, the legal commitment by each jurisdiction does not exceed the amount for which it has appropriate authorization thereby avoiding costly delay. With respect to any increase above these minimum amounts, each jurisdiction would pledge its faithful cooperation and best efforts to satisfy any increased allocation. Recomputation of cost estimates midway through the construction period will allow sufficient time for any additional local authorizations in the event they are required. Obligation of these funds would not be required until 1977. If delay were encountered for reasons now unforeseeable, temporary or short-term borrowings against accrued reserve fund revenues could be utilized to keep the construction program on schedule.

## CONCLUSION

Congress determined years ago that rapid rail transit is a desirable investment for the National Capital Region. In referenda last November, voters of the region attested strongly to the desirability of the adopted plan and program. Now a team of independent economic analysts have concluded that Metro is a sound financial investment—one that will produce benefits three times greater than its net cost. The four-month scientific investigation of benefits and costs of the adopted regional rapid rail transit system testifies to the wisdom of the Congressional recommendation and the voter endorsement. Here are some of the major findings of the economic analysis of Metro:

(1) The National Capital Region is ideally suited for rapid rail transit. Its unique combination of characteristics with its strong downtown, relatively compact suburban areas, and traditionally high transit ridership results in benefits unmatched by any other city in the nation.

(2) Measurable cumulative benefits, developed by projecting both benefits and costs over the life of the project and discounting both to present day, will achieve a benefit-to-cost ratio of over 3 to 1 with the break-even point occurring in 1982. These benefits generally can be ascribed to the continuing or constant transit user, to motorists using the transit system, to motorists not using transit, and to the business community. The federal government as the region's principal employer is a prime beneficiary.

(3) Introduction of Metro into the National Capital Region will have broad, positive implications for the social environment and overall well-being of the region. By increasing urban capacity while allowing orderly suburban growth, by opening accessibility to employment opportunities for the disadvantaged, by providing adequate transportation for the young and aged and others dependent upon public transportation, by broadening educational opportunities, and by making cultural and recreational sites more accessible, transit will create additional substantial, if nonmeasurable, benefits.

(4) Implementation of the adopted regional rapid rail transit system is a sound and profitable investment for the federal establishment and for the local governments of the Washington region. Congress and the local area leaders have long recognized social and economic benefits that would accrue from the implementation of rapid rail transit. Among the general benefits cited in the past are the following:

Promotion of orderly growth in suburban areas along well-defined and carefully planned lines.

Greater ease of movement into and out of downtown Washington and throughout the region.

Lessening of surface traffic congestion in the city and on the major thoroughfares of the region.

More efficient utilization of parking spaces in the central city.

Access to jobs in the suburbs for residents of the inner city, and greater work force selection for suburban employers.

A stimulus to tourism in the national capital area.

Attraction of new business and industry and expansion of job opportunities.

Creation of thousands of jobs by the construction of the system and its operation.

Opening of new population centers.

De-emphasis of the dependence on surface vehicles for movement in the heart of the city.

Better and more efficient use of existing transportation facilities, both public and private.

Broadening of tax bases.

Enhancement of real estate values throughout the region.

A recognition of Washington's leadership role in matters of public interest, and a reaffirmation of the growth of what is already the nation's fastest growing major metropolitan region.

Washington's rapid growth demands early implementation of a balanced transportation system involving rapid rail transit, bus service, and an efficient freeway network. Metro is a vital element of such a balanced system. Referenda results attest to the wide public support of Metro. Congressional support is well documented. The action phase is now.

**Metro is ready.**

## CHRONOLOGY

July 19, 1962	Congress passes National Capital Planning Act authorizing studies of regional transportation.	February 19, 1968	D.C. Commissioners endorse interstate compact legislation.
March, 1964	Maryland and Virginia join D.C. in joint commission to study Washington area passenger carrier facilities.	August 29, 1968	Senate consents to compact legislation.
April 22, 1955	Congress funds half-million-dollar Mass Transportation Survey.	October 7, 1968	House consents to compact legislation.
July 1, 1958	Mass Transportation Survey completed; cites need for regional rapid rail by 1980.	November 6, 1968	Legislation signed creating the Washington Metropolitan Area Transit Authority.
March 14, 1960	Legislation introduced to create National Capital Transportation Agency.	November 17, 1968	Maryland executes compact.
May 3 & 8, 1960	Joint Congressional Committee holds hearings on legislation.	November 22, 1968	D.C. and Virginia execute compact.
July 14, 1960	National Capital Transportation Act enacted creating NCTA to begin developing a rapid rail system.	February 20, 1967	Washington Metropolitan Area Transit Authority officially comes into existence.
September, 1960	Congress appropriates \$250,000 for NCTA's first budget.	July 12, 1967	Legislation introduced to modify and improve the 1965 transit system.
November 3, 1962	NCTA completes Transit Development Program proposing 87 miles of regional rapid rail transit.	October 1, 1967	The Washington Metropolitan Area Transit Authority assumes responsibility from NCTA for transit development.
May 27, 1963	NCTA Plan submitted to Congress.	October 20, 1967	WMATA Board of Directors unanimously approves a Proposed Regional Rapid Rail Transit System.
June, 1963	Legislation introduced to implement transit portion of NCTA plan.	December 26, 1967	Legislation enacted modifying the 1965 transit system.
December 4, 1963	House District Committee approves revised transit plan.	January 10, 1968	WMATA Board begins official hearings in the District of Columbia, Virginia, and Maryland on the proposed system.
December 9, 1963	House of Representatives recommit's transit legislation.	March 1, 1968	WMATA Board unanimously adopts a 97.2-mile regional system.
March, 1964	Virginia establishes the Northern Virginia Transportation District, a Commission of members from governing bodies of Northern Virginia.	March 17, 1968	Maryland Legislature authorizes Prince Georges County to issue \$86 million in bonds for Metro construction costs.
February 10, 1965	Legislation to authorize a 25-mile basic rapid transit system introduced in Congress.	August 10, 1968	Construction funds for rapid rail withheld by D.C. Appropriations Subcommittee pending resolution of freeway impasse.
March, 1965	Maryland approves interstate compact calling for creation of Washington Metropolitan Area Transit Authority.	August 19, 1968	Montgomery County Council authorizes issuance of \$116 million in bonds for its share of Metro construction costs.
March, 1965	Maryland establishes the Washington Suburban Transit District, a Commission of officials of Montgomery and Prince Georges Counties.	October 21, 1968	Congress appropriates \$3.2 million in D.C. funds for fiscal year 1969, releasing \$6.3 million in already appropriated federal matching money but restricts use to non-construction items.
July 19, 1965	House approves transit authorization legislation without amendment.	November 5, 1968	72 per cent of voters in jurisdictions holding referendum authorize bonds for local shares of Metro costs.
August 23, 1965	Senate approves transit authorization legislation without amendment.	January 15, 1969	Fiscal Year 1970 budget requests appropriation of \$8.2 million to support federal share bonds (totaling \$82.9 million); included is request for \$22.9 million of District of Columbia money.
September 8, 1965	Congress receives request for first NCTA appropriation.	January 17, 1969	\$18.7 million in D.C. funds for transit construction requested in Fiscal Year 1969 supplemental.
October 14, 1965	House appropriates funds for start of NCTA program.	January 23, 1969	Legislation introduced to authorize federal share bonds for financing federal participation in the net project cost of Metro.
October 20, 1965	Senate appropriates NCTA funds.	February 7, 1969	WMATA adopts revised rapid rail transit plan and program.
October 21, 1965	NCTA begins \$5.1 million program for fiscal year 1966.		
February 4, 1966	Virginia approves interstate compact calling for creation of Washington Metropolitan Area Transit Authority.		

40 Wall Street  
New York, N. Y. 10005

February 10, 1969

Frederick A. Babson, Esq.  
Chairman, Board of Directors  
Washington Metropolitan Area Transit Authority  
Washington, D.C. 20024

Dear Mr. Babson:

In our role as financial advisors to the Authority, we have worked closely with the Board of Directors, its staff, and its consultants. We have found the assignment to be challenging and stimulating and are pleased to be affiliated with the program.

The Authority's engineering and traffic consultants are firms with outstanding reputations and we believe the work undertaken by them is of high quality and will meet the scrutiny of the financial review. Based upon data supplied by these consultants, we have developed a financial program which permits the sale of \$835,000,000 of tax-exempt revenue bonds.

In preparing a financing plan for the Authority, we have recommended that its revenue bonds be secured by pledge of the gross revenues of the System. In order to obtain the widest market acceptance for the bonds, we have, however, assumed that net revenues, after operating expenses (excluding depreciation), should cover debt service on the revenue bonds at least 1.20x, and we have calculated the aggregate amount of bonds so as to meet this test. The bonds will be further protected by reserve, built up from net revenues after debt service and allowances for depreciation, in an amount equal to total debt service.

Based upon these assumptions, and on the further assumption that the Authority's revenue bonds will be issued at an average interest cost of 5% over a seven-year period commencing in 1971, and the Federal Government and the participating Local Governments fulfill their obligations projected under the plan, we believe that the Regional Rapid Rail Transit Plan and Program, March 1, 1968 (revised February 7, 1969) is feasible from a financing standpoint.

Very truly yours,

KUHN, LOEB & CO.  
DILLON, READ & CO. INC.

By: *[Signature]*  
Kuhn, Loeb & Co.

Financial Consultants

W. C. GILMAN & CO., INC.  
AND  
ALAN M. VOORHEES & ASSOCIATES, INC.  
1070 Old Springhouse Road  
McLean, Virginia 22101

February 7, 1969

Mr. Frederick A. Babeon,  
Chairman, Board of Directors  
Washington Metropolitan Area Transit Authority  
Washington, D. C. 20024

Dear Mr. Babeon:

We are transmitting herewith our Report on Traffic, Revenue and Operating Costs. Additional supplemental reports will be published at a later date in accordance with our contract with the Authority.

Included in this Report are methodology, assumptions and findings for our analysis of ridership, gross revenues, operating expenses and net revenues of the Regional Rapid Rail Transit Plan and Program, March 1, 1966 (revised February 7, 1969). Also included is a description and disclaimer of coordinated bus and rail operations, an analysis of the financial impact upon four private bus companies, and an analysis of three alternative fare systems.

Our findings, which are detailed for each year from 1972 through 2030 in the Report, indicate that in 1990 approximately 295,000,000 riders will use the rapid rail transit system. Gross revenues after splitting costs with the bus companies may be expected to total \$89,000,000 and operating and maintenance expenses will be \$32,000,000, leaving over \$57,000,000 for Association and debt service. The Report also covers our analysis of the financial situation of the bus companies with the advent of rail transit and indicates that the companies can maintain a satisfactory situation with the fare split described in the Report.

Recognition should be given to the assistance and cooperation provided by the staffs of the Washington Metropolitan Area Transit Authority, the Washington Metropolitan Area Transit Commission and of the four private bus companies, as well as to Comstock & Colpitts and Analytical Techniques, Incorporated, subcontractors for the rail transit operating costs and fare collection facilities respectively.

We should like to assure you that the latest and most acceptable techniques for traffic and cost forecasting have been utilized and in our judgment the findings appear realistic. It is our opinion that the findings and conclusions of this Report provide a firm support for the implementation of the Adopted Rapid Rail Transit System.

Sincerely yours,

W. C. GILMAN & CO., Inc. and  
ALAN M. VOORHEES & ASSOCIATES, INC.

By Robert T. Pollock  
Robert T. Pollock, President  
W. C. Gilman & Co., Inc.

By Alan M. Voorhees  
Alan M. Voorhees, President  
Alan M. Voorhees & Associates, Inc.

Transportation Consultants



**DE LEUW, CATHER & COMPANY**  
ENGINEERS

CHICAGO NEW YORK BOSTON TORONTO OKLAHOMA CITY SAN FRANCISCO  
580 L'ENFANT PLAZA SOUTH, SW - WASHINGTON, D.C. 20024  
AREA CODE 202 BR-9310

February 13, 1969

Mr. Frederick A. Babson, Chairman  
Board of Directors  
Washington Metropolitan Area  
Transit Authority  
Washington, D. C. 20024

Dear Sir:

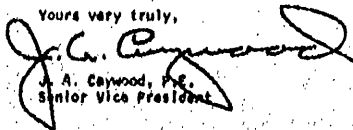
We are pleased to transmit herewith our technical reports covering the preliminary design and development of capital costs for the Adopted Regional System of rail rapid transit for the Washington Metropolitan Area.

De Leuw, Cather & Company, serving as General Engineering Consultant to the Authority, developed preliminary designs and capital costs in full coordination with the staff of Washington Metropolitan Area Transit Authority, Harry Weese & Associates, as General Architectural Consultant, and Mueser, Rutledge, Ventworth & Johnston, as General Soils Consultant. Throughout the preparation of designs and development of costs, we have sought the advice and counsel of the above parties to ensure an exemplary design for this system and to make certain that the costs were fully adequate to construct the system.

We are confident that the base year costs for construction that have been developed for the system along with the assumed escalation rate are adequate. We assume that appropriate cost controls will be maintained and that stated fiscal policies of the Administration will be implemented.

It has been a pleasure to have participated in the preparation of this report. We sincerely believe that these documents clearly and adequately demonstrate the feasibility and practicability of constructing the system as developed herein and that the end result will be a valuable contribution to the Washington Metropolitan Area communities.

Yours very truly,



J. A. Caywood, P.E.  
Senior Vice President

*Engineering Consultants*

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# THE ECONOMICS OF METRO

PREPARED BY WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

## INTRODUCTION

Metro is ready for construction. The routes have been selected. The program for local financing has been approved. The way is clear for the action phase to begin.

How feasible is Metro? Who will benefit? Will the benefits justify the costs? Is Metro a good public investment for the National Capital Region and its financial partner, the federal government?

To obtain answers to these and related questions, the Washington Metropolitan Area Transit Authority decided in early 1968 to retain an independent economic consultant to analyze Metro and report objectively on its economic feasibility. Development Research Associates, a Los Angeles-based economic consulting firm which had conducted transit evaluation studies in San Francisco, Seattle and Los Angeles, was selected to undertake a comprehensive "benefit-cost" investigation. After an intensive four-month evaluation of the 97-mile system, the consulting firm's analysis revealed total cumulative benefits *three times greater* than the combined federal-local investment in Metro. How DRA arrived at this conclusion and what it means to the Washington Region is the subject of this report.

## THE UNIQUENESS OF WASHINGTON

As the research proceeded, it became apparent to the DRA study team that Washington is ideally suited for rapid transit. A large measure of the anticipated success of Metro is directly related to the region's unique physical and economic characteristics.

Growth is one of these characteristics. The National Capital Region is one of the fastest growing urban areas in the nation—its 2.5 million population should nearly double by 1990.

Washington has maintained a relatively healthy downtown during a time when most downtown areas throughout the nation have been declining. This is due in large measure to the presence of the federal government in the downtown area and the large amount of related office construction in recent years. In the future, strong economic growth is expected regionally—in *both* the downtown and its suburbs.

Washington has carefully retained large areas of open space in its downtown and suburban areas. This has resulted in the development of urbanized "corridors" and activity "nodes." This form of urban growth is well suited to the Metro's rail-bus system.

Finally, Washingtonians are highly transit oriented. Today, nearly 30 percent of downtown-destined commuters travel by public transportation. This is a unique situation for a city without rail transit, and reflects a strong latent receptiveness to a more efficient public transportation system.

## THE APPROACH

The DRA study team, headed by its president, John W. McMahan, measured the feasibility of Metro by the use of "benefit-cost" analysis. This approach is a well-accepted analytical tool commonly used for both public and private investment decisions. In essence, benefit-cost analysis identifies and attempts to quantify the benefits and costs associated with an investment over an appropriate period of time.

The identification and measurement of costs is relatively uncomplicated. The identification and measurement of benefits, however, is complex. The first problem is to understand what actually constitutes a benefit. For the purpose of this

report, DRA defined a benefit as producing a *net economic increase to the region, directly attributable to the implementation of Metro*. In other words, if Metro were not built, the benefit would not occur.

In requiring that a benefit produce a "net economic increase to the region," DRA purposely excluded a factor that is often claimed to be a major benefit from rail transit—that of increased construction activity and property value appreciation around the stations. The consultant team decided to treat these changes as "transfers" of economic growth, from other areas in the region. In such cases, DRA determined that Metro "redistributes" economic growth rather than creating it. Other changes, such as increased retail sales and tax base shifts were also treated as "transfers" and have not been included in the benefit-cost analysis.

DRA also required that, to be included in the benefit-cost comparison, a benefit must be readily measurable. This does not mean, however, that measurable benefits are the only benefits resulting from Metro. There are many benefits which cannot be measured within the current "state of the arts." Recognizing the importance of these non-quantifiable benefits, DRA spent considerable effort in attempting to evaluate their impact on the region. These benefits are discussed in greater detail later in this report.

Benefits and costs were evaluated over a fifty-year period. This period was selected because of its relationship to the economic life of many of the components of the system as well as its comparability to the analysis of other public investments. The year 1990 was selected as the "study year" and benefits and costs are scaled forward or backward in time from this base point.

In order to compare costs and benefits flowing over widely ranging years, both factors were discounted to their "present value." This technique is perhaps best illustrated through an example. If \$0.85 is invested today at a return of 4 percent compounded annually, it would be worth \$1.00 in four years. This, of course, represents the productivity of money over a specific period of time. Conversely, it is also true that the \$1.00 received four years from today is only worth \$0.85 currently. If an individual must wait four years for his investment to be worth \$1.00, he would not desire to invest *more* than \$0.85 now at a 4 percent return.

The situation is the same for a public investment. If the public must wait in order to realize benefits from a project currently under construction the benefits—when realized—must be greater than the costs involved just for the project to "break even."

The question of the rate of return on a public investment is complex. There are many theories which attempt to deal with this question, but there is less than general agreement on the subject. For the purpose of this study, DRA selected 4 percent as the rate of return that the National Capital Region should realistically expect from its public investment. In view of the current "tight money" situation, it should be noted that this represents a long term evaluation of the return that should be expected over the entire 50 years of the study period.

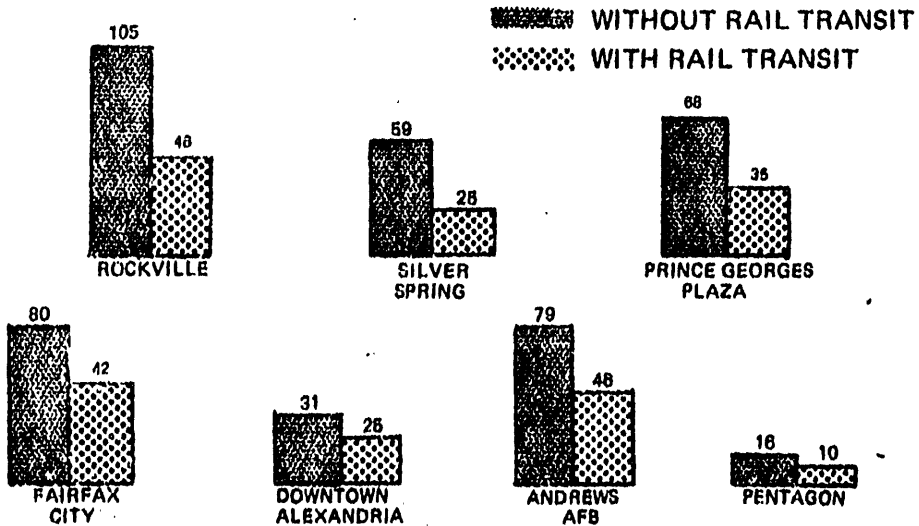
#### QUANTIFIABLE BENEFITS

A number of "net economic increases" attributable to Metro can be assigned a dollar magnitude. Generally, these "quantifiable" benefits accrue to specific groups within the region. The dollar value of each of these benefits accruing to the various groups *in 1990* is discussed below.

##### BENEFITS TO BUS RIDERS—\$82,920,600

Individuals travelling to work by public transportation face the same traffic problems as automobile commuters. Numerous stops, traffic congestion, and other delays will be avoided by Metro, and former bus riders will be able to save a considerable amount of time in their journey to work.

**COMPARATIVE TRANSIT TRAVEL  
TIMES TO DOWNTOWN\***  
(Portal to Portal)



\*Figures based upon study year: 1990.  
Source: Alan M. Voorhees and Associates, Inc.  
and Development Research Associates

**BENEFITS TO MOTORISTS USING METRO—\$58,205,000**

Many individuals now travelling by auto will switch to Metro once it is in operation. As they do, they will realize time savings and significant savings in out-of-pocket expenses.

**Time Savings:** The trip to work will be shorter and faster by Metro than by auto, and those motorists who switch to Metro will save time amounting to \$11,130,000 annually by 1990.

**Operating Cost Savings:** Because the fares paid to ride Metro will be less than the costs of travelling by auto, motorists switching to Metro will save \$11,637,000 annually as a group.

**Parking Cost Savings:** For those commuters with downtown destinations, parking costs will be eliminated. This saving will total \$15,441,000 annually in 1990.

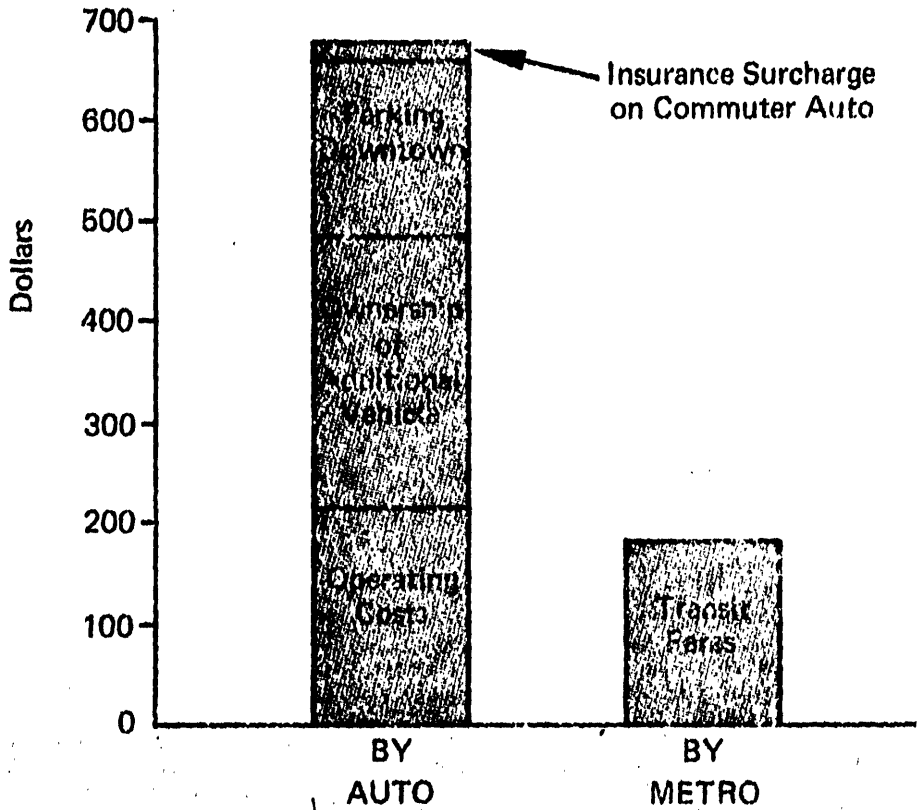
**Insurance Savings:** Persons now using their automobile for commuting must pay an additional amount for their auto insurance. By switching to Metro, former auto commuters should save \$2,177,700 annually by 1990.

**Additional Vehicle Savings:** Many households now owning an additional vehicle to drive to work will find that they no longer need it. This savings will amount to \$17,908,000 in 1990.

**BENEFITS TO MOTORISTS NOT USING METRO—\$36,750,000**

Motorists not switching to public transportation will also benefit from the operation of Metro. By reducing the number of vehicles on the road during the congested peak travel periods, Metro will help unclog traffic and allow motorists to save time in their journey to work.

**COMPARATIVE OUT-OF-POCKET EXPENSES  
TO THE MOTORIST DIVERTED TO TRANSIT  
1990**



## BENEFITS TO THE BUSINESS COMMUNITY—\$8,104,000

*Time Savings To Truckers:* The trucking industry, which operates many of its trucks during peak periods, will save a considerable amount of time as congestion is reduced. This should amount to \$4,620,000 in 1990.

*Parking Facility Savings To Suburban Employers:* Suburban employers, who must provide parking facilities for their employees, will save a portion of this expense as their employees utilize Metro instead of autos. These savings should equal \$3,484,000 in 1990.

## BENEFITS AND COSTS COMPARED

The benefits discussed in the previous section are those which accrue in the study year (1990). Clearly, Metro will produce benefits before and after the study year. Thus, it is necessary to "annualize" the benefits over the entire study period so that the full scope of Metro's impact can be evaluated.

The first leg of Metro is scheduled to be operational in 1972; therefore, this date was selected as the date for initial benefits. Thus, 1990 benefits were scaled down to 1972 and forward to 2020 on the basis of Metro's estimated patronage.

As indicated previously, the identification and "annualization" of costs was relatively uncomplicated. DRA considered only "net project costs"—total costs less those that can be covered through operating revenues. For the purpose of this report, it was assumed that the federal government would contribute two-thirds of these costs in the form of grants during the construction period; the local share was assumed to amount to one-third of net project costs, financed through bonds issued as construction costs were incurred.

Since the benefit and costs "flows" were staggered—with costs being incurred at the beginning of the study period and dropping off quickly once construction is complete, while benefits begin in 1972 and continue for the remainder of the study period—both benefits and costs were converted to their present value.

In present value terms, benefits amounted to nearly \$3 billion over the study period. Costs totaled approximately \$950 million.



**SUMMARY OF BENEFITS**  
**(Present Value, 1972-2020)**

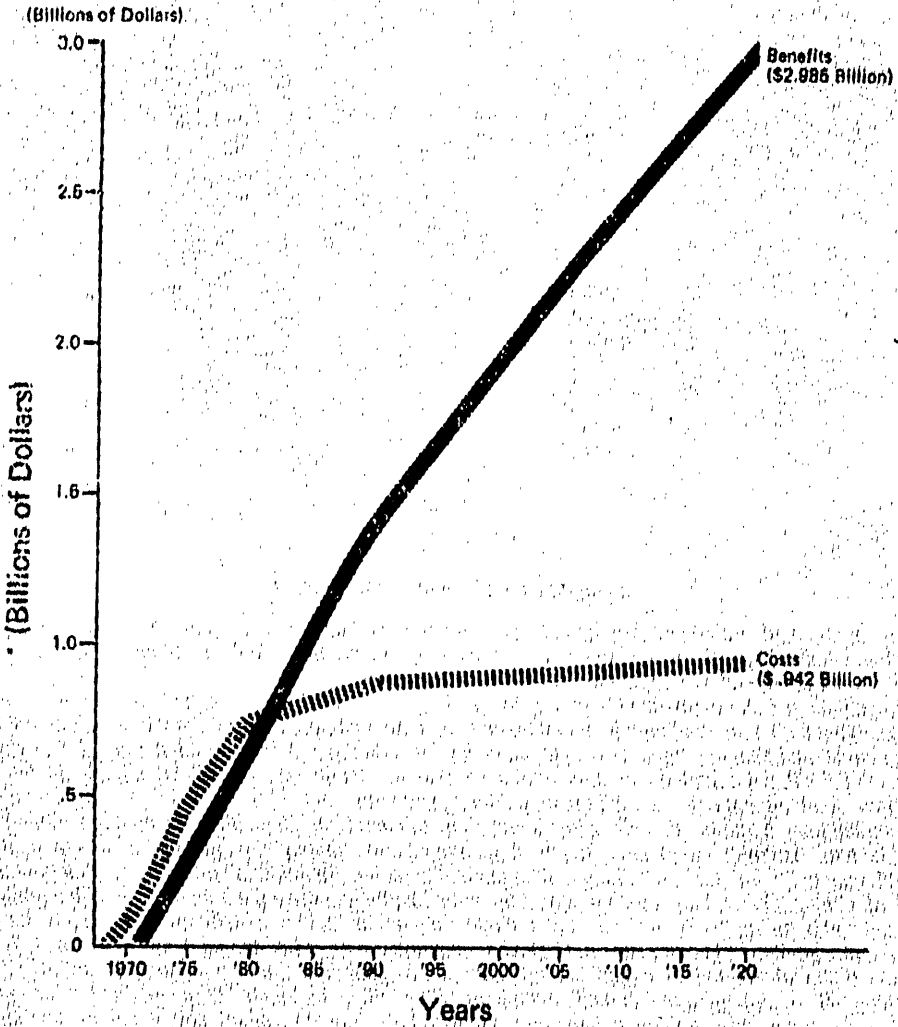
<b>Bus Riders</b>		<b>\$1,371,962,600</b>
<b>Motorists Using Metro</b>		
Time Savings	165,375,800	
Operating Cost Savings	192,540,400	
Parking Savings	253,735,400	
Insurance Savings	35,821,500	
Additional Vehicle Savings	<u>294,333,100</u>	
		941,806,200
<b>Motorists Not Using Metro</b>		<b>545,680,500</b>
<b>Business Community</b>		
Trucking Industry	68,657,800	
Parking Facility Savings to Suburban Employees	<u>57,015,800</u>	
		<u>125,673,600</u>
<b>TOTAL</b>		<b>\$2,985,122,900</b>

**FEDERAL/LOCAL INVESTMENT IN METRO**  
**(Present Value, 1968-2004)**

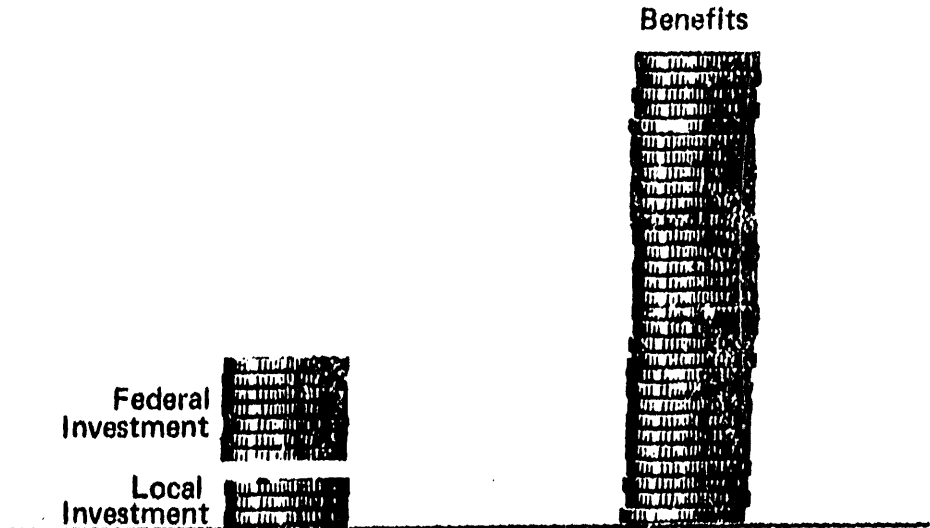
Federal Investment	\$ 625,123,900
Local Investment	<u>316,971,800</u>
	<b>\$ 942,095,700</b>

The benefit-cost ratio then is in excess of 3:1. This means that for every *dollar* invested in Metro, more than *three dollars* will be returned in *quantifiable benefits alone*.

### PRESENT VALUE OF CUMULATIVE BENEFITS AND COSTS



**FOR EVERY DOLLAR OF INVESTMENT  
THE COMMUNITY WILL RECEIVE \$3.00 OF BENEFITS  
1968 - 2020**



#### NON-QUANTIFIABLE BENEFITS

As indicated earlier, many of the potential benefits to the National Capital Region cannot be given dollar magnitudes (i.e., "quantified"). Nevertheless, these benefits are important and should be identified.

*Facilitating Regional Growth:* Washington's rapid growth has served to increase the distance between its suburbs and downtown. Metro will help coordinate the growth of these areas more closely by increasing the accessibility of the downtown as well as employment centers in the suburbs. In short, it will help to link the two and encourage an efficient growth pattern.

*Providing Access To Employment Opportunities For The Disadvantaged:* As retail and industrial firms have decentralized, many lower-income residents of Washington's inner city have suffered from economic immobility. Without the use of a car, their journey to work is often burdensome and sometimes impossible. Metro will help to alleviate this problem by making employment opportunities more accessible. In addition, future employment opportunities will tend to develop around Metro stations, and this will further increase job accessibility.

*Providing Adequate Transportation For The Transit Dependent:* The youth and aged, an increasingly larger proportion of Washington's population, are dependent on public transportation for much of their mobility. Metro's rapid service will assist those dependent on transit in their travel needs.

*Increasing Accessibility To Educational Opportunities:* Washington's colleges and universities as well as its primary and secondary schools will also be well served by Metro. In fact, the new Washington Technical Institute and Federal City College may be dependent on the comprehensive public transportation which Metro will provide.

*Increasing Accessibility To Cultural And Recreational Activities:* Washingtonians seeking cultural and recreational activities often face severe traffic congestion and parking shortages. These problems are compounded by the large numbers of auto-driving tourists attracted to these same activities. Metro will reduce this problem through comprehensive service to the heavily traveled areas

downtown and to sites such as the Zoological Park and Robert F. Kennedy Stadium where many thousands of persons gather.

#### CONCLUSIONS

The intensive fourth-month investigation of the benefits and costs of Metro revealed that the National Capital Region is ideally suited for rapid rail transit. Its unique combination of characteristics results in benefits that are perhaps unmatched by any other city in the nation.

In this analysis Metro has been evaluated in terms of a *balanced transportation system* involving rapid rail transit, bus service, and an efficient freeway network. All of the benefits identified in this analysis accrue from a "balanced" system. Clearly, the impact of Metro would be greatly reduced without adequate highways and buses.

Viewed in this context, the economics of Metro are sound. Benefits exceed costs by a substantial margin, supporting the conclusion that transit is not only a desirable investment, but a profitable one for the National Capital Region.

Economic Consultants: Development Research Associates, 731 South Flower St., Los Angeles, Calif.

Transportation and Planning Consultants: Alan M. Voorhees & Associates, Inc., 7070 Old Spring House Road, McLean, Va.