HUNTER

NORTHEAST CORRIDOR IMPROVEMENT PROJECT

REDIRECTION STUDY

JANUARY 1979

PREFACE

The Northeast Corridor Improvement Project was authorized by the Railroad Revitalization and Regulatory Reform Act of 1976. This project is intended to significantly improve rail service between Washington, D.C., and Boston, Massachusetts. On January 4, 1978, Secretary of Transportation Brock Adams initiated a comprehensive review, referred to as the Redirection Study, of this project. This review was predicated on two major concerns: that the service needs of commuters and freight operators had not received sufficient consideration along with intercity rail passenger service, and also that project scope, schedule, and budget had deficiencies.

The Redirection Study addressed this problem in four parts:

I. Amtrak Intercity Passenger Traffic
II. Commuter and Freight Traffic
III. Amtrak Equipment Requirements
IV. Development of a Recommended Redirected Program

Thanks to a great deal of assistance and cooperation from representatives of Amtrak, the commuter authorities, Conrail, and other interested organizations, this report contains the results of the Redirection Study.

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BACKGROUND

The Northeast Corridor Improvement Project (NECIP), authorized by the Railroad Revitalization and Regulatory Reform Act of 1976 (4R Act), is designed to upgrade and improve rail passenger service between Washington, D.C. and Boston, Massachusetts 1/. Congress has required trip-times of 2 hours, 40 minutes between Washington and New York City and 3 hours, 40 minutes between New York City and Boston by 1981. The law gives the responsibility for improving the NEC facilities, over which Amtrak operates, to the U.S. Department of Transportation.

On January 4, 1978, Secretary of Transportation Brock Adams addressed the Transportation Research Board of the National Academy of Sciences and said that NECIP planning had been inadequate. He concluded that many vital issues had not been considered, particularly the service needs of all Corridor users, as well as the scope, cost, and scheduling for Corridor construction. Specifically, Secretary Adams was concerned that:

- Previous planning, exemplified by the August 1977 Implementation Master Plan (IMP), had become unrealistic and untenable. Not only was the IMP in need of revision in terms of project features, but it was also apparent that the authorized funds would be inadequate to meet the intent of the 4R Act.

- Corridor commuter and freight users were concerned about equitable consideration in the development process and the resulting upgraded system.

- The significance of equipment selection, operations, and maintenance had been underrated in planning the project. An adequate program plan cannot be developed without full consideration of equipment characteristics, fleet size, schedules, maintenance, and servicing. Some of these factors had been given minimal attention since they were judged to be more the concern of the National Railroad Passenger Corporation (Amtrak) than of the NECIP, which had been viewed essentially as a construction project.

1/ The Northeast Corridor (NEC) is defined as the mainline rail system between Washington, D.C., and Boston via Philadelphia, New York, New Haven and Providence.

In 1976, a compromise was reached between the Congress and the Administration on a $1.75 billion, 5-year program. The compromise program compressed the schedule of an earlier plan which had been proposed and thus required substantial concurrent program development, design and construction, and extensive out-of-service time for the track during construction.

Secretary Adams ordered an evaluation of the existing program, hired a new project director, and called for a realistic plan for completing the NECIP, taking into account the needs of intercity passengers, commuters, and shippers. The Secretary ordered a detailed look at Amtrak's service plan for facility and equipment needs, right-of-way improvements and future right-of-way maintenance requirements. This plan, known as the Redirection Study, is now finished. It concludes that effective program management can be accomplished only after a stable program of specific NECIP features and a performance schedule are finally adopted. Such a program is presented in this report.

The redirection objectives were achieved as a part of the concerted efforts of many participants. The lead was taken by the Federal Railroad Administration's (FRA) Northeast Corridor Project Office (NECP). Those aspects dealing with operations, equipment, and operating costs were coordinated with Amtrak. Reviews by other FRA offices, the Urban Mass Transportation Administration (UMTA), and the Office of the Assistant Secretary for Budget and Programs, and meetings with the Northeast Corridor Commuter Rail Authorities Committee (NECCRAC) provided valuable insights to commuter needs and the magnitude of the rolling stock conversion problem. Conrail, the major freight carrier, was involved in the discussion of major issues involving operations and system configuration.

RESULTS

It is now clear that the present $1.75 billion authorization will not buy the Corridor Project as it was originally conceived. Overoptimism, underestimation, inflation, and the immense problems associated with creating and managing a project of the NECIP's magnitude created the conditions leading to the need for a Redirection Study.

To complete the project satisfying the goals of the 4R Act will require additional time and an increased authorization from Congress. The recommended program described here will cost a total of $2.5 billion. This figure represents the original $1.75 billion, a new authorization of $654 million,

and includes $66 million of public grade-crossing funds and $30 million of non-NECIP funds for Union Station. The revised program is scheduled for completion in 1983.

The NECIP redirection effort was structured around four main concerns:

- Amtrak service and operations
- Amtrak equipment
- Commuter and freight coordination
- The NECIP Redirected Program - a realistic scope of work, budget, and schedule for NECIP implementation.

AMTRAK SERVICE AND OPERATIONS

The first major area of the redirection effort deals with operations. The starting point in this activity was a preliminary "design" timetable for post-NECIP train service. The design timetable is an essential planning tool in the decision making processes for support facilities and future operating and maintenance costs. The Philadelphia-Springfield and express train services have been included in the timetable to ensure sufficient system capacity along the Corridor mainline should those services be operated. The preliminary timetable includes the following type and frequency of services:

- Twice-hourly service through the day (6 a.m. - 11 p.m.) in the Washington-New York market on a 2 hour, 40 minute schedule with five stops (Baltimore, Wilmington, Philadelphia, Trenton, Newark, and certain trains stopping at New Carrollton or Metropark).

- Hourly service throughout the day (6 a.m. - 11 p.m.) in the New York-Boston market on a 3 hour, 40 minute schedule with five stops. (Stamford, New Haven, New London, Providence, and Route 128).

- Continuation of the current level of peak-hour commuter or "clocker" trains between Philadelphia and New York.

- Two-hour service throughout the day (6 a.m. - 11 p.m.) between Philadelphia and Springfield via New Haven on a 4 hour, 30 minute schedule with ten stops (every third train terminating or originating at Boston via the inland route).

- Existing long-distance trains.

- Possible express trains on 2 hour, 30 minute schedules in the Washington-New York market, and 3 hour, 20 minute schedules in the New York-Boston market introduced as required by increased demand.

In terms of trains per day for each market, the preliminary timetable represents an 18 percent increase over 1978 service levels. The service outlined above will offer frequent, high-quality service at the best possible trip-times consistent with the recommended funding. Initially, expansion of the service to meet increased demand will be accommodated by expanding train lengths.

AMTRAK EQUIPMENT

To perform this service, the use of existing proposed equipment that would incorporate current state-of-the-art technology was investigated. Of Amtrak's current fleet, only upgraded Metroliners and Amfleet cars are capable of high-speed operations. The E-60 locomotives could be used in slower service, but they would not be fully suitable because they were designed as freight locomotives and were modified for passenger service. Th GG-1 locomotives should be retired as soon as possible because of their very high maintenance costs and the diseconomies associated with converting them to the improved NECIP power supply system. The Electro-Motive Division of General Motors is under contract to build 30 locomotives for Amtrak based on the Swedish ASEA RC4a design. The first locomotive will be delivered in December 1979, with 23 scheduled for delivery by February 1981. The full order would be completed by June 1981. An intensive test program is planned for the first locomotives built under this contract to ensure their ability to make their expected contributions in meeting the 4R Act goals.

To determine the fleet mix required, an economic analysis was conducted using the design timetable, based on the assumptions that either Metroliner or Amfleet cars can be "turned" for a return trip in two hours, and that virtually all trains will consist of 6 cars. Fixed train length eliminates the need for switching, either in the immediate station area or at more remote yards, and results in significant savings in operational costs. The economic analysis shows that 34 Metroliners should be upgraded. All 34 of these upgraded Metroliners will be available in 1981 for 2 hour, 40 minute service. To provide hourly service between Washington and New York, approximately 9 working train sets, or 12 sets including spares, are required. Metroliners can be used for 5, and AEM-7's hauling Amfleet cars for the remainder.

COMMUTER AND FREIGHT COORDINATION

The NECP examined the commuter and freight users' current and post-NECIP operations and requirements. On the basis of

schedule, operating, terminal, and equipment information for current and post-NECIP projected service provided by State Departments of Transportation and commuter authorities, the improvements proposed in the Redirection Program can accommodate anticipated growth in commuter service in all NEC metropolitan areas, by either lengthening or adding trains, or a combination of both, with no detrimental effect to the commuter or other NEC services. In addition, the integration of commuter services at several points along the NEC could produce operational economies not currently being realized. Moreover, the integration of commuter service with intercity service will provide increased access to high-speed trains for smaller communities and produce additional economies in overall NEC rail oeprations.

A major NEC user, and one which receives full consideration in the redirection effort, is the Conrail freight service. Despite past projections of increasing freight tonnage on the NEC during the 1960's and 1970's, tonnage has actually decreased annually over these periods. In terms of track and fixed plant maintenance requirements, freight usage currently provides two-thirds or greater of the total tonnage throughout the Corridor. In terms of scheduling requirements, however, maximum freight usage of the Corridor occurs in Maryland where freight trains represent at most one-third of all trains per day. The study of freight service requirements clearly demonstrates that since a drastic increase or decrease in freight usage of the Corridor is not likely, freight movements through 1990 are unlikely to restrict or be restricted by intercity or commuter services, provided the train operations of these three users can be appropriately coordinated.

The impact of the planned modernized signal system on NEC operations has been established. Improvements will require modification of much of the current intercity and commuter motive power and multiple-unit equipment (at NECIP expense) to ensure compatibility with the new signal system.

Similarly, a substantial number of cars within existing fleets will require electric conversion to enable all users to operate using the modernized NEC power system. Conrail is responsible for the conversion of its motive power, while NECIP funding will be used for the conversion of the multiple-unit commuter equipment.

The provision of adequate track capacity in the NEC has been a primary concern of all users of the Corridor and has, therefore, been coordinated with the commuter authorities and with Conrail to assure sufficient system capacity through 1990. In addition, NECP has initiated a study on

the conflict between the needs of commuter and intercity rail passenger service in the NEC and on the allocation of access rights to key terminals.

Planning for the NECIP in the area of station improvements includes items that will enhance both intercity and commuter train service, and will, at the same time, support the integration of the two operations.

In order to best promote the integration of both Amtrak's and other users' interests and operations, the NECP proposes the formulation of a coordinating team or Train Planning Unit (TPU). This body, to be composed of NECP, Amtrak, commuter authorities, and Conrail representatives would be charged with coordinating the interests and train operations of all concerned, to integrate daily train schedules and operations, minimize conflicts between NEC users, and, ultimately, to maximize the use of the improved NEC rail system while providing optimum service to all users.

CONCLUSIONS - THE NECIP REDIRECTED PROGRAM

Fiscal Year 1978 and the early days of Fiscal Year 1979 were a period of critical review, reassessment, and reorganization for the NECIP. This period began with the realization that the Implementation Master Plan (IMP) of August 1977 was unattainable in the light of the true scope of work required and the existing funding authorization. This realization, coupled with an increased sensitivity to needs of parallel users, led to an examination of the program with a view toward greater consideration of other users' requirements. The redirection charter included a thorough review of the project's features and the impact of changes in scope, refined cost estimates, and inflation on the current NECIP funds authorization.

Several alternatives were evaluated, all of which were constrained within the $1.75 billion authorization:

- In one option, by retaining extension of electrification to the entire Corridor, severe cuts would be necessary in certain station, communications, service facility, and trip-time improvements.

- In another option, by eliminating the extension of electrification from New Haven to Boston, sufficient funds would be made available to carry out more suitable communications, signalling, fencing, and service facility programs. Unfortunately, trip-time cushions would still be inadequate in the South Corridor (Washington-New York) and the mandated times could not be met in the North Corridor (New York-Boston).

- o A third alternative studied would have required a change in the legislation to permit free use of the $150 million authorized for cost-sharing. By reprogramming a portion of these funds into other improvements in communications, bridges, and other areas, this alternative came closest to meeting the requirements of the 4R Act. This alternative, unfortunately, would generate serious shortcomings in service facilities, and station improvements would be essentially eliminated.

Although each of these alternatives would stay within the $1.75 billion authorized by the 4R Act, all would fall far short of meeting the goals and intent of the Act with any sustained reliability.

The recommended program was determined by employing a different approach. Working from a set of improved features common to all three of the $1.75 billion program options just described, the NECP defined a set of features which would result in a program meeting all Congressional goals and established the costs associated with these features. The resulting program would require $2.404 billion of Federal funds, a new realistic construction completion date, and would permit achievement of program goals by late 1983. With $30 million of additional Union Station funds authorization and $66 million of currently authorized grade-crossing elimination funds, the total Federal commitment would come to $2.5 billion. An increased authorization to accomplish this program will be requested. Table A shows the program work distribution by Fiscal Year and program subsystem in millions of dollars. Table B reflects the work schedule compatible with the Redirection Study.

The Redirection Program, briefly summarized on the foregoing pages, represents the best alternative to the draft program that was considered in August, 1977. The Redirected Program also is the most responsive to Congressional goals, the needs of all NEC users, and Amtrak operational limitations.

TABLE A

RECOMMENDED PROGRAM

($450M FY 80 PROGRAM)
($000,000)

PROGRAM ELEMENT	77 & PRIOR	78	SUB-TOTAL	79	80	81	82	83	TOTAL
A. FUNDING LIMIT-NONMATCHING									
ROUTE REALIGNMENTS	3.3	2.4	5.7	16.0	32.5	30.4	0.0	0.0	84.6
TRACK STRUCTURES	154.5	183.1	337.6	138.5	98.3	79.7	67.9	0.0	722.0
BRIDGES	21.9	20.7	42.6	60.5	51.3	43.0	42.2	0.0	239.6
ELECTRIFICATION	2.1	19.7	21.8	55.2	64.3	106.0	102.6	0.0	349.9
SIGNALING	1.1	9.4	10.5	149.2	30.1	35.9	34.0	0.0	259.7
COMMUNICATIONS	0.3	3.4	3.7	18.2	5.9	5.8	0.0	0.0	33.6
GRADE CROSSINGS	1.0	12.0	13.0	0.0	3.0	0.0	0.0	0.0	16.0
STATIONS	2.5	7.1	9.6	7.8	26.7	18.7	15.1	0.0	77.9
SERVICE FACILITIES	4.3	2.8	7.1	23.9	32.5	41.0	55.4	0.0	159.9
TUNNELS	0.0	3.4	3.4	8.3	18.0	0.0	0.0	0.0	29.7
DCP PM/SE	26.8	46.5	73.3	35.8	34.3	34.2	28.0	18.5	224.1
FRA PM/SE	6.0	10.6	16.6	7.2	9.5	8.6	7.9	7.2	57.0
SUBTOTAL	223.8	321.1	544.9	520.6	406.4	403.3	353.1	25.7	2,254.0
B. FUNDING LIMIT $150 MILLION MATCHING									
FENCING AND BARRIERS									
FED.-100% SAFETY-RELATED	0.3	1.2	1.5	24.8	10.1	7.4	0.0	0.0	43.8
FED.-SHARED	0.0	0.0	0.0	0.0	2.8	0.0	0.0	0.0	2.8
STATE/LOCAL - SHARED	(0.0)	(0.0)	(0.0)	(0.0)	(2.8)	(0.0)	(0.0)	(0.0)	(2.8)
STATIONS-NONOPERATIONAL									
FED.-100% SAFETY-RELATED	0.7	2.0	2.7	1.4	14.3	10.1	0.0	0.0	28.5
FED.-SHARED	0.0	0.2	0.2	0.0	13.3	26.7	20.2	0.0	60.4**
STATE/LOCAL - SHARED	(0.0)	(0.0)	(0.0)	(0.0)	(13.3)	(14.4)	(20.2)	(0.0)	(47.9)***
DCP PM/SE	0.2	0.5	0.7	6.6	2.1	1.5	0.0	0.0	10.9
FRA PM/SE	0.0	0.0	0.0	1.6	1.0	1.0	0.0	0.0	3.6
STATE - SHARED PM/SE	(0.0)	(0.0)	(0.0)	(0.0)	(0.8)	(0.8)	(0.7)	(0.0)	(2.3)
SUBTOTAL (FED. ONLY)	1.2	3.9	5.1	34.4	43.6	46.7	20.2	0.0	150.0
C. TOTAL (FED. ONLY) *	225.0	325.0	550.0	555.0	450.0	450.0	373.3	25.7	2,404.0
D. OTHER NON-NECIP FUNDS									
PUBLIC GRADE CROSSINGS	0.0	0.0	0.0	35.0	31.0	0.0	0.0	0.0	66.0
INDEMNIFICATION		100.0	100.0	NOTE: THROUGH PL 85-804, $100M WILL BE MADE AVAILABLE FOR USE ON PROGRAM IN FY 79 AND SUBSEQUENT YEARS					
UNION STATION	0.0	0.0	0.0	0.0	20.0	10.0	0.0	0.0	30.0
TOTAL	0.0	100.0	100.0	35.0	51.0	10.0	0.0	0.0	96.0

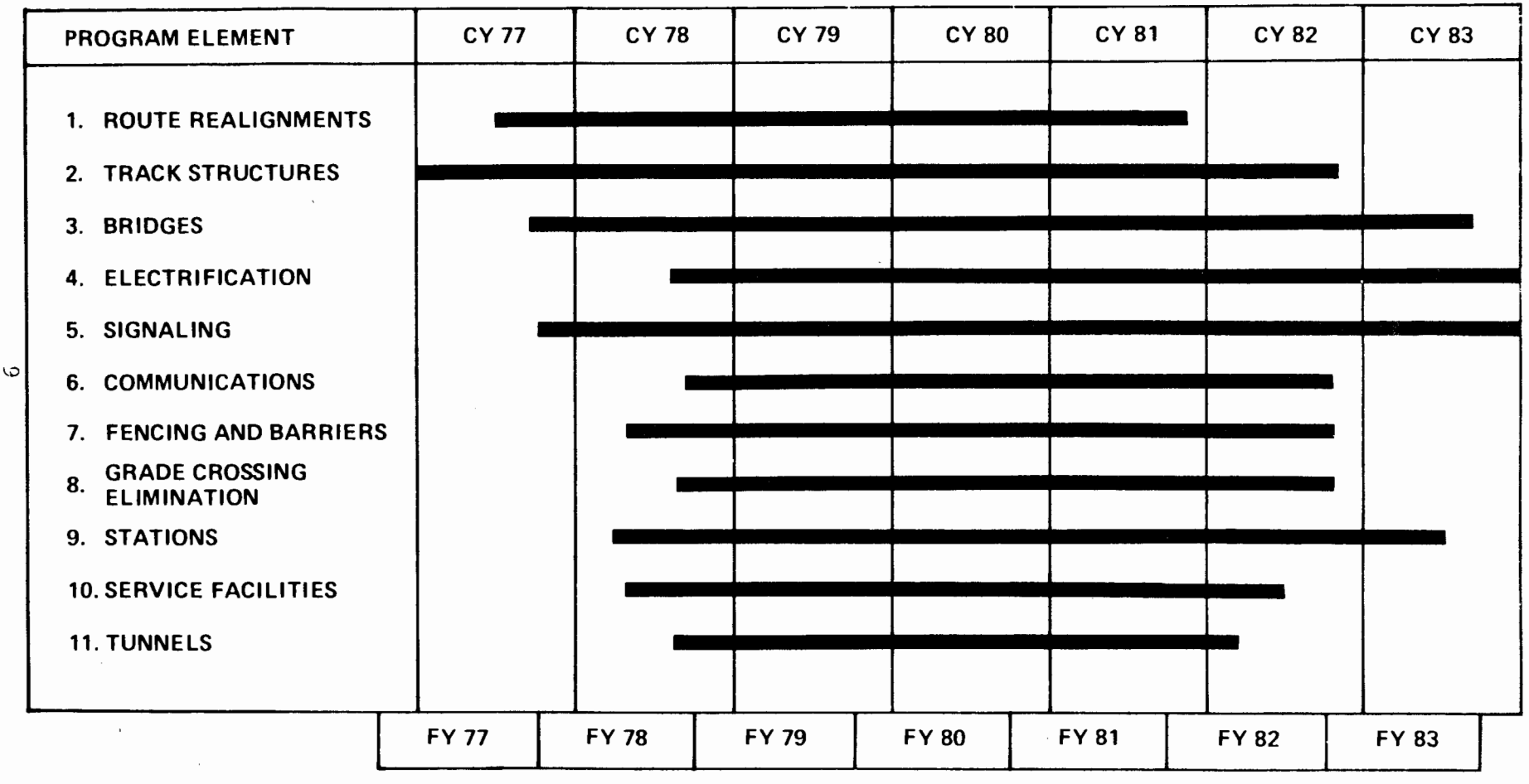
*The pre-1980 fund estimates are based on actual or intended obligations; the post-1979 fund estimates are based on intended appropriation requests.

**This figure reflects current estimates of availability of local matching funds. If more or less local matching funds actually materialize, these figures will be adjusted accordingly. No increase in authorization will be required unless the subtotal (Federal only) exceeds $150.0 million.

***This figure does not match the $60.4 million Federal share because the local matching share for Washington Union Station is being covered by $12.5 million of $30.0 million Federal funds cited in Section D of this table. This assumes enactment of appropriate authorization and appropriation legislation during FY 79.

TABLE B

WORK SCHEDULE: RECOMMENDED PROGRAM



A. INTRODUCTION

The primary objective of the Northeast Corridor Improvement Project (NECIP) 1/ is to improve intercity rail passenger service on the Northeast Corridor 2/. This improvement in the quality of rail service will be basically in the reduction of passengers' trip-times between cities and an increase in the overall reliability of the system.

Presented in this part of the report are analyses of the current and projected intercity passenger traffic and service on the Corridor. The components of intercity passenger traffic: NEC trains, through trains, and feeder service trains, are discussed. A preliminary timetable of post-NECIP improved train service, an essential planning tool, has been introduced.

B. INTERCITY PASSENGER SERVICE

The National Railroad Passenger Corporation (Amtrak) operates a broad range of intercity passenger train services on the Corridor (NEC). These services are composed of the major intercity trains linking cities along the Corridor mainline (including trains between Philadelphia and New York that primarily serve long-distance commuters), long-haul trains which traverse sections of the Corridor as part of a much longer journey (e.g., "The Montrealer" between Washington and Montreal leaves/enters the NEC at New Haven), and a number of relatively short-haul trains that feed into the Corridor mainline (e.g., Harrisburg/New York via North Philadelphia). The total number of daily Amtrak train operations (long-haul, feeder and intercity) approaches 140 on an average weekday, a level that far exceeds that in any other part of the country.

1/Reference is made in the text to the NECIP which is the program authorized by the Railroad Revitalization and Regulatory Reform Act of 1976. The text also refers to the NECP, the Northeast Corridor Project, which is the organization established within the Federal Railroad Administration (FRA) to implement the NECIP.

2/For purposes of this report, the Northeast Corridor is defined as the mainline rail system between Washington, D.C., and Boston via Philadelphia, New York, New Haven and Providence.

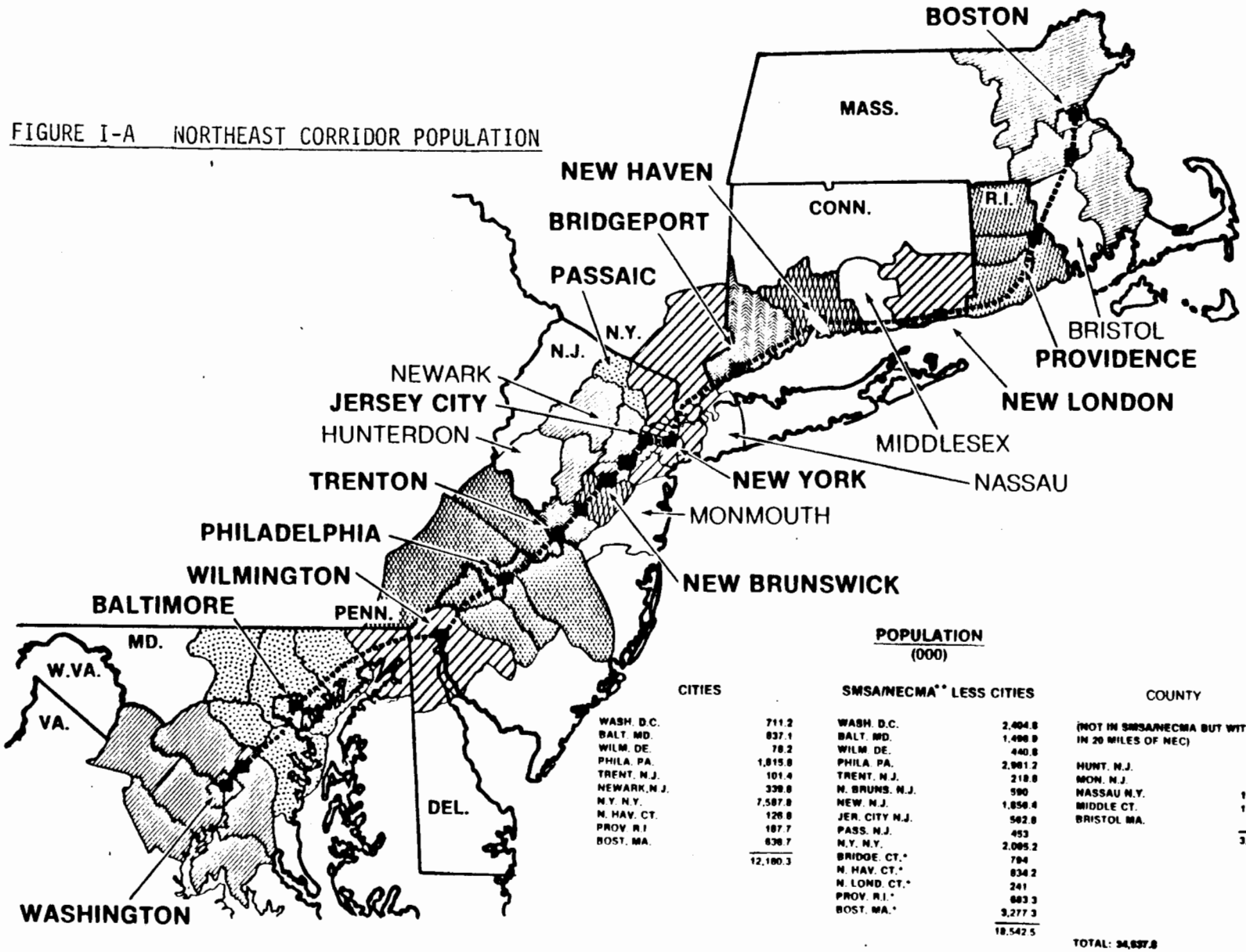
Population density, highway congestion, scarcity of available land for expanding road networks and airports, environmental considerations, and growing energy constraints explain both the tradition of rail service in the Corridor and its potential for expansion. Between Boston, Massachusetts, and Washington, D.C., the total population is 34 million, or over 1,100 people per square mile (see Figure I-A). Figure I-B shows that of the 38 Standard Metropolitan Statistical Areas (SMSA) and New England County Metropolitan Statistical Areas (NECMA) in the Northeast, 22 are served by the NEC mainline or feeder services. Those so served contain 86 percent of the total SMSA/NECMA population. The benefits to be derived from the NECIP will be enjoyed by passengers covering a wide spectrum of age and income levels. Table I-A presents the results of the 1977 National Travel Survey and shows that a greater proportion of those who travel by rail are elderly, young, and from lower income groups than the average users of the other modes. Similarly, rail attracts a greater than proportionate share of the "under-25" age bracket travelers: 14 percent of all train passengers as compared with 8 percent of all modes. The data also shows that although households with an annual income of less than $10,000 have a lower propensity to travel, rail captures a considerably greater proportion (32 percent vs 22 percent) of these passengers than do the other modes combined.

Table I-B shows that trip purpose in the Northeast differed from the national sample. Particularly significant is that 3 percent of all business-motivated trips are taken by train in the Northeast, whereas only 1 percent take trains on the national average. These figures indicate that rail service enjoys some popularity among Northeast businessmen.

C. NORTHEAST CORRIDOR TRAINS

In common with rail passenger services nationally, ridership in the Northeast Corridor showed a steady, continuous decline from the peaks achieved during and immediately after World War II. Figure I-C shows total U.S. intercity rail passenger miles from 1940 through 1977. By the early 1960's, concern with persistent problems of intercity passenger travel in the congested northeastern section of the United States had led to studies aimed at defining the best ways of developing a total passenger transportation system in the region.

FIGURE I-A NORTHEAST CORRIDOR POPULATION



POPULATION
(000)

CITIES		SMSA/NECMA** LESS CITIES		COUNTY	
WASH. D.C.	711.2	WASH. D.C.	2,404.8	(NOT IN SMSA/NECMA BUT WITHIN 20 MILES OF NEC)	
BALT. MD.	837.1	BALT. MD.	1,496.9		
WILM. DE.	78.2	WILM. DE.	440.8		
PHILA. PA.	1,815.8	PHILA. PA.	2,981.2	HUNT. N.J.	70
TRENT. N.J.	101.4	TRENT. N.J.	218.8	MON. N.J.	491
NEWARK, N.J.	339.8	N. BRUNS. N.J.	590	NASSAU N.Y.	1,382
N.Y. N.Y.	7,587.8	NEW. N.J.	1,856.4	MIDDLE CT.	1,369
N. HAV. CT.	126.8	JER. CITY N.J.	562.8	BRISTOL MA.	404
PROV. R.I.	187.7	PASS. N.J.	453		3,815
BOST. MA.	636.7	N.Y. N.Y.	2,085.2		
	12,180.3	BRIDGE. CT.*	794		
		N. HAV. CT.*	834.2		
		N. LOND. CT.*	241		
		PROV. R.I.*	883.3		
		BOST. MA.*	3,277.3		
			18,542.5		

TOTAL: 34,537.8

BASED ON JULY 1975 PROVISIONAL ESTIMATES BY THE BUREAU OF THE CENSUS

*NEW ENGLAND COUNTY METROPOLITAN STATISTICAL AREA

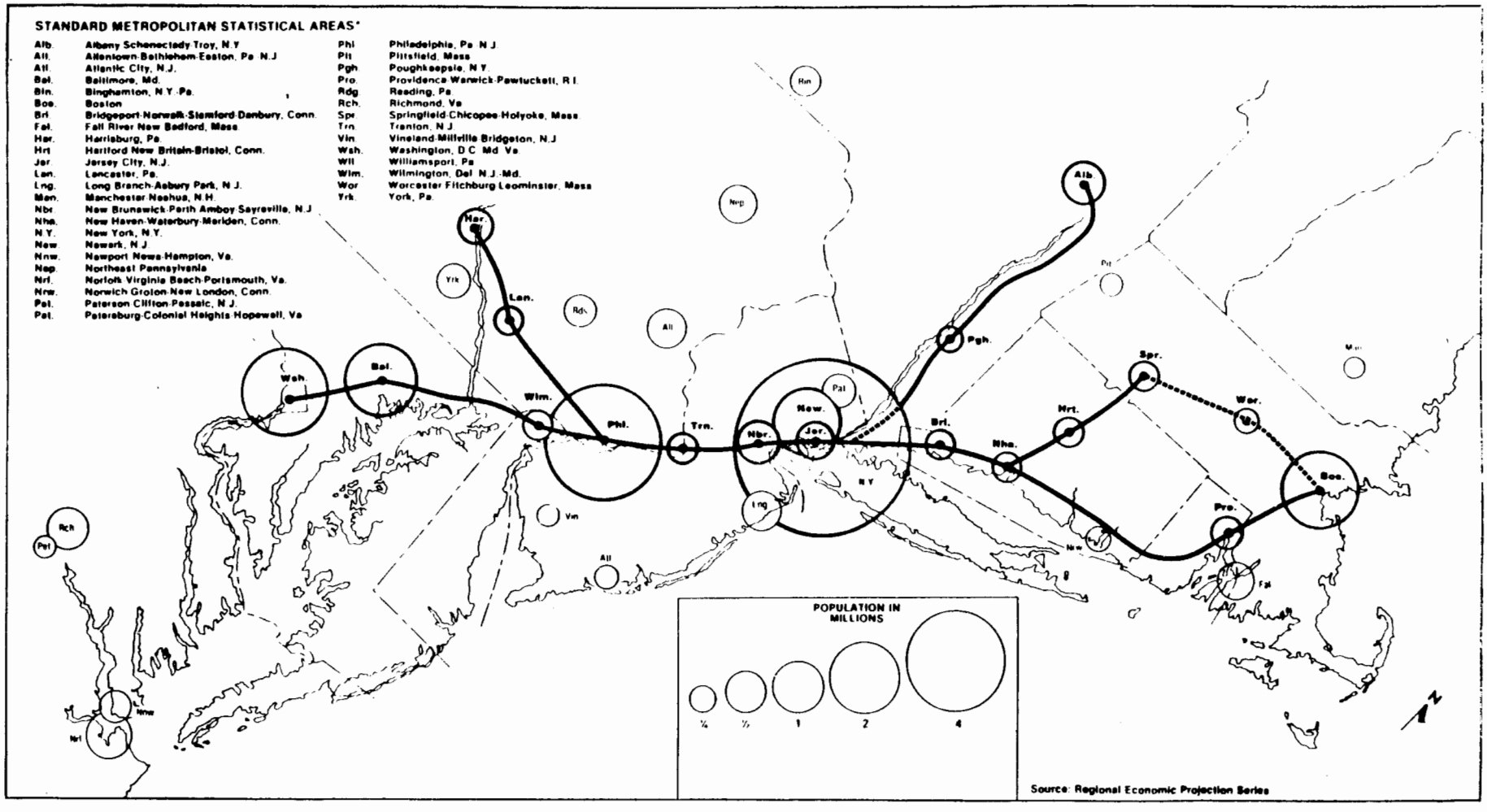


FIGURE I-B 1980 PROJECTED SMSA POPULATIONS WITHIN OR ADJACENT TO THE NORTHEAST CORRIDOR

TABLE I-A

CHARACTERISTICS OF HOUSEHOLD TRIPS 1/
IN THE NORTHEAST 2/

Characteristics	Total Households	Rail	Other 3/
Sex of Household Head			
Male	73%	76%	83%
Female	27%	24%	17%
	100%	100%	100%
Age of Household Head			
Under 25	7%	14%	8%
25 to 64	74%	73%	83%
65 and over	19%	13%	9%
Median	47 yrs.	43 yrs.	44 yrs.
Annual Family Income			
Under $10,000	39%	32%	22%
$10,000-$25,000	46%	31%	51%
Over $25,000	15%	37%	27%
	100%	100%	100%

1/ 1977 Census of Transportation, National Travel Survey. First Quarter 1977, special tabulation made by the U.S. Department of Commerce, Bureau of the Census at the request of FRA/NECP

2/ One or more members of a household traveling together to a place at least 100 miles away from home and returning together.

3/ Includes bus, air, auto, camper.

TABLE I-B

TRIP PURPOSE IN THE NORTHEAST
VS. THE NATIONAL AVERAGE

Northeast

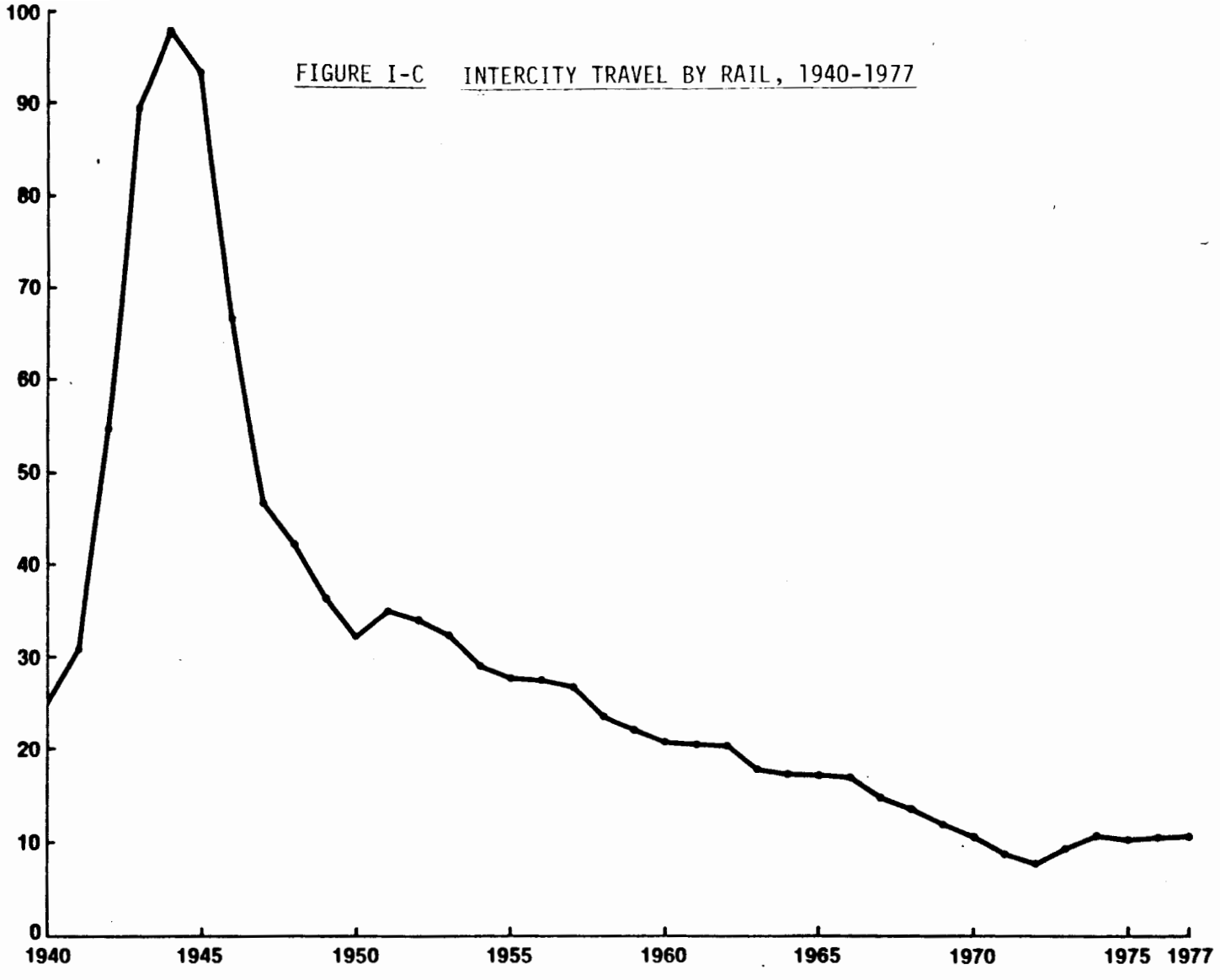
Purpose	Auto	Truck	Bus	Rail	Air	Total
Business	54%	2%	1%	3%	40%	100%
Vacation	65%	4%	12%	2%	17%	100%
Personal	72%	3%	4%	5%	16%	100%
Other	62%	1%	18%	3%	16%	100%

United States

Purpose	Auto	Truck	Bus	Rail	Air	Total
Business	54%	12%	2%	1%	31%	100%
Vacation	68%	12%	7%	1%	12%	100%
Personal	77%	7%	4%	1%	11%	100%
Other	59%	8%	19%	1%	13%	100%

Source: 1977 Census of Transportation, National Travel Survey. First Quarter 1977, special tabulation made by the U.S. Department of Commerce, Bureau of Census at the request of NECP.

FIGURE I-C INTERCITY TRAVEL BY RAIL, 1940-1977



Source: Transportation Association of America, Facts and Trends, 13th edition, December 1976 and quarterly supplement, March 1977

As a result of these studies, the revitalization of the underutilized rail plant between Washington and Boston began with the Metroliner and Turbotrain demonstration programs. The Metroliner demonstration program between Washington and New York was in effect from 1970 through 1973 while the Turbotrain demonstration between New York and Boston ran from 1969 through 1973. These programs explored the public reaction to a more frequent, high-quality, fast, and modern passenger train service.

The demonstration service in the north end of the Corridor, between Boston and New York, had little impact; in fact, the downward trend in patronage continued. Poor equipment reliability often reduced actual Turbotrain service below the rather minimal scheduled frequency of two trains per day in each direction. In essence, an adequate test of passenger response was never really developed. In contrast, the Metroliner project between Washington and New York was an immediate success, with ridership building up steadily as additional services were introduced. In the important city-pair market of New York-Washington, Metroliner service made significant inroads into the air shuttle's share of the intercity market (See Figures I-D and I-E). Ridership gains might have been even greater had two restrictions not existed: the fleet size (61 cars) precluded increased service frequency beyond 1973 levels, and train size was restricted to six cars by the limitations of the electrical system to supply traction power.

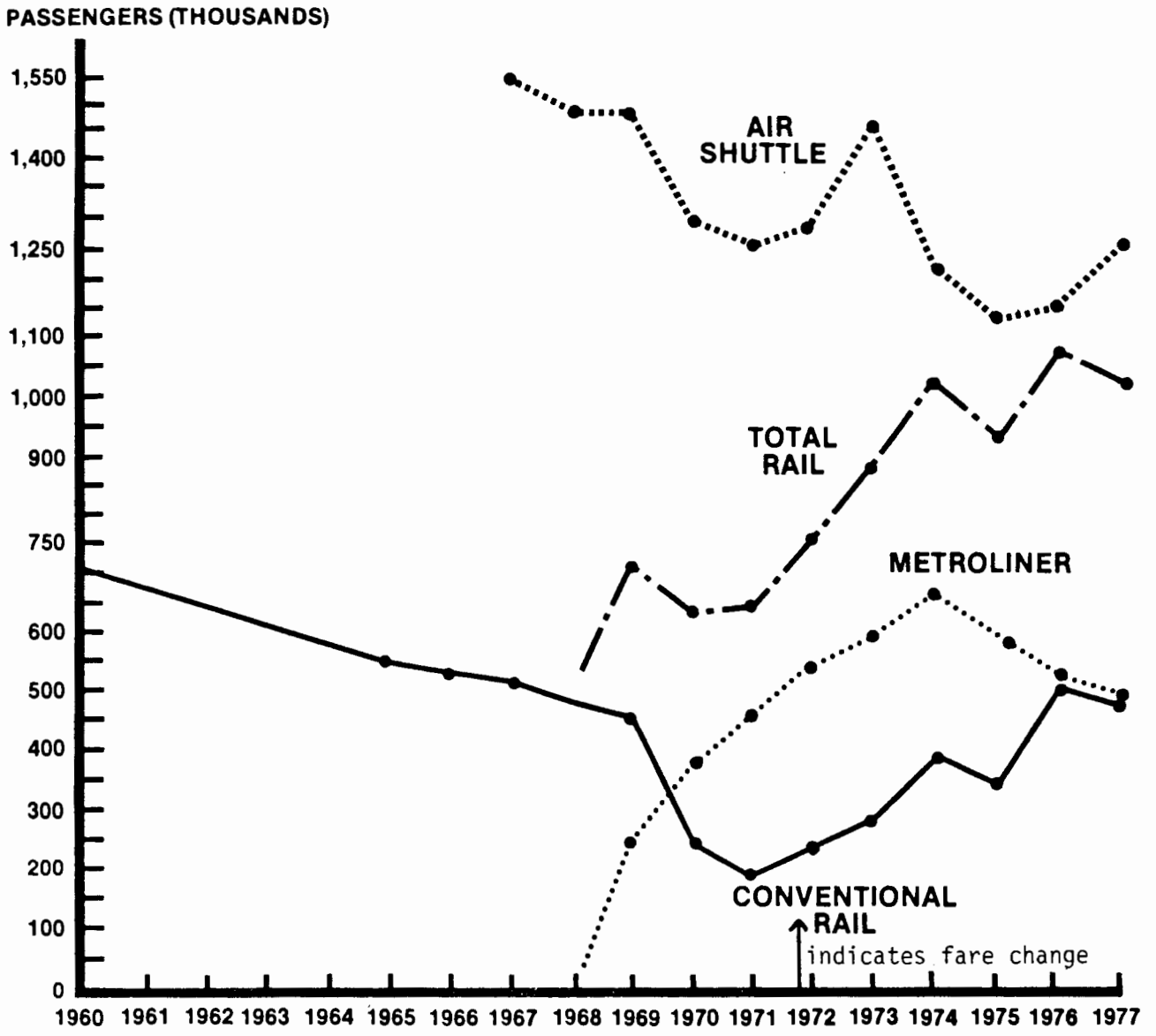
Conventional train services, left virtually untouched by the demonstration programs, experienced a continuation in patronage decline. Between New York and Washington, part of the decline was due to passengers transferring to Metroliners. This downward trend was not reversed until 1972 when Amtrak lowered fares in the Washington-New York and New York-Boston segments of the Corridor 1/. The market reacted immediately and the gain in ridership has continued, reinforced recently by new Amfleet passenger cars now in use on all conventional trains.

In the last two years, Metroliner service has become less attractive to the traveling public. Metroliner equipment availability has been poor primarily because it is old and therefore less reliable. Additionally, the condition of Corridor track and bridges has led to significant speed restrictions. These two factors have caused a sharp deterioration in on-time performance as illustrated in Figure I-F. In some recent periods, only 25-30 percent of the trains have been within 10 minutes of the scheduled arrival time at

1/ The fare reduction between Boston and New York became effective in December 1971.

FIGURE I-D

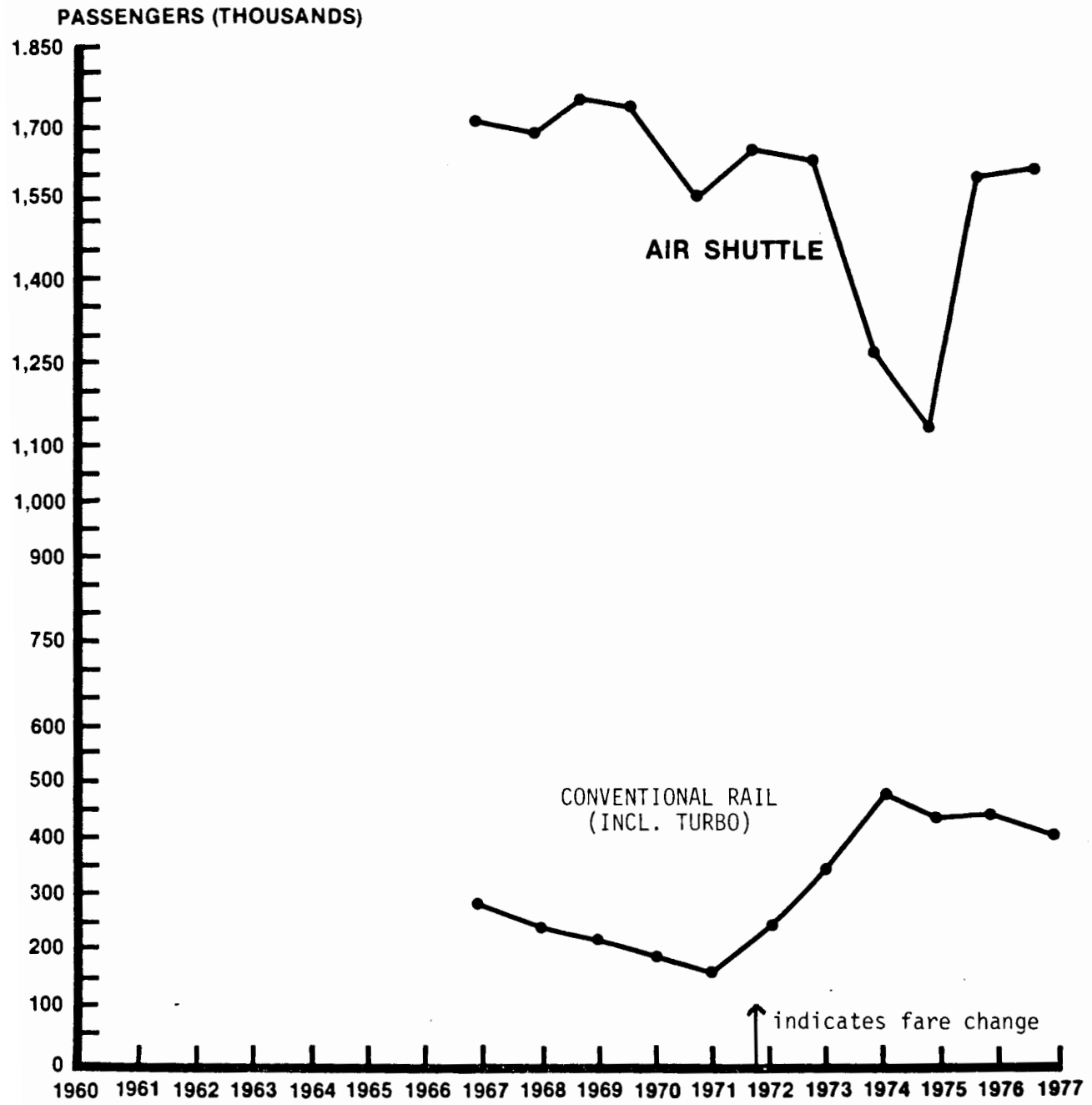
NEW YORK - WASHINGTON, D.C. RAIL AND AIR SHUTTLE PASSENGER DATA



SOURCE: ROBERT L. WINESTONE "STAFF PAPER TEN YEARS OF TRAIN-AIR DATA IN NEW YORK TO WASHINGTON PASSENGER MARKET," DEPARTMENT OF TRANSPORTATION, FEDERAL RAILROAD ADMINISTRATION, OFFICE OF FEDERAL ASSISTANCE, RAIL PASSENGER PROGRAMS DIVISION

FIGURE I-E

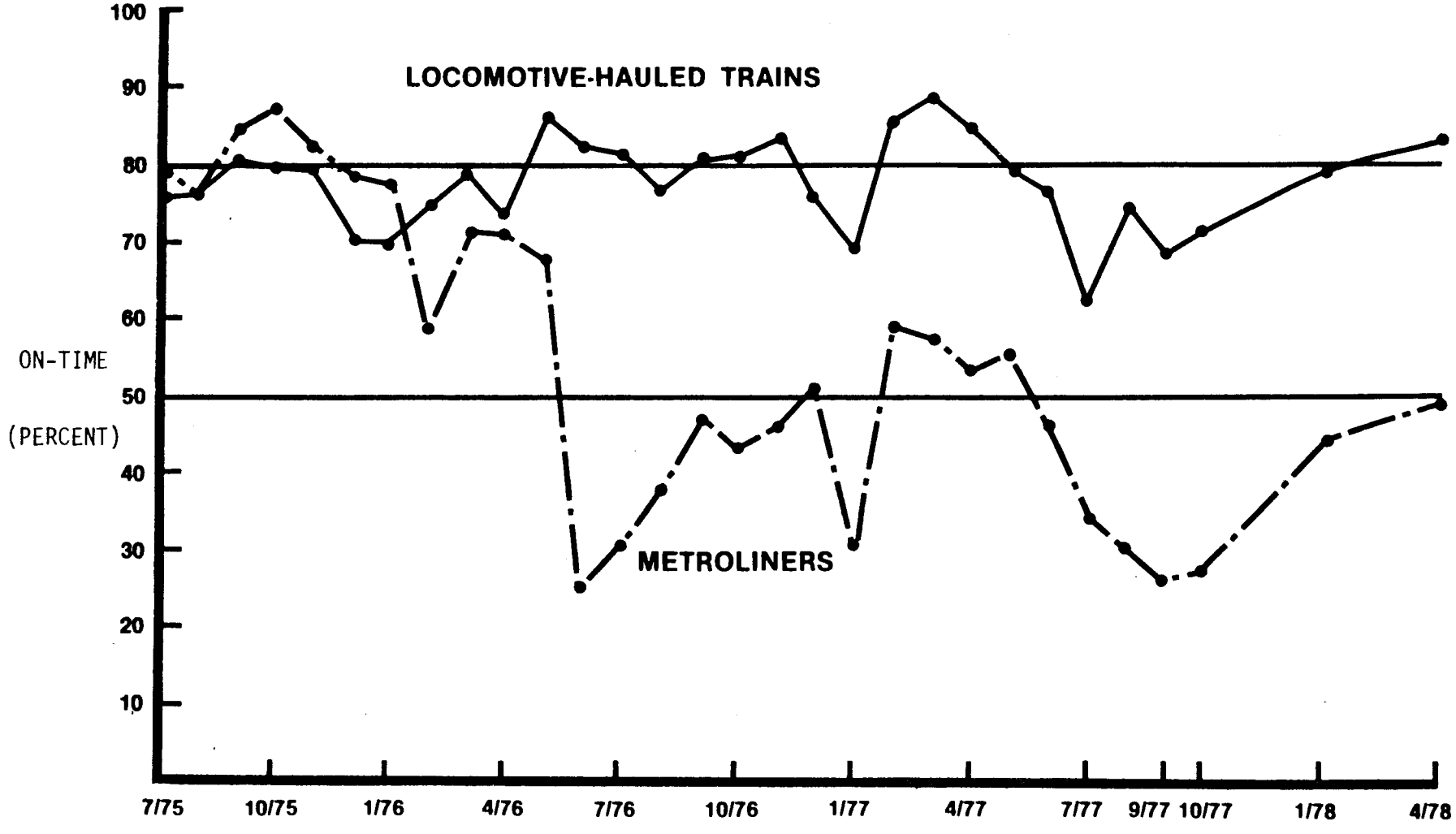
NEW YORK - BOSTON RAIL AND AIR SHUTTLE PASSENGER DATA



SOURCE: ROBERT L. WINESTONE "STAFF PAPER TEN YEARS OF TRAIN-AIR DATA IN NEW YORK TO WASHINGTON PASSENGER MARKET," DEPARTMENT OF TRANSPORTATION, FEDERAL RAILROAD ADMINISTRATION, OFFICE OF FEDERAL ASSISTANCE, RAIL PASSENGER PROGRAMS DIVISION

FIGURE I-F

NEC ON-TIME PERFORMANCE TRENDS



SOURCE: AMTRAK ON-TIME PERFORMANCE REPORTS

terminal stations. The inferior service has begun to have an effect on ridership levels. For instance, Metroliner ridership in 1977 decreased by 5 percent from the previous year.

In contrast, the improved punctuality record of conventional trains and the superior comfort level of Amfleet cars have increased patronage of this service. The relatively strong demand for conventional trains has actually offset the decline in Metroliner patronage, demonstrating a strong underlying demand for improved rail service. In order for this demand to be translated into substantial ridership, it is important that Amtrak provide quality service that is competitive with other transportation modes in the Northeast Corridor.

1. Current Competitive Position

There are three well-defined categories of rail travelers who use Amtrak service. One large group, predominantly Metroliner travelers, is mostly concerned with speed, frequency, and comfort. For this group, price is relatively unimportant. The second major group normally travels on conventional Amfleet trains. This group is clearly price sensitive as is well evidenced by the significant growth in conventional train patronage after Amtrak reduced fares in 1972. These fare reductions made conventional trains competitive in price with bus travel. However, this second group is also influenced by greater comfort; the introduction of Amfleet equipment has buttressed demand. Importantly, when the prime criterion of competitive price has been met, ridership will be influenced by speed and service frequency. A third major group, commuters, use intercity trains largely between Trenton and New York. Table I-C gives traffic and financial details for each category of rail travelers in 1976.

At present the Metroliner service is substantially less expensive than the air shuttle, its major competitor; however, rail service cannot match the shuttle's total journey time. Comparison of other aspects of service quality tend to offset each other. Metroliner's better standards of seat comfort and amenities are offset by a poorer ride quality and a passenger's uncertainty as to the ability to travel at his/her choice of time, (i.e., limited capacity). Also, the present all-reserved seat arrangement and the time-consuming procedures for booking tickets and picking up reservations contrast unfavorably with the ease of traveling on the air shuttle, where extra seats are provided to meet random demand patterns, reservations are not needed, and tickets are sold on-board.

TABLE I-C
COMPARISON OF AMTRAK NEC MARKETS, 1976

Category	Metroliner Time-sensitive	Amfleet Price-sensitive Non-commuter	Amfleet Price-sensitive Commuter
Passengers (million)	2.2	5.1	2.0
% of total passengers	23.7%	54.8%	21.5%
Passenger-miles (million)	321.7	614.9	116.0
% of total pass.	30.6%	58.4%	11.0%
Transportation Revenue*	$40.1M	$43.3M	$ 4.1M
% of Total Revenue	45.8%	49.5%	4.7%
Transportation revenue per passenger-mile	0.125	0.070	0.035
Total operating cost per passenger-mile	0.167	0.152	0.122
Deficit per passenger-mile	0.042	0.082	0.087

*Metroliner revenue comprises full fares plus supplement. Amfleet non-commuter revenue includes excursion fares.

Source: Amtrak Five Year Corporate Plan of 1976

While in most circumstances Metroliner service is now quicker than automobile, it cannot match the auto's flexibility, convenience, and price. Even so, the Metroliner remains attractive as a stress- and problem-free alternative when compared to an automobile trip.

Amfleet-equipped conventional trains compete with the bus and the automobile south of New York; north of New York they are also an alternative to travel by air, since rail premium service is nonexistent there. Table I-D shows that between Washington and New York, conventional Amfleet trains offer a slightly shorter total-journey travel time than buses at somewhat higher fare. In addition, the train offers a more comfortable ride and a catering facility not provided by the bus. However, the train loses to the automobile on journey time and convenience and is not price competitive when more than one traveler shares the automobile. The same observations are generally true in the New York-to-Boston market. Tables I-D and I-E show the competitive levels of the major transportation modes on speed, frequency, and price between New York and Washington and New York and Boston.

TABLE I-D

COMPARISON OF ESTIMATED TRIP TIMES AND FARES,
BY MODE, NEW YORK CITY--WASHINGTON D.C.
MAY 1978

Travel Mode	Line Haul Fare	Total Cost 1/ Taxi	Total Cost 1/ Public Transit	Travel Time (hr./min.) Line haul	Travel Time (hr./min.) Access/ Connection	Travel Time (hr./min.) Total Time
Rail:						
Metroliner:						
Coach	$26.00	$30.00	-	3h20m	1h	4h20m
Club	$41.50	$45.50	-	3h20m	1h	4h20m
Conventional:						
Coach	$21.00	-	$22.00	3h50m	1h40m	5h30m
Club	$33.50	$37.50	-	3h50m	1h	4h50m
Round trip 2/ off peak	$15.75	-	$16.75	3h50m	1h40m	5h30m
Air:						
Shuttle	$41.00	$56.00	-	1h	1h40m	2h40m
	$41.00	-	$46.15	1h	2h30m	3h30m
Round trip						
Weekend	$26.50	$41.50	-	1h	1h40m	2h40m
	$26.50	-	$30.25	1h	2h30m	3h30m
Bus:						
Express	$20.95	-	$21.95	4h10m	1h40m	6h
Excursion, 30-day	$15.50	-	$16.50	4h20m	1h40m	6h
Automobile: 3/						
1 person	$15.75	$18.25		4h20m	30m	4h50m
2 persons	$ 7.90	$ 9.15		4h20m	30m	4h50m
4 persons	$ 3.95	$ 4.60		4h20m	30m	4h50m

1/Line haul plus access

2/Fares and times are shown one-way for round trip options. Access by automobile for rail or air may be expected to equate roughly the costs and time of taxi.

3/Line haul out-of-pocket costs calculated at 4.2¢ per mile plus tolls. Access cost is half the parking fee. Access time includes parking and walking from garage.

TABLE I-E

COMPARISON OF ESTIMATED TRIP TIMES AND FARES, BY MODE, NEW YORK CITY--BOSTON
MAY 1978

Travel Mode	Line Haul Fare	Total Cost 1/		Travel Time (hr./min.)		
		Taxi	Public Transit	Line haul	Access/ Connection	Total Time
Rail:						
Coach	$19.50	-	$20.50	4h50m	1h40m	6h30m
Club	$27.50	$31.50	-	4h50m	1h	5h50m
Round trip 2/ off peak	$12.50	-	$13.50	4h50m	1h40m	6h30m
Air:						
Shuttle	$38.00	$42.00	-	50m	1h40m	1h50m
Round trip Weekend	$24.50	$28.50	-	50m	1h40m	1h50m
Bus:						
Express	$19.45	-	$20.45	4h30m	1h40m	6h10m
Excursion, 30-day	$14.70	-	$15.70	4h30m	1h40m	6h10m
Automobile: 3/						
1 person	$13.40	$15.90	-	4h45m	30m	5h15m
2 persons	$ 6.70	$ 7.95	-	4h45m	30m	5h15m
4 persons	$ 3.35	$ 4.00	-	4h45m	30m	5h15m

1/Line haul plus access

2/Fares and times are shown one-way for round trip options. Access by automobile for rail or air may be expected to equate roughly the costs and time of taxi.

3/Line haul out-of-pocket costs calculated at 4.2¢ per mile plus tolls. Access cost is half the parking fee. Access time includes parking and walking from garage.

2. Service Levels - Post NECIP

At the completion of NECIP, Corridor intercity rail service will compete against modes whose service levels most likely will not have changed significantly from that offered before NECIP. The trip-time differential in the Washington-New York market between high-speed rail and air will be 1 hour, whereas today it is 1 hour, 40 minutes. In the New York-Boston market, rail travel time will have an advantage for the first time over auto and bus; however, air travel will continue to offer a substantial trip-time advantage. Tables I-F and I-G present comparisons of travel times and costs for all modes between Washington and New York, and New York and Boston.

The advent of more frequent and faster trains (all having virtually the same journey time), improved equipment, and a higher standard of on-time performance 1/ will require that changes be made to current marketing and pricing policies. For example, charging a premium fare for faster service, as is the case with today's Metroliner service, may not be a realistic option in 1982 when no meaningful difference exists between services. Comparability of trip-times will present Amtrak with an important pricing decision.

If all fares are increased to the level of today's Metroliner service, some ridership will be lost. If an average fare somewhere between today's conventional and Metroliner levels is set, Amtrak stands to lose the revenue advantage of charging a premium fare. This latter issue is particularly important, since after NECIP it will be possible to restore the fare relationship that existed between Metroliners and the air shuttle during the premium days of the former.

One promising alternative is to revise the fare structure to be peak/off-peak sensitive. In this way, a standard fare equal to, and in some cases higher than, the existing Metroliner fare would be charged in the peak period, and lower fares would be set in the off-peak period to attract additional ridership.

1/An 80-percent on-time performance criterion will be accompanied by a tighter standard for measuring punctuality. Currently, if a train arrives within 10 minutes of scheduled arrival time in Washington-New York or New York-Boston trips, Amtrak considers them to be on-time. Post-NECIP performance criterion will reduce this leeway to 5 minutes.

TABLE I-F

COMPARISON OF ESTIMATED TRIP TIMES AND FARES,
BY MODE, NEW YORK CITY--WASHINGTON D.C.
1982

(BASED ON 1978 DOLLARS)

Travel Mode	Line Haul Fare	Total Cost 1/ Taxi	Total Cost 1/ Public Transit	Travel Time (hr./min.) Line haul	Access/ Connection	Total Time
Rail:						
Standard (peak)						
Coach	$33.00	$37.00	-	2h40m	1h	3h40m
Club	$50.00	$54.00	-	2h40m	1h	3h40m
Reduced (off-peak)						
Coach	$21.00	-	$22.00	2h40m	1h40m	3h55m
Club	$33.50	$37.50	-	2h40m	1h	3h40m
Round trip 2/ off-peak	$15.75	-	$16.75	2h40m	1h40m	3h55m
Air:						
Shuttle	$41.00	$56.00	-	1h	1h40m	2h40m
	$41.00	-	$46.15	1h	2h30m	3h30m
Round trip	$26.50	$41.50	-	1h	1h40m	2h40m
Weekend	$26.50	-	$32.25	1h	2h30m	3h30m
Bus:						
Express	$20.95	-	$21.95	4h20m	1h40m	6h
Excursion 30-day	$15.50	-	$16.50	4h20m	1h40m	6h
Automobile: 3/						
1 person	$15.75	$18.25	-	4h20m	30m	4h50m
2 persons	$ 7.90	$ 9.15	-	4h20m	30m	4h50m
4 persons	$ 3.95	$ 4.60	-	4h20m	30m	4h50m

1/Line haul plus access

2/Fares and times are shown one-way for round trip options. Access by automobile for rail or air may be expected to equate roughly the costs and time of taxi.

3/Line haul out-of-pocket costs calculated at 4.2¢ per mile plus tolls. Access cost is half the parking fee. Access time includes parking and walking from garage.

TABLE I-G

COMPARISON OF ESTIMATED TRIP TIMES AND FARES,
BY MODE, NEW YORK CITY--BOSTON
1982

(BASED ON 1978 DOLLARS)

Travel Mode	Line Haul Fare	Total Cost 1/		Travel Time (hr./min.)		
		Taxi	Public Transit	Line haul	Access/ Connection	Total Time
Rail:						
Coach	$19.50	-	$20.50	3h40m	1h40m	5h20m
Club	$27.50	$31.50	-	3h40m	1h	4h40m
Round trip 2/ off peak	$12.50	-	$13.50	3h40m	1h40m	5h20m
Air:						
Shuttle	$38.00	$42.00	-	50m	1h40m	1h50m
Round trip Weekend	$24.50	$28.50	-	50m	1h40m	1h50m
Bus:						
Express	$19.45	-	$20.45	4h30m	1h40m	6h10m
Excursion 30-day	$14.70	-	$15.70	4h30m	1h40m	6h10m
Automobile: 3/						
1 person	$13.40	$15.90		4h45m	30m	5h15m
2 persons	$ 6.70	$ 7.95		4h45m	30m	5h15m
4 persons	$ 3.35	$ 4.00		4h45m	30m	5h15m

1/Line haul plus access

2/Fares and times are shown one-way for round trip options. Access by automobile for rail or air may be expected to equate roughly the costs and time of taxi.

3/Line haul out-of-pocket costs calculated at 4.2¢ per mile plus tolls. Access cost is half the parking fee. Access time includes parking and walking from garage.

Support for this concept can be drawn from existing data which shows that one-third of conventional and nearly one-half of Metroliner travelers travel during the hours of 7 am to 9 am and 4 pm to 6 pm. Other alternatives and combinations of mixed-system operations will depend on Amtrak's market evaluations as information on demand levels under improved Corridor operations is accumulated. Decisions on fare strategy will have a major impact on revenue and demand levels.

As noted above, post-NECIP Boston-New York rail trip times will remain somewhat slower than air trip times. This situation, and the less frequent service than that available in the southern segment, could preclude use of peak and off-peak pricing schemes in the northern segment. As a consequence, only a single fare level roughly comparable to today's is assumed. Tables I-F and I-G also show the relationship between modes for journey times and fares after the introduction of faster trip-times. Figure I-G is a graphic display of changes between 1978 and 1982 in fares and trip times among competitive modes in the major segments of the Corridor.

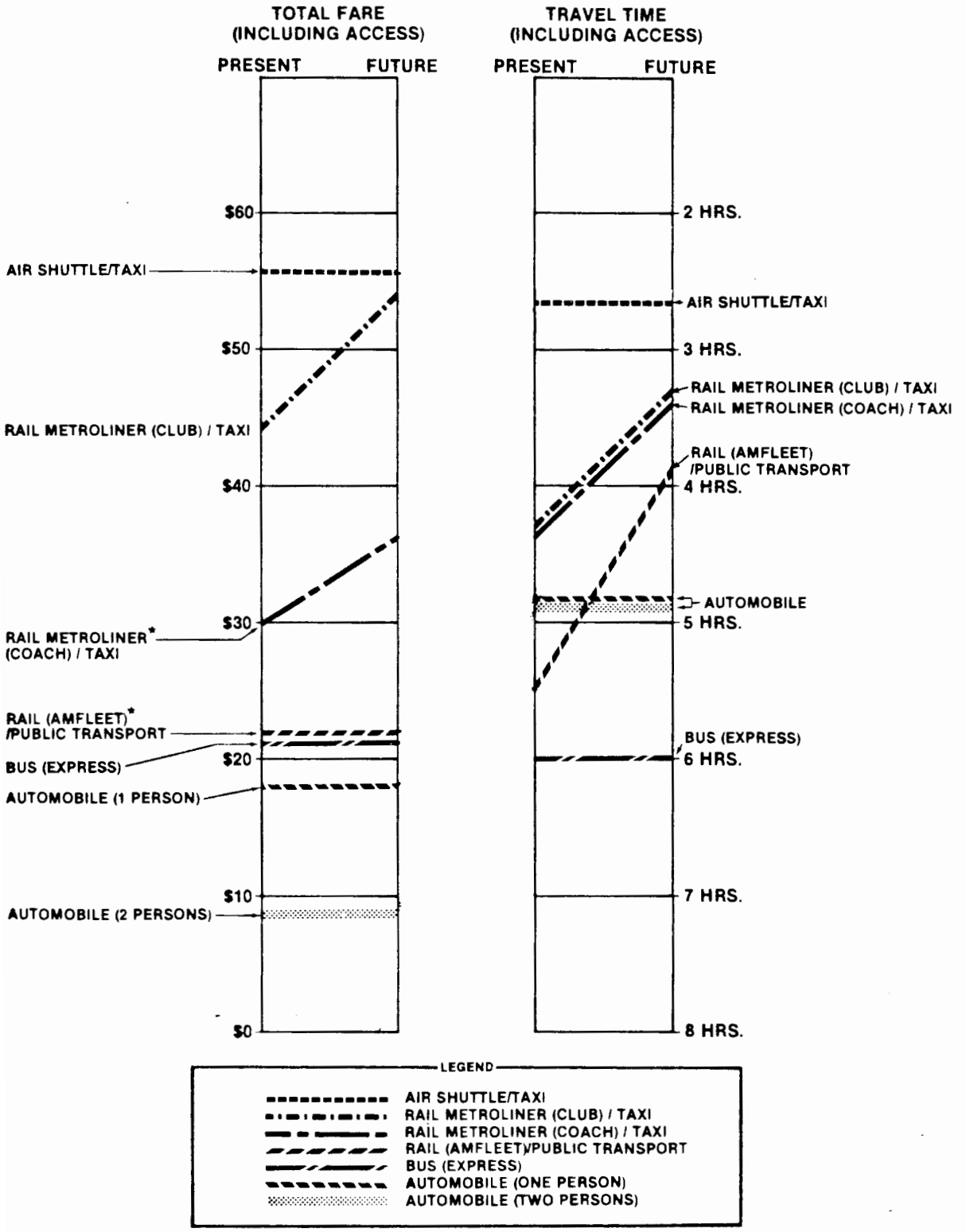
As noted previously, population along the NEC is concentrated in major cities and their immediate suburbs. These same cities generate most NEC rail travel. Table I-H shows the percentages of passengers and passenger-miles traveled between cities of varying sizes. Travel between the six largest cities accounts for 66 percent of passenger miles and 61 percent of riders. These six markets therefore generate about two-thirds of all intercity rail travel. When travel between large and medium cities is added, the percents increase to 85 and 84, respectively. The remaining 15 to 16 percent of both passenger-miles and passengers are widely scattered among 300 additional city-pair flows 1/.

Since current demand for intercity rail travel is heavily concentrated in the largest markets, it follows that the bulk of future increases in demand will come from the same markets. Improvements in journey time between major city pairs is a very important factor in calculating the NECP forecast of 14.8 million riders for the first full year of post-NECIP service. Lengthening the journey time between major cities by adding stops, for example, has been shown to decrease demand. The addition of three more stops (beyond the five now planned) in both the Washington-New York and New York-Boston segments is estimated to reduce total annual ridership by 900,000. Such a loss in riders would reduce revenues by over $13 million.

1/Based on SMSA populations and historical intercity train frequencies.

FIGURE I-G

COMPARISON OF FARE AND JOURNEY TIME BY MODE
WASHINGTON TO NEW YORK
1978 - 1982



* Fares now reflect two separate services. After NECIP completed, reference will be to peak and off-peak fares.

TABLE I-H

PERCENT OF PASSENGERS AND PASSENGER MILES BETWEEN LARGE, MEDIUM, AND SMALL CITIES 1977

	City Size 1/			
From/To	Large	Medium	Small	% of TOTAL
Large				
Passengers	60.7%	23.5%	12.6%	96.8%
Pass. Miles	65.7%	19.5%	12.2%	97.4%
Medium				
Passengers		1.0%	2.0%	3.0%
Pass. Miles		1.0%	1.3%	2.3%
Small				
Passengers			0.2%	0.2%
Pass. Miles			0.3%	0.3%
TOTAL				
Passengers	60.7%	24.5%	14.8%	100%
Pass. Miles	65.7%	20.5%	13.8%	100%

Large Cities	Medium Cities	Small Cities
Boston	Providence	Route 128 3/
New York	Bridgeport 2/	Kingston
Newark	Stamford 2/	Westerly
Philadelphia	New Haven	Mystic
Baltimore	Trenton	New London
Washington	Wilmington	Old Saybrook
		Rye
		Metropark 3/
		New Brunswick
		Princeton Junction
		Aberdeen
		New Carollton 3/

Source: Amtrak Passenger Statistics, FRA

1/ Large city-population greater than 300,000
Medium city-population between 75,000 - 300,000
Small city-population less than 75,000

2/ The population criteria place Bridgeport and Stamford in the category of medium - size cities; however, ridership for these cities is undoubtedly understated since Amtrak prohibits travel locally between the two cities and between them and New York and New Haven

3/ "Beltway" stations

Markets in smaller communities are best served and more easily expanded by providing ready access through a network of connector services linked to high-speed intercity trains.

To meet the demand forecast for the intercity market, train service having the following characteristics is proposed:

- Frequent, high-quality service, offering best journey times between a limited number of major cities.

- Secondary integrated service for the remaining stations linked and coordinated at key points to the main service to provide greatly increased travel opportunities to and from the smaller stations. This would be provided in a coordinated service between Amtrak and transit authority trains.

- Service that accommodates the needs of commuters for stable and reliable service, and that is flexible enough at peak periods to avoid severe conflicts with commuters for use of the available train capacity of the route.

A preliminary timetable of post-improvement train service has been developed by NECP and Amtrak. It is an essential planning tool in making decisions concerning rolling stock, support facilities, and future operating and maintenance costs. The Philadelphia-Springfield and express train services have been included in the timetable to insure sufficient system capacity along the Corridor mainline should those services be operated. The preliminary timetable presented in Appendix "A" includes the following type and frequency of service:

- Half-hourly service throughout the day (0600-2300) in the Washington-New York market with a trip time of 2 hours, 40 minutes with five stops

- Hourly service throughout the day (0600-2200) in the New York-Boston market with a trip time of 3 hours, 40 minutes with six stops

- Continuation of the current level of peak hour commuter "clocker" trains between Philadelphia and New York

- Two-hour service throughout the day (0600-1830) between Philadelphia and Springfield via New Haven with a trip time of 4 hours, 30 minutes with ten stops; every third train will terminate or originate at Boston

- o Existing long distance trains
- o Express trains with trip times of 2 hours, 30 minutes in the Washington-New York market, and 3 hours 20 minutes in the New York-Boston market introduced as required by increased demand.

In terms of trains per day for each market (train-series number), this preliminary timetable represents an 18 percent increase over 1978 service levels. Table I-I summarizes and compares present and post-NECIP operations.

TABLE I-I

TOTAL TRAINS PER DAY

Series (Market)	1978 Service	Preliminary Timetable	% Change
10 (Through Trains)	18	18	N.C.
100 (Wash.-NY-Bost.)	55	75	+36%
200 (Phila.-NY.)	15	13	-13%
300 (Phila.-Spfd.) 1/	0	12	∞
400 (N.Haven-Spfd., Phila-Wash.,Misc.)	22	12	-45%
TOTAL	110	130	+18%

Source: "1981-85 Amtrak Design Timetables", typical Friday Schedule.

The service outlined in Table I-I offers frequent, high-quality service at the best possible trip times consistent with the funding limits of the 4R Act. Any additional stops added to the 100-series trains will prohibit their attaining the trip time specified in the 4R Act. Intermediate stations

1/Six trains per day, or half the service, will begin or end in Boston.

are served by 200-, 300-, and 400-series trains as well as the commuter trains of the various sponsoring agencies along the Corridor. Expansion of the service as demand increases will, at least initially, be accommodated by expanding train size, e.g., from six to seven or eight cars.

D. THROUGH TRAINS

Twenty-four trains traverse the NEC daily enroute to points well beyond the limits of the NEC itself 1/. In general, these trains place restrictions on passenger travel between NEC cities in order to provide adequate space for long-distance travelers. For this reason, they are not considered further in this report. Where appropriate, these trains have been included in Corridor station and track capacity planning; travelers on these long-distance trains will receive schedule benefits from Corridor improvements, though not in proportion to the time savings that will be enjoyed by passengers on intra-Corridor high-speed trains.

E. FEEDER SERVICES

Services from Harrisburg and Springfield feed directly into the Corridor at Philadelphia and New Haven, respectively. The Harrisburg-Philadelphia service operates hourly and caters to two markets: commuters to and from Philadelphia, and passengers transferring to and from NEC mainline trains. Total daily travel averages 2,500 riders, with about one-third going on to use Corridor service for part of their trip. The service from Springfield to New Haven runs about every 2 hours and carries nearly 750 riders daily, of whom slightly over half transfer to or from NEC trains.

The other main feeder service links Albany, New York, with New York City (Grand Central Terminal), and generates over 2,000 daily trips. Travelers going to or coming from the NEC must transfer between stations in New York (Pennsylvania Station and Grand Central Terminal). Because the transfer is inconvenient, few of the 2,000 daily trips originate or terminate on the Corridor.

1/These trains include: six to eight Florida trains depending on the season, and roundtrips between: Washington-Montreal, New York City-Chicago (plus the Washington section), NYC-Kansas City, NYC-Atlanta/New Orleans, NYC-Savannah, NYC-Richmond, and NYC-Newport News.

A. INTRODUCTION

The Northeast Corridor Improvement Project (NECIP) 1/ is a Federal commitment to improve intercity rail passenger service between Washington, D.C., and Boston, Massachusetts. While an important goal of NECIP remains the trip-times specified in the Railroad Revitalization and Regulatory Reform Act of 1976 (4R Act), Secretary of Transportation Adams has directed that every effort be made by the Federal Railroad Administration's Northeast Corridor Project (NECP) to insure that the service needs of all Corridor users (intercity passengers, commuters, and freight shippers) are considered 2/. In responding to this directive, the NECP and the Corridor users have recognized that service coordination and integration are essential if the Federally-upgraded rail system is to be efficiently utilized.

By virtue of its size and the ambitious nature of its goals, the NECIP will make a lasting impression on the Corridor, both physically and in future operations. Rehabilitation of the right-of-way, structures, stations, and communications and signaling systems between Washington, D.C., and Boston, Massachusetts, will modernize the railroad and expand its capacity to the benefit of all users. The totally new electrification between New Haven and Boston will benefit primarily intercity passenger service, and it could also lead to an expansion of commuter service sponsored by the Metropolitan Transportation Authority (MTA) and the Connecticut Department of Transportation (CDOT).

Deciding exactly where and to what level funds are to be spent among the competing alternative improvements to the Corridor is the responsibility of the NECP. Such decisions will be predicated on achieving the best possible use of Federal funds in the construction of a coordinated system that provides high-speed intercity, commuter, and freight service benefits to the American public.

1/Reference is made in the text to the NECIP which is the program authorized by the Railroad Revitalization and Regulatory Reform Act of 1976. The text also refers to the NECP, the Northeast Corridor Project, which is the organization established within the Federal Railroad Administration (FRA) to implement the NECIP.

2/Speech delivered by Secretary Adams to the Transportation Research Board, National Academy of Sciences, Washington, D.C., on January 4, 1978.

This Part II of the report analyzes: future demands for separate Corridor commuter and freight services and whether the new capacity provided by the NECIP will be sufficient; changes in commuter and freight operating patterns that are likely to evolve out of the NECIP investment; concerns that have been expressed by commuter authorities and freight carrier representatives as to near- and long-term impacts of the NECIP on their operations; and a recommendation for the establishment of a mechanism to ensure the best service for all users through integration of operations.

B. COMMUTER SERVICE AND OPERATIONS

The quantity and quality of intercity rail services in the Corridor are mirrored by a similar intensity of commuter rail services. Presently, 400 daily commuter trains operate on the NEC right-of-way transporting 110,000 passengers. The average trip length for a NEC commuter is approximately 25 miles, and most commuters make daily round trips.

The track access requirements of these services are greatest during short periods each weekday morning and evening, and are much reduced or nonexistent during the remainder of the day and on weekends. Nearly all of the service is provided by self-propelled electric cars, with the exceptions of: Amtrak locomotive-hauled trains between Philadelphia and New York 1/, New Jersey Department of Transportation (NJDOT) sponsored service that joins the NEC at Rahway and uses GG-1 class electric locomotives, and conventional diesel locomotive-pulled trains and rail diesel cars operated by the Boston and Maine Railroad for the Massachusetts Bay Transportation Authority (MBTA).

Despite the substantial level of commuter service on the NEC right-of-way, commuter passenger miles are only 64-percent that of intercity passenger miles. Therefore, since revenue per passenger mile is higher from intercity service than from commuter service, total Corridor revenues generated are nearly 72-percent from intercity travel and 28-percent from commuter travel. Even when commuters using Amtrak's Philadelphia-New York service are grouped with transit authority patrons, these percentages change only to 69-percent and 31-percent, respectively. Table II-A summarizes NEC passenger miles and revenues for both commuter and intercity travel.

1/Amtrak and NJDOT are currently negotiating a lease that will permit the substitution of multiple-unit New Jersey Arrow cars in this service for a limited time.

TABLE II-A

ANNUAL PASSENGERS, PASSENGER MILES AND REVENUE
FOR PASSENGER SERVICE ON THE NEC 1977(1)

Type Service Commuter - Service Endpoints (sponsor)	Passengers		Passenger Miles		Revenue	
	(Millions)	% Of Total	(Millions)	% Of Total	(Millions)	% Of Total
Washington D.C./Baltimore, Md. (MDOT)	.4	1.0	4.8	.3	.3	.2
Wilmington, Del./Philadelphia, Pa. (SEPTA)	3.0	7.8	35.8	1.9	2.7	2.0
Philadelphia, Pa./Trenton, N.J. (SEPTA)	2.9	7.6	48.6	2.6	2.6	1.9
Trenton, N.J./New York (NJDOT)	9.0	23.6	216.8	11.7	14.0	10.3
New Rochelle, N.Y./N. Haven Conn. (MTA/CTA)	9.0	23.6	276.0	15.0	16.3	12.0
Providence, R.I./Boston, Mass. (MBTA)	3.6	9.4	39.7	2.2	2.2	1.6
Subtotal	27.9	73.0	621.7	33.7	38.1	28.0
Philadelphia, Pa./New York (Amtrak)	1.8	4.7	97.3	5.3	3.8	2.8
Total Commuter	29.7	77.7	719.0	39.0	41.9	30.8
Intercity						
Metroliner - (Amtrak)	2.1	5.5	292.8	15.9	34.9	25.7
Amfleet - (Amtrak)	5.8	15.2	749.6	40.6	55.0	40.4
Long Haul - (Amtrak)	.6(2)	1.6	84.0(2)	4.5	4.2	3.1
Subtotal	8.5	22.3	1,126.4	61.1	94.1	69.2
Total NEC	38.2	100.0	1,845.4	100.0	136.0	100.0
Totals						
Commuter Authorities	27.9	73.0	621.7	33.7	38.1	28.0
Amtrak	10.3	27.0	1,223.7	66.3	97.9	72.0

(1) excludes services using NEC for a short distance

(2) estimate by NECP

Source: Commuter authorities and Amtrak

At the request of the NECP, State departments of transportation and regional transit authorities have provided data on current operation and estimates of future demand for the services they sponsor. Table II-B presents selected Fiscal Year 1977 operating and traffic statistics for services that serve stations on the Corridor. Appendix "B" contains detailed maps of all commuter rail operations which illustrate the physical relationship of those operations to the Corridor and the specific instances where commuter service uses the NEC right-of-way.

Each NEC commuter operation has been examined to determine current and projected (through-1990) demand, and the corresponding increase in train operations that will be required. This has been done in order to identify both potential NEC capacity limitations and future conflicts between commuter, intercity, and freight services. An independent study of options to minimize the impact of the NECIP on NJDOT and the Southeastern Pennsylvania Transportation Authority (SEPTA) commuter service has been initiated by the Northeast Corridor Commuter Rail Authorities Committee (NECCRAC).

Commuter operations sponsored by the Maryland Department of Transportation (MDOT) are the least complex of any provided on the Corridor. Four trains per day account for most of the service, two into Washington from Baltimore each weekday morning and two returning each evening. A pair of trains, "The Chesapeake", have been added as a joint Amtrak/MDOT experiment. Patronage through 1990 is expected to grow at a rate of 1.0 to 1.5 percent per annum or to approximately 1,900 trips per weekday. This increase can be met by adding cars to existing trains or expanding frequency by one train daily. Either of these alternatives can be accommodated without difficulty.

SEPTA operates two commuter services along the NEC, Wilmington-Philadelphia and Philadelphia-Trenton. Currently almost 23,500 weekday passenger trips are generated by these services. Peak morning commuter service into Philadelphia from the south averages three trains per hour; however, many do not originate in Wilmington but from stations closer to Philadelphia. From Trenton, the service is less frequent, but no trains originate at intermediate stations. Annual growth through 1990 will be about 1-percent, yielding a 1990 weekday average of approximately 28,500. SEPTA is not forecasting an increase in train frequency since most trains will simply be lengthened to accommodate the expanded demand.

TABLE II-B

RAIL COMMUTER SERVICE ON THE NEC - SELECTED STATISTICS FOR 1977

Service Endpoints (sponsor)	Trains/ Day	Cars in Service/ Day	Pass. Trips/ Wkday	Trains per hour In Any One Srvc Peak	Off-Peak	Annual Revenue Pass. Miles (millions)	Average Daily Load Factor	Annual Revenue (millions)
Washington D.C./Baltimore, Md. (MDOT)	4	5	1,400	.7	-	4.8	52%	$ .3
Wilmington, Del./Philadelphia, Pa. (SEPTA)	39	38	11,800	3.0	.7	35.8	59%	$ 2.7
Philadelphia, Pa./Trenton, N.J. (SEPTA)	34	32	11,500	2.0	.8	48.6	64%	$ 2.6
Trenton, N.J./New York (NJDOT)1/	108	212	35,200	1.8	.7	216.8	52%	$14.0
N. Rochelle N.Y./N. Haven, Conn. (MTA/CTA)	148	244	35,000	9.5	3.0	276.0	70%	$16.3
Providence, R.I./Boston, Mass. (MBTA)2/	56	152	14,000	2.0	1.1	39.7	40%	$ 2.2
TOTAL	389	683	108,900			621.7		$38.1

1/Includes service originating/terminating at Jersey Avenue and New Brunswick, and that portion of North Jersey Coast Line service between Rahway and Newark/New York.

2/Includes services entering/leaving the NEC mainline at Canton Jct., Readville and Forest Hills.

Sources: Commuter authorities

Most commuter services sponsored by the NJDOT along the Corridor originate and terminate at Trenton or New Brunswick. Service from the North Jersey coastline joins the Corridor at Rahway. Over 35,000 weekday riders use the services, with growth through 1990 forecast by NJDOT at 1.3 percent annually to nearly 42,000 riders per day. One additional train in the Trenton service during morning and evening peaks plus expanded train lengths should be sufficient for the anticipated growth. The North Jersey Shore Service could experience faster growth, particularly in the Monmouth County area, and for this reason two additional trains may be needed during the peak periods by 1990. NJDOT plans to electrify this line (12.5kv, 60Hz) from South Amboy to Long Branch under an Urban Mass Transportation Administration (UMTA) grant. Future service between Long Branch and Bay Head has not yet been resolved. Extending the area of electrification will eliminate time now lost changing engines and will conceivably increase demand. Regardless, Corridor capacity should not be affected by the addition of the small number of trains contemplated.

The joint MTA-CDOT service to Stamford and New Haven from New York currently transports 35,000 weekday riders along the NEC mainline. Recent rapid growth in commuter traffic, primarily as a consequence of New York State and Connecticut policies providing stable fares, improved services, and a substantial investment in new equipment, has led MTA-CDOT officials to forecast that weekday passenger trips will grow through 1990 at a 3 percent annual rate during the peak ridership periods and at 4.1 percent during the off-peak. If these projections materialize, weekday riders could exceed 50,000 by 1990. During hours of peak demand some of the increase can be met by adding equipment. When trains reach their maximum length, generally 12 cars, new trains must be added to the timetable. Approximately three such trains will be needed during the peak by 1990, one from New Haven and two from Stamford.

The Massachusetts Bay Transportation Authority (MBTA) operates commuter trains from South Station Boston along the NEC mainline to Providence, Rhode Island. Three branchlines off the mainline, to Needham Heights, Franklin, and Stoughton, enter the Corridor at Forest Hills, Readville, and Canton Junction, respectively. Presently the weekday volume of riders approaches 14,000 for all the services, with the Needham line accounting for nearly 5,000 of these riders. Train frequency of two trains per hour during the peak is expected to increase substantially on each of the lines by 1990 if all the service goals of the MBTA are

met. These include: greater frequency, better equipment, and track improvements to reduce travel times. Using an average annual increase of 3.5 percent through 1990 would mean that approximately 22,000 daily riders will use MBTA services that traverse part of the Corridor mainline.

Undoubtedly, some new service will be needed, particularly during peak hours. Whether or not most or all of it can be in the form of expanded train length is uncertain. Even if frequencies in excess of those suggested by the MBTA are needed, the improvements planned by the NECIP for track and signaling will provide adequate capacity.

In addition to rail commuter service operating directly on the Corridor mainline, there are commuter services that connect with the NEC. Table II-C provides an information summary of these services similar to that shown on Table II-B, Rail Commuter Service on the NEC. The total number of weekday commuters using these services is three times the number using Corridor commuter trains. In terms of annual passenger-miles and revenues, the proportions are essentially the same.

C. FREIGHT SERVICE

Future levels of freight train activity on the NEC will be influenced by the amount Amtrak charges freight operators for the use of its property, the strength or weakness of the regional economy, and competitive pressures from other modes. The first factor will be resolved through negotiations between Amtrak and Conrail. Concerning the latter two (the economic viability of the Northeast and competitive pressures), past forecasts of NEC freight traffic relying on assumptions of economic growth and changing market share have not been very accurate. A study by United Research Inc. 1/ analyzed future economic activity in the NEC region 2/ from an early 1960's perspective and concluded that demand for freight transportation, measured

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1/ Intercity Freight Transportation Requirements of the Washington Boston Corridor in 1980, Nov. 1963, United Research, Inc., Cambridge Mass.

2/ United Research defined the NEC as all counties in the following states: Massachusetts, Rhode Island, Connecticut, New Jersey, and Delaware; and 2 counties in New Hampshire, 7 in New York, 28 in Pennsylvania, all but 2 in Maryland, 32 in Virginia, and 3 in West Virginia.

TABLE II-C

RAIL COMMUTER SERVICE CONNECTING WITH THE NEC

Commuter Service	Trains/ Day	Cars in Pass. Service/Trips/ Day	Wkday	Trains per Hour in any One Service Peak	Off-Peak	Annual Revenue Pass. Miles (millions)	Average Daily Load Factor	Annual Revenue (millions)
Other Washington, D.C. Service (MDOT)	20	261	6,200	1.7		25.7	52%	$ 1.5
Other Philadelphia, Pa. Service (SEPTA)	701	337	108,500	2.4	.7	338.6	48%	$22.9
Other No. Jersey Service (NJDOT)	116	82	34,700	3.2	.8	119.7	54%	$ 8.3
Montauk, N.Y./New York (MTA-LIRR)	715	650	185,000	20	7.3	1,545.6	48%	$93.3
Other Boston Service (MBTA)	33	75	5,000	2.3	.5	14.4	51%	$ 3.2
Total	1,585	1,405	339,400			2,044.0		$129.2

Source: Commuter authorities

in tons originated, would rise substantially between 1960 and 1980. Although rail's share of the total was expected to decline, rail tons originated were forecast to grow. While no data exactly comparable with that used in the study is available, Tables II-D and II-E permit comparison of the United Research forecast of rail tons originated in the NEC with actual rail tons originated in the Eastern District 1/, as defined by the Association of American Railroads. For 18 years, 1960 through 1977, rail tons originated by railroads in the Eastern District declined at an annual rate of 1 percent, a significant variation from the United Research forecast of a 1.7-percent per annum increase, 1960 through 1980.

As a further check on trends, in 1977 Conrail carried 269 million tons of freight, or 15.3-percent below the United States Railway Association's (USRA) Final System Plan forecast of 316 million tons. For the period 1978 through 1982, Conrail's Five-Year Business Plan revised downward the USRA estimates by nearly 10 percent. Assuming that reductions are spread evenly throughout the 5 year period, it will not be until 1984 that Conrail will carry more freight than its constituent roads carried in 1973 2/.

The relative importance of freight traffic in the Corridor depends on the method and purpose of measurements used. For example, since rail-line output is best measured in trains per day, freight is not a major user of Corridor capacity. Table II-F illustrates that only on the section of the Corridor between Perryville, Maryland, and Bay (Baltimore) do freight trains exceed one-third of the total trains operated.

This situation is substantiated by Conrail and Penn Central records of trains passing daily over those sections of the NEC with the heaviest freight volume (see Table II-G).

Measured in gross ton miles, which are a major indicator of the relative contribution to line maintenance, freight traffic dominated the Corridor, reaching two-thirds of the

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1/Source: Yearbook of Railroad Facts, 1974 and 1978, Association of American Railroads.

2/In 1973, the on-time record of passenger trains was nearly 85-percent. It is reasonable to conclude, therefore, that with freight service at levels approximating 1984 projections, the probability is high that combined commuter and intercity passenger service will be able to be operated without undue interference.

TABLE II-D
FORECAST OF TOTAL RAIL TONS ORIGINATED
IN THE NEC THROUGH 1980 1/

Category	1960 (Actual)	1980 (Estimated)	Per Annum Change
Total Tons Originated-NEC	411.2M	762.5M	+3.1%
Rail Tons Originated-NEC	82.2M	114.4M	+2.7%
Rail Share	20.0%	15.0%	-

TABLE II-E
ACTUAL RAIL TONS ORIGINATED IN EASTERN DISTRICT 2/

Category	1960	1977	Per Annum Change
Rail Tons Originated-Eastern District	512.4M	430.9M	-1.0%

Sources:

1/ Intercity Freight Transportation Requirements of the Washington-Boston Corridor in 1980, November 1963, United Research, Inc., Cambridge, Mass.

2/ Yearbook of Railroad Facts, 1974 and 1978, Association of American Railroads.

TABLE II-F
DENSITY OF TRAIN OPERATIONS ALONG KEY CORRIDOR SECTORS

(Trains/Day)

Division/Sector	Freight	Passenger	Total	Freight as a % of Total
Boston - New York				
Mansfield - Providence (19 miles)	7	37	44	16%
New York - Philadelphia				
Lane - Morris (45 miles)	37	141	178	21%
Philadelphia - Baltimore				
Perryville - Bay (32 miles)	33	55	88	38%
Baltimore - Wasington				
Union - Bowie (25 miles)	29	66	95	31%

Source: Internal Reports, Penn Central and Conrail

TABLE II-G
AVERAGE FREIGHT TRAINS/DAY

Section	1971	1976	% Decrease	% Decrease Per Annum
Lane to Union, NJ	47	40	15	3.2
Perryville to Bay, MD.	41	33	20	4.2

Source: Internal Reports, Penn Central and Conrail

total gross ton miles on many sectors between Washington and New York. North of New York, freight density is much less; but in this segment the predominance of freight traffic over passenger traffic, in terms of gross ton miles, has significant implications when maintenance of the Corridor track structure is considered (Table II-H).

In view of the consistent trend of decreasing NEC freight tonnage over recent years and the gradual move of industry away from the NEC, a dramatic reversal of the decline in freight movement in future years does not appear likely. Minor increases in freight traffic may result from the National Energy Plan's 1/ emphasis on increased coal consumption. For example, present forecasts suggest that over the next ten years coal traffic might increase by a train a day on the sector of the NEC south from Perryville, Maryland. Plans for increased export of grain could involve movements across but probably not along the NEC.

TABLE II-H
ANNUAL GROSS TON MILES PER MILE

(millions)

Division/Sector	Freight	Pass.	Total	Freight as a % of Total
Boston - New York Mansfield - Providence (19 miles)	39.5	8.9	48.4	82%
New York - Philadelphia Lane - Morris (46 miles)	46.3	25.0	71.3	65%
Philadelphia - Baltimore Perryville - Bay (32 miles)	50.6	12.6	63.2	80%
Baltimore - Washington Union - Bowie (25 miles)	36.4	12.7	49.1	74%

Source: Internal Reports, Penn Central and Conrail

1/ The National Energy Plan, Executive Office of the President, Energy, Policy and Planning, April 29, 1977.

Intermodal freight is a potential source of additional traffic, but several obstacles must be overcome, including resolution of disagreements on revenue division among railroads, height and width restrictions, and a lack of space for expansion at existing terminals. On the other hand, since Conrail has expressed no plans to move freight traffic away from the NEC, dramatic declines also do not appear likely. Therefore, it seems unlikely that freight traffic will exceed the 1971 level at least until 1990, and thus it should present no significant capacity problems to the improved NEC.

D. IMPACT OF NECIP

Once completed, the NECIP will have rehabilitated and modernized a major portion of the rail mainline between Washington, D.C., and Boston. Virtually every program work element, e.g., track, signaling, stations, electrification, and structures, will produce benefits for most Corridor users. Track capacity will be increased; trains will travel faster and be more punctual; and stations will better serve the needs of all rail travelers. These improvements will bring about changes in NEC rail operations, both during the construction period and after the inauguration of high-speed intercity service.

Recognizing the short- and long-term impact of the NECIP, commuter authorities that sponsor services over segments of the Corridor mainline formed the Northeast Corridor Commuter Rail Authorities Committee (NECCRAC) in May 1976. This group represents the interests of the following agencies: Maryland Department of Transportation; Southeastern Pennsylvania Transportation Authority; New Jersey Department of Transportation; Port Authority of New York and New Jersey; Metropolitan Transportation Authority; Connecticut Department of Transportation; Rhode Island Department of Transportation; and the Massachusetts Bay Transportation Authority. NECCRAC reviews technical and operational issues pertaining to the NECIP, identifies current or potential problems, and often suggests solutions. Conrail has also kept the NECP apprised of its concerns pertaining to the project and proposed changes in Conrail's future operating plans.

In the course of planning the NECIP, NECP representatives have reviewed the concerns raised by the various commuter

authorities and Conrail. The major concerns are grouped into the following categories for discussion purposes 1/:

- o NECIP impact on train operations during construction
- o Issues associated with the modernization of signaling system
- o Issues associated with the modernization of the electrification system
- o Track capacity and related issues
- o Conrail freight service
- o Stations.

1. NECIP Impact on Train Operations During Construction

Construction work currently underway, and that which is to follow, will temporarily disrupt Corridor train operations. To ensure that the disruptions will have minimal impact on ridership, NECIP planners have subdivided the mainline into 11 geographic segments called Railroad Development Projects. The boundaries of the RDPs were selected to provide for the diversion of train movements at major interlockings where planned construction will require the use of one or more tracks.

Additionally, a Track Access Evaluation Simulator (TAES) has been utilized to model current operations on the existing right-of-way and to analyze alternative operating plans aimed at minimizing conflicts between construction objectives and train operations. The simulator also enables planners to analyze the impact of a section of track being taken out of service. Lastly, a section-by-section analysis of the impact of track outages on total operations has been documented for use as a planning tool.

1/Many other issues, of a more local or relatively minor nature, will be discussed directly with the authority involved.

The NECP is making every effort to incorporate the knowledge of transit and freight operators into construction planning. The NECP will fully coordinate planned construction activities with Amtrak, commuter authorities, and Conrail representatives.

2. Issues Associated with Modernization of Signaling System

Wayside signals are being retained at interlockings and their approaches but they are expected to be eliminated elsewhere. To replace the worn-out signals that are being eliminated with a modern wayside system would require the prohibitively expensive relocation and construction of signal support structures. As a consequence, automatic train control (ATC) and seven-aspect cab signals 1/ (four for freight) will be provided as appropriate on trains operating on the Corridor. The NECIP will fund the installation of this equipment for passenger service at an estimated cost of approximately $3.5 million. The possible installation of this equipment on other vehicles which will use the Corridor at a later date (i.e. SEPTA Reading Line cars, Erie-Lackawanna cars and North Jersey Coastline cars) is being examined as a part of a study being funded by the NECP for NECCRAC.

Consideration was given to the contention that this modernized signal system might reduce the total system train capacity due to the requirement for greater spacing between trains because of high-speed operations and cause freight trains to be forced to make unwanted stops if the ATC system

1/ Cab signals were introduced into modern railroad operations primarily as a means for sharply reducing the probability of rear-end collisions. Cab signals have been made an integral part of the ATC. Should the engineer, for whatever reason, ignore the cab signal reading of track conditions, the ATC braking system would automatically come into operation. Wayside signals, which preceded cab signals in train operations, are on the right-of-way and are most commonly located near interlockings. They provide the engineer with a visual representation of track conditions, but there is no automatic control system to override any human error or physical condition that results in the engineer ignoring a caution signal. Therefore, as a part of the NECIP, a number of wayside signals can safely be removed reducing NECIP cost and future maintenance requirements.

caused unnecessary full-service brake applications to be made. It was thought that the latter potential problem might develop since without wayside signals, engineers could no longer reduce speeds in advance of a cab aspect change; the train would be forced to a full-service brake application whenever a less favorable signal occurred.

An NECP study indicates that track capacity will not be reduced, but instead will be increased by the new seven-aspect system 1/. With regard to Conrail freight operations, all locomotives will be equipped with special cab-signal apparatus allowing a two-stage application of brakes to enable the engineer to continue responding in a normal manner and not be forced to a full stop. This will greatly reduce the likelihood of trains "parting" due to the presence of an ATC system, and permit normal, even improved, freight operations.

3. Issues Associated with Modernization of Electrification System

The NECIP-proposed modernization of the NEC electrification system will consist of converting the current 11 kV 25 Hz system to 25 kV, 60 Hz over much of the Corridor (from Washington to New Rochelle), and installing a new 25 kV, 60-Hz catenary system north of New Haven to Boston. This modernization will provide more reliable and cost-effective electric traction service to all NEC users.

Presented herein is a brief summary of the proposed schedule for electrical system conversions, the scope of modifications required to existing commuter cars and Conrail locomotives, and related issues pertaining to the conversion. This scope and schedule has been developed by the NECP for planning purposes only. Additional, more definitive information will be forthcoming soon from a study to be performed by NECCRAC.

The current schedule for electrification is as follows:

Third Quarter, 1981:	Convert to 25 kV, 60 Hz at the rate of one substation per week from Washington to Wilmington.

1/ Signaling and Traffic Control System Standards Volume 2, Task 205, USDOT, Federal Railroad Administration, July 1978, pp. 5-5, 5-6.

Second Quarter, 1982:	Convert to 25 kV, 60 Hz at the rate of one substation per week from Trenton to New Rochelle.
Second Quarter, 1982:	Energize new catenary from New Haven to Readville.
Third Quarter, 1982:	Convert to 25 kV, 60 Hz at a rate of one substation per week from Wilmington to Trenton.
1984:	Energize new catenary from Readville to South Station depending on completion of the MBTA Southwest Corridor Project.

The system conversion will require NECIP funding of the modification of up to 291 multiple-unit SEPTA and NJDOT commuter cars to permit operation on either the new voltage or on both the new and old (11 kV and 25 Hz) depending on where they are used. The number, type, and ownership of the cars are as follows:

NJ DOT	SEPTA [1]
34 Jersey Arrow I's	37 Silverliner II's
70 Jersey Arrow II's	20 Silverliner III's
104	130 Silverliner IV's
	187

The cost to make these vehicles compatible with 25 kV, 60 Hz and the new signal system is estimated at $33.5 million. The proposed vehicle conversion schedule is as follows:

Third Quarter, 1979:	First commuter cars taken out of service for conversion. Requirements as follows:

	Number of Cars	Conversion Time
Silverliner IV	4-6 cars	3 wks/car
Jersey Arrow II	2-3 cars	3 wks/car
Jersey Arrow I	2-3 cars	10 wks/car
Silverliner II & III	4-6 cars	10 wks/car

1/The exact number of cars to be converted is dependent on an agreed operating plan.

Second Quarter, 1981: Experience gained on first cars permits accelerated output.

	Number of Cars	Conversion Time
Silverliner IV	10-12 cars	2 wks/car
Jersey Arrow II	6-8 cars	2 wks/car
Jersey Arrow I	4-5 cars	8 wks/car
Silverliner II & III	8-10 cars	8 wks/car

This schedule is shown graphically on Figure II-A. Over the nearly 2½ years needed to convert as many as 300 cars, only 15-30 cars will be out of service at any one time. If these conversion programs are implemented as planned, the present service levels can be maintained even though a large number of cars will be out of service. The equipment ultimately destined for service in NJDOT's Erie Lackawanna territory currently is available to augment both the NJDOT North Jersey service and SEPTA's Philadelphia suburban service through the end of 1980. It is therefore essential that the conversion work on both NJDOT and SEPTA equipment begin immediately so that advantage may be taken of the temporary augmentation. The previously mentioned study to be done for NECCRAC will investigate more closely the details of equipment conversion and replacement.

Conrail is aware that it must convert 10 E-33 and 66 E-44 locomotives and replace 49 GG-1-type units before the electrification conversion dates indicated.

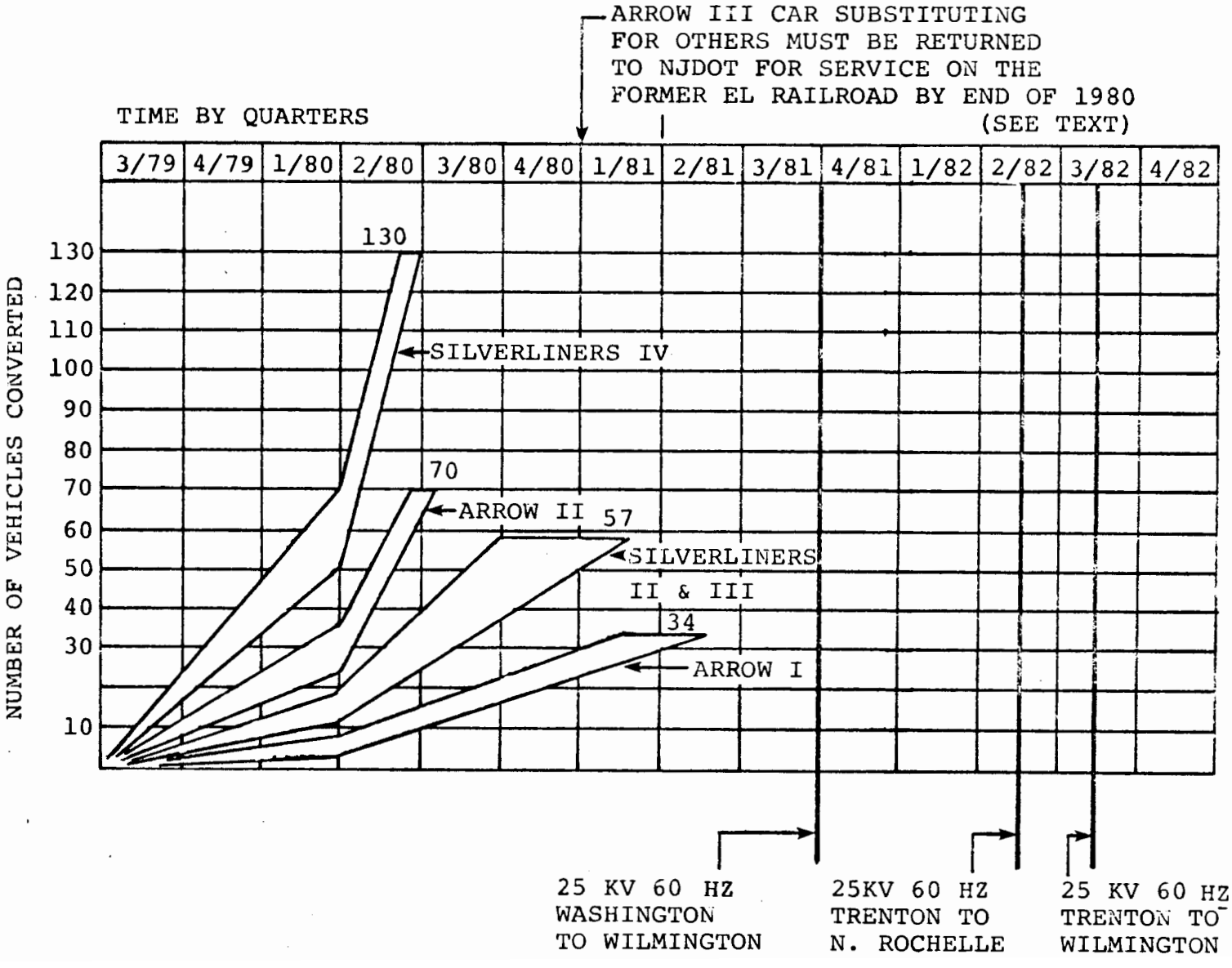
Table II-I below summarizes the numbers of multiple-unit cars and locomotive units requiring modification or replacement for all fleets to become compatible with the modernized electrification system:

TABLE II-I
VEHICLE CONVERSION/REPLACEMENT PLAN

	Owner/Equipment		Convert	Replace
A.	NECIP FUNDS AVAILABLE			
	NJDOT	Jersey Arrows	104	-
	SEPTA	Silverliners	187	-
B.	NECIP FUNDS NOT AVAILABLE			
	Conrail	E-33 Locomotives	10	-
	Conrail	E-44 Locomotives	66	-
	Amtrak	GG-1 Locomotives	-	40
	Amtrak	Metroliners	-	27
	NJDOT	GG-1 Locomotives	-	13
	SEPTA	Philadelphia Division	-	38
	SEPTA	Reading Division	-	38

Source: FRA/NECP

FIGURE II-A PROPOSED VEHICLE CONVERSION SCHEDULE



Conrail conversion should not be a problem once that organization decides whether to continue present electrified operations, modernize and expand its electrified operations, or convert to full diesel operations 1/. The scope and timing of a total Conrail conversion program, moreover, are beyond the purview of the NECIP. Conrail, for example, agrees that its future costs are its responsibility, but currently has its entire electrification program under study. Any decision by Amtrak concerning the Harrisburg line must await Conrail's decision due to the shared facilities in this area.

4. Track Capacity and Related Issues

Presented below is a brief summary of various track capacity and related issues that have been identified during this study for each NEC territory. Also included are brief synopses of the findings or resolutions to potential or actual issues.

MBTA Territory

South Station Reconstruction: The extent of all improvements to South Station are still being studied and discussed between the MBTA and the NECP. Once an agreement is reached on the basic design required for existing commuter service and projected NEC service, a final agreement should follow. Any additional facilities needed to accommodate commuter traffic are the responsibility of the MBTA.

Track Capacity Between Canton and Attleboro: The MBTA has argued that a third track is required in this area at a cost of $25 million. The NECP has concluded that with improvements to the existing Attleboro Station sidings, full reverse signaling, and three tracks between Readville and Boston, all included in the present NECIP plan, no problem will exist until at least 1990 2/. The NEC train schedule for system design purposes has been worked out so that any required passing of commuter trains occurs either north of Readville using the third track or at Attleboro using the sidings.

1/A Conrail study on this issue is reportedly scheduled for completion early in 1979.

2/Report on The Development of Approaches to Integrating Commuter and Intercity Passenger Train Operations, by Transmark, June 1978.

The MBTA could alleviate any future problem in this geographic area by acquiring high-speed electric commuter cars of the Arrow type used by NJDOT and SEPTA since the NECIP will be electrifying this line. Such cars, with 100-mph top speeds, plus acceleration and deceleration capabilities far in excess of locomotive-hauled trains, would virtually eliminate any requirement for intercity trains to pass commuter trains in the two-track territory.

Rhode Island - RIDOT

Providence Station: The capability to turn and store MBTA commuter trains at Providence Station will not be adversely affected by NECIP construction.

Connecticut - CDOT

Ownership: The future ownership of the New Haven-to-New York State line segment, now under 60-year lease to CDOT from the Penn Central Trustees, is an issue that will be resolved in court. Amtrak has instituted a suit against the Penn Central Trustees for fee title to the CDOT Zone and is currently attempting to negotiate with the Trustees an out-of-court settlement that would establish their ownership rights in this area.

Electrification and Signal Conversion - New Haven Line: NECIP will not change the 12.5 kV, 60 Hz electrification and signal system being installed in this territory.

New York - MTA

Electrification and Signal Conversion - New Rochelle to New Haven Line: NECIP will not change the 12.5 kV, 60 Hz electrification and signal system being installed in this territory.

Harold and Shell Interlockings: North of New York, approximately 450 trains of the Long Island Railroad service cross the northbound Corridor tracks on the same track level each day at the Harold Interlocking. At peak periods, this results in delays to intercity and commuter trains and contributes significantly to the need for additional running time between New York and Boston to compensate for delays. A similar but lesser conflict exists at the New Rochelle (Shell) Interlocking, where 79 outbound MTA/CDOT trains cross the path of inbound and outbound intercity trains daily. Grade separation at Harold and Shell could give improved trip times of 3 minutes, 25 seconds to the Corridor trains and eliminate random delays of between 2 minutes and 3 minutes per train. No funds exist in the current program to relieve congestion at these locations.

Pennsylvania Station, New York: The number of tracks in Pennsylvania Station and the capacity of each has long been an issue. The Long Island Railroad forecasts a need for 12 extra trains in the peak period, or about four trains per peak hour. This would require the equivalent of one additional track. The NJDOT forecasts suggest three or more additional trains to existing routes serving Pennsylvania Station in the peak hour. NJDOT proposes to schedule another eight trains in the peak period serving Pennsylvania Station via a new connection with the former Erie-Lackawanna (EL) Railroad at Kearny, N. J. 1/.

Should plans for a rail/air line to J. F. Kennedy Airport materialize, a service of four trains an hour would require the equivalent of one additional track. More intensive use of the station by Amtrak is unlikely to increase the number of tracks required, although careful planning will be required.

With respect to all of the foregoing projected increases in train service, examination by European rail experts has led to the conclusion that the additional service to Pennsylvania Station could be accommodated with the existing number of tracks.

Other plans exist for additional trains to serve the Pennsylvania Station. For instance, under DRAP, NJDOT proposes a future connection with the former EL at Secaucus, N. J. New York State is proposing a Pennsylvania Station West Side Access Project. If these plans materialize, they are likely to be constrained by the capacity of the tubes under the Hudson and East Rivers before exhausting the capacity of the station.

Access Tunnels to New York Pennsylvania Station: At the west end of the station, the two tubes beneath the Hudson River now handle 13 trains in the morning peak hour and 16 trains in the evening peak hours. After completion of the NECIP, tube capacity is estimated at 21 trains per hour. This is in excess of firm planned demand beyond 1990.

At the east end of the station, four tubes connect with Long Island. Two are less frequently used than the others in peak periods, and they provide ample reserve capacity for future demand increases. The FRA has initiated a study of the conflict between the needs of commuter and intercity rail passenger service in the NEC, and on allocation of access rights to key terminals, with emphasis on Penn Station.

1/ Direct Rail Access Project (DRAP), sponsored by the Port Authority of New York and New Jersey, March, 1977.

New Jersey - NJDOT

Electrification Conversion to 60 Hz on the North Jersey Coast Line: This branch line leaves the NEC spine at Rahway and is electrified at 11 kV, 25 Hz for nine miles to South Amboy. At this point, GG-1 electrics are detached and diesel locomotives are operated to Bay Head, a distance of 35 miles. The NJDOT now owns and operates 13 GG-1's for this service. These are 40 years old, are well beyond their economic life, and must be replaced. While NJDOT is planning to extend the electrification 20 miles to Long Branch at 25 kV, 60Hz, no plans exist for the remaining 15 miles to Bay Head. NECIP is not converting the nine miles of 11 kV, 25 Hz electrification on the branch to 25 kV, 60Hz.

UMTA approved a grant application for design of the extension at 60 Hz to Red Bank and the acquisition of 50 multiple unit (MU) cars for this extension. The State subsequently purchased 50 Jersey Arrow III electric MU commuter cars in 1976. These cars are designed to operate on either voltage and frequency combination, but do not have automatic changeover capability nor automatic train control. To add these capabilities will cost approximately $2.3 million for the 50 cars.

It is the NJDOT's position that the NECIP must assume the financial responsibility for replacement of all 13 GG-1's, modify the 50 Arrow III's, and convert the first nine miles (Rahway to South Amboy) of the North Jersey Coast Line branch. The NECP argues that the GG-1's require replacement regardless of the option exercised because they are now operating beyond their useful economic life; that NECIP funds may be used to pay for conversion if necessary; and lastly, that keeping the current nine-mile sector at 25 Hz will not hamper future Corridor intercity service.

Until New Jersey defines its detailed plans for the entire Shore Service, no final action can be taken by the NECP. The NECP is funding a joint NECP/UMTA/NJDOT/SEPTA study of equipment requirements in the SEPTA and NJDOT areas. The results of this study will assist in determining the cars to be converted or replaced.

Maintenance Facilities at Sunnyside Yard, New York: Today, Amtrak maintains all 154 New Jersey Arrow MU cars at Sunnyside Yard, New York, except for major repairs performed at Wilmington. Existing facilities at Sunnyside are inadequate; consequently, maintenance is not optimum.

NECIP plans provide for improvements to the maintenance facilities for high speed rail Corridor service, but do not provide for shop facilities for NJDOT cars.

A new joint facility could be developed at Sunnyside, and the NECP is now estimating its cost. However, New Jersey must commit itself to maintaining its cars at Sunnyside for the long term and to contribute the additional money to provide a joint shop. Unless the NJDOT makes a firm commitment soon, it will be too late to include its needs in the NECIP design and construction schedule. The NECP still awaits any commitment by the NJDOT to outline proposals submitted to the NJDOT.

Bergen Interlocking Direct Rail Access Program (DRAP) Connection: A new interlocking to be named "Bergen", between Penn Station, New York, and the Hackensack River Bridge is planned by the NECP. At the request of the NJDOT, it will be located so as to accommodate the future DRAP Secaucus connection with the former Erie Railroad service, if the DRAP traffic materializes.

Portal Drawbridge - Hackensack River: The Portal Drawbridge over the Hackensack River in the vicinity of Kearny-Secaucus, New Jersey, has long been a source of delay to rail and water traffic. A study of a 30-day period in the spring of 1978 revealed that on the average day, the bridge was opened approximately four times for 10 minutes each time, to allow the passage of four vessels. The average vessel was delayed 11 minutes. An average of two trains were delayed daily for a few minutes. The conflict would be most serious during the morning and evening rail-commuter rush hours when the traffic would experience long delays. Some of the train delays are due to the bridge's mechanical malfunctioning. NECIP funds are programmed to improve the reliability of the bridge operation, and this should alleviate part of the problem. Increasing the number of Amtrak intercity trains passing over the Portal Drawbridge from the present 82 trains daily to 113 trains daily in 1981, as proposed by the NECIP design schedule, will not materially alter this situation.

The addition of DRAP traffic will close the remaining daytime windows, thereby causing serious delays to either rail or river traffic, or both. The options of limiting the off-peak commuter traffic for replacement with a

high-level bridge is being reviewed. Such replacement is not needed by the NECIP, per se, and will not be provided by the project. Currently, Amtrak's traffic over the bridge is approximately 40 percent of the total; Amtrak estimates that it would decrease to 25 percent of the total in the future with additional DRAP traffic.

Pennsylvania - SEPTA

Electrification Conversion and the Center City Commuter Rail Connection (CCCRC): The original NECIP plan was to convert the NEC mainline and the spur from 30th Street, Philadelphia, to Suburban Station to 25 kV, 60 Hz. There are 187 modern Silverliner cars used on the former Pennsylvania commuter lines which now terminate at Suburban Station. All of these cars would have been equipped with speed controls and made operable on either 60 Hz or 25 Hz at NECIP expense; if this conversion were made.

However, upon reexamination of the effects this would have on UMTA funding and SEPTA operations, it now appears that the most desirable approach would be to convert only the actual NEC mainline, and not the spurs, and to allow the bulk of the SEPTA system to remain at 11 kV,25 Hz. As a result of this change, it is possible that fewer cars would require conversion. This will be evaluated as a part of a study funded by NECP. The current NECIP budget allows for the conversion of 187 cars but it could be revised pending a final count by SEPTA of cars to be converted. With the present program, all SEPTA cars, including the former Reading equipment, will operate without conversion through Suburban Station to the 30th Street Station and the Powellton Avenue Yards, and in all branches except those that are part of the NEC mainline.

Phase breaks will be provided at Zoo and Arsenal Interlockings by the NECIP to accommodate this change, and Arsenal Interlocking will be reconfigured. Under this scheme, dual-voltage cars will only be required for through service to the lines that use the NEC spine including Trenton, Chestnut Hill, Wilmington, and the future Airport High-Speed Line. The number of cars presently assigned to this service, excluding Airport Line needs, is approximately 90.

However, now that the CCCRC is being constructed and SEPTA intends to through-route some of its trains, the number of cars required could change depending on the operating plan devised by SEPTA. Therefore, no firm decision can be made until SEPTA defines its proposed operating plan for this service.

The NECIP position is that the 187 cars currently programmed will remain in the budget, but only the 90 presently required to operate this service will be converted before implementation of the CCCRC. This number would be increased only after SEPTA submits its proposed CCCRC operating plan to NECP and UMTA for review 1/.

Maryland - MDOT

Replace Electric Commuter Cars: The MDOT has requested NECIP funds to replace the old multiple-unit cars formerly operating in Baltimore-Washington commuter service. The age and condition of these cars make it necessary to replace them. The MDOT is leasing surplus Jersey Arrow cars from the State of New Jersey. When New Jersey requires the return of this equipment, the MDOT will have to replace them at MDOT's expense, probably through an UMTA application.

The Baltimore Tunnel: The Baltimore and Potomac (B&P) Tunnel in Baltimore is a congested area on the Corridor due to the deteriorated condition of the track and ancillary structure. The NECIP will remedy deferred maintenance, build a stable track structure in the tunnel and improve freight movement. The NECP has recently undertaken a year-long study of the Baltimore Tunnel problem. Relief of current and potential future congestion problems is being analyzed along a couple of possible avenues of resolution: feasibility of operational revisions, and capacity expansion by modification of the existing B&P tunnel. The results of this study should be available in early 1979.

5. Conrail Freight Service

Conrail's concern relating to electrification and signaling problems was discussed earlier. A remaining issue concerns track capacity and the ability of the NEC mainline to expeditiously handle freight trains, especially through two areas of heavy demand: Landover to Perryville in Maryland; and Morrisville, Pennsylvania, to Newark, New Jersey.

1/ The joint NECP/UMTA/NJDOT/SEPTA study of equipment requirements mentioned above will determine exact SEPTA needs as well.

Improvements currently funded and planned for these areas will ease most congestion problems. Between Landover and Perryville, the NECIP will install reverse signaling and centralized traffic control (CTC), and will add capacity to separate freight and passenger trains. However, improvements of the same magnitude are not planned between Morrisville and Newark. Notwithstanding the absence of such improvements in this sector, congestion is less severe since the number of available tracks is double that between Landover and Perryville (four to six versus two to three). This ensures significant flexibility for the handling of freight operations.

6. Stations

To be fully effective, improvements to train services must be matched by a corresponding upgrading of station facilities and passenger-handling procedures. Station rehabilitation, expansion, or reconstruction as part of the NECIP is considered essential if projected increases in patronage are to be realized. Stations must provide essential passenger processing facilities in safe, comfortable, pleasant environments. Public services and concessions must be readily accessible and responsive to rail travelers' needs. All facilities must be designed to allow smooth access by a variety of private and public sector modes. Of paramount importance are safe, secure parking spaces located within a moderate distance of major entrances to the station complex.

The rail traveler's first and last impression of the high-speed rail system is made by the station. It is seen by travelers as a single facility and the condition of its components, whether for the intercity or commuter passenger, influences travel decisions.

Following is a brief discussion of the NECIP's effort to promote the integration of commuter and NEC service at NECIP stations, and to rehabilitate, expand, or reconstruct these facilities.

South Station, Boston

South Station is an integrated complex providing both dedicated and shared facilities for commuters and intercity travelers. The "Headhouse" is planned to be renovated by NECIP to improve passenger processing, to provide greater passenger comfort, and to simplify operating functions. Proposed new high-level platforms will improve the efficiency of passenger flow as well as provide access for the handicapped. By simplifying track configuration in the station and yards, greater train speed will be

permitted on entering and exiting the terminal. Equipment turnaround time will be reduced through proposed improvements to inspection and service capabilities.

Route 128 Station

NECIP-proposed contruction work is premised on the need to accommodate and allow cross- or same-platform transfer of commuters to the high-speed rail service. Joint use of all station facilities will be provided.

Providence Union Station

Joint use of tracks and stations will be extended from Boston to Providence. High-level platforms will allow cross-or same-platform transfer in both directions. A simplified track configuration will permit commuter trains to turn or reach storage yards without conflicting with high-speed rail service.

New London Station

There is at present no commuter service at New London.

New Haven Station

Due to the heavy commuter traffic between New Haven and New York as well as Amtrak traveler needs at this location, a joint-use, four-track concept has been proposed with two high-level island platforms serving four tracks designed to encourage cross-platform transfer between all services. This station is also the transfer point for the important NEC feeder markets in western Connecticut and Massachusetts. Transfering to high-speed service at New Haven will be made easier by the NECIP.

Pennsylvania Station, New York

Pennsylvania Station is the major point on the Corridor for rail-commuter, long-haul-intercity, and high-speed services. Providing for cross-platform transfers is not generally required since most passengers using the terminal terminate or originate travel here. Wherever joint use is contemplated, however, this is reflected in construction design. Other joint considerations were discussed previously.

Newark Penn Station

Passenger transfer between PATH transit, NJDOT commuter, and Amtrak service is extremely heavy at Newark. NECIP will make improvements to ease passenger processing, to reduce impediments to passenger flows, and to increase the comfort and security of all patrons.

Metropark Station

Track crossovers at each end of the station will allow access to this station by intercity high-speed trains without interference to commuter operations.

Trenton Station

Crossover improvements to existing track configurations will reduce interference of higher speed intercity trains with commuter trains. Joint operations and through-running of NJDOT and SEPTA trains, which now terminate at Trenton, will reduce yard movements at this location and generate additional demand.

30th Street Station, Philadelphia

Commuter trains will continue to use the upper-level suburban tracks, with high-speed rail and long-distance trains remaining on the lower-level platforms. Existing circulation patterns from upper to lower level and vice versa will not change; however, some easing of the transfer is planned.

Wilmington Station

Wilmington is the southern terminus for most SEPTA commuter trains on the Corridor mainline. Use of the high-level platform by SEPTA will be encouraged and should facilitate transfer and improved safety and efficiency.

Baltimore Station

A new track configuration will be provided between the tunnel portals to allow greater speed through the station. These improvements will also greatly aid the MDOT commuter service at this station.

New Carrollton Station

This station will be served by Washington Metropolitan Area Transit Authority (WMATA) Metrorail, MDOT, and Amtrak. In order to allow northbound commuter trains to stop here and also stop at other Maryland stations, a crossover will be provided from Track 2. Southbound track configurations are such that no additional crossovers are needed.

Union Station, Washington, D.C.

Union Station is an intermodal terminal providing direct connections among Metrorail, bus, and commuter rail services as well as Amtrak high-speed and long-distance trains. A proposed reconfiguration of the station would provide for rail use of the west wing and concourse. The walls and interior fixtures of the current station would be removed and certain of the passenger tracks extended to a position near where they had been prior to the conversion of the station to the National Visitors Center (NVC). Funding of any change to the present configuration of Union Station/NVC is unresolved.

E. INTEGRATION OF RAIL OPERATIONS ON THE NEC

Beginning in 1958 with the bankruptcy of the New York, New Haven, and Hartford Railroad, continuing through the complete demise of the Penn Central and other eastern railroads in the early 1970's, and now in the recent era of Federal restructuring and purchase, larger and larger sections of the NEC mainline have been sold or leased by the owners to transit authorities and to Amtrak. Today, only 47 miles remain in private hands. Table II-J summarizes current Corridor ownership.

Amtrak owns 364 miles, or 80 percent, of the NEC; the remaining 92 miles, or 20 percent, is owned or leased to commuter authorities. Of the 54 miles immediately south of New Haven, Amtrak is contesting the fee ownership of the 47 miles in Connecticut. This split ownership has resulted in fragmentation of commuter operations as shown in Table II-K.

The NEC mainline is used extensively by commuter trains, especially between Wilmington, Delaware and New Haven, Connecticut. Many of the services operate entirely on the Corridor while others connect to it. The number of stations served by the total of these services exceeds 500. Figure II-B displays stations on the Corridor mainline currently served by intercity trains, connections at through stations to other modes

TABLE II-J
OWNERSHIP OF THE NEC

Section	Mileage	Owned By	Leased To	Maintained By [1]
Washington, D.C. Terminal	1	Amtrak/Chessie		WTC
Washington to New York (Penn)	226	Amtrak	-	Amtrak
New York to New Rochelle	19	Amtrak	-	Amtrak
New Rochelle to Conn. State Line	7	MTA	-	MTA/CDOT
Conn. State Line to New Haven	47	Penn Central [2] Trustees	CDOT	MTA/CDOT
New Haven to Mass. State Line	118	Amtrak	-	Amtrak
Mass. State Line to Boston South Sta.	38	MBTA	-	Amtrak
TOTAL	456			

1/ WTC - Washington Terminal Company
MTA - Metropolitan Transportation Authority
CDOT- Connecticut Department of Transportation
MBTA- Massachusetts Bay Transportation Authority

2/Amtrak is contesting this ownership.

Source: FRA/NECP Study of July, 1978.

TABLE II-K

COMMUTER SERVICES

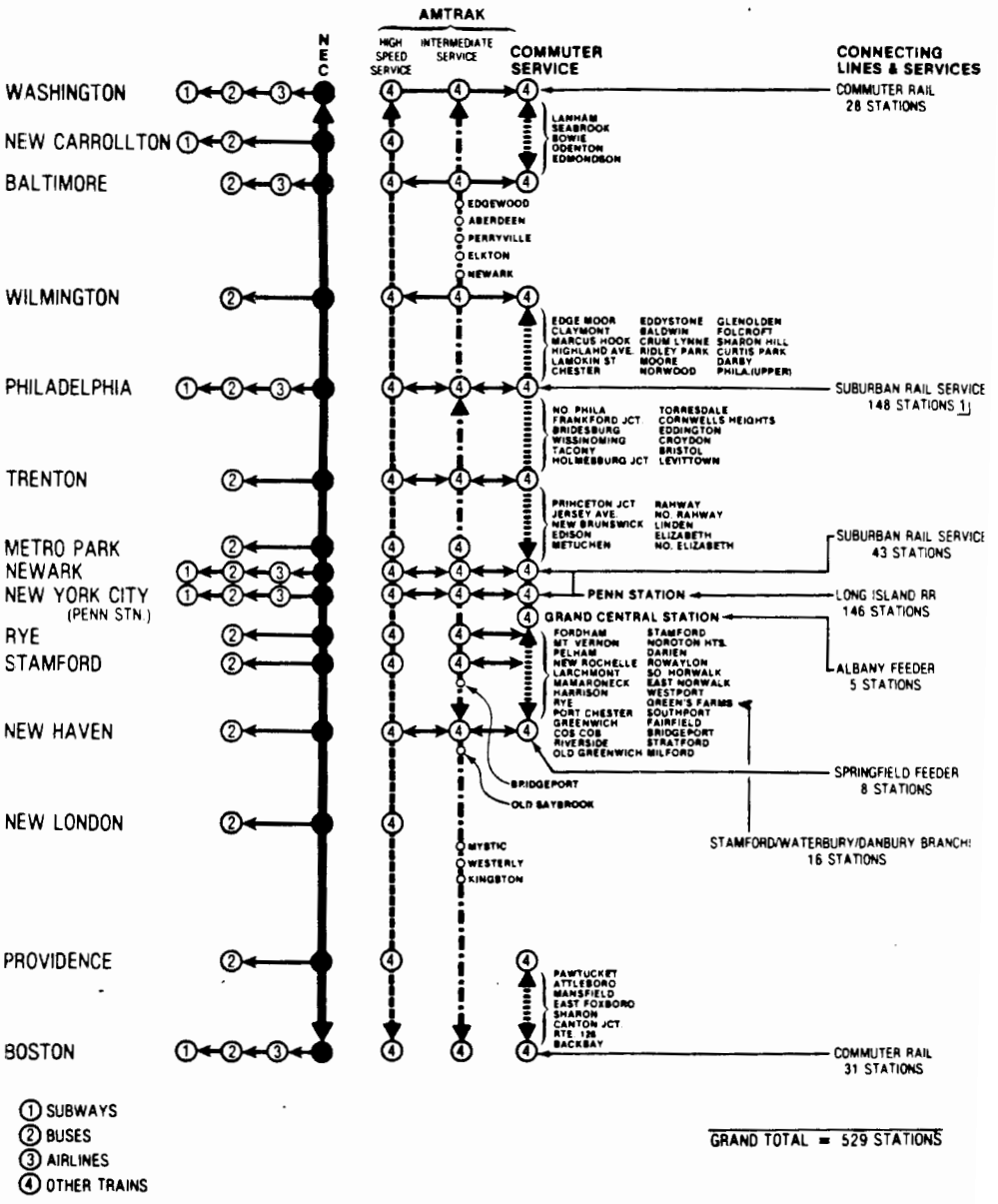
Service Endpoints	Financial Sponsor	Equipment		Crews	Dispatching/ Scheduling	Track	
		Owner	Maint.			Owner	Maint.
Washington-Baltimore	MDOT	NJDOT	Amtrak	Conrail	Amtrak	Amtrak	Amtrak
Wilmington-Philadelphia	SEPTA	SEPTA	SEPTA	Conrail	Amtrak	Amtrak	Amtrak
Philadelphia-Trenton	SEPTA	SEPTA	SEPTA	Conrail	Amtrak	Amtrak	Amtrak
Trenton - New York	NJDOT	NJDOT	Amtrak	Conrail	Amtrak	Amtrak	Amtrak
Philadelphia-New York	Amtrak	Amtrak	Amtrak	Conrail	Amtrak	Amtrak	Amtrak
New York - New Haven	MTA/CDOT	MTA/CDOT	Conrail	Conrail	Conrail	MTA/CDOT	Conrail
Providence - Boston	MBTA	MBTA	B & M 1/	B & M	Amtrak	MBTA	Amtrak

Source: FRA/NECP Study of July, 1978.

1/ Boston and Maine

FIGURE II-B

INTEGRATION OF TRANSPORTATION ON NEC



1/ INCLUDES 90 STATIONS ON THE FORMER READING RAILROAD LINE THAT WILL GAIN ACCESS TO NEC WHEN PHILADELPHIA MID-TOWN TUNNEL IS COMPLETED.

of transportation, stations on the mainline served by commuter rail, and stations off the Corridor mainline but with direct rail connections to stations receiving high-speed service.

Disruptions caused by conflicts between operating authorities, either actual or imagined, have led to suspicions on the part of both Amtrak and the authorities that when their trains operate in a "foreign" territory they are not given proper priority. Emphasis is now being placed on the integration of services along the Corridor between Amtrak and operating transit authorities.

There are very obvious benefits to be gained from the integration and coordination of all services which traverse or connect with the Corridor. Perhaps the most obvious example of the kind of service integration needed along the NEC is at Trenton, New Jersey, a major intercity station as well as the terminal station for both NJDOT and SEPTA services. Local trains, from both Philadelphia and New York, terminate here and cross all tracks to make return trips. Operating these trains through Trenton, both North and Southbound, particularly during off-peak hours, would result in operating economies to both NJDOT and SEPTA and, equally important, would eliminate the switching movements across the mainline for most of the day. Service integration would also provide through access from intermediate stations located between Philadelphia and Trenton, and Newark and Trenton, to Newark and Philadelphia respectively. Cross-platform train changes at Trenton between commuter and intercity trains would afford rapid trip times between the smaller stations and distant cities via Trenton.

A similar situation suitable for service integration exists north of New York, where the interface between MTA/CDOT and Corridor services would be at Stamford and New Haven. At New Haven, the track layout will be altered to ease passenger transfer and allow cross-platform changes. Ideally, the two hourly NEC trains (one in each direction) would alternate stops at Stamford with the existing MTA/CDOT service into Grand Central Station to improve frequency between Stamford and both New York stations. Such a pattern would give Stamford half-hourly high-speed service.

Present institutional arrangements, however, limit the Corridor from realizing its full potential. Train planning, scheduling, dispatching, operational control, and methods for resolving conflicts related to these functions can and should be improved. Many present delays occur because of the present lack of integration of these functions.

Recognizing the potential for conflict between the various Corridor rail users, the 4R Act specified the establishment of the Operational Review Panel (ORP) consisting of one representative from Amtrak, one from Conrail, one person representing all commuter rail authorities on the Corridor, and two neutral members selected by the Chairman of the National Mediation Board. The ORP has the authority to take actions, which shall be final and binding on all parties, necessary to resolve differences of opinion concerning Corridor operations. As presently structured, the ORP should only be required for serious interface problems.

It appears, however, that a definite need exists for a working-level coordinating body which would represent all the various interests on a continuing basis. Towards that end, the NECP recommends the establishment of a Train Planning Unit (TPU) that would include full-time representatives from NECCRAC, Amtrak, and Conrail, and during NECIP construction, the NECP would also be represented. In the event of unresolved conflicts involving serious interface problems, the TPU would provide a summary of the issues to the ORP for final resolution.

The primary functions of the TPU would be to:

- Plan for future train services in cooperation with various marketing concepts.
- Prepare integrated schedules that are efficient, cost effective and meet marketing criteria, and secure agreement of all interests to them.
- Provide plans for station use and platform allocation.
- Provide detailed schedules for use of crews and equipment.
- Identify and correct existing and potential intercity/commuter/freight conflicts.
- Work with the NECP to prepare detailed plans for train operations during the construction phase to maximize construction production and minimize train delays.
- Prepare and issue a coordinated rail public timetable covering all services concerned with the NEC.

- Provide presentations to the Operational Review Panel (ORP) in the event of unresolved conflicts involving serious interface problems.

It is felt that the concept of a Train Planning Unit has considerable merit as a means of improving communications and providing improved operations, fully integrated to meet the demands of all Corridor users. Obviously, the TPU will succeed only with the wholehearted backing and cooperation of Amtrak, NECCRAC, and Conrail. The NECP is prepared to act as a catalyst to bring together the necessary parties as may be required.

A. INTRODUCTION

As discussed in Parts I and II of this report, the Northeast Corridor Improvement Project (NECIP) 1/ will improve all aspects of intercity, commuter, and freight service between Washington, D.C., and Boston, Massachusetts. Amtrak, the primary owner of Corridor property, must be fully prepared for the changes brought on by the NECIP, and Amtrak's future plans with respect to the Corridor must primarily focus on the service to be offered in 1981 and after. Part of this planning must include attendant Amtrak equipment needs and service facilities and a right-of-way maintenance plan. These issues are vital if returns from the NECIP investment are to be maximized.

The NECIP Design Timetable introduced in Part I 2/ was used as the first step in developing an operating plan and in estimating the number of cars and locomotives needed for service between 1981 and 1985. Next, the suitability of current Amtrak equipment for such service was assessed. The gap between the present fleet and the equipment needed to maintain the design timetable defined the amount of new equipment to be purchased. An economic analysis then determined the most cost-effective choice of upgraded Metroliners and new locomotives.

B. SERVICE PLAN FOR HIGH-SPEED OPERATIONS: 1981-1985

A NECIP Design Timetable of post-improvement train service was developed by the NECP and Amtrak. It is an essential planning tool in making decisions concerning rolling stock, support facilities, and future operating and maintenance costs. This design timetable includes the following type and frequency of service:

- Half-hourly service throughout the day (0600-2300) in the Washington-New York market on a 2-hour, 40-minute schedule with five stops (Baltimore, Wilmington, Philadelphia, Trenton, and Newark, with certain trains calling at New Carrollton or Metropark)

1/Reference is made in the text to the NECIP, which is the program authorized by the Railroad Revitalization and Regulatory Reform Act of 1976 (4R Act). The text also refers to the NECP, the Northeast Corridor Project, which is the organization established within the Federal Railroad Administration (FRA) to implement the NECIP.

2/See Appendix "A"

- Hourly service throughout the day (0600-2200) in the New York-Boston market on a 3-hour, 40-minute schedule with five stops (Stamford, New Haven, New London, Providence, and Route 128)

- Continuation of the current level of peak-hour commuter or "clocker" trains 1/ between Philadelphia and New York

- 2-hour service throughout the day (0600-1830) between Philadelphia and Springfield via New Haven on a 4-hour, 30-minute schedule with ten stops (every third train terminating or originating at Boston)

- Existing long-distance trains

- Possible express trains on 2-hour, 30-minute schedules in the Washington-New York market, and 3-hour, 20-minute schedules in the New York-Boston market introduced as required by increased demand.

In terms of trains per day for each market (train-series number), the design timetable represents a 20 percent increase over 1978 service levels. Table III-A summarizes and compares present and post-NECIP operations.

TABLE III-A
TOTAL TRAINS PER DAY

Series (Market)	1978 Service	1981-85 Design Timetable	% Change
10 (Through Trains)	18	18	N.C.
100 (Wash.-NY-Bost.)	55	75	+36%
200 (Phila.-NY.)	15	13	-13%
300 (Phila.-Springfield)	0	12	
400 (N. Haven-Spfd. Phila-Wash., Misc)	22	12	-45%
TOTAL	110	130	+18%

1/Clocker trains refers to Amtrak's Philadelphia - New York service.

2/Three trains per day each way will begin or end in Boston.
Source: 1981-85 Design Timetable.

The service outlined in Table III-A offers frequent, high-quality service at the best possible trip times consistent with the funding limits of the 4R Act. Any additional stops added to the 100-series train service will prohibit their attaining the trip-times specified in the 4R Act. Intermediate stations are served by 200-, 300-, and 400-series trains as well as the commuter trains of the various sponsoring agencies along the Corridor. Expansion of the service as demand increases will, at least initially, be accommodated by expanding train size, e.g., from six to seven or eight cars.

C. CURRENT AMTRAK EQUIPMENT FLEET AND ITS SUITABILITY FOR HIGH-SPEED SERVICE

1. Metroliners

Under two separate leasing agreements 1/, Amtrak operates 61 multiple-unit (MU) 2/ cars commonly known as Metroliners. The cars were originally designed to operate at 160 mph but have actually never exceeded 130 mph in revenue service. After 10 years of intense operation, the cars are in urgent need of major overhaul. A combination of equipment deterioration and track conditions limits current top speeds to around 105 mph. An expenditure of $64 million is required to repair and upgrade the cars for high-speed service on the improved Corridor.

2. E-60 Locomotives

Amtrak owns 26 General Electric E-60 locomotives which have been in Corridor service since 1976. The E-60 is restricted to top speeds of 90 mph since its weight makes it unsuitable for high-speed traction. At the completion of the NECIP, the E-60 locomotives could be used for inter-Corridor, commuter, or, if modified, freight service.

1/Amtrak makes annual lease payments of $60,000 on each of 12 cars and $31,000 on each of 49 cars. In 1984, Amtrak will own the 12 cars outright, but 4 years of payments will remain on the 49. In 1988, a new lease can be negotiated, or the cars can be purchased at market value.

2/Self-propelled cars used in multiple fashion to form a train.

3. GG-1 Locomotives

The mainstay of electrified operations on the NEC since the late 1930's has been the GG-1 locomotive. Amtrak owns 40 of these GG-1 locomotives, and each is between 35 and 45 years old.

Body-frame cracks and other indications of stress fatigue show clearly that this equipment has reached the end of its useful life. Those GG-1's being kept in service, pending replacement by new locomotives, have a very high maintenance expense of about $3.00 per locomotive mile, or more than twice the per-mile cost of the E-60. The GG-1's cannot operate at 25 kV 60 Hz, and studies have shown conclusively that it is much more economical to replace than to modify them.

4. Amfleet Cars

Early in 1978, Amtrak received final delivery on an order of 494 Amfleet cars. The cars are designed for 120-mph operations and are quite similar in outward appearance to Metroliners, but they are locomotive hauled. Of the total fleet, 317 are currently in NEC service; the remainder are spread throughout the Amtrak system.

5. Summary

Of Amtrak's current fleet, only upgraded Metroliners and Amfleet cars are capable of high-speed operations. The E-60 locomotives could be used in slower service.

D. EQUIPMENT OPTIONS FOR NEC OPERATIONS

1. Current Equipment Financing

The Electro-Motive Division of General Motors is under contract to build 30 locomotives for Amtrak based on the Swedish ASEA RC4a design. The first locomotive will be delivered in December 1979, with 23 scheduled for delivery by February 1981. The full order should be complete by June 1981. European engineers familiar with high-speed electric operations have reviewed, in conjunction with Amtrak and FRA engineers, the design of the General Motors locomotive (AEM-7) 1/. Their report states that the AEM-7 can supply the necessary power to meet the trip-time goals

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1/The locomotive being built by General Motors is not an exact duplicate of the model Amtrak tested. Certain modifications, primarily an increase in tractive effort, have been made for use on the NEC.

of the 4R Act. As a precaution, however, an intensive test program is planned in 1980 for the first locomotives built to establish their capability and reliability for the service levels required on the NEC.

With respect to the Metroliner fleet, the General Electric Company is under contract to upgrade 34 of these vehicles. A combination of factors influenced this decision, including the rapid deterioration of the Metroliner fleet and the realization that a number of AEM-7's sufficient for full (Washington-Boston) service could not be available before February 1981. General Electric's contract calls for the cars to be upgraded for 120-mph service on the improved Corridor and to be made more reliable, particularly during winter operations. The cost to Amtrak is $39.5 million or $1.16 million per car.

2. Economic Analysis of Options

The following economic analysis of the best mix of Metroliners, AEM-7's, and Amfleet cars needed to provide the service outlined in the design timetable is premised on two assumptions: that either Metroliner or Amfleet cars can be "turned" for a return trip in two hours, and that virtually all trains will have a fixed consist of six cars. (Metroliners would have 398 revenue seats per train; Amfleet trains would have 438.) Fixed consists eliminate the need for switching, either in the immediate station area or at more remote yards, resulting in significant savings in operational costs.

Table III-B through III-F present an economic comparison of two alternative equipment-investment options: upgrade 34 Metroliners, (which Amtrak has already contracted for); or upgrade the entire fleet of 61 Metroliners 1/.

This analysis uses the net present value of projected capital expenditures and operating costs over the 12-year life of upgraded or new equipment. No additional track-maintenance costs are included in the analysis, notwithstanding that each Metroliner car weighs almost as much as an AEM-7 locomotive (190,000 pounds for a loaded Metroliner versus 205,000 pounds for a locomotive). The Metroliner also has significantly higher unsprung axle loadings and weighs nearly twice as much as an Amfleet car.

1/Regardless of whether 34 or 61 Metroliners are upgraded, most service will be provided by AEM-7's and Amfleet cars. This analysis simply compares the options of upgrading 34 Metroliners plus the number of AEM-7 and Amfleet cars needed to match the seat miles provided if all 61 Metroliners were upgraded with the alternative of upgrading all 61 Metroliners.

TABLE III-B

INCREMENTAL OPERATING STATISTICS (MILLIONS)

	Upgrade 34 Metroliners				Upgrade 61 Metroliners			
	Train Miles				Train Miles			
Category	1979	1980	1981	1982-91	1979	1980	1981	1982-91
Upgraded Metroliner	1,200	1,200	1,200	1,458	1,200	2,100	2,100	2,616
Metroliner	600	600	600	--	600	--	--	--
GGI's	300	300	300	--	300	--	--	--
AEM-7's	--	--	--	1,072	--	--	--	--
	Car Miles				Car Miles			
Upgraded Metroliner	7,000	7,000	7,000	8,750	7,000	12,500	12,500	15,698
Metroliner	3,700	3,700	3,700	--	3,700	--	--	--
GG-1's	300	300	300	--	300	--	--	--
Amfleet	1,800	1,800	1,800	6,434	1,800	--	--	--
AEM-7's	--	--	--	1,072	--	--	--	--

Source: NECP

TABLE III-C

INCREMENTAL OPERATING EXPENSE (Millions of Dollars)

	Upgrade 34 Metroliners				Upgrade 61 Metroliners			
Category	1979	1980	1981	1982-91	1979	1980	1981	1982-91
Equipment Maintenance	$17.6	$17.6	$17.6	$16.8	$17.6	$15.5	$15.5	$19.5
Energy Costs	1.9	1.9	1.9	3.1	1.9	1.9	1.9	3.3
Crew Costs	4.8	4.8	4.8	7.1	4.8	4.4	4.4	6.5
Lease Methods	2.2	2.2	2.2	1/	2.2	2.2	2.2	1/
Switching Costs	.1	.1	.1	.4	.1	-	-	-

1/ Lease payments are $2.2 annually, 1982-84. Between 1985 and 1988 payments are reduced to $1.5 because 12 cars are paid for. The payments are doubled to $3.0 between 1989 and 1991 to reflect an estimate of what Amtrak would pay to own the cars outright by the end of 1991.

Source: NECP

TABLE III-D

INCREMENTAL EQUIPMENT CAPITAL COSTS

Millions of 1978 Dollars

	Upgrade 34 Metroliners Purchase AEM-7's & 25 Amfleet Cars	Upgrade 61 Metroliners
Upgraded Metroliners	$19.5	$49.4
AEM-7's	11.3	-
Amfleet	16.8	0
1988 Lease Termination	7.0	-
Total	$54.6	$49.4

Source: NECP

TABLE III-E

NEC EQUIPMENT ALTERNATIVES DISCOUNTED CASH FLOW ANALYSIS OF INCREMENTAL INVESTMENT
(Millions of 1978 Dollars)

	Upgrade 34 Metroliners Purchase AEM-7's & 25 Amfleet				Upgrade 61 Metroliners		
Fiscal Year	8% Discount Factor 1/	Capital	Operating 2/	Discounted Total	Capital	Operating 2/	Discounted Total
1979	1.00	19.5	$26.6	$46.1	$49.4	$26.6	76.0
1980	0.93		26.6	24.7		24.0	22.3
1981	0.86	28.2	26.6	47.1		24.0	20.6
1982	0.79		29.7	23.5		31.6	25.0
1983	0.74		29.7	22.0		31.6	23.4
1984	0.68		29.7	20.2		31.6	21.5
1985	0.63		29.0	18.3		30.9	19.5
1986	0.58		29.0	16.8		30.9	17.9
1987	0.54		29.0	15.7		30.0	16.7
1988	0.50		29.0	14.5		30.9	15.4
1989	0.46		30.5	14.0		32.4	14.9
1990	0.43		30.5	13.1		32.4	13.9
1991	0.40	7.0	30.5	15.0		32.4	12.9
		54.7	$376.4	$290.7	$49.4	$390.2	300.1
1992	0.37	(15.4)		(5.6) 3/			
NET		$39.3	$376.4	$285.1 4/	$49.4	$390.2	300.1

1/ Discount rate of 8% utilized based on cost-of-capital to Federal Government.
2/ Lease costs have been added for 1982-1991 to costs appearing on Table II-C.
3/ Residual value of AEM-7's and Amfleet cars.
4/ This amount is based on the purchase of new Amfleet cars in 1982 to replace those Metroliners not upgraded. With the Amtrak Head End Power Program, however, new Amfleet cars will not be required. This reduces the discounted total cost by approximately $8 million to $227.1 million.

Source: NECP

TABLE III-F

SUMMARY OF CAPITAL, OPERATING AND MAINTENANCE COSTS

(Millions of 1978 Dollars)

	Upgrade 34 Metroliners	Upgrade 61 Metroliners
Capital Investment	$ 39.3	$ 49.4
Operating and Maintenance Costs	376.4	390.2
Total	$415.7	$439.6
Discounted Total	$285.1	$300.1
Adjusted for HEP Program	(8.0)	—
Adjusted Total	$277.1	$300.1

Savings when only 34 Metroliners upgraded $23.0

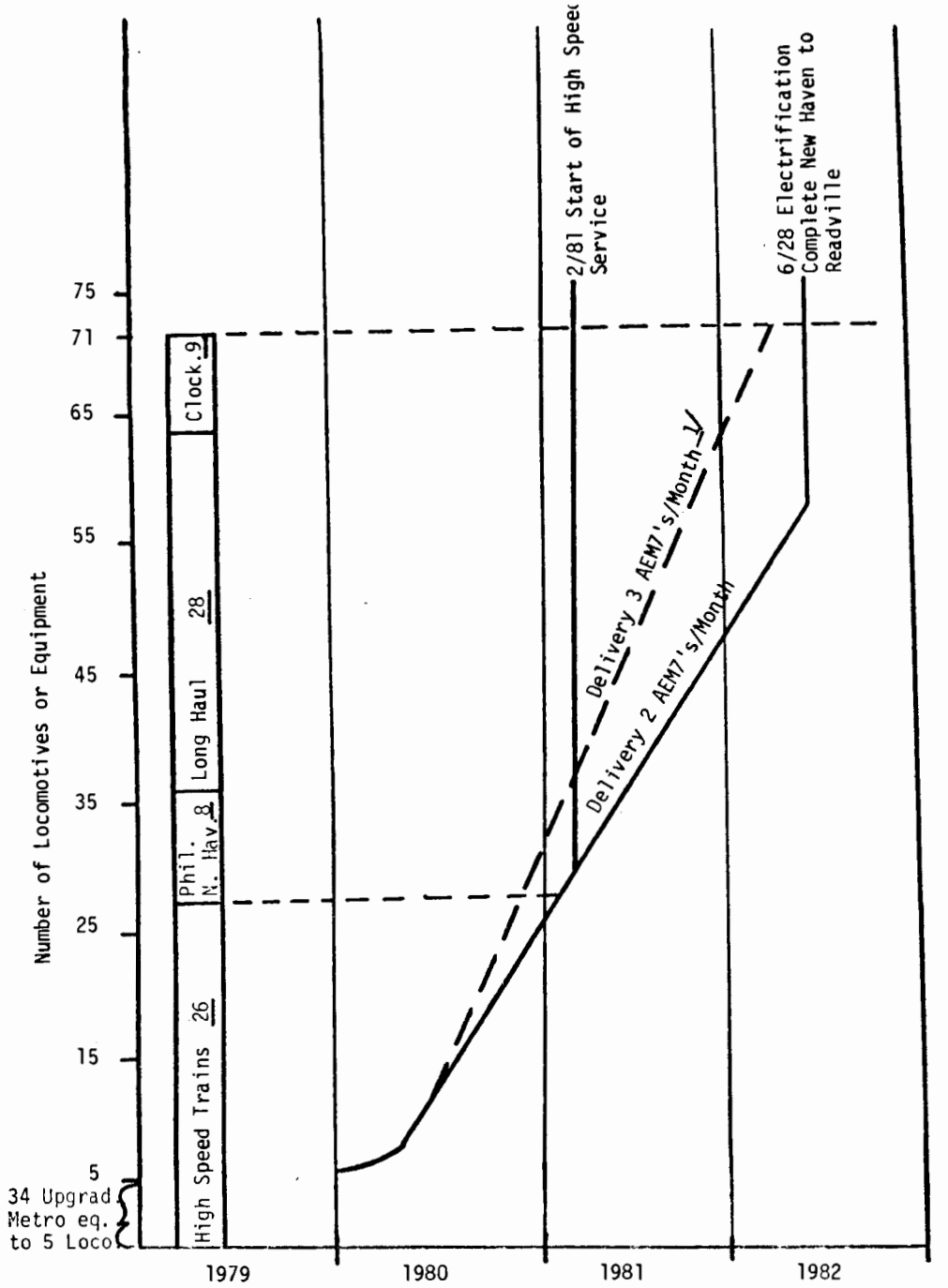
Source: NECP

3. Results of Economic Analysis

The economic analysis shows that the Metroliner upgrading program should stop at 34. All 34 upgraded Metroliners will be available in 1981 for 2-hour, 40-minute service between Washington, D.C. and New York. To provide hourly service between Washington and New York in February 1981, approximately 9 working train sets, or 12 sets including spares, are required. Metroliners can be used for 5, and AEM-7's hauling Amfleet cars for the remainder. Figure III-A displays graphically the arrival of new locomotives and the phasing-in of high-speed service.

FIGURE III-A

MOTIVE POWER FLEET



1/ If production of AEM7's by General Motors can be increased to 3 locomotives per month, the motive power fleet will be large enough for full high-speed service in 1982.

Source: NECP Staff Analysis

A. INTRODUCTION

This part of the redirection effort reports the development of Northeast Corridor Improvement Project (NECIP) plans to date; points out how they were influenced by the variations in policy, budget, direction, design, costs, and productivity experienced during the February 1976 to September 1978 period; and with this background in mind, develops a set of options and a recommended program.

B. PROGRAM REVIEW

The planning for Northeast Corridor (NEC) improvements specified in the Regional Rail Reorganization Act of 1973 (3R Act) culminated in a program recommended to the United States Railway Association (USRA) in June 1975 for inclusion in the USRA Final System Plan (table IV-A).

After the compromise which produced the Railroad Revitalization and Regulatory Reform Act of 1976 (4R Act) with its authorizations of $1.6 billion full Federal funding and $150 million Federal/State sharing and a reduced 5-year schedule, a revised program was quickly developed. The revised program retained most of the basic program structure of the earlier plans but was scaled down to fit the new funding.

The Federal Railroad Administration (FRA) project planners immediately recognized that the compromise authorization would not permit any physical improvements to the three NEC feeder lines, i.e., Harrisburg, Pennsylvania, Albany, New York; and the Boston-New Haven Inland Route via Hartford, Connecticut, and Springfield, Massachusetts. One driving facet of the revised program was that compression of the program into a 5-year schedule required substantial concurrent program development, design, and construction and extensive out-of-service time for the track. This concurrency was required to meet the extremely tight February 1981 goal for achievement of trip times. Funding of program elements was tailored to fit the new authorization level with priority given to those features that enhanced speed and schedule reliability for intercity high-speed service. Some initial system goals developed by the project managers were not modified to meet the changed situation, and in reality became unattainable within the authorized funding

Table IV-A
NORTHEAST CORRIDOR IMPROVEMENT PROGRAM
EVOLUTION OF FUNDING REQUIREMENTS: 1975 - August 1977

PROGRAM ELEMENT	JUNE 75 FSP[3] INPUT		JAN 76 $1.75 4R ACT	AUG 77 IMP
ROUTE REALIGNMENTS	49[1]		326	165
TRACK STRUCTURES	447		244	498
BRIDGES	361[2]		345	264
ELECTRIFICATION	173		245	256
SIGNALING	300		170	178
COMMUNICATIONS	----------included in Signaling----------			27
GRADE CROSSINGS	----------included in Track----------			4
STATIONS	231		315	242
SERVICE FACILITIES	163		120	113
TUNNELS			35	20
FENCING	67	---	100	53
FRA PM/SE	30			
INTERIM MAINTENANCE	110			
PROTOTYPE ROLLING STOCK	25			
LONG-LEAD MATERIAL	174			
ROLLING STOCK MODIFICATION	40			
CONSTRUCTION ENG & MGMT	50			
RAILROAD SUPPORT	25			
PRODUCTION ROLLING STOCK	187			
SYSTEM TEST	6			
IMPROVED FREIGHT FACILITIES	51			
	2,489		1,900[4]	1,820

[1] Land only

[2] Includes Tunnels

[3] Refers to the USRA Final System Plan

[4] Includes $150 million of State and local matching funds

limit (e.g., 95-percent schedule reliability within 5 minutes). The program-element budgets remained essentially unchanged from January 1976 until the spring of 1977. Although the overall cost estimates for program elements generally did not change in this period, their internal structure and content continuously evolved as system engineering progressed and budgetary estimates were refined.

The August 1977 Draft Implementation Master Plan (IMP) was the first total system planning document to attempt an integrated engineering and construction approach. Improvements were divided into railroad development projects (RDPs) which were either site-specific, system-wide, or linear, i.e., grouping projects within a segment of the right-of-way. Through this planning technique, the complex relationship between improvements in different program elements taking place in the same location were accommodated with regard to track access and other operational constraints. The August 1977 IMP is summarized in table IV-B.

The August 1977 IMP emphasized improvements in those features of the physical plant that would contribute to achieving safety, trip-time goals, and schedule reliability. Passenger comfort was treated as a desirable but not critical objective and many other improvements and projects were deferred with a view to their possible further consideration in the Two-Year and Six-Year reports to Congress (see Section 703(1)(E) of the 4R Act). Although the August 1977 IMP included $23 million for conversion of some 250 commuter vehicles of the Southeastern Pennsylvania Transportation Authority (SEPTA) and the New Jersey Department of Transportation (NJDOT), there was no provision for $100 million of contractor indemnification, or for $2.0 million of the $62 million NECIP contribution to the Massachusetts Bay Transportation Authority (MBTA) Southwest Corridor Project. Subsequently, the $100 million for indemnification was set aside out of the fiscal year (FY) 78 appropriation and was unavailable to the project.

Without these additional unanticipated costs, the August 1977 IMP proposed to complete the project within the 5-year time frame and at a cost of $1.82 billion, including State and local cost sharing. An

Table IV-B
AUGUST 1977 IMPLEMENTATION MASTER PLAN (IMP)

SUBSYSTEM COST SUMMARY BY YEAR
(CURRENT OBLIGATED FUNDS IN 000s)

	PRIOR TO 1978	1978	1979	1980	TOTAL
ROUTE REALIGNMENTS	12,200	9,900	90,800	38,300	151,200
TRACK STRUCTURES	116,500	185,500	83,100	63,100	448,200
BRIDGES	16,600	40,800	116,400	68,700	242,500
ELECTRIFICATION	12,200	34,200	117,600	70,800	234,800
SIGNALING	8,000	46,400	68,100	40,800	163,300
COMMUNICATIONS		9,300	7,700	7,700	24,700
FENCING AND BARRIERS	4,400	3,700	23,400	17,000	48,500
GRADE CROSSINGS	1,000	2,000	1,000		4,000
STATIONS	12,200	29,600	96,800	83,600	222,200
SERVICE FACILITIES	4,500	22,400	64,300	12,600	103,800
TUNNELS		1,200	17,200		18,400
PROGRAM MANAGEMENT	23,600	24,400	27,300	31,600	106,900
SYSTEM ENGINEERING	13,800	15,600	11,300	10,800	51,500
TOTAL (Annual)	225,000	425,000	725,000	445,000	1,820,000
CUMULATIVE TOTAL	225,000	650,000	1,375,000	1,820,000	

aspect of the ongoing project, the full impact of which was not appreciated at the time the August 1977 IMP was produced, was the unusually low Amtrak productivity in the critical trackwork program. Only 59.5 percent of the work scheduled in the 1977 season was completed at 130 percent of the budgeted cost, for a cost efficiency of 45.8 percent. (In the 1978 season, through September 1978, 41.3 percent of the annual work scheduled has been completed at an expenditure of 56.7 percent of budget, for a cost efficiency of 72.8 percent.)

The August 1977 Draft IMP was circulated as an internal planning document, and served as the basis for FY 79 budget estimates submitted to the Office of Management and Budget (OMB). A change in the FRA's top management had taken place at about the time the IMP was completed. The combination of questions raised by the new Administrator and negotiations with the OMB during the succeeding four months convinced all concerned that the $780 million program projected for FY 79 was utterly unrealistic. A reduction to $455 million was eventually decided on, and concurrently the prospect of program stretchout became a certainty, resulting in additional inflation and extended program-management/ system-engineering costs. The only way a portion of the original schedule and goals could be retained was to concentrate on improvements related to trip time that could be completed by February 1981, leaving other portions related to system maintenance, station improvement, etc., to be finished later.

By the time the Secretary called for the redirection effort in January 1978, the FRA had already taken under reexamination program plans that resulted in a tentative new February 1978 program. This program was adopted within the FRA's Northeast Corridor Project Office (NECP) for planning purposes. The February 1978 program assumed that alternatives other than NECIP authorized funds would release $155 million of program funds that were being budgeted for contractor indemnification and public grade crossing removal. Only limited attempts were made to estimate additional program stretchout costs, i.e., program management and inflation, pending indepth analysis by the redirection study team.

The cost of and the schedule for the February 1978 tentative program are shown in table IV-C and

Table IV-C
SUMMARY
NECIP FEBRUARY 1978 PROGRAM
(000,000)

	PROGRAM ELEMENT	TOTAL
A.	FUNDING LIMIT	
	$1.6 Billion	
	Route Realignments	38.0
	Track Structures	561.8
	Bridges	188.0
	Electrification	267.0
	Signaling	177.0
	Communications	24.0
	Grade Crossings	4.0
	Stations	59.5
	Service Facilities	89.0
	Tunnels	19.4
	DCP PM/SE	137.8
	FRA PM/SE	34.5
	SUBTOTAL	1,600.0
B.	Funding Limit	
	$150 Million Matching	
	Fencing and Barriers	
	Fed.-100% Safety Related	36.4
	Fed.-Shared	2.8
	State/Local-Shared	(2.8)
	Stations-Nonoperational	
	Fed.-100% Safety Related	18.4
	Fed.-Shared	67.5
	State/Local-Shared	(67.5)
	DCP PM/SE	20.2
	FRA PM/SE	4.7
	State Shared PM/SE	(4.7)
	SUBTOTAL (Fed. Only)	150.0
C.	TOTAL (Fed. Only)	1,750.0
D.	Other Non-NECIP Funds	
	Public Grade Crossings	55.0
	Indemnification	100.0
	Union Station	0.0
	TOTAL	155.0

figure IV-A, respectively. The more significant differences between this program and the August 1977 IMP are:

- Route realignment - a decrease of $113.2 million with deletion of all speed curves. Those retained are driven primarily by station platform configurations, interlockings, and spiral (comfort) adjustments.

- Track structures - an increase of $114 million to reflect the increased cost estimated for planned trackwork.

- Maintenance of maintenance-of-way (MOW) equipment being used to carry out the NECIP - an increase of $34.9 million. This item simply had been omitted from the August 1977 program.

- MBTA Southwest Corridor - an increase of $2.0 million for features in excess of original NECIP plans for that territory.

- Metropolitan Transportation Authority (MTA)/ Connecticut Department of Transportation (CDOT) electrification upgrade between New Rochelle and New Haven - a deletion of $20.2 million in estimated cost.

- New Haven to Boston catenary costs - an increase of $20.9 million in estimated cost.

- Component repair shop - a reduction of $18.4 million in features.

Table IV-D contains a complete list of the differences between the two plans. It should be noted that the February 1978 program development did not include post-1981 escalation and program-management costs, although improvements in major program elements such as electrification and signaling were known to extend into 1983. In addition, the MBTA work in the Southwest Corridor will not be completed until 1984 at the earliest. As the redirection effort proceeded, the cost of the February 1978 program was updated to include all of the features contained in the original

FIGURE IV-A
WORK SCHEDULE: FEBRUARY 1978 PROGRAM

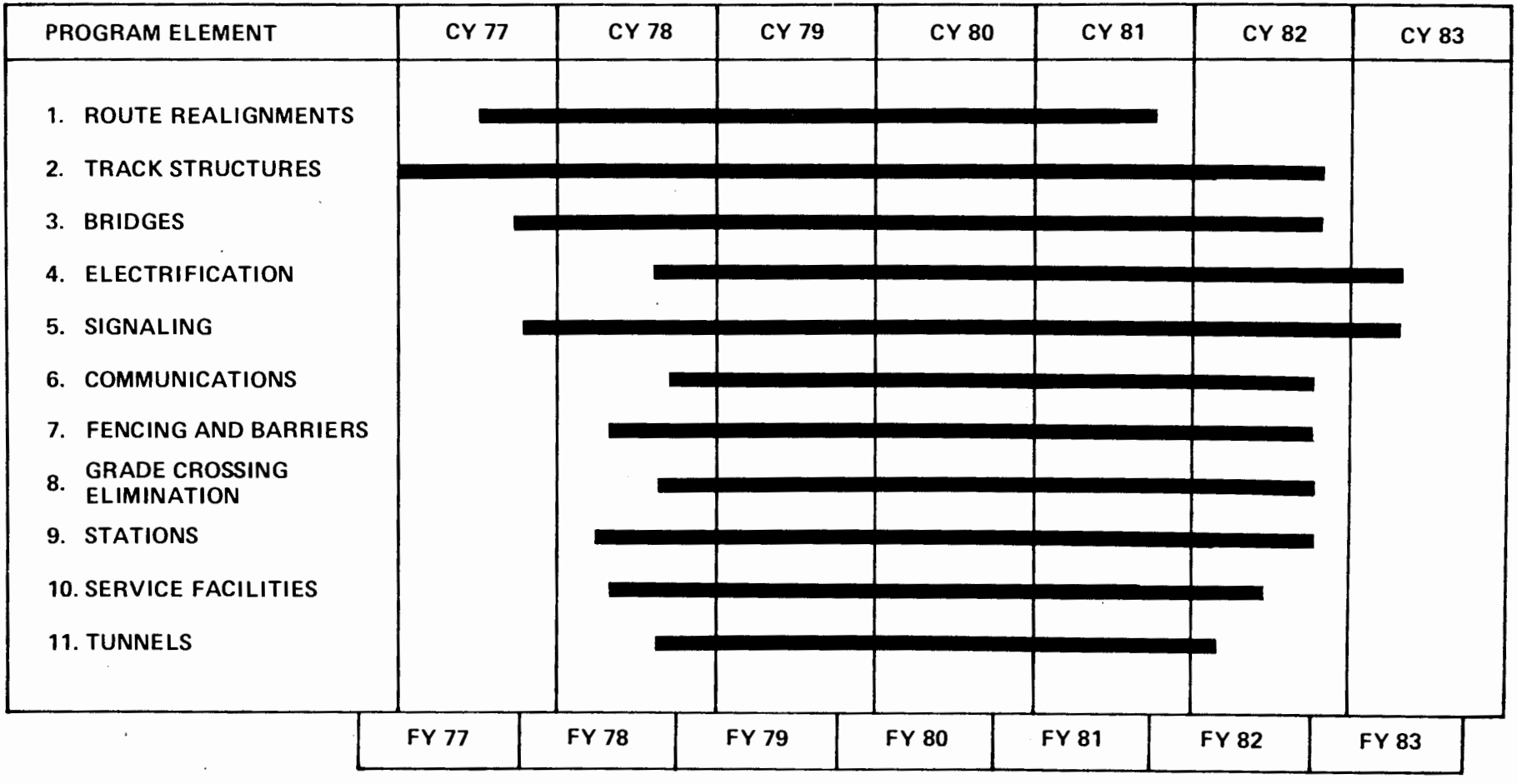


Table IV-D

COMPARISON OF AUGUST 1977 IMP
WITH
FEBRUARY 1978 PROGRAM

PROGRAM ELEMENT	FEBRUARY 1978	AUGUST 1977 IMP (INCL. PM/SE)	AUGUST 1977 IMP (CONSTRUCTION ONLY)
	BUDGET* (MILLIONS OF DOLLARS)		
1. ROUTE REALIGNMENTS	38.00	165.0	151.2
2. TRACK STRUCTURES	532.68	498.0	448.2
3. BRIDGES	188.00	264.0	242.5
4. ELECTRIFICATION	267.00	256.0	234.8
5. SIGNALING	177.00	178.0	163.3
6. COMMUNICATION	24.00	27.0	24.7
7. FENCING AND BARRIERS	42.00	53.0	48.5
8. GRADE CROSSINGS	4.00	4.0	4.0
9. STATIONS	212.85	242.0	222.2
10. SERVICE FACILITIES	89.00	113.0	103.8
11. TUNNELS	19.47	20.0	18.4
12. DCP PROGRAM MANAGEMENT AND SYSTEMS ENGINEERING	162.70	--	
13. AMTRAK PROGRAM MANAGEMENT AND SYSTEMS ENGINEERING	29.10	--	
14. FRA PROGRAM MANAGEMENT AND SYSTEMS ENGINEERING	39.20	--	
SUBTOTAL	1,825.00	(2.80 ADDITIONAL MASSACHUSETTS FENCING MATCHING FUNDS)	
15. PUBLIC GRADE CROSSING ELIMINATION	55.00		
16. INDEMNIFICATION	100.00		
GRAND TOTAL	1,980.00	1820.0	1661.6

* COSTS INCLUDE:
DESIGN AND CONSTRUCTION
ESCALATION FOR WORK COMPLETED PRIOR TO 1981
CONTINGENCIES OF 7% FOR AMTRAK TRACKWORK, 10% OTHER
COSTS DO NOT INCLUDE POST-1981 COSTS FOR ESCALATION AND PROGRAM MANAGEMENT

February 1978 tentative program and to recognize certain features that brought the total $2,062.6 February cost to $2,212.6 million, of which $2,062.6 million fell within those elements covered by the $1.6 billion authorization limit. The difference between the original February 1978 and the updated programs is attributable to three factors: updated and more accurate cost estimates, escalation due to program stretchout, and changes in program scope. Table IV-E shows the significant details of the variances between these two estimates.

The foregoing review of NECIP plan development presents a picture of continuous refinement as estimates were sharpened and the real world of the construction program confronted the thinking of the original program proponents. In retrospect, the attempt to meet the mandated schedule within the authorization was clearly founded upon many assumptions that proved to be inaccurate or excessively optimistic. Many expedients were devised to bring the program back into line, but their effect was only palliative. It is quite clear that many conditions of the initial authorization were unrealistic and that the attempt to meet the February 1981 construction completion deadline through concurrent design and construction was not achievable. As a result of the redirection review, it became apparent that a considerable amount of work will extend at least through mid-FY 83 and that the choices available were to either request an increase in total authorization or drastically revise the program goals, or both.

C. TOWARD A RECOMMENDED PROGRAM

The first step in developing a redirected program, however, had to be a full answer to the question of what could be achieved if, for whatever reason, no change in the present $1.75 billion total Federal authorization was allowed. Although this turned out to be a very restrictive condition, it deserved a detailed answer. Three broad program options appeared to be available, all of which would conform to the current, total Federal authorization of $1.75 billion. These options were titled as:

- Full Electric Traction (ET) option
- Partial ET option
- $150 Million Reprogram option.

Table IV-E
NECIP PROGRAM FUNDING REQUIREMENTS
(millions of $)

	2/78	2/78 UPDATE	VARIANCES TOTAL	COST REESTIMATED	CHANGE SCOPE	STRETCHOUT
A. FUNDING LIMIT $1.6 BILLION						
Route Realignments	38.0	58.3	20.3	3.7	13.4	2.7
Track Structures	561.8	582.7	120.9	20.7	47.5	52.7
Bridges	188.0	239.6	51.6	5.6	31.1	14.9
Electrification	267.0	328.4	61.4	18.7	26.8	15.9
Signaling	177.0	221.3	44.3	6.5	17.3	20.5
Communications	24.0	32.8	8.8	7.2	0.0	1.6
Grade Crossings	4.0	16.0	12.0	0.0	12.0	0.0
Stations	59.5	76.4	16.9	0.0	11.1	5.8
Service Facilities	89.0	99.8	10.8	2.2	6.6	2.0
Tunnels	19.4	29.7	10.3	10.0	0.0	0.3
DCP PM/SE	137.8	224.2	86.4	0.0	0.0	86.4
FRA PM/SE	34.5	53.4	18.9	0.0	0.0	18.9
SUBTOTAL	1,600.0	2,062.6	462.6	74.6	166.3	221.7
B. FUNDING LIMIT $150 MILLION MATCHING						
Fencing and Barriers						
Fed.-100% Safety Related	36.4	43.8	7.4	0.0	8.4	2.0
Fed.-Shared	2.8	2.8	0.0	0.0	0.0	0.0
State/Local-Shared	(2.8)	(2.8)	(0.0)	(0.0)	(0.0)	(0.0)
Stations-Nonoperational						
Fed.-100% Safety Related	18.4	28.5	10.1	0.0	0.0	0.0
Fed.-Shared	67.5	60.4	-7.1	0.0	0.0	0.0
State/Local-Shared	(67.5)	(47.9)	(-19.6)	(0.0)	(0.0)	(0.0)
DCP PM/SE	20.2	10.9	9.3	-9.3	0.0	0.0
FRA PM/SE	4.7	3.6	-1.1	-1.1	0.0	0.0
SUBTOTAL	150.0	150.0	0.0	-10.4	8.4	2.0
C. TOTAL (Fed. Only)	1,750.0	2,212.6	462.6	64.2	174.7	223.7
D. OTHER NON-NECIP FUNDS						
Public Grade Crossings	55.0	66.0	11.0	11.0	0.0	0.0
Indemnification	100.0	100.0	0.0	0.0	0.0	0.0
Union Station	0.0	30.0	30.0	0.0	30.0	0.0
TOTAL	155.0	196.0	41.0	11.0	30.0	0.0

Other assumptions were associated with all three options:

- Public grade crossing elimination costs of $78 million would be fully funded with non-NECIP funds except for $12 million already committed for this purpose.

- Indemnification of contractors would be accomplished under PL 85-804 or legislation giving similar relief, and the $100 million previously set aside would be available for obligation in FY 79.

- The NECIP would receive $30.0 million under a separate authorization for Union Station development, although previously planned operational improvements would remain a NECIP responsibility.

These three broad options do not, of course, represent all of the impossibly complex combinations of specific project features. The options were intended instead to characterize the three major program paths that might be taken.

1. Full Electric Traction Option

In the Full ET option, the critical goal of end-to-end electrification is retained. Trackwork and realignment improvements are marginally acceptable. Among the shortcomings of this option are inadequate trip-time cushion on the south end of the Corridor, minimum comfort realignments, essentially nonexistent servicing and maintenance capabilities, deferral of necessary communication upgrading, elimination of most Federally funded station operational improvements, and deferral of an FRA commitment to upgrade unsafe bridges in the MTA/CDOT territory. The resulting system would not permit reliable service and would involve high maintenance costs leading to substantial future investments by Amtrak due to the need for additional rolling stock, service facilities, and communications.

2. Partial Electric Traction Option

In the Partial ET option, the planned electrification between New Haven and Boston would be dropped from the program, freeing approximately $150 million for use in other program elements. This would permit

more service facilities, a more adequate safety-related fencing program, and restoration of significant amounts to communications, bridges, and signaling. The program would still be short in needed realignments, track-structure improvements, and station operational improvements. The trip-time cushion between Washington and New York would be inadequate, and the mandated times simply could not be met on the north end of the Corridor. The most serious defect of this option is that it does not provide a unified traction system for the entire Corridor, requiring changes of motive power at New Haven. A truly integrated Corridor would not be provided from Washington to Boston.

3. $150 Million Reprogram Option

The $150 Million Reprogram option would require legislation removing the restrictions on use of the sharing and safety-related funds. The consideration of this option is largely based on the fact that many of the states may choose not to take advantage of the sharing feature and on the opinion that observance of proper program priorities would not restrict uses of the $150 million within a rigid $1.75 billion Federal total. Therefore, if a legislative change were to be made, some funds could be made available for highly desired improvements without an increase in funds authorization.

By shifting about $80 million out of stations and fencing, the reprogramming option compared to the Full ET option would restore the MTA/CDOT bridge work, reconfigure the Baltimore terminal area, and increase the amount of track and signal maintenance. However, this option still lacks an adequate number of curve realignments for reliable achievement of trip times south of New York and desirable comfort levels. Maintenance and service facilities have been reduced to such a low level (albeit better than the Full ET option) that equipment availability and maintenance of way would be costly and would hinder operations. Both operational and nonoperational station improvements would be essentially eliminated. The ability to reprogram funds is, of course, wholly dependent upon the legislative process and therefore cannot be ensured. In any event, the resulting system would still be of low schedule reliability and would require a substantial subsequent investment by Amtrak in service facilities.

The three options discussed above have only one merit: they stay within the 4R Act authorization of $1.75 billion. The option that allows reprogramming of the $150 million is the least undesirable of the alternatives in that it does provide a degree of flexibility to shift funds to projects that would provide a system marginally more responsive to program goals. Table IV-F shows the major differences between the reprogramming option and the February 1978 update of the IMP. Table IV-G lists the features reduced or eliminated. None of the alternatives can be defended as reasonably responsive to the goals or requirements of the 4R Act.

4. Recommended Program

The essential fact is that the present $1.75 billion authorization simply will not buy a Corridor project that meets the 4R Act goals. The causes for this dilemma, primarily a Congressional/Administration compromise on a $1.75 billion/ 5-year program that lacked specificity as to subsystem scope, and overoptimism on the part of project management, coupled with inflation, underestimating, and the immense problems associated with initiating and managing a project of this magnitude, have been discussed earlier . Either the goals must be abandoned or modified, or additional authorization for the project must be sought. A primary objective for the redirection effort has been to develop valid estimates of the scope, schedule and budgets required to provide a project responsive to the 4R Act goals and to recommend a credible program that meets these goals in the most effective way.

As the initial step in arriving at a recommended program, features common to all three options at the $1.75 billion level were identified. To these features were then added the features peculiar to the $150 million Reprogram Option. This combination was adopted as a starting point or basic level to which additions would be made. To recap the capabilities and deficiencies of that basic level, it would provide acceptable improvement levels in bridges, electrification, communications, and grade crossing elimination. Signaling and tunnels would receive minimum acceptable funding, while route realignments, track structures, stations, and service facilities would fall significantly short of the February 1978 levels. Adequate trip-time cushion, improvement of many speed and comfort curves, and suitable station operational facilities would be lacking. Developments would still be

Table IV-F
NECIP PROGRAM FUNDING REQUIREMENTS
(2/78 UPDATE VS. $1.75 BILLION AUTHORIZATION OPTION)
(millions of $)

	PROGRAM ELEMENT	2/78 UPDATE	REPROGRAM $150M
A.	FUNDING LIMIT $1.6 BILLION		
	Route Realignments	58.3	25.9
	Track Structures	682.7	605.5
	Bridges	239.6	239.6
	Electrification	328.4	308.5
	Signaling	221.3	202.5
	Communications	32.8	3.5
	Grade Crossings	16.0	16.0
	Stations	76.4	15.9
	Service Facilities	99.8	3.5
	Tunnels	29.7	18.3
	DCP PM/SE	224.2	195.4
	FRA PM/SE	53.8	45.7
	SUBTOTAL	2,062.6	1,680.6
B.	FUNDING LIMIT $150 MILLION MATCHING		
	Fencing and Barriers		
	Fed.-100% Safety Related	43.8	4.8
	Fed.-Shared	2.8	2.8
	State/Local-Shared	(2.8)	(2.8)
	Stations-Nonoperational		
	Fed.100% Safety Related	28.5	28.5
	Fed.-Shared	60.4	24.9
	State/Local-Shared	(67.5)	(24.8)
	DCP PM/SE	10.9	6.6
	FRA PM/SE	3.6	1.8
	State Share PM/SE	(7.5)	(2.3)
	SUBTOTAL (Fed. Only)	150.0	69.4
C.	TOTAL (Fed. Only)	2,212.6	1,750.0
D.	OTHER NON-NECIP FUNDS		
	Public Grade Crossings	66.0	66.0
	Indemnification	NOTE: Through PL85-804, $100M will be made available for use on program in FY 79.	
	Union Station	30.0	30.0
	TOTAL	96.0	96.0

Table IV-G

$1.75 BILLION AUTHORIZATION OPTION
REPROGRAM $150M - PROGRAM FEATURES REDUCED FROM FEBRUARY 1978 PROGRAM

PROGRAM ELEMENT	REDUCTIONS
Route Realignments	o Realignments in connection with reduced station improvements o Spiral adjustment curves removed
Track Structures	o Eliminate contingency interlocking except Bergen; lines 3 & 4 tunnels trackwork o Minimal service facilities trackwork o Reduce equipment, undercutting, ballast cleaning, and wood ties
Bridges	o No reductions
Electrification	o Reduce Amtrak's work o Eliminate extra transformers o Eliminate electrification to selected service and maintenance facilities
Signaling	o Eliminate 7-aspect signaling system Wilmington-Trenton
Communication	o Eliminate PABX o Reduce MOW radios
Fencing	o Eliminate all fencing except Massachusetts and overhead bridge fencing
Grade Crossing	o No reductions
Stations	o Eliminate all operational improvements except Washington Union o Eliminate nonoperational improvements where funds are unlikely to be matched
Maintenance and Service Facilities	o Eliminate Wilmington, Washington, Philadelphia, New York, and Boston service facilities o Eliminate all MOW bases and car wash
Tunnels	o Eliminate Union and East Haven tunnel work o Reduce North and East River (firelines and lighting)

needed in track structures, signaling, service facilities, and tunnels. Deficiencies in these areas would have a severe impact on schedule reliability and equipment availability.

Recommended additions above the basic level that compensate for these deficiencies were identified and tested in several reprogramming iterations over a period of several months. These additional improvements are summarized in table IV-H, which also shows the $150 Million Reprogram option and the recommended program. It should be noted that the recommended program preserves the original $150 million authorization limit for nonoperational station improvements, fencing, and safety-related features; an increase in only the $1.6 billion portion of the original authorization will be required. The following paragraphs describe the total recommended Redirected Program in greater detail.

Route Realignments. Three minutes and 43 seconds northbound, and 3 minutes and 46 seconds southbound of time-saving improvements at six locations will facilitate achievement of trip-time/reliability goals. Improvements also will enhance Conrail freight operations and selectively enhance MDOT and SEPTA operations. Time-saving improvements will reconfigure Fair, Zoo, North Philadelphia, and Dock interlockings, and increase operating speed to 120 mph on two groups of curves.

New, designated high-speed tracks will be constructed in New Haven and Baltimore to provide additional capacity. The Baltimore track will facilitate the separation of Amtrak and Conrail freight operations. New Haven track will provide separation of Amtrak's Boston and Springfield services.

Spirals will be lengthened on 34 curves to increase ride comfort for all NEC passengers.

Segments of tracks will be constructed or shifted at six locations where interlockings are being reconfigured to conform to the designated high-speed track concept, enhancing schedule reliability, and at three locations to connect existing alignment to alignment for new movable bridges.

Platform configuration realignments will be implemented at the following stations: New Carrollton, Baltimore, Stamford, New Haven, New

Table IV-H
SUMMARY OF RECOMMENDED PROGRAM DEVELOPMENT
(millions of $)

	PROGRAM ELEMENT	REPROGRAM $150M	ADDITIONS	RECOMMENDED PROGRAM
A.	FUNDING LIMIT $1.6 BILLION			
	Route Realignments	25.9	58.7	84.6
	Track Structures	605.5	116.5	722.0
	Bridges	239.6	-	239.6
	Electrification	308.5	41.4	349.9
	Signaling	202.5	57.2	259.7
	Communications	3.8	29.8	33.6
	Grade Crossings	16.0	-	16.0
	Stations	15.9	62.0	77.9
	Service Facilities	3.5	156.4	159.9
	Tunnels	18.3	11.4	29.7
	DCP PM/SE*	195.4	28.7	224.1
	FRA PM/SE	45.7	11.3	57.0
	SUBTOTAL	1,680.6	573.4	2,254.0
B.	FUNDING LIMIT $150 MILLION MATCHING			
	Fencing and Barriers			
	Fed.-100% Safety Related	4.8	39.0	43.8
	Fed.-Shared	2.8	-	2.8
	State/Local-Shared	(2.8)	-	(2.8)
	Stations-Nonoperational			
	Fed.-100% Safety Related	28.5	-	28.5
	Fed.-Shared	24.9	35.5	60.4
	State/Local-Shared	(24.8)	23.1	(47.9)
	DCP PM/SE	6.6	4.3	10.9
	FRA PM/SE	1.8	1.8	3.6
	State-Shared PM/SE	(2.3)	(5.2)	(7.5)
	SUBTOTAL (Fed. Only)	69.4	80.6	150.0
C.	TOTAL (Fed. Only)	1,750.0	654.0	2,404.0

* Program Management/System Engineering

London, Providence, and Boston. All except the reconfigurations at New London will significantly enhance commuter operations. Reconfigurations at Baltimore will also improve Conrail operations through the congested Baltimore area.

Track Structures. A sound track structure/roadbed is a primary feature required to operate a reliable high-speed rail transportation system. Cost-effective renewal/replacement of components will contribute to maintainability, post-NECIP, and will enhance ride comfort for commuters as well as Amtrak passengers. Removal of slow orders also will remove existing restrictions to freight operations. The track structures rehabilitation program will upgrade existing structure to standards for proposed operating speeds; deferred maintenance will be eliminated, existing slow orders removed, and a sound structure provided for future maintenance operations.

Four-hundred-thirty-plus miles of designated track will be reconstructed with concrete ties, 230 of which will have continuous welded rail installed concurrently.

All designated tracks and at least one adjacent outside track will be undercut to remove material that is fouling ballast and to improve drainage from the track structure, thus enhancing maintainability. Segments of other tracks will have only shoulder ballast cleaned.

Fifty interlockings will have their existing configuration improved either by adding, relocating or changing their size. Reconfigurations will remove turnouts from curves, alter layout to conform to designated tracks, and provide increased operating flexibility. Rehabilitated interlockings will be upgraded to NECIP standards.

The B&P Tunnel track will be replaced with direct-fixation track, enhancing maintainability. Ballasted track will be replaced in North River Tunnels and lines 1 and 2 of the East River Tunnels. All except the East River Tunnels trackwork will significantly benefit Amtrak and commuter operations.

Trackwork will be upgraded or newly installed at service facilities and MOW bases to provide storage and staging capacity for the current program as well

as access to new facilities. Equipment to install new material and maintain track will be procured and funds to maintain equipment during the program will also be provided.

The NECIP will provide a portion of the MBTA cost to upgrade the right-of-way as part of the Southwest Corridor Project. This will be an MBTA commuter/subway enhancement as well as a benefit to Amtrak. As necessary to connect to Southwest Corridor track, a direct-fixation track will be constructed. Project limits are approximately Back Bay to South Station. This will also benefit MBTA commuters.

Bridges. The program includes repair and rehabilitation work on 155 undergrade bridges to be performed by Amtrak bridge crews; the work on 94 other bridges, including bridge replacements, will be by contract.

All bridges with a rating below E-55 will be upgraded or replaced; 29 bridges will be replaced where upgrading is not feasible.

Funds will be provided for replacement of bridge timbers on 80 additional open-deck bridges.

Electrification. The NEC will be electrified between New Haven and Boston to provide a unified system. Centralized supervisory control of substations will be located in New Haven.

The existing catenary system between Washington and New Rochelle will be rehabilitated and upgraded to provide for increased operating speeds, and to eliminate deferred maintenance. Wire will be replaced and existing catenary retensioned.

The existing electrification power supply from Washington (Potomac Yard) to New Rochelle will be converted to 25 kV, 60 Hz. Supervisory control will be located in Philadelphia. The system capacity also will be increased in highdensity traffic areas to minimize potential Amtrak/commuter/Conrail delays during peak-load times.

Clearance for 100 existing overhead bridges will be increased to meet standards for 25 kV. At 90 locations the existing track profile will be lowered 1 to 17 inches. At one location a combination of bridge replacement and track lowering must be used. Ten bridges will be replaced. Additional clearance, which

was not a recognized requirement in earlier programs, is also necessary to enable Conrail to continue to operate oversize cars in various segments.

Funding will be provided for conversion of selected SEPTA and NJDOT commuter cars for operation on the NEC at 25 kV.

Increased clearance for 25 kV in New York tunnels will be provided through modifying the tunnel roof and installing redesigned supports and trolley wire. Catenary installation requirements for movable bridges are also funded.

Electrification construction and modification of existing catenary at service facilities will provide for full utilization of facilities. Wilmington, Philadelphia, and New York improvements will provide for increased utilization by SEPTA and NJDOT vehicles.

Signaling. An upgraded signal system is essential for the establishment and control of reliable train operations on the NEC. Signal failures and malfunctions are a significant cause of delays to freight and commuter trains as well as Amtrak trains.

Existing track circuits will be modified for compatibility with 25 kV, 60 Hz electrification between Washington and New Rochelle. A new signal system will be installed between New Haven and Boston. Improvements between New Rochelle and New Haven are presently being undertaken by MTA/CDOT and will benefit Amtrak.

A centralized traffic control system will be installed from Washington to Ragan (south of Wilmington) and from New Haven to Boston. Signaling at 57 interlockings will be replaced with all new equipment and at other interlockings will be rehabilitated and upgraded. The upgraded interlockings will be easily maintainable and will be less subject to delay-causing malfunctions.

Bidirectional (reverse) signaling will be installed on all designated tracks where not currently installed and on all outside tracks below New York. Reverse signaling will provide operational flexibility when operating problems arise or when tracks are out-of-service to perform maintenance work. The flexibility will maximize all train operations and thus serve to minimize delays.

Hot-box detectors and dragging-equipment detectors will be installed at strategic locations (interlockings) to minimize the impact of defective freight and passenger cars. High-wide-load detectors will be installed at locations where freight trains enter the Corridor. A switch-heater installation program, when completed, will ensure that interlocking switches do not freeze-up during winter storms.

To prevent vandalism to the signal and communication-cable systems and to minimize electromagnetic interference, a new duct line will be installed between New Haven and Boston. Between Washington and New Rochelle, Amtrak currently is rehabilitating and rebuilding, as necessary, the existing duct line. A new signaling control cable will be installed as required to ensure reliability of the signaling system.

To ensure the compatibility of SEPTA, MBTA, and NJDOT vehicles with the upgraded signaling system and to provide automatic speed control on these vehicles, NECIP funds will be utilized to pay for the required conversions. Automatic speed control will ensure compliance with the signal system and thus enhance system safety.

The present four-aspect signal system between Wilmington and New York will be replaced with a seven-aspect system. By providing 80-mph and 60-mph aspects, the capacity of the system will be increased by enabling trains to safely follow another train at a speed other than the current maximum 45 mph. Installation in this high-traffic-density area will enhance the reliability of all train operations.

Signal changes at Penn Station and Washington Union Station will decrease trip times by enabling Amtrak trains to make straight moves (without going through a switch) into station platform tracks at a speed greater than the current system allows. These will result in time savings of .9 minutes northbound and .54 minutes southbound at Union Station, and approximately 1.3 minutes in both directions at Penn Station.

Communications. The ability to reliably communicate information between Amtrak personnel and between train dispatchers/operators and trains is essential to reliable Corridor train operations. The ability to

instantaneously communicate instructions during an emergency or as problems arise will serve to shorten the time required to restore normal conditions and thus minimize resultant delays to Amtrak, commuter, and Conrail trains.

Radio communications will be provided through two separate systems: operations and maintenance of way.

Funding will be provided for the initial leasing of a Corridor-wide private automatic branch exchange (PABX) telephone network.

Although the alternative of installing a fiber-optics backbone transmission system is still being pursued, the funding shown will provide for either that or a microwave transmission system with a multi-pair-cable local distribution system.

Fencing, Barriers, and System Security. Intertrack fencing will be installed at approximately 56 commuter and passenger stations to provide pedestrian safety and reduce incidence of delays to Amtrak, commuter, and freight operations.

Construction of specially designed overhead bridge fencing at approximately 125 locations will complete this coverage which will protect the public from high-voltage catenary and the railroad from vandalism (material thrown in front of trains).

New construction of pedestrian-access structures at four locations will provide cross-track access in a safe and efficient manner and eliminate the incidence of passengers crossing the railroad at these locations.

Right-of-way fencing will be installed at selected security-related locations, parklands, MOW bases, and equipment service facilities to ensure public safety as well as deter crime and vandalism.

The program includes installation of security equipment to detect intrusion, criminal activities, and fire; to automatically extinguish fire in critical electronic equipment areas; to limit access into critical train control areas; to provide warning in duress situations; to provide emergency telephones for patrons; and to provide integration of these security

subsystems with railroad police operations. The installation of this equipment will result in adequate protection of patrons and employees in the NEC, the Federal investment, and Amtrak and other users' property.

Grade Crossings. With the exception of selected grade crossings in New London, Connecticut, all at-grade rail-highway crossings will be eliminated from the NEC. In addition to being a potential hazard to train operations, crossings also present a maintenance problem in that they must be removed and replaced whenever tie, rail, or track-laying-system work is scheduled through them. Further, as time passes they generally become muddy areas that cause ride discomfort and, if uncorrected, create slow orders.

NECIP funds will pay for the costs associated with eliminating private crossings. (In FY 78 $12 million was obligated to fund Federal Highway Administration public-grade-crossing renewal projects.)

Stations. The program includes improvements and rehabilitation work at 12 existing rail stations; completion of a new joint subway/ Amtrak station; and construction of two new stations. Major work at existing stations will improve passenger safety and comfort, upgrade passenger processing, facilitate platform access, rehabilitate essential building systems, and accomplish repair work on the buildings to ensure their continued safe occupancy. Passenger-processing capacity will be increased to accommodate projected 1990 patronage. Unimpaired access for the handicapped will be provided.

Commuter facilities will be improved at 11 stations through shared funding. This work includes passenger-platform access, platform safety and security as well as improvements to passenger processing for commuter rail. Also included are facilities for local bus and subway.

Additional parking will be provided for approximately 7,000 cars at ten stations through shared funding to benefit both Amtrak passengers and commuters.

Vehicular and pedestrian site-access improvements will be provided through shared funding at 11 stations. These improvements will enhance passenger

safety and convenience, provide access to short-term parking, and increase drop-off/pick-up capacity.

Service Facilities. The condition and availability of vehicles are important factors in reliable train operations. Vehicles must be maintained to high standards to provide required levels of passenger comfort. The facilities planned for the NEC will provide for periodic inspection and maintenance, train servicing, and for unit overhaul and component repair. Sufficient vehicles to operate trains as scheduled must be available, and therefore facilities at terminal areas are required to inspect, clean and restock recently arrived vehicles for inclusion in a scheduled outbound train. The maintenance capability recommended in this program will permit a 2-hour turnaround of Corridor trains, significantly improving rolling-stock utilization and, concurrently, reducing rolling-stock requirements.

Inspection and maintenance facilities, car storage, and train servicing will be provided at Washington, New York, and Boston. Running-repair facilities will be provided at Philadelphia. A facility for unit overhaul and component repair will be located at Wilmington. Although not designed for added servicing of commuter cars, the NECIP facilities will not preclude provision of such capabilities. At New Haven, a diesel-fueling facility for Amtrak Hartford-Springfield trains will be constructed to replace the existing facility, which is in violation of local codes.

MOW bases will be constructed at centralized maintenance storage, servicing, and staging areas. Eventually, they will be the core of the post-NECIP effort to maintain each feature to its upgraded level.

Tunnels. The structural integrity of the NEC tunnels is critical to the reliable performance of Amtrak, commuter, and freight trains. Any feature failure or restriction in the B&P, Union, and East and North River Tunnels can severely impact on-time performance, because they provide the only direct passenger access into and out of Baltimore and New York.

Although not directly controlling operations, the poor condition of tunnel drainage and mechanical systems has directly contributed to the deteriorated

quality of the track structure, and this has in turn impacted the quality of the signal system. These conditions result in unpredictability of train operations. Therefore, in conjunction with the track replacement program in the B&P and New York Tunnels, the drainage system and tunnel pumps will be replaced.*

Systems essential to facilitate safety and convenience of passengers during an emergency or an abnormal condition will be provided. Installation of fire lines as well as fluorescent lighting and replacement of existing fans are all essential improvements that are funded by the NECIP.

Due to their relatively short length and good overall condition, improvements to the Union and East Haven Tunnels will be minimal.

Recapitulation. The program features described above would provide reasonable schedule reliability, a sound infrastructure, and adequate maintenance capabilities. Funding would be more equitably distributed, ensuring at least a fully viable program in each element and application of resources to those features that contribute the most to achievement of program goals, the most significant of which is the reliable achievement of mandated trip times.

The net impact of the expenditure in timesaving additions will be an approximate 5-minute, 54-second northbound decrease and 5-minute, 36-second southbound decrease in trip time between Washington and New York compared to the February plan. The time savings will be achieved through improvements at eight locations, two of which are route realignments. The remaining six locations, which provide approximately 5 minutes of time savings, involve track and signaling reconfigurations at Trenton, Zoo, New York Avenue (Washington), New York Penn Station, Newark, and North Philadelphia. Train performance simulations indicate that this will provide approximately a 9-minute cushion in meeting the 2-hour, 40-minute trip-time goal south of New York

*The recent collapse of a portion of the B&P tunnel floor slab due to undermining by free-flowing water points up the serious condition that exists. A current study of rail traffic in the Baltimore area treats the tunnel situation in some detail.

required by the 4R Act. This cushion is in excess of the 8-minute cushion which is the minimum necessary for meeting trip-time goals on a reliable basis. The cushion on the south end of the Corridor is critically needed; a tight but adequate cushion on the north end already exists.

Table IV-I and figure IV-B show the distribution of $2.5 billion worth of work throughout the proposed program on a fiscal-year basis. Of this amount, $2,404 billion is from NECIP authorizations. The funding reflects the approved FY 79 appropriation of $455 million with an addition of $100 million previously set aside for contractor indemnification, to bring the total apportionment for that year to $555 million of Federal funds; it also reflects the $450 million appropriation request for FY 80. This spending level will cause a minor extension of the total program, but this has some positive aspects. One of the primary causes of project shortfalls in the past has been the lack of schedule slack and the severe pressures of the 5-year limit. A slightly "stretched" program would be more credible and have a greater likelihood of achievement. The only new obligations in FY 83 would be for continued program management through closeout since all construction awards will have been made by FY 82, and the remaining new work will be in construction supervision, inspection, acceptance of work completed, contract administration, and similar management-oriented activities.

D. CONCLUSIONS

The estimates generated under the redirection effort shown in table IV-I, the recommended $2.5 billion program, reflect the best and most accurate now available; however, no illusion of high precision should be inferred. Projects of this scale always have surprises, usually unpleasant. Some of the problems that may arise have a policy rather than physical origin and are nominally within the control of the FRA or DOT; this type of problem can be avoided by decision. On the other hand, some potential problems may be unavoidable and result in costs above those now projected. This highlights the critical need to settle on a set of project features which will, within limits, shape the budget, rather than the budget shaping the project features.

The most severe problem which the NECIP now faces is the conflict between performance goals and authorization limits. The redirection effort has now identified the most cost-effective way of meeting the 4R Act

goals. Unfortunately, as a comparison of the proposed program features over time has shown, the history of the program, prior to the recommended Redirected Program, has been continual shrinkage or removal of features to stay within a fixed budget. If the benefits of the redirection effort are to be fully realized, then a stable program of specific NECIP features and a schedule, preferably based on the appropriation levels as reflected in the recommended $2.5 billion program, must be adopted.

In summary, redirection analyses have pointed up the gross inadequacy of the current $1.75 billion authorization and the need for a program requiring about $2.5 billion of Federal funds to provide features conforming to the 4R Act goals. Specifically, in addition to $66 million of public grade crossing funds and $30 million of non-NECIP funds for Union Station, there is a need for $654.0 million in new, NECIP, non-sharing Federal authorizations.

TABLE IV-I

RECOMMENDED PROGRAM

($450M FY 80 PROGRAM)
($000,000)

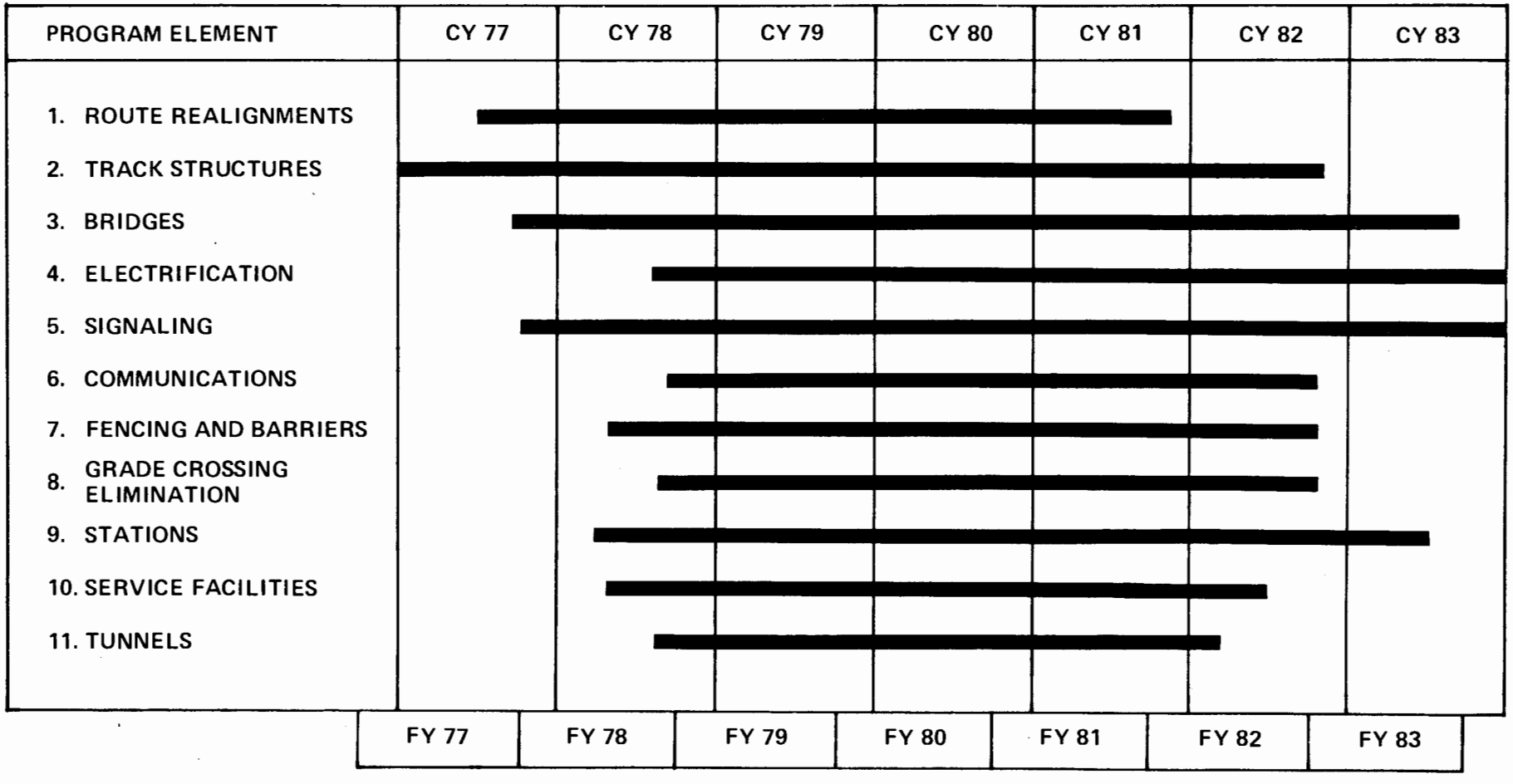
PROGRAM ELEMENT	77 & PRIOR	78	SUB-TOTAL	79	80	81	82	83	TOTAL
A. FUNDING LIMIT-NONMATCHING									
ROUTE REALIGNMENTS	3.3	2.4	5.7	16.0	32.5	30.4	0.0	0.0	84.6
TRACK STRUCTURES	154.5	183.1	337.6	138.5	98.3	79.7	67.9	0.0	722.0
BRIDGES	21.9	20.7	42.6	60.5	51.3	43.0	42.2	0.0	239.6
ELECTRIFICATION	2.1	19.7	21.8	55.2	64.3	106.0	102.6	0.0	349.9
SIGNALING	1.1	9.4	10.5	149.2	30.1	35.9	34.0	0.0	259.7
COMMUNICATIONS	0.3	3.4	3.7	18.2	5.9	5.8	0.0	0.0	33.6
GRADE CROSSINGS	1.0	12.0	13.0	0.0	3.0	0.0	0.0	0.0	16.0
STATIONS	2.5	7.1	9.6	7.8	26.7	18.7	15.1	0.0	77.9
SERVICE FACILITIES	4.3	2.8	7.1	23.9	32.5	41.0	55.4	0.0	159.9
TUNNELS	0.0	3.4	3.4	8.3	18.0	0.0	0.0	0.0	29.7
DCP PM/SE	26.8	46.5	73.3	35.8	34.3	34.2	28.0	18.5	224.1
FRA PM/SE	6.0	10.6	16.6	7.2	9.5	8.6	7.9	7.2	57.0
SUBTOTAL	223.8	321.1	544.9	520.6	406.4	403.3	353.1	25.7	2,254.0
B. FUNDING LIMIT $150 MILLION MATCHING									
FENCING AND BARRIERS									
FED.-100% SAFETY-RELATED	0.3	1.2	1.5	24.8	10.1	7.4	0.0	0.0	43.8
FED.-SHARED	0.0	0.0	0.0	0.0	2.8	0.0	0.0	0.0	2.8
STATE/LOCAL - SHARED	(0.0)	(0.0)	(0.0)	(0.0)	(2.8)	(0.0)	(0.0)	(0.0)	(2.8)
STATIONS-NONOPERATIONAL									
FED.-100% SAFETY-RELATED	0.7	2.0	2.7	1.4	14.3	10.1	0.0	0.0	28.5
FED.-SHARED	0.0	0.2	0.2	0.0	13.3	26.7	20.2	0.0	60.4**
STATE/LOCAL - SHARED	(0.0)	(0.0)	(0.0)	(0.0)	(13.3)	(14.4)	(20.2)	(0.0)	(47.9)***
DCP PM/SE	0.2	0.5	0.7	6.6	2.1	1.5	0.0	0.0	10.9
FRA PM/SE	0.0	0.0	0.0	1.6	1.0	1.0	0.0	0.0	3.6
STATE - SHARED PM/SE	(0.0)	(0.0)	(0.0)	(0.0)	(0.8)	(0.8)	(0.7)	(0.0)	(2.3)
SUBTOTAL (FED. ONLY)	1.2	3.9	5.1	34.4	43.6	46.7	20.2	0.0	150.0
C. TOTAL (FED. ONLY) *	225.0	325.0	550.0	555.0	450.0	450.0	373.3	25.7	2,404.0
D. OTHER NON-NECIP FUNDS									
PUBLIC GRADE CROSSINGS	0.0	0.0	0.0	35.0	31.0	0.0	0.0	0.0	66.0
INDEMNIFICATION		100.0	100.0	NOTE: THROUGH PL 85-804, $100M WILL BE MADE AVAILABLE FOR USE ON PROGRAM IN FY 79 AND SUBSEQUENT YEARS					
UNION STATION	0.0	0.0	0.0	0.0	20.0	10.0	0.0	0.0	30.0
TOTAL	0.0	100.0	100.0	35.0	51.0	10.0	0.0	0.0	96.0

*The pre-1980 fund estimates are based on actual or intended obligations; the post-1979 fund estimates are based on intended appropriation requests.

**This figure reflects current estimates of availability of local matching funds. If more or less local matching funds actually materialize, these figures will be adjusted accordingly. No increase in authorization will be required unless the subtotal (Federal only) exceeds $150.0 million.

***This figure does not match the $60.4 million Federal share because the local matching share for Washington Union Station is being covered by $12.5 million of $30.0 million Federal funds cited in Section D of this table. This assumes enactment of appropriate authorization and appropriation legislation during FY 79.

FIGURE IV-B
WORK SCHEDULE: RECOMMENDED PROGRAM



APPENDIX "A"

1981-1985 AMTRAK NEC DESIGN TIMETABLE

1981-1985 AMTRAK NEC Design Timetable*

July 1978

NORTHBOUND

TRAIN NUMBER	400	100*	102	300	104	200	202	204	106	108	110*	206	112	402	42	114
WASHINGTON, D.C. ...Dp									0610	0640	0700		0710			0740
New Carrollton, MD..									0620	0650	|		0720			|
BALTIMORE (Penn. Sta.)									0642	0712	0730		0742			0810
Aberdeen, MD.....									|	|	|		|			|
WILMINGTON, DE									0725	↓	↓		0825			0852
PHILA., PA (30th St.)				0600	0640	0700	0714	0735	0744	0813		0824	0844			0911
N. Philadelphia, PA .				|	|	0710	0724	0745	|	|		0834			0836	|
Trenton, NJ.....				0631	0707	0733	0747	↓	↓	0840	↓	↓	↓			0902	0938
Princeton Jct.....				0643	↓	0745	0759			↓						0912	↓
New Brunswick.....				0656		0758	0812						0926			↓	
Metropark				|	|	|						|				
NEWARK, NY				0711	0736	0816	0830	083	0835	0906		0920	|			0941	1006
NEW YORK NY .....Ar				0725	0750	0830	0845	0847	0850	0920	0930	0935	0950			0955	1020
NEW YORK, NY .....Dp		0600	0700	0735	0800				0900	0930	0935		1000				
Rye, NY		|	|	0808				|	1003							
Stamford, CT.....		↓	0740	0818	↓				0940	1013			↓				
Bridgeport.....			|	0845					|	1040							
NEW HAVEN ..... Ar		0714	↓	0905	0912				1014	1100			1112				
NEW HAVEN.....Dp	0650	0715		0917	0913				1015				1113	1115			
Wallingford.....	0709	|		|				|				|	|			
Meriden.....	0720	|		|				|				|	1140			
Berlin	0731	|		|				|				|	|			
HARTFORD.....	0745	↓		0957					↓				↓	1159			
Windsor.....	0755	|		|									|			
Windsor Locks.....	0804	|		|									1213			
Thompsonville, CT.	0812	|		|									|			
SPRINGFIELD, MA...	0830	|		1032										1245			
Worcester.....		|		1140													
Framingham, MA....		↓		1217	↓												
Old Saybrook, Ct....		0747															
New London		0805			1000								1200				
Mystic, CT.....		0817			1012				↓				|				
Westerly, RI.....		0827							1120				|				
Kingston		0843	↓		↓				|		↓		1232				
PROVIDENCE, RI.....		0906	0939		1055				1155		1214		1255				
Route 128, MA.....		0933	1006	↓	1122				1222		|		1322				
BOSTON (Back Bay)...		0944	1017	1302	1133				1233		1248		1333				
BOSTON, MA (S. Sta).Ar		0950	1023	1308	1139				1239		1254		1339				

INLAND ROUTE

VALLEY FORGE FROM HARRISBURG → To 446

*THIS TIMETABLE IS FOR DESIGN PURPOSES ONLY. IT IS NOT INTENDED THAT ANY SPECIFIC TRAIN BE RUN EXACTLY AS SHOWN. EXTRA TRAINS (#100, #110, #119 & 163) FOR GROWTH (1985) ARE SHOWN PRIMARILY FOR FACILITIES DEFINITION PURPOSES. THIS TIMETABLE REPRESENTS A TYPICAL FRIDAY SCHEDULE.

NORTHBOUND

300 Series Trains Typically Connect with 100 Series Trains at Phila. and New Haven.

TRAIN NUMBER	208	84	448	116	118	302	86	120	40	122	124	2	126	304	128	30
					1/		1/				2/	2/				
WASHINGTON, D.C. ...Dp		0702		0810	0840		0818	0910		0940	1010	0942	1040		1110	
New Carrollton, MD..		|		0820	|		|	0920		|	1020	0954	1050		|	
BALTIMORE (Penn. Sta.)		0744		0842	0910		0855	0942		1010	1042	1022	1112		1140	
Aberdeen, MD.....		0809		|	|		|	|		|	|	|		|	
WILMINGTON, DE		0844			0952		0954			1052	1125	1117			1222	
PHILA., PA (30th St.)	0855	0913		0944	1011	0955	1018	1043		1111	1144	1146	1212	1155	1241	
N. Philadelphia, PA .	0905	|		|		|	|	1051	|		|	|	1203		1234
Trenton, NJ.....	0928	0945		1011		1028	1051	1110	1115	1138		1217	1239	1228	1308	1258
Princeton Jct.....	0940					1040								1240		
New Brunswick.....	0953					1053								1253		
Metropark	|			1054	1100		1129			1229			1300		
NEWARK, NY	1011	1023		1036	1106	1111	1126	|	1158	1206	|	1255	1306	1311	1336	1341
NEW YORK NY .....Ar	1025	1037		1050	1120	1125	1140	1150	1212	1220	1250	1309	1320	1325	1350	1355
NEW YORK, NY .....Dp				1100		1135		1200			1300			1333	1400	
Rye, NY				|			|			|			1408	|	
Stamford, CT.....				1140		1218					1340			1418		
Bridgeport.....				|	1245					|			1445		
NEW HAVEN ..... Ar				1214		1305		1312			1414			1505	1512	
NEW HAVEN.....Dp				1215		1317		1313			1415			1517	1513	
Wallingford.....				|			|			|		|	|	
Meriden.....						1342										
Berlin						|									
HARTFORD.....						1401								1557		
Windsor.....						|							|		
Windsor Locks.....						1415								|		
Thompsonville, CT.						|							|		
SPRINGFIELD, MA...	402	1255				1447								1632		
Worcester.....		1405												1740		
Framingham, MA....		1440												1817		
Old Saybrook, Ct....				1247				1400							1600	
New London				|			1412							|	
Mystic, CT				|			|		1520				1632	
Westerly, RI				|			|		|				1655	
Kingston				|			1455			1555				1722	
PROVIDENCE, RI.....				1355				1522			1622				1733	
Route 128, MA				1422				1533			1633			1902	1739	
BOSTON (Back Bay)...				1433				1539			1639			1908		
BOSTON, MA (S. Sta).Ar		1524		1439												
		1530														

INLAND ROUTE

SILVER METEOR FROM MIAMI

THE LAKE SHORE LIMITED FROM CHICAGO

THE WEST COAST CHAMPION FROM ST. PETE.

THE BROADWAY LIMITED FROM CHICAGO

THE SOUTHERN CRESCENT FROM NEW ORLEANS

THE NATIONAL LIMITED FROM KANSAS CITY

1/ Train 118 passes Train 86 Between West Yard and Landlith

2/ Train 124 passes Train 2 in Phila. 30th Street Station; Train 2 arrives at 30 th street Station at 1140

TRAIN NUMBER	130	132	134	306	136	138	140	142	308	144	146	210	82	148	431	420
WASHINGTON, D.C. ...Dp	1140	1210	1240		1310	1340	1415	1440		1510	1540		1512	1610	1615	1634
New Carrollton, MD..	|	1220	|		1320	|	|	|		|	1550		|	1620	1627	1646
BALTIMORE (Penn. Sta.)	1210	1242	1310		1342	1410	1445	1510		1540	1612		1548	1642	1653	1716
Aberdeen, MD.....	|	|	|		|	|	↓	|		↓	|		|	↓	1739
WILMINGTON, DE	|	1325	1352		1425	1452		1552			1654		1643	1725	(P'VILL)	1809
PHILA., PA (30th St.)	1310	1344	1411	1355	1444	1511	1545	1611	1555	1640	1713	1655	1706	1744		1834
N Philadelphia, PA .	|		|	1405			|	1605	|		1705	|			
Trenton, NJ.....	1337		1438	1428				1638	1628	1707			1728	1736			
Princeton Jct.....	|		|	1440			|	1640	|		1740	|			
New Brunswick.....	|		↓	1453		↓		↓	1653	|		1753	↓			
Metropark	1354	↓		1500	↓	1554	↓		1700	1724	↓		|				
NEWARK, NY	1406	1436	1506	1511	1536	1606		1706	1711	1736	1806	1811	1813	1836			
NEW YORK NY .....Ar	1420	1450	1520	1525	1550	1620	1650	1720	1725	1750	1820	1825	1828	1850			
NEW YORK, NY .....Dp		1500		1535	1600		1700		1735	1800				1900		
Rye, NY		|		1608			|	1808					|		
Stamford, CT.....		1540		1618	↓		1740	|	1818	↓				1940		
Bridgeport.....		|		1643			|	1845					|		
NEW HAVEN ..... Ar		1614		1705	1712		1814		1905	1912				2014		
NEW HAVEN.....Dp		1615		1717	1713		1815		1917	1913				2015		
Wallingford.....		|		1734				|					|		
Meriden.....		|		1750				1942					|		
Berlin		|		1755				|					|		
HARTFORD.....		|		1807				2001					|		
Windsor.....		|		1817				↑					|		
Windsor Locks.....		|		1822				2015					|		
Thompsonville, CT.		|		1834				|					|		
SPRINGFIELD, MA...		|		1854				2047						|		
Worcester.....		|												|		
Framingham, MA....		↓			↓		↓			↓				↓		
Old Saybrook, Ct....		1647														
New London.....		|		1800					2000						
Mystic, CT.....		|		1812					|						
Westerly, RI.....		|		↓					2020						
Kingston		↓					↓			|				2132		
PROVIDENCE, RI.....		1755			1855		1940			2055				2155		
Route 128, MA		1822			1922		2007			2122				2222		
BOSTON (Back Bay)...		1833			1933		2018			2133				2233		
BOSTON, MA (S. Sta).Ar		1839			1939		2024			2139				2239		

INLAND ROUTE

THE SILVER STAR FROM MIAMI

THE NATIONAL LIMITED TO KANSAS CITY VIA PORT DEPOSIT

THE CHESAPEAKE

NORTHBOUND

TRAIN NUMBER	150	310	441	152	154	156	158 3/	212	160	60 3/	162 4/	164	90 4/	166	168	170
WASHINGTON, D.C. ...Dp	1640		1705	1710	1740	1810	1840		1910	1825	1940	2010	1925	2040	2110	2140
New Carrollton, MD..	|		|	1720	|	1820	|	1920	1837	|	|	1937	|	2120	|
BALTIMORE (Penn. Sta.)	1710		1744	1742	1810	1842	1910		1942	1912	2010	2042	2012	2110	2142	2210
Aberdeen, MD.....	|		|	|	|	|	|			1937	|	|	|	|
WILMINGTON, DE	|		1838	1825	|	|	1952		|	2007	2052	|	2105	2152	|	2252
PHILA., PA (30th St.)	|	1755	1904	1844	1911	1943	2011	1955	2043	2030	2111	2144	2128	2211	2244	2311
W. Philadelphia, PA .	|	1805	(200)	|	|	|	|	2005	|	2138	|	2144	|	|	|
Trenton, NJ.....	|	1828	|	1911	1937	2010	|	2028	2110	2103	|	2211	2201	|	2311	|
Princeton Jct.....	|	1840	|	|	|	|	|	2040	|	2115	|	|	2213	|	|	|
New Brunswick.....	|	1853	|	|	|	|	|	2053	|	|	|	|	2226	|	|	|
Metropark	1851	1900	|	|	1954	|	2054	|	|	2135	2154	|	2234	|	|	2354
NEWARK, NY	1903	1911	|	|	2006	2036	2106	2111	2136	2146	2206	2236	2244	2306	2336	0006
NEW YORK NY .....Ar	1917	1925	|	1950	2020	2050	2120	2125	2150	2200	2220	2250	2258	2320	2350	0020
NEW YORK, NY .....Dp		1935	|	2000		2100			2200	2210	2230					
Rye, NY		2008	|	|		|			|	2242	2303					
Stamford, CT.....		2018	|	|		2140			2253	2313					
Bridgeport.....		2045	|	|		|			2316	2340					
NEW HAVEN ..... Ar		2105	|	2112		2214			2312	2334	2400					
NEW HAVEN.....Dp		2117	|	2113		2215			2313	2344						
Wallingford.....		|	|		|			|	|						
Meriden.....		2142	|	|		|			0009						
Berlin		|	|		|			0019						
HARTFORD.....		2201	|	|		|			0034						
Windsor.....		|	|		|			|						
Windsor Locks.....		2219	|	|		|			|						
Thompsonville, CT.		|	|		|			|						
SPRINGFIELD, MA...		2247	|	|		|			0109						
Worcester.....			|	|		|									
Framingham, MA....			|	|		|									
Old Saybrook, Ct....			|	2145												
New London...			|	2202		|		2400							
Mystic, CT			|	|		|		|						
Westerly, RI.....			|	|		2312		|						
Kingston.....			|	|		2355		|						
PROVIDENCE, RI.....			|	2255			0022		0055							
Route 128, MA			|	2322			0033		0122							
BOSTON (Back Bay)...			|	2333			0039		0133							
BOSTON, MA (S Sta).Ar			|	2339					0139						

INLAND ROUTE

THE BROADWAY LIMITED TO CHICAGO

THE MONTREALER TO MONTREAL

THE PALMETTO FROM SAVANNAH GA.

3/ Train 158 passes Train 60 in Baltimore Station; Train 60 arrives at Baltimore at 1905

4/ Train 162 passes Train 90 in Baltimore Station; Train 90 arrives at Baltimore at 2005

NORTHBOUND

TRAIN NUMBER	172	66
WASHINGTON, D.C. ...Dp	2240	2310
New Carrollton, MD..	|	2323
BALTIMORE (Penn. Sta.)	2310	0003
Aberdeen, MD.....	|	0021
WILMINGTON, DE	2352	0051
PHILA., PA (30th St.)	0011	0118
N. Philadelphia, PA	↓	|
Trenton, NJ.....	↓	0148
Princeton Jct.....	↓	↓
New Brunswick.....	↓	↓
Metropark	↓	↓
NEWARK, NY	0106	0228
NEW YORK NY .....Ar	0120	0245
NEW YORK, NY .....Dp		0315
Rye, NY..		|
Stamford, CT.....		0400
Bridgeport.....		0423
NEW HAVEN ..... Ar		0445
NEW HAVEN.....Dp		0450
Wallingford.....		↓
Meriden.....		↓
Berlin		↓
HARTFORD.....		↓
Windsor.....		↓
Windsor Locks.....		↓
Thompsonville, CT.		↓
SPRINGFIELD, MA...		↓
Worcester.....		↓
Framingham, MA....		↓
Old Saybrook, Ct....		0523
New London.....		0544
Mystic, CT		|
Westerly, RI.....		0605
Kingston.....		0619
PROVIDENCE, RI.....		0647
Route 128, MA		0734
BOSTON (Back Bay)...		0756
BOSTON, MA (S. Sta).Ar		0802

INLAND ROUTE

THE NIGHT OWL

SERIES	#TRAINS
10	10
100	37
200	7
300	6
400	6
TOTAL	66

SOUTHBOUND

TRAIN NUMBER	101	421 5/	103 5/	201	105	61	107	109	89	111	113	81	301	115	440	117
BOSTON, MA (S. Sta)...Dp																0610
BOSTON, (BACK BAY) ...																0617
Route 128, MA																0628
PROVIDENCE, RI																0655
Kingston																↓
Westerly.....																
Mystic, CT.....																0745
New London.....																
Old Saybrook, CT.....																
Framingham, MA.....						THE MONTREALER FROM MONTREAL										
Worcester													0603			
SPRINGFIELD.....						0330							↓			
Thompsonville, CT...						↓							0622			
Windsor Locks.....													↓			
Windsor													0640			
HARTFORD.....						0403							0654			
Berlin						0414							0703			
Meriden						0424							0713			
Wallingford.....						↓							0733			0835
NEW HAVEN .....Ar						0500							0743			0837
NEW HAVEN .....Dp						0510		0625					0803			↓
Bridgeport.....						0529		0645					0830			0910
Stamford						0553		0708					0840			↓
Rye, NY						0605		0720					0913			0950
NEW YORK, NY.....Ar						0635		0750								
NEW YORK, NY.....Dp	0600		0630	0635	0700	0702	0730	0800	0802	0830	0900	0910	0923	0930		1000
NEWARK, NJ	↓		0643	0648	0713	0717	↓	↓	0817	0843	0913	0925	0936	↓		1013
Metropark	0622		↓	↓	0724	0736		0822	0832	0854	↓	↓	0949	0952		↓
New Brunswick.....	↓			0707	↓	↓		↓	0841	↓			0956	↓		
Princeton Jct.....				0720		0756			0854				1008			
TRENTON, NJ.....	0643		0712	0732		0807		0843	0905	0915		1002	1020	1013		1042
N. Philadelphia, PA...	↓		↓	0756		0832		↓	0930	↓	↓	↓	1043	↓		↓
PHILA. PA.(30th St.).	0710	0715	0739	0805	0807	0844		0910	0944	0942	1004	1042	1053	1040	1045	1109
WILMINGTON, DE	0728	0740	↓		0825	0906		0928	1004		1022	1102		1058	1107	
Aberdeen, MD.....	↓	0810			↓	↓		↓	1035		↓	↓		↓	↓	
BALTIMORE	0810	0840	0838		0910	1000	0930	1010	1107	1040	1105	1153		1140	1207	1205
New Carrollton, MD....	↓	0904	0900		↓	1027	↓	↓	1132	↓	1130	↓		↓	↓	1230
WASHINGTON, DC.....Ar	0840	0914	0910		0940	1037	1000	1040	1142	1110	1140	1230		1210	1242	1240

INLAND ROUTE

THE CHESAPEAKE

THE PALMETTO TO SAVANNAH, GA.

THE SILVER STAR TO MIAMI, FL.

THE BROADWAY LIMITED FROM CHICAGO

5/ Train 103 passes Train 421 in Baltimore Station; Train 421 arrives at Baltimore at 0835

SOUTHBOUND *

TRAIN NUMBER	119	121	430	123	303	125	127	129	131	401	133	135	137+	1	139	81
BOSTON, MA (S.' Sta)...Dp	0700		Runs	0740	0603		0840		0940				1040			
BOSTON, (BACK BAY) ...	0707		Tu Th	0747	0611		0847		0947				1047			
Route 128, MA	0718		& Sa	0758			0858		0958				1158			
PROVIDENCE, RI			Only	0825			0925		1025				1225			
Kingston							0948									
Westerly.....									1100							
Mystic, CT.....																
New London.....				0915									1208			
Old Saybrook, CT.....				0935					1120							
Framingham, MA.....					0658											
Worcester					0735											
SPRINGFIELD.....					0843					1030						
Thompsonville, CT...																
Windsor Locks.....										1049						
Windsor																
HARTFORD.....					0918					1207						
Berlin																
Meriden										1230						
Wallingford.....																
NEW HAVEN .....Ar				1007	0958		1105		1207	1158			1305			
NEW HAVEN .....Dp				1008	1013		1107		1208		1213		1307			
Bridgeport.....					1033						1233					
Stamford					1100		1140				1300		1340			
Rye, NY					1110						1310					
NEW YORK, NY.....Ar	1020			1120	1143		1220		1320		1343		1420			
NEW YORK, NY.....Dp	1030	1100		1130	1153	1200	1230	1300	1330		1353	1400	1430	1445	1500	1520
NEWARK, NJ		1113		1143	1206	1213	1243	1313	1343			1413		1500	1513	1535
Metropark		1124			1219	1224		1324				1424			1524	
New Brunswick.....					1226						1422					
Princeton Jct.....					1238						1435					
TRENTON, NJ.....		1145			1250		1312		1412		1445		1512	1537		1612
N. Philadelphia, PA...					1313						1505					
PHILA. PA. (30th St.).	1135	1210		1234	1323	1307	1339	1407	1439		1515	1507	1539	1610	1607	1646
WILMINGTON, DE				1252		1325		1425			1535	1525	1557	1632	1625	1708
Aberdeen, MD.....			(P'VILLE)													
BALTIMORE	1235	1310	1330	1335		1408	1438	1508	1538		1618	1608	1640	1727	1708	1810
New Carrollton, MD....			1355	1400			1500		1600		1640		1700	1755		
WASHINGTON, DC.....Ar	1305	1340	1405	1410		1440	1510	1540	1610		1650	1640	1710	1805	1740	1847

INLAND ROUTE — THE NATIONAL LIMITED TO KANSAS CITY VIA SHORT DEPOSIT

THE SOUTHERN CRESCENT TO NEW ORLEANS, LA.

THE SILVER METEOR TO MIAMI, FL.

* SEE FOOTNOTE PAGE 1

300 SERIES TRAINS TYPICALLY CONNECT WITH 100 SERIES TRAINS AT PHILA. AND NEW HAVEN.

+ Runs through to Newport News, Virginia as "The Colonial".

SOUTHBOUND

TRAIN NUMBER	141	305	7/ 143	203	145	205	8/ 85	31	147	43	207	403	8/ 149	209	41	151
BOSTON, MA (S. Sta)...Dp	1140				1240								1340			
BOSTON, (BACK BAY) ...	1147				1247								1347			
Route 128, MA	1158				1258								1358			
PROVIDENCE, RI	1225				1325								1425			
Kingston	↓				1348								↓			
Westerly.....					↓								1500			
Mystic, CT.....													↓			
New London.....	1315												1520			
Old Saybrook, CT.....	1335															
Framingham, MA.....	↓				↓								↓			
Worcester																
SPRINGFIELD.....		1230										1428				
Thompsonville, CT...		↓										↓				
Windsor Locks.....		1249										1447				
Windsor		↓										↓				
HARTFORD.....		1307										1505				
Berlin		↑										1519				
Meriden		1330										1538				
Wallingford.....	↓	↓			↓							1548				
NEW HAVEN .....Ar	1407	1358			1505							1558	1607			
NEW HAVEN .....Dp	1408	1413			1507								1608			
Bridgeport.....	↓	1433			↓								↓			
Stamford		1500			1540											
Rye, NY		1510			1620											
NEW YORK, NY.....Ar	1520	1543			1630								1720			
NEW YORK, NY.....Dp	1530	1553	1600	1602	1643	1632	1645	1655	1700	1706	1710		1730	1732	1745	1800
NEWARK, NJ	1543	1606	↑	1615	↓	1645	1700	1710	↓	1720	1723		1743	1745	1800	↑
Metropark	↓	1619	1622	↓	↓	↓	↓	↓	↓	↓	↑		↓	↓	↓	1822
New Brunswick.....		1626	↓	↑	↓	1713	↓	↓	↓	↓	1742		↓	1817	↓	↓
Princeton Jct.....		1638	↓	1643	1712	1728	1737	1748	↓	1757	1755		1812	1829	1838	↓
TRENTON, NJ.....		1650	↓	1658	↓	1752	↓	1814	↓	1823	1807		↑	1852	1904	↓
N. Philadelphia, PA...	↓	1713	↓	1722	↓	1802	1815	↓	1805	↓	1830		1839	1902	↓	1907
PHILA. PA (30th St.).	1634	1723	1705	1732	1739		1837	(100)	↑	(100)	1842		1857		(100)	1925
WILMINGTON, DE	1652		1723		1757		1908		↑				↑			↑
Aberdeen, MD.....	↓		↓		↑		1942		1905				1940			2008
BALTIMORE	1735		1806		1840		↓		1927				↓			2030
New Carrollton, MD....	1800		1830		↓		2020		1937				2010			2040
WASHINGTON, DC.....Ar	1810		1840		1910											

INLAND ROUTE

THE NATIONAL LIMITED TO KANSAS CITY

THE WEST COAST CHAMPION TO ST. PETE

THE VALLEY FORGE TO HARRISBURG

THE BROADWAY LIMITED TO CHICAGO

7/ Train 143 passes Train 83 in Baltimore Station; Train 83 arrives at Baltimore at 1803

8/ Train 149 passes Train 85 in Baltimore Station; Train 85 arrives at Baltimore at 1935.

SOUTHBOUND

TRAIN NUMBER	211	153	307	155	157	309	449	159	161	163	165	167	311	169	171	173
BOSTON, MA (S. Sta)...Dp		1440		-	1540	1403	1540	1640		1700		1740		1840	1940	2040
BOSTON, (BACK BAY) ...		1447			1547	1410	1547	1647		1707		1747		1847	1947	2047
Route 128, MA		1458			1558	↓	↓	1658		1718		1758		1858	1958	2058
PROVIDENCE, RI		1525			1625			↓		1745		1825		1925	2025	2125
Kingston		↓			↓					1808		↓		↓	↓	2148
Westerly.....										↓						↓
Mystic, CT.....		1608										1900		2008		
New London.....		↓			1718							↓		↓	↓	
Old Saybrook, CT.....					1735	↓	↓					1920			2118	
Framingham, MA.....						1458	1615								2135	
Worcester						1535	1644								↓	
SPRINGFIELD.....			1530			1643	1752						1830			
Thompsonville, CT...			↓			↓							↓			
Windsor Locks.....			1549										1849			
Windsor			↓										↓			
HARTFORD.....			1607			1718							1907			
Berlin			↓			↓							↓			
Meriden			1630										1930			
Wallingford.....			↓										↓			
NEW HAVEN .....Ar		1705	1658		1807	1758				1925		2007	1958	2105	2207	2307
NEW HAVEN .....Dp		1707	1713		1808	1813				1926		2008	2013	2107	2203	2308
Bridgeport.....		↓	1733			1833				↓		↓	2033	↓	↓	↓
Stamford		1740	↓			1900				2000			2100	2140	2247	2340
Rye, NY		↓	1810			1910				↓			2110	↓	↓	↓
NEW YORK, NY.....Ar		1820	1843		1920	1943		2000		2040		2120	2143	2220	2320	0020
NEW YORK, NY.....Dp	1802	1830	1853	1900	1930	1953		2010	2030		2100	2130	2153	2230	2325	0025
NEWARK, NJ	1815	1843	1906	1913	1943	2006		↓	2043		2113	2143	2206	↓	2336	0038
Metropark	↓	↓	1919	1924	↓	2019			↓		2124	↓	2219		2351	0051
New Brunswick.....			1926	↓		2026					↓		2226		2358	0058
Princeton Jct.....	1847	↓	1938		↓	2038			2112			2212	2238	↓	0010	0110
TRENTON, NJ.....	1859	1912	1950		2012	2050			↓			↓	2250	2310	0022	0122
N. Philadelphia, PA...	1922	↓	2013		↓	2113							2313	↓	0045	0145
PHILA. PA (30th St.).	1932	1939	2023	2007	2039	2123		2115	2139		2209	2239	2323	2337	0055	0155
WILMINGTON, DE				2025	2057						2227					
Aberdeen, MD.....		↓		↓	↓			↓	↓		↓	↓		↓		
BALTIMORE		2038		2110	2140			2215	2238		2310	2338		0038		
New Carrollton, MD....		2100		↓	↓			↓	2300		↓	↓		0100		
WASHINGTON, DC.....Ar		2110		2140	2210			2245	2310		2340	0010		0110		

INLAND ROUTE

THE LAKE SHORE LIMITED TO CHICAGO

* SEE FOOTNOTE PAGE 1

SOUTHBOUND

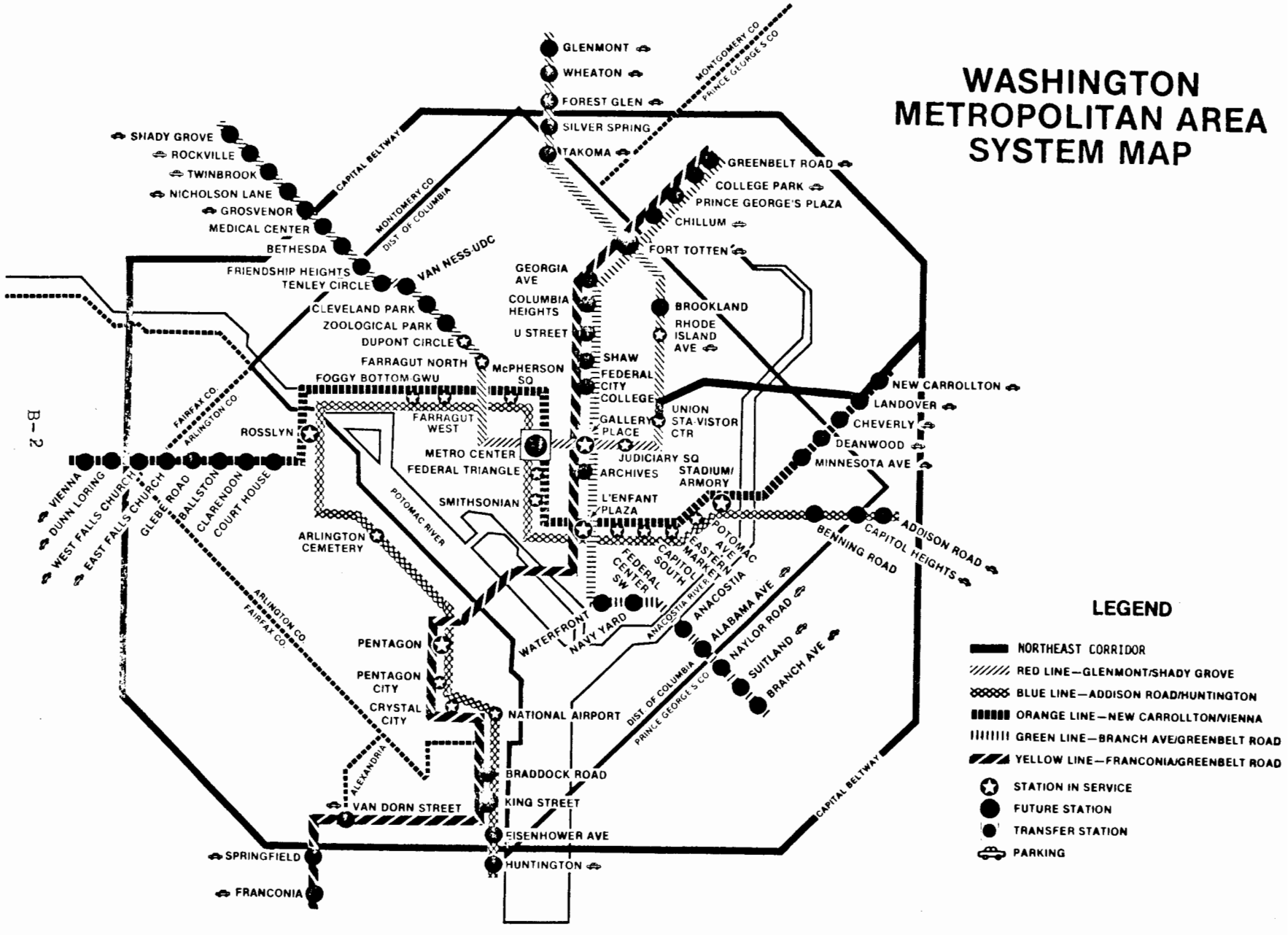
TRAIN NUMBER	175	67
BOSTON, MA (S. Sta)...Dp	2140	2220
BOSTON, (BACK BAY) ...	2147	2227
Route 128, MA	2158	2238
PROVIDENCE, RI	2225	2313
Kingston	|	2339
Westerly.....	|	|
Mystic, CT.....	|	2356
New London.....	2318	0019
Old Saybrook, CT.....	|	0042
Framingham, MA.....	|	THE NIGHT OWL
Worcester	|	↓
SPRINGFIELD.....	|	|
Thompsonville, CT...	|	|
Windsor Locks.....	|	|
Windsor	|	|
HARTFORD.....	|	|
Berlin	|	|
Meriden	|	|
Wallingford.....	|	|
NEW HAVEN .....Ar	0005	0115
NEW HAVEN .....Dp	0006	0130
Bridgeport.....	0026	|
Stamford	|	0150
Rye, NY	|	0218
NEW YORK, NY.....Ar	0120	0313
NEW YORK, NY.....Dp		0345
NEWARK, NJ		0402
Metropark		0417
New Brunswick.....		|
Princeton Jct.....		|
TRENTON, NJ.....		0453
N. Philadelphia, PA...		|
PHILA. PA (30th St.).		0530
WILMINGTON, DE		0612
Aberdeen, MD.....		0645
BALTIMORE		0715
New Carrollton, MD....		0750
WASHINGTON, DC.....Ar		0805

INLAND ROUTE

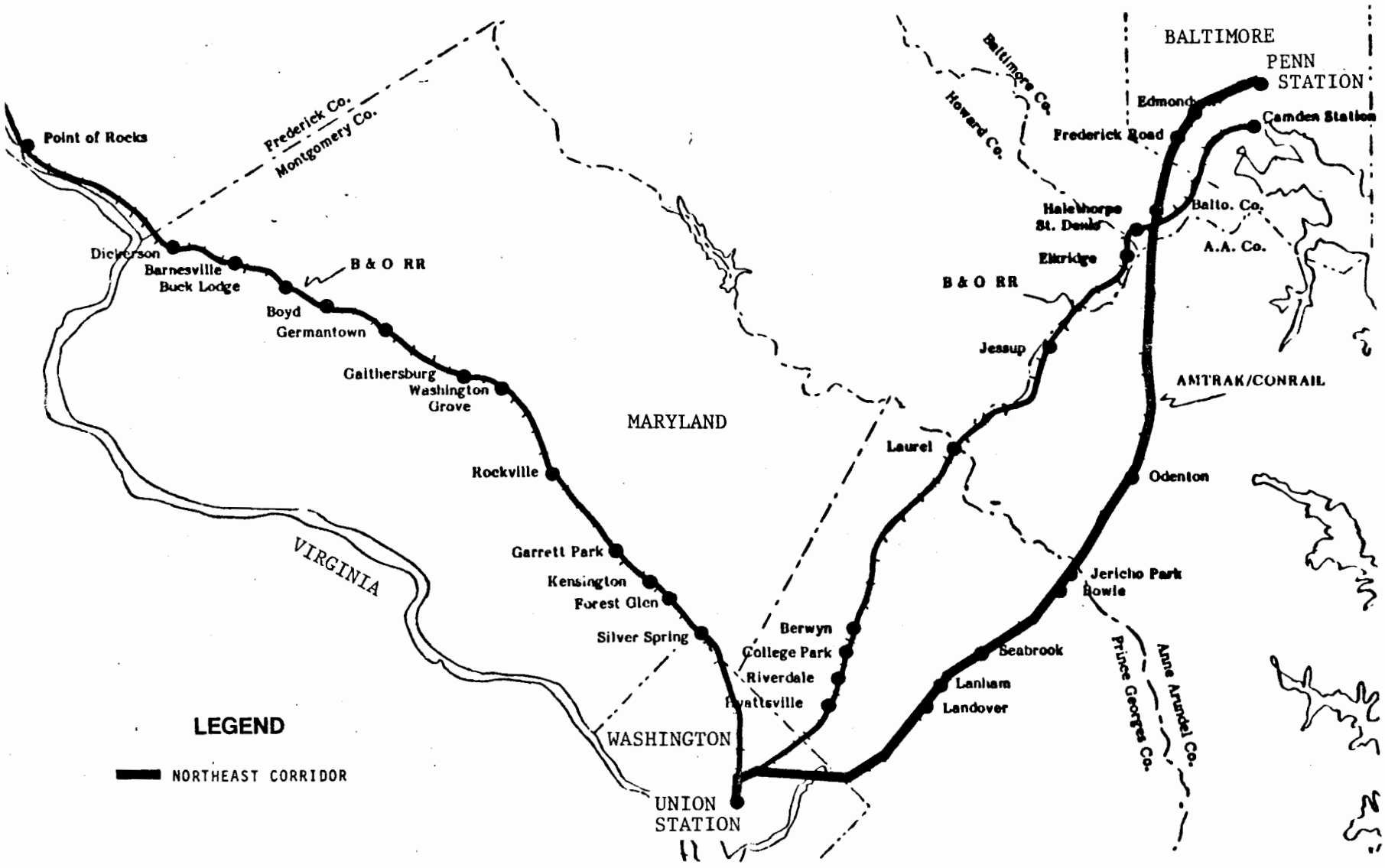
SERIES	# TRAINS
10	10
100	38
200	6
300	6
400	6
TOTAL	66

APPENDIX "B"

MAPS OF NEC-RELATED COMMUTER RAIL OPERATIONS

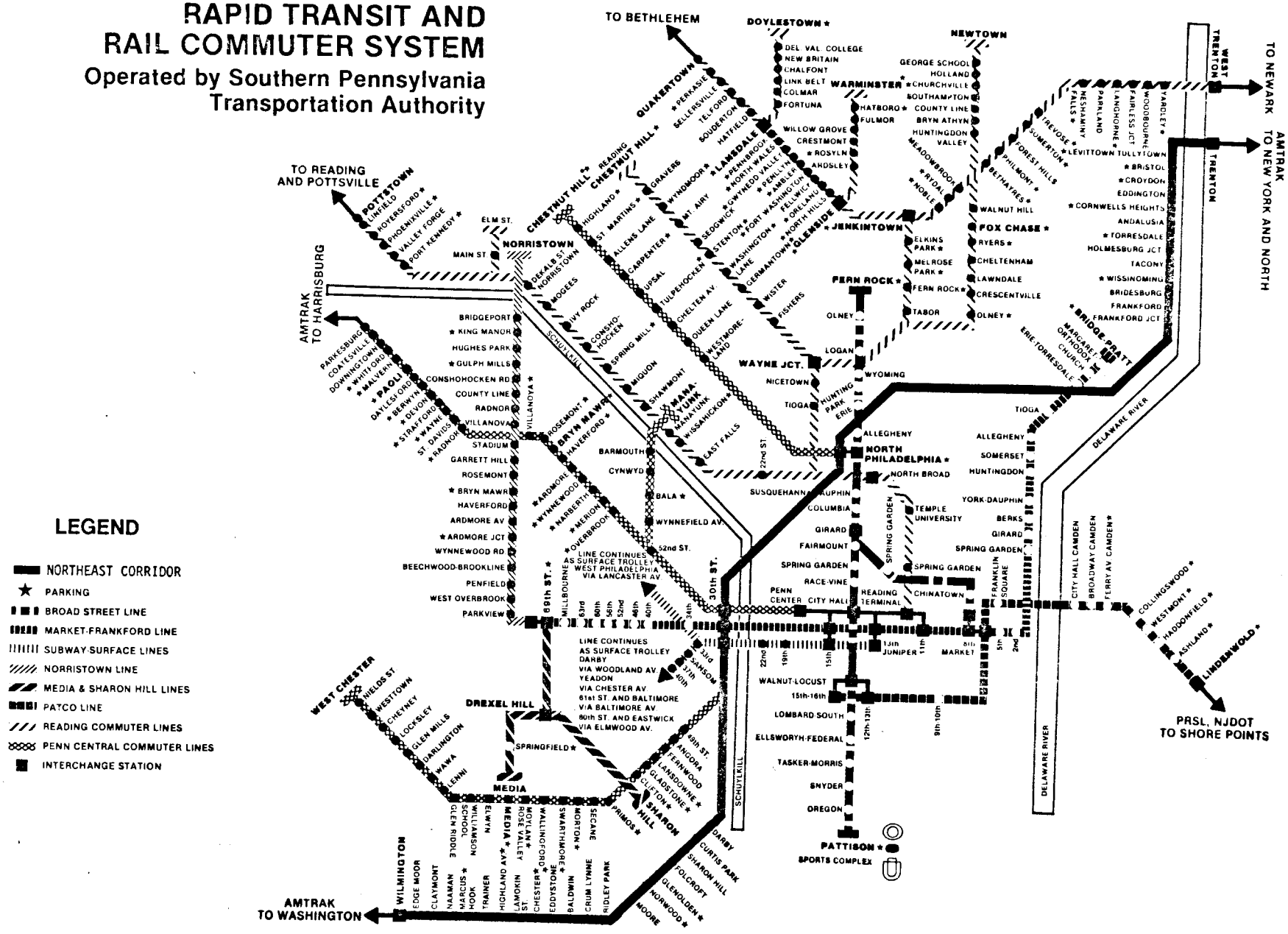

WASHINGTON METROPOLITAN AREA SYSTEM MAP
GLENMONT
WHEATON
FOREST GLEN
SILVER SPRING
TAKOMA
MONTGOMERY CO
PRINCE GEORGE'S CO
SHADY GROVE
ROCKVILLE
TWINBROOK
NICHOLSON LANE
GROSVENOR
MEDICAL CENTER
BETHESDA
CAPITAL BELTWAY
MONTGOMERY CO
DIST OF COLUMBIA
FRIENDSHIP HEIGHTS
TENLEY CIRCLE
VAN NESS-UDC
CLEVELAND PARK
ZOOLOGICAL PARK
DUPONT CIRCLE
FARRAGUT NORTH
FOGGY BOTTOM-GWU
McPHERSON SQ
FARRAGUT WEST
METRO CENTER
FEDERAL TRIANGLE
SMITHSONIAN
ARCHIVES
L'ENFANT PLAZA
FEDERAL CENTER SW
GALLERY PLACE
JUDICIARY SQ
UNION STA-VISTOR CTR
STADIUM/ ARMORY
GEORGIA AVE
COLUMBIA HEIGHTS
U STREET
SHAW
FEDERAL CITY COLLEGE
BROOKLAND
RHODE ISLAND AVE
FORT TOTTEN
CHILLUM
GREENBELT ROAD
COLLEGE PARK
PRINCE GEORGE'S PLAZA
NEW CARROLLTON
LANDOVER
CHEVERLY
DEANWOOD
MINNESOTA AVE
ADDISON ROAD
CAPITOL HEIGHTS
BENNING ROAD
POTOMAC AVE
EASTERN MARKET
CAPITOL SOUTH
ANACOSTIA
ANACOSTIA RIVER
ALABAMA AVE
NAYLOR ROAD
SUITLAND
BRANCH AVE
DIST OF COLUMBIA
PRINCE GEORGE'S CO
FAIRFAX CO
ARLINGTON CO
ROSSLYN
VIENNA
DUNN LORING
WEST FALLS CHURCH
EAST FALLS CHURCH
GLEBE ROAD
BALLSTON
CLARENDON
COURT HOUSE
POTOMAC RIVER
ARLINGTON CEMETERY
ARLINGTON CO
FAIRFAX CO
PENTAGON
PENTAGON CITY
CRYSTAL CITY
NATIONAL AIRPORT
WATERFRONT
NAVY YARD
ALEXANDRIA
BRADDOCK ROAD
KING STREET
VAN DORN STREET
EISENHOWER AVE
HUNTINGTON
SPRINGFIELD
FRANCONIA
CAPITAL BELTWAY
LEGEND
NORTHEAST CORRIDOR
RED LINE—GLENMONT/SHADY GROVE
BLUE LINE—ADDISON ROAD/HUNTINGTON
ORANGE LINE—NEW CARROLLTON/VIENNA
GREEN LINE—BRANCH AVE/GREENBELT ROAD
YELLOW LINE—FRANCONIA/GREENBELT ROAD
STATION IN SERVICE
FUTURE STATION
TRANSFER STATION
PARKING

MARYLAND COMMUTER RAIL SYSTEM

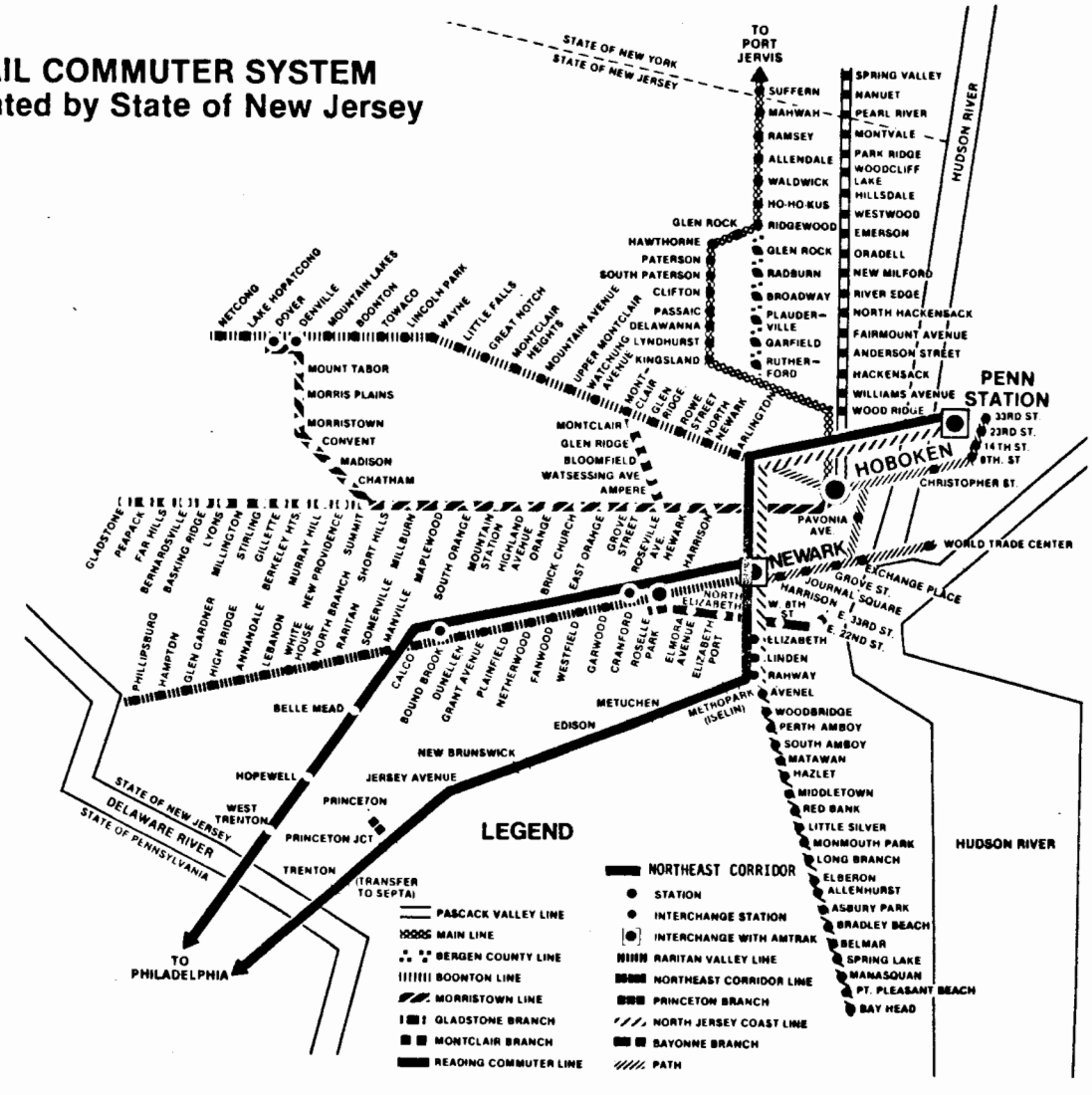


RAPID TRANSIT AND RAIL COMMUTER SYSTEM

Operated by Southern Pennsylvania Transportation Authority

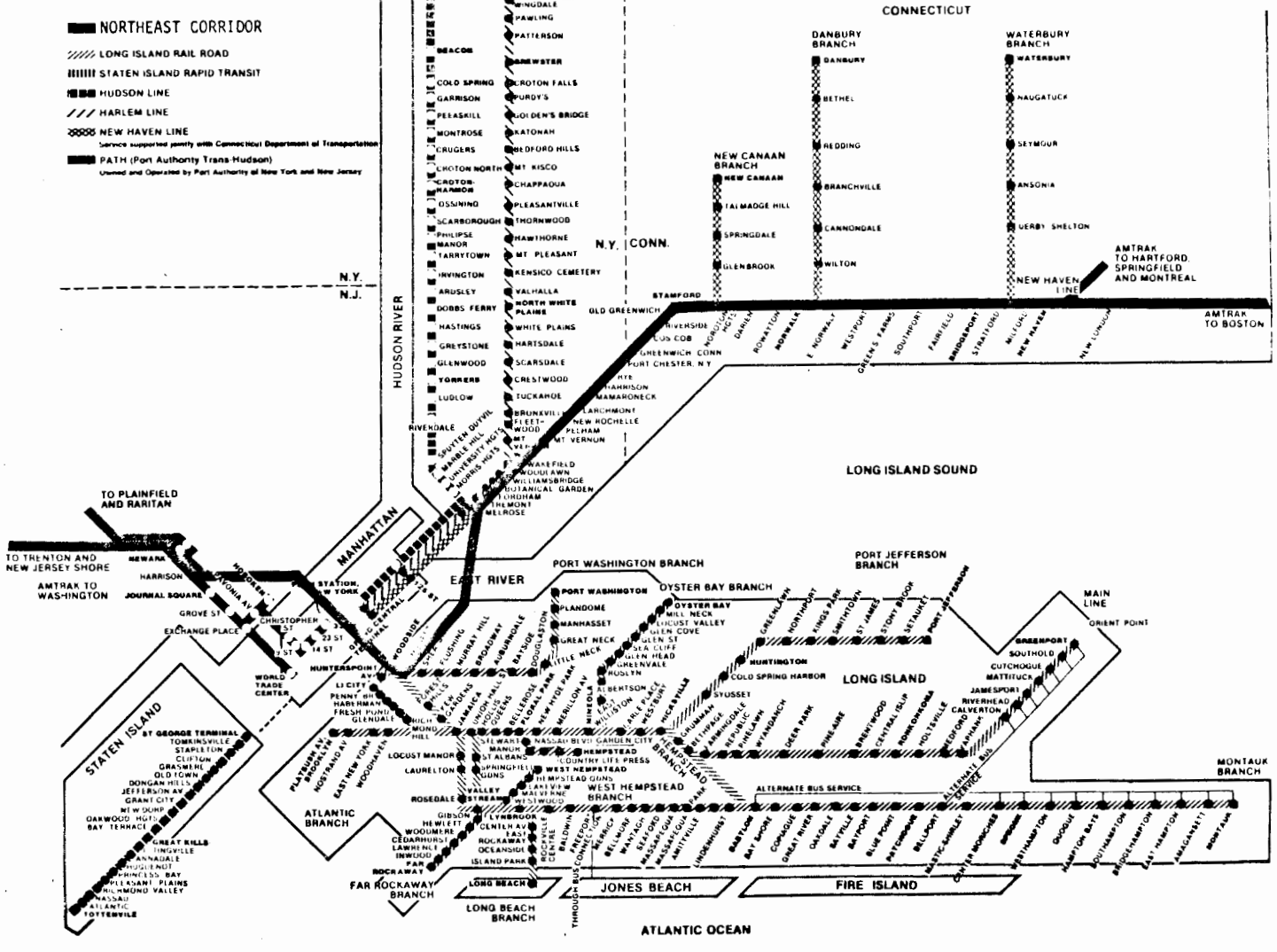


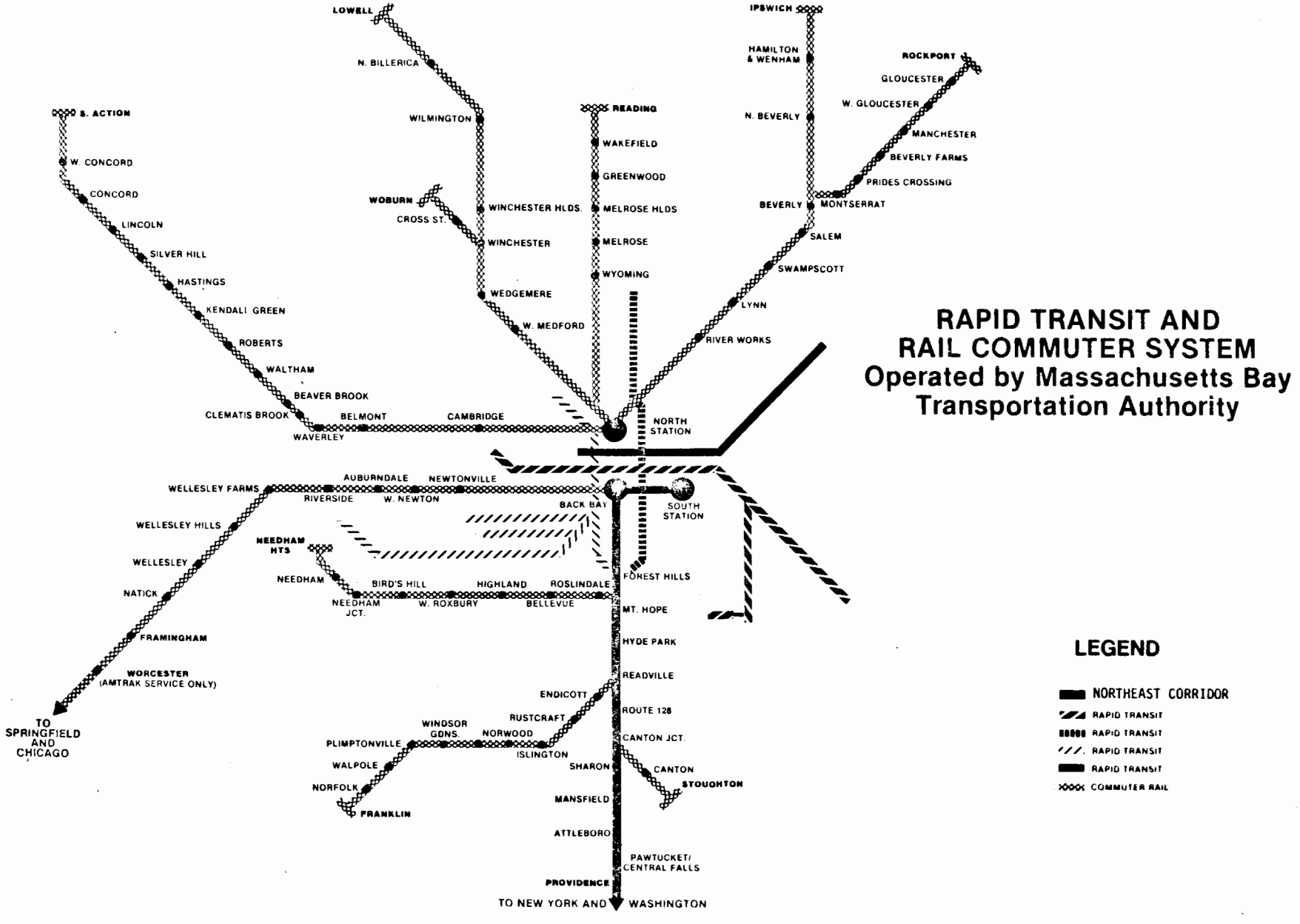
RAIL COMMUTER SYSTEM
Operated by State of New Jersey



COMMUTER RAIL SYSTEM MAP

The Metropolitan Transportation Authority Rail Commuter Facilities in the New York Metropolitan Region





RAPID TRANSIT AND RAIL COMMUTER SYSTEM
Operated by Massachusetts Bay Transportation Authority

LEGEND

- NORTHEAST CORRIDOR
- RAPID TRANSIT
- RAPID TRANSIT
- RAPID TRANSIT
- RAPID TRANSIT
- COMMUTER RAIL