# PHILADELPHIA - HARRISBURG RAIL STUDY

## Executive Summary

Prepared for the

Pennsylvania Department of Transportation

by the

Delaware Valley Regional Planning Commission

in Association with

R.L. Banks & Associates, Inc.
Main Line Management Services, Inc.
LTK Engineering Services
Canby Associates

January 1992

Delaware Valley Regional Planning Commission
The Bourse Building, 21 South Fifth Street, Philadelphia, PA 19106

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Created in 1965, the Delaware Valley Regional Planning Commission (DVRPC) is an interstate, intercounty and intercity agency which provides continuing, comprehensive and coordinated planning for the orderly growth and development of the Delaware Valley region. The region includes Bucks, Chester, Delaware, and Montgomery counties as well as the City of Philadelphia in Pennsylvania and Burlington, Camden, Gloucester, and Mercer counties in New Jersey. The Commission is an advisory agency which divides its planning and service functions among the Office of the Executive Director, the Office of Public Affairs, and four line Divisions: Transportation Planning, Regional Information Services Center, Strategic Planning, and Finance and Administration. DVRPC's mission for the 1990s is to emphasize technical assistance and services and to conduct high priority studies for member state and local governments, while determining and meeting the needs of the private sector.

The DVRPC logo is adapted from the official seal of the Commission and is designed as a stylized image of the Delaware Valley. The outer ring symbolizes the region as a whole while the diagonal bar signifies the Delaware River flowing through it. The two adjoining crescents represent the Commonwealth of Pennsylvania and the State of New Jersey. The logo combines these elements to depict the areas served by DVRPC.

# DELAWARE VALLEY REGIONAL PLANNING COMMISSION

## Publication Abstract

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### Geographic Area Covered:

Philadelphia-Harrisburg Rail Corridor in Philadelphia, Montgomery, Delaware, Chester, Lancaster, and Dauphin counties

### Key Words:

Intercity rail passenger service, track structure, electrification, stations, travel demand, service level, rolling stock, financial analysis, capital needs, operating expenses, management options

## ABSTRACT

*This summary reviews the findings of the study, and considers the current condition of the line, needed capital improvements, 1996 travel demand under alternative operating scenarios, equipment needs, alternative ownership and management configurations, operating revenue and expenses, funding sources, and financing options.*

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## INTRODUCTION

Philadelphia-Harrisburg passenger trains, collectively named the *Keystone Service*, have been operated by the National Railroad Passenger Corporation (Amtrak) since 1971 with financial assistance from the Commonwealth of Pennsylvania. Since 1980 Amtrak service on the line has been reduced from thirteen to seven weekday round trips, scheduled running times have been lengthened, and annual ridership has fallen steadily reaching 335,000 in 1990. Since the service is not a key component in its national system, Amtrak assigns the corridor a low priority.

The Pennsylvania Department of Transportation (PennDOT), however, recognizes the *Keystone Service* as an important link in the Commonwealth's regional/intercity public transportation network. With the recent passage of Federal legislation requiring states to develop transportation plans addressing intermodalism, congestion management, and clean air initiatives, the *Keystone* corridor takes on an added significance as a valuable asset in Pennsylvania.

The Department commissioned the Delaware Valley Regional Planning Commission (DVRPC) to conduct a comprehensive study of the *Keystone* corridor to produce the following:

- a factual base of information on the current condition of the infrastructure;
- an assessment of institutional arrangements for management and operations; and
- an assessment of associated costs and options for providing needed investment and upgrading the service.

The study was not designed to produce definitive recommendations on each detailed topic of study, but rather to serve as a basis for decision making on the merits of a stronger presence and possible direct investment by PennDOT in upgrading the service. This summary describes the existing condition of the line, and considers capital investment options and/or opportunities to improve mobility within this corridor.

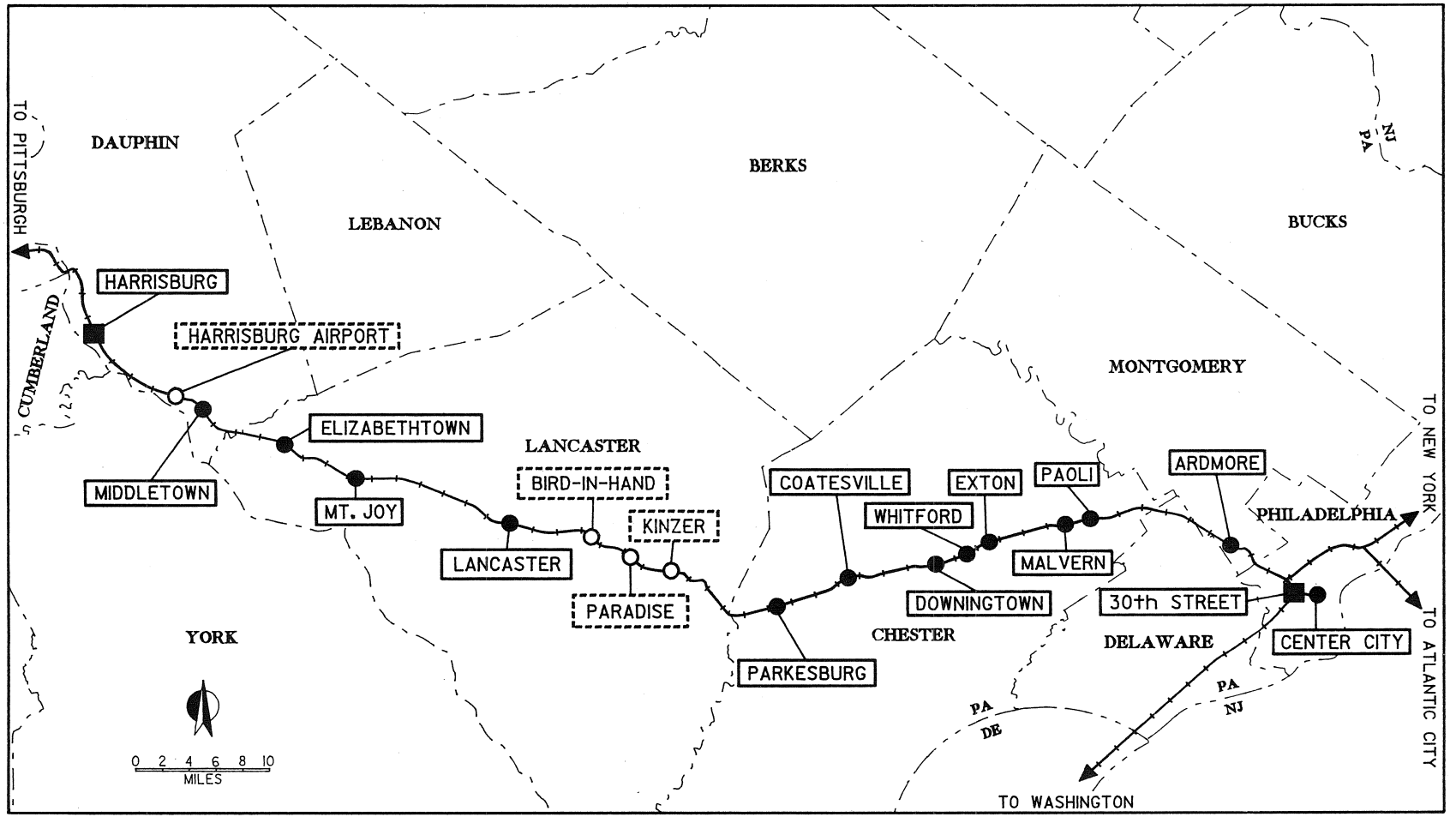
## INFRASTRUCTURE

### Track Structure

The majority of running track used by the *Keystone* trains is now laid with welded rail, with most of the remaining jointed rail located either east of Paoli or west of Lancaster. Most of the track with welded rail now permits 90 mph operation, the principal exceptions being segments where speeds are restricted by curves and the commuter territory east of Paoli. Amtrak limits speeds to 80 mph on jointed rail, and

MAP 1

# PHILADELPHIA – HARRISBURG RAIL LINE

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east of Paoli speeds are further limited to 70 mph because of signal spacing and traffic density.

Raising speeds to 90 mph west of Paoli would require replacing all of the jointed rail with welded rail; but this is not recommended, as the resulting savings in running time does not justify the expense. In addition, much of this rail has more than one-half of its useful life left. Instead, it is recommended that as rail is replaced, it be replaced with welded rail, with the exception that six track-miles east of Lancaster now laid with jointed rail should be upgraded to welded rail. Approximately 17 percent of the ties should be replaced within the next four years.

At the end of the four-year program, the line will be fully laid with welded rail between Paoli and Lancaster, permitting 90-mph operation. Jointed rail will still prevail between Lancaster and Harrisburg, limiting speeds to 80 mph, but the ride quality will be much improved and slow orders removed. Between Philadelphia and Paoli, speeds will still be restricted to 70 mph, but the track structure will be in good operating condition.

**Electric Traction and Signal System**

The principal components of the electrification plant that will require attention within the next five years are the substations and the overhead catenary. The coolant in each of the transformers should be tested and filtered (or replaced, where appropriate). The oil-filled circuit breakers are antiquated and should be replaced by modern 12-kV switchgear. Based on spot checks it is estimated that 80 percent of the contact wire will have to be replaced within five years.

The line uses an automatic block signaling system supplemented by cab signals. Though old, it is still serviceable and generally adequate for 90 mph. No upgrade is recommended at this time. The warning circuits at the protected grade crossings in Lancaster County, which are currently set for 70 mph operation, should be lengthened to accommodate 90 mph.

**Bridges and Stations**

The almost 200 bridges on the line are generally in good structural condition. Only one bridge was found in need of repairs or replacement, and this was over Chamounix Road at the St. Davids Station.

Two of the stations, Coatesville and Parkesburg, were found to be in poor condition. It is recommended that the platforms be rebuilt and that prefabricated shelters with heat, lights, and a telephone be installed at these two stations. It is also recommended that a waiting room be provided in the currently closed station building at Elizabethtown.

FIGURE 1

***Eastbound Platform at Paoli.*** *This is a major suburban stop for Amtrak and the western terminus of dense SEPTA commuter service.*

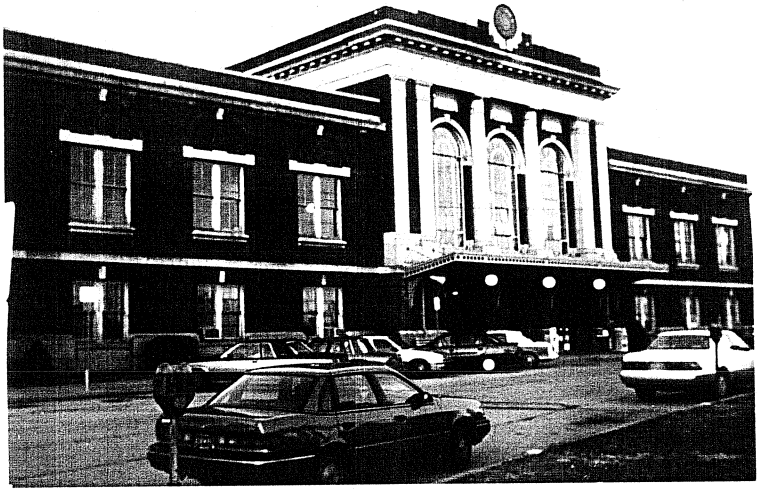
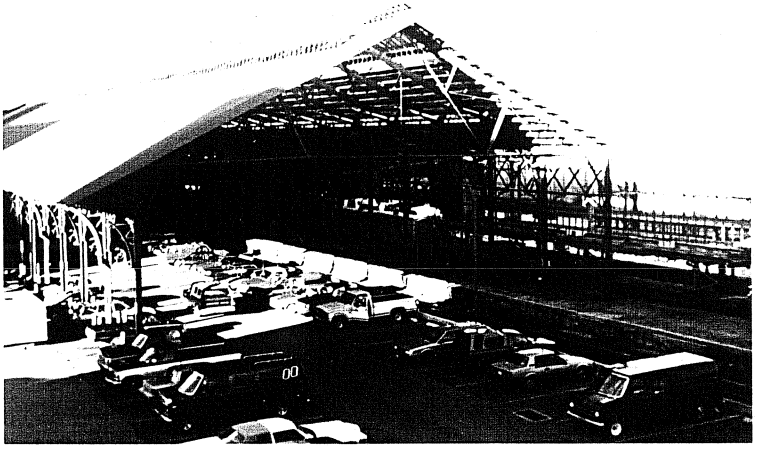


FIGURE 2

***Lancaster Station.*** *With the exception of 30th Street Station, Lancaster is the busiest Amtrak station on the line.*

FIGURE 3

***Harrisburg Train Shed.*** *Work trains with high wire cars also use the station.*



Almost all of the stations will require significant modifications in order to be fully accessible to the handicapped by the year 2010, as required by the Americans with Disabilities Act of 1990. These costs have not been estimated and are not included in the capital program. Also, every station from Downingtown east is in need of more parking.

*Keystone* trains currently serve 14 stations, but the station spacing is very uneven. It is recommended that stops at Malvern and Whitford be eliminated as *Keystone* stops, and a new station be established in eastern Lancaster County. A new station at Paradise would fill the 24-mile gap between Parkesburg and Lancaster and could provide connections with the tourist-oriented Strasburg Railroad. Alternatives include Kinzer and Bird-in-Hand, which have sites suitable for development as stations and offer reasonable highway accessibility.

If SEPTA extends its service west to Atglen, as is currently proposed, then the *Keystone Service* should shift its stop from Parkesburg to Atglen. The latter is directly accessible from Route 41, and the move would eliminate the need for station improvements at Parkesburg. Similarly, accessibility at Mount Joy could be improved by shifting the station from its present location to Eby Cheques Road at the eastern end of town. Since Middletown is also a weak traffic generator, it is recommended that this station be replaced by a new one that could serve Harrisburg International Airport and the Harrisburg Campus of Pennsylvania State University.

**Capital Requirements**

The restoration of the line to a state of good repair will require an investment of $20.3 million, which can be categorized as follows:

| | | |
|---|---|---|
| **Ties** | **$6.9 million** | **Replace 133,000 ties (17% of total)** |
| **Rail** | **1.9** | **Replace 6 mi.; line and surface 111 mi.** |
| **Stations** | **1.4** | **Improve 3 stations; add 4 new stations** |
| **Electrification** | **9.1** | **Replace 35 circuit breakers; refill 6 transformers; replace 223 mi. of catenary wire** |
| **Bridges** | **1.0** | **Replace 1 bridge** |
| **Total** | **$20.3** | |

Although no detailed allocation of costs between long-distance, *Keystone*, and SEPTA trains has been made, approximately $4.4 million of the preceding total may be assigned to SEPTA's local service. If electrification is not maintained west of SEPTA's operating territory, the cost could be reduced by $4.5 million, though this does have ramifications for service and ridership. In this event SEPTA's share would increase by an additional $2.3 million, as it would then be the sole user of electric power on the line.

## SERVICE AND DEMAND

Several reasons can be advanced to explain the drop in *Keystone* ridership from 1,025,000 in 1980 to 335,000 in 1990. Weekday service was cut from eleven to nine round trips in 1983, and then to six round trips in 1986. Ridership fell by eight percent in response to the first cut, but the second provoked a 45 percent loss. The reintroduction of SEPTA service west of Paoli in October 1985 also played a role. In 1990, SEPTA carried 585,000 on trips extending west of Paoli. [Combined ridership for Amtrak and SEPTA are shown in Figure 4 and combined service in Figure 5. On the SEPTA side only passengers and trains traveling west of Paoli are tallied. Daily round trips represent a weekly average.] Other factors that may have affected ridership include reduced speeds, steady deterioration in the quality of the rolling stock, and elimination of service to Suburban Station in Center City Philadelphia.

Population growth in the corridor is now occurring mainly in the middle. Since 1980 Chester County has grown by 19 percent and Lancaster County by 17 percent. Because of this growth, Lancaster now boards more passengers than does Harrisburg. Improving highway access to stations in these two counties and adding one or two new stations in eastern Lancaster County should enhance the ability of the *Keystone Service* to tap this growing market.

Three scenarios with differing levels of service were used to estimate 1996 ridership. In Scenario I, service levels were assumed to remain unchanged at six daily round trips on weekdays and three on weekends. Scenario II raised the weekday round trips to nine and those on weekends to five; and Scenario III went to thirteen and eight round trips, respectively. It is assumed that these trains will be supplemented by one daily round trip by non-*Keystone* trains on weekdays and two extra round trips on weekends. The projections were made for a five-year horizon, and in Scenario I simply reflect the market growth that is expected to occur, assuming that the service is run reliably. Two sets of elasticities were used in order to create a range of estimates for Scenarios II and III. The assumed service levels and projected annual ridership for the three operating scenarios for *Keystone* trains only:

| | Daily Round Trips | | | | Annual Ridership (000) | | | |
|---|---|---|---|---|---|---|---|---|
| | Scenario | | | | 1990 | 1996 Scenario | | |
| | I | II | III | Elasticity | | I | II | III |
| Mo-Fr | 6 | 9 | 13 | Low | 335 | 367 | 462 | 570 |
| Sa, Su | 3 | 5 | 8 | High | | | 524 | 717 |

Assuming that the line is upgraded according to schedule, that new equipment has been provided, and that the service is operated reliably and marketed effectively, the high end of the range of the ridership projections should be attainable.

FIGURE 4

## COMBINED LINE RIDERSHIP

**Amtrak and SEPTA (west of Paoli)**

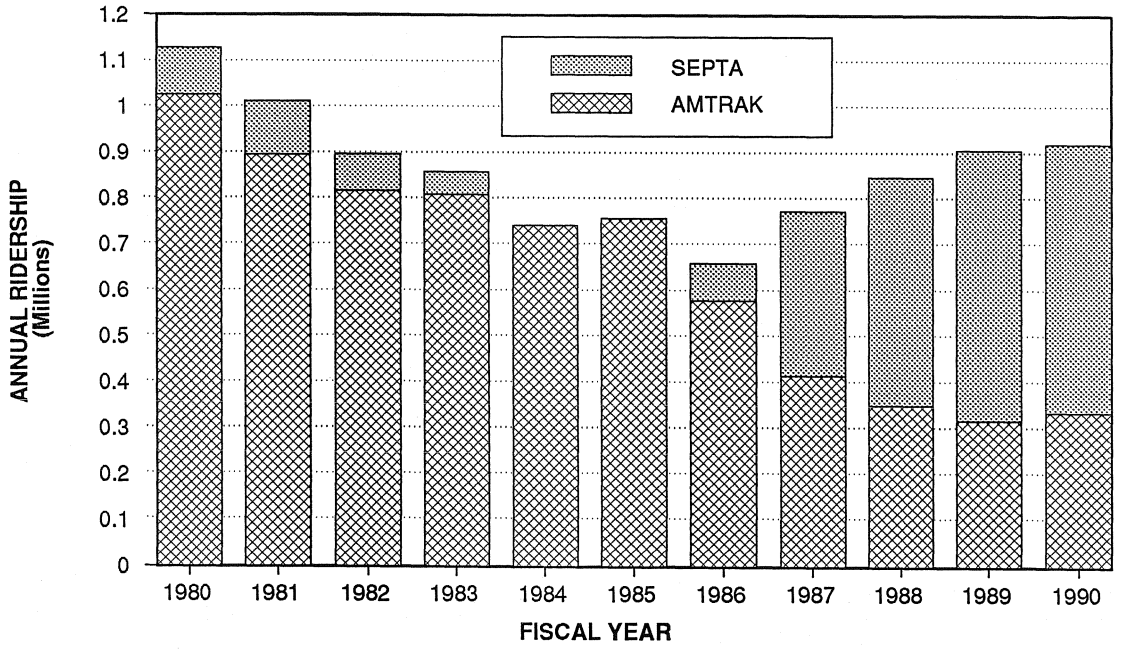
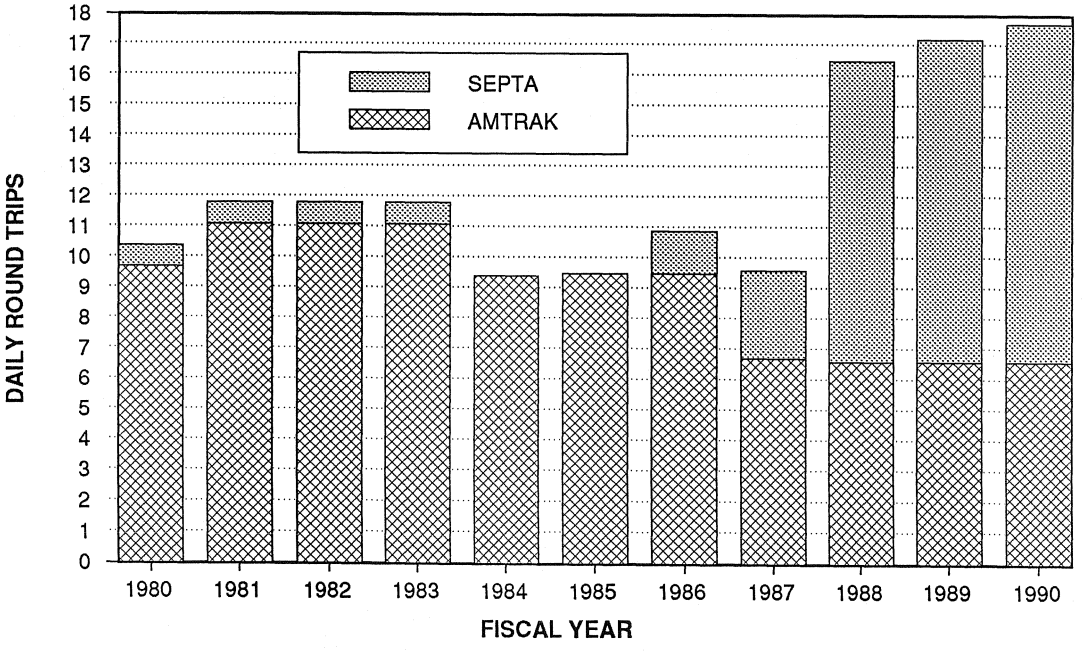



FIGURE 5

## COMBINED LINE SERVICE

**Amtrak and SEPTA (west of Paoli)**



## EQUIPMENT

The ridership projections indicate that three-car consists should provide adequate capacity. Some savings may be obtained if consists are reduced to two cars during times of light demand, though at least one car in each consist must be handicapped accessible. Policy decisions should be made concerning the choice of traction power, whether to use locomotive-hauled or self-propelled coaches, and whether to provide food and beverage service.

The first, and most important, decision is whether to keep the electrification or to switch to diesel power. There are three principal advantages to diesel power: cost, ready availability of equipment, and the ability to run beyond electric territory. A new diesel locomotive suitable for passenger use can be bought for $1.9 million, whereas a new electric locomotive costs $4.7 million. The market for diesel equipment is competitive, and this holds down the price, increases the variety of models offered, and ensures quicker delivery. However, use of electric propulsion would allow the trains to return to Center City Philadelphia, which would greatly strengthen the *Keystone*'s ability to capture work and business trips, and would permit operation of through trips to New York.

Electric trains also have better operating characteristics. Higher acceleration allows them to cover a given route in less time and reduces the time penalty for adding station stops. This advantage is particularly important where trains make frequent stops, as is the case with the *Keystone Service*, and can be enhanced through use of self-propelled or multiple-unit (MU) equipment. While self-propelled diesel cars have been used in the past by both Amtrak and SEPTA, this type of equipment is no longer available. If MU cars are to be used, they must be electric.

Amtrak uses six locomotives and 14 coaches to protect the existing service, and the capital costs to equip Scenario I are predicated on this level. Scenario II will require eight locomotives and 22 coaches, and for Scenario III the pool must be increased to nine locomotives and 25 coaches. The above includes allowances for spares. If self-propelled cars are used, the locomotives can be eliminated. The existing coach fleet is over 40 years old and rebuilding is probably not cost-effective. Buying new equipment offers the options of using either electric MU equipment or locomotive-hauled cars.

The following summarizes the equipment required and its total cost for each of the operating scenarios:

| | Equipment Required | | | | Equipment Cost (millions of 1991 dollars) | | |
|---|---|---|---|---|---|---|---|
| | I | II | III | Propulsion | I | II | III |
| Train Sets | 4 | 6 | 7 | Electric | $35.8 | $56.6 | $64.1 |
| Spare Cars | 2 | 4 | 4 | Diesel | 28.6 | 42.3 | 47.8 |

## EVALUATION OF MANAGEMENT OPTIONS

Three separate functions should be considered: ownership of the line, policy management, and train operations.

Amtrak can continue to own the line and still turn over operation of the *Keystone* trains to another party. The operating agency would simply buy trackage rights from Amtrak for whatever trains it chooses to operate. The disadvantage of this arrangement is that Amtrak retains control over investment decisions and dispatching, and the needs of the *Keystone Service* will continue to receive low priority. The only realistic alternative to Amtrak ownership is State ownership, which grants Pennsylvania the right to set priorities. The principal disadvantage is that the State must then produce the funds needed for renewal and improvements, and this might be difficult, though the new Federal legislation does give states added flexibility in the allocation of transportation monies.

If any changes in the institutional arrangements are made, they should include passing control of policy decision making to the State. Though day-to-day management would be provided by whoever operates the service, the State would retain the right to set general policy regarding service, fares, promotion, and capital investment. The State would also maintain oversight control over the operator.

The State could contract with either SEPTA, Amtrak, or an independent contractor for train operation, with the choice depending to a great extent on the particular terms that can be negotiated. From SEPTA's perspective, the *Keystone Service* would be seen as a natural extension of its existing service to Parkesburg. Better equipment with a higher level of onboard amenities would be required. If Amtrak operated the service under State control, the trains would lose their Amtrak identity and be marketed as a local service. Finally, the service could be contracted to an independent operator. This has the potential of being the lowest cost option.

The institutional choices can be summarized in the following diagram:

| | Owner | Manager | Operator |
|---|---|---|---|
| **Base Case:** | Amtrak | Amtrak | Amtrak |
| **Alternatives:** | Amtrak<br>PennDOT | PennDOT | Amtrak<br>SEPTA<br>Contractor |

## FINANCIAL ANALYSIS

About $20.3 million will be required to bring the existing infrastructure to a state of good repair and to add four new stations, as recommended. If diesel power is used, this cost is reduced to $11.2 million, but this total does not include the $4.6 million required to renew the electrification plant for the portion of the line east of Parkesburg on which SEPTA operates. Equipment costs range from $28.6 to $64.1 million, depending on the choice of traction power and the level of service provided.

The total capital costs required to upgrade the line and provide new equipment are:

| | Scenario | | |
|---|---|---|---|
| Propulsion | I | II | III |
| | (millions of 1991 dollars) | | |
| Electric | $56.1 | $76.9 | $84.4 |
| Diesel | 39.8 | 53.5 | 59.0 |

Though the above includes the cost of building four new stations, no allowance has been made for the purchase of land, or for improving access and parking at new or existing stations. A more detailed analysis of power requirements and a full field inspection may show that the work program can be reduced by as much as $2.15 million. The estimates for the diesel alternative do not include the cost of maintaining electrification for SEPTA's use.

Capital spending can be put on a pay-as-you-go (PAYG) basis, or can be spread over the useful life of the project by borrowing and amortizing the debt. Since the capital improvements will have an extended useful life, bond financing of the State's shares is a reasonable approach. Pay-as-you-go is more feasible with the infrastructure improvements, as the costs are spread over four years. However, using this approach for the acquisition of new rolling stock poses a problem, since costs are incurred upfront, and in addition constitute the larger part of the total costs. Four funding approaches were considered in the analysis.

### 100% Pay-As-You-Go

If Amtrak owns the line, it can use Federal appropriations to pay costs as they are incurred. This approach that offers the least total cost, but requires that all of the cost for acquiring new rolling stock be loaded into the first year. Though this offers the lowest total cost, it may be difficult to implement, given the constraints placed by the size of Amtrak's appropriation and higher priorities assigned elsewhere. If PennDOT were to acquire the line, the pay-as-you-go approach is probably not feasible because of the difficulty in meeting the first-year load.

**50% Financing and 50% Pay-As-You-Go**
This approach uses appropriations to pay for 50 percent of the investment on a PAYG basis, and finances the remainder. This approach reduces the first-year cash flow, but significantly increases the total cost. For purposes of comparison, it was assumed that Amtrak can borrow money using debt-equity instruments at 9.5 percent interest, and that PennDOT can issue tax-free general obligation bonds paying 7 percent interest. All loans are to be retired over a 20-year period.

**100% Financing for Equipment and 100% Pay-As-You-Go for Infrastructure**
This approach, financing the rolling stock, but paying for infrastructure improvements from current appropriations, further lowers the initial cash flow and raises the total cost. Amtrak would probably find this approach feasible, only if another party were to finance the equipment. If PennDOT were to provide the financing, Section 9 funds from UMTA would cover a major share of the debt service.

**100% Financing**
The full financing approach was not used for Amtrak ownership, because it would add unduly to the corporation's debt burden.

Using the "worst case" (Scenario III with electric traction) as an example, the first year and total expenditures are summarized in the following table for the various combinations of financing and pay-as-you-go):

| | | Ownership | |
|---|---|---|---|
| Funding Approach | Expenditure | Amtrak | PennDOT |
| | | (millions of 1991 dollars) | |
| 100% PAYG | 1st Year | $70.5 | |
| | Total | 84.4 | |
| 50% Financing | 1st Year | 36.9 | 36.5 |
| 50% PAYG | Total | 138.0 | 121.9 |
| Equipment (100% Finance) | 1st Year | 9.4 | 8.6 |
| Infrastructure (100% PAYG) | Total | 165.8 | 141.3 |
| 100% Financing | 1st Year | | 2.5 |
| | Total | | 159.4 |

Using electric traction does entail a higher level of investment, on the order of $40 million for most operating scenarios and financing approaches, but there are several mitigating factors. Some of these costs could be shared by SEPTA. Indeed, turning

off the electricity west of Parkesburg will raise SEPTA's operating costs significantly, by forcing it to assume all of the costs of maintaining the catenary and substations. The operating budget for the electric and diesel traction alternatives, assuming ridership is unaffected by the choice of power, and for the three operating scenarios is:

| | Scenario | | |
|---|---|---|---|
| Propulsion | I | II | III |
| | (millions of 1991 dollars) | | |
| Electric: | | | |
| Expenses | $10.00 | $13.40 | $16.84 |
| Revenues | 3.11 | 4.62 | 6.55 |
| Deficit | $6.89 | $8.78 | $10.29 |
| Diesel | | | |
| Expenses | 9.70 | 13.11 | 16.61 |
| Revenues | 3.11 | 4.62 | 6.55 |
| Deficit | 6.59 | 8.49 | 10.06 |

Maintaining attractive service on the line will help Pennsylvania meet the goals of improved air quality, congestion relief, and intermodalism established by the Clean Air Act Amendments of 1990 and the Intermodal Surface Transportation Efficiency Act of 1991. This may be an opportune time for the State of Pennsylvania, and other interested parties, to express their concerns and accept an increased responsibility for the service. Regardless of any outcome with respect to the *Keystone Service*, it is expected that Amtrak will continue to use the line for its longer-distance trains.