RHODE ISLAND DEPARTMENT OF TRANSPORTATION

Rail Corridor

Feasibility Study

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Introduction

The purpose of the study was to determine the potential for the use of existing railroad rights-of-way for public transportation facilities and services using light rail, commuter rail, or busway technologies. Existing rights-of-way may offer a convenient place in which to locate facilities for enhanced public transportation services.

The study was not intended to develop a system plan for public transportation, as railroad rights-of-way are not the only places where enhanced public transportation services might be appropriate. Developing a public transportation system is a multistep process. This study is the first step, intended solely to determine whether such an enhanced system would be appropriate in a specified set of locations.

The Rhode Island Department of Transportation analyzed twenty rail corridors in the state and selected nine with the best potential for public transportation. Those nine rail corridors were addressed in this study:

Amtrak Shore Line—Connecticut line to Massachusetts line
Bristol Secondary Track—Bristol to Providence
East Providence Secondary Track—East Providence to Cumberland

Harbor Junction Industrial Track—Southern Providence
Newport Secondary Track—Newport to Tiverton
P&W Main Line—Central Falls to Woonsocket
Pontiac Secondary Track—Warwick to Cranston
Quonset Point Industrial Track—North Kingstown
Washington Secondary Track—Coventry to Providence

Where necessary, connections beyond each rail corridor were included to allow direct service to major activity centers.

History of Rail Service in Rhode Island

The first task in the study was a review of Rhode Island's rail history. The most important aspect of that history for this study is the effect that the railroads had upon the development of the land within the state. Although the recent past has brought many new forces to bear upon the patterns of urbanization and suburbanization, the power of the railroads in shaping Rhode Island's development is still clear.

Transportation System Characteristics

Presently existing transportation characteristics were defined through data-collection efforts that focused on the characteristics that would have the greatest effect upon the feasibility of services in the study corridors. Data on the roadway network, ridesharing programs, public transportation services, intercity rail passenger services, rail freight services, and specialized services within the study corridors were used to identify the conditions that could affect the feasibility of public transportation services.

Conditions in the Study Corridors

Present conditions in the study corridors are important because they would affect the costs of developing public transportation facilities there. Those conditions were identified through field inspections in each of the nine corridors, supplemented by interviews with people who had specific information about the corridors. The purpose of the field inspections was to create a comprehensive, current, directly observed assessment of the conditions that would affect the types of construction that would be necessary. Maps of the corridors were created by adding the locations of existing tracks, wayside facilities, and structures onto U.S. Geological Survey maps.

Conditions in the study corridors were found to vary widely, from railroad facilities in excellent condition that exceed the Federal Railroad Administration standard for 110 mph service, to worn and misaligned track that would require major reconstruction, to a corridor in which the rails have been removed and a bikeway constructed.

Selection of Corridors for Detailed Study

To assure that the resources available for this study would be most effectively used, the nine initially identified corridors were screened to select the ones that demonstrate the greatest potential for feasibility. The information developed to support the selection included two basic factors related to feasibility—ridership and characteristics of the right-of-way. Ridership is the most important factor in determining the feasibility of any public transportation system, as it is a measure of the benefits that the system would produce. Characteristics of the right-of-way are also important because they would affect the cost of establishing a public transportation project.

The Amtrak Shore Line, the Bristol Secondary Track, the East Providence Secondary Track, the Newport Secondary Track, the P&W Main Line, and the Washington Secondary Track were selected to be studied in more detail. A variation on the Newport Secondary that would connect to the Bristol Secondary was also included in the study. The Harbor Junction Industrial Track, the Pontiac Secondary Track, and the Quonset Point-Davisville Industrial Track were not studied in more detail but could still be considered for transit system improvements in future planning efforts.

Alternatives

Alternative improvements were defined in each corridor using three fixed-guideway public transportation technologies. *Light rail transit* is a metropolitan railway system with vehicles similar to streetcars but which is separated from other traffic as much as possible. *Commuter rail* is a longer-distance passenger railroad using trackage that is a part of the general railroad network. *Busways* are roads that are used exclusively by buses. Not all technologies would be appropriate in all corridors.

Station Locations

Each of the corridors selected for study was examined to identify potential locations for public transportation stations and stops. Station locations are important for estimating ridership, determining the accessibility of a public transportation line from the surrounding area, and examining the environmental impacts of station development. Criteria used for the selection of station locations included amount of development in the vicinity, compatibility of a station with surrounding development, and accessibility from the roadway network.

Ridership

Estimates of ridership in 2010 on each line were developed based upon projected future geographic distribution of population and employment in Rhode Island, projected trip patterns both within Rhode Island and to Boston, and the usage characteristics of public transportation systems in other urban areas. A single ridership estimate was made for each corridor regardless of the type of public transportation line that could be built there. A range of daily ridership was estimated for each corridor reflecting variations in the portion of total trips that could be attracted to public transportation.

In general, the ridership projections are highest for those areas that are projected to have the highest amount of development and where there is a natural attraction between the area in the corridor and a downtown, either Providence or Boston.

Environmental Issues

Environmental conditions in the corridors were reviewed to identify any that might preclude the development of public transportation. None was found, but noise impacts could require mitigation. Further detailed analysis would be needed on some issues, including impacts upon historic sites and traffic impacts, and permits would be required in coastal areas.

Institutional Issues

Organizational issues would require resolution before undertaking a project, including the definition of responsibilities for construction, finance, and operations. Project planning would need to follow federal guidelines if federal funds are to be sought for construction.

Capital and Operating Costs

Probable capital costs were estimated for the initial construction of facilities and acquisition of vehicles. Estimates were also developed for the annual operating cost, including maintenance. The costs were based upon cost information from the Rhode Island Public Transit Authority and other public transportation agencies, especially the Massachusetts Bay Transportation Authority.

Evaluation of Alternatives

The feasibility of public transportation improvements in the corridors was assessed based upon costs, ridership, and environmental effects. The characteristics of the alternatives in each corridor are shown below.

Summary Characteristics of the Alternatives

Alternative	Route Miles	Capital Cost, Millions	Annual Operating Cost, Millions	Total Annualized Cost, Millions	Daily Ridership
Amtrak Shore Line Commuter Rail to Westerly	43.0	$48.75	$13.60	$17.90	3,300-5,000
Amtrak Shore Line Commuter Rail to Kingston	27.2	41.72	9.41	12.83	3,200-4,800
Bristol Secondary Busway	16.2	71.17	4.30	9.81	
Bristol Secondary LRT	16.2	109.52	5.10	13.67	2,900-4,300
Bristol Secondary Commuter Rail	15.5	72.72	7.97	13.92	
East Providence Secondary Busway	9.2	66.71	3.75	9.23	4,200-6,300
East Providence Secondary LRT	9.2	88.78	3.47	10.42	
Newport Secondary Commuter Rail to Fall River	21.2	64.70	6.50	11.52	500-800
Newport-Bristol Combination Busway	30.5	95.96	5.58	13.00	3,200-4,800
Newport-Bristol Combination LRT	30.5	228.65	7.80	25.38	
P&W Main Line Commuter Rail	16.5	63.25	8.46	13.71	2,200-3,300
Washington Secondary Busway	14.3	45.09	3.69	7.24	3,300-4,900
Washington Secondary LRT	14.3	98.35	4.24	11.98	

Several evaluation measures were developed for the alternatives, including capital cost per mile, annual operating cost per mile, annual operating cost per passenger, and total annualized cost per passenger that included both capital and operating cost. They are shown below:

Evaluation Measures for the Alternatives

Alternative	Capital Cost per Mile, Millions	Annual Operating Cost per Mile	Annual Operating Cost per Daily Rider*	Total Annualized Cost per Daily Rider*
Amtrak Shore Line Commuter Rail to Westerly	$1.13	$316,000	$3,300	$4,300
Amtrak Shore Line Commuter Rail to Kingston	1.53	346,000	2,400	3,200
Bristol Secondary Busway	4.39	266,000	1,200	2,700
Bristol Secondary LRT	6.76	315,000	1,400	3,800
Bristol Secondary Commuter Rail	4.69	514,000	2,200	3,900
East Providence Secondary Busway	7.25	408,000	700	1,800
East Providence Secondary LRT	9.65	377,000	700	2,000
Newport Secondary Commuter Rail to Fall River	3.05	306,000	10,000	18,000
Newport-Bristol Combination Busway	3.15	183,000	1,400	3,300
Newport-Bristol Combination LRT	7.50	256,000	2,000	6,300
P&W Main Line Commuter Rail	3.83	513,000	3,100	5,000
Washington Secondary Busway	3.15	258,000	900	1,800
Washington Secondary LRT	6.88	297,000	1,000	2,900

* At midpoint of range of ridership estimate

Conclusions

- Development patterns in the study corridors do not exhibit the scale of concentrations that are typically recommended to support a light rail system. Community plans, zoning ordinances, and development incentives would need to be revised to encourage higher-density development.

- Railroad rights-of-way can allow inexpensive construction of fixed-guideway public transportation facilities.

- Railroad rights-of-way are not in all cases the best location for fixed-guideway lines. Where they follow bodies of water, the ridership potential can be limited and there may be greater environmental sensitivity.

- Design and operating standards can have a significant effect upon cost-effectiveness. Lower standards than the ones used in this study could reduce costs, but could reduce ridership.

- The ability to develop a financial plan for a fixed-guideway project is a critical issue.

- The Amtrak Shore Line provides the easiest opportunity to develop a fixed-guideway line in Rhode Island. Commuter rail fits the characteristics of the corridor well.

- The East Providence Secondary has the highest ridership of the corridors studied; it also has the highest capital cost per mile. It shows the best potential for fixed-guideway development after the Amtrak Shore Line.

- The Washington Secondary is one of the better-performing corridors in the analysis because it runs through a developed area. Performance measures are better for a busway, but light rail would have better environmental characteristics.

- The Bristol Secondary would be a challenging location for fixed-guideway development because of moderate ridership. The facility would require creative design to accommodate the existing bikeway. A busway shows the best cost-per-rider performance.

- The P&W Main Line would have relatively low ridership, which would reduce performance measures. Any further analysis should consider opportunities for cost reduction.

- The Newport-Bristol Combination would reflect the characteristics of the two corridors that it comprises. Total cost per daily rider would be higher for the combination corridor than for the Bristol Secondary alone. The LRT alternative would have a high capital cost because of the new bridge over Mount Hope Bay. The combination of this high cost and the low ridership on the Newport Secondary portion of the corridor would create a high total cost per rider.

- The Newport Secondary has the lowest capital cost of the corridors studied other than the Amtrak Shore Line. But ridership would be low, and cost per rider would be highest of the corridors analyzed. Increased development levels and strategies to reduce costs would be necessary for fixed-guideway development.

Recommendations

- Development of commuter rail service on the Amtrak Shore Line should proceed incrementally.

- Because of the large capital investments that would be necessary, a decision must be made whether further fixed-guideway public transportation should occur, based upon Rhode Island's transportation, development, and fiscal goals.

- If fixed-guideway development is to occur, the next decision will concern project funding. If federal funds are deemed to be necessary, federal planning procedures will need to be followed. This would begin with the development of a system plan, selection of a priority corridor, and analysis of alternative public transportation improvements in that corridor.

1
Introduction

The Rhode Island Rail Corridor Feasibility Study was undertaken to determine the potential for the use of existing railroad rights-of-way for public transportation facilities and services.

Existing rights-of-way are valuable assets because the creation of new rights-of-way is costly and difficult. In many locations where transportation facilities are needed, the land is already developed, so using it for transportation purposes would disrupt neighborhoods and be expensive. Using existing rights-of-way for new transportation facilities can avoid this problem. Transportation facilities can occupy land that is already configured to accommodate such facilities and has a history of transportation use.

In Rhode Island, as in many areas, the need to consider the use of existing rights-of-way for public transportation is growing. Increasing traffic volumes, and the resulting congestion, will place greater strains on the roadway network, especially in the Providence metropolitan area. Opportunities to expand roadway capacity are limited by community, environmental, and fiscal concerns. Consequently, the development of enhanced public transportation services may be the most appropriate means of improving the transportation system. Existing rights-of-way may offer a convenient place in which to locate facilities for those enhanced services.

The study was designed to focus on the question of the feasibility of using existing railroad rights-of-way for public transportation purposes. Other public transportation issues were excluded to allow study resources to be devoted to this central question. The study was not intended to promote the development of any particular type of transit system. Nor was it designed to create a public transportation system plan, as railroad rights-of-way are not the only places where enhanced public transportation services might be appropriate. Existing railroad rights-of-way are a suitable place to begin consideration of public transportation improvements because of the potential they offer for low-cost construction. If public transportation is found to be appropriate on these rights-of-way, other locations should also be analyzed.

1.1 Policy Context for the Study

The study was guided by the State's goal to make more efficient use of existing transportation facilities, to reduce traffic congestion, improve safety and mobility and minimize adverse environmental impacts on the State's transportation network.

This goal is consistent with the goals expressed in other State transportation plans. The Ground Transportation Plan, March, 1992, contains goals that apply to all transportation systems in the State. Several relate to this study:

(1) Provide a balanced transportation system in terms of the type and level of services needed to meet travel demand.

(2) Improve existing transportation facilities and services in order to provide for safe, dependable, and convenient passenger travel.

(5) Develop an energy-efficient transportation system.

(6) Develop transportation programs that contribute toward implementing environmental, economic, and other state policies.

The Rhode Island State Rail Plan, August, 1990, also states goals for the State's railroad network. The general philosophy behind the State's involvement in passenger rail service is:

> to provide for the continued and improved availability of rail passenger service to the state's citizens and to businesses that are located in (or may decide to locate in) Rhode Island, where such rail passenger travel is appropriate under present and future economic, energy, and environmental conditions.

That philosophy is supported by more-specific rail policies, two of which address the concerns in this study:

6. Public funding for rail passenger service should be consistent with energy, environmental, economic development, and social policy, considering long-term costs of non-rail alternatives.

7. All likely future options should be preserved and the permanent destruction of rail lines or rights-of-way with potential future use should be avoided.

The policies in the rail plan are in turn supported by several sets of goals that pertain to different aspects of the rail system. The ones that apply to passenger rail are:

- Promote reliable and frequent high-speed northeast corridor passenger rail service
- Promote appropriate passenger services and effective marketing of commuter rail operations
- Promote the use of new technological innovations in the provision of passenger rail service
- Provide cost competitive passenger rail service

Federal transportation requirements also affect the subject of the study. The Intermodal Surface Transportation Efficiency Act of 1991, which made significant changes in federal programs, requires each state to undertake a transportation planning process. That process must consider "Preservation of rights-of-way for construction of future transportation projects, including identification of unused rights-of-way which may be needed for future transportation corridors, and identify those corridors for which action is most needed to prevent destruction or loss." and "Methods to expand and enhance transit services and to increase the use of such services." The Act authorizes increased funding for public transportation services and broadens the categories of funds that can be used for public transportation projects.

1.2 The Fixed-Guideway Transit Planning Process

Developing a fixed-guideway system is a multistep process. This study is the first step, intended solely to determine whether such a system would be appropriate in a specified set of locations. If the results of this study are positive, several subsequent activities could be necessary, depending upon the nature of the system to be developed. A fixed-guideway project that required little or no construction, such as the initiation of commuter rail service on existing trackage, could be relatively simple to develop. By contrast, developing a light rail line or busway that required extensive construction and a large capital investment would require a process of more-detailed planning.

Should this study lead to the decision to proceed with a major capital investment, a system planning study should be done to identify all transportation needs that a fixed-guideway system would meet. The study should analyze other corridors that are not included in this study, such as those that follow roadways. The system study should identify the first line to be built, and assure that it is designed to be compatible with other later additions.

After the priority corridor has been selected, more-detailed work would be necessary to plan the characteristics of the line to be built within that corridor. If federal funds are to be used for system development, there is a federally prescribed planning process that would provide the basis for decisions about the appropriate transit technology and the ways that the line would be integrated with the overall transportation system. The planning process addresses the financial and environmental characteristics of a project and produces an environmental impact statement. Following its completion, preliminary and final engineering would be necessary before construction could begin.

1.3 Study Approach

The Rhode Island Department of Transportation designed the study to focus on the rail corridors with the highest likelihood of feasibility. In preparation for the study, an evaluation was made of twenty rail corridors that were either fully intact or partially intact and could be reclaimed fairly easily. Nine were selected to be included in the study. The corridors are shown on the map in Figure 1-1 and listed in Table 1-1.

This study was organized into two phases. The first phase analyzed the nine railroad corridors to determine their general feasibility. The corridors that showed the most promise in this phase were then analyzed in more detail in the second phase to determine whether or not they could justify public transportation improvements.

The tasks in the study are shown in Figure 1-2. Task 1 was a review of the history of railroad service in Rhode Island to establish an understanding of the conditions affecting the creation of the rights-of-way and how they relate to their surroundings. Task 2 was the collection of data on railroad and public transportation systems and on travel demand. Task 3 developed estimates of ridership on public transportation in the study corridors. Physical conditions in the corridors were inventoried in Task 4 to determine their adaptability to new transportation uses. The first phase culminated in Task 5, which identified those corridors that showed sufficient promise to warrant more-detailed analysis.

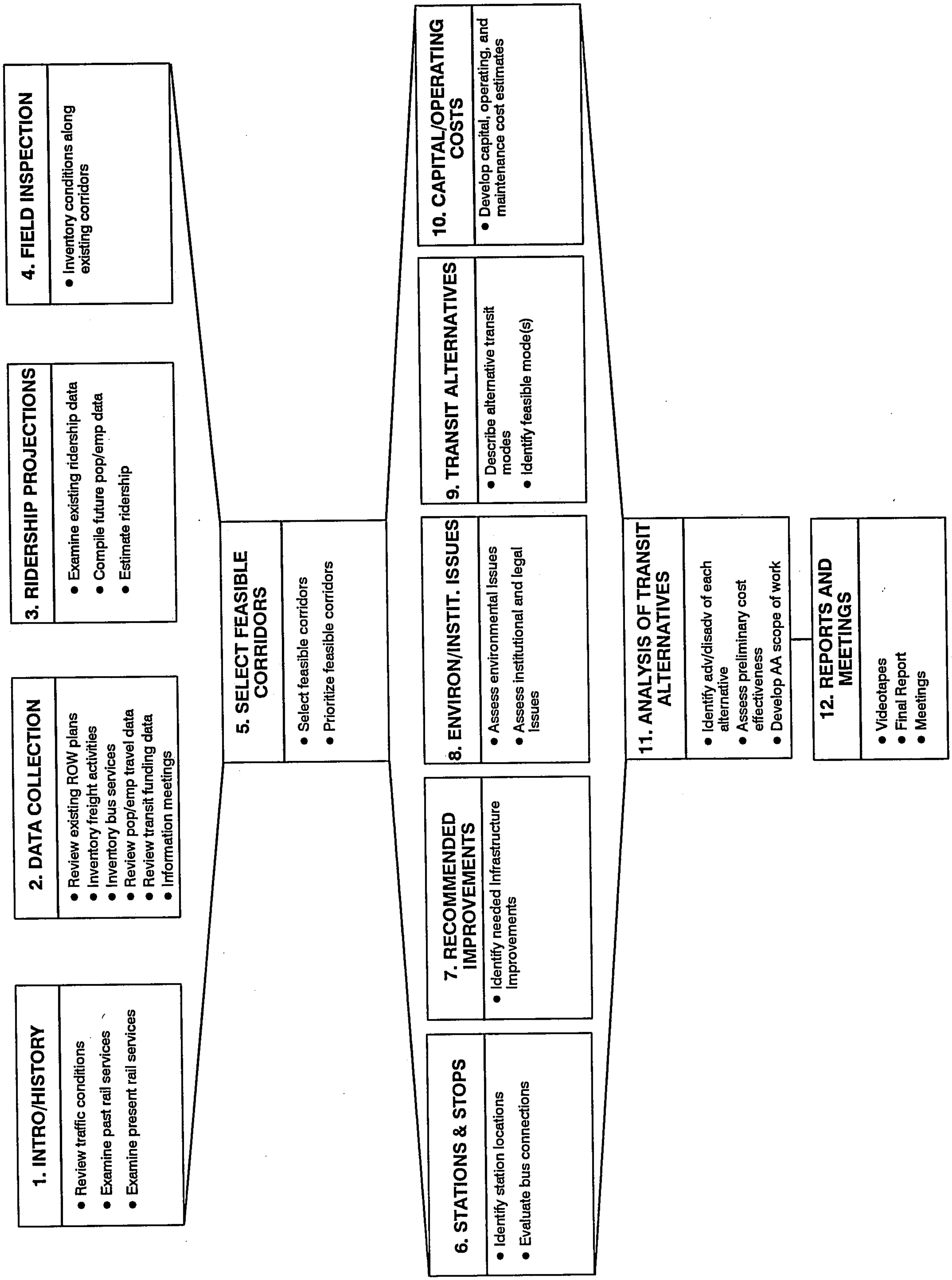

FIGURE 1–2
Study Tasks

Table 1-1
Study Corridors

Amtrak Shore Line -- Northeast Corridor from Connecticut line to Massachusetts line
Bristol Secondary Track -- Bristol to Providence, including East Side Rail Tunnel
East Providence Secondary Track -- East Providence to Cumberland
Harbor Junction Industrial Track -- Southern Providence
Newport Secondary Track -- Newport to Tiverton
P & W Main Line -- Central Falls to Woonsocket
Pontiac Secondary Track -- Warwick to Cranston
Quonset Point - Davisville Industrial Track -- North Kingstown
Washington Secondary Track -- Coventry to Providence

In the second phase, Task 6 identified appropriate locations along the remaining six corridors for stations and stops. Physical improvements needed to create public transportation improvements were identified in Task 7. Task 8 considered the environmental, institutional, and legal issues that would affect public transportation system development. Task 9 addressed the types of transit technologies that could be applied in the corridors, and Task 10 estimated the capital and operating costs of transit facilities and services. The study recommendations were developed in Task 11, where the various transit alternatives were analyzed to determine which are the most promising corridors.

Task 12 continued throughout the study, providing for the meetings and reports necessary for the presentation of study progress and findings.

The results of these tasks are described in the following chapters in this report.

1.4 Study Management Organization

The study was performed under the direction of the Program Development staff of the Rhode Island Department of Transportation. Assistance and coordination was provided by a Project Advisory Committee established for the study. Technical analysis was provided by a consultant team of Barton-Aschman Associates, Inc., De Leuw Cather & Company, and ASEC Corporation.

2
History of Rail Service in Rhode Island

This study focused upon the future; it examined the opportunities to develop new transportation services and facilities. But planning for the future is more effective when it begins from an understanding of the past. The first task in the study was a review of Rhode Island's rail history.

2.1 Significance of Rail History

In this study, the most important aspect of that history is the effect that the railroads had upon the development of the land within the state. From the 1830's, when railroads began to supersede waterways as the preferred means of transportation, until the 1920's, when they began to lose their dominance to the automobile and truck, the rail lines were the armatures around which the forms of the cities, towns, and industrial districts were shaped. Although the recent past has brought many new forces to bear upon the patterns of urbanization and suburbanization, the power of the railroads in shaping Rhode Island's development is still clear.

As in most areas that developed before and during the nineteenth century, Rhode Island has a long, complex, and fascinating history of rail transportation. A recounting of it all would fill volumes, and, in fact, much has been written about this subject. Since this study requires only a general understanding of the origins of the rail network, no attempt has been made to compile a complete description. Instead, existing sources have been drawn upon to define the relevant characteristics. A list of the references from which this information has been drawn is at the end of this chapter.

2.2 The Geographic Setting

As transportation systems improve and develop, each mode of travel is shaped by and in turn leaves its imprint in the historical development patterns of places. In Rhode Island, travelling any distance requires crossing water; the state is wrapped around Narragansett Bay and veined with rivers. In colonial times, water routes, primarily the Bay, were the connecting thoroughfares of the early settlements. Ferries were the first public utilities regulated by the colonial government.

When Rhode Island declared its independence from Great Britain, international trade dominated Narragansett Bay life, and Newport dominated the maritime economy. Eighty-five years later, on the eve of the Civil War, Rhode Islanders looked to manufacturing instead of the sea for their livelihood and to Providence instead of Newport for their economic leadership.

Providence entrepreneurs so clearly recognized the significance of transportation as an instrument for extending, consolidating, and protecting their economic interest that Rhode Island's transportation history is a story of small groups of financiers trying to secure their markets and expand their reach into the Providence hinterlands.

Dependant on water, the grist and textile mills developed at scattered sites in the river valleys. The early towns that sprang up around these sites were spontaneous and unplanned, as opposed to the specifically laid-out mill cities that emerged later. The need for raw materials to feed the mills and transport the finished goods fostered transportation improvements in the form of turnpikes. These early roads were often improved Indian paths, but many were built specifically to provide access to mill villages such as Phenix and Hope.

Rhode Islanders began substituting steam for water as the source of power as early as 1829. The development of steam power brought a wholly new industry into being in Rhode Island—the manufacture of steam engines. By the Civil War, steam engine manufacturing had become a major segment of the Rhode Island economy.

Within a decade, the use of the steam engine was exerting a profound influence on both the rate of economic growth and on the locale of industrial activity. Every locality with access to coal supplies was now a potential manufacturing site, which weakened the monopoly enjoyed by towns with water power. The invention of the steam engine allowed larger mills to be constructed closer to the Bay, and, while not eliminating the demand for turnpikes, the steam engine heralded a significant transportation mode, the railroad.

This new technology eventually became a dominant force in the structure of settlements and economic development, but it was first greeted with misgivings by some. "Experts" of the day warned that at speeds over 20 mph, passengers would be suffocated when the air was sucked out of the cars.

2.3 The Development of Railroads in Rhode Island

Because Rhode Island straddles the sea-level overland route between Boston and New York, its railroads developed as an integral part of New England rather than as a purely state-wide transportation system. In the early years, it was a combination rail-stagecoach-water journey that linked Boston and New York through the Providence area.

As the railroads developed, competition became so fierce between ferries and rail that the Boston and Providence railway would cancel trains to strand passengers arriving on the steam boats in Providence. Most steam boats were driven to the freight business, and, after protracted and bitter price wars, the railroads abandoned freight movement. In return, the steamer companies withdrew their passenger vessels. Turnpike companies also either succumbed to the competitive battle with the railroads, or were bought out by state and local authorities.

The new technology had proved itself, but building and operating a railway required new expertise. In all, promoters submitted 21 railroad charter petitions between 1830 and 1860. Of the 17 corporations created, only six had their lines in operation when the Civil War broke out. All served Providence. Two ran down the eastern shore of Narragansett Bay to Warren and Fall River, and the others ran to Boston, Worcester, Hartford, and Stonington. The bird's-eye view looking south along the bay in Figure 2-1 shows the extension of the rail lines through the southern part of the state by 1885.

At the hub of the wheel, Providence became the trade center of New England. Figure 2-2 shows the center of Providence in 1895, with the original Union Passenger Depot and its then-proposed replacement, Union Station, which was not completed until 1898, occupying prominent locations.

Figure 2-1
Rail Lines in Southern Rhode Island, 1885

Figure 2-2
Central Providence and Railroad Stations, 1895

The city had a natural advantage as a convenient transfer point for freight and passengers moving along the busy route between Boston and New York. Providence became a staging point for raw materials and finished products of the emerging industrial communities in eastern Connecticut and southwestern Massachusetts as well as Rhode Island.

Soon after the railway age began, Rhode Island included in its constitution a virtual prohibition against using state credit directly or indirectly for paying "the obligations of others" and set a limit on the size of the state debt. As a whole, then, private individuals furnished the means of construction; they purchased stock, the only securities that the early railroads issued.

Generally, the first railroads were built as cheaply as possible to keep costs down and to maximize immediate profits. Since the passenger cars were built by coachmakers, the first passenger coaches physically resembled stagecoaches. The early railbeds were turnpike-like surfaces with single tracks laid on them, the beds were poorly drained and often flooded, and the low quality of the first iron rails led to derailments. Wooden trestles were built instead of stone bridges. As a result, maintenance costs were high and repairs were frequent.

Before the Civil War, financial desperation drove many railroads to other methods of raising money, often short-term loans, but especially bonds. The Boston and Providence was one of many New England railroads that created funded debt to finance the construction or expansion of the line. It wasn't long before the major lines were floating on a sea of debt. Corruption penetrated every grade of the railroad hierarchy, from conductors who appropriated fares to presidents who overissued stocks and plundered treasuries.

Not only corruption, but safety issues and especially tariffs and fares fueled emotional public debate. Popular disapproval of the railroads grew strong enough in the 1830s that in 1838, Rhode Island established a railroad commission with "powers of investigation and report in order to secure for the citizens the full and equal privilege of the transportation of persons and property...and [rates] in proportion to the distance any such person or property may be transported."

As a major railroad junction, Providence benefitted from both rate wars and discriminatory tariff schedules, whereas Washington County, which expected to derive great benefit from railroad construction, partly blamed its slow rate of industrialization on discriminatory railroad practices. It was served by only the Stonington Line which had fare structures beneficial to long-distance through travel and disadvantageous to local trade. Perhaps coincidentally, present rail passenger service continues this pattern. Amtrak service is tailored to long-distance trips to and from major population centers; other locations along the rail lines have no passenger service.

Legislative restrictions, first imposed on the Stonington line and then extended to the railway industry generally, included issues of public safety (such as bells on locomotives and signals at level crossings) and issues of discrimination (in 1839, legislation to make rates proportional to distance and requiring equal treatment of connecting steamboats was passed). The Stonington line in particular was targeted in the 1850s and charged with "oppressive and vindictive discrimination" before the railroad commission in 1851.

By 1855, Rhode Island's first comprehensive regulatory statute indicated some of the questions surrounding the railroads—the majority of railroad commissioners concluded that the lines were more interested in profits than community benefits. Although some restrictions were passed, the Assembly refused to regulate rates.

The last decades of the nineteenth century witnessed the consolidation of the railroads and, as a result, greater funds for improvements and extensions were available. In 1893, the majority of the rail lines in Rhode Island became part of the New York, New Haven and Hartford Railroad Company. With the advent of the 1920s and the proliferation of private automobiles, however, the railroads declined. World War II confirmed the importance of train travel, but the revival was short-lived.

In the twentieth century, Rhode Island railroads have felt the impact of competing forms of transportation—trucks, buses, airplanes, cars and pipelines. During the 1930s and '40s, passenger and freight service continued at diminished levels. Bankruptcies, reorganizations, abandonments, the floods of 1955 and 1968 all play a part in the history of the post-war decline of the great railroads. By the 1960s, the New York, New Haven and Hartford Railroad was in bankruptcy, and the Penn Central, which took over the New Haven's operations, followed into bankruptcy in 1971.

In the early 1970s, faced with the imminent collapse of the rail transportation system, the Consolidated Railroad Corporation was created by an act of Congress. Soon after, Northeast Corridor ownership was transferred to Amtrak, with Conrail retaining the rights for freight operation. The Northeast Rail Services Act of 1981 allowed Conrail to divest itself of some of its lines, including all those in Rhode Island. Bristol Secondary, East Junction Secondary, Harbor Junction Industrial, Newport Secondary, Slatersville Secondary, Valley Falls Industrial, Washington Secondary, and the rights to operate freight service over Amtrak's Northeast Corridor were then transferred to the Providence & Worcester Railroad (P&W).

In the last two decades, some unused rights-of-way have been abandoned or have been considered for other uses—hiking paths, bikeways, and light rail. At the same time, service on some lines has been improved.

2.4 Study Corridors

The study addressed nine rail corridors within the state. Each of them has its own colorful history—a history of a new technology, entrepreneurs, and the development of the land.

Amtrak Shore Line

The Amtrak Shore Line, also known as the Amtrak Main Line, part of the Northeast Corridor, and originally called the Stonington line, was completed through southern Rhode Island in 1837 as a vital link in a Boston-to-New York route. Two years earlier, the first railway from Boston to Providence had opened, reaching a terminal at India Point, which required a transfer to a ferry to the heart of the city. The completion of the Stonington line extended rail service to Stonington, Connecticut, where passengers took a boat to New York City. Such early intermodal connections between the railroads and the ferries were common. It wasn't until more than 55 years later that a direct, continuous rail route from Boston to New York through Providence was provided, augmenting travel in this major corridor by linking and consolidating local lines.

The New York, Providence and Boston Railroad, which built the Stonington line, had various statutory restrictions on the company's freedom, such as a maximum annual return on capital, bars on any investor from voting more than a quarter of the stock, and authorization for the state to purchase up to a thousand shares and appoint one director.

The Stonington line ran into political difficulties almost immediately, and financial problems soon after. Complaints about the acquisition of right-of-way led to a provision that, in the appeals from condemnation proceedings, the railroad had to pay all court costs if it lost, and its own court costs if it won. The Assembly also required the railroad to erect fences along its route, made it liable for damages caused by fires started by its locomotives, and revoked its power to build branch lines.

Financial difficulties also plagued the line's operations. Neither freight nor passenger traffic met expectations, in part because the company operated steam boats in competition with its own train lines.

The line was one of the New Haven Railroad lines that was included in the Penn Central merger in 1969. The Penn Central diverted most freight traffic to the Boston and Albany line, leaving the majority of the traffic on the Shore Line as passenger traffic. This line passed into public ownership after the bankruptcy of the Penn Central, and improvements to the line, including upgrading track and structures, were made in the early 1980s as a part of the Northeast Corridor Improvement Project. Past plans to electrify this line have not been implemented because of lack of funding, but efforts are once again being made to do so. This line is the location of the majority of the present rail passenger service in Rhode Island, both intercity and commuter rail service, as well as freight service connections to a number of branch lines.

Bristol Secondary Track

The Bristol Secondary was established in 1855 as the mainline of the Providence, Warren and Bristol railroad. It was later controlled by the Boston & Providence, which was leased by the Old Colony in 1888, and subsequently it was acquired by the New Haven as it expanded throughout New England. The line was electrified, and the New Haven operated passenger service using multiple-unit cars.

A tunnel connection between this line and downtown Providence was constructed between 1906 and 1908. The tunnel resolved a long-running debate about the best way to connect the rail lines on the eastern shore of the bay with Union Station. Running between Benefit and Gano Streets on the East Side of Providence, the tunnel still exists, although its connection to downtown was removed when the Amtrak Main Line was relocated and the present Providence Station built in the early 1980s.

Passenger service was discontinued about 1940, and the electrification was subsequently removed. Control of the line passed from the New Haven to the Penn Central to Conrail to RIDOT, the last change in ownership occurring in 1982. The present service on the line between Crook Point and Squantum Woods in East Providence is strictly freight. The rails have been removed from Squantum Woods south to Bristol, and a bikeway has been constructed as an interim use on the right-of-way, although it is still considered a railroad as it has not been formally abandoned.

East Providence Secondary Track

In 1874, the P&W opened this line branching from the main line at Valley Falls and running through the east side of Pawtucket to East Providence. This line replaced an earlier line to Fox Point on city streets, where heavy volumes of freight, particularly coal, caused conflicts between trains and other activities. At a point just south of the Washington Bridge, a new coal-handling facility had been built at the new steamship terminal. The terminal was named Wilkes-Barre Pier after the origin of much of the coal handled there. During the period when the P&W was controlled by the New Haven and the Penn Central, this was known as the India Point Branch because it extended that far over a drawbridge over the Seekonk River. The East Providence Secondary had passenger service, but it was discontinued around the turn of the century.

This line is one that the P&W acquired from Conrail in 1981. Ownership was transferred to RIDOT the following year to provide the right-of-way for a highway. Within the City of

Pawtucket, the right-of-way is now owned by the City, but RIDOT still holds title to the portion in East Providence and all of the track and structures. Present freight service is operated by the P&W.

Harbor Junction Industrial Track

The Harbor Junction track was originally part of the Stonington line, providing the means of entry into the central area of Providence from the south. The line ran to a terminal at Crary Street on the west side of the Providence River, from which a ferry provided a connection to the India Point terminal on the rail line to Boston. This connection was used until a new west-end bypass was built to carry the Stonington line around downtown and into the original Union Passenger Depot, which was completed in 1848. The by-pass created the first direct rail connection through Providence without the need for a transfer to a ferry. After the construction of the west-end by-pass, the Harbor Junction line continued to provide freight service to the industrial area on the south side of central Providence.

The Harbor Junction line was acquired by the P&W from Conrail in 1982, and in 1985 was acquired by the City of Providence. The location of part of the line in Allens Avenue has limited the ability of the line to accommodate freight traffic without disrupting traffic.

Newport Secondary Track

The completion of the Old Colony Railroad from Boston to Fall River in 1846 eventually reduced the significance of Providence as a through-freight-traffic center. Adding the Newport Extension from Fall River to Newport (now the Newport Secondary) was an attempt to stimulate economic expansion onto Aquidneck Island, partly by making the railroad an additional reason for establishing a naval base at Newport. To induce the Navy to do so, Newport and Middletown acquired the right-of-way. It was not until 1864 that a regular passenger train ran the entire line to Newport.

The new line to Newport was heavily patronized by farmers, who used it to ship their produce to market, and the coal mines at Portsmouth. Passenger service on the Newport line was well established into the 1920s, and was heavily used by the wealthy summer residents of Newport. The line was a pivotal link for travel from Newport to Providence, an importance which declined with the opening of the Mount Hope Bridge in 1929. In 1913, for example, there were eleven passenger trains a day in each direction, by 1934 there were only two and no Sunday service. By 1938, the New Haven Railroad discontinued all passenger service. During the Second World War and the fifties, troop trains, some special trains for government workers, and a diminished freight service operated between Fall River and Newport.

In 1979, the State of Rhode Island purchased the southern portion of the line in Newport, Middletown, and Portsmouth from Conrail, and in 1983 acquired from the P&W the remainder to the state line in Tiverton. The bridge between Portsmouth and Tiverton has been closed since February 1988 as a result of being struck by a barge, ending freight service on Aquidneck Island. This line currently has scheduled passenger service in the form of a dinner train and a tourist sightseeing train.

Pontiac Secondary Track

The original rail line was built as a branch from the Stonington line by the Pontiac Branch Railroad and connected with what is now the Washington Secondary Track, then operated by the Hartford, Providence and Fishkill Railroad. It was leased to the New York, Providence and Boston Railroad in 1891 and later merged into that system. Although the line was at one time extended to Hope, an abandonment in 1924 terminated the line at Pontiac. The outer portion of the line between Pontiac and the Cranston-Warwick city line has been out of service since the early 1970s. Freight service is operated only on the section nearest the Amtrak Shore Line; service on the balance of the line was abandoned in January, 1992.

Providence & Worcester Main Line

Starting at Pawtucket, the textile industry spread up the Blackstone Valley, creating a new village at every point where sufficient waterfall existed to power a mill. The expansion into the valley required better transportation than the Blackstone Canal, opened in 1828, which froze solid in the winter months and stranded barges in insufficient water in the summer. In Rhode Island, this need sparked interest in a rail connection between Woonsocket and Providence. Not only would this serve the valley, it would also strengthen port activity in Providence by attracting traffic that had been going to Boston.

The Providence & Worcester Railroad Corporation was incorporated in both Massachusetts and Rhode Island. Construction started in 1844, and three years later the line opened in the riparian valley from Providence to Worcester. The company selected a route through the heart of Central Falls and Pawtucket, down the Moshassuck Valley to the central section of Providence, where a complex of passenger and freight stations was built. This area became the site of Providence's first Union Passenger Depot in 1848. The importance of the line to the communities it served is illustrated in Figure 2-3. This 1876 view shows the line as it passed through Woonsocket, serving a number of mills and the surrounding development along the Blackstone River.

Competition with the P&W drove the Blackstone Canal out of business; the last tolls were collected on the canal in 1848. The railway stimulated economic growth throughout the northeast region, especially after the Boston Line built a branch to Pawtucket and after Union Station opened in Providence. These improvements gave Blackstone Valley communities ties to Boston, Worcester, Stonington, and later Fall River and Hartford. The line served the residents with a fair amount of passenger service, with both local service and an express train that made the trip from Providence to Worcester in only one hour and forty-five minutes.

Although stock was sold to cover the full estimated cost of construction, the early years of the P&W were marked by financial uncertainty. The cost of the construction was almost twice what had been estimated. The competition with other lines for the traffic between New York and western Massachusetts put the P&W at a disadvantage; the trade had to transfer from steamships to the line at Providence. The tariffs for long-distance trade was secretly cut, which both angered local merchants and further limited the corporation's revenues.

Passenger service in the late nineteenth century was as high as eight through trains in each direction, with frequent local service, but the financial difficulties continued. In an effort to reduce operating expenses the directors began to install more automated equipment, such as automated warning gates to replace flagmen and electric track switches to control traffic flow, and to replace iron rails with the more-durable steel. When the road was first constructed, only a single track was laid and a strict time schedule was followed to allow two-way traffic, but by 1869, a second track had to be installed. Culverts were placed under the railbed to allow for better drainage, and by 1883 the replacement of the rotting wooden bridges with iron trestles had begun.

In 1889, the P&W Main Line suffered a competitive blow when the last link in the Shore Line between New York and Boston was completed, creating a more-direct all-rail route from Boston to New York through Providence. The Shore Line quickly became the preferred route, diverting virtually all the through traffic from the older, less-direct lines that ran by way of Worcester. The P&W, unable to support itself, ceased independent operations the same year and was leased to the New York, Providence and Boston Railroad, which continued to upgrade the rails and replace the bridges. Only four years later, the new lessees were purchased by the New Haven Railroad.

Figure 2-3
P&W Main Line in Woonsocket, 1876

Under the New Haven operations, the P&W Main Line had a busy freight and passenger schedule, although competition from trolley cars (also controlled by the New Haven Railroad) resulted in the elimination of almost all of the short runs and a reduction in the local service all along the line.

The supporting construction and repair shops in Valley Falls, which had been the center of all the heavy locomotive repair and car shops for the independent P&W, were slowly closed. The depression, coupled with increased competition from the automobile, brought an end to all but one round-trip passenger train. In the mid-forties, three New Haven east-coast passenger trains were rerouted through Providence using the P&W Main Line, but even that service slowly declined until the last scheduled passenger train was discontinued in 1960. The line itself was also downgraded by the New Haven, which removed the second track and signals.

When the P&W Railroad became independent again in 1973, it regained control of this, its original line, from the Penn Central. The line formed the backbone of the P&W's freight operations, which continue for the remaining industries and steel yards, with the addition of some excursion trains.

Quonset Point-Davisville Industrial Track

The Quonset Point trackage is of more recent vintage than the other rail lines in the study. Most of the trackage was built between 1941 and 1955 to serve the Naval Air Station at Quonset and the Naval Construction Battalion Center at Davisville. A large part of this area has been converted to civilian use as an industrial park under the ownership of the Rhode Island Port Authority, which holds title to the rail right-of-way. Freight service continues to be operated by the Seaview Transportation Company, which interchanges cars with the P&W.

Washington Secondary Track

The line from Providence to Waterbury, via Hartford, Connecticut, (of which the Washington Secondary is a surviving segment) grew up from the end-to-end union of many small roads in 1864. Figure 2-4 shows this line where it served the Natick Mills at a location now in Warwick, near where it joined the Pontiac Secondary track, which also appears in the lower corner of the drawing. The original line was owned by the Hartford, Providence & Fishkill Railroad. While several independent railroads were competing to be the most attractive route from Boston to New York, the history of this line is primarily one of trying to build itself up into any system at all.

Figure 2-4
Washington Secondary and Pontiac Secondary Tracks in Natick, 1889

After several changes of ownership, the connection from Providence to Willimantic became part of the New York & New England Railroad which had links to New York City (via a boat line) and the west out of Providence through Willimantic and Hartford. The company had high hopes for coal traffic to New England, as well as lumber, iron ore and cattle. When the system had been built to this extent, it ceased to make any important acquisitions, while the management concentrated on keeping the line solvent or selling it off to some other railroad. The competition with the Springfield route to Boston proved too taxing, and after several bankruptcies, control of the system went to the New Haven Railroad. As soon as the competing Shore Line was completed, providing a direct all-rail route between Boston and New York, this route became even less important.

The line was acquired by the P&W from Conrail in 1982. The segment west of Washington, which is not included in this study because of its less-urbanized development patterns, was abandoned in 1968. Freight service on the portion in the study was terminated in 1985, the line was abandoned by the P&W in 1990, and the tracks were removed in 1992.

2.5 The Development of Urban Rail Transit in Rhode Island

In addition to the railroad system in the state, Providence served as the focus of an urban transit system that used rail technology. That system is less pertinent to this study because its routes did not follow the study corridors. But the urban rail system is significant because its technology is similar to the types of transit service that are considered for development in the study corridors.

The history of urban rail transit in Rhode Island is closely related to that of the railroads including similar technology and, for a while, common ownership.

The first application of rail transit service was in the form of horsecars, coaches that were horse-drawn on rails laid in the streets. The first line, the Providence and Pawtucket, was built in 1864. Lines were quickly built into other parts of Providence, providing new accessibility that allowed outlying neighborhoods to develop.

With the construction of multiple horsecar lines, duplication of service and competition became a problem. In 1865, the Union Railroad Company was formed to bring order to the proliferation of horsecar lines in the city. The company eventually came to control all of the lines.

The steep terrain on the East Side of Providence led to an early innovation in transit technology, a cable tramway up College Hill. To avoid the circuitous route that horsecars had to use, a system using an underground continuously moving steel cable and grip cars began operation in 1890. This system and variations on it operated until 1914 when a second tunnel beneath College Hill, between South Main Street and Thayer Street, was completed.

The real innovation in transit technology was the development of the electric streetcar in 1888. Electric traction transformed urban transit—trolleys had better performance characteristics, electricity was cleaner, and operators no longer had to rely on animals that were subject to illness and sensitive to the weather. The first trolley operated in Providence in 1892, and by 1894 the entire system had been electrified, the rapidity of the change demonstrating the superiority of the technology.

Electrification of the system came about with the assistance of the owners of the Narragansett Electric Company, who saw the opportunity to expand their market through this new technology. They achieved a controlling interest in the Union Railroad Company and, in 1893, established the Union Traction and Electric Company. That company's transit interests were transferred in 1902 to the Rhode Island Company, which in turn was acquired in 1906 by the New Haven Railroad as a part of its effort to create a transportation monopoly in New England. The New Haven invested in new rolling stock and upgraded facilities. At its peak, the trolley system was extensive, with suburban and interurban lines to Woonsocket, Pawtucket, Chepachet, North Scituate, Washington, East Greenwich, and Hope.

A 1912 study of transit in Providence, undertaken because of concerns about the ability of the trolley system to operate on congested streets and to expand to meet new demands, recommended a number of improvements. This led to a proposal for a never-to-be-built subway system in Providence.

The New Haven was forced to divest itself of the Rhode Island Company for antitrust reasons in 1914, and without the financial backing of the railroad, the transit company's poor financial performance drove it into bankruptcy in 1919. United Electric Railways was created to take over the system, which it did in 1921. The beginning of the end of rail transit came the following year, when the company introduced its first bus. A trolley improvement program was undertaken in 1926, but the program did not survive the Great Depression; suburban operations had already been discontinued by 1929. Another reorganization of the ownership of the company saw the creation of a holding company, Rhode Island Public Service Company, to operate the system. Trackless trolleys—electric buses—were introduced in 1935 to allow the use of the system's overhead wires without the costs of maintaining the tracks. But the economics were inexorable, and trolley operations were discontinued in 1948. Trackless trolleys, too, were scrapped seven years later, and public transportation became an exclusively diesel bus operation.

In 1952, ownership was once again transferred, this time to the United Transit Company, which continued to control the system until 1966, when the financial strain of transit operations prompted public ownership of the system by the Rhode Island Public Transit Authority, created by the state legislature for this purpose.

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3 Transportation System Characteristics

Any enhanced public transportation services must be compatible with the presently existing transportation conditions. Those conditions were defined in the study through data-collection efforts that focused on the characteristics that would have the greatest effect upon the feasibility of services in the study corridors. The data described here are the most recent available at the time of the study. Some transportation system characteristics, such as bus and train schedules, can and do change.

3.1 Roadway Network

The roadway network is one of the most important elements of the existing transportation system, and it affects the potential for new public transit services in complex ways. One effect is that of competitor, the system on which people can drive. Where the roadway network is congested and allows only slow auto trips, people will be more willing to use public transit, particularly if it operates on a separate right-of-way. If public transit can attract large numbers of riders, the need to improve the roadways may be reduced. But the roadway network also provides support for public transit services, for it defines routes that buses can take, and creates opportunities for access to any fixed-guideway stations for feeder services by bus and by car.

The roadway network in Rhode Island is described in *Transportation 2010: Ground Transportation Plan*. Roadways were analyzed by type, including interstate highways and urban principal arterials, and by segments defined by city and town boundaries. The plan provides a variety of information on each roadway, such as pavement condition and accident rates. Most important for this study, the plan identifies the highways that were considered to perform at a substandard level, as measured by operating speeds and the volumes of traffic that they carried as compared to their capacity.

The plan states that the interstate highways met standards of acceptable performance, except for I-195, which carries high traffic volumes, and some I-95 interchanges in Providence, which have high accident rates. Traffic volumes on I-195 could be affected by transit improvements in some of the rail corridors in this study.

A number of urban principal arterial highways were found to be deficient, including some that parallel the study corridors. Any trips diverted from these roadways to new transit facilities could improve their operating conditions. They include RI 2 in Cranston, Warwick, East Greenwich, and North Kingstown; RI 4 in Cranston and Warwick; RI 114 and RI 138 in the East Bay; RI 117 in Warwick and West Warwick; RI 136 in Bristol and Warren; and RI 146.

Other urban principal arterials that were identified as deficient probably would not benefit from the transit improvements under study because they are not oriented to serve trips along the study corridors. They include US 6; US 44; RI 3 in Westerly; RI 7 in Providence, North Providence, and Smithfield; RI 102 in North Smithfield, Burrillville, and North Kingstown; and RI 138 in South Kingstown.

3.2 Ridesharing Program

A ridesharing program is operated by the Rhode Island Department of Transportation to encourage carpooling and vanpooling. One component of the program is a matching service. People who call the ridesharing office are matched with others who have similar transportation patterns. Another aspect of the program offers financing for people to purchase vans to be used for vanpools. The DOT provides interest-free loans that cover the cost of purchasing a van, including the sales tax, registration, and title fee. Funding made available through this program supports vans that operate to Electric Boat in Quonset and one van that operates from Newport to downtown Providence.

3.3 Public Transportation Services

New public transportation services would need to be carefully designed to respect existing public transportation patterns, although in some locations the existing services would be revised to complement the new services. Information on the services that are now being operated was collected from a variety of sources, including the operators of those services, to define the present transportation system into which the new services would have to fit.

The services described here are regularly scheduled ones that are available to the public for general transportation purposes. This excludes charter services and privately operated transportation that is offered only to select groups. There is one exception to this exclusion— specialized rail transportation services that are now operated on railroad tracks in the study corridors, of which there are two examples.

Publicly Operated Bus Service

Publicly operated bus service is provided by the Rhode Island Public Transit Authority (RIPTA). It is the successor to the private companies that operated streetcar, trolley bus, and urban services over the past century.

RIPTA service extends throughout the state, serving 36 of the 39 municipalities. The Rhode Island DOT estimates that 75 percent of the residents of the state have RIPTA service available. The service consists of 66 routes, including 52 local, 10 express, 3 crosstown and loop, and a special route. The local routes are located mostly in the urban areas of the state, and provide general mobility, with frequent stops along each route. The express routes are limited-stop routes that are designed to serve specific commuter-travel markets. The crosstown and loop routes connect neighborhoods with shopping and medical facilities and allow transfers to other bus routes. The special service focuses upon local schools.

The majority of local routes, especially those that serve more-urbanized areas, operate seven days a week; the rest do not operate on Sundays and holidays. The express and crosstown and loop routes operate only on weekdays. On weekdays, most service starts between 5:00 A.M. and 6:00 A.M. and operates until at least 7:00 P.M. Most routes serving the urban areas operate until 10:00 P.M. or later. On Saturdays, operation typically begins an hour later than weekday service but runs until the same time as its weekday counterpart. On Sundays, service typically begins later and ends earlier than on Saturdays. Service frequency on different routes ranges from seven to ninety minutes.

Nearly two-thirds of RIPTA service focuses on the Kennedy Plaza Transit Mall in downtown Providence, which serves as a major transfer point among routes. Other focal points for the service are located in Pawtucket, Woonsocket, and Newport.

RIPTA's fare structure is zone-based using four zones. The base fare is $0.85; the fare for trips to the other zones is $1.40, $1.65, and $2.50. A maximum fare of $3.50 is charged to passengers travelling to Westerly. The fare for trips within the Providence CBD is $0.25. Transfers cost $0.15. Books of tickets and monthly passes are sold to reduce riders' costs. Elderly and disabled people ride for free during off-peak periods, including weekends and holidays. Students also receive a discount.

RIPTA operates a fleet of 233 buses. The average fleet age is six years. The entire fleet is wheelchair-lift-equipped, except for small buses with bodies that resemble vintage trolleys.

Passenger facilities include those at the Kennedy Plaza Transit Mall, which has twenty-one boarding sites each with an enclosed shelter. RIPTA provides a total of 213 passenger shelters, and RIDOT and the City of Providence have also constructed shelters.

RIPTA provides four park-and-ride lots, and serves most of the twenty-seven park-and-ride lots throughout the state, twenty-five of which have been provided by RIDOT. These lots are free to users who wish to carpool, vanpool, or take a bus. The statewide average utilization of the park-and-ride lots is 42 percent, but it varies considerably by site. The highest usage recorded by RIDOT at any lot is over 100 percent of available capacity.

RIPTA operates from two garages. The larger one is on Melrose Street in Providence, which is the base for 201 buses. This is also the location of the administrative offices and a maintenance shop. The other garage, a leased facility in Middletown, houses 32 buses.

Because the roadway network that buses follow is different from the rail corridors, direct correlations between the existing bus routes and the study corridors are difficult. The differences in routes, along with the differences in operating conditions, mean that expected ridership on new services cannot be based upon existing ridership. However, many of RIPTA's routes serve the same travel markets that would be served by new public transportation services in the rail corridors. The bus routes can, in some cases, offer an indication of the market for public transportation ridership in the corridors. This is especially useful to consider in locations where existing ridership is highest.

Any new service on the Amtrak Shore Line would be oriented to longer trips and so would serve the same markets as the longer bus routes that now operate in this corridor. Those routes include the park-and-ride route that runs between Westerly and Providence, the Buttonwoods-Providence Express, the Jamestown-Providence route, the URI service, and Route 14 Wickford-Narragansett between Narragansett and Providence. Route 12 East Greenwich, between East Greenwich and Providence, might also be affected, although it serves shorter trips.

The Bristol Secondary corridor is now served by Route 36 Warren Avenue, which runs between West Barrington and Providence; the East Providence Crosstown Service; and the Newport-Bristol-Providence route. Route 36 has moderately high present ridership.

No RIPTA route now operates directly in the East Providence Secondary corridor. The area through which it runs is served by east-west routes, such as Route 76 Central Avenue and Route 77 Benefit-Broadway that carry trips into downtown Pawtucket where they can transfer to Route 98-99 Providence-Pawtucket, which is the second-highest-ridership route in the RIPTA system. The rail corridor could offer a more direct route to Providence for some of those trips. Further south, within East Providence, Route 38 Rumford-Tunnel is on the edge of the corridor.

The portion of the Harbor Junction that is in Allens Avenue is directly served by part of Route 3 Warwick Ave., but the rail corridor duplicates only a small part of the bus route.

In Newport, the existing bus routes focus upon the Gateway Center, as would any new service on the Newport Secondary. The rail corridor contains the Third Street Service route that connects to the Naval Station and the Newport Mall. It also contains parts of the Broadway, Gate #4 & Shopping Centers route, the route that connects to URI, and the Newport-Bristol-Providence route.

The Pontiac Secondary corridor follows the outer portion of Route 21 Reservoir and Route 22 Pontiac through the Rhode Island Medical Center and State Institution and near the malls. It is also close to a portion of Route 13 in Cranston.

RIPTA's 71 Broad Street-Lincoln Mall Service route parallels the P&W Main Line through Central Falls and Valley Falls. The rail corridor could serve the same market as Route 54 Woonsocket-Providence for trips that would travel the entire length of the route, although they are not close together for most of their length.

The Quonset Point-Davisville corridor would serve a small part of the route that is now served by RIPTA's Quonset Point Service, which is a route that connects to Jamestown and Newport.

The Washington Secondary corridor parallels Route 31 Cranston Street through much of Cranston, and it follows Route 13 Arctic-Washington through Arctic in West Warwick and Anthony in Coventry. Route 31 is one of RIPTA's higher-ridership lines. Other routes that serve parts of the rail corridor and that could provide similar service, depending upon how service from the corridor were routed into downtown Providence, include Route 18 Union Ave., Route 19 Westminster, and Route 27 Broadway.

Long-Distance Bus Service

Two private bus companies, Bonanza Bus Lines and Greyhound Lines, operate regularly scheduled long-distance service in the state.

Bonanza Lines operates service across a large area of New England; several routes serve Rhode Island. The base of Bonanza's operations in the state is a terminal located at Exit 25 from I-95 in Providence. All service to Providence stops at this location.

Two routes connect Providence to Boston. One route operates as an express between Providence and Boston with only one intermediate stop in Pawtucket. This route stops at Kennedy Plaza as well as the Bonanza terminal in Providence and at the Back Bay Station in Boston. In Pawtucket, the buses stop at the Dunkin Donuts at Exit 30 off I-95. The route is operated daily, with 19 trips in each direction. Eight northbound and seven southbound trips on this route also go beyond Providence to New York City, with no intermediate stops.

The other Providence-Boston route terminates at Logan Airport, and stops in both Pawtucket and Foxboro, Massachusetts. It, too, operates daily with 12 trips in each direction.

Another route connects New York City with Cape Cod and stops in Providence. It terminates at the Port Authority Bus Terminal in New York and at Hyannis, with other intermediate stops in New York State, Connecticut, Massachusetts. There are four trips in each direction through Providence each day, plus one in each direction that covers only the portion of the route between Hartford, Connecticut, and Providence and that operates only on Friday and Sunday.

Newport, Middletown, and Portsmouth are connected to Boston via a route that also stops at Fall River. Rhode Island is served by six trips daily in each direction on this route.

There is one Greyhound Lines route that passes though Rhode Island. The Greyhound station in Providence is located at 102 Fountain Street. The route connects Boston and New York City, with an intermediate stop in Providence, and other stops in Connecticut at New London, New Haven, Bridgeport, and Stamford, and in New York at White Plains and New Rochelle. There are three trips daily in each direction; all three serve Providence but not all trips serve all other intermediate stops. The travel time between Boston and Providence is an hour; between Providence and New York it is between four and five hours, depending upon the time of day and the number of other stops.

Commuter Rail Service

After a period in which no short-distance rail passenger service was operated in the state, commuter rail service was reinstituted in 1988. A single route is operated, an extension to Providence of a Boston route that had previously terminated in Massachusetts.

The service consists of four trips to Boston in the morning and one in the evening, and one trip to Providence in the morning and four in the evening. The terminal stations are Providence Station in Providence and South Station in Boston, and intermediate stops are made in Massachusetts at South Attleboro, Attleboro, Mansfield, Sharon, Canton Junction, Route 128, Hyde Park, Ruggles, and Back Bay, although not all trips stop at all stations. The service operates seven days a week, but the weekend schedule has less service; it extends to Providence only on weekdays.

The service is operated by the Massachusetts Bay Transportation Authority (MBTA) under the Pilgrim Partnership Agreement with the Rhode Island Department of Transportation. The Rhode Island DOT provided capital funds for the purchase of rail rolling stock, and in return, the MBTA operates the service. The operating agreement between the two parties extends until January, 1995. The Rhode Island DOT and the MBTA have begun discussing extension of the service beyond that date.

The fare for the trip from Providence to Boston is $4.75. Half fares are charged to senior citizens. A monthly pass is available for this trip for $136.00. Ridership on the line is over four thousand trips per week, about 425 people each day. In the past, it has exceeded five thousand.

3.4 Intercity Rail Passenger Service

Rhode Island is served by Amtrak service on the Northeast Corridor. The service extends to Boston at the northern end of the Corridor and to Washington, D.C. on the south. Some trains continue on beyond Washington to points south, and all trains offer opportunities for transfers to other Amtrak services in Boston, New York, and Washington.

The service through Rhode Island consists of ten trains in each direction each weekday. Two of the trips are New England Express trips that stop at fewer stations along the way. The weekend schedule is almost the same as the weekday schedule; a couple of trains do not run on weekends and a few others are added on weekend days. The travel time between Providence Station in Providence and Penn Station in New York City is about 4 hours, with intermediate stops at Kingston and Westerly in Rhode Island, Mystic, New London, Old Saybrook, New Haven, Bridgeport, and Stamford in Connecticut, and New Rochelle in New York. The express trains cut about three-quarters of an hour from the trip by stopping only at New London and New Haven. The travel time between Providence and South Station in Boston is 45 to 50 minutes, with stops at Route 128 and Back Bay Station. The express trains save about 5 minutes by allowing only boardings on the southbound trains and alighting from the northbound trains at the intermediate stations.

Recent ridership data from Amtrak show annual total ridership to and from Rhode Island of 385,616, more than three-quarters of which uses Providence Station.

3.5 Rail Freight Service

There are freight railroad services in some of the corridors that could affect the design or operations of passenger transportation services and facilities. Accommodating both existing freight services and a new rail passenger service on the same tracks would call for coordinated scheduling of both services, or could require that a new rail or bus facility be developed next to the existing tracks.

Information on the present freight service was obtained from Amtrak, which dispatches all trains on the Amtrak Shore Line, and from the Providence & Worcester Railroad, which is the predominant freight carrier in the state.

On the Amtrak Shore Line and the Harbor Junction Line, the P&W operates one freight train each weekday from the Valley Falls yard south to Davisville and back, operating during the day. Along the way, freight service is provided to Olneyville, the Port of Providence, the Warwick Industrial area, and other customers along the Amtrak Shore Line. At Davisville, it interchanges with the Seaview Railroad. Additional service along this line is anticipated, including double-stack containers and trilevel auto racks between Worcester and Davisville if clearances along the line are increased to accommodate the taller rolling stock and sufficient operating windows are provided.

The Rhode Island Department of Transportation is performing the Freight Rail Improvement Project, which will produce an environmental impact statement on freight rail improvements on a 22-mile segment of the Amtrak Shore Line between Boston Switch and Davisville. The purpose of the improvements is to provide improved, expanded, and flexible freight service along the corridor.

On the East Providence Secondary, there is one train each weekday, operating from the Valley Falls yard south to the Red Bridge and onto the East Junction, after which it returns to the Valley Falls yard. This train also operates during the day. Completion of the South Quay project is expected to increase substantially the volume of traffic, but the amount of the increase has not yet been determined.

One train also operates on the P&W Main Line. It operates north from Valley Falls Yard to Worcester at night and then returns in the early morning. It runs five days a week, making its first trip out on Sunday night and its last return trip on Friday morning.

3.6 Specialized Services within the Study Corridors

Specialized services that are different from the transportation services under study are operated in one of the study corridors. Although they are different, these services should be considered simply because they are within the area being studied.

The Newport Secondary Track is used by the Newport Star Clipper Dinner Train. Dinner is served on the train while it operates a round trip from a terminal on America's Cup Avenue in Newport to Common Fence Point in Portsmouth and back. The train operates in the evening and on some days at lunchtime. Some trips include entertainment as well as food service.

Since the purpose of the dinner train is luxury dining and nostalgia, its operation has little bearing upon the transportation markets under study. However, the operation of the dinner train could be complementary to the operation of a transportation service in the Newport Secondary corridor and could benefit from the upgrading of the trackage, structures, and support facilities.

The National Rail Foundation and Museum of Newport also operates a train on the Newport Secondary Track. This service is a sight-seeing train that operates over the same route as the dinner train. Like the dinner train, the market for the sightseeing train is different from the transportation services under study, but the operations could be complementary.

4
Conditions in the Study Corridors

Present conditions in the study corridors are important because they would affect the costs of developing public transportation facilities there. Those conditions were identified through field inspections in each of the nine corridors, supplemented by interviews with people who had specific information about the corridors.

4.1 Field Inspections

The purpose of the field inspections was to create a comprehensive, current, directly observed assessment of the conditions that would affect the types of construction that would be necessary. The first step was the development of a set of field inspection guidelines that would assure completeness and consistency of the work. Track charts and other information collected earlier in the study served as a basis for the data that the inspections produced.

The inspections were carried out by engineering inspection teams on portions of the corridors, typically at one- to two-mile intervals. Significant features found in the inspections, such as structures that would require major rehabilitation or locations of particularly serious problems, were photographed to create a visual record of the findings. The locations of roadway crossings and encroachments were noted. Data describing the existing conditions of the bridge structures within the nine rail corridors were also collected and documented. Maps of the corridors were created by adding the locations of existing tracks, wayside facilities, and structures onto U.S. Geological Survey maps, a standard base for displaying geographic information. The USGS maps were the most recent ones available. Some roadway configurations had changed since the maps were made, but this did not reduce their usefulness as a geographic reference. The resulting corridor maps are included at the end of this chapter. The map legend is Figure 4.1. All information gathered was collected in a technical report from which this description is extracted.

Subsequent to the field inspections, interviews were held with railroad and Rhode Island DOT personnel to supplement and verify the information collected in the field. Interviews were held with representatives from the Providence & Worcester Railroad to further fill in the gaps in information which existed at the completion of the data-collection task in the study, as well as to check the accuracy and completeness of the information collected. Interviews were conducted with DOT personnel pertaining to the physical condition, ownership, and existing use of the nine rail lines. Members of the Project Advisory Committee were also contacted in order to acquire additional information.

Assessment of conditions requires some standard against which to evaluate. In this study, the design standards represent the accepted practices of both mature and recent "start-up" systems in North America, viewed in light of the likely requirements for Rhode Island. Major sources of standards included two Massachusetts Bay Transportation Authority documents, *Railroad Operations—Book of Standard Plans—Track and Roadway* and *Specifications for Construction and Maintenance of Track.* Another reference was the new FRA Track Safety Standards, as published in *Progressive Railroading's 1992-1993 Track Yearbook.*

4.2 Existing Conditions

The conditions presented here for each corridor are its location, existing usage, ownership, and additional material describing the physical condition of the line, including its rail, ballast, ties, and right-of-way. Conditions described are those that existed at the time of the field inspections; some conditions may have subsequently changed. References to mileposts (M.P.) are keyed to the corridor maps in Figures 4-2 through 4-10.

Amtrak Shore Line

Existing Use: Amtrak intercity passenger service on Northeast Corridor route, MBTA commuter service on section north of Providence, and freight service.

Owner: National Railroad Passenger Corporation (Amtrak).

Location: From Westerly (M.P. 141) to Massachusetts border (M.P. 191).

Length: Approximately 49.7 miles, as shown in Figure 4-2.

Rails: In excellent condition, 140-lb. welded rails.

Ballast: Full bed of crushed stone.

Drainage: Satisfactory.

Ties: In excellent condition; concrete ties.

Grade Crossings: One existing vehicular grade crossing at Wolf Rocks Road in Exeter. The elimination of this grade crossing is currently under design by RIDOT.

Train Control: Directional automatic system is being converted to full centralized traffic control (CTC) from Boston.

Bridges/Structures: 75 overhead bridges and 40 track bridges.

Right-of-Way: Adequately maintained.

General Assessment: Presently rated in excess of FRA Class VI (110 mph); no improvements except terminal station arrangements required for additional passenger service.

Bristol Secondary Track

Existing Use: Majority of line converted to interim use as a bike path; remaining track inactive (from M.P. 0.00 to M.P. 4.00).

Owner: Rhode Island Department of Transportation

Location: Extends from the vicinity of North Main Street in Providence (M.P. 0.00) to Independence Park in Bristol (M.P. 15.37).

Length: Approximately 16 miles, as shown in Figure 4-3.

Rails: No track found south of the Squantum Point area of East Providence (M.P. 4.5). Rails in poor condition with evidence of wear on remaining portion of line. Rail is overgrown with vegetation near M.P. 1.0 in Providence.

Ballast: Crushed stone; completely washed away at numerous locations, particularly near M.P. 1.0 in Providence and M.P. 4.5 near Squantum Cove.

Drainage: Particularly poor in the area of M.P. 1.0 (East Side Rail Tunnel) and M.P. 2.0 (Washington Bridge); drainage ditches on both sides of track filled with dirt and vegetation.

Ties: In very poor condition near M.P. 1.0; less than 1 percent in useable condition. Ties in slightly better condition near M.P. 4.5; about 10 percent in useable condition.

Grade Crossings: Rails were below surface of asphalt in the vicinity of M.P. 2.0 (Mauran Avenue). Signal equipment in place.

Train Control: None, track is inactive.

Bridges/Structures: Complete inspection of East Side Rail Tunnel not completed; filled with water. Drawbridge over Seekonk River in fair to poor condition, particularly superstructure.

Right-of-Way: Adequately maintained as bike path south of M.P. 4.5.

General Assessment: Major rehabilitation (replacement of existing rails and installation of new rails on southern portion) would be necessary in order for this line to be used for passenger service.

East Providence Secondary Track

Existing Use: Freight service operated by P&W Railroad.

Owner: Rhode Island Department of Transportation.

Location: Extends from Valley Falls Yard (M.P. 0.00) in Cumberland to Crook Point (M.P. 7.0) in East Providence.

Length: Approximately 7 miles, as shown in Figure 4-4.

Rails: In poorer condition in portion of line south of M.P. 3; rails in northern portion of line in fair to good condition near M.P. 1.

Ballast: Crushed stone, completely washed away at numerous locations, particularly between mileposts 3.5 and 7.0 (Pawtucket Avenue) and in the vicinity of M.P. 2.0 (Cottage Street).

Drainage: Particularly poor in the area of I-195; drainage ditches on both sides of track filled with dirt and vegetation.

Ties: Fair to poor condition throughout line (M.P. 0.00 - M.P. 1.0). Approximately 40 percent in marginally useable condition on northern portion. On the southern portion of the line near Pawtucket Avenue, approximately 60 percent of ties in marginally useable condition.

Grade Crossings: Rails were below surface of asphalt in the vicinity of M.P. 2.0; improvements for these grade crossings are contained in the state's Transportation Improvement Program (TIP). Signals in place and operating near I-195.

Train Control: Train order.

Bridges/Structures: Generally in fair condition. Vertical clearances appear to be adequate for existing use. Six bridges inspected ranged from poor to good condition. Bridge over Ten Mile River in Phillipsdale (MP 4.95) in particularly poor condition. Single span bridge in Valley Falls (M.P. 0.95) in poor to fair condition.

Right-of-Way: Adequately maintained.

General Assessment: Major rehabilitation (replacement of existing rails) would have to be completed in order for it to be utilized for passenger service.

Harbor Junction Industrial Track

Existing Use: Limited active freight service on southern branch near Route 1A.

Owner: City of Providence

Location: Runs between Amtrak's Shore Line in Cranston (M.P. 0.00) and the intersection of Allen's Avenue and Crany Street in Providence (M.P. 2.38).

Length: Principal line less than three miles in length, as shown in Figure 4-5.

Rails: Rail is in generally poor condition, with extensive wear. Portion of rail on southbound branch near Route 1A is active and is rated FRA Class 1. Much of the rail on the northern branch is abandoned and paved over along Allen's Avenue.

Ballast: Washed away at many locations on the main line as well as on the active southern branch near Fields Point.

Drainage: Track set in pavement along Allen's Avenue. Satisfactory drainage between M.P. 0.00 and Broad Street (M.P. 0.88).

Ties: In roadway set in concrete; poor condition.

Grade Crossings: At all grade crossings, the level of the rail was below the level of the asphalt. Some existing signal equipment.

Train Control: Train order.

Bridges/Structures: Elmwood Avenue bridge has suffered damage, but the capacity of the structure appears to be unaffected. Broad Street and Eddy Street bridges in good condition.

Right-of-Way: No encroachments noted. Vegetation growing in right-of-way.

General Assessment: This line would need major reconstruction in order to achieve reasonable operating speeds for passenger service.

Newport Secondary Track

Existing Use: Tourism/excursion services operate over southern portion of this line. No direct route to Providence exists.

Owner: Rhode Island Department of Transportation.

Location: Extends from the Massachusetts border at Tiverton (M.P. 14.2) to Newport (M.P. 30.5).

Length: Approximately 16.3 miles, as shown in Figure 4-6.

Rails: Worn and misaligned (M.P. 14.24 to M.P 17) in Tiverton; here track is generally not maintained. As the line enters Portsmouth, the rail is in better condition; limited maintenance is undertaken. Rail from Goat Island Connector Road to Washington Street in Newport was removed for construction of the Newport Gateway Transportation Center.

Ballast: Washed away at various locations, particularly to the north in Tiverton and Portsmouth. Ballast is missing completely in the area of Bridge Street in Newport (M.P. 30).

Drainage: Poor, with erosion and evidence of washouts from M.P. 14.24 to M.P. 17 in Tiverton, and in the area of M.P. 19 in Portsmouth. Poor drainage also found near Mount Hope Bridge (M.P. 20.14).

Ties: Approximately 20 percent in useable condition. In particularly poor condition in the area of Milepost 19, where about 6 percent of ties are in useable condition.

Grade Crossings: 28 at-grade public crossings on this line. Pavement is over rail at grade crossings in the area of M.P. 19 in Tiverton. Signalization found at grade crossings.

Train Control: Train order.

Bridges/Structures: Many bridges along the northerly portion of this line (particularly in the Town of Tiverton) are in need of superstructure replacement (i.e. Riverside Rd.(M.P. 16.94) and Sakonnet River (M.P. 17.08)). Many bridges along the southern portion of the line appear to have been rehabilitated.

Right-of-Way: Growth of vegetation in right-of-way found near M.P. 17 and M.P. 19. Right-of-way being maintained from M.P. 20 in Portsmouth to M.P. 30 in Newport.

General Assessment: Major reconstruction of this line, including the Sakonnet River bridge, would be required in order to use this line for passenger service. Additional reconstruction would be required in Massachusetts to establish a connection to the national network.

Pontiac Secondary Track

Existing Use: All freight service beyond M.P. 1.21 currently abandoned on this line.

Owner: Providence & Worcester Railroad and Amtrak.

Location: Extends from Amtrak Shore Line in Cranston (M.P. 0) to its terminus at Greenwich Avenue in the City of Warwick (M.P. 5).

Length: Approximately 5 miles, as shown in Figure 4-7.

Rails: Extensive wear apparent particularly between M.P. 0.00 and M.P. 1.53, where misalignment was also evident. Portions of sidings near M.P. 2.94 (Route 37) being removed. Rail has been removed from the Cranston-Warwick city line (M.P. 4.36) to Greenwich Avenue (M.P. 5.0) in Warwick.

Ballast: Gravel and crushed stone, completely washed away in many locations, particularly between M.P. 0 and M.P. 1.53.

Drainage: Satisfactory, with some vegetation evident in drainage ditches. Some drainage problems evident between M.P. 0.00 and M.P. 1.53.

Ties: Approximately 10 percent in useable condition, with ties in particularly poor condition between M.P. 0 and M.P. 1.53.

Grade Crossings: At Forest Avenue (M.P. 1.53) grade crossing, the level of the rail was below the level of the asphalt. Grade crossings at Pontiac Avenue (M.P. 2.15) and Sockanosset Road (M.P. 2.74) in good condition. Crossing signals also in good condition.

Train Control: None.

Bridges/Structures: I-95 (M.P. 1.31) and Pawtuxet Valley bridges are in good condition. 2-span timber bridge at Forest Avenue (M.P. 1.53) in poor condition. Pocasset River bridge (M.P. 2.05) also in poor condition.

Right-of-Way: New industrial park construction is encroaching on right-of-way in the City of Warwick. No maintenance being carried out on portions of right-of-way included in field inspections.

General Assessment: This line would need to be completely replaced in order to accommodate rail passenger service.

Providence & Worcester Main Line

Existing Use: Primarily used for freight service and intermittently for passenger excursions.

Owner: Providence & Worcester Railroad.

Location: Runs southeast from the Massachusetts state line in Woonsocket (M.P. 17.73) to Amtrak's Shore Line (M.P. 5.0).

Length: Approximately 12.5 miles, as shown in Figure 4-8.

Rails: Generally in worn but useable condition; worn rail particularly evident near M.P. 5 in Valley Falls.

Ballast: Stone, washed away in many locations, particularly near M.P. 5 in Valley Falls, M.P. 6.7 near Broad Street, and M.P. 8.4 in Berkeley. Ballast at M.P. 9.5 (Route 116) in good condition.

Drainage: Satisfactory. Maintenance being carried out on drainage ditches near M.P. 6.7. No serious drainage problems.

Ties: In better condition on the northern portion of the line (Woonsocket-Hamlet Avenue and Lincoln-Manville Road) where as many as 60 percent are in useable condition. Further to the south (Valley Falls-Broad Street and Cumberland-Route 116) approximately 25 percent in useable condition.

Grade Crossings: Many grade crossings have been rebuilt over the past ten years. At the Martin Street grade crossing in Cumberland (M.P. 8.4), pavement is over the surface of the rails.

Train Control: Train order, except for the junction with the Shore Line.

Bridges/Structures: 25 bridges inspected; many in poor condition (defined as extensive repairs and/or replacement of members required), such as Manville Passway bridge (M.P. 12.33) and the Albion bridge (M.P. 10.94).

Right-of-Way: No encroachments noted. Maintenance being carried out to the right-of-way on this line.

General Assessment: Although this line is in a general condition that is acceptable for the present freight operations, substantial rehabilitation would be necessary to accommodate passenger operations.

Quonset Point/Davisville Industrial Track

Existing Use: Freight service presently operated by Seaview Transportation Company.

Owner: Rhode Island Port Authority and Economic Development Corporation.

Location: Entire line is located in the Town of North Kingstown.

Length: 26 miles of track on a main line of four route miles with spur lines, as shown in Figure 4-9.

Rails: Signs of wear at various locations on the main line and the main auxiliary lines.

Ballast: Washed away at various locations on the main line and the auxiliary lines.

Drainage: Poor, with erosion and evidence of washouts.

Ties: Approximately 50 percent in useable condition on main line and auxiliary lines.

Grade Crossings: Eight existing public at-grade crossings, two signalized.

Train Control: Train order.

Bridges/Structures: Post Road bridge only bridge structure inspected; appeared to be in good condition.

Right-of-Way: No encroachments noted.

General Assessment: Major rehabilitation of this line would be required for use of the track for passenger service.

Washington Secondary Track

Existing Use: All freight service presently abandoned on this line.

Owner: Providence & Worcester Railroad and the Town of Coventry.

Location: Extends from the southwest corner of the City of Providence (M.P. 0.00) to the Town of Coventry (M.P. 14.31).

Length: Approximately 14.5 miles long, as shown in Figure 4-10.

Rails: Completely removed from M.P. 0.00 in Providence to M.P. 10 near Route 117 at the West Warwick/Coventry town line. Rails on portion of line from M.P. 10 to the terminus are in very poor condition.

Ballast: On portion of line with tracks, remaining ballast has been washed away at many locations. Much of the ballast in the area of M.P. 10 in Coventry has been completely washed away near Route 117 and the Pawtuxet River bridge.

Drainage: Poor between M.P. 6 and M.P. 10, with signs of erosion and washouts evident.

Figure 4-1
Legend

5 Selection of Corridors for Detailed Study

To assure that the resources available for this study would be most effectively used, the nine initially identified corridors were screened to select the ones that demonstrate the greatest potential for feasibility. Detailed analysis in this study would be performed only on that smaller group. The screening was designed only as an evaluation tool for this study; corridors not selected for detailed analysis could still be considered for transit system improvements in future planning efforts that would consider the interconnection of multiple lines in a regional system.

5.1 Basis for the Selection

Information to support the selection was developed by the consultant team, which recommended corridors for selection. After the recommendations were reviewed by the Project Advisory Committee, the Rhode Island DOT selected the corridors for study. The information developed to support the selection included two basic factors related to feasibility—potential ridership market and characteristics of the right-of-way.

Ridership is the most important factor in determining the feasibility of any public transportation system, as it is a measure of the benefits that the system would produce. One reason that ridership is important is the value for the overall transportation system that higher ridership can create. If the use of a public transportation line can reduce the need for other transportation investments, such as highway improvements, there is a greater justification for the development of the public transportation line. Ridership is also important for financial reasons, as ridership is the source of operating revenues from fares. Finally, ridership is important in judging the societal benefits of a project. The projects that serve the highest number of people are those that are the most appropriate for the use of limited public funds.

Because ridership is so important, it is a central factor in all public transportation planning. For example, guidelines established by the Federal Transit Administration require that there be 15,000 present public transportation riders per day in a corridor to justify a request for federal funds to support detailed planning for a fixed-guideway project. After such planning is finished and federal funds are requested to build a major public transportation project, the measures that the FTA uses to evaluate that funding request include only ridership and cost. FTA policy reflects the view that ridership is the prime measure of the benefit of a public transportation investment, and serves as an adequate surrogate for other benefits such as congestion reduction and air quality improvement.

Characteristics of the right-of-way are also important because they affect the cost of establishing a public transportation project. A new line would be least expensive to develop in a corridor that had an intact right-of-way with physically sound structures, that was oriented to the locations where ridership demand would exist, and that could accommodate a public transportation line in addition to existing functions. By contrast, a line would be more expensive to develop in a corridor that would require acquisition of new rights-of-way, construction of new structures, replacement of existing ones, and creation of new links in the alignment. Obviously, the less the cost of a project, the greater the probability of its feasibility.

This evaluation reflects the interaction of both of these factors. For example, a corridor that had moderate ridership potential might still be considered a candidate for development if the characteristics of the corridor would allow inexpensive development of a public transportation facility.

By its nature, the corridor selection process was not a detailed analysis. Because the purpose of the selection was to allow study resources to be devoted to the strongest candidates, the selection process uses broad, simple measures that did not require time-consuming analysis. These methods are described as sketch-planning techniques.

Because the selection process used sketch-planning techniques, it could not reflect several factors that would clearly be important in the actual development of a public transportation facility. One is community consensus. At this early stage in the analysis, the characteristics of the facility that could be built in each corridor are not yet defined. There is no way to gauge community acceptance of a facility for which the characteristics are not yet known. Developing consensus will require involvement of the groups and neighborhoods that would be affected; this must occur during the further planning that would be required for project development. A second factor is the range of environmental and institutional constraints that could preclude project development. These constraints were addressed in the more-detailed analysis of the selected corridors, but were not considered in corridor selection.

5.2 Method of Evaluating Potential Ridership Market

Ridership was evaluated by defining the potential market for public transportation services in the corridors, rather than through the development of precise ridership estimates. This level of detail is consistent with the sketch-planning approach.

Evaluation of the ridership market was a two-step process. The first step was an analysis of travel patterns in the state. Transportation data showing projected volumes of trips in 2010 were obtained from the Planning Division of the Department of Administration. The data describe trip patterns by indicating the municipalities in which each trip begins and ends. Using a computerized transportation model, trips were assigned to a hypothetical transportation system that included all nine rail corridors under consideration to see which corridors are in locations that have the highest trip volumes.

The resulting information is useful in defining transit potentials by showing the relative travel demand in the corridors, but it does not necessarily reflect the ability of public transportation to attract those trips. These travel projections cannot offer precise indications of public transportation ridership potential because the projections tabulate the trip ends at a relatively large geographic scale. Municipalities are too big to provide much information about the how close a trip end is to one of the corridors, and public transportation trips are particularly sensitive to access to a line.

Attracting ridership to a public transportation line requires concentrations of development at or near the stops. Residential development must be within easy access by car, by feeder bus, by bicycle, or by walking. Commercial development must be even more concentrated, because most people must walk between public transportation stops and their jobs or shopping. The higher the quality and construction cost of the line, the larger the ridership needed to justify the investment, and the larger the concentration needed to create that ridership.

To provide greater information at a finer geographic scale, the second step in the process supplemented the transportation data with information on land-use characteristics. Land-use data were available for census tracts, which are much smaller geographic areas and so can reflect the conditions within a shorter distance of each rail corridor. The land-use data show the number of trip generators and attractors that would be served by a public transportation line.

The land-use characteristics in the nine corridors were compared against guidelines for threshold characteristics that are considered necessary to justify different types of public transportation service. Shown in Table 5-1, these guidelines were developed by the Institute of Transportation Engineers to reflect typical conditions. Because they are guidelines, they cannot be used as precise planning tools. A given situation might be atypical in a way that the guidelines could not reflect. For this reason, the guidelines should not be used as the only basis for judging whether a particular service or project should be put into place, and they were not used for that purpose in this study. They are, however, appropriate for comparisons among the corridors for study.

5.3 Results of Ridership Market Evaluation

The results of the first phase of the analysis, the identification of the pattern of travel volumes that was created by assigning the projected 2010 trip volumes to the transportation network that includes the rail lines, are shown in Figure 5-1. In the figure, the width of the line in each study corridor indicates the travel volume in the corridor. The figure shows that the largest trip volumes occur in the areas surrounding downtown Providence, especially in those corridors to the south.

In the second phase of the analysis, employment patterns were displayed on a map that includes all of the rail lines in the state, shown in Figure 5-2. The data show the number of employees as well as employees per acre. The employment data used are 2010 projections developed by the Rhode Island Department of Administration, since that is the best available source of information on future employment in the state.

The figure shows both the largest concentrations of employment, which is the measure used in the guidelines, as well as other areas in the state with lower numbers of employees. Each concentration is shown by a dot, the size of which corresponds to the number of jobs in that location. Since the employment data were expressed in numbers of employees, those data were converted to square feet of nonresidential development in each of the concentrations, to allow comparison with the guidelines. The conversion used the rate of 250 square feet per employee, which reflects typical space use in commercial buildings. In areas outside the concentrations, employment is shown by census tracts that are shaded to reflect the density of employment located there. Downtown Providence is the largest concentration of employment in Rhode Island. The three census tracts that include the state capitol complex, the financial district, the retail core, the jewelry district, and the university area are projected to have employment of almost 65,000 jobs in 2010. Those jobs translate to about 16.2 million square feet of nonresidential space, above the threshold for intermediate bus service but below the threshold for frequent bus service or light rail.

Table 5-1
General Thresholds for the Initiation of Transit Service

A minimum level of local bus service (20 daily bus trips in each direction or one bus per hour) is often provided in residential areas averaging 4-5 dwelling units per acre. Typically, these residential densities correspond to gross population densities of 3,000-4,000 people per square mile. This level of bus service is suitable for non-residential concentrations of activities in the range of 5-8 million square feet of floorspace, occasionally lower.

An intermediate level of local bus service (40 daily bus trips in each direction or one bus every half hour) is often provided in residential ares averaging 7 dwelling units per acre (5,000-6,000 people per square mile) and for non-residential concentrations of activities from 8-20 million square feet.

A frequent level of local bus service (120 daily bus trips in each direction or one bus every 10 minutes) is often provided in residential areas averaging 15 dwellings per acre (8,000-10,000 people per square mile) and for non-residential concentrations of activities from 20-50 million square feet.

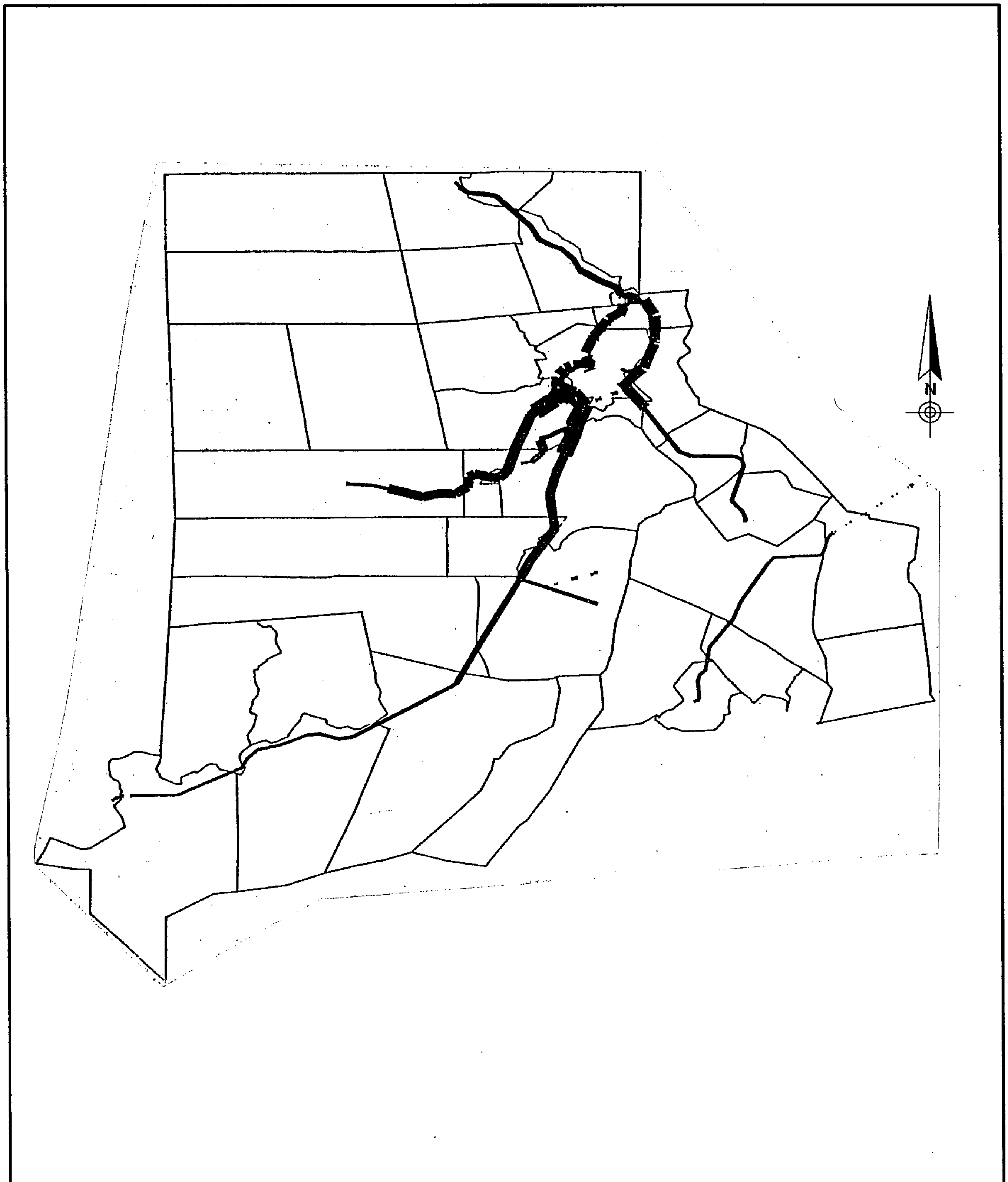
Once we move into the range of land use activities found in the frequent level of service range, the speed of bus service tends to decline rapidly due to on-street congestion and more frequent pick-up/drop-off of passengers. If routes are of considerable length, the attractiveness of such slow service can decline rapidly as well. Thus, at non-residential concentrations in the 20 million square foot range and above, faster transit service is called for. One way of achieving this without resorting to different technology is to create express bus service, thereby avoiding local traffic. Such service can be further speeded up if exclusive rights-of-way are provided.

Express bus service can operate in two distinct ways. If the express bus route circulates in a residential area with most riders accessing the bus by walking to bus stops, the bus will suffer from added costs because of the added operator time involved and lower revenues because the service will not be as attractive to the potential rider. If the express route boards riders at only a few designated locations—with park-and-ride lots to promote concentrated pick-up points—the service may be more attractively operated from both the operator and rider perspective.

Light rail transit is most suitable for service to non-residential concentrations of 35-50 million square feet. If rights-of-way can be obtained at grade, thereby lowering capital costs, this threshold can be lowered to the 20 million square foot range. Average residential densities of about 9 dwelling units per acre over the line's catchment area are most suitable. For longer travel distances where higher speeds are needed, rapid transit is most suitable for non-residential concentrations beyond 50 million square feet and in corridors averaging 12 dwelling units per acre or more.

Commuter rail service, with its high speed, relatively infrequent service (based on a printed schedule rather than regular headways), and greater station spacing is suitable for low density residential areas—1-2 dwelling units per acre. However, the volumes required are only likely in corridors leading to non-residential concentrations of 100 million square feet or more, found only in the nation's largest cities.

Source: *A Toolbox for Alleviating Traffic Congestion*, Institute of Transportation Engineers, 1989, pg. 93.

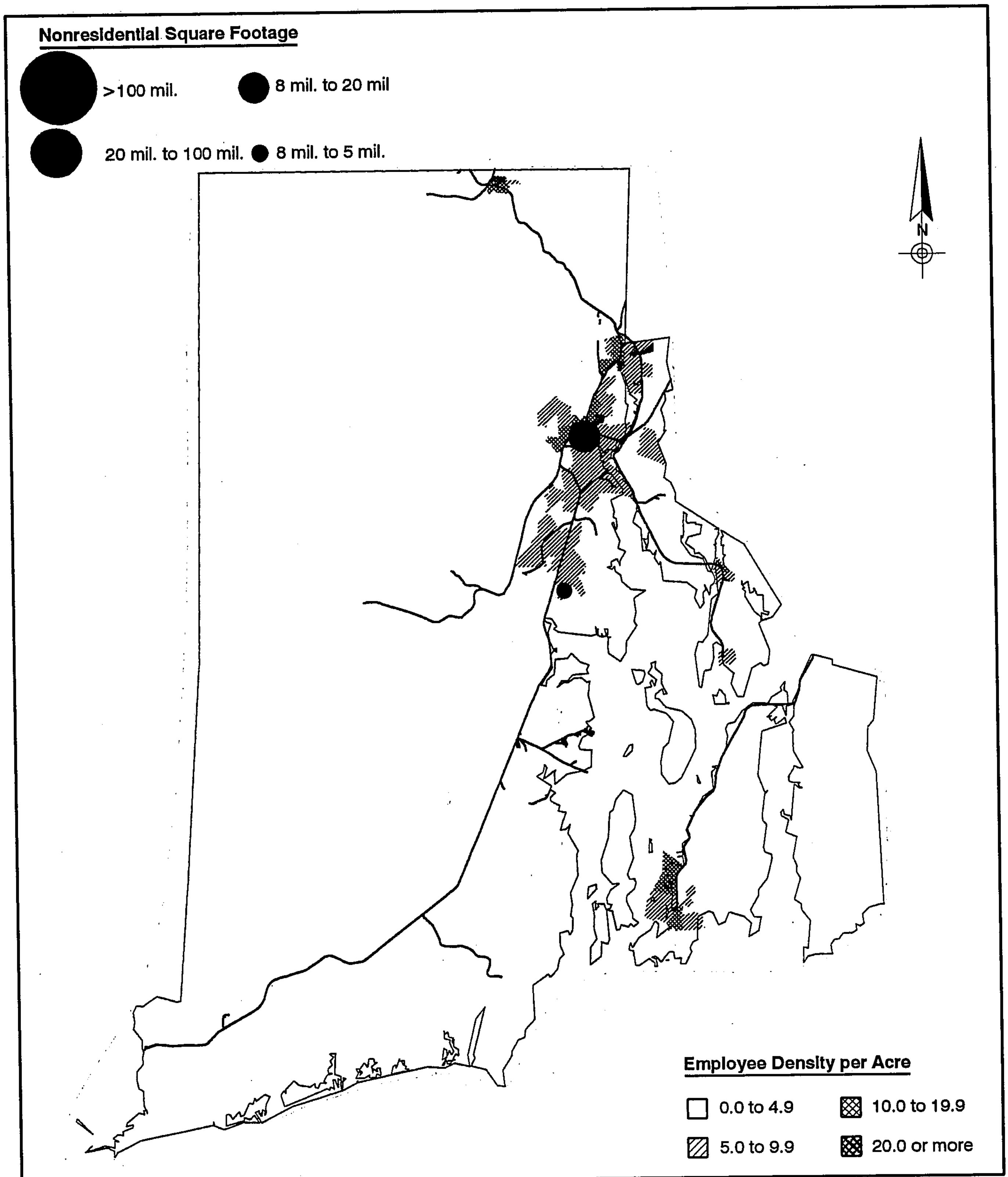


RAIL CORRIDOR FEASIBILITY STUDY
RHODE ISLAND DEPARTMENT OF TRANSPORTATION

BARTON-ASCHMAN ASSOCIATES, INC
WASHINGTON, DC

FIGURE 5—1
Relative Public Transportation Markets in Study Corridors

SCHEMATIC



RAIL CORRIDOR FEASIBILITY STUDY
RHODE ISLAND DEPARTMENT OF TRANSPORTATION

BARTON-ASCHMAN ASSOCIATES, INC
WASHINGTON, DC

FIGURE 5–2
Employment by Census Tract

SCHEMATIC

The only other employment location that meets the requirements in the guidelines is in Cranston and Warwick, near and including T.F. Green Airport. The three census tracts in this area are projected to account for almost 31,000 jobs, or about 7.7 million square feet of nonresidential space. Because these census tracts are larger, the jobs would be less concentrated so that their average density would be only about one-tenth that of central Providence.

No other location within Rhode Island has a large enough projected concentration of employment to meet the guidelines. However, other locations have smaller amounts of employment as shown by the shaded tracts.

Residential patterns were displayed on the same map showing all of the rail lines in the state, shown in Figure 5-3. The density data are shown in households per acre, since the number of households has the highest correlation with trip generation. The residential data used are 1990 Census data. Census data were used because they include information on households; available forecasts of 2010 data do not. The use of 1990 data is not a serious drawback since the state population is projected to increase only 5.6 percent from 1990 to 2010, from 1,003,464 to 1,059,706.

The intervals that were selected for displaying the density data are generally related to the guidelines for justifying public transportation service cited above. The highest-density areas shown are those above 12 households per acre, indicating the areas that could meet the frequent-bus-service threshold. The next-highest category is six to 12 households per acre, covering both the intermediate-bus threshold and the light-rail threshold. The category of three to six households per acre reflects the household density indicated for minimum bus service. Finally, the category of less than three households per acre shows the areas that are below the threshold for even minimum bus service, but could be considered for commuter rail service if they could be linked to a suitable employment concentration. Obviously, an area that meets a higher threshold would also meet a lower one; for example, an area that would justify light rail would also justify at least minimum local bus service.

The only areas that meet the highest-density residential threshold are in the West End area of Providence and in part of Central Falls. The next-highest threshold, the level that the guidelines indicate would be needed to support light rail, is met by several areas in Providence, including the East Side, the North End, Silver Lake, Olneyville, Smith Hill, Elmhurst, and Mount Hope. Other areas that meet this threshold are in Pawtucket, Central Falls, Woonsocket, Bristol, and Newport. The next-lower household density threshold, which is for minimum local bus service, is met by broader areas within several cities.

The Project Advisory Committee reviewed this analysis and recommended that the data be refined to compensate for large undevelopable parcels of land, such as T.F. Green Airport. The Committee suggested that such a parcel would lower the calculated density for the census tract in

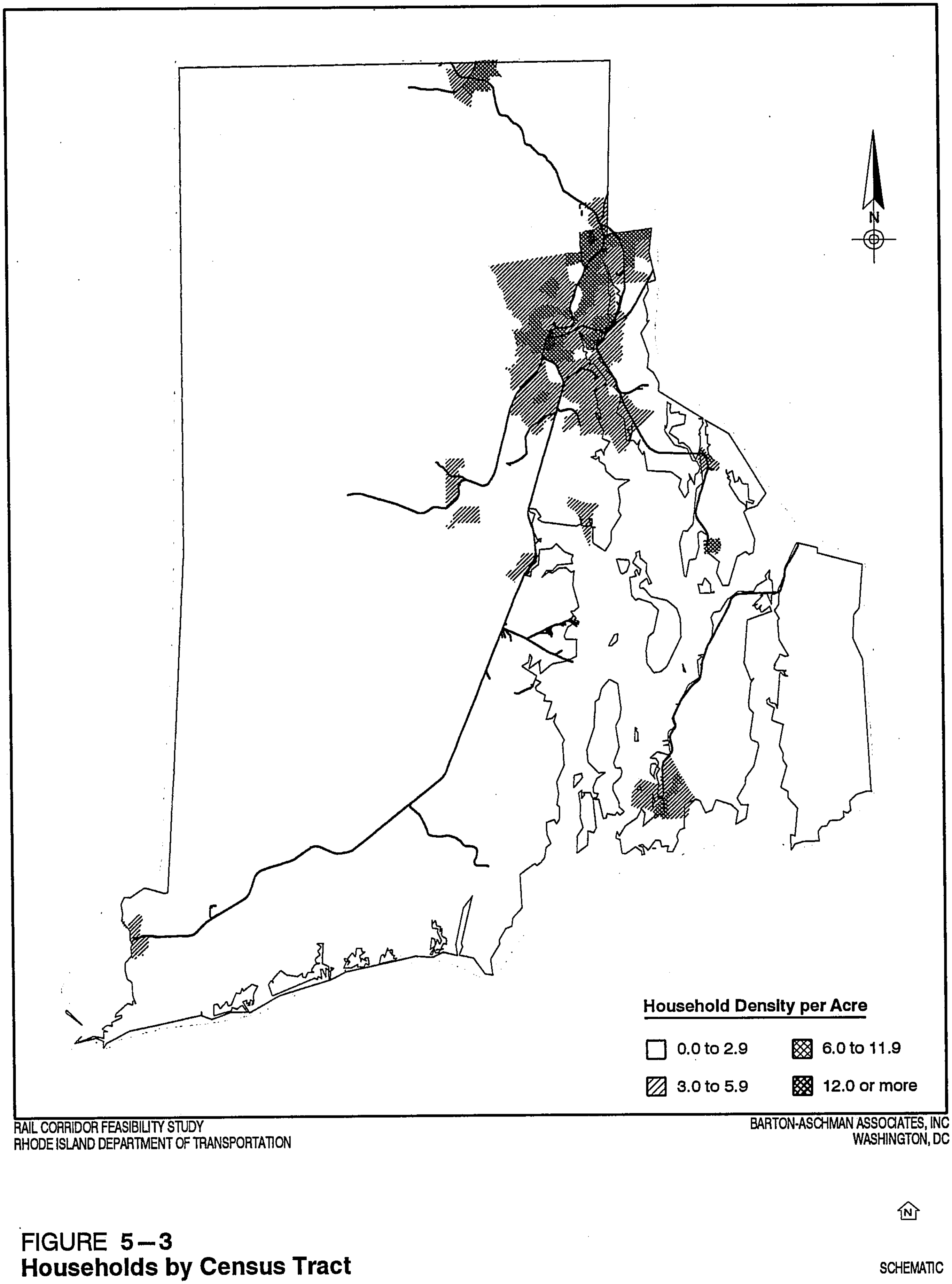


FIGURE 5—3
Households by Census Tract

which it is located, and so present a misleading picture of the nature of the development in the balance of the tract. The Committee's recommendation was followed; the analysis was revised to delete large undevelopable areas. Maps and census data were reviewed to identify large tracts that would affect the calculated density—airports, cemeteries, parks, and wildlife management areas. The land areas of those tracts were subtracted from the areas of the census tracts, and densities were recalculated. Figures 5-2 and 5-3 show the revised densities.

An assessment of the potential of the corridors requires that both the employment information in Figure 5-2 and the residential population information in Figure 5-3 be taken into account, because public transportation requires concentrations of both employment and residential development. To be a high-ridership-potential location for a public transportation facility, a corridor must serve both an employment concentration and high-density residential areas; serving only one is not sufficient.

5.4 Characteristics of the Study Corridors

As with the potential ridership market, the analysis of the conditions in the corridors was a general assessment, intended to consider only as much detail as would be necessary to guide corridor selection. Corridor conditions were defined by a general measure of the difficulty of introducing new public transportation facilities and services there. Estimation of that difficulty was determined by whether additional right-of-way would be needed to extend the existing line to reach important travel generators or to create adequate width for new facilities. The degree to which existing structures would have to be rebuilt to accommodate a public transportation line was also a factor.

The findings from the field inspections described in the preceding chapter were used as the basis for determining the characteristics of the corridors. The information from the inspection was generalized into three categories of difficulty of implementation—simplest, moderately difficult, and most difficult.

Difficulty of implementation was judged separately for three different public transportation technologies because the characteristics and right-of-way needs are different for each. A more-detailed description of the characteristics of the technologies will be included in a later chapter.

The results of this analysis are shown in Table 5-2.

Table 5-2
Difficulty of Implementation

Corridor	Commuter Rail	Light Rail	Busway
Amtrak Shore Line	○	●	●
Bristol Secondary	⊗	⊗	⊗
E. Providence Secondary	⊗	⊗	●
Harbor Junction Industrial	⊗	●	●
Newport Secondary	○	⊗	⊗
Pontiac Secondary	○	⊗	⊗
P & W Main Line	○	●	●
Quonset Point Industrial	○	⊗	⊗
Washington Secondary	○	⊗	⊗

○ Simplest
⊗ Moderately Difficult
● Most Difficult

5.5 Selected Corridors

The results of the assessment of the corridors and the selection for further study are described below and are shown in Table 5-3.

Table 5-3
Corridors Selected for Further Study

Shore Line	Yes
Bristol Secondary	Yes
E. Providence Secondary	Yes
Harbor Junction Industrial	No
Newport Secondary	Yes
Pontiac Secondary	No
P & W Main Line	Yes
Quonset Point Industrial	No
Washington Secondary	Yes

The Amtrak Shore Line was selected to receive further study because it lies in a corridor of high travel volumes, it connects to the major activity centers of downtown Providence and Boston, and is already in excellent condition for commuter rail service.

The Bristol Secondary Track was studied because it passes through some moderately high-density neighborhoods in East Providence and has the opportunity to reach downtown Providence through the East Side Rail Tunnel. It has the advantage of no present rail service on the line, allowing the institution of passenger service without conflicts with freight operations. It also has drawbacks, including the complication of accommodating both a bikeway and a public transportation facility over part of the line, and the need to develop a connection between the west portal of the East Side Rail Tunnel and the heart of downtown Providence.

The East Providence Secondary Track was included in the corridors to be studied because, like the Bristol Secondary, it could use the East Side Rail Tunnel, and it would serve even higher-density and higher-travel-volume areas. Although it carries freight service, the amount of that service is small enough that passenger service could also be accommodated. Also like the Bristol Secondary, this line shares the disadvantage of the need for a downtown connection from the west portal of the East Side Rail Tunnel.

The Harbor Junction Industrial Track was not selected to be studied. Because the line is short, it would function primarily as a means of entry into downtown Providence from the Shore Line or the Pontiac Secondary. The Shore Line already has access to downtown and does not need the addition of another right-of-way. The Pontiac Secondary Track is not recommended for more-detailed study, as described below. The feasibility of the Harbor Junction Industrial Track to be a part of an improved public transportation system could be improved if other rights-of-way, such as arterial highways, are included in planning for major public transportation facilities in the future.

The Newport Secondary Track was selected to be studied in more detail. Although the line does not serve areas of high travel volumes, and it serves no major employment concentrations, it has the potential to be connected to a Massachusetts commuter rail line that may be extended to Fall River. The potential to connect to Boston suggests that there may be larger regional-system reasons for developing more information about this corridor.

A variation on the Newport Secondary that would connect to the Bristol Secondary was also included in the study. The Newport-Bristol Combination would offer some of the advantages of each corridor, and would create a connection between Newport and Providence. A new connecting link between the two railroad corridors would need to be defined.

The Pontiac Secondary Track was not studied in more detail. Although this line would allow access to major regional shopping centers, the adjacent land uses do not include much residential development, limiting the potential ridership market. Further, the ridership shed that the line would serve overlaps that of the Washington Secondary Track, which, as noted below, is a better candidate for study. The Pontiac Secondary Track could be feasible as a part of a public transportation system that included other nonrailroad rights-of-way.

The Providence & Worcester Main Line was included in the lines to be studied in more detail. The southern portion of the corridor within Valley Falls is both densely developed and would have access to central Providence via either the East Providence Secondary or the Amtrak Shore Line. Along most of the corridor, there is little residential development, but portions of Woonsocket show higher-density patterns. One drawback is that the level of freight service on the line may require major construction to accommodate passenger service in much of the corridor, construction that would be difficult because of the location of the existing trackage in the valley of the Blackstone River.

The Quonset Point-Davisville Industrial Track was not selected for more-detailed study. The lack of residential development in the areas served by the line would produce little ridership. Although there is a major employer at the east end of the line, the number of employees there is not large enough to support a major public transportation facility. Other employment in the developing industrial park is quite spread out and difficult to serve by public transportation. Since the line is short, it could function as a public transportation facility only if it were connected to another line. The Amtrak Shore Line, which was selected for further study, presents the opportunity for such a connection. Service to the Quonset Point-Davisville Industrial Park, taking into account both the Quonset Point Industrial Track and the Amtrak Shore Line, was considered further in a separate study, allowing the consideration of more than the set of alternatives included in this study and their relationship to a wider regional network.

The Washington Secondary Track was included in those to be studied in more detail. It would serve trips between Providence and parts of Cranston, Warwick, and West Warwick, which constitute some of the higher trip-interchange volumes in the state. It could serve the highest-density residential areas in Providence, depending upon how the line is connected to downtown Providence. The corridor could accommodate public transportation facilities since there is no rail service there, but this corridor has the disadvantage of no existing direct connection into downtown Providence, requiring the acquisition of additional right-of-way and additional construction.

6
Public Transportation Alternatives

The accepted method for analyzing a major public transportation project is a comparison among potential alternative projects to determine which would be most beneficial. To allow such a comparison in the study corridors, appropriate alternatives were defined in each corridor using three types of public transportation technologies—light rail transit, commuter rail, and busways. All three are considered fixed-guideway technologies.

6.1 Definition of the Alternatives

Light rail transit is a metropolitan railway system that is designed to serve general trip purposes. The vehicles are similar to streetcars; they are electrically powered, drawing current from overhead wires, and can be operated as single cars or in short trains. Light rail systems are designed to be separated from other traffic as much as possible by using exclusive rights-of-way at ground level, on aerial structures, and in subways; they operate in streets only where no other right-of-way is available.

Commuter rail is a passenger railroad service that is designed to serve primarily work trips, typically over longer distances. Commuter rail services use trackage that is part of the general railroad system and that in many locations also carries freight. Because the passenger services must be compatible with general railroad operations, they use heavy rolling stock, usually operated in short trains. The passenger cars may be self-propelled or locomotive-hauled, the propulsion may be electric or diesel.

Busways are roads that are used exclusively by buses. The buses are standard ones that are able to leave the busway and also operate on the general roadway network. A busway can be built to share a right-of-way with a general-purpose road or as an independent facility.

Not all of these technologies would be appropriate in every corridor. The alternatives that were defined in each corridor include the technologies that would be compatible with the corridor's physical characteristics, development patterns, and the nature of the roadway network. Each corridor was examined individually to determine which technologies could be considered there.

Each alternative was designed to use railroad right-of-way wherever possible, because the purpose of the study was to assess the feasibility of using the railroad corridors for public transportation. Where the railroad right-of-way could not be used, either because of physical problems that would be expensive to remedy or because the right-of-way does not serve major activity centers, some other connection was defined.

To allow comparisons among alternatives, the alternatives within each corridor were also defined to be as similar as possible to each other, except where that would have required illogical designs. Because the three public transportation technologies have different operating characteristics, there are some situations where different designs would be the most effective. For example, in several locations, a new structure would be needed to carry a rail line, but buses could use an existing roadway segment, saving the cost of the structure. In such a situation, the busway alternative was designed to use the available road.

6.2 Alternatives Evaluated in Each Corridor

Amtrak Shore Line

Only one transit technology is appropriate in this corridor—commuter rail. The commuter rail service would operate from Westerly to Providence Station, connecting to existing service beyond Providence to Boston. Neither a light rail line nor a busway would be appropriate since neither could coexist on the tracks that carry freight service and high-speed Amtrak passenger service in the corridor. Building either light rail or a busway would require the construction of a separate facility parallel to the existing tracks, a prohibitively expensive undertaking for passenger service alone.

Bristol Secondary Track

All three technologies could be appropriate in the Bristol Secondary corridor. Each of the alternatives would need to be designed to accommodate the bikeway that is now on the right-of-way.

The light rail alternative would follow the right-of-way from Bristol to and through the East Side Rail Tunnel in Providence. West of the tunnel portal, the line would run on an elevated structure, touch down at street level at Kennedy Plaza, and continue in exclusive lanes on Sabin Street to the Providence Civic Center.

The commuter rail alternative would also follow the right-of-way from Bristol through the East Side Rail Tunnel in Providence. Because commuter railroad rolling stock would be difficult to accommodate any farther into the downtown area, the line would stop at the west portal of the tunnel, and a terminal station would be built there. Penetration of downtown would not be feasible because commuter rail requires larger turn radii and flatter grades than light rail, and cannot safely operate on city streets as can light rail.

The busway alternative would be similar to the light rail alternative; it would follow the right-of-way from Bristol through the East Side Rail Tunnel. Beyond the west portal, the busway would be supported on a structure to get the buses down to street level. The buses would operate into downtown to Kennedy Plaza via city streets.

East Providence Secondary

The alternatives considered in this corridor include a light rail line and a busway. Commuter rail was not included because of the short spacing between stations and the right-of-way's large number of at-grade street crossings. Those characteristics would create frequent starts and stops, which would not be compatible with commuter rail's lower rates of acceleration and deceleration. The alternatives were designed to use a short portion of the P&W Main Line between its junction with the East Providence Secondary and Lonsdale to create a more logical terminal location.

The light rail alternative would run from Lonsdale on the P&W, onto the East Providence Secondary, to Providence, and through the East Side Rail Tunnel. The light rail line would use the same approach to Kennedy Plaza and the Providence Civic Center as described for the Bristol Secondary.

The busway alternative in this corridor would follow the same alignment as the light rail line, beginning at Lonsdale on the P&W, and running onto the East Providence Secondary and through the East Side Rail Tunnel to downtown Providence. As in the busway alternative for the Bristol Secondary, the buses would use an elevated structure beyond the west portal of the tunnel, and follow city streets to Kennedy Plaza.

Newport Secondary Track

Commuter rail was analyzed on the Newport Secondary. Because it does not directly serve a large downtown, the Newport Secondary could not be expected to attract sufficient ridership to justify a fixed-guideway facility unless it were to be connected to another line that would provide access to such a downtown. Service to Boston could be established by connecting the Newport Secondary to an existing rail line in Fall River. No passenger rail service is presently operated on that line, but commuter rail service there is under consideration by the Massachusetts Bay Transportation Authority. The analysis in this study included not only the Newport Secondary in Rhode Island, but also the part in Massachusetts between the Rhode Island state line and Fall River. Commuter rail is the only alternative that was considered from Newport to Boston via Fall River because commuter is under consideration for the Fall River-Boston segment of the line.

Newport-Bristol Combination

Service on the Newport Secondary to Providence was also considered, which would be made possible by connecting the Newport Secondary to the Bristol Secondary. Two alternatives, a busway and light rail, were analyzed.

Initial planning for the connection was based upon the possibility that a rail line could use the Mount Hope Bridge. This proved to be infeasible, as the bridge was found to be unsuitable for this use. Information on the characteristics of the bridge was obtained from Steinman Boynton Gronquist & Birdsall, the engineering firm that designed the original structure. The bridge was designed to a load standard that would accommodate trucks, a lower standard than needed for a rail line. The geometric configuration is also inappropriate for rail use, as the grades on the bridge are too steep for rail operations. Modifying the bridge to accommodate rail use would not be feasible.

Because of the inability of the existing bridge to accommodate a rail line, a new bridge would be needed for the rail alternatives. New additional right-of-way would also be needed to connect the new bridge to the Bristol Secondary. The additional right-of-way would be different for different alternatives.

The light rail alternative from Newport to downtown Providence was follow the Newport Secondary alignment northward from Newport to a new high-level bridge. On the north side of the mouth of Mount Hope Bay, the line would follow Metacom Avenue north to Bayview

Avenue. There it would turn west for a short distance to an existing utility right-of-way, which it would follow north to an abandoned east-west rail right-of-way north of Franklin Street in Warren. It would run west less than half a mile to join the Bristol Secondary, and then continue northward with the same characteristics as the light rail alternative examined for the Bristol Secondary.

The busway alternative would not require a new bridge, since buses could use the existing Mount Hope Bridge roadway. The busway alternative would run north on the Newport Secondary to the vicinity of the bridge. Buses would use local streets to climb to the level of the Mount Hope Bridge. After crossing the bridge, buses would use RI 114 into and through downtown Bristol. North of downtown Bristol they would enter a busway on the Bristol Secondary. The entry into downtown Providence for the busway would be the same as for the busway alternative for the Bristol Secondary.

A commuter rail alternative from Newport to downtown Providence was defined, but was dropped from consideration because of cost. It would also follow the Newport Secondary north to a new bridge. North of the mouth of the bay, the line would go into a new tunnel that would carry the line under downtown Bristol to a point west of Hope Street, where it would rejoin the Bristol Secondary Track. Preliminary cost estimates for this alternative showed that the cost of the tunnel would cause the capital cost to be more than $50 million higher than that of the light rail alternative, making this alternative compare poorly with the others, so it was dismissed.

P&W Main Line

Only one alternative was considered on the P&W Main Line, commuter rail. Neither light rail nor a busway was considered because of the present freight operations and the topography of the corridor. The amount and types of freight traffic on the P&W would preclude operating a light rail line on the same tracks, requiring the construction of new tracks paralleling the existing ones. The active status of the railroad would also require that a busway be a new facility located next to the existing rail line. Because of the location of the line in the river valley, building either would be a complicated and disruptive process, requiring significant recontouring of the land and extensive structures. This would be environmentally undesirable and prohibitively expensive.

The commuter rail alternative would follow the existing alignment from Woonsocket to the junction with the Amtrak Shore Line. It would run on the Shore Line into Providence Station.

Washington Secondary Track

Light rail and busway alternatives were considered for the Washington Secondary. The urbanized nature of the corridor, reflected in the short station spacing in some parts of the line, would make it inappropriate for commuter rail.

The light rail alternative would be built upon the Washington Secondary right-of-way from Washington to the Amtrak Shore Line. From that point, the light rail line would parallel the Shore Line to the Olneyville Square area, where the light rail tracks would leave the rail corridor by following Troy Street, which would be dedicated to rail operations only. The rail line would follow Broadway, operating in exclusive lanes, to the Providence Civic Center and Kennedy Plaza in downtown Providence.

The busway alternative would follow the same alignment as the light rail line. Buses would operate on Troy Street and on Broadway in mixed traffic rather than in exclusive lanes, and would run to Kennedy Plaza in downtown Providence.

7
Potential Station Locations

Each of the corridors selected for study was examined to identify potential locations for public transportation stations and stops. The purpose of identifying station locations was not only to begin the determination of where stations could be built but also to assist in the definition of other system characteristics. Station locations are important for estimating ridership, determining the accessibility of a public transportation line from the surrounding areas, and examining the environmental impacts of station development.

7.1 Process for Identifying Station Locations

The station locations identified are the sites where stations could be built, not necessarily where they will be built. Final station locations would result from more-detailed planning further along in the development of a specific public transportation project. That planning would include a public-participation process to obtain the views of the affected communities, and would require more-thorough analysis of such issues as site ownership, cost, and availability; compatibility with surrounding development and neighborhoods; and environmental characteristics. The more-detailed planning could result in changes in station locations; until the more-detailed planning is done, station locations cannot be defined with absolute certainty.

The station locations are suitable for corridor feasibility testing, even though they are preliminary. The identified locations were selected to be reasonable and appropriate, and have the characteristics necessary for station development. They all could be developed as station locations.

There were several criteria for the identification of potential station locations. One is that there must be some amount of development in the vicinity of the station. Since a station exists only as an entry point for people to the public transportation service, there is no need for a station if there are no residences or commercial developments within easy access. This criterion also helped define the extent of each public transportation line, since the outermost location near developed areas would be the terminal station on a line. Within downtown Providence, each line was extended through downtown to serve as much of the development there as possible.

A location must be reasonably available. Vacant parcels are most desirable, as are sites where redevelopment would be beneficial. Constructing a station should not require the demolition of existing buildings that are occupied and in good condition. Related to this criterion is the need for a site to be large enough to accommodate the necessary station facilities, including loading areas, bus access, and, depending upon the station characteristics, park-and-ride spaces. In some cases, the railroad right-of-way would be adequate to accommodate a station. The need for adequate space was especially important in selecting the outermost station location on a line, since that station is especially likely to attract park-and-ride users.

Another criterion required that a station be compatible with the surrounding development. A station should not disrupt the existing fabric of the community by introducing activities where they are inappropriate. A station can be most easily integrated into a commercial area, where there is already public activity. Such a location can also allow for easy walking access between the station and surrounding stores, offices, or other places of business. A station may also be readily located in an undeveloped area, although there may be no need for a station if there is no activity to be served. Introducing stations into residential areas can be difficult, but stations are necessary in those areas, so care in siting and design is especially important.

The characteristics of the site should also allow station development without major environmental or construction problems. This would rule out a site that is an environmentally sensitive area, such as on a wetland, or one that had steep grades.

A station location must be accessible from the surrounding roadway network at a place where the roads could accommodate additional traffic. Any station will need to be reached by either feeder buses or automobiles or both. This accessibility can be best accomplished at major arterial roadways, although in some cases lesser roadways can also serve this purpose.

Station site selection also took into account the need for reasonable station spacing. Spacing is a function of the character of the surrounding development. In built-up areas, stations should be closer together and allow for walking access, not auto access. In lower-density areas, access can be expected to be almost completely by motor vehicle—bus and car—and so stations can be farther apart, with park-and-ride facilities where appropriate. The number of stations on a given line should be the smallest number that would provide adequate access. Stopping at a station slows transit operations, so unnecessary stations would degrade the quality of service.

The use of existing rail rights-of-way creates both problems and opportunities for station locations. The most significant problem is that the locations of the rail lines were established in another era and to serve other purposes from the use assessed in this study. Some lines were laid out to follow waterways to take advantage of the gradual grades and to provide access to the water-powered mills. In some cases, the resulting rail alignments are not optimum for public transportation, where convenience to present urban centers and access to the regional highway network are paramount. Some waterside rail segments have no locations that are sufficiently accessible and spacious to allow station development, and so in those segments there would be long distances between stations.

Opportunities are created by the fact that the rail lines did have passenger service at one time and so had passenger stations. The Amtrak Shore Line, of course, still does. Some of the former station sites are well located with respect to present development patterns and provide adequate space for the bus drop-off and park-and-ride lots that are needed for the public transportation uses under study.

7.2 Selected Locations

The selected station locations are listed below and shown in the following figures. Each station is identified by the municipality in which it would be located and by the name of the nearest street if the station name is not the same as a street name. The figures were produced by the GIS Team of the RIDOT Program Support Division, Management Information Section.

Amtrak Shore Line - Figure 7-1

- Westerly—at the existing railroad station on Railroad Avenue
- Carolina—at Carolina Back Road in Charlestown
- Kingston—at the existing railroad station in South Kingstown
- Wickford Junction—at Ten Rod Road in North Kingstown
- East Greenwich—south of Rocky Hollow Road in East Greenwich
- T.F. Green Airport—south of Kilvert Street in Warwick
- Providence—at Providence Station on Gaspee Street

Bristol Secondary Track - Figure 7-2

- Independence Park—at Thames Street in Bristol
- Franklin Street—in Warren
- County Road—in Barrington
- West Barrington—at Washington Road in Barrington
- Crescent View—in East Providence
- Riverside—at Turner Avenue in East Providence
- Red Bridge—in East Providence
- Kennedy Plaza—in Providence
- Civic Center—on Sabin Street in Providence

East Providence Secondary Track - Figure 7-3

- Lonsdale—at Mill Street in Cumberland
- Valley Falls—near Eli and Broad Streets in Cumberland
- Mill Street—in Cumberland
- Broadway—in Pawtucket
- Cottage Street—in Pawtucket
- Mineral Springs—at Armistice Boulevard in Pawtucket
- Columbus Avenue—in Pawtucket
- Beverage Hill—in Pawtucket
- Rumford—at Noyes Street in East Providence
- Red Bridge—in East Providence
- Kennedy Plaza—in Providence
- Civic Center—on Sabin Street in Providence

Newport Secondary Track - Figure 7-4

- Tiverton—at Riverside Drive in Tiverton
- Willow Lane—in Portsmouth
- Melville—at Stringham Avenue in Portsmouth
- Greens Lane—in Middletown
- Coddington—in Middletown
- Admiral Kalbfus—in Newport
- Gateway—at the Gateway Transportation Center in Newport

Newport-Bristol Combination

Locations identified for Newport Secondary and Bristol Secondary, plus two additional locations.

- Bayview Avenue—at Metacom Avenue in Bristol
- Roger Williams College—on Metacom Avenue in Bristol

Providence & Worcester Main Line - Figure 7-5

- Woonsocket—at the former railroad station on Depot Square
- Hamlet—near Manville Road in Woonsocket
- Manville—at Main Street in Lincoln
- Albion—at School Street in Cumberland
- Berkeley—at Martin Street in Cumberland
- Lonsdale—at Mill Street in Cumberland
- Valley Falls—near Eli and Broad Streets in Cumberland

Washington Secondary Track - Figure 7-6

- Washington—at Station Street in Coventry
- Anthony—at Laurel Avenue in Coventry
- Brookside Street—in West Warwick
- Arctic—at Providence Street in West Warwick
- River Point—at Hay Street in West Warwick
- Westcott—at Providence Street in Warwick
- Natick—at East Avenue in Warwick
- Oaklawn—at Wilbur Avenue in Cranston
- Uxbridge—in Cranston
- Knightsville—at Park Avenue in Cranston
- Burnham Avenue—in Cranston
- Brewery—at Cranston Street in Cranston
- Olneyville Square—at Broadway and Westminster Street in Providence
- Federal Hill—on Broadway at Knight Street in Providence
- Civic Center—on Sabin Street in Providence
- Kennedy Plaza—in Providence

8 Ridership

Ridership is a central element in evaluating each corridor. To provide ridership information to support the evaluation, ridership projections were developed for public transportation lines in the selected corridors.

8.1 Methodology for Ridership Estimation

Different ridership estimation techniques produce results with different degrees of precision. The method used must be tailored to the purpose of the analysis.

The method described in Chapter 5 that was used for corridor selection is a general assessment of the potential market, based exclusively on land use. Such a general method could be used for comparisons among corridors, but is not sufficient for assessments of feasibility within a given corridor.

At the other extreme is the ridership forecasting technique used for detailed planning for a fixed-guideway project. This method typically uses complex mathematical models designed to replicate the transportation system and to reflect the ways in which people make decisions about using it.

A transportation model that projects public transportation ridership, called a mode-split model because it allocates trips to different modes of transportation, is expensive to develop; it requires extensive data and significant efforts to assure that the model is properly designed and calibrated to local conditions. Such a model did not exist for Rhode Island at the time that this study was done; developing one would have been beyond the level of effort in the study and unnecessary to produce the degree of precision needed.

For this analysis, an intermediate methodology was used. The estimation procedure was a sketch-planning technique that allowed available information to be used to develop general projections of rider volumes. These estimates were more detailed than the ridership information used in corridor selection, but avoided the time and expense that would have been required for the development of computer models.

The ridership-estimation method was based upon the projected future geographic distribution of population and employment in Rhode Island, projected trip patterns both within Rhode Island and to Boston, and usage characteristics of public transportation systems in other urban areas. The alignments of potential public transportation lines in the corridors, their extent, and the identified station locations were used in developing the estimates.

A single ridership estimate was made for each corridor, regardless of the type of public transportation line that could be built there. The estimates assume representative public transportation service levels and fares, and so reflect the ridership levels that would be expected with typical operating characteristics. By combining ridership response to typical service characteristics with the specific configuration of the corridors, the estimates show the relative size of the ridership market for public transportation in the study corridors. The estimation included three steps:

- Define the projected population and employment in the lines' service areas.
- Estimate the total number of trips to be made to and from those service areas.
- Estimate the numbers of those trips that would use the public transportation lines in the rail corridors instead of using automobiles.

The first step was the definition of the population and employment that a public transportation line in each corridor would serve. This required the delineation of the geographic service area of potential public transportation lines in the corridors. A computerized geographic information system (GIS) database was created that contained census tracts, municipal boundaries, and the rail corridors, including the locations identified for stations. Rhode Island Department of Administration estimates of population and employment, organized by census tract, were included in the database.

The service area of a public transportation line is the geographic area closest to it. The public transportation line would be convenient for use by people making trips to and from the service area. Locations outside the service area would be too far away for the line to provide convenient service. The boundary of the service area was determined by the access distance that people would reasonably be willing to travel to reach the line. Separate access distances were defined for three types of transportation that could be used for access to a station, walking, feeder buses, and autos. The access distance was set at one-third mile for walk access, two miles for feeder-bus access, and four miles for auto access. At the outermost station on each line, the auto-access distance was extended to six miles.

The GIS was used to calculate the population and employment within the service area for each station. Between home and a public transportation station, people can travel by walking, feeder bus, or car, so population was calculated within a service area for each of the three types of access transportation. In other words, for each station, the number of people who would live within walking distance, those who would live within bus-riding distance, and those who would live within driving distance were calculated.

At the workplace end of a trip, people typically must walk from a public transportation station to their jobs, so the amount of employment was calculated only within walking distance of stations. Downtown Providence is the single largest employment location in the state, so special attention was paid to assuring that downtown employment would fall within walking distance of the stations there.

For each corridor, the amounts of population and employment within the service areas were then aggregated by municipality for use in the next step in the process.

The second step was the estimation of the total number of trips that would begin or end within the service areas of each corridor, regardless of whether or not they would use public transportation. A table of projected total trips in 2010 between every possible combination of pairs of municipalities in the state was used. The trip table was developed by the Rhode Island Department of Administration. The proportion of each municipality's population and employment located within each service area was applied to the number of trips beginning and ending in the entire municipality to determine the total number of trips beginning and ending in the service areas for the public transportation lines.

Additional information was needed on trips made to and from points outside the state, especially trips along the corridor between Rhode Island and Boston. To provide that information, the 1990 Census Journey to Work file, which lists the number of work trips between each pair of towns in the nation, was used. In the corridors that would go outside of Rhode Island, the estimate of interstate travel was added to the estimate of intrastate travel to produce total trip volumes.

The third step was the estimation of the portion of total trips in the service areas that a public transportation line could capture. Individual capture rates were calculated for those people who could walk to a station, those who could ride a bus, and those who could drive there. The rate was highest for walkers and lowest for drivers, reflecting the greater convenience of shorter access. The capture rates were developed from data reported in "Characteristics of Urban Transportation Demand," published by the U.S. Department of Transportation. Those data represent the most recently available information on transportation use characteristics in metropolitan areas in the United States. Conditions in Rhode Island could differ from those other metropolitan areas, so ranges of capture rates were calculated to allow for variations.

8.2 Ridership Estimates

The resulting ridership estimates are shown in Table 8-1. The numbers show the number of one-way daily trips projected to be made on a typical weekday in 2010. High and low estimates are shown in each corridor, reflecting the use of the range of public transportation capture rates.

Table 8-1
Estimates of Daily Ridership

Corridor	Low Estimate	High Estimate
Amtrak Shore Line	3,300	5,000
Bristol Secondary	2,900	4,300
East Providence Secondary	4,200	6,300
Newport Secondary	500	800
Newport-Bristol Combination	3,200	4,800
P&W Main Line	2,200	3,300
Washington Secondary	3,300	4,900

8.3 Ridership Findings

In general, the ridership projections are highest for those areas that are projected to have the highest amount of development and where there is a natural attraction between the area in the corridor and a downtown, either Providence or Boston. Where the corridor runs through an area that is not heavily developed, the ridership projections are lower. The longer the corridor, the higher the potential for ridership, since the service area would be larger. Increasing the length of a line would not add proportionally to the ridership, however, since the number of trips that people make falls off with increasing distance. Increasing the length of a line would also add to the cost, which is addressed in a subsequent chapter.

None of the ridership projections for the corridors studied would meet the threshold of 15,000 daily riders set by the Federal Transit Administration as the amount needed to justify the analysis of investment of federal funds in the development of a fixed-guideway public transportation project.

Amtrak Shore Line

Ridership was projected to be moderate in this corridor. The access to the Boston market would add to the numbers of riders that would use the line to reach downtown Providence. The areas along the corridor south of downtown Providence are well developed, and they generate travel demand to the downtown area. The large territory covered by this line would add to the ridership, as this was one of the longer corridors studied.

Bristol Secondary

This corridor would produce somewhat lower ridership compared to the others studied. Although there are some parts of the corridor with residential concentrations, that is not the case for the entire line. Significant portions run along the bay and through parklands, where there is no development opportunity.

East Providence Secondary

Even though this was the shortest corridor studied, it was projected to have the highest ridership. The large amount of residential development within a short distance of the line and access to downtown Providence would allow people to use it conveniently.

Newport Secondary

The ridership in this corridor was projected to be the lowest of the corridors studied even though it is one of the longer ones. The small amount of residential development along the line because of its waterfront location would limit the ridership market. Service to Boston would attract trips, but few people who work in Boston live this far away; only a small number would make the trip from the area served by this corridor. Although the roadway network on Aquidneck Island carries significant traffic volumes, not many of those trips have geographic patterns that could conveniently be served by public transportation in this corridor.

Newport-Bristol Combination

This corridor was projected to have moderate ridership, partly because its length would cover a large territory. It would attract the riders projected to use the Bristol Secondary and add riders from Aquidneck Island who would travel to downtown Providence and other locations along the Bristol Secondary. The ridership projection for the combination is lower than the total of the projections for the two separate corridors because of the differences in alignment and the lack of service to Boston.

P&W Main Line

Ridership was projected to be relatively low in this corridor. Although it would provide access to employment in both downtown Providence and central Woonsocket, the small amount of development along most of the corridor would limit the potential market.

Washington Secondary

This corridor was projected to have moderate ridership. Large parts of the corridor are developed and generate travel demand to downtown Providence as well as to other commercial districts along the corridor.

9
Environmental and Institutional Issues

Successfully developing new public transportation services in Rhode Island would require the resolution of a number of issues. Two types that are particularly important are environmental and institutional issues.

Environmental issues would arise from the construction of a fixed-guideway public transportation system. Even though public transportation is typically considered to be environmentally friendly, any construction project can create changes in both natural and human-built systems. A fixed-guideway public transportation system could be developed only if the resulting environmental impacts are acceptable or can be mitigated.

The assignment of responsibilities for improved public transportation services would create institutional issues. Each aspect of planning, engineering, construction, and operations would need to be administered by some public agency or organization, and an organizational arrangement that defined those responsibilities would be needed.

For all of these issues, further work would be part of the implementation planning for a project in any corridor. This study provides an initial examination to assess the feasibility of establishing services and to identify the issues that will require the most attention.

9.1 Environmental Issues

The purpose of the environmental review was to identify any major problems, particularly at proposed station sites, that might make fixed-guideway public transportation service infeasible in any of the corridors selected for analysis. The analysis was not a full environmental impact assessment but rather a broad review to define general conditions and to bring to light any that might preclude fixed-guideway development.

The environmental review addressed air and water quality, vegetation and local ecology, noise, local traffic impacts, land use and adjacent development, public use and recreation areas, and historic districts. The review was based upon site visits and examination of available documentation of environmental conditions. Environmental characteristics of the individual station sites are listed in the appendix.

Air and Water Quality

None of the alternatives appears to be infeasible because of regulatory requirements for air quality. The diesel-propelled technologies, commuter rail and busway, would generate localized emissions of particulate matter and combustion products (oxides of nitrogen, sulfur, and carbon monoxide). LRT would have no such localized emissions. For any alternative, cars using station parking lots would also generate localized emissions, principally at peak hours. At a larger scale, each corridor project is intended to reduce emissions by reducing vehicle-miles of travel in each corridor.

Because of community concerns, visible bus and train exhaust, and precipitation of particulate matter from that exhaust onto immediately adjacent properties (especially for commuter rail) should be addressed wherever diesel-powered rail service is not presently operating.

No water-quality issue sufficient to make any alternative infeasible is foreseen. Paved areas, principally busways and parking lots, would have drainage systems to prevent runoff into adjacent waters. Maintenance and layover facilities would be designed with drip pans and oil-water separators discharging into the public sewer system.

Permits for development in several of the corridors would be required from the Coastal Resource Management Council. The CRMC has jurisdiction over areas within two hundred feet of a shoreline, areas outside that area that would generate storm water discharge, and the watershed of the Narrow River in southern Rhode Island. This jurisdiction would include portions of the Bristol Secondary in Warren and Bristol, portions of the East Providence Secondary in East Providence, and portions of the Newport Secondary in Portsmouth, Middletown, and Newport.

Vegetation and Local Ecology

None of the proposed corridor services appears to be infeasible because of impacts on wildlife or vegetation. Except for the Washington and Bristol Secondaries, the proposed corridors are in existing railroad use, and the introduction of corridor public transportation service would be unlikely to have a detectable effect on vegetation and ecology.

The Amtrak Shore Line and the Bristol Secondary affect wildlife management area owned or operated by the Rhode Island Department of Environmental Management. The Amtrak Shore Line passes through the Great Swamp Management Area in South Kingstown and a portion of the Burlingame State Park/Management Area in Charlestown. It is adjacent to the Woody Hill Management Area in Westerly. The Bristol Secondary passes through Haines Memorial State Park and is adjacent to the Veterans Memorial Park in Barrington. In the town of Bristol, the Bristol Secondary passes through a saltwater marsh area at Jacobs Point and through Colt State Park. The Washington Secondary appears to intrude on habitat areas mapped by the Rhode Island Natural Heritage program, but also has a history of railroad use.

Based on the operational experience of MBTA and RIPTA in southern New England, corridor operations are not considered likely to have a detectable impact on fisheries or wildlife. Nevertheless, state and federal agencies would require database searches and possible field investigations along the corridors selected to make a definitive determination.

The construction of these projects would involve cutting of new growth and overgrowth along the existing railroad rights-of-way, and minor clearing of vegetation at the station sites.

Noise

The reintroduction of service into any corridor that does not presently carry rail traffic would create a significant issue of noise effects.

For commuter rail, the MBTA's experience with the reintroduction of diesel-hauled service to established southern New England communities has demonstrated that noise, particularly from trains standing at stations, waiting on sidings for meets, or laying over at terminals, can be a significant issue where residences are in the general vicinity. Noise studies for the MBTA indicate that modern diesel commuter rail locomotives and coaches will not exceed Federal Railroad Administration standards (90-93 dBA measured 100 feet from the track) in normal use. During a small fraction of passbys, these standards may be exceeded when horns are sounded or air brake pressure is released. However, the MBTA's experience has also been that commuter rail noise less than these standards has generated objections, particularly when the equivalent sound level (Leq) over the peak operational hour exceeds 55 to 60 dBA. At the service levels anticipated for the Rhode Island corridors, with a typical suburban residential background noise level (40 dBA), this will occur frequently within 100 feet of the tracks, and infrequently beyond 400 feet from the tracks. In noisier urban environments with background levels at 60 dBA, impacts beyond 75 feet from the tracks would be infrequent.

For the Amtrak Shore Line, the commuter rail service would not constitute a significant increase in train traffic, and would not likely be a major issue along the right-of-way where trains operate at speed. Noise from standing or slower-moving commuter trains would not likely exceed that presently generated at existing Amtrak stops at Providence, Kingston and Westerly; in effect, commuter rail would continue the existing noise pattern rather than facilitate the reduction that would take place with electrification of the Amtrak Shore Line. In the vicinity of the new proposed stations at Carolina, Wickford Junction, East Greenwich, and T.F. Green Airport, "new" noise would be generated by standing and accelerating diesel commuter trains, but the number of receptors in proximity to station locations is small. The most direct and universal mitigation would be to use electric locomotives for the commuter service, at an additional probable cost of $2 million each, or a total cost of $10 million. A far less expensive mitigation approach would be construction of relatively short noise barriers at the few points where they may be warranted.

On the Providence & Worcester Main Line, the commuter service would represent a significant increase in train frequency, but the trains would be shorter and quieter than the existing freight trains. The track improvements for commuter rail would also tend to reduce both the level and duration of exposure to noise from freight trains. Given the existing use, noise impacts from operation along the right-of-way are not likely to be a major issue. In the station vicinities, however, there appear to be residences that would be impacted by noise from standing and slow-moving commuter trains. On this line, use of electric locomotives would not be an option, so noise barriers would be the basic form of mitigation.

On the Bristol Secondary and Newport Secondary, the new commuter rail services would be an effectively complete restoration of rail service, requiring investigation of noise both from trains running at speed and in station vicinities. The existing rail operations on the Newport Secondary are so infrequent, and operate at such low speeds, that their baseline noise emissions can effectively be discounted in considering the new service. Areas requiring attention to the effect of trains operating at speed would be:

- the Riverside area of East Providence,
- residences north of the right-of-way in central Barrington,

- various trackside locations in Warren,
- the Bristol Highlands neighborhood in Bristol,
- trackside locations in the Pocasset Heights and the Hummocks sections of Portsmouth, and
- trackside locations in North Tiverton (e.g., Old Colony Terrace).

For LRT, noise from passing trains could be an issue for some residences in the immediate vicinity of the right-of-way. In general, this technology presents the lowest noise impact of those under consideration, lower than commuter rail by 10 or more dBA. FRA standards would not be exceeded, and Leq is likely to be less than 55 in suburban areas except within 30 to 50 feet of the tracks. In noisier urban areas, impacts are likely to be confined to spaces immediately adjacent to the tracks. Little noise barrier mitigation would probably be required for LRT service.

Busway operation raises noise concerns because of both the operation of diesel vehicles and the higher service frequencies required to move passengers. Although buses are quieter than commuter rail trains, they would operate roughly ten times as often, placing expected Leq in the same vicinity as commuter rail in suburban areas. Noise barrier treatment should also be considered as applicable for busway alternatives.

Local Traffic Impacts

Three types of local traffic impact would be most likely in the corridors—impacts from station traffic, changes in traffic along the corridor, and impacts at grade crossings. Further analysis of specific traffic impacts would be necessary as a part of project planning when more-detailed ridership estimates are possible.

To a large extent, impacts from station parking lot traffic can be managed by the siting and sizing of the lots. In an existing urbanized area, severely congested and constrained sites are generally identifiable.

The corridor ridership volumes at the low end of forecast ridership would be likely to rely on a lower level of auto-based access than the high end. At the lower end of the ridership scale, station parking lots would generally be relatively small (50-200 spaces), and could simply be omitted where local concerns or traffic issues dictate. If a larger ridership were to be drawn from a larger commutershed, a few larger lots (200-500 cars) would likely be required. Ability of the local street system to accommodate traffic from these lots would be a prime consideration in locating them.

For the commuter rail and LRT alternatives, the distribution and impacts of parking lot traffic would likely be similar to existing MBTA commuter rail parking lots in the Boston metropolitan area. These are relatively minor, comprising a few minutes of higher-than-average turning movements into the lot prior to inbound train times in the A.M. peak, and a few minutes of queuing within the lot after outbound arrivals. For busway alternatives, these impacts would be less noticeable, being spread out among more-frequent bus arrivals and departures.

For smaller lots, active traffic control devices to manage traffic would typically not be necessary; for some larger lots, traffic signals may be advisable.

Except in the immediate vicinity of a lot that might be located on a very low-volume road, increases in traffic volumes to and from stations would likely be relatively small (perhaps on the order of 10 percent) compared to background peak-period traffic on existing arterials. At some locations, a reduction in highway level of service might be experienced in the peak period; again, lot location and design would be important factors in mitigating such impacts.

Public transportation riders diverted from automobiles would result in decreased traffic along the corridor, particularly on the portions closer to downtown Providence. This can be expected to contribute to a small to moderate relative improvement on major arterials near and roughly parallel to the transit corridors. The magnitude of the forecast ridership does not suggest that significant changes in regional traffic patterns are likely.

Many of the LRT and commuter rail alternatives would result in increased rail traffic at existing grade crossings, or in reactivation of presently unused crossings. These will cause occasional, relatively brief delays (on the order of 3-60 seconds) to traffic at these locations. At most such locations, no other traffic impacts or loss of effective traffic capacity would be expected. At some locations, specific design features, such as traffic signal interconnection or special railroad grade-crossing approach circuits may be required to mitigate traffic impacts or possibly unsafe queuing conditions. At reactivated crossings, a safety eduction campaign would be warranted, especially for pedestrians and students.

Commuter rail crossings would generally be equipped with both flashers and gates, including sidewalk gates where there is a sidewalk. LRT could use the same approach, but with its superior deceleration characteristics, LRT has available a number of other possible design treatments for grade crossings, including operation under standard traffic signals or stop signs. LRT has been successfully incorporated into urban streets and pedestrian areas, albeit at a cost in speed. As a general rule, if required to stop for a crossing, LRT will incur less delay than a commuter train.

Busway operation would be more frequent than LRT or commuter rail operation, offering the possibility of higher delays at crossings. Traffic signals might be the standard treatment for most busway grade crossings, with pre-emption of the signal by buses provided where possible. Where potential traffic impacts dictate, buses could be required to stop prior to receiving a signal.

Land Use and Adjacent Development

There does not appear to be any major land use or development issue that would make any of the proposed corridor services infeasible. Locations for stations and passing sidings can be adjusted during the design process to reduce impacts. Most of the right-of-way for vehicle operation is either in railroad right-of-way or existing streets. There are two principal exceptions.

One is the proposed elevated structure carrying the busway or LRT services that would use the East Side Rail Tunnel. Some property takings or easements, such as corners of lots, might be required to construct this structure. It would have an adverse visual impact on both existing structures and Kennedy Plaza. In order to avoid such a structure, it would be necessary to reconstruct the tunnel to reach grade at Benefit Street, at considerably higher cost. Another approach would be to terminate the service at the west end of the tunnel, although this would reduce the ridership potential.

The other would occur where the busway and LRT services on the Washington Secondary would require a transition from the Washington Secondary right-of-way to street running in Broadway. This would probably require taking property on the west side of the Amtrak Shore Line to effect a transition to street running in Troy Street, and reconstruction of the Troy-Westminster-Broadway intersection.

A few station locations could be affected by some other land-use impacts.

Public Use and Recreation Areas

The Bristol Secondary is the only corridor studied that would not use existing railroad right-of-way, streets, or land not in public or recreational use. For most of its length, this right-of-way has been converted into a bicycle trail. It bisects Haines Memorial State Park in Barrington, and lies adjacent to the northern limits of Veterans Memorial Park in the same town. It also passes through Colt State Park in Bristol, effectively linking all these public areas, and providing a major recreational resource. Adding a public transportation facility to this right-of-way might encounter institutional and community obstacles, even though the Rhode Island DOT has expressly designated the bike path as an interim use, and has reserved the right to reinstitute rail service.

Regardless of the provisions made for the right-of-way, a 4(f) evaluation of constructive-use impacts appears to be necessary for these parks, and for at least one site on the Washington Secondary near the proposed Oaklawn station.

Historic Districts

All of the corridors touch upon historic sites. The corridors were evaluated using information that describes sites that are on or are eligible for the National Register of Historic Places.

The Amtrak Shore Line is adjacent to sites in Providence and Warwick. It passes through a site on the North Kingstown-Exeter border, is adjacent to additional sites in South Kingstown and Charlestown, and is adjacent to or passes through three sites in Westerly.

The Bristol Secondary is adjacent to a portion of the Veterans Memorial Parkway in East Providence, which has been designated as a candidate site. The line is adjacent to seven additional sites in Warren. The East Providence Secondary is adjacent to one site in East Providence.

The Sakonnet River Bridge, which would be used by the Newport Secondary, has been designated as a site. The Newport Secondary passes through the U.S. Naval Station in Middleton, and is adjacent to or passes through four sites in Newport.

The P&W Main Line is adjacent to or passes through five sites in Cumberland and Woonsocket. Three station sites on the Washington Secondary were found to have potential historic implications, and the line passes through three other sites in Cranston, West Warwick, and Coventry.

The Rhode Island Historic Preservation Commission (RIHPC) should be consulted for information on historic districts that exist in the vicinity of the station sites in corridors that may move forward in the planning process.

9.2 Institutional Issues

Institutional issues include organizational, financial, legal, and regulatory concerns. The significance of each of these issue would vary from one corridor to another, but for any corridor, successful resolution of all of them would be necessary to allow project development to proceed.

Organization

Defining the organizational structure is a basic step, for it will determine the parties that are responsible for dealing with all of the other issues. There are several functions that the organizational structure must cover. There are a number of entities, both existing and newly created for a specific purpose, that could have roles in the organizational structure. Public agencies must have oversight and policy responsibilities, but private companies could have other responsibilities under contract to the public agencies. The functions and entities could organized in a variety of ways.

The basic organizational role is that of lead agency in project development. Some agency must take responsibility for the overall process of development of the new public transportation facilities. This could include the selection of the corridor in which to develop the facilities and services, overseeing the planning and financing functions, coordinating the development process with local elected officials, and acting as the grantee for any federal funds that are used. This responsibility must be borne by a public body. There are three options—the Rhode Island DOT, RIPTA, or a new entity of some sort. Both the DOT and RIPTA already have many of the capabilities that would be needed for this role, but if extensive new facilities are planned, it might be desirable to create a separate organization that would be responsible specifically for new public transportation.

Engineering and construction of the facilities is another important role. Some entity must oversee the construction to assure quality and cost control. The lead agency for project development could have this role, or it could be another agency. Given the DOT's experience in construction, it would be the logical candidate. The actual engineering and construction of the facilities would typically be performed by private companies under contract to the public agency. These functions could follow the traditional path of multiple phases, or they could be combined in a turn-key process that has the potential to save both time and money.

The function with the longest lifespan is that of operation of the service and maintenance of the facilities. There are several basic options, with many variations, that are possible.

One option would be to assign the responsibility to one or more existing entity. RIPTA is an obvious candidate for operating and maintenance responsibilities for any new bus services related to a busway, as it already has that responsibility for existing bus services. RIPTA could also be given the responsibility for rail services, although that would require changes in RIPTA's staffing and organization to introduce the needed skills. The existing commuter rail service in the state is operated by the Massachusetts Bay Transportation Authority. The MBTA might be interested in providing additional services, especially extension of the existing services on the Amtrak Shore Line, but also possibly services in other corridors. However, the MBTA's interest in providing additional services in Rhode Island could be limited by the fact that it is a public agency established to serve Massachusetts.

The DOT could also be assume the operations and maintenance role, although this would introduce a new type of responsibility into the agency's internal organization and staffing.

This responsibility could also be undertaken by a new public agency. Such an agency would have the advantage of being designed specifically for the tasks that is would undertake, but could have the drawback of conflicts with other existing agencies with similar responsibilities.

The operations and maintenance functions could also include one or more private companies retained under contract to perform specified tasks. This approach has the potential to create lower costs by introducing a competitive element into the process of selecting an operator. Both Amtrak and the Providence & Worcester Railroad Co. would be potential candidates to operate services.

Operating Rights and Ownership

The development of a new service would require that the responsible public agencies have legal access to the right-of-way. This could be accomplished through direct ownership of the line or through the negotiation of operating rights with the owner.

Several of the corridors in the study are already in DOT ownership. These corridors would allow for the simplest implementation process, since there would be no need for acquisition of the rail right-of-way or property rights. However, even in these corridors, some property acquisition would be necessary for stations, park-and-ride lots, and yards and shops for any new rail line. Where agreement could not be reached with property owners for the purchase of their properties, eminent domain would need to be used for acquisition.

Other corridors are owned by railroad companies. In such a case, there would be a choice as to the ownership arrangement. Where the railroad operates service on the line and will continue to do so (for example, Amtrak service on the Shore Line), the most reasonable arrangement may be to negotiate with the railroad for operating rights for the new passenger service. In that case, agreement would have to be reached not only on the level of monetary compensation to the railroad for the use of the right-of-way, but also upon the scheduling of existing and new movements, the responsibility for dispatching, the allocation of responsibility for maintenance costs, and liability protection.

Another option for corridors that are owned by a railroad is for the DOT or some other public agency to purchase the right-of-way from the railroad. If the existing service is to continue, operating rights could be granted to the railroad, also after negotiations on the financial arrangements that would accompany those rights.

Finally, where a railroad owns the right-of-way, that railroad could be the operator of new passenger service, under a contract with a public agency that would cover the costs of the operation.

Funding

Funding for a fixed-guideway project includes both the capital funds necessary to build the project and the operating funds that would be needed to support the costs of its continued functioning as a part of the public transit system.

Obtaining the funds to construct a facility will be the first concern, and a major one, given the amounts of money that are required. Typically, the funding program for a major capital investment in public transportation facilities draws upon a number of funding sources to compile the needed amounts.

One significant potential source of funds is the federal public transportation program, defined by the Federal Transit Act and most recently amended by the Intermodal Surface Transportation Act of 1991 (ISTEA). The program is administered by the Federal Transit Administration of the U.S. Department of Transportation. It provides financial support for a number of public transportation purposes.

The federal capital support for new fixed-guideway projects, including commuter rail, light rail, and busways, is provided under Section 3 of the Act. The Section 3 program makes available grants and loans for:

> the construction of new fixed guideway systems and extensions to existing fixed guideway systems, including the acquisition of real property, the initial acquisition of rolling stock needed for such systems, the detailed alternative analysis relating to the development of such systems, and the acquisition of rights-of-way, and relocation, for fixed guideway corridor developments for projects in advanced stages of any such detailed alternatives analysis or preliminary engineering.

The 1991 Act authorized $5 billion in Section 3 funds for use in new fixed-guideway projects over the six-year period covered by the Act, but actual amounts to be made available depend upon annual appropriations by the Congress. Grants made under Section 3 are discretionary; projects must compete for funding approval based upon their merits. The grants can cover 80 percent of project cost, with the remainder provided through some nonfederal source that can include state, local government, and privately provided funds. Some public transit agencies have requested less than 80 percent of the needed funds for a project to increase the likelihood of grant approval. Obtaining funds from this source will be difficult because the Act also earmarked funds for specific projects; the earmarked funds exceed the amount of the authorization.

The federal transit program also includes a block-grant program established by Section 9. This program provides capital funds that are intended for more-routine purchases and construction, such as the regular replacement of buses. These funds are made available annually; the amount that is available to each metropolitan area is based upon an allocation formula. Funds that are not needed for routine needs can be used for major expenditures such as a fixed-guideway project.

The amount made available to the Providence metropolitan area in 1993 is about $5 million. RIPTA now receives a large part of its capital funds through this program. RIPTA's capital needs have not used all of the funds available from this source, and so unexpended funds exist. However, RIPTA faces larger capital needs in future years to replace aging buses and to add vehicles designed for use by people with transportation-related disabilities.

The Act also created another new category of federal funds for transit use. For the first time, federal funds that are generally authorized by highway projects can be transferred to transit uses. Funds in the Surface Transportation program, one of the basic federal highway programs, may be transferred to transit capital projects. Funds that are transferred are available at the same 80 percent ratio, and other program requirements and regulations that exist under the transit program apply to these highway funds.

The 1991 amendments increase the emphasis upon funding issues by requiring that transportation plans include financial plans. Projects that are proposed to be built must be shown to have adequate funds available for project completion.

Federal funds are also available to support operating costs. The Section 9 block grant described above also includes a component of funds that can be used for this purpose. The Providence metropolitan area presently receives about $4.5 million per year. That amount is entirely used to support the operations of the RIPTA bus system, so no excess funds from this source are available.

Another source of funds is state or local funding programs. The capital costs of fixed-guideway projects in some other metropolitan areas have been financed entirely with state and local funds because of the time that it takes to fulfill the requirements for federal funds. Even if federal funds are used, some other source of funds must provide the nonfederal matching share.

The present state source of funds for public transportation in Rhode Island is a three-cent-per-gallon gasoline tax. This source has been projected to be inadequate for future needs even if no fixed-guideway project were to be built. A recent study, Systemwide Analysis for the Rhode Island Public Transit Authority, found that the projected operating and capital costs of the RIPTA system through 2010 will exceed the amounts that will be available from the present sources. The study found that even maintaining the present level of public transportation service and meeting the service requirements specified in the federal Americans with Disabilities Act will require "greatly expanding funding for public transportation."

Private sources may also provide funds for a project. The most effective way to involve private interests in project development is through the joint development of real estate at stations. Such joint development can help to offset the capital cost of constructing some facilities and also increase the ridership market by concentrating development at fixed-guideway stations. Joint-development opportunities vary by location, and are most successful where the market for development is strong. Experience in other cities has shown that joint development can provide a small but significant part of capital needs for a fixed-guideway project.

Funding will be one of the most significant issues in the development of a fixed-guideway project in Rhode Island, since the costs will be high and additional funding sources will be required to pay for those costs.

Project Planning

Moving forward from this feasibility study to the construction of a project will require additional planning and engineering studies. The exact nature of the studies will depend upon the corridor selected, the types of facilities to be built. and whether or not federal funds are to be used. Federally funded projects must meet federal planning requirements.

For a project that would require modest amounts of federal funds, the required planning is straightforward. The project would need to be included in the state's long-range transportation plan as one component of the intermodal transportation system. The plan must describe the transportation, social, economic, environmental, and financial impacts of such a project. As the project moved to implementation, specific environmental aspects would need to be addressed, and a financial plan would be needed to demonstrate that adequate funding would be available to complete the project. Of the alternatives examined in this study, only commuter rail on the Amtrak Shore Line would have low-enough capital funding needs to follow this planning process.

A project in any of the other corridors would have higher capital costs, and would require additional planning if federal capital funds are sought. This process includes a major investment study, and is required of both highway and public transportation projects. The process is newly revised as a result of the provisions of ISTEA, and at the time of this study is still being defined. Federal transportation planning regulations were issued on October 28, 1993; those regulations stated that additional federal guidance on planning for major metropolitan transportation investments would be issued.

The regulations state that major investment studies are to "evaluate the effectiveness and cost-effectiveness of alternative investments or strategies in attaining local, State and national goals and objectives. The analysis shall consider the direct and indirect cost of reasonable alternatives and such factors as mobility improvements; social, economic, and environmental effects; safety; operating efficiencies; land use and economic development; financing; and energy consumption." The major investment study is intended to provide the basis for an environmental assessment, and may include the preparation of a draft environmental impact statement. The requirement for a major investment study is especially important if Section 3 funds are to be used, as federal law requires an alternatives analysis for the use of those funds.

A major investment study is conducted with intense federal oversight. Federal approval of the planning methods that would be used is necessary, and enhancements to those methods may be required. In Rhode Island, improvements to the computerized transportation planning models would be called for, including the addition of a mode-split model that would project the proportions of total trips that would use automobiles and public transportation.

Before a major investment study could be done, the priority transportation corridor that would be the focus of study would have to be selected, as a major investment study is typically restricted to only one corridor. Selecting the priority corridor would require a transportation system-wide analysis of needs. The results of this rail corridor study would be an important contribution to a system study, but additional information would be needed on nonrail corridors. Enhanced transportation planning models should be used for the system study.

The major investment study would consider alternative transportation investments within the corridor. Federal regulations require a collaborative process to define the alternatives; an evaluation of the effectiveness and cost-effectiveness of the alternatives in achieving local, state, and national goals; consideration of a broad set of effects of the alternatives, including direct and indirect costs; a public-involvements process; and documentation of the study. The study may be designed to produce an environmental impact statement.

The successful completion of a major investment study would allow the beginning of preliminary engineering, which would establish the design criteria for the project and better define its characteristics. An environmental impact statement would be produced during preliminary engineering if it had not been completed during the major investment study. Final design would then create the construction documents and specifications from which the project would be built. Completing a system study, selecting a priority corridor, performing a major investment study, preparing an environmental impact statement, and doing preliminary and final engineering could take five to seven years.

Operating and Safety Regulations

All railroad operations in the United States, including commuter railroads, are regulated by the Federal Railroad Administration. The principal effect of FRA regulations for passenger railroads is in the setting and enforcement of safety standards, the basis for which are established in federal law. The FRA has established standards for track condition that limit operating speeds, and specifies certain aspects of locomotive and car design and condition, as well as operating and signalling practices. Railroads are subject to inspection to assure compliance with FRA requirements.

Urban public transportation systems, including both bus and rail systems, are not subject to federal operating regulations.

10
Capital and Operating Costs

Probable capital and operating costs were estimated for each of the alternatives. One component of capital cost was calculated for the construction of the facilities for each alternative. Another component of capital cost included the acquisition cost of the vehicle fleet. Probable operating and maintenance cost estimates were based upon an operating plan developed for each alternative.

Both capital and operating cost estimates for each corridor include the costs that would be incurred if improvements were made in only that corridor. If improvement were made in more than one corridor using the same public transportation technology, there would be some savings where multiple lines could share facilities. For example, the LRT alternative in each corridor includes a segment through downtown Providence. The capital costs of building that segment and of the vehicles to operate on it, as well as the operating cost of service on that segment, are included in the estimates for each corridor. If more than one light rail line were to be built, only one line would need to include the cost of the downtown segment. The approach allowed fair comparisons among corridors and avoided prejudgments about the extent of any system.

10.1 Facilities Capital Cost Estimation Methods

In order to estimate the capital cost of upgrading facilities, standards were defined for the design and construction of the facilities. The characteristics necessary to derive capital costs at the degree of precision appropriate for this study are track condition and use, right-of-way, service frequency, vehicle length and configuration, track and lane configuration, operations control, grade crossing protection, station type, terminal configuration, storage and maintenance facilities, and bridges and overpasses.

For the rail alternatives (commuter rail and LRT), track should be built to, or brought up to, FRA Class 3, permitting 59-mph operation by passenger trains. Unless station spacings are very long, the travel-time savings for higher maximum speeds are likely to be very small. The higher maintenance costs associated with high-speed operation on lines other than the Amtrak Shore Line will also make such service less economically viable.

The railroad routes investigated as a part of this study included track structures of varying conditions from poor to excellent. The basis for track evaluation was the Federal Railroad Administration Track Safety Standards. These standards address roadbed, track geometry, track structure, and track appliances and track-related devices.

For either commuter rail or LRT, rail freight service to any existing customers could be retained. Designs to include continued freight service can constrain the design and increase costs, however, especially for LRT. On lines where there is no current or potential rail freight customer, the new transit service should not be designed to accommodate freight. Where freight service may need to be reintroduced to serve future industrial development, transit facilities should be designed to allow for potential modification.

For busways, the 55-mph highway speed limit was applied. Although local rail freight service can be operated on tracks laid in the pavement of a busway, high-speed highway operation is incompatible with such railroad operation. Retention of local freight service would require a dedicated separate track, adding considerably to the total right-of-way requirement. This may preclude the busway option in narrow rights-of-way if rail freight service must be provided.

Right-of-Way Requirements

Under ideal conditions, the transit facilities should be designed with preferred standards for clearances, pavement shoulders, and other features. Ideally, they would also be designed with open drainage, to reduce construction costs. Under constrained conditions, however, smaller (but acceptable) clearances can be provided, and closed drainage can be designed. Table 10-1 shows widths following typical recent North American practice, measured between fences at either side, for both ideal and constrained (minimum) conditions.

Table 10-1
Typical Right-of-Way Requirements

Transit Mode	Single-Track ROW Ideal	Single-Track ROW Constrained	Two-Track ROW (ft) Ideal	Two-Track ROW (ft) Constrained
Commuter Rail	31	18	44	30
Light Rail Transit	32	18	45	28
Busway (without parallel rail freight)	N/A	N/A	60	32
Busway (with parallel rail freight)	N/A	N/A	88	54

N/A - Not applicable

Service Frequency

For capital-costing purposes, generalized operations plans were developed. Two approaches were followed to determine reasonable service intervals—derivation of service requirements from the estimated upper-limit demand, and comparison with peer operations. To determine the headways required to meet the maximum demand, vehicles with the characteristics and capacities shown in Table 10-2 were assumed.

Table 10-2
Design Transit Vehicle Characteristics

	Single-Unit Bus	Articulated Bus	Articulated LRV	Commuter Rail Coach	Bi-Level Rail Coach
Length (ft)	40.0	60.0	75.0	85.0	85.0
Width (ft)	8.5	8.5	9.0	10.5	10.5
Seats (1)	53	72	84	120	162
Standees (2)	7	22	51	10	108
Capacity	60	94	135	130	270

(1) For commuter rail vehicles, 2+3 configuration at .42 square meters per seat. For LRV, 2+3 configuration at .38 square meters per seat. For buses, 2+2 configuration at .38 square meters per seat.

(2) For all vehicles, 4 passengers per interior square meter, excluding seats, .558 meter (22-inch) aisle allowance between seats, and driver/cab areas.

Commuter rail consists were assumed to range from four single-level cars to seven bi-level cars; this corresponds to a practical capacity of 520 to 1,890 passengers per train. Corresponding demand-based headways for 2,720 passengers per hour, the likely maximum on the most heavily traveled corridor, would be about 11 to 42 minutes. Economics would dictate running towards the longer end of this range.

In actual practice, the range of service headways found acceptable and economic for both startup and mature commuter rail operations in North America in cities of up to 4 million metropolitan population is from 20 to 40 minutes. For startup services and smaller cities, 25 or 30 minutes is typical.

Modern LRT consists typically range from one to five articulated railcars; this corresponds to a practical capacity of 135 to 675 passengers per train. Corresponding demand-based headways for 2,720 passengers per hour would be 3 to 15 minutes. In practice, startup LRT systems in North America have generally adopted an initial service frequency of 15 minutes, which permits some single-track operation. Increases in capacity are obtained by adding cars until the capacity of the maximum consist is exceeded.

Modern busways operate with either single-unit or articulated buses. Corresponding demand-based headways for 2,720 passengers per hour would be between 1 and 2 minutes. In practice, average headways may be as low as 45 seconds, and individual vehicles may operate only a few seconds apart in line-of-sight operation.

Vehicle Length and Configuration

The length of vehicles and their operating configurations are required primarily to estimate station characteristics. Guidance was developed from typical North American practice.

The maximum likely commuter rail consist would be one locomotive and seven coaches, each nominally 85 feet in length. Recommended assumed train length is 680 feet. Except for the Amtrak Shore Line, all operation would be by diesel locomotives. The Amtrak Shore Line is expected to be electrified by the turn of the century; electrified service will probably also be locomotive-hauled, similar to some other commuter rail services that now operate on the electrified portions of the Northeast Corridor.

The maximum likely LRT consist would be five 75-foot articulated cars, for a total of 375 feet. Each car would be motored and equipped for multiple-unit operation, with a pantograph for electric power collection from an overhead catenary, and a cab at each end for bidirectional operation.

Single-articulated (two-section) buses are typically 55 to 60 feet in length; the larger number would be an appropriate maximum assumption.

Track and Lane Configuration

When service frequency permits, single-track or single-lane operation may be appropriate to reduce capital costs. De Leuw, Cather has developed a method for determining appropriate single-track lengths that was applied for this study. Passing siding lengths depend on operational requirements as discussed below. Typical practice is also noted.

For a 25-minute headway on commuter rail, a single-track running time between passing tracks should be no more than nine minutes to minimize delays to peak-direction trains; at a typical average service speed of 30 mph, this corresponds to about 4.5 miles.

Because ridership on commuter rail is invariably strongly directional, it proves economic to arrange meets so that off-peak direction trains take the sidings. A recent operational study for the MBTA's proposed Newburyport extension determined that the economically optimum passing track length was 1800 feet.

The resulting recommended passing-track configuration for commuter rail is 1800-foot passing tracks spaced at 4.8 miles center-to-center. This is similar to the configuration of the MBTA's Needham Line, which was recently rebuilt, and resumed operation in 1987.

For a 15-minute LRT headway, a single-track running time between passing sidings should be no more than four minutes to minimize delays to peak-direction trains; at a typical average service speed of 25 mph, this corresponds to about 1.8 miles.

Because LRT ridership can be less directional than commuter rail, provision should be made for minimal delays in both directions. This requires a passing-track length of about one mile. The resulting recommended passing-track configuration for LRT is one-mile sidings spaced at 2.8 miles center-to-center. The LRT systems in Sacramento, CA and Baltimore, MD have a similar configuration.

Busway headways under four minutes cannot be operated over single-lane sections of any length without delays that would be considered unacceptable in a modern transit operation. With a passing-lane requirement on the order of one mile, it is clear that the busway should be a full two-lane bidirectional roadway for its entire length. Both bus "rapid transit" busways in North America (in Pittsburgh, PA and Ottawa, Ontario) share this configuration.

Operational Control

Assumptions for operational control were developed from prevailing North American practice.

For 25-minute commuter rail service on a single-track line, full signalling with centralized traffic control (CTC) is appropriate. Because the Amtrak Shore Line through the state and as far as New Haven, CT, as well as all MBTA south-side commuter service, is already controlled from the Centralized Electrification and Traffic Control (CETC) center at Boston's South Station, it is reasonable to assume that operational control of commuter rail territory in Rhode Island would be exercised from this location.

For LRT service, full signalling with CTC is also appropriate. This would be accomplished from a small dedicated control center, similar to those of other newly built LRT lines. This facility, unlikely to exceed 600 square feet, could be located within a RIPTA operating garage or other existing location.

Signalling is not required to maintain separation between buses for full two-way busway operation. As in Pittsburgh and Ottawa, line-of-sight control by bus operators would be employed. Control could for all practical purposes be integrated with RIPTA local bus operations, although a dedicated small control center and bus tracking system, with space requirements similar to LRT, could be developed.

Grade Crossings

The cost of introducing new grade separations at highway crossings was assumed to be prohibitive, but most or all existing grade crossings were assumed to remain. Assumptions for grade-crossing protection for each mode were based on Federal Railroad Administration (FRA) guidelines, MBTA standards, and prevailing North American practice.

Based on the FRA formulas for grade-crossing accident hazards, both flashing signals and gates are recommended for all commuter rail public crossings, to avoid increasing risks over present levels. The need for protection at grade crossings can be evaluated according to a methodology presented in the "Rail-Highway Crossing Resource Allocations Procedure User's Guide." The procedure predicts the number of accidents that would occur at a given grade crossing based upon factors including the type of roadway forming the crossing and an exposure index derived from the product of highway and train traffic.

Calculations based upon the variable factors in the allocation procedure were used to calculate the effects of increased train activity upon an average study-area grade crossing. Gates along with the existing flashing lights were found to be required to prevent an increase in the expected accident rate.

To maintain good average speeds, all crossing protection would actuate automatically on approach of a train. With a signalling system already required, the elements necessary to effect this level of protection are easily added.

With LRT service more frequent than commuter rail, FRA formulas would again suggest gates and flashers at all public crossings. Crossing protection features similar to commuter rail are therefore recommended for preliminary costing; with the signal system in place, these features are easy to add. In more-detailed studies for a specific corridor, opportunities to substitute other technologies may be identified to reduce costs.

Because the busway system would not require a positive bus tracking or signalling technology, the degree of crossing pre-emption attainable differs slightly. The assumed crossing control technology is a traffic signal, actuated by buses via detector loops on approaches to crossings. This technique is applied at various locations on busways in North America.

Private crossings would be controlled by stop signs on the approaches from the abutting properties.

Stations

Preliminary design assumptions for stations are based on prevailing North American practice. The key standards concentrate on the platform areas; provisions for parking lots and site access are likely to be similar for each alternative technology.

Commuter rail stations were assumed to consist of low platforms on one side of the tracks, 800 feet long and 12 feet wide, with two pedestrian accesses to each side of the station. Benches and bus-stop-type shelters would be provided. To meet the requirements of the Americans With Disabilities Act, a covered "mini-high" platform would be provided. Stations would be located in single-track sections, and passengers would cross the tracks at grade when no train was present. This configuration is essentially the same as that used on the MBTA's recently renovated Needham Line. Stations on the Amtrak Shore Line might have to be different from the standard used for these costs estimates, to assure compatibility with other improvements to be made as a part of Amtrak's High-Speed Rail Project.

LRT stations would be similar to commuter rail stations, except at two-track locations. In these cases, a low platform and "mini-high" would be provided on each side, and an active train-approach warning system would be provided for the pedestrian crossing. Platforms would be only 450 feet long, and only a single pedestrian access would be provided on each side.

Some LRT alternatives included stations at on-street locations. Examples of this type of LRT station included the Providence Civic Center, and the Washington Secondary line between Olneyville Square and Kennedy Plaza. Line items were added for these alternatives to represent the cost of imbedding track in the street at these locations and the provision of special traffic signal systems to provide priority for transit vehicles.

Busway stations would be sized for simultaneous stops by three buses on each side of the busway, for a total length of 300 feet. Platforms would be 12 feet wide. Stops would be made "off-line" with a through lane in each direction allowing for skip-stop or express operation by some routes. Access for people with disabilities would be provided by on-board bus equipment. A single pedestrian access would be provided on each side. Because of the frequent operation and the possibility of nonstop through buses, a single overhead pedestrian bridge, with wheelchair ramps, would be provided to connect the two sides.

Terminals

For costing purposes, a standard outer-terminal configuration was assumed for each public transportation technology.

The commuter rail terminal station was assumed to have two tracks, each of which would extend 2500 feet beyond the station to provide layover storage and a signalized control point for inbound train dispatching. "Push-pull" operation, which does not require trainsets to be turned around for operation in the reverse direction, was assumed. For the Shore Line, a single terminal track would be located parallel to the present two-track main line, with a single turnout and crossover track arrangement connecting it to the mainline; sufficient tangent track between the mainline turnout and the terminal station would be provided to allow commuter trains to make relatively high-speed (45-mph) moves on and off the Amtrak mainline.

The LRT terminal configuration was assumed to be a two-track station. Beyond the station (i.e., farther from Providence), the two tracks would be brought together again to a single track with sufficient storage for two five-car trainsets (i.e., 900 feet). Trains in service would normally be dispatched from the terminal platforms.

The outermost busway station would have a configuration identical to all other busway stations. Because one of the principal advantages of a busway is the ability to run feeder services directly onto it, connections to the existing highway or street system would be made beyond the last busway station where possible. In these cases, buses would be assumed to lay over and reverse direction on existing streets. Where a convenient connection cannot be made, a dedicated loop

Storage and Maintenance Facilities

Additional costs were included in the estimates of probable capital cost to cover expenses for facilities to store and maintain transit vehicles used in the alternatives. These line items included expansion of bus garages, LRV maintenance facilities, and LRV storage yards. The commuter rail estimates already included track for overnight storage of equipment, while the estimates of probable operating cost include the use of existing MBTA facilities for heavy maintenance.

Bridges and Overpasses

Visual inspections of the existing bridges, overpasses, and other structures in the rail corridors were completed during the field inspections. Each structure was rated according to its suitability for use by commuter rail, LRT, and busway vehicles. Based upon this rating, a determination was made whether restoration or full reconstruction of each structure would be required.

Costs estimates representing restoration and reconstruction of three different bridge types were developed. The estimates included rail, HS20 (Busway) and overpass structures. Separate estimates were developed for those bridge types assuming timber, steel truss, steel beam, concrete, and granite-block construction. Estimates were also developed for the Seekonk River Bridge on the Bristol Secondary Track and the Sakonnet River Bridge on the Newport Secondary Track, as well as for the East Side Rail Tunnel. Average unit costs for restoration and reconstruction were then developed from these data and were used in the development of the estimates for recommended improvements. In some corridors, the busway would require new dedicated structures, which were estimated separately.

The cost of providing an elevated guideway to bring busway and LRT lines to street level from the west end of the East Side Tunnel was also included in the capital cost estimates for the Bristol, East Providence and Newport Secondary alternatives. The cost of reconditioning the tunnel was also added to these alternatives.

Environmental Analyses

The cost of environmental analyses for existing and new rights-of-way was included in the capital cost estimates. For the purposes of these estimates, "existing" right-of-way consisted of those areas included in the original railway corridors, while "new" right-of-way included those areas not included in the original railway corridors. Generally, the costs involved in studying new on-street right-of-way were included in the cost estimates, but the cost of acquiring such right-of-way would not be assumed by the developer of these transit facilities. An additional line item in the cost estimates was also provided for the completion of a general environmental study for each corridor, as well as for earthwork needed to prepare new right-of-way.

10.2 Vehicle Capital Cost Estimation Methods

Capital costs for transit vehicles were estimated by applying an average unit cost per vehicle to the number of vehicles required for each alternative.

Vehicle Unit Costs

Vehicle unit costs were established for 40-foot standard buses, articulated buses, single- and double-deck commuter rail coaches, commuter rail locomotives and light rail vehicles. A base of vehicle cost data was accumulated from recent vehicle purchases made by North American transit agencies. This information was used as the basis for the calculation of an average unit cost for each of the vehicle types. The total purchase price was modified through the use of a factor to adjust to 1992 dollars. Average unit costs used for cost-estimating purposes are shown in Table 10-3.

Table **10-3**
Average 1992 Vehicle Costs

Type	Average 1992 Cost
Standard bus	$215,700
Articulated bus	485,200
Light rail vehicle	1,539,000
Single-level commuter rail car	1,081,000
Double-level commuter rail car	1,344,000
Locomotive	2,092,000

Fleet-Size Requirements

The number of transit vehicles required for each alternative was determined from the vehicle capacity, corridor demand level, and travel time along the corridor.

For operating-cost evaluation purposes, the following vehicle types were selected:

- Standard single-unit transit bus with a capacity of 70 passengers. This vehicle would be sufficiently similar to the existing RIPTA fleet to permit common maintenance facilities.

- Six-axle articulated light rail vehicle (LRV) with a capacity of 200 passengers. This is essentially the standard configuration for North American LRT systems.

- Single-level commuter rail coach with a capacity of 130 passengers.

Travel times between stations were estimated through the use of the Sequential Transit Operations Modelling Program (STOMP), a microcomputer-based simulation implemented in QBASIC. STOMP is a macroscopic event-advanced simulation that has the ability to represent vehicles of different lengths, acceleration/deceleration, capacity, and passenger-loading characteristics and includes speed limits reflecting curves, civil restrictions, or other features. The simulation can also reflect interaction with street traffic signals (if any), including optional green extension or advance features. For this application, dwell times typical of North American operations were used: 45 seconds for commuter rail, 25 seconds for LRT, and 20 seconds for bus. Schedule recovery and layover times were derived from observations of typical operating practice. The values employed were 13 minutes for commuter rail, 6 minutes for LRT, and 4 minutes for bus.

Weekday operating schedules were established for each alternative. Trips operated for Saturday and Sunday service were established at levels typical for North America for each technology and weekday service level proposed. Fleet requirements were estimated as that necessary to operate the scheduled weekday service, with no explicit allowance for spares. A provision for spares amounting to 10 percent of the transit equipment capital cost was added to the annualized capital costs. This might be accomplished by acquiring spare vehicles, or arranging with another operator (e.g., MBTA or Amtrak) to borrow equipment.

With the exception of the Newport Secondary, all trips were assumed to operate over the entire corridor. On the Newport Secondary, the commuter rail service from Boston was assumed to be a direct extension of a proposed extension of MBTA commuter rail service from Stoughton to Fall River, MA. The commuter rail timetable is based on the proposed schedule found in Table 6-7 of the "New Bedford/Fall River Commuter Rail Extension Feasibility Study Final Report." The busway extension from Bristol was assumed to operate at a policy headway of 15 minutes in the peak, and 30 minutes off-peak in view of the relatively low forecast ridership. Most bus trips would turn back at Independence Park in Bristol.

10.3 Operating and Maintenance Cost Estimation Methods

The estimates of probable operating and maintenance costs were derived using the resource-build-up approach, which associates costs with output measures such as vehicle hours or vehicle miles of service. Estimates of the unit costs for producing each of these outputs were applied to the estimated output levels required to operate a specific service. Expenses for management, planning, administration, and related activities were estimated as overhead applicable to other costs.

General Approach

Three operating and maintenance (O & M) cost models were developed for this study:

- Motor Bus O & M Cost Model
- Light Rail Transit O & M Cost Model
- Commuter Rail O & M Cost Model

For each of the three public transportation cost models, different submodels were developed for two of the components of operating and maintenance costs, vehicle operating costs (VOC) and vehicle maintenance costs (VMC). A common formulation was developed for the non-vehicle maintenance costs (NVMC). General and administration costs (GAC) were estimated as a multiplier of the other costs (G&A). For each technology, the total operating and maintenance cost (TOMC) is the sum of these submodels:

$$\mathbf{TOMC = f_{g\&a}\,(VOC + VMC + NVMC)}$$

These models comprise unit costs applied to variables such as vehicle miles, vehicle hours and station and way capital costs. The unit costs of systems with characteristics similar to those under consideration were computed and were used to support the results of the models.

Motor Bus Service Operating and Maintenance Cost Model

Operations and maintenance statistics of 41 North American transit systems, with fleet sizes of 100-250 vehicles, were used to develop the operations and maintenance cost model for motor-bus service. These statistics were obtained from the National Urban Mass Transportation Statistics—Section 15—report produced by the Federal Transit Administration.

The statistics that were considered in the modeling effort included fleet size, annual vehicle hours, annual vehicle miles, annual platform hours, annual total operating expenses, vehicle operating expenses, operators expenses, vehicle maintenance expenses, non-vehicle maintenance costs, general administration costs, cycle time, population served and revenue hours.

Linear regression was used to estimate the coefficients of the submodels. The results are the conclusion of different trials involving different variables to determine the most appropriate equation to estimate the actual costs.

Light Rail Transit Service Operating and Maintenance Cost Model

Operations and maintenance statistics for the fiscal year 1991 of nine North American light rail transit systems were used to develop the model for the operating and maintenance costs. These statistics were also obtained from the National Urban Mass Transportation Statistics—Section 15—report.

The statistics that were used included fleet size, number of surface stops and stations, number of underground stations, track miles, train hours, vehicle hours, vehicle miles, train crew, and the operating and maintenance expenses.

The models are the result of different trials using linear regression, time-series analysis, and other methods to determine the most appropriate mathematical equation that represents the operating and maintenance costs of providing LRT service.

Commuter Rail Service Operating and Maintenance Cost Model

Operations and maintenance statistics of nine North American commuter rail transit systems were used in developing the model for the operating and maintenance costs. These statistics were obtained from the National Urban Mass Transportation Statistics—Section 15—report and other publications such as the Transportation Research Record No. 1361, published by the Transportation Research Board.

The statistics that were used included fleet size, number of stations, track miles, train hours, vehicle hours, coach hours, vehicle miles, train crew, and the operating and maintenance expenses.

The models are the result of different trials using linear regression, time-series analysis and others to determine the most appropriate mathematical equation that represents the operating and maintenance costs of commuter rail service.

Non-Vehicle Maintenance Cost

Non-vehicle maintenance cost includes right-of-way maintenance, signal maintenance, operating control center maintenance and other maintenance costs that are not related to the vehicles (bus, light rail or commuter rail). Linear regression was used to develop the general model for the non-vehicle maintenance cost.

General Administrative Cost

Statistical methods similar to the ones used to develop the vehicle operating and maintenance cost models in the previous sections were used to estimate the general administrative cost multiplier. The general administrative cost model was developed as a fraction of all other operating and maintenance costs combined.

Validation of Results

To verify the models, estimated total operating costs reported under Section 15 were compared to values estimated by the models. The 1992 Rhode Island Public Transit Authority Section 15 reported statistics were also used to verify the operating and maintenance cost models. Table 10-4 presents both the reported and estimated operating and maintenance costs. Reported vehicle hours and capital value were used as input to the motor-bus service operating and maintenance cost models.

Table 10-4
Comparison of Operating Costs for RIPTA Bus Systems

1992 $	VOC	VMC	NVMC	GAC	Total
Reported-R	17,667,971	5,039,172	453,357	3,176,507	26,337,007
Estimated-E	17,480,906	5,132,447	435,886	3,564,399	26,613,638
[E-R]/R %	-1.0 %	1.8%	-3.8%	12.2%	1.0%

10.4 Estimates of Probable Capital and Operating Costs

Amtrak Shore Line Commuter Rail

Although commuter rail is the only transit technology considered in this corridor, two variations in the length of the line were considered. Present and future Amtrak service will require both existing tracks to be maintained for high-speed passenger rail operation. The principal requirement for adding commuter rail service would be improvements at the southern terminal for the service. The annual operating costs shown for both variations assume that RIDOT would incur a portion of the non-vehicle maintenance cost required to maintain Amtrak property. The estimate of probable capital cost is $48,750,000. The estimate of probable annual operating and maintenance costs is $13,600,000.

To provide additional information, cost estimates were prepared for a second version of this alternative. It would extend from Providence only as far as Kingston Station. The estimate of probable capital cost for this version is $41,720,000. The estimate of probable operating and maintenance costs is $9,410,000. This version would attract slightly lower ridership, since it would not provide direct service to the southwestern part of the state.

Bristol Secondary Busway

The capital costs for this alternative include upgrading the East Side Rail Tunnel and the construction of an elevated structure built to carry the busway from the end of the tunnel down to street level. Because of the frequency of bus operations, the tunnel would require ventilation. The estimate of probable capital cost is $71,170,000. The estimate of probable annual operating and maintenance costs is $4,300,000.

Bristol Secondary Commuter Rail

Because the commuter rail alternative would terminate at the western end of the East Side Rail Tunnel, no structure beyond the end of the tunnel is included in the capital cost. Partial ventilation of the tunnel would be required. The estimate of probable capital cost is $72,720,0-00. The estimate of probable annual operating and maintenance costs for this alternative is $7,970,000.

Bristol Secondary LRT

This alternative would also use an elevated structure between the Civic Center and the East Side Rail Tunnel, but would require no tunnel ventilation. North of milepost 4.5, where this track is still in service, it was treated in the same way as the East Providence Secondary. Any existing freight services would share track with the LRT service. South of this point, rail freight service was assumed not to be required, and therefore this alternative could be built within the existing right-of-way. The estimate of the probable capital cost for this alternative $109,520,000. The estimate of probable annual operating and maintenance costs is $5,100,000.

East Providence Secondary Busway

This alternative would use the East Side Rail Tunnel, approaching downtown Providence through the use of the elevated structure similar to the Bristol Secondary Busway alternative. Rail freight service was assumed to be operated on relocated tracks. This would require the relocation of freight tracks; 40 feet of right-of-way width was assumed to be acquired for the project, and both freight track relocation and widening of all overhead bridges was included in the estimate of probable capital costs, which totals $66,710,000. The estimate of probable annual operating and maintenance costs is $3,750,000.

East Providence Secondary LRT

The costs assume that freight operations could be restricted by time of day, and that both freight and LRT could be operated on reconstructed tracks entirely within the right-of-way. No bridges were assumed to require widening. Any significant increases in freight traffic could require the construction of additional trackage to accommodate both freight and LRT. The East Providence Secondary LRT alternative would require reconditioning of the East Side Rail Tunnel. The estimate of probable capital cost for this alternative is $88,780,000. The estimate of probable annual operating and maintenance costs is $3,470,000.

Newport Secondary Commuter Rail

The analysis of this line included the portion in Massachusetts between the state line and Fall River as well as the Rhode Island portion. Commuter rail service from Newport to Boston would require a connection between this line and an existing rail line between Fall River and Boston. Passenger rail service does not presently operate to Fall River on this line, but an extension of commuter rail service from Stoughton, MA is under consideration by the MBTA. The estimate of probable capital and annual costs included an estimate for the restoration of the Sakonnet River Bridge. The estimated capital costs for this alternative is $64,700,000. Estimated annual operating and maintenance costs are $6,500,000.

Newport-Bristol Combination Busway

The estimates reflect the assumption that tourist rail service would not continue if the busway were built; rail freight service was also assumed not to be operated. Maintaining rail service in the corridor would require separate parallel bus and rail facilities, which would add significantly to costs. Assuming no rail service would allow no property takings or bridge widenings to be required. No cost for bridge construction at Mount Hope Bay has been included, as this alternative would use the existing Mount Hope Bridge to connect the Newport Secondary to Route 114 into downtown Bristol, where it would connect with the Bristol Secondary. Two stops would be located in downtown Bristol. The toll plaza at the north end of the bridge would have to be relocated and reconstructed to allow for priority transit operation. Some daily bus trips would travel to and from Gateway Center in Newport, while the majority of trips would run only as far as Independence Park Station in Bristol. The estimate of probable capital cost for this alternative is $95,960,000. The estimate of probable annual operating and maintenance costs is $5,580,000.

Newport-Bristol Combination LRT

The costs for this alternative include the development of a light rail line on the Newport Secondary as far north as a point near the Mount Hope Bridge. A new high-level bridge across Mount Hope Bay is included in the cost estimate, as well as the reconstruction of Metacom Avenue to accommodate a light rail line and the use of a utility right-of-way for the line through Bristol and Warren. As this line would also use most of the length of the Bristol Secondary, the cost estimate includes the same cost elements that were derived for that portion of the Bristol Secondary LRT alternative. This study did not include detailed geotechnical and design studies for the new bridge, so that element of the capital cost has a higher degree of uncertainty than the other cost elements. The estimate of probable capital costs is $228,650,000. The estimate of probable annual operating and maintenance cost is $7,800,000.

Providence & Worcester Main Line Commuter Rail

The estimates of probable cost for the commuter rail line assume shared use of the P&W mainline with freight service, with major track reconstruction to FRA Class 3, and additional passing sidings. The estimate of operating cost assumes that RIDOT would accept a portion of the non-vehicle maintenance cost required to maintain Amtrak property. The estimate of probable capital cost is $63,250,000. The estimate of probable annual operating and maintenance costs is $8,460,000.

Washington Secondary Busway

This alternative would leave the Washington Secondary corridor at the Brewery Station in Cranston and would parallel the Amtrak Shore Line to Olneyville Square. The estimates reflect the assumption that right-of-way would have to be acquired in the Olneyville Square area to accommodate the busway once it leaves the Amtrak corridor. From Olneyville Square, no right-of-way acquisition would be required, since this alternative would approach downtown Providence in existing travel lanes on Broadway to Kennedy Plaza. Rail freight service was assumed not to be provided on the Washington Secondary right-of-way, so no property takings or bridge widenings would be required to allow for freight trackage. The cost estimate assumes that only the portion of the line south of M.P. 10 contains existing tracks which would have to be removed in order to allow for construction of new track. Estimates of probable capital cost and annual operating and maintenance costs are $45,090,000 and $3,690,000, respectively.

Washington Secondary LRT

Since the Washington Secondary LRT alternative would use the same route as the busway, some right-of-way characteristics are similar. The estimate of probable capital cost for this alternative is $98,350,000. The estimate of probable annual operating and maintenance costs is $4,240,000.

10.5 Opportunities to Reduce Costs

The estimates of probable operating and maintenance cost in this section have been formulated using service and design standards that are representative of those used by other transportation agencies, particularly RIPTA and MBTA. Significant reductions in operating costs for commuter rail could be obtained by adopting different standards, such as the "limited commuter rail" concept used in some corridors in Toronto, Ontario. Features of such a limited service would include:

- rail service in peak period, peak direction only,
- longer headways (e.g., 40-45 minutes) between trains in the peak period,
- midday and evening bus service to/from rail stations, at headways of an hour or more,
- proof-of-payment (self-service) fare collection, and
- no Saturday, Sunday, or holiday service.

Some reductions in LRT operating cost could also be achieved by increasing both train length and headways in the peak periods and by cutting back or eliminating weekend service. In both these cases, there would be a decrease in passenger demand in response to the lower-than-standard level of service.

Further more-detailed planning for any corridor should explicitly address service and design standards. The standards used for construction and operations should fit ridership market conditions and travel needs in each corridor. Development of corridor specific standards could improve the performance of a given alternative.

11 Evaluation of Alternatives

The feasibility of fixed-guideway transit in the rail corridors is a function of many factors, but a few are most important—costs, ridership, and environmental effects. To arrive at judgements about feasibility, the information developed on those subjects in the earlier tasks in the study was assessed.

11.1 Evaluation Methodology

The evaluation was designed to indicate the general feasibility of fixed-guideway development, the appropriateness of the different public transportation technologies that were considered, and the relative performance of the corridors. The evaluation was based upon comparisons among the cost, ridership, and environmental characteristics of the alternatives. Comparisons among the corridors examined all three characteristics; comparisons among the public transportation technologies within each corridor did not address ridership, since a single ridership estimate was developed for each corridor regardless of the technology.

11.2 Findings

Characteristics of the alternatives in each corridor are summarized in Table 11-1. To allow a cost comparison among the alternatives that recognizes both capital and operating costs, a single annualized cost was calculated. This figure includes the annual operating cost and an annualized component of the capital cost, calculated at a seven-percent discount rate.

Table 11-1
Summary Characteristics of the Alternatives

Alternative	Route Miles	Capital Cost, Millions	Annual Operating Cost, Millions	Total Annualized Cost, Millions	Daily Ridership
Amtrak Shore Line Commuter Rail to Westerly	43.0	$48.75	$13.60	$17.90	3,300-5,000
Amtrak Shore Line Commuter Rail to Kingston	27.2	41.72	9.41	12.83	3,200-4,800
Bristol Secondary Busway	16.2	71.17	4.30	9.81	
Bristol Secondary LRT	16.2	109.52	5.10	13.67	2,900-4,300
Bristol Secondary Commuter Rail	15.5	72.72	7.97	13.92	
East Providence Secondary Busway	9.2	66.71	3.75	9.23	4,200-6,300
East Providence Secondary LRT	9.2	88.78	3.47	10.42	
Newport Secondary Commuter Rail to Fall River	21.2	64.70	6.50	11.52	500-800
Newport-Bristol Combination Busway	30.5	95.96	5.58	13.00	3,200-4,800
Newport-Bristol Combination LRT	30.5	228.65	7.80	25.38	
P&W Main Line Commuter Rail	16.5	63.25	8.46	13.71	2,200-3,300
Washington Secondary Busway	14.3	45.09	3.69	7.24	3,300-4,900
Washington Secondary LRT	14.3	98.35	4.24	11.98	

Evaluation measures were calculated from these characteristics. The evaluation measures allow for comparisons among the corridors and the technologies by providing information on the relative cost and ridership of each. Evaluation measures of costs per passenger were based upon the midpoint in the range of estimated ridership shown in Table 11-1. The evaluation measures are:

Capital cost per mile is an indication of the difficulty of building each technology in each corridor. This measure allows a comparison of different corridors regardless of their length.

Annual operating cost per mile shows how the operating characteristics and service plan for each technology would be affected by the corridor characteristics. This measure provides comparisons both among the different public transportation technologies in each corridor and among the corridors.

Annual operating cost per passenger introduces the projected ridership into the evaluation. This measure allows comparisons of how well each technology fits the ridership demand in each corridor. It also is an indicator of the potential for financial success of a fixed-guideway line, as fare revenue is typically used to support operating costs.

Total annualized cost per passenger is an overall measure of how well each technology fits not only the physical characteristics of the corridor but also the ridership demand there. It compares the cost of both building and operating a fixed-guideway line against the number of people who could be expected to use it. This measure is the most significant one, as it provides a comparison of the financial resources that would need to be invested against the number of riders that would use the it, which is a measure of the benefits that the investment would create. The lower the cost per passenger, the better the performance of a given alternative.

These measures are useful only for comparisons among the alternatives; they cannot be interpreted as the actual unit costs of building a line. Actual costs would also need to include any potential added costs for feeder-bus service to provide access to the fixed-guideway line. Actual costs may also be reduced by savings from reductions in existing bus service that would be replaced by the fixed-guideway service, as well as any other transportation system improvements, such as highway construction or widening, that might not be needed if a fixed-guideway line were built. These measures also only reflect costs, not benefits such as environmental improvements and travel-time savings, and so cannot be used as the sole measure of the effects of fixed-guideway development.

Table 11-2
Evaluation Measures for the Alternatives

Alternative	Capital Cost per Mile, Millions	Annual Operating Cost per Mile	Annual Operating Cost per Daily Rider*	Total Annualized Cost per Daily Rider*
Amtrak Shore Line Commuter Rail to Westerly	$1.13	$316,000	$3,300	$4,300
Amtrak Shore Line Commuter Rail to Kingston	1.53	346,000	2,400	3,200
Bristol Secondary Busway	4.39	266,000	1,200	2,700
Bristol Secondary LRT	6.76	315,000	1,400	3,800
Bristol Secondary Commuter Rail	4.69	514,000	2,200	3,900
East Providence Secondary Busway	7.25	408,000	700	1,800
East Providence Secondary LRT	9.65	377,000	700	2,000
Newport Secondary Commuter Rail to Fall River	3.05	306,000	10,000	18,000
Newport-Bristol Combination Busway	3.15	183,000	1,400	3,300
Newport-Bristol Combination LRT	7.50	256,000	2,000	6,300
P&W Main Line Commuter Rail	3.83	513,000	3,100	5,000
Washington Secondary Busway	3.15	258,000	900	1,800
Washington Secondary LRT	6.88	297,000	1,000	2,900

* At midpoint of range of ridership estimate

For comparison, operating costs per route mile were calculated for commuter rail and light rail operations in the Boston area and for bus operations in the Providence area. The per-route-mile amount for MBTA commuter rail is $368,000 and for light rail, $948,000. RIPTA bus per-route-mile costs were calculated at $58,000, reflecting a number of assumptions about cost allocation. The comparability for commuter rail reflects primarily the similar service standards. MBTA's LRT costs are substantially higher because they include maintenance costs for a downtown subway system, and because each LRV is individually crewed. Given the higher service level on the busway than on typical RIPTA bus routes, and the costs of maintaining the busway, the busway costs appear to be in line.

Comparisons Among Alternative Public Transportation Technologies

From the characteristics of those corridors where two or more public transportation technologies were evaluated, general observations about their relative merits can be made.

Light rail transit generally has the highest overall capital cost. This is to a large extent the result of the cost of electrification and the specialized maintenance facilities required, although the cost of the vehicles is also a factor. Spreading these fixed costs over more riders results in significant economies of scale at higher demand levels.

For the demand levels anticipated, busways and LRT would have similar total operating and maintenance costs. All other things being equal, LRT would exhibit economies of scale, i.e. decreasing operating cost per passenger, as volumes increase.

Busways would generally have a distinct advantage over LRT in total annualized cost (i.e. annualized capital cost plus annual operating and maintenance costs) in the anticipated demand range. Studies for other cities suggest that the annualized costs for busways are less than those for LRT if the demand level is less than about 20,000 passengers per day. Cities that have opted for exclusive busway systems for volumes below this level include Pittsburgh, Pennsylvania, and Ottawa, Ontario.

Although busways would have the advantage in total annual cost, they would have some environmental disadvantages, especially compared to LRT. Busways would raise concerns about noise and air quality in several of the corridors and may require extra efforts for mitigation. LRT would have the most favorable noise and air quality effects of the three technologies considered.

Commuter rail tends to be more expensive than busways or LRT in operating cost per mile. Part of the reason for this higher cost is the high level of service that was assumed, reflecting the present operating practice at the MBTA. The opportunities for savings in operating costs for commuter rail through reductions in the level of service are illustrated by the Newport-Fall River service plan developed for this study. This line was assumed to operate with a lower frequency than services into Providence (or current MBTA services into Boston) because of the projected low ridership. The frequent station stops assumed in this study for commuter rail also contribute to higher costs by decreasing the average speed of trains, particularly along the P&W Main Line and the Newport Secondary. Commuter rail would introduce the most significant concerns about noise and air quality in the corridors that do not now have rail activity.

Comparisons Among Corridors

The measures of capital costs show, as expected, that the corridors with the lowest costs are those where the least construction is needed to develop a fixed-guideway line. The Amtrak Shore Line would have by far the lowest capital cost per mile, as the needed facilities are mostly in place. By contrast, the East Providence Secondary, which would require reconditioning of the East Side Rail Tunnel and, depending upon the technology, construction of a means of entry into downtown Providence and relocation of freight rail tracks, would have the highest per-mile capital cost.

The measures show that ridership is an especially important factor affecting operating cost performance. Corridors that have high capital costs can still have low total annual cost per rider if the ridership demand in the corridor is high. The corridors where ridership demand is highest are those that have the most development close to the fixed-guideway line. The best operating-cost performance would occur in the East Providence Secondary and the Washington Secondary; the worst on the Newport Secondary.

No corridor has both a low capital cost and good operating cost performance. Generally speaking, higher amounts of development in a corridor, which generate ridership and good operating cost performance, also complicate the construction of a fixed-guideway facility, increasing the capital cost. A qualified exception to this finding is the Amtrak Shore Line, where capital costs are low and development patterns would generate higher ridership. However, the operating cost per passenger there would still be relatively high because the choice of technologies is constrained to commuter rail.

The types of environmental concerns in the corridors are related to the amount of development there. In corridors that have little development, environmental issues are more likely to be those related to natural conditions, such as parks, wetlands and wildlife. These are the corridors that are most likely to have the lowest ridership. In corridors that have greater development, environmental issues include effects upon people, such as air quality and noise. Some corridors have sections that are developed and other sections that are less so, and so have both types of concerns.

Observations on Feasibility

The estimated ridership in all the corridors is lower than is typically viewed as necessary to justify the costs of LRT construction, but in some corridors is within the range that could support busway or commuter rail. The costs that were estimated for construction of all of the alternatives are lower than those experienced in other cities, attesting to the value of the available railroad rights-of-way as the potential locations for public transportation facilities.

12 Conclusions and Recommendations

The analysis generated a number of conclusions about fixed-guideway systems in Rhode Island; those conclusions support recommendations for action.

12.1 Conclusions

The decision to build a fixed-guideway public transportation system in Rhode Island is a major one. Fixed-guideway systems are expensive both to build and to operate, and would have significant effects upon other decisions about the transportation system and broader community characteristics. A decision to build a fixed-guideway system must be based upon a thorough understanding of the implications of doing so. This study identified several issues worth considering.

One issue is the character of development patterns in Rhode Island. Because fixed-guideway systems are designed to carry large numbers of riders, they work best where development, especially commercial activity, is clustered into large concentrations. Ridership volumes estimated in this study for the fixed-guideway alternatives are lower than the volumes on most of the LRT systems that have been built recently in the United States. The reason for this finding is that development patterns in the study corridors do not exhibit the scale of concentrations that are typically recommended to support a LRT system. Consequently, if LRT lines are to be built, community plans, zoning ordinances, and development incentives in areas to be served must be reviewed and revised to encourage higher-density development, especially for commercial development in downtown Providence.

Another issue is the use of existing railroad rights-of-way as the location of fixed-guideway lines. This study analyzed only those rights-of-way because they can offer opportunities for low-cost construction. The study showed that railroad rights-of-way can allow inexpensive construction; the Amtrak Shore Line, the Newport Secondary, and the Washington Secondary are the best examples in this study.

But railroad rights-of-way have other drawbacks that may offset the opportunity for low-cost improvements. Railroad rights-of-way are not in all cases the best locations for fixed-guideway lines to attract ridership. In Rhode Island, many railroad lines follow bodies of water. That can limit the potential ridership for a line by reducing the amount of developed and developable land that a fixed-guideway system can conveniently serve. That may also create concerns about environmental impacts upon wetlands and waterfront areas. This is illustrated in this study by the Bristol Secondary.

Another issue is design standards and their effect upon the potential cost of a project. This study used typical standards for the design and operation of fixed-guideway lines, drawing where appropriate upon the practice of the MBTA. To the extent that lower standards, such as less-frequent service, were be used, the cost characteristics of the systems would be improved, although lowered standards could also reduce ridership.

Finally, the ability to develop a financial plan for a fixed-guideway project is a critical issue. Such a plan must consider both capital and operating funds. Because of the significant capital cost of a project, federal funds will probably be a large part of project capital funding. Qualifying for federal funds will require the completion of a detailed planning process that will demonstrate the value of investment in a fixed-guideway project in Rhode Island. Operating funds may be an even greater concern. The addition of one of the corridors studied would increase public transit operating costs in Rhode Island by ten to twenty-five percent, depending upon the corridor selected, the amount of service operated, and changes to the existing bus service. The increased cost would be a continuing obligation, and would require the expansion of state funding for public transit and perhaps the creation of a new state funding mechanism.

These conclusions are reflected in observations about the potential in each corridor. Comments on the corridors are presented in order from the most feasible to the least.

Amtrak Shore Line

This corridor provides the easiest opportunity to develop a fixed-guideway line in Rhode Island. Because the needed facilities are mostly in place, the development of the service would require only the acquisition of a fleet and relatively minor facility improvements. Although the choice of public transportation technologies is limited to only one, commuter rail, that choice is one that is already operating north of Providence on this right-of-way and fits the characteristics of the corridor well. The potential for both ridership and financial success are enhanced by the ability to serve Boston in addition to locations within Rhode Island.

Development would be the quickest of those analyzed because the facilities are in place; the planning and design process would be simple and the assembly of project funding would be easiest. Planning and design of commuter rail services and facilities must be coordinated with Amtrak to assure compatibility with future high-speed rail operations in the corridor.

Because the analysis in this study found that the operating cost for the Amtrak Shore Line would be relatively high, a second service plan with a reduced level of service was developed at the request of the Project Advisory Committee. The revised service plan includes ten trips in each direction on weekdays only; four of those trips would terminate at Kingston and six at Westerly. Because this would require a smaller fleet, this change would reduce both capital and operating costs, although it would also reduce ridership somewhat as well. This change would reduce the capital cost from $48.75 million to $39.08 million, and the annual operating cost from $13.60 million to $7.28 million. This would reduce the total annualized cost by 40 percent. Further reductions could be achieved by other changes, such as terminating all trains at Kingston.

East Providence Secondary

The East Providence Secondary has the highest projected ridership of the corridors studied, even though it is the shortest, reflecting the higher levels of development surrounding it. It also has the highest capital cost per mile because of the need for more construction than other corridors, including the issues created by the East Side Rail Tunnel.

In spite of the higher capital cost, the East Providence Secondary has better evaluation measures than other corridors. Except for the Amtrak Shore Line, the East Providence Secondary shows the best potential for fixed-guideway development of the corridors studied, assuming that issues about entry into downtown Providence can be resolved.

Bristol Secondary

Introducing fixed-guideway service on the Bristol Secondary would be a challenge. Moderate projected ridership makes the cost per rider higher than in some of the other corridors. The presence of the bikeway in the corridor would require creative design to assure the continued ability of bicyclists to use the corridor. There are some environmentally sensitive areas that would require careful design and mitigating measures.

The busway alternative shows the best cost-per-rider performance in this corridor, but would be more difficult to integrate with the bikeway since a busway is wider than a rail line. A busway would also make future freight rail service difficult to establish. Since there may be opportunities for cost reduction in the commuter rail alternative, that alternative may be worthy of further scrutiny, yet it would be the most difficult to connect into downtown Providence.

The East Side Rail Tunnel on this line is both an opportunity and a problem. It offers a convenient approach to downtown Providence, yet would require an expensive structure to make a direct link, a structure that would raise esthetic concerns.

Washington Secondary

Because it runs through a developed area, the Washington Secondary is one of the better-performing corridors in the analysis. The cost and ridership performance measures for the busway alternative are better than those of the light rail alternative, predominantly because of lower capital costs for the busway. However, a busway could preclude any future freight service, and the environmental characteristics of the light rail alternative would be superior to the busway.

P&W Main Line

The relatively low ridership that would be produced on the P&W Main Line reduces the performance measures of this corridor. The low amount of development along most of the line is the reason for this condition. Since there could be opportunities for cost reduction for the commuter rail service that was analyzed in the corridor, those opportunities should be explored in any further analysis.

Newport-Bristol Combination

The combination corridor would reflect the characteristics of the two individual corridors that it comprises. The busway alternative would have a low capital cost because of the physical characteristics of both rights-of-way. Total cost per daily rider on a busway would be higher for the combination corridor than for the Bristol Secondary alone, because of the low ridership on the Newport Secondary portion of the corridor. A busway on the combined corridor has the disadvantage that reintroducing freight service would be expensive if not impossible.

The LRT alternative in the combined corridor would have a high capital cost because of the new bridge over Mount Hope Bay. The combination of this high cost and the low ridership on the Newport Secondary portion of the corridor would create a high total cost per rider.

Newport Secondary

This corridor has the lowest capital cost of the corridors other than the Amtrak Shore Line, and traffic conditions on Aquidneck Island create the hope that an alternative means of transportation would be successful here. But because of the relatively modest amount of development along the corridor, only a small number of people would find fixed-guideway service to be convenient, and few drivers would be attracted from their cars.

In spite of low capital costs, commuter rail in this corridor does not have good performance measures. Costs per rider would be the highest of all corridors analyzed. Any future consideration of service in the corridor must be related to increased development levels as well as strategies to reduce even further the cost of fixed-guideway development and operation.

12.2 Recommendations

The analysis in the study led to the following recommendations:

- Among the corridors studied, the Amtrak Shore Line south of Providence presents the best opportunity among those examined for the development of fixed-guideway service. This is a function of the low capital cost of the already-built facilities, the amount of development in the urbanized areas along the line, the combined ridership draw of both downtown Providence and Boston, and the limited environmental effects of adding service on an active railroad. Because the facilities are in place, developing service would be relatively quick. Extensive planning studies to justify the investment and to satisfy federal would not be needed for the service, although environmental studies of stations would be necessary.

  Operating costs could be reduced from those estimated in the study through the reduction in the level of service offered.

Development of commuter rail service on the Amtrak Shore Line should proceed incrementally. Service expansion should be focused upon the strongest ridership markets and expanded as the market for such service is demonstrated.

- Decisions about further fixed-guideway development in other corridors besides the Amtrak Shore Line should take into account the financial implications, the needed changes in development patterns, and the effects upon the broader transportation system. Given the large capital investments that would be necessary for the other corridors that were analyzed, careful analysis is needed to support decisions about project implementation. The first step in the process is a decision whether to proceed with fixed-guideway planning and development. Decision makers, including the Rhode Island Department of Transportation, should weigh the information presented in this report and determine whether fixed-guideway development is consistent with the transportation, development, and fiscal policies of Rhode Island.

  If fixed-guideway development is to occur, the next decision will concern project financing. If federal funds are deemed to be necessary, federal planning procedures will need to be followed, as described in Chapter 9. The first step in this process is system planning. This step would be a regional analysis of transportation needs to identify the single transportation corridor with the highest need for investment in fixed-guideway facilities. Such an analysis would not be limited to only railroad rights-of-way. System planning would require the use of a more-sophisticated travel demand forecasting model to provide more-detailed ridership estimates than those produced in this study, because ridership is one of the most important factors in fixed-guideway justification.

  Following selection of the corridor that is most in need of fixed-guideway service, an analysis of alternative solutions would be performed. That study would use some of the same techniques used in this study, but with a greater degree of precision in ridership estimates and a broader look at transportation system consequences. The completion of that analysis would be a condition of an application for federal funds for preliminary engineering and construction.

If fixed-guideway development is to be pursued, actions will be necessary to increase the amounts of development in the corridors to be served. Increasing the location of employment and commercial activity in downtown Providence is especially important, but efforts to focus residential and commercial development elsewhere in the corridors will also be needed. Local governments' zoning ordinances and comprehensive plans will need to be revised. Public investment policies and development incentives most encourage the location of development in public transportation corridors.

- Under any circumstances, the Rhode Island Department of Transportation should consider and act upon the long-term potential for the use of rail rights-of-way. Railroad rights-of-way are valuable resources that should be preserved. In a developed, urbanized area, creating new rights-of-way is virtually impossible, so present rights-of-way should be kept for potential use in the future. Changes in the conditions that affect the demand for transit use could improve the feasibility of fixed-guideway service. Increases in energy cost or decreases in availability, more-aggressive efforts to improve air quality, or adjustments in development patterns and amounts could improve the ridership potential. In addition, the rights-of-way can be used for a variety of purposes other than fixed-guideway services, and then could, if the need arises, be made available for a fixed-guideway line in the future. Potential other uses include bikeways and hiking trails, parks, and utility rights-of-way.

RHODE ISLAND RAIL CORRIDOR FEASIBILITY STUDY
Task 8A Appendix
Environmental Review of Potential Station Sites

AMTRAK SHORE LINE (4 STATIONS)

(1) CAROLINA STATION

- The railroad tracks pass beneath Carolina Road in a substantial rock cut. The only apparent feasible location for a station is on the northern side of the tracks east of Carolina Road. Land use in this area is sparse residential. Noise barriers are not recommended.

- There are no wetlands, water quality, vegetation or local ecology, noise, park or recreational, or historic impacts anticipated in this area.

(2) WICKFORD JUNCTION STATION

- Land use in the vicinity of the proposed station is sparse residential. Noise barriers are unlikely to be necessary at this site.

- There are no wetlands, water quality, vegetation or local ecology, noise, park or recreational, or historic impacts anticipated in this area.

(3) EAST GREENWICH STATION

- This site is very open and is accessed through a small lumber operation. A large unvegetated area on the western side of the tracks within the right-of-way would make an ideal location for a station.

- There are no wetlands, water quality, vegetation or local ecology, noise, park or recreational, or historic impacts anticipated in this area.

(4) T.F.GREEN AIRPORT STATION

- The primary and only environmental concern related to this site is the status of the former T.H. Baylis Chemical Company, located immediately adjacent to the site. Apparently the company was closed because of environmental problems. The EPA has been involved with cleanup of this site, and should be contacted for information regarding the status of the cleanup prior to proceeding with any work on this proposed station.

- There are no wetlands, water quality, vegetation or local ecology, noise, park or recreational, or historic impacts anticipated in this area.

BRISTOL SECONDARY (7 STATIONS)

(1) RED BRIDGE STATION:

- The site was contaminated by an old junk yard but has since been cleaned up by the EPA (i.e. soil has been scraped down and removed and junk cars etc. have been removed from the area). The status of the clean-up effort is unknown and should be investigated with the EPA prior to any land purchase or work in the area.

- Access is difficult due to closed Waterman Ave. bridge over the railroad tracks.

- Algonquin gas pipeline located in the vicinity of the proposed station.

- No wetlands, water quality, vegetation or local ecology, noise, park or recreational, land use, or historic impacts are anticipated in this area.

(2) RIVERSIDE STATION

- The railroad right-of-way has been converted into a paved public walkway/bikeway. Despite its interim use, a 4(f) evaluation would need to be prepared because the path might be constructively impacted by a rail project.

- Land use in the area is mixed commercial and residential. Placing noise barriers at this location is not recommended, because they would add permanent visual and aesthetic impacts to this area for the sake of reducing spot noise impacts.

- The area was once a station as evidenced by the depot building. There are no wetlands, water quality, vegetation or local ecology, noise, or historic impacts anticipated in this area.

(3) CRESCENT VIEW STATION

- See discussion presented for the Riverside station regarding 4(f) implications.

- There are no wetlands, water quality, vegetation or local ecology, noise, or historic impacts anticipated in this area.

(4) WEST BARRINGTON STATION

- See discussion presented for the Riverside station regarding 4(f) implications.

- Noise barriers are recommended in this area due to adjacent residential development and should be investigated further.

- There are no wetlands, water quality, vegetation or local ecology, or historic impacts anticipated in this area.

(5) COUNTY ROAD STATION

- See discussion presented for the Riverside station regarding 4(f) implications.

- Noise barriers are not recommended for this location because they would introduce permanent visual impacts in remedying spot noise impacts.

- There are no wetlands, water quality, vegetation or local ecology, or historic impacts anticipated in this area.

(6) FRANKLIN STREET STATION

- See discussion presented for the Riverside station regarding 4(f) implications.

- Noise barriers are not recommended for this location because they would introduce permanent visual impacts in remedying spot noise impacts.

- There are no wetlands, water quality, vegetation or local ecology, or historic impacts anticipated in this area.

(7) INDEPENDENCE PARK STATION

- 4(f) at this site would not only apply to the walkway/bikeway, but it will also apply to Independence Park itself. The design of the station at this location would determine the extent of impact that this 4(f) property would incur. Avoidance of this property to the greatest extent practicable is recommended.

- Work in this area might be subject to Coastal Resource Management Council review because it is within the coastal zone of Rhode Island.

- Historic impacts are not anticipated in this area.

EAST PROVIDENCE SECONDARY (7 STATIONS)

(1) MILL STREET STATION

- No wetlands, water quality, vegetation or local ecology, noise, park or recreational, land use, or historic impacts are anticipated in this area.

- Easy access and open area to the east could provide parking for 40+ vehicles.

- Good location for a station.

(2) BROADWAY STATION

- Very complicated intersection is located immediately south of the proposed station location and could pose traffic as well as safety problems. Provision of extensive parking is not recommended.

- Land use is residential (apartments and houses) and commercial. Noise levels in the area are already high as a consequence of the busy intersection. Despite this, it is recommended that the placement of noise barriers north of the intersection be investigated with respect to the proposed station.

- No wetlands, water quality, vegetation or local ecology, park or recreational,or historic impacts are anticipated in this area.

(3) COTTAGE STREET STATION

- Land use is industrial and commercial. A major thoroughfare is to the east of the tracks and carries a high volume of traffic. The proposed station could disrupt a rubbish removal business and a florist. If the station were moved north of Cottage Street to a more open area, there would be no impact to these establishments.

- No wetlands, water quality, vegetation or local ecology, noise, park or recreational,or historic impacts are anticipated in this area.

- Overall, the site appears to be a good location for a station when considering environmental concerns.

(4) MINERAL SPRINGS STATION

- Land use is industrial and commercial (a large plaza located east of the tracks is a good destination for shoppers). A major thoroughfare to the west of the tracks carries a high volume of traffic, which could pose a safety problem for station pedestrians. The station might displace some commercial business depending on its ultimate location.

- No wetlands, water quality, vegetation or local ecology, noise, park or recreational,or historic impacts are anticipated in this area.

- Overall, the site appears to be a good location for a station when considering environmental concerns.

(5) COLUMBUS AVENUE STATION

- Land use in the immediate vicinity of the proposed station is commercial. A major thoroughfare runs parallel along the western side of the tracks and could pose safety problems for station pedestrians.

- If the station were located along the western side of the tracks, commuters would need to cross the busy roadway in order to board the train. The station might be more appropriate on the eastern side of the tracks, because a small strip of land in this area is available for a platform and parking.

- No wetlands, water quality, vegetation or local ecology, noise, park or recreational,or historic impacts are anticipated in this area.

- Overall, the site appears to be a good location for a station when considering environmental concerns.

(6) BEVERAGE HILL STATION

- Land use in the vicinity of the proposed station is a mix of commercial (used-car dealership) and residential. At present, parking would be limited. To provide more parking for commuters, displacement of commercial businesses might be required.

- No wetlands, water quality, vegetation or local ecology, noise, park or recreational,or historic impacts are anticipated in this area.

- Overall, the site appears to be a good location for a station when considering environmental concerns.

(7) RUMFORD STATION

- Land use on the eastern side of the tracks consists of commercial and residential properties. The placement of noise barriers should be investigated further in this area due to the proximity of these properties to the tracks. To the west is the Seekonk River and its associated estuary, which are currently managed. This area should be investigated further to determine if any rare, threatened or endangered species utilize this estuary and if they might be impacted by a project.

- Parking is presently limited to 10-15 cars and an area might have to be provided for additional parking for commuters. This provision might result in impact to adjacent properties.

- There are no direct wetland, water quality, park or recreational, or historic impacts anticipated for this area.

NEWPORT SECONDARY (7 STATIONS)

(1) TIVERTON STATION

- The presence of a former platform indicates that this site once served as a station. Land use is sparse residential. There appears to be no need for noise barriers in this area.

- There are no wetlands, water quality, vegetation or local ecology, noise, park or recreational, or historic impacts anticipated in this area.

(2) WILLOW LANE STATION

- Land use in this area is residential to the east, and to the west is a vacant industrial plant. A noise barrier would protect these residences from increased noise levels but it would also introduce visual impact to the area. Noise barriers should be investigated further at this site.

- There are no wetlands, water quality, vegetation or local ecology, park or recreational, or historic impacts anticipated in this area.

(3) MELVILLE STATION

- A small insignificant swale exists at the base of the hill on the eastern side of the tracks.

- There are no wetlands, water quality, vegetation or local ecology, park or recreational, or historic impacts anticipated in this area.

(4) GREENS LANE STATION

- Area is open space-- a parking lot near naval housing.

- There are no wetlands, water quality, vegetation or local ecology, noise, park or recreational, or historic impacts anticipated in this area.

(5) CODDINGTON STATION

- Proposed station location was inaccessible as it was fenced off on government property.

- There are no wetlands, water quality, vegetation or local ecology, noise, park or recreational, or historic impacts anticipated in this area.

(6) ADMIRAL KALBFUS STATION

- Land use in this area is commercial and residential (apartments west of the tracks).

- A small swale exists on the western side of the tracks, south of the road.

- There are no wetlands, water quality, vegetation or local ecology, noise, park or recreational, or historic impacts anticipated in this area.

(7) GATEWAY STATION

- A station for tourist rail service already exists.

- There are no wetlands, water quality, vegetation or local ecology, park or recreational, or historic impacts anticipated in this area.

- Further investigation of the noise impacts of introducing frequent operation of large locomotives is recommended.

PROVIDENCE AND WORCESTER MAIN LINE (7 STATIONS)

(1) WOONSOCKET STATION

- Land use is mixed commercial, industrial, and residential in the vicinity of a busy intersection. Noise barriers are recommended along the eastern side of the tracks, north of the intersection and should be further investigated. Residences are adjacent to the rail corridor in this area.

- A station built in the vicinity of this busy street intersection could pose traffic and pedestrian safety problems.

- No wetlands, water quality, vegetation or local ecology, park or recreational,or historic impacts are anticipated in this area.

(2) HAMLET STATION

- A poor location for a station. The tracks are elevated approximately 25 feet above the surrounding landscape for quite a distance. To the east is a closed landfill and access road which is fenced off. To the west are residential developments well below the railbed. The station would have to be substantially elevated, and there is minimal parking. A station at this site could be costly.

- No wetlands, water quality, vegetation or local ecology, noise, park or recreational,or historic impacts are anticipated in this area.

(3) ALBION STATION

- An old six-story mill to the west of the tracks is in the process of being converted into condominiums. The Blackstone River, a watershed area, is located east of the tracks and should be avoided.

- A large parking area is already present. The site appears to be ideal for a station.

- There are no wetlands, water quality, vegetation or local ecology, noise, park or recreational, or historic impacts anticipated in this area. The presence of historic districts and threatened or endangered species should be investigated further at this site due to its less urbanized nature.

(4) MANVILLE STATION

- Land use in this area is commercial and open. The Blackstone River is located east of the site.

- There are no wetlands, water quality, vegetation or local ecology, noise, park or recreational, or historic impacts anticipated in this area.

(5) BERKELEY STATION

- Land use in this area is industrial and open space. An open lot west of the tracks appears ideal for parking and a platform.

- There are no wetlands, water quality, vegetation or local ecology, noise, park or recreational, or historic impacts anticipated in this area.

(6) LONSDALE STATION

- A former station was located here as evidenced by the depot building. Land use is predominantly commercial and light industrial.

- There are no wetlands, water quality, vegetation or local ecology, noise, park or recreational, or historic impacts anticipated in this area.

(7) VALLEY FALLS STATION

- A rail yard is located at this site. Land use is mixed residential and commercial, elevated above the tracks.

- There are no wetlands, water quality, vegetation or local ecology, noise, park or recreational, or historic impacts anticipated in this area.

WASHINGTON SECONDARY (12 STATIONS)

(1) BREWERY STATION

- Land use is commercial on the west side of the tracks and on the east side is an abandoned factory that is fenced off. It is unknown whether the factory is part of an historic district, and therefore it is recommended that this be further investigated. Possible contamination also warrants further investigation prior to proceeding with the project.

- Some impact to commercial businesses may occur in order to create enough room for the station, particularly for parking for commuters. Mitigation could include additional parking spaces at other stations.

- No wetlands, water quality, vegetation or local ecology, noise, or park or recreational impacts are anticipated in this area.

(2) BURNHAM AVENUE STATION

- Land use is a mix of commercial (car dealership to the west), residential (elderly housing complex to the west), and industrial (Falvey Linen Supply Factory to the east). In order to minimize impacts to the car dealership, the station could be located on the north side of Burnham Avenue, west of the tracks in an open lot with disturbed vegetation.

- The tracks are elevated in this area (approximately 10 to 15 feet above adjacent land). The placement of noise barriers to the south in the vicinity of the elderly housing complex should be investigated further.

- There are no wetlands, water quality, vegetation or local ecology, park or recreational, or historic impacts anticipated in this area.

- Overall, the site appears to be a good location for a station when considering environmental concerns.

(3) KNIGHTSVILLE STATION

- Land use in this area is a mix of commercial, industrial, and residential (one house located west of the tracks). The industrial uses are located primarily on the eastern side of the tracks. The potential for contaminated soils exists based on the nature of these industrial activities, and should be investigated further prior to land purchasing and construction.

- There are no wetlands, water quality, vegetation or local ecology, noise, park or recreational, or historic impacts anticipated in this area.

(4) UXBRIDGE STATION

- Land use in the immediate vicinity of this site is commercial on the eastern side of the tracks. To the west, Cranston Street parallels the tracks and residential properties are to the west of Cranston Street. These residential properties appear to be far enough away so that noise from the railway would not be a major factor, however this may need to be investigated further.

- The area is subject to flash flooding which became a problem when the railroad stopped operating 10 years ago. The construction of a parking lot for commuters in this area could remedy this problem.

- Insignificant drainage swales exist on the eastern side of the tracks.

- There are no wetlands, water quality, vegetation or local ecology, park or recreational, or historic impacts anticipated in this area.

(5) OAKLAWN STATION

- Land use is terraced residential to the west,higher than the tracks, and commercial to the east, lower than the tracks. Noise barriers in this area would have to be extremely tall in order to reduce noise impacts on the residential area. The placement of these barriers is recommended and should be investigated further.

- A small public park exists to the southwest of the proposed station and may have Section 4(f) implications. This area should be avoided completely.

- There are no wetlands, water quality, vegetation or local ecology, or historic impacts anticipated in this area.

(6) NATICK STATION

- Land use is residential (duplexes) to the east and an open disturbed (graded) area to the west. This open area is perfect for a station parking lot. The placement of noise barriers is recommended along the eastern side of the tracks to protect the nearby residences from noise impacts. This barrier would have to be quite high as the houses are approximately 5-7 feet higher that the tracks. The need for noise barriers should be investigated further at this site.

- There are no wetlands, water quality, vegetation or local ecology, park or recreational, or historic impacts anticipated in this area. Further research on the presence or absence of historic districts in this area should be conducted prior to making a conclusion about historic impacts.

(7) WESTCOTT STATION

- Land use in this area is primarily commercial. There is an existing parking area where the station would be located. A busy intersection exists south of the tracks.

- There are no wetlands, water quality, vegetation or local ecology, noise, park or recreational, or historic impacts anticipated in this area. There is an insignificant drainage swale located on the northern side of the railroad right-of-way.

(8) RIVER POINT STATION

- The area in the immediate vicinity of the proposed station is primarily flat and open to the south of the tracks. To the north is light industrial land use. The vegetation in the area is characteristic of disturbed soils.

- Contaminated soils might be a problem in this area but would have to be investigated further before a conclusion can be made.

- There are no wetlands, water quality, vegetation or local ecology, noise, park or recreational, or historic impacts anticipated in this area.

(9) ARCTIC STATION

- Land use in this area is mixed commercial and residential. The location of the station might disrupt parking for a commercial business (Chinese restaurant) on the eastern side of the tracks. Structures are located far enough away on the eastern side of the tracks that noise impacts would be unlikely. However, the houses located along the western side of the tracks abut the right-of-way; noise barriers are recommended, but should be investigated further.

- There are no wetlands, water quality, vegetation or local ecology, park or recreational, or historic impacts anticipated in this area.

(10) BROOKSIDE STATION

- Land use in this area is a mix of commercial, light industrial, and residential. A six-story apartment building is located west of the tracks opposite a road. The placement of noise barriers at this location would do little to decrease noise levels.

- A disturbed excavated area full of assorted refuse is located immediately east of the tracks. This area could be cleaned up, graded and used as a parking area for commuters.

- There are no wetlands, water quality, vegetation or local ecology, park or recreational, or historic impacts anticipated in this area.

(11) ANTHONY STATION

- A former railroad station occupied this location as evidenced by the deteriorating platform on the western side of the tracks. A simple upgrade of this area may be all that would be needed.

- The Pawtuxet River is located east of the tracks and should be avoided.

- There are no wetlands, water quality, vegetation or local ecology, noise, park or recreational, or historic impacts anticipated in this area.

(12) WASHINGTON STATION

- Land use in this area is primarily open field and residential. An old house, possibly a former station, is located to the west of the tracks and is the closest structure. Noise barriers might help minimize noise levels in this area and should be investigated further.

- There are no wetlands, water quality, vegetation or local ecology, noise, park or recreational, or historic impacts anticipated in this area. The presence of Historic districts and threatened or endangered species should be investigated further at this site due to its less urbanized nature.