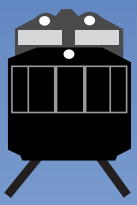
Program for Mass Transportation

P M T



PROGRAM FOR MASS TRANSPORTATION

P M T

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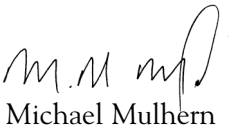

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EXECUTIVE SUMMARY

The Program for Mass Transportation (PMT) is a central element of capital planning at the Massachusetts Bay Transportation Authority (MBTA) and is the foundation for transit infrastructure planning and programming in eastern Massachusetts. The PMT defines a vision for regional mass transportation and sets priorities for infrastructure investments in the areas of system preservation, service enhancement, and system expansion, without financial constraints.

BACKGROUND

The MBTA is the largest transit provider in the Massachusetts Bay region. It directly operates or contracts out for service using eight different modes: heavy rail, light rail, bus rapid transit, local/express bus, trackless trolley, commuter rail, commuter boat, and paratransit. The MBTA system serves the area in a largely hub-and-spoke network. In Boston, 55% of all work trips and 42% of all trips into downtown are made by transit. In the Boston Metropolitan Planning Organization region overall, 6.8% of all trips are made by transit, and it is estimated that that number will increase to 7.47% by 2025.

The MBTA district is made up of 175 communities with a total population of 4.7 million. Almost three-quarters of all Massachusetts residents live within the MBTA service area. The MBTA transit system was originally designed to move people efficiently into and around fourteen communities in the urban core, but is now called on to supply multimodal travel options for residents of eastern Massachusetts and parts of central Massachusetts. Regional population grew at a moderate rate of 6.07% during the 1990s, but significant growth of over 25% took place along the Route 495 corridor. (It should be noted though that the city of Boston experienced a rebound in population growth in the 1990s after several decades of decline.)

The Boston region is one of the most economically vibrant areas in the country. The number of jobs in the region has increased by 44% over the last thirty years. In the last decade, the MBTA district experienced job growth of 12.6%. Economic growth is most pronounced in the Route 495 corridor, where the job base expanded at rates more than three times the region's average.

Together, these demographic changes have impacted commuting trends within eastern Massachusetts and have strained the overall

transportation system. In particular, traffic congestion on most of the major highways in the region has increased significantly during the past twenty-five years. The corridors served by most of the radial highways that are close to or over practical capacity are also served by MBTA commuter rail or rapid transit lines. Transit can provide some solutions to this mobility problem; however, transit alternatives for the circumferential Route 128 and Route 495 corridors present great challenges.

Anderson Regional Transportation Center

Forecasts estimate that overall MBTA ridership will grow by 32% between now and 2025. MBTA commuter rail ridership is predicted to increase by 45% during the same period. The current capacity constraints of the MBTA system, if not addressed, would limit the Authority's ability to improve regional mobility and meet future demand for public transit.

Capacity issues exist both on vehicles and at MBTA facilities. Numerous bus routes in the urban core exceed MBTA Service Delivery Policy guidelines for maximum loads, especially during peak periods and school commute times. Each of the MBTA's rapid transit lines also experiences loads exceeding Service Delivery Policy guidelines on multiple trips, and peak 30-minute average maximum loads exceed 80% of practical capacity on all four lines.

Over the next twenty-five years, rail and boat terminals, as well as station access facilities such as parking lots and pedestrian walkways, and maintenance facilities must be expanded to address growing demand for transit service. In particular, the predicted growth in commuter rail ridership suggests that capacity problems will be significant over that period.

Furthermore, the commuter rail system is limited by the capacities of the downtown Boston terminal stations and layover facilities.

Overall, the changing demographics of the region indicate the need for more transportation options in eastern Massachusetts. For the MBTA to play its role in providing greater mobility for residents, capacity-building projects need to be prioritized to address the limitations of the existing transit system.

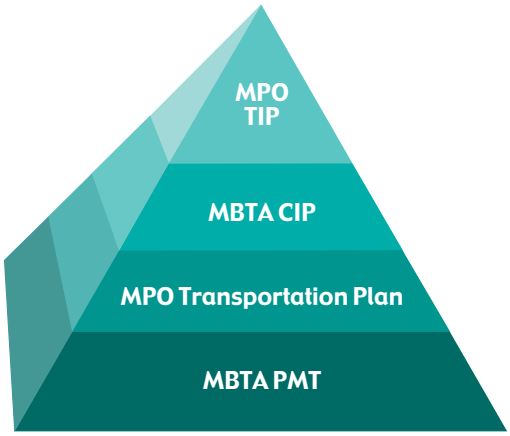
DEVELOPMENT OF THE PMT

This PMT is the first to be completed since the restatement of the MBTA's enabling legislation in 1999. In that year, Governor Paul Cellucci signed into law a major initiative, "Forward Funding," that altered the MBTA's financial structure and expanded the MBTA's service area from 78 municipalities to the current 175. Several changes were also included in "Forward Funding" that strengthen the MBTA's capital planning process. For example, the MBTA will complete an updated PMT every five years. "Forward Funding" also called for the institution of annual Capital Investment Programs (CIPs). These are rolling five-year documents that program specific projects for implementation and identify funding sources.

The PMT has a timeframe of twenty-five years and incorporates a financially unconstrained, consistent evaluation of project ideas. Projects included in the PMT then define the universe of projects for all subsequent stages of regional transit planning conducted by the MBTA and other decision-making bodies such as metropolitan planning organizations (MPOs).

The relationship between the PMT and other

regional planning documents is depicted in the diagram below.



The PMT prioritizes infrastructure investments in the areas of system preservation, service enhancement, and system expansion, and must balance the demand for expanded service with the need to reinvest in the existing system. By establishing a universe of potential transit capital projects, the PMT helps to design a strategy for public transportation investments over the next twenty-five years.

Work on this PMT began in the spring of 2001. The process involved extensive outreach to the general public, detailed consultation with a public advisory committee, technical analysis and evaluation, and policy-level reviews.

There were five main steps in producing the PMT:

1. Development of a Vision Statement, Goals, and Objectives

Through an extensive public process, a vision statement was developed to describe the role of transit in eastern Massachusetts's transportation network in twenty-five years. Goals and objectives were established to outline the strategy for implementing this vision.

2. Project Screening

Extensive public outreach generated hundreds of project ideas for all modes – eight public workshops were held in the fall of 2001 throughout the service area. These ideas were included in the universe of projects evaluated in the PMT. The MBTA and the PMT process Working Committee reduced the universe to a shorter list of feasible projects that warranted further evaluation. Consistent criteria were defined for use in conducting this screening process. These criteria included, but were not limited to, considerations of whether a project met an existing legal commitment or addressed an environmental justice issue.

3. Project Evaluation

The projects that emerged from the screening phase were evaluated using performance measures to determine how well they met PMT goals and objectives. Performance measures were developed for the following three investment categories:

System Expansion

Projects that introduce service to an area or time period in which it currently does not exist, or convert an existing service to a new mode.

Service Enhancements

Projects that improve the quality of service provided on an existing transit line or at an existing station. These were organized into general enhancements, accessibility (for people with disabilities) projects, and sta-

The RIDE operator and customer

tion access projects.

System Preservation

Projects aimed at keeping the MBTA's system in a state of optimal repair.

The project ideas were further divided by mode type: commuter rail, rapid transit, bus/trackless

MBTA bus crossing the Tobin Bridge

trolley, boat, and other modes. Projects were then evaluated within each mode.

System expansion and general service enhancement projects were evaluated based on thirty-five individual performance measures divided into the following seven categories:

- Utilization
- Mobility
- Cost-Effectiveness
- Air Quality
- Service Quality
- Economic and Land Use Impacts (not applied to general service enhancement projects)
- Environmental Justice

For each performance measure that was applicable to a given project, a high, medium, or low rating was assigned. In the case of quantitative measures, the thresholds for high, medium, and low ratings were defined by first listing the corresponding impacts of all projects in a given grouping in order of magnitude. Natural breaks, or large gaps between the impacts of successive projects in the list, were identified and the first grouping was given a high rating. The second and third groupings were given medium and low ratings, respectively. For qualitative measures, the thresholds for high, medium, and low ratings were defined before their application to specific projects.

The ratings for each performance measure category were then combined to define an overall rating for each project. Lists of projects rated high, medium, and low overall begin on page ES-6 of this summary.

4. Review of draft PMT

Four workshops around the MBTA service area were held in January 2003 to gather input from the public on the evaluation process and preliminary results. On February 12, 2003, the MBTA released the PMT for a thirty-day public review period. Two public hearings were then held in March on the draft PMT.

5. Finalization of PMT

All comments received during public review were considered, and where appropriate, were incorporated into the PMT. This draft was reviewed and approved by the MBTA board of directors. Final acceptance of the PMT rests with the MBTA Advisory Board, which approved this PMT on May 29, 2003.

VISION AND GOALS

As described above, the first step of the PMT process was to develop the following twenty-five-year vision for public transportation in the Massachusetts Bay region.

The MBTA will:

- Provide safe, cost-effective, and efficient services that increase ridership and respond

to the expanding mobility demands of individuals and communities.

- Maintain existing infrastructure in a state of optimal repair to improve quality, convenience, accessibility, and reliability of service.
- Transport customers in a system that promotes a desirable quality of life, supports the sustainable development of communities, improves the quality of the environment throughout the Massachusetts Bay region, and distributes benefits and burdens equitably.

This vision will be implemented through the following goals.

The MBTA will strive to:

- Preserve and modernize the transit system and improve accessibility.
- Improve mobility for area residents and visitors now and in the foreseeable future.
- Minimize transportation-related pollution of the environment.
- Promote the equitable sharing of the transportation system's benefits and burdens.
- Serve as a partner for community development within the MBTA service area.

IMPLEMENTATION OF GOALS

As one of the country's oldest transit systems, the MBTA is faced with an enormous backlog of system preservation needs. Currently, this backlog is estimated at $3.0 billion, with $13 billion in additional needs forecast over the next twenty years. A central element of this PMT is the MBTA's reinvestment in the existing system to improve service to our customers. To meet the PMT's identified goals, the MBTA's investment strategy is to:

- Address the backlog of system preservation needs.
- Reinvent the MBTA bus system.
- Improve environmental performance of facilities and operations.
- Relieve system capacity constraints.
- Strive for a balanced capital program that is responsive to urban core mobility needs and suburban demand for transit choices.

Based on this investment strategy and the individual project ratings included in the PMT, the following projects have been identified as the highest priority for implementation, and the MBTA is currently exploring options for securing their funding:

System Expansion

- Silver Line Phase III: South Station–Boylston Station connector
- Urban Ring: new circumferential transit services
- Fairmount Line improvements: additional stations and improved frequency

Blue Line at Wonderland Station

- Blue Line extension from Wonderland to Lynn

Service Enhancements

- Expanded reverse-commuting options systemwide

- 300 new bus shelters
- Signal improvements on Blue, Orange, and Red Lines
- Installation of Intelligent Transportation Systems

System Preservation

- Installation of automated fare collection system
- Revenue vehicle replacement
- Bridge rehabilitation
- Commuter rail and rapid transit track replacement
- Station improvements

In addition to these projects, the PMT provides a sense of relative priorities for all system expansion, service enhancement, and system preservation projects that passed the project screening phase. These proposed projects are located throughout the Massachusetts Bay region and may be considered for inclusion in regional capital programming documents when funding becomes available. Projects that receive a high rating in the PMT offer a good starting point for an expanded and improved public transportation system in twenty-five years. It should, however, be noted that the classification of a project as having a high rating does not guarantee its implementation.

Silver Line

In the interests of meeting the diverse mobility needs of the region, avoiding duplicative projects, and responding to fiscal realities, medium-priority projects will also be given due consideration for implementation. Even low-priority projects are eligible for advancement in other regional capital programming documents, especially in cases where future residential and employment development results in increases in projected demand or where outside funding sources are identified. An example of such a project is the proposed Commonwealth Flats Silver Line grade separation in the South Boston Waterfront area.

Below are listings of system expansion and general service enhancement projects receiving high, medium, and low ratings. Maps ES-1 and ES-2 show the locations of projects in the high rating list. Maps ES-3 and ES-4 show high priority accessibility and parking improvement projects. Details on medium- and low-priority accessibility projects are given in Chapter 5B.

HIGH PRIORITY

System Expansion Projects

Rapid Transit

Blue Line: Wonderland to Lynn

Silver Line Phase III: South Station to Boylston via Chinatown

Silver Line south extension to Ashmont and Mattapan

Urban Ring Phase 2

Urban Ring Phase 3

Bus/Trackless Trolley

Improve suburban feeder bus service to commuter rail

Urban Ring Phase 1

Commuter Rail

New station on Fitchburg Line at Union

Square, Somerville

Improve Fairmount Line: new stations and improve frequency

Extend line from Stoughton to Fall River and New Bedford

Construct North-South Rail Link (multistate project)

Commuter rail branch from existing Old Colony lines to Greenbush

Boat

New service to Russia Wharf

Service Enhancement Projects

Rapid Transit

Signal improvements on Blue Line

Signal improvements on Orange Line

Signal improvements on Red Line

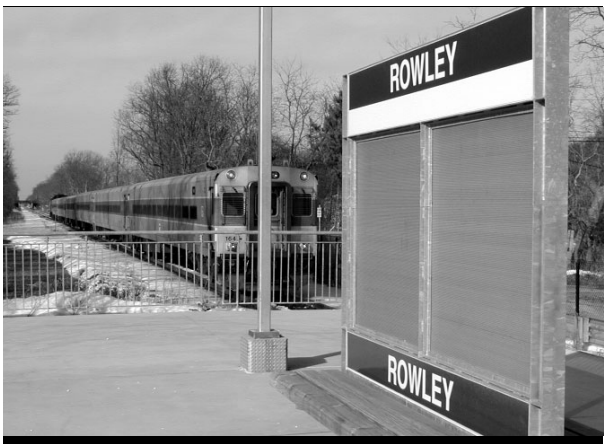
Bus/Trackless Trolley

Install 300 shelters

Install Intelligent Transportation Systems

Commuter Rail

Operate a Yawkey–Back Bay–South Station shuttle



Rowley commuter rail station

Operate more frequent service between Framingham and Worcester

Expand reverse-commuting options

Systemwide

Improve pedestrian access to all rapid transit and commuter rail stations

MEDIUM PRIORITY

System Expansion Projects

Rapid Transit

Blue Line: Bowdoin to West Medford

Blue Line: Lynn to Salem

Blue-Red Connector: Bowdoin to Charles/MGH

Green Line: Heath Street to Arborway

Green Line: Lechmere to West Medford

Silver Line west extension: Boylston to Allston and Longwood

Silver Line east extension: South Station to City Point

Bus/Trackless Trolley

Provide dedicated bus lanes approaching Alewife Station

Commuter Rail

Improve Fitchburg Line by adding a station at Alewife

Extend line from Fitchburg to Gardner

Improve Framingham/Worcester Line: new station in Allston/Brighton

Operate high-frequency service: Readville to Allston Landing

Improve Worcester Line: new station in Millbury

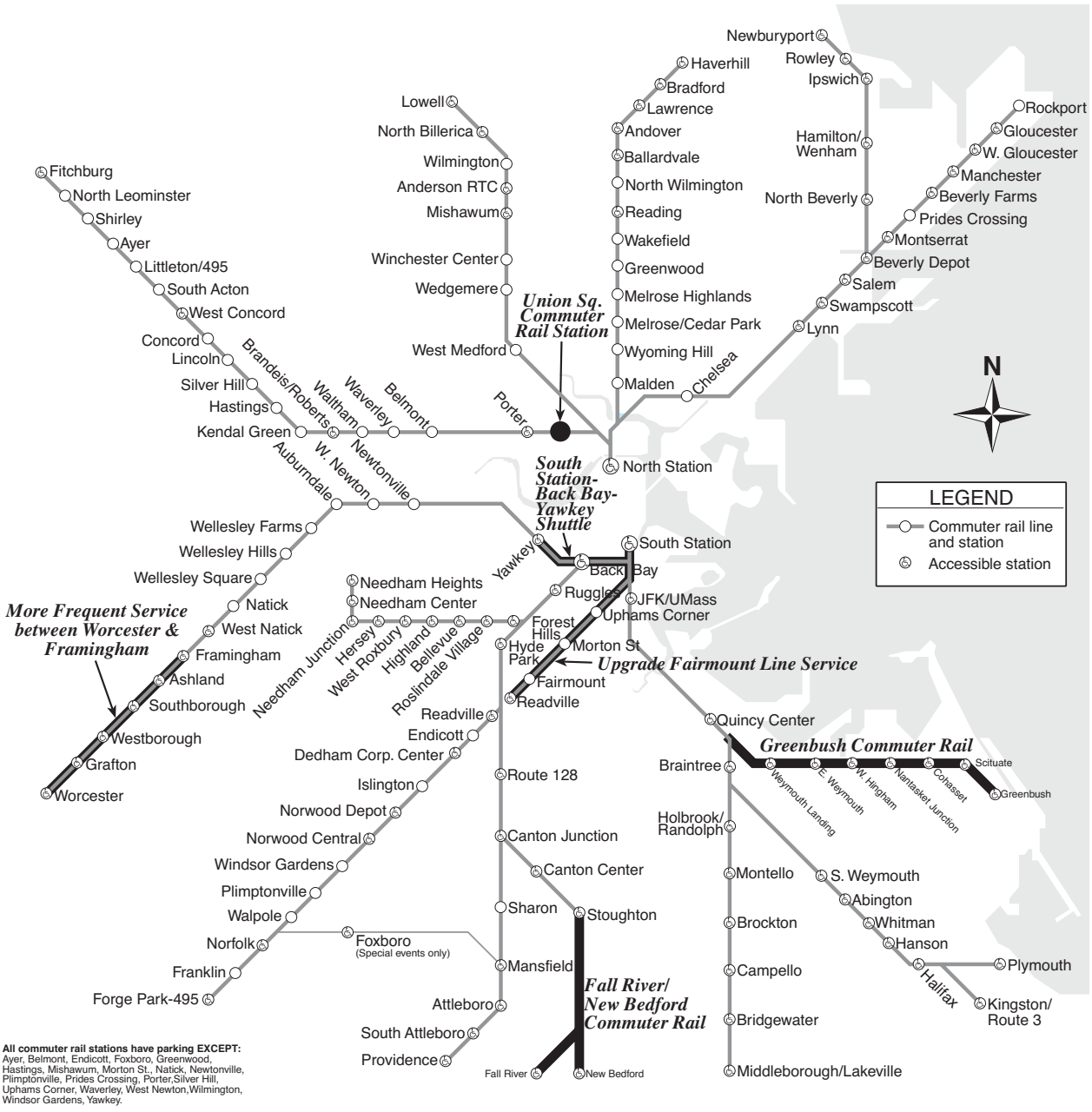
Improve Framingham/Worcester Line: new sta-

MAP ES-1 HIGH-PRIORITY SYSTEM EXPANSION AND SERVICE ENHANCEMENT PROJECTS: RAPID TRANSIT, BUS, TRACKLESS TROLLEY, AND BOAT

High-priority projects not labeled on map:

- Improve suburban commuter rail feeder bus service
- Signal improvements on Blue, Orange, and Red Lines
- Install 300 bus shelters
- Install Intelligent Transportation Systems
- Improve pedestrian access to all rapid transit and commuter rail stations

MAP ES–2 HIGH-PRIORITY SYSTEM EXPANSION AND SERVICE ENHANCEMENT PROJECTS: COMMUTER RAIL (EXCLUDES MULTISTATE EXPANSION PROJECTS)

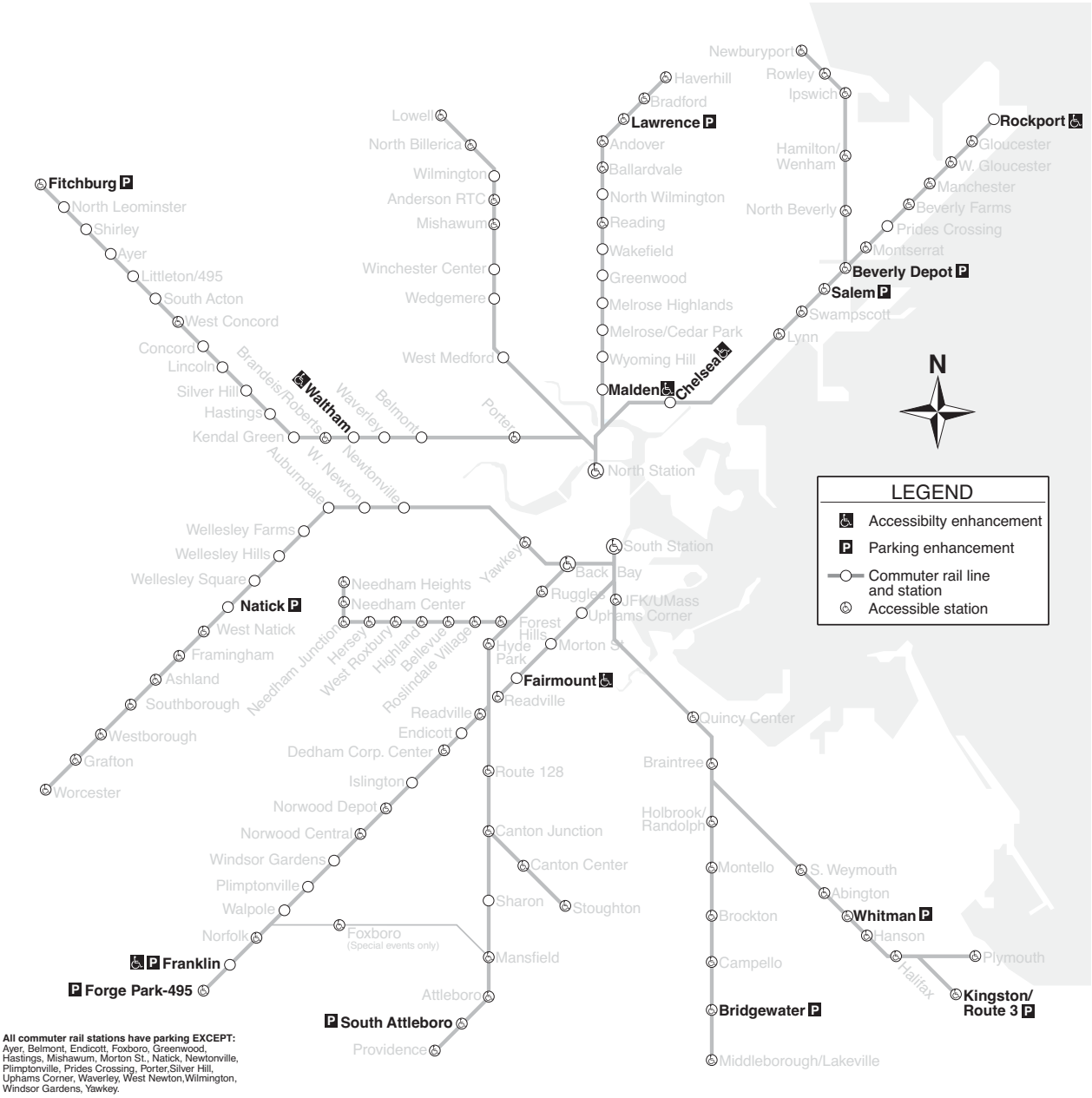


High-priority projects not labeled on map:

- Expand reverse-commuting options
- Improve pedestrian access to all rapid transit and commuter rail stations
- Note: The North-South Rail Link also received a high-priority designation in the PMT but is not shown on this diagram since it is classified as a multistate expansion project.

MAP ES-3 HIGH-PRIORITY RAPID TRANSIT ACCESSIBILITY AND PARKING ENHANCEMENTS

MAP ES-4 HIGH-PRIORITY COMMUTER RAIL ACCESSIBILITY AND PARKING ENHANCEMENTS



All commuter rail stations have parking EXCEPT:
Ayer, Belmont, Endicott, Foxboro, Greenwood, Hastings, Mishawum, Morton St., Natick, Newtonville, Plimptonville, Prides Crossing, Porter,Silver Hill, Uphams Corner, Waverley, West Newton,Wilmington, Windsor Gardens, Yawkey.

tion at Riverside

Extend line from Middleborough to Wareham

Build spur from Salem to Danvers via Peabody

Extend line from Forge Park to Milford via Bellingham

Improve Rockport/Newbury Line: new station in South Salem

Extend line from Providence to T. F. Green Airport (multistate project)

Extend line from Haverhill to Plaistow, N.H (multistate project)

Build spur from Framingham to Leominister

Extend line from Lowell to Nashua via North Chelmsford (multistate project)

Extend line from Needham to Millis via Medfield and Dover

Boat

Restore service from East Boston to Boston

Improve service from South Shore

Service Enhancements

Rapid Transit

Operate 8-car trains on Orange Line

Operate 8-car trains on Red Line

Preemptive traffic signals on Green Line B, C, and E branches

Bus/Trackless Trolley

Add bus lanes and priority signals on top 10 busiest bus routes

Acquire 100 new buses

Commuter Rail

Operate express service from outer stations

Install a fourth track on the Fort Point Channel Bridge

Install double-tracking on entire commuter rail system

Type–8 Green Line car

Systemwide

Install bike racks at rapid transit and commuter rail stations

Install more enclosed waiting areas along MBTA lines

LOW PRIORITY

System Expansion Projects

Rapid Transit

Blue Line: build commuter rail connector at Wonderland

Green Line: build spur from Eliot to Needham Junction

Orange Line: add a station at Assembly Square

Orange Line: extend from Forest Hills to Hyde Park/Route 128

Orange Line: extend from Forest Hills to West Roxbury/Needham

Orange Line: extend from Oak Grove to Reading/Route 128

Red Line: extend from Alewife to Route 128

Red Line: extend from Braintree to Weymouth

Silver Line: convert to light rail from Dudley to Boylston

Bus/Trackless Trolley

Extend trackless trolley #71 from Watertown to Newton Corner

Route 128 bus service using an HOV lane

Commuter Rail

Improve Fitchburg Line: new station on Route 2 west of I-495 in Ayer

Operate high-frequency Riverside–JFK/Umass Commuter Rail Service

Operate high frequency Riverside–South Station commuter rail service

Operate full-time service to Foxborough

Improve Framingham/Worcester Line: new regional station at I-495

Extend Line from Wareham to Hyannis

Boat

New route from North Shore to Logan Airport

Service Enhancement Projects

Rapid Transit

Commonwealth Flats Silver Line grade separation

Operate 4-car trains on Green Line

Signal improvements on Green Line

Commuter Rail

Install platforms on both sides of stations in Newton for reverse commuting

Increase speed and frequency of Needham service

Purchase DMU trains to allow for increased frequency on commuter rail lines

Electrify all commuter rail lines (excluding yards)

Build new layover facility in Bellingham for the Franklin Line

Systemwide

Add bike racks to commuter rail coaches

Add more motorcycle parking spaces systemwide

Commuter boats at Lovejoy Wharf

As an additional factor in determining priorities for implementing transit capital improvements, it should be noted that the Commonwealth has committed to several public transportation projects and initiatives to meet various state and federal mandates and obligations (these are collectively known as the "Legal Commitments"). In particular, the Commonwealth has identified improving transit as a way to address the requirements associated with the State Implementation Plan (SIP) for the Clean Air Act and the mitigation, pursuant to 310 CMR 7.36 and 310 CMR 7.38, required by environmental agencies to allow for the permitting of the Central Artery/Tunnel (CA/T) Project. In 2000, the Executive Office of Transportation and Construction (EOTC) and the Department of Environmental Protection (DEP) entered into an Administrative Consent Order (ACO) related to the CA/T Project that established additional legal commitments and clarified deadlines for

their completion. In 2001, the ACO was amended to provide further clarity for some of the Legal Commitments.

The MBTA is playing an active role in fulfilling the Legal Commitments. Although the commitments are binding on the Commonwealth, the MBTA is evaluating and prioritizing the commitments within the PMT so that these projects continue to be eligible for programming within the CIP. Table ES-1 on the following page shows the status of the Legal Commitments.

FINANCING STRATEGIES

As a financially unconstrained analysis of transit projects, the PMT includes significantly more projects than can be funded by the MBTA or the Commonwealth. The funding situation is complicated by the Commonwealth's legal commitments related to the State Implementation Plan (SIP) for the Clean Air Act and the Central Artery/Tunnel (CA/T) mitigation program. New and innovative financing sources will be needed to supplement more traditional funding in order to implement many of the projects in this PMT.

The new Enabling Act under "Forward Funding" established dedicated sources of revenue and mandated that the MBTA is to operate as an independent, financially self-sustaining public transportation agency. Prior to "Forward Funding," the Commonwealth funded the MBTA in arrears.

Beginning on July 1, 2000, the MBTA no longer received net-cost-of-service or debt assistance. Instead, under the restated Enabling Act, the MBTA receives a dedicated revenue stream consisting of assessments paid by the 175 cities and towns in accordance with the Enabling Act and a portion of the statewide sales tax. In addition to the dedicated revenues, the MBTA's operations are funded by fare and nonfare revenues. Nonfare funding can include revenues from advertising, parking, concessions, real estate sales, and interest income.

Innovative financing is an important element of project implementation. These sources can often mean the difference in a project moving forward within a region's planning process. As a project moves from the PMT into other elements of the planning process, financial constraints are increasingly introduced that force regional decisions on priorities.

Innovative sources of funding can be found at all levels of government, as well as the private sector. Some examples of innovative funding tools include tax increment financing, joint development, and project financing.

Table ES-1 Status of SIP and CA/T Projects

COMPLETED PROJECTS

Project	SIP Commitment	CA/T Commitment	ACO Commitment
Newburyport Commuter Rail Extension	Yes	Yes	No
Service to Worcester Commuter Rail Extension	Yes	Yes	No
Interim Worcester Stations	No	No	Yes
Washington Street Replacement Service	No	Yes	Yes
400 New Buses	No	Yes	No
20,000 Additional Parking Spaces	Yes	Yes	Yes
Old Colony Commuter Rail Restoration – Middleborough/Kingston	Yes	Yes	No
Bus Retrofits	No	No	Yes

PROJECTS UNDERWAY

Project	SIP Commitment	CA/T Commitment	ACO Commitment	Status
Old Colony Commuter Rail Restoration – Greenbush	Yes	Yes	Yes	Design and permitting ongoing
Red Line–Blue Line Connector	Yes	Yes	Yes	In planning stages
Blue Line Station Platform 6 Car Trains	Yes	Yes	Yes	Under construction
Green Line Extension to Tufts (Medford Hillside)	Yes	Yes	Yes	In planning stages
Green Line Arborway Restoration	Yes	Yes	Yes	In planning stages
New Orange Line Vehicles	No	Yes	No	In planning stages
South Boston Piers Transitway	Yes	Yes	Yes	Under construction
2 Commuter Boat Facilities	No	Yes	No	In planning stages
Alternative-Fuel Bus Purchases (358 CNG Buses)	No	No	Yes	Purchase orders issued
Orange Line Signal Improvements	No	No	Yes	In planning stages
Service to T. F. Green Airport	No	No	Yes	In planning stages (RIDOT)
Silver Line Phase III	No	No	Yes	

SIP: State Implementation Plan for the Clean Air Act

CA/T: Central Artery/Tunnel Project

ACO: EOTC/DEP Administrative Consent Order

CHAPTER 1

Overview of the Program for Mass Transportation Process

The Program for Mass Transportation (PMT) is a central element of capital planning at the Massachusetts Bay Transportation Authority (MBTA) and is the foundation for transit infrastructure planning and programming in eastern Massachusetts. The MBTA's original enabling legislation (now repealed) and, more recently, its replacement "Forward Funding" legislation provide direction for this long-range planning. The PMT defines a vision for regional mass transportation and sets priorities for infrastructure investments in the areas of system preservation, service enhancement, and system expansion, without being financially constrained. As the 25-year "master plan" for the MBTA, the PMT must strike a balance between service expansion and the need to reinvest in the existing system.

MBTA Enabling Legislation, "Forward Funding," and Capital Planning

Prior to its incorporation and reworking as part of "Forward Funding," the MBTA's original enabling legislation (M.G.L. Chapter 161A, Section 5g) obligated the Authority to develop a long-range capital program. The Executive Office of Transportation and Construction developed the first PMT in 1966 and adopted major revisions in 1978 and 1994.

In 1999, Governor Paul Cellucci signed into law the major initiative, "Forward Funding," that altered the MBTA's financial structure and expanded the MBTA service area from 78 communities to the current 175 cities and towns.

The Current MBTA Capital Planning Process

"Forward Funding" brought several changes that strengthen the MBTA's capital planning process. The MBTA must now complete an updated PMT every five years (the original enabling legislation did not establish a schedule for regular reviews of the PMT). "Forward Funding" also further defined the development of the Capital Investment Program (CIP). The CIP is a rolling five-year capital plan that is updated annually. The PMT and CIP work together, with the PMT defining the long-range vision for mass transportation in

eastern Massachusetts and prioritizing infrastructure investments, and the CIP serving as a tool with which the MBTA implements its priorities from the PMT.

The Massachusetts Bay Transportation Authority (MBTA) created the Capital Investment Program (CIP) to provide an understanding of the Authority's planned capital expenditures for a five-year planning horizon, as well as to outline the need for future capital investment. The program classifies similar capital efforts together into structured projects and further into programmatic areas.

The PMT's Role in Regional Planning

The MBTA interacts with a number of different planning processes in Eastern Massachusetts. The Boston Region Metropolitan Planning Organization (MPO) is comprised of 101 municipalities, all in the MBTA's service area. Due to this geographic overlap, the MBTA works closely with the MPO on transit planning. Together, the PMT and CIP directly inform the MPO's capital planning efforts, which involve the development of a Regional Transportation Plan (Plan) and the annual Transportation Improvement Program (TIP).

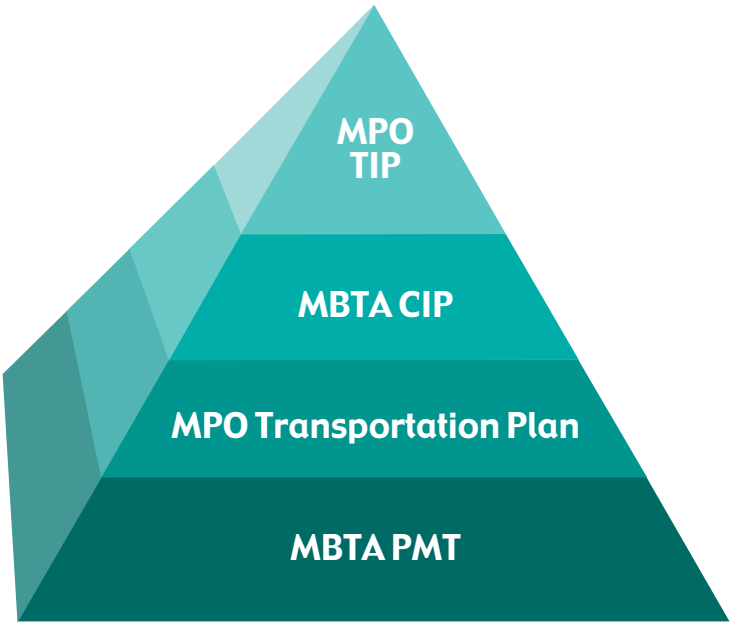
These closely coordinated MBTA and MPO processes function as a pyramid-like structure for transit planning in the Boston MPO region. As a financially unconstrained and objective analysis, the PMT establishes the project universe for all subsequent stages of planning and programming for the MPO. In deciding transit priorities within the Plan, the MPO introduces the region's financial constraints, then considers PMT projects for inclusion. For a project to move forward, it next must be programmed in the CIP. Using the projects identified in the PMT and the Plan, the MBTA develops this capital program. The CIP funds these priorities with both federal and non-federal monies. The MPO then programs the MBTA's federal projects selected from the CIP in the annual TIP.

Other MPOs with communities in the MBTA service area use the PMT in their planning processes as well. With all MPOs, the MBTA's internal framework for capital planning provides an objective tool for decision-makers to use in making intelligent choices about programming MBTA projects in their regions.

PMT – The Vision of Future Transit

By establishing the universe of projects for regional transit planning, the PMT helps to build a vision of what public transit could look like over the next twenty-five years. The fiscal challenges that face the Commonwealth and the MBTA will influence how much of this vision is implemented.

As one of the country's oldest transit authorities, the MBTA is faced with an enormous backlog in system preservation needs. Currently, this backlog is estimated at $3.0 billion, with $13 billion in additional needs forecast over the next twenty years. To meet this challenge, the MBTA has instituted a policy of



dedicating at least 70% of capital spending to system preservation projects. In order to meet or exceed this goal, the MBTA will continue to utilize the backlog of system preservation needs identified in the "universe of projects" in programming future CIPs.

In the Draft FY04 - FY08 Capital Investment Program (CIP), the MBTA has programmed $2.8 billion in capital projects. The CIP is broken down into four major programmatic areas: 1)reinvestment in the infrastructure ($1.85B); 2) accessibility improvements ($136M); 3) enhancement of existing service ($237M); and 4) system expansion efforts ($569M). These first three areas of the CIP support the Authority's commitment to reinvesting in its present system, with the most substantial share of the programmed spending ($2.2B or 80%) devoted to the maintenance (system preservation) and enhancement (system enhancement) of the existing system. It is important to note that the PMT establishes priorities within investment categories; whereas, the CIP, as the implementing process for the PMT, provides project-specific details on expenditures. Because the PMT is meant to provide information at the asset category level, it does not cite all the specific projects, which the MBTA would consider for programming in the CIP. Therefore, a central element of this PMT is the MBTA's reinvestment in the existing system to improve service to our customers.

Anderson Regional Transportation Center

This PMT also recognizes the significant transit needs within the MBTA's now expanded service district. The PMT provides a sense of relative system expansion priorities for consideration when money becomes available to the region. Ultimately, the PMT offers a vision that is responsive to urban core mobility needs and suburban demand for transit choices.

THE PMT DEVELOPMENT PROCESS

The 2003 PMT was developed during a twenty-month process which involved extensive outreach to the general public, detailed consultation with the PMT Working Committee, technical analysis and evaluation, and policy-level reviews.

Overview

Work on the 2003 PMT began in the spring of 2001 with the start of the planning process. Work included outreach, information gathering, technical analysis and evaluation, and reviews by the MBTA and Central Transportation Planning Staff. A broad outreach to the general public and major stakeholders brought in ideas and other input to guide and refine the PMT. In the spring of 2003, the process will culminate in the MBTA Board of Directors' consideration of the document. After their concurrence, the MBTA Advisory Board will consider the PMT for final approval.

Steps in the PMT Process

There were five main steps in the development of the PMT: "visioning," project screening, project evaluation, review of the draft PMT, and finalization of the PMT.

Visioning

Development of Vision, Goals, and Objectives

The first step was "visioning," open-ended brainstorming with local and regional officials and other members of the public to define the

region's future transit system. In this open process, the PMT project team solicited any ideas members of the public might have for improvements to meet current and future transit needs. Input was also requested on the PMT vision statement, goals, and objectives.

The MBTA opened public discussion on the PMT process in the summer and fall of 2001 by convening the PMT Working Committee, conducting a series of eight public workshops, and inviting many local and regional groups to discuss the PMT.

First, a vision statement was completed to define the role of public transportation in eastern Massachusetts's transportation network in 2025. Next, goals and objectives were drafted to outline the strategy for implementing this vision as part of the MBTA's planning process. The Working Committee, as well as members of the public, provided input to the development of these important policies. Committee members were particularly interested in the PMT establishing values and a clear and forward-looking vision that would support well-defined goals. Achieving a state of optimal repair was important. Protecting the environment (including minimizing impacts), supporting sustainable development, and, particularly, taking steps to improve air quality and slow climate change were serious issues for the committee.

The PMT Vision for Public Transportation

The MBTA has adopted the following vision for public transportation.

- Provide safe, cost-effective, and efficient services that increase ridership and respond to the expanding mobility demands of individuals and communities.
- Maintain existing infrastructure in a state of optimal repair to improve quality, convenience, accessibility, and reliability of service.

Ashmont Station

- Transport customers in a system that promotes a desirable quality of life, supports the sustainable development of communities, improves the quality of the environment throughout the Massachusetts Bay region, and distributes benefits and burdens equitably.

The PMT Goals and Objectives

The vision of the PMT will be implemented through these numbered goals and their corresponding objectives.

1. Preserve and modernize the transit system and improve accessibility.
   - Support infrastructure projects that improve customer service, ensure the safety and security of passengers, and enhance the efficiency of the system.
   - Adhere to a timely schedule for infrastructure maintenance.
   - Provide better access to the system for all customers, with particular focus on meeting the goals of the Americans with Disabilities Act.
2. Improve mobility for area residents and visitors now and in the foreseeable future.
   - Increase transit mode share in the Massachusetts Bay region.
   - Provide transit access to commercial and

residential centers both in the urban core and the suburbs, taking into account anticipated growth.

- Enhance the interconnectivity of all transit services by promoting seamless transfers at intermodal facilities, eliminating the need for transfers where possible, and providing improved customer information on available connections.
- Improve the on-time performance of MBTA services through improved monitoring of routes and modifications to rights-of-way.

3. Minimize transportation-related pollution of the environment.
   - Reduce the MBTA's environmental impact on the Commonwealth by implementing projects and programs that increase the use of low-polluting fuels and efficient engine technology in all transit vehicles and that reduce greenhouse gas and particulate matter emissions.
   - Minimize community disruption and negative environmental impacts.
   - Construct and operate facilities that reduce traffic congestion and improve air quality by providing residents of the Massachusetts Bay region with an attractive alternative to traveling in private automobiles.
4. Promote the equitable sharing of the transportation system's benefits and burdens.
   - Expand capacity and reallocate resources to relieve passenger crowding on vehicles and facilitate ridership growth.
   - Identify and remove structural and operational transportation barriers faced by disadvantaged populations.
   - Enhance the mobility of transit-dependent populations located both in the urban core and suburban areas.
5. Serve as partner for community development within the MBTA service area.
   - Implement transportation investments that sustain and stimulate regional economic development.
   - Respond to communities' requests for transportation improvements that support transit-oriented development and sustainable-land-use plans.
   - Improve mass transportation in a manner that enhances the competitiveness of local businesses and the economic vitality of neighborhoods, with special emphasis on disadvantaged areas.

Development of the Universe of Project Ideas

The MBTA then developed the Universe of Projects (Universe), the set of all projects considered in the PMT. An important part of this effort was the project-level review of previous PMTs and other MBTA planning documents, the Capital Investment Program, the State of Good Repair Program, the Parking Expansion Program, and other various studies conducted to support capital investment planning by the MBTA. The 2000–2025 Regional Transportation Plan was also reviewed. The results of this work provided the essential, baseline inputs to the set of projects considered for inclusion in the PMT. Extensive public outreach and review by the Working Committee, the MBTA Advisory Board, and members of the public yielded hundreds of project ideas to supplement the initial list. Many ideas were new, broadening the PMT's viewpoint.

At the end of the visioning phase, the PMT team had developed a Universe, which included ideas for transportation improvements in all modes, and consensus on the PMT vision, goals, and objectives. (Please see the Appendices for a complete listing of the Universe.)

Project Screening

Working with the Universe that emerged from the visioning phase, the MBTA and the Working Committee reduced the Universe to a shorter, feasible list of projects that warranted further evaluation. A set of screening criteria, reviewed with the Working Committee and the MBTA Advisory Board, identified issues to be considered in this process. These screening criteria, along with performance measures to be described in the following section, are consistent with the MBTA's amended enabling legislation. A project's ability to meet an identified need or an existing legal commitment was an important consideration. Environmental justice issues, such as ensuring equitable provision of service to minority and low-income communities, and whether a project was included in the 1994 PMT were also taken into account. Community support and coordination with local plans were considered. Concepts that were technically infeasible, currently impracticable, or inconsistent with established MBTA transit priorities were separated out of the Universe. Some of the suggestions did not require additional capital resources for implementation and were referred to the MBTA's service planning process. System preservation projects were included in the Universe without undergoing screening.

The MBTA Advisory Board was briefed during the screening process. The Working Committee discussed the screening at two of its meetings, and consensus was reached on the projects to be advanced. These projects were organized into three categories—system preservation, service enhancements, and system expansion. (The Universe of Projects and the screening results are shown in Appendix E.)

Commuter rail–Hamilton/Wenham Station

Project Evaluation

Projects that emerged from the screening phase were evaluated using performance measures to determine how well each met the PMT goals and objectives and other regional transportation planning priorities.

Performance Measures

The MBTA developed sets of performance measures for each of the three categories of projects, which are described below.

- System Expansion: Projects which introduce service to an area or time period where it currently does not exist, or convert an existing service to a new mode. Rapid transit, bus, trackless trolley, commuter rail, and boat projects were identified.
- Service Enhancements: Projects that would improve the quality of service provided on an existing transit line or at an existing station. These were organized into general enhancements, accessibility projects, and projects improving access to service.
- System Preservation: Projects aimed at keeping the MBTA's system in a state of optimal repair.

Project ideas were then further divided by mode. Commuter rail, rapid transit, bus/trackless trolley, boat, and other modal (including pedestrian and bicycle) ideas were evaluated separately. This resulted in eight overall groupings of projects—system expansion and service enhancement projects for all modes except for boat and other modes. Only system expansion

projects were submitted for consideration under the boat mode, and only service enhancement projects were submitted for the "other modes" grouping.

System expansion and general service enhancement project ideas were evaluated based on thirty-five individual performance measures divided into seven categories as listed below. Additional detail is provided in Appendix A.

- ***Utilization***
  Total ridership; new transit riders; travel time benefit; impact on mode share to key destinations, including downtown Boston; and reductions in crowding and vehicle miles traveled.
- ***Mobility***
  Expansion of transit access to geographical areas underserved by transit; during time periods poorly served by transit; and to major employment centers underserved by transit.
- ***Cost-Effectiveness***
  Capital cost and operating costs per new transit rider and per unit of travel time savings.
- ***Air Quality***
  Percent reduction and capital cost per unit reduction in emissions of volatile organic compounds, nitrogen oxide, carbon monoxide, and carbon dioxide.
- ***Service Quality***
  Enhancements to customers' personal safety; improvements to station access and/or comfort of vehicles and stations, to reliability of service, to interconnectivity between modes (including nonmotorized modes), and to customer information, including navigational tools; and elimination of transfers/minimization of transfer time.

MBTA bus and Silver Line vehicle–Washington St.

- ***Economic and Land Use Impacts (not applied to service enhancement projects)***
  Service to a state-designated revitalization area/initiative; consistency with local plans that promote coordinated, transit-oriented development and support sustainable land use patterns in the immediately surrounding area(s); consistency with regional plans; and support for brownfield and infill development.
- ***Environmental Justice***
  Service to minority, low-income, and transit-dependent neighborhoods; rectification of structural and/or operational transportation barriers faced by minority, low-income, and transit-dependent neighborhoods; response to environmental justice issues identified in MPO Regional Transportation Plans, including poor connections between targeted residential neighborhoods and major employment centers; and burdens and benefits to minority, low-income, and transit-dependent neighborhoods.

  These measures are consistent with the Boston MPO's environmental justice policies and performance measures, developed in its consultation with representatives of low-income and minority communities in the region.

The Working Committee reviewed the evaluation measures and offered refinements over the course of several of its meetings. Members

wanted to make sure that the criteria addressed the goals and objectives. They supported improving mobility, particularly to areas with unmet demands, and wanted the PMT to reflect current views on development by giving priority to transit projects serving transit-oriented development. They also strongly supported service improvements to environmental justice target communities. The performance measures were also discussed with the Capital Planning Committee of the MBTA Advisory Board. Other members of the public were invited to comment through the PMT Monitor, the newsletter *TRANSREPORT*, and the PMT Web site.

The Evaluation Process

For each performance measure that was applicable to a given project, a high, medium, or low rating was assigned. In the case of quantitative measures, the thresholds for high, medium, and low ratings were defined by first listing the corresponding impacts of all projects in a given grouping in order of magnitude. Natural breaks, or large gaps between the impacts of successive projects in the list, were then identified, and the first grouping was given a high rating, the second group a medium rating, and so on. This resulted in a set of ratings for individual projects that were relative in nature.

In the case of qualitative measures, the thresholds for high, medium, and low ratings were defined before their application to specific project ideas. Additional details on these definitions for each measure are included below. In some cases, the vast majority of project ideas received the same rating on a given qualitative performance measure, unlike the approach for quantitative measures. For example, almost all project ideas that would have an impact on environmental justice target communities were determined to not result in a substantial burden on those communities without a commensurate benefit. Consequently, almost all projects received high ratings on that measure.

Green Line–Coolidge Corner

Evaluation information was reported in tabular form using three symbols to describe each project's rating in every performance area:

- high rating ●
- medium rating ◗
- low rating ❍

Projects then fell into three overall groupings, and those with the highest overall evaluations were designated as high priority; those in the middle, medium priority; and those satisfying the fewest performance measures, low priority.

Review of Preliminary Results and Draft PMT

The preliminary results of this analysis were discussed initially with the Working Committee and with MBTA operations, planning, and finance personnel. The MBTA then conducted four workshops around the region to gather input from members of the general public on the evaluation process and preliminary results. These were similar in format and outreach method to the initial eight conducted in 2001. The Regional Transportation Advisory Council, the Access Advisory Board to the MBTA, and the Boston MPO's Environmental Justice Committee participated in the public review. The additional information from these sources was considered and revisions were incorporated in a draft PMT document.

The draft PMT was circulated for public review during a thirty-day comment period. Notice of its availability was advertised in legal notices of the major daily newspaper, posted on the PMT Web site, and sent to members of the Working Committee, the MBTA Advisory Board, the state legislature, and the Regional Transportation Advisory Council. Regional transit authorities, MAPC subregions, and the chief elected officials, administrators, and planning directors of municipalities throughout the MBTA service area were also contacted. Notice of the PMT's availability was announced in *TRANSREPORT* and was sent to the hundreds of citizens and officials on the Boston MPO's and the PMT's public information mail distribution lists. Two public hearings were held to listen to comments. Special briefings for the Boston MPO's Transportation Planning and Programming Committee were also conducted.

Finalizing the PMT

All comments received during public review were considered and, as appropriate, incorporated into the PMT, which was then sent to the MBTA Board of Directors for approval. Final acceptance rests with the MBTA Advisory Board.

Partners in the Process

The broad scope of the PMT called for significant public involvement. The MBTA sought many perspectives and ideas through its public process initiatives, which reached into every corner of the service area to attract individual members of the public, officials, and organizations. Through the PMT Working Committee, the MBTA developed an ongoing and in-depth dialogue with stakeholders in the region's transit system. The 2003 PMT has been shaped by this public input and guidance and reflects a balance of technical analysis, operational issues, and public perspectives.

The PMT Working Committee

The PMT Working Committee

The PMT Working Committee served as the MBTA's principal public advisory body in developing the PMT. The sixteen members making up the initial committee were selected from a wide geographic area and a variety of views and interests. Members represented the City of Boston, state agencies, regional agencies and groups (including several participants from the MBTA Advisory Board, the Regional Transportation Advisory Council, and the Access Advisory Committee to the MBTA), and a community group. They were asked not only to provide their organization's views during PMT discussions, but also to relay information and views from the Working Committee back to their group. This way, their voices reflected the issues important to their constituents, and their constituents input was informed by a good awareness of how the PMT's development was proceeding.

The Working Committee met frequently, usually monthly, to review PMT work products and to provide advice and guidance in the development of the PMT. Early activities focused on building members' knowledge base about MBTA financing, the Capital Improvement Program, the parking expansion program, system preservation analysis, environmental justice, and travel demand modeling.

From this base, members participated in every step of the PMT. They provided input and guidance on PMT policies (the vision, the goals and objectives), project performance measures, and development of the final plan. The committee identified specific project ideas for inclusion in the PMT and raised issues for discussion. (See the Appendices for a list of committee members and meeting notes.

The MBTA Advisory Board

The MBTA consulted with the MBTA Advisory Board on several levels throughout the development of the PMT. As the final decision-maker on acceptance of the 2003 PMT, the Advisory Board plays a key role in the process. In order to ensure that issues of importance to the Advisory Board were addressed, the MBTA provided several briefings to the entire body and discussed the PMT often with its Capital Planning Committee. In particular, the Board provided input for the Universe of Projects and the PMT goals and objectives.

Metropolitan Planning Organizations

The Boston Metropolitan Planning Organization

The Boston MPO was important in the development of the PMT. Its Regional Transportation Plan provided one of the early inputs for the PMT Universe of Projects. The PMT vision, goals, and objectives are consistent with the MPO's policies. MPO members, through their Transportation Planning and Programming Committee designees, were provided several briefings and opportunities for comment.

Pedestrians near Arlington Station

Environmental Justice

The Boston MPO's standing committee on environmental justice is assisting the MPO with ensuring that all of its regional planning efforts consider the needs of low-income and minority communities. The aim is to strengthen the connections between the region's transportation planners and the individuals and front-line organizations playing a direct service or community development role in improving conditions in low-income and minority neighborhoods. The PMT incorporated the Boston MPO's environmental justice policies in its analysis and will review the results with the Environmental Justice Committee.

The Regional Transportation Advisory Council

Though not directly in the line of PMT approval, the Boston MPO's Regional Transportation Advisory Council is responsible for citizens' review of and input to the MPO's products and processes. Because of its active role and members' regional perspective on transportation planning, the Council was represented on the Working Committee and was briefed periodically by PMT staff.

Other MPOs/Regional Planning Agencies

As part of the initial outreach, the MBTA met with each of the MPOs that have communities in the MBTA service area through the regional planning agencies corresponding to the MPOs: the Old Colony MPO (Old Colony Planning Council), the Southeastern Massachusetts MPO (Southeastern Regional Planning and Economic Development District),

Central Massachusetts MPO (Central Massachusetts Regional Planning Commission), Montachusett MPO (Montachusett Regional Planning Commission), Northern Middlesex MPO (Northern Middlesex Council of Governments), and the Merrimack Valley MPO (Merrimack Valley Planning Commission). These meetings helped the MBTA build valuable relationships and opened the door for ongoing communication.

Interest Groups

Early in the PMT process, the MBTA conducted an initial outreach to more than fifty local or regional organizations. Some, such as the Access Advisory Committee to the MBTA, have a very specific role in transit planning. Others, such as the Metropolitan Area Planning Council subregions, have a longstanding interest in transit planning. Many of the other groups contacted are not normally active in transit planning discussions, but the MBTA wanted to gather a broad range of views and hear from people not previously involved. Neighborhood and community groups around the service area were asked to devote a portion of a regularly scheduled meeting to a PMT briefing. The discussions served as both an invitation to submit ideas for the PMT and an opportunity to explain the MBTA planning process. (See the Appendices for a listing of organizations contacted.)

Members of the Public

Twelve public, widely advertised workshops were conducted in accessible locations all around the region. The first round was conducted in November and December 2001 and served to introduce the PMT and the MBTA planning process, and to actively solicit ideas and comments. The second round, conducted in January 2003, reviewed the PMT process, the evaluation criteria, and the preliminary results of the analysis. The open-house, workshop format of these events allowed members of the public to visit numerous "stations" set up to stimulate ideas about rapid transit, bus, commuter rail, commuter boat, and bicycle/pedestrian transportation. Maps showing transit routes, lines, and other facilities were available for discussion, and participants used them to show their ideas for transit improvements. Some people also submitted written comments. All ideas and input collected at the workshops were addressed in the PMT process. Some suggestions provided ideas for projects and insights and guidance on policy issues. For example, members of the public were often interested in environmental justice issues and enhancing mobility to key employment centers. They also spoke about service quality issues such as improving reliability and eliminating transfers.

Two public hearings were also held by the MBTA in early March 2003 to solicit final comments on the draft PMT. Unlike the earlier workshops, these hearings did not provide the opportunity for dialogue with the MBTA staff, but the proceedings were recorded by a stenographer and are addressed in Appendix D.

Public Information

The *PMT Monitor,* the project's newsletter, provided current information and progress reports on the development of the PMT and on Working Committee activities. It announced workshops, presented the project schedule, showed progress through the phases of PMT development, and invited readers to provide input and ideas. Three editions were published and they were circulated widely. They were posted on the PMT Web site and mailed to chief elected and executive officers and planning boards in the MBTA-service-area communities outside the Boston MPO area. Within the Boston MPO region, copies were sent to the MPO's e-mail group, MPOINFO, which includes all selectmen's and mayors' offices, town administrators, planning directors, legislators, and many interested citizens—approxi-

mately 550 recipients. The newsletter was also sent to everyone (570 people) on the PMT mailing list, which consisted of individuals who attended public meetings and expressed interest in being kept informed.

Information from the *PMT Monitor* was published in articles in the Boston MPO's newsletter, *TRANSREPORT,* which is circulated to more than 2,550 readers in the MPO region. *TRANSREPORT* also included notices of the workshops held to solicit initial project ideas and to review preliminary results. Separate notices were placed in advance of the official public review period and the March 2003 public hearings: press releases were sent to local and regional newspapers in the MBTA service area, and a legal notice was also placed.

The project team established a PMT Web site, linked to both the MBTA and the Boston MPO Web sites. The PMT site included general information on the project, notices of the public workshops and hearings, and information on the Working Committee and PMT-development products such as the vision statement, goals and objectives, project screening criteria, performance measures, and results of both the project screening and the full project evaluations. The site also provided an electronic form for citizens to use to register ideas and comments or request more information.

Comments

Citizens submitted ideas in a variety of ways: via the Web site's public comment form; at workshops, using written comment forms or large-scale paper maps; and via traditional correspondence. All comments were considered in the development of the PMT.

CHAPTER 2

Existing Conditions

The MBTA is the primary transit provider in eastern Massachusetts, and its system is one of the five largest public transportation systems in the United States. It directly operates or contracts out for service using eight different modes: heavy rail, light rail, bus rapid transit, local/express bus, trackless trolley, commuter rail, commuter boat, and paratransit. Its system serves the area in a largely hub-and-spoke network. The commuter rail network extends to the far reaches of the MBTA's 175-community district, while local MBTA bus service extends from Boston to just beyond Route 128. Rapid transit, streetcar, and bus rapid transit service is limited to communities within Route 128.

Boston stands among five other national urban areas—Chicago, New York, Philadelphia, San Francisco, and Washington—as a megacity in which transit carries more than 3 percent of all passenger miles and more than 8 percent of commuter travel. The "big six" carry two out of three of the transit passenger miles traveled in America. In Boston, 55 percent of all work trips and 42 percent of all trips into downtown are by transit. In the Boston MPO region overall, 6.8 percent of all trips are made by transit, and that number is estimated to increase to 7.47 percent by 2025.

Rapid Transit, Light Rail, and Bus Rapid Transit

The MBTA rapid transit, light rail, and bus rapid transit systems serve 134 stations on six lines: the Green Line, Blue Line, Orange Line, Red Line, Mattapan High Speed Line, and Silver Line. Daily ridership on the rapid transit/light rail system is over 689,000, with over 10,000 riders per weekday on the bus rapid transit system. In this chapter, all ridership data is a composite average and is reported as unlinked trips.

Green Line

Opened on September 1, 1897, the Green Line has been providing transit riders in Boston with service for more than a century and is the oldest operating underground subway in the United States. The

original underground alignment ran along Tremont and Boylston Streets between Park Street and the Public Garden, and the majority of this route is still in use today. Realignment in 1914 resulted in the closure of the Public Garden portal and the opening of a new underground tunnel under Boylston Street to Copley Square. Between 1897 and 1959, the Green Line underwent extensive expansion, with branch lines added, realignments of tracks and portals, and vehicle upgrades. This era of Green Line expansion ended with the conversion of the Highland Branch, a former heavy rail right-of-way, into the present-day D Line extending to Riverside in Newton.

Today, the Green Line uses light rail vehicles (LRVs) and generates approximately 215,000 trips per weekday over 23 miles of track in Cambridge, Boston, Brookline, and Newton. The line operates both above and below ground along the four branch lines and within the central subway. There are a total of 70 stations on the Green Line. The number of stations on each branch is as follows:

Blue Line–Aquarium Station

- Central Subway – 13 stations
- B Line – 22 stations
- C Line – 13 stations
- D Line – 13 stations
- E Line – 9 stations

The northern terminus of the Green Line's E and D branches is at Lechmere Station in Cambridge. Because Green Line ridership north of downtown Boston is much lower than to the west and southwest, B Line and C Line trains turn around at Government Center. There are 170 light rail vehicles in the Green Line fleet, which consists of 55 cars built in 1976–78, 95 built in 1986–87, and 20 built in 1997. One hundred ten (110) passengers per car is considered the maximum load for these vehicles. Delivery of 100 new low-floor cars began in 1999. These cars are intended to replace the 55 cars built in 1976–78 and are designed to be accessible to the disabled and elderly.

Park-and-ride facilities on the Green Line provide over 1,900 spaces. Rush hour trains operate at 5- to 8-minute intervals on the four branches and at 1.3-minute intervals between Copley and Government Center Stations. The peak hour directional line capacity totals 9,020 passengers.

Blue Line

The six-mile-long Blue Line is the shortest of the three heavy rail lines and operates between Wonderland Station in Revere and Bowdoin Station in the Government Center area of Boston. Built in 1904, the Blue Line was originally a streetcar line between Court Street in Boston and Maverick Square in East Boston. In 1924, it was converted to high-platform, third-rail rapid transit. Over the years, expansions have included new stations and vehicle upgrades.

Twelve stations, eight of which are currently accessible, generate 59,394 weekday trips. These trips are generated primarily as inbound and outbound work trips. The Blue Line fleet consists of 70 vehicles built in 1978–80; 95 passengers per car is considered the design load. Park-and-ride facilities provide over 3,900 spaces. Rush hour trains operate at 3.5-minute intervals at an average speed of 18.7 mph. All trains are four cars in length at all times, and

the peak hour directional line capacity totals 6,460 passengers.

At present, the Blue Line is undergoing major reconstruction work at Airport and Aquarium Stations to comply with the Americans with Disabilities Act (ADA) requirements. Reconstruction of stations at Government Center, Maverick, Orient Heights, and State is also planned. The MBTA has procured a new fleet of 94 vehicles for Blue Line service and will run six-car trainsets once all construction work is completed.

Orange Line

Opened in June 1901, the Orange Line began as an elevated railway between Sullivan Square in Boston and Dudley Square in Roxbury. Over the decades, the Orange Line was routed underground via a tunnel under Washington Street, it was extended to Everett and to Forest Hills in Jamaica Plain, and portions of its elevated tracks were removed. In 1987, the Orange Line underwent its biggest change when the line was rerouted to the Southwest Corridor (originally designated for a new highway in the 1970s) into a below ground right-of-way where it presently operates.

The existing Orange Line, a rapid transit line is 11 miles long and operates between Oak Grove on the Malden/Melrose line and Forest Hills, serving the municipalities of Malden, Medford, and Boston. Sixteen of its 19 stations are accessible, and 170,873 trips are generated each week day. The Orange Line fleet consists of 120 vehicles built in 1979–81. During the peak period, 130 passengers per car is considered the design load. Park-and-ride facilities provide over 5,400 spaces.

Orange Line–Roxbury Crossing Station

The MBTA runs six-car trains during weekday peak and midday hours and four-car trains at all other times. Rush hour trains operate at 5-minute intervals at an average speed of 20.2 mph. The peak hour directional line capacity is approximately 10,140 passengers. The MBTA plans to improve the signal system between Haymarket and Oak Grove to match the signal capabilities already in place on the remainder of the line.

Red Line

Of the three rapid transit lines, the Red Line is the longest, at 21 miles, and the most heavily utilized, generating an average of 226,812 trips per weekday. Opened in March 1912 and expanded over the decades, the present Red Line has 22 stations, 17 of which are accessible. Service runs on two branches, from Alewife Station in North Cambridge to either Ashmont Station in Dorchester or Braintree Station. The municipalities directly served are Cambridge, Somerville, Boston, Quincy, and Braintree. All service operates along a common alignment between Alewife and JFK/UMass Station in Dorchester, at which point service branches off to either Ashmont or Braintree.

Throughout most of the day, service is split equally between the two branches. The MBTA runs six-car trains during the A.M. and P.M. peak hours and four-car trains at other times. There are 218 cars in the Red Line fleet. The fleet consists of 74 cars built in 1969, 58 cars built in 1987–88; and 86 cars built in 1994. During the peak period, 170 passengers per car is considered the design load. Park-and-ride facilities provide over 11,000 parking spaces.

Rush hour trains operate at 8-minute intervals from Braintree and Ashmont and at 4-minute intervals between

JFK/UMass and Alewife. Average speeds on the Braintree and Ashmont Branches are 23.3 mph and 19.2, mph respectively. The peak-hour directional line capacity totals 12,200 passengers.

Mattapan High Speed Line

The Mattapan High Speed Line connects with the Red Line and operates between Ashmont and Mattapan Stations through the Dorchester neighborhood of Boston and the town of Milton. The 2.7-mile line has 8 stations, with cars operating at 5 minute intervals during peak periods and at 10-13 minute intervals at all other times.

The High Speed Line uses 10 President's Conference Committee (PCC) streetcar vehicles built in 1945–46. These PCC cars are the oldest operating revenue vehicles on the entire MBTA system. A program to restore the cars and extend their service life by at least an additional 10 years is ongoing, with 6 of the 10 having been restored and a seventh in the process. The cars are being restored to the orange and cream paint design that was used when the vehicles were first delivered to the Metropolitan Transit Authority, the predecessor to the MBTA.

The High Speed Line can be considered an extension of the Red Line, in most respects, as it connects with Ashmont Station. Its vehicles, however, are maintained and operated as part of the Green Line fleet and run as single cars. Eighty-seven passengers per car is considered the maximum load. The line has over 300 parking spaces and generates 7,752 passenger trips per weekday.

Silver Line

In July 2002, the first phase of the Silver Line, the MBTA's newest rapid transit line, opened between Dudley Square and Downtown Crossing along Washington Street in Boston. The route, which was part of the elevated Orange Line until 1987, is a bus rapid transit (BRT) line that consists of a busway featuring priority lanes, shelters, real-time schedule information, electronic signage, a public address system, and an intercom assistance system. Currently, 17 forty-foot compressed natural gas (CNG)–powered buses operate on the 2.2-mile line. Four-minute intervals are provided during peak-periods. These buses will be replaced in 2003 with sixty-foot articulated buses. Ridership on the Silver Line is over 10,000 passenger trips per weekday.

The second phase of the Silver Line is presently under construction and is expected to open in December 2003. Service on this segment will operate from South Station to Logan

TABLE 2–1
CHARACTERISTICS OF THE RAPID TRANSIT SYSTEM

Line	Fleet Size	Passenger Trips per Weekday	Length of Line (in miles)	Headway (in minutes)
Red Line	**218**	**226,812**	**21.0**	**4.0**
Green Line	**170**	**215,000**	**23.0**	**1.3**
Orange Line	**120**	**170,873**	**11.0**	**5.0**
Blue Line	**70**	**59,394**	**6.0**	**3.5**
Silver Line	**17**	**10,000**	**2.2**	**4.0**
Mattapan High Speed Line	**10**	**7,752**	**2.7**	**11.0**

Note: 1.3-minute Green Line headway is between Government Center and Copley, and 4-minute Red Line headway is between Alewife and JFK/UMass.

Airport via an underground transitway, with stops at the John Joseph Moakley Federal Courthouse and the World Trade Center connecting with the Ted Williams Tunnel to go to Logan. A branch surface route will connect to the new Boston Convention and Exhibition Center and the Boston Marine Industrial Park in South Boston.

The plan for the third phase of the Silver Line is to connect the Washington Street and South Boston segments between New England Medical Center and South Station. A pre-existing tunnel under Tremont Street between New England Medical Center and Boylston Stations would be built, along with another tunnel from Boylston Station to South Station via Chinatown. Efforts to secure funding for this phase are underway, with the goal of completion by 2010.

Bus and Trackless Trolley

The MBTA operates approximately 170 bus routes serving the following 44 municipalities:

> Arlington, Bedford, Belmont, Beverly, Boston, Braintree, Brookline, Burlington, Cambridge, Chelsea, Danvers, Dedham, Everett, Hingham, Holbrook, Lexington, Lynn, Malden, Marblehead, Medford, Melrose, Milton, Nahant, Needham, Newton, Norwood, Peabody, Quincy, Randolph, Reading, Revere, Salem, Saugus, Somerville, Stoneham, Swampscott, Wakefield, Walpole, Waltham, Watertown, Westwood, Weymouth, Winchester, Woburn

Four electric trackless trolley lines provide additional service in the communities of Cambridge, Watertown, and Belmont. Total bus and trackless trolley ridership is approximately 376,000 trips per weekday.

Nearly all bus and trackless trolley routes connect with the rapid transit system. In areas close to the Boston core, buses provide crosstown service, feeder service to rapid transit stations, and line-haul service (in heavily congested areas). Outside the urban core, buses provide local service and feeder service to rapid transit and some commuter rail branches.

MBTA bus–Hyde Park Ave.

The MBTA bus fleet consists of 366 diesel buses built in 1985–87, 194 diesel buses built in 1989, 396 diesel buses built in 1994–95, and 4 alternative-fuel vehicles built in 1999. The fleet also includes 40 electric trackless trolleys built in 1976. The MBTA is in the process of procuring additional alternative-fuel buses, including CNG buses, dual-mode vehicles for the South Boston Piers Transitway, and new trackless trolleys to replace the present fleet. Currently, the average age of the entire fleet is 11.79 years. It is estimated that by 2005, the average age will be 4.49 years.

The MBTA also operates express bus service to Boston from 12 communities:

> Burlington, Lynn, Marblehead, Medford, Nahant, Newton, Salem, Saugus, Swampscott, Waltham, Watertown, Woburn, and the Boston neighborhood of Brighton.

MBTA buses serve over 8,600 stops, approximately 355 of which are equipped with bus shelters. Park-and-ride lots for bus service have over 400 parking spaces. The present MBTA bus network consists mostly of routes taken over from the Metropolitan Transit Authority in 1964 and from several private operators at

various points in time. Most of these routes have lengthy histories, and many had their origins as streetcar lines built before 1900. Schedules and route alignments have been revised gradually over the years, but most continue to operate along the same general alignments in response to continuing demand.

Commuter Rail

The history of the commuter rail system begins in the mid-1830s. The three original railroads that came to Boston at that time were the Boston & Worcester, Boston & Providence, and Boston & Lowell. These lines constituted Boston's first commuter rail system. Over the decades, the system has adapted to the employment patterns of its customers and expanded with the addition of other railroad lines. In the 1960s and 1970s, the MBTA incrementally became owner and operator of the commuter rail system.

The present MBTA commuter rail network is comprised of 13 radial lines, with 123 stations (81 of which are accessible) and 365 miles of track. Ridership per weekday is over 140,000 passengers. The commuter rail system feeds two different downtown Boston terminals. North Side service operates to and from North Station, and South Side service to and from South Station. The Massachusetts Turnpike is generally considered the dividing line between North and South Station service. All routes north of the Turnpike—the Rockport, Newburyport, Haverhill, Lowell, and Fitchburg lines—serve North Station. Lines along the Turnpike or to the south—the Framingham/ Worcester, Needham, Franklin, Attleboro/ Providence, Stoughton, Fairmount, Middleborough/Lakeville, and Kingston/ Plymouth Lines—have South Station as their terminus. Back Bay Station is served by the Framingham/ Worcester, Needham, Franklin, Attleboro/ Providence, and Stoughton Lines.

Commuter rail–Westborough Station

The 76 municipalities served directly by commuter rail are:

> Abington, Acton, Andover, Ashland, Attleboro, Ayer, Belmont, Beverly, Billerica, Boston, Braintree, Bridgewater, Brockton, Cambridge, Canton, Chelsea, Concord, Dedham, Fitchburg, Framingham, Franklin, Gloucester, Grafton, Halifax, Hamilton, Hanson, Haverhill, Holbrook, Ipswich, Kingston, Lakeville, Lawrence, Leominster, Lincoln, Littleton, Lowell, Lynn, Malden, Manchester, Mansfield, Medford, Melrose, Middleborough, Natick, Needham, Newburyport, Newton, Norfolk, Norwood, Plymouth, Providence (RI), Quincy, Randolph, Reading, Rockport, Rowley, Salem, Sharon, Shirley, Southborough, Stoughton, Swampscott, Wakefield, Walpole, Waltham, Wellesley, Wenham, Westborough, Weston, Westwood, Weymouth, Whitman, Wilmington, Winchester, Woburn, Worcester

The Attleboro/Stoughton Line is the most heavily used line, with an average of 10,300 persons boarding per weekday. This line extends to Providence, just over the Massachusetts–Rhode Island border which contributes to its high ridership. In contrast, the Fairmount Line is the only commuter rail line that operates exclusively within the inner core of Boston, yet it has the lowest ridership, in part because of its small number of stops and its

low frequency compared to nearby bus routes. The Fitchburg Line is the longest in the commuter rail system, at 49.5 miles. Commuting times per mile on the Fitchburg Line are the greatest in the system, because of close stop spacing, speed restrictions, along the line and lack of express train service.

The commuter rail passenger coach fleet consists of 378 vehicles: 57 single-level coaches built in 1979 and rebuilt in 1996, 214 single-level coaches built in 1987–90, 75 double-deck coaches built in 1990–91, 17 double-deck coaches built in 1997, and 15 double-deck coaches delivered in 2001–2002. Double-deck coaches have seating capacities of 182, versus 127 for a single-level car.

The commuter rail locomotive fleet consists of 83 units: 18 units built in 1978–80, 25 units built in 1987–88, 12 units built in 1991–93, and 25 remanufactured units delivered in 1997–99. The fleet also includes 3 work locomotives built in the 1950s, which are used for non-revenue duties.

Of all of the components of the MBTA's transportation network, the commuter rail system serves the broadest market geographically, but it carries fewer passengers than the rapid transit system. A total of 457 weekday inbound and outbound trips are scheduled, with headways ranging from 25 to 40 minutes during peak periods, and from one to four hours during off-peak times. Over 30,000 park-and-ride spaces are provided for commuter rail riders, or are under construction.

Commuter Boat

Modern-day commuter boat service is a relatively new component of the public transportation system. In the early 1800s, steamboats ran to Boston from several coast communities. With the construction of the railroads in the mid-1800s, the market for boat service was reduced to seasonal and recreation travel. Boat service in Boston was not significantly used as a commuter alternative again until the 1970s.

Commuter boat–Rowes Wharf

Commuter boat service is provided on five routes by both the MBTA and subsidized private contractors. The routes operate between:

- Hingham and Rowes Wharf (Boston)
- Point Pemberton (Hull) and Long Wharf (Boston) via Quincy Shipyard (Quincy)
- Charlestown Navy Yard and Long Wharf
- Charlestown Navy Yard and Lovejoy Wharf (Boston)
- Lovejoy Wharf and the World Trade Center via the John Joseph Moakley Federal Courthouse (Boston)

Commuter boat service from Hingham originated in 1975 and was subsidized by the state between 1977 and 1981. During the 1980s and early 1990s, a number of renewed state-funded contracts and private operators provided commuter boat service on the route. In July 1997, the MBTA awarded a contract for the Hingham route to Harbor Cruises, LLC, a consortium that included Boston Harbor Cruises, Inc., which had been running commuter boat service between Long Wharf and the Charlestown Navy Yard since the 1980s.

Ferry service began operating from Hull in the mid-1850s as a steamboat service; by the 1890s it was being used primarily as a recreational service to Nantasket Beach, Paragon Park, and

other amusement areas in Hull. In 1963, a newly formed Mass. Bay Lines took over the Hull service and operated one round-trip per day, with a schedule suitable for Boston commuters. By 1967, the route was averaging about 40 riders each way per day. Service was discontinued in 1981 due to a decline in popularity and was reestablished years later under the Bay State, Spray, & Provincetown Steamship Company, which had been running Boston-to-Provincetown cruises for a number of years. Service was provided by the company and its successor, Bay State Cruise Company, without a subsidy until 1997. At that time, a subsidy was provided by the MBTA; however a competitive bidding process changed operators, and Harbor Express took over the route. Service was increased to two round-trips per day; both serve Quincy as well as Boston.

The present Quincy route is the newest of the South Shore commuter boat routes. Begun in December 1996 by Harbor Express, the service provides a direct connection to Logan Airport and Long Wharf. Earlier attempts to run commuter boat service in the 1980s from Marina Bay in Quincy lasted only a short time due to an inconvenient boarding point, high fares, and less frequency than the Red Line from North Quincy. The commuter boat terminal is now located in the former Quincy Shipyard complex on the Fore River. In 2002, the MBTA purchased this terminal from Water Transportation Alternatives, Inc. This purchase also included two catamaran vessels, a loading barge at Long Wharf, parking areas, and miscellaneous equipment for repairs and maintenance. The MBTA is a sub-lessee of the Quincy commuter boat parking facility that holds seven hundred spaces. The land is owned by the Massachusetts Water Resources Authority (MWRA), and it has expressed its intention to not renew the current lease that expires on June 30, 2003. The MBTA may need to acquire this facility in the future to support parking for its ferry customers.

Inner Harbor service is provided via three routes: Charlestown Navy Yard to Long Wharf, Charlestown Navy Yard to Lovejoy Wharf, and Lovejoy Wharf to the World Trade Center and John Joseph Moakley Federal Courthouse. Of the three routes, the Charlestown–Long Wharf route has the highest ridership, and it has constant two-way traffic. In addition to commuters, this route is attractive to tourists traveling to the USS *Constitution* and downtown workers who use it for lunchtime cruises. The Charlestown–Lovejoy Wharf route is the least patronized of the three Inner Harbor routes and serves primarily as a commuter option for residents of Charlestown. The Lovejoy Wharf–World Trade Center/Courthouse route is well used and operates primarily as a commuter route, with significant patronage from Lovejoy Wharf on A.M. trips and from the World Trade Center and Courthouse on P.M. trips. All Inner Harbor routes are accessible to persons with disabilities, and all stops connect with MBTA ground transportation.

MBTA ferry services operate between 6:00 A.M. and 10:30 P.M., with a total of 108 weekday inbound and outbound trips scheduled. Ridership is approximately 1.4 million passengers annually. Service is provided by a variety of boats and catamarans, and a total of 1,815 parking spaces are provided at the Hingham, Hull, and Quincy terminals.

Key Stations Program

The Americans with Disabilities Act (ADA), enacted by the federal government in 1990, mandates improvements to a wide variety of facilities and infrastructure throughout the country, for the purpose of providing full access to all. This mandate creates particular challenges for the MBTA, which has some of the nation's oldest transit facilities. The age of the system, combined with the fact that more than half of the MBTA's light rail stations are streetcar stops, resulted in the creation of the MBTA's Key Station Program. This program

designated 80 stations in the MBTA system that must be brought into compliance with ADA guidelines.

The Key Stations Program includes several commuter rail and heavy rail stations that were not previously compliant, most Green Line subway stops, and several important Green Line surface stops. All transfer points between the Blue, Red, Orange, Green, and commuter rail lines are also in the program. Currently, 51 of these 80 stations are compliant, and 27 more are in the design or construction stage. All new stations, such as those on the Silver Line and on the commuter rail extensions to Worcester, Newburyport, Middleborough, and Plymouth, are designed in compliance with the ADA. They are therefore not included in the Key Station Program. The same is true of the recently modernized Blue Line stations.

Mattapan High Speed Trolley–Ashmont Station

In the first few years of the program, the MBTA succeeded in bringing all but seven commuter rail Key Stations into compliance. Since that time, compliance has been achieved at five of the seven stations: Bradford, Fitchburg, Framingham, Canton Junction, and Route 128. Work remains to be done at Fairmount Station and Malden Station. Aside from commuter rail stations, the majority of work that remains in the Key Stations Program is on the Green Line's downtown subway and Green Line surface routes.

Surface streetcar stations included in the Key Station Program overall are those at the transfer points between the Green Line and major bus routes and those that serve large academic and medical institutions. Examples include BU East, BU Central, Harvard Avenue, Washington Street, Boston College, St. Mary's Street, Coolidge Corner, Washington Square, Cleveland Circle, Northeastern, Museum of Fine Arts, Longwood Medical Area, Brigham Circle, and Heath Street/VA Medical Center.

Underground and elevated Green Line stations included in the Key Station plan are Lechmere, North Station, Haymarket, Government Center, Park Street, Arlington, Copley, and Kenmore. The stations on the Riverside Branch are Fenway, Brookline Village, Reservoir, Newton Centre, and Riverside.

Temporary access has been achieved at 13 stations, including Park Street, North Station, and Lechmere, through the use of portable wayside lifts. Construction of raised platforms which are compatible with low-floor cars has been completed at 4 stations on the Riverside Branch. Construction of raised platforms is also planned at surface Key Stations on the B, C, and E Lines. The two terminal stations of the Mattapan High Speed Line are also designated as Key Stations.

Work is presently underway to upgrade (and make accessible) the outbound component of Chinatown Station on the Orange Line. The Orange Line component of North Station was completed in 2001. The Orange Line stations at Malden and Community College will also be made accessible under the Key Station Program. Design work is presently underway to replace Charles/MGH Station on the Red Line, making it accessible. Although not designated as Key Stations, the Savin Hill, Fields Corner, and Shawmut Red Line stations are slated for major renovations that will include providing accessibility for people with disabilities.

Paratransit

THE RIDE is a paratransit service operated by private carriers under contract to the MBTA as an alternative to fixed-route public transportation for persons with disabilities. THE RIDE operates sedans and lift-equipped vans in the following 62 municipalities within the MBTA district:

Arlington, Bedford, Belmont, Beverly, Boston, Braintree, Brookline, Burlington, Cambridge, Canton, Chelsea, Cohasset, Concord, Danvers, Dedham, Dover, Everett, Framingham, Hingham, Holbrook, Hull, Lexington, Lincoln, Lynn, Lynnfield, Malden, Marblehead, Medfield, Medford, Melrose, Middleton, Milton, Nahant, Natick, Needham, Newton, Norwood, Peabody, Quincy, Randolph, Reading, Revere, Salem, Saugus, Sharon, Somerville, Stoneham, Swampscott, Topsfield, Wakefield, Walpole, Waltham, Watertown, Wellesley, Wenham, Weston, Westwood, Weymouth, Wilmington, Winchester, Winthrop, Woburn

Annual ridership is over 1 million riders. The program has a fleet of over 300 vehicles.

THE RIDE

Private-Carrier and Suburban Bus Service

Four private carriers provide regular local bus transportation in East Boston, Winthrop, Medford, Milton, Canton, Hingham, and Hull under contract to the MBTA. Annual ridership is approximately 691,000 passengers. Nine additional private carriers are subsidized through the MBTA's Interdistrict Transportation Program (ITP) to provide commuter service to downtown Boston from the following 49 communities:

Amesbury, Andover, Barnstable, Bourne, Boxford, Bridgewater, Canton, Dighton, Dover, Duxbury, Easton, Fall River, Framingham, Georgetown, Groveland, Hanover, Haverhill, Hudson, Kingston, Lawrence, Marlborough, Marshfield, Medfield, Medway, Methuen, Middleborough, Milford, Millis, Newbury, Newburyport, Northborough, Peabody, Plymouth, Raynham, Rockland, Sandwich, Somerset, Southborough, Sudbury, Taunton, Topsfield, Wayland, West Bridgewater, Worcester

Through the ITP, the MBTA also finances local services such as the Framingham LIFT which provides service to the surrounding towns of Ashland, Holliston, Hopkinton, Marlborough, Milford, and Southborough, and a commuter service between Braintree Station and Hanover, Marshfield, and Plymouth. Annual ITP ridership for these local services is approximately 593,700 passengers.

The MBTA also provides funding to local communities to operate their own local transit systems. The Suburban Bus Program is geared toward low-density communities where regular MBTA service would not be cost-effective. The program, which began in 1979, subsidizes 11 communities: Bedford, Beverly, Burlington, Dedham, Framingham, Lexington, Lynn, the Mission Hill neighborhood of Roxbury, Natick, Needham, and Norwood. Some communities operate fixed-route bus service, while others use the program to operate demand-response service with vans or through taxi vouchers. Annual ridership is approximately 452,900 passengers.

Transportation Management Associations

Transportation management associations (TMAs) are nonprofit coalitions of local businesses dedicated to reducing traffic congestion and pollution and to improving commuting options for their employees. Several TMAs support shuttle services which connect employment locations with MBTA rapid transit or commuter rail stations. Some of these services are only available to employees of member companies, while others are open to the general public.

ITS Integration and the MBTA

Intelligent transportation systems (ITS) have a number of useful applications in the provision of transit services. The MBTA is integrating ITS into its operations in several ways. The Operations Control Center (OCC) was upgraded in the late 1990s to provide improved monitoring and location information for the rapid transit system. This control center allows operators to have real-time information on service and accidents and to plan service changes accordingly.

Development of a new bus operations center was started in 2002. When complete, the facility will integrate global positioning systems (GPS) on MBTA buses so that it can better schedule and direct the bus fleet. Automatic stop announcement equipment has been installed on the MBTA's crosstown bus routes, and the Silver Line vehicles are equipped with GPS-based automatic vehicle location (AVL) technology.

The MBTA is moving forward with procuring new fare collection equipment. Both magnetic-strip fare media and contactless "smart cards" are being considered. The MBTA will have some elements of an automated fare collection system implemented by the end of 2004.

The MBTA has advertised for the procurement and installation of interactive travel information kiosks at the South Station Transportation Center. These kiosks would provide a direct link to the MBTA's Web site, where customers could access schedule information for all bus, rail, and boat service. New automatic trip planning functions are also likely to be added to the Web site during the next two years.

Private-carrier bus-Riverside Station

The MBTA is nearing completion of a Request for Proposals to provide an enhanced customer service information system. This system would be tied directly to the MBTA's new vehicle and driver scheduling software now being used by the Scheduling Department. This would allow customers to access next-trip information for all routes over the telephone or the Web. An itinerary-planning tool would also be available to customers on the Web, generating origin-destination routing suggestions without the need to talk to a customer service agent. Other improvements would include TTY capabilities for all customer service agents, in order to reduce telephone-waiting time for persons with hearing impairments.

Access to Jobs and Reverse Commuting

Access to Jobs

The MBTA receives funding from the Federal Transit Administration through the federal Job Access Reverse Commute (JARC) program to

expand the existing fixed-route system to improve access to employment opportunities.

The MBTA operates early morning service (before 6:00 A.M.) from Roxbury, Dorchester, Mattapan, and South Boston to Logan Airport and downtown Boston. Other bus routes serving major suburban shopping centers have also had frequency improvements as a result of this program.

Reverse Commuting

In 2001, the Central Transportation Planning Staff conducted a Reverse Commuting Study for the MBTA. The study examined the feasibility and potential of modifying existing commuter rail schedules to meet the needs of persons working in suburban areas who live in the urban core. It was discovered that, for a number of reasons, the commuter rail network systemwide is currently not well suited to providing reverse commuting service. At the Boston end, most residential areas are beyond walking distance to commuter rail stations, requiring connecting services. At the suburban end, most major work sites are beyond walking distance of stations, requiring connecting van or bus service.

Most employment centers on Route 128 and I-495 are not served directly by commuter rail and only a few are served by feeder buses connecting with commuter rail stations. The Reverse Commuting Study identified potential opportunities for providing additional feeder buses to additional employment centers. These are discussed in Chapter 5C.

Employment locations near the Route 128 corridor that currently have bus connections to commuter rail or rapid transit stations include:

- Employment centers in Woburn (to Anderson RTC)
- Industrial and office parks on both sides of Route 128 in Waltham (to Waltham Station)
- Employment areas in Westwood and Norwood (to Route 128 Station)
- Centennial Park in Peabody (to Lynn Station)
- Square One Mall in Saugus (to Lynn and Malden Stations)
- South Shore Mall in Braintree (to Quincy Center and Braintree Stations)
- Business centers in Burlington and Bedford (to Alewife Station)

Employment locations in the I-495 corridor that have such connections are:

- Employment areas in Hopkinton and Milford (to Southborough Station)
- Solomon Pond Mall in Marlborough (to Framingham Station)

One of the important pieces of information that will be derived from the 2000 U.S. census, once the data are available in mid-2003, is how commuting patterns have changed in the past decade. Figures from the 1990 U.S. census showed that 83% of employed Boston residents worked either in Boston or in one of the ten surrounding municipalities with rapid transit and light rail service. Nine of the ten municipalities are within 15 rail miles of downtown Boston. Only 11% of employed Boston residents worked in cities or towns now served directly by commuter rail but not rapid transit and light rail. On average, only 3% of the workers employed in those cities and towns lived in Boston. In absolute terms, these municipalities were the work locations of 29,200 Boston residents out of 276,300 who worked anywhere in 1990.

The largest reverse commuting attractions for Boston residents are, and will likely continue to be, those within about 15 miles of downtown Boston. In most cases, better transit access to these destinations could be provided via express buses or a combination of rapid transit

and feeder buses than via commuter rail. Cities and towns with existing regional transit authority bus service, or other community-based bus service may also be able to modify routes and schedules to provide improved reverse commuting connections from commuter rail stations at relatively little cost.

Access to Service

Park-and-Ride Facilities

A major constraint within the MBTA system is the number of parking spaces at park-and-ride facilities and the limited amount of space available to expand these facilities.

At Commuter Rail Stations

There are 76 commuter rail stations within the Boston region that have parking facilities. These lots charge between $2 and $4 per day. There is a wide variance in the vehicle capacity of the commuter rail lots. Route 128 Station can currently hold 2,100 vehicles. Pride's Crossing, Plimptonville, and Silver Hill Stations each have spaces for fewer than 10 vehicles. The total number of spaces available at commuter rail stations in 2002 was 30,889.

Of the 76 commuter rail park-and-ride lots, 62 were considered to be at capacity in 2002. The MBTA considers parking facilities to be at capacity when they are over 85% full. Most of the lots that were below capacity were smaller ones: facilities with capacities of under 100 vehicles. The lone exception was Lynn, where the 965-vehicle facility (the commuter rail system's third largest) was observed to be only 38% full. The excess space in Lynn is partly due to its location in an urban downtown that is not well served by the highway network.

Park-and-ride lot-Riverside Station

Another problem is the early time of morning at which many of these lots reach capacity. Although no studies have focused primarily on this situation, there is evidence that travel schedules and even work hours have to be shifted in order for commuters to arrive at commuter rail stations early enough to secure a parking space. Limited parking results not only in commuters being forced to drive into Boston on particular occasions when they find a commuter rail lot to be full, but also in some commuters making long-term decisions to forgo transit altogether due to the uncertain availability of parking.

Several projects have been built or are being planned to help remedy the parking shortage. Most recently, the largest parking project was the construction of the Anderson Regional Transportation Center. This new station has a parking capacity of 2,400 vehicles, with some of this capacity being reserved for patrons of Logan Express bus service. The expansion of Route 128 Station resulted in a total of 2,750 spaces, 550 of which are still reserved for long-term or Amtrak parking. The addition of three new stations in 2002 between Framingham and Worcester on the Framingham/Worcester Line increased parking by 1,150 vehicles. Other parking expansion projects will add approximately 1,000 more spaces of parking.

It is projected that even with these new additions, the majority of the commuter rail network's park-and-ride lots will continue to be at or above capacity. This problem is compounded by the increased difficulty of locating and acquiring additional land around existing sta-

tions for parking expansion. Many stations are located in town or city centers where vacant land for expansion is scarce. Stations that are located outside of busy commercial districts are now attracting development themselves, complicating the expansion of these sites as well. Others are bounded by protected wetlands. It is also becoming increasingly difficult politically to expand existing stations, as the areas around many stations are impacted by commuter rail–related traffic that originates outside the town hosting the facility. Cost is another concern for the MBTA. The cost for each additional parking space ranges from $5,000 to $20,000. This figure does not include the cost of land acquisition.

Bicycle rack

At Rapid Transit Stations

The MBTA's rapid transit system is the location of another 29 park-and-ride lots. Ten of these are on the light rail system (Green Line and Mattapan High Speed Line), and the rest are on the three heavy rail lines. Parking charges at rapid transit stations are typically between $2.50 and $3.50; Alewife Station is $4.50. The two largest parking facilities are on the Red Line. They are Quincy Adams (2,378 spaces) and Alewife (2,515 spaces). The total number of spaces on the rapid transit system is 18,060.

All of the rapid transit parking facilities were considered in 2002 to be at capacity by the MBTA's 85% standard, with the exception of the three Mattapan High Speed Line stations. These three stations— Butler, Mattapan, and Milton—account for only 317 spaces. Since almost all of the MBTA's rapid transit stations are in dense urban areas, the difficulties of expanding parking are even more acute there than for the commuter rail system. There are currently no significant parking expansion projects underway or planned for the rapid transit system.

Bicycle and Pedestrian Access

Over the last several years, the MBTA has made significant progress in enhancing its Bikes-on-the-T program. The MBTA has worked on numerous aspects of the program to expand accessibility to the system for bicyclists. The following list details system improvements to date, as well as areas of continued effort:

- The MBTA has strengthened its relationship with Massachusetts Bicycle Coalition (MassBike) through creation of a formal advisory committee that works with the MBTA to address all bicycle accessibility issues related to its transit services. On this committee, the MBTA has included representatives from several departments, including Capital Planning, Railroad Operations, and Service Planning, as well as a representative from the Executive Office of Transportation and Construction (EOTC).
- The MBTA participates as an advocate of the bicycling community at special events such as the Statewide Bicycle/Pedestrian Conference. The MBTA served as a panelist at that conference.
- The MBTA has actively worked with community bicycle committees to develop master plans that promote transit and bicycle use. In 2001, the MBTA participated (along with MassHighway and EOTC) in the development of Boston's Bicycle Plan,

and it has consulted with communities on requests to develop better bicycle paths, station facilities, etc.

- The MBTA works with the Commonwealth's regional transit authorities to support development and operation of bicycle-accessible services to intermodal transportation centers in key cities including Brockton, Fitchburg, Lawrence, Lowell, Woburn, and Worcester. These services will permit bicyclists to access places of employment, residence, and recreation.

System Access Improvements for Bicyclists

- The MBTA has eliminated its bicycle permit program. This change has enhanced system access, trip mode flexibility, and customer satisfaction.
- The MBTA has expanded and enhanced its information on bicycle use systemwide through improved data collection efforts. Survey work targeting transit riders has been modified to include bicyclists and questions pertaining to the use of bicycles. In 2001, CTPS published useful bicycle transportation survey data collected in an EOTC-funded 2000 MBTA water transportation passenger survey.
- MBTA policy has been amended to allow folding bicycles on the commuter rail system at all times, without peak-period restrictions. A similar policy is under evaluation for the subway system.
- The MBTA has installed bicycle racks on buses assigned to crosstown routes and, in concert with MassBike, is considering rack installations on other bus routes. Options include retrofitting existing buses or including racks as a specification in future bus purchases.

Bicycle Parking Improvements

- The MBTA has instituted a capital program to expand bicycle parking facilities systemwide. This program dedicates transit enhancement funding in the amount of $50,000. The MBTA has worked with the MassBike to identify locations for bicycle racks. The MBTA has also installed bicycle parking at stations as part of its station modernization program.

Bicycle-Related Marketing Initiatives

- In conjunction with several of the above service improvements, the MBTA produced a new brochure to promote the Bikes-on-the-T program. These brochures have been distributed at various MBTA events.
- The MBTA and MassBike have developed a sign for stations to describe the Bikes-on-the-T program and its rules. This sign will also help to advertise the program.
- The MBTA's comprehensive system map now shows which stations have bicycle parking.
- Creation of an EOTC-funded, MBTA-designed water transportation Web site, www.massferryroutes.com, promoting this system's accessibility for bicyclists.

Pedestrian Access

Pedestrian access is also considered in the design or reconstruction of stations. Existing stations built before World War II are typically found to be within walking distance of a neighborhood or downtown area. In many cases, pedestrian access is better than automobile access. In suburbs with newly constructed stations, the automobile is generally the primary mode of access; however sidewalks are usually included in the design and connect to existing sidewalks within the community.

Progress of Legal Commitments since the 1994 PMT

To meet various state and federal mandates, the Commonwealth has committed to several projects and initiatives over the past twenty years.

In particular, the Commonwealth has pursued transit as a way to answer the requirements associated with the State Implementation Plan (SIP) for the Clean Air Act and the mitigation required by environmental agencies (pursuant to 310 CMR 7.36 and 310 CMR 7.38) to allow for the permitting of the Central Artery/Tunnel (CA/T) Project. As mentioned previously, the project screening process for the PMT included legal commitments as a criteria for ideas to undergo further analysis. By evaluating and prioritizing these commitments within the PMT, these projects continue to be eligible for programming within the CIP.

To date, the MBTA has played an active role in the implementation of many such commitments. Since 1994, many of the legal commitments have been completed, and many are in the process of being completed. In 2000, the Executive Office of Transportation and Construction (EOTC) and the Department of Environmental Protection (DEP) signed an Administrative Consent Order (ACO) related to the CA/T Project that established additional legal commitments. (In 2001, the ACO was amended to provide further clarity for some of these commitments.) Table 2-2 shows the status of legally-committed projects.

TABLE 2–2
STATUS OF SIP AND CA/T PROJECTS*

COMPLETED PROJECTS

Project	SIP Commitment	CA/T Commitment	ACO Commitment
Newburyport Commuter Rail Extension	Yes	Yes	No
Service to Worcester Commuter Rail Extension	Yes	Yes	No
Interim Worcester Stations	No	No	Yes
Washington Street Replacement Service	No	Yes	Yes
400 New Buses	No	Yes	No
20,000 Additional Parking Spaces	Yes	Yes	Yes
Old Colony Commuter Rail Restoration–Middleborough/Kingston	Yes	Yes	No
Bus Retrofits	No	No	Yes

PROJECTS UNDERWAY

Project	SIP Commitment	CA/T Commitment	ACO Commitment	Status
Old Colony Commuter Rail Restoration–Greenbush	Yes	Yes	Yes	Design and permitting ongoing
Red Line – Blue Line Connector	Yes	Yes	Yes	In planning stages
Blue Line Station Platform 6 Car Trains	Yes	Yes	Yes	Under construction
Green Line Extension to Tufts (Medford Hillside)	Yes	Yes	Yes	In planning stages
Green Line Arborway Restoration	Yes	Yes	Yes	In planning stages
New Orange Line Vehicles	No	Yes	No	In planning stages
South Boston Piers Transitway	Yes	Yes	Yes	Under construction
2 Commuter Boat Facilities	No	Yes	No	In planning stages
Alternative Fuel Bus Purchases (358 CNG Buses)	No	No	Yes	Purchase orders issued
Orange Line Signal Improvements	No	No	Yes	In planning stages
Service to T.F. Green Airport	No	No	Yes	In planning stages (RIDOT)
Silver Line Phase III	No	No	Yes	

**SIP: State Implementation Plan for the Clean Air Act*
CA/T: Central Artery/Tunnel Project

CHAPTER 3

Mobility Challenges for the 21st Century

Changes in demographics, growth patterns, and commuting behavior bring new demands to the Boston region's transportation system. The transit infrastructure of that system, in large measure planned and developed a century ago, is one of the nation's most extensive. It was designed as a hub-and-spoke system with the various rail line corridor spokes leading to the urban center. Boston today remains the region's economic and cultural center, but decades of dispersed development, population shifts, declining household size, and increasing automobile usage pose challenges for transit operation. The city of Boston now has two-thirds of the population it had in 1950, and many of its suburban communities require large minimum lot sizes for single family dwellings.

A transit system originally designed to move people efficiently into and around the fourteen communities of the urban core is now called on to supply multimodal travel options for residents of eastern and central Massachusetts. Transit service is a critical component of smart growth strategies aimed at forestalling sprawl and spurring revitalization of urban areas. Its efficient operations play a central role in regional efforts to maintain healthy air quality standards and to relieve highway traffic congestion, an increasing detriment to urban and suburban quality of life. Finally, decisions about where transit investments take place have socioeconomic impacts as well. All of these consequences speak to the need for coordinated and comprehensive planning.

To meet this array of challenges requires that the region address the MBTA's significant system capacity issues.

POPULATION GROWTH

The MBTA district is made up of 175 communities with a total population, according to the 2000 U.S. Census, of 4.7 million people. Almost three-quarters of all Massachusetts citizens reside within the MBTA service area. The district's communities include urban centers, mature suburbs, high-growth suburbs, and rural exurbs. Regional population grew at a moderate 6.07% rate during the 1990s.

Stability in the eastern Massachusetts population numbers, however, masks significant growth shifts within the region. High growth—exceeding 25%—took place along the Route 495 corridor in communities such as Franklin, Hopkinton, Mansfield, Southborough, Tyngsborough, Westborough, Groton, Westford, Norton, Lakeville, and Medway. Land availability and housing at costs more affordable than those found in the inner suburbs drove high growth in these once rural towns.

Meanwhile, many mature suburbs closer to Boston experienced low growth or, in the case of communities such as Arlington, Belmont, Dedham, Burlington, Medford, Melrose, and Watertown, actually lost population during the 1990s. Aging populations, declining household size, diminished supply of available land for development, and escalating home prices contributed to the lack of population growth in these communities.

MBTA commuter parking—Needham Junction Station

In 1950, more than 800,000 people lived in the City of Boston, or nearly one in every four residents of the present MBTA district. Over succeeding decades, with suburbanization aided by development of the interstate highway system, Boston experienced a population decline to 563,000 residents by 1980. Jobs and people migrated to the suburbs. Since 1980, the population has stabilized, for reasons including new immigrant growth and urban core revitalization. The city experienced population growth exceeding 2% in both the 1980s and 1990s, a turnaround from the average 11% population loss that took place in each of the three preceding decades.

By 2000, Boston's population accounted for about one in eight residents of the 175-community total.

ECONOMIC GROWTH

The Boston region is one of the most economically vibrant areas in the country. While the population increased by about 10% from 1970 to 2000, the number of jobs in the region increased over the same period by 44%. In the last decade, the 175 communities within the MBTA district reported robust job growth of 12.6%.

Economic growth and change is most pronounced in the Route 495 belt, where the job base expanded at rates more than three times the region's average. In the high-growth communities of Franklin and Westford, employment more than doubled between 1990 and 2000.

Within the 14 inner core communities of the MBTA district, the employment base increased by 8% during the 1990s, from 831,481 jobs in 1990 to 898,060 in 2000. The 64 inner ring suburban communities experienced 10.5% job growth. The 97 outer ring communities had 20% job growth in that same decade and by 2000 could claim total employment almost equal to that of the inner core communities (1990 employment—723,559; 2000 employment—864,680).

Together, these demographic changes have impacted commuting trends within eastern Massachusetts and have strained the overall transportation system.

COMMUTING PATTERNS

Highway Congestion

Traffic congestion on most of the major highways in the region has increased significantly during the past twenty-five years. Highway capacity is generally considered to be 2,000 vehicles per lane per hour, with congestion occurring when volumes exceed 1,750 vehicles per lane per hour. Because traffic is never distributed uniformly over 24 hours, practical daily capacity is defined as 20,000 vehicles per lane. In 1977, the only Greater Boston highways with daily volumes in excess of practical capacity were the Southeast Expressway, the Central Artery, and I-93 south between Route 24 and I-95. By 1997, other highways with daily traffic exceeding capacity included most of Route 128 from Canton on the south to Danvers on the north, most of I-93 within the state, Route 3 North from Route 128 almost to the New Hampshire border, Route 3 South from Braintree to Hanover, Route 1 North from Revere to Route 128, Route 2 from Concord to Route 128, the Massachusetts Turnpike from Natick to Newton Corner, and Route 24 from Stoughton to I-93. Several other major highways that had daily volumes well below capacity in 1977 were rapidly approaching capacity by 1997. These included I-95 South from Route 128 to the state line, Route 3 South from Hanover to Plymouth, Route 24 from Stoughton to West Bridgewater, the Massachusetts Turnpike from Newton Corner to Boston and from Framingham to Natick, and I-495 from Haverhill to Milford.

MBTA bus–Park Street Station

Highways that are classified as over capacity on a daily basis are free-flowing during some hours. Conversely, highways that carry traffic at lower than daily capacity levels can be congested at some times of day. In 1997, the most severely congested highway in the region was the Central Artery, segments of which showed congestion for over six hours in the morning and over eight hours in the afternoon and evening.

The corridors served by most of the radial highways that are close to or over practical capacity are also served by MBTA commuter rail or rapid transit lines. As discussed below, these parallel transit lines have either excess capacity or the potential to provide improved frequency. Transit alternatives in the circumferential highway corridors (principally Routes 128 and I-495) present greater challenges. Without exclusive lanes, transit vehicles using these highways would be subject to the same delays as other traffic. Converting existing lanes to transit lanes would increase congestion in the other lanes, and in any case it would be impossible to offer bus routes suitable for the travel needs of the majority of auto users. The cost of adding new exclusive transit lanes would be prohibitive. Parallel rail lines exist only in a few scattered locations in these corridors.

Capacity Issues on the Transit System

Vehicles

Rapid Transit

At present, passenger crowding on MBTA rapid transit vehicles occurs mostly during spans of one hour or less within A.M. and P.M. peak commuting times. Under MBTA service standards, the maximum load per vehicle during peak hours should not exceed a specified percentage of the seating capacity. This per-

centage varies among services depending on vehicle configuration. Demand is not uniformly distributed over the course of any hour, so it is possible for individual trips to be overcrowded even if the average hourly load is within the standard. It should also be noted that these crowding standards assume substantial numbers of standees, so many customers may perceive crowding with lighter loads.

Rapid transit station entry and exit counts conducted in 1997 contained sufficient information for calculations of ridership volumes on each line segment for each train on a typical weekday. The crowding conditions by line stated below are those that would have occurred if all scheduled peak-period trips were operated, and if each passenger took the first train departing the boarding point after the passenger arrived on the platform. In reality, some passengers would have waited for a less crowded train even if the load on the first one was within the service standard.

It is important for trains to run at or close to their scheduled intervals on all lines in order to prevent crowding from being more severe than indicated by the figures below. For example, the peak-period scheduled headway on the Blue Line is 3.5 minutes. If several successive trips normally have peak loads slightly over half the maximum standard when operating on schedule, a delay in service that creates a gap of 7.0 minutes will result in a load above the maximum standard on the next train. After that, one or more trains may follow at intervals of less than 3.5 minutes, and carry unusually low loads.

The peak load points referred to below are the segments where the 1997 count results indicated that passenger loads were highest on all or most trains during the time periods under discussion. In many cases, loads on other nearby segments were only slightly lower.

In 1997 the Blue Line had the highest incidence of overcrowding among the rapid transit lines. (This was a result of the lower capacities of Blue Line trains, as the other lines carried higher total volumes.) During the busiest 45 minutes in the A.M. peak, with service running on schedule, 60% of trains had more riders than the maximum standard at the peak load point between Maverick and Aquarium stations. Ridership was more dispersed in the P.M. peak, but 30% of trains in the busiest 45 minutes were overcrowded at the peak point. Plans are underway to increase the length of Blue Line trains from four to six cars. This would eliminate overcrowding with present train frequency even with a substantial ridership increase.

Red Line–Savin Hill Station

On the Orange Line's north-of-downtown section, maximum A.M. peak loads in 1997 occurred on southbound trains between North Station and Haymarket. During the busiest 45 minutes, 30% of these trains were overcrowded when service ran on schedule. In the P.M. peak, 10% of northbound trains in the busiest 45 minutes were overcrowded at the peak point. All trains on the south-of-downtown section of the Orange Line had loads within the crowding standard. Orange Line trains are already at the practical limit of six cars, so increased capacity would require shorter headways.

On the south-of-downtown section of the Red Line, maximum A.M. peak loads in 1997 occurred on northbound trains between

Broadway and South Station. Among trains originating on the Braintree Branch, 27% had peak loads close to but not above the crowding standard during the busiest hour if service ran on schedule. No trains originating at Ashmont exceeds the crowding standard. In the busiest 45 minutes in the P.M. peak, 20% of southbound Braintree trains were close to or over the crowding standard at the peak load point, but no Ashmont trains were. On the north-of-Boston section of the Red Line no trains exceeded the crowding standard during either the A.M. or P.M. peak. Red Line trains are already at the practical limit of six cars, so increased capacity would require shorter headways.

In the Green Line Central Subway, the maximum load point during A.M. peak hours in 1997 was entering Copley Station inbound. During the busiest 45 minutes, 25% of B Line trains, 38% of C Line trains, and 40% of D line trains had loads above the crowding standard there when all scheduled trips were run. No E Line trains were overcrowded. During P.M. peak hours the maximum load point was between Arlington and Copley stations. During the busiest 45 minutes, 10% to 25% of the trains on the B,C, and D lines had peak loads above the crowding standard but no E Line trains did. When these counts were conducted, all peak-period trips were run with two-car trains. Three-car trains are now run on some D Line trips when equipment is available.

Commuter rail–Stoughton Station

Bus/Trackless Trolley

MBTA bus routes in the urban core are subject to crowded conditions, especially in the peak periods and during school commute times. High-frequency bus routes with numerous crowded trips include: Route 15 Kane Square–Ruggles; Route 23, Ashmont–Ruggles; Route 28, Mattapan– Ruggles; Route 32, Wolcott Square–Forest Hills; Route 39, Forest Hills–Back Bay Station; Route 77, Arlington Heights–Harvard; and Route 111, Woodlawn (Chelsea)–Haymarket.

Standard-size urban transit buses have total seating capacity in the 39- to 43-passenger range, and are designed to accommodate 15–20 standing passengers. Crowding on peak trips can result in excessive standees or passengers unable to board a vehicle which is at maximum capacity. Improving frequencies in high-demand periods or using larger, articulated (two- section) buses would provide more capacity.

Buses on routes operating in heavy traffic conditions can be vulnerable to delays. These delays can result in long gaps in service and, especially if the route has a high frequency, bus bunching. Improving bus communication systems and installing signal priority equipment for buses could result in improved schedule adherence and reliability, and less crowding resulting from unscheduled gaps in service.

Commuter Rail

Capacities of MBTA commuter rail trains vary according to the number of cars and the mix of car types in the train. Until recently, service standards called for peak loads no greater than the number of seats. Peak-load-point counts conducted in 2000 found that no North Side trains had more riders than seats, but some passengers stood though they did not have to. On the South Side system, only the Fairmount and Needham Lines had no trains with more riders than seats in either

peak period. The Framingham and Franklin Lines each had at least one train with more riders than seats in the A.M. peak but none in the P.M. peak. The Attleboro/Stoughton, Middleborough/ Lakeville, and Plymouth/ Kingston Lines all had at least one train in each peak with a maximum load above seating capacity.

The capacity of MBTA commuter rail and rapid transit lines is limited not only by the capacity of the trains themselves, but also by the capacities of the modes used to access the trains. For commuter rail lines especially, adequate parking capacity is essential to diverting trips from private autos.

Facilities

Capacity issues at MBTA facilities must be addressed to meet future ridership demand before the Authority can play a more significant role in the region's mobility challenges. Forecasts estimate that overall MBTA ridership will grow by 32% between now and 2025. MBTA commuter rail ridership is predicted to rise by 45% during the same time period. These numbers, when combined with the crowding problems described above, suggest that capacity problems will be significant in the commuter rail system. Commuter rail system capacity is also limited by the throughput capacities of the downtown Boston terminal stations, as discussed below. They limit the times at which additional trips could be run on existing routes or on new extensions.

South Station is the Boston terminal for all MBTA South Side commuter rail lines and for Amtrak Northeast Corridor, Inland Route, and Chicago intercity service. North Station is the Boston terminal for all MBTA North Side commuter rail lines and for Amtrak Downeaster service from Maine. Both terminals currently have many fewer tracks than they originally did. South Station now has 13 tracks and North Station has 10. At times during peak commuting hours all tracks at South Station are occupied. North Station reaches 80% of capacity during the P.M. peak period. The problems associated with limited track space are compounded by the substantial expansion of commuter rail service over the last twenty years. Available time slots for tracks do not necessarily coincide with times at which demand for added service is greatest.

Expansion of South Station would involve reacquiring the sites of former tracks and platforms on the east side that are currently occupied by the U.S. Postal Service's General Mail Facility (formerly called the South Postal Annex). Increasing track capacity is necessary for any future expansion of South Side service. The MBTA also must site a new layover facility for commuter rail service on the South Side, since it will soon lose its existing storage location in Readville. Expansion of North Station would involve reacquiring the sites of former tracks and platforms on the west side that are currently occupied by a privately owned parking lot.

The capacity of the terminal stations also impacts the amount of yard capacity needed for midday or overnight storage of trains. When a platform must be vacated to make room for a subsequent train arrival, the departing equipment must either be used on an outbound revenue trip or sent to a yard in non-revenue service. Running either non-revenue trips or revenue trips at times when there is low demand increases daily operating costs. As in the case of the terminal stations, the capacity of rail yards in Boston has decreased significantly compared with historic peaks. Siting of new yards is difficult anywhere, but especially so near downtown Boston because of competition with other land uses. These issues must be taken into consideration in the operating plans for any expansion of commuter rail service.

The changing demographics of the region indicate the need for more transportation opportunities in eastern Massachusetts. The transporta-

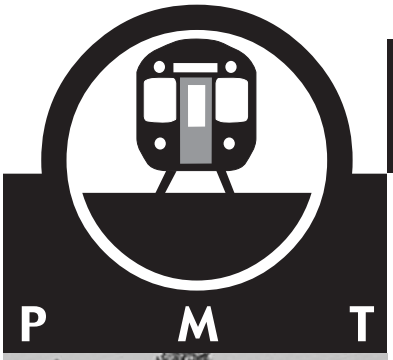
tion network currently faces significant capacity challenges. For the MBTA to play its role in providing greater mobility for residents, capacity-building projects must address the limitations of the existing transit system.

Projected Transit Projects from Regional Transportation Plan

As explained in Chapter 1, the PMT is closely linked to the Boston MPO's 2000–2025 Regional Transportation Plan (RTP), which is also a long-range planning document but is multimodal in nature. While transit improvements identified in future RTPs will be informed by this PMT, it is useful to note that the existing RTP already recommends some transit expansion projects for eventual implementation. Unlike the PMT, the RTP is constrained by assumed funding availability. The RTP allocates 70% of transit funds to infrastructure maintenance, accessibility improvements, and system enhancements. The remaining 30% is allocated to system expansion. The amount of money available for transit system expansion from the present through the year 2025 is assumed to be $2.36 billion from local sources and $875 million from federal funds, making a combined total of $3.23 billion.

With this assumed funding limit, only eleven transit expansion projects were included in the Regional Transportation Plan's list:

- Green Line restoration between Heath Street and Arborway
- 100 additional buses to improve service on existing routes
- Fairmount commuter rail line improvements
- Red Line–Blue Line connector
- Russia Wharf Ferry Terminal
- Silver Line Phase 3
- New Bedford/Fall River commuter rail extension
- Old Colony Greenbush Branch commuter rail extension
- Medford Hillside Green Line extension
- Urban Ring Phase 1
- Assembly Square Orange Line station



CHAPTER 4

Financing Strategies

The Program for Mass Transportation is financially unconstrained and encompasses various projects for which the sources of funding are as yet unidentified. Such sources are limited, however, due to the Commonwealth's legal commitments to the State Implementation Plan for the Clean Air Act and the Central Artery/Tunnel Project mitigation program. In an attempt to fund some of the unfunded projects, the Authority has entertained various innovative financing strategies to supplement more traditional funding sources.

TRADITIONAL FUNDING SOURCES

Operating

The recently enacted fiscal reform legislation substantially altered the Authority's funding environment. The new Enabling Act established dedicated sources of revenue and mandated that the Authority is to operate as an independent, financially self-sustaining public transportation agency. Previously, the Commonwealth had funded the MBTA in arrears. The Enabling Act and the new financing mechanism for the MBTA have been referred to as Forward Funding, to reflect the fact that the MBTA's costs will no longer be funded in arrears.

Commencing July 1, 2000, the Authority no longer received net-cost-of-service or debt assistance. Instead, under the Enabling Act, the Authority receives a dedicated revenue stream consisting of assessments paid by the 175 cities and towns in accordance with the Enabling Act and the greater of (1) the amount raised by a 1% statewide sales tax, which equals 20% of the existing statewide 5% sales tax, or (2) $645,000,000, in either case to be funded from existing sales tax receipts, subject to upward adjustment under certain circumstances set forth in the Enabling Act.

In addition to the dedicated revenues, the Authority's operations are funded by fare revenue and nonfare revenue, such as revenue from advertising, parking, concessions, and real estate sales, and interest income. The Authority has experienced a decline in both fare and

sales tax revenues. Growth in sales tax revenues is expected to remain flat in fiscal year 2003, with the MBTA receiving the guaranteed floor amount. Additionally, the floor amount will not increase in fiscal year 2004.

Capital

The MBTA's capital program is primarily funded by four major sources: revenue bonds, pay-as-you-go capital, federal grants, and project financing. Prior to Forward Funding, the MBTA's nonfederal portion of the capital program was funded by General Transportation System bonds issued by the MBTA and backed by the Commonwealth Guaranty. Under Forward Funding, it is primarily funded in the early years by revenue bonds secured by the dedicated revenues under two separate credits established under the Enabling Act: assessment bonds and sales tax bonds. The assessment bonds are secured by the assessments paid by the 175 cities and towns in the MBTA district and the sales tax bonds are secured by the sales tax revenues received by the Authority. The MBTA sales tax and assessment credits are further enhanced by a cross collateralization that exists for additional security.

The MBTA's goal is to preserve sufficient funding for the operating budget, and it cannot allow debt service expenses to increase in relation to operating expenses. Taking this into consideration, the MBTA will look to transition itself from heavy reliance on debt financing to greater use of pay-as-you-go financing of capital projects. The transition from debt financing to pay-as-you-go will take time and discipline, and it depends, to some extent, on factors beyond the MBTA's control, such as ridership, the growth in future sales tax collections, and cost containment.

Federal Funding

The MBTA receives funding from several different federal programs:

- Section 5307 Urbanized Formula Funds.
- Section 5309 Rail Modernization Formula Funds.
- Section 5309 Bus Discretionary Funds.
- Section 5309 ("New Starts") grants. The Federal Transit Administration's Section 5309 program is highly competitive nationwide and involves an application process in which the project must be justified based on forecasted impacts on mobility and the environment, operating efficiencies, cost-effectiveness, and land use. The application must also include a reasonable plan to finance the proposed project.
- Transportation Infrastructure Finance and Innovation Act (TIFIA): This act established a new federal credit program under which the U.S. Department of Transportation may provide federal credit assistance to major transportation investments of critical or national significance.

SOME NATIONAL EXAMPLES OF TIFIA PROJECTS

Project	Location
State Route 125 South	San Diego County, California
Washington Metropolitan Area Transit Authority Capital Improvement Program	District of Columbia, Maryland, Virginia
Miami Intermodal Center	Miami, Florida
Reno Transportation Rail Access Corridor	Reno, Nevada
Farley Penn Station	New York City, New York
Staten Island Ferries and Terminals	New York City, New York
Tren Urbano	San Juan, Puerto Rico
Cooper River Bridge	Charleston, South Carolina
Central Texas Turnpike	Austin–San Antonio Corridor, Texas
Tacoma Narrows Bridge	Tacoma, Washington

The TIFIA program is designed to fill market gaps and leverage substantial private co-investment by providing supplemental and subordinate capital and credit.

- Grant Anticipation Notes (GANs): GANs are short-term debt instruments that are secured by future federal grants, which will be received after the debt is issued. Financial institutions may buy anticipation notes on behalf of project sponsors in advance of receiving other financial assistance, to make possible a faster project start. This is an innovative financing tool that will allow the MBTA to leverage future federal funds.

  Example: The MBTA is currently using GAN financing to accelerate the procurement of 175 emission-control buses.

The combination of these funding sources supports the MBTA's current operating budget of $1.2 billion and capital budget of $2.6 billion for fiscal years 2003–07.

INNOVATIVE FUNDING

Innovative financing is a critical element of project implementation. This often determines the project's ability to receive the necessary funding and has an impact on the project moving forward within the region's planning process. As a project advances from the PMT into other elements of the planning process, financial constraints are increasingly introduced that force regional decisions on priorities. In the current fiscal climate, a project that is partially or fully funded by innovative financing sources is more likely to be implemented.

Innovative sources of funding can be found at all levels of government, as well as in the private sector.

Local Funding Options

- *Tax Increment Financing (TIF):* TIF is a mechanism that is applied differently in Massachusetts than in other parts of the country. In the Commonwealth, TIFs offer developers tax incentives for their projects. Across the United States, TIFs are used to capture growing tax revenues that accrue from the increased property values produced by a specific transit investment by utilizing a portion to finance the transit investment.

- *Payment in Lieu of Taxes (Pilot):* This concept attempts to capture some revenue from tax-exempt institutions that receive a benefit from a new project.

  Example: This program is currently used in the cities of Boston and Cambridge to generate revenue to support services provided to institutions that are exempt from property taxes.

- *Joint Development:* This option would involve a partnership between the MBTA and municipalities to improve an existing transit asset.

  Example: Tri-Met (Portland, Oreg.) Airport MAX Red Line Expansion is a $125 million, 5.5-mile rail extension to the Portland International Airport terminal. The project was funded through Passenger Facility Charges, Urban Renewal funds, and contributions from Tri-Met and the builder/private developer. The builder/private developer contributed 20% of the total project cost in return for an 85-year lease on a nearby 120-acre site. The developer is undertaking a mixed-use, transit-oriented development.

- *Betterment Assessment District:* This alternative involves the imposition of a fee to a property within a certain catchment area. This concept could be applied to communi-

ties in a transit corridor where investment will occur to help pay for the transit investment. Because a betterment assessment is not technically considered a tax, it could be applied to both tax-exempt and taxable properties.

- *Impact Fee:* Impact fees could be introduced on developments within a certain catchment area along a transit corridor. These fees could help to support the transit investment in that area.
- *Parking Surcharge:* This alternative is a surcharge on parking spaces within certain catchment areas. These surcharges could be used to finance transit investments.

State Funding Options

- *General Obligation Bonds:* General obligation bonds are currently the bonds most commonly used by the Commonwealth to finance major public infrastructure projects. The full faith and credit of the state is pledged for the payment of principal and interest when due.
- *Highway-Flexed Funding:* This option flexes federal highway dollars to implement transit projects.

  Example: In federal fiscal year 2003, the Massachusetts Highway Department flexed $1.3 million in Congestion Mitigation and Air Quality Improvement Program (CMAQ) funds to the MBTA for its low-sulfur-fuel program.

- *Outside Sections in the State Budget:*
  - The state Legislature can provide funding assistance for projects through an earmark in the state's budget.

  Example: In 2002, the Legislature provided the option for debt service funding to construct the Fall River/New Bedford project.

  - *MBTA Infrastructure Fund:* The state may provide funding for the MBTA's infrastructure program by transferring funds from the General Account.

    Example: Red Line Station modernization.

Private Funding Options

- *Property Transfer:* The MBTA could enhance a given investment's financing by avoiding certain land acquisition costs through the transfer of MBTA property to private landholders. This situation could occur where specific, privately held property is needed to implement a particular transit project, and the MBTA can transfer a parcel to the private landholder in that area.
- *Station Sponsorship:* The MBTA would generate revenues from the naming rights associated with selected MBTA stations and use these proceeds to support transit improvements.
- *Private Employers Currently Financing Transit:* Private employers who currently run their own services may wish to instead invest in new MBTA service.

  Example: The Urban Ring Major Investment Study suggested that the operators of the twelve private shuttles (including Medical Academic and Scientific Community Organization, Inc., and University of Massachusetts at Boston) in the Urban Ring corridor could make payments to the MBTA for Urban Ring service instead of operating their own services.

- *MBTA-Promoted Development:* This alternative involves the MBTA's leveraging of its property holdings to generate funding for project implementation. This option could include the disposition of air rights or the sale/lease of property. This funding

source could be an important component of any transit-oriented development initiative.

- *63-20 Corporation:* A 63-20 Corporation is a private Massachusetts nonprofit entity organized for the limited purpose of taking the actions necessary to provide financing for a capital investment. This corporation would be exempt from federal income tax under Section 501(c)(3) of the tax code.

  Example: The MBTA funded the construction of the Route 128 Station parking facility by forming a 63-20 Corporation.

- *Project Financing:* This option involves the generation of funds to finance an economically separable capital investment project. It can be arranged when a facility or a set of assets is capable of functioning profitably as an economically independent unit. The providers of the funds look primarily to the cash flow from the project as the source of funds to service their loans.

Multijurisdictional Funding

A number of projects within the PMT would require significant coordination between various jurisdictional entities. In particular, the North-South Rail Link and the commuter rail extensions into New Hampshire and Rhode Island would need agreements between state governments to secure adequate funding for these projects. Projects within the MBTA service area may also rely on multijurisdictional financing for implementation. A recent example of a successful state project is the recently completed Anderson Regional Transportation Center in Woburn, where the MBTA, Massachusetts Highway Department, and Massachusetts Port Authority collaborated to construct this facility.

* * *

These innovative funding alternatives are described to provide an overview of possible financing strategies for PMT projects. These concepts were generated from projects that are currently being funding in Massachusetts and across the country. The MBTA and the Commonwealth will consider using all of these funding strategies to implement a balanced set of preservation and expansion projects.

CHAPTER 5A

System Preservation

The MBTA is responsible for maintaining an extensive network of transit infrastructure and other capital assets. The assets include:

- 275 stations
- Approximately 8,600 bus stops
- 100 elevators and 132 escalators
- 31,400 surface parking spaces and 10,600 garage spaces
- 19 miles of tunnel
- 560 bridges
- 36 maintenance facilities
- Approximately 785 miles of track
- More than 2,000 vehicles

The Authority has inventoried nearly 2,500 capital assets and has established a computer database that includes information on each asset's useful service life, age, operational impact, replacement/rehabilitation cost, and affected ridership. The Systemwide Condition Assessment and Capital Investment Program Database and Forecasting Model is a capital planning tool designed to document system infrastructure needs and priorities.

Analysis using the database indicates that over the course of the next twenty years with unlimited budget authority, the MBTA would need to spend more than $12.5 billion in current dollars to bring the system into a state of ideal repair. Table 5A-1 breaks this down into the costs of the high-, medium-, and low-priority system-preservation tasks. Sustaining the system at its existing level of performance will require an estimated annual capital expenditure of $470 million dedicated to system preservation.

TABLE 5A–1
SYSTEM PRESERVATION COSTS OVER THE NEXT TWENTY YEARS: A SUMMARY

	High–Priority Costs	Medium–Priority Costs	Low–Priority Costs	Total 20–Year Costs
TOTAL	**$2,663,700,643**	**$6,827,394,254**	**$3,161,665,006**	**$12,652,759,903**

REVENUE VEHICLES

The revenue vehicle fleet is one of the most visible and important components of the MBTA service network. The MBTA's fleet of revenue vehicles is composed of:

- 408 heavy rail rapid transit vehicles serving the Red, Orange, and Blue Lines
- 180 light rail vehicles serving the Green Line and Mattapan High Speed Line
- 377 commuter rail passenger coaches
- 80 commuter rail locomotive units
- 957 diesel motor bus coaches
- 17 compressed-natural-gas buses for the Silver Line
- 2 hybrid buses
- 40 electric trackless trolleys
- 426 RIDE vehicles
- 2 passenger ferries

The MBTA adheres to a general standard life-cycle of 35 years for heavy rail and light rail vehicles, 25 years for commuter rail locomotives, 25 to 30 years for commuter rail coaches, and 15 years for buses. The condition of each vehicle fleet is generally dependent on age. Several of the older fleets are currently in need of major component replacements, overhauls, or, in some cases, replacement. Without scheduled overhauls and planned retirements, maintaining the existing MBTA revenue fleet in operation and maintaining service reliability would require unwarranted consumption of resources.

Red Line

Table 5A-2, at the end of this section, gives projected costs for the preservation and replacement of revenue vehicles during the next twenty years.

Heavy Rail/Light Rail

- There are 218 Red Line cars made up of three separate series of cars: 74 No. 1 cars (acquired in 1969), 58 No. 2 cars (1988), and 86 No. 3 cars (1994). Preventative maintenance inspections are mileage based and occur every 8,500 miles for the No. 1 and No. 2 cars and every 10,000 miles for the No. 3 cars.

  Procurement of a new fleet to replace the No. 1 cars is anticipated between 2010 and 2014.

- The Blue Line fleet is comprised of 70 No. 4 cars (1979). The development of specifications for a replacement fleet was initiated in fiscal year 1999. A contract for 94 new Blue Line vehicles was awarded to Siemens Transportation in 2001. Preventative maintenance inspections are done on each car approximately once a month.

- The Orange Line fleet consists of 120 No. 12 series cars (1981). Preventative maintenance inspections are time-based and occur on a 90-day interval. Procurement of a new Orange Line fleet is anticipated between 2010 and 2014.

- There are 180 light rail vehicles (LRVs) comprising three separate series of cars: 55 Boeing LRVs (1976-83), 115 Type 7 cars (1986-88, 1997), and 10 PCC cars (1945-46). The first two series are used on the Green Line and the third series is used on the Mattapan High Speed Line, which has the oldest set of vehicles on MBTA proper-

ty. A rehabilitation program for the Mattapan PCC fleet to further extend the service life by 10 years is presently underway. The procurement of 100 Type 8 vehicles is currently funded and underway and will enable the retirement of the 55-car Boeing fleet, thus increasing the Green Line fleet by 45 vehicles. These new vehicles will be put into service over the next 3 years. Procurement of PCC replacement vehicles for the High Speed Line is anticipated to take place between 2010 and 2014.

Heavy rail rapid transit rolling stock generally has a useful life of 35 years or more. However, due to the salt-air environment of the Blue Line, its cars are not scheduled to have a useful life of more than 27 years. The MBTA subscribes to a philosophy of ongoing preventative maintenance for light rail and heavy rail vehicles. This approach keeps the vehicles safe and reliable at a reasonable cost. The Authority includes in its preventative maintenance program major components such as floors, pantographs, couplers, and overhead blower motors.

Commuter Rail

The commuter rail fleet consists of passenger coaches and locomotive units.

Coaches

There are 377 coaches, comprising four series:

- 57 Pullman Standard coaches (procured in 1979); this fleet was overhauled in 1995–96.
- 67 MBB coaches (1987–88).
- 146 Bombardier coaches (1987, 1989–90).
- 107 bi-level Kawasaki coaches (1990–91, 1997, 2002).

The MBTA is in the process of acquiring 24–28 additional bi-level coaches to meet the requirements of the Greenbush Line.

Silver Line

Future procurements to replace single-level coaches built in 1979, 1987-88, and 1989–90 will be bi-level equipment.

Locomotives

The revenue locomotive fleet is comprised of 80 units:

- 18 model F40PH-2 locomotives (procured in 1978, 1980); this fleet was upgraded in 1989–90.
- 25 model F40PH-2C locomotives (1987–88); a midlife overhaul was completed in 2002.
- 12 model F40PH-2M locomotives (1991, 1993); a midlife overhaul process began in 2002 and is ongoing.
- 25 model GP40-MC locomotives (1997–98).

Locomotives and coaches are typically considered to have a useful life of 25 years. Generally top-deck overhauls are scheduled for locomotives on a 6- to 6.5-year schedule. Mid-life overhauls are usually conducted at 12.5 years; they are designed to enable a vehicle to reach its full service life in terms of power, performance and dependability. Locomotives and coaches are typically replaced after a vehicle has met its 25-year life expectancy. Procurement of new locomotives to replace those built in 1978–80 is anticipated by 2005.

Silver Line

The MBTA is still constructing the new Silver Line, a bus rapid transit (BRT) system with service on Washington Street and the South Boston Piers Transitway. The new Silver Line service will provide connections between residential neighborhoods and job centers in the Financial District, and between South Station and the South Boston Seaport District. The service will also be coordinated with Massport to provide service to Logan Airport. Vehicle procurements have been made for Silver Line service on Washington Street (2002) and the South Boston Piers Transitway (2003). The vehicles are anticipated to have a useful life of 12 to 15 years. The introduction of the new fleets will entail additional operating funds for service and maintenance.

Bus

This program includes vehicles to support the MBTA's bus, trackless trolley, and demand-responsive (RIDE) services. The MBTA's bus and trackless trolley system is comprised of approximately 170 routes. THE RIDE, a paratransit service for individuals with mental or physical disabilities, provides accessible service in 62 cities and towns.

CNG bus

Bus Fleet

The bus fleet consists of 957 active diesel buses (of six major classifications), 17 compressed-natural-gas (CNG) buses, 2 diesel-electric hybrid buses, and 40 trackless trolley vehicles. The 40-foot diesel and CNG coaches have a useful life of 15 years, and the trackless trolleys have a useful life of 20 years. Major procurement efforts over the next few years will transition these vehicles to lower-emissions technologies.

Presently on order are 44 60-foot CNG buses (to be partially allocated to the Silver Line), 299 40-foot CNG buses, 28 40-foot electric trackless trolleys, and 175 low-emissions vehicles. By 2005, all vehicles built prior to 1994 will have been replaced. All of the new vehicles will feature easier-to-access low-floor designs, easier-to-read destination signs, and automatic stop-announcement equipment.

In addition, 426 RIDE vehicles are maintained under the bus program.

Present Fleet

2001 CNG New Flyer

This series comprises 15 40-foot CNG-powered low-floor buses procured in 2001. This equipment is currently in service on the Silver Line on a temporary basis prior to the arrival of new articulated buses.

1999 Future Bus Prototype

To determine the most appropriate technology for future-bus purchases, the Authority has undertaken a future bus pilot program. In the summer of 1999, the MBTA accepted the delivery of 2 New Flyer CNG buses and 2 Orion diesel-electric hybrid buses. Both bus types are 40 feet in length. The prototype program enabled a decision to be made on which bus propulsion technology to advance.

1995 Nova RTS

The newest and most recent diesel bus acquisitions of the MBTA are 149 coaches equipped with wheelchair lifts and air conditioning.

1994 TMC RTS

This series is comprised of 247 diesel coaches equipped with wheelchair lifts and air conditioning.

1989 TMC RTS

This series is comprised of 195 diesel coaches. Within this series, 30 coaches are 35 feet long, the only non-40-foot-length buses in the fleet. The buses are equipped with wheelchair lifts and air conditioning. These vehicles were rebuilt in 1996.

1985–87 GMC RTS

This fleet is made up of 366 diesel coaches. These buses were delivered in three distinct phases: 189 in 1985, 89 in 1986, and 88 in 1987. These 40-foot coaches had full midlife rebuilds in either 1994 or 1996.

Trackless Trolleys

The trackless trolley fleet includes 40 electric trolley buses (1976). The trackless trolleys have attained their service life expectancy and are in the process of being replaced. Service life for the new trackless trolleys remains to be confirmed; however, it is expected to be approximately 20 years.

THE RIDE

THE RIDE's fleet consists of 426 cars and vans that have a normal life span of 5 years. The MBTA owns 265 sedans and vans, and the remaining 161 vehicles are supplied by four different contractors. The Authority is moving toward a contracting program for all these vehicles. Those owned by the MBTA are not being replaced as they reach their service life expectancy.

Boat

The vessels owned by the MBTA are 2 82-foot high-speed diesel catamarans. The MBTA purchased these pre-owned vessels in 2002 from Water Transportation Alternatives, Inc.

NON–REVENUE EQUIPMENT

Non-revenue equipment includes both non-revenue vehicles and work equipment. Systemwide, non-revenue vehicles support the entire range of Authority operations. Included in this category are a wide array of rubber-tired vehicles that are used for maintenance, safety, field supervision, and revenue collection. The MBTA owns and maintains 858 non-revenue vehicles, including 479 vehicles to support

TABLE 5A–2
REVENUE VEHICLES
Preservation and Replacement Costs over the Next Twenty Years

	High–Priority Costs	Medium–Priority Costs	Low–Priority Costs	Total 20–Year Costs
Access (THE RIDE)	$3,866,561	$12,779,258	$6,389,629	$23,035,448
Bus	$341,980,697	$708,308,657	$169,276,761	$1,219,566,115
Silver Line (incl. South Boston)	$0	$70,520,560	$86,360,000	$156,880,560
Commuter Rail	$310,566,960	$1,428,601,680	$304,094,340	$2,043,262,980
Ferry	$158,400	$633,600	$3,294,720	$4,086,720
HR/LRV				
Blue Line	$288,320,560	$46,394,480	$0	$334,715,040
Green Line	$102,643,000	$34,353,000	$12,870,000	$149,866,000
Orange Line	$7,460,640	$534,900,960	$34,650,000	$577,011,600
Red Line	$10,791,000	$262,548,000	$234,927,000	$508,266,000
HR/LRV Total	$409,215,200	$878,196,440	$282,447,000	$1,569,858,640
TOTAL	$1,065,787,818	$3,099,040,195	$851,862,450	$5,016,690,463

heavy rail rapid transit/light rail and bus operations, 115 police vehicles, 219 vehicles to support commuter rail, and an additional 45 specialty vehicles such as fork trucks, sweepers, trailers, generators, and pumps. Non-revenue vehicles have a service life of approximately 10 years.

Non-revenue vehicles used to maintain commuter rail rights-of-way include rail-mounted or on-track machines such as track geometry cars, flat cars, cranes, tampers, ballast regulators, ballast cars, tie handlers, and brush cutters.

Categorized as "work equipment" are other brush cutters, as well as loaders, pumps, tractors, air compressors, and other equipment. Maintenance-of-way work equipment includes several types of trucks: crane, bucket, cable, platform, and snow-fighting. Rubber-tired construction work equipment includes front-end loaders, backhoes, and cranes. Work equipment has a service life of approximately 10 years.

Table 5A-3 gives projected costs for the preservation and replacement of non-revenue equipment during the next twenty years.

TRACK

Rapid Transit/Light Rail

The MBTA currently operates heavy rail rapid transit and light rail service over 185 miles of track. The commuter rail system is operated over 600 miles of track. On each rail line, replacement efforts are programmed for different segments based on geographical location or type of track construction.

The right-of-way generally consists of track, ballast, and concrete or timber ties. Track has a useful life of 25 years. Grade crossings have special maintenance and replacement needs, and are typically replaced as part of a stand-alone program.

- The Red Line (heavy rail) operates over 45 miles of revenue track. The types of track construction are timber tie, concrete dual block tie, direct fixation, and concrete floating slab. The entire line is powered by third rail.
- The Orange Line (heavy rail) operates over 22 miles of revenue track. The types of track construction are timber tie, direct fixation, and concrete floating slab. The entire line is powered by third rail.
- The Blue Line (heavy rail) operates over 12 miles of revenue track. Its primary track type is timber tie; however, sections of the track are monoblock concrete tie track. The line is powered by third rail and overhead catenary lines.
- The Green Line (light rail) has a total of 46 revenue track miles. Although the track type varies throughout the Green Line, the majority of the line is wood tie and ballast units; there is some monoblock concrete tie track as well. The running rail on the line consists of both "T" rail and girder guardrail. The entire line is powered by overhead catenary.

Heavy rail/light rail grade crossings have a useful life ranging from 12 to 15 years. There are 64 grade crossings along the Green Line and other crossings within MBTA yards. The heavy

TABLE 5A–3
NON–REVENUE EQUIPMENT
Preservation and Replacement Costs over the Next Twenty Years

	High–Priority Costs	Medium–Priority Costs	Low–Priority Costs	Total 20–Year Costs
TOTAL	**$39,817,699**	**$62,194,136**	**$44,027,475**	**$146,039,310**

rail/light rail fleets operate over 1 million feet of mainline-ballasted track and over 400,000 feet of yard-ballasted track. The MBTA has approximately 560 mainline turnouts (including equipment), which have useful lives ranging from 4 to 25 years. There are 675 total yard turnouts (including equipment) which have useful lives ranging from 8 to 25 years.

Commuter Rail

Commuter rail right-of-way consists of rail, wooden ties, railroad crossties, grade crossings, and fencing. The commuter rail system is divided into eleven major operating lines:

North Side—North Station Terminal

- The Fitchburg Line (90 miles of track)
- The Lowell Line (50 miles of track)
- The Haverhill Line (55 miles of track)
- The Newburyport/Rockport Line (92 miles of track)

South Side—South Station Terminal

- The Worcester Line (89 miles of track)
- The Needham Line (13 miles of track)
- The Franklin Line (34 miles of track)
- The Attleboro/Stoughton Line (116 miles of track)
- The Fairmount Line (19 miles of track)
- The Middleborough/Lakeville Line (approximately 47 miles of track).
- The Plymouth/Kingston Line (32 miles of track)

Rail in the commuter rail system can be expected to last approximately 40 years, although curve rail has a shorter life span. The system contains over 1,300 miles of rail. There are approximately 1.5 million timber crossties and switch timbers supporting the commuter rail system. Railroad crossties are renewed on a cyclical schedule that ensures that failed ties do not impose speed restrictions that result in train delays. Railroad crossties usually have a life span of 25 to 30 years, depending on a variety of mechanical and environmental factors. They also require a renewal of approximately 48,000 crossties and 5,000 switch timbers annually.

Track and signal

Grade crossings are the most prominent fixtures of the commuter rail system. The Authority has 257 grade crossings on the commuter rail system, requiring a replacement program averaging 21 crossings per year. They provide comfort and safety for both commuter rail passengers and highway motorists. Grade crossings have a life expectancy of 12 years. The automatic protection equipment is maintained under the signal program.

The majority of rail in the commuter rail network is welded rail. There are still sections of older, bolted rail on the Haverhill, Lowell, and Fitchburg Lines. The PMT process has identified replacement of older rail along the Fitchburg Line as a high priority.

As part of the PMT process, concerns were raised about track flooding issues at Natick Station and near the Boston Engine Terminal on the Fitchburg Line. Modifications to track and drainage structures in the area would be budgeted within the commuter rail track maintenance resource allocation.

TABLE 5A–4
TRACK
Preservation and Replacement Costs over the Next Twenty Years

	High–Priority Costs	Medium–Priority Costs	Low–Priority Costs	Total 20–Year Costs
Commuter Rail	$88,409,465	$1,018,975,938	$466,420,515	$1,573,805,918
HR/Light Rail	$68,475,514	$273,908,154	$136,954,077	$479,337,745
TOTAL	$156,884,979	$1,292,884,092	$603,374,592	$2,053,143,663

SIGNALS

Train control is an integral part of operating a transit system. The signal system's primary goal is maintaining train separation while attempting to minimize headways and run times. In order to maintain proper train separation principles for route integrity, speed control and broken rail protection are employed in the design. These signal system aspects are thoroughly tested as part of the installation process and require ongoing maintenance. The MBTA utilizes two basic types of signals: absolute block signaling (ABS) and automatic train control (ATC). The ABS system uses AC circuits and is applied on the Blue Line where train separation is maintained by the use of trip stops. On the Green Line, ABS is also used, but the operator has the sole responsibility for adhering to signal aspects. The ATC system uses audio frequency track circuits. This allows transmission of the maximum allowed speed to an intelligent carborne subsystem. Maximum allowed speed is determined by civil restrictions as well as track conditions and is enforced by the wayside signal system in conjunction with the carborne subsystem. The baseline for signal systems is the use of vital relays that operate in a "fail-safe" mode. This equipment is housed in central instrument rooms/houses and in wayside cases or bungalows. Signal control systems rely on relays, fuses, transformers, rectifiers, and resistors, as well as switches, signals, track circuits, heaters, train stops, and train approach lights.

Signal System Components (Shared by Commuter Rail and Heavy Rail/Light Rail)

Switches, Crossovers, and Switch Heaters

Switches and crossovers are incorporated into the track system to reroute trains. Both electric and hand-throw switches are used. Switch heaters are used to keep switches functioning during the winter months. Switches, crossovers, and switch heaters typically have a 5-year useful life.

Signals/Wayside Lights

Wayside lights display a combination of signal aspects to communicate the status of the next track segment to the train operator. They typically have a useful life of 2 years.

Track Circuits

The track circuit is the most vital part of the signal system and consists of a power source, a transformer or transmitter circuit, and a receiver or relay end. AC track circuits are used on the Blue and Green Lines as well as on all interlocking areas. Audio frequency track circuits, made up of a transmitter and receiver end, are used on the Red and Orange Lines. They have a 20-year useful life.

Grade Crossing Signals

Grade crossing signals are used on the commuter rail network to warn automobile drivers and pedestrians of oncoming trains. They have a useful life of 20 years.

Heavy Rail/Light Rail

The Authority's heavy rail/light rail signal program consists of the two control systems (ATC and ABS), varying by line. Each line consists of mainline and yard segments.

- The Red Line signal system consists of several yard and mainline segments. It is an ATC system, which means that it uses vehicle systems and wayside controls to regulate train movements. There are a total of 135 switches, 210 signals, 355 track circuits, 1,632 third-rail heaters, 68 switch heaters, 2 train stops, 2 train-stop heaters, 12 train-approach lights, and 16 instrument houses. Currently, the Authority is in the process of replacing generation-one track on the Red Line at Central Square, Downtown Crossing, JFK/UMass, Ashmont, and on the Braintree branch. The significant number of third-rail heaters is due to the large segment of the line that is above ground and exposed to the elements.
- The Orange Line utilizes a combination of ATC and wayside–block signal systems. It has a total of 107 switches, 199 signals, 245 track circuits, 457 third-rail heaters, 101 switch heaters, 34 train-stop heaters, 17 train stops, 48 train-approach lights, and 12 instrument houses. The signal system from Chinatown to Oak Grove is about 25 years old and is currently programmed for replacement.
- The Blue Line has a total of 86 switches, 154 signals, 181 track circuits, 12 third-rail heaters, 43 switch heaters, 145 trip stops (each with two heaters), 145 train stops, 74 train-approach lights, and 6 instrument houses. After completion of work on Airport and Aquarium Stations, there will be 2 additional instrument houses. The Blue Line is equipped with ABS (with train stops), and it does not utilize on-board subsystems for train movement.
- The Green Line signal system is the oldest in the United States, and the age of portions of it exceeds the industry standards for useful life. It is equipped with an ABS signal system, but without train stops. It has a total of 91 switches, 497 signals, 497 track circuits, and 40 switch heaters. Portions were upgraded following the flood of 1996, including the section from Brookline Village to Hynes Auditorium/ ICA. The Haymarket-to-North Station section is being upgraded as part of the North Station reconstruction.

The Operations Control Center (OCC) equipment, bungalows/central instrument locations, wayside systems, and yard systems are universal throughout the subway system. Each has a useful life of 25 years, with the exception of the OCC equipment. Its useful life is based on the availability of spare parts for computers, which have a life cycle of 5 years.

Blue Line

Commuter Rail

The Authority's commuter rail signal system consists of over 480 miles of signalized track, 190 miles of aerial pole line, 80 interlockings, 10 train-control machines, over 1,000 signal heads, 476 electric switches, and 200 grade crossings with automatic protection equipment. There are also 35 bungalows and 52 bungalow/ houses in the commuter rail signal system, and they all have a useful life of 25 years. The two

systemwide signal units are the wayside system and the OCC signal equipment. Both systems have a 25-year useful life.

Annual replacement of underground signal cable, aerial signal cable, electric switch machines, and electric grade crossing mechanisms is required to ensure the safety and reliability of the signal system within an effective life-cycle cost.

The MBTA has devoted $15.0 million towards commuter rail signals in the current Capital Investment Program, which is 8.1% of the total signal effort. Signal maintenance is performed under the commuter rail management contract and is funded primarily by the operating budget.

COMMUNICATIONS

Systemwide

The Communications Department is responsible for a variety of low-voltage systems at the MBTA. Its responsibilities include maintaining an extensive inventory of equipment and overseeing contract services for two-way radio systems, security systems, fire alarms, telephones, police/public call boxes, closed-circuit television, public address systems, light-emitting diode (LED) signs, and the Supervisory Control and Data Acquisition (SCADA) system. These systems have been developed over time and vary significantly in age and condition. The MBTA communications system also includes the OCC.

The Operations Control Center

The OCC is one of the most automated transit control centers in the world. It consists of proven, state-of-the-art, computer-based technology that permits real-time monitoring and supervisory control of the signal and communications systems for all four heavy rail/light rail lines. The Bus Radio System Network is also integrated into the OCC communications system. The OCC systems have a useful life of 25 years.

Telephone Equipment and Services

Telephone equipment has an average useful life of 4 years and includes:

- Electronic key and analog telephones
- ISDN equipment
- PENTA voice communications switches (controlling services for subway and bus dispatch)
- A wayside/emergency telephone network (pump rooms, emergency exits, vent shafts, bungalows, and rights-of-way)
- A voice-messaging system
- 650 public pay telephones
- A network of special services for communications applications
- A network of copper and fiber-optic cables

TABLE 5A–5
SIGNALS
Preservation and Replacement Costs over the Next Twenty Years

	High–Priority Costs	Medium–Priority Costs	Low–Priority Costs	Total 20–Year Costs
Commuter Rail	$209,579,040	$531,043,920	$201,920,400	$942,543,360
HR/Light Rail	$386,867,942	$475,786,008	$234,725,661	$1,097,379,611
TOTAL	$596,446,982	$1,006,829,928	$436,646,061	$2,039,922,971

Supervisory Control and Data Acquisition (SCADA) II

The SCADA II system monitors and controls equipment (fans, fire alarms, generators, pump rooms, etc.) at remote locations. The SCADA II system has a useful life of 20 years. It includes:

- A main and standby central processor
- Remote-control terminal cabinets

Systemwide Security

Systemwide security includes (useful life in parentheses):

- 28 closed-circuit television systems (5 years)
- Public address/signage systems (8 years)
- Security and alarm systems (20 years)
- Fire alarm systems (15 years)
- Police/public call boxes (10 years)

Systemwide Radios

The current radio system is an analog system and is programmed for replacement by a new digital system by the end of 2003. All systemwide radios have a useful life of 7 years, with the exception of base stations and support equipment, which last for 25 years. Current system components include:

- On-vehicle radios (bus, heavy rail and light rail)
- Non-revenue vehicle radios
- Police mobile radios
- Portable radios
- Base stations and support equipment
- Recorders

Commuter Rail Operations Control Center (CROCC)

The CROCC provides real-time monitoring and supervisory control of the signal and communications systems of the commuter rail network. The center features a Real-Time Active Train Summary display for lines controlled by the CROCC. There is a proposal to expand this system to provide data for lines controlled by Amtrak and Guilford.

POWER

For heavy rail, trackless trolley and light rail, the MBTA runs power, supplied by Dominion Power, through its own distribution equipment. The power system includes cables, substations, circuit breakers, switch boxes, switch heaters, manholes, ductiles (as well as storage facilities for cable and power equipment), switchboards, and circuit breakers. The power program also includes the catenary systems for the Green and Blue Lines, and overhead wire networks for the trackless trolley lines.

The commuter rail system's electrical network provides lighting and power for signal systems,

TABLE 5A–6
COMMUNICATIONS
Preservation and Replacement Costs over the Next Twenty Years

	High–Priority Costs	Medium–Priority Costs	Low–Priority Costs	Total 20–Year Costs
Commuter Rail	**$11,919,051**	**$31,497,499**	**$7,600,172**	**$51,016,722**
HR/Light Rail	**$2,324,100**	**$25,831,800**	**$1,874,520**	**$30,030,420**
Systemwide	**$27,218,640**	**$26,875,740**	**$3,429,000**	**$57,523,380**
TOTAL	**$41,461,791**	**$84,205,039**	**$12,903,692**	**$138,570,522**

communications systems, lift bridges, buildings, stations, parking lots, maintenance facilities, layover facilities, and grade crossings. The power program is also responsible for lighting at the following five ferry facilities: Lovejoy Wharf, Hingham Shipyard, World Trade Center, Long Wharf, and the Charlestown Navy Yard.

Heavy Rail/Light Rail

Power Substations

The MBTA maintains substation equipment to convert 13.8-kilovolt AC transmission–level power down to 600-volt DC distribution–level power to feed third-rail heavy rail loads and 480-volt AC distribution–level power for passenger stations, vent shafts, and signal bungalows. Substation equipment is expected to last 30 years. In addition, the Green Line has track switch equipment, which has a useful life of 15 years.

Unit Substations

Unit substation loads are various and include systems necessary for transportation, specifically the signal feeds, and other systems that protect both the customers and the system. There are 48 unit substations along the heavy rail/light rail system: 16 on the Red Line, 10 on the Green Line, 18 on the Orange Line, and 4 on the Blue Line. All substations are required to be in close proximity to the equipment they power. The useful life of a unit substation is 20 years.

Traction Power Substations

There are a total of 48 traction power substations in the heavy rail/light rail system: 25 on the Red Line, 7 on the Orange Line, 7 on the Blue Line, and 9 on the Green Line. Traction power stations have a useful life of 20 years.

Cable

The MBTA has over 3 million feet of AC cable distributed through the heavy rail/light rail system. It has a useful life of 40 years, except along the Green Line, where the useful life is 15 years. The Orange Line has over 600,000 feet of H-N negative cable, which has a useful life of 20 years. There are also 18 SWC MODs and cable on the Orange Line, and these cables have a useful life of 15 years. The Green Line has about 750,000 feet of DC feeder cable. The useful life of the DC cable is 30 years.

Overhead Contact Systems

Overhead contact systems (OCSs) are located along the Green and Blue Lines and on the Mattapan High Speed Line. These systems have a useful life of 20 years.

Passenger Station Low-Voltage Switchgears

There are 54 passenger station low-voltage switchgears in the heavy rail/light rail system. Low-voltage switchgears feed power to the signal system, pump rooms, car houses, escalators, elevators, and other various areas of the Authority's property where power is required. These systems provide protection for customers, Authority equipment, and the system overall. Along the Red and Orange Lines, these systems also feed fire alarm systems, the Amtrak signal system, ventilation equipment, and various other equipment. Passenger low-voltage switchgears have useful lives ranging from 20 to 30 years.

Commuter Rail

The commuter rail electrical system provides lighting and power for signal systems, communications systems, bridges, buildings, stations, parking lots, maintenance facilities, layover facilities (Bradford, Needham, and North Station), and grade crossings. It also provides redundant power at critical facilities and to cables to operate mechanical power on the Beverly Drawbridge.

Signal Systems

The commuter rail power programs are responsible for maintaining 366 switch heaters and 24 gas switch heaters. Both switch and gas switch heaters have 20-year useful lives.

Layover Facilities

Each layover facility's power control center has a 20-year useful life.

Systemwide

Systemwide power covers the main distribution system as well as the backup generators. This section also covers the catenary system for the trackless trolleys.

South Boston Power Complex Gas Turbines

The MBTA owns and maintains 2 emergency backup generators in South Boston. They exist primarily to provide power to the Authority's power grid if the BECo 115-kilovolt lines are lost. The jet turbine units and switch stations were built in the 1980s and provide backup power to 80% of the system. Each unit has a useful life of 25 years.

Supervisory Systems

There are two supervisory control systems that allow for continuous remote monitoring and control of all power facilities. The primary system, called Supervisory Control and Data Acquisition, employs two VAX computers that constantly poll all traction substations and present the received data on 4 workstation consoles located at Power Control. The backup system, called "One on One," employs a simplified system of point-to-point communication between microprocessors located at the CROCC and at the field sites. The received data are mapped onto an array of LEC lamps, which are read by dispatch personnel. The system has a useful life of 25 years.

Substation Equipment

Traction power substation equipment is used to convert 13.8-kilovolt AC transmission–level power to 600-volt DC distribution–level power (which feeds third-rail heavy rail loads) and to 480-volt AC distribution–level power (for passenger stations, vent shafts, and signal bungalows). The equipment used in the process consists of 15-kilovolt rated AC switchgear, rectifier transformers, DC rectifiers, 600-volt-rated DC switchgear, unit power transformers, station batteries, and supervisory control units. Substation equipment has a useful life of 25 to 30 years.

Unit Substations

There are 65 unit substations (USS) throughout the Authority. Unit substations provide power to lights, vents, and fans. The USS loads are various and include systems necessary for transportation, specifically the signal feeds, and other systems that protect both the customers and the system. Substations are required to be in close proximity to the equipment they power. The useful life of a unit substation is 20 years.

Substations

There are 10 substations: 7 located at Charlestown, 2 located at Everett Shops, and 1 heavy rail/light rail central control at 45 High Street. These substations were built in the 1970s. The useful life of a substation is 25 years.

YARD AND SHOP

Maintenance facilities, or yards and shops, are where the MBTA conducts regularly scheduled maintenance and emergency repairs on its vehicle fleets. The Authority maintains 4 heavy rail, 4 light rail, 3 commuter rail, and 9 bus yards and shops, including 1 bus repair shop. There are also 17 smaller general maintenance facilities throughout the system. A new

TABLE 5A–7
POWER
Preservation and Replacement Costs over the Next Twenty Years

	High–Priority Costs	Medium–Priority Costs	Low–Priority Costs	Total 20–Year Costs
Commuter Rail	$79,672,483	$72,492,477	$27,798,716	$179,963,676
HR/Light Rail and Trackless Trolley	$57,269,634	$180,261,310	$276,241,612	$513,772,556
Systemwide	$0	$2,560,320	$9,732,264	$12,292,584
TOTAL	$136,942,117	$255,314,107	$313,772,592	$706,028,816

facility is being constructed to maintain Silver Line vehicles. Each facility generally includes a basic building structure with a mechanical plant and shop equipment. The expected life cycle of each of these facilities is 50 years.

Heavy Rail/Light Rail

Maintenance facilities for heavy rail and light rail fleets include:

- A Red Line facility at Cabot
- An Orange Line facility at Wellington
- A Blue Line facility at Orient Heights
- Green Line facilities at Boston College, Riverside, Reservoir, and Mattapan Yard
- A main subway repair facility in Everett

All maintenance facilities have useful lives of 50 years. Included in this program are the basic structure of each facility and its critical maintenance equipment (lifts, hoists, etc.).

Commuter Rail

The commuter rail maintenance facilities are as follows.

- The Boston Engine Terminal (BET) is a new, state-of-the-art facility constructed in Somerville in 1997 consisting of over eight acres under one roof. The building consists of areas for service and inspection, periodic maintenance, wheel truing, coach repair, and locomotive repair, along with allied shops.
- The South Side Service and Inspection Facility is a two-track structure located at Wydett Circle in South Boston. This facility can accommodate two nine-car trains and has fueling and sanding capabilities as well as the ability to perform running repairs.
- The Readville Light Inspection facility was constructed at the same time as the BET. It is a Butler-type building with three tracks and capable of holding six coaches. It is dedicated to special projects such as retrofits, wheel truing and ACSES installation.

Commuter rail maintenance facilities, including their basic structure and critical maintenance equipment, have useful lives of 50 years.

Layover Facilities

The Authority has layover facilities at the following locations:

- Rockport
- Franklin
- Newburyport
- East Junction (Attleboro)
- Bradford
- Kingston
- Lowell

- Middleborough
- Fitchburg
- Worcester
- Needham
- Readville (midday storage)

Layover facilities are located at or near the end of commuter lines and are used as nighttime storage locations for train sets as well as points for fueling and performing minor repairs to rolling stock equipment. The construction of a new layover facility in Pawtucket, R.I., is anticipated to begin this year. Expansion of layover facilities in Worcester would be required to support expanded service. Relocation of midday layover facilities at Readville is a critical support element for the commuter rail network.

All layover facilities have a useful life of 50 years.

Commuter Rail Maintenance Storage Facilities

All commuter rail maintenance storage facilities have useful lives of 50 years. These facilities are:

- Readville Mechanical, Readville MOW, Abington MOW, Wilmington MOW, and Roland Street MOW

The following are the commuter rail equipment storage facilities:

- Lowell, Attleboro, Franklin, Rockport, and Wilmington

Bus

The Authority maintains seven bus garages and one central bus repair shop.

- Albany Street (built in 1941)
- Bartlett (1931)
- Cabot (1975)
- Charlestown (1979)
- Fellsway (1925)
- Lynn (1936)
- Quincy (1930)
- Everett Central repair shop

New facilities for maintaining CNG equipment are planned at Arborway and Southampton Street The Southampton Street facility will also house dual-mode equipment. The Arborway facility will replace the present Bartlett facility.

Bus maintenance facilities have a useful life of 50 years. Included in this program are the basic structure of each facility and its critical maintenance equipment (lifts, hoists, etc.).

A bus facility needs-assessment study is presently underway. This project is a master planning study of the bus maintenance facility needs for the MBTA that attempts to locate sites for such facilities. Currently, two are being built (Arborway and Southampton), one is scheduled for closure (Bartlett), and two will be retrofitted (Cabot and Everett) for maintenance of CNG vehicles. In addition, four other facilities—Albany, Lynn, Fellsway, and Quincy—may need to be either rebuilt or replaced.

Systemwide

Systemwide maintenance facilities include structures and buildings that the Authority uses for various tasks and purposes. There are 16 systemwide maintenance facilities:

- Cabot Heating Plant
- Auto Repair Facility
- Signal Repair Facility
- MOW Training and Backup CC
- Testing Lab
- Arborway Yard
- Oak Square Emergency Garage
- Campbell's Gate MOW
- Truck Storage and Repair
- Rail Bending Shop

- Light Maintenance Shop
- Heavy Maintenance Shop
- Pipefitter's Building
- Materials Storehouse
- Salt Sheds
- Rice Buildings

All systemwide maintenance facilities have a useful life of 50 years.

STATIONS

Heavy Rail/Light Rail

The MBTA has a total of 131 heavy rail and light rail stations, which includes 6 shared stations (North Station, Haymarket, State Street, Government Center, Park Street, and Downtown Crossing).

- The Red Line has a total of 22 stations
- The Orange Line has a total of 19 stations
- The Blue Line has a total of 12 stations
- The Green Line has a total of 71 stations on 4 routes:

  Boston College/B Line (23 stations), Cleveland Circle/C Line (13 stations), Riverside/D Line (13 stations), and Arborway/E Line (11 stations). The remaining 11 stations are on the Central Subway serving more than one branch.
- The Mattapan High speed line has 7 surface stations

Subway stations typically have a useful life of 50 years.

The MBTA is in the design process to modernize the Red Line stations in Dorchester (Ashmont, Shawmut, Fields Corner, and Savin Hill). As part of the effort to complete the ADA Key Station plan, other stations will be upgraded to meet accessibility requirements. Total costs of $131 million are anticipated.

Commuter Rail

There are four main commuter rail lines on the North Side of the system, which terminate at North Station. The South Side system has seven lines terminating at South Station. Four of the South Side lines also provide service to Back Bay Station. The MBTA currently has 129 commuter rail stations on these eleven commuter rail lines:

North Side

- North Station terminal
- 18 stations on the Newburyport/Rockport Line
- 13 stations on the Haverhill/Reading Line
- 8 stations on the Lowell Line
- 17 stations on the Fitchburg/South Acton Line

TABLE 5A–8
YARD AND SHOP
Preservation and Replacement Costs over the Next Twenty Years

	High–Priority Costs	Medium–Priority Costs	Low–Priority Costs	Total 20–Year Costs
Bus	**$45,031,989**	**$117,916,108**	**$85,045,749**	**$247,993,846**
Commuter Rail	**$1,383,069**	**$9,379,157**	**$13,388,396**	**$24,150,622**
HR/Light Rail	**$21,760,426**	**$29,436,039**	**$96,809,558**	**$148,006,023**
Systemwide	**$52,901,531**	**$39,428,667**	**$176,524,841**	**$268,855,039**
TOTAL	**$121,077,015**	**$196,159,971**	**$371,768,544**	**$689,005,530**

South Side

- South Station terminal
- Back Bay Station
- 18 stations on the Framingham/Worcester Line
- 3 stations on the Fairmount Line
- 12 stations on the Franklin Line
- 12 stations on the Attleboro/Stoughton Line
- 9 stations on the Middleborough/Lakeville Line
- 9 stations on the Needham Line
- 7 stations on the Plymouth/Kingston Line

Commuter rail stations have useful lives ranging from 35 to 70 years, depending upon structure type. Commuter rail stations generally consist of a low-level platform with lights, shelters, and other components. Mini-high platforms are provided at most stations and full high-level platforms are found along the Old Colony lines, at the downtown terminals, and at Worcester Station. System expansion brought 4 new commuter rail stations online in 2001 and 2002, including Southborough, Westborough, and Ashland on the Worcester Branch; and JFK/UMass on the Old Colony Branch. A new station at the Anderson Regional Transportation Center in Woburn opened in 2001. Minor commuter rail station improvements are also made as part of parking improvement and expansion projects. Currently, station improvements are programmed as part of parking projects at the Wilmington and Hamilton/ Wenham stations.

Silver Line

There are 13 new Silver Line stations in service between Downtown Crossing and Dudley as of 2002, including the pre-existing Dudley Station. Three additional Silver Line stations along the South Boston Piers Transitway will open in 2003. Silver Line stations are expected to have a useful life of 50 years.

Bus

The MBTA operates approximately 170 bus and trolley routes, which serve about 9,000 bus stops. In general, capital components found at bus stops include only bus stop signage. Some also have benches and 303 include shelters. There are several major bus terminals (e.g., Harvard Square, Ruggles, Ashmont, and Forest Hills), but with the exception of the South Station Transportation Center and Dudley Station, these structures are considered part of intermodal subway stations. All bus stations have useful lives of 50 years.

Boat

Docking facilities for commuter boat service are owned, leased, or utilized in Hingham, Hull, Quincy, and Charlestown, and at Lovejoy Wharf, Rowes Wharf, and Long Wharf.

TABLE 5A–9
STATIONS
Preservation and Replacement Costs over the Next Twenty Years

	High–Priority Costs	Medium–Priority Costs	Low–Priority Costs	Total 20–Year Costs
Commuter Rail	$56,422,004	$18,503,968	$43,372,561	$118,298,533
Boats	$0	$694,944	$1,085,088	$1,780,032
HR/Light Rail	$77,655,633	$183,418,699	$151,644,543	$412,718,875
TOTAL	$134,077,637	$202,617,611	$196,102,192	$532,797,440

FACILITIES

Heavy Rail/Light Rail

Heavy rail/light rail facilities include administrative buildings and operators' lobbies on each of the lines, ventilation structures, and other miscellaneous structures.

Commuter Rail

Commuter rail facilities include any structures or facilities at the eleven outlying layover points, five maintenance buildings and five storage buildings throughout the system. It also includes the administrative facility operation center at Cobble Hill.

Fencing along the commuter rail system is used to prevent trespassing, and to protect pedestrians and MBTA property. It is necessary to keep trespassers from interfering with fast moving trains, and also to prevent illegal dumping of trash and contaminated materials.

Boat

As noted in the previous section, docking facilities are owned or leased in Quincy, Hingham, Hull, and Boston to support the commuter boat operation.

Systemwide

Systemwide facilities include administrative buildings and other miscellaneous structures owned by the MBTA. These include inactive structures, noise walls, office buildings, and systemwide support facilities. MBTA-owned administrative buildings include 45 High Street, 500 The Arborway, Arlington Avenue (Charlestown), the commuter rail operations facility at Cobble Hill, the Quality Control Facility on Freeport Street, and the police station on Southampton Street. The MBTA facility program also includes the ferry pier at Hingham. Other ferry facilities are leased.

ELEVATORS AND ESCALATORS

Systemwide

The Authority has 100 elevators and 132 escalators located throughout the system. All elevators and escalators have 20-year useful lives.

PARKING

Systemwide

Parking lots and garages are also included here. The MBTA owns approximately 31,400 surface parking spaces and 10,600 garage spaces with useful lives of 50 years.

TUNNELS, WALLS,AND CULVERTS

Systemwide

Tunnels, walls, and culverts are located throughout the system. Tunnels are mainly on the core subway system and in several locations in the commuter rail network. The heavy rail

TABLE 5A–10
FACILITIES
Preservation and Replacement Costs over the Next Twenty Years

	High–Priority Costs	Medium–Priority Costs	Low–Priority Costs	Total 20–Year Costs
Bus	$970,184	$2,815,021	$528,888	$4,314,093
Commuter Rail	$0	$28,512,000	$29,462,400	$57,974,400
HR/Light Rail	$3,142,101	$35,973,397	$18,043,259	$57,158,757
Systemwide	$4,894,372	$8,342,373	$7,234,446	$20,471,191
TOTAl	$9,006,657	$75,642,791	$55,268,993	$139,918,441

TABLE 5A–11
ELEVATORS AND ESCALATORS
Preservation and Replacement Costs over the Next Twenty Years

	High–Priority Costs	Medium–Priority Costs	Low–Priority Costs	Total 20–Year Costs
Commuter Rail	$0	$0	$401,637	$401,637
Bus	$0	$0	$401,637	$401,637
HR/Light Rail	$47,068,263	$51,241,643	$21,852,731	$120,162,637
Systemwide	$0	$8,032,750	$0	$8,032,750
TOTAl	$47,068,263	$59,274,393	$22,656,005	$128,998,661

system has 14 miles of tunnels. The light rail system has 5 miles of tunnels. Tunnels generally have a useful life of 100 years. The MBTA's network of retaining walls and culverts is also extensive. There are 767 culverts along the commuter rail system and 16 on the subway system. All culverts have a useful life of 50 years. Retaining walls also have a useful life of 50 years and are located along the commuter rail and rapid transit systems.

BRIDGES

Systemwide

The MBTA maintains 560 bridges, made up of 412 railroad bridges, 60 transit bridges, and 88 highway bridges (carrying vehicles over track and rights-of-way). Railroad and transit bridges typically have a useful life of 70 years, while highway bridges have a useful life of 50 years. Both railroad and transit bridges have the same maintenance schedule. Renewal of bridge deck replacement occurs after 50 years of use. Bridge

TABLE 5A–12
PARKING
Preservation and Replacement Costs over the Next Twenty Years

	High–Priority Costs	Medium–Priority Costs	Low–Priority Costs	Total 20–Year Costs
Commuter Rail	$0	$22,735,460	$7,151,507	$29,886,967
HR/Light Rail	$2,389,178	$166,713,442	$23,463,246	$192,565,866
TOTAL	$2,389,178	$189,448,902	$30,614,753	$222,452,833

TABLE 5A–13
TUNNELS, WALLS, AND CULVERTS
Preservation and Replacement Costs over the Next Twenty Years

	High–Priority Costs	Medium–Priority Costs	Low–Priority Costs	Total 20–Year Costs
Bus	$9,408,960	$0	$0	$9,408,960
Commuter Rail	$7,574,391	$0	$0	$7,574,391
HR/Light Rail	$83,904,579	$0	$0	$83,904,579
TOTAL	$100,887,930	$0	$0	$100,887,930

deck waterproofing is replaced after 40 years, and steel is repainted after 30 years. Highway bridges, however, have a different maintenance schedule. Bridge deck replacements occur after 30 years of use and steel is repainted every 15 years.

In an effort to upgrade and maintain these bridges, the Authority has developed a bridge management program known as the PONTIS program. This program is used to evaluate the condition of each bridge based on results of an inspection and a load-rating analysis of the bridge. This program also establishes a priority list for the rehabilitation/reconstruction of bridges. A bridge inspection program is tailored to ensure that all the bridges receive adequate attention. The frequency and type of inspection for each bridge depends on the structural condition of the bridge. For example, some bridges are considered fracture critical, and some are posted for speed and load restrictions. Bridges in good condition receive a routine inspection every 24 months, while fracture critical bridges receive an in-depth inspection every 12 months.

The PONTIS program enables the Authority to maintain an up-to-date database of all the Authority-owned bridges. It also contains information on the frequency of inspection for each bridge, and detailed structural information such as the bridge description, dimensions, and the conditions of the deck, superstructure, and substructural elements. The database also contains inventory and operating values of each bridge, which indicate the load carrying capacity of the structure. A priority list for rehabilitation/replacement is established based on the ratings.

Bridge replacement projects which have been identified as priorities through the PMT process include upgrades to the Fairmount commuter rail line at Columbia Road and upgrades to the Mattapan line viaduct at Ashmont Station.

FARE EQUIPMENT

Systemwide

The MBTA's fare-collection system differs by mode and includes station-based, vehicle-based, and system-control equipment. On the subway/rapid transit system, fare-collection equipment includes 475 turnstiles at 90 barrier fare collection locations. Fare-collection booths and exit gates at rapid transit stations are also considered to be part of the fare-collection system as well as on-board conductors, who perform fare-collection on the commuter rail system. There is no associated capital equipment for commuter rail.

The existing fare-collection equipment is 25 to 30 years old. Continued upkeep of the existing system is increasingly expensive due to its age and the cost of replacement parts. The Authority has initiated the procurement of a new Automated Fare Collection (AFC) system. This procurement calls for new fare-collection equipment for the Authority's subway, bus, trackless trolley, and Green Line services. All existing fare collection equipment will be

TABLE 5A–14
BRIDGES
Preservation and Replacement Costs over the Next Twenty Years

	High–Priority Costs	Medium–Priority Costs	Low–Priority Costs	Total 20–Year Costs
Commuter Rail	$57,181,678	$131,966,566	$46,442,775	$235,591,019
HR/Light Rail	$47,756,564	$148,923,919	$80,013,508	$276,693,991
TOTAL	$104,938,242	$280,890,485	$126,456,283	$512,285,010

TABLE 5A–15
FARE EQUIPMENT
Preservation and Replacement Costs over the Next Twenty Years

	High–Priority Costs	Medium–Priority Costs	Low–Priority Costs	Total 20–Year Costs
TOTAL	**$101,508,098**	**$11,006,013**	**$89,638,667**	**$202,152,778**

replaced. The overall project has three major components: procurement of the AFC equipment and related construction work required for its installation, initiation of a new station management structure that provides an enhanced level of customer convenience, and installation of a state-of-the-art telecommunications infrastructure that will improve station security. The Revenue Department also maintains and operates control, counting, and security equipment through a central computer system at a central facility. Wayside equipment has a 17-year useful life. Associated software is also maintained.

ADMINISTRATION

Systemwide

As with any large organization, the Authority assumes a cost to conduct business. The Authority must provide administrative offices and a working environment equipped with computers, phones, furniture, and the necessary systems and support services to carry out their responsibilities effectively and efficiently. Also included are costs required to support administration of the capital program. These costs include the cost of bond issuance as well as engineering support services. Much of the MBTA's computer equipment (PCs, printers, etc.) was upgraded as part of the year 2000 program. The Authority has one enterprise server (mainframe) that services the MBTA's computer network supporting over 2000 external devices. The server is assigned a 6-year useful life. The Authority has 1500 computers systemwide (not including police), which are impacted directly by the advances in technology. They have a useful life of 3 years. The MBTA police department also has 117 computers, each having a useful life of 5 years.

It is anticipated that $1.6 million will be required for the acquisition of a new computer system used for THE RIDE passenger reservations and vehicle scheduling.

TABLE 5A–15
ADMINISTRATION
Preservation and Replacement Costs over the Next Twenty Years

	High–Priority Costs	Medium–Priority Costs	Low–Priority Costs	Total 20–Year Costs
TOTAL	**$5,406,237**	**$11,886,591**	**$6,572,707**	**$23,865,535**

CHAPTER 5B

Service Enhancements

Service enhancements consist of suggested projects that would improve the service provided on MBTA routes that are already in operation. In general, these projects would not extend service to any new locations. The service enhancement projects discussed in this chapter are divided into three categories with separate evaluation criteria.

The first category, General Enhancements, includes changes such as increased frequency and improvements to vehicle fleets or fixed facilities to make possible faster, more comfortable, or more reliable service. The evaluation criteria for projects in this category are discussed in Chapter 1. The second category, Accessibility Enhancements (see pages 5B-28–5B-31), includes projects to improve accessibility for passengers with disabilities, such as installation of elevators at rapid transit stations and installation of high-level platforms at commuter rail stations. The third category, Access to Service (see pages 5B-32–5B-36), includes projects to improve general access to transit stations, such as parking expansion, installation of bicycle racks, and improvements to pedestrian approaches. The evaluation criteria used for projects in the second and third categories are discussed in their respective sections in this chapter. Most cost estimates and all ridership estimates for each of the categories were developed by CTPS. Additional details on quantitative indicators for individual projects may be found in Appendix C.

Each project has been given a rating for each of the evaluation criteria applicable to it and has also, based on those ratings, been given an overall rating. The ratings are indicated using the following icons:

- ● High rating
- ◗ Medium rating
- ❍ Low rating

The overall rating given to each project reflects whether implementation of the project is a high, medium, or low priority.

For each project that has its own page, its overall rating is given at

the upper left corner of the page and its ratings by individual criterion are given at the bottom. For the projects that do not have their own page, all of the ratings are given in tabular form. Within each of the three categories of projects, the projects are grouped by overall rating, the high-priority projects being presented first, medium-priority next, and low-priority last.

For each project, both the overall rating and the ratings by criterion were based on performance relative only to the other projects being evaluated within the same mode. For this purpose, the projects were divided into four modes: rapid transit (including the Red, Orange, Blue, Green, and Silver Lines, and Phase 2 and 3 Urban Ring), commuter rail, bus/trackless trolley, and other modes.

GENERAL ENHANCEMENTS

When the ratings by individual criterion of the General Enhancement projects, given at the bottom of the following pages, were combined to produce an overall rating for the project, a ❍ was considered to be equivalent to 1/3 of a ●, and 1/2 of a ◗. Additional information on the evaluation of these projects is provided in Appendix A.

SIGNAL AND TRAIN CONTROL IMPROVEMENTS ON BLUE LINE

Description

This proposal calls for increasing peak capacity on the Blue Line by installing new-generation signal systems which will allow for closer spacing between trains than present signal equipment allows. Infrastructure investments required to accomplish this would include installation of Communication-Based Train Control (CBTC) equipment, expanding storage yards, expanding power system capacity, and purchasing additional rolling stock. Present peak spacing between trains on the Blue Line is 3.5 minutes on average. Applying new signal technology could allow train frequencies of every 2 minutes, a 75% increase in capacity.

Capital Features

Installation of new signal system, purchase of additional vehicles, expansion of yard storage capacity, and expansion of power system.

Capital Cost	**$228.1 million**
Operating Cost	**$41,500 per weekday**
Daily Ridership Increase on Mode	**8,800**
Net Increase in Daily Transit Ridership	**2,700**
Capital Cost/New Transit Rider	**$84,500**
Operating Cost per Wkday/New Transit Rider	**$15.40**
Capital Cost/Travel Time Benefit	**$465,700 per hour**
Operating Cost/Travel Time Benefit	**$84.80 per hour**
Travel Time Savings	**490 hours per weekday**

Assessment

This is a high-priority rapid transit enhancement project. The capital cost of this project would be $228.1 million and the increase in the typical daily operating cost would be $41,500. Expanding the capacity of the Blue Line through signal improvements and the expansion of the vehicle fleet would result in 8,800 new riders to the mode, of which 2,700 would be new transit riders. The capital cost would be $84,500 per new transit rider, and the operating cost would be $15.40 per new transit rider. The project receives a medium score for capital cost per new transit rider, a good score for operating cost per new transit rider, and a high cost-effectiveness ranking overall compared to other rapid transit system enhancement projects. Utilization would be high, as new riders would be attracted by the improved peak frequencies. Peak crowding conditions presently occur between Aquarium and Maverick Stations. Crowding would be reduced. System reliability would be improved by the replacement of old signal equipment.

The MBTA is presently completing a project to modernize the Blue Line and increase the Blue Line train maximum length from four cars to six cars. Completion of this project should result in reductions in crowding within the next five years. The costs and calculations used in this analysis assume a 75% increase in capacity over operating future six-car trains of Blue Line cars at present frequencies. If future demand warrants a lesser increase in capacity, capital and operating costs could be lowered.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Environ. Justice
Facility Improvement	●	❍	●	●	◗	◗

SIGNAL AND TRAIN CONTROL IMPROVEMENTS ON RED LINE

Description

This proposal calls for increasing peak capacity on the Red Line by installing new-generation signal systems that will allow for closer spacing between trains than present signal equipment allows. Present peak spacing between trains in the shared segment of the Red Line between Alewife and Andrew Stations is 3.5 minutes on average. Applying new signal technology could allow train frequencies of every 2 minutes, a 75% increase in capacity.

Capital Features

Installation of a new Communication-Based Train Control (CBTC) signal system, purchase of additional vehicles, expansion of yard storage capacity, and expansion of power system.

Capital Cost	**$789.4 million**
Operating Cost	**$128,800 per weekday**
Daily Ridership Increase on Mode	**9,700**
Net Increase in Daily Transit Ridership	**3,400**
Capital Cost/New Transit Rider	**$233,500**
Operating Cost per Wkday/New Transit Rider	**$38.10**
Capital Cost/Travel Time Benefit:	**$1,447,300 per hour**
Operating Cost/Travel Time Benefit	**$236.30 per hour**
Travel Time Savings	**545 hours per weekday**

Assessment

This is a high-priority rapid transit enhancement project. The capital cost of this project would be $789.4 million and the increase in the typical daily operating cost would be $128,800. Expanding the capacity of the Red Line through signal improvements and the expansion of the vehicle fleet would result in 9,700 new riders to the mode, of which 3,400 would be new transit riders. The capital cost would be $233,500 per new transit rider and the operating cost would be $38.10 per new transit rider. This results in a medium score for capital costs and a high score for operating costs per new transit rider compared to other rapid transit expansion projects. Peak crowding conditions are presently experienced on the Red Line between Central and Kendall on the northern section of the line and between South Station and Broadway on the southern section of the line. The utilization score for the project is high as ridership would increase, new riders would be attracted to the mode, mode share would increase, and crowding would be reduced. System reliability would be improved with the installation of new signal equipment in place of older, more failure-prone equipment. The cost calculations used in assessing the project assume a 75% increase in capacity. If future demand warrants a lesser increase in capacity, capital and operating costs could be lowered.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Environ. Justice
Facility Improvement	●	❍	◗	●	◗	❍

SIGNAL AND TRAIN CONTROL IMPROVEMENTS ON ORANGE LINE

Description

This proposal calls for increasing peak capacity on the Orange Line by installing new-generation signal systems that will allow for closer spacing between trains than present signal equipment allows. Present peak spacing between trains on the Orange Line is 4.5 minutes on average. Applying new signal technology could allow train frequencies of every 2 minutes, a 125% increase in capacity. Orange Line improvements are an ACO legal commitment (see Table 2-2).

Capital Features

Installation of new Communication Based Train Control (CBTC) signal system, purchase of additional vehicles, expansion of yard storage capacity, and expansion of power system.

Capital Cost	**$367.0 million**
Operating Cost	**$78,100 per weekday**
Daily Ridership Increase on Mode	**10,900**
Net Increase in Daily Transit Ridership	**4,500**
Capital Cost/New Transit Rider	**$82,100**
Operating Cost per Wkday/New Transit Rider	**$17.50**
Capital Cost/Travel Time Benefit	**$449,100 per hour**
Operating Cost/Travel Time Benefit	**$95.90**
Travel Time Savings	**815 hours per weekday**

Assessment

This is a high-priority rapid transit enhancement project. The capital costs for this project would be $367 million, and the increase in the typical daily operating cost would be $78,100. Expanding the capacity of the Orange Line through signal improvements and the expansion of the vehicle fleet would result in 10,900 new riders to the mode, of which 4,500 would be new transit riders. The capital cost would be $82,100 per new transit rider and the operating cost would be $17.50 per new transit rider. This results in a medium score for both capital costs and operating costs per new transit rider compared to other rapid transit expansion projects. Currently, the most severe peak crowding conditions occur between Community College and State Street on the northern end of the line and between Back Bay Station and Downtown Crossing on the southern end of the line. The utilization score for the project is high, as mode ridership would increase, new transit riders would be attracted, mode share would increase, and crowding would be reduced. System reliability would be improved with the installation of new signal equipment in place of older, more failure-prone equipment.

The cost calculations used in assessing the project assume a 125% increase in capacity. The MBTA is proceeding with plans to replace antiquated signals between State Street and Oak Grove as a system preservation project. This signal replacement project will increase line capacity, but by a smaller percentage increase than this analysis considered. If future demand warrants a lesser increase in capacity than anticipated by this analysis, there may be no need for additional improvements beyond those already programmed.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Environ. Justice
Facility Improvement	●	❍	●	●	◗	◗

INSTALL 300 SHELTERS

Description

This proposal calls for the installation of 300 new bus shelters. Bus shelters protect passengers from inclement weather and provide seating for passengers awaiting buses. Shelters would primarily be placed at stops with high ridership and adequate space for shelters.

Capital Features

Purchase 300 bus shelters.

Capital Cost	**$1.0 million**
Operating Cost	**No ncrease in operating cost**
Daily Ridership Increase on Mode	**No impact**
Net Increase in Daily Transit Ridership	**No impact**
Capital Cost/New Transit Rider	**No impact**
Operating Cost per Wkday/New Transit Rider	**NA**
Capital Cost/Travel Time Benefit	**No impact**
Operating Cost/Travel Time Benefit	**NA**

Assessment

Installing new bus shelters would have no measurable impact on ridership, but would improve the quality of service for existing riders. Installing shelters along well-utilized routes would result in quality-of-service improvements for many environmental justice target areas, especially those with a high concentration of transit-dependent residents. Shelters could provide opportunities to post additional public information about routes, such as schedules, fare information, maps, and other marketing campaigns. Shelters are targeted for stops with 100 or more boardings per day.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Environ. Justice
Facility Improvement	NA	❍	NA	NA	◗	●

INSTALL INTELLIGENT TRANSPORTATION SYSTEMS (ITS) FOR BUS FLEET

Description

This proposal calls for making real-time bus location data available to both passengers and MBTA managers, and using this technology to reduce bus travel times through signal prioritization.

Capital Features

Install ITS subsystem, including Automatic Vehicle Locator systems and Automatic Passenger Counters.

Capital Cost	**To be determined**
Operating Cost	**No increase in operating cost**
Daily Ridership Increase on Mode	**No impact**
Net Increase in Daily Transit Ridership	**No impact**
Capital Cost/New Transit Rider	**NA**
Operating Cost per Wkday/New Transit Rider	**NA**
Capital Cost/Travel Time Benefit	**NA**
Operating Cost/Travel Time Benefit	**NA**

Assessment

There is no measurable impact on ridership associated with this project. However, providing real-time service performance data would give bus dispatchers more information with which to make immediate service adjustments and would give passengers information on the time of the next bus arrival. Bus location data could also be tied into traffic signal priority systems. Adding Automatic Passenger Counters would provide ridership data for every stop on a route and would also give planners more and better data to adjust schedules and improve bus reliability. Overall, Intelligent Transportation Systems could improve passenger perceptions of bus service and make bus service more attractive. Installation of an ITS network could be incremental, as Automatic Vehicle Locator systems could be installed on vehicles first as part of improved communication packages, while other items such as bus information kiosks at stops could be installed on a route-by-route basis. Automatic Passenger Counters would only need to be installed on 10-15% of the bus fleet.

Type of Project	Utilization	Mobility	Cost-Effectiveness.	Air Quality	Service Quality	Environ. Justice
Travel Time Improvement	NA	❍	NA	NA	●	◗

EXPAND REVERSE COMMUTING OPTIONS

Description

This project would increase the possibilities for commuting from homes in Boston to suburban work locations by expanding commuter rail service to provide at least three outbound A.M. peak trips and at least three inbound P.M. peak trips at all stations serving significant employment areas. New shuttle bus services would need to be provided between suburban stations and employment centers beyond walking distance of them.

Capital Features

At least five new train sets would be required in order to bring reverse-commuting service on all lines up to minimum standards while also maintaining present levels of peak-direction service.

Capital Cost	**$82.7 million**
Operating Cost	**$60,600 per weekday (excluding shuttle bus connections)**
Daily Ridership Increase on Mode	**7,800**
Net Increase in Daily Transit Ridership	**3,100**
Capital Cost per New Transit Rider	**$26,500**
Operating Cost per Wkday/New Transit Rider	**$19.40**
Capital Cost/Travel Time Benefit	**$90,900 per hour**
Operating Cost/Travel Time Benefit	**$67.00 per hour**
Travel Time Savings	**910 hours per weekday**

Assessment

This project would open new possibilities for suburban employment to residents of Boston's urban core. Many suburban employment locations have no transit links from Boston, or have service with arrival and departure times incompatible with starting and ending times of work shifts. This project would enhance service on MBTA commuter rail lines to provide multiple outbound A.M. peak and inbound P.M. peak trips between Boston and major suburban employment centers. At best, however, most reverse commuters would face time-consuming journeys on such service. The majority would need to use rapid transit or bus service to access commuter rail in Boston. In most cases, shuttle bus connections between the stations and the work locations would be needed at the outer trip end. (The cost of such services is assumed above to be funded by sources other than the MBTA.) At full potential, reverse-commuting service would be among the more cost-effective commuter rail projects analyzed in terms of capital cost per new transit rider. Operating cost per new rider would be in the mid-range among projects. Stations at which shuttle services appear most promising are Anderson/Woburn, Waltham, Route 128, and Southborough. These all have some present or planned shuttles. Overall, this project is rated high priority.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Environ. Justice
Frequency Improvement	●	●	◗	◗	◗	◗

OPERATE A YAWKEY–BACK BAY–SOUTH STATION SHUTTLE

Description

This project would implement a short-turn commuter rail service on the Framingham/Worcester Line between Yawkey Station in the Fenway section of Boston and South Station. Service would run every 15 to 20 minutes during peak hours and every 30 minutes at other times.

Capital Features

The existing Yawkey Station would be reconfigured to provide platforms on both tracks. A set of crossovers would be installed to allow trains to change tracks near the station. Three train sets would be needed to provide service at times of maximum frequency.

Capital Cost	**$29.9 million**
Operating Cost	**$4,600 per weekday**
Daily Ridership Increase on Mode	**1,400**
Net Increase in Daily Transit Ridership	**380**
Capital Cost per New Transit Rider	**$78,900**
Operating Cost per Wkday/New Transit Rider	**$12.00**
Capital Cost/Travel Time Benefit	**$3,748,000 per hour**
Operating Cost/Travel Time Benefit	**$571.80 per hour**
Travel Time Savings	**8 hours per weekday**

Assessment

This project would provide an alternative to the Green Line for travel between the Fenway and Copley Square areas, and an alternative to a combination of the Green and Red Lines for travel between the Fenway and the Waterfront and Financial/Retail districts. Some service between Yawkey, Back Bay, and South Stations is already provided by through commuter rail trains, but shuttle service would be much more frequent. It would provide more frequent connections to Back Bay Station than are currently available for passengers on the Fairmount Line and the Old Colony lines, which terminate at South Station and do not pass through Back Bay. The Framingham/Worcester Line is the only commuter rail route running via Yawkey Station. This would be among the more cost-effective commuter rail projects in terms of operating expense relative to new ridership. It would be in the mid-range of such projects in capital cost per new transit rider. Overall it is rated high priority.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Environ. Justice
Frequency Improvement	◗	◗	◗	◗	◗	●

OPERATE MORE FREQUENT SERVICE BETWEEN FRAMINGHAM AND WORCESTER

Description

This project would improve commuter rail service on the outer end of the Framingham/Worcester Line by changing one peak-period Worcester local round trip to an express and adding a new local round trip at a different time.

Capital Features

This project would require no capital investment if the additional train was run at a time of day when the equipment would otherwise be idle.

Capital Cost	**None**
Operating Cost	**$4,500 per weekday**
Daily Ridership Increase on Mode	**900**
Net Increase in Daily Transit Ridership	**450**
Capital Cost per New Transit Rider	**None**
Operating Cost per Wkday/New Transit Rider	**$10.00**
Capital Cost/Travel Time Benefit	**None**
Operating Cost/Travel Time Benefit	**$20.00 per hour**
Travel Time Savings	**220 hours per weekday**

Assessment

This project would provide faster travel times to Boston for some passengers boarding Framingham/Worcester Line trains at stations west of Framingham, and would provide an additional off-peak trip in each direction. It would be very cost-effective if operated with rolling stock that would otherwise be idle. The operating cost per new rider would be among the lowest for all commuter rail projects analyzed. The total number of weekday round trips between Boston and Worcester would increase from 10 to 11. The Worcester station is located in the central business district of the second-largest city in the state. Overall this project is rated high priority.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Environ. Justice
Frequency Improvement	◗	◗	●	◗	○	●

D OPERATE 8-CAR TRAINS ON ORANGE LINE

Description

The proposal calls for expanding capacity on the Orange Line by operating maximum train lengths of eight cars in the peak period. Present maximum train lengths are six cars. Longer trains would expand line capacity by over 30% and accommodate projected future increases in ridership

Capital Features

Extend station platforms, expand yard capacity, expand power capacity, modify signal systems, and expand vehicle fleet to support the operation of 8-car trains.

Capital Cost	**$177.7 million**
Operating Cost	**$26,000 per weekday**
Daily Ridership Increase on Mode	**3,300**
Net Increase in Daily Transit Ridership	**700**
Capital Cost/New Transit Rider	**$269,200**
Operating Cost per Wkday/New Transit Rider	**$39.50**
Capital Cost/Travel Time Benefit	**$1,198,700 per hour**
Operating Cost/Travel Time Benefit	**$175.40 per hour**
Travel Time Savings	**149 hours per weekday**

Assessment

This is a medium-priority rapid transit enhancement project. The capital costs associated with this project would be $177.7 million and the typical daily operating cost would be $26,000. The project would attract 3,300 new riders to the mode of which 700 would be new to transit. The capital costs per new rider would be $269,200 and the operating cost per new rider would be $39.50. The cost effectiveness score for the project is medium for both capital and operating expenses per new rider compared to other rapid transit expansion projects. Currently, the most severe peak crowding conditions occur between Community College and State Street on the northern end of the line and between Back Bay Station and Downtown Crossing on the southern end of the line. This project would reduce crowding for existing riders, but would only have a moderate impact on attracting new riders. Because of the low number of new riders attracted, there would only be a moderate impact on air quality. Crowding would be reduced in environmental justice target communities served by the Orange Line.

Extending station platforms would require excavations at underground station locations, and could result in major utility relocation and impacts on abutting properties in downtown Boston.

Improving signal systems to allow more frequent peak service is another alternative considered within the PMT to increase capacity.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Environ. Justice
Facility Improvement	◗	❍	◗	◗	❍	●

D OPERATE 8-CAR TRAINS ON RED LINE

Description

The proposal calls for expanding capacity on the Red Line by operating maximum train lengths of eight cars in the peak period. Present maximum train lengths are six cars. Infrastructure investments required to accomplish this would include extending station platforms, expanding storage yards, expanding power system capacity, modifying signal blocks, and purchasing additional rolling stock. Longer trains would expand line capacity by over 30% and accommodate projected future increases in ridership

Capital Features

Extend station platforms, expand yard capacity, expand power capacity, and expand vehicle fleet to support the operation of 8-car trains.

Capital Cost	**$261.3 million**
Operating Cost	**$42,900 per weekday**
Daily Ridership Increase on Mode	**3,800**
Net Increase in Daily Transit Ridership	**1000**
Capital Cost/New Transit Rider	**$275,100**
Operating Cost per Wkday/New Transit Rider	**$45.20**
Capital Cost/Travel Time Benefit	**$1,610,100 per hour**
Operating Cost/Travel Time Benefit	**$264.60**
Travel Time Savings	**162 hours per weekday**

Assessment

This is a medium-priority rapid transit enhancement project. The capital costs associated with this project would be $261.3 million and the increase in typical daily operating costs would be $275,100. The project would attract 3,800 new riders to the mode of which 1000 would be new to transit. The capital costs per new rider would be $275,100 and the operating cost per new rider would be $45.20. The cost effectiveness score for the project is medium for both capital and operating expenses per new rider. Peak crowding conditions are presently experienced between Central and Kendall on the northern section of the line and between South Station and Broadway on the southern section of the line. This project would reduce crowding for existing riders, but would only have a moderate impact on attracting new riders. Because of the low number of new riders attracted, there would only be a moderate impact on air quality.

Extending station platforms would require excavations at underground station locations, and could result in major utility relocation and impacts on abutting properties in downtown Boston and Cambridge.

Improving signal systems to allow more frequent peak service is another alternative considered in the PMT to increase capacity.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Environ. Justice
Facility Improvement	◗	○	◗	◗	○	◗

D PREEMPTIVE SIGNALS ON BEACON, COMMONWEALTH, AND HUNTINGTON

Description

This proposal calls for the installation of preemptive signals along the segments of the Green Line which operate in street medians with frequent grade crossings. The signal equipment would extend a green light cycle for an approaching rail vehicle or decrease the green cycle for crossing vehicular traffic. This signal equipment would reduce the time streetcars must wait at crossings and decrease trip times along these segments.

Capital Features

Install new signals.

Capital Cost	**$0.5 million**
Operating Cost	**no increase in operating costs**
Daily Ridership Increase on Mode)	**270**
Net Increase in Daily Transit Ridership	**60**
Capital Cost/New Transit Rider	**$8,200**
Operating Cost per Wkday/New Transit Rider	**no change**
Capital Cost/Travel Time Benefit	**$29,800 per hour**
Operating Cost/Travel Time Benefit	**NA**
Travel Time Savings	**17 hours per weekday**

Assessment

This is a medium-priority rapid transit enhancement project. The capital costs for this project would be $0.5 million. Improved running times resulting from the installation of preemptive signals would attract 270 new riders to the mode of which 60 would be new to transit. The capital cost per new transit rider would be $8,200. Although the ridership impact is small, the low capital costs results in this project being of comparatively high cost effectiveness compared to other rapid transit enhancement projects. To get the greatest benefit from traffic pre-emption equipment, it may also be required to relocate several surface stations to the far sides of intersections. Service reliability should improve, as there would be fewer delays at crossing locations.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Environ. Justice
Travel Time Improvement	❍	❍	●	◗	❍	◗

D ADD EXCLUSIVE LANES AND PRIORITY SIGNALS ALONG THE TOP TEN HIGHEST RIDERSHIP BUS OR TRACKLESS TROLLEY ROUTES

Description

This proposal calls for the installation of exclusive bus lanes and bus priority signals along high-ridership local bus routes. Exclusive bus lanes reduce the amount of time spent in congestion and mixed traffic and could result in faster, more reliable bus service. Routes 1 (Harvard-Dudley), 15 (Kane Square-Ruggles), 22 (Ashmont-Ruggles), 23 (Ashmont-Ruggles), 32 (Wolcott Square-Forest Hills), 28 (Mattapan-Ruggles), 57 (Watertown-Kenmore), 66 (Harvard-Dudley), 73 (Waverley Square-Harvard), and 111 (Woodlawn-Haymarket) are candidates for such improvements.

Capital Features

Construct exclusive bus lanes, bus priority signals, and shelters with passenger amenities.

Capital Cost	**$53.1 million**
Operating Cost	**No increase in operating costs**
Daily Ridership Increase on Mode	**3,000**
Net Increase in Daily Transit Ridership	**800**
Capital Cost/New Transit Rider	**$68,100**
Operating Cost per Wkday/New Transit Rider	**NA**
Capital Cost/Travel Time Benefit	**$211,400 per hour**
Operating Cost/Travel Time Benefit	**NA**
Travel Time Savings	**251 hours per weekday**

Assessment

This is a medium-priority bus enhancement project. The capital cost for this project would be $53.1 million. The width of streets involved, their volume of general traffic handled and the impact on parking, would determine how practical it would be to install bus-only lanes or bus priority lanes on individual route segments. Capital costs could vary greatly from route to route. This assessment only used an average per mile cost for installing bus rapid transit on arterial streets. Improving travel times on the 10 busiest routes would have a modest total impact on ridership. There would be 3,000 additional bus riders of which 800 would be new transit riders. The cost effectiveness compared to other bus enhancement projects would be low, as the capital cost per new transit rider would be $68,100. There would be a neutral impact or slight reduction on operating costs, as it is assumed travel times would be reduced and vehicle requirements reduced or reinvested in more frequent service. Reliability would be improved through the use of priority lanes, signal prioritization, and Automatic Vehicle Locator systems providing real time vehicle location information to dispatchers, planners, and customers. Several of the routes proposed from enhancement serve neighborhoods which are targets for environmental justice.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Environ. Justice
Travel Time Improvement	◗	○	○	◗	◗	●

D PURCHASE 100 NEW BUSES

Description

The proposal calls for expanding the MBTA bus fleet by 100 vehicles. These additional buses would allow for improved service frequencies on 50 bus routes serving the inner 14 communities of the MBTA service area, including Boston. Routes projected to receive increased service are those with crowding problems, as well as routes operating infrequent service through neighborhoods with high density and high transit dependent populations. Service would be improved in both the peak and off-peak.

Capital Features

Purchase 100 buses.

Capital Cost	**$33.8 million**
Operating Cost	**$45,400 per weekday**
Daily Ridership Increase on Mode	**5,700**
Net Increase in Daily Transit Ridership	**1,400**
Capital Cost/New Transit Rider	**$23,600**
Operating Cost per Wkday/New Transit Rider	**$31.50**
Capital Cost/Travel Time Benefit	**$36,800 per hour**
Operating Cost/Travel Time Benefit	**$49.50 per hour**
Travel Time Savings	**918 hours per weekday**

Assessment

This is a medium-priority bus enhancement project. The capital cost for this project would be $33.8 million and the increase in typical daily operating costs would be $45,400. This project would attract 5,700 additional riders to urban bus routes, of which 1,400 would be new transit riders. The capital cost per new rider would be $23,600 and the operating cost per new rider would be $31.50. The cost effectiveness of this project would be moderate compared to other bus enhancement projects. There would be minimal air quality improvements associated with this project. This project would help reduce crowding conditions on existing bus routes and would provide improved service frequencies to a number of environmental justice target communities in the urban core. There would be a high increase in riders who are new to the mode, but only a moderate increase in new transit riders.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Environ. Justice
Frequency Improvement	●	❍	◗	❍	❍	●

D INSTALL A FOURTH TRACK ON THE FORT POINT CHANNEL BRIDGE

Description

This project would increase the capacity of the railroad bridges across Fort Point Channel near South Station. These bridges are used by all commuter trains on the Old Colony and Fairmount lines and by commuter and intercity train sets being shifted between South Station and yards on the opposite side of the channel for servicing or storage.

Capital Features

A fixed-span bridge about 200 feet long (excluding approaches) that would be built next to the existing railroad bridges over the channel.

Capital Cost	**$2.5 million**
Operating Cost	**Reduced delays could result in lower operating costs**
Daily Ridership Increase on Mode	**None**
Net Increase in Daily Transit Ridership	**None**
Capital Cost per New Transit Rider	**Not applicable**
Operating Cost per Wkday/New Transit Rider	**Not applicable**
Capital Cost/Travel Time Benefit	**Undetermined**
Operating Cost/Travel Time Benefit	**Undetermined**

Assessment

This project would increase the efficiency and reliability of commuter rail operations by reducing delays to trains waiting for clear tracks across Fort Point Channel. The savings are difficult to quantify without more detailed analysis of delays with present and anticipated future schedules. This project by itself would not expand transit access to any new residential or employment areas. It could, however, contribute to the feasibility of implementing new South Side commuter rail routes by helping to reduce congestion at the inner terminal. Overall this project is rated medium priority.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Environ. Justice
Frequency Improvement	NA	❍	NA	NA	◗	●

D INSTALL DOUBLE-TRACKING ON ENTIRE COMMUTER RAIL SYSTEM

Description

This project would install a second track on all segments of the commuter rail system that now have only one track.

Capital Features

A second track would be installed on approximately 125 route-miles that now have only one track. This would require some widening of bridges and relocation of platforms and crossing protection devices.

Capital Cost	**$398.3 million for track and signals only.**
Operating Cost	**Would depend on how service is changed after installation of second track.**
Daily Ridership Increase on Mode	**Undetermined**
Net Increase in Daily Transit Ridership	**Undetermined**
Capital Cost per New Transit Rider	**Undetermined**
Operating Cost per Wkday/New Transit Rider	**Undetermined**
Capital Cost/Travel Time Benefit	**Undetermined**
Operating Cost/Travel Time Benefit	**Undetermined**

Assessment

This project would increase the efficiency of commuter rail operations by reducing potential delays to trains waiting for single-track segments to be vacated. It would also increase flexibility in setting schedules, by reducing constraints on locations where one train can pass another. Such constraints affect both the possible schedules of trains traveling in opposite directions and those of local and express trains traveling in the same direction on a given line. The ridership and operating cost impacts would depend on how much service was changed as a direct result of the new scheduling possibilities. Currently, the longest segments of single track between passing tracks or double track include from Ipswich to Newburyport on the Newburyport Line (8.8 miles), from Reading to Andover Street (in Lawrence) on the Haverhill Line (13.6 miles), and from South Acton to Willows (in Ayer) on the Fitchburg Line (8.4 miles). The location of the single track on the Fitchburg Line would prevent operation of reverse-commuting service on the outer half of the line without disruption of present peak-direction service. Overall, the project is rated as medium priority.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Environ. Justice
Frequency Improvement	NA	❍	NA	NA	◗	◗

D OPERATE EXPRESS SERVICE FROM OUTER STATIONS

Description

This project would implement new peak-period express trips on selected commuter rail lines. These trips would stop at several stations near the outer ends of their routes and then run non-stop to Boston. Some of these would run in addition to present local trains covering the full route. Others would replace full-route locals, with new short-turn local trains serving the inner stations.

Capital Features

A total of 15 new train sets would be needed in order to operate peak-period express service without elimination of other services.

Capital Cost	**$255.6 million**
Operating Cost	**$53,400 per weekday**
Daily Ridership Increase on Mode	**8,200**
Net Increase in Daily Transit Ridership	**3,000**
Capital Cost per New Transit Rider	**$84,100**
Operating Cost per New Transit Rider	**$17.60**
Capital Cost/Travel Time Benefit	**$171,500 per hour**
Operating Cost/Travel Time Benefit	**$35.60 per hour**
Travel Time Savings	**1,491 hours per weekday**

Assessment

This project would reduce trip times for passengers traveling to Boston from stations on outer segments of those commuter rail lines that now have track capacity for such added service. It would also reduce crowding on inner segments by diverting through riders from trains stopping at the inner stations. It would not increase the frequency of service at the inner stations, and would not necessarily increase frequency at the outer stations. Potential trip time reductions would be greatest on longer routes, such as the Fitchburg Line. In some cases where express service has been requested, such as on the Newburyport/Rockport Line between Beverly and Boston, present train frequency would permit express service only if some service to stations closer to Boston were eliminated. Overall, the capital and operating costs per new rider for express service additions would be in the mid-ranges of such costs among commuter rail projects analyzed. The capital costs relative to air quality improvements would also be in the mid-range among commuter rail projects. The overall rating of this project is medium priority.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Environ. Justice
Travel Time Improvement	●	❍	●	◗	❍	❍

OPERATE 4-CAR TRAINS ON GREEN LINE

Description

This project calls for the extension of platforms, purchase of additional rolling stock, expansion of maintenance facilities, and upgrades of power and signal systems necessary to operate four-car trains during peak periods on the Green Line. Presently, the maximum train length possible on the Green Line is three cars. The majority of Green Line trains are now two-car trains, but operation of additional three-car trains is anticipated for the future as ridership demand increases. This project would respond to capacity needs beyond that provided by three-car trains. Four-car trains would increase capacity by 30% over the already projected increased operation of three-car trains and would double capacity compared to existing two-car trains.

Capital Features

Purchase of additional vehicles, expansion of yard capacity, expansion of power system capacity, and extension of surface station platforms to accommodate four-car trains.

Capital Cost	**$339.4 million**
Operating Cost	**$267,700 per weekday**
Daily Ridership Increase on Mode	**4,100**
Net Increase in Daily Transit Ridership	**410**
Capital Cost/New Transit Rider	**$827,700**
Operating Cost per Wkday/New Transit Rider	**$653.00**
Capital Cost/Travel Time Benefit	**$2,921,400 per hour**
Operating Cost/Travel Time Benefit	**$2,304.70 per hour**
Travel Time Savings	**116 hours per weekday**

Assessment

This is a low-priority rapid transit enhancement project. The capital costs for this project would be $339.4 million and the increase in typical daily operating costs would be $267,700. This project would attract 4,100 riders to the mode of which 410 would be new transit riders. The capital cost per new transit rider would be $827,700 and the operating cost per new transit rider would be $653.00. As very few new riders would be attracted to the system with this enhancement, the project scores low for both capital and operating costs per new transit rider, compared to other rapid transit enhancement projects. Utilization receives a medium score compared to other rapid transit expansion projects, as crowding would be reduced but the number of new riders attracted and the impact on mode share would only be moderate. There would be little impact on air quality, as few riders would be attracted from automobiles. The projected ridership of the Green Line in 2025 exceeds the anticipated capacity provided by operating three-car trains. If no other projects are developed to divert ridership from the Green Line, it may be necessary to increase capacity in order to meet demand. The analysis of this project assumed the capital and operating cost of operating 100% 4-car trains during the peak on the entire Green Line network. Operating 4-car trains on only a portion of the Green Line network, or on only a limited number of trains would have lower capital costs than full implementation, and may be a strategy to investigate in future PMTs.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Environ. Justice
Facility Improvement	◗	❍	❍	❍	❍	●

SIGNAL AND TRAIN CONTROL IMPROVEMENTS ON GREEN LINE

Description

This proposal calls for making signal and train control improvements to the Green Line, which would provide a train control signal system with automatic stop features. The present Green Line signal system allows for very close spacing of trains up to 1.5 minutes apart, but does not provide automatic protection to prevent a train from entering an occupied signal block. This proposal calls for the installation of Communication Based Train Control (CBTC) equipment to provide this additional protection. There would most likely not be an increase in potential capacity from this installation because of the already close frequencies. Any signal installation which could not allow for 1.5-minute frequencies could actually reduce the capacity of the system.

Capital Features

Installation of new signal system.

Capital Cost	**$327.0 million**
Operating Cost	**No increase in operating costs**
Daily Ridership Increase on Mode	**0**
Net Increase in Daily Transit Ridership	**0**
Capital Cost/New Transit Rider	**No new riders**
Operating Cost per Wkday/New Transit Rider	**No change**
Capital Cost/Travel Time Benefit	**NA**
Operating Cost/Travel Time Benefit	**NA**

Assessment

This is a low-priority rapid transit enhancement project. The capital costs for this project would be $327 million. Because of the already close frequencies operated in the central subway of the Green Line, installation of a new signal system is not anticipated to result in any capacity improvements, and could result in capacity decreases compared to the current operating procedures. Such an installation would, however, have positive benefits for the safe and reliable operation of the system.

Present Green Line signal systems depend entirely on operator visual observations of wayside signals and do not have any automatic method to reduce speed or stop trains if signals are not followed correctly. Installation of a new signal system with automatic stop protection would reduce the chance of human error resulting in accidents.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Environ. Justice
Facility Improvement	❍	❍	❍	❍	◗	❍

CONSTRUCT COMMONWEALTH FLATS GRADE-SEPARATION PROJECT

Description

This proposal calls for extending the Silver Line bus tunnel under D St. This would reduce the amount of mixed-traffic operation required for Silver Line buses leaving World Trade Center station. Buses would avoid a stop light at the top of the transitway portal with this project.

Capital Features

Extend tunnel and relocate portal.

Capital Cost	**$70.0 million**
Operating Cost	**No increase in operating costs**
Daily Ridership Increase on Mode	**180**
Net Increase in Daily Transit Ridership	**100**
Capital Cost/New Transit Rider	**$700,000**
Operating Cost per Wkday/New Transit Rider	**No impact on operating costs**
Capital Cost/Travel Time Benefit	**$26,250,000 per hour**
Operating Cost/Travel Time Benefit	**(Travel time benefits not yet calculated)**
Travel Time Savings	**3 hours per weekday**

Assessment

This is a low-priority rapid transit enhancement project. This project would improve Silver Line reliability and improve travel times by reducing the amount of interface with automobile traffic at the D Street tunnel portal. The project would attract 180 new riders to the mode of which 100 would be new to transit. The capital cost per new transit rider would be very high at $700,000. However, there would be no anticipated increase in operating costs. The project would have little or no impact on utilization, mobility, air quality, or service quality. These results would likely change, though, upon full buildout of the South Boston waterfront. Indeed, the MBTA will continue to work with the city of Boston, Massport, and other interested parties to seek funding for this project in anticipation of such buildout.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Environ. Justice
Travel Time Improvement	❍	❍	❍	❍	❍	◗

EXPAND THE WAITING AREA AT NORTH STATION

Description

This project would provide more room for passengers waiting to board trains at North Station.

Capital Features

An enlarged waiting area would be built, with amenities similar to those at South Station, including more benches, tables, food concessions, newsstands and other conveniences.

Capital Cost	**Undetermined**
Operating Cost	**No increase in operating costs**
Daily Ridership Increase on Mode	**Undetermined**
Net Increase in Daily Transit Ridership	**Undetermined**
Capital Cost per New Transit Rider	**Undetermined**
Operating Cost per Wkday/New Transit Rider	**NA**
Capital Cost/Travel Time Benefit	**NA**
Operating Cost/Travel Time Benefit	**NA**

Assessment

The present waiting area at North Station, which serves the majority of all North Side commuter rail passengers, is much smaller than that at South Station. It has few benches or concessions. The waiting area can become quite crowded, especially during P.M. peak hours. Patrons of events at the Fleet Center, which occupies the upper floors of the same building, must also enter through the station waiting room and line up to wait for the doors to open and pass through security checks. This often overlaps with peak commuting times. No significant permanent expansion of the present waiting room will be feasible until the privately owned property between the building in which it is located and Causeway Street is redeveloped. To some extent, daily commuters are able to time their trips to the station to minimize the amount of time spent in the waiting room. Overall, this project is rated low priority.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Environ. Justice
Facility Improvement	NA	❍	NA	NA	◗	❍

INCREASE SPEED AND FREQUENCY OF NEEDHAM SERVICE

Description

This project would reduce travel times to downtown Boston from stations on the outer end of the Needham Line and increase the frequency of service at those stations. This would be accomplished by running some peak-period express trains that by-pass stations in West Roxbury in addition to present local service.

Capital Features

At least four additional equipment sets would be needed to provide more frequent peak service.

Capital Cost	**$52.3 million**
Operating Cost	**$13,900 per weekday**
Daily Ridership Increase on Mode	**1,000**
Net Increase in Daily Transit Ridership	**230**
Capital Cost per New Transit Rider	**$227,500**
Operating Cost per Wkday/New Transit Rider	**$60.50**
Capital Cost/Travel Time Benefit	**$674,400 per hour**
Operating Cost/Travel Time Benefit	**$178.50 per hour**
Travel Time Savings	**78 hours per weekday**

Assessment

This project would make commuter rail service somewhat more convenient for passengers boarding at stations in Needham, but because of the present high transit share of trips from there, the potential for attracting new transit riders is limited. Because of this, the capital and operating costs per new transit rider would be among the highest for commuter rail projects analyzed for the PMT. At present, peak-period Needham Line trains are not overcrowded, especially when compared with trains on several of the other South Side lines. Overall, this project is rated low priority.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Environ. Justice
Frequency Travel Time Improvement	◗	❍	❍	❍	❍	❍

BUILD NEW LAYOVER FACILITY IN BELLINGHAM FOR THE FRANKLIN LINE

Description

This project would increase the capacity for overnight storage of trains near the outer end of the Franklin Line by replacing or supplementing the existing Franklin layover facility with a new one in Bellingham.

Capital Features

Yard tracks and related equipment for secure storage of up to six trainsets would be built adjoining an existing rail freight line. About 2.5 miles of track and one grade crossing would need to be upgraded to allow trains to operate safely to the new facility, which would be located beyond the present end of passenger service at Forge Park.

Capital Cost	**$17.9 million**
Operating Cost	**Could increase or decrease depending on service strategy**
Daily Ridership Increase on Mode	**Undetermined**
Net Increase in Daily Transit Ridership	**Undetermined**
Capital Cost per New Transit Rider	**Undetermined**
Operating Cost per Wkday/New Transit Rider	**Undetermined**
Capital Cost/Travel Time Benefit	**Undetermined**
Operating Cost/Travel Time Benefit	**Undetermined**

Assessment

This project would improve the efficiency of operation of the Franklin Line by reducing the need to shift equipment between Boston and Forge Park at the beginning and end of the service day. This could either allow present service to be maintained at reduced cost or increased service to be run at less additional cost than would otherwise be incurred. The new facility would be compatible with, and essential for, a future extension of commuter rail service to Milford. Because it is possible to maintain present service without this facility, it is rated low priority overall.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Environ. Justice
Frequency Improvement	NA	❍	NA	NA	❍	❍

INSTALL PLATFORMS ON BOTH SIDES OF TRACKS AT STATIONS IN NEWTON

Description

This project would install platforms on the north side of the double-track Framingham/Worcester commuter rail line at the Newtonville, West Newton, and Auburndale stations. At present these stations have platforms on only the south side. Trains in both directions stopping at these stations must operate on the south track, and trains operating on the north track run non-stop through them.

Capital Features

A second platform would be installed at each of three stations. The new platforms would be wheelchair-accessible, and the present platforms would also be made accessible. Because of freight train clearance restrictions, the platforms would be mostly low-level, with mini-high-level platforms at the outer ends.

Capital Cost	**$5.2 million**
Operating Cost	**No increase in operating costs**
Daily Ridership Increase on Mode	**50**
Net Increase in Daily Transit Ridership	**10**
Capital Cost per New Transit Rider	**$522,100**
Operating Cost per Wkday/New Transit Rider	**Too small to calculate**
Capital Cost/Travel Time Benefit	**$5,221,000 per hour**
Operating Cost/Travel Time Benefit	**Too small to calculate**
Travel Time Savings	**1 hr/day**

Assessment

This project would allow some trains that now run non-stop past the three Newton stations to stop there. This would be advantageous mostly to reverse commuters traveling from Newton to points further out on the line, but there is very limited demand for such service. It would have little impact on the level of service provided for commuting between Newton and Boston. There is existing bus service to Boston from the same neighborhoods served by each of the three stations. At Auburndale and West Newton, substantial excavation would be needed in order to create space for platforms on the north side. At all three stations, both platforms would have to be made wheelchair-accessible. This would require installation of an elevator to each platform from the street. This would be one of the most costly commuter rail projects analyzed relative to the number of new transit riders attracted. Overall it is rated low priority.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Environ. Justice
Frequency Improvement	❍	❍	❍	◗	❍	❍

PURCHASE DIESEL MULTIPLE UNIT TRAINS TO ALLOW FOR INCREASED FREQUENCY ON COMMUTER RAIL LINES

Description

This project would bring the level of off-peak service up to at least hourly in both directions on all commuter rail lines that now have less frequent service than that. This would be done with Diesel Multiple Unit (DMU) cars because of their lower operating costs for trains requiring limited capacity. DMU cars are self-propelled and can operate as single units or in trains.

Capital Features

A total of 77 DMUs would be needed to run all present and added off-peak service with DMUs.

Capital Cost	**$264.4 million for 77 DMUs, excluding layover and servicing facilities.**
Operating Cost	**$7,500 per weekday**
Daily Ridership Increase on Mode	**800**
Net Increase in Daily Transit Ridership	**310**
Capital Cost per New Transit Rider	**$853,100**
Operating Cost per Wkday/New Transit Rider	**$24.20**
Capital Cost/Travel Time Benefit	**$3,347,500 per hour**
Operating Cost/Travel Time Benefit	**$95.00 per hour**
Travel Time Savings	**79 hours per weekday**

Assessment

This project would make commuter rail service more convenient for passengers traveling during off-peak hours, but operating cost savings of DMUs would not offset their high initial cost. Because off-peak ridership is relatively low, this would be one of the most costly commuter rail projects examined in terms of capital cost per new transit rider. At present, only one railcar manufacturer in the world offers a model of DMU that complies with current Federal Railroad Administration crash-safety standards. So far, only a single demonstrator car has been built, so there is no experience with actual operating and maintenance costs. No unit price for these cars has been announced. The capital cost above is based on an estimate of $3.4 million per car. Any model of DMU would be expected to require some specialized maintenance facilities. When not in use, each DMU would take up about the same amount of yard space as one standard coach. During late-night hours when no trains are run, adding a fleet of 77 DMUs to the present coach fleet would require an increase of over 20% in yard capacity. The MBTA already has a shortage of storage space for the existing equipment alone. Overall, this project is rated low priority. In the future, though, consideration could be given to the use of DMU's to provide connecting rail service on short spurs off of commuter rail main lines. This would be a strategy for expanding the reach of the commuter rail system without degrading frequency for existing passengers.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Environ. Justice
Frequency Improvement	◗	●	○	○	○	◗

ELECTRIFY ALL COMMUTER RAIL LINES

Description

This project would electrify all MBTA commuter rail lines, and replace diesel locomotives on all trains with electric locomotives. This would allow faster acceleration and deceleration of trains and eliminate locomotive emissions.

Capital Features

With the present service network and track layout, a total of about 500 miles of track would need to be electrified, excluding yard tracks. (The Providence Main Line tracks are already electrified for intercity service, but MBTA trains on this line use diesels.) A total of 80 electric locomotives would be needed to operate the present number of trips on each line.

Capital Cost	**$2.0 billion**
Operating Cost	**Undetermined**
Daily Ridership Increase on Mode	**1,700**
Net Increase in Daily Transit Ridership	**900**
Capital Cost per New Transit Rider	**$2,227,000**
Operating Cost per Wkday/New Transit Rider	**Undetermined**
Capital Cost/Travel Time Benefit	**$5,982,900 per hour**
Operating Cost/Travel Time Benefit	**Undetermined**
Travel Time Savings	**335 hours per weekday**

Assessment

This project would result in average travel time savings of about five minutes per trip for each commuter rail passenger. Savings would not be uniformly distributed, and would range from about one minute on the shortest trips to about 12 minutes on the longest trips. The project would have high air quality benefits resulting from the elimination of locomotive emissions. Meanwhile, the number of auto trips eliminated would be only in the mid-range among commuter rail projects. It would be one of the most costly of all of the commuter rail projects examined for the PMT, both in absolute terms and relative to new transit ridership, to travel time savings, and to air quality improvements. Also, it would result in no measurable impacts on mobility or service quality. Overall, this project is rated low priority.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Environ. Justice
Travel Time Improvement	◗	❍	❍	●	❍	❍

ACCESSIBILITY ENHANCEMENTS

Introduction

The MBTA Key Station accessibility program for heavy rail/light rail and commuter rail lines is now nearly complete. The next phase of the program will provide accessibility to stations that were not included on the Key Station list. The PMT evaluations of accessibility projects are intended to help prioritize the order of the next stations to be made accessible, since resources would not permit all of them to be implemented simultaneously.

Stations on the Red, Orange, and Blue Lines all have high platforms, meaning platforms at the same height as vehicle floors. In general, accessibility improvements to such stations will consist of installing elevators to transport passengers between the platform levels and the streets outside the stations, and eliminating obstacles to wheelchair circulation within the stations. At stations with parking facilities, some modifications will be made to provide some number of accessible spaces.

Green Line stations and stops have low-level platforms, and Green Line cars have several interior steps. Low-floor cars being acquired for the Green Line have reduced floor heights at the center sections of the cars, but for technical reasons these are still several inches higher than the station platform heights that were used historically. Accessibility improvements to Green Line stations will include raising the platform heights to the level of the lower floor sections in the low-floor cars. Accessibility improvements to Green Line Central Subway stations, as at Red, Orange, and Blue Line stations, will include installation of elevators and removal of obstacles to wheelchair circulation. Platforms at surface stops on the B, C, and E Branches of the Green Line are entered directly from adjoining streets. Some stops on the D Branch are below street level, requiring construction of ramps at suitable grades for wheelchair access. Most Green Line stops do not include parking facilities. At those that do, some expansion of accessible parking may be needed in conjunction with the other improvements.

MBTA commuter rail cars are designed for boarding at either low-level or high-level platforms. At low-level platforms, passengers use stairs in the vestibules at the ends of each car. High-level platforms are the same height as the car vestibule floors. At stations with such platforms, the car stairwells are covered by trap doors. Accessibility improvements to commuter rail stations will include installation of full-length high-level platforms where technically feasible. At some locations, site constraints or clearance requirements for freight trains necessitate the use of mini-high-level platforms instead. The latter are located at one end of the station and are only one car length long. Depending on station layout, installation of full-length or mini-high-level platforms also requires installation of ramps or elevators to connect the platforms with adjacent ground height. Some changes in parking facilities may be needed to provide accessible spaces.

Station Ratings

The stations are listed in Table 5B-1, which also gives each station's rating.

Ratings for Individual Criteria

Ratings were given to each station for each of the evaluation criteria described below. In the table, a blank cell represents the lowest rating for that criterion, (no "credit" is given to the station with regard to that criterion). The icon ❍ represents a low rating (but one in which the station receives some "credit"), ◗ represents a medium rating, and ● represents a high rating.

Passenger Boardings

Stations with inbound boardings of 1,000 or higher were given a rating of ●. Stations with

inbound boardings between 500 and 999 were given a rating of ◗. Stations with inbound boardings between 100 and 499 were given a rating of ❍. Stations with less than 100 boardings were screened out of the evaluation unless they received at least one ❍ in another evaluation criterion.

Improvement of Transfers between Rail Lines

Stations were evaluated for providing connections between rail lines. All stations which serve as connecting points between rail lines are already designated as Key Stations.

Interconnectivity

Stations which are served by a single bus service (MBTA, private carrier, or regional transit authority) were given a rating of ❍. Stations served by multiple infrequent bus routes were given a rating of ◗. Stations served by multiple frequent bus routes were given a score of ●.

Terminal Locations

Stations which are terminals were given a rating of ●.

Service to Major Centers

Stations serving major activity centers, such as employment or government centers, institutions of higher education, hospitals or other major health care facilities, or other facilities that are major trip generators for persons with disabilities, were given a rating of ●.

Overall Ratings

The individual-criterion ratings were combined into overall ratings for each station, which translated into low, medium, and high priorities in the PMT. In the combining of ratings, a ❍ was considered to be equivalent to 1/3 of a ●, and 1/2 of a ◗. Stations with at least one ● rating and one ❍ rating (or an equivalent composite set of ratings) are considered to be a high priority. Other stations with at least one ◗ rating (or an equivalent composite set of ratings) are considered a medium priority. All remaining stations are low priorities.

TABLE 5B-1 ACCESSIBILITY ENHANCEMENT PROJECT RATING*

Station	Service	Inbound Ridership	In Process	Ridership	Rail Transfers	Inter-connectivity	Terminal Locations	Major Centers	Overall
Arlington	Green		●						●
Ashmont	Red-M		●						●
Babcock St	Green-B	1761		●				●	●
Blanford St	Green-B	2096		●				●	●
Boylston	Green	5934		●				●	●
Brighton Ave	Green-B	1571		●		❍			●
Brookline Hills	Green-D	2097		●				●	●
BU West	Green-B	899		◗				●	●
Charles	Red		●						●
Chelsea	CRR	257		❍		❍		●	●
Copley	Green		●						●
Fairmount	CRR		●						●
Fields Corner	Red		●						●
Franklin	CRR	1311		●		❍		●	●
Government Ctr	Green/Blue		●						●
Hynes ICA	Green	8579		●		◗		●	●
Kenmore	Green		●						●
Longwood	Green-D	2536		●				●	●
Malden	CRR		●						●
Malden	Orange		●						●
Mattapan	Red-M		●						●
Maverick	Blue		●						●
Newton Highlands	Green-D	1257		●		❍			●
Pleasant St	Green-B	1014		●				●	●
Rockport	CRR	215		❍		❍	●		●
St. Paul St	Green-B	814		◗				●	●
Savin Hill	Red		●						●
Science Park	Green	1360		●				●	●
Shawmut	Red		●						●
State	Blue		●						●
Symphony	Green-E	1065		●				●	●
Waltham	CRR	521		◗		◗			●
Wollaston	Red	4269		●		❍			●
Woodland	Green-D	1044		●		❍		●	●
Allston St	Green-B	1115		●					◗
Auburndale	CRR	376		❍		❍			◗
Back of the Hill	Green-E	86						●	◗
Beaconsfield	Green-D	896		◗					◗
Belmont	CRR	131		❍		❍			◗
Central Ave	Red-M	598		◗		❍			◗
Chestnut Hill	Green-D	1035		●					◗
Chestnut Hill Ave	Green-B	861		◗					◗
Chiswick Rd	Green-B	735		◗					◗
Eliot	Green-D	595		◗					◗
Englewood Ave	Green-C	585		◗					◗
Fairbanks	Green-C	500		◗					◗
Fordham Rd	Green-B	921		◗					◗
Griggs St	Green-B	1260		●					◗
Kent St	Green-C	510		◗					◗
Melrose Highlands	CRR	402		❍		❍			◗
Milton	Red-M	311		❍		❍			◗
Morton St	CRR	248		❍		❍			◗
Natick	CRR	960		◗		❍			◗
Newtonville	CRR	574		◗		❍			◗

*The rating icons are explained on page 5B-28 and 5B-29

TABLE 5B-1 ACCESSIBILITY ENHANCEMENT PROJECT RATING (CONT.)

Station	Service	Inbound Ridership	In Process	Ridership	Rail Transfers	Inter-connectivity	Terminal Locations	Major Centers	Overall
Sharon	CRR	1088		●					◗
St. Paul St	Green-C	886		◗					◗
Summit Ave	Green-B	583		◗					◗
Sutherland St	Green-B	923		◗					◗
Tappan St	Green-C	1020		●					◗
Uphams Corner	CRR	148		❍		❍			◗
Wakefield	CRR	679		◗		❍			◗
Walpole	CRR	865		◗		❍			◗
Warren St	Green-B	1629		●					◗
Waverly	CRR	127		❍		❍			◗
Wellesley Farms	CRR	535		◗					◗
Wellesley Hills	CRR	520		◗					◗
Wellesley Sq	CRR	790		◗					◗
West Medford	CRR	309		❍		❍			◗
West Newton	CRR	401		❍		❍			◗
Winchester	CRR	628		◗		❍			◗
Winchester St	Green-C	921		◗					◗
Windsor Gardens	CRR	552		◗					◗
Ayer	CRR	228		❍					❍
Brandon Hall	Green-C	360		❍					❍
Butler	Red-M	134		❍					❍
Cedar Grove	Red-M	110		❍					❍
Concord	CRR	439		❍					❍
Dean Rd	Green-C	316		❍					❍
Endicott	CRR	281		❍					❍
Fenwood St	Green-E	343		❍					❍
Greenwood	CRR	214		❍					❍
Greycliff Rd	Green-B	109		❍					❍
Hawes St	Green-C	426		❍					❍
Islington	CRR	226		❍					❍
Kendal Green	CRR	106		❍					❍
Lincoln	CRR	284		❍					❍
Littleton/495	CRR	146		❍					❍
Melrose Cedar Pk	CRR	285		❍					❍
Mount Hood Rd	Green-B	282		❍					❍
No. Leominster	CRR	208		❍					❍
No. Wilmington	CRR	180		❍					❍
Parker Hill	Green-E	462		❍					❍
Shirley	CRR	151		❍					❍
So. Acton	CRR	466		❍					❍
South St	Green-B	237		❍					❍
Waban	Green-D	427		❍					❍
Wedgmere	CRR	324		❍					❍
Wyoming Hill	CRR	196		❍					❍

ACCESS TO SERVICE

Over the last decade, public attention has centered on the lack of adequate parking supply to meet the growing demand for automobile access to MBTA services. This focus can be attributed in large part to the Central Artery/Tunnel Project mitigation that required the MBTA to increase parking by 20,000 spaces throughout the system. Expansion of the commuter rail system has also produced further demand for parking. Today, many communities continue to pursue parking initiatives with the MBTA to meet the needs of their residents. However, the focus on automobile parking has overshadowed other transportation modes that MBTA customers use to access the Authority's services.

Across the entire MBTA system, 84% of riders bicycle or walk to stations. This mode share suggests more attention should be given to types of access other than the automobile. Increasingly, transportation policy makers and the riding public have generated support for a "balanced" station access analysis for all modes. Their typical interests are in travel time, cost, convenience, safety and congestion reduction. This PMT reflects the importance of automobile parking to the region, but it also addresses the need to further promote other access modes to transit.

Automobile Parking

In the commuter rail system, 54% of users drive to stations to access service. Clearly, automobile parking is a critical access mode for the MBTA system. Because communities are so different, the MBTA has developed a process to analyze the large number of parking projects that are currently under consideration. The PMT has incorporated this evaluation process to ensure that past work informs this new parking prioritization.

Project Screening

Every commuter rail, commuter boat, and heavy rail/light rail station in the system was preliminarily reviewed based on information available at the MBTA or the Central Transportation Planning Staff. Stations that lack elements necessary for project development, including available property for expansion and municipal support, were made low priorities. A low prioritization was also assigned to stations where an expansion was completed within the last ten years or is currently underway.

Station Ratings

Ratings were applied with respect to the following evaluation criteria for most commuter rail stations, heavy rail/light rail stations, and boat terminals included in the prescreened parking facility expansion project listing:

- **Customer Access**—Quality of automobile access to the station parking lot from major arterial roadways
- **Land/Air Rights**—MBTA ownership of (or access to) land and/or air rights for expansion of the parking facility
- **Projected Demand**—Magnitude of expected future demand for parking at the station
- **Potential Utilization**—Ability of potential parking expansion to meet the needs of projected demand
- **Cost per Parking Space**—Expected cost per parking space, either in surface lot or garage
- **Environmental Status**—Barriers to parking expansion resulting from existing environmental issues
- **Ease of Construction**—Barriers to parking expansion resulting from space constraints, land acquisition issues, challenging terrain, etc.

- **Community Support**—Level of support demonstrated by local and/or regional officials and community groups for expansion of the parking facility
- **Funding Availability**—Availability of non-MBTA funding sources for expansion of the parking facility

For each criterion, a high rating is signified by a ●. A medium rating is signified by a ◗, and a low rating is signified by a ❍. "NA" means not applicable. The individual-criterion ratings were then combined into overall ratings for each station, which translated into low ❍, medium ◗, and high ● priorities for the PMT. When combining ratings, a ❍ was considered to be equivalent to 1/3 of a ●, and 1/2 of a ◗.

Stations with at least four ● ratings and five ◗ ratings (or an equivalent composite set of ratings) are considered to be a high priority for implementation. Other stations with at least nine ◗ ratings (or an equivalent composite set of ratings) are considered a medium priority. All remaining stations are a low priority.

Individual-criterion ratings were not applied to stations where parking facilities are currently being expanded or are planned for expansion, or where substantial community opposition exists to potential expansion projects. Each of these stations was instead classified as low priority for implementation, overall. Project ratings are shown in table 5B-2.

Shuttles

Housing and employment development beyond the Route 128 corridor has created demand for nontraditional transportation services. Chapter 3, which discussed the region's mobility challenges, details the demand for new and expanded transit choices for suburban commuters. Shuttle transportation is often regarded as a viable alternative. The PMT has analyzed the potential for such service. Because some shuttle routes are long enough to be considered system expansion projects, the shuttle projects are presented in Chapter 5C.

Bicycle/Pedestrian

Chapter 2 details improvements that the MBTA has made to the Bikes-on-the-T Program over the last several years. These changes have expanded upon the MBTA's standing policy to provide bicycle parking as part of any station improvement project. Together, these efforts have resulted in some enhancements to bicycle access to the MBTA system. However, with the preponderance of MBTA customers accessing service by walking or bicycling, the Authority is strengthening its focus on promoting and improving these access modes. The overall ratings assigned to bicycle and pedestrian systemwide access projects in the PMT echo the importance of these service enhancements (see pages 5B-37 - 5B-40). These access modes are also significant due to eastern Massachusetts's highway congestion problems and the Commonwealth's constrained financial condition.

To implement these priorities, the MBTA is working with the Executive Office of Transportation and Construction (EOTC) and the Massachusetts Highway Department (MassHighway) to analyze bicycle and pedestrian access to MBTA stations. This project will evaluate approximately twenty stations and will estimate the demand for bicycle and pedestrian access to these sites. The analysis will assess current conditions, which will serve as the basis for recommended improvements at these stations. Once improvements are implemented, an evaluation will be performed to determine the success of the station enhancements.

Unlike automobile parking projects, the MBTA does not have specific criteria to prioritize individual bicycle and pedestrian projects, and few such projects were introduced during the public process for the PMT. This MBTA/EOTC/MassHighway initiative will provide the information necessary to better evaluate such improvements in future updates of the PMT and will facilitate comparisons between all access modes to MBTA service.

The MBTA is also continuing to work with other interested parties to consider ways to

expand bicycle parking systemwide, including the increased use of lockers and the potential for a bicycle station. Assessments of bicycle and pedestrian enhancement projects, along with other access-to-service projects are shown on the pages following Table 5B-2. In the ratings of these projects by individual criteria, the meanings of the icons are the same as has been explained for the General Enhancements, as are the values assigned to those ratings when combining them to produce an overall rating.

TABLE 5B-2 PARKING ENHANCEMENT PROJECT RATING*

Station	Service	Cust. Access	Land/ Air Rights	Proj. Dem	Pot. Util.	Cost Per Pkg Space	Envir. Status	Ease of Constr.	Comm. Supp.	Fund. Avail.	Over-all
Beverly Depot	CRR	●	●	●	◗	◗	◗	●	●	◗	●
Bridgewater	CRR	◗	●	●	●	●	●	◗	●	◗	●
Fitchburg	CRR	◗	●	❍	●	●	◗	◗	●	●	●
Forge Park	CRR	◗	●	●	●	◗	●	◗	◗	◗	●
Franklin	CRR	❍	●	◗	●	●	●	◗	●	◗	●
Kingston	CRR	◗	●	●	●	●	●	◗	◗	◗	●
Lawrence	CRR	◗	●	◗	●	◗	◗	●	●	●	●
Natick	CRR	◗	●	◗	●	●	◗	●	●	◗	●
No. Quincy	Red-B	◗	●	●	❍	●	●	◗	●	◗	●
Quincy Adams	Red-B	●	●	●	●	●	●	◗	◗	◗	●
Salem	CRR	●	●	●	●	◗	◗	●	●	●	●
So. Attleboro	CRR	●	●	●	●	◗	●	◗	●	●	●
Whitman	CRR	●	●	◗	●	●	◗	●	●	◗	●
Woodland	Green-D	◗	●	●	❍	◗	●	●	●	●	●
Abington	CRR	◗	❍	●	●	❍	●	●	◗	◗	◗
Attleboro	CRR	◗	●	●	●	❍	❍	❍	●	●	◗
Devens-Shirley	CRR	◗	◗	◗	●	●	◗	◗	❍	●	◗
Gloucester	CRR	◗	●	❍	●	❍	◗	◗	●	●	◗
Hingham	Boat	◗	◗	●	●	●	◗	◗	◗	◗	◗
Littleton	CRR	●	●	◗	◗	◗	●	◗	◗	◗	◗
Mansfield	CRR	◗	●	●	❍	❍	◗	◗	●	●	◗
Milton	Red-M	◗	◗	❍	◗	◗	●	●	●	●	◗
Norfolk	CRR	❍	●	●	●	●	●	◗	❍	◗	◗
No. Leominster	CRR	◗	●	❍	◗	◗	◗	◗	●	●	◗
Rockport	CRR	◗	●	❍	●	❍	◗	◗	●	◗	◗
So. Weymouth	CRR	◗	❍	●	●	◗	◗	●	◗	◗	◗
Walpole	CRR	◗	◗	●	●	❍	❍	◗	●	◗	◗
Alewife	Red										❍
Anderson RTC	CRR										❍
Andover	CRR										❍
Ashland	CRR										❍
Auburndale	CRR										❍
Ayer	CRR	◗	❍	◗	❍	◗	❍	❍	●	❍	❍
Ballardvale	CRR										❍
Brockton	CRR										❍
Campello	CRR										❍
Canton Junction	CRR										❍
Dedham Corp. Ctr	CRR										❍
Forest Hills	CRR										❍
Framingham	CRR										❍
Grafton	CRR										❍
Halifax	CRR										❍
Hamilton/ Wenham	CRR										❍
Hanson	CRR										❍
Haverhill	CRR										❍
Holbrook/ Randolph	CRR										❍
Hyde Park	CRR	❍	❍	◗	●	❍	❍	◗	❍	❍	❍
Kendal Green	CRR										❍
Lincoln	CRR	◗	●	◗	❍	◗	❍	◗	◗	◗	❍
Lowell	CRR										❍
Malden Center	CRR										❍

*The rating icons are explained on page 5B-33

TABLE 5B-2 PARKING ENHANCEMENT PROJECT RATING (CONT.)

Station	Service	Cust. Access	Land/ Air Rights	Proj. Dem.	Pot. Util.	Cost Per Pkg. Space	Envir. Status	Ease of Constr.	Comm. Supp.	Fund. Avail.	Over-all
Malden Center	Orange										❍
Middleborough/ Lakeville	CRR										❍
Montello	CRR										❍
Needham Hghts.	CRR										❍
Needham Junct.	CRR										❍
Newburyport	CRR										❍
North Billerica	CRR										❍
Norwood Ctr.	CRR										❍
Norwood Depot	CRR										❍
Readville	CRR										❍
Route 128	CRR										❍
Rowley	CRR										❍
Sharon	CRR										❍
South Acton	CRR										❍
Southborough	CRR										❍
Stoughton	CRR										❍
Wellesley Sq	CRR										❍
Wellington	Orange										❍
West Medford	CRR	❍	◗	◗	❍	◗	◗	❍	●	◗	❍
West Natick	CRR										❍
Westborough	CRR										❍
Wilmington	CRR										❍
Winchester	CRR	❍	●	◗	●	◗	◗	❍	❍	◗	❍
Wollaston	Red-B										❍
Woodland	Green-D										❍
Worcester	CRR										❍

IMPROVE PEDESTRIAN ACCESS TO ALL RAPID TRANSIT AND COMMUTER RAIL STATIONS

Description

This project would improve walking paths to commuter rail and rapid transit stations throughout the system to facilitate walking as a means of station access and egress.

Capital Features

Improvements would be designed on a station-by station basis, and would include such features as new or upgraded sidewalks, improved lighting, and pedestrian lights at busy street intersections. Most improvements would take place within a one-mile radius of a station.

Capital Cost	**Undetermined**
Operating Cost	**See discussion in assessment below**
Daily Ridership Increase on Mode	**Undetermined**
Net Increase in Daily Transit Ridership	**Undetermined**
Capital Cost per New Transit Rider	**Undetermined**
Operating Cost per Wkday/New Transit Rider	**Undetermined**
Capital Cost/Travel Time Benefit	**Undetermined**
Operating Cost/Travel Time Benefit	**Undetermined**

Assessment

Overall, this project is rated high priority. Improvements to pedestrian access can result in increased ridership without costly expansion of parking facilities. To the extent that passengers walking to stations are diverted from private autos, walking access improvements can contribute to improved air quality. Pedestrian improvements have no vehicle operating costs, but walkways do need to be maintained and kept clear of snow and debris. In addition, lighting systems have costs for electric power and maintenance. In some locations, pedestrian safety may require deployment of traffic officers at busy intersections. Because of population density and distribution, most stations would still have to allow for means of access other than walking regardless of the quality of walking paths. Few passengers will take the time to walk more than one mile to or from a station on a regular basis, and not all who would have walking paths of under one mile will choose to walk.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Environ. Justice
Access Improvement	NA	❍	NA	NA	●	●

D IMPROVE PEDESTRIAN ACCESS TO ANDERSON RTC FROM WESTERN SIDE OF TRACKS

Description

This project would provide safe and direct pedestrian access to the Anderson Regional Transportation Center Station on the Lowell commuter rail line in Woburn from the west side of the tracks.

Capital Features

A pedestrian bridge over the inbound track, connecting Boston Street with the center island platform, or a combined pedestrian and vehicular bridge from Boston street to the station parking lot would be built.

Capital Cost	**$1.6 million**
Operating Cost	**No increase in operating costs**
Daily Ridership Increase on Mode	**40**
Net Increase in Daily Transit Ridership	**20**
Capital Cost per New Transit Rider	**$77,700**
Operating Cost per Wkday/New Transit Rider	**NA**
Capital Cost/Travel Time Benefit	**$776,900 per hour**
Operating Cost/Travel Time Benefit	**NA**
Travel Time Savings	**2 hours per weekday**

Assessment

This project would reduce the access distance to the station by three miles or more for some passengers starting from points on the west side. The number that could take advantage of this improvement is fairly small, but the capital cost would also be small, making this one of the more cost-effective projects analyzed. A pedestrian bridge would also improve access to some light industrial development to the west side of the rail line. This station is well served by trains suitable for reverse commuting, so the bridge would expand employment opportunities within walking distance of the station. Overall, this project is rated medium priority.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Environ. Justice
Access Improvement	❍	◗	●	◗	◗	◗

D INSTALL BIKE RACKS AT RAPID TRANSIT AND COMMUTER RAIL STATIONS

Description

This project would provide new or improved bicycle parking facilities at commuter rail and rapid transit stations throughout the system to facilitate bicycle riding as a means of station access and egress.

Capital Features

Improvements would be designed on a station-by station basis, and could range from simple open-air racks to fully-enclosed lockers.

Capital Cost	**$40,000 (for minimum facilities)**
Operating Cost	**See discussion in assessment below**
Daily Ridership Increase on Mode	**Undetermined**
Net Increase in Daily Transit Ridership	**Undetermined**
Capital Cost per New Transit Rider	**Undetermined**
Operating Cost per Wkday/New Transit Rider	**Undetermined**
Capital Cost/Travel Time Benefit	**Undetermined**
Operating Cost/Travel Time Benefit	**Undetermined**

Assessment

Overall, this project is rated medium priority. Improvements to bicycle parking facilities can result in increased ridership without costly expansion of automobile parking facilities. The cost to install a six-foot open-air bicycle rack at every rapid transit and commuter rail station that does not currently have any bicycle racks would be about $40,000. This would provide limited lock-up capacity, with no protection from weather, vandalism, or theft. To the extent that passengers bicycling to stations are diverted from private autos, bicycle parking improvements can contribute to improved air quality. Bicycle parking facilities have no vehicle operating costs, but racks or lockers do need to be kept in a state of good repair in order to attract users. To make use of bicycle parking facilities, passengers must be able to reach stations safely by bicycle, so the broader issue of bicycle routes must be considered when prioritizing sites for bicycle parking.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Environ. Justice
Access Improvement	NA	❍	NA	NA	◗	●

INSTALL MORE ENCLOSED WAITING AREAS ALONG MBTA LINES

Description

This project add more shelters at commuter rail and rapid transit stations.

Capital Features

Improvements would be designed on a station-by station basis, and would depend on typical ridership volumes and on the extent to which shelters are already provided.

Capital Cost	**Undetermined**
Operating Cost	**See discussion in assessment below**
Daily Ridership Increase on Mode	**Undetermined**
Net Increase in Daily Transit Ridership	**Undetermined**
Capital Cost per New Transit Rider	**Undetermined**
Operating Cost per Wkday/New Transit Rider	**Undetermined**
Capital Cost/Travel Time Benefit	**Undetermined**
Operating Cost/Travel Time Benefit	**Undetermined**

Assessment

Overall, this project is rated medium priority. Improvements to waiting facilities at stations can encourage greater use of transit lines and improve service for passengers already using the lines. To the extent that providing shelters induces passengers to shift to transit from private autos, this can help improve air quality. Shelters have no vehicle operating costs, but must be cleaned and maintained to remain attractive. Shelters are only one component of the overall transit experience, which must also include adequate capacity on the transit vehicles and adequate means of access to stations.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Environ. Justice
Access Improvement	NA	❍	NA	NA	●	◗

ADD BIKE RACKS TO COMMUTER RAIL COACHES

Description

This project would provide specially equipped areas within commuter rail coaches for transportation of bicycles.

Capital Features

Bicycle racks and tie-down devices would be provided in a certain number of coaches on all commuter rail trains. In some cases this would require replacement of some existing non-moveable seats with flip-up seats.

Capital Cost	**Undetermined**
Operating Cost	**No increase in operating costs**
Daily Ridership Increase on Mode	**Undetermined**
Net Increase in Daily Transit Ridership	**Undetermined**
Capital Cost per New Transit Rider	**Undetermined**
Operating Cost per Wkday/New Transit Rider	**None**
Capital Cost/Travel Time Benefit	**NA**
Operating Cost/Travel Time Benefit	**NA**

Assessment

This project would make commuter rail travel more convenient for passengers that want or need to use bicycles for both access to and egress from trains. It could also be helpful for reverse-commuters going to jobs that are beyond walking distance of the nearest rail stations and to which no connecting transit service is provided. There is little information from which to estimate the number of riders that would take advantage of on-train bike racks. Survey results indicate that under 0.5% of MBTA commuter rail riders use bicycles for access to their initial boarding stations. This proportion is lower than it might be if bicycles could be brought on board trains or parked at more secure facilities at stations. On-board bicycle racks could result in some reduction of the number of seats on equipped cars. Overall, this project is rated low priority.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Environ. Justice
Access Improvement	NA	❍	NA	NA	◗	❍

ADD MORE MOTORCYCLE PARKING SPACES SYSTEMWIDE

Description

This project would designate some spaces specifically for motorcycle parking at commuter rail and rapid transit stations.

Capital Features

Improvements would be designed on a station-by station basis, and could consist either of re-striping and new signage in sections of existing parking areas or of construction of new spaces specifically for motorcycles.

Capital Cost	**Undetermined**
Operating Cost	**See discussion in assessment below**
Daily Ridership Increase on Mode	**Undetermined**
Net Increase in Daily Transit Ridership	**Undetermined**
Capital Cost per New Transit Rider	**Undetermined**
Operating Cost per Wkday/New Transit Rider	**Undetermined**
Capital Cost/Travel Time Benefit	**Undetermined**
Operating Cost/Travel Time Benefit	**Undetermined**

Assessment

Overall, this project is rated low priority. Improvements to motorcycle parking facilities can result in increased ridership at a lower cost than expansion of automobile parking facilities because several motorcycles can be parked in the same amount of space as one automobile. However, the year-round demand for motorcycle parking at transit stations is quite low. Motorcycle parking facilities have no vehicle operating costs other than those paid by the riders, but they do need to be kept in a state of good repair in order to attract users. Passengers accessing stations by motorcycle would use the same roads as passengers arriving by auto.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Environ. Justice
Access Improvement	NA	❍	NA	NA	❍	◗

CHAPTER 5C

System Expansion

System expansions are projects that would extend a transit line to an area it does not currently serve, implement service on an existing line at a time of day when it is not currently provided, or change the mode of transportation operated on an existing route. The assessments of expansion projects in this chapter are divided into two groups: projects within Massachusetts and multistate projects. The latter consist mostly of commuter rail extensions crossing into New Hampshire or Rhode Island that would require cooperative capital funding agreements with those states. The North-South Rail Link in Boston is also classified as a multistate project, as it would be used by interstate passenger trains in addition to commuter trains.

The evaluation criteria used in the project assessments have been discussed in Chapter 1. The ratings for each project for each of these criteria are shown at the bottom of the assessment page for that project. A ● indicates a high rating, a ◗ indicates a medium rating, and a ❍ indicates a low rating. An overall rating based on a composite of the ratings for all of the evaluation criteria appears at the top of the same page. For the overall ratings the icons meanings are as follows:

- ● High priority
- ◗ Medium priority
- ❍ Low priority

The individual-criteria ratings for each project were based on performance relative to other projects being evaluated within the same mode only. For this purpose, projects were divided into four modes: rapid transit (including the Red, Orange, Blue, Green, and Silver Lines, and Phase 2 and 3 Urban Ring), commuter rail, bus/trackless trolley, and boat. In combining individual-criterion ratings to produce its overall rating, a ❍ was considered to be equivalent to 1/3 of a ●, and 1/2 of a ◗.

The projects within Massachusetts are presented first, followed by multistate projects. Within each of these groups, the order of presentation is from high priority to medium priority to low priority. In each priority category, projects are grouped according to the four modes described above. Key cost and ridership estimates are included with each assessment. Additional details on other quantitative indicators for each project are included in Appendix C.

Expansion Projects within Massachusetts

MAP 5C-1 EXTEND BLUE LINE FROM WONDERLAND TO LYNN

EXTEND BLUE LINE FROM WONDERLAND TO LYNN

Description

This project would extend the Blue Line rapid transit line 4.5 miles from Wonderland Station in Revere to Central Square, Lynn. The alignment would either be parallel to the Newburyport/Rockport commuter rail line or it would make use of the abandoned narrow gauge right of way through Oak Island Center and Point of Pines Center. The MBTA is currently evaluating these options as part of its Draft Environmental Impact Statement (DEIS) for the Revere to Salem corridor. The DEIS will provide additional details on the relative benefits of each alignment. The extension would also include a crossing of the Saugus River, which is a navigable waterway. Consequently, a bridge there would need to accommodate both large vessels on the river and high-frequency rapid transit service. It should be noted that this extension of the Blue Line is intended to complement – not replace – existing commuter rail service to the North Shore.

Capital Features

Rapid Transit line extension including a major river crossing, possible wetlands mitigation requirements, two potential new stations, and purchase of additional Blue Line vehicles.

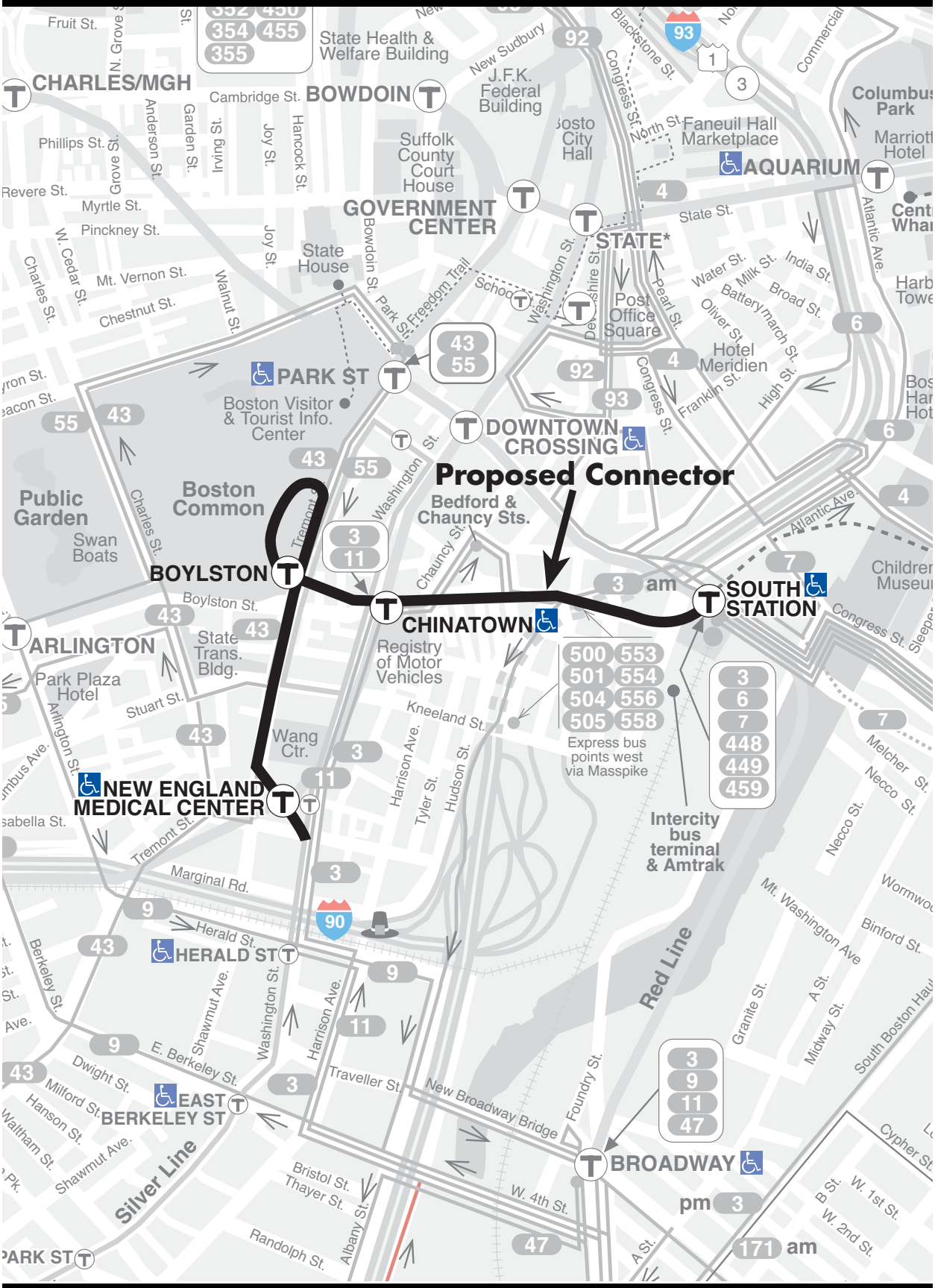
Capital Cost	**$357.6 million (CTPS estimate)**
Operating Cost	**$72,500 per weekday**
Daily Ridership Increase on Mode	**21,000**
Net Increase in Daily Transit Ridership	**7,900**
Capital Cost/New Transit Rider	**$45,300**
Operating Cost per Wkday/New Transit Rider	**$9.20**
Capital Cost/Travel Time Benefit	**$355,800 per hour**
Operating Cost/Travel Time Benefit	**$72.10 per hour**
Travel Time Savings	**1005 hours per weekday**

Assessment

This is a high priority rapid transit expansion project. The capital cost for the project would be $357.6 million and the typical daily operating cost would be $72,500. Extending Blue Line service to Lynn would attract 21,000 new rapid transit riders of which 7,900 would be new transit riders. The remaining 13,100 would be diverted from MBTA bus routes and from the Rockport/Newburyport commuter rail line. The capital cost per new transit rider would be just over $45,000 and the operating cost per new rider would be $9.20. The extension is expected to have major land use and economic impacts on Lynn, particularly in the downtown area, which is a state designated revitalization area with substantial commercial and residential development. Lynn is considered a target area for projects providing environmental justice. Service quality would improve for those passengers now riding MBTA bus service in the area, as transfers would be reduced, travel times to Boston would be improved compared to the bus mode, and frequency of service would be greatly expanded. The extension would provide for transfers between the Newburyport/Rockport commuter rail line and the Blue Line at Lynn Station, and improve access to Logan Airport from locations on the North Shore.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
Line Extension	●	◗	◗	●	◗	●	●

MAP 5C-2 SILVER LINE PHASE III: SOUTH STATION – BOYLSTON CONNECTOR



SILVER LINE PHASE III: SOUTH STATION–BOYLSTON CONNECTOR

Description

This project would construct a new transitway tunnel from South Station to New England Medical Center station with intermediate stops at Boylston and Chinatown stations. The segment would link Phase 1 of the Silver Line, which runs between New England Medical Center and Dudley, with Phase 2 from South Station to Logan Airport via the World Trade Center. The Phase III segment would also allow for direct transfers from all segments of the combined Silver Line with the Red Line, Orange Line, and Green Line. Silver Line Phase III is an ACO legal commitment (see table 2-2).

Capital Features

Construction of a transitway tunnel with three new underground stations at major transfer points with other rapid transit lines. Purchase of additional dual-mode vehicles.

Capital Cost	**$951.9 million (MBTA Planning Dept. estimate)**
Operating Cost	**$2,600 per weekday**
Daily Ridership Increase on Mode	**20,500**
Net Increase in Daily Transit Ridership	**4,500**
Capital Cost/New Transit Rider	**$210,600**
Operating Cost per Wkday/New Transit Rider	**$0.60**
Capital Cost/Travel Time Benefit	**$386,700 per hour**
Operating Cost/Travel Time Benefit	**$1.00 per hour**
Travel Time Savings	**2,462 hours per weekday**

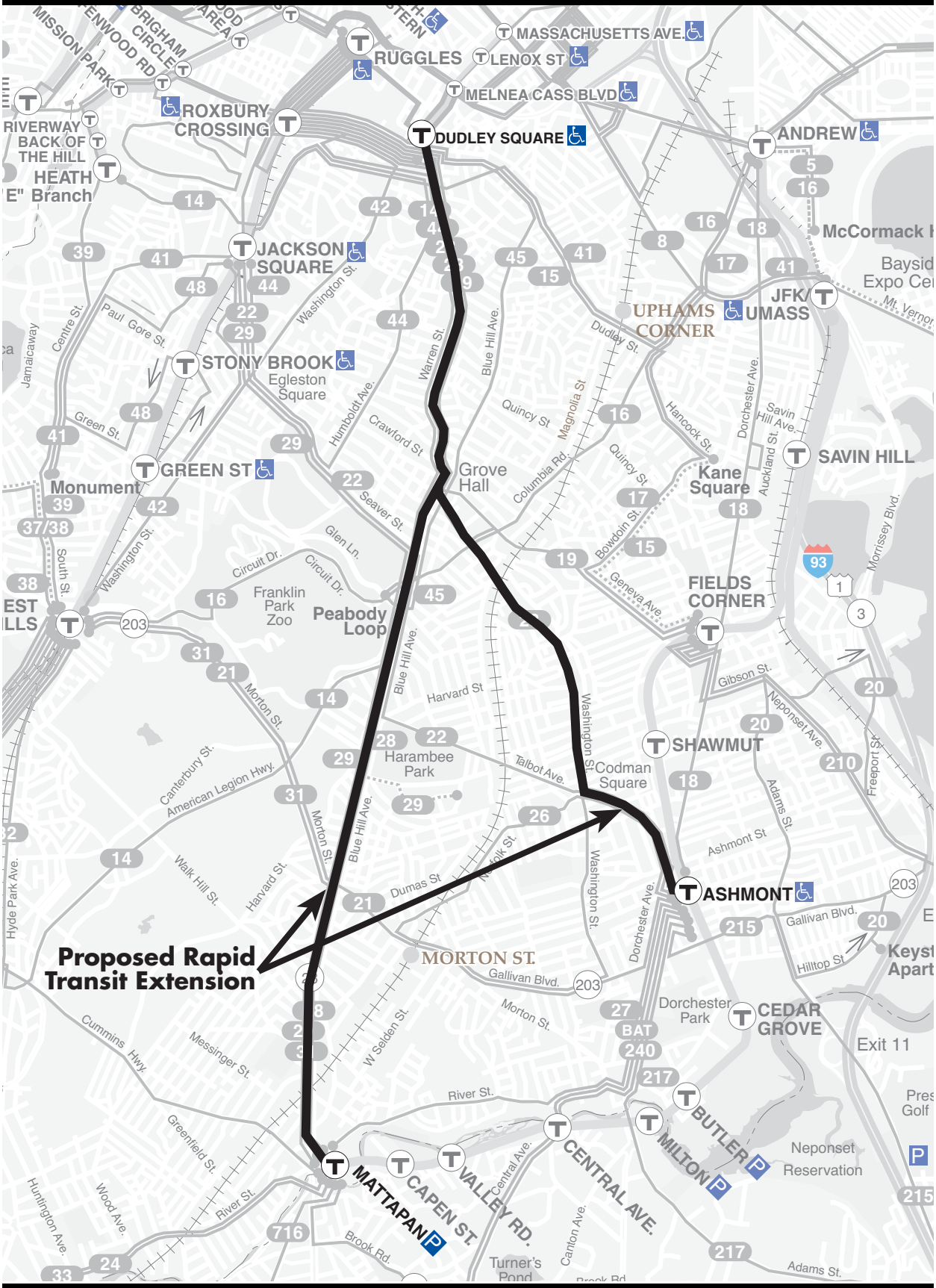
Assessment

This is a high priority rapid transit expansion project. The capital cost for this project would be $951.9 million. This figure is a planning level estimate that includes 50% contingency and inflation based on a projected year of expenditure with completion by 2010. The typical daily operating cost would be $2,600. This project would connect two disconnected segments of the Silver Line and created one through route between Roxbury, Downtown, South Boston, and Logan Airport. The project would attract 20,500 passengers to the mode of which 4,500 would be new transit riders. This project would result in a moderate reduction in air pollution. The anticipated high construction costs result in moderate cost effectiveness per new transit rider despite drawing a large number of new riders. Because the segment of new construction is short and would also result in a combination of two planned or existing services, the operating cost per new passenger would be very low.

The project would provide improved access and connections to the South Boston Waterfront area, which is expected to be an area of high employment growth and mixed use development with residential areas, and would provide improved access from residential areas in Roxbury which are a high priority for environmental justice. Direct transfers would be provided to the Green Line, Orange Line, and the Red Line.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
Line Extension	●	●	◗	◗	◗	●	●

MAP 5C-3 SILVER LINE SOUTH EXTENSION TO ASHMONT AND MATTAPAN



SILVER LINE SOUTH EXTENSION TO ASHMONT AND MATTAPAN

Description:

This project would extend Silver Line bus rapid transit service beyond Dudley station to Ashmont and Mattapan. Service would follow Warren Street from Dudley to Grove Hall, and would then split into two branches. One branch would be 4.4 miles in length (including the segment between Dudley and Grove Hall) and continue on Blue Hill Avenue to Mattapan station, and the other would be 3.5 miles long and continue along Washington Street to Ashmont. These branches would replace present MBTA bus Routes 23 and 28. Bus priority lanes and sheltered stops containing passenger information would be constructed along the route. ITS technology would be used to monitor and regulate service.

Capital Features

Construction and installation of dedicated bus lanes, priority signals, and passenger shelters with amenities. Purchase of additional dual-mode buses.

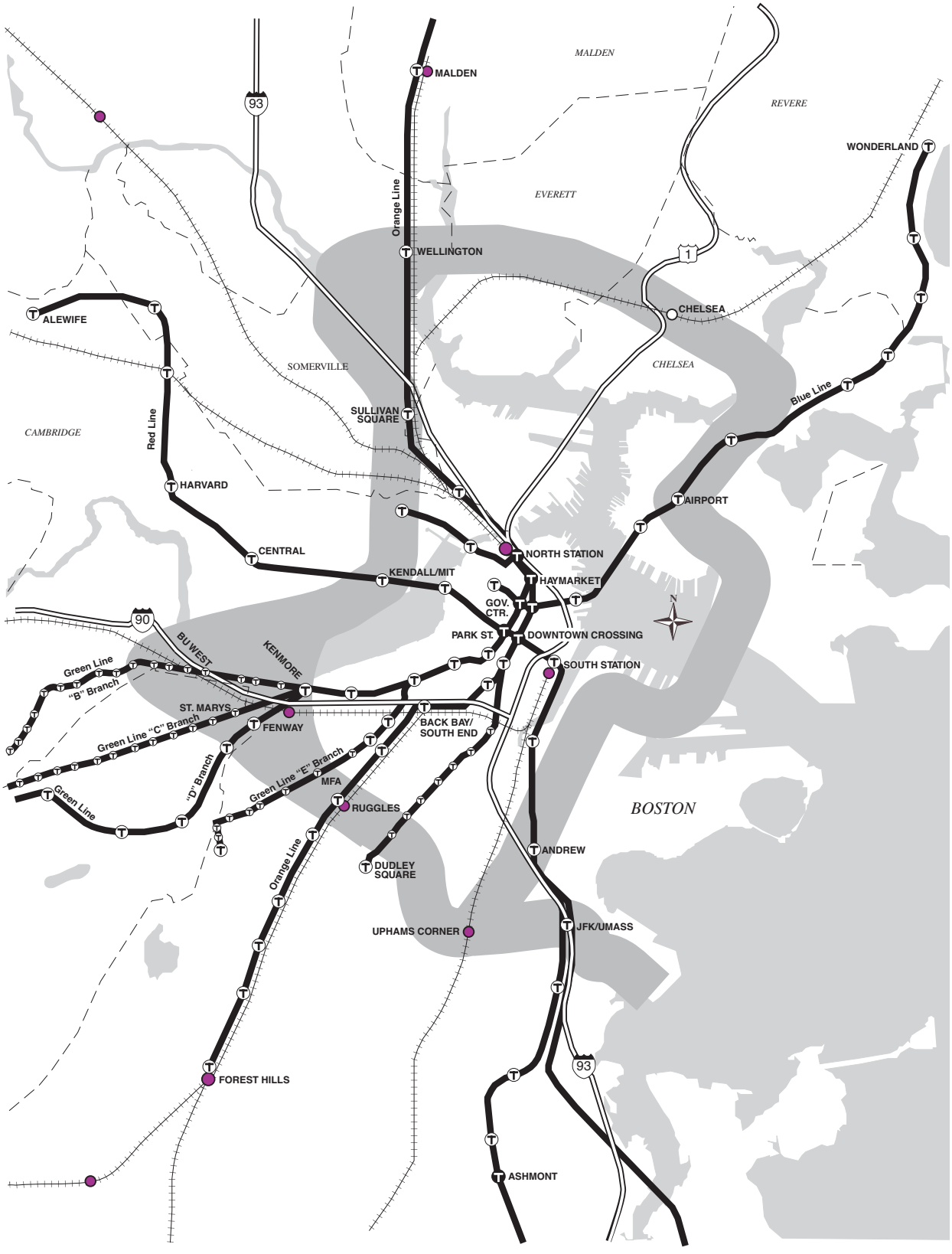
Capital Cost	**$43.7 million (CTPS estimate)**
Daily Operating Cost	**No added cost, replaces bus Routes 23 and 28**
Daily Ridership Increase on Mode	**29,300**
Net Increase in Daily Transit Ridership	**1,300**
Capital Cost/New Transit Rider	**$35,000**
Operating Cost per Wkday/New Transit Rider	**No increase, would replace existing service**
Capital Cost/Travel Time Benefit	**$172,300**
Operating Cost/Travel Time Benefit	**None**
Travel Time Savings	**250 hours per weekday**

Assessment

This is a high priority rapid transit expansion project. The capital cost for this project would be $43.7 million. This project would replace existing bus service and there would be no added operating cost compared to the service replaced. This service would attract 29,300 riders to the mode, of which only 1,300 would be new transit riders. The capital costs per new rider would be $35,000. The majority of riders would be diverted from existing bus Routes 23 and 28 which would be replaced by this service. There would be no major improvements in air quality resulting from this service, as few riders would be drawn from automobiles. Reducing the number of stops, installing signal priority systems for buses, and installing bus-only lanes would however improve travel time compared to existing local bus service. The larger articulated vehicles used on this service would reduce crowding. Reliability would be improved through the use of dedicated rights of ways, priority lanes, signal prioritization, and Automatic Vehicle Locator systems that provide real time vehicle location information to dispatchers, planners, and customers. Direct service to Downtown Boston would be available without transferring at Dudley or Ruggles as required now. Service would be provided to neighborhoods in Dorchester and Roxbury, which are target neighborhoods for environmental justice purposes. The population served would be within low-income, high-minority, and transit-dependent neighborhoods. The project would fill a gap in the rapid transit system between the existing Red Line Dorchester branch and the Orange Line.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
Line Extension	◗	◗	●	◗	●	●	●

MAP 5C-4 URBAN RING PHASE 2



URBAN RING PHASE 2

Description

The Urban Ring is a multi-phase project. Three phases have been defined and each phase will be additive; that is each new service will add capacity to previous improvements-not replace them. Phase 2 of the Urban Ring builds upon the bus routes of Phase 1 by adding seven Bus Rapid Transit (BRT) routes through the Urban Ring corridor. Some of the BRT routes in Phase 2 would be new and others would be modified or upgraded versions of Phase I bus routes. Phase 2 would utilize 60' articulated low-floor, low emission buses, segments of exclusive busway, Intelligent Transportation System (ITS) features, and supporting elements to improve connections with radial transit and commuter rail lines. Among the supporting elements would be new or expanded commuter rail stations at Downtown Chelsea, Sullivan Square, Gilman Square, Union Square, Yawkey, Ruggles, and Uphams Corner.

Capital Features

Construction of grade-separated and exclusive lane BRT segments, construction of new or expanded commuter rail stations, installation of signal priority systems for BRT vehicles, and purchase of BRT vehicles.

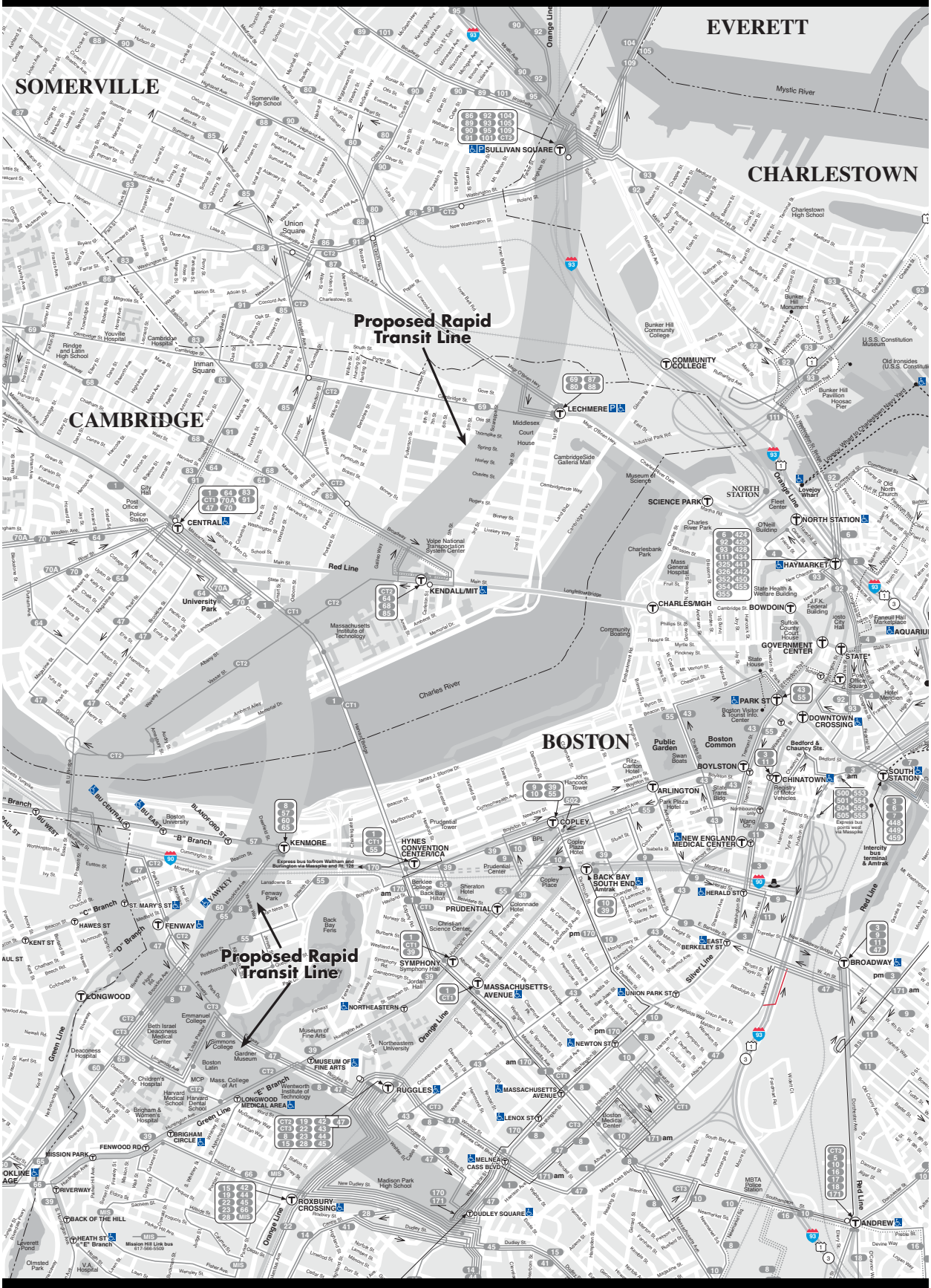
Capital Cost	**$500.0 million (Urban Ring MIS)**
Operating Cost	**$70,700 per weekday**
Daily Ridership Increase on Mode	**53,000**
Net Increase in Daily Transit Ridership	**15,000**
Capital Cost/New Transit Rider	**$33,300**
Operating Cost per Wkday/New Transit Rider	**$4.70**
Capital Cost/Travel Time Benefit	**$26,800 per hour**
Operating Cost/Travel Time Benefit	**$3.80 per hour**
Travel Time Savings	**18,692 hours per weekday**

Assessment

This is a high priority rapid transit expansion project. The capital costs for this project would be $500 million and the typical daily operating cost would be $70,700. Phase 2 of the Urban Ring would bring in 53,000 riders to the mode of which 15,000 would be new transit riders. The remaining riders would be diverted from other modes. The capital cost per new transit rider would be $33,300. The operating cost per new transit rider would be $4.70. The Urban Ring scores high for cost effectiveness both for capital and operating costs per new transit rider. Improvements to air quality as a result of this project would score highly, thanks to the large number of new transit riders diverted from automobiles. The routes would serve a number of environmental justice target neighborhoods including parts of Everett, Chelsea, Somerville, Cambridge, Roxbury, and Dorchester. Existing or proposed employment areas at Logan Airport, Chelsea, Assembly Square, Kendall Square, Cambridgeport, Longwood Medical Area, and Crosstown Center would receive direct service from this project. This results in a very high rating for land use and economic impacts. All existing radial rapid transit and commuter rail lines would interface with Urban Ring Phase 2 routes. Riders could avoid traveling through Downtown Boston by using the Urban Ring instead of transferring between existing services. Riders diverted to the Urban Ring would free up capacity on other parts of the transit network including the Red, Orange, and Green Lines. Reliability would be improved through the use of dedicated rights of ways, priority lanes, signal prioritization, and Automatic Vehicle Locator systems.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
Line Extension	●	●	●	●	●	●	●

MAP 5C-5 URBAN RING PHASE 3



URBAN RING PHASE 3

Description

The Urban Ring is a multi-phase project. Three phases have been defined and each phase will be additive; that is each new service will add capacity to previous improvements-not replace them. Phase 3 of the Urban Ring adds a new Urban Ring rail system between the Orange Line at Assembly Square and Dudley Square operating through Sullivan, Lechmere, Kendall Square, MIT, Boston University, Longwood Medical Area, and Ruggles. Light rail or heavy rail technology would be utilized.

Capital Features

Construction of a rail rapid transit line and stations using either light rail or heavy rail modes.

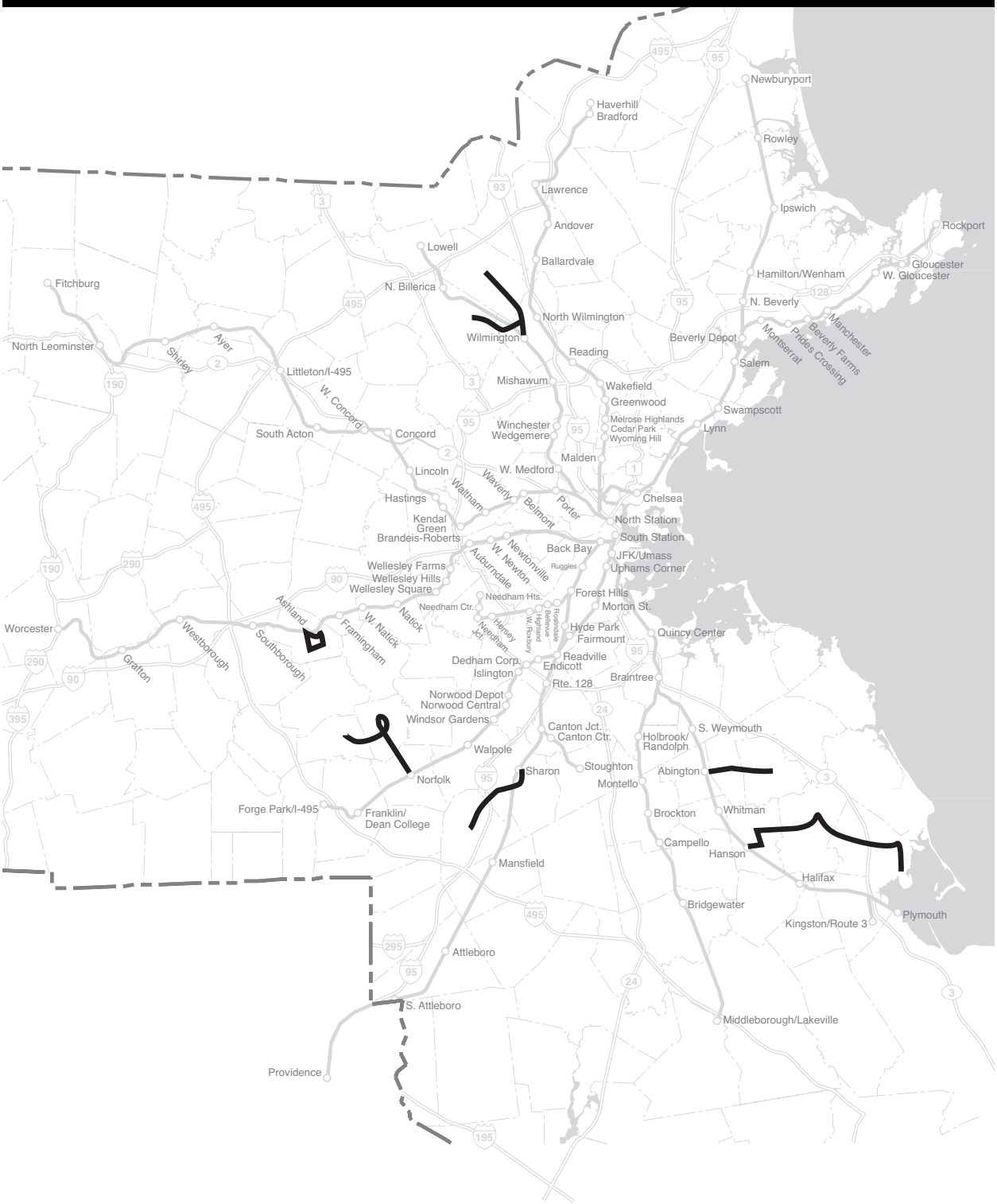
Capital Cost	**$2.8 billion (Urban Ring MIS)**
Operating Cost	**$195,600 per weekday**
Daily Ridership Increase on Mode	**134,700**
Net Increase in Daily Transit Ridership	**54,600**
Capital Cost/New Transit Rider	**$51,300**
Operating Cost per Wkday/New Transit Rider	**$3.60**
Capital Cost/Travel Time Benefit	**$56,300 per hour**
Operating Cost/Travel Time Benefit	**$3.90 per hour**
Travel Time Savings	**49,695 hours per weekday**

Assessment

This is a high priority rapid transit expansion project. The capital cost for this project would be $2.8 billion and the typical daily operating cost would be $195,600. This project would complete the proposed Urban Ring network by constructing a rail system using either heavy rail technology similar to the Orange Line or light rail technology similar to the Green Line. The routing would replace a portion of the proposed Phase 2 BRT service. The total ridership increase for the mode would be 134,700 of which 54,600 would be new transit riders. The project capital cost of $2.8 billion is the most expensive rapid transit project evaluated. The capital cost per new rider would be $51,300. The operating cost per new transit rider would be $3.60. Despite the high total costs, the project scores high for both capital and operating costs per new transit rider compared to all rapid transit expansion projects. Urban Ring Phase 3 would improve mobility by reducing the number of transfers required to reach areas of anticipated employment growth in Cambridge, Allston, and Roxbury. This results in a very high rating for land use and economic impacts. Riders could avoid traveling through Downtown Boston by using the Urban Ring instead of transferring between existing services. Passengers diverted to the Urban Ring would free up capacity on other parts of the transit network including the Red, Orange, and Green Lines. There would be positive improvements in air quality, because of the large number of new transit riders this service would attract. Environmental justice needs would be met, as service would be expanded and improved to target neighborhoods in Somerville, Cambridge and Roxbury.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
Line Extension	●	●	●	●	●	●	●

MAP 5C-6 SUBURBAN COMMUTER RAIL FEEDER BUS SERVICES



SUBURBAN COMMUTER RAIL FEEDER BUS SERVICES

Description

This project would implement new feeder bus services to several suburban commuter rail stations that currently have no transit service connections.

Capital Features

An average of two vehicles would be needed to operate peak-period service on each new feeder route.

Capital Cost	**$7.5 million (assuming up to 15 routes–CTPS estimate)**
Operating Cost	**$29,000 per weekday (for 15 routes with all-day service)**
Daily Ridership Increase on Mode	**2,700**
Net Increase in Daily Transit Ridership	**1,900**
Capital Cost per New Transit Rider	**$3,900**
Operating Cost per Wkday/New Transit Rider	**$14.90**
Capital Cost/Travel Time Benefit	**$36,100 per hour**
Operating Cost/Travel Time Benefit	**$137.40 per hour**
Travel Time Savings	**208 hours per weekday**

Assessment

This project would provide a new alternative for access to suburban commuter rail stations. At present, use of many stations is constrained by shortages of parking capacity and a lack of access alternatives other than private automobile. Designing productive suburban routes is difficult because of low population density and scattered trip origins. Preliminary analysis indicates that the more promising new routes would include ones from the south side of Billerica to Wilmington Station, from the southeast side of Ashland to Ashland Station, from Medway via Millis to Norfolk Station, from Foxborough to Sharon Station, from Hanover via Rockland to Abington Station and from South Duxbury via Pembroke to Hanson Station. While many new suburban routes would not serve environmental justice target areas, some would serve small urban areas with low income neighborhoods. Overall, this project is rated high.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Environ. Justice
Line Extension/ New Line	◗	●	◗	◗	●	●

MAP 5C-7 URBAN RING PHASE 1

URBAN RING PHASE 1

Description

The Urban Ring is a multi-phase project. Three phases have been defined and each phase will be additive; that is each new service will add capacity to previous improvements-not replace them. Phase 1 of the Urban Ring consists of a significant expansion in the number of routes and reach of the Crosstown (CT) bus route network within Boston, Brookline, Cambridge, Chelsea, Everett, and Somerville, and the addition of new Express Commuter (EC) service to provide single seat radial and crosstown service from suburban locations into the Urban Ring corridor communities. Phase 1 bus routes will utilize 100 40-foot low-floor CNG powered buses. Maintenance facilities must be expanded to accommodate these vehicles.

Capital Features

Purchase of 100 additional CNG buses and expansion of CNG maintenance facilities.

Capital Cost	**$100.0 million (Urban Ring MIS)**
Operating Cost	**$100,300 per weekday**
Daily Ridership Increase on Mode	**21,400**
Net Increase in Daily Transit Ridership	**5,500**
Capital Cost/New Transit Rider	**$18,200**
Operating Cost per Wkday/New Transit Rider	**$ 18.20**
Capital Cost/Travel Time Benefit	**$72,000 per hour**
Operating Cost/Travel Time Benefit	**$72 per hour**
Travel Time Savings	**1388 hours per weekday**

Assessment

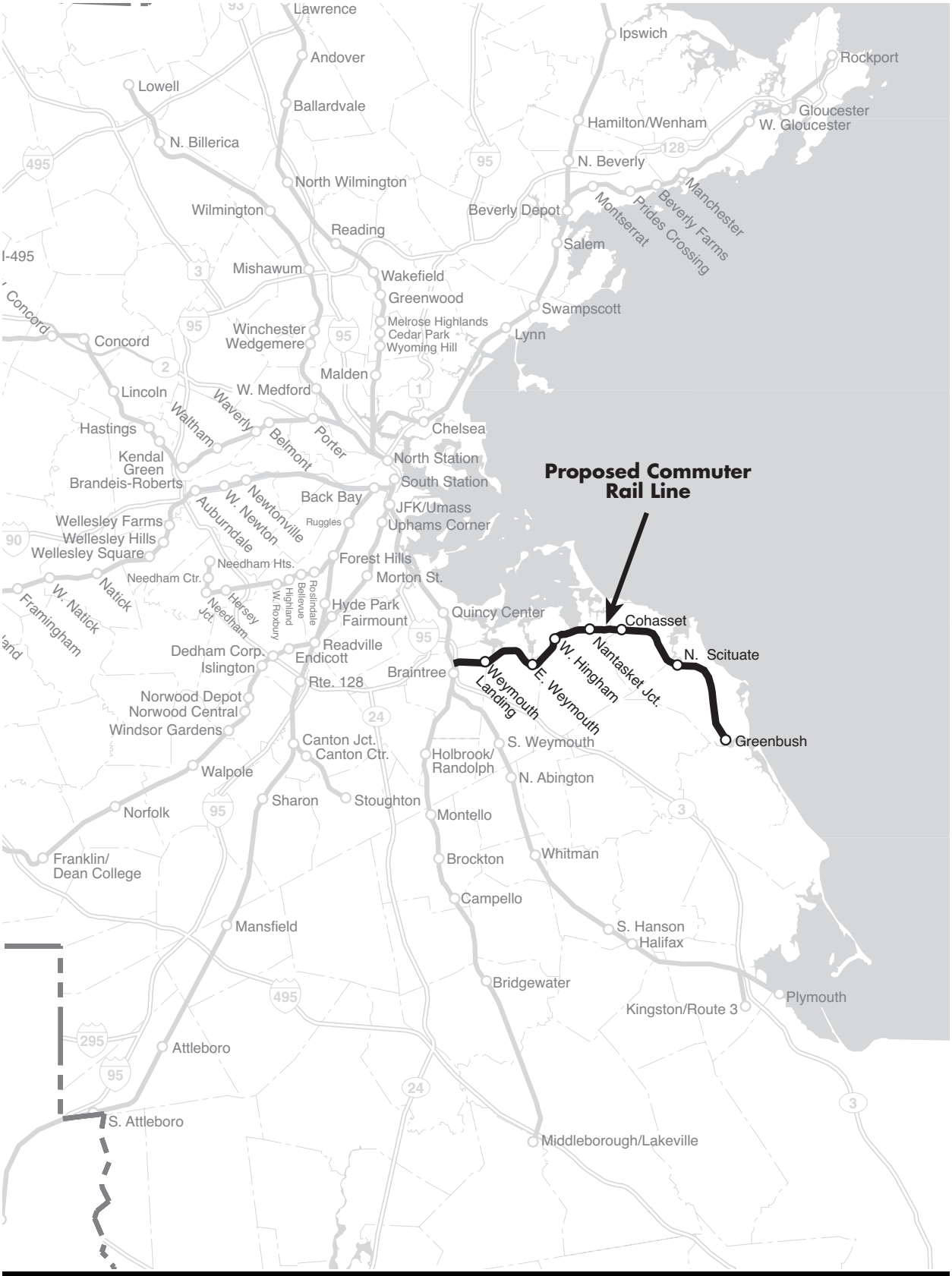
This is a high-priority bus expansion project. The capital costs for this project would be $100 million and the typical daily operating costs would be $100,300. This project would attract 21,400 riders to the mode of which 5,500 would be new transit riders. Capital cost per new transit rider would be $18,200 and operating cost per new transit rider would be $18.20. Capital costs would be limited to the acquisition of vehicles and the provision of maintenance facilities for the vehicles. The project would not be very cost effective for either capital or operating costs per new rider compared to other bus/trackless trolley expansion projects. The project would have little impact on air quality.

The service would have high utilization though and would help reduce crowding on other transit services by diverting riders. There would be a moderate impact on mobility, as the Phase I routes serve areas that have other transit alternatives, although total service offered would be increased.

Service quality would improve, as Phase I routes would reduce the amount of transfers required to complete journeys in the urban core area. The routes would serve target neighborhoods for environmental justice including parts of Chelsea, Everett, Somerville, Cambridge, Roxbury, and Dorchester. Existing or proposed employment areas at Logan Airport, Chelsea, Assembly Square, Kendall Square, University Park, Longwood Medical Area, and Crosstown Center would receive direct service from this project. All existing radial rapid transit lines would interface with Urban Ring Phase 1 routes. Riders diverted to the Urban Ring would free up capacity on other parts of the transit network including the Red, Orange, and Green Lines.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Environ. Justice
Line Extension/ New Line	●	◗	❍	❍	●	●

MAP 5C–8 COMMUTER RAIL BRANCH FROM EXISTING OLD COLONY LINES TO GREENBUSH



COMMUTER RAIL BRANCH FROM EXISTING OLD COLONY LINES TO GREENBUSH

Description

This project would restore commuter rail service on a third branch of the Old Colony lines, diverging from the route of the Middleborough/Lakeville and Plymouth/Kingston lines in Braintree and following a combination of active and inactive rail freight routes to the Greenbush section of Scituate. Rail passenger service on this branch was last operated in 1959. This project is a SIP, CA/T, and ACO legal commitment (see table 2-2).

Capital Features

Commuter rail service would be extended over 18 route-miles, of which about one mile is currently used for freight service. Extensive reconstruction on the inactive segment and upgrading of track on the active segment would be required. Several grade crossings at Hingham Center would be eliminated by placing the rail line in a tunnel. A major grade-separation project at Weymouth landing is also anticipated. There would be seven new stations on the line, in Weymouth, Hingham, Cohasset, and Scituate. The Greenbush terminal would be a short distance from the border of Marshfield.

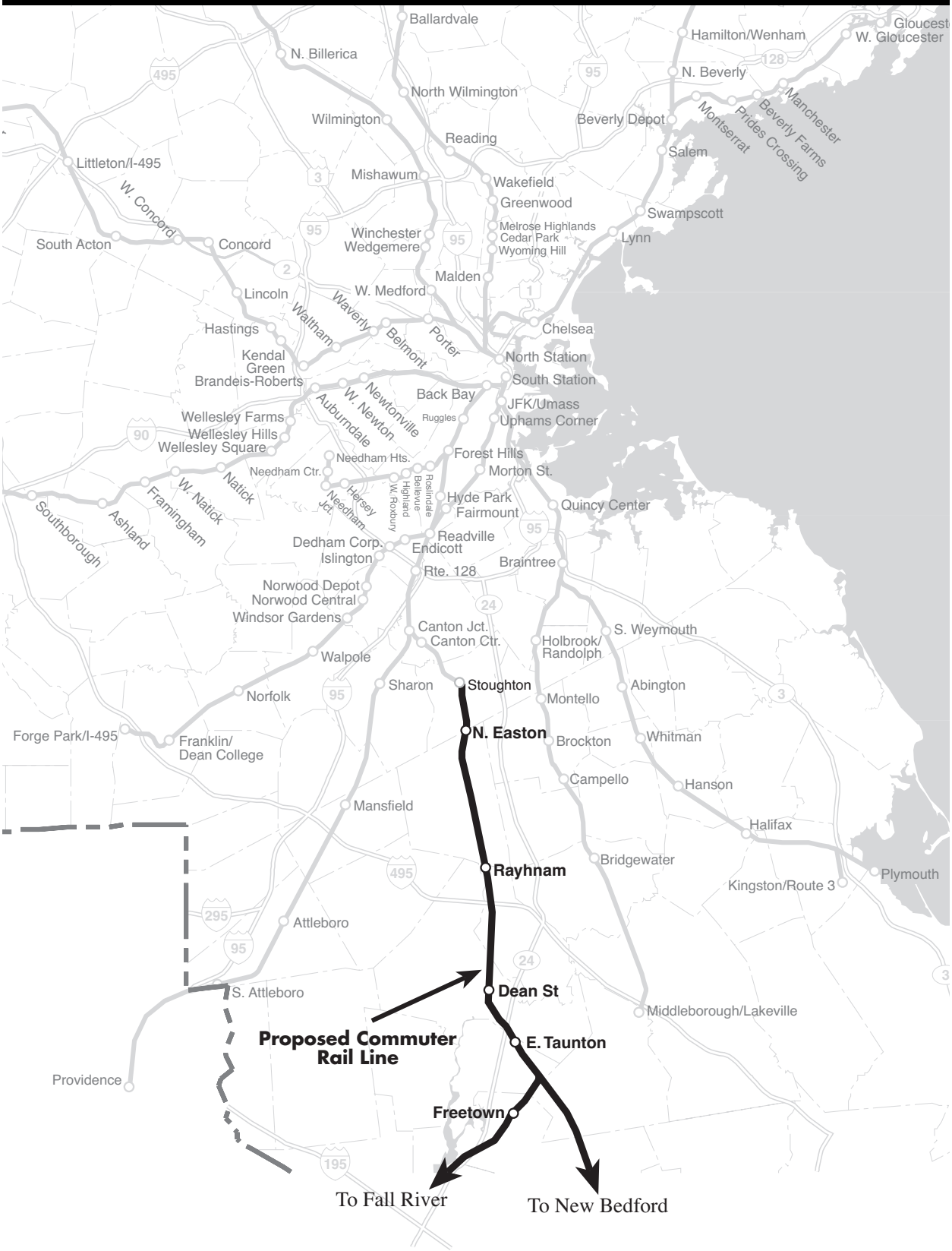
Capital Cost	**$470.0 million**
Operating Cost	**$34,000 per day**
Daily Ridership Increase on Mode	**11,400**
Net Increase in Daily Transit Ridership	**4,600**
Capital Cost per New Transit Rider	**$102,000**
Operating Cost per Wkday/New Transit Rider	**$7.40**
Capital Cost/Travel Time Benefit	**$435,500 per hour**
Operating Cost/Travel Time Benefit	**$31.40 per hour**
Travel Time Savings	**1,079 hours per weekday**

Assessment

Overall, this project is rated high priority. It would attract the second-largest number of total riders and the third-largest number of new transit riders of all commuter rail projects examined for the PMT. In absolute terms it would have one of the highest capital costs of all commuter rail projects, but because of the high ridership, the capital cost per new rider would be near the upper end of the mid-range among such projects. The operating cost per new rider would be at the lower end of the mid-range for commuter rail projects. The project would not serve any environmental justice target communities, but three of the seven stations would serve state-designated revitalization areas. It would rank fourth among all commuter rail projects in reductions of CO, CO2, and VOC emissions, but it would result in the sixth-highest increase in NOx emissions of all commuter rail projects. It would produce the fourth-highest travel time savings among such projects.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
New Line	●	●	◗	◗	❍	❍	❍

MAP 5C-9 COMMUTER RAIL TO NEW BEDFORD/FALL RIVER



COMMUTER RAIL TO NEW BEDFORD/FALL RIVER

Description

This project would extend commuter rail service from the end of the Stoughton Line via a combination of inactive and active rail freight routes to Fall River and New Bedford. Rail passenger service to Boston from Fall River and New Bedford was last operated in 1958.

Capital Features

Commuter rail would be extended over 47 route-miles, of which 21 would be used by trains from both Fall River and New Bedford, and the rest would consist of separate branches to the two cities. Extensive reconstruction on the inactive segments and upgrading of tracks and signals on the active segments would be required. There would be seven new stations, in Easton, Raynham, Taunton, Freetown, Fall River, and New Bedford.

Capital Cost	**$670.0 million (MBTA Planning Dept. estimate)**
Operating Cost	**$69,200 per weekday**
Daily Ridership Increase on Mode	**8,700**
Net Increase in Daily Transit Ridership	**7,100**
Capital Cost per New Transit Rider	**$94,500**
Operating Cost per Wkday/New Transit Rider	**$9.80**
Capital Cost/Travel Time Benefit	**$156,800 per hour**
Operating Cost/Travel Time Benefit	**$16.20 per hour**
Travel Time Savings	**4,273 hours per weekday**

Assessment

Overall, this project is rated high-priority. It would attract the second-largest number of commuter rail riders and new transit users of all commuter rail projects examined for the PMT. New Bedford and Fall River are the seventh and eighth largest cities in Massachusetts in total population, and the largest municipalities within a 50-mile radius of Boston that now have neither commuter rail nor other rail transit service. The majority of the stations would be in state-designated revitalization areas. The project is rated medium in cost-effectiveness and in air quality benefit. In absolute terms, it would be the second-costliest commuter rail project examined, but the cost per new transit rider would be in the mid-range among such projects. It would be second only to a North-South rail link in reductions of CO, CO2, and VOC emissions, but because of the substantial number of additional locomotive-miles required, it would increase NOx emissions more than any project except a Framingham/Leominster extension.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
Line Extension	●	●	◗	◗	○	◗	◗

MAP 5C–10 NEW COMMUTER RAIL STATION AT UNION SQUARE, SOMERVILLE

NEW COMMUTER RAIL STATION AT UNION SQUARE, SOMERVILLE

Description

This project would add a new commuter rail station on the Fitchburg commuter rail line near Union Square in Somerville, between the existing Porter Square Station in Cambridge and North Station in Boston. A previous Union Square station was discontinued in 1938.

Capital Features

This project would consist of one new station on an existing line. No upgrading of tracks would be needed. No increase in rolling stock would be needed.

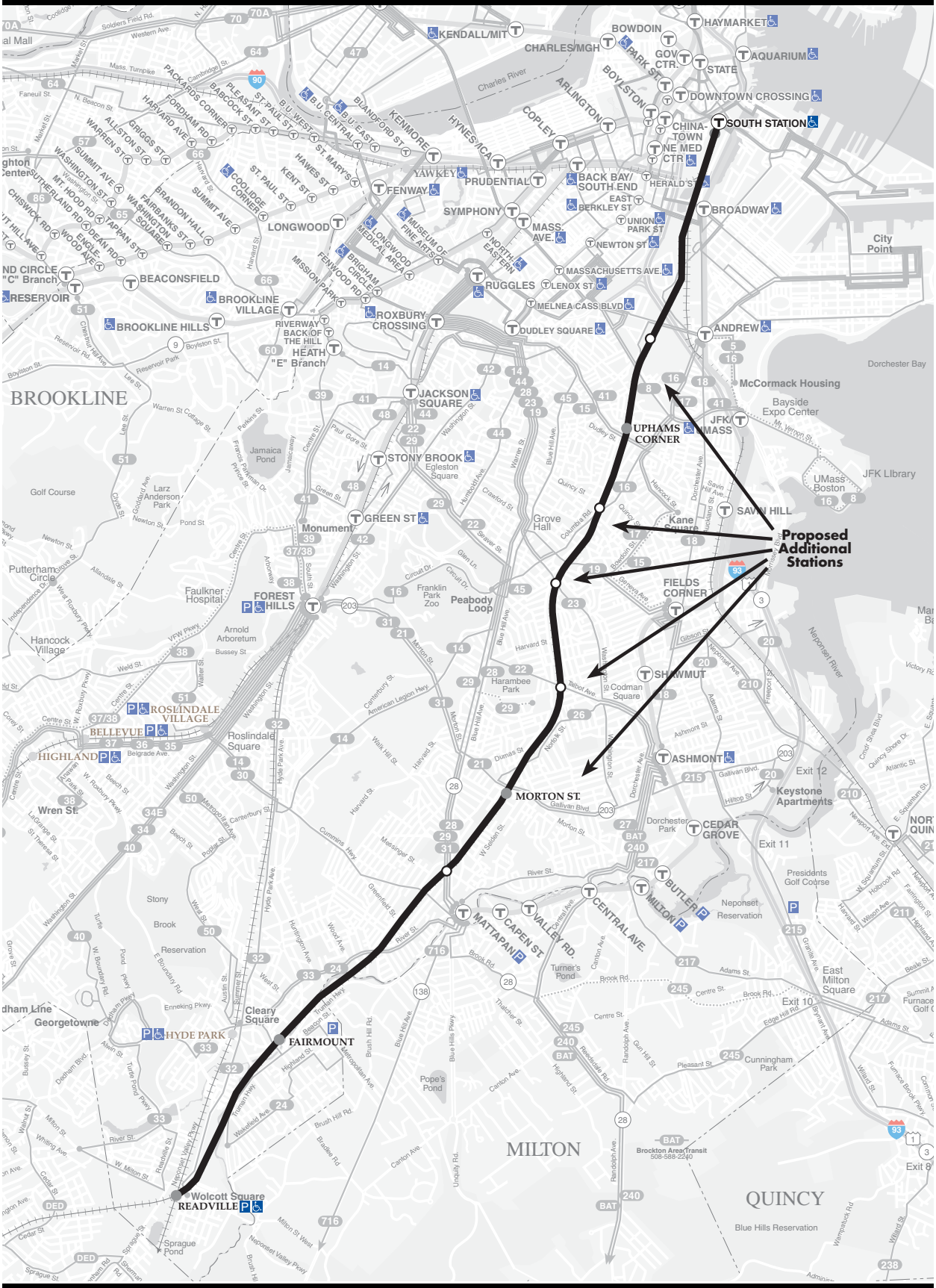
Capital Cost	**$4.1 million (CTPS estimate)**
Operating Cost	**Increased fuel from extra starts and stops, too small to calculate**
Daily Ridership Increase on Mode	**390**
Net Increase in Daily Transit Ridership	**160**
Capital Cost per New Transit Rider	**$25,400**
Operating Cost per Wkday/New Transit Rider	**Too small to calculate**
Capital Cost/Travel Time Benefit	**$58,600 per hour**
Operating Cost/Travel Time Benefit	**Too small to calculate**
Travel Time Savings	**69 hours per weekday**

Assessment

Overall, this project is rated high priority. It would provide direct commuter rail service to a densely developed section of Somerville that is now served by several local bus routes that connect with rapid transit lines. It would attract relatively few new transit riders, but because the only cost involved would be that of a new station, the capital cost per new rider would be among the lowest of all commuter rail expansion projects analyzed for the PMT. The maximum load point on Fitchburg Line trains occurs west of Porter Square, so there is sufficient excess capacity for new riders between Union Square and North Station. This project has excellent ratings in terms of environmental justice, as it would introduce direct rail service to downtown Boston from a minority neighborhood. It also rates high in economic and land use impacts because it would be in a state-designated revitalization area with plans for substantial mixed-use development. It would, however, have only a limited impact on air quality.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
New Station	○	◗	●	◗	○	●	●

MAP 5C-11 FAIRMOUNT LINE IMPROVEMENTS



FAIRMOUNT LINE IMPROVEMENTS

Description

This project would upgrade service on the Fairmount commuter rail line by adding new stations on the existing route and by increasing the frequency of service.

Capital Features

Up to five new stations would be built in Boston neighborhoods, interspersed with existing stations. Approximate locations under consideration include Blue Hill Avenue near Mattapan Square, Talbot Avenue, Washington Street and Columbia Road in Dorchester, and Newmarket Square in Roxbury. Route length would not change. Some additional rolling stock would be needed to increase peak service frequency.

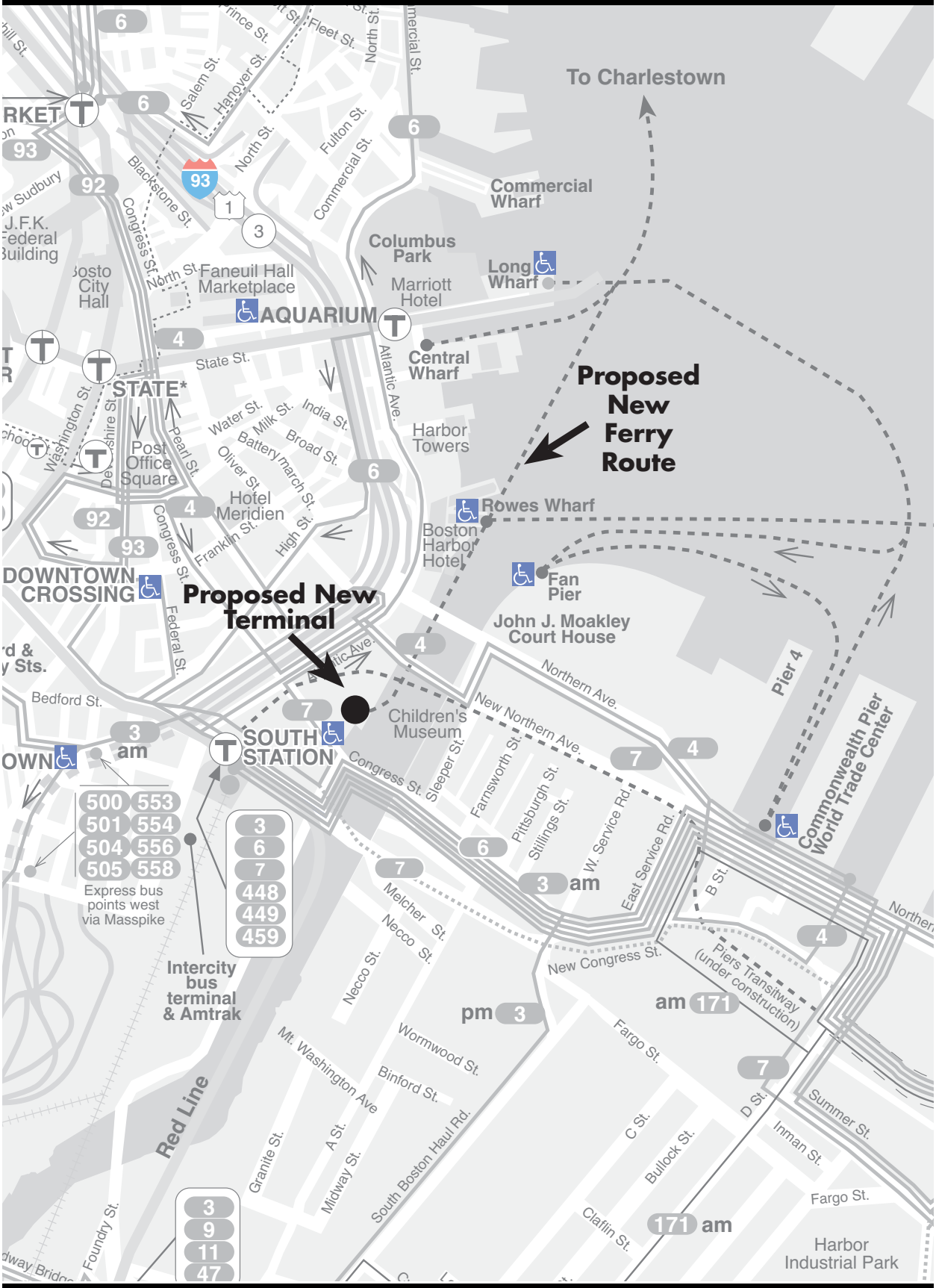
Capital Cost	**$70.0 million (MBTA Planning Dept. estimate)**
Operating Cost	**$2,800 per weekday**
Daily Ridership Increase on Mode	**6,500**
Net Increase in Daily Transit Ridership	**220**
Capital Cost per New Transit Rider	**$318,180**
Operating Cost per Wkday/New Transit Rider	**$12.70**
Capital Cost/Travel Time Benefit	**$158,000 per hour**
Operating Cost/Travel Time Benefit	**$6.30 per hour**
Travel Time Savings	**443 hours per weekday**

Assessment

Overall, this project is rated high priority. It would provide direct rail service to the Financial and Waterfront districts from sections of Dorchester now served by feeder buses to rapid transit lines. The number of riders served would be among the largest of any of the commuter rail expansion projects examined for the PMT, but the majority of them would be diverted from other transit services. Consequently, the capital cost per new transit rider would be among the highest of any commuter rail project, but the capital cost per hour of travel time saving would be among the lowest. There would be little benefit to air quality, because few auto trips would be eliminated. The project is rated high in economic and land-use impacts. All of the existing and proposed new station sites are located in state-designated revitalization areas. Local plans call for high-density residential development near these sites, along with new commercial or industrial development. Most of the stations would be in environmental justice target neighborhoods, and most of the new ones would serve areas that are not currently served directly by rail transit lines to downtown Boston. It is the only commuter rail project with a high rating for service quality, because of its contributions to passenger safety and security, comfort and convenience, and reductions of transfers.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
New Station	◗	●	◗	○	●	●	●

MAP 5C-12 FERRY EXPANSION-RUSSIA WHARF/SOUTH STATION



FERRY EXPANSION–RUSSIA WHARF/SOUTH STATION

Description

This project would implement a new ferry route in Boston Inner Harbor, from the existing terminal at the Charlestown Navy Yard to a new terminal at Russia Wharf, in Fort Point Channel at Congress Street. The construction of Russia Wharf is a CA/T legal commitment (see table 2-2).

Capital Features

This route would require acquisition of two medium-size low-speed commuter ferries, and construction of a new terminal at Russia Wharf.

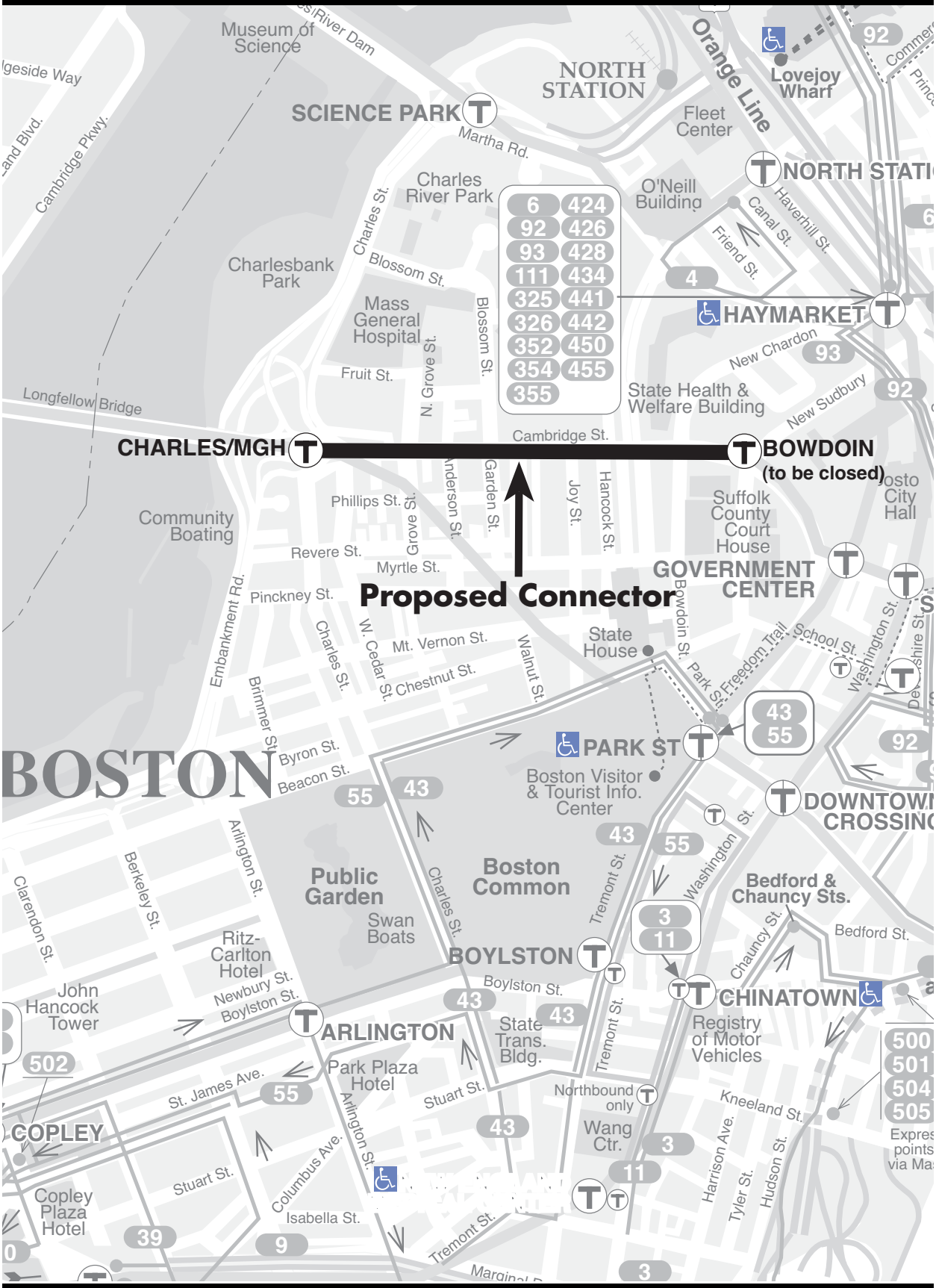
Capital Cost	**$4.0 million (CTPS estimate)**
Operating Cost	**$3,400 per day**
Daily Ridership Increase on Mode	**1,000**
Net Increase in Daily Transit Ridership	**50**
Capital Cost per New transit Rider	**$80,000**
Operating Cost per Wkday/New transit Rider	**$67.10**
Capital Cost/Travel Time Benefit	**$467,800 per hour**
Operating Cost/Travel Time Benefit	**$397.70 per hour**
Travel Time Savings	**9 hours per weekday**

Assessment

This project would provide more convenient connections from homes in the former Charlestown Navy Yard complex to work locations in much of the Financial/Retail and Waterfront districts than is currently provided by existing transit alternatives. It would attract few riders that would not otherwise use some form of transit. The capital and operating costs per new transit rider would be the second-lowest among water transportation projects examined for the PMT. The route would not provide direct service to any environmental justice target communities, but the Russia Wharf terminal would serve a state-designated revitalization area. The overall rating of this project is high priority.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
Line Extension/ New Line	◗	◗	●	○	◗	●	○

MAP 5C-13 BLUE-RED CONNECTOR



BLUE–RED CONNECTOR

Description

This project would extend the Blue Line from Bowdoin Station in Boston to the Charles/MGH Red Line Station via a new subway, allowing a direct transfer between these lines. The Blue-Red Connector is a SIP, CA/T, and ACO legal commitment (see table 2-2).

Capital Features

This would be a 0.4-mile extension, entirely in a new subway, including the addition of a new level to the Charles/MGH Station. (Bowdoin Station is scheduled to be closed in conjunction with implementation of six-car train service on the Blue Line.)

Capital Cost	**$174.6 million (Based on 2000–2025 RTP update)**
Operating Cost	**$7,200 per weekday**
Daily Ridership Increase on Mode	**6,500**
Net Increase in Daily Transit Ridership	**2,800**
Capital Cost per New Transit Rider	**$63,500**
Operating Cost per Wkday/New Transit Rider	**$2.60**
Capital Cost/Travel Time Benefit	**$107,500 per hour**
Operating Cost/Travel Time Benefit	**$4.50 per hour**
Travel Time Savings	**1,625 hours per weekday**

Assessment

Overall, this project is rated medium priority. Capital cost would be in the mid-range among rapid transit extension projects analyzed. It would be among the more cost-effective projects in terms of capital cost relative to new transit rider and to air quality improvements. Operating cost per new passenger would be among the lowest of any project. The connector would permit direct transfers between the Blue Line and the Red Line for the first time. It would be used mostly by passengers traveling between Red Line stations from Alewife to Charles/MGH inclusive and Blue Line Stations from State to Wonderland (or beyond if the Blue Line is extended in that direction). It is rated high in economic and land-use development impacts. It would be located in a state-designated revitalization area, where local plans call for mixed-use development. The MBTA will soon begin work on an analysis of the Blue-Red Connector that will provide greater detail on this project.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
Line Extension	◗	◗	●	◗	◗	●	◗

MAP 5C-14 CONSTRUCT ORANGE LINE STATION AT ASSEMBLY SQUARE

D CONSTRUCT ORANGE LINE STATION AT ASSEMBLY SQUARE

Description

This project would add a station on the existing Orange Line at the Assembly Square development in Somerville, between Sullivan Square Station in Charlestown and Wellington Station in Medford.

Capital Features

This project would consist of one new rapid transit station, but would not add any route mileage.

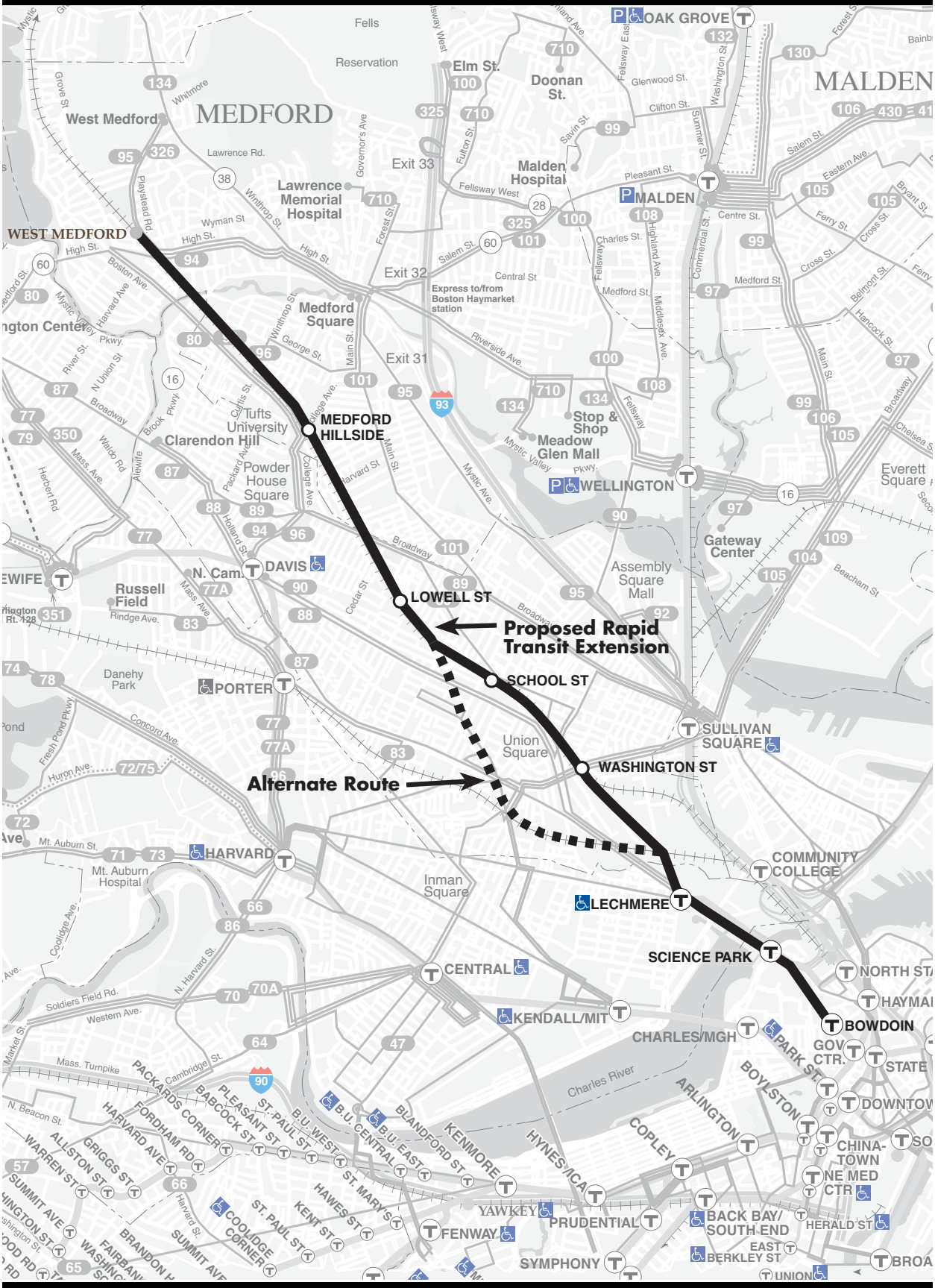
Capital Cost	**$29.3 million (MBTA Planning Dept. estimate)**
Operating Cost	**None, unless demand requires more frequent service**
Daily Ridership Increase on Mode	**1,700**
Net Increase in Daily Transit Ridership	**1,100**
Capital Cost per New Transit Rider	**$26,900**
Operating Cost per Wkday/New Transit Rider	**None, unless demand requires more frequent service**
Capital Cost/Travel Time Benefit	**$145,700 per hour**
Operating Cost/Travel Time Benefit	**None, unless demand requires more frequent service**
Travel Time Savings	**201 hours per weekday**

Assessment

Overall, this project is rated medium priority. It would add a station in a section of Somerville that the Orange Line currently runs through without stopping. This would be one of the least costly of all rapid transit expansion projects analyzed, both in absolute terms and relative to the new ridership attracted. Because of its location relative to roads, other transit stations, and most of the population of Somerville, such a station would be of use mostly for travel to and from the Assembly Square redevelopment. At this time, the mix of uses in this project has not been finally determined, making demand projections difficult. Adding an Assembly Square station would increase travel times slightly for passengers riding between stations further north and stations further south, and could worsen crowding on trains during peak hours. It gets a high rating in economic and land use impact because the station would be in a state-designated revitalization area. This includes a brownfield site. Several mixed-use transit-oriented development projects are under consideration for this location. The project receives a medium rating for environmental justice since the station is not located in a minority or transit-dependent neighborhood.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
New Station	○	○	●	◗	○	●	◗

MAP 5C-15 EXTEND BLUE LINE FROM BOWDOIN TO WEST MEDFORD



D EXTEND BLUE LINE FROM BOWDOIN TO WEST MEDFORD

Description

This project would extend Blue Line service from Bowdoin Square in downtown Boston to West Medford via a new subway to Lechmere, then partly via an existing rail freight line and partly beside the Lowell commuter rail line. It would be an alternative to a Green Line extension to West Medford.

Capital Features

This would be a 5.3-mile extension, including a new subway between Bowdoin and Lechmere, six new stations in Somerville and Medford, a relocated Lechmere Station, and a new underground Science Park Station. (Bowdoin Station itself is scheduled to be closed in conjunction with implementation of six-car train service on the Blue Line.) A variation adding about one half mile would run closer to Union Square in Somerville, via a new subway under Prospect Hill. This variation is not reflected in the capital cost estimate.

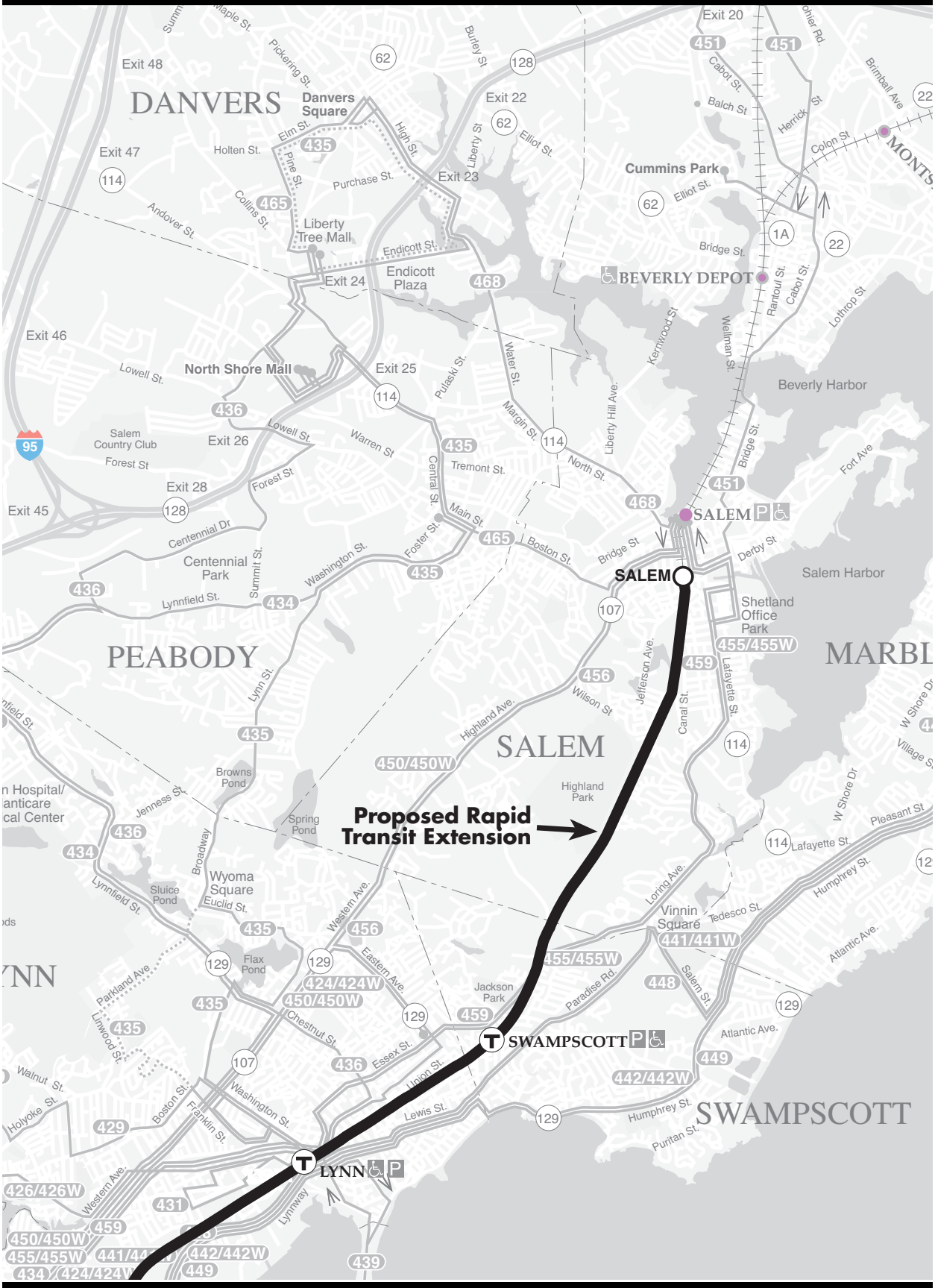
Capital Cost	**$696.5 million (Based on 1994 PMT, adjusted to 2003)**
Operating Cost	**$76,800 per weekday**
Daily Ridership Increase on Mode	**13,500**
Net Increase in Daily Transit Ridership	**5,800**
Capital Cost per New Transit Rider	**$119,500**
Operating Cost per Wkday/New Transit Rider	**$13.20**
Capital Cost/Travel Time Benefit	**$343,300 per hour**
Operating Cost/Travel Time Benefit	**$37.90 per hour**
Travel Time Savings	**2,029 hours per weekday**

Assessment

Overall, this project is rated medium priority. It would provide rail transit service to densely developed sections of Somerville and Medford that are currently served by bus routes connecting with the Green, Red, or Orange lines. It would serve more total riders and new transit riders than a Green Line extension to West Medford, but would also have a much higher capital cost per new transit rider. In absolute terms, it would be one of the most costly rapid transit projects examined. Travel times between extension stations and destinations in downtown Boston would be a few minutes faster via the Blue Line than via the Green Line. Air quality improvements would be about twice as great for a Blue Line extension as for a Green Line extension. It is rated high in economic and land use impacts. The majority of the stations would be located in state-designated revitalization areas where transit-oriented development is planned. This would include a mixture of high-density residential, commercial, and industrial development.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
Line Extension	◗	◗	◗	◗	◗	●	●

MAP 5C-16 EXTEND BLUE LINE FROM LYNN TO SALEM



D EXTEND BLUE LINE FROM LYNN TO SALEM

Description

This project would continue the proposed Lynn extension of the Blue Line 5 miles further north to Salem. The Blue Line would be constructed parallel to the Newburyport/Rockport commuter rail line, and the terminus would likely be placed south of the existing portal at the south end of the commuter rail tunnel under Downtown Salem. An intermediate stop would be located at Swampscott. The MBTA is currently evaluating this project as part of its Draft Environmental Impact Statement (DEIS) for the Revere to Salem corridor. It should be noted that this extension of the Blue Line is intended to complement – not replace – existing commuter rail service to the North Shore.

Capital Features

Construction of a rapid transit line extension parallel to an existing commuter rail line, purchase of additional vehicles.

Capital Cost	**$363.8 million (CTPS estimate)**
Operating Cost	**$80,500 per weekday**
Daily Ridership Increase on Mode	**15,500**
Net Increase in Daily Transit Ridership	**8,900**
Capital Cost/New Transit Rider	**$40,900**
Operating Cost per Wkday/New Transit Rider	**$9.10**
Capital Cost/Travel Time Benefit	**$666,400 per hour**
Operating Cost/Travel Time Benefit	**$147.50 per hour**
Travel Time Savings	**546 hours per weekday**

Assessment

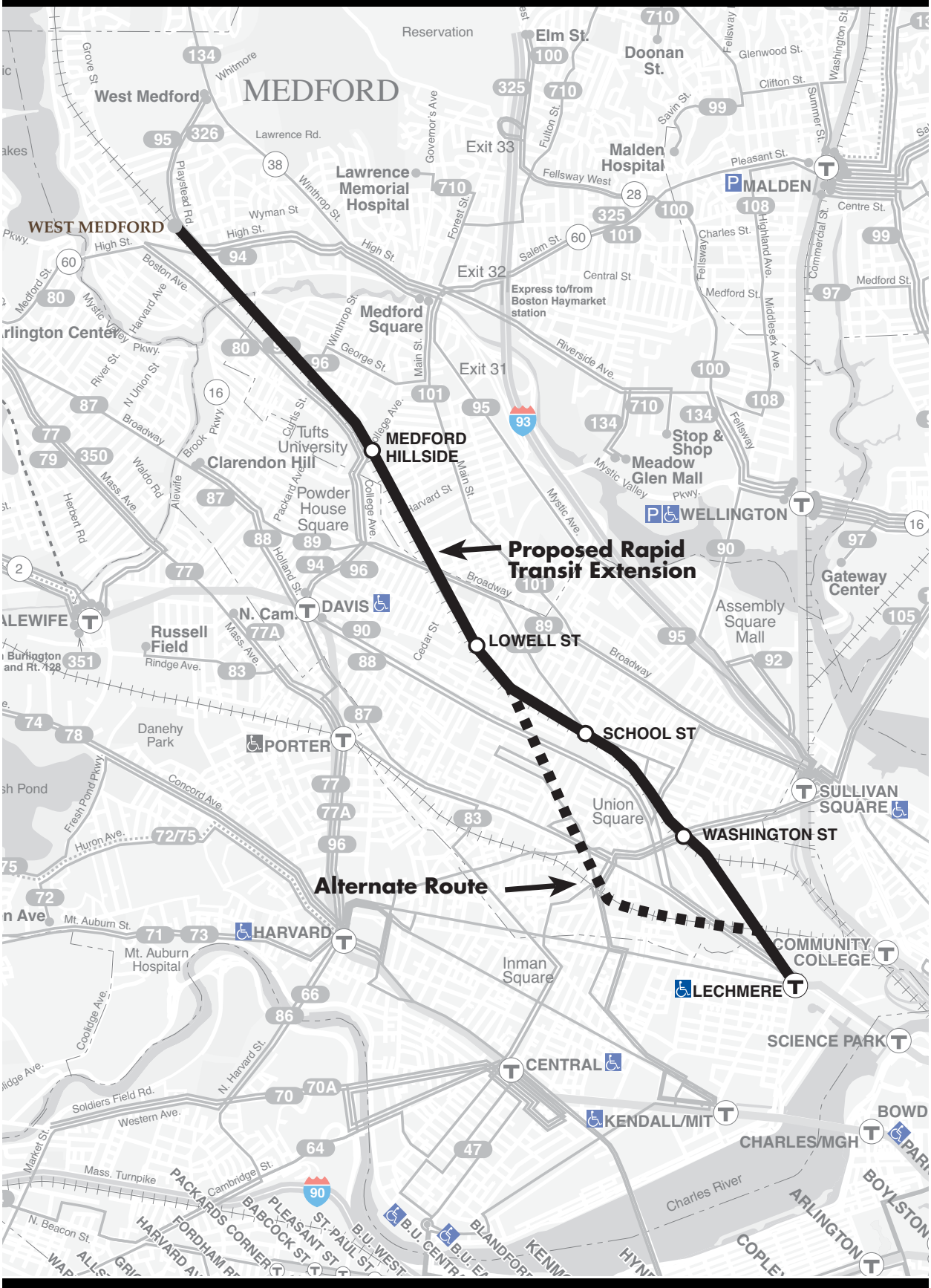
This is a medium priority rapid transit expansion project. The capital cost for this project would be $363.8 million and the typical daily operating cost would be $80,500. The extension would draw 15,900 riders to the rapid transit mode, of which 8,900 would be new transit riders. Capital costs per new transit rider would be $40,900 and operating cost per new transit rider would be $9.10. These costs are at the lower end of proposed rapid transit expansion projects, but they are surpassed by several other projects.

The improvements in air quality associated with this project are high, as there a large number of riders diverted from automobiles.

Frequency of transit service to Swampscott and Salem would increase compared to existing bus and commuter rail service. The proposed new station in Salem would also provide direct rapid transit access to an environmental justice target neighborhood not currently served by that mode.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
Line Extension	●	◗	◗	●	○	◗	◗

MAP 5C-17 GREEN LINE TO WEST MEDFORD



D GREEN LINE TO WEST MEDFORD

Description

This project would extend Green Line service from Lechmere Station to West Medford partly via an existing rail freight line and partly beside the Lowell commuter rail line. It would be an alternative to a Blue Line extension to West Medford. A Green Line extension to Medford Hillside is a SIP, CA/T, and ACO legal commitment (see table 2-2).

Capital Features

This would be a 4.2-mile extension, including six new stations, in Somerville and Medford and a relocated Lechmere Station. A variation adding about one half mile would run closer to Union Square in Somerville, via a new subway under Prospect Hill. This variation is not reflected in the capital cost estimate.

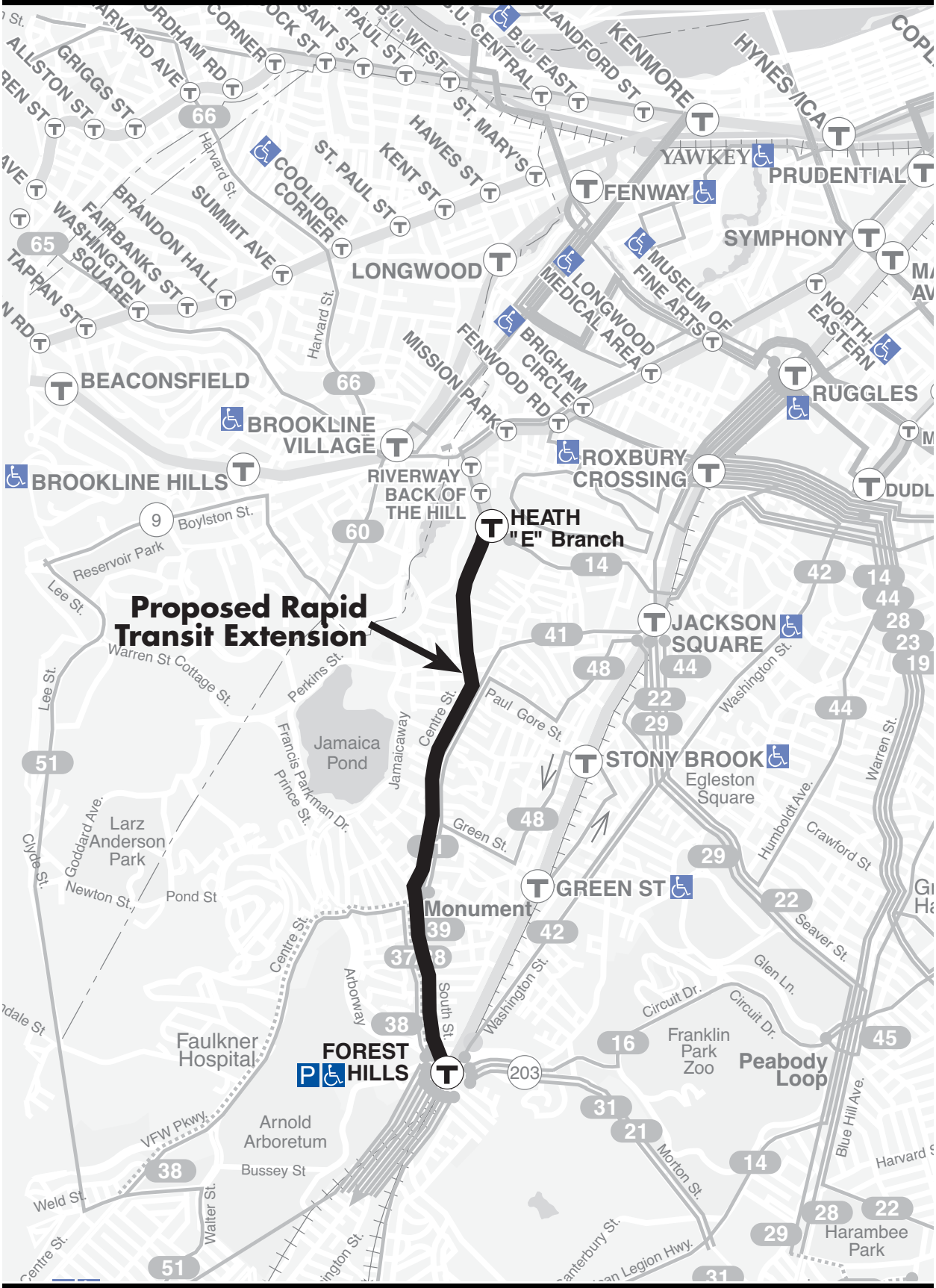
Capital Cost	**$375.0 million (Based on 2000–2025 RTP update)**
Operating Cost	**$41,700 per weekday**
Daily Ridership Increase on Mode	**8,400**
Net Increase in Daily Transit Ridership	**3,500**
Capital Cost per New Transit Rider	**$105,900**
Operating Cost per Wkday/New Transit Rider	**$11.80**
Capital Cost/Travel Time Benefit	**$227,640 per hour**
Operating Cost/Travel Time Benefit	**$25.30 per hour**
Travel Time Savings	**1,647 hours per weekday**

Assessment

Overall, this project is rated medium priority. It would provide rail transit service to densely developed sections of Somerville and Medford that are currently served by bus routes connecting with the Green, Red, or Orange lines. This would be of greater benefit in terms of convenience than of actual trip time, as it would result in fewer passengers having to transfer from bus to rail to make their trips. Air quality improvements would be only moderate, but the capital cost relative to the air quality benefits would fall in the lower range among rapid transit extensions examined. It is rated medium in economic and land use impacts. The majority of the stations would be located in state-designated revitalization areas where transit-oriented development is planned. This would include a mixture of high-density residential, commercial, and industrial development. The MBTA will soon begin work on an analysis of the extension of Green Line service to West Medford that will provide greater detail on this project.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
Line Extension	◗	◗	◗	◗	◗	◗	●

MAP 5C-18 RESTORE GREEN LINE SERVICE BETWEEN HEATH ST AND ARBORWAY



D RESTORE GREEN LINE SERVICE BETWEEN HEATH ST AND ARBORWAY

Description

This project would restore service on the Green Line E-branch between Heath Street and Arborway, a distance of 1.9 miles. Rail service in this segment was last operated in 1985 with PCC streetcars. The infrastructure would need to be replaced and upgraded to allow for operation of modern light-rail equipment.

Restoration would include replacement of track, replacement of catenary and power systems, installation of accessible station platforms at intermediate stops, and construction of a storage yard at Arborway. This project is a SIP and ACO legal commitment (see table 2-2).

Capital Features

Reconstruction of 1.9 miles of street-running light rail trackage, construction of intermediate stations, and purchase of additional vehicles.

Capital Cost	**$71.9 million (Based on 2001 MBTA Planning Study)**
Operating Cost	**No added cost, would replace Route 39**
Daily Ridership Increase on Mode	**14,200**
Net Increase in Daily Transit Ridership	**200**
Capital Cost/New Transit Rider	**$359,400**
Operating Cost per Wkday/New Transit Rider	**No added cost**
Capital Cost/Travel Time Benefit	**$11,115,800**
Operating Cost/Travel Time Benefit	**No added cost**
Travel Time Savings	**6 hours per weekday**

Assessment

This is a medium priority rapid transit expansion project. The capital cost for this project is $71.9 million. Because this project would replace Route 39 bus service, there would be no anticipated increase in total system operating costs. Green Line service between Heath Street and Arborway was replaced with Route 39 bus service in December 1985. Restoration of Arborway service is a project required as part of Central Artery mitigation agreements. The existing E-Heath Street Green Line branch would be extended back to Arborway (Forest Hills) and Route 39 bus service discontinued. Green Line ridership would expand by 14,200 compared to the existing Heath Street service. Of this total, 200 passengers per day would be new transit riders, the majority would be former patrons of Route 39 bus service. The capital cost per new transit rider would be very high at $359,400. There would be no increase in operating costs per new passenger however, as this project would replace bus Route 39.

Impacts on air quality would be low, as few new riders would be diverted from automobiles to this service. Part of the line would serve environmental justice communities. Restoration of service would provide one-seat rides between Jamaica Plain and Park Street, with improved transfers to the remainder of the rapid transit system. Frequency of service available in the entire corridor between Forest Hills and Copley, however, would be reduced, as the present overlap of service in the Heath Street-Copley segment between bus Route 39 and E-Heath Street Green Line service would be eliminated.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
Line Extension	❍	❍	◗	❍	●	●	◗

D SILVER LINE EAST EXTENSION TO CITY POINT

Description

This project would extend Silver Line bus rapid transit service 2.9 miles beyond World Trade Center station into the South Boston neighborhood of City Point. Bus Rapid Transit vehicles would leave the transitway tunnel at World Trade Center and continue on the surface via Summer Street, L Street and East Broadway. Bus priority lanes and sheltered stops containing passenger information would be constructed along the route. ITS technology would be used to monitor and regulate service.

Capital Features

Construction and installation of dedicated bus lanes, priority signals, and passenger shelters with amenities. Purchase of additional dual-mode vehicles.

Capital Cost	**$11.4 million (CTPS estimate)**
Operating Cost	**$3,800 per weekday**
Daily Ridership Increase on Mode	**6,800**
Net Increase in Daily Transit Ridership	**1,400**
Capital Cost/New Transit Rider	**$8,400**
Operating Cost per Wkday/New Transit Rider	**$2.80**
Capital Cost/Travel Time Benefit	**$71,900**
Operating Cost/Travel Time Benefit	**$23.60**
Travel Time Savings	**159 hours per weekday**

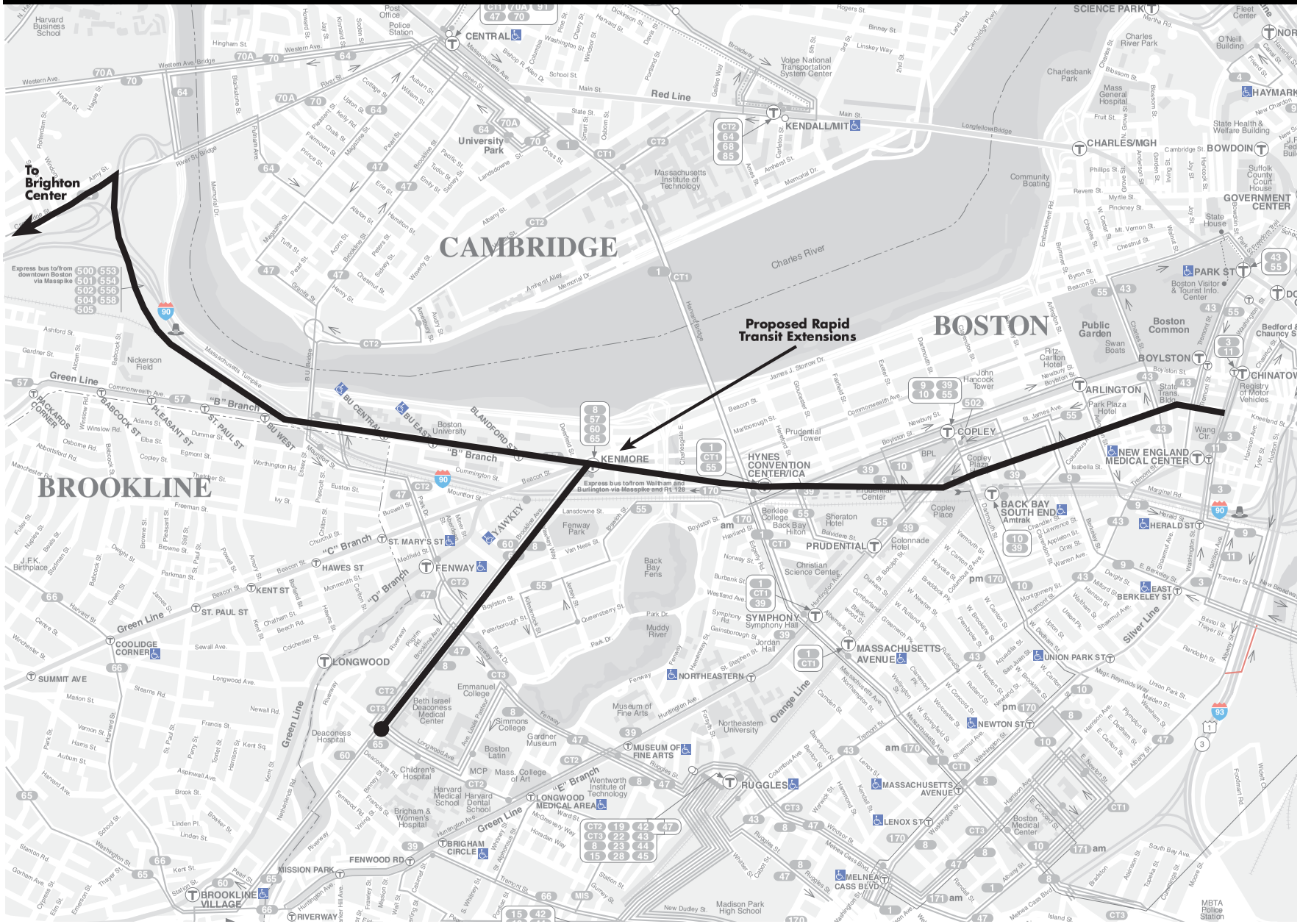
Assessment

This is a medium priority rapid transit expansion project. The capital cost for this project would be $11.4 million and the typical additional daily operating cost would be $3,800. This project would provide Silver Line service farther into South Boston beyond the Phase-2 service to Courthouse and World Trade Center stations now already under construction. Capital investment would be minimal, as buses would make use of improvements to the existing street network between World Trade Center and City Point. The service would attract 6,800 riders, of which approximately 20% (1,400) would be new transit riders. The remaining passengers would be diverted from existing bus routes, especially Route 7 City Point-Downtown, which would be replaced by this service. The capital cost per new transit rider would be low at $8,400 and the operating cost per new transit rider beyond that required by existing Route 7 service would also be low at $2.80. This would be a very cost-effective project.

Reliability would be improved through the use of dedicated rights of ways, priority lanes, signal prioritization, and Automatic Vehicle Locator systems that provide real time vehicle location information to dispatchers, planners, and customers.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
Line Extension	◗	❍	●	◗	◗	●	❍

MAP 5C-20 SILVER LINE WEST EXTENSIONS TO ALLSTON AND LONGWOOD MEDICAL AREA



D SILVER LINE WEST EXTENSIONS TO ALLSTON & LONGWOOD MEDICAL AREA

Description

This project calls for the construction of a new bus rapid transit tunnel which would split from the Phase III Silver Line tunnel near Boylston station and continue under Stuart Street and a new alignment to Kenmore Square. From Kenmore, service would continue along the surface on two branches. One would operate to the Longwood Medical Area, and the other would operate to Oak Square, Brighton via the Allston Landing development, Union Square, Allston, and Brighton Center.

It should be noted that through its *Access Boston* process, the city of Boston has identified an alternative description for a western extension of the Silver Line that could be achieved at a lower capital cost. This option would involve bus rapid transit along surface streets and the Massachusetts Turnpike through the Back Bay instead of through an underground subway line. However, only the first option is assessed in the PMT.

Capital Features

Construction of a bus rapid transit tunnel, roadway improvements west of Kenmore Square, and purchase of additional dual-mode vehicles.

Capital Cost	**$540.9 million (CTPS estimate)**
Operating Cost	**$25,600 per weekday**
Daily Ridership Increase on Mode	**27,900**
Net Increase in Daily Transit Ridership	**7,800**
Capital Cost/New Transit Rider	**$69,000**
Operating Cost per Wkday/New Transit Rider	**$3.30**
Capital Cost/Travel Time Benefit	**$619,640 per hour**
Operating Cost/Travel Time Benefit	**$29.35 per hour**
Travel Time Savings	**873 hours per weekday**

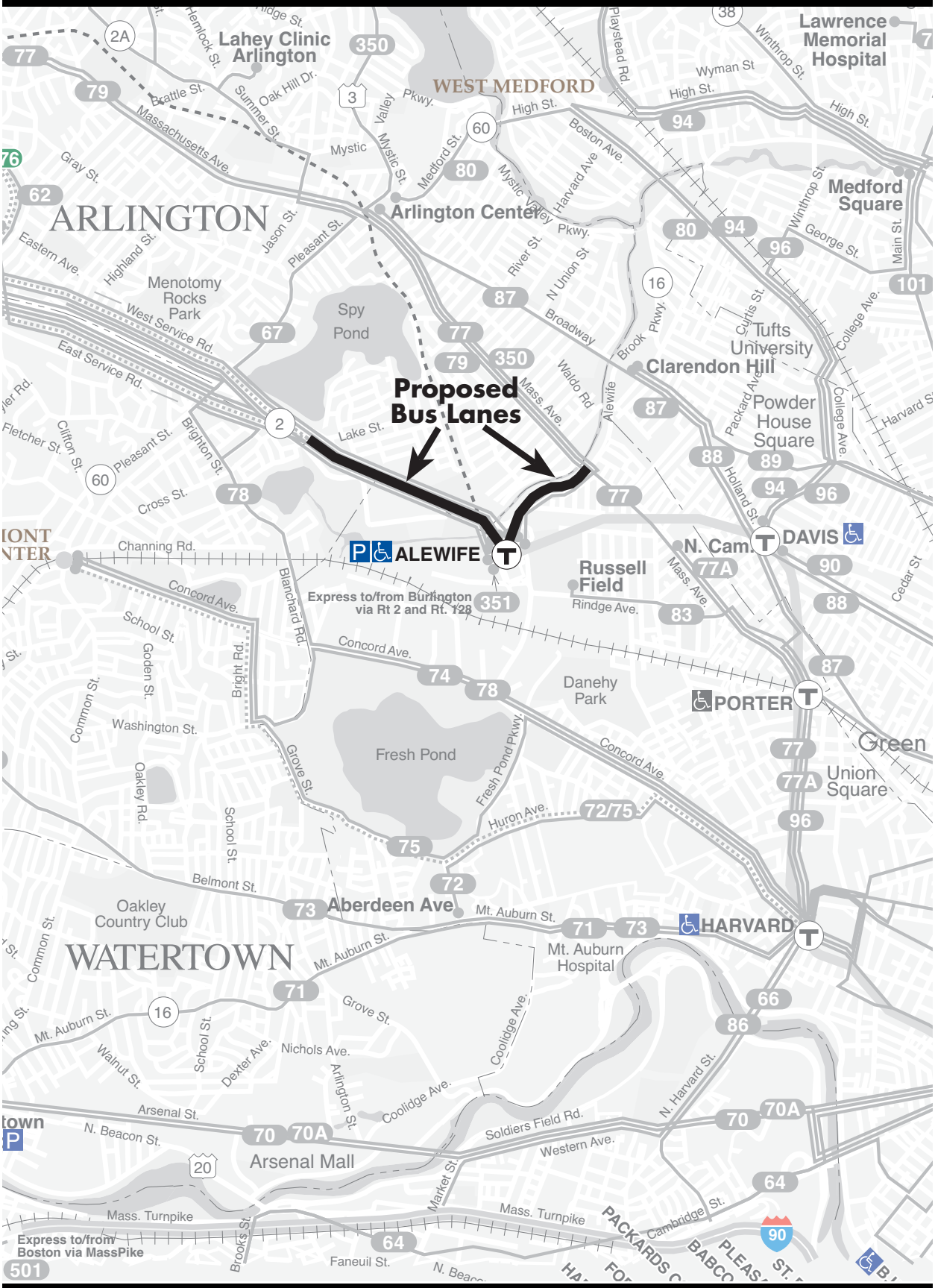
Assessment

This is a medium priority rapid transit expansion project. The capital cost for this project would be $540.9 million and the typical daily operating cost would be $25,600. This project would attract 27,900 passengers to the mode of which 7,800 would be new transit riders. The capital cost for the project would be $69,000 per new transit rider, and the operating cost per new transit rider would be $3.30. The project would have a positive impact on air quality, as many users would be diverted from automobiles. The project would also provide crowding relief to the parallel Green Line through the Back Bay. The Allston branch would provide direct service to the Allston Landing development area and densely developed mixed-use developments in Allston and Brighton. The Allston branch would fill a gap in the rapid transit system between the Red Line in Cambridge and the Green Line B-branch. The Longwood Avenue branch would increase service to the Longwood Medical Area. Direct service to Downtown Boston would be provided from Allston/Brighton and Longwood Medical Area, eliminating transfers.

Reliability would be improved through the use of dedicated rights of ways, priority lanes, signal prioritization, and Automatic Vehicle Locator systems that provide real time vehicle location information to dispatchers, planners, and customers.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
Line Extension	●	◗	◗	◗	◗	●	◗

MAP 5C-21 BUILD NEW BUSWAYS TO ALEWIFE STATION



D BUILD NEW BUSWAYS TO ALEWIFE STATION

Description

This proposal calls for the installation of exclusive bus lanes between Alewife Station and Massachusetts Avenue along Alewife Brook Parkway and between Alewife Station and Lake St. along Route 2. These lanes would improve travel times for bus Routes 62 (Bedford-Alewife), 67 (Turkey Hill-Alewife), 76 (Hanscom Air Force Base-Alewife), 79 (Arlington Heights-Alewife), 84 (Arlmont-Alewife), and 350 (Burlington-Alewife).

Capital Features

Construction of exclusive bus lanes.

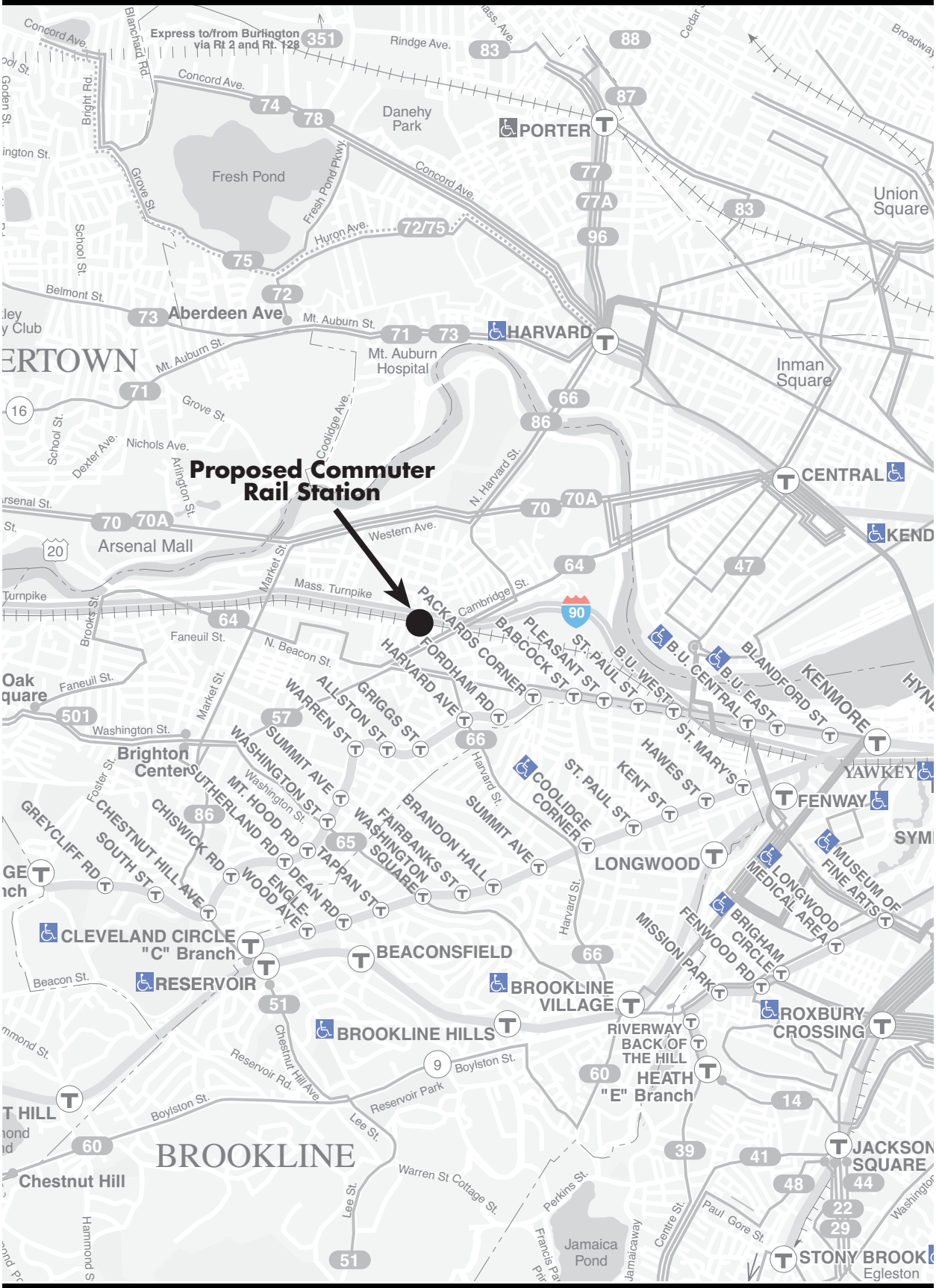
Capital Cost	**$340,000 (CTPS estimate)**
Operating Cost	**none**
Daily Ridership Increase on Mode	**600**
Net Increase in Daily Transit Ridership	**340**
Capital Cost/New Transit Rider	**$1000**
Operating Cost per Wkday/New Transit Rider	**no change**
Capital Cost/Travel Time Benefit	**$5,9100per hour**
Operating Cost/Travel Time Benefit	**NA**
Travel Time Savings	**58 hours per weekday**

Assessment

This is a medium-priority bus expansion project. The capital cost for this project would be $340,000. There is no anticipated additional operating cost. This project would attract 600 new users to the mode of which 340 would be new transit riders. The capital cost per new transit rider would be $1000. The total cost effectiveness for the project scores high compared to other bus expansion projects. Providing exclusive lanes for buses on the roadways approaching Alewife Station would improve the travel times of the existing bus service and would improve the reliability, as buses would be less vulnerable to delays caused by heavy traffic congestion in the Alewife area. There would be no improvement in mobility, as all bus routes using the busways would be existing ones.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Environ. Justice
Line Extension/ New Line	○	○	●	◗	◗	○

MAP 5C-22 BUILD A NEW ALLSTON/BRIGHTON COMMUTER RAIL STATION



BUILD A NEW ALLSTON/BRIGHTON COMMUTER RAIL STATION

Description

This project would add a new commuter rail station on the Framingham/ Worcester commuter rail line in either Allston or Brighton. It would be between the existing Newtonville and Yawkey stations. Four previous commuter rail stations in Allston and Brighton were all discontinued in 1959 as part of a larger service reduction.

Capital Features

This project would consist of one new station with limited parking on an existing line. No upgrading of tracks would be needed. No new rolling stock would be required to accommodate the additional riders.

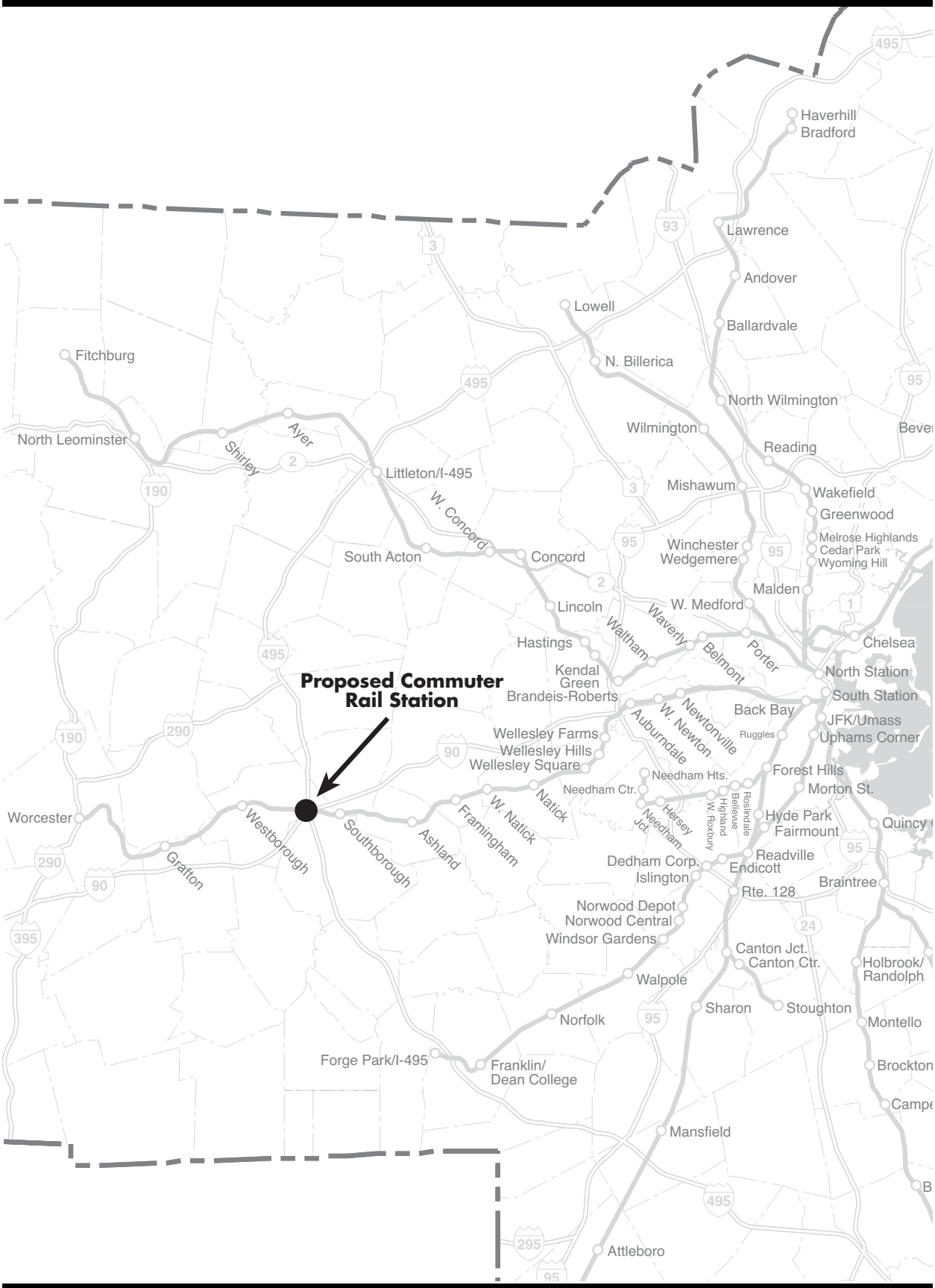
Capital Cost	**$4.1 million (CTPS estimate)**
Operating Cost	**Too small to calculate**
Daily Ridership Increase on Mode	**70**
Net Increase in Daily Transit Ridership	**50**
Capital Cost per New Transit Rider	**$81,300**
Operating Cost per Wkday/New Transit Rider	**Too small to calculate**
Capital Cost/Travel Time Benefit	**$223,800 per hour**
Operating Cost/Travel Time Benefit	**Too small to calculate**
Travel Time Savings	**18 hours per weekday**

Assessment

Overall, this project is rated medium priority. It would attract few total riders or new transit riders. The capital cost would also be relatively small in absolute terms, but the cost per new rider would be at the upper end of the mid-range among commuter rail expansion projects analyzed. Because of the relatively small saving in VMT for each new transit user, cost-effectiveness of air quality improvements would be only moderate. The Allston location does, however, receive a high rating for economic and land-use impacts, because it would be in a state-designated revitalization area, where local plans call for new industrial and high-density residential development. It would also introduce one-seat rail service to downtown Boston from an environmental justice target neighborhood that does not currently have rapid transit service.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
New Station	○	◗	◗	◗	○	●	●

MAP 5C-23 BUILD COMMUTER RAIL STATION ON I-495 IN METROWEST AREA



D BUILD COMMUTER RAIL STATION ON I-495 IN METROWEST AREA

Description

This project would add a new station on the Framingham/Worcester commuter rail line at Route I-495 in Westborough, between the existing Westborough and Southborough Stations. Both of those stations opened in 2002. Previous commuter rail stations in both towns had been discontinued in 1960.

Capital Features

This project would consist of one new station with a regional parking facility on an existing line. No upgrading of tracks would be needed. Peak capacity would need to be increased by six coaches. A new highway interchange would be needed for access to the station.

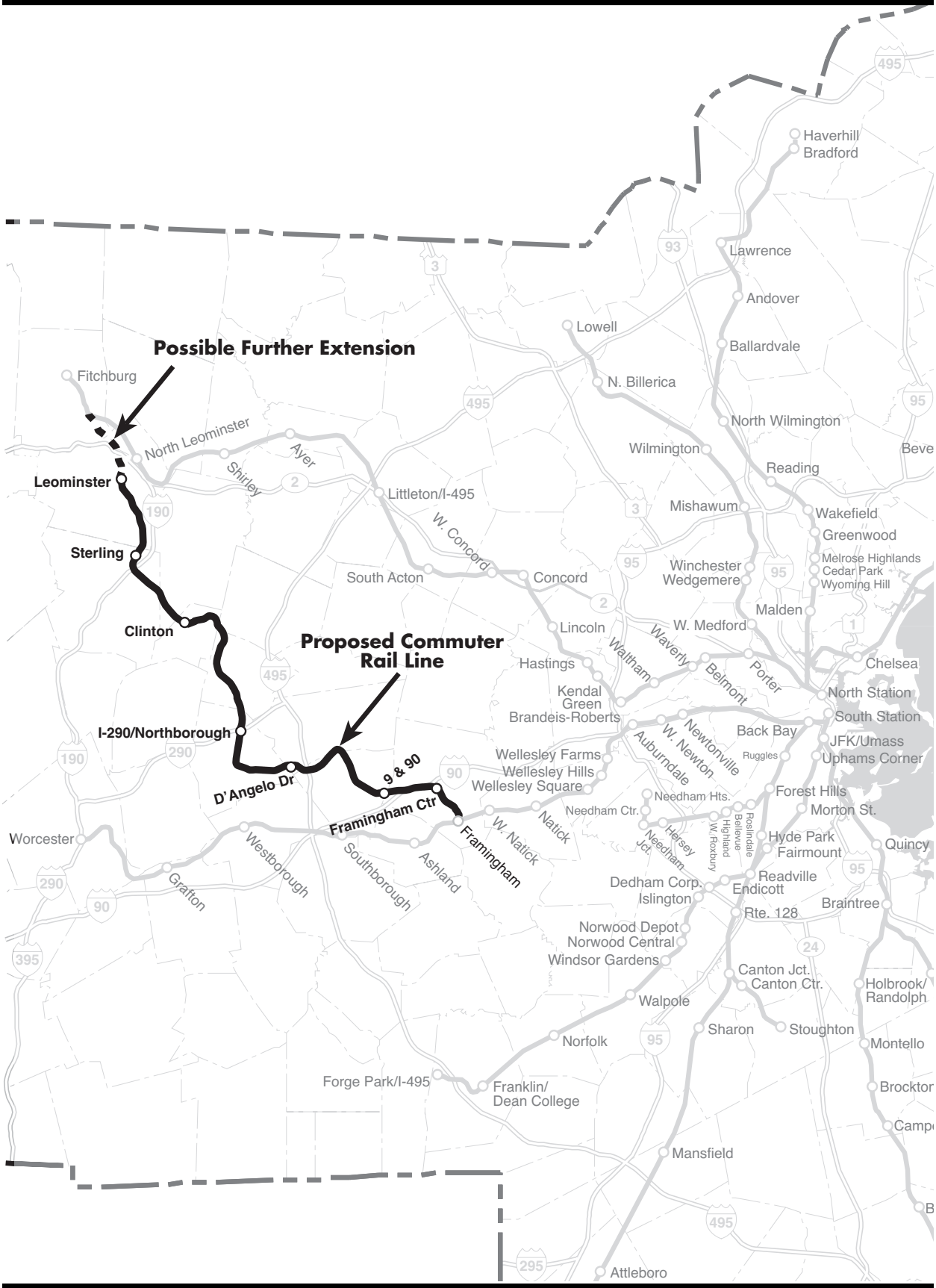
Capital Cost	**$111.1 million (CTPS estimate)**
Operating Cost	**Increased fuel from extra starts and stops, too small to calculate**
Daily Ridership Increase on Mode	**1,500**
Net Increase in Daily Transit Ridership	**900**
Capital Cost per New Transit Rider	**$122,100**
Operating Cost per Wkday/New Transit Rider	**Too small to calculate**
Capital Cost/Travel Time Benefit	**$449,000 per hour**
Operating Cost/Travel Time Benefit	**Too small to calculate**
Travel Time Savings	**247 hours per weekday**

Assessment

Overall, this project is rated medium priority. New transit ridership would fall near the lower end of the mid-range among commuter rail projects analyzed for the PMT. It would not require any track upgrading, but because it would require construction of a new highway interchange, it would also fall near the lower end of the mid-range with respect to cost effectiveness. The project has a low rating for economic and land-use impacts, as it would not satisfy any of the goals in that category. It would not serve any environmental justice target communities.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
New Station	◗	❍	◗	●	❍	❍	❍

MAP 5C–24 COMMUTER RAIL LINE FROM FRAMINGHAM TO LEOMINSTER



D COMMUTER RAIL LINE FROM FRAMINGHAM TO LEOMINSTER

Description

This project would implement passenger service on an existing rail freight line that connects with the Framingham/Worcester Line at Framingham Station. Passenger service was last operated on the southern end of this route in 1937, and on the remainder in 1931. The MBTA completed work in 2001 on a feasibility study that examined a commuter rail extension from Framingham to Northborough. That study provides detailed cost and ridership information for that segment of this larger service corridor.

Capital Features

This would be a 33-mile extension, including seven new stations, in Framingham, Marlborough, Northborough, Clinton, Sterling, and Leominster. Extensive upgrading of tracks and signals would be required.

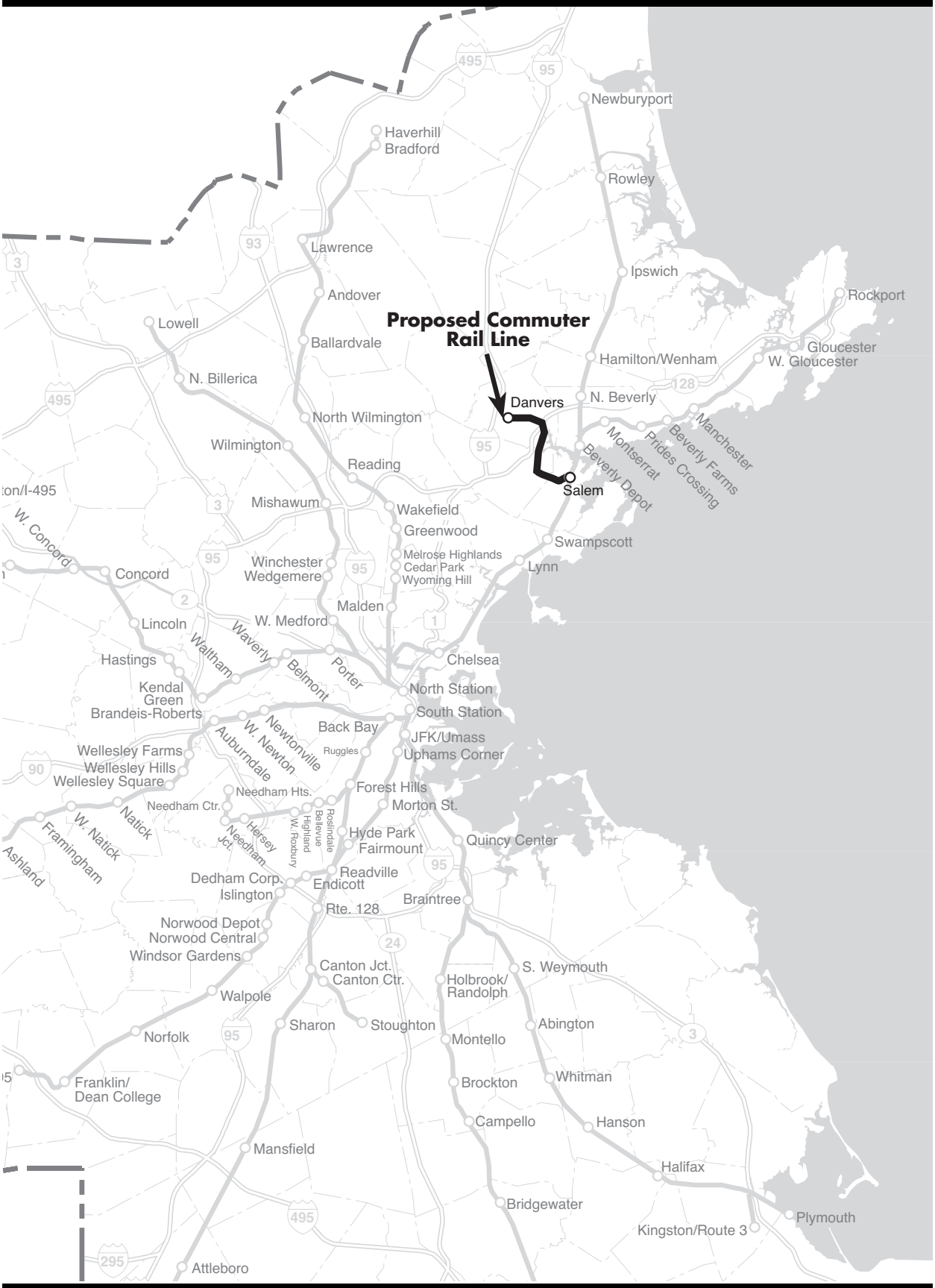
Capital Cost	**$375.4 million (CTPS estimate)**
Operating Cost	**$93,700 per weekday**
Daily Ridership Increase on Mode	**3,000**
Net Increase in Daily Transit Ridership	**1,300**
Capital Cost per New Transit Rider	**$282,300**
Operating Cost per Wkday/New Transit Rider	**$70.40**
Capital Cost/Travel Time Benefit	**$640,100 per hour**
Operating Cost/Travel Time Benefit	**$159.70 per hour**
Travel Time Savings	**587 hours per weekday**

Assessment

The overall rating of this project is medium priority. It would be one of the better commuter rail expansion projects examined in terms of the numbers of new transit riders and total riders served, and would serve an area with very limited existing transit service. Nevertheless, it would rate poorly in terms of capital and operating costs per new transit rider. Benefits to air quality would be very limited, with moderate reductions in emissions of CO and CO2, but increases in emissions of NOx and VOC. Ridership would consist predominantly of work trips from homes in or near the communities with stations to employment locations in Boston or Cambridge. Some of the communities that would be served have had substantial growth in employment in office or industrial parks in recent years. Attraction of reverse commuters and local trips on the extension would, however, require implementation of an extensive network of feeder services because of the distance from the rail line to major trip attractions. Costs of such service are not included above.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
Line Extension	●	●	○	○	○	●	◗

MAP 5C-25 COMMUTER RAIL LINE FROM SALEM TO DANVERS



D COMMUTER RAIL LINE FROM SALEM TO DANVERS

Description

This project would implement passenger service on a combination of active and inactive rail freight lines from Salem Station on the Newburyport/Rockport Line through Peabody to Danvers. Passenger service was last operated on this line in 1959. This project is currently being evaluated in the North Shore Major Investment Study which will provide more detailed information about its impacts.

Capital Features

This would be a five-mile extension, including two new stations, in Peabody and Danvers. Extensive upgrading of tracks and signals would be required. A new bridge across the Waters River in Danvers would be needed to replace a damaged wooden trestle.

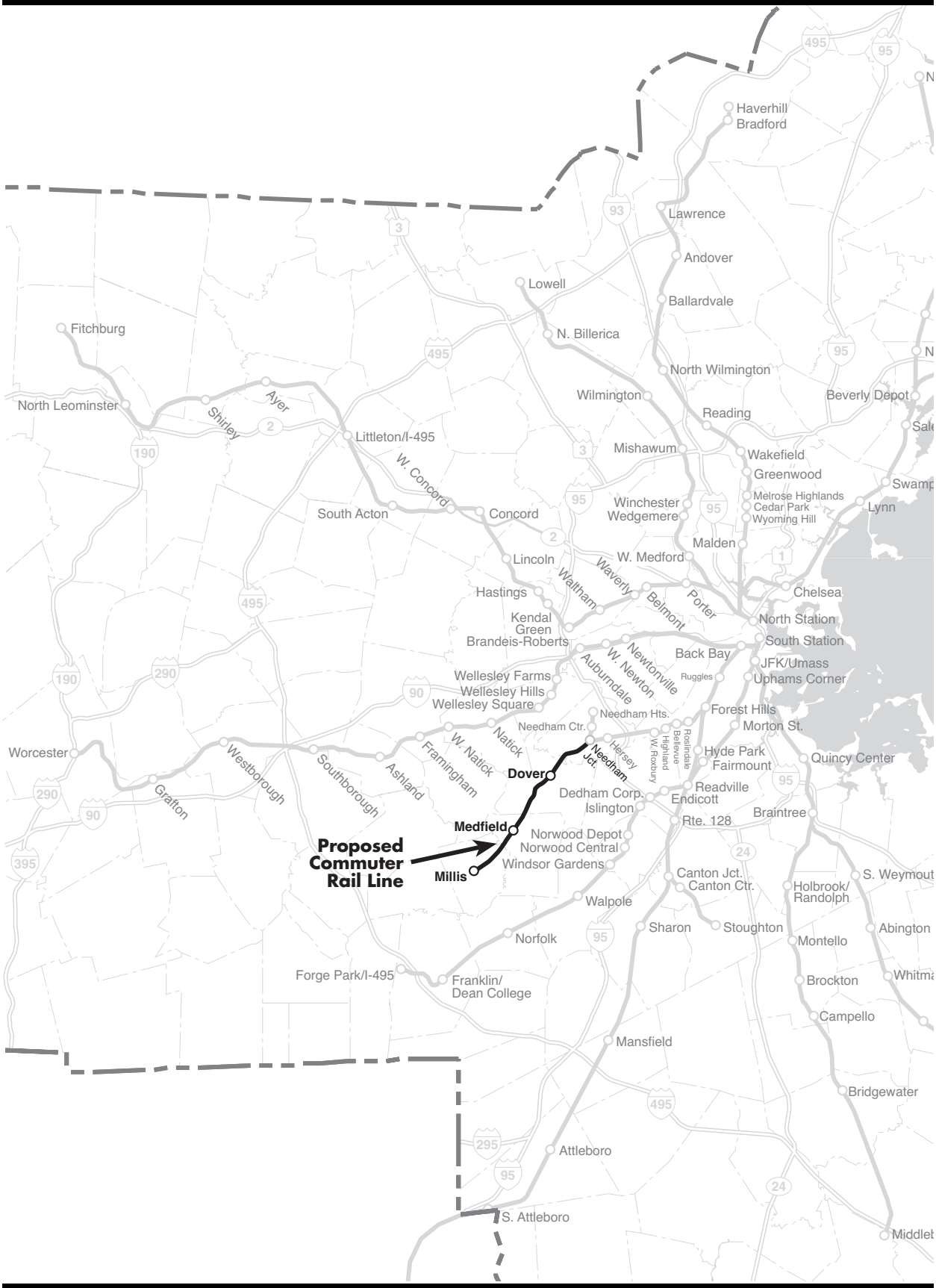
Capital Cost	**$56.1 million (CTPS estimate)**
Operating Cost	**$10,900 per weekday (limited frequency service)**
Daily Ridership Increase on Mode	**1,700**
Net Increase in Daily Transit Ridership	**700**
Capital Cost per New Transit Rider	**$80,000**
Operating Cost per Wkday/New Transit Rider	**$15.50**
Capital Cost/Travel Time Benefit	**$207,000 per hour**
Operating Cost/Travel Time Benefit	**$40.60 per hour**
Travel Time Savings	**271 hours per weekday**

Assessment

The overall rating of this project is medium priority. It would be moderately successful in attracting riders. The areas it would serve have limited direct transit service but are fairly close to existing stations on the Newburyport/Rockport Line. Capital costs for this project would be in the mid-range of costs among commuter rail extensions examined. Capital and operating costs per new transit rider would also be in the mid-range for commuter rail projects. It would have only a moderate impact on air quality. Emissions of CO, CO2, and VOC would be reduced, but those of NOx would increase. Coordination of schedules of Danvers trains with those of Newburyport and Rockport trains between Salem and Boston could be difficult. Shuttle trains between Salem and Danvers could prove to be preferable to through trains from Danvers to Boston both from an operations standpoint and in quality of service provided.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
Line Extension	◗	●	◗	◗	○	○	◗

MAP 5C–26 COMMUTER RAIL FROM NEEDHAM JUNCTION TO MILLIS



D COMMUTER RAIL FROM NEEDHAM JUNCTION TO MILLIS

Description

This project would implement passenger service on an existing rail freight line from Needham Junction Station on the Needham Line to Millis. Passenger service was last operated on this line in 1967.

Capital Features

This would be a ten-mile extension, including three new stations, in Dover, Medfield, and Millis. Extensive upgrading of tracks and signals would be required.

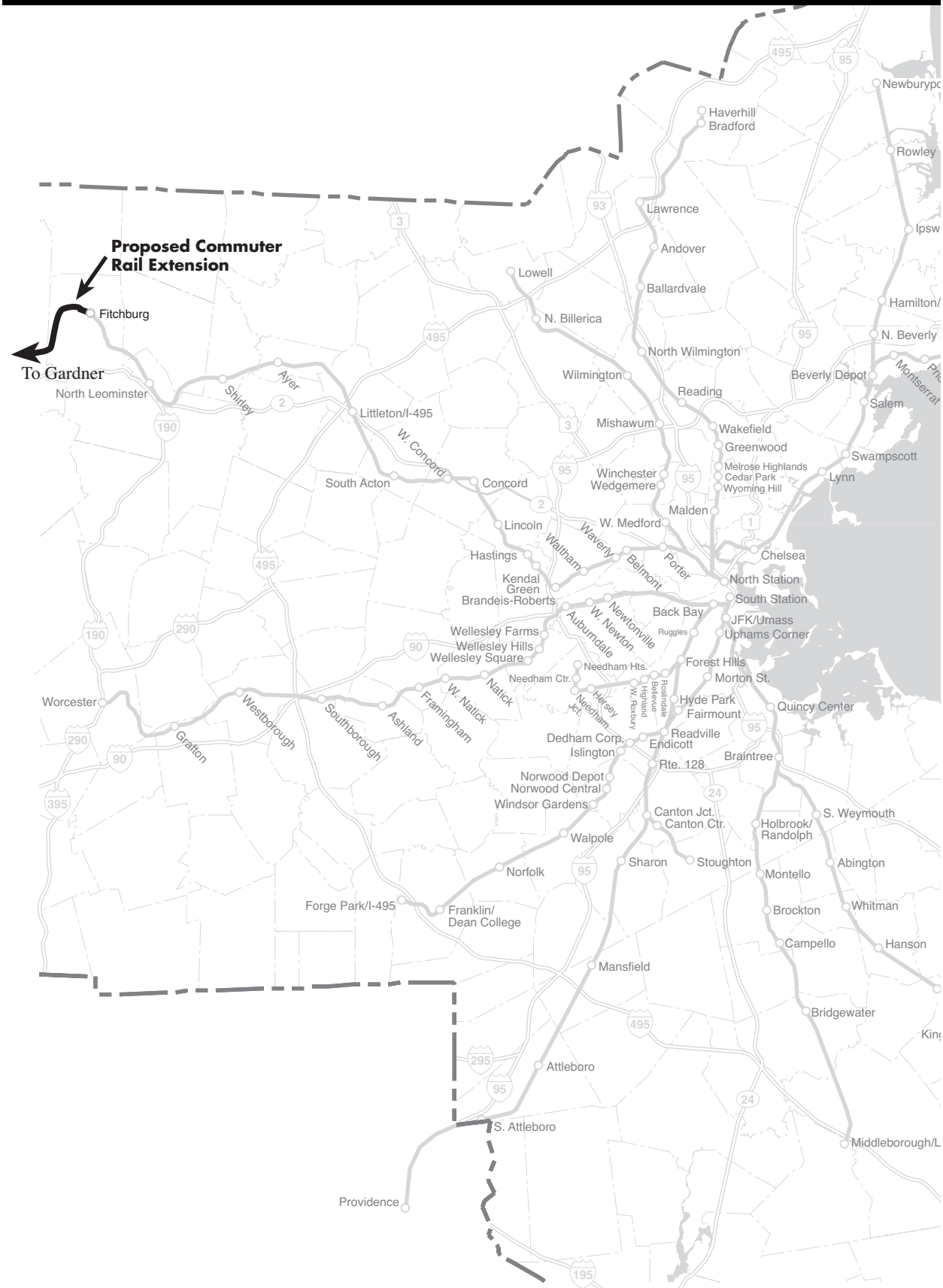
Capital Cost	**$128.8 million (Based on 1998 Millis Feasibility Study, adjusted to 2003)**
Operating Cost	**$35,800 per weekday**
Daily Ridership Increase on Mode	**4,000**
Net Increase in Daily Transit Ridership	**2,700**
Capital Cost per New Transit Rider	**$47,700**
Operating Cost per Wkday/New Transit Rider	**$13.30**
Capital Cost/Travel Time Benefit	**$334,900 per hour**
Operating Cost/Travel Time Benefit	**$93.60 per hour**
Travel Time Savings	**385 hours per weekday**

Assessment

The overall rating of this project is medium priority. It would be one of the more successful commuter rail expansion projects in attracting riders, but capital costs would be at the upper end of the mid-range among extensions examined. Therefore it would have a medium rating in terms of capital and operating costs per new transit rider. Some of the new ridership would be attracted by increased frequency and faster travel times at existing Needham Line stations, and the same improvements could be made without a Millis extension. Emissions of CO, CO2, and VOC would be reduced, but those of NOx would increase. The overall impact on air quality would be medium. This project would not serve any environmental justice target communities.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
Line Extension	●	●	◗	◗	❍	❍	❍

MAP 5C–27 EXTEND COMMUTER RAIL FROM FITCHBURG TO GARDNER



D EXTEND COMMUTER RAIL FROM FITCHBURG TO GARDNER

Description

This project would implement commuter service on an existing rail freight line from the end of the Fitchburg Line to Gardner. Passenger service was last operated on this line in 1986.

Capital Features

This would be a 15.6-mile extension, including one new station in Gardner with parking facilities. Extensive upgrading of tracks and signals would be required.

Capital Cost	**$104.2 million (CTPS estimate)**
Operating Cost	**$16,900 per weekday**
Daily Ridership Increase on Mode	**50**
Net Increase in Daily Transit Ridership	**50**
Capital Cost per New Transit Rider	**$2,084,200**
Operating Cost per Wkday/New Transit Rider	**$337.70**
Capital Cost/Travel Time Benefit	**$5,437,100 per hour**
Operating Cost/Travel Time Benefit	**$887.00 per hour**
Travel Time Savings	**19 hours per weekday**

Assessment

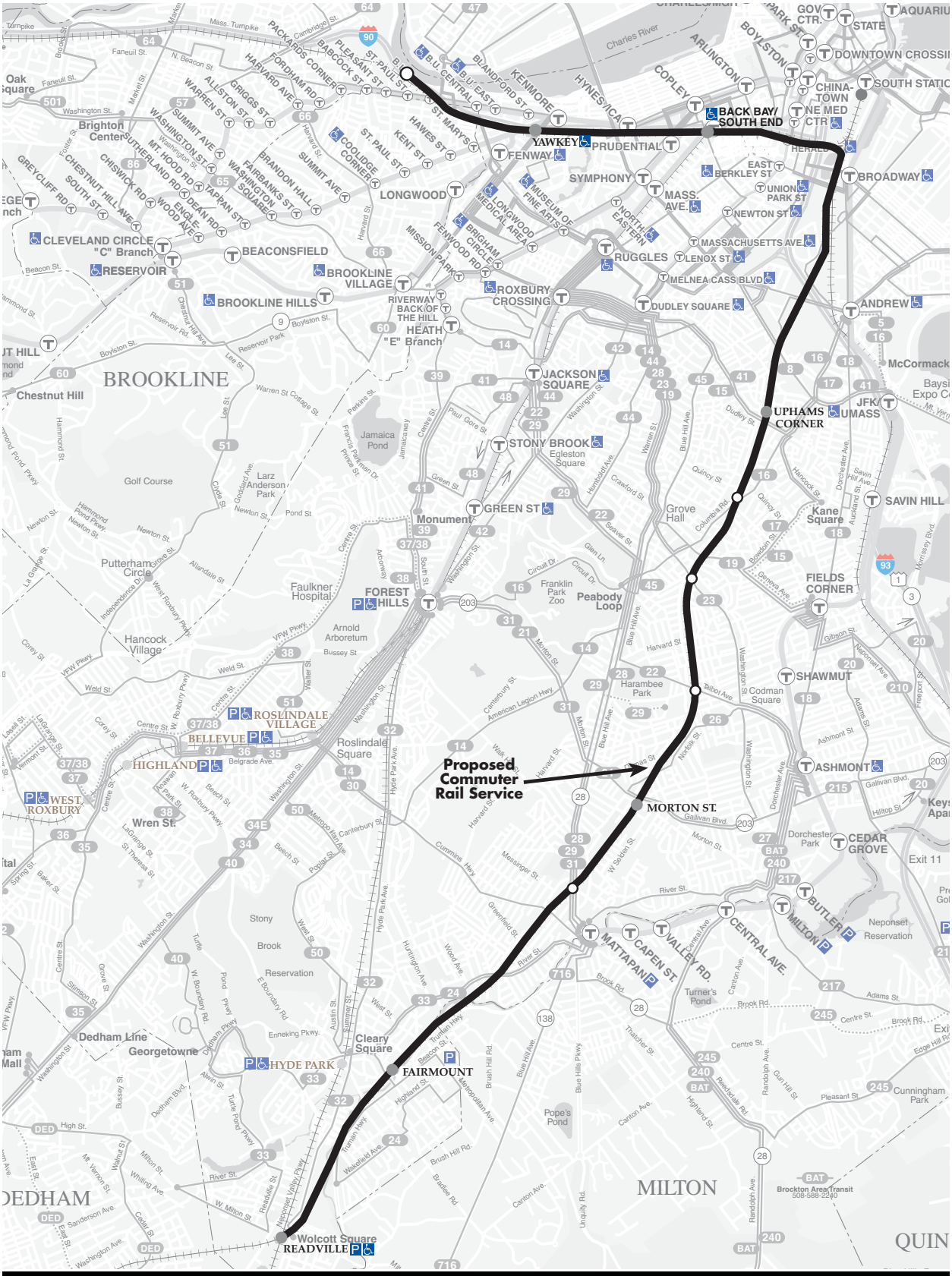
Overall, this project is rated medium priority. It would extend direct rail transit service to an area that currently has only an infrequent feeder bus connection to rail service at Fitchburg. It would, however, attract few riders, resulting in the highest capital and operating costs per new transit rider of any commuter rail expansion project analyzed for the PMT. It would be of little benefit to air quality, reducing emissions of CO and CO2, slightly, while increasing those of VOC and NOx.

Fitchburg and Gardner are located on opposite sides of the Wachusett Mountain range. In order to maintain acceptable grades, the rail line between them is 35% longer than the state highway. The fastest feasible train time from Gardner to Fitchburg would be 20 minutes.

This project has substantial support from local elected officials, as reflected in their Regional Transportation Plan. It is viewed as a means of facilitating access to older urban centers with substantial low-income populations and as a tool for economic development. The Gardner station would be in a state-designated revitalization area.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
Line Extension	❍	●	❍	❍	❍	●	◗

MAP 5C-28 OPERATE HIGH-FREQUENCY READVILLE-ALLSTON LANDING COMMUTER RAIL SERVICE



D OPERATE HIGH-FREQUENCY READVILLE–ALLSTON LANDING COMMUTER RAIL SERVICE

Description

This project would institute new commuter rail service between Readville Station and a new station in Allston using portions of the routes of the Fairmount Line and the Framingham/Worcester Line, but by-passing South Station. This service would be in addition to rather than in place of other service on those lines.

Capital Features

This project would consist of new service over existing lines. It would require one new station, at Allston Landing, and four new train sets. The cost calculations assume that these would each be two-car diesel multiple unit (DMU) trains.

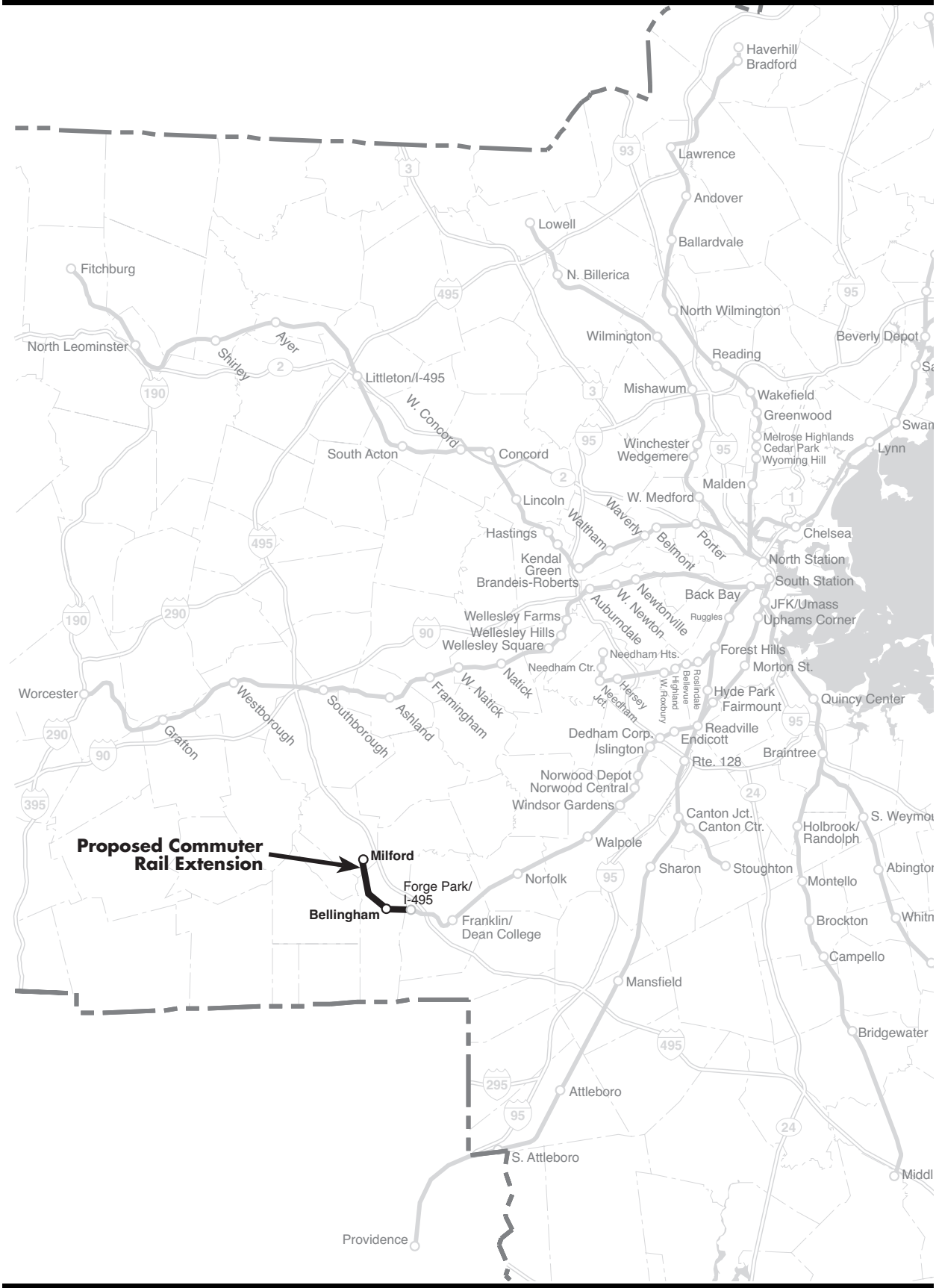
Capital Cost	**$34.3 million (CTPS estimate)**
Operating Cost	**$16,200 per day**
Daily Ridership Increase on Mode	**900**
Net Increase in Daily Transit Ridership	**80**
Capital Cost per New Transit Rider	**$428,600**
Operating Cost per Wkday/New Transit Rider	**$201.90**
Capital Cost/Travel Time Benefit	**$482,900 per hour**
Operating Cost/Travel Time Benefit:	**$228.60 per hour**
Travel Time Savings	**71 hours per weekday**

Assessment

Overall, this project is rated medium priority. It would attract relatively low numbers of total riders or new transit riders. The capital cost would be near the lower end of the mid-range among commuter rail projects in absolute terms, but because of the limited ridership, the cost per new rider would be among the highest for all such projects. Likewise, the absolute operating cost would be relatively low, but the cost per new transit rider would be high. Because most of the riders would be diverted from other transit services, and the route would be operated with internal combustion powered trains, it would result in a net worsening of air quality. The main benefit of this project would be in providing new through service between two environmental justice target areas. It would, however, be among the more costly projects in both capital and operating cost per hour of travel time saved per day. Routing conflicts between this service and other South Side commuter rail routes could result in an overall degradation of service on the system.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
Line Extension	❍	◗	❍	❍	❍	●	●

MAP 5C-29 EXTEND COMMUTER RAIL FROM FORGE PARK TO MILFORD



D EXTEND COMMUTER RAIL FROM FORGE PARK TO MILFORD

Description

This project would implement commuter service on an existing rail freight line from the end of the Franklin Line to Milford. Extensive upgrading of tracks and signals would be required. Passenger service was last operated on the inner end of this line in 1940 and on the outer end in 1920.

Capital Features

This would be a six-mile extension, including two new stations, in Bellingham and in Milford. Extensive upgrading of tracks and signals would be required.

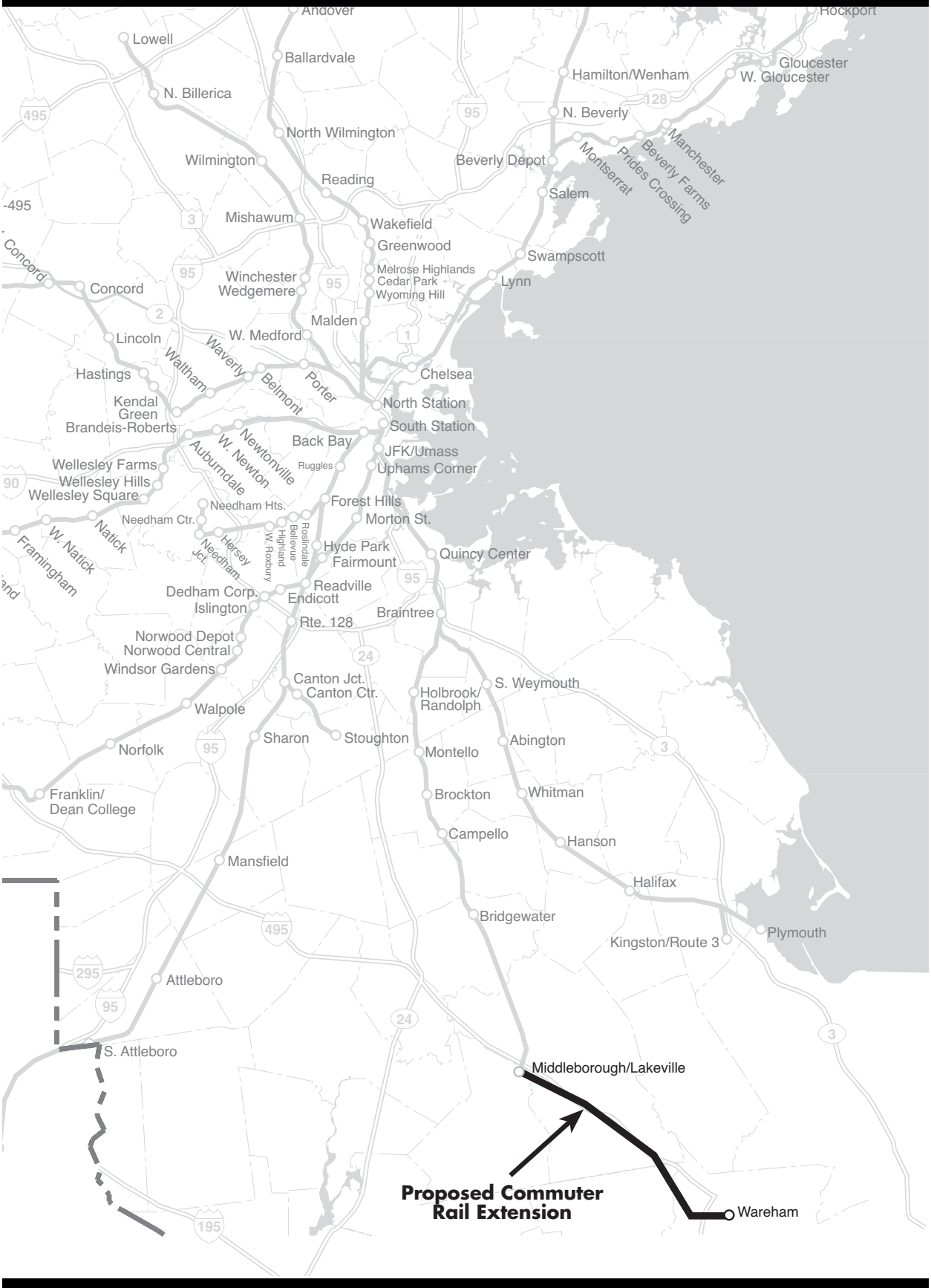
Capital Cost	**$70.5 million (CTPS estimate)**
Operating Cost	**$10,100 per weekday**
Daily Ridership Increase on Mode	**1,800**
Net Increase in Daily Transit Ridership	**800**
Capital Cost per New Transit Rider	**$93,100**
Operating Cost per Wkday/New Transit Rider	**$13.20**
Capital Cost/Travel Time Benefit	**$227,100 per hour**
Operating Cost/Travel Time Benefit	**$32.20 per hour**
Travel Time Savings	**310 hours per weekday**

Assessment

The overall rating of this project is medium priority. It would be moderately successful in attracting riders. The areas it would serve have very limited direct transit service but are fairly close to the present end of the Franklin Line at Forge Park. Capital costs for this project would be in the mid-range of costs among commuter rail extensions examined. It would be among the more cost-effective projects in terms of capital and operating costs per new transit rider. It would be in the mid-range of projects in terms of air quality impacts. Emissions of CO, CO2, and VOC would be reduced, but those of NOx would increase. It is rated low in economic and land use impacts. A downtown Milford station would serve a state-designated revitalization area, but there are no current plans for new high-density development there.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
Line Extension	◗	●	◗	◗	○	○	◗

MAP 5C-30 EXTEND COMMUTER RAIL FROM MIDDLEBOROUGH TO WAREHAM



D EXTEND COMMUTER RAIL FROM MIDDLEBOROUGH TO WAREHAM

Description

This project would extend commuter rail along an existing rail freight line from the end of the Middleborough/Lakeville Line to Wareham. Through passenger service from Wareham to Boston on this route was last operated in 1959. During summer months from 1984 to 1988 connecting service was operated from Cape Cod and Wareham to the Braintree Red Line station.

Capital Features

This would be a 13.5-mile extension, with one new station, including a park-and-ride lot. This line was extensively rehabilitated in the 1980s for seasonal intercity passenger service. Upgrading for commuter rail service would include completion of a signal system that is already partly in place and some replacement of ties. Increased running time would require one additional train set to maintain schedules.

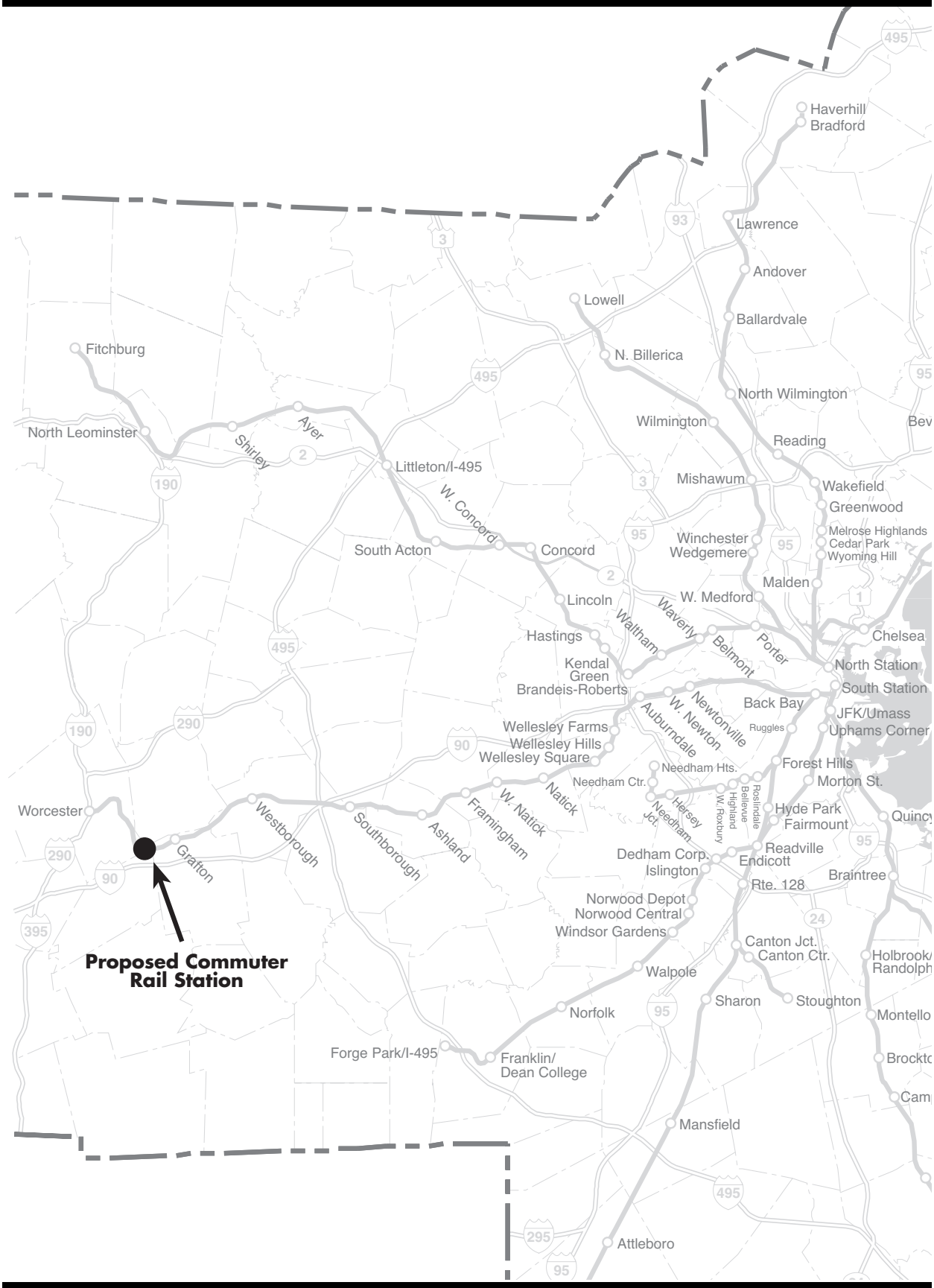
Capital Cost	**$35.8 million (CTPS estimate)**
Operating Cost	**$16,500 per weekday**
Daily Ridership Increase on Mode	**1,300**
Net Increase in Daily Transit Ridership	**420**
Capital Cost per New Transit Rider	**$85,200**
Operating Cost per Wkday/New Transit Rider	**$39.20**
Capital Cost/Travel Time Benefit	**$179,400 per hour**
Operating Cost/Travel Time Benefit	**$82.50 per hour**
Travel Time Savings	**200 hours per weekday**

Assessment

The overall rating of this project is medium priority. Ridership would be near the lower end of the mid-range among commuter rail extension projects examined, but many of the riders would be diverted from other transit services. Wareham itself has very limited express bus service to Boston, but towns south of the Cape Cod Canal from which the extension could draw riders have frequent express bus service. Capital costs for this project would be near the lower end of the mid-range of costs among commuter rail extensions examined, but because of the limited ridership, capital cost per new rider would be among the highest for projects with similar absolute costs. Operating cost per new rider would also be relatively high. The project would have only a moderate impact on air quality. Emissions of CO, CO2, and VOC would be reduced, but those of NOx would increase.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
Line Extension	◗	●	○	◗	○	◗	○

MAP 5C–31 NEW STATION AT MILLBURY ON FRAMINGHAM/WORCESTER LINE



D NEW STATION AT MILLBURY ON FRAMINGHAM/WORCESTER LINE

Description

This project would add a new commuter rail station on the Framingham/ Worcester commuter rail line in Millbury, near Massachusetts Turnpike Interchange 11. It would be between the existing Worcester and Grafton stations.

Capital Features

This project would consist of one new station with a regional parking facility on an existing line. No upgrading of tracks would be needed. Peak capacity would need to be increased by one coach. A new access road would be needed to reach the site from the nearest highway, but the cost of that has not been calculated.

Capital Cost	**$7.4 million (CTPS estimate)**
Operating Cost	**Increased fuel from extra starts and stops, too small to calculate.**
Daily Ridership Increase on Mode	**300**
Net Increase in Daily Transit Ridership	**140**
Capital Cost per New Transit Rider	**$52,900**
Operating Cost per Wkday/New Transit Rider	**Too small to calculate**
Capital Cost/Travel Time Benefit	**$119,000 per hour**
Operating Cost/Travel Time Benefit	**Too small to calculate**
Travel Time Savings	**62 hours per weekday**

Assessment

Overall, this project is rated medium priority. It would attract a relatively small number of riders. Nevertheless, because it would not require any upgrading of track, it would rank high on cost-effectiveness among commuter rail projects relative to new ridership and to air quality improvements. The largest sources of ridership at this station would be expected to be the towns of Millbury and Auburn, and the southeast corner of the city of Worcester. The towns of Sutton, Oxford, Webster, Dudley, Douglas, and Charlton would also originate a few trips each. Ridership from more distant points would be too small to enumerate.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
New Station	○	◗	●	◗	○	●	○

MAP 5C-32 NEW STATION AT SOUTH SALEM ON ROCKPORT/NEWBURYPORT LINE

D NEW STATION AT SOUTH SALEM ON ROCKPORT/NEWBURYPORT LINE

Description

This project would add a new station on the Newburyport/Rockport commuter rail line south of downtown Salem, between the existing Salem and Swampscott stations. A previous station known as Castle Hill at about the same location was discontinued in the 1950s, and had been served mostly by trains on a branch to Marblehead that diverged there.

Capital Features

This project would consist of one new station on an existing line. No upgrading of tracks would be needed. Peak capacity would need to be increased by three coaches.

Capital Cost	**$8.2 million (MBTA Planning Dept. estimate)**
Operating Cost	**Increased fuel from extra starts and stops, too small to calculate.**
Daily Ridership Increase on Mode	**1,100**
Net Increase in Daily Transit Ridership	**840**
Capital Cost per New Transit Rider	**$9,800**
Operating Cost per Wkday/New Transit Rider	**Too small to calculate**
Capital Cost/Travel Time Benefit	**$80,400 per hour**
Operating Cost/Travel Time Benefit	**Too small to calculate**
Travel Time Savings	**102 hours per weekday**

Assessment

Overall, this project is rated medium priority. It would provide direct commuter rail service to a section of Salem now served by a bus route that can also be used as a commuter rail connection. It would attract only a moderate amount of new transit ridership, but because no upgrading of track would be required, the capital cost per new rider would be among the lowest of all commuter rail expansion projects analyzed for the PMT. It would have medium ratings in terms of environmental justice and economic/land use impacts. It would be located in a state-designated revitalization area, and it would improve access to Salem State College, a major institution of higher education. The new station would have a positive effect on air quality, and would be among the more cost-effective commuter rail projects with respect to these improvements.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
New Station	○	◗	●	●	○	◗	◗

MAP 5C–33 CONNECT FITCHBURG CRR LINE WITH RED LINE AT ALEWIFE

D CONNECT FITCHBURG COMMUTER RAIL LINE WITH RED LINE AT ALEWIFE

Description

This project would add a new station on the Fitchburg commuter rail line near the Alewife Red Line station in Cambridge, between the existing Porter Square Station in Cambridge and Belmont Station. A previous station at this location was discontinued in 1938.

Capital Features

This project would consist of one new station on an existing line. No upgrading of tracks and no rolling stock would be needed, but a pedestrian connection between the commuter rail station and the Red Line station would have to be provided. Costs for this connection have not been included.

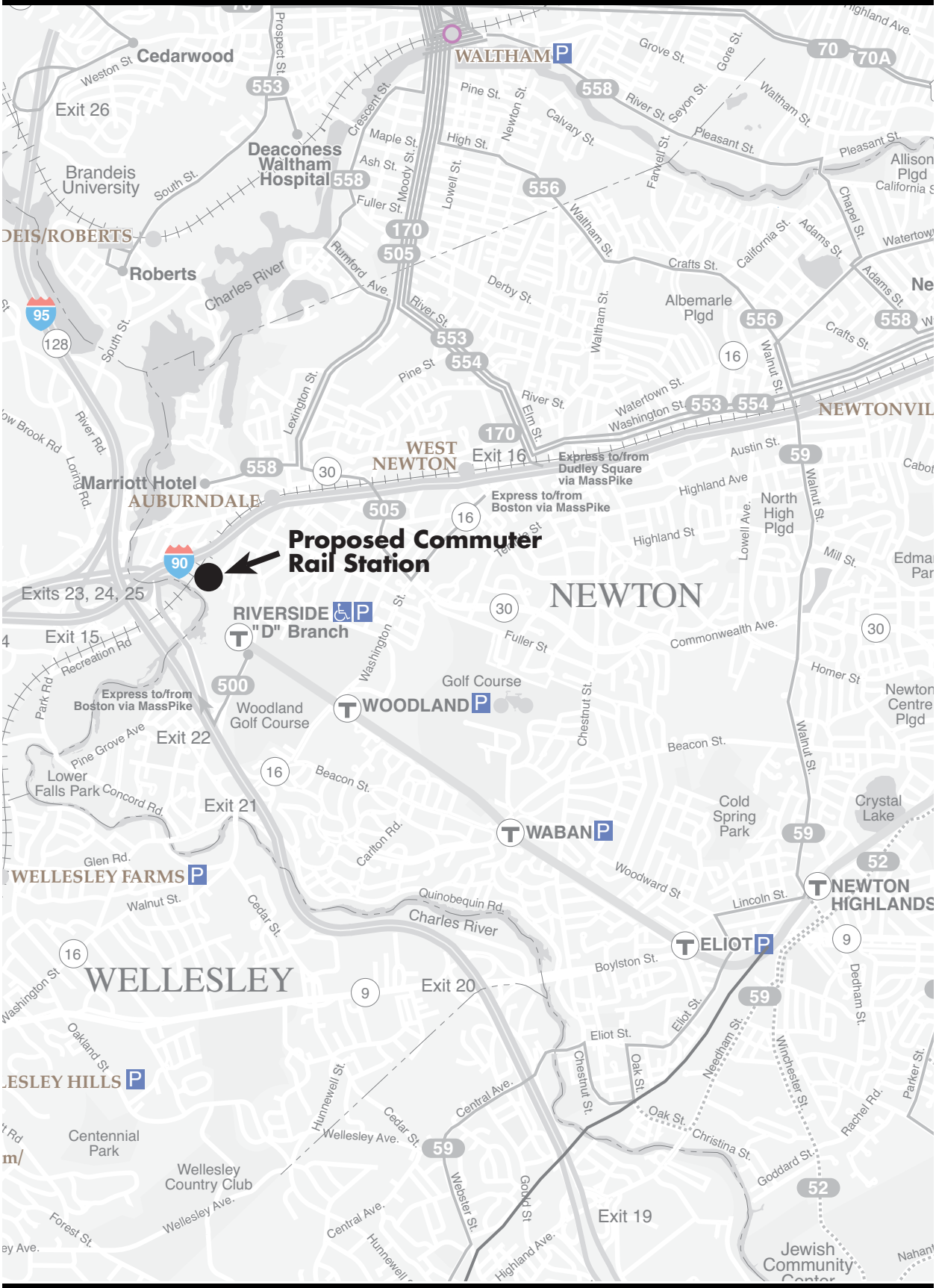
Capital Cost	**$4.1 million (CTPS estimate)**
Operating Cost	**Increased fuel from extra starts and stops, too small to calculate.**
Daily Ridership Increase on Mode	**60**
Net Increase in Daily Transit Ridership	**40**
Capital Cost per New Transit Rider	**$101,600, excluding cost of pedestrian connection**
Operating Cost per Wkday/New Transit Rider	**Too small to calculate**
Capital Cost/Travel Time Benefit	**$1,219,700 per hour**
Operating Cost/Travel Time Benefit	**Too small to calculate**
Travel Time Savings	**3 hours per weekday**

Assessment

Overall, this project is rated medium priority. It would attract very few total riders or new transit riders. The capital cost would be relatively small in absolute terms, but because of the low ridership, the cost per new rider would be at the upper end of the mid-range of such costs among commuter rail expansion projects. It would receive a high rating for economic and land-use impacts, because it would be in a state-designated revitalization area, where local plans call for new mixed-use development, including an office park on a brownfield site along with commercial and residential construction.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
New Station	○	○	◗	◗	◗	●	○

MAP 5C-34 NEW COMMUTER RAIL STATION AT RIVERSIDE



D NEW COMMUTER RAIL STATION AT RIVERSIDE

Description

This project would add a new station on the Framingham/ Worcester commuter rail line near Route 128 on the border of Newton and Weston. It would be between the existing Wellesley Farms and Auburndale stations, possibly replacing the latter. A previous commuter rail station in this vicinity was discontinued in 1977 because of very low ridership.

Capital Features

This project would consist of one new station with a regional parking facility on an existing line. No upgrading of tracks would be needed. Peak capacity would need to be increased by two coaches. A new or upgraded access road would be needed to reach the site from Route 128, but the cost of that has not been calculated.

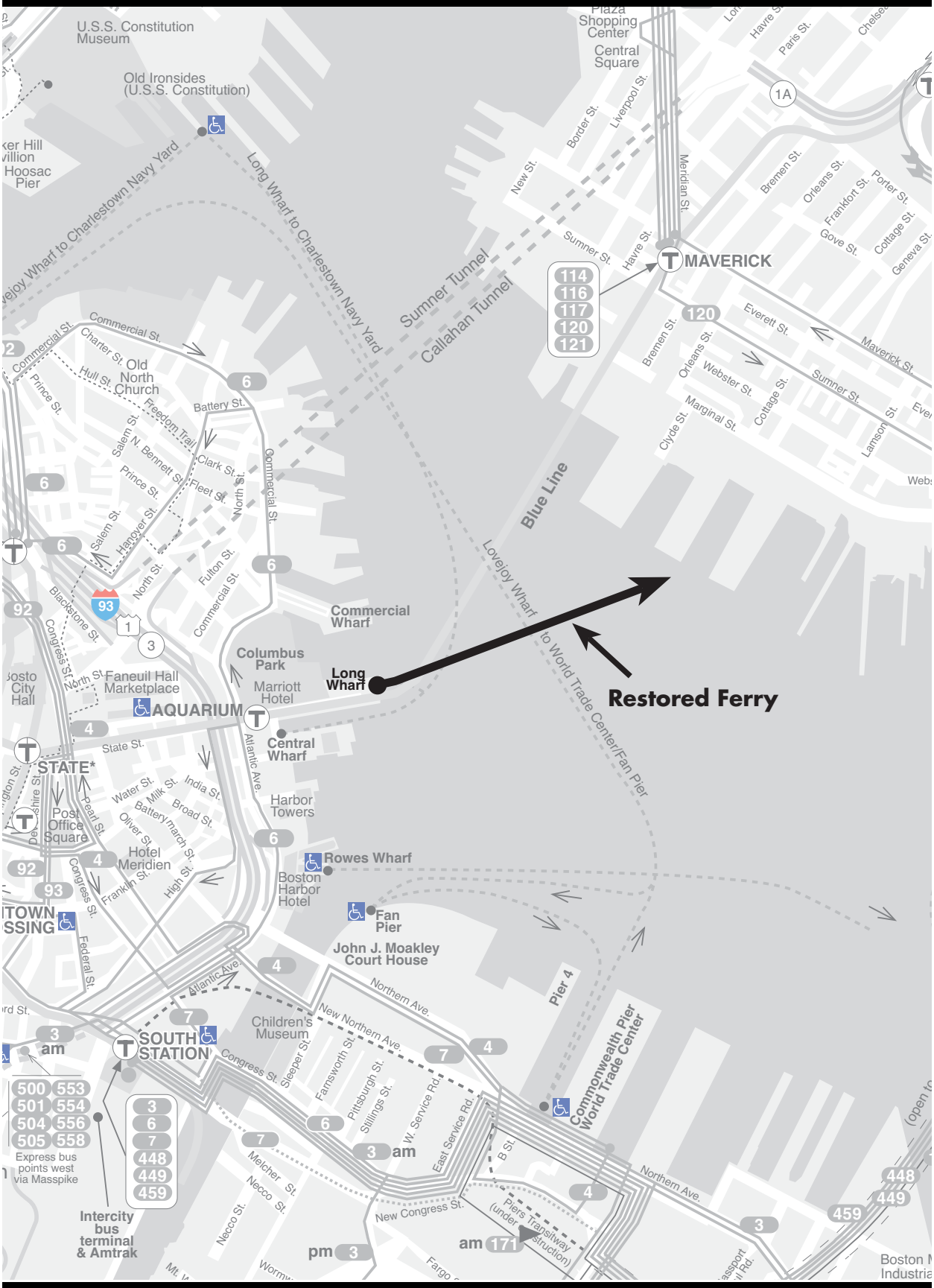
Capital Cost	**$10.7 million (CTPS estimate)**
Operating Cost	**Too small to calculate**
Daily Ridership Increase on Mode	**700**
Net Increase in Daily Transit Ridership	**250**
Capital Cost per New Transit Rider	**$43,000**
Operating Cost per Wkday/New Transit Rider	**Too small to calculate**
Capital Cost/Travel Time Benefit	**$133,300 per hour**
Operating Cost/Travel Time Benefit	**Too small to calculate**
Travel Time Savings	**81 hours per weekday**

Assessment

Overall, this project is rated medium priority. It would attract relatively low numbers of total riders or new transit riders. The capital cost would be relatively small in absolute terms, such that even with limited ridership, the cost per new rider still ranks high among commuter rail expansion projects. Because of the relatively small saving in VMT for each new transit user, cost-effectiveness of air quality improvements would be only moderate. The project would rate low in economic and land-use impacts as it would not serve an area with significant existing or planned development. It would not serve any environmental justice target areas. Its main benefit would be in improving inter-connectivity, as it would provide a new connection between a commuter rail line and the Green Line. Because of the distance separating the two lines, this connection would be only fair.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
New Station	○	○	●	◗	◗	○	○

MAP 5C-35 RESTORE EAST BOSTON FERRY



D RESTORE EAST BOSTON FERRY

Description

This project would reinstate ferry service between East Boston and Long Wharf or Rowes Wharf on the downtown Boston waterfront. A similar route was run most recently from 1995 to 1997, but was discontinued because of low ridership. Previous ferry service from East Boston had ended in 1952. The project analyzed for the PMT would use an East Boston terminal closer to new development than that of the 1990s service.

Capital Features

This route would require acquisition of two small low-speed commuter ferries, and construction of a new terminal in East Boston.

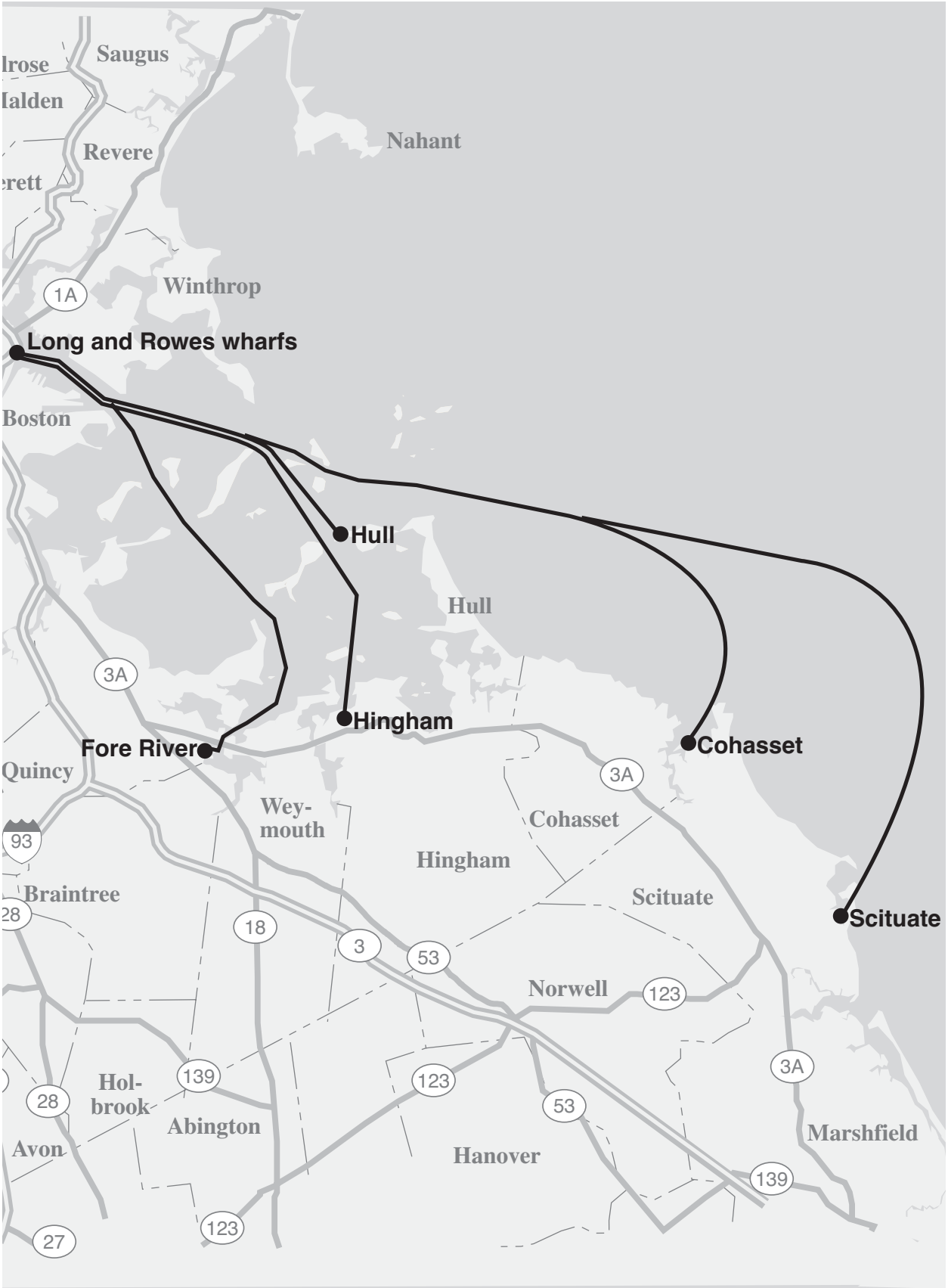
Capital Cost	**$3.5 million (CTPS estimate)**
Operating Cost	**$2,500 per day**
Daily Ridership Increase on Mode	**290**
Net Increase in Daily Transit Ridership	**70**
Capital Cost per New transit Rider	**$50,000**
Operating Cost per Wkday/New transit Rider	**$35.20**
Capital Cost/Travel Time Benefit	**$1,200,000 per hour**
Operating Cost/Travel Time Benefit	**$854.00 per hour**
Travel Time Savings	**3 hours per weekday**

Assessment

This project would provide a new transit alternative for travel from homes in East Boston to work locations in much of the Financial/Retail and Waterfront districts. It would attract few riders that would not otherwise use some form of transit. In absolute terms, the capital and operating costs would be the lowest among all water transportation projects examined for the PMT. Relative to new transit ridership, this project would have the lowest operating cost. It would also have the lowest capital cost per new transit rider if the South Shore projects are considered as a group, and the second-lowest if they are considered individually. However, the costs per unit travel time benefit rank very low. This would be the only one of the water transportation projects that would provide direct service to an environmental justice target community. The overall rating of this project is medium priority.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
Line Extension/ New Line	❍	❍	◗	❍	❍	●	●

MAP 5C-36 IMPROVED FERRY SERVICE FROM SOUTH SHORE COMMUNITIES TO BOSTON



D IMPROVED FERRY SERVICE FROM SOUTH SHORE COMMUNITIES TO BOSTON

Description

This project would include several elements that could be implemented individually or together. The full project would increase service frequency on the existing Hingham and Quincy/Hull commuter boat routes and establish new routes to Boston from Cohasset and Scituate.

Capital Features

The full alternative would require acquisition of 13 medium-size high-speed commuter boats. Of these, seven would be used to replace slower boats on the Hingham route and increase the frequency of peak service. Each of the other routes would need two new boats. New terminals with parking would be required at Scituate and Cohasset, and some parking expansion at Hingham and Hull would be needed.

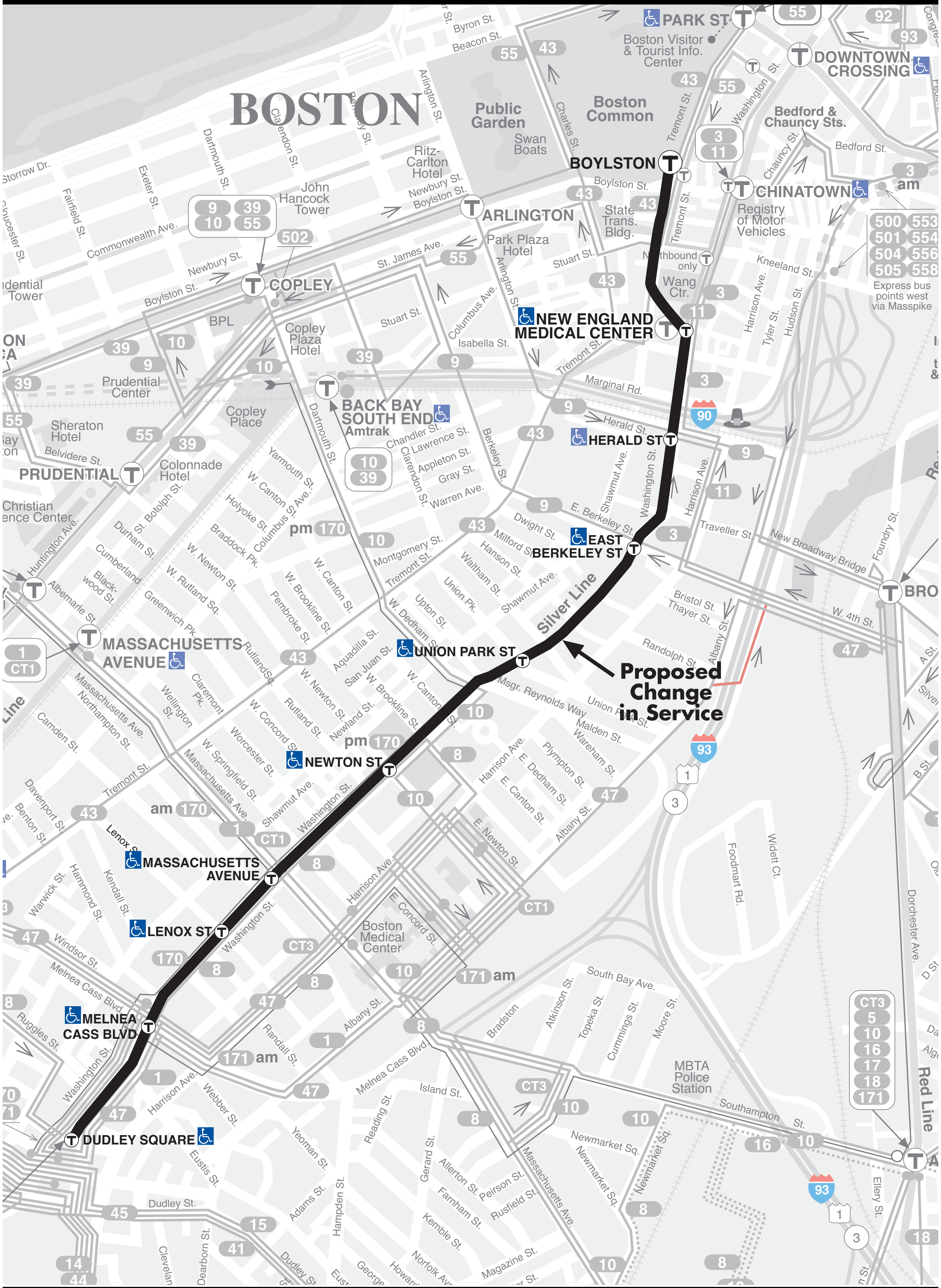
Capital Cost	**$39.7 million (CTPS estimate)**
Operating Cost	**$66,300 per day**
Daily Ridership Increase on Mode	**800**
Net Increase in Daily Transit Ridership	**270**
Capital Cost per New transit Rider	**$146,900**
Operating Cost per Wkday/New transit Rider	**$245.50**
Capital Cost/Travel Time Benefit	**$263,900 per hour**
Operating Cost/Travel Time Benefit	**$441.00 per hour**
Travel Time Savings	**150 hours per weekday**

Assessment

This project would add new transit options for travel to Boston from South Shore points, but would have to compete with other transit alternatives including commuter rail and combinations of bus and rapid transit. For all elements of the project combined, the capital cost per new transit rider would be second-highest and the operating cost per new transit rider highest among all water transportation projects examined for the PMT. When the four elements of this project are considered individually, each of them would have higher operating costs per new transit rider than any of the non-South Shore projects. In term of capital cost per new transit rider, a Scituate route and an enhanced Hingham route would both be more costly than any of the other water transportation projects examined, but an enhanced Quincy/Hull route would be the least costly project. A Cohasset route would have the second-lowest capital cost per new transit rider among the South Shore projects, but the second-highest when compared only with the non-South Shore projects. The existing Hingham, Hull, and Quincy terminals serve state-designated revitalization areas, but Scituate and Cohasset terminals would not. Overall, the South Shore commuter boat projects are rated medium priority.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
Frequency Imp./ New Line	●	◗	◗	❍	❍	❍	◗

MAP 5C-37 CONVERT DUDLEY-BOYLSTON SILVER LINE TO LIGHT RAIL



CONVERT DUDLEY–BOYLSTON SECTION OF SILVER LINE TO LIGHT RAIL

Description

This project would convert the 2.4-mile long Dudley-Boylston section of the Silver Line bus rapid transit service to light rail. Service would be operated as a branch of the Green Line, making use of an abandoned Green Line tunnel segment located under Tremont Street, to access Boylston station. Stops on Washington Street between Herald St. and Dudley would remain the same as the present Silver Line.

Capital Feature

Upgrade abandoned Green Line tunnel for service, construct new portal to tunnel, build new surface light rail line on Washington Street from portal to Dudley, purchase additional vehicles.

Capital Cost	**$373.6 million (CTPS estimate)**
Operating Cost	**$6,100 per weekday**
Daily Ridership Increase on Mode	**34,300**
Net Increase in Daily Transit Ridership	**130**
Capital Cost/New Transit Rider	**$2,873,500**
Operating Cost per Wkday/New Transit Rider	**$46.60**
Capital Cost/Travel Time Benefit	**$642,800 per hour**
Operating Cost/Travel Time Benefit	**$10.40 per hour**
Travel Time Savings	**581 hours per weekday**

Assessment

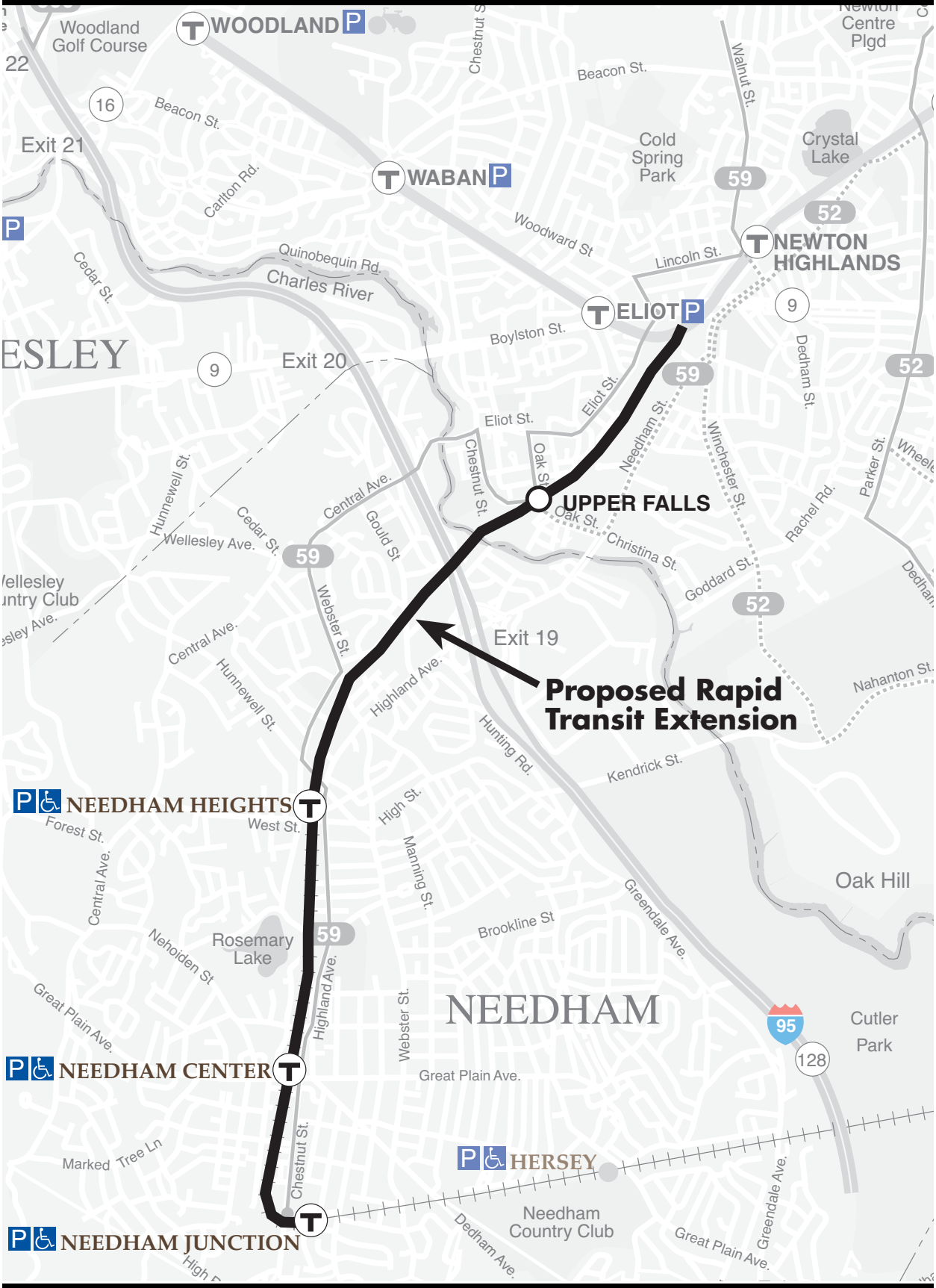
This is a low-priority rapid transit expansion project. Service on the Washington Street corridor between Dudley and Downtown Boston is presently provided by Phase 1 of the Silver Line bus rapid transit project. The MBTA proposes a Phase 3 project which would link the present Phase 1 Dudley-Downtown service with Phase 2 South Station-South Boston waterfront service. However, this project proposes that transit service on Washington Street instead be converted to light-rail and operated as a branch of the Green Line to Government Center.

The projected capital costs would be $373.6 million. Additional typical daily operating costs above the present Silver Line service would be $6,100. There would be 34,300 passengers new to the mode with this project. Only 130 would be new transit riders, since the majority of riders would be diverted from Washington Street Silver Line Bus Rapid Transit service. The capital cost per new transit rider would be the highest of any rapid transit project evaluated at $2,873,500. The additional operating cost per new transit rider would be $46.60. If this project is pursued, Phase III of the Silver Line BRT project would be reduced to only include a South Station-Boylston Street segment. Correspondingly, initial engineering plans for a turn around loop and station at Boylston Street would need to be changed.

The impact on air quality would be low, as few new riders would be diverted from automobiles. The project would provide one-seat rides between locations along Washington Street and Government Center. Transfer opportunities with other parts of the Green Line, the Blue Line and the Red Line would be improved. This project would also provide direct service to areas of Roxbury which are environmental justice target neighborhoods.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
Line Extension	○	○	○	○	◗	●	●

MAP 5C-38 NEW GREEN LINE NEEDHAM BRANCH



NEW GREEN LINE NEEDHAM BRANCH

Description

This project would add a branch to the Green Line, diverging from the D Branch between the Newton Highlands and Eliot stations and following the alignment of a lightly used rail freight line and the outer end of the Needham Commuter rail line to Needham Junction. Commuter rail service to Needham Center and Needham Heights would be discontinued.

Capital Features

This would be a 3.8-mile extension, including one new station in Newton, a new facility for transfer between commuter rail and Green Line at Needham Junction and substitution of Green Line service for commuter rail at two other stations in Needham.

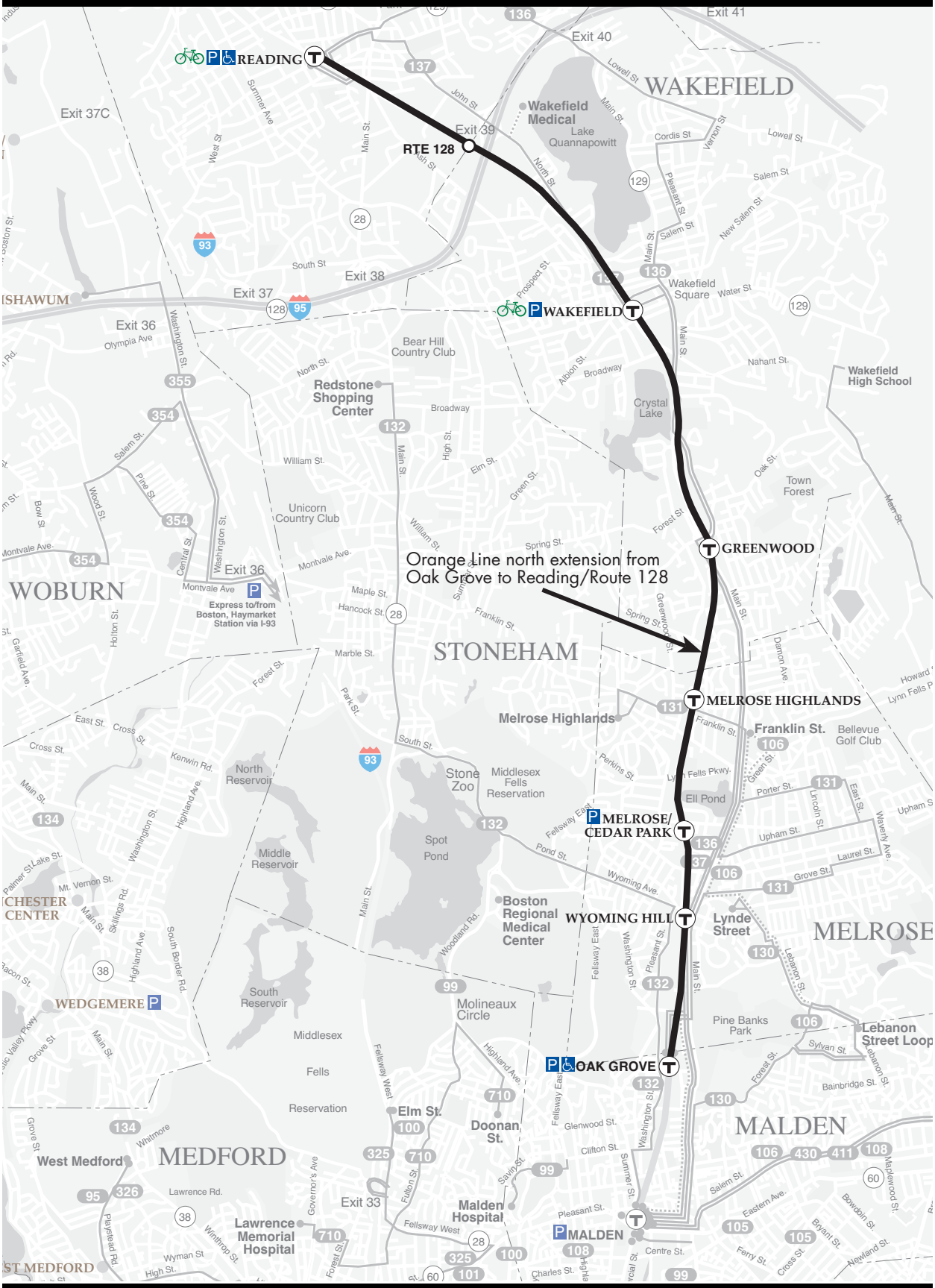
Capital Cost	**$123.9 million (CTPS estimate)**
Operating Cost	**$16,600 per weekday**
Daily Ridership Increase on Mode	**3,400**
Net Increase in Daily Transit Ridership	**500**
Capital Cost per New Transit Rider	**$247,800**
Operating Cost per Wkday/New Transit Rider	**$33.30**
Capital Cost/Travel Time Benefit	**$2,655,000 per hour**
Operating Cost/Travel Time Benefit	**$356.30 per hour**
Travel Time Savings	**47 hours per weekday**

Assessment

Overall, this project is rated low priority. It would replace the outer end of an existing commuter rail line with a rapid transit extension, providing more frequent service and direct service to a greater number of destinations. It would also provide rail transit service to a densely populated section of Newton that is currently served only by local buses. It would not serve any environmental justice target communities. In absolute terms, this would be one of the less costly rapid transit extensions examined, but it would be among the more costly projects relative to the amount of new ridership attracted. This project would be compatible with a commuter rail extension from Needham Junction to Millis. It would add to the complexity of Green Line operations, as service would need to be coordinated with that of the D Branch above ground and with B, C, and E branch service in the Central Subway. It might necessitate some reduction in the amount of D branch service provided at stations west of Newton Highlands.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
Line Extension	❍	❍	❍	❍	◗	❍	❍

MAP 5C-39 ORANGE LINE NORTH EXT. FROM OAK GROVE TO READING/RT 128



ORANGE LINE NORTH EXTENSION FROM OAK GROVE TO READING/RT 128

Description

This project would extend Orange Line service from Oak Grove Station to Reading via the Haverhill/Reading commuter rail line right-of-way. Commuter rail service on this line would be discontinued between Boston and North Wilmington. Service to points further north would be re-routed via Wilmington and the Lowell Line.

Capital Features

This would be a 6.5-mile extension, including six new stations, in Melrose, Wakefield, and Reading and elimination of 12 present grade crossings by lowering of the tracks and of one by building a new highway overpass.

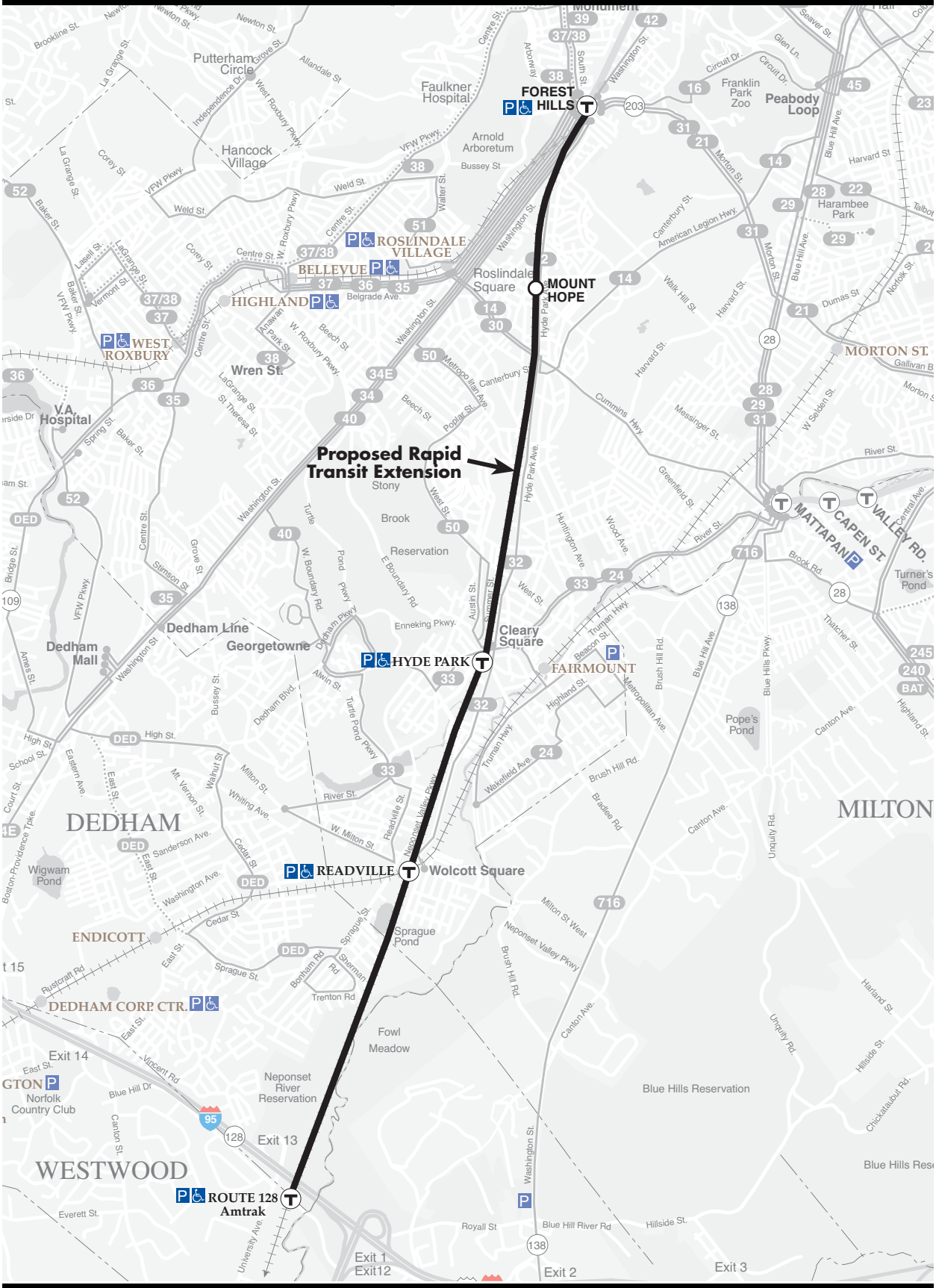
Capital Cost	**$487.8 million (CTPS estimate)**
Operating Cost	**$109,500 per weekday**
Daily Ridership Increase on Mode	**9,400**
Net Increase in Daily Transit Ridership	**5,400**
Capital Cost per New Transit Rider	**$90,500**
Operating Cost per Wkday/New Transit Rider	**$20.30**
Capital Cost/Travel Time Benefit	**$413,800 per hour**
Operating Cost/Travel Time Benefit	**$92.90 per hour**
Travel Time Savings	**1,179 hours per weekday**

Assessment

Overall, this project is rated low priority. It would replace an existing commuter rail line with a rapid transit extension, providing more frequent service and eliminating a transfer for passengers with destinations on the Orange Line beyond walking distance of North Station. In absolute terms, the capital cost would fall in the upper mid-range of all rapid transit extensions examined for the PMT. It would, however, also be in the upper mid-range in terms of air quality improvement. It would not serve any environmental justice target communities.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
Line Extension	◗	❍	❍	◗	❍	❍	❍

MAP 5C-40 ORANGE LINE SOUTH EXTENSION FROM FOREST HILLS TO RT 128



ORANGE LINE SOUTH EXTENSION FROM FOREST HILLS TO RT 128

Description

This project would extend Orange Line service from Forest Hills Station in Boston to Route 128 via the Providence commuter rail line right-of-way. Commuter and intercity rail passenger service on this line would also continue.

Capital Features

This would be a 6.4-mile extension, including three stations in Boston neighborhoods and terminating at the existing Route 128 park-and-ride station. This segment of the rail line is already fully grade-separated. Some reconfiguration of the tracks would be needed to allow for two Orange Line tracks in addition to railroad tracks.

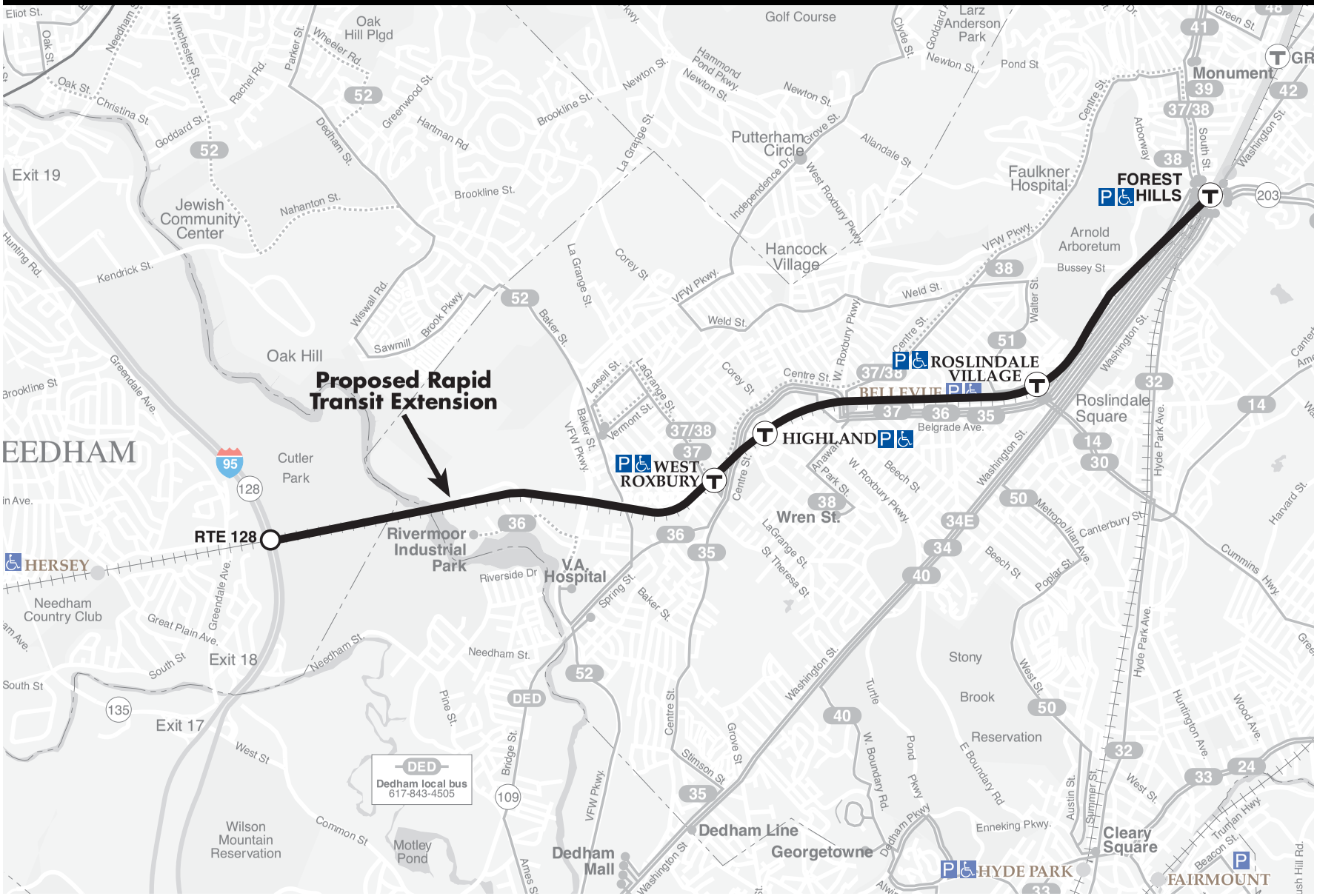
Capital Cost	**$342.8 million (CTPS estimate)**
Operating Cost	**$94,900 per weekday**
Daily Ridership Increase on Mode	**4,700**
Net Increase in Daily Transit Ridership	**2,000**
Capital Cost per New Transit Rider	**$172,300**
Operating Cost per Wkday/New Transit Rider	**$47.70**
Capital Cost/Travel Time Benefit	**$677,100 per hour**
Operating Cost/Travel Time Benefit	**$187.40 per hour**
Travel Time Savings	**506 hours per weekday**

Assessment

Overall, this project is rated low priority. It would supplement an existing commuter rail line with a rapid transit extension, providing more frequent and direct service to a greater number of destinations. This would be one of the more costly extensions examined in absolute terms and in capital and operating cost per new transit rider. It would be moderately effective in terms of air quality improvement and in cost relative to this improvement. Wetlands along the alignment near Route 128 could prevent the grade from being widened sufficiently to add Orange Line tracks. The existing Route 128 station layout does not provide for any additional tracks or platforms.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
Line Extension	❍	❍	❍	◗	◗	◗	◗

MAP 5C-41 ORANGE LINE SOUTH EXTENSION FROM FOREST HILLS TO WEST ROXBURY/NEEDHAM



ORANGE LINE SOUTH EXTENSION FROM FOREST HILLS TO NEEDHAM

Description

This project would extend Orange Line service from Forest Hills Station in Boston to Route 128 via the Needham commuter rail line right-of-way. Commuter rail service on this line would be discontinued.

Capital Features

This would be a 5.1-mile extension, including two or three stations in West Roxbury, and a major park-and-ride facility at the outer terminal. This segment of the rail line is already fully grade-separated, but is mostly single-tracked. A second track would be needed for Orange Line service.

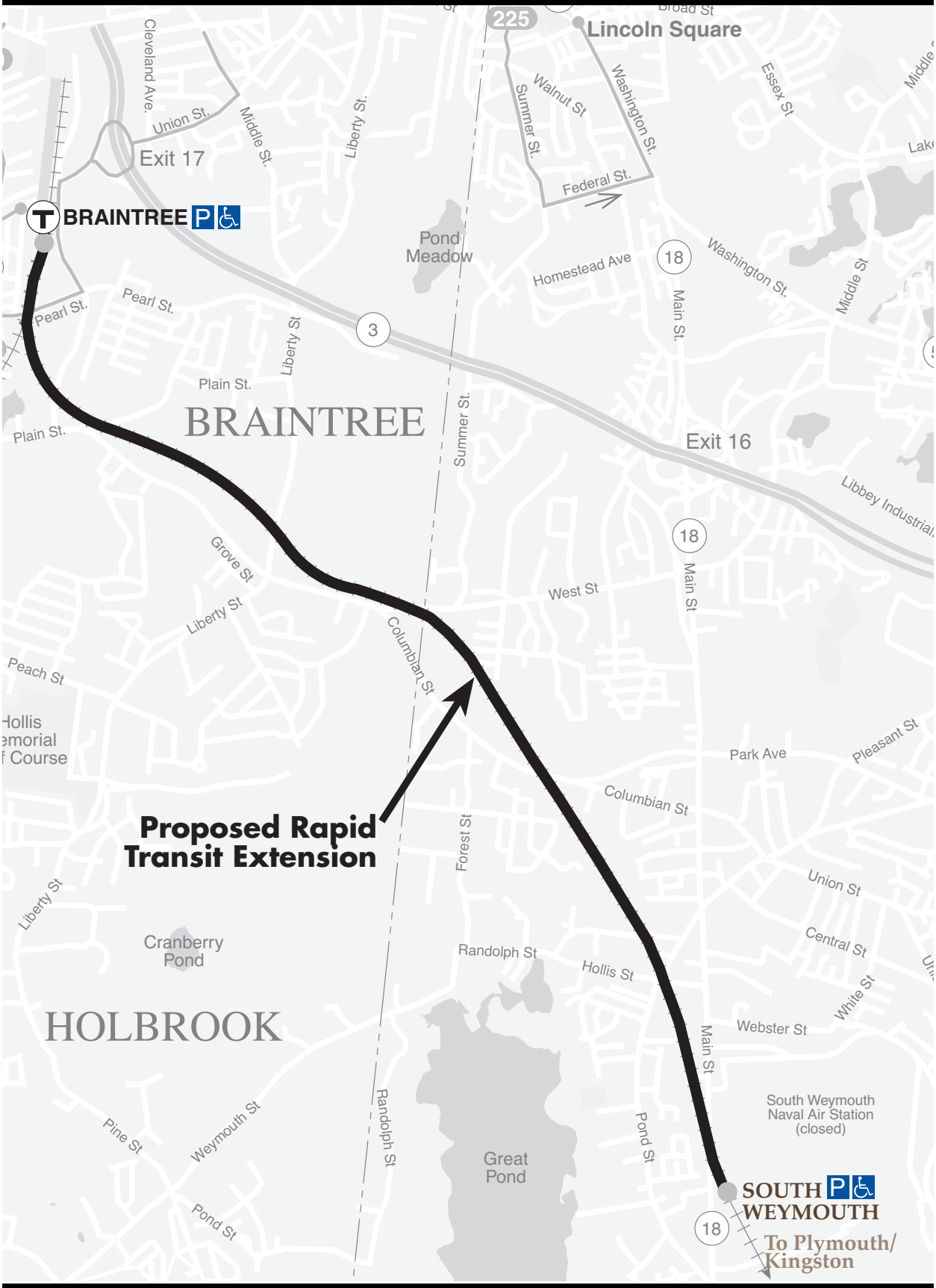
Capital Cost	**$316.2 million (Based on 1994 PMT, adjusted to 2003)**
Operating Cost	**$79,900 per weekday**
Daily Ridership Increase on Mode	**11,300**
Net Increase in Daily Transit Ridership	**600**
Capital Cost per New Transit Rider	**$514,200**
Operating Cost per Wkday/New Transit Rider	**$129.90**
Capital Cost/Travel Time Benefit	**$2,804,700 per hour**
Operating Cost/Travel Time Benefit	**$708.70 per hour**
Travel Time Savings	**113 hours per weekday**

Assessment

Overall, this project is rated low priority. It would replace an existing commuter rail line with a rapid transit extension, providing more frequent and direct service to a greater number of destinations. This would be one of the more costly extensions examined in absolute terms and in capital and operating cost per new transit rider. It would be relatively ineffective in terms of air quality improvement and in cost to achieve to this improvement. The three outer stations on the present commuter rail line would no longer have rail transit service, and a commuter rail extension to Millis via Needham would no longer be feasible.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
Line Extension	❍	❍	❍	❍	❍	❍	◗

MAP 5C-42 RED LINE EXTENSION TO WEYMOUTH



RED LINE EXTENSION TO WEYMOUTH

Description

This project would extend Red Line service from Braintree Station to South Weymouth, sharing the right-of-way of the Plymouth/Kingston commuter rail line.

Capital Features

This would be a 4.3-mile extension, including one new station with a major park-and ride facility in Weymouth. Elimination of four grade crossings of roads and a grade separated crossing of the Red Line with the Old Colony commuter rail lines would be required.

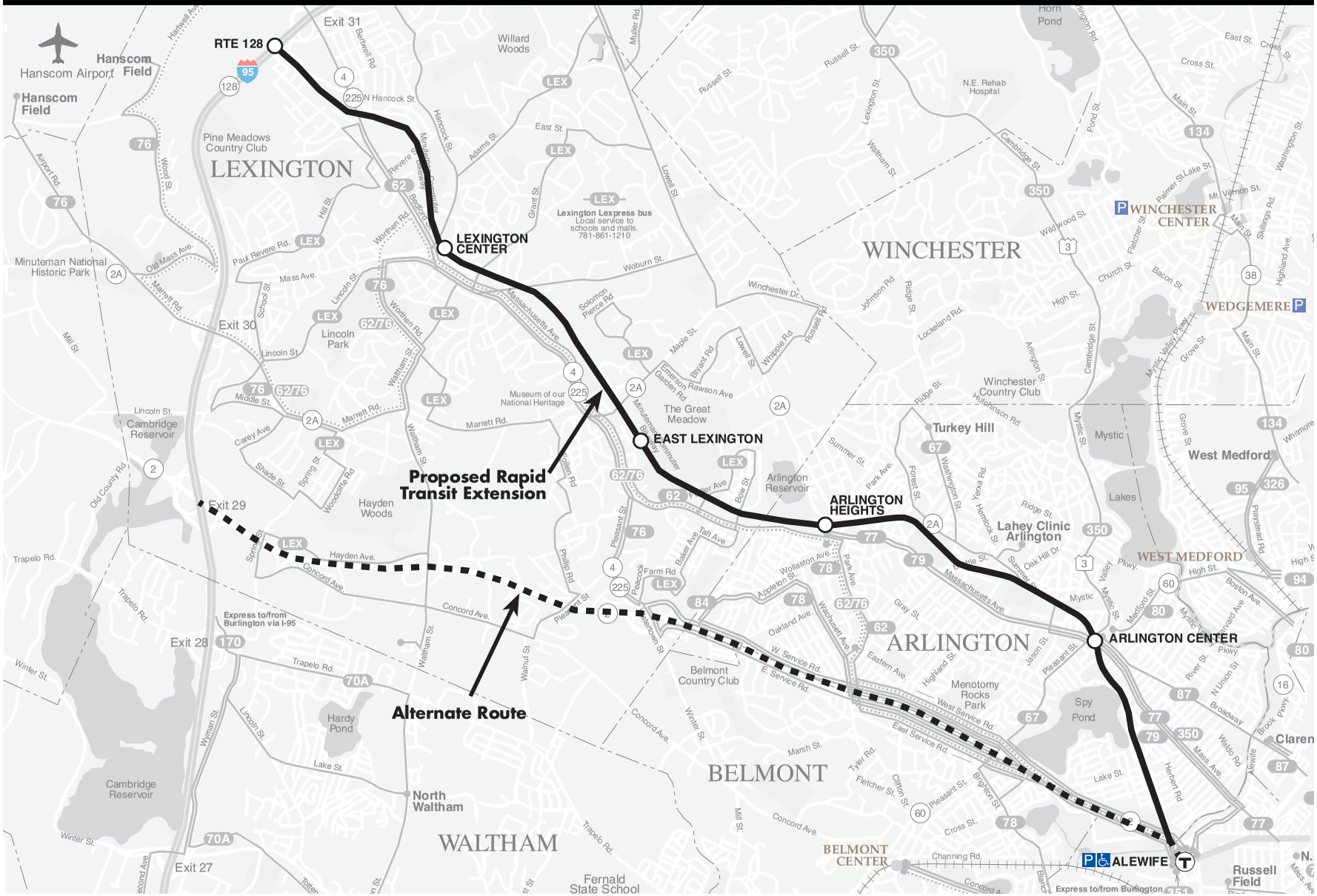
Capital Cost	**$304.2 million (CTPS estimate)**
Operating Cost	**$52,000 per weekday**
Daily Ridership Increase on Mode	**6,700**
Net Increase in Daily Transit Ridership	**2,900**
Capital Cost per New Transit Rider	**$104,900**
Operating Cost per Wkday/New Transit Rider	**$17.90**
Capital Cost/Travel Time Benefit	**$1,000,000 per hour**
Operating Cost/Travel Time Benefit	**$171.00 per hour**
Travel Time Savings	**304 hours per weekday**

Assessment

Overall, this project is rated low priority. It would bring Red Line service closer to the sources of many of the trips that are currently made via Braintree or Quincy Adams, and would help prevent overcrowding on the inner end of the Plymouth/Kingston commuter rail line. However, it would not result in transit service being provided to an area that does not currently have such service. Capital cost would be in the mid-range among rapid transit extension projects analyzed. It would also be in the mid-range of projects in terms of capital cost relative to new transit riders and to air quality improvements, even though the overall cost-effectiveness rating is low. It does, however receive a high rating for economic and land use impacts. The Weymouth station would be in a state-designated revitalization area and would aid in the redevelopment of a brownfield site.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
Line Extension	◗	❍	❍	◗	❍	●	❍

MAP 5C-43 RED LINE NORTHWEST EXTENSION FROM ALEWIFE TO RT 128



RED LINE NORTHWEST EXTENSION FROM ALEWIFE TO RT 128

Description

This project would extend Red Line service from Alewife Station in Cambridge to Route 128 via the former Lexington Branch railroad alignment (now the route of the Minuteman Bikeway).

Capital Features

This would be an 8.3-mile extension, including five new stations, in Arlington and Lexington, with a major park-and-ride facility at the outer terminal. Because of numerous grade-crossings, the tracks would have to be placed in cuts or subways for much of the way.

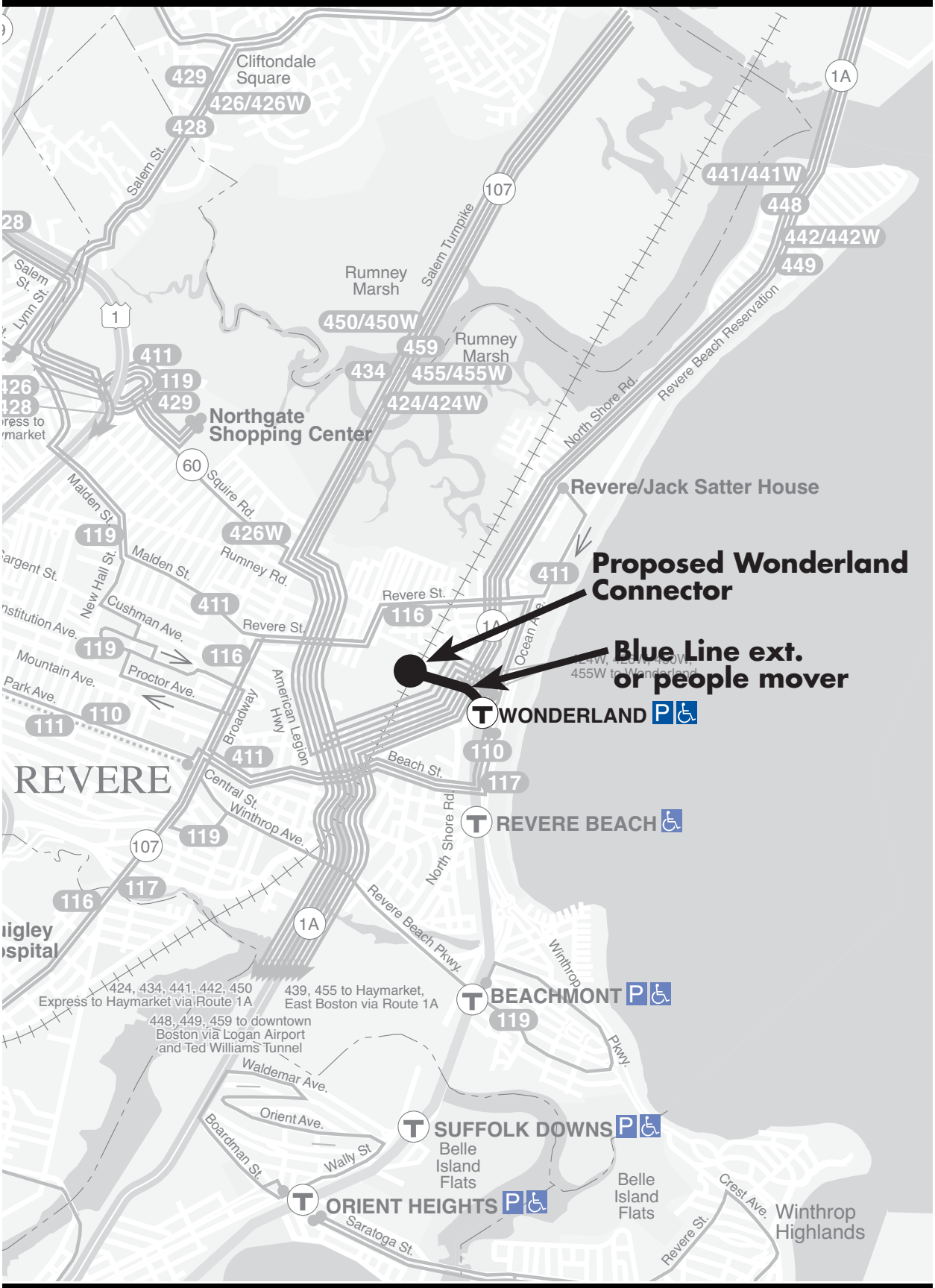
Capital Cost	**$749.3 million (CTPS estimate)**
Operating Cost	**$121,800 per weekday**
Daily Ridership Increase on Mode	**6,700**
Net Increase in Daily Transit Ridership	**1,700**
Capital Cost per New Transit Rider	**$440,800**
Operating Cost per Wkday/New Transit Rider	**$71.70**
Capital Cost/Travel Time Benefit	**$421,700 per hour**
Operating Cost/Travel Time Benefit	**$68.60 per hour**
Travel Time Savings	**1,777 hours per weekday**

Assessment

Overall, this project is rated low priority. It would provide rail transit service to sections of Arlington and Lexington that are currently served by bus routes connecting with the Red Line. In absolute terms, it would be among the most costly of all rapid transit extensions examined for the PMT. It would also be in the lower range of projects in terms of new transit ridership attracted, and air quality benefits. Operating cost per new transit rider would be among the highest of any extension. Segments of the popular Minuteman Bikeway would have to be shut down during construction, and some might be lost permanently. The area served by this project has relatively sparse commercial or mixed-use development. The route would not provide direct service to any environmental justice target communities.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
Line Extension	○	○	○	◗	◗	○	○

MAP 5C-44 WONDERLAND CONNECTOR



WONDERLAND CONNECTOR

Description

This project calls for the construction of a station along the Newburyport/Rockport commuter rail line near Wonderland Station in Revere. Various alternatives exist to provide a direct physical link between the Blue Line and commuter rail service including a realignment of the Blue Line and an automated peoplemover system. The MBTA is currently evaluating these options as part of its Draft Environmental Impact Statement (DEIS) for the Revere to Salem corridor.

Capital Features

Construction of an inter-modal passenger facility.

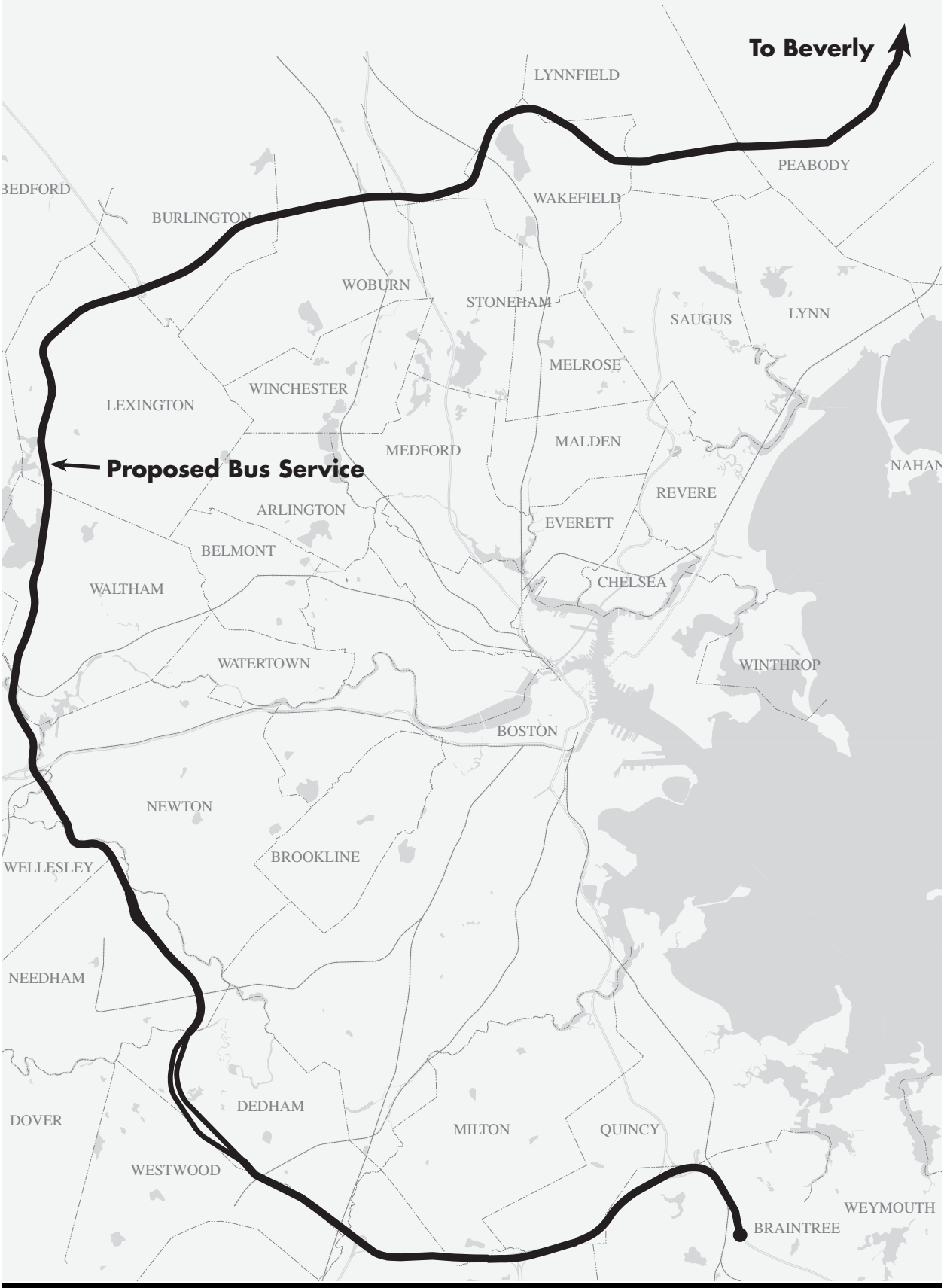
Capital Cost	**$70.0 million (Based on 1997 Wonderland Feasibility Study, adjusted to 2003)**
Operating Cost	**none**
Daily Ridership Increase on Mode	**900**
Net Increase in Daily Transit Ridership	**500**
Capital Cost/New Transit Rider	**$140,100**
Operating Cost per Wkday/New Transit Rider	**none**
Capital Cost/Travel Time Benefit	**$604,600 per hour**
Operating Cost/Travel Time Benefit	**NA**
Travel Time Savings	**116 hours per weekday**

Assessment

This is a low priority rapid transit expansion project based on an analysis of the peoplemover option. Other alternatives currently under review in the DEIS do not appear to match the community's plans or the MBTA's operational needs. The capital cost for this project would be $70 million. There would be no additional typical day Blue Line operating costs. This project would attract 900 riders to the rapid transit mode, of which 500 would be new transit riders. Capital cost per new transit rider would be $140,100. There would be minimal added costs to operate the connector once it is constructed. Access to Logan Airport would be improved via connections between the Blue Line and Commuter Rail. While this major transportation facility would be located in Revere, the city would receive little direct transportation benefit from the project. Thus the project receives a low environmental justice rating. The expansion of a transit facility in Wonderland would be compatible with regional plans and designated revitalization areas. The travel time benefit for this project would primarily be for commuter rail riders bound for destinations in the financial district which have close access to Aquarium and State Street stations on the Blue Line.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
New Station	○	○	◗	◗	○	●	○

MAP 5C-45 ROUTE 128 CIRCUMFERENTIAL BUS SERVICE



ROUTE 128 CIRCUMFERENTIAL BUS SERVICE

Description

This proposal calls for providing bus service along Route 128 which would operate every 30 minutes in the peak and every 60 minutes in the off-peak. Service would operate between Beverly and Braintree, with stops provided at major interchanges and at connecting transit facilities. Employer feeder shuttles would link with the circumferential buses. Connections would be made with commuter rail, the Braintree branch of the Red Line, the Riverside branch of the Green Line, and several local bus routes. A general purpose travel lane in each direction would be converted to an HOV lane to improve bus travel times.

Capital Features

Purchase of additional buses, conversion of a general traffic lane to an HOV lane in both directions.

Capital Cost	**$29.0 million (CTPS estimate)**
Operating Cost	**$22,400 per weekday**
Daily Ridership Increase on Mode	**4,200**
Net Increase in Daily Transit Ridership	**4,500**
Capital Cost/New Transit Rider	**$6,900**
Operating Cost per Wkday/New Transit Rider	**$5.00**
Capital Cost/Travel Time Benefit	**No benefit**
Operating Cost/Travel Time Benefit	**No benefit**
Travel Time Savings	**There are no travel time benefits**

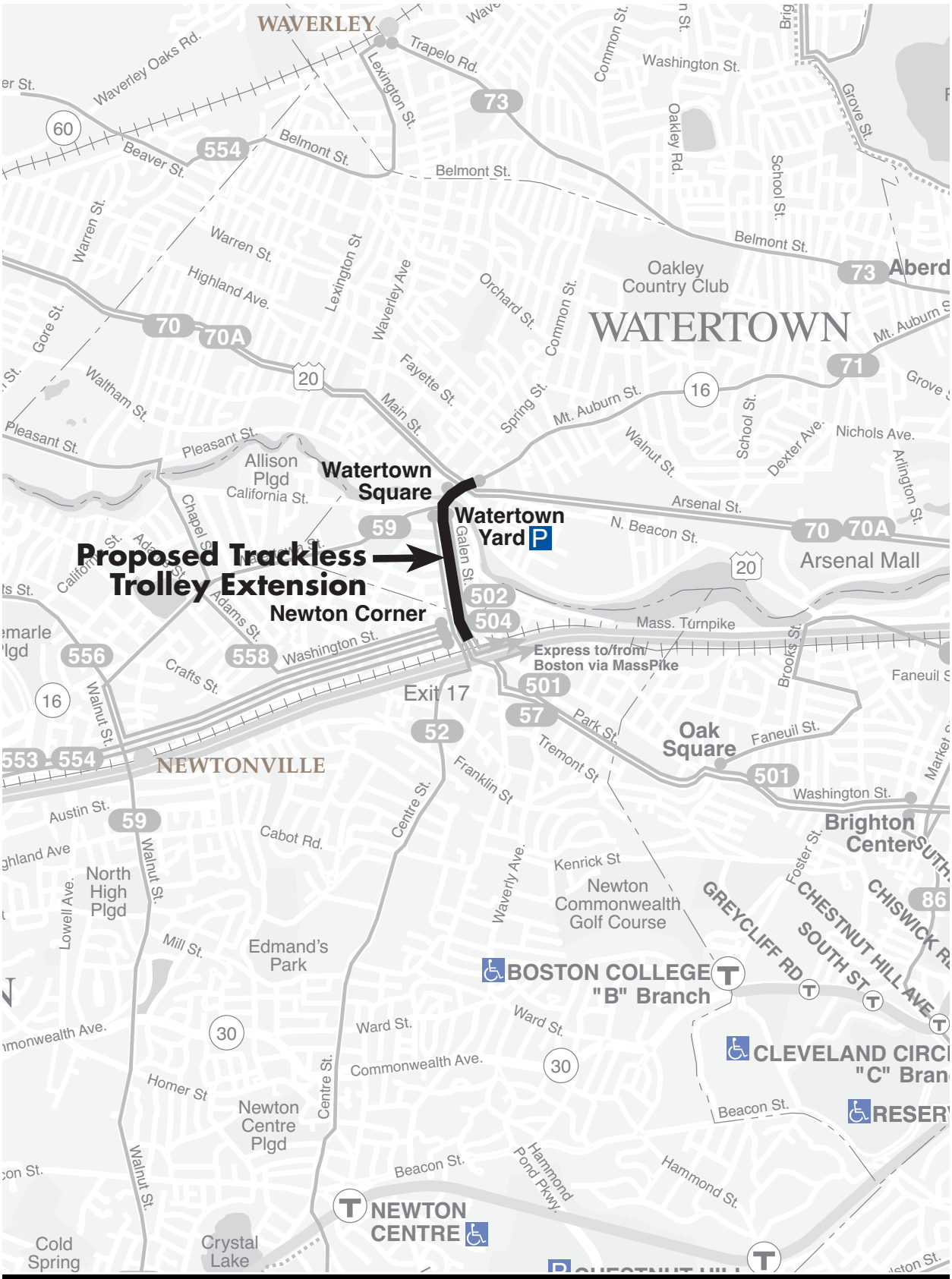
Assessment

This is a low-priority bus expansion project. The capital costs for this project would be $29 million and the typical daily operating costs would be $22,400. This project would attract 4,200 riders to the mode, of which 4,500 would be new to transit. The capital cost per new transit rider would be $6,900 while the operating cost per new rider would be $5.00. The operating cost per new rider only receives a medium score compared to other projects in the same category and cost-effectiveness overall is rated low. Utilization receives a medium score, as the project would draw new riders from automobiles and increase transit mode share, but the travel time savings for this project are very poor. Mobility would be improved, as access would be provided to employment areas now without transit service. Direct connections would be provided to radial transit routes. Suburb to suburb travel would be direct and require shorter trips.

The service would not provide direct service to environmental justice target comminutes, but connections to the existing transit network would provide access to employment areas now only reachable via automobile. Service quality would be low however, as travel times would be long and reliability would be vulnerable to traffic congestion. Multiple transfers would still be required, as all riders traveling to suburban workplaces would need to transfer to circulator shuttles provided by employers to reach their final destination. The conversion of general purpose highway lanes to HOV lanes to benefit this project would result in a dramatic increase in congestion and travel times overall.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Environ. Justice
Line Extension/ New Line	◗	●	❍	❍	❍	❍

MAP 5C-46 EXTEND TRACKLESS TROLLEY #71 FROM WATERTOWN TO NEWTON CORNER



EXTEND TRACKLESS TROLLEY #71 FROM WATERTOWN TO NEWTON CORNER

Description

This proposal calls for extending Route 71 Watertown-Harvard trackless trolley service between Watertown Square and Newton Corner. This would provide direct one-seat service between Newton Corner and locations served by Route 71 in Watertown and Cambridge. It would also provide a direct connection between Route 71 and bus routes 553, 554, 556, and 558 at Newton Corner. New trackless trolley wire would be extended over 0.5 miles of Galen Street in Watertown and the trackless trolley fleet would expand by one vehicle to provide the additional service.

Capital Features

Installation of 0.5 route miles of new trackless trolley overhead contact system, purchase of one additional vehicle.

Capital Cost	**$1.5 million (CTPS estimate)**
Operating Cost	**$1,400 per weekday**
Daily Ridership Increase on Mode	**800**
Net Increase in Daily Transit Ridership	**600**
Capital Cost/New Transit Rider	**$2,500**
Operating Cost per Wkday/New Transit Rider	**$2.40**
Capital Cost/Travel Time Benefit	**$23,200 per hour**
Operating Cost/Travel Time Benefit	**Travel time benefits not yet calculated**
Travel Time Savings	**65 hours per weekday**

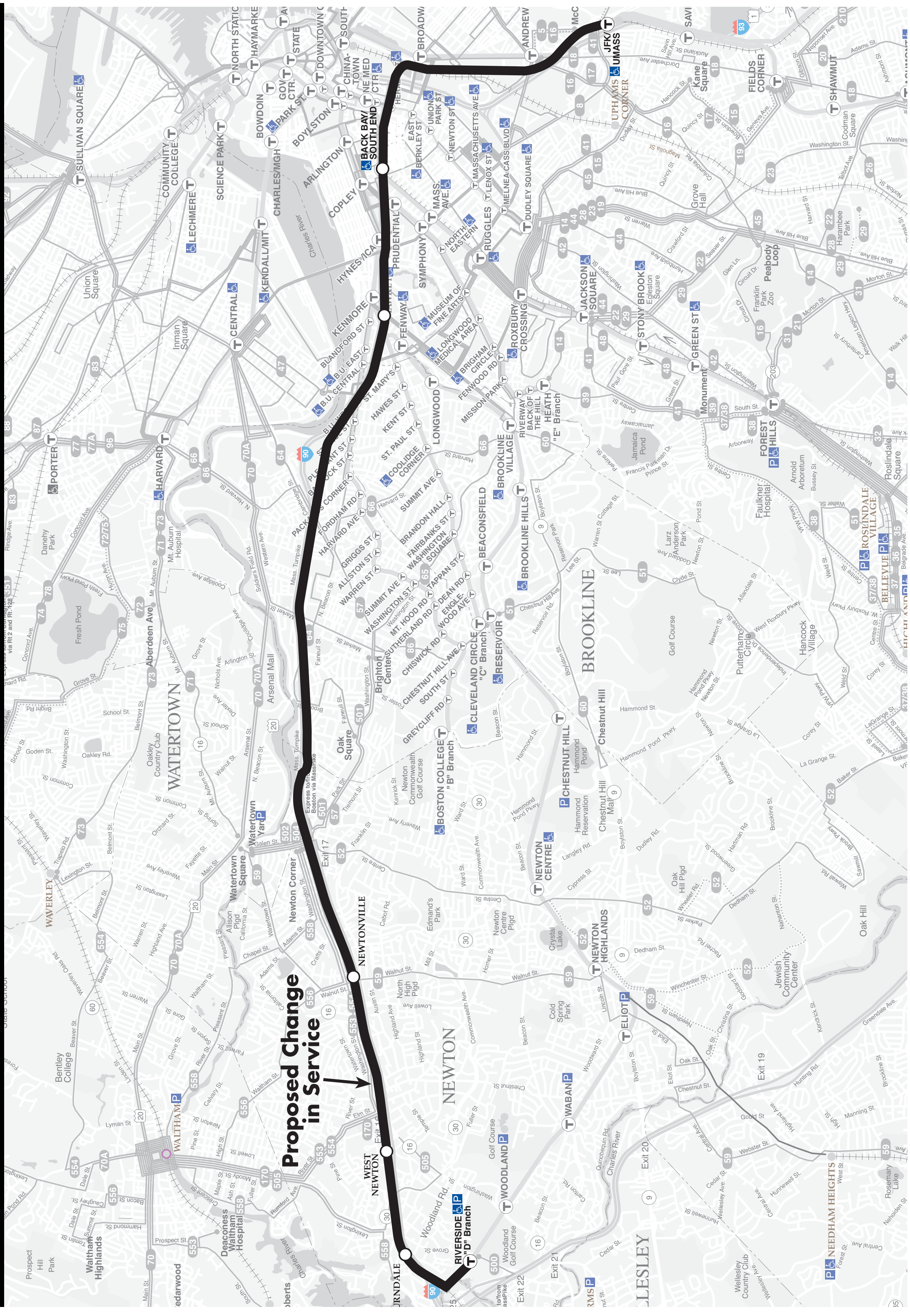
Assessment:

This is a low-priority bus expansion project. The capital costs for this project would be $1.5 million and the typical daily operating costs would be $1,400. This project would attract 800 riders to the mode, of which 600 would be new transit riders. The capital cost per new transit rider would be $2,500 and the operating cost would be $2.40 per new transit rider.

Utilization of this project would be low compared to other bus expansion projects proposed. The project would be cost effective overall compared to other bus expansion projects, operating costs per new passenger are good while capital costs per new transit rider receive a medium rating compared to other bus expansion projects. The project would result in a moderate positive impact on air quality, the actual reductions would be low but the capital cost per unit of reduction receives a medium score. Connectivity between several existing bus routes would be improved, providing new one transfer service from a number of Newton communities.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Environ. Justice
Line Extension/ New Line	❍	❍	●	◗	❍	❍

MAP 5C-47 OPERATE HIGH-FREQUENCY RIVERSIDE-JFK/UMASS COMMUTER RAIL SERVICE



OPERATE HIGH-FREQUENCY RIVERSIDE-JFK/UMASS COMMUTER RAIL SERVICE

Description

This project would institute new commuter rail service between the MBTA's Riverside terminal in Newton and the JFK/UMass station in Dorchester using portions of the routes of the Framingham/Worcester Line and the Old Colony lines, but by-passing South Station. This service would be in addition to, rather than in place of, other service on those lines.

Capital Features

This project would consist of new service over existing lines. It would require one new commuter rail platform, at Riverside, and four new train sets. The cost calculations assume that these would each be two-car diesel multiple unit (DMU) trains.

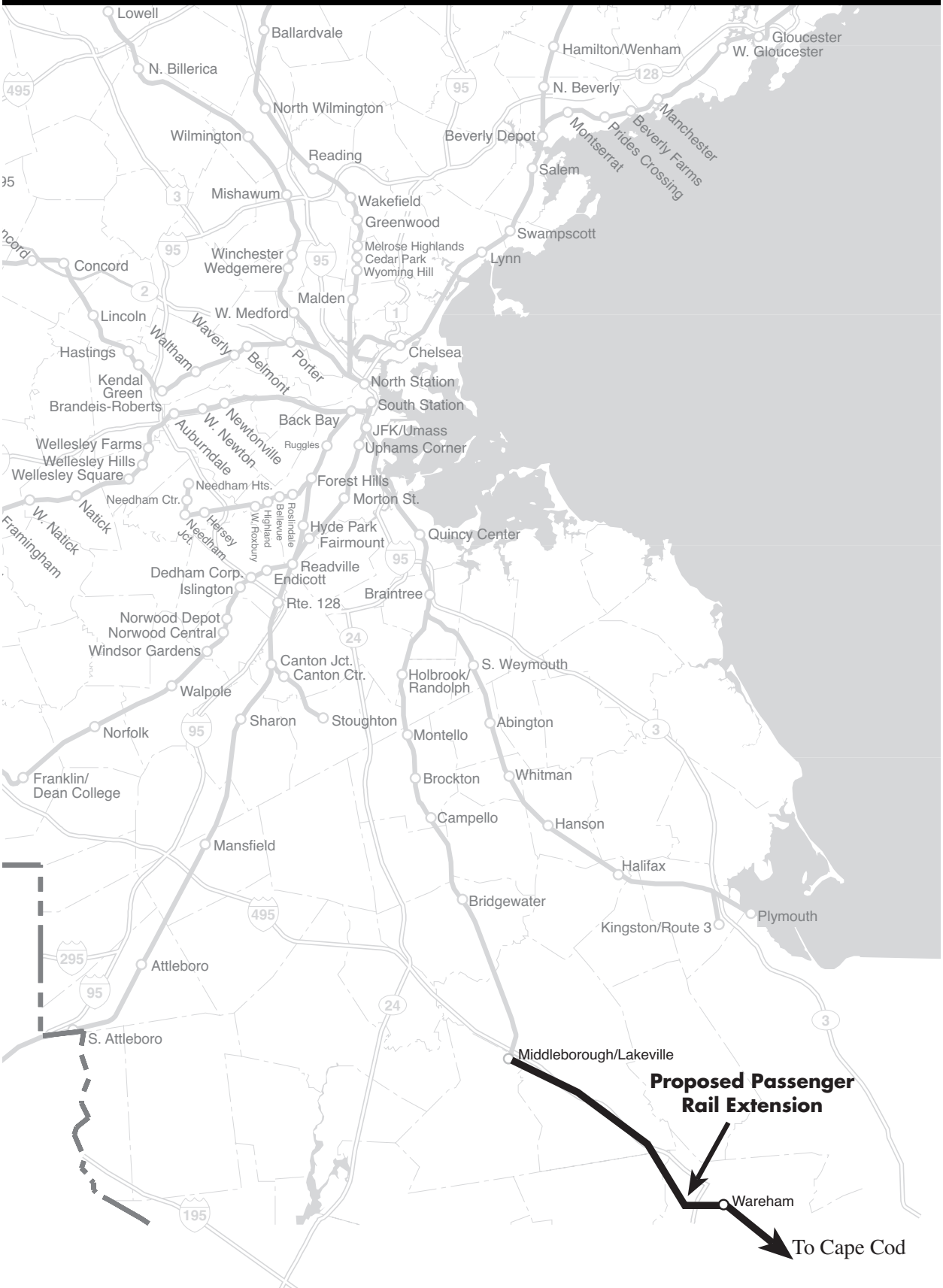
Capital Cost	**$31.5 million (CTPS estimate)**
Operating Cost	**$17,800 per day**
Daily Ridership Increase on Mode	**2,200**
Net Increase in Daily Transit Ridership	**100**
Capital Cost per New Transit Rider	**$314,700**
Operating Cost per Wkday/New Transit Rider	**$177.90**
Capital Cost/Travel Time Benefit	**$715,300 per hour**
Operating Cost/Travel Time Benefit	**$404.30 per hour**
Travel Time Savings	**44 hours per weekday**

Assessment

Overall, this project is rated low priority. It would rank in the upper mid-range of commuter rail projects in total ridership, but would be near the bottom of the mid-range in new transit ridership. The capital cost would be near the lower end of the mid-range among commuter rail projects in absolute terms, but because of the limited ridership, the cost per new rider would be among the highest for all such projects. Likewise, the absolute operating cost would be relatively low, but the cost per new transit rider would be high. Because most of the riders would be diverted from other transit services, and the route would be operated with internal combustion powered trains, it would result in a net worsening of air quality. The main benefit of this project would be in providing new through service between the Fenway and Back Bay areas and the station serving UMass Boston and the JFK Library. (Shuttle bus connections from the station to those sites would still be required.) It would, however, be among the more costly projects in both capital and operating cost per hour of travel time saved per day. Routing conflicts between this service and other South Side commuter rail routes could result in an overall degradation of service on the system.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
Line Extension	◗	❍	❍	❍	❍	◗	◗

MAP 5C–48 EXTEND PASSENGER RAIL SERVICE FROM WAREHAM TO HYANNIS



EXTEND PASSENGER RAIL SERVICE FROM WAREHAM TO HYANNIS

Description

This project would further extend rail passenger service beyond what is proposed for the Middleborough/Wareham commuter rail extension, along an existing rail freight line to Hyannis. Through passenger service from Hyannis to Boston on this route was last operated in 1959. During summer months from 1984 to 1988 connecting service was operated from Hyannis to the Braintree Red Line station.

Capital Features

This would be a 28.9 mile extension (in addition to the 13.5 mile extension required to reach Wareham) with stations in Bourne, Sandwich, and Barnstable, including some park-and-ride facilities. This line was extensively rehabilitated in the 1980s for seasonal intercity passenger service. Upgrading for passenger rail service would include completion of a signal system that is already partly in place and some replacement of ties. Increased running time would require two additional train sets to maintain schedules.

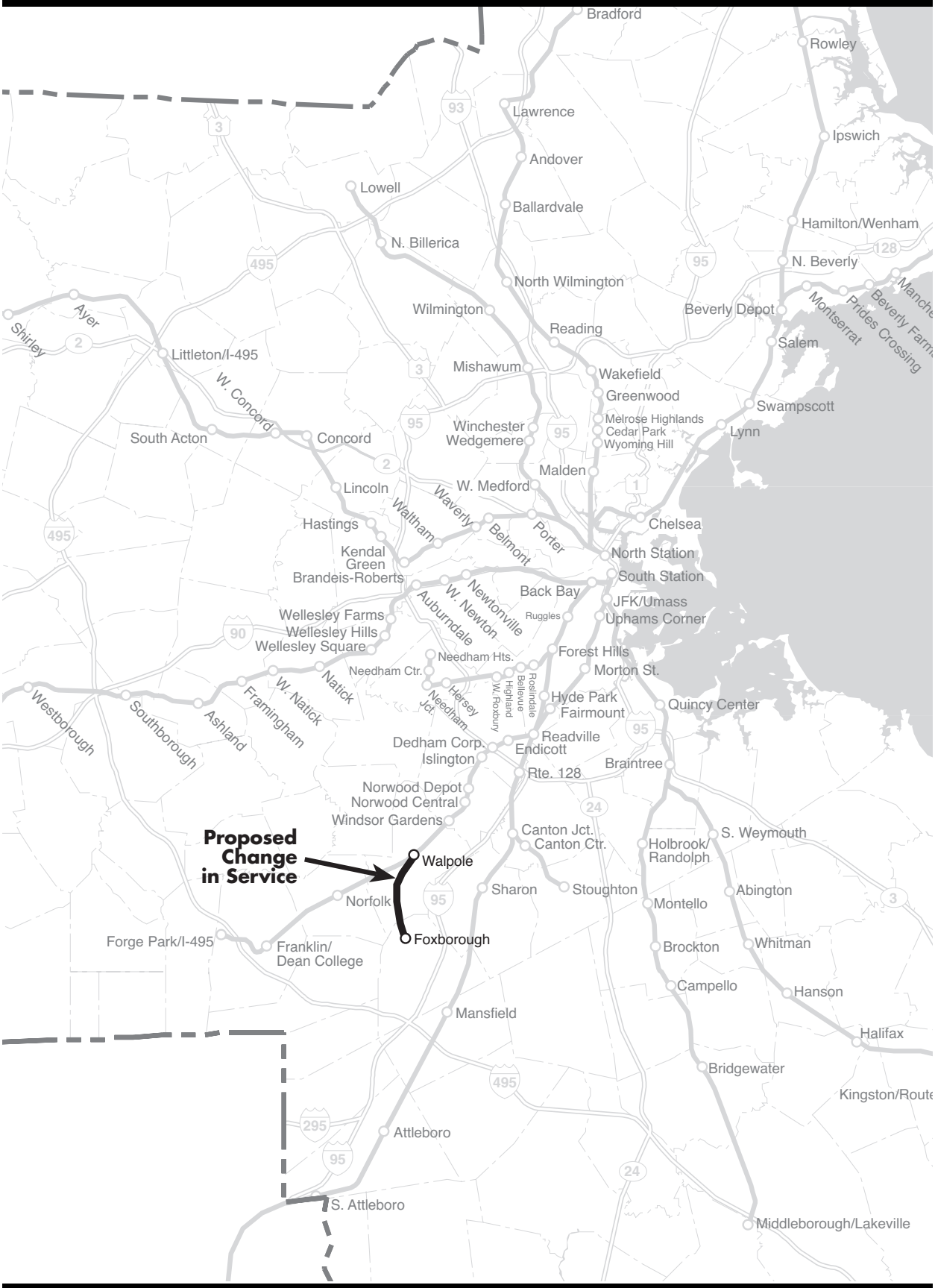
Capital Cost	**$77.1 million (CTPS estimate)**
Operating Cost	**$35,300 per weekday**
Daily Ridership Increase on Mode	**1,800**
Net Increase in Daily Transit Ridership	**1000**
Capital Cost per New Transit Rider	**$79,500**
Operating Cost per Wkday/New Transit Rider	**$36.30**
Capital Cost/Travel Time Benefit	**$196,200 per hour**
Operating Cost/Travel Time Benefit	**$89.00 per hour**
Travel Time Savings	**390 hours per weekday**

Assessment

The overall rating of this project is low priority. It would provide direct rail service to an area that is currently served by frequent express bus service to Boston. Capital costs would be near the lower end of the mid-range of costs among commuter or other passenger rail extensions examined, but because of the limited ridership, capital cost per new rider would be among the highest for projects with similar absolute costs. Operating cost per new rider would also be relatively high. It would be among the better projects in impact on air quality. Emissions of CO, CO2, and VOC would be reduced, but those of NOx would increase. This project is not intended to serve a commuting population; it would instead serve as a congestion mitigation measure for tourist traffic. Consequently, it would not benefit environmental justice target communities.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
Line Extension	◗	❍	❍	●	❍	❍	❍

MAP 5C-49 OPERATE FULL TIME SERVICE TO FOXBORO STATION



OPERATE FULL TIME SERVICE TO FOXBORO STATION

Description

This project would implement full-time commuter rail service over an existing rail freight line that diverges from the Franklin Line at Walpole Station and runs past Gillette Stadium in Foxborough. Since the 1970s the MBTA has operated special trains to football games and other events at the stadium and the previous one that it replaced. Regularly scheduled passenger service on the line ended in 1933, and was never oriented toward Boston commuting.

Capital Features

This would be a 3.7-mile extension. Present track condition is adequate for the stadium trains but extensive upgrading of track and signals would be needed to allow attractive commuter service. The track layout at Walpole station would require a second platform there. Additional rolling stock would be needed for the Foxborough trains.

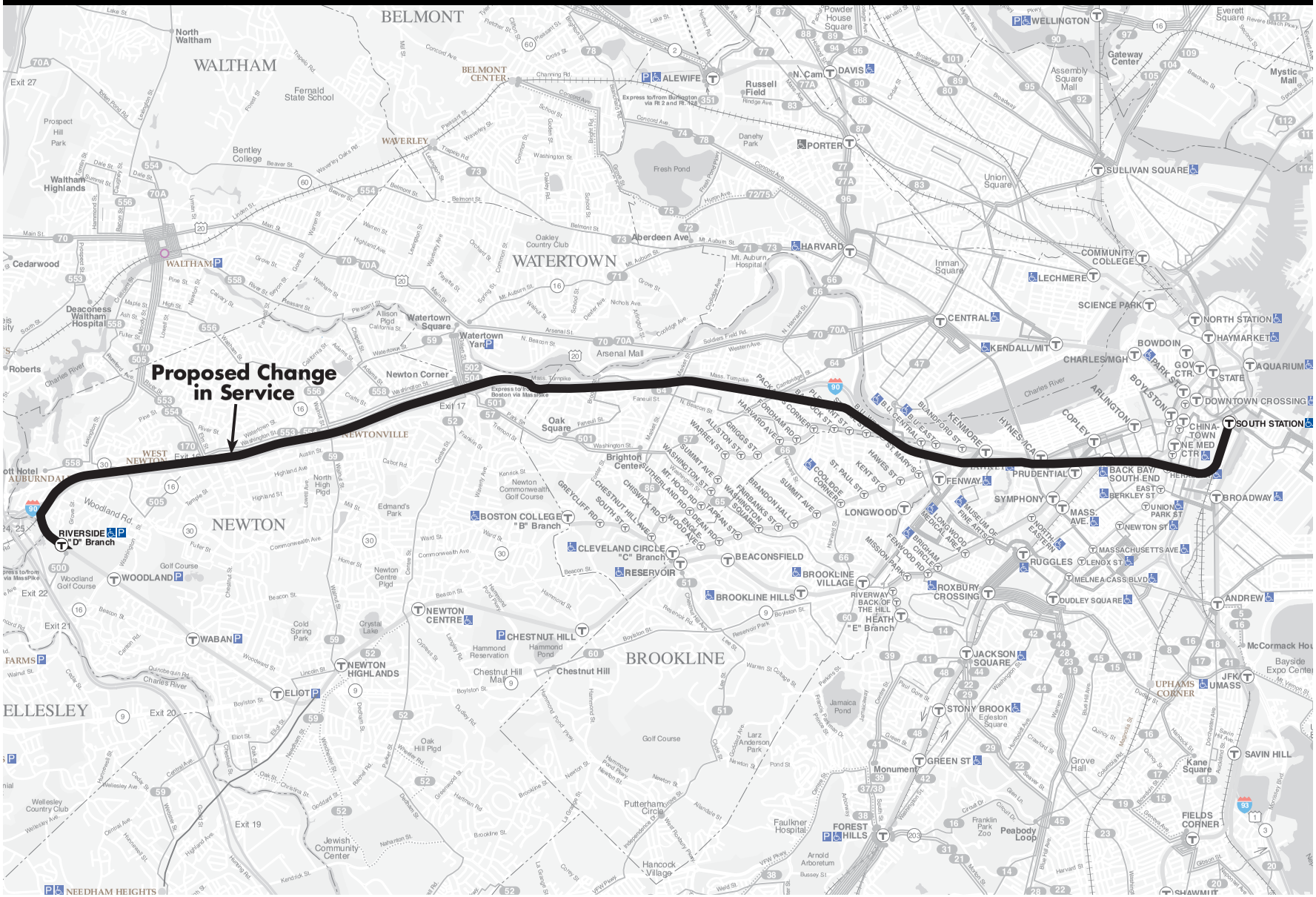
Capital Cost	**$71.3 million (CTPS estimate)**
Operating Cost	**$33,600 per day**
Daily Ridership Increase on Mode	**800**
Net Increase in Daily Transit Ridership	**600**
Capital Cost per New Transit Rider	**$113,100**
Operating Cost per Wkday/New Transit Rider	**$53.30**
Capital Cost/Travel Time Benefit	**$537,700 per hour**
Operating Cost/Travel Time Benefit	**$253.50 per hour**
Travel Time Savings	**133 hours per weekday**

Assessment

Overall, this project is rated low-priority. It would be near the lower end of the mid-range in terms of commuter rail riders and new transit users attracted and also in terms of air quality benefits among all commuter rail projects examined for the PMT. The cost per new transit rider would be at the upper end of the mid range for such projects. It would serve only one station not on the present Franklin Line, and it would not be located in an environmental justice target community. The significant parking available at Gillette Stadium does provide an option to alleviate parking demand in that area.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
Line Extension	❍	◗	❍	◗	❍	❍	❍

MAP 5C-50 OPERATE HIGH FREQUENCY RIVERSIDE-SOUTH STATION COMMUTER RAIL SERVICE



OPERATE HIGH FREQUENCY RIVERSIDE–SOUTH STATION COMMUTER RAIL SERVICE

Description

This project would institute new commuter rail service between the Riverside MBTA terminal in Newton and South Station via the Framingham/ Worcester Line. This service would be in addition to, rather than in place of, other service on that line.

Capital Features

This project would consist of new service over an existing line. It would require one new commuter rail platform, at Riverside, and four new train sets. The cost calculations assume that these would each be two-car diesel multiple unit (DMU) trains.

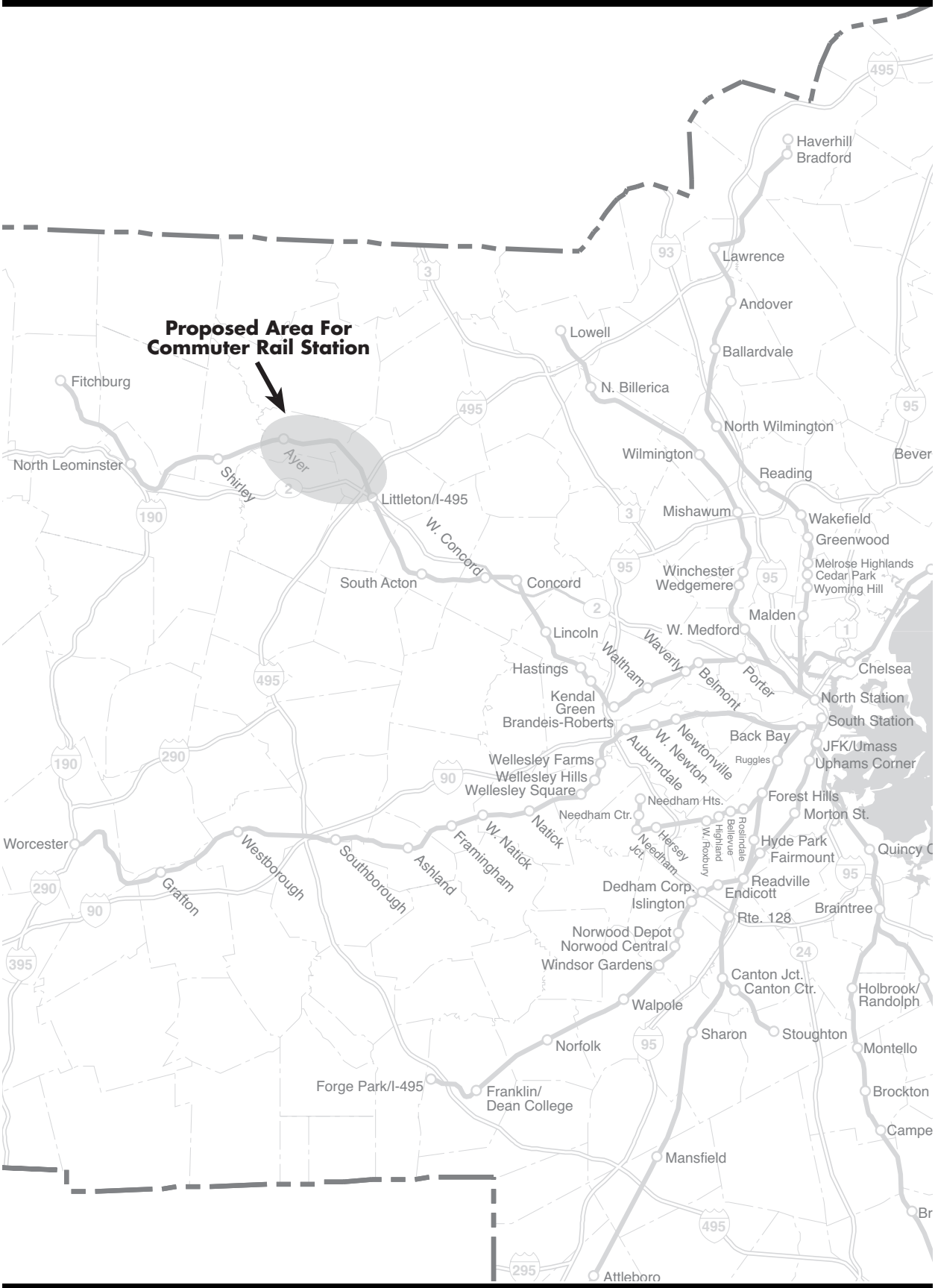
Capital Cost	**$31.5 million (CTPS estimate)**
Operating Cost	**$16,000 per day**
Daily Ridership Increase on Mode	**800**
Net Increase in Daily Transit Ridership	**130**
Capital Cost per New Transit Rider	**$242,100**
Operating Cost per Wkday/New Transit Rider	**$122.80**
Capital Cost/Travel Time Benefit	**$1,165,700 per hour**
Operating Cost/Travel Time Benefit	**$591.00 per hour**
Travel Time Savings	**27 hours per weekday**

Assessment

Overall, this project is rated low priority. It would attract relatively few total riders or new transit riders. The capital cost would be near the lower end of the mid-range among commuter rail projects in absolute terms, but because of the limited ridership, the cost per new rider would be among the highest for all such projects. Likewise, the absolute operating cost would be relatively low, but the cost per new transit rider would be high. Because most of the riders would be diverted from other transit services, and the route would be operated with internal combustion powered trains, it would result in a net worsening of air quality. The main benefits of this project would be in relieving crowding on other trains on the inner end of the Framingham/ Worcester Line and in providing an alternative to the Green Line or express buses for travel from Riverside to downtown Boston. It would, however, be among the more costly projects in both capital and operating cost per hour of travel time saved per day. Competition for scarce track space at South Station during peak hours could result in an overall degradation of service on the system.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
Line Extension	❍	❍	❍	❍	❍	◗	❍

MAP 5C-51 BUILD COMMUTER RAIL STATION ALONG RT 2 AT OR NEAR I-495



BUILD COMMUTER RAIL STATION ALONG RT 2 AT OR NEAR I-495

Description

This project would relocate a station on the Fitchburg commuter rail line in or near the former Fort Devens complex on the border of Ayer and Shirley.

Capital Features

This project would consist of one new station with a regional parking facility (500 spaces) on an existing line. No upgrading of tracks would be needed. No new rolling stock would be required to accommodate the additional riders.

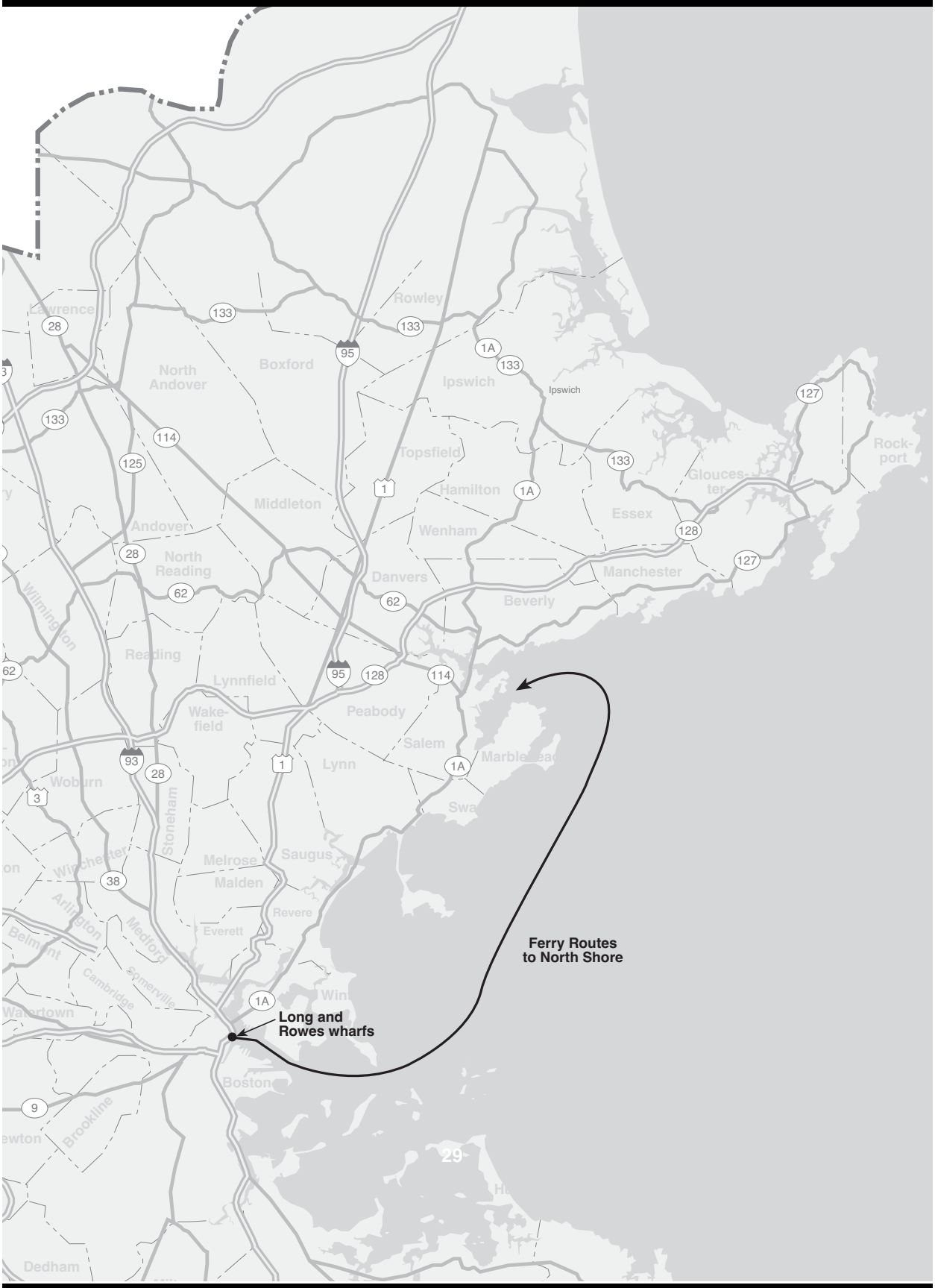
Capital Cost	**$8.2 million (MBTA Planning Dept. estimate)**
Operating Cost	**None, if one existing station is discontinued**
Daily Ridership Increase on Mode	**100**
Net Increase in Daily Transit Ridership	**40**
Capital Cost per New Transit Rider	**$205,000**
Operating Cost per Wkday/New Transit Rider	**Too small to calculate**
Capital Cost/Travel Time Benefit	**$424,100 per hour**
Operating Cost/Travel Time Benefit	**Too small to calculate**
Travel Time Savings	**19 hours per weekday**

Assessment

Overall, this project is rated low priority. It would attract few total riders or new transit riders. The capital cost would be relatively small in absolute terms, but because of the low ridership, the cost per new rider would be at the high end of such costs among commuter rail expansion projects. However, because of the relatively large saving in VMT for each new transit user, and the ability to serve the station with no change in train-miles, cost-effectiveness of air quality improvements would fall in the mid-range for commuter rail expansions. The project has a low rating for economic and land-use impacts, as it would not satisfy any of the goals in that category. It would not serve any environmental justice target communities.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
New Station	○	○	○	◗	○	○	○

MAP 5C-52 HIGH SPEED FERRY FROM NORTH SHORE TO BOSTON & THE AIRPORT



HIGH SPEED FERRY FROM NORTH SHORE TO BOSTON AND THE AIRPORT

Description

This project would implement a new high-speed commuter boat route from Salem to Logan Airport and the downtown Boston waterfront. A similar route was run experimentally in 1998, but with much less frequent service than analyzed here.

Capital Features

This route would require acquisition of five medium-size high-speed commuter boats, and construction of a new terminal in Salem with park-and-ride facilities.

Capital Cost	**$16.3 million (CTPS estimate)**
Operating Cost	**$12,400 per day**
Daily Ridership Increase on Mode	**350**
Net Increase in Daily Transit Ridership	**100**
Capital Cost per New transit Rider	**$162,900**
Operating Cost per Wkday/New transit Rider	**$123.80**
Capital Cost/Travel Time Benefit	**$723,900 per hour**
Operating Cost/Travel Time Benefit	**$551.10 per hour**
Travel Time Savings	**23 hours per weekday**

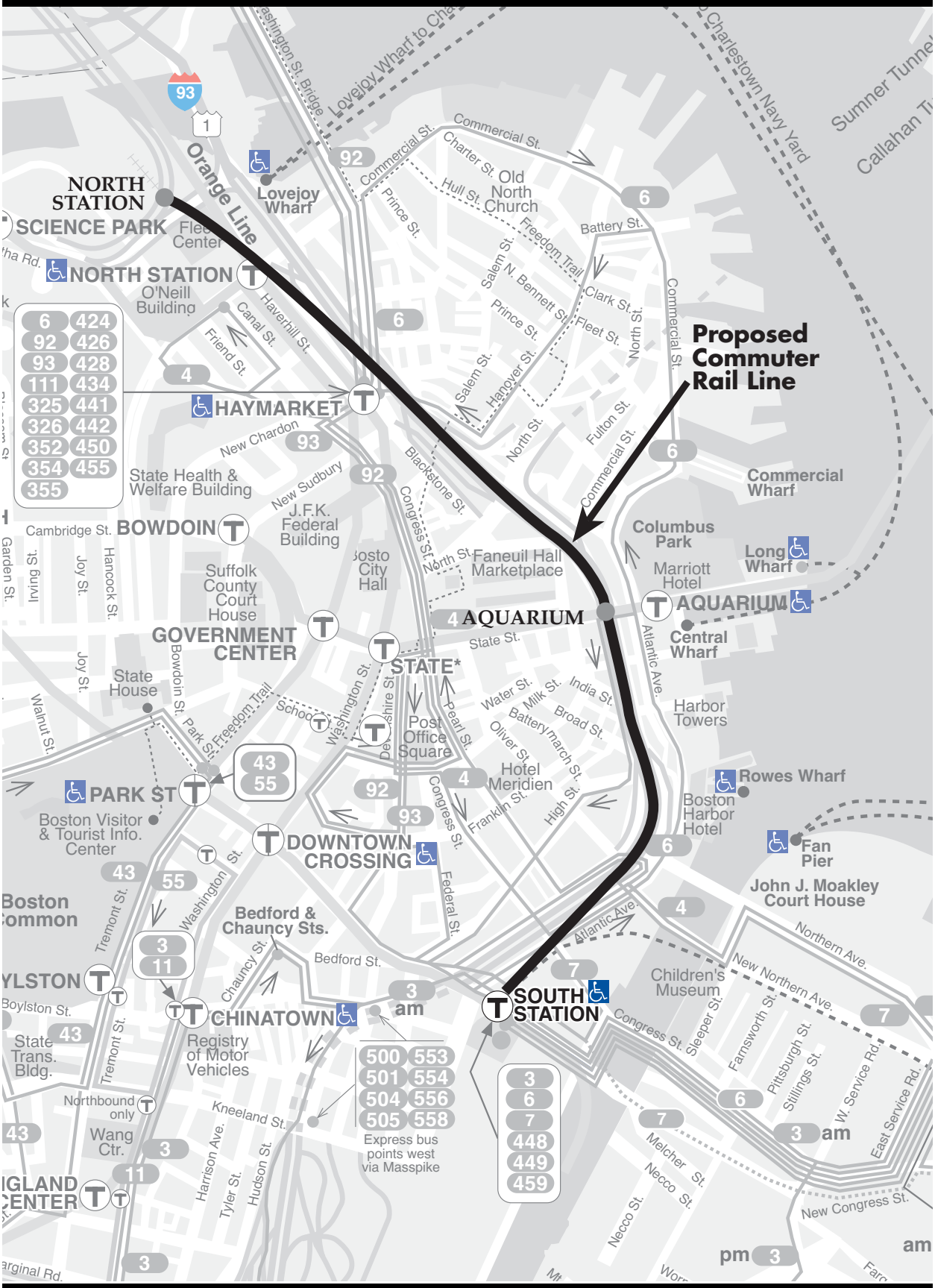
Assessment

This project would provide a new alternative for travel from the North Shore to downtown Boston and Logan Airport, but would have to compete for ridership with several well-established transit alternatives. The capital cost per new transit rider would be the highest among water transportation projects examined for the PMT, (when the South Shore improvements are considered as one project) and the operating cost per new rider would be the second-highest. The Salem terminal would be in a state-designated revitalization area, but the route would not serve any mixed-use development projects on the North Shore directly. Overall, this project is rated low priority.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
Line Extension New Line	◗	❍	❍	❍	❍	◗	◗

Multi-State Expansion Projects

MAP 5C-53 NORTH-SOUTH RAIL LINK



NORTH–SOUTH RAIL LINK

Description

This project would provide a connection through downtown Boston between the rail lines that terminate at North Station and those that terminate at South Station, allowing through-routing of trains between North Side and South Side lines.

Capital Features

This project would consist of a four-track tunnel over one mile long, with new underground stations in the vicinities of North Station, South Station and a new central station near the Aquarium rapid transit station.

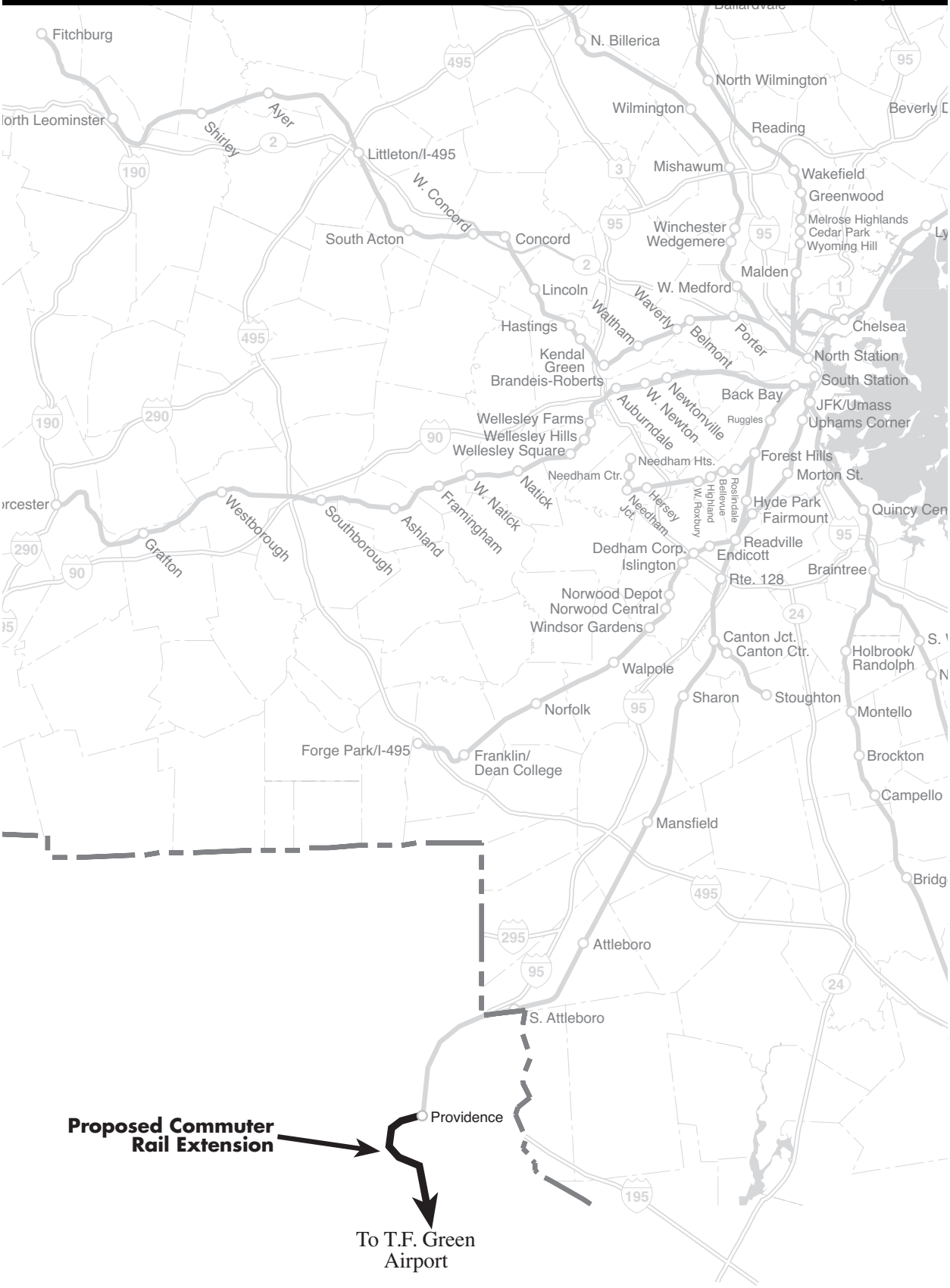
Capital Cost	**$8.7 billion (MBTA Planning Dept. estimate)**
Operating Cost	**$231,000 per weekday (including service changes on entire commuter rail system directly related to the Rail Link)**
Daily Ridership Increase on Mode	**96,100**
Net Increase in Daily Transit Ridership	**54,400**
Capital Cost per New Transit Rider	**$160,100**
Operating Cost per Wkday/New Transit Rider	**$4.20**
Capital Cost/Travel Time Benefit	**$490,700 per hour**
Operating Cost/Travel Time Benefit	**$13.00 per hour**
Travel Time Savings	**17,730 hours per weekday**

Assessment

Overall, this project is rated high-priority. It would attract the largest numbers of commuter rail riders and new transit users of all commuter rail projects examined for the PMT. In absolute terms, it would be by far the costliest project examined, but because of the high ridership, the cost per new transit rider would be at the upper end of the mid-range among commuter rail projects. It would improve distribution of commuter rail passengers within downtown Boston, open up new possibilities for travel between points on North Side and South Side commuter rail lines, improve efficiency of train operations, and help relieve capacity constraints at the Boston terminals. It would result in the largest absolute travel time savings of any commuter rail project examined for the PMT. It would also be beneficial to projects to restore intercity rail passenger service to points north of Boston, both within Massachusetts and beyond. Consequently, it is expected that it would be funded at least in part through sources dedicated for intercity transportation improvements. It is rated high priority in economic and land use impacts because the new central station would be in a state-designated revitalization area, where local plans call for mixed-use transit-oriented development. This would include industrial and high-density residential uses.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
Line Extension	●	◗	◗	◗	◗	●	◗

MAP 5C–54 EXTEND COMMUTER RAIL FROM PROVIDENCE TO T. F. GREEN (RI)



D EXTEND COMMUTER RAIL FROM PROVIDENCE TO T. F. GREEN (RI)

Description

This project would extend commuter rail service along the Amtrak Northeast Corridor route between Providence, Rhode Island and T. F. Green Airport in Warwick, Rhode Island. Passenger service making local stops on this line segment was last operated in 1981, and had consisted of only one round trip per day for many years before that. This project is an ACO legal commitment (see table 2-2).

Capital Features

This would be an 8.5-mile extension, with one new station, including a major park-and-ride facility near the airport, with a people-mover connection to the airline terminals. Trains would operate either on the existing Northeast Corridor tracks or on an adjoining freight by-pass track being planned by the state of Rhode Island. Capital costs would be mostly those for rolling stock and for the terminal station.

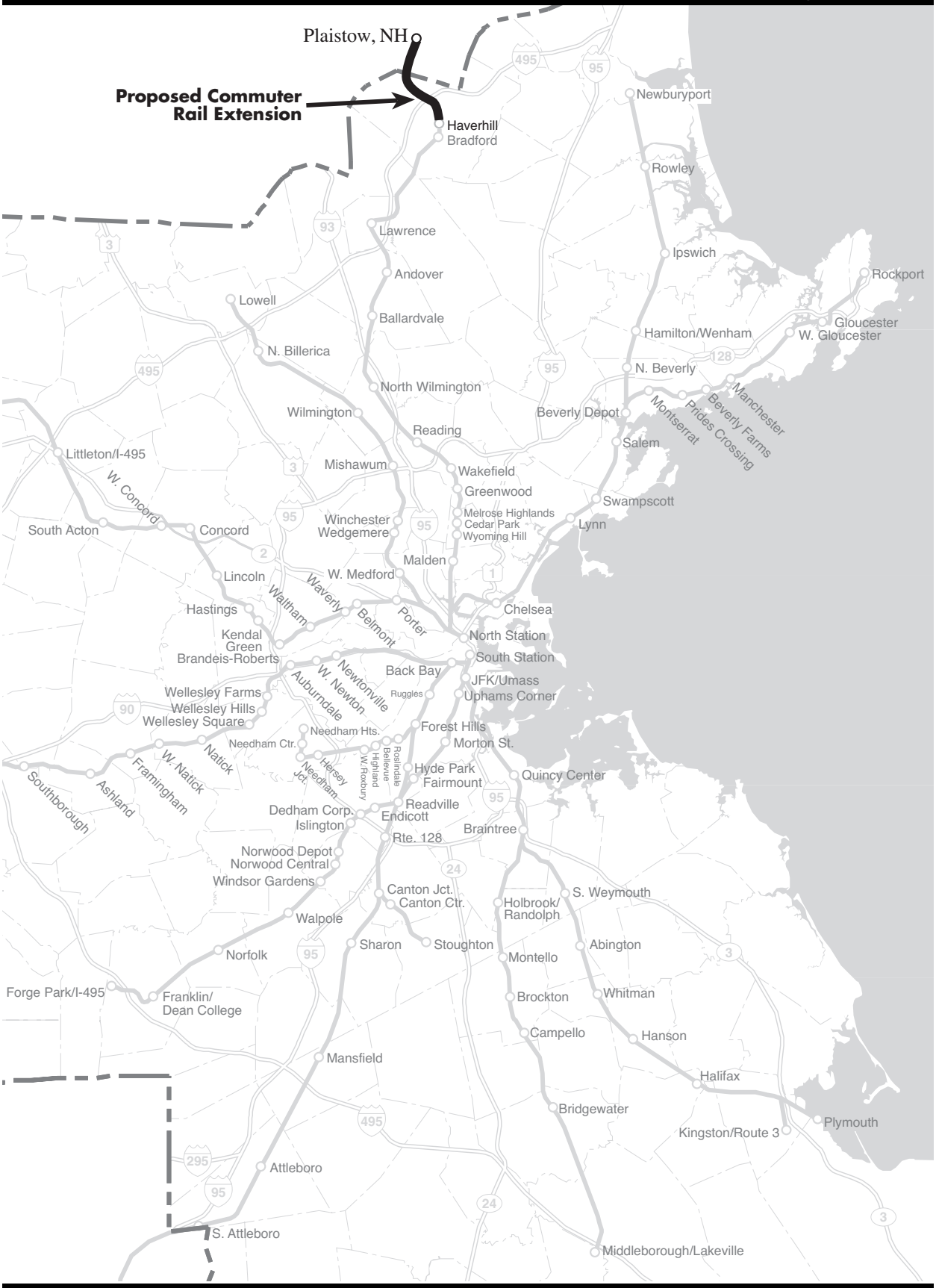
Capital Cost	**$42.8 million (Based on 2001 South County Commuter Rail Service Study adjusted to 2003)**
Operating Cost	**$10,400 per weekday**
Daily Ridership Increase on Mode	**1,500**
Net Increase in Daily Transit Ridership	**900**
Capital Cost per New Transit Rider	**$66,667**
Operating Cost per Wkday/New Transit Rider	**$11.52**
Capital Cost/Travel Time Benefit	**$149,700 per hour**
Operating Cost/Travel Time Benefit	**$36.20 per hour**
Travel Time Savings	**286 hours per weekday**

Assessment

The overall rating of this project is medium priority. Ridership would be near the lower end of the mid-range among commuter rail extension projects examined. It would restore rail transit service to an area that is now served by much slower bus connections to commuter rail at Providence, and would also improve options for travel to the largest airport in the state of Rhode Island. This airport also has many users from Massachusetts, but because of scattered origins, not all would be able to take advantage of rail service. This project was initiated by the state of Rhode Island, and is contingent on arrangement of funding by that state. A feasibility study conducted for Rhode Island indicates that for operational reasons the extension should continue at least as far as Wickford Junction, 19.3 miles from Providence, rather than terminating at the airport. This would increase the capital and operating costs, but would also attract much greater ridership, according to the study. Many of these riders would, however, be traveling entirely within Rhode Island, and would be best served by trains on different schedules from those running through to Boston.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
Line Extension	◗	●	◗	◗	◗	○	○

MAP 5C–55 EXTEND COMMUTER RAIL FROM HAVERHILL TO PLAISTOW, NH



EXTEND COMMUTER RAIL FROM HAVERHILL TO PLAISTOW, NH

Description

This project would implement commuter service on an existing rail freight and intercity passenger service line, from the end of the Haverhill Line to Plaistow, New Hampshire. Commuter service was last operated on this line in 1967. Intercity service from Portland, Maine was restored in 2001 after extensive track upgrading.

Capital Features

Commuter rail service would be extended for 5.4 miles beyond its present limit, but no additional track upgrading would be needed. One new station with parking facilities would be built in Plaistow. One additional train set would be required to maintain schedules because of the increased running time.

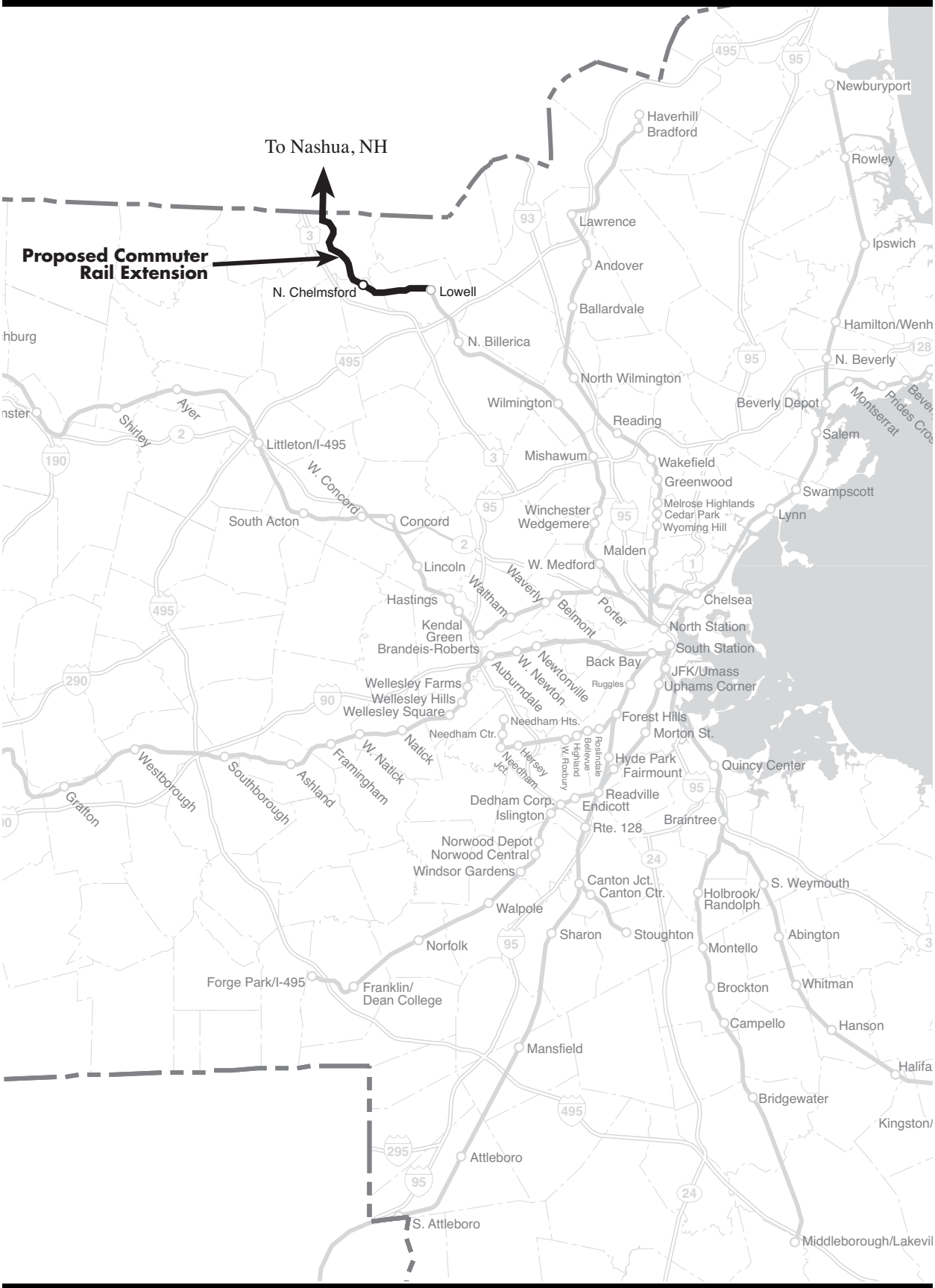
Capital Cost	**$21.8 million (CTPS estimate)**
Operating Cost	**$7,100 per weekday**
Daily Ridership Increase on Mode	**1,700**
Net Increase in Daily Transit Ridership	**1,300**
Capital Cost per New Transit Rider	**$16,600**
Operating Cost per Wkday/New Transit Rider	**$5.40**
Capital Cost/Travel Time Benefit	**$77,100 per hour**
Operating Cost/Travel Time Benefit	**$24.80 per hour**
Travel Time Savings	**282 hours per weekday**

Assessment

Overall, this project is rated medium priority. It would attract substantial total and new ridership relative to the increased route length. It would provide direct rail service to an area that now has infrequent express bus service to Boston, but is also close to the existing Haverhill terminal. The total capital cost and cost per new transit rider would be among the lowest of any commuter rail expansion projects, because the route has recently been upgraded for intercity passenger service. It would be among the better projects in air quality improvements because of the large number of auto diversions and the small number of additional train-miles. Almost all of the riders would be New Hampshire residents, so this project would be contingent on arrangement of funding by New Hampshire.

Type of Project	Utilization	Mobility	Cost-Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
Line Extension	●	❍	●	●	❍	❍	❍

MAP 5C–56 EXTEND COMMUTER RAIL FROM LOWELL TO NASHUA



D EXTEND COMMUTER RAIL FROM LOWELL TO NASHUA

Description

This project would implement commuter service on an existing rail freight line from the end of the Lowell Line to Nashua, New Hampshire. Passenger service was last operated on this line in 1981.

Capital Features

This would be a 13-mile extension, including one new station in Massachusetts at North Chelmsford and one or two new stations in New Hampshire. Extensive upgrading of tracks and signals would be required.

Capital Cost	**$35.5 million (Nashua Regional Planning Commission estimate)**
Operating Cost	**$29,000 per weekday**
Daily Ridership Increase on Mode	**3,100**
Net Increase in Daily Transit Ridership	**2,200**
Capital Cost per New Transit Rider:	**$16,100**
Operating Cost per Wkday/New Transit Rider	**$13.10**
Capital Cost/Travel Time Benefit	**$98,100 per hour**
Operating Cost/Travel Time Benefit	**$80.20 per hour**
Travel Time Savings	**362 hours per weekday**

Assessment

Overall, this project is rated medium priority. It would be one of the better commuter rail expansion projects examined in terms of the numbers of new transit riders and total riders served, and would serve an area with very limited existing transit service. It would also be one of the better commuter rail expansion projects in terms of air quality impacts. Emissions of CO, CO2, and VOC would be reduced, but those of NOx would increase. Capital costs for this project would be in the mid-range of costs among commuter rail extensions examined. It would be among the more cost-effective projects in terms of capital and operating costs per new transit rider. This would be a joint project with the state of New Hampshire, and would be contingent on arrangement of funding by New Hampshire.

Type of Project	Utilization	Mobility	Cost-- Effectiveness	Air Quality	Service Quality	Economic/ Land Use Impacts	Environ. Justice
Line Extension	●	●	◗	●	❍	❍	❍

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