SWRPA
South Western Regional Planning Agency

AECOM

Greenwich/Norwalk Bus Rapid Transit Study

Final Report

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Prepared for:

South Western Regional Planning Agency

Prepared by:

AECOM Transportation
TranSystems
Herbert S. Levinson

Greenwich/Norwalk Bus Rapid Transit Study – Executive Summary

In 2008 the South Western Regional Planning Agency (SWRPA) engaged a consultant team to study the feasibility of bus rapid transit (BRT) service in the U.S. 1 corridor between Greenwich and Norwalk. The team was led by AECOM Transportation in partnership with TranSystems and Herbert S. Levinson.

Defined broadly, bus rapid transit represents an array of service and infrastructure improvements that can be developed and implemented to create a more attractive transit alternative in conjunction with local bus service and other modes such as regional commuter rail. Goals of BRT service include shorter travel times, better passenger amenities (including real-time schedule and arrival information and off-board fare collection), and more frequent service than typical of local bus service.

The study team was charged with reviewing existing transit and traffic operations in the corridor, soliciting feedback and priorities from local and regional stakeholders and the general public, and identifying appropriate service alternatives and studying their feasibility in advance of a fully developed plan for the preferred alternative. The operating plans developed through this study outline both service requirements for enhanced bus service as well as their relationship to local bus services and intermodal connections.

The project included a Technical Advisory Committee, comprised of regional transit operators, municipalities, and SWRPA staff, as well as a larger Stakeholder Advisory Committee (SAC) engaging key representatives from transportation, civic, municipal, and educational interests in the study region for whom transportation and public transit represent important issues either directly or in relation to their constituents. These two groups provided valuable feedback on study documents as the project progressed.

Two rounds of public information meetings were also held to inform interested members of the public, including both transit users and non-users, and solicit feedback on priorities and approaches to providing a new, enhanced bus service in the U.S. Route 1 corridor.

Opportunities for Corridor Service Improvements

While local bus routes provide an adequate level of service in the U.S. Route 1 corridor between Greenwich and Stamford (CT Transit Routes 11A/11B) and between Stamford and Norwalk (CT Transit Route 41), travel times are lengthy and buses are not considered to be competitive with the Metro-North Railroad or the private automobile. The two halves of the Greenwich to Norwalk corridor are not balanced in terms of ridership and system usage and each segment presents its own challenges pertaining to improved travel speed and ridership potential.

Investigation during the study and input solicited from stakeholders highlighted several issues:

- Ridership is heavier between Stamford and Norwalk than between Greenwich and Stamford
- Bus travel times in the corridor are affected by specific bottlenecks in congested areas
- Travel times vary by time of day; midday congestion is often worse than the AM peak period
- Support for BRT or enhanced bus services and transit initiatives is strong among stakeholders; concern remains about the potential to significantly improve bus travel times to be competitive with private automobiles
- Stakeholders prefer a degree of improvement commensurate with the investment required
- Non-transit users are more likely to consider a new bus service if it is frequent, reliable, and convenient to both work and home

A primary challenge faced in the effort to improve bus travel times throughout the corridor relates to local traffic bottlenecks and areas prone to delays and the feasibility of traffic and transit improvements to overcome these delays. Between Greenwich and Stamford, buses are most often delayed due to narrow streets and localized traffic congestion between U.S. Route 1 and the Greenwich railroad station. Between Stamford and Norwalk, the primary source of travel delays occurs in downtown Darien at the Metro-North Railroad underpass.

Ultimately, to justify major investment in a new bus service, travel times must be lowered significantly in conjunction with other passenger and operating amenities implemented to improve the comfort and experience of taking public transit rather than driving.

Study Process

The study includes an extensive review of background data and current conditions to assess the factors most influential on bus travel times and ridership throughout the corridor, as well as the potential for localized improvements to achieve the goals and objectives identified by the study advisory committees, regional stakeholders, and the public.

Primary data collection and analysis focused on the following:

- Ridership patterns by location and by time of day on CT Transit's Route 11 and 41 services
- Bus travel times
- Relative time buses spend moving vs. stopped (congestion, signals, dwell time at bus stops)
- Non-user surveys to assess priorities and inclination to use new, enhanced bus services
- Identification of local traffic bottlenecks and potential mitigation for transit and all traffic
- Planning for current and proposed development projects that may support ridership growth

The study begins with an assessment of the viability of enhanced bus services in each half of the corridor (Greenwich to Stamford, Stamford to Norwalk) to ensure that resources are directed appropriately.

Viability of Enhanced Bus Service

The background data and existing conditions analyzed in throughout the study, as well as input from stakeholders, current bus riders and non-users, indicate that the justification for enhanced bus service (EBS) in the U.S. Route 1 corridor is based primarily on policy objectives rather than present ridership and demand levels. The objectives that can be addressed through the design and implementation of EBS include:

- Improved bus service reliability and passenger comfort
- Traffic congestion mitigation
- Environmental benefits
  - Reduced vehicular emissions
  - Lessened dependence on single occupant vehicles
  - Support for responsible growth and transit oriented development (TOD) to curb sprawl
- Improved mobility and connectivity
- Support for economic development activities

Based on a review of ridership levels and activity patterns on the existing CT Transit Route 11A and Route 41 services, the study team does not recommend implementing new enhanced bus services between Port Chester, NY and Stamford. Light ridership activity is seen between Port Chester and Greenwich and between Greenwich and Stamford. Significant ridership can be seen around the Greenwich railroad station and in the Town of Greenwich, yet these trips are not through trips on the corridor and thus are well served by the existing bus and shuttle services: CT Transit's Route 11A and 11B services, and NTD-operated Commuter Connection shuttle services.

The table below shows weekday ridership and average passenger loads by time period for the two primary services in the U.S. Route 1 corridor today: CT Transit Route 11A (Port Chester, NY to Stamford) and CT Transit Route 41 (Stamford to Norwalk). Ridership on Route 41 is substantially higher than Route 11A, although neither route appears to warrant a dramatic increase in service levels based on the average passenger loads. Nonetheless, CT Transit has experienced steady ridership growth over each of the past five years and this growth is expected to continue.

Average Daily Ridership - CT Transit Routes 41 and 11

Route/Direction	Weekday Passengers	Saturday Passengers	Sunday Passengers
Route 11A Eastbound	476	283	192
Route 11A Westbound	547	290	193
Route 11B Eastbound	692	377	177
Route 11B Westbound	662	369	229
Route 41 Eastbound	1,440	1,180	567
Route 41 Westbound	1,509	1,116	569

Source: CT Transit Trip Summary Reports, April 2006 - April 2008

Furthermore, overcrowding on mid-day as well as evening rush hour trips on Route 41 does highlight the need for some increase in service. Combined with the goal of a faster, more comfortable service between key stops in the U.S. Route 1 corridor between Norwalk and Stamford, this growth trend warrants attention.

The transit alternatives outlined at this point do not recommend the service frequency of a typical bus rapid transit (BRT) system (10-15 minute headways), rather they are based on the provision of a number of other amenities associated with BRT, including:

- Appropriate span of service (hours of operation)
- Improved schedule reliability (transit signal priority, traffic and intersection improvements)
- Improved public information and facilities (real time schedule displays and other amenities)
- New vehicles with a specific service and brand identity

All of these amenities would be provided at a cost commensurate with the service provided and would constitute an EBS between Stamford and Norwalk that would complement existing local bus services in the corridor. Furthermore, the South Western Region enhanced bus service (EBS) is designed as a supplemental overlay to the existing local bus services because ridership and passenger load factors indicate that a reduction in local service frequencies would be detrimental. In Norwalk, for example, Norwalk Transit District (NTD) recently increased its service frequency on several routes, including 20 minute headways on those with the highest ridership. This service increase will support future connections to EBS service between Norwalk and Stamford.

Development of Route Concepts

After reviewing existing services and ridership patterns, opportunities for time savings and access to new markets, and consideration of policy and operational concerns for a potential enhanced bus service, a basic service concept was developed for the U.S. Route 1 corridor between Stamford and Norwalk. The Stamford Transportation Center and Norwalk Wheels Hub would serve as the endpoint anchors for the EBS service, which would be developed from the

foundation provided by CT Transit's Route 41 bus schedule. While the basic corridor and route structure follows U.S. Route 1, several local variations were considered during the planning process for the enhanced bus service design, notably in Darien and Norwalk.

Stamford

In Stamford, prior to full construction of the Urban Transitway (Phase 2 is anticipated to open in 2012), Tresser Boulevard (U.S. Route 1) is seen as the best connecting route between Broad Street/East Main Street and the Stamford Transportation Center. Providing EBS service on Tresser Boulevard connects large employment sites with both the Transportation Center and residential areas on the east side of Stamford and throughout the U.S. Route 1 corridor. CT Transit's Route 41 local route is among those slated to be rerouted along the Urban Transitway upon the opening of Phase 2 of the project, and as such this study would recommend revisiting the EBS routing and its relationship to local services in advance of this change, as appropriate.

The EBS service would pick up and discharge passengers within the Stamford Transportation Center bus lanes and return eastbound via Washington Boulevard, Broad Street, and East Main Street. This expanded loop provides customers with access to the Stamford Government Center and the University of Connecticut's Stamford campus in addition to other retail and employment sites and residential development eastbound on Broad Street. The Route 41 local service will continue to follow its current alignment to and from the Stamford Transportation Center via Atlantic Street (inbound) and Tresser Boulevard/Atlantic Street (outbound).

Darien

The primary consideration for EBS operating alignments in Darien is whether or not to serve downtown Darien on U.S. Route 1 (Boston Post Road) or bypass congestion downtown by using I-95 between Exits 11 and 13. If the Option 1 bypass were implemented and proven successful, subsequent phases could include consideration of a longer bypass between Exits 9 and 13.

Option 1

In Option 1, local services continue to operate as CT Transit Route 41 does today, serving downtown Darien via Boston Post Road. Enhanced bus service would bypass downtown Darien using I-95 between Exits 11 and 13.

Option 2

In Option 2, both the EBS and local services follow Boston Post Road through downtown Darien. In this case, traffic improvements to assist in transit and traffic movement through Darien would be pursued, including queue bypass lanes approaching the railroad underpass.

Norwalk

Three service options are suggested for the eastern anchor of the corridor in Norwalk. A choice exists whether to shift the local and EBS routes to a new alignment to address current and planned development, to split the local and EBS to maximize coverage, or to follow current service alignments for both local and EBS services. These options may be considered temporally, expanding coverage and shifting to new markets as those developments come on line but beginning with maintenance of the existing service pattern.

Option 1

With new residential and mixed use development planned and under construction along West Avenue in Norwalk, a realignment of the local CT Transit Route 41 service along with the proposed EBS is suggested as an option between the Norwalk WHEELS Hub and U.S. Route 1 (Connecticut Avenue). This new alignment would use West Avenue, Reed Street, and Fairfield Avenue before rejoining Connecticut Avenue.

Customers currently using the CT Transit Route 41 service to reach Norwalk Hospital on Van Buren Avenue would have to transfer to Norwalk Transit District services to the hospital, either on Connecticut Avenue, or by traveling to the WHEELS Hub and making a transfer to an outbound NTD bus. Conversely, this new alignment would open up new ridership opportunities and, in the case of new development along West Avenue, would do so before new residents have established driving as their only means of travel.

Option 2

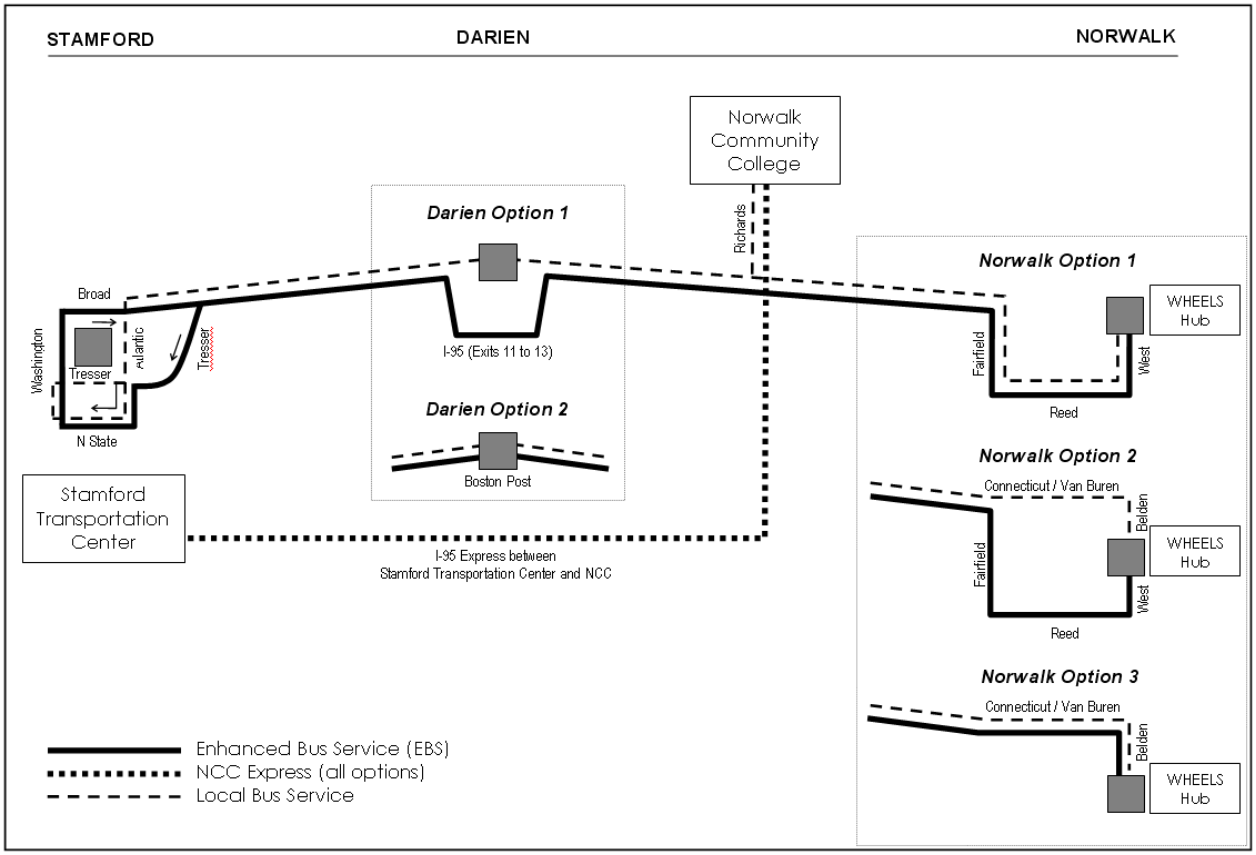
In Option 2, the local CT Transit Route 41 service would operate is it currently does, via Van Buren Avenue and Belden Avenue to the WHEELS Hub, while new EBS services would follow the West Avenue, Reed Street and Fairfield Avenue routing from the WHEELS Hub to Connecticut Avenue (Route 1). With this option, local service to Norwalk Hospital is maintained while new markets in Norwalk are served by the new EBS route.

Option 3

Norwalk Option 3 represents continuity with existing services by having both the local and EBS follow the current Van Buren Avenue and Belden Avenue approach to the WHEELS Hub. This option could be presented as the initial service plan, while adjustments may be considered within the next 1-2 years as development on West Avenue is completed.

These local service options are summarized in the map on the following page.

Local Options Considered in Route Development



Complementary Local Service Improvements

Several recommendations can be made with respect to the existing local bus services, both as part of a combined EBS/local service plan as well as in segments of the initial study corridor that are not found to warrant significant service increases. These improvements address the overall study goals of improved travel times and service efficiency. For example:

- Operate CT Transit Route 11A directly from Port Chester to Stamford, bypassing the Greenwich railroad station
- Increase trip frequency on CT Transit Route 41 (coordinated with EBS headways)
- Adjust frequency and headways on local services to address heavier passenger loads

Selection of Preferred Alternative

To select the preferred enhanced bus service alternative, the study team identified appropriate EBS alternatives based on their feasibility. Incorporating feedback solicited from SWRPA and the technical and stakeholder advisory committees, as well as additional on-site field work

conducted by the team, a full service plan was developed including the selection of preferred local operating alternatives in Stamford, Darien, and Norwalk.

Stamford

The EBS alignment following Tresser Boulevard inbound and Broad Street outbound was recommended for advancement in the Final Report. However, as indicated, revisiting the EBS and local Route 41 alignments and their relationship to other local services in advance of the opening of Phase 2 of the Urban Transitway is recommended.

Darien

The two routing options for the EBS in Darien are retained in the Final Report. To maximize service availability, EBS service and local Route 41 service may operate on U.S. Route 1 (Boston Post Road). This alignment is seen to be contingent upon local traffic improvements and transit priority measures such as a bus queue-bypass lane in each direction on U.S. Route 1 approaching the Metro-North Railroad underpass.

In the absence of these improvements, designed to improve all traffic flow through Darien and improve bus travel times, a bypass of the downtown area between I-95 exits 11 and 13 would be recommended. This decision requires additional local planning to determine the feasibility of each option and which would ultimately be most valuable to the community.

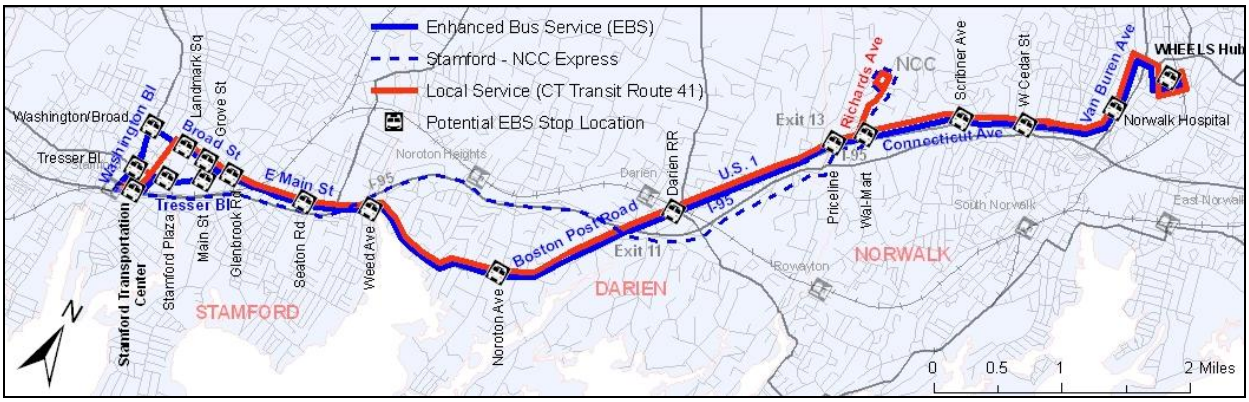
Norwalk

In the short term, the EBS and local CT Transit Route 41 alignments will remain unchanged on the Norwalk end, following Connecticut Avenue (U.S. Route 1) as it becomes Van Buren Avenue, turning south onto Belden Avenue, and into the WHEELS Hub via Wall Street and Main Street.

As a longer term recommendation, as development such as the District 95/7 project on West Avenue nears completion, a realignment of the local CT Transit Route 41 service along with the proposed EBS is suggested as an option between the Norwalk WHEELS Hub and U.S. Route 1 (Connecticut Avenue). The modified alignment would use West Avenue, Reed Street, and Fairfield Avenue before rejoining Connecticut Avenue.

This new alignment would open up new ridership opportunities and, in the District 95/7, would do so before new residents have established driving as their only means of travel. Customers currently using CT Transit Route 41 to reach Norwalk Hospital on Van Buren Avenue would have to transfer to Norwalk Transit District services to the hospital, either on Connecticut Avenue, or by traveling to the WHEELS Hub and making a transfer to an outbound NTD bus.

Combined EBS and Route 41 Alignment (Preferred Alternative)



Station Locations

The selection of stations for EBS service is based on ridership volumes at existing bus stops on the CT Transit Route 41. Westbound, beginning at Norwalk WHEELS Hub, the following EBS station locations are recommended:

Norwalk

- West Ave / Reed St
- Connecticut Ave / W Cedar St
- Connecticut Ave / Scribner Ave
- Connecticut Ave / Richards Ave
- Connecticut Ave between Richards Ave and W Norwalk Rd

Darien

- Boston Post Rd / Darien Railroad Station
- Boston Post Rd / Noroton Ave (possible park & ride location)

Stamford

- Boston Post Rd / Weed Ave
- E Main St / Seaton Rd
- E Main St / Glenbrook Rd
- Tresser Blvd / E Main St
- Tresser Blvd / Stamford Plaza
- Stamford Transportation Center

Unlike the Route 41 local service, which returns to Atlantic Street via Tresser Boulevard, the EBS will service a one-way loop connecting the Stamford Transportation Center with the Washington and Broad Street corridors. Passing Tresser Boulevard eastbound, EBS stop locations will mirror those in the westbound direction. Stops along the Stamford loop include:

- Washington Blvd / Tresser Blvd
- Washington Blvd / Broad St
- Broad St / Landmark Square
- Broad St / Grove St

Service Plan

Implementation of enhanced bus service is recommended for weekdays only between Stamford and Norwalk with endpoints at the Stamford Transportation Center and the Norwalk WHEELS Pulse Point (WHEELS Hub). It is envisioned that this new service would be operated by CT Transit in a coordinated schedule with the existing Route 41 local service. The following parameters define the enhanced bus service to be implemented in conjunction with schedule changes on CT Transit Route 41. These parameters stem from analysis of current ridership patterns, anticipated market and usage, and various policy considerations.

EBS Service Hours:	6am to 7pm, weekdays only
EBS Service Frequency:	Every 30 minutes during peak periods, 40 minutes off-peak
Local Route 41 Hours:	Same as current service (5am to 12:30am on weekdays)
Local Route 41 Frequency:	Every 30 minutes during peak periods, 40 minutes off-peak

Additional components of the EBS/local Route 41 service plan include:

- Three proposed park & ride lots
  - Norwalk WHEELS Pulse Point (Yankee Doodle Garage)
  - Norwalk Community College (campus parking)
  - Noroton Heights (e.g, church lots, private lots, shared parking agreements)
- Route 41Bx express trips operate as complete round trips (e.g., outbound morning express trips from Stamford to Norwalk Community College return as morning express trips to Stamford rather than locals)
- After 7pm, local service operates current schedule (including present level of service to Norwalk Community College via Routes 41A and 41B)
- EBS bus layovers are taken in Norwalk at the WHEELS Hub

Elements of Enhanced Bus Service

A number of elements, when combined, will create a unique and exciting new bus service in the U.S. Route 1 corridor. These elements focus on passenger comfort and amenities as well as the marketing and branding of the new service.

Unique Brand Identity

The enhanced bus service is designed to operate in a coordinated schedule with the CT Transit Route 41 local service. To attract new users and highlight the benefits associated with EBS, a

unique branding program will represent a key component of the marketing and public education to introduce these improvements.

Capitalizing on the success of the Coastal Link bus service between Norwalk and Milford, a brand name such as “The Breeze” would provide a valuable local identity to distinguish the service. This identity would be employed consistently throughout the system, including service timetables, distinctly painted vehicles, bus stops, and other marketing materials.

Vehicles

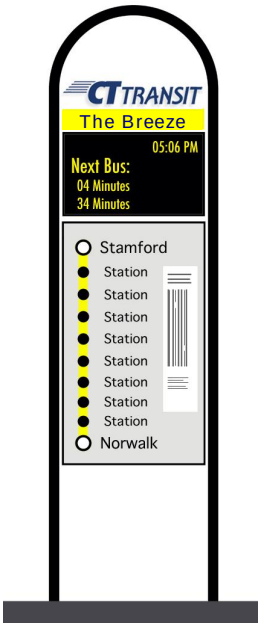
Survey feedback received from non-transit users during this study highlighted the importance of on-time performance, convenience, and comfort as key factors in the viability of enhanced bus service. Distinctive, modern vehicles have often been among the hallmarks of successful bus rapid transit and other new transit services.

As such, the study team recommends the purchase of five new, articulated diesel electric hybrid buses to provide sufficient capacity (i.e., seated capacity is high enough to avoid standing loads on buses) and a new identity and level of comfort for customers. Articulated buses would help address specific times of heavy passenger loads on the current Route 41 service as well as ensure adequate capacity for future growth of the EBS program. Five vehicles would provide for four in-service vehicles during peak EBS service hours as well as a spare vehicle. Providing spare vehicles identical to regularly scheduled vehicles is critical to maintaining the image and identification of the new service.

Example of Modern, High Capacity Transit Vehicle

A full set of vehicles must be purchased for EBS implementation, including vehicle spares to maximize the visual and marketing impact of the new service. Phased purchasing of vehicles and key capital components is strongly discouraged.

Improved Bus Stops/Stations

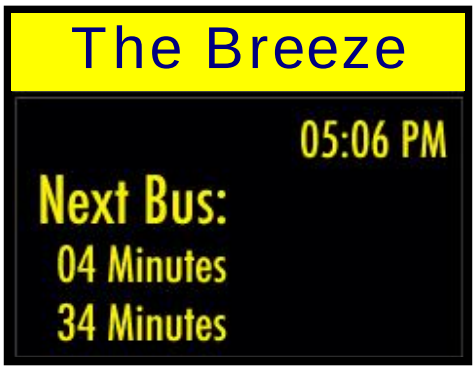


Station design for EBS service is an important factor in developing a brand identity for the new service while at the same time providing more amenities for all bus riders (EBS and CT Transit Route 41) at major stop locations. A system of icons and information components at all EBS station locations provides a strong, consistent identity and differentiates the EBS from local bus services. Ultimately, all local bus stops should also provide a greater amount of route and schedule information to further encourage and facilitate transit use throughout the system.

Station shelter design should, as a rule, be commensurate with relative activity levels at each location. The Stamford Transportation Center already features a covered series of bus lanes and would require only additional EBS identity markings to highlight the service. The Norwalk WHEELS Hub, for which a series of physical improvements are under design by the Norwalk Transit District, should similarly feature distinguishing shelter and waiting space (shelters) for the EBS service. Mid-route, modular shelter designs can provide the flexibility needed in terms of total covered space, relative passenger activity, and available space and physical constraints at each station location. Station design will require coordination between CT Transit, Connecticut Department of Transportation, and local municipalities to reach consensus on design criteria.

Information Technology

Intelligent Transportation Systems (ITS) offer many possibilities in terms of facilitating the operation of the new EBS service being developed for the U.S. Route 1 corridor and attracting riders to these services. While there are many ITS technologies that could be proposed for deployment as part of the new service, specific technologies should be considered in light of the types of services being planned, the environment in which these services will operate, and the characteristics of the potential customers of the new services.



ITS should be considered for three primary reasons:

- To inform potential riders about the services provided before they make a trip
- To provide transit riders with location-specific information while they are taking their trip
- To facilitate the operation of the EBS service.

Based on these objectives, the study team determined that the key ITS technologies that are most appropriate for this application are as follows (in descending order of importance):

- Static in-terminal/wayside information
- Automatic vehicle location (AVL)
- Real-time information: pre-trip, in-vehicle and in-terminal/wayside
- Automated annunciation (ADA-required next stop announcements)
- Automatic passenger counting

Implemented together, these systems will provide customers with up to the minute schedule and bus arrival information at bus stops as well as clear and frequent announcements of bus stops aboard the buses. Furthermore, the systems will afford CT Transit improved data collection capabilities to monitor ridership patterns as well as respond efficiently to delays and incidents affecting on-time performance of buses on the road.

Estimated Capital Costs, Operating Costs, and Ridership Gains

The project capital and operating costs for the EBS program will depend largely upon capital purchase decision for vehicles, ITS components, and bus stop shelters. Anticipated cost ranges are included in this plan as a guideline prior to a formal procurement program based on final design criteria. Station and shelter designs include the widest range of possible costs, depending upon the size and features associated with each EBS stop. Final design specifications (e.g., EBS stations) will also influence ongoing maintenance costs.

Capital Cost Guidelines

	Capital Cost ($)	
	Low	High
Vehicles (low-floor, diesel-electric hybrid)	$600,000 (40-foot)	$1,000,000 (60-foot)
ITS Components - System	$465,700	$822,250
ITS Components - Communications	$93,635	
ITS Components - Vehicles (12)	$126,600	$250,800
Traffic Signal/Transit Priority	$47,000	$54,000
Stations/Shelters	$15,000 each	$200,000 each

Operating cost guidelines are based on incremental increases relative to CT Transit's current Route 41 operations rather than fully allocated system costs. The tables on the following page outline current operating costs for the Route 41, followed by the overall EBS program costs, for which Route 41 schedules are coordinated with the enhanced bus service.

Ridership estimates for EBS and local Route 41 services are based on a number of factors resulting from changes in service frequency, reduced travel times, and the introduction of specific new features designed to enhance customers' travel experiences. An estimated 142,545 additional trips are anticipated on the EBS and enhanced Route 41 services annually.

Existing CT Transit Route 41 Service (Weekdays 6am – 7pm)
Estimated Daily and Annual Costs

Direction	Pattern	Number of Trips	Miles Per Trip	Miles	Hours	Cost
Eastbound	41	21	9.8	205.8	19.4	$1,182
	41A	11	11.1	122.1	10.2	$655
	41B	1	7.3	7.3	0.9	$49
	41Bx	3	7.5	22.5	1.4	$104
Westbound	41	23	9.5	218.5	18.2	$1,170
	41A	9	10.8	97.2	7.8	$510
	41B	2	7.3	14.6	1.2	$78
	41X	2	6.9	13.8	0.9	$65
Total Daily Cost						**$3,812**
Total Annual Cost (Daily cost x 255 weekdays)						**$972,060**

Proposed EBS and Route 41 Services (Weekdays 6am – 7pm)
Estimated Daily and Annual Costs

Direction	Pattern	Number of Trips	Miles Per Trip	Miles	Hours	Cost
Eastbound	Local	23	11.1	255.3	21.5	$1,375
	EBS	23	9.8	225.4	18.4	$1,193
	Express	5	7.5	37.5	2.3	$171
Westbound	Local	23	9.5	218.5	21.5	$1,287
	EBS	23	10.8	248.4	17.3	$1,209
	Express	5	6.9	34.5	1.8	$146
Total Daily Cost						**$5,382**
Total Annual Cost (Daily cost x 255 weekdays)						**$1,372,410**

Conclusion

The recommendations outlined in this study represent a system of improvements to create a distinct, new bus service between Stamford and Norwalk that places a greater emphasis on efficient travel speeds and customer comfort. This new, enhanced bus service is designed to operate in conjunction with existing local bus services, providing an overall increase in service and greater flexibility for passengers traveling between major activity centers in the corridor. The acquisition of modern, high-capacity, comfortable vehicles along with improved customer amenities and travel information will combine to improve the commuting experience for current transit users and attract new users living and working in the corridor.

Greenwich/Norwalk Bus Rapid Transit Study

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Introduction

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Section 1 – Baseline Conditions

1.1 Existing Services

A variety of bus and rail services currently operate within the U.S. Route 1 corridor between Greenwich and Norwalk. Bus service in the corridor includes CT Transit, which operates local bus routes through its Stamford Division with Route 11 covering the western portion of the corridor into Port Chester, NY, and Route 41 covering the eastern portion of the corridor into Norwalk. CT Transit Routes 14, 24B, and 42 also cover short segments of the corridor within Stamford and eastern Greenwich.

The Norwalk Transit District (NTD) operates the WHEELS bus system in Norwalk, including Routes 11 and 13 that run along portions of U.S. Route 1 in Norwalk. Additionally, the I-Bus service, an express bus route connecting southwestern Connecticut to White Plains, NY, stops at both the Stamford and Greenwich railroad stations before running express to White Plains. It should be noted that the Connecticut Department of Transportation will soon be announcing funding for bus service improvements, which may impact the schedules for certain CT Transit and Norwalk Transit District routes.

Rail service includes the New Haven Line of the Metropolitan Transportation Authority's Metro-North Railroad, which also parallels U.S. Route 1 throughout the corridor. Additionally, select Shore Line East trains serve the Stamford Transportation Center, as do several Amtrak services.

Additional commuter shuttle services operate between the Stamford Transportation Center and points along U.S. Route 1 in Stamford, and between the Greenwich rail station and points along U.S. Route 1 in Greenwich. These include: the Stamford Commuter Connection (East Route), which is operated by CT Transit and serves a portion of U.S. Route 1 (East Main Street) in Stamford; and the Greenwich Commuter Connection, which is operated by Norwalk Transit District and runs two loops between segments of U.S. Route 1 and the Greenwich rail station. Table 1-1 outlines transit options available throughout the corridor.

1.1.1 CT Transit

CT Transit operates service in several cities throughout Connecticut, including Hartford, New Haven, and Stamford. The Stamford Division of CT Transit operates service in the Stamford area, spanning the U.S. Route 1 corridor for the entire length of the proposed BRT route. Fares for CT Transit routes are $1.25 for adults, $1.00 for youth, and $0.60 for seniors and persons with disabilities. Ten rides can be purchased for $11.25, and passes are available in the following denominations: 1 day for $3.25, 3 days for $7.50, 5 days for $11.25, 7 days for $15.00, and 31 days for $45.00. CT Transit also operates the I-BUS, which is described in further detail below.

Table 1-1: Summary of Existing Transit Services in the U.S. Route 1 Corridor

Operator	Route	Segment	Days	Span	Period	Frequency	Peak Fare
CT Transit	11A	Port Chester – Stamford	M – F Sa Su	6:00 AM – 12:00 AM 7:00 AM – 6:00 PM 7:30 AM – 8:00 PM	AM Peak Midday PM Peak Evening Saturday Sunday	30 60 60 N/A 120 120	$1.25
	11B	Greenwich – Stamford	M – F Sa Su	5:00 AM – 12:30 AM 6:00 AM – 10:30 PM 8:00 AM – 7:30 PM	AM Peak Midday PM Peak Evening Saturday Sunday	30 60 60 60 120 120	$1.25
	14	Stamford (west of downtown)	M – F	6 trips each direction 7 trips each direction	AM Peak PM Peak	30 30	$1.25
	24B	Greenwich (Old Greenwich)	M – F	4 trips each direction 4 trips each direction	AM Peak PM Peak	N/A N/A	$1.25
	41/41A	Stamford – Norwalk	M – F Sa Su	5:00 AM – 12:30 AM 5:30 AM – 10:30 PM 8:00 AM – 7:30 PM	AM Peak Midday PM Peak Evening Saturday Sunday	20 30 20 60 30 45 (30/60)	$1.25
	41B	Stamford – NCC	M – F	1 eastbound trip 2 westbound trips	N/A	N/A	$1.25
	41Bx	Stamford – NCC express	M – F	3 eastbound trips 2 westbound trips	N/A	N/A	$1.25
	42	Stamford – Darien	M – F Sa	6:00 AM – 8:00 PM 7:00 AM – 7:30 PM	Weekday Saturday	30 60	$1.25
	Stamford Commuter Connection (East)	Stamford (east of downtown)	M – F	6:30 AM – 9:30 AM 3:30 PM – 7:00 PM	AM Peak PM Peak	30 30	$1.25
	I-BUS	White Plains – Stamford	M – F Sa Su	5:30 AM – 10:00 PM 8:00 AM – 10:00 PM 8:00 AM – 8:00 PM	AM Peak Midday PM Peak Evening Saturday Sunday	30 60 30 60 60 60	$2.50
Norwalk Transit District	1	Downtown Norwalk	M – F Sa	6:20 AM – 7:15 PM 7:20 AM – 6:20 PM	Weekday Saturday	60 60	$1.25
	11	Western Norwalk	M – F Sa	6:20 AM – 7:15 PM 7:20 AM – 6:20 PM	Weekday Saturday	30 30	$1.25
	12	Western Norwalk	M – F Sa	6:20 AM – 7:15 PM 7:20 AM – 6:20 PM	Weekday Saturday	60 60	$1.25
	13	Norwalk	M – F Sa	6:20 AM – 7:15 PM 7:20 AM – 6:20 PM	Weekday Saturday	30 30	$1.25
	Connecticut Avenue (Evening and Sunday)	Norwalk	M – F Sa Su	7:30 PM – 10:30 PM 6:30 PM – 9:30 PM 8:40 AM – 6:45 PM	Weekday Saturday Sunday	60 60 60	$1.25

Table 1-1: Summary of Existing Services in the U.S. Route 1 Corridor (continued)

Operator	Route	Segment	Days	Span	Period	Frequency	Peak Fare
Norwalk Transit District	Greenwich Commuter Connection (Central)	Downtown Greenwich	M – F	7:00 AM – 9:30 AM 3:45 PM – 6:15 PM	AM Peak PM Peak	15 20	$1.25
	Greenwich Commuter Connection (West)	Western Greenwich	M – F	7:00 AM – 9:30 AM 3:45 PM – 6:15 PM	AM Peak PM Peak	20 15	$1.25
	Coastal Link	Norwalk – Milford	M – F Sa Su	5:30 AM – 11:00 PM 5:30 AM – 10:30 PM 8:30 AM – 7:30 PM	AM Peak Midday PM Peak Evening Saturday Sunday	20 60 20 60 30 60	1.25 1.50
	7 Link	Norwalk – Danbury	M – F	8 trips each direction	N/A	N/A	$1.25
MTA Metro-North Railroad	New Haven Line	New York City – New Haven	M – F Sa Su	5:00 AM – 3:00 AM 5:00 AM – 3:00 AM 5:00 AM – 3:00 AM	AM Peak Midday PM Peak Evening Saturday Sunday	5-10 20-30 10-15 20-30 20-30 20-30	N/A
CT DOT	Shore Line East	Stamford – Old Saybrook	M – F	2 westbound trips 3 eastbound trips	N/A	N/A	N/A
Amtrak	Northeast Corridor	N/A					
	Vermonter						

Sources: Fall 2008 CT Transit, Norwalk Transit District, and MTA Metro-North Railroad public timetables.

CT Transit Routes 11A / 11B

CT Transit Routes 11A/11B cover the Port Chester, NY to Stamford portion of the U.S. Route 1 corridor. Route 11A follows U.S. Route 1 from the Port Chester rail station to downtown Greenwich, where it diverges from U.S. Route 1 at Field Point Road to serve the Greenwich rail station, rejoining Route 11B then returning to U.S. Route 1 via Mason Street. From downtown Greenwich, both Routes 11A and 11B follow U.S. Route 1 (East Putnam Avenue) into Stamford, where they continue along U.S. Route 1 (West Main Street and Tresser Boulevard). Both routes turn onto Washington Boulevard and terminate at the Stamford Transportation Center. Key generators along this route include the Port Chester, Greenwich, and Stamford rail stations, downtown Port Chester, Greenwich, and Stamford, and Greenwich Hospital.

Route 11 operates Monday through Friday from 5:18 AM to 12:27 AM, Saturday from 6:06 AM to 10:22 PM, and Sunday from 7:28 AM to 8:02 PM. On weekdays, Route 11 operates every 30 minutes (alternating between the 11A and 11B services), every 15 minutes from 7:00 AM to 8:00 AM, and every 60 minutes after 8:00 PM. On weekends, Route 11 operates every 60 minutes.

CT Transit Routes 41 / 41A / 41B / 41Bx

CT Transit Route 41 serves the eastern portion of the U.S. Route 1 corridor between the Stamford Transportation Center and the WHEELS Hub in downtown Norwalk. Regular service (Route 41) operates along the entire route from Stamford to Norwalk. Certain trips operate as Route 41A, which operates the entire route and also serves Norwalk Community College (NCC) via Richards Avenue. Other trips operate as Route 41B, which serves U.S. Route 1 between the Stamford Transportation Center and NCC, and Route 41Bx, which operates as an express service between the Stamford Transportation Center and NCC via Interstate 95.

Weekday service on Route 41 is provided from 5:10 AM to 12:30 AM, with 11 eastbound and 13 westbound 41A trips, one eastbound and two westbound 41B trips, and three eastbound and two westbound 41Bx trips (one eastbound and one westbound trip when school is not in session). Service operates approximately every 30 minutes throughout the day with additional trips during rush hours, and every 60 minutes during the evening. Weekend service operates every 30 minutes from 5:30 AM to 10:30 PM on Saturdays and every 60 minutes from 8:00 AM to 7:30 PM on Sundays. No weekend trips serve NCC. It should be noted that Route 41 buses are generally interlined with Routes 11A/11B, Route 14, and Routes 22/24.

CT Transit Routes 14, 24B, 42, and Stamford Commuter Connection (East)

CT Transit Route 14 serves the Stamford portion of Route 11, functioning as a "short turn" of Route 11 operating between downtown Stamford and the intersection of U.S. Route 1 (West Main Street) and Alvord Lane. This route operates 6 trips in each direction (every 30 minutes) during the weekday AM peak period and 7 trips in each direction (every 30 minutes) during the weekday PM peak period, serving as a supplement to Route 11A/B service during rush hours.

Route 24B is an extension of Route 24, connecting the segment of U.S. Route 1 between Sound Beach Avenue and Laddin's Rock Road in Adams Corner with the Old Greenwich rail station. Service operates on weekdays only, with four trips in each direction during both the AM and PM peak periods.

Route 42 connects downtown Stamford with Glenbrook, Noroton Heights, and Darien, serving rail stations in each of the above. The route follows Route 41 eastbound to Lawn Avenue before turning off and serving areas north of U.S. Route 1, terminating at the Darien rail station (which is also served by Route 41). On weekdays, service operates every 30 minutes from 6:00 AM to 8:00 PM; on Saturdays, service operates hourly from 7:00 AM to 7:30 PM. Route 42 does not operate on Sundays.

The Stamford Commuter Connection (East Route) is a peak-period loop connecting the Stamford Transportation Center to employers along U.S. Route 1 east of downtown, from the

intersection of East Main Street and Broad Street to East Main Street and Weed Avenue. It operates every 30 minutes from approximately 6:30 AM to 9:30 AM and 3:30 PM to 7:00 PM.

I-BUS

CT Transit also operates the I-BUS Express (Interstate Connection), which connects downtown White Plains, NY with downtown Stamford via Interstates 95 and 287. Monday through Friday service operates from 5:30 AM to approximately 10:00 PM, half-hourly during peak periods and every 60 to 90 minutes off peak. Saturday service operates hourly from 8:00 AM to 10:00 PM, and Sunday service operates hourly from 8:00 AM to 8:00 PM. All trips stop at Atlantic Square and Stamford Transportation Center in Stamford, with a few weekday trips also serving the Greenwich Rail station.

Fares for the I-BUS are $2.50 for a one-way trip, $1.25 for seniors/disabled, and free for Children 4 years of age or younger. Transfers to CT Transit, Bee-Line, Greenwich Commuter Connection, or Transport of Rockland routes are free. Ten rides can be purchased for $20.00, a 1-day pass for $5.00, or a 31-day pass for $75.00. I-BUS passes are valid on all connecting services, although sometimes with zone surcharges, and I-BUS accepts passes from CT Transit, Bee-Line, and Metro-North (UniTicket), sometimes with additional fare.

1.1.2 Norwalk Transit District

Norwalk Transit District (NTD) provides bus transit service within Norwalk, as well as a commuter shuttle service in Greenwich between the train station and points along U.S. Route 1 (East and West Putnam Avenue). Additionally, NTD operates the Coastal Link and 7 Link services between Norwalk and Milford and Norwalk and Danbury, respectively. Fares are $1.25 for adults or $0.60 for seniors/disabled. 10 rides can be purchased for $10.50, 20 for $21.00, or 40 for $42.00. WHEELS routes operate from 6:00 AM to 7:15 PM on weekdays, and from 7:20 AM to 6:20 PM on Saturdays and Sundays. NTD also operates an evening and Sunday shuttle service, with routes operating from 7:30 PM to 10:30 PM Monday through Friday, 6:30 PM to 9:30 PM on Saturdays, and 8:40 AM to 6:45 PM on Sundays.

WHEELS Routes 1, 11, 12, and 13

Route 1 follows U.S. Route 1 from the WHEELS Hub to the Norwalk Hospital before heading northwest towards Fox Run Elementary School. This route operates every 60 minutes Monday through Saturday (every 70 minutes on weekday afternoons).

Route 11 connects the WHEELS Hub to the South Norwalk Rail station and NCC, running along U.S. Route 1 from Scribner Avenue to Richards Avenue. Route 11 operates every 30 minutes Monday through Saturday (every 35 minutes on weekday afternoons).

Route 12 operates between the WHEELS Hub and Roton Middle School, following U.S. Route 1 from Stuart Avenue to West Cedar Street. This route operates every 60 minutes Monday through Saturday (every 70 minutes on weekday afternoons).

Route 13 follows CT Transit Route 41 along U.S. Route 1 (Van Buren Avenue and Connecticut Avenue) from the WHEELS Hub to Richards Avenue, where it leaves U.S. Route 1 to terminate at NCC. The route returns to downtown Norwalk via West Cedar Street and U.S. Route 1. This route operates every 30 minutes Monday through Saturday (every 35 minutes on weekday afternoons).

WHEELS Connecticut Avenue Evening and Sunday Shuttle

The Connecticut Avenue Evening and Sunday Shuttle serves to extend the hours of WHEELS Route 10 (South Norwalk) and Route 13 (Connecticut Avenue/NCC). The western leg of the Connecticut Avenue Evening and Sunday Shuttle follows U.S. Route 1 (Van Buren Avenue and Connecticut Avenue) and Richards Avenue in the same manner as CT Transit Route 41A and WHEELS Route 13 (although it returns via Richards Avenue, not West Cedar Street, similarly to Route 41A rather than Route 13). This route operates on 60 minute headways.

Greenwich Commuter Connection (Central and West Loops)

The Greenwich Commuter Connection consists of two loops, the West Loop, which serves the Greenwich rail station and U.S. Route 1 (West Putnam Avenue) from Prospect Street to the New York state line, and the Central Loop, which serves the Greenwich rail station, Field Point Road, the Greenwich Hospital, and Mason Street. These loop routes operate during the AM and PM Peak periods, from 7:00 AM to 9:30 AM and from 3:45 PM to 6:15 PM, serving to shuttle passengers between the Greenwich rail station and employers throughout downtown Greenwich and along U.S. Route 1 (West Putnam Avenue).

Coastal Link and 7 Link

Norwalk Transit District operates the Coastal Link service along U.S. Route 1 between Norwalk and Milford, serving Westport, Fairfield, Bridgeport, and Stratford along the way. Coastal Link service operates on weekdays from approximately 5:30 AM to 11:00 PM, with service every 20 minutes during peak periods and hourly during the midday period and evenings, on Saturdays from approximately 5:30 AM to 10:30 PM with half-hourly service during the day and hourly service in the evening, and hourly on Sundays between 8:30 AM and 7:30 PM. The 7 Link operates on weekdays with eight trips in each direction between Danbury and Norwalk.

1.1.3 MTA Metro-North Railroad

The Metropolitan Transportation Authority's Metro-North Railroad parallels U.S. Route 1 along the Connecticut coast, with stations in or near the Greenwich – Norwalk corridor at Port

Chester, Greenwich, Cos Cob, Riverside, Old Greenwich, Stamford, Noroton Heights, Darien, Rowayton, and South Norwalk. Metro-North connects the region with New Haven, Bridgeport, Danbury, Waterbury, New Canaan, Westchester County (NY), and New York City. Connections are available to CT Transit Route 11 at Port Chester, Greenwich, and Stamford stations, and to CT Transit Route 41 at Stamford and Darien stations.

On weekdays, trains run through the region from approximately 5:00 AM to 3:00 AM, with the first New York-bound train departing Stamford at 4:43 AM and the last train arriving at Stamford (from New York) at 3:11 AM. On weekends and holidays, the first New York-bound train departs Stamford at 5:03 AM (the last train is the same). Stamford is the busiest station on the route, with trains running as frequently as every five-to-ten minutes towards New York City during the AM peak period. Off-peak service operates every 20-30 minutes between Stamford and New York.

Fares vary depending on distance traveled. From Port Chester to South Norwalk, the fare is $4.50 for an adult or $2.25 for a senior, disabled person, or child, or $92.00 for a monthly pass. From Stamford to Greenwich or Stamford to South Norwalk, the fare is $2.25 for an adult, $1.00 for a senior, disabled person, or child, or $50.00 for a monthly pass.

1.1.4 Shore Line East

Owned and operated by the Connecticut Department of Transportation under a service agreement with Amtrak, Shore Line East is a commuter rail line that runs between Old Saybrook or New Haven and New London, with a few rush hour trips extended to Stamford. Two westbound trains and one eastbound train have been extended to Stamford during the AM peak period, and two eastbound trains originate at Stamford during the PM peak period. All Shore Line East trains connect to Metro-North New Haven Line trains to Stamford or New York City.

1.2.5 Amtrak

Amtrak also operates service along its Northeast Corridor and Vermonter routes through the area, serving the Stamford Transportation Center.

1.2 Terminal Descriptions

The proposed BRT route would likely serve two major terminals: the current Norwalk Transit District Pulse Point in downtown Norwalk, and the Stamford Transportation Center. These two terminals are described in greater detail below. In addition, the route may serve the Darien, Greenwich, and Port Chester rail stations.

1.2.1 Norwalk Pulse Point

Figure 1-1: Norwalk Pulse Point

Source: Urbitran Associates

The Norwalk Pulse Point, also known as the WHEELS Hub, is the terminal for Norwalk Transit District's WHEELS routes, as well as the Coastal Link service to Bridgeport and Milford, the 7 Link service to Danbury, and CT Transit's Route 41 service along U.S. Route 1 between Norwalk and Stamford. Located on Burnell Boulevard at Belden Avenue, the Pulse Point includes diagonal curbside parking for each route terminating there, as well as signs depicting the berth for each route. Additional amenities include two bus shelters, safety bollards, a clock, newspaper boxes, trees, street lighting, pay phones, posted system maps and schedules, and trash receptacles. There is also a municipal parking garage across the street. Figure 1-1 shows the Norwalk Pulse Point.

The WHEELS Hub is currently slated for complete redesign. Current plans by SEA Consultants, Inc. include a transit center with fifteen concrete, diagonal bus bays with granite dividers, improved drainage, a ticket kiosk, and a drivers' building (with restrooms, etc.). The passenger waiting area will be fully covered by a canopy spanning much of the length of the block. Additional amenities include four shelters, ten benches, bike racks, police phone and blue light phone, as well as improved handicapped access and landscaping. Cost estimates range from $2.2 million to $2.9 million, with some of the variance attributed to whether the drivers' building will be located within the existing parking structure or whether it will be freestanding. The drivers' building is estimated to cost approximately $280,000 if freestanding, $115,000 if part of the existing garage, and the canopy is estimated to cost approximately $700,000.

1.2.2 Stamford Transportation Center

The Stamford Transportation Center is an intermodal transportation center connecting intercity and commuter rail, long-distance and local bus, as well as private automobiles, taxis, and employer shuttles. Transportation providers serving the center include Amtrak, Metro-North Railroad, Shore Line East, Greyhound, and CT Transit's Stamford Division. The facility includes restrooms and indoor seating, a newsstand, a Dunkin Donuts, a Coffee Shop, Amtrak and Greyhound ticket centers, and a CT Transit customer service office. A large parking garage is located across the street that charges both daily and monthly rates.

The bus terminal, located under Interstate 95, includes bus lanes for Greyhound and CT Transit, each with shelters, benches, trash cans, and newspaper boxes. CT Transit's bus lanes are

broken down by route groups, each of which serves a different direction out of downtown Stamford: Lane 1 includes Routes 11, 13, and 14 (west); Lane 2 includes Routes 21, 22, and 24 (southwest), Lane 3 includes Routes 31, 32, 33, and 34 (north) and Lane 4 includes Routes 41, 42, 43, and 44 (south and east). Additionally, there is a separate boarding area for private shuttles, such as employer shuttles. Figure 1-2 shows bus bays at the Stamford Transportation Center as seen from North State Street.

Figure 1-2: Bus Bays at the Stamford Transportation Center

Source: Urbitran Associates

1.2.3 Bus Stop Characteristics and Amenities

Bus stops along Routes 11 and 41 are spaced approximately every two blocks, sometimes every block in busy areas, amounting to spacing between 0.1 and 0.25 miles along each route. While the WHEELS Hub and Stamford Transportation Center both include a wide array of amenities for passengers (detailed in section 1.3), other stops contain fewer amenities. Bus stop signs, denoting the system name and logo, as well as a phone number providing passenger information, were found at every stop. Some stops further included the route number(s) serving the stop and/or schedule information. Some stops also included benches, shelters, and/or trash receptacles.

1.3 Corridor Travel Times

A fundamental goal of the study of bus service enhancements in the U.S. Route 1 corridor is reducing travel times for passengers making mid-length or long trips, such as the full length of the CT Transit Route 41 service from Stamford to Norwalk. Therefore, determining how buses are effected by traffic congestion, signal timing, and other factors is an important step in assessing how and where time savings could ultimately be achieved. Furthermore, understanding how much time could be saved through various improvements is necessary to determine the benefits of transit and traffic improvements relative to their projected costs.

For this study, corridor travel time data were gathered in two ways: from driving the existing bus routes along U.S. Route 1 between Port Chester and Norwalk, and from riding the bus services along the U.S. Route 1 corridor, including CT Transit Routes 11 and 41. This

information was used to determine overall travel times at various times of the day as well as delays and locations and road segments where delays are the greatest. Data collection onboard buses occurred on May 15 and 21, 2008. Car travel time surveys took place on May 21 and June 3, 2008.

1.3.1 Methodology

Over the course of two days, surveyors rode the CT Transit Stamford Division's Routes 11 and 41, recording where and for how long buses stopped as well as the number of boarding passengers. Surveyors were given forms that listed, in order, the potential signals, stop signs, and bus stops that would cause the bus to come to a stop. The surveyors rode along the route and used stopwatches to record the time when the bus came to a complete stop and when the bus went back into motion. Time was recorded in minutes and seconds from departure using stop watches which were zeroed at the beginning of each trip. Surveyors also used the forms to note areas of high congestion, or causes for delays such as construction or accidents.

In total, 61 trips were successfully recorded (20 eastbound and 20 westbound Route 41 trips, 9 eastbound Route 11 trips, and 12 westbound Route 11 trips), covering the full range of operating times on each route. Fewer Route 11 trips were recorded than Route 41 trips because approximately half of all Route 11 trips operate as Route 11B, which does not travel along U.S. Route 1 between Greenwich and Port Chester. Route 41 also deviates from U.S. Route 1 on some trips to serve the Norwalk Community College – these trips have been excluded from some calculations (such as trip time) in order to ensure accuracy. Bus trips surveyed are listed in Appendix 1. From the data that was gathered and recorded a number of factors were evaluated, including trip time, ratio of moving versus stopped time, vehicle speed, passenger volumes, and delay-causing intersections.

1.3.2 Bus Travel Times

Overall travel times between eastbound and westbound trips did not vary significantly over the course of the day. Also, stopped time made up about one-third of total travel time across all four trips types (CT Transit Routes 11 and 41, eastbound and westbound). The following analysis breaks down these four trip types into further detail, and stopped time is divided among time spent at traffic signals and time spent at bus stops. Table 1-2 summarizes the percent of time spent stopped versus the percent of time spent moving for each of the four trip types.

Table 1-2: Bus Travel Time

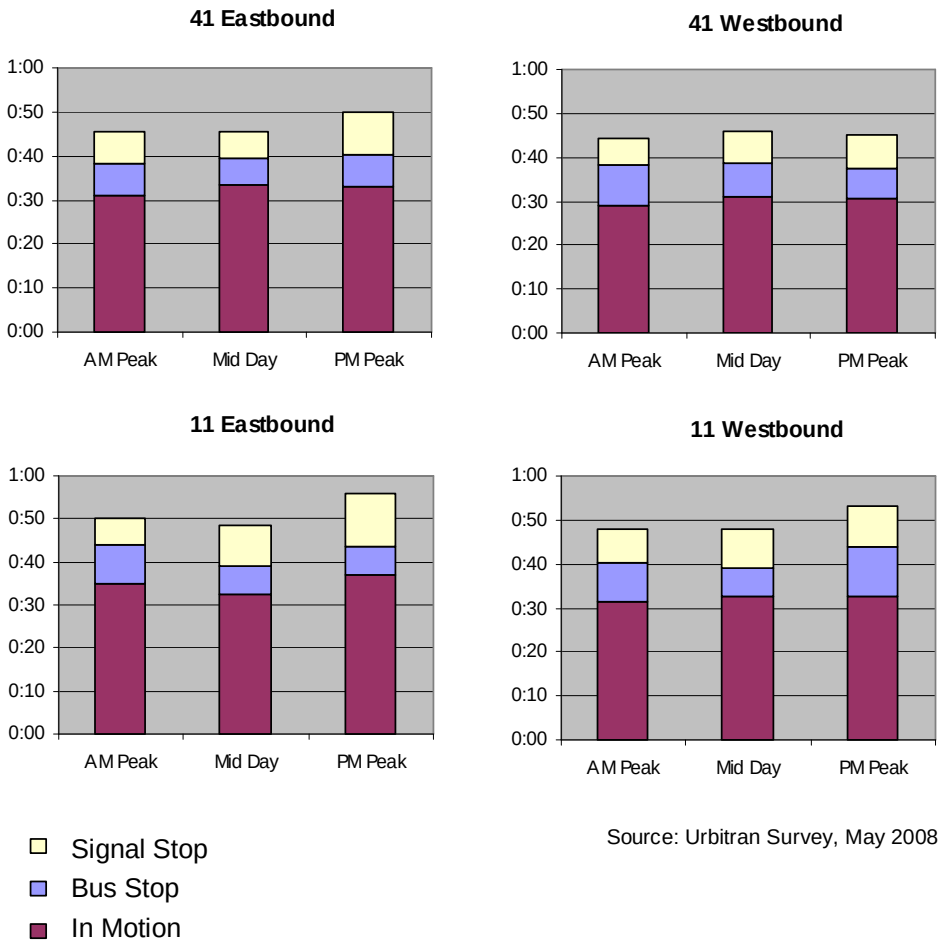
Trip Type	Average Trip Length	Percent of Time Stopped	Percent of Time In Motion
41 Eastbound	0:46:09	30%	70%
41 Westbound	0:45:00	32%	68%
11 Eastbound	0:49:04	32%	68%
11 Westbound	0:49:10	34%	66%

Source: Urbitran Survey, May 2008

Further analysis of each route for both eastbound and westbound runs is summarized later on in this document. The routes have been further broken down into segments to better identify where delays are happening and what is causing them. The information collected onboard has been summarized by segment as an average of recorded trips (see Figure 1-3).

Trip length and breakdown of stopped time was also considered by time of day. For the purpose of this analysis, AM peak has been defined as 6:00 AM - 9:00 AM, midday as 9:00 AM - 4:00 PM, and PM peak as 4:00 PM - 7:00 PM. Generally, PM peak trips tended to be the longest, but the total time difference between these three periods was less than five minutes. On Route 41 westbound trips, the longest trip lengths occurred during the midday period. Figure 1-3 shows the amount of time spent at signals, bus stops, and in motion for Routes 11 and 41 by direction and time of day.

Figure 1-3: Signal, Stop, and Go Time by Route and Direction



Source: Urbitran Survey, May 2008

1.3.3 Car Travel Times

In addition to bus travel time, five car trips were recorded for each eastbound and westbound section of the bus routes. Average car travel time was consistently shorter than average bus travel time, particularly when traveling westbound. Car travel times tended to be the longest following the AM peak period. Table 1-3 compares average car travel times to average bus travel times for Routes 11 and 41 in each direction. It should be noted that travel times reflect car travel along the bus routes, and do not reflect driving exclusively on U.S. Route 1. The full breakdown of car travel times can be found in the Appendix 1.

Table 1-3: Car Travel Time

Trip Type	Car Trip Time	Bus Trip Time	Time Difference
41 Eastbound	0:36:08	0:45:00	+24.55%
41 Westbound	0:32:08	0:46:09	+43.59%
11 Eastbound	0:39:57	0:49:10	+23.07%
11 Westbound	0:35:34	0:49:04	+37.94%

Urbitran Speed Runs and Urbitran Survey, May – June 2008

1.3.4 Corridor Segment Analysis

This next section describes both CT Transit Routes 11 and 41, in both directions, broken down into smaller segments. These segments were examined for average travel time, average travel speed, proportion of time spent moving or stopped, average number of signals and bus stops causing the bus to stop, boarding passengers, and boardings per stop.

CT Transit Route 41 Eastbound

On Route 41 outbound trips, downtown Stamford was the slowest segment, with speeds below 10 miles per hour. The bus traveled much more rapidly at 24 miles per hour through the residential section of Noroton Heights. Between downtown Darien and Norwalk, speeds were consistent between 12 and 14 miles per hour. Table 1-4 shows average time, distance, and speed for each segment of Route 41 in the eastbound direction.

The bus was in motion for the majority of the route, with the exception of Stamford, where it was stopped 77% of the time. The delays in Stamford were caused by a combination of bus stops (57%) and signals (43%). In Darien, signals accounted for a larger proportion of delays (65%), and elsewhere the split is about even. Unlike on westbound, where boardings were spread out, boardings on eastbound trips took place almost exclusively in Stamford near the origin of the route. Similar to westbound trips, there was less than one passenger per stop in Noroton Heights. While traveling through Noroton Heights, the bus was in motion for almost the entire 2.5 mile segment (87%). Table 1-5 shows time in motion versus time stopped for Route 41 in the eastbound direction.

Table 1-4: Route 41 Eastbound – Speed

Segment	Average Time	Distance (miles)	Average Speed (MPH)
Stamford Transportation Center to Seaside Avenue (Stamford)	0:15:23	2.2	9
Seaside Avenue (Stamford) to Ledge Road (Darien)	0:06:22	2.5	24
Ledge Road (Darien) to Birch Road (Darien)	0:05:40	1.2	13
Birch Road (Darien) to Scribner Avenue (Norwalk)	0:08:06	1.6	12
Scribner Avenue (Norwalk) to WHEELS Hub (Norwalk)	0:07:58	1.9	14
Total	42:49	9.4	13
*does not include Route 41A trips serving NCC (7:15 AM, 3:45 PM, 4:40 PM, 6:00 PM).			

Source: Urbitran Survey, May 2008

Table 1-5: Route 41 Eastbound - Moving versus Stopped

Segment	% Time Bus is in Motion	% Time Bus is Stopped	Number of Signals	Average Signals Stopped	Number of Bus Stops	Average Bus Stops Stopped	Average Boardings	% Stop Time at Bus Stops
Stamford Transportation Center to Seaside Avenue (Stamford)	23%	77%	23	7	14	8	2.63	57%
Seaside Avenue (Stamford) to Ledge Road (Darien)	87%	13%	8	1	14	2	0.50	56%
Ledge Road (Darien) to Birch Road (Darien)	74%	26%	10	2	10	2	0.50	35%
Birch Road (Darien) to Scribner Avenue (Norwalk)	74%	26%	14	3	15	5	0.40	58%
Scribner Avenue (Norwalk) to WHEELS Hub (Norwalk)	69%	31%	11	4	9	4	0.25	48%
* does not include Route 41A trips serving NCC (7:15 AM, 3:45 PM, 4:40 PM, 6:00 PM)								

Source: Urbitran Survey, May 2008.

Route 41 Westbound

Route 41 westbound trips experienced similar patterns of slow traffic in Stamford and high speeds through Noroton Heights; speeds between Norwalk and Darien were consistently between 12-14 miles per hour. Table 1-6 shows average time, distance, and speed for Route 41 in the westbound direction.

Table 1-6: Route 41 Westbound – Speed

Segment	Average Time	Distance (miles)	Average Speed (MPH)
WHEELS Hub (Norwalk) to Scribner Avenue (Norwalk)	0:07:56	1.9	14
Scribner Avenue (Norwalk) to Richmond Drive (Darien)	0:07:24	1.5	12
Richmond Drive (Darien) to Ledge Road (Darien)	0:06:31	1.4	13
Ledge Road (Darien) to Seaside Avenue (Stamford)	0:05:52	2.5	26
Seaside Avenue (Stamford) to Stamford Transportation Center	0:16:10	2.2	8
Total	0:42:33	9.5	13
* does not include Route 41A trips serving NCC (2:20 PM, 4:40 PM, 6:01 PM, or 6:51 PM)			

Source: Urbitran Survey, May 2008

Between the WHEELS Hub and Scribner Avenue in Norwalk the bus spent the greatest proportion of time stopped at signals. Along U.S. Route 1 (Connecticut Avenue) in Norwalk, the density of boardings was high, but the amount of time spent stopped remained steady at about 30%. As the route traveled through Darien there were fewer boardings and signals had a greater effect on stop time. In Noroton Heights, the bus stayed in motion for over 84% of the time, stopping at few signals or bus stops. Closer to its terminus in downtown Stamford, the bus made frequent stops and spent a greater portion of time than any other segment of the route stopped at bus stops. Table 1-7 shows time in motion versus time stopped for Route 41 in the westbound direction.

Table 1-7: Route 41 Westbound - Moving versus Stopped

Segment	% Time Bus is in Motion	% Time Bus is Stopped	Number of Signals	Average Signals Stopped	Number of Bus Stops	Average Bus Stops Stopped	Average Boardings	% Stop Time at Bus Stops
WHEELS Hub (Norwalk) to Scribner Avenue (Norwalk)	69%	31%	14	5	8	4	1.20	40%
Scribner Avenue (Norwalk) to Richmond Drive (Darien)	71%	29%	9	3	8	3	2.33	51%
Richmond Drive (Darien) to Ledge Road (Darien)	70%	30%	10	2	9	2	0.50	45%
Ledge Road (Darien) to Seaside Avenue (Stamford)	84%	16%	10	2	12	2	1.00	50%
Seaside Avenue (Stamford) to Stamford Transportation Center	60%	40%	20	7	15	8	1.11	53%
* does not include Route 41A trips serving NCC (2:20 PM, 4:40 PM, 6:01 PM, or 6:51 PM)								

Source: Urbitran Survey, May 2008

Route 11 Eastbound

Eastbound Route 11 trips experienced the slowest speeds while traveling off of U.S. Route 1 to serve the Greenwich rail station and the Stamford Transportation Center. While on U.S. Route 1, speeds remained fairly consistent, between 11-15 miles per hour. Speeds generally decreased as the route traveled away from Port Chester. Table 1-8 shows average time, distance, and speed for each segment of Route 11 in the eastbound direction.

Table 1-8: Route 11 Eastbound – Speed

Segment	Average Time	Distance (miles)	Average Speed (MPH)
Willett Avenue (Port Chester) to Field Point Road (Greenwich)	0:10:17	2.5	15
Field Point Rd (Greenwich) to East Putnam Avenue (Greenwich)	0:10:21	1.7	10
East Putnam Avenue (Greenwich) to Laddins Rock Road (Greenwich)	0:15:41	3.5	13
Laddins Rock Road (Greenwich) to North State Street (Stamford)	0:08:34	1.6	11
North State Street (Stamford) to Stamford Transportation Center	0:02:41	0.2	4
Total	46:54	9.5	12

Source: Urbitran Survey, May 2008

Route 11 eastbound trips were consistently moving more than they were stopped, however the route experienced a greater ratio of stop time while traveling to and from the Greenwich rail station and in Stamford. Signals accounted for 66% of stop time on the off-U.S. Route 1 portion of the route serving the Greenwich rail station, and 55% of stop time in Stamford. Boardings were heaviest near the origin of the route in Port Chester. While in Port Chester, the route experienced the fewest delays and spent the majority of stop time at bus stops. For the rest of the route, boardings remained between one or fewer passengers per bus stop, and signals accounted for a greater proportion of stopped time. Table 1-9 shows time in motion versus time stopped for Route 11 in the eastbound direction.

Table 1-9: Route 11 Eastbound - Moving versus Stopped

Segment	% Time Bus is in Motion	% Time Bus is Stopped	Number of Signals	Average Signals Stopped	Number of Bus Stops	Average Bus Stops Stopped	Average Boardings	% Stop Time at Bus Stops
Willett Avenue (Port Chester) to Field Point Road (Greenwich)	76%	24%	8	3	17	6	1.50	55%
Field Point Rd (Greenwich) to East Putnam Avenue (Greenwich)	59%	41%	11	5	14	6	0.67	34%
East Putnam Avenue (Greenwich) to Laddins Rock Road (Greenwich)	65%	35%	19	6	23	7	1.00	38%
Laddins Rock Road (Greenwich) to North State Street (Stamford)	54%	46%	14	4	12	5	0.80	45%
North State Street (Stamford) to Stamford Transportation Center	74%	26%	2	1	2	1	0.00	36%

Source: Urbitran Survey, May 2008

Route 11 Westbound

Similar to Route 11 eastbound trips, the segment serving the Greenwich rail station was the segment with the lowest speeds on westbound 11 trips. Throughout the rest of the route, speeds were fairly consistent with the highest speeds in Greenwich east of the rail station. Table 1-10 shows average time, distance, and speed for each segment of Route 11 in the westbound direction.

Table 1-10: Route 11 Westbound – Speed

Segment	Average Time	Distance (miles)	Average Speed (MPH)
Stamford Transportation Center to Havemeyer Lane (Greenwich)	0:08:52	1.6	11
Havemeyer Lane (Greenwich) to Mason Street (Greenwich)	0:16:05	3.5	13
Mason Street (Greenwich) to West Putnam Avenue (Greenwich)	0:10:15	1.6	9
West Putnam Avenue (Greenwich) to Westchester Avenue (Port Chester)	0:13:36	2.8	12
Total	48:08	9.5	12

Source: Urbitran Survey, May 2008

Route 11 westbound trips were consistently moving more than they were stopped. Similar to eastbound trips, the stop time made up a greater proportion of the trip in Stamford and around the Greenwich rail station. While the majority of stop time was spent at bus stops in Stamford, the majority of stop time was spent at signals in downtown Greenwich. The greatest number of boardings per bus stop occurred in Stamford near the origin of the route and the lowest density in Byram and Port Chester near the route's terminus. Table 1-11 shows time in motion versus time stopped for Route 11 in the westbound direction.

Table 1-11: Route 11 Westbound - Moving versus Stopped

Segment	% Time Bus is in Motion	% Time Bus is Stopped	Number of Signals	Average Signals Stopped	Number of Bus Stops	Average Bus Stops Stopped	Average Boardings	% Stop Time at Bus Stops
Stamford Transportation Center to Havemeyer Lane (Greenwich)	56%	44%	16	4	12	8	1.38	64%
Havemeyer Lane (Greenwich) to Mason Street (Greenwich)	62%	38%	22	7	21	8	0.88	38%
Mason Street (Greenwich) to West Putnam Avenue (Greenwich)	57%	43%	12	6	12	5	1.00	44%
West Putnam Avenue (Greenwich) to Westchester Avenue (Port Chester)	76%	24%	12	4	22	7	0.43	52%

Source: Urbitran Survey, May 2008

Maps on the following two pages provide a visual summary of this segment analysis.

Figure 1-4: Eastbound Segment Analysis

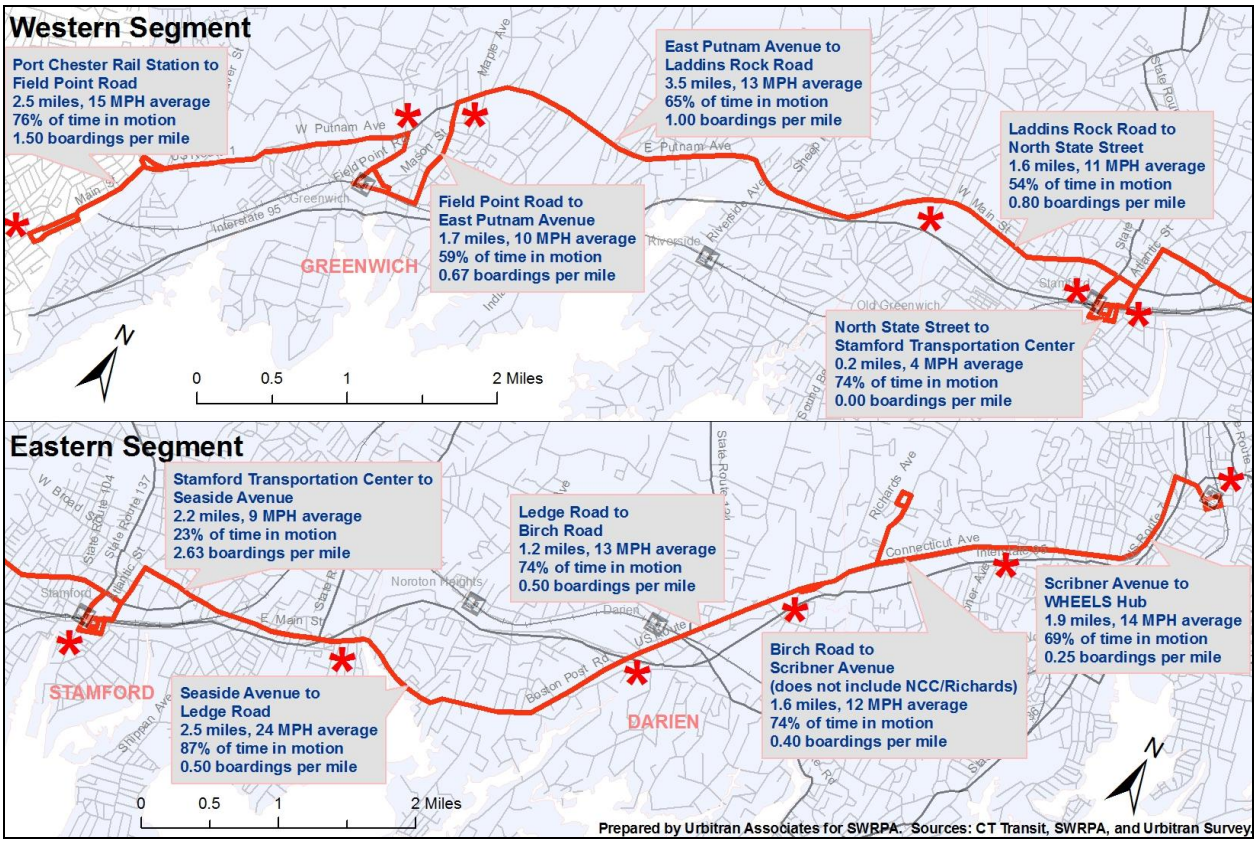
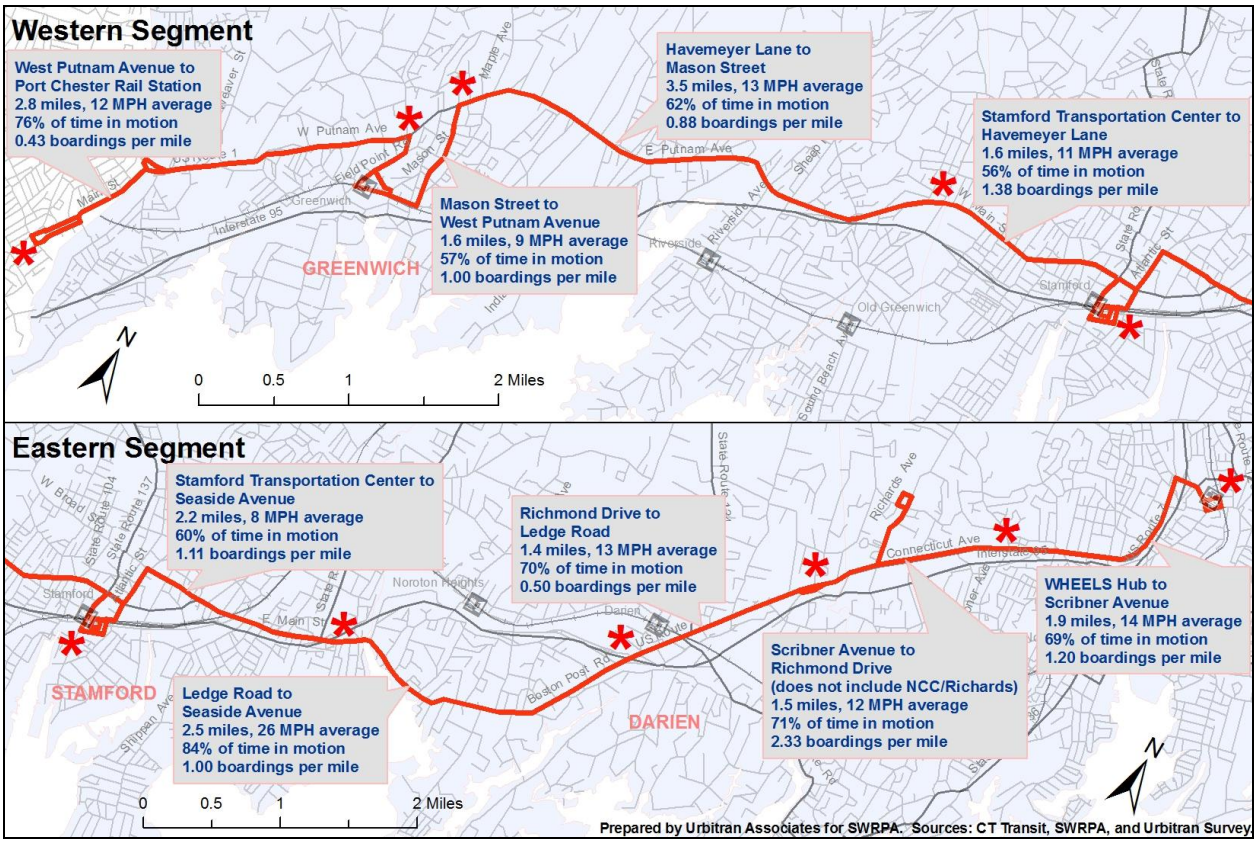


Figure 1-5: Westbound Segment Analysis



1.3.5 Signal Delays and Dwell times

The top ten signal delays were found by ranking the average length of time the bus spent at each signal for both eastbound and westbound trips. The longest signal delays occurred primarily on CT Transit Route 41 between Stamford and Norwalk. The longest signals varied by direction, but there were some signals that made the top ten in both directions. These included the Greenwich rail station, and two signals in downtown Stamford close to the Stamford Transportation Center.

Signal Delays

Table 1-12 shows the intersections with the 10 longest signal delays along Routes 11 and 41 in each the eastbound and westbound directions. Signal delays for all stops can be found in the Appendix 1.

Table 1-12: Top 10 Signal Delays Eastbound and Westbound

Eastbound	Westbound
1. Railroad Avenue & Arch Street (Greenwich) – 60 seconds	1. Field Point Road & West Putnam Avenue (Greenwich) – 36 seconds
2. East Putnam Avenue & Laddins Rock Road (Greenwich) – 31 seconds	1. East Putnam Avenue & Neil Lane (Greenwich) – 36 seconds
3. East Putnam Avenue & Riverside Lane (Greenwich) – 28 seconds	3. Railroad Avenue & Arch Street (Greenwich) – 31 seconds
3. 1250 East Putnam Avenue (Greenwich) – 28 seconds	4. East Putnam Avenue & Old Church Road (Greenwich) – 26 seconds
3. Broad Street & East Main Street (Stamford) – 28 seconds	5. East Main Street & Glenbrook Road (Stamford) – 25 seconds
6. North Main Street & Mill Street (Port Chester) – 27 seconds	6. East Putnam Avenue & Orchard Street (Greenwich) – 24 seconds
7. Boston Post Road & Center Street (Darien) – 25 seconds	7. North State Street & Washington Boulevard (Stamford) – 21 seconds
8. Field Point Road & Railroad Avenue (Greenwich) – 24 seconds	8. East Putnam Avenue & Mason Street (Greenwich) – 19 seconds
9. Atlantic Street & Broad Street (Stamford) – 23 seconds	9. Broad Street & Bedford Street (Stamford) – 18 seconds
10. Mason Street & East Putnam Avenue (Greenwich) – 22 seconds	9. Atlantic Street & North State Street (Stamford) – 18 seconds
10. Tresser Boulevard & Atlantic Street (Stamford) – 22 seconds	9. Atlantic Street & Tresser Boulevard (Stamford) – 18 seconds

Source: Urbitran Survey, May 2008

In the eastbound direction, longer and more densely located delays were experienced in eastern Greenwich, downtown Stamford, on the segment accessing the Greenwich rail station, and near the Darien Rail station.

When broken down into time of day, signal delays in downtown Greenwich appear to increase from AM peak to midday to PM peak. Delays along U.S. Route 1 through eastern Greenwich and western Stamford remain fairly consistent, spread out along the corridor. Similarly, East Main Street through Stamford demonstrates heavy delays across all three periods, with a slight increase during the PM peak. Signal delays near the Darien rail station are worst during the PM peak and lightest during the midday period, while delays along U.S. Route 1 (Connecticut Avenue) in Norwalk are consistent throughout the day. The following maps compare signal delays between the AM peak, midday, and PM peak periods in the eastbound direction.

In the westbound direction signal delays closely paralleled eastbound delays with a greater number of signal delays in eastern and downtown Greenwich, as well as in downtown Stamford.

When broken down into time of day, westbound signal delays were worst in Port Chester during the midday period, in downtown Greenwich during the AM peak period, and in eastern Greenwich and Stamford during the PM peak period. Darien included the greatest amount of signal delays during the midday period (around the train station), and Norwalk remained fairly consistent throughout the day.

The following maps show signal delays along CT Transit Routes 11 and 41 in both the eastbound and westbound directions. These maps are broken down by time of day in the Appendix 1.

Figure 1-6: Eastbound Signal Delays

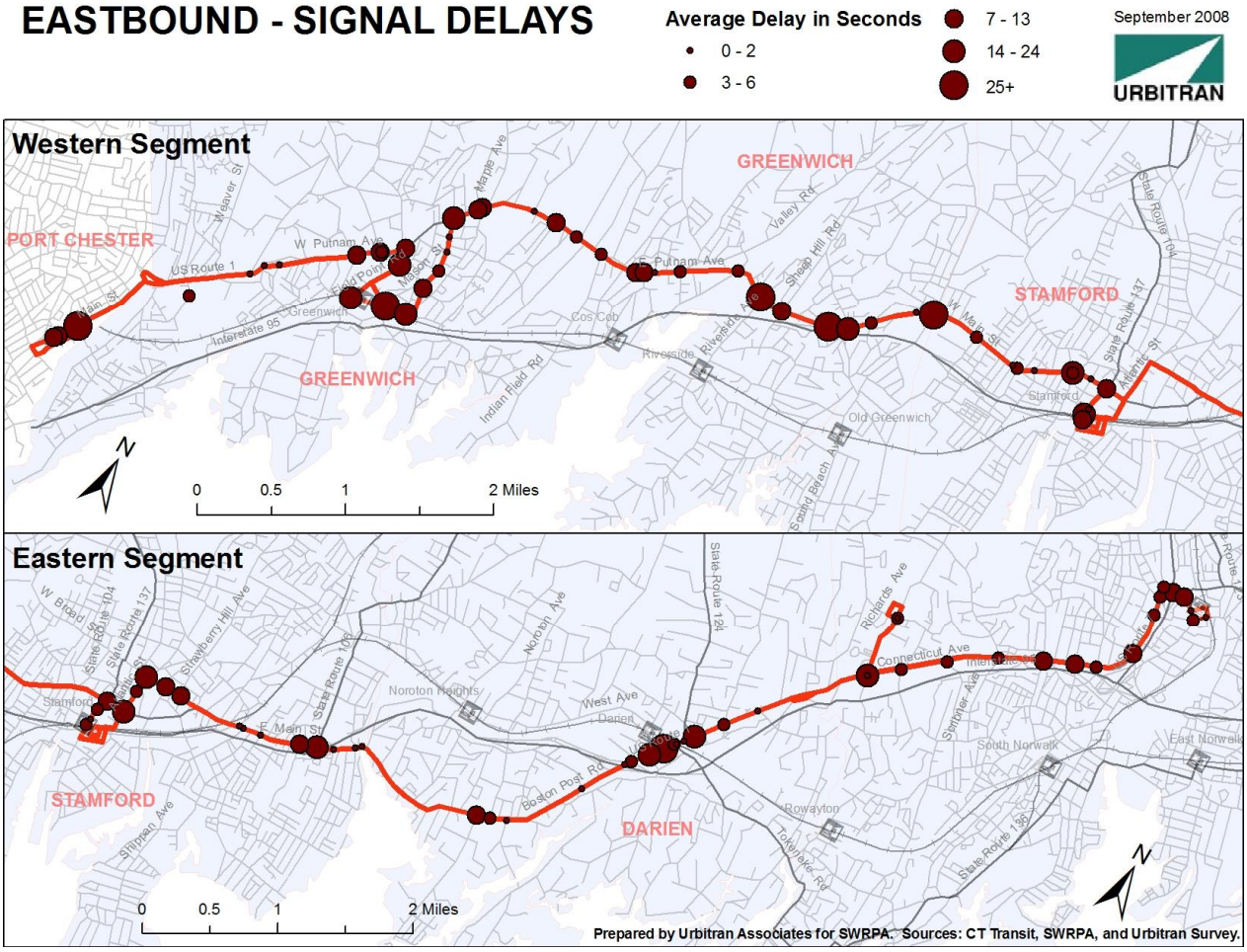
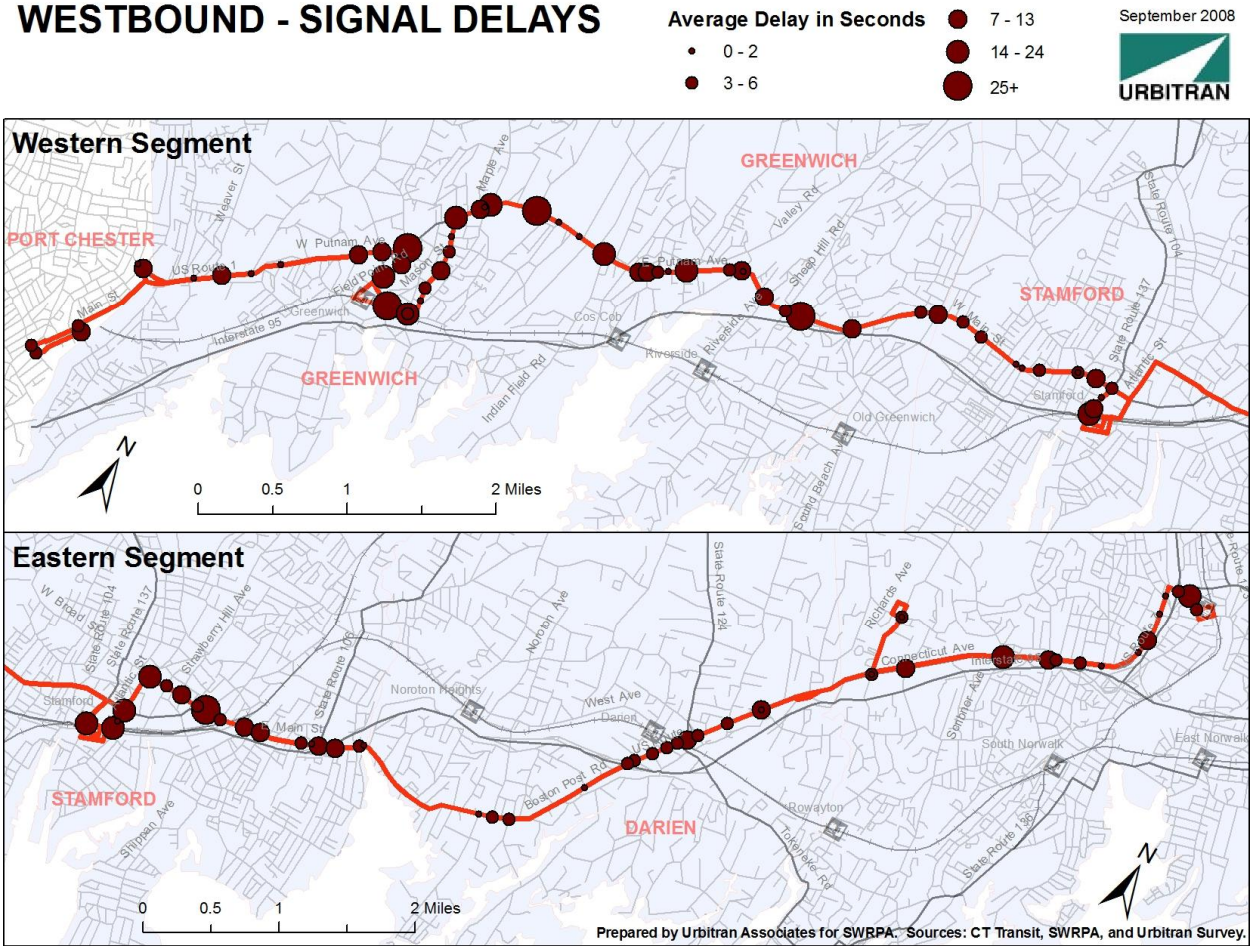


Figure 1-7: Westbound Signal Delays



Dwell times

Dwell times, are defined as the amount of time the bus spends at a particular stop with its doors open in order to receive and discharge passengers. They are generally proportionate to the number of passengers boarding or disembarking at a particular stop. When onboard fare collection is used, such as on CT Transit Routes 11 and 41, dwell times are particularly affected by boarding passengers as each passenger must take time to pay before boarding the bus. Passes that are flashed, such as monthly or weekly passes, may speed up the boarding process for some passengers, thus reducing dwell time.

The top ten dwell times were found by ranking the average length of time the bus spent at each bus stop for both eastbound and westbound trips. As shown in the following table, dwell times were spread out along Routes 11 and 41, but the largest number (and overall longest) were in Stamford. Table 1-13 shows the ten longest dwell times in each the eastbound and westbound

directions for Routes 11 and 41 (combined). Dwell times for all stops can be found in the Appendix 1.

Table 1-13: Top 10 Dwell Times Eastbound and Westbound

Eastbound	Westbound
1. Atlantic Street & Veterans Park (Stamford) – 77 seconds	1. Greenwich Rail Station (Greenwich) – 50 seconds
2. Washington Boulevard & Tresser Boulevard (Stamford) – 28 seconds	2. Atlantic Street & Main Street (Stamford) – 48 seconds
3. Broad Street & Greyrock Place (Stamford) – 27 seconds	3. West Main Street & Stillwater Avenue (Stamford) – 38 seconds
4. West Main Street & West Avenue (Stamford) – 24 seconds	4. Boston Post Road & Tokeneke Road (Darien) – 32 seconds
5. East Main Street & Lockwood Avenue (Stamford) – 22 seconds	5. Connecticut Avenue & Wal-Mart (Norwalk) – 28 seconds
6. East Putnam Avenue & Sound Beach Avenue (Greenwich) – 19 seconds	6. East Putnam Avenue & Orchard Street (Greenwich) – 25 seconds
7. Greenwich Rail Station (Greenwich) – 18 seconds	7. Boston Post Road & Richmond Drive (Darien) – 22 seconds
8. West Main Street & Diaz Street (Stamford) – 17 seconds	7. East Main Street & Myrtle Avenue (Stamford) – 22 seconds
9. North Main Street & Willett Avenue (Port Chester) – 16 seconds	9. Broad Street & Greyrock Place (Stamford) – 20 seconds
10. Belden Avenue & Burnell Boulevard (Norwalk) – 16 seconds	10. Connecticut Avenue & Taylor Avenue (Norwalk) – 18 seconds
	10. East Main Street & Lincoln Avenue (Darien) – 18 seconds

Source: Urbitran Survey, May 2008.

Following are maps depicting dwell times in the eastbound and westbound directions. Maps depicting average dwell times in both directions broken down into the AM peak, midday, and PM peak periods can be found in Appendix 1.

Figure 1-8: Eastbound Dwell Times

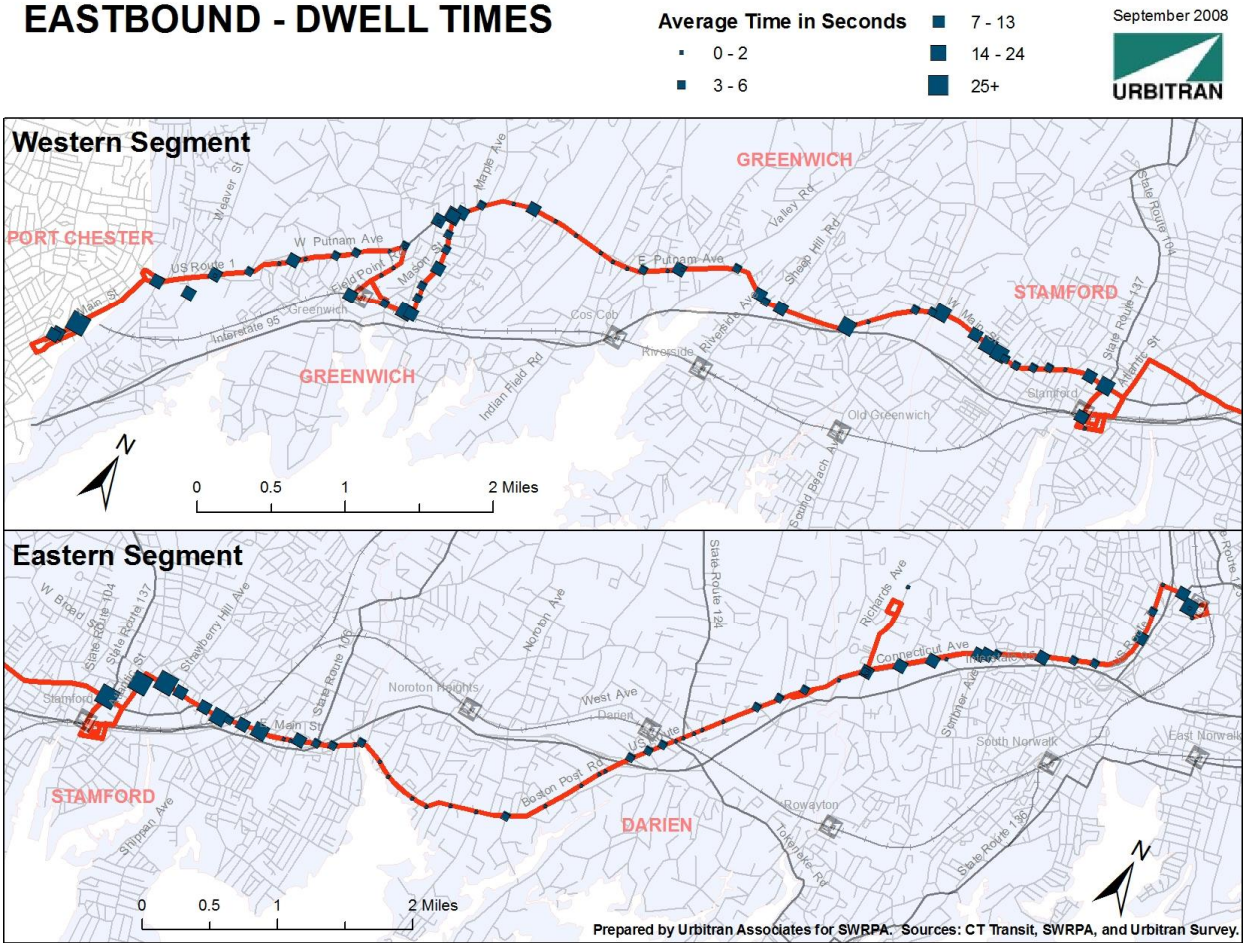
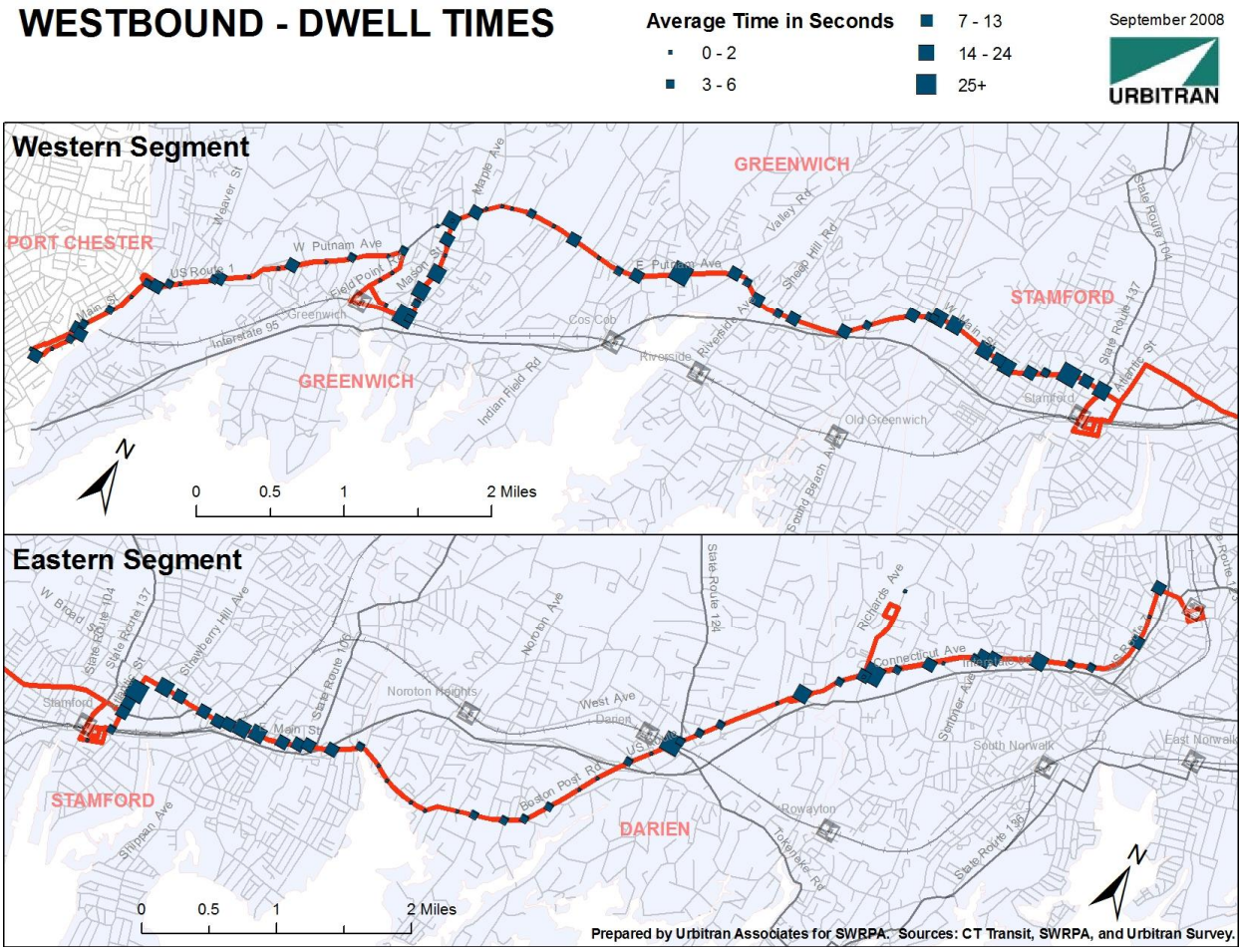


Figure 1-9: Westbound Dwell Times



1.4 On/Off Counts, Load Factors, and Other Observations

On/off counts were provided by CT Transit, taken over the course of two years (April 24, 2006 to April 24, 2008). This data was used to determine ridership, including major boarding locations, to create maps showing ridership along Routes 11 and 41 in each direction, and to examine load factors. Surveys and observations conducted by Urbitran in May 2008 were used to examine on-time performance and bus stop amenities.

1.4.1 Ridership

The bus stops with the top ten ridership levels, including both boardings and alightings, were found by ranking the ridership numbers provided by CT Transit. As the following table demonstrates, peak ridership was very similar in both directions. On Route 11, the stops with the heaviest ridership were the origin and terminus of the route as well as the Greenwich rail

station. On Route 41, the origin and terminus of the route, as well as some stops along U.S. Route 1 in Norwalk and downtown Stamford had the heaviest ridership. Table 1-14 shows total ridership numbers for Routes 11 and 41 in each direction. It should be noted that Route 11A represents the closest approximation to the proposed BRT corridor, traveling along U.S. Route 1 from Stamford to Port Chester. Route 11B travels along U.S. Route 1 only for the Stamford to Greenwich segment, following a different routing from Greenwich to Port Chester via Byram.

Table 1-14: Total Ridership for Routes 11 and 41

Route	Weekday Passengers	Saturday Passengers	Sunday Passengers
Route 11A Eastbound	476	283	192
Route 11A Westbound	547	290	193
Route 11B Eastbound	692	377	177
Route 11B Westbound	662	369	229
Route 41 Eastbound	1440	1180	567
Route 41 Westbound	1509	1116	569

Source: CT Transit, April 2008

Table 1-15 shows the stops with the greatest number of boardings and alightings for Routes 11 and 41 (combined) in both the eastbound and westbound directions. The full breakdown of ridership by stop for each route in each direction can be found in the Appendix 1, as well as charts showing boarding and alighting activity at each stop.

Table 1-15: Busiest 10 Stop Locations, Eastbound and Westbound

Eastbound	Average Weekday Total Activity	Westbound	Average Weekday Total Activity
1. Stamford Transportation Center (Stamford)	514	1. Stamford Transportation Center (Stamford)	601
2. North Main Street & Westchester Avenue (Port Chester)	427	2. WHEELS Hub (Norwalk)	439
3. Atlantic Street & Main Street (Stamford)	375	3. Atlantic Street & Main Street (Stamford)	272
4. Belden Avenue & Burnell Boulevard (Norwalk)	224	4. Broad Street & Greyrock Place (Stamford)	259
5. East Main Street & Lockwood Avenue (Stamford)	171	5. North Main Street & Westchester Avenue (Port Chester)	208
6. WHEELS Hub (Norwalk)	165	6. Connecticut Avenue & Wal-Mart (Norwalk)	138
7. Broad Street & Greyrock Place (Stamford)	137	7. Greenwich Rail Station (Greenwich)	131
8. Greenwich Rail Station (Greenwich)	125	8. East Main Street & Lockwood Avenue (Stamford)	130
9. Washington Boulevard & Tresser Boulevard (Stamford)	124	9. East Main Street & Myrtle Avenue (Stamford)	120
10. Connecticut Avenue & Taylor Avenue (Norwalk)	105	10. Richards Avenue & NCC West Campus (Norwalk)	109

Source: CT Transit, April 2008

The following maps further illustrate the similarities between eastbound and westbound ridership patterns, and add detail to where ridership occurred beyond the bus stops with the greatest ridership counts. Also noticeable on the maps is the dearth of ridership throughout Byram, Darien, and Noroton Heights.

Figure 1-10: Eastbound Ridership Activity

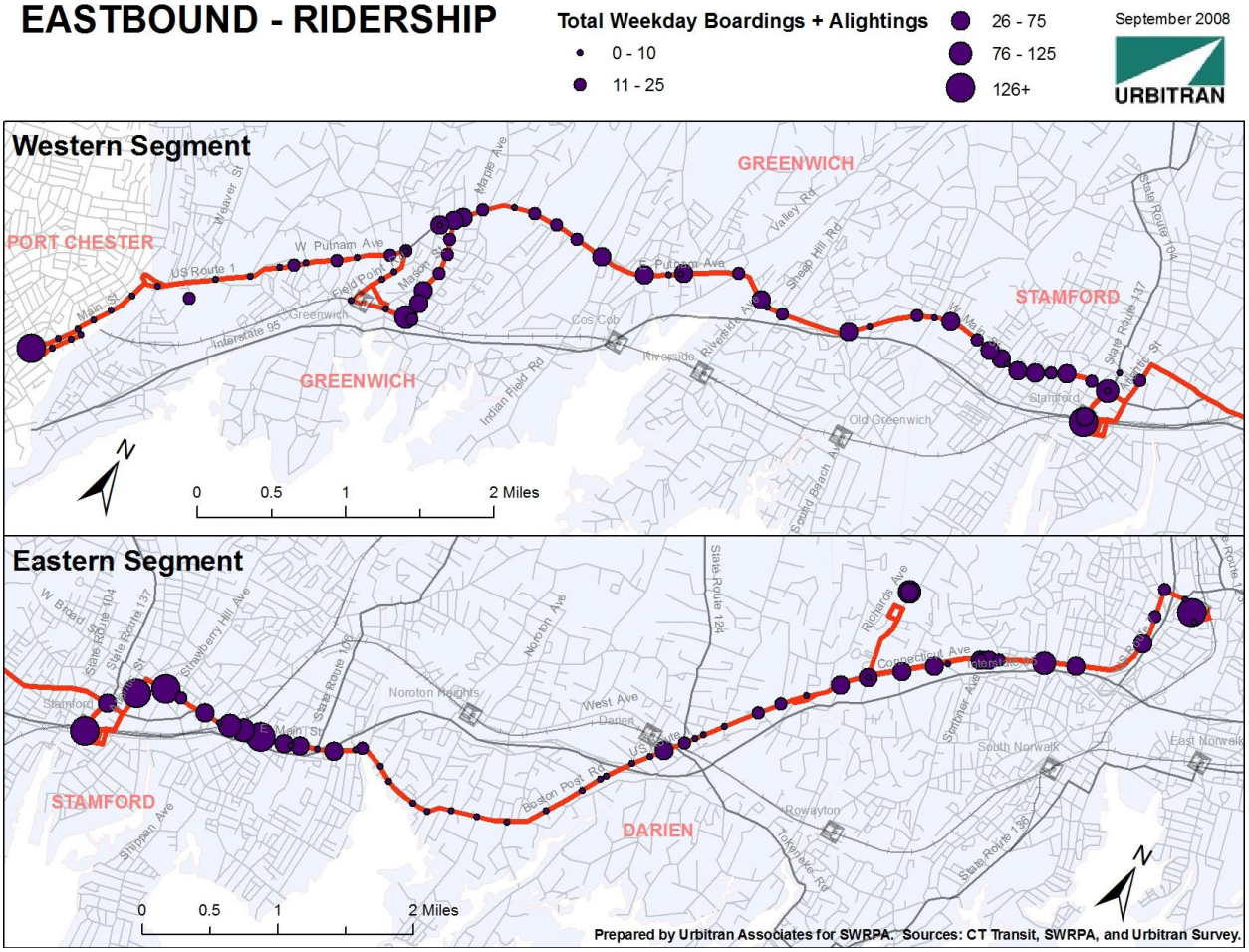
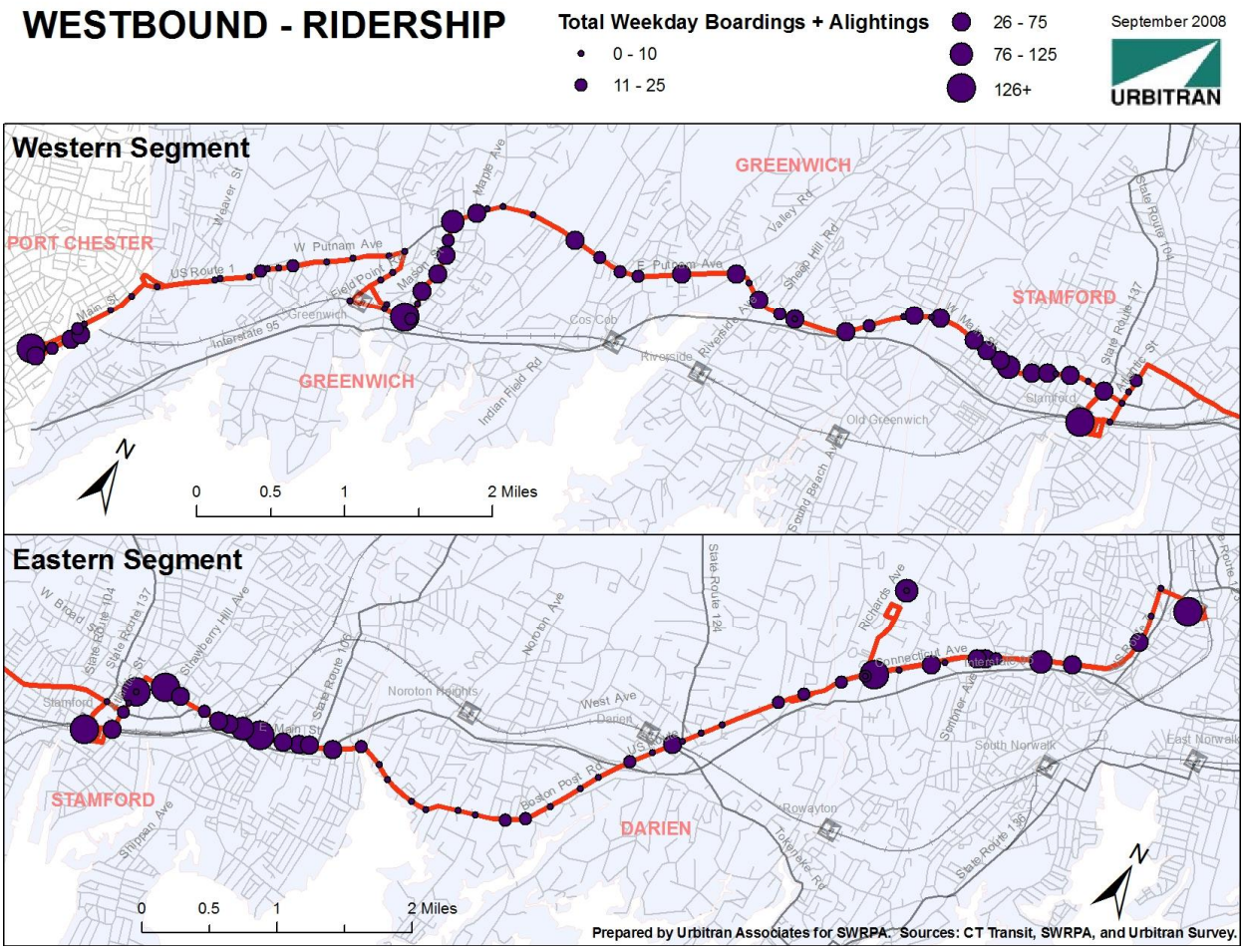


Figure 1-11: Westbound Ridership Activity



1.4.2 Load Factors and Maximum Load Points

Load factors were examined from the CT Transit ridership data. These data demonstrated that only one trip on Routes 41 and 11 combined exceeded 40 passengers – the 6:27 AM eastbound trip on Route 41 had 44 passengers. Only one trip on Route 11, the 7:03 AM eastbound trip, reached 40 passengers. A majority of trips were well below the vehicle capacity of 36. It should be noted that a few trips during the May 2008 Urbitran survey exceeded these numbers, particularly during the AM Peak period on Route 41, when over 50 passengers were observed on the bus on one eastbound trip.

Maximum load points for Route 41 generally occurred along Broad Street or East Main Street in Stamford at all times, except in the westbound direction during PM Peak when they often occurred in Darien. For Route 11 eastbound, maximum load points tended to occur in western Greenwich and Port Chester during the morning, and shifted to eastern Greenwich and Stamford in the afternoon. Conversely, maximum load points for Route 11 westbound tended

to occur in western Stamford during the morning, and in central and western Greenwich in the afternoon.

1.4.3 On-Time Performance

In order to determine on-time performance, scheduled running times were compared to actual running times recorded during Urbitran's survey in May 2008. Running time was defined as the total amount of time from when the bus pulled away from the first (terminal) stop along the route – the WHEELS Hub in Norwalk, the Stamford Transportation Center, or the corner of Westchester Avenue and North Main Street in Port Chester – to the time when all passengers had exited the bus at the end of the route. "On-time" was considered to be an actual running time that neither exceeded five minutes more than the scheduled running time (late), nor was shorter than the scheduled running time (early).

Of the surveyed trips, Route 41 was found to be on time 45% of the time in the eastbound direction and 35% of the time in the westbound direction. While a few trips were not on time due to lateness, a majority of trips not considered to be on time were due to actual running times that were shorter than the scheduled running times, meaning the bus was running early. For Route 11, 22% of the eastbound surveyed trips and 75% of the westbound surveyed trips were considered to be on time. As with Route 41, most of the trips that were not on time were due to running early, rather than late. This comparison can be found in the appendix of this memorandum. Scheduled and actual running times for each surveyed trip can be found in the Appendix 1.

1.5 Development in Study Corridor

An important underpinning of the need for enhanced bus services in the U.S. Route 1 corridor is a variety of newly completed development and projects coming on line that will support ridership and potentially provide access to new markets. Marketing services to new residents or employees in the corridor who may not be accustomed to using public transportation will encourage transit use before new commuting patterns are set and automobile use becomes a de-facto decision.

Development projects in a range of scales are underway and planned in the three corridor communities, summarized below.

1.5.1 Stamford

East of downtown Stamford, several new residential complexes have come on line or are nearing completion. The Glenview House (East Main Street and Glenbrook Road) is a condominium development featuring 142 units (10% affordable housing) and 14,000 square

feet of neighborhood retail. Nearby, the East Side Commons development offers more condominiums in the East Main Street corridor between Lafayette Street and Quintard Terrace.

The Trump Parc Tower is scheduled to open in Stamford in Spring of 2009. This 34-story high rise condominium development features 170 dwelling units located at the corner of Broad and Washington Streets, across from the University of Connecticut Stamford campus. Also downtown, the Park Square West development is opening in several phases and will eventually feature 558 apartment units and neighborhood retail on Summer Street between Main and Broad Streets.

1.5.2 Darien

Recent development has come on line in the vicinity of the Darien railroad station. Continued redevelopment in downtown Darien focuses on mixed uses to combine residential and commercial/office space, much of which is within a short distance from the Darien railroad station. Over 70,000 square feet of new retail and commercial uses have opened on Boston Post Road since 2007, with a number of retail and mixed use projects planned in the next five years.

1.5.3 Norwalk

Norwalk redevelopment efforts will bring new residential and commercial projects to the WHEELS Hub area, including 300 apartment units and mixed use development under construction at the Avalon site adjacent to Burnell Bouelvard and Belden Avenue, and residential and retail developments on Isaac Street and Wall Street.

Another major development in progress in Norwalk, the District 95/7 SoNo project, is expected to bring 1 million square feet of mixed residential, office, retail, and hotel space to a 12 acre site at the junction of I-95 and U.S. Route 7 and adjacent to the Norwalk Harbor and historic South Norwalk. This development is among the primary factors for the proposed routing of EBS and local Route 41 services via West Avenue, Reed Street, and Fairfield Avenue between the Norwalk WHEELS Hub and U.S. Route 1/Connecticut Avenue. The West Avenue alignment would provide service directly to this development which will bring substantial residential and commercial activity to the area between the WHEELS Hub and South Norwalk. Pending construction of this property, however, the EBS will continue to follow the current CT Transit Route 41 alignment. A summary of recent and planned developments in the corridor is provided in Table 1-16.

Table 1-16: Development in Corridor – Current and Anticipated Projects

Name/Location	Project Type	Completion	Square Feet (office/retail)	Residential Units
Norwalk - Current				
AvalonBay Communities 24 Belden Ave	Mixed use	Scheduled 2010	5,000 sq. ft. new retail	312
Pepperidge Farms 595 Westport Ave	Mixed use	Scheduled Fall 2009	100,000 sq. ft. corporate office	235
JER Realty 360 Westport Ave	Mixed use	2008	2,000 sq. ft. retail	10
12 Willard Rd	Multi-family	2008		14
CVS 6 Willard Rd	New retail store	2008	12,900 sq. ft. retail	
HSBC Bank 310 Connecticut Ave	New bank	2008	3,000 sq. ft. bank	
Stew Leonard's 100 Westport Ave	Retail addition to existing store	2010	16,000 sq. ft. addition	
Health Club 770 Connecticut Ave	Addition and conversion from mfg./office	2010	26,200 sq. ft. health club, 5,000 sq. ft. office	
Wendy's 149 Westport Ave	New restaurant	2010	3,000 sq. ft. restaurant	
Norwalk – Next 5 Years				
Former Translux Richards Ave	Office addition	2012	17,962 sq. ft. office addition, 116,000 sq. ft. mfg. conv.	
American Cancer Society Richards Ave	New office	2012	13,350 sq. ft. office	
Lillian August 32 Knight St	Residential addition to existing retail	2015		100
Darien - Current				
TD Bank 55 Post Rd	Bank	2008	4,100 sq. ft. bank	
HSBC Bank 151-165 Boston Post Rd	Bank	2007	4,000 sq. ft. bank	
Fairfield County Bank 714 Boston Post Rd	Bank	2007	4,350 sq. ft. bank	
Bruegger's Bagels 800 Boston Post Rd	Retail	2008		
979-987, 995 Boston Post Rd	Mixed use	2008	32,000 sq. ft. retail, restaurant, office	
1020 Boston Post Rd	Mixed use	2008	30,000 sq. ft. retail, restaurant, office	6
1063 Boston Post Rd	Retail	2006		
1441 Boston Post Rd	Municipal	2009	54,000 sq. ft. library	
Darien – Next 5 Years				
71 Boston Post Rd	Food retail	2009	3,000 sq. ft. food service	1
13 Grove St, 1015 Post Rd	Mixed use/residential	TBD	5,500 sq. ft.	6
2 Squab La	Mixed use	2010	11,500 sq. ft.	
17 Old Kings Hwy N	Retail/office	2010	18,800 sq. ft. retail, office	
150 Ledge Rd	Retail	2011	50,000 sq. ft. grocery store	
35 Leroy Ave	Residential	2012		21
1292 Boston Post Rd	Office/commercial	TBD	TBD	
Stamford - Current				
Glenview House East Main St	Mixed use	2009	14,000 sq. ft. retail	142
East Side Commons East Main St	Residential	2009		
Trump Parc Tower Broad St		2009		170
Park Square West Summer St	Residential			558

Sources: City of Norwalk, Town of Darien 2009

Section 2 – Public Outreach

The Greenwich/Norwalk Bus Rapid Transit Study featured several public outreach components, including public information sessions, non-user surveys sent to employers along the corridor, stakeholder and technical advisory committees, as well as stakeholder interviews. Rider opinion surveys or "on-board surveys" were not conducted, and previous rider surveys were considered to be too out of date to include in this analysis; CT Transit does not conduct rider surveys at all, and Norwalk Transit District's most recent rider surveys were conducted in 1998. Prior to 1998, NTD administered biannual rider surveys, but these were discontinued due to repeatedly receiving the same results.

2.1 Non-User Survey Results

Non-user surveys seek to determine potential and underserved transit markets. They are distributed to individuals living or working in a certain area in order to determine commuting habits and the willingness of individuals to consider other modes, such as bus or rail. The following survey was distributed among employers along the U.S. Route 1 corridor in order to reach individuals who would use the corridor for their commutes.

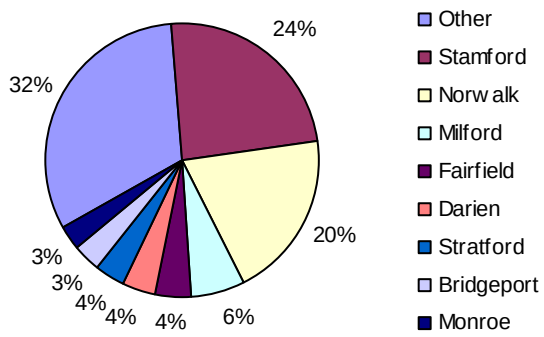
2.1.1 Survey Methodology

This survey was conducted using a web-based survey instrument, seeking to better understand the commutes of workers along the U.S. Route 1 corridor and to gauge their interest in a BRT service. It was distributed through The Business Council of Fairfield County and SWRPA to employers of various sizes along the U.S. Route 1 corridor (not including Port Chester or Greenwich) using the web instrument. Additional efforts by SWRPA ensured the participation of major employers such as Priceline.com and the City of Stamford. In total, 304 surveys were collected between May 27th and July 4th. A copy of the survey can be found in the Appendix 2.

2.1.2 Survey Respondents

The majority of survey respondents commuted from Connecticut (88%), with Stamford, Norwalk, and Milford making up the top three places of residency within that state (see Figure 1-4). Additionally, a large group of survey respondents commuted from New York (11%), and a small portion from New Jersey (1%). Over 90% of respondents lived within three counties: Fairfield County, New Haven County, and Westchester County (New York). Figure 2-1 shows the places of residency of respondents from Connecticut, and the proportion of respondents from each location. It should be noted that there were no responses from workplaces in Darien.

Figure 2-1: Respondents from Connecticut



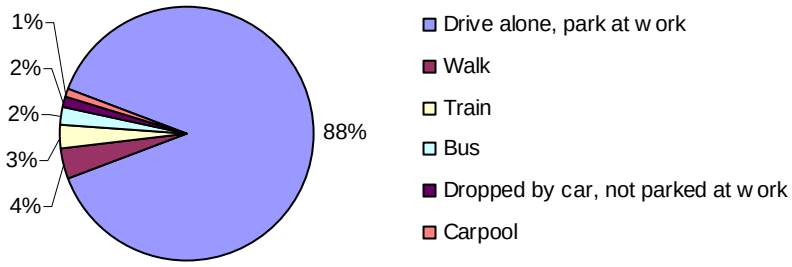
Source: Urbitran Non-User Survey, May – July 2008

Of all respondents, 25% commuted to Norwalk and 75% commuted to Stamford. Purdue Pharma in Stamford represented the largest portion of survey respondents, followed by Priceline.com in Norwalk and City of Stamford employees at the Stamford Government Center.

2.1.3 Daily Commute

Overall average commute time was 21 minutes. The majority of respondents drove alone to work and parked at their place of work. The second most commonly used mode was walking. Also of note, only 3% of commuters took the train, compared to 25% of overall survey respondents. Figure 2-2 shows the mode that survey respondents used to travel from their homes to their places of work.

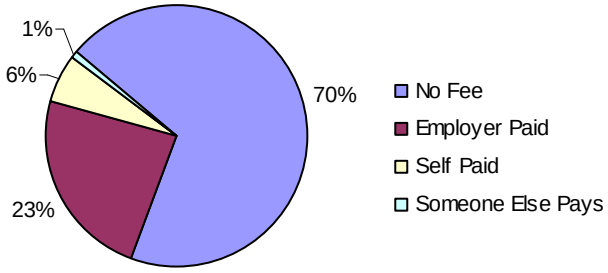
Figure 2-2: Mode to Work



Source: Urbitran Non-User Survey, May – July 2008

Of those who drove to work and parked at their place of work, over 90% did not pay for parking either because there was no fee, their employer paid their parking fee, or someone else paid for their parking. Figure 2-3 shows survey respondents' method of payment for parking at their places of work.

Figure 2-3: Parking Fee Payment



Source: Urbitran Non-User Survey, May – July 2008

Respondents tended to leave their homes between 6:30 AM and 9:30 AM, (Figure 2-4), and leave work between 4:00 PM and 7:00 PM (see Figure 2-5).

Figure 2-4: Times Respondents Left Their Homes

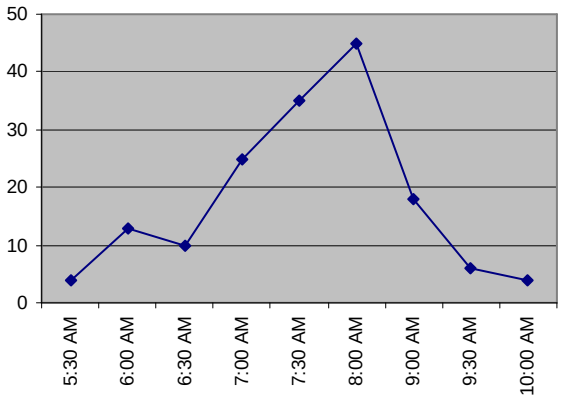
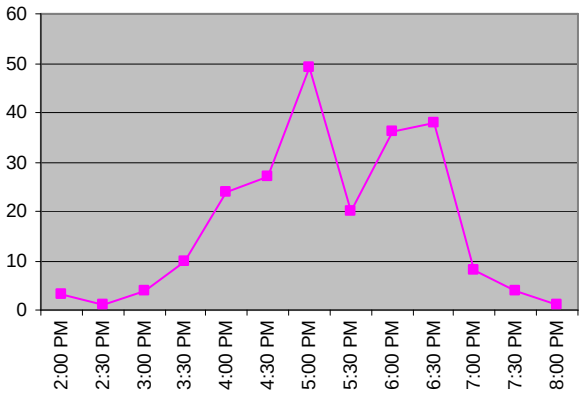


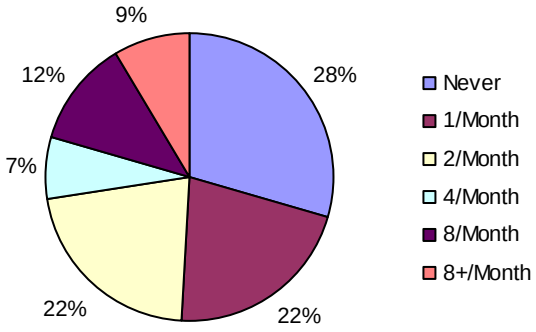
Figure 2-5: Times Respondents Left Work



Source: Urbitran Non-User Survey, May – July 2008

Across all modes of travel about half of respondents were late one or fewer times a month due to congestion; 26% of respondents were late more than twice per month. Delays per month increased with leave for work time starting at 6:00AM, and then decreased after 9:30AM. Figure 2-6 shows the typical number of delays per month respondents experienced on their way to work in the morning.

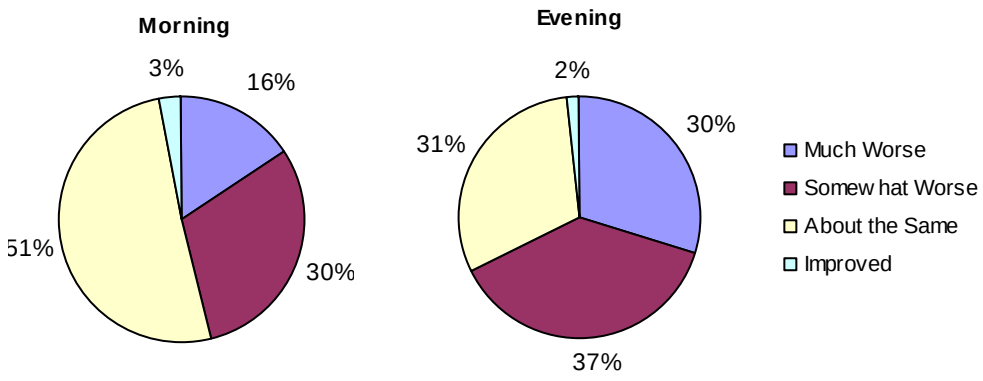
Figure 2-6: Delays per Month



Source: Urbitran Non-User Survey, May – July 2008

Generally respondents felt neutral or positively about their commute with 84% believing that their commute was average or better. However, 68% of respondents felt that over the past five years the evening commute had gotten worse and 48% of respondents felt the morning commute had gotten worse. Figure 2-7 shows the proportion of respondents that felt their commutes had improved, were about the same, were somewhat worse, or were much worse than they were five years ago, broken down into morning and evening commutes.

Figure 2-7: Commute Quality Over Five Years



Source: Urbitran Non-User Survey, May – July 2008

2.1.4 Public Transportation Use

Only three respondents used the bus to get to and from work. All three users rode on CT Transit routes and rated their commute as average or better than average. Bus riders used two or more buses to get to and from work, but reported that they were late no more than twice per month.

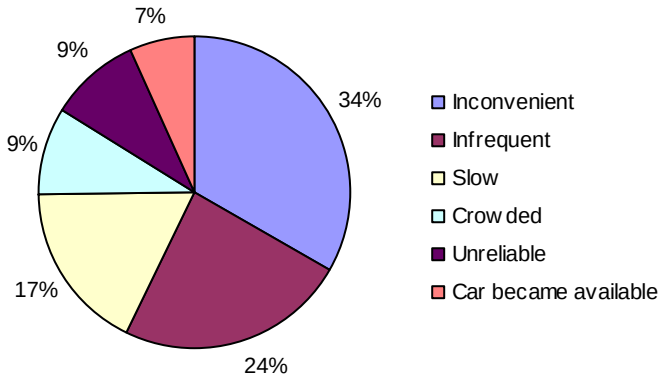
Only four respondents used the train to get to and from work. All four took the train to Stamford from stations east of Stamford. It took rail riders 5 to 30 minutes to get from their home to the train station; half of riders walked to the station and half drove and parked at the station. Upon arriving at their destination, three respondents were picked up by a company vehicle and one walked. It took them 5 to 15 minutes to get from the station to work. Three out of four respondents stated that they might consider using a bus for their trip, provided that certain improvements were made.

Although over 90% of respondents got to work by car, 53% recognized that public transportation was available between their home and workplace. An additional 29% of respondents were not aware of public transportation options and could not state whether or not transit was available for their daily commute.

Ten percent of respondents have used public transportation for their commute in the past; the majority of them did so for less than six months. Most cited general inconvenience of use, infrequent service, or slow commute time as their reason for discontinuing use of public transportation. Some respondents noted that a car became necessary because of off-site work meetings or the need to make family-related trips while going to/from work. Figure 2-8 shows

the breakdown of reasons that respondents cited for discontinuing their use of public transportation for commuting.

Figure 2-8: Reason for Discontinuing Use of Public Transit for Commutes

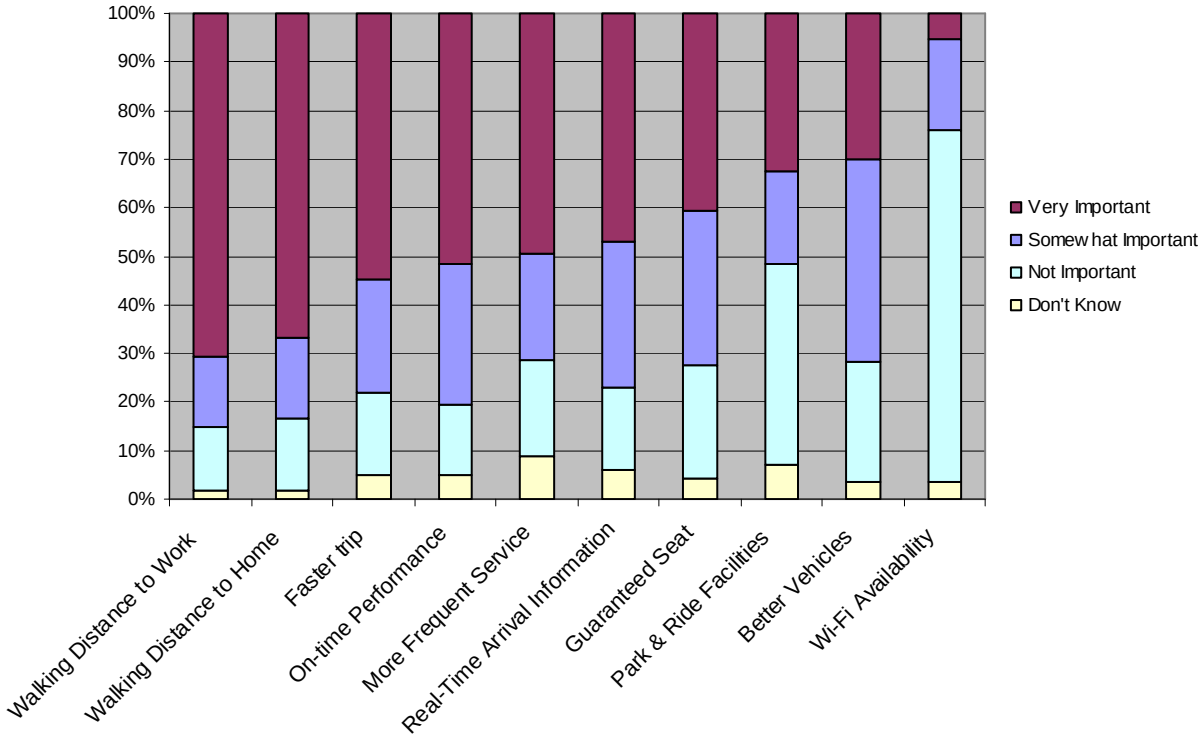


Source: Urbitran Non-User Survey, May – July 2008

2.1.5 Bus Service Priorities

When asked which factors or improvements were important in deciding to use bus service, proximity to the bus stop from home and work emerged as most significant factors. Speed of service and on-time performance were also high priorities for respondents. Figure 2-9 shows the importance of various bus service improvements to respondents.

Figure 2-9: Importance of Various Bus Service Improvements



Source: Urbitran Non-User Survey, May – July 2008

2.1.6 Improvement Options

Respondents were also asked to rate their likeliness to use a bus for their commutes given five different improvement options. While 2% of respondents currently used the bus, over 20% of respondents said they would be likely to use the initial option of general service improvements. Option 5, with the greatest amount of improvements, was ultimately the most attractive with over 35% of respondents claiming to be likely to use it. Across the five options over 10% of respondents consistently stated that they would never use the service.

While respondents rated proximity to work and home as the most important bus service improvements, the addition of park & ride facilities did not have a dramatic impact on their likeliness to use the improved bus service. Figure 2-10 on the following page shows respondents' likeliness to use a bus service based on the five above options.

Option 1 – General Service Improvements

- Service Frequency: Every 20 minutes in peak periods
- Travel Time: 46 minutes between Norwalk and Stamford
  25 minutes between Greenwich and Stamford
- Seating: Comfortable and guaranteed
- Infrastructure: Sheltered stops
- Information: Maps and real-time arrival information
- Fares: Similar to local service

Option 2 – Faster and More Reliable – same as above plus:

- Travel Time: 40 minutes between Norwalk and Stamford
  20 minutes between Greenwich and Stamford
- Performance: On time 90% of the time

Option 3 – Park & Ride Facilities - same as above plus:

- Park & Ride: Facilities at several stops

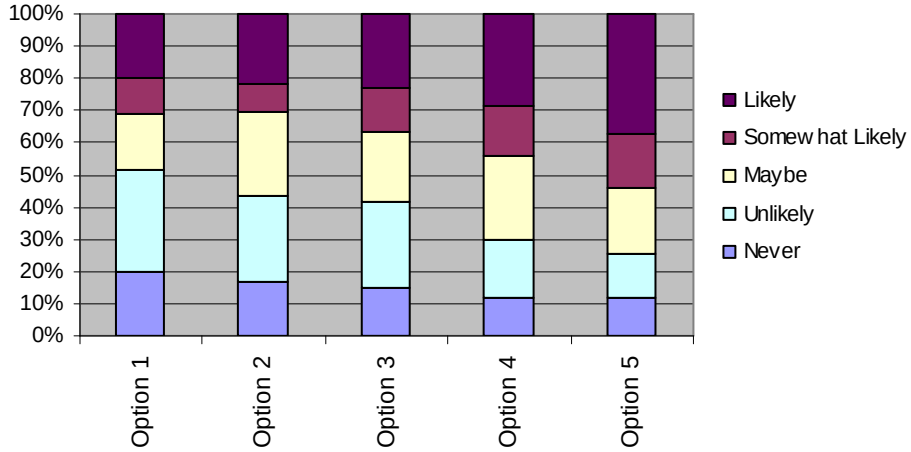
Option 4 – Even Faster and More Reliable - same as above plus:

- Travel Time: 30 minutes to Norwalk, 20 to Greenwich
- Performance: On time 95% of the time

Option 5 – Greater Frequency - same as above plus:

- Service Frequency: Every 10 minutes in peak periods

Figure 2-10: Likeliness to Use Bus Service Based On Improvement Options 1 - 5



Source: Urbitran Non-User Survey, May – July 2008

2.1.7 Comments

In addition to taking the time to answer the survey's questions, about 25% of respondents also made additional comments. Many chose to address some of the issues that prevented them from taking the bus or stated specifically which circumstances would allow them to use the service. One of the most common comments was from people who would like to use the service, but live either further east or north of the corridor. These individuals would consider using a service that either extended towards New Haven or towards Danbury.

The need to use personal vehicles for child care and work-related trips was not addressed in the survey, and many respondents pointed out that this poses a barrier to relying on public transportation. Another point made in the comment section was that the buses should have bicycle racks (all CT Transit buses currently contain bike racks on the front grille).

Others emphasized what the survey results showed; proximity to the bus stop is very important:

> *"Availability to nearest possible location to work and home is very important for me. Even if I get to the stop using the car near home, the other end should be close to work."*

Related to this point, some flatly stated that if the trip took longer than by car or train they would not have an incentive to use it:

> *"As much as I would like to do my part in helping the environment, the time I save is more important to me."*

Some respondents used the comment space to give praise for the idea:

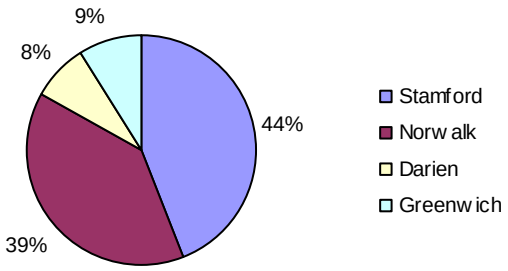
> *"If it was there for us to use I would use this service every day and night. I hope you can make this happen from Norwalk to Stamford and back. Thanks."*

2.1.8 Survey Sample

Because the aim of the survey was to gather information from potential riders, respondents who lived outside of the study corridor were not included in the final survey analysis. Corridor towns include: Darien, Greenwich, Norwalk, and Stamford. By filtering the responses, the commute patterns and preferences that were observed had a greater relevancy to the study. In total, 132 respondents lived in towns through which the corridor runs; the breakdown of these residents by town is shown in Figure 2-11. From this point forward, all survey findings reflect the information provided by these 132 respondents. While respondents represented a variety of

employers, 52% of respondents were from a single employer, Purdue Pharma in downtown Stamford. Additionally, there were no participating employers in Darien or Greenwich.

Figure 2-11: Respondents Living in Corridor Towns



Source: Urbitran Non-User Survey, May – July 2008

The majority of respondents (83%) commuted to Stamford. No responses were received from employees working in locations other than Stamford or Norwalk.

2.2 Stakeholder Interviews

As part of the study outreach program, the consultant team conducted a number of interviews with local and regional stakeholders. These meetings allowed representatives from municipal, business, and civic organizations to provide input on transportation needs in the study area and the Bus Rapid Transit service concept in the U.S. Route 1 corridor.

All of the interviews were conducted with the understanding that the comments made by individuals would be kept in confidence by the consulting team and only used to create a summary of findings based on input from all participants. This protocol encouraged greater candor during the interview process and ultimately allows for more valuable, productive input from the stakeholders.

Representatives were interviewed from the following organizations:

Town of Greenwich
Greenwich Chamber of Commerce
City of Stamford
University of Connecticut Stamford
Town of Darien
Darien Chamber of Commerce
City of Norwalk
Norwalk Chamber of Commerce
Norwalk Community College
Priceline.com
South Western Regional Planning Agency
Connecticut Dept. of Transportation

2.2.1 Regional Transportation and Employment Needs

Commuting patterns and markets vary throughout the U.S. Route 1 corridor. Stamford serves as the central anchor, while several employment concentrations exist throughout the corridor between Greenwich and Norwalk. Furthermore, smaller employers line the corridor throughout most of its length, with the exception of more residential areas between towns.

A majority of employees working in the more suburban segments of the corridor drive to work, as parking is readily available at most office complexes and many workers also live in towns north of the study area from which bus and rail connections are not readily available. This information was evident in responses to the commuter survey distributed to corridor employers and reinforced by stakeholders during the interview process.

The high cost of housing in the study area was frequently mentioned in stakeholder interviews as a primary contributing factor to longer commutes and employees traveling to the corridor from points north and east. For certain segments of the job market, a disconnect exists between wages of service sector and entry level jobs and the cost of living close to those jobs.

At present, public and private shuttle buses serve a number of employers situated along the corridor and outside of walking distance from the Metro-North Rail stations. Public shuttles include the Commuter Connection route from the Greenwich rail station, while private shuttles are operated by individual employers, office complex management companies, or educational institutions such as the University of Connecticut in Stamford.

These shuttle services may duplicate existing local bus services, yet they are seen as more desirable to employers and employees, and are often considered an amenity of a business development. Marketing of new transit services will be important if the goal is to attract riders who currently use these shuttles. However, since most are oriented around rail stations and train commuters, the target market for enhanced bus service along the U.S. Route 1 corridor will be different.

For many stakeholders, important transportation connections to be made are from points east and north, in particular the Super 7 interchange at the Merritt Parkway, as well as service to and from Fairfield and Bridgeport. These connections could be considered for initial implementation or for a subsequent phase of bus rapid transit study in the region. Some interviewees voiced concern that the Greenwich/Port Chester to Norwalk corridor does not fully capture the regional commuting patterns and too closely parallels the Metro-North Railroad corridor.

2.2.2 Enhanced Bus Service Opportunities

Stakeholders cited a number of reasons for supporting bus rapid transit and other public transportation improvements. Regional traffic congestion was often the first factor mentioned

when discussing the opportunities for enhanced transit service in the corridor. Not only is peak hour traffic consistently heavy on I-95, even minor incidents on the highway can provoke traffic overload on local streets as commuters seek alternate routes. Furthermore, rising gas prices are now routinely mentioned as an impetus to consider alternative commuting choices.

Some physical improvements, including in particular signal timing and reconfiguration of traffic lanes at bottlenecks, are of interest if they can also help move all traffic and not just transit. For example, if right turn traffic approaching the Darien railroad underpass can be removed from the primary travel lane in conjunction with a bus queue jump, this would be more attractive to local constituents.

As a component of the enhanced bus service, park & ride development represents an additional enhancement that may draw a larger ridership of potential riders who live near the corridor but not necessarily within walking distance of a bus/EBS stop. In advance of a full evaluation of potential park & ride locations, stakeholders in Norwalk and Darien discussed the potential for such development.

In Norwalk, use of the Yankee Doodle garage across Burnell Boulevard from the WHEELS pulse point could provide BRT users with a parking option (possibly at a reduced fee) at the initial eastern anchor of the service. Mid-route, the Norwalk Community College, which relies heavily on student and employee use of bus service to access the campus, indicated a willingness to explore options such as an agreement that provides park & ride space on campus in return for increased transit service to NCC including dedicated shuttle services.

Finally, Darien representatives indicated that space for park & ride lots may be available if the town is able to acquire a private parking lot near the rail station. Otherwise, existing church parking lots near the corridor may represent a shorter term opportunity.

2.2.3 Perceived Obstacles

Some stakeholders expressed concern that a service along the U.S. Route 1 corridor may not sufficiently address the commuting needs of regional residents and employers, either because of longer commutes from areas north of the corridor, or a perceived lack of intra-corridor commuting patterns. The need to create new transit connections to Merritt 7 and to Fairfield and Bridgeport was cited frequently as a necessary extension of the U.S. Route 1 corridor as defined for this study.

A number of those stakeholders interviewed expressed doubt that a bus rapid transit service could effectively skirt the congestion issues that exist at key bottlenecks along the corridor. The assumption remains that buses will be stuck in the same traffic as cars, and thus will not be a viable alternative to choice riders who currently drive.

Concerning physical and infrastructure changes that could be made to the U.S. Route 1 corridor to accommodate enhanced bus service (and by extension, all transit) operations, opinions varied on the feasibility and attractiveness of the menu of improvements. Proposed traffic operations changes such as queue jumps, bus priority signal treatments, and signal improvements will be met with different levels of enthusiasm in different municipalities.

While specific proposals were not discussed with stakeholders, conceptual improvements such as the creation of bus lanes and queue jumps at key intersections were described to explain the potential of enhanced bus service. While concerns over local traffic congestion and travel times along the corridor were fairly consistent among all stakeholders, expectations of successful implementation of these conceptual BRT improvements did vary.

For example, potential for buy-in and cooperation from local businesses concerning on-street parking and traffic lane configurations may vary among municipalities. Some stakeholders expressed concern about limited parking availability for customers of local merchants, while others acknowledged that where off-street parking does exist, merchants may be more willing to compromise with changes to on-street parking in the immediate vicinity of their stores. Some concern was also expressed over the use of daily parking intended for commercial patrons by employees of local businesses. This represents a parking policy and enforcement issue as much as a capacity constraint.

2.2.4 Summary of Stakeholder Priorities

Stakeholders interviewed generally expressed support for the study of enhanced bus service in the U.S. Route 1 corridor. At the same time, certain perceived constraints were mentioned for consideration in the study effort.

- Identifying target ridership and extensive marketing are critical
- Focus on bus service enhancements as congestion reduction and alternative to driving and new parking construction
- New, higher density development in selected areas should be tied to transit improvements (e.g., residential development in Norwalk near pulse point)
- Important to demonstrate benefits to all traffic to sell transit-oriented improvements
- Look ahead to connections to Fairfield, Bridgeport, and Merritt 7, either in current study or as subsequent phase
- Phasing of implementation may allow for service improvements in short term and more advanced infrastructure changes in a second phase

Section 3 – Development of Alternatives

3.1 Justifications for Enhanced Bus Service

The background data and existing conditions analyzed in Section 1 – Baseline Conditions, as well as input from stakeholders and non-users in Section 2 – Public Participation, indicate that the justification for enhanced bus service (EBS) in the U.S. Route 1 corridor is based primarily on policy objectives rather than ridership and demand levels at present. The objectives that can be addressed through the design and implementation of EBS include:

- Improved bus service reliability and passenger comfort
- Traffic congestion mitigation
- Environmental benefits
    - Reduced vehicular emissions
    - Lessened dependence on single occupant vehicles
    - Support for responsible growth and transit oriented development (TOD) to curb sprawl
- Improved mobility and connectivity
- Support for economic development activities

Table 3-1 shows weekday ridership and average passenger loads by time period for the two primary services in the U.S. Route 1 corridor today: CT Transit Route 11A (Port Chester, NY to Stamford) and CT Transit Route 41 (Stamford to Norwalk). Ridership on Route 41 is substantially higher than Route 11A, although neither route appears to warrant a dramatic increase in service levels based on the average passenger loads. That being said, CT Transit has experienced steady ridership growth over each of the past five years and this growth is expected to continue.

Table 3-1: Average Daily Ridership by Time Period

Route/Direction	Period	Total Passengers	Average Maximum Load
Route 11A Eastbound	Morning (5:30 AM – 8:30 AM)	134	29.0
	Midday (8:30 AM – 2:30 PM)	138	17.0
	Afternoon (2:30 PM – 5:30 PM)	156	20.3
	Evening (5:30 PM – 5:30 AM)	48	15.0
	TOTAL	**476**	**20.2**
Route 11A Westbound	Morning (5:30 AM – 8:30 AM)	165	30.5
	Midday (8:30 AM – 2:30 PM)	197	19.2
	Afternoon (2:30 PM – 5:30 PM)	141	24.0
	Evening (5:30 PM – 5:30 AM)	44	32.0
	TOTAL	**547**	**24.4**
Route 41 Eastbound	Morning (5:30 AM – 8:30 AM)	396	26.3
	Midday (8:30 AM – 2:30 PM)	517	25.9
	Afternoon (2:30 PM – 5:30 PM)	291	24.6
	Evening (5:30 PM – 5:30 AM)	236	19.8
	TOTAL	**1440**	**24.5**
Route 41 Westbound	Morning (5:30 AM – 8:30 AM)	354	20.6
	Midday (8:30 AM – 2:30 PM)	508	20.4
	Afternoon (2:30 PM – 5:30 PM)	401	29.4
	Evening (5:30 PM – 5:30 AM)	246	16.7
	TOTAL	**1509**	**21.3**

Source: CT Transit Trip Summary Reports, April 2006 - April 2008

The transit alternatives outlined at this point do not recommend the service frequency of a typical bus rapid transit (BRT) system (10-15 minute headways), rather they are based on the provision of a number of other amenities associated with BRT, including:

- Appropriate span of service (hours of operation)
- Improved schedule reliability (transit signal priority, traffic and intersection improvements)
- Improved public information and facilities (real time schedule displays and other amenities)
- New vehicles with a specific service and brand identity

All of these amenities would be provided at a cost commensurate with the service provided. Furthermore, the South Western Region enhanced bus service (EBS) is designed as a supplemental overlay to the existing local bus services because ridership and passenger load factors indicate that a reduction in local service frequencies would be detrimental. In Norwalk, for example, Norwalk Transit District (NTD) is planning to increase its service frequency on several routes, including planned 20 minute headways on those with the highest ridership. Once implemented, this service increase would support future connections to EBS service between Norwalk and Stamford.

3.2 Design of Enhanced Bus Service

3.2.1 Defining the Corridor

Based on a review of ridership totals and ridership patterns on the existing CT Transit Route 11A and Route 41 services, the study team does not recommend implementing new enhanced bus services between Port Chester, NY and Stamford. Little ridership activity is seen between Port Chester and Greenwich and between Greenwich and Stamford. Significant ridership can be seen around Greenwich railroad station and in the Town of Greenwich, yet these trips are not through trips on the corridor and thus are well served by the existing bus and shuttle services: CT Transit's 11A and 11B services, and NTD-operated Commuter Connection shuttle services.

Table 3-2: Average Daily Ridership - CT Transit Routes 41 and 11

Route/Direction	Weekday Passengers	Saturday Passengers	Sunday Passengers
Route 11A Eastbound	476	283	192
Route 11A Westbound	547	290	193
Route 11B Eastbound	692	377	177
Route 11B Westbound	662	369	229
Route 41 Eastbound	1440	1180	567
Route 41 Westbound	1509	1116	569

Source: CT Transit Trip Summary Reports, April 2006 - April 2008

Considering the ridership numbers above, initial implementation of EBS elements in the U.S. Route 1 corridor is recommended for weekdays only between Stamford and Norwalk with endpoints at the Stamford Transportation Center and the Norwalk Wheels Pulse Point (transit hub). Weekend improvements would likely focus on greater frequency of the existing local services, consistent with NTD's recently implemented frequency improvements and shuttle network expansion. To the extent possible, EBS schedules would coordinate with NTD services in Norwalk to facilitate transfers between bus routes.

3.2.2 Proposed EBS Service Outline

While final operating plans are subject to refinement, conceptual EBS alternatives would be based on a number of assumptions and parameters. These parameters stem from analysis of current ridership patterns, anticipated market and usage, and policy considerations mentioned above.

- EBS Operates from 6am to 7pm on weekdays only
- EBS Operates on 15-20 minute headways during peak periods, 30 minutes off-peak
- Local bus operates current schedule, or improves based on passenger loads/running times
- Goal of three park & ride lots
  - Norwalk WHEELS Pulse Point (Yankee Doodle Garage)
  - Norwalk Community College (campus parking)
  - Noroton Heights (church parking lots as possibility)
- Integrates existing Norwalk Community College express trips (41BX) into EBS service (operating to NCC express via I-95 and returning to Stamford as EBS) using EBS vehicles
- After 7pm, local service operates current schedule (routing based on selected alternative)
- EBS bus layovers are taken in Norwalk (at WHEELS Hub)

3.2.3 Supporting Local Service Improvements

Several recommendations can be made with respect to the existing local bus services, both as part of a combined EBS/local service plan as well as in segments of the initial study corridor that are not found to warrant significant service increases. For example:

- CT Transit Route 11A operates directly from Port Chester to Stamford, bypassing the Greenwich railroad station
- Trip frequency is increased on CT Transit Route 41 (coordinated with EBS headways)
- Frequency and headway adjustments are made on local services to address heavier passenger loads

3.3 Service Alternatives

After reviewing existing services and ridership patterns, opportunities for time savings and access to new markets, and consideration of policy and operational concerns for a potential enhanced bus service, a basic service concept was developed for the U.S. Route 1 corridor between Stamford and Norwalk. The Stamford Transportation Center and Norwalk Wheels Hub would serve as the endpoint anchors for the EBS, which would be developed from the foundation provided by CT Transit's Route 41 bus schedule. While the basic corridor and route structure follows U.S. Route 1, several local variations were considered during the planning process for the enhanced bus service design, notably in Darien and Norwalk.

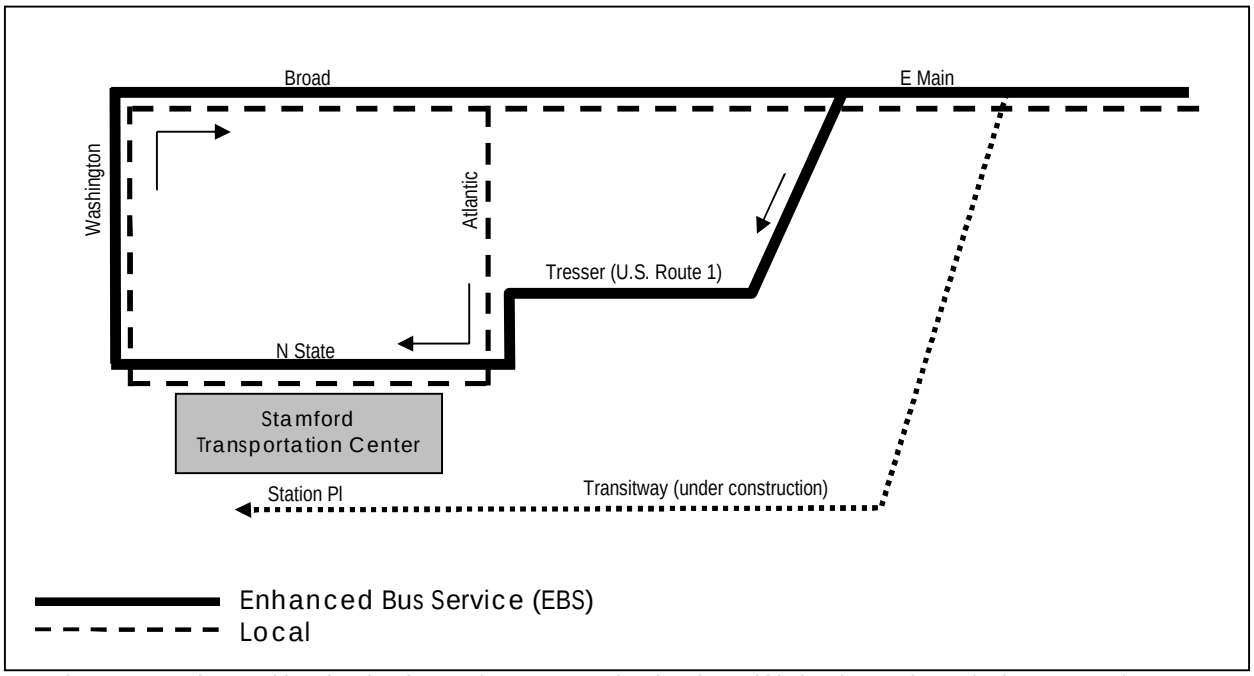
3.3.1 Stamford

<u>Option 1</u>

In Stamford, prior to full construction of the Urban Transitway (Phase 2 is anticipated to open in 2012), Tresser Boulevard (U.S. Route 1) is seen as the best connecting route between Broad Street/East Main Street and the Stamford Transportation Center. Providing enhanced bus service on Tresser Boulevard connects large employment sites with both the Transportation Center and

residential areas on the east side of Stamford and throughout the U.S. Route 1 corridor. CT Transit's Route 41 local route is among those slated to be rerouted along the Urban Transitway upon the opening of Phase 2 of the project, and as such this study would recommend revisiting the EBS routing and its relationship to local services in advance of this change, as appropriate.

Figure 3-1: Stamford EBS and Local Bus Routing



* EBS bus stop may be considered on local street (N State Street) rather than within bus lanes of Stamford Transportation Center

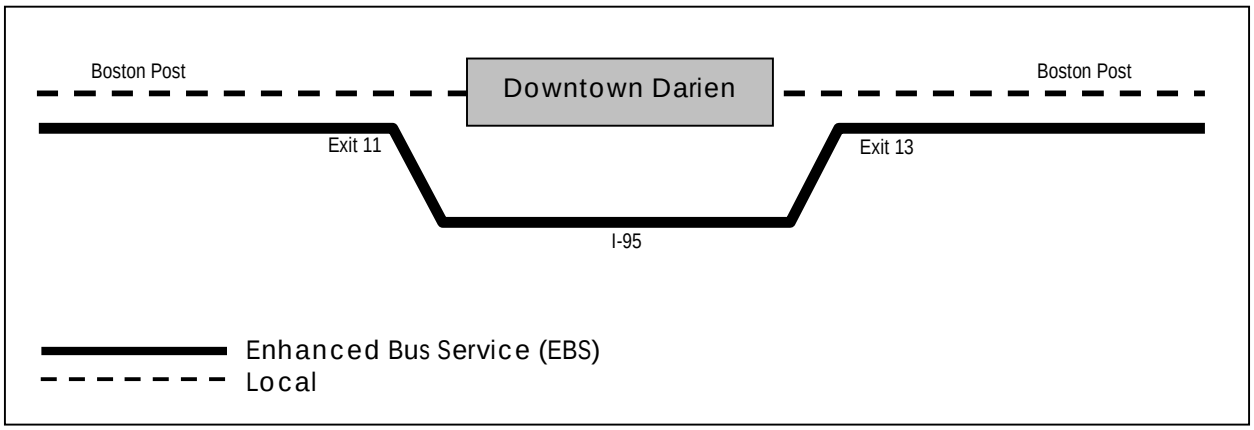
3.3.2 Darien

The primary consideration for EBS operating alignments in Darien is whether or not to serve downtown Darien on U.S. Route 1 (Boston Post Road) or bypass congestion downtown by using I-95 between Exits 11 and 13. If the Option 1 bypass were implemented and proven successful, subsequent phases could include consideration of a longer bypass between Exits 9 and 13.

Option 1

In Option 1, local services continue to operate as CT Transit Route 41 does today, serving downtown Darien via Boston Post Road. Enhanced bus service would bypass downtown Darien using I-95 between Exits 11 and 13.

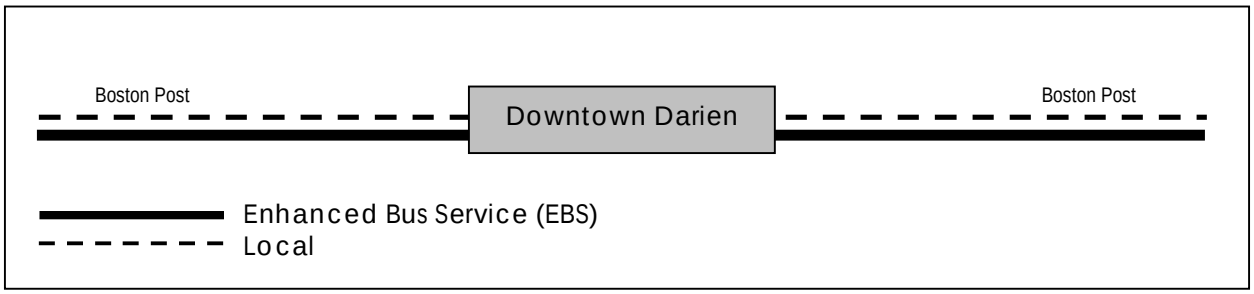
Figure 3-2: Darien EBS and Local Bus Routing (Option 1)



Option 2

In Option 2, both the EBS and local services follow Boston Post Road through downtown Darien. In this case, traffic improvements to assist in transit and traffic movement through Darien would be pursued, including queue bypass lanes approaching the railroad underpass.

Figure 3-3: Darien EBS and Local Bus Routing (Option 2)



3.3.3 Norwalk

Three service options are suggested for the eastern anchor of the corridor in Norwalk. A choice exists whether to shift the local and EBS routes to a new alignment to address current and planned development, to split the local and EBS to maximize coverage, or to follow current service alignments for both local and EBS services. These options may be considered temporally, expanding coverage and shifting to new markets as those developments come on line but beginning with maintenance of the existing service pattern.

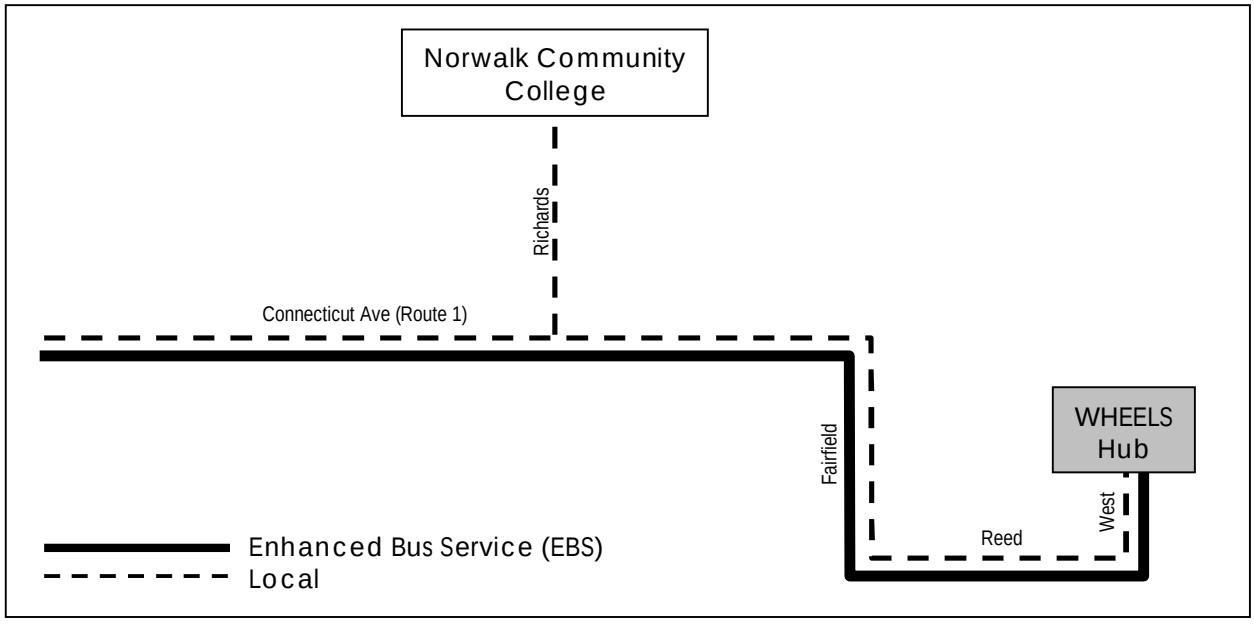
Option 1

With new residential and mixed use development planned and under construction along West Avenue in Norwalk, a realignment of the local CT Transit Route 41 service along with the

proposed EBS is suggested as an option between the Norwalk WHEELS Hub and U.S. Route 1 (Connecticut Avenue). This new alignment would use West Avenue, Reed Street, and Fairfield Avenue before rejoining Connecticut Avenue.

Customers currently using the CT Transit Route 41 service to reach Norwalk Hospital on Van Buren Avenue would have to transfer to Norwalk Transit District services to the hospital, either on Connecticut Avenue, or by traveling to the WHEELS Hub and making a transfer to an outbound NTD bus. Conversely, this new alignment would open up new ridership opportunities and, in the case of new development along West Avenue, would do so before new residents have established driving as their only means of travel.

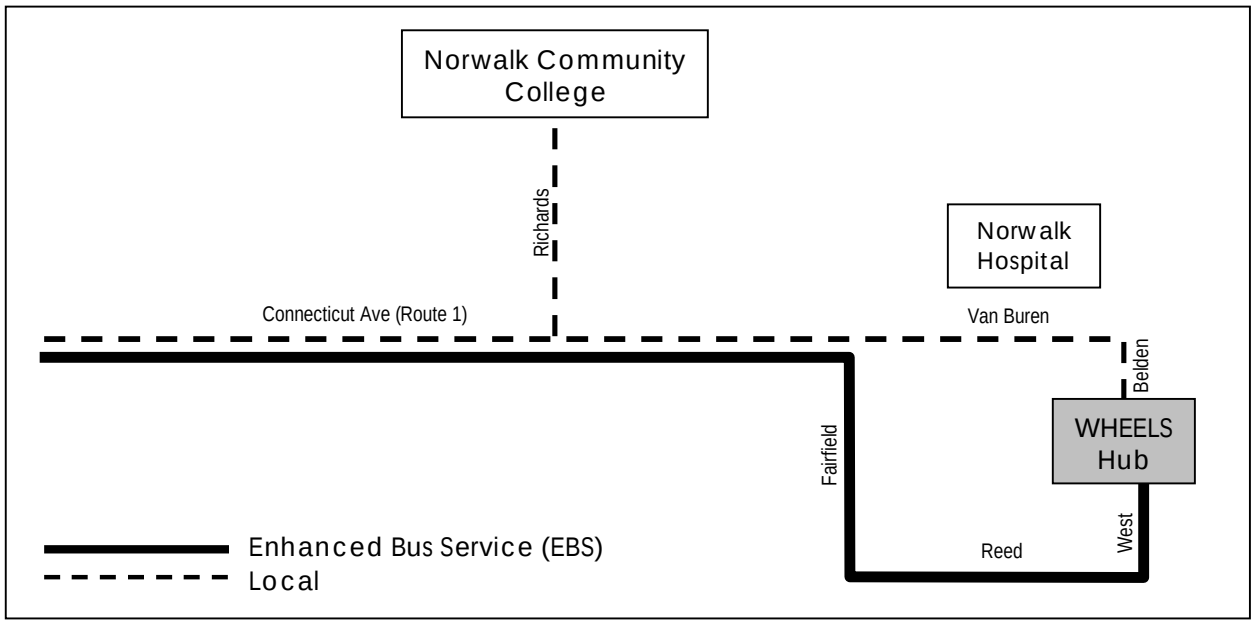
Figure 3-4: Norwalk EBS and Local Bus Routing (Option 1)



Option 2

In Option 2, the local CT Transit Route 41 service would operate is it currently does, via Van Buren Avenue and Belden Avenue to the WHEELS Hub, while new EBS would follow the West Avenue, Reed Street and Fairfield Avenue routing from the WHEELS Hub to Connecticut Avenue (Route 1). With this option, local service to Norwalk Hospital is maintained while new markets in Norwalk are served by the new EBS route.

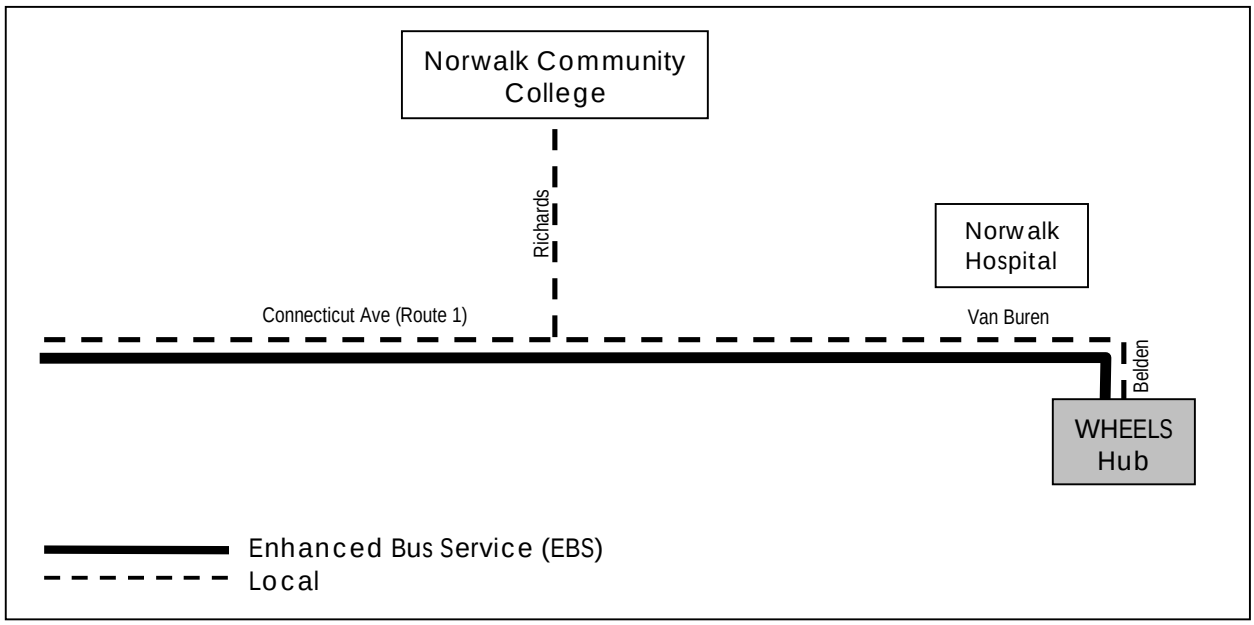
Figure 3-5: Norwalk EBS and Local Bus Routing (Option 2)



Option 3

Norwalk Option 3 represents continuity with existing services by having both the local and EBS follow the current Van Buren and Belden Avenue approach to the WHEELS Hub. This option could be presented as the initial service plan, while adjustments may be considered within the next 1-2 years as development on West Avenue is completed.

Figure 3-6: Norwalk EBS and Local Bus Routing (Option 3)



3.4 EBS Route and Service Variations

In addition to the variations on the EBS alignment presented above, service parameters were also considered in several additional configurations. For example:

- All-day EBS service: 6am-7pm
- Weekday peak period service only: 6-9am, 4-7pm
- 15-20 minute EBS headways all day
- 15-20 minute peak period EBS headways; 30 minute off-peak headways

3.5 How a U.S. Route 1 EBS Compares to Other Modes

A preliminary comparison can be drawn between the conceptual enhanced bus service and existing modes that accommodate similar trips within the corridor and study area. The goal of a new bus service developed in this study is to provide trip times that are competitive with other modes, including the private automobile, which is generally recognized to be the fastest mode if no significant time is required for parking at the destination end.

Estimated travel times of approximately 38 minutes one way for the EBS concept alternatives compare well with rail travel (particularly if users require additional time to reach stations and destinations) and are favorable to current local bus services, given the nature of EBS as a limited stop service with a heavier focus on longer trip segments. These travel times are outlined in Table 3-3 on the following page.

Table 3-3: Running Time Estimate for Sample Concept Alternative (Stamford, Darien Option 1, Norwalk Option 1)

Segment	Routing	Mileage	Estimated Speed*	Estimated Time
Eastbound				
Stamford Transportation Center to Seaside Avenue (Stamford)	West on North State Street North on Washington Boulevard East on Broad Street East on East Main Street	2.4	9	16:00
Seaside Avenue (Stamford) to Exit 11 (Darien)	East on Boston Post Road	2.4	25	5:45
Exit 11 (Darien) to Exit 13 (Darien)	North on Interstate 95	1.9	40	2:50
Exit 13 (Darien) to Fairfield Avenue (Norwalk)	East on Connecticut Avenue	1.8	12	9:00
Fairfield Avenue (Norwalk) to WHEELS Hub (Norwalk)	South on Fairfield Avenue East on Reed Street North on West Street	1.3	14	5:35
EASTBOUND TOTAL		**9.8**	**15**	**39:10**
Westbound				
WHEELS Hub (Norwalk) to Connecticut Avenue (Norwalk)	South on West Street East on Reed Street North on Fairfield Avenue	1.3	14	5:35
Connecticut Avenue (Norwalk) to Exit 13 (Darien)	West on Connecticut Avenue West on Boston Post Road	2.2	12	11:00
Exit 13 (Darien) to Exit 11 (Darien)	South on Interstate 95	1.4	40	2:05
Exit 11 (Darien) to Seaside Avenue (Stamford)	West on Boston Post Road	2.5	25	6:00
Seaside Avenue (Stamford) to Stamford Transportation Center	West on East Main Street West on Tresser Boulevard South on Atlantic Street West on North State Street	1.9	9	12:40
WESTBOUND TOTAL		**9.3**	**15**	**37:20**

*Estimated speeds based on Urbitran's bus travel time survey, May 2008

The following table offers a comparison of scheduled travel times for various transit services, automobile times compiled during field work conducted by the study team, and the projected travel time of a concept EBS alternative in each corridor segment between Stamford and Norwalk.

Table 3-4: Table of Competing Modes
Stamford Transportation Center to Norwalk (AM Peak)

Mode	Segment	Travel Time*		Frequency	Fare
		Eastbound	Westbound		
Rail – Local Train	Stamford to Darien RR	8:00	9:00	30	$2.25
	Darien RR to Norwalk	6:00	7:00	30	$2.25
	Stamford to Norwalk	14:00	16:00	30	$2.25
Rail – Express Train	Stamford to Darien RR	N/A	N/A	N/A	$2.25
	Darien RR to Norwalk	N/A	N/A	N/A	$2.25
	Stamford to Norwalk	N/A	12:00	20	$2.25
Route 41	Stamford to Darien RR	24:00	24:00	30 EB; 20 WB	$1.25
	Darien RR to Norwalk	22:00	22:00	30 EB; 20 WB	$1.25
	Stamford to Norwalk	46:00	46:00	30 EB; 20 WB	$1.25
Route 41A	Stamford to Darien RR	24:00	N/A	60 EB; N/A WB	$1.25
	Darien RR to Norwalk	27:00	N/A	60 EB; N/A WB	$1.25
	Stamford to Norwalk	51:00	N/A	60 EB; N/A WB	$1.25
Private Automobile (on U.S. 1)	Stamford to Darien RR	21:00	18:00	N/A	Gas + Parking
	Darien RR to Norwalk	15:00	14:00	N/A	Gas + Parking
	Stamford to Norwalk	36:00	32:00	N/A	Gas + Parking
Proposed EBS	Stamford to Norwalk	39:10	37:20	20 or 30	$1.25**

* According to printed timetables (January/April 2008), except Private Automobile which is from the Urbitran field work (May 2008)
** Park & ride facilities may require user parking fee

3.6 Selection of Preferred Alternative

The service parameters and local alternatives presented in this section represent the preliminary recommendations developed for EBS in the U.S. Route 1 corridor given the existing transit services available and current and anticipated ridership patterns on these services. Additionally, the alternatives described in this document reflect potential operating responses to specific traffic congestion bottlenecks and a desire to provide a new bus service that focuses on travel through the corridor, serving the busiest bus stops, and enhancing connections with existing local bus routes.

These alternatives were refined and selected through feedback from SWRPA staff, the project Technical Advisory Committee, Stakeholder Advisory Committee, and public presentations in Stamford, Darien and Norwalk. The following section outlines how the preferred alternative was selected for more detailed development.

Section 4 – Preferred EBS Alternative

To select the preferred enhanced bus service alternative, the study team identified appropriate EBS alternatives based on their feasibility. Incorporating feedback solicited from SWRPA and the technical and stakeholder advisory committees, as well as additional on-site field work conducted by the team, a full service plan was developed including the selection of preferred local operating alternatives in Stamford, Darien, and Norwalk.

4.1 Enhanced Bus Service / Local Bus Service Outline

Implementation of enhanced bus service is recommended for weekdays only between Stamford and Norwalk with endpoints at the Stamford Transportation Center and the Norwalk WHEELS Pulse Point (WHEELS Hub). It is envisioned that this new service would be operated by CT Transit in a coordinated schedule with the existing Route 41 local service. The following parameters define the enhanced bus service to be implemented in conjunction with schedule changes on CT Transit Route 41. These parameters stem from analysis of current ridership patterns, anticipated market and usage, and various policy considerations.

- EBS operates from 6am to 7pm on weekdays only
- EBS operates on 30 minute headways during peak periods, 40 minutes off-peak
- Local (Route 41) operates 30 minute headways during peak periods, 40 minutes off-peak
- Three proposed park & ride lots
  - Norwalk WHEELS Pulse Point (Yankee Doodle Garage)
  - Norwalk Community College (campus parking)
  - Noroton Heights (e.g, church lots, private lots, shared parking agreements)
- Route 41Bx express trips operate as complete round trips (e.g., outbound morning express trips from Stamford to Norwalk Community College return as morning express trips to Stamford rather than locals)
- After 7pm, local service operates current schedule (including Norwalk alignment change and present level of service to Norwalk Community College via Routes 41A and 41B)
- EBS bus layovers are taken in Norwalk (at WHEELS Hub)

4.1.2 Additional Supporting Local Service Improvements

Several changes to existing local services have been identified as potential improvements to be incorporated in conjunction with the service plan, including improvements for the Port Chester, NY to Stamford segment that was not found to warrant significant service increases given ridership levels and trip patterns. Improvements may include the following and may be implemented independently of the primary EBS operating plan:

- Operate CT Transit Route 11A directly from Port Chester to Stamford, bypassing the Greenwich railroad station. This will shorten travel times between Port Chester and Stamford while the railroad station will continue to be served by the 11B as well as Commuter Connection shuttles.
- Make weekend frequency and headway adjustments on local services to address heavier passenger loads.

4.2 Service Alignment

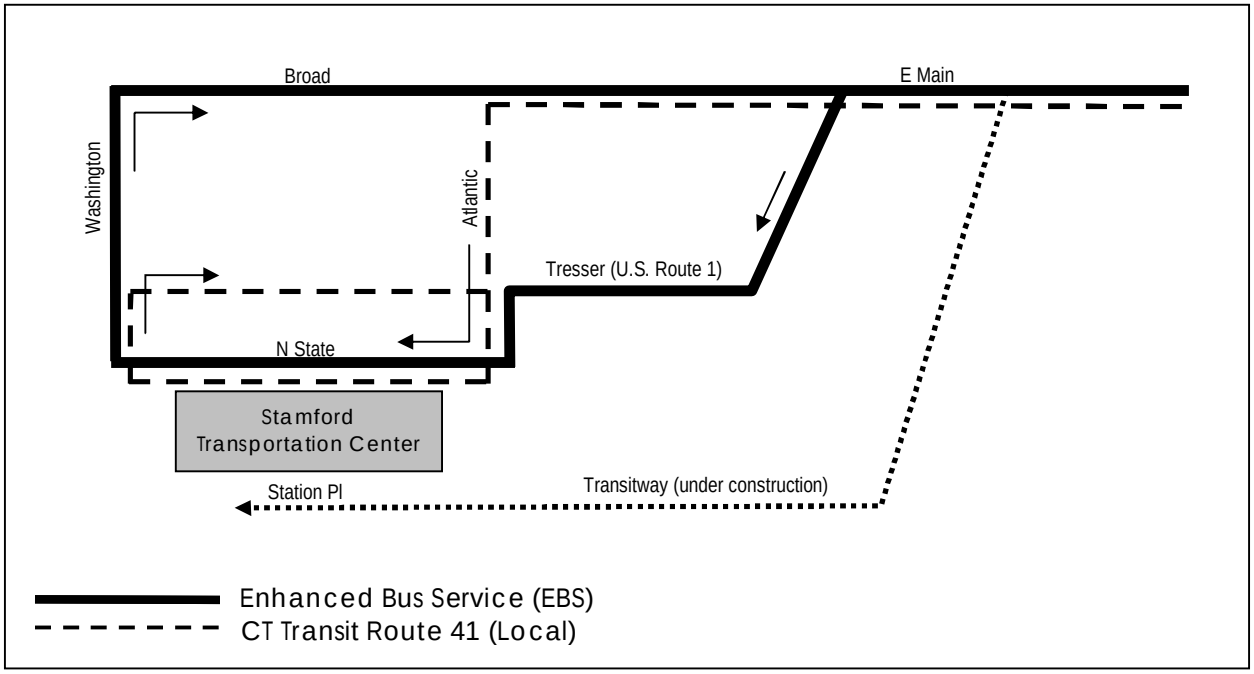
The enhanced bus service proposed is based on the route structure of the CT Transit 41 service, connecting downtown Stamford with Norwalk. The Stamford Transportation Center and Norwalk WHEELS Hub will serve as the endpoint anchors for the EBS service, which will feature local changes relative to the existing Route 41 service in both downtown Stamford and in Norwalk.

4.2.1 Stamford

In Stamford, prior to full construction of the Urban Transitway (Phase 2 is anticipated to open in 2012), Tresser Boulevard (U.S. Route 1) is seen as the best connecting route between Broad Street/East Main Street and the Stamford Transportation Center. Providing EBS service on Tresser Boulevard connects large employment sites with both the Transportation Center and residential areas on the east side of Stamford and throughout the U.S. Route 1 corridor. CT Transit's Route 41 local route is among those slated to be rerouted along the Urban Transitway upon the opening of Phase 2 of the project, and as such this study would recommend revisiting the EBS routing and its relationship to local services in advance of this change, as appropriate.

The EBS service would pick up and discharge passengers within the Stamford Transportation Center bus lanes and return eastbound via Washington Boulevard, Broad Street, and East Main Street. This expanded loop provides customers with access to the Stamford Government Center and the University of Connecticut's Stamford campus in addition to other retail and employment sites and residential development eastbound on Broad Street. The Route 41 local service will continue to follow its current alignment to and from the Stamford Transportation Center via Atlantic Street (inbound) and Tresser Boulevard/Atlantic Street (outbound).

Figure 4-1: Stamford EBS and Local Bus Routing



* All bus services will pick up and discharge passengers within the Stamford Transportation Center bus lanes

4.2.2 Darien

Two routing options for the EBS are presented in Darien. To maximize service availability, EBS service and local Route 41 service would operate on U.S. Route 1 (Boston Post Road). Because the railroad underpass is both prone to flooding and acts as a bottleneck during heavy traffic volumes, localized signal and transit priority improvements are recommended to improve traffic flow through this area. A bus priority and right turn signal is recommended eastbound at Tokeneke Road and westbound at West Avenue, allowing general traffic to more easily make right turns thereby reducing the queue length at these key intersections. The right turn lane would also be available to buses continuing straight on U.S. Route 1, providing a queue bypass at this area of localized congestion. These traffic improvements are described in detail in a subsequent section.

Operating the proposed service through downtown Darien is largely contingent upon the implementation of the traffic and signal improvements described in this report, as these will play an important role in improving traffic flow, lowering bus travel times, and maintaining on-time performance. In the absence of these recommendations, the use of I-95 from Exits 13 to 11 is a recommended alternative for the EBS to bypass congestion at the railroad underpass and save an estimated 2-3 minutes of running time in each direction. Local CT Transit Route 41 service is expected to remain on U.S. Route 1 in either scenario.

4.2.3 Norwalk

In the short term, the EBS and local CT Transit Route 41 alignments will remain unchanged on the Norwalk end, following Connecticut Avenue (U.S. Route 1) as it becomes Van Buren Avenue, turning south on Belden Avenue, and into the WHEELS Hub via Wall Street and Main Street (Figure 4-2).

As a longer term recommendation, a realignment of the local CT Transit Route 41 service along with the proposed EBS is suggested as an option between the Norwalk WHEELS Hub and U.S. Route 1 (Connecticut Avenue). The modified alignment would use West Avenue, Reed Street, and Fairfield Avenue before rejoining Connecticut Avenue (Figure 4-3).

This new alignment would open up new ridership opportunities and, in the case of new development along West Avenue such as the District 95/7 project, would do so before new residents have established driving as their only means of travel. Customers currently using the CT Transit Route 41 service to reach Norwalk Hospital on Van Buren Avenue would have to transfer to Norwalk Transit District services to the hospital, either on Connecticut Avenue, or by traveling to the WHEELS Hub and making a transfer to an outbound NTD bus. This six minute trip can be made on NTD Route 13, with 20 minute service frequency, as well as NTD Routes 1 and 12 with less frequent service. Current ridership on CT Transit Route 41 at the stop nearest the hospital is 34 boardings and 40 alightings on weekdays during the route's service span of 5am to 12am. This recommended alignment is shown in Figure 3 on the following page.

Figure 4-2: Norwalk EBS and Local Bus Routing (Short Term)

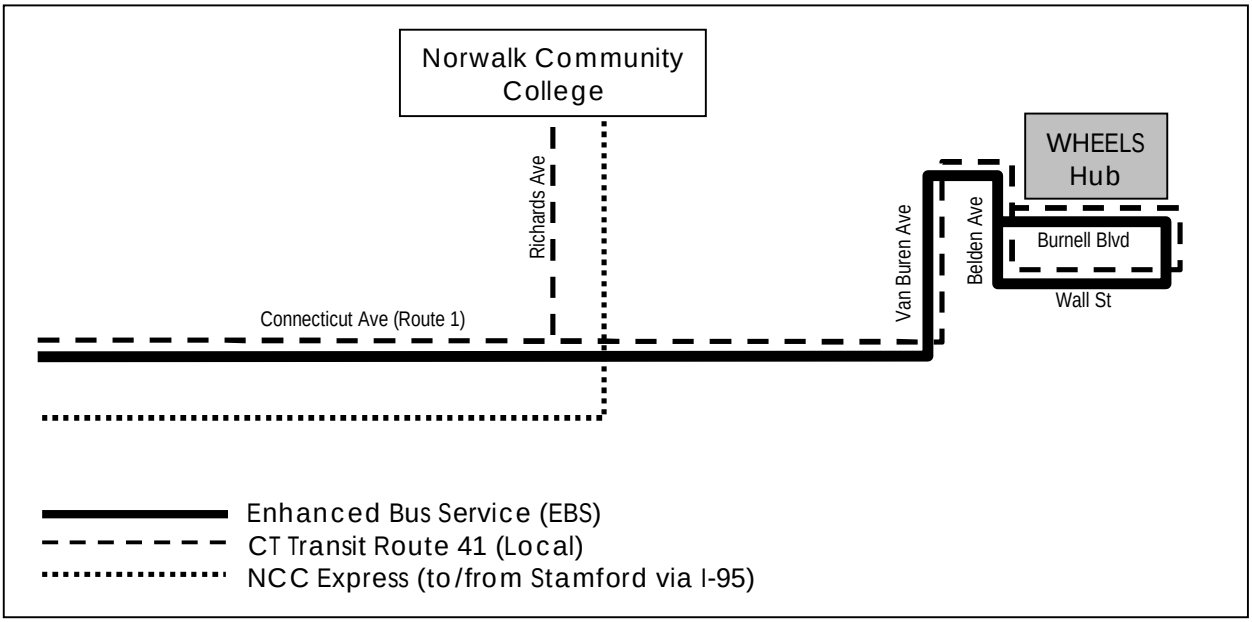


Figure 4-3: Norwalk EBS and Local Bus Routing (Long Term)

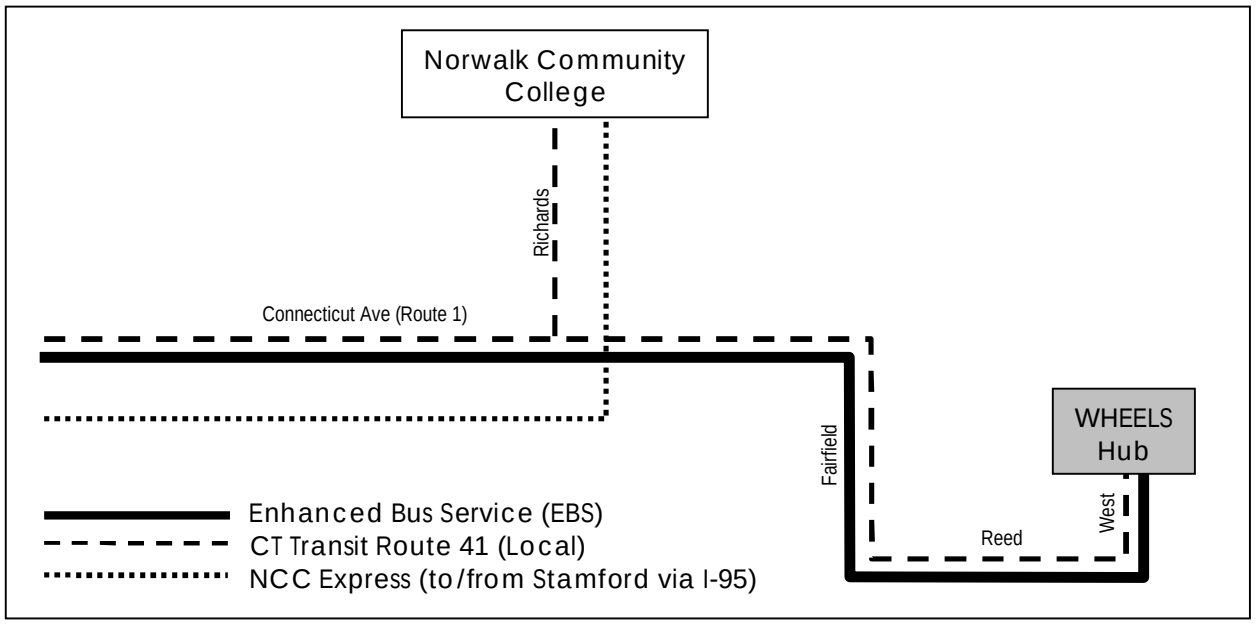
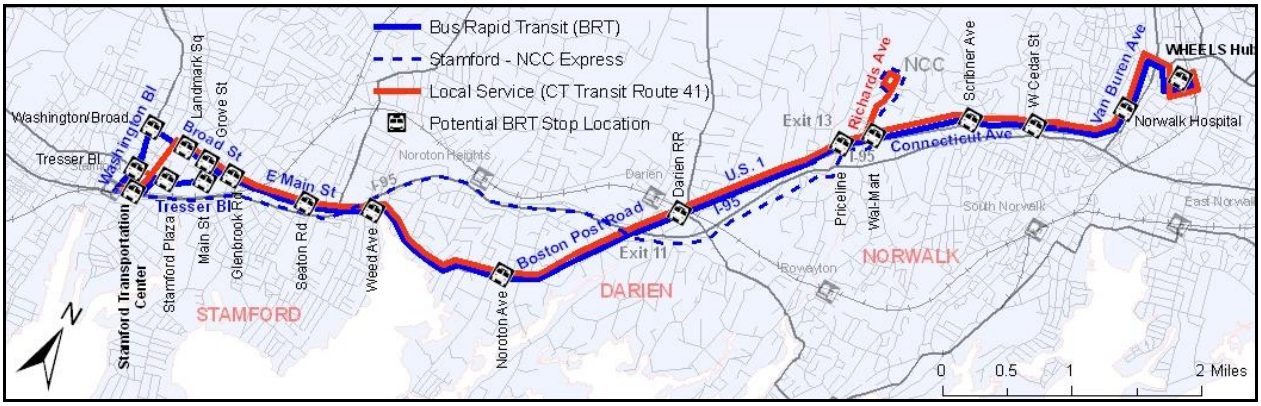


Figure 4-4 shows the entire EBS and local service corridor along with major stop locations, which are identified in the subsequent section. Estimated running times and corridor segment lengths are summarized in Appendix 4.

Figure 4-4: Combined EBS and Route 41 Alignment



EBS Station Locations

The selection of stations for EBS service is based on ridership volumes at existing bus stops on the CT Transit Route 41. Westbound, beginning at Norwalk WHEELS Hub, the following EBS station locations are recommended:

Norwalk

- West Ave / Reed St
- Connecticut Ave / W Cedar St
- Connecticut Ave / Scribner Ave
- Connecticut Ave / Richards Ave
- Connecticut Ave between Richards Ave and W Norwalk Rd

Darien

- Boston Post Rd / Darien Railroad Station
- Boston Post Rd / Noroton Ave (assuming possible park & ride location)

Stamford

- Boston Post Rd / Weed Ave
- E Main St / Seaton Rd
- E Main St / Glenbrook Rd
- Tresser Blvd / E Main St
- Tresser Blvd / Stamford Plaza
- Stamford Transportation Center

Unlike the Route 41 local service, which returns to Atlantic Street via Tresser Boulevard, the EBS service will service a one-way loop connecting the Stamford Transportation Center with the Washington and Broad Street corridors. Passing Tresser Boulevard eastbound, EBS stop locations will mirror those in the westbound direction. Stops along the Stamford loop include:

- Washington Blvd / Tresser Blvd
- Washington Blvd / Broad St
- Broad St / Landmark Square
- Broad St / Grove St

Section 5 – Traffic Improvements and Transit Priority Treatments

To address localized congestion in Darien, an assessment of the feasibility to preempt existing traffic signals for transit (bus) priority on U.S. Route 1 (Boston Post Road) at Center Street, Tokeneke Road, and Mechanic Street/ West Avenue was performed by the study team. The proposed preemption concept involves the creation of a bus queue jump lane using right-turn lanes on U.S. Route 1 approaching Center Street and Tokeneke Road northbound and West Avenue southbound.

5.1 Existing Conditions

U.S. Route 1 at the study signalized intersections has one basic lane and one parking lane in each direction and services a predominately retail section of the corridor. The Metro-North Railroad right of way is elevated over U.S. Route 1 between Tokeneke Road and West Avenue/Mechanic Street.

On-street parking is permitted on the northbound side of U.S. Route 1, south of Center Street, and between Center Street and Tokeneke Road. There is no parking on the southbound side between West Avenue and Center Street; several curb cuts mark this segment between the underpass and Day Street, notably the Darien railroad station entrance. Parking regulations and on-street parking capacity are summarized in Table 5-1 below.

Table 5-1: U.S. Route 1 On-Street Parking Availability and Regulations

From	To	Number of Spaces	Regulations
Southbound			
Sedgewick Ave	Mansfield Ave	7	1 hour parking, 8am-6pm
Mansfield Ave	West Ave	9	1 hour parking, 8am-6pm
Northbound			
Day Street	Center St	18	1 hour parking, 8am-6pm
Center St	Tokeneke Rd	3	1 hour parking, 8am-6pm

The southbound U.S. Route 1 approach to West Avenue features an exclusive right-turn lane for approximately half of the block between Sedgewick Avenue and West Avenue. The northbound traffic signals at Center Street and Tokeneke Road are relatively close with only a three-car storage capacity between the stop bars. Traffic signal controllers at the three intersections operate on a semi-actuated mode under central computerized control. They are of the span wire type with the span poles located on the northeast and southeast corners and are under jurisdiction of ConnDOT.

Buses currently operate in mixed traffic and are subject to signal delays and traffic congestion. The closest bus stops to these intersections are at Tokeneke Road northbound and at

Sedgewick Avenue southbound. The northbound stop at Tokeneke Road would have to be relocated to the beginning the of bus priority lane, approximately 100 feet before Center Street, to ensure proper, efficient operation of the right turn/bus queue jump lane approaching the railroad underpass.

5.2 Roadway Improvement Concept and Signal Preemption Operation

A modern, on-street transit preemption system improves travel time by allowing transit vehicles to request and receive green lights as they approach critical intersections. The proposed "priority lane" is an auxiliary lane that would be shared by both transit vehicles and general traffic. The proposed preemption system would also discriminate between transit and non-transit vehicles. While efficiency and on-time performance are expected to improve for transit vehicles, signal progression would not be disrupted during preemption.

Given roadway constraints on U.S. Route 1 at the railroad bridge (one lane in each direction) and the considerable difficulty and cost of another through lane at this location, the following improvement is proposed based on the use of right turn lanes by buses at Tokeneke Road and West Avenue as queue jump lanes:

- Prohibit parking from 6-10am, 4-6pm on the northbound side of U.S. Route 1 from a position east of Day Street to Center Street (i.e., not the entire block) and between Center Street and Tokeneke Road and create an auxiliary right-turn lane that would serve as a queue jump lane for buses (4 to 5 per hour) and also be used other motorists turning right on Tokeneke Road.
- Designate the existing U.S. Route 1 southbound right-turn lane at West Avenue as an auxiliary queue jump lane that would be used for buses. Buses [proceeding straight on U.S. Route 1] would share the right-turn lane with vehicles that currently use it for right-turn movements.
- Remove on-street parking (or prohibit from 6:00 – 10:00 AM, 4:00 – 6:00 PM) on southbound U.S. Route 1 between Sedgewick Avenue and West Avenue
- Provide an advance preemption phase for the buses on northbound and southbound U.S. Route 1 at Tokeneke Road and West Avenue, respectively
- Upgrade the existing controller or provide a new controller at the three signalized intersections that would accommodate the preemption devices. New preemption devices would consist of the following:
  - Phase selector/discriminator unit and card rack inside the controller cabinet; (As an example the phase selector could be based on infrared communication technologies (e.g. 3M OPTICOM model 700 series or equivalent)
  - Receiver at on one of the traffic signal poles
  - In-vehicle emitter (buses)
- Add new traffic signal heads and lane-use control signs on the span wire

- Propose new post-mounted on-street parking regulation and regulatory lane-use control signs and remove existing, conflicting signs
- No-Parking-Zone signs would be installed on the northbound side of U.S. Route 1 from mid-block between Day and Center Street to Tokeneke Road. Signs 31-0604 (L, D, R) would be installed on this block face to read "No Parking 6:00 AM TO 10:00 AM and 4:00 PM TO 6:00 PM".
- CTDOT regulatory sign 31-0122 "Right Lane Must Turn Right" would need to be modified to read "Right Lane Must Turn Right - Except Buses". "Except Buses" would be added to a supplemental plaque. This modification that applies to northbound U.S. Route 1 at Tokeneke Road as well as southbound U.S. Route 1 at West Avenue would need to be discussed with CTDOT and the Town of Darien.

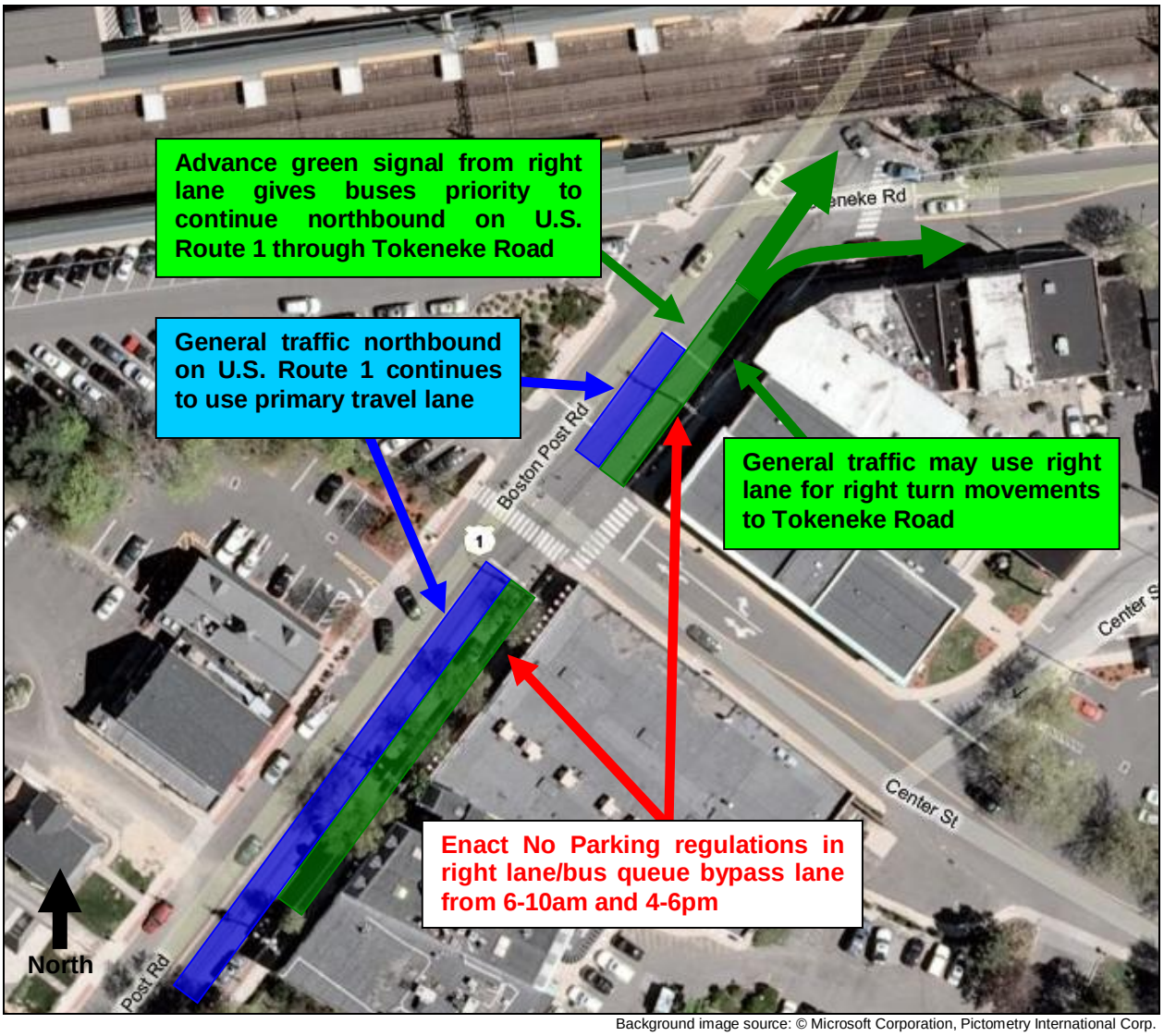
The primary benefits of this signal plan include congestion mitigation (all traffic) in central Darien as well as improved travel times for buses in the U.S. Route 1 corridor. The recommended prohibition of parking during peak hours as part of a transit-priority signal program will require both local outreach and education as well as diligent, coordinated enforcement. The restricted hours proposed above are a recommended guideline.

5.3 Additional Investigation

Additional investigation required to further pursue these recommendations as part of a detailed traffic study would include an inspection of traffic signal controller cabinets at the three intersections to determine capabilities of the controllers to accommodate the preemption phase and conducting traffic counts and traffic signal controller phasing and timing and signal offsets.

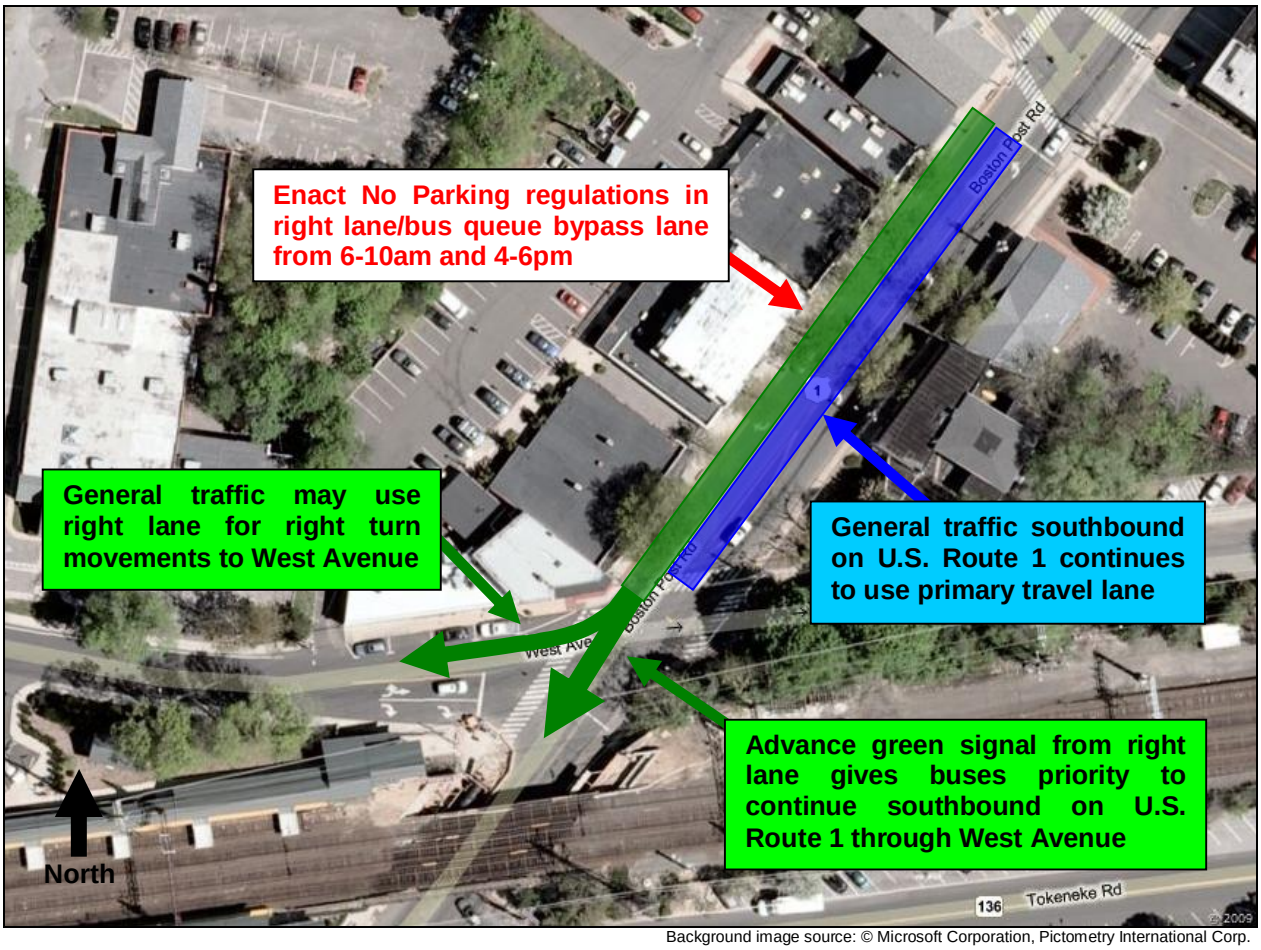
Traffic signal plans at the three intersections would also need to be modified to include the internal preemption settings (e.g. delay, alternative minimum green, yellow and red, "hold" and "exit" phases). Figures 5-1 and 5-2 on the following pages illustrate the proposed signal changes and vehicle lane requirements.

Figure 5-1: Transit Priority Measures in Darien (U.S. Route 1 Northbound)



Background image source: © Microsoft Corporation, Pictometry International Corp.

Figure 5-2: Transit Priority Measures in Darien (U.S. Route 1 Southbound)



Background image source: © Microsoft Corporation, Pictometry International Corp.

Section 6 – Applicable ITS Technologies

6.1 Applicable ITS Technologies

Intelligent Transportation Systems (ITS) offer many possibilities in terms of facilitating the operation of the new EBS service being developed for the U.S. Route 1 corridor and attracting riders to these services. While there are many ITS technologies that could be proposed for deployment as part of the new service, specific technologies should be considered in light of the types of services being planned, the environment in which these services will operate, and the characteristics of the potential customers of the new services. Thus ITS should be considered for three primary reasons:

- To inform potential riders about the services provided before they make a trip
- To provide transit riders with location-specific information while they are taking their trip
- To facilitate the operation of the EBS service.

Based on these objectives, the study team determined that the key ITS technologies that are most appropriate for this application are as follows (in descending order of importance):

- Static in-terminal/wayside information
- Automatic vehicle location (AVL)
- Real-time information: pre-trip, in-vehicle and in-terminal/wayside
- Automated annunciation (ADA-required next stop announcements)
- Automatic passenger counting

This section describes these ITS applications, how they might be used in providing the new EBS service, and their associated costs. These technologies are described in order of priority.

1. Static In-Terminal / Wayside Transit Information

Scheduled arrival and departure information can be displayed on electronic signs or monitors at major bus stops, transfer centers and attractions. This static information, which can be provided without the need for AVL technology, may help to attract riders to the EBS service and to transit in general. It is particularly important to provide information on schedules to riders who may not be familiar with the new EBS schedules.

If an AVL system is deployed, real-time arrival and departure times can be computed and displayed. (As described below in Section 3, real-time information is recommended.) Most agencies using electronic signs display real-time information at bus stops, but it would be fairly straightforward to display scheduled times if an AVL system is not deployed. If an AVL system is deployed at some later time, real-time information could simply replace the scheduled times.

2. Automatic Vehicle Location / Computer-Aided Dispatch with Mobile Data Terminals

Automatic vehicle location systems provide information regarding each equipped vehicle's location and other data, such as vehicle speed and direction. Automatic vehicle location is a backbone technology; it is necessary to perform real-time arrival calculations (see Section 3 below). Also, AVL provides one critical capability that will ensure that the new services are reliable: schedule adherence computation. Schedule adherence is the calculation of how each vehicle is doing against its schedule (e.g., running five minutes behind).

Armed with this information, both drivers and dispatchers can better operate the new transit service so that it adheres to schedule. Schedule adherence is critically important whenever service is less frequent than 15 minutes. Furthermore, schedule adherence is a fundamentally important factor in creating a pleasant transit experience for visitors that will attract ridership.

Automatic vehicle location systems include in-vehicle hardware and software, and dispatch hardware and software. In-vehicle components include:

- A mobile data terminal (MDT) or mobile data computer (MDC), which performs calculations, such as those necessary to determine schedule adherence; provides an interface to a radio (which transmits vehicle location data, and transmits and receives data messages from dispatch); and provides a display and function keys for the driver
- A global positioning system (GPS) receiver, which calculates position data based upon data received from a series of GPS satellites
- A GPS antenna, which allows data to be received by the GPS receiver
- A silent alarm feature, which provides the driver with a way of silently notifying dispatch about a serious incident. Silent alarms often include covert microphones, which can be used by dispatchers to assess the emergency situation on-board before contacting emergency management services
- Engine and/or transmission monitoring interfaces. Most new buses provide the capability to monitor these systems using an AVL system

In-vehicle components are often connected to a vehicle area network (VAN). Similar to a computer local area network, this allows in-vehicle devices to be easily added and networked together.

Dispatch hardware and software include dispatcher workstations with display monitors for displaying vehicles' locations and incident information, software to control the displays, and software to perform additional functions using the AVL data.

Information about how well the vehicle is operating against its schedule (a.k.a. schedule adherence computation) is displayed to the driver on an MDT. This information is also provided

to the dispatcher when a vehicle is running "out of tolerance", ensuring operational efficiency. The dispatcher is only notified when a bus is running off schedule.

The schedule adherence capability is the key function within an AVL system that can help to ensure reliable travel times by informing the drivers about their schedule adherence (ahead/behind schedule by *n* minutes) and informing the dispatchers about on-time problems in real-time.

Automatic vehicle location systems have been deployed in many transit systems across the U.S., including those operating EBS services. For example, one of the highlights of several EBS services is the use of AVL technology to enhance operations and to provide real-time information at bus stops, on the Internet and on mobile devices (e.g., BlackBerry).

3. Real-time In-Terminal / Wayside, Pre-Trip and In-Vehicle Information

Real-time arrival and departure information displayed on electronic signs (also known as dynamic message signs, or DMS) or monitors at major bus stops and/or transfer centers can be very effective in improving the perception of any transit service and attracting riders.

An AVL system is required to compute real-time arrival information. Additionally, a communication system capable of transmitting the real-time information to each media device (electronic sign, display monitor) is required. Many transit agencies across the U.S. and the rest of the world have deployed real-time arrival information based on the location of the bus, the speed of travel and traffic conditions along the route. The information is provided at key bus stops, on the Internet and on mobile devices. Bus Rapid Transit (BRT) systems, such as Los Angeles' Metro Rapid and Boston's Silver Line, have deployed real-time arrival/departure signs at key stops to attract people to the transit service, thus reducing the number of automobiles traveling in these very congested areas.

Figure 6-1: Sample Real-Time Arrival Information (Dynamic Message Signs)

Real-time information could also be provided to travelers before their trip and on the vehicles. This could be considered once the new EBS service has been operating for at least a year and an AVL system has been deployed. Providing such real-time information before a person takes a transit trip not only improves the perception of transit (and lessens the rider's stress), but also allows riders to better time their arrival at the bus stop, etc. This technology strategy also has potential to persuade people who are making a trip to choose transit as their mode of choice, thus, furthering the objective of attracting riders to the new EBS service.

Pre-trip notification of real-time status on bus service can be provided in several different ways, including mobile phone (such as that provided by the major airlines) or e-mail.

Real-time pre-trip information has been provided by several transit agencies in the U.S. to date. One of these systems is Los Angeles' Metro Rapid BRT service, which provides real-time information on mobile phones (rapidbus.net).

This information could also be provided on-board the vehicles via an automated annunciation system (described below). Real-time information provided audibly and visually on-board a vehicle can keep riders informed about the status (e.g., estimated time to arrival) of the service and possibly on the status of other local services (if that information is available from those providers).

Limited real-time general information (beyond next-stop announcements, including weather, news and sports scores, etc.) is being provided onboard some transit system vehicles. For example, on specific Orlando Lynx buses, limited real-time general information is provided using a video display (rather than the usual light-emitting diode signs).

Also, real-time information together with estimated highway travel times can be provided on DMS placed on major highways (e.g., I-95, U.S. Route 1). This would require the capability to send real-time transit information to the facility that controls the displays on Connecticut DOT-controlled DMS. If possible, these DMS should be placed strategically near exits that are close to selected EBS stops to alert transit users of known incidents and delays.

4. In-Vehicle Transit Information (Automated Annunciation)

Automated annunciation systems can provide travel information to riders as they take their trip. While these systems typically provide next-stop information based on the vehicle's location as provided by an AVL system, this type of system could be operated manually (without AVL) by the driver pressing a button that reads and displays messages specific to the area that the vehicle is driving through. For example, the driver could initiate a message just before reaching a specific stop that describes points of interest (e.g., businesses or municipal facilities).

The use of manually-activated annunciation systems for EBS is not common, although it is used in other types of ground transportation systems, such as airport transportation. For example, Boston's Logan Express bus service uses manually-activated annunciation to inform passengers about estimated travel time, terminal stop announcements and information about connecting ground transportation options (e.g., taxi service).

The advantage of an AVL-based annunciation is that the annunciation functionality is integrated with the AVL system, meaning that announcements can be made automatically based on the location of the vehicle.

5. Automatic Passenger Counters (APCs)

Automatic Passenger Counters (APCs), which automatically count boardings and alightings for an equipped vehicle at each stop, can provide invaluable data on passenger activity that can enhance the service planning process. Many transit agencies across the U.S. have deployed APC systems to measure route and vehicle performance in terms of ridership, boardings and alightings, load volumes, etc. It may be even more important to have access to this information in a new system such as the proposed EBS system, so that the service and schedule can be fine-tuned in response to the demand.

In summary, there are several key ITS technologies that should be considered to facilitate the operation of the new services and to attract riders to the new services.

Section 7 – Station Design and Amenities

7.1 Station Design/Amenities

Station design for EBS service is an important factor in developing a brand identity for the new service while at the same time providing more amenities for all bus riders (EBS and CT Transit Route 41) at major stop locations. A system of icons and information components at all EBS station locations provides a strong, consistent identity and differentiates the EBS from local bus services. Ultimately, all local bus stops should also provide a greater amount of route and schedule information.

1. CT Transit regulatory sign: existing design is retained for system-wide consistency and legibility
2. EBS logo: Logo, word mark, or icon that is unique to EBS service (examples are illustrative only; service may not be referred to as "The Breeze")
3. Variable message sign: Displays dynamic next bus arrival information
4. Local bus sign panels: where local bus shares EBS stops, existing sign panel design may be retained for system-wide consistency and legibility (white local bus location panel might best omitted at EBS-only stops)
5. EBS route map: static display with schematic map

Figure 7-1: Sample EBS Station Signage

Items 1 through 5 above may be internally or externally illuminated. While this is recommended for maximum impact and visibility, existing street lighting may provide adequate illumination. Specific designs of EBS station elements will be influenced by feedback from stakeholders including municipal agencies, business representatives, local neighborhood associations, etc.

Branding of the new service is of the utmost importance. A distinct service name such as "The Breeze" can capitalize on the success of the neighboring Coastal Link bus service between Norwalk and Milford and providing a sense of complementary identity in the U.S. Route 1 corridor.

Station shelter design should, as a rule, be commensurate with relative activity levels at each location. The Stamford Transportation Center already features a covered series of bus lanes and would require only additional EBS identity markings to highlight the service. The Norwalk WHEELS Hub, for which a series of physical improvements are under design by the Norwalk Transit District, should similarly feature distinguishing shelter and waiting space (shelters) for the EBS service. Mid-route, modular shelter designs can provide the flexibility needed in terms of total covered space, relative passenger activity, and available space and physical constraints at each station location.

Key components for EBS stations include:

- Adequately sized shelters, commensurate with ridership activity at each location (modular designs provide flexibility) and availability of curb space
- Adequate curb space to allow easy bus entry and exit from stations (~80 feet for articulated buses)
- Supporting sidewalk and pedestrian amenities to encourage safe, convenient access
- Real-time bus arrival information
- Schedule and route information for EBS and local bus services

Figure 7-2: Sample EBS Station Layout

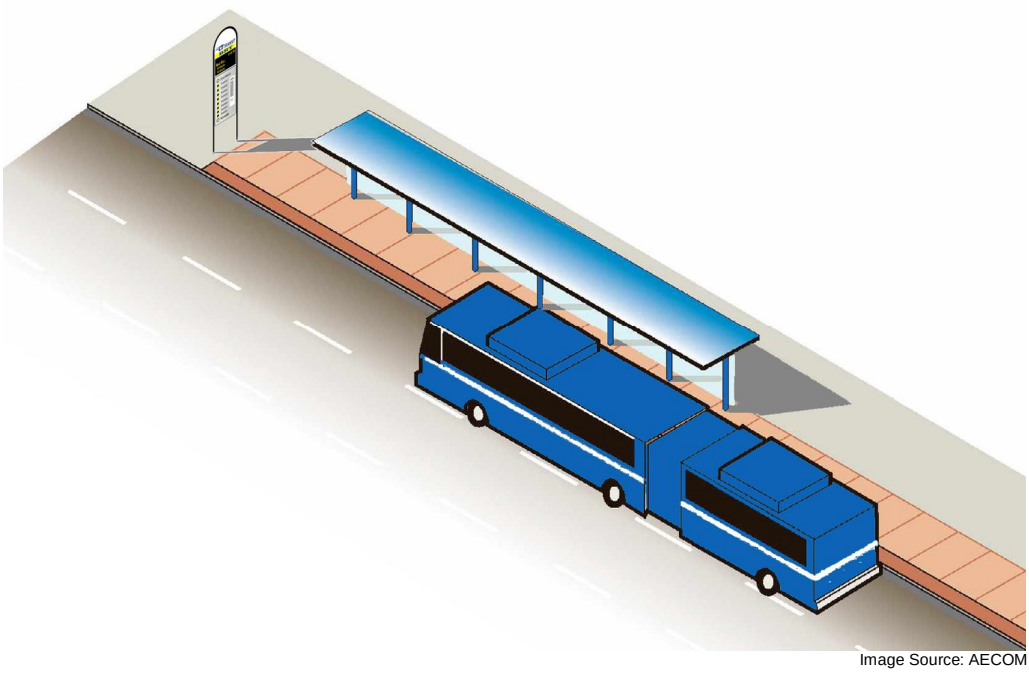


Image Source: AECOM

The design and placement of new bus shelters (and new shelter designs) is subject to review and approval by the Connecticut Department of Transportation as well as all appropriate municipal and community design review processes.

Section 8 – System Capital Costs

8.1 Capital Costs

8.1.1 Vehicles

Survey feedback received from non-transit users during this study highlighted the importance of on-time performance, convenience, and comfort as key factors in the viability of enhanced bus service. Distinctive, modern vehicles have often been among the hallmarks of successful bus rapid transit and other new transit services.

As such, the study team recommends the purchase of five new, articulated diesel electric hybrid buses to provide sufficient capacity (i.e., seated capacity is high enough to avoid standing loads on buses) and a new identity and level of comfort for customers. Articulated buses would help address specific times of heavy passenger loads on the current Route 41 service as well as ensure adequate capacity for future growth of the EBS program. Five vehicles would provide for four in-service vehicles during peak EBS service hours as well as a spare vehicle. Providing spare vehicles identical to regularly scheduled vehicles is critical to maintaining the image and identification of the new service.

Figure 8-1: Example of Modern, High Capacity Transit Vehicle

High capacity, articulated diesel electric hybrids are expected to cost approximately $1,000,000 each, according to estimates provided by CT Transit. By comparison, new 40-foot diesel electric hybrid bus will cost approximately $600,000 each. A full set of vehicles must be purchased for EBS implementation, including vehicle spares to maximize the visual and marketing impact of the new service. Phased purchasing of vehicles and key capital components is strongly discouraged. Procurement of new vehicles will also require consideration of specific local operating constraints, including the 11'9" clearance at the Darien railroad underpass on U.S. Route 1.

8.1.2 ITS Components

Preliminary costs for each major group of technologies described above are shown in Table 8-1. The assumptions that were used to develop these figures are outlined in Appendix 8.

Table 8-1: Preliminary Costs for ITS Technologies for EBS

Technology for BRT	Capital Cost ($)		Annual Operation and Maintenance Cost ($)	
	Low	High	Low	High
AVL/CAD/MDT	$56,000	$93,250	$5,000	$7,330
Real-Time Information*	$173,200	$344,000	$9,928	$16,760
Automated Annunciation System	$146,500	$222,500	$13,370	$20,012
APC System	$90,000	$162,500	$8,100	$14,600
TOTAL	$465,700	$822,250	$36,398	$58,702

* requires an AVL/CAD system

The study team developed a cost estimate for the use of the existing voice communication system and General Packet Radio Service (GPRS, a packet-oriented mobile data service) for the AVL/CAD system for EBS service. It is shown in Table 8-2. This estimate does not include the data communication required to display real-time information on the DMS.

Table 8-2: EBS AVL/CAD Communications Estimate

Comm Type	BRT vehicles (5)	
	Initial cost	Annual cost
Voice	$ 26,535	$ 1,080
Data	$ 67,100	$ 20,000
Total	$ 93,635	$ 21,080

Finally, an additional estimate of on-board hardware was developed to equip the buses that operate on CT Transit Routes 41 and 11, which at present are interlined for operational efficiency, i.e., Route 41 buses continue in service on Route 11 rather than turning around at Stamford. This estimate, shown in Table 8-3, only includes AVL/CAD, automated annunciation and APC hardware for the 12 peak vehicles that operate on these routes. It does not include additional workstations, central APC and annunciation software, and a wireless LAN, and assumes that an AVL/CAD system already exists.

Table 8-3: Preliminary Costs for ITS Technologies for Route 11/41 Vehicles

Technology for Route 11/41 Vehicles	Capital Cost ($)		Annual Operation and Maintenance Cost ($)	
	Low	High	Low	High
AVL/CAD/MDT	$24,000	$79,800	$960	$3,192
Automated Annunciation System	$51,600	$90,000	$2,088	$3,628
APC System	$51,000	$81,000	$2,940	$4,140
TOTAL	$126,600	$250,800	$5,988	$10,960

8.1.3 Traffic Signal / Transit Priority

Capital costs for transit priority measures in Darien, involving three traffic signals (two southbound, one northbound) include the following estimated costs per signal[1]:

- Controller Upgrade with phase selector/discriminator, receiver at signal and traffic signal head assembly and wiring: $10,000 to $17,000 (estimated range)
- New Controller with phase selector/discriminator, receiver at signal and traffic signal head assembly and wiring: $22,000

Other costs in the study area include signage updates and special pavement markings to draw attention to new traffic patterns and lane configurations.

- Signage and pavement marking: $10,000 (new information and lane-use control signs, removal of on-street parking and other conflicting signs)

Finally, per-vehicle costs focus primarily on the emitters necessary to trigger transit priority at designated signalized intersections.

- In-vehicle emitter[2]: $1,000 per vehicle (minimum five vehicles required to implement EBS)

8.1.4 Stations / Shelters

Figure 8-2: Example of EBS Station (Boston Silver Line)

The design criteria and associated costs of bus shelters appropriate for EBS stations varies dramatically. Shelter design can range from fully enclosed, climate-controlled spaces to traditional box shelters, with or without available seating.

For the U.S. Route 1 EBS service proposed, a design akin to that used by MBTA in Boston for the Silver Line appears most appropriate. This design is an open-air shelter that provides more shelter than a traditional bus shelter and provides more space and opportunity for schedule information and seating.

Prices for bus shelters can range from minimal investment of $5,000-$20,000 to a high-end, substantial investment of over $200,000 per shelter. While final costs will depend on features

[1] Traffic signal modification fee is not included in the estimate.
[2] Compatible emitter to be installed in each transit vehicle

included, procurement bids and other purchasing criteria, the experiences of several systems can provide guidelines for what ranges might be expected. Shelters for EBS in this U.S. Route 1 corridor would likely fall in the low- to mid-range costs.

- New Haven - $300,000 each (average based on multiple designs)
- Boston (MBTA Silver Line) - $170,000 each
- Salt Lake City - $2,000-$15,000 each

Section 9 – System Operating Costs

9.1 Operating Costs

An estimate of operating costs for implementation of a new EBS service in conjunction with the existing CT Transit Route 41 service is based on unit costs provided by CT Transit and bus frequencies and vehicle requirements as determined by the study team. The costs presented are approximate, incremental costs relative to the current CT Transit Route 41 alignment and level of service. Nominal mileage differences between the current Route 41 alignment and the proposed route of the EBS and revised Route 41 are not expected to prompt appreciable changes in operating costs.

- EBS operates 6am-7pm along with coordinated Route 41 schedule changes
- Before 6am and after 7pm, Route 41 operates as it does at present
- Mileage differences between current Route 41 and the proposed EBS/Route 41 alignments are negligible
- Upon implementation, all local trips are assumed to serve Norwalk Community College

Operating cost estimates are based on CT Transit's current rates of $35.57 per vehicle hour and $2.39 per vehicle mile. These figures, when combined, provide an accurate incremental cost relative to the service that is provided now. They do not represent full-allocated system costs.

Additional operating costs for CT Transit would include increases in road supervision and maintenance costs commensurate with the additional service levels provided. Furthermore, an extensive marketing program to advertise and promote the new EBS service (and service changes on the Route 41 local) will be required both leading up to and following implementation of the system.

Given the intricacies of route scheduling, operator shift assignments (run-cutting), and interlining of buses with other routes, the costs presented here are approximates and are designed to highlight the anticipated increase in cost for implementation of the EBS service and local Route 41 changes during the weekday EBS service span.

Table 9-1: Existing CT Transit Route 41 Service (Weekdays 6am – 7pm)
Estimated Daily and Annual Costs

Direction	Pattern	Number of Trips	Miles Per Trip	Miles	Hours	Cost
Eastbound	41	21	9.8	205.8	19.4	$1,182
	41A	11	11.1	122.1	10.2	$655
	41B	1	7.3	7.3	0.9	$49
	41Bx	3	7.5	22.5	1.4	$104
Westbound	41	23	9.5	218.5	18.2	$1,170
	41A	9	10.8	97.2	7.8	$510
	41B	2	7.3	14.6	1.2	$78
	41X	2	6.9	13.8	0.9	$65
Total Daily Cost						**$3,812**
Total Annual Cost (Daily cost x 255 weekdays)						**$972,060**

Table 9-2: Proposed EBS and Route 41 Services (Weekdays 6am – 7pm)
Estimated Daily and Annual Costs

Direction	Pattern	Number of Trips	Miles Per Trip	Miles	Hours	Cost
Eastbound	Local	23	11.1	255.3	21.5	$1,375
	EBS	23	9.8	225.4	18.4	$1,193
	Express	5	7.5	37.5	2.3	$171
Westbound	Local	23	9.5	218.5	21.5	$1,287
	EBS	23	10.8	248.4	17.3	$1,209
	Express	5	6.9	34.5	1.8	$146
Total Daily Cost						**$5,382**
Total Annual Cost (Daily cost x 255 weekdays)						**$1,372,410**

9.1.1 Revenue and Net Cost

The proposed EBS and Route 41 services are expected to cost $1,372,410, or $400,350 more per year than the existing Route 41 services. While revenue increases from ridership gains will offset the total operating cost, CT Transit's average fare cannot be applied directly to these incremental costs since they are not fully allocated. Nonetheless, an anticipated increase of 142,545 riders will provide $142,545 in revenue based on the $1.00 average fare. Ridership estimates are outlined in the following section.

Section 10 – Ridership Estimates

10.1 Ridership Estimates

Ridership estimates for EBS and local Route 41 services are based on a number of factors resulting from changes in service frequency, reduced travel times, and the introduction of specific new features designed to enhance customers' travel experiences. The estimates in this section are based largely on the "building block" method set forth in TCRP 118, the Bus Rapid Transit Practitioner's Guide, published by the Transportation Cooperative Research Program in 2007. The application of this methodology builds upon ridership figures provided by CT Transit as part of this study and the study team's own primary data collection.

To begin determining the ridership impacts associated with implementation of the EBS service, which is effectively an overlay service in concert with the Route 41 local service, the existing weekday ridership was divided between the existing local and proposed EBS trips. The approach to estimating base ridership involves an analysis of current on/off patterns at EBS-designated bus stops as well as non-EBS stops and identifying riders who will both board and alight at the key stops.

Next, new ridership is allocated to EBS service based on route changes and improved penetration of key employment areas (e.g., Tresser Boulevard east of Atlantic Street in Stamford). The initial distribution of existing ridership to EBS coupled with anticipated gains from new route alignments and service areas provides the "base" EBS ridership. From this base, several other factors can be computer to determine the extent to which new ridership is expected to be attracted to the EBS service:

- Improved travel times
- Greater service frequency
- Improved schedule reliability
- Other EBS features (e.g., stations, real-time information, new vehicles, etc.)

While most of the ridership gains anticipated are associated with specific factors pertaining to the EBS service, an increase in ridership on the local CT Transit Route 41 service is also expected, particularly in the mid-day period when service frequencies are effectively doubled between major stop locations, i.e., the combined headway of local and EBS services becomes 20 minutes vs. 40 minutes at present. Therefore, a similar elasticity for service frequency increase is applied to the mid-day local ridership on Route 41.

Customers who are already using CT Transit services in the corridor are likely to take advantage of the increased service frequencies and take the first bus that comes to their boarding location, assuming they are alighting at a stop served by both the EBS and local. On the other hand, some new customers attracted to the specific features of the EBS service may be more

inclined plan their schedules to ride these buses as opposed to boarding the first bus. Assuming an overall satisfaction with the transit service provided, this behavior may shift in favor of riding all buses over time. On average, approximately 80% of Route 41 ridership occurs at the designated EBS station locations, indicating that the number of customers traveling between non-key bus stops is relatively small.

With this subtotal of current and short-term gain established, a 25% growth factor over five years is also applied to both local and EBS services. This factor accounts for strong growth in the Route 41 service ridership in recent years and overall background growth. Contributing background growth elements include residential and commercial development along the corridor and increased enrollment at Norwalk Community College, which has seen total enrollment grow 22% since 2000. This growth is expected to continue. Furthermore, ridership on CT Transit's Route 41 has been increasingly steadily in recent years, increasing vehicle requirements and leading to overcrowding at various times during the day.

Note that all ridership gains are applied to the EBS service in this set of calculations, focusing on the added frequency and amenities provided by this new service. It is likely, however, that even further gains may be realized on the Route 41 local service given the overall service frequency increase, particularly during the off-peak period.

Detailed ridership estimation methodology is provided in Appendix 10.

Summary of Annual Ridership Estimates

1.	Existing weekday CT Transit Route 41 riders	723,690
	a. Allocated to EBS	406,980
	b. Remaining on Route 41 local	316,710
2.	Added riders (EBS):	
	a. Rerouting EBS in Stamford	76,500
	b. Travel time savings	26,520
	c. Greater service frequency	18,870
	d. EBS features (stations, vehicles, ITS, etc.)	20,655
Subtotal		142,545 added EBS riders
3.	Total EBS riders	549,525
	Total Route 41 riders	316,710
4.	Total system riders (Route 41 + EBS)	866,235
5.	Growth factor: 25% to 2014	1,082,794 annual passengers (EBS and Route 41 services)

Section 11 – Conclusion

This plan provides an outline for the operational, planning, and capital considerations necessary for implementation of an enhanced bus service in the U.S. Route 1 corridor between Stamford and Norwalk. The EBS is designed as an overlay to operate in a coordinated schedule with CT Transit's Route 41 service in the corridor with a distinctive new identity and new passenger amenities and equipment.

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