Chapter 2
Minimum Build Scenario

The chapter that follows evaluates a "Minimum Build" Scenario. This scenario could be described in general terms as the minimum amount of improvement that would be necessary to allow a commuter rail service to function in the existing infrastructure found in the corridor. The minimum build scenario comprises commuter rail service between Springfield and New Haven that could be operated over the existing rail infrastructure with minimum improvements. Only existing stations along the corridor were used for this scenario.

2.1 Minimum Build Scenario Service

Illustrative schedules were developed to determine the potential level of service that can be provided. The schedules reflect current Amtrak train service (March 2003) and utilize only those stations now in service. Based on the results of the ridership analysis, the minimum build scenario attempts to satisfy the following service objectives:

- Southbound morning peak service originating in Springfield traveling into Hartford, with comparable afternoon return trains.
- Southbound morning peak service originating in Springfield traveling into New Haven, with comparable afternoon return trains.
- Southbound morning service originating in Springfield traveling into New Haven that permits connections to Metro North for commuters destined west of New Haven, with comparable afternoon return service.
- Northbound morning peak service originating in New Haven traveling into Hartford, with comparable afternoon return trains.
- Northbound morning peak service originating in New Haven traveling into Springfield, with comparable afternoon return trains.

The Rail Traffic Controller (RTC) simulation software was used to develop illustrative operating schedules, built around the assumption that current Amtrak schedules would be retained and no additional track capacity (no new sidings or siding extensions) would be provided for meets between northbound and southbound trains. The service pattern that appears most feasible is shown in Table 2-1 and Table 2-2.

Table 2-1
Minimum Build Illustrative Southbound Weekday Schedule

	AM						PM				
Station	CDOT #1	Amtrak #141	CDOT #3	CDOT #5	CDOT #7	Amtrak #471	Amtrak #55	Amtrak #475	CDOT #9	CDOT #11	Amtrak #477
Springfield	5:30	6:00	6:30	7:10	8:10	9:00	**12:55**	**4:15**	**4:55**	**5:25**	**6:40**
Windsor Locks	5:49	6:20	6:49	7:29	8:36	9:18	----	**4:33**	**5:14**	**5:41**	**6:58**
Windsor	5:55	6:26	6:55	7:35	8:42	9:23	----	**4:38**	**5:24**	**5:59**	**7:03**
Hartford	6:04	6:38	7:04	7:44	8:52	9:34	**1:30**	**4:49**	**5:33**	**6:09**	**7:14**
Berlin	6:17	6:51	7:20	7:58	9:04	9:45	**1:46**	**5:00**	**5:46**	**6:21**	**7:25**
Meriden	6:27	7:01	7:30	8:08	9:14	9:53	**1:56**	**5:08**	**5:56**	**6:31**	**7:33**
Wallingford	6:35	7:09	7:39	8:17	9:24	10:00	----	**5:15**	**6:05**	**6:40**	**7:40**
State Street	6:48	----	7:53	8:30	9:37	----	----	----	**6:19**	**6:53**	----
New Haven	6:51	7:28	7:56	8:33	9:40	10:20	**2:23**	**5:35**	**6:22**	**6:56**	**8:00**
Running Time	1:21	1:28	1:26	1:23	1:30	1:20	1:28	1:20	1:27	1:31	1:20

Source: Amtrak, Wilbur Smith Associates

Table 2-2
Minimum Build Illustrative Northbound Weekday Schedule

	AM					PM						
Station	CDOT #2	CDOT #4	Amtrak #490	Amtrak #56	Amtrak #474	CDOT #6	CDOT #8	CDOT #10	Amtrak #142	CDOT #12	Amtrak #494	Amtrak #148
New Haven	6:30	7:10	9:05	**1:00**	**2:10**	**3:45**	**4:20**	**4:55**	**5:25**	**6:35**	**7:20**	**8:30**
State Street	6:33	7:14	----	----	----	**3:49**	**4:23**	**4:58**	----	**6:39**	----	----
Wallingford	6:48	7:27	9:18	----	**2:23**	**4:02**	**4:37**	**5:12**	**5:39**	**6:52**	**7:33**	**8:44**
Meriden	6:57	7:36	9:25	----	**2:30**	**4:11**	**4:46**	**5:21**	**5:48**	**7:01**	**7:40**	**8:52**
Berlin	7:08	7:46	9:34	----	**2:39**	**4:21**	**4:56**	**5:31**	**5:57**	**7:11**	**7:49**	**9:02**
Hartford	7:20	7:58	9:47	**1:44**	**2:52**	**4:33**	**5:10**	**5:45**	**6:11**	**7:32**	**8:02**	**9:16**
Windsor	7:29	8:07	9:55	----	**3:00**	**4:43**	**5:20**	**5:55**	**6:20**	**7:42**	**8:10**	**9:24**
Windsor Locks	7:36	8:13	10:00	----	**3:05**	**4:49**	**5:26**	**6:01**	**6:26**	**4:48**	**8:15**	**9:30**
Springfield	7:55	8:32	10:25	**2:20**	**3:30**	**5:12**	**5:44**	**6:19**	**6:50**	**8:06**	**8:40**	**9:55**
Running Time	1:25	1:22	1:20	1:20	1:20	1:27	1:24	1:24	1:25	1:31	1:20	1:25

Notes: Commuter schedules are illustrative, based on RTC simulation of train operations. AMTRAK schedules are current (March 2003) schedules. PM times are shown in bold face. Source: Amtrak, Wilbur Smith Associates

The schedules provide four southbound trains during the morning peak. The first of these departs Springfield at 5:30 AM and arrives in New Haven before 7:00 AM. It facilitates transfer to Metro North service to communities west of New Haven with arrival times before 8:00 AM. The first commute train is followed by Amtrak #141, which serves all the same stations except State Street, and continues through New Haven to New York and Washington. Three more commute trains then follow, departing Springfield at 6:30, 7:10, and 8:10 AM. Ideally, the last of these should leave Springfield earlier, but the schedule is determined by the arrival of a northbound commute train in Springfield that uses the same equipment.

These southbound morning schedules are mirrored in the afternoon, with three departures from New Haven at 3:45, 4:20, and 4:55 PM, followed by Amtrak #142 at 5:25 PM, and a final commuter train at 6:35 PM.

In the reverse direction, the schedules provide two northbound commute trains leaving New Haven at 6:30 and 7:10 AM, followed by Amtrak #490 at 9:05 AM. Comparable afternoon service leaves Springfield at 4:55 and 5:25 PM. These trains are complemented by Amtrak southbound trains at 4:15 and 6:40 PM.

This service would require 4 sets of commuter equipment to make 12 one-way trips each weekday.

The RTC simulation shows that this level of service would be feasible, but would depend on a high degree of schedule adherence. Should any one train in the morning or afternoon peak periods experience a delay, the limited number of passing locations on the line would cause collateral delays to one or more successive trains in both directions. Some trains would need to meet four trains in the opposing direction, and there are only five locations for these meets. The current track infrastructure effectively limits passenger train frequencies to about one train every 30 to 35 minutes. The number of trains suggested by the illustrative schedules during the morning and evening peaks would also place significant restrictions on the ability to provide freight service during these time periods. This would effectively preclude switching to industries located directly on the main line, but would have a lesser impact on freight service that can utilize yard track and industrial leads without blocking the main line.

Three caveats are required concerning the illustrative commuter rail schedules. First, detailed analyses of station operations in Springfield and New Haven have not been conducted, and the schedules are based on assumptions that station capacity is sufficient. Further evaluation of the schedules with Amtrak and Metro North will be necessary to confirm their viability, and some adjustments may be anticipated. Second, the needs of the freight operators and customers on the line need to be reviewed with Amtrak and each freight operator to determine their abilities to adjust current freight operations to "work around" the morning and evening peak periods. Third, it is expected that Amtrak's own schedules will change over time, and these changes may impact the ability to operate commuter service at the most desirable times. A number of schedule revisions were

made in April 2003, after the minimum build work was completed. Further Amtrak service changes are anticipated before commuter service can be initiated.

2.2 Stations Under a Minimum Build Scenario

The minimum build scenario comprises commuter rail service between Springfield and New Haven that could be operated over the existing rail infrastructure with minimum improvements. As shown in Figure 2-1, only existing stations along the corridor were used for this scenario. The service would therefore include the following stops:

- New Haven Union Station
- New Haven State Street Station
- Wallingford Station
- Meriden Station
- Berlin Station
- Hartford Union Station
- Windsor Station
- Windsor Locks Station
- Springfield Union Station

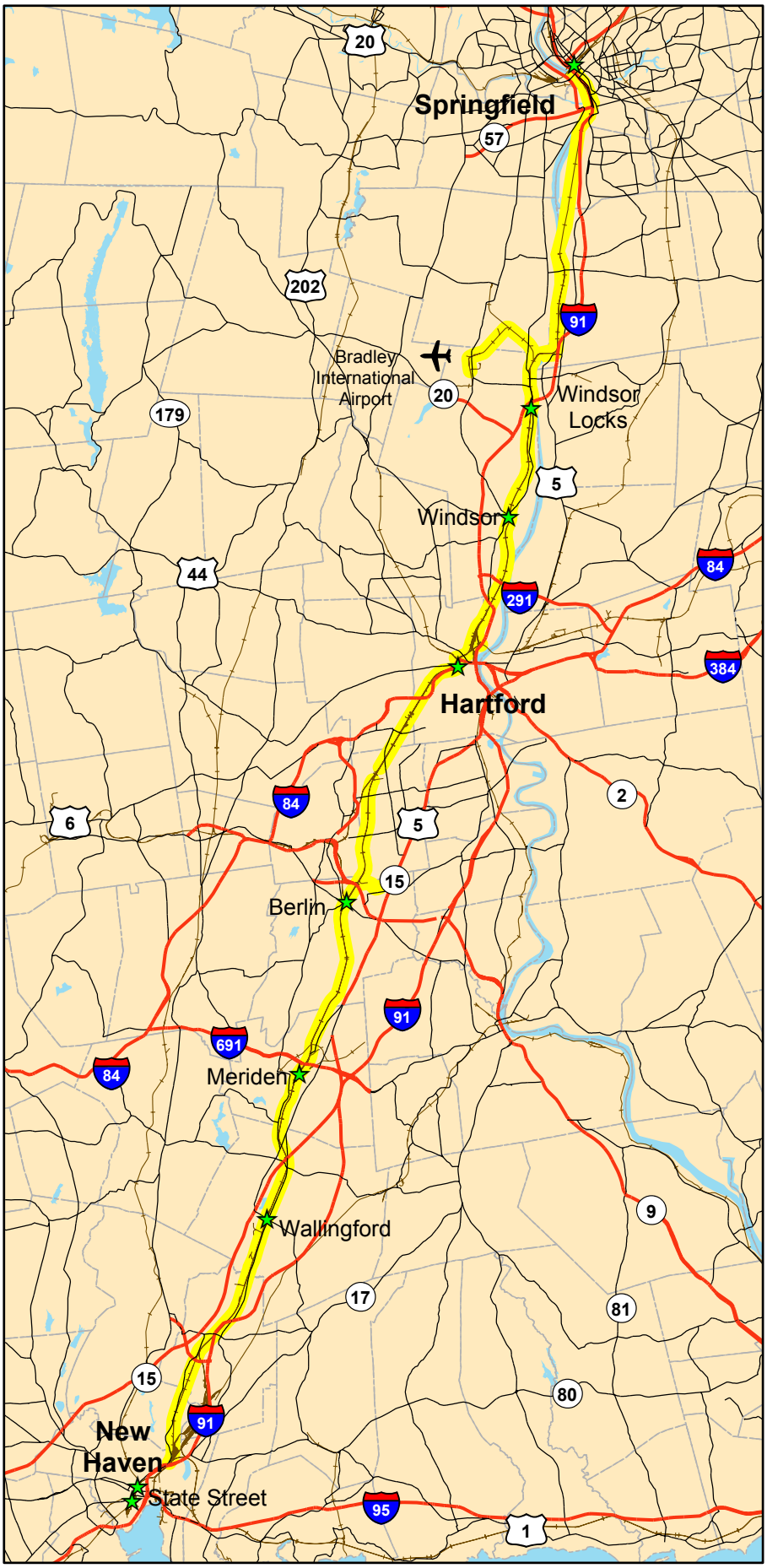
2.3 Construction of a Minimum Build Service

For this scenario, it was assumed that no additional double track segments would be added. Station platforms and buildings would be used in their current condition. However, additional parking would be provided at these stations as required by the projected ridership that would be generated.

2.4 Ridership Levels Under a Minimum Build Service

The ConnDOT model was used as the primary basis for calculating ridership on the line. Using the 2020 no build model, the seven stations from Wallingford north were added to the model with service headways of 30 minutes in the peak hours. Factors were developed to estimate ridership to and from Springfield, as this is an external node in the model. The resulting ridership was slightly modified to reflect reasonable rail capture rates derived from a comparison between home based work trips and rail trips. The resulting commuter ridership was factored up by 10% to account for non-home based and home based other trips occurring on the line. These trips are considered minimal with this service, because it would primarily run in the weekday peak hours.

The resulting station to station minimum build daily ridership is shown in Table 2-3. It is estimated that this new service scenario would generate 1,767 total daily trips on the corridor. In addition, it is expected that Amtrak will continue to have approximately 600 daily trips on trains between Springfield and New Haven (not including Vermonter ridership).



Minimum Build Stations

New Haven - Hartford - Springfield
Commuter Rail Feasibility Study

Legend

- Rail Study Corridor
- Highways
- Major Roads
- Existing Rail Stations

N W E S

0 5 10 Miles

Figure 2.1

Table 2-3
Minimum Build Daily Ridership

Station	Daily Trips
Metro North / Shore Line	210
New Haven	57
State Street	97
Wallingford	343
Meriden	167
Berlin	155
Hartford	436
Windsor	99
Windsor Locks	62
Springfield	141
Total	**1,767**

Note: Does not include approximately 600 daily Amtrak trips on the line
Source: Wilbur Smith Associates as modified from the ConnDOT Model

2.5 Capital Costs for a Minimum Build Service

Capital costs for the minimum build scenario consist of three components: train set equipment (locomotives and cars), a maintenance facility for the equipment, and additional parking at the stations sufficient to handle the anticipated ridership.

2.5.1 Train Set Equipment

For minimum build New Haven-Hartford-Springfield service, the anticipated train set would consist of a locomotive and three passenger cars. The service would require four train sets, plus spares. The specific equipment required is discussed in this section.

Locomotives

An appropriate locomotive type for the New Haven-Hartford-Springfield service would be a basic "mid range" locomotive used in commuter rail service today. One locomotive can typically haul 5 or 6 commuter cars, but in the minimum build scenario, it would only haul three. The estimated costs of a locomotive come in a range of about $2.8 million for a basic "no frills" passenger locomotive[1] to about $4.5 million for a high-end AC power locomotive[2]. Delivery costs would be a negligible percentage of the purchase price.

[1] Per conversation with Preston Cook of Engine Systems Inc. (ESI), distributor for EMD.
[2] Per conversation with Peter Richter of the Connecticut Department of Transportation.

Cars

The cars would need to board and alight riders at stations that currently have either low or high platforms. The New Haven-Hartford-Springfield service would use two car types: a cab car and a trailer car or coach. The cab car has an engineer's compartment, which the coach does not. Cab cars are used in a "push pull" configuration. With a cab car on the opposite end of the train from the locomotive, the train set can be operated in either direction, obviating the need to reposition the locomotive from front to back. A cab car typically has 109 seats. A coach car typically has 111 seats with a restroom. An average cost of $1.37 million is assumed for both car types.[3] Delivery costs would be a negligible percentage of the purchase price.

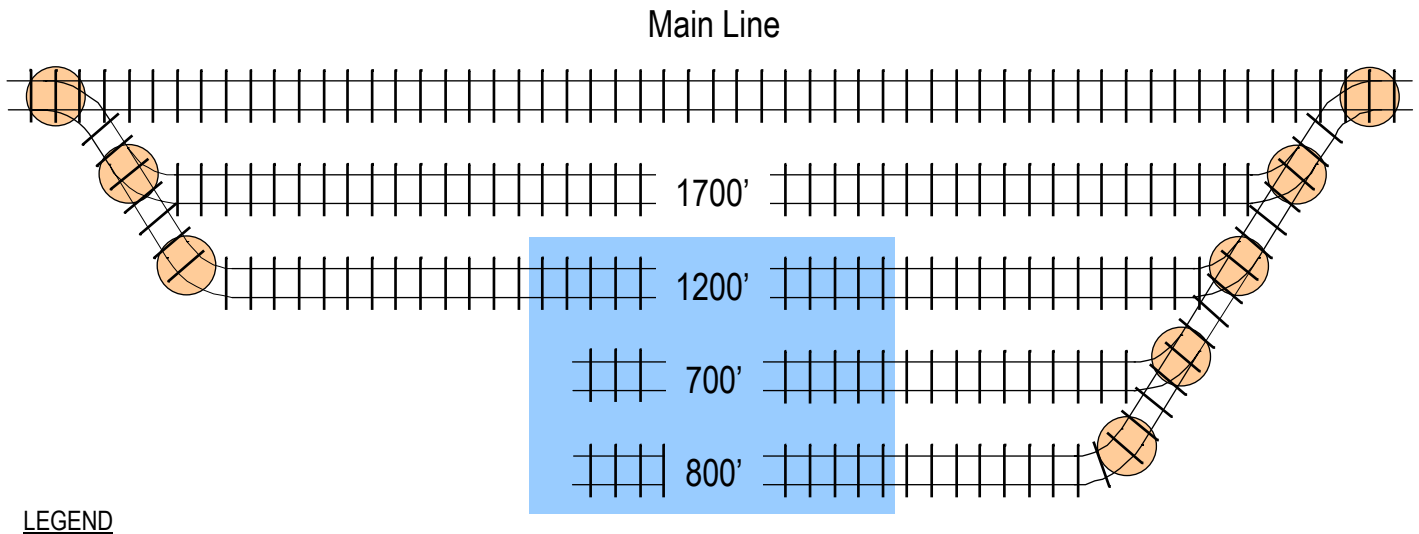
2.5.2 Maintenance Facility/Storage

Regardless of the service scenario, there would be a need for a maintenance and storage facilities. Accordingly, a maintenance facility is not a distinguishing factor *per se* for the various service scenarios to be considered during the course of this project. While it would be ideal that the rolling stock could be maintained at the existing Shore Line East maintenance facility in New Haven, the limitations of existing track and space for new track to store and service trains sets there may preclude this potential. In any case, one train set would overnight in New Haven. This would require a layover at Union Station, where the set could be serviced prior to the next day's runs.

Currently, ConnDOT has plans for the expansion of its New Haven maintenance facility. It is believed that this expansion would not be able to accommodate current and future New Haven Line and Shore Line East rolling stock plus the New Haven – Hartford – Springfield equipment. It is likely that with the expanded maintenance and shop facilities, servicing New Haven – Hartford – Springfield equipment could be done in New Haven, but storage of the equipment may still be a problem. A representative schematic of the facility is shown in Figure 2-2. Conceptually, the facility could include the following:

- A 1,700-foot siding off of the main line track where the rail service equipment would be stored overnight. This includes two switches off the main line. The facility itself would have three tracks: a 1,200-foot run through track linking with the siding and two stub-end tracks, totaling 1,500 track feet. This track arrangement would permit three train sets to be maintained without one blocking the other, and would also provide room for fleet expansion. Facility track feet would total 4,400 feet.
- The facility would include a 250-foot by 500-foot insulated prefabricated metal shop building with a cast in-place concrete floor, work bench/shop area, small office area and utility / restroom area.

[3] Per Connecticut Department of Transportation study entitled *New Haven Line Fleet Configuration Analysis*, Task 5: Lifecycle Cost Analysis, page 102.



LEGEND

250’ x 500’ insulated pre-fab building

Switch

Notes:

- 1700’ siding off rail line
- 1200’ run through track
- 700’ stub track for work / storage
- 800’ stub track for work / storage

MAINTENANCE FACILITY SCHEMATIC FOR MINIMUM BUILD

ENGINEERS
PLANNERS
ECONOMISTS

Wilbur Smith Associates

FIGURE 2.2

- The area around the building would be paved, including a paved access road to the facility tracks. The areas on each side of and between the rails would also be paved to facilitate all weather vehicular access to the rail equipment.
- The site improvements around the facility – including the building and surrounding yard area, access roads, and rail equipment tracks – would be illuminated.
- The maintenance facility would be furnished with the appropriate maintenance tools and necessary supplies and equipment for routine servicing and cleaning of the rail equipment including four 100-ton screw jacks, crane or hoist, and welding, grinding, bending and machining equipment and fueling facility. The facility would have its own electrical generator in case of a local power failure.
- The maintenance facility would be furnished with a 4x4 pickup for maintaining the parking areas and maintenance access areas.

The cost for such a facility would be approximately $12 million, inclusive of contingencies, but not including land acquisition. Land requirements would be in the range of 15 to 22 acres, estimated at about $4 million, exclusive of environmental clean-up that may be required due to the necessary location along the rail right-of-way. Therefore the total cost would be approximately $16 million, exclusive of environmental costs.

2.5.3 Station Costs

Parking is currently available to some degree at almost all stations along the line. At many stations, the number of parking spaces is limited and is currently almost filled to capacity with Amtrak riders. By matching boardings with existing station parking facilities along the line, it was determined that there would be a deficit of approximately 510 parking spaces. For the minimum build, additional parking would be constructed or leased in the following amounts:

- Wallingford 200 spaces
- Meriden 175 spaces
- Berlin 85 spaces
- Windsor 50 spaces

ConnDOT is typically able to construct surface lot parking for about $5,000 per space including construction costs for the entire lot (aisles, entrance, etc). An additional cost for land was added in the amount of $200,000 per acre. Typically, approximately 100 spaces can be constructed per acre. An additional land acquisition cost of $2,000 per space was therefore added to the $5,000 construction cost. Assuming a unit cost of $7,000 per parking space, 510 new parking spaces would cost $3,570,000.

In addition to the parking costs, a second platform will need to be constructed at Meriden Station for the proposed service. Currently, Amtrak trains only use one of the tracks that

pass Meriden Station and both tracks will need to be used for this service. The cost of this platform is estimated at $50,000. However, a high-level platform may be required if new platforms are constructed due to ADA regulations. This will be investigated further in the implementation plan.

2.5.4 Total Capital Costs

A summary of capital costs appears in Table 2-4. The total capital cost of $85.82 million includes four train sets, spares, the maintenance facility and additional parking.

Table 2-4
Minimum Build Scenario Capital Costs

	Cost/unit	Units	Cost
Locomotive	$4,500,000	5	$22,500,000
Coach	1,370,000	9	12,330,000
Cab car	1,370,000	5	6,850,000
Total train set cost			**41,680,000**
Maintenance facility			16,000,000
Parking	7,000	510	3,570,000
Second Meriden Platform			50,000
Subtotal			**61,300,000**
Contingency		40%	24,520,000
Total capital costs			**$85,820,000**

Source: Wilbur Smith Associates

2.6 Operating Costs for a Minimum Build Service

This analysis calculates operating costs by multiplying the New Haven-Hartford-Springfield service's projected annual train miles for its minimum build scenario times a representative cost per train mile.

2.6.1 Train Miles

A train mile measures the distance a train travels. That is, a train set traveling one mile equals one train mile. The minimum build scenario schedule developed to date has 6 round trips per day or 12 one-way trips each weekday. According to Amtrak, a run between New Haven and Springfield is 58 miles; 6 round trips would generate 696 revenue train miles per day. Fifty-two weeks at 5 days per week totals to 260 days of operation, less some holidays on which New Haven-Hartford-Springfield service would not run. (Note that Shore Line East and most commuter rail systems in the US have approximately 254 operating weekdays per year). Annual train miles are thus calculated:

696 train miles multiplied by 254 days produces 176,784 train miles per year, exclusive of any shop moves or deadheading for maintenance purposes.

2.6.2 Cost per Train Mile

To understand a relevant operating cost per train mile, this analysis considered current operating costs on Shore Line East (SLE). The New Haven-Hartford-Springfield service would have operating characteristics similar to SLE. That is, just as SLE, the service would run on an Amtrak line and likely use Amtrak crews. It would be dispatched by Amtrak dispatchers in Boston and likely would be maintained by Amtrak forces. It is reasonable to assume, therefore, that its operating cost per train mile would be similar to that of SLE. SLE operating costs, revenue train miles, and operating costs per train mile for three recent years appear below in Table 2-5.

Table 2-5
Shore Line East Operating Costs per Train Mile

Year	Operating Cost	Train Miles	Cost/ Train Mile
1999	$5,702,061	160,160	$35.60
2000	$6,081,910	132,117	$46.03
2001	$7,486,284	197,314	$37.94

Source: Wilbur Smith Associates

A cost estimate for the New Haven-Hartford-Springfield service of $40 per train mile is reasonable, given the SLE experience. Accordingly, an annual operating cost for the service would be derived as follows: 176,784 annual train miles at $40 per train mile totals to $7,071,360.

2.7 Revenue Under a Minimum Build Service

To calculate farebox revenue for the minimum build service, a similar fare structure to that used for Shore Line East and Metro North was developed by ConnDOT. Table 2-6 shows the suggested one-way fare matrix for service on the line using the formula $2.293 + $.138 per mile greater than 10 miles, rounded to the nearest quarter dollar. Table 2-7 shows the suggested monthly fares on a per trip basis. Monthly fares are 50% of the one-way fares and the per trip cost is based on 42 trips per month. For this service, it was assumed that 80% of riders would be using a monthly pass.

Based on the fare structure and daily ridership presented, revenue would be $3,432 per day. Using 254 days of service per year, the annual revenue would be $871,728. This equates to a farebox recovery rate of 12.3%. Therefore, given the minimum build scenario is projected to cost $7.07 million to operate with revenues at $0.87 million, the annual operating deficit would be at $6.2 million annually and the subsidy per passenger would be $13.81. This is in addition to the capital costs of $85.82 million.

Table 2-6
Proposed One-Way Fare Matrix

From/To	New Haven	State Street	Wallingford	Meriden	Berlin	Hartford	Windsor	Wind. Locks	Springfield
New Haven	--	$2.25	$2.75	$3.50	$4.50	$6.00	$6.75	$7.50	$9.50
State Street	$2.25	--	$2.50	$3.50	$4.50	$6.00	$6.75	$7.25	$9.50
Wallingford	$2.75	$2.50	--	$2.25	$2.75	$4.25	$5.00	$5.75	$7.75
Meriden	$3.50	$3.50	$2.25	--	$2.25	$3.50	$4.25	$4.75	$7.00
Berlin	$4.50	$4.50	$2.75	$2.25	--	$2.25	$3.25	$3.75	$6.00
Hartford	$6.00	$6.00	$4.25	$3.50	$2.25	--	$2.25	$2.25	$4.50
Windsor	$6.75	$6.75	$5.00	$4.25	$3.25	$2.25	--	$2.25	$3.50
Windsor Locks	$7.50	$7.25	$5.75	$4.75	$3.75	$2.25	$2.25	--	$3.00
Springfield	$9.50	$9.50	$7.75	$7.00	$6.00	$4.50	$3.50	$3.00	--

Note: Fare calculated at $2.293 + $.138 per mile greater than 10 miles, then rounded to nearest quarter dollar. Source: ConnDOT

Table 2-7
Proposed Monthly Fares per Trip

From/To	New Haven	State Street	Wallingford	Meriden	Berlin	Hartford	Windsor	Wind. Locks	Springfield
New Haven	--	$1.15	$1.32	$1.73	$2.25	$2.98	$3.42	$3.70	$4.73
State Street	$1.15	--	$1.28	$1.70	$2.22	$2.94	$3.39	$3.67	$4.70
Wallingford	$1.32	$1.28	--	$1.15	$1.39	$2.11	$2.56	$2.84	$3.87
Meriden	$1.73	$1.70	$1.15	--	$1.15	$1.70	$2.15	$2.42	$3.46
Berlin	$2.25	$2.22	$1.39	$1.15	--	$1.18	$1.63	$1.91	$2.94
Hartford	$2.98	$2.94	$2.11	$1.70	$1.18	--	$1.15	$1.18	$2.22
Windsor	$3.42	$3.39	$2.56	$2.15	$1.63	$1.15	--	$1.15	$1.77
Windsor Locks	$3.70	$3.67	$2.84	$2.42	$1.91	$1.18	$1.15	--	$1.49
Springfield	$4.73	$4.70	$3.87	$3.46	$2.94	$2.22	$1.77	$1.49	--

Note: Trip cost equals 50% of un-rounded One-Way fare formula based on 42 trips per month. Source: ConnDOT

2.8 Minimum Build Service Issues and Concerns

As shown by the RTC simulation, the level of service provided by this minimum build scenario would be feasible, but would depend on a very high degree of schedule adherence. The delay of any one train in the morning or afternoon peak periods would cause collateral delays to one or more successive trains in both directions due to the limited number of passing locations on the line. As mentioned previously in this report, some trains would need to meet four trains in the opposing direction, and there are only five locations for these meets. In addition to the delay to commuter and Amtrak trains, the operation of such a rigorous schedule on the line would cause significant delays to the freight operators on the line, pushing almost all freight operations into the mid-day and overnight hours.

It has also been shown with the RTC simulation that decreasing the service frequencies to 45 minutes will not improve service. The meets on this line are designed for service at 30-35 minutes or intervals of this time period (60-70 minutes, 90-85 minutes, etc). Even hourly service on the line would have to maintain a high degree of schedule adherence. In order to improve the reliability of the 30 minute bidirectional service, additional second track segments will be required.