APPENDIX A RIDERSHIP FORECASTING METHODOLOGY

A.1 INTRODUCTION

This report presents the methodology utilized by AECOM's in development and application of an intercity passenger rail ridership forecasting model for the Inland Route and Boston-to-Montreal Route. The study was conducted for the Commonwealth of Massachusetts with the participation of the State of Vermont and the State of Connecticut. The Inland Route connects the cities of Boston, Massachusetts, and New Haven, Connecticut, via the cities of Worcester, Massachusetts, and Springfield, Massachusetts. This Boston-to-New Haven route via Springfield has been identified as the Inland Route to differentiate it from the Northeast Corridor, which also connects the two cities. The study's Boston-to-Montreal Route connects the cities of Boston, Massachusetts and Montreal, Quebec, via the cities of Springfield, Massachusetts and White River Junction, Vermont.

The model utilized for this study is based on travel market data throughout Massachusetts, Connecticut (and Northeast Corridor) and Vermont, historical rail ridership data and trends, and demographic data. Other models providing a foundation for the model include models developed for Amtrak's Northeast Corridor, Southeast Corridor, California Corridor, Florida and the Midwest States.

Below is a list of inputs required to complete the analysis:

- Rail schedules for the Inland Route & Boston-to-Montreal Route services.
- Geographic zone system covering the entire study area.
- Highway network connecting all the zones, all the rail stations and all the airports in the study area.
- Socio-economic data for the zone system.
- Ridership information for existing passenger rail services in Massachusetts, Connecticut and Vermont.
- Travel characteristics for auto, air, and rail in the study area.

A.2 STUDY AREA GEOGRAPHY

The study area includes the states of Massachusetts, Connecticut, Vermont, and Southern New Hampshire, Montreal, QC metro area (including Montreal, Monteregie, and Laval) and New York metro area (New York City, Nassau County, Suffolk County, and Bergan County, New Jersey).

A geographic based zone system was developed for this study area. This zone system defines the geographic level of detail at which the intercity travel demand forecasting process is applied. The zone system is based on census division for the entire study area. The zone system prepared for the Northeast corridor study was used as the starting point to create the zone system for this study. This current study is focused around the geographic area surrounding the Boston-Springfield-Hartford-Montreal-New York metro areas. Figure A-1 shows the study area zone system consisting of a total of 74 zones along the study area corridor. Figure A-2 shows aggregated system for regions, consisting of groups of zones, with 12 major markets for data display and summary purposes.

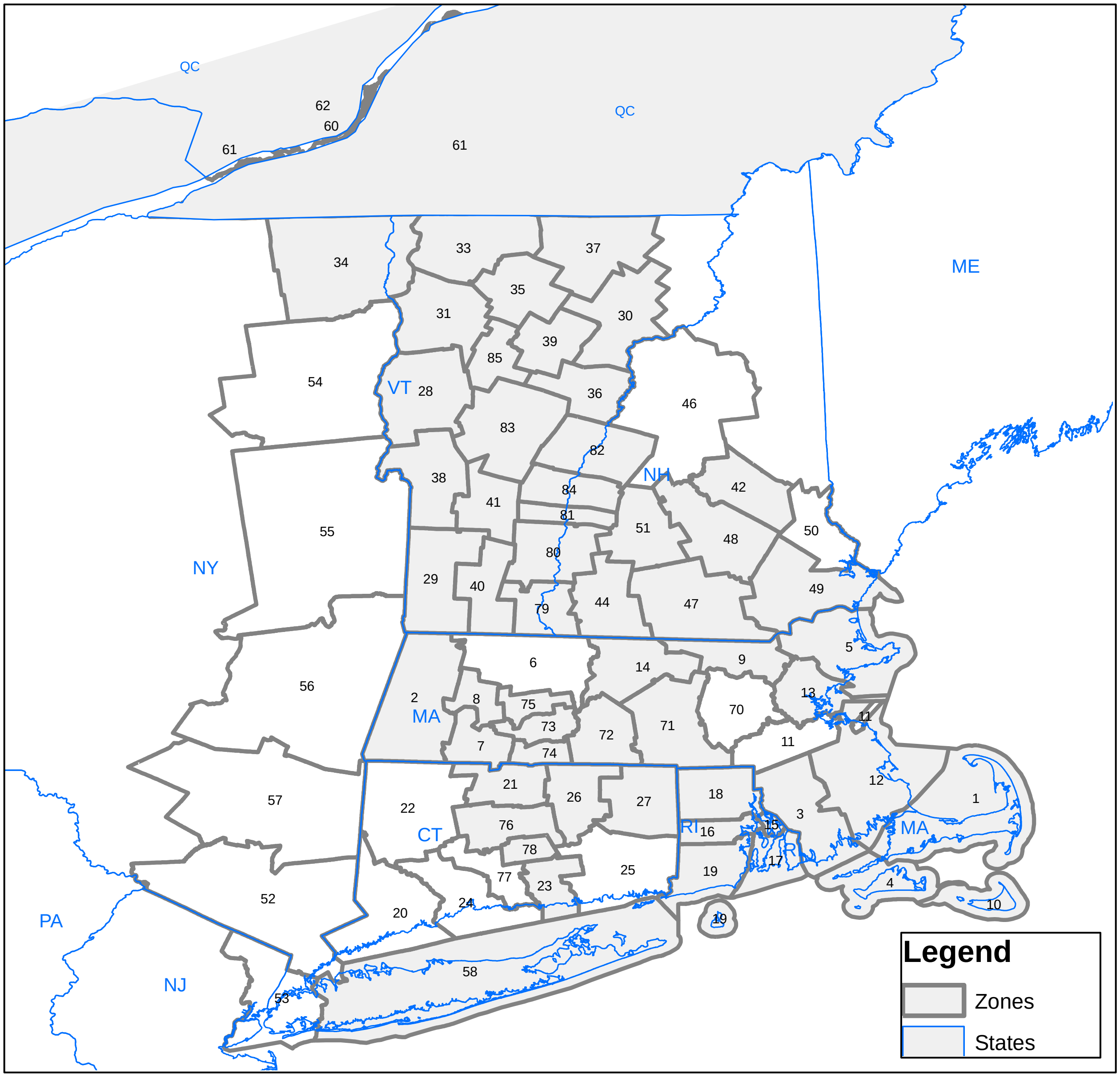


Figure A-1: Study Area Zone System

Figure A-2: Study Area Regions

A.3 BASE TRAVEL MARKET DATA

Intercity passenger travel market data for this study were assembled from a number of different existing sources. These sources include socio-economic and travel related service characteristics for the study markets. The scope of the study included relying as much as possible on existing travel survey data as opposed to collecting new travel survey data. In the current study, travel related service data is collected from the publicly available resources and socioeconomic data was obtained from AECOM's commercial vendor-Economy.com.

A.4 BASE AUTO MARKET DATA

Base auto market data was assembled using two sources. For the New England major markets, zonal base auto market data was estimated using the NEC Intercity Auto Origin-Destination study provided by Northeast Corridor Commission. For the rest of study area, zonal base auto market data was estimated using socio-economic characteristics including population, employment and income and travel related service characteristics including distance and travel time. The auto market estimation process is also the basis for most of the other nationwide studies conducted for Amtrak.

A.5 BASE RAIL MARKET DATA

Amtrak currently provides different types of services in the study area:

- Vermonter trains originating in St Albans, Vermont providing service to Vermont stations, Springfield, Hartford and New York;
- Northeast Regional trains originating in Springfield providing service to Hartford, New Haven, and New York; and
- Lake Shore Limited trains originating in Boston providing service to Springfield continuing to Chicago, Illinois.

Commuter services included in the study area:

- Hartford Commuter services providing service between Hartford and New Haven
- Massachusetts Bay Commuter Rail providing service between cities and towns throughout Massachusetts and Boston

Market data for rail travel was developed from station-to-station Amtrak ridership provided by Amtrak. Table A-1 below summarizes existing Amtrak service in the corridor providing the number of daily round trips serving a selection of major stations. The daily round trips in the table provide a summary for the different intercity services in the corridor.

Table A-1. Summary of Existing Inland Route Corridor Intercity Train Services

Service	Regional	Lakeshore	Vermonter	Total
Boston - Springfield	0	1	0	1
Springfield - New Haven	5	0	1	6
St-Albans - Springfield	0	0	1	1

A.6 BASE AIR MARKET DATA

Air market data (i.e., airport-to-airport volume data) was developed from the Federal Aviation Administration (FAA) 10 percent ticket sample and other similar sources. Major airports serving the study area include:

- General Edward Lawrence Logan International (BOS)
- Bradley International (BDL)
- Montreal International Airport (YUL)
- Burlington International (BTV)
- Manchester Boston Regional (MHT)
- New York Airports (JFK, EWR, LGA)

Table A-2 below summarizes the travel time, distance, and average fare for the major market airport pairs.

Table A-2. Summary for Major Market Airport Pairs

Origin	Destination	Fare	Time (mins)
BOS	JFK	$128	141
BOS	YUL	$287	75
BDL	YUL	$300	80
EWR	YUL	$200	90
BTV	LGA	$147	204
JFK	BTV	$115	80
JFK	MHT	$165	69

A.7 SUMMARY OF BASE MARKET DATA

Table A-3 summarizes the total estimated 2012 person trip volumes by purpose travel between different regions within the study area. The trip table estimation is based on combination of base auto, rail and air market data described in the above section. The trips by purpose are estimated using the NEC Auto Intercity Origin/ Destination Data trip purpose percentage share for the inland region.

Table A-3. Summary of 2012 Estimated Total Person Trips

Region to All Other Regions	Total	Business	Recreate	Other
Boston	1,298,103,460	197,557,741	267,448,451	833,097,267
Worcester	87,247,773	13,278,197	17,975,672	55,993,905
Springfield	270,648,342	41,189,841	55,761,719	173,696,782
Hartford	316,541,445	48,174,290	65,217,082	203,150,073

Region to All Other Regions	Total	Business	Recreate	Other
New Haven	340,097,391	51,759,258	70,070,317	218,267,816
New York	1,426,645,887	217,120,551	293,932,067	915,593,268
Southern VT-NH	320,232,510	48,736,032	65,977,552	205,518,926
Northern VT	270,978,027	41,240,016	55,829,644	173,908,367
Montreal	1,583,705,922	241,023,443	326,291,170	1,016,391,310

Note: Trips represent total person trips in both directions

A.8 MARKET GROWTH

Socio-economic data and forecasts were used to estimate market growth. These data were obtained from AECOM's national vendor Economy.com; which provides the forecasting data at annual intervals up to 2040 by county level. The three socio-economic indicators used in this project include:

- Population
- Employment
- Per Capita Income

Socio-economic data were obtained from the following sources:

- Economy.com
- Institute of Statistics of Quebec

Economy.com provided all the population and employment forecast, at the county level, for the study area within the United States region; whereas Institute of Statistics of Quebec was used for the study area within the Quebec, Canada region. The county level forecast was then projected at the census division level to eventually estimate the data at the zonal level.

Table A-4 provides a summary of 2012, 2020 and 2035 socio-economic data for the market regions within the study area.

Table A-4. Summary of Socio-Economic Data

Market Name	2012			2020			2035		
	Pop	Emp	Per Cap	Pop	Emp	Per Cap	Pop	Emp	Per Cap
Boston	5,674,830	2,910,242	48,947	5,882,427	3,195,636	60,146	6,050,430	3,343,694	81,244
Worcester	748,537	302,598	39,866	774,491	318,569	48,860	793,879	321,037	65,856
Springfield	789,607	336,977	35,947	813,241	355,439	43,869	825,749	366,427	60,817
Hartford	1,238,716	614,918	46,686	1,263,739	662,729	56,502	1,300,105	666,696	74,141
New Haven	1,029,302	432,847	44,419	1,049,871	459,087	52,683	1,082,200	466,249	66,991

Market Name	2012			2020			2035		
	Pop	Emp	Per Cap	Pop	Emp	Per Cap	Pop	Emp	Per Cap
New York	15,418,498	6,956,140	51,386	15,776,480	7,737,659	61,708	16,456,999	8,155,933	80,604
Providence	1,045,991	463,865	39,122	1,062,363	503,659	46,067	1,093,987	515,425	58,872
New London	392,863	170,941	39,304	403,473	186,727	48,203	420,803	191,006	64,427
Southern VT-NH	636,913	309,191	37,807	653,459	340,832	43,877	676,098	357,119	55,899
Northern VT	527,516	254,236	35,777	540,605	271,773	37,911	555,186	300,784	43,869
Montreal	3,861,642	1,939,300	46,254	4,077,023	2,048,772	46,051	4,480,863	2,254,031	45,721
Barnstable	245,223	112,515	50,703	256,120	117,943	60,070	269,689	125,586	80,915

A.9 TRAVEL DEMAND MODEL AND INPUTS

The travel demand modeling approach used in this project is based on a model system developed by AECOM and used in many previous applications to evaluate proposed intercity and high speed rail services for several states and Amtrak throughout the country. The travel demand model was originally developed from extensive market research and observed travel volumes and service characteristics by mode, conducted/assembled in the various study corridor markets including Northeast, Southeast and other regions. For application in this study area, data describing travel within the Massachusetts, Connecticut, Vermont and Southern New Hampshire, Montreal, QC metro area and New York metro area was used, including existing person trips by mode and purpose, and population/employment market growth, as described above.

A.10 MODEL STRUCTURE

The travel demand forecasting approach utilizes a two-stage model system. The first stage forecasts the growth in the total number of person trips in each market, and the second stage predicts the market share of each available mode in each market. Both stages are dependent on the service characteristics of each mode and the socio-economic characteristics of the corridor. The key markets addressed in the forecasting model system are defined by geographical location (i.e., origin-destination zone pair).

The first stage addresses the growth in the total intercity person travel volumes. This includes “natural” growth and “induced” demand. The “natural” growth component is measured by the growth in population and total non-farm employment. The “induced” component is captured by including a measure of the composite level of modal service, represented by the sum of the exponentiated utilities of all available modes as expressed in the mode share model, within the total travel model.

The second stage of the model is the mode share component, which estimates the share of total person travel by mode. Three different modes of travel considered were auto, rail, and air. Key variables in the mode share model include:

- Line haul travel time for all modes;

- Access/egress time for rail and air;
- Travel cost or fare; and
- Frequency of service for rail and air.

Total market-to-market frequencies were scaled based on arrival and departure times of each train serving the market. These scaling factors are based on the observed performance of trains in different departure/arrival time slots within rail corridors throughout the US. A train's utility and market share is determined by the combination of arrival and departure factors along with the time to the previous and subsequent trains, travel time, cost, access/egress times and on-time performance.

A.11 NETWORK AND SERVICE CHARACTERISTICS

Service characteristics are the key independent variable for the mode choice modeling process. The model in this project uses the following service characteristics:

- Travel time (minutes)
- Travel cost (dollars)
- Frequency (air and rail departures per day)

A.12 HIGHWAY NETWORK AND AUTO SERVICE CHARACTERISTICS

The auto service characteristics for each study area zone pair, including time, distance, and cost, were developed using a GIS-based intercity highway network. The network was derived from the Oak Ridge National Laboratory's existing highway database. Several modifications were made to match the highway network characteristics including functional classification within the study area for the states within the study area. Figure A-3 shows the resulting highway network, for the study area.

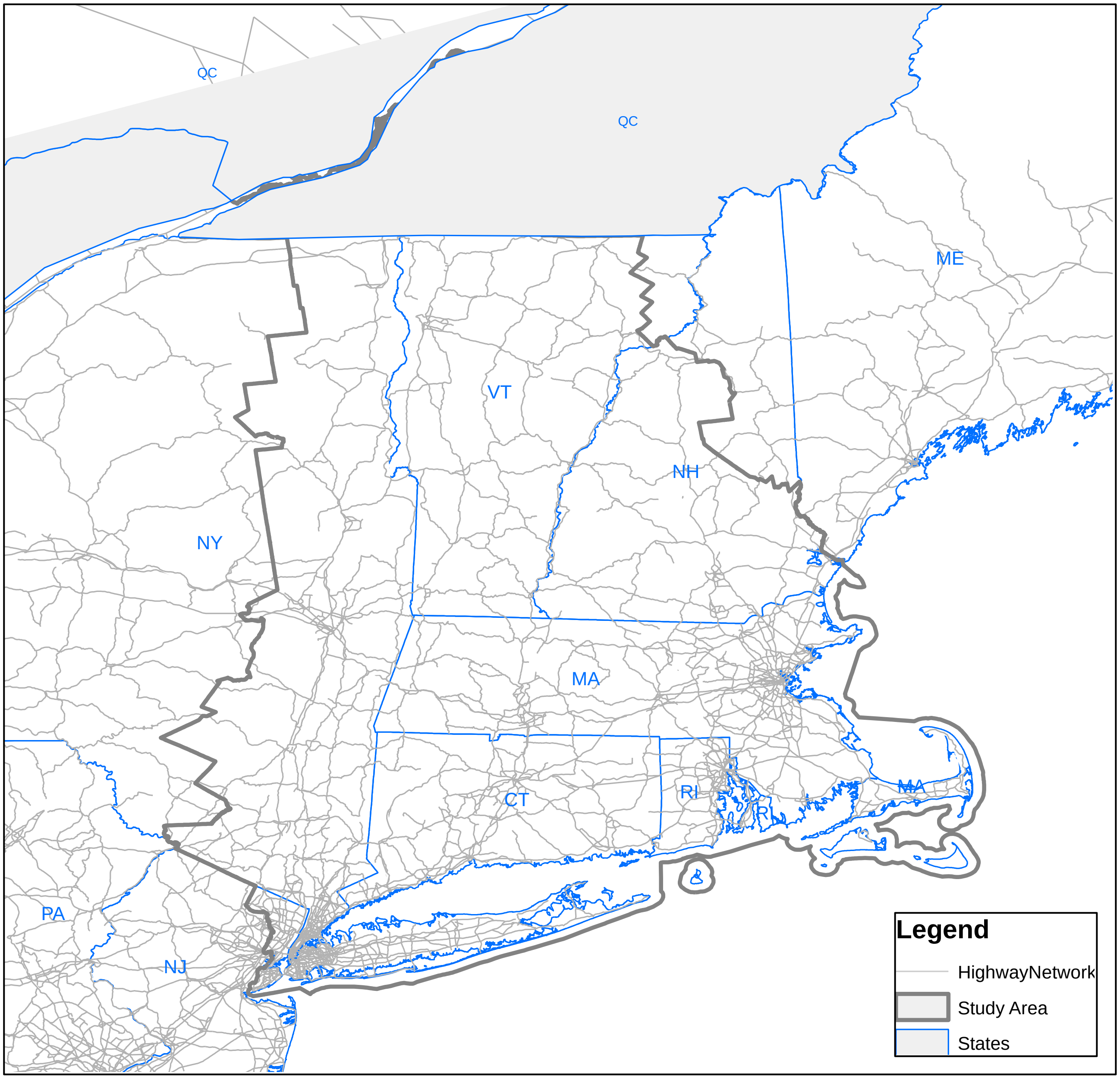


Figure A-3: Study Area Highway Network

In order to create zone-to-zone minimum travel times, a set of network skims were produced using an ArcGIS based application called Network Analyst. Network Analyst was used to calculate the minimum path, based on minimizing congested travel time, to/from each of the zone centroids in the study area. Each minimum path calculation developed the time, distance, and toll costs associated with the trip. Using the same procedure, access and egress times were calculated for all rail stations and airports within the study area.

This process produced zone-to-zone distance, toll, and time matrices based on the minimum congested travel time route between each study area zone pair. Table A-5 below summarizes the auto distance and congested travel time for the key markets in the corridor. It should be noted that the zone-to-zone estimated congested travel times may be higher than the Google/Mapquest travel times because of the in-route traffic congestion delays.

Table A-5. Summary of Auto Trip Characteristics for Key Markets

Origin	Destination	Distance (mi)	Avg. Time (mins)*
Boston	Montreal	342	360
Boston	Springfield	95	119
Springfield	Montreal	310	325
Springfield	New York	140	190
Worcester	New Haven	98	122

Note: Includes estimated delays in route due to congestion, etc.

Also in the above summary the origin and the destination for the markets represent the study area zonal centroids not necessarily the exact city center.

A.13 RAIL AND AIR SERVICE CHARACTERISTICS

Travel characteristics for rail and air travel were developed for each study area zone pair. The travel characteristics for rail and air were based on published timetables and the highway network. The key characteristics include line haul time, frequency of service, fares, terminal times, access/egress times and costs, and rail on-time performance. The line haul time is the scheduled rail/air time between stations/airports.

Published Amtrak timetables (2013) and airline data (2012), obtained from Bureau of Transportation Statistic (BTS), provide the basis for quantifying the line haul time and frequency of service in each market. Average rail fares were computed by dividing actual Amtrak revenue by ridership and average air fares were computed by dividing the total market fare by total passengers obtained from BTS.

The access/egress times and costs include the time/cost traveling from the origin zone to the boarding rail station/airport; the time/cost associated with the station, including waiting/boarding times and parking costs; and the time/cost traveling from the destination station/airport to the final destination zone. Access/egress times and costs for travel between zones and stations/airports were developed using the same network procedure and cost per mile rates described above and used for the auto zone-to-zone travel characteristics.

A.14 MODEL CALIBRATION

The mode choice model was calibrated to match existing ridership within the study area. The calibration process involved running the model using the time, cost, and frequency characteristics of the existing Amtrak service, with current population, employment and income data. The model parameters were then adjusted until the forecasted output corresponded with the actual ridership data.

APPENDIX B PROJECT COST ESTIMATE METHODOLOGY AND ASSUMPTIONS

This report presents the assumptions and methodology utilized for the development of capital cost estimates for the NNEIRI study. This includes information regarding what is included in the groups of projects that have been identified in the Investment Options. Each discrete project is estimated with unit costs and quantities. The total cost is estimated by using unit costs and multiplying that number by how many units (i.e. what length) of that item is needed. A 30% - 50% contingency value has been added to these costs to account for the level of project definition. All costs are developed using 2014 dollars.

The Recommended Alternative will provide modernization improvements, as well as upgrading infrastructure to accommodate at least 79 mph operations or Class 4 operating. Double tracking will be implemented between Worcester, Springfield, and Vermont. Further, the Recommended Alternative assumes the purchase of 8-10 trainsets to serve fleet requirements for the proposed services. The total capital cost of the Recommended Alternative is estimated between $827 – 969 million.

B.1 SECOND TRACK RESTORATION AND EXTENSIONS

Between Worcester and Springfield, there are three sections of track where a second track is proposed to be restored. The full double track from Worcester to Springfield was identified in the TPC analysis as necessary to accommodate full build passenger and freight operations. Historically, these segments have been double tracked but the second track was removed in the mid-20th century. Detailed in Tables B-1, B-2, B-3, and B-4 are the components of the proposed second track segments in Massachusetts and their associated costs. Project Task identifies the specific component, Quantity identifies how many of those components will be part of the project while Unit Cost is how much a unit of each component will cost. The Total Cost column then sums how much that specific component will cost to implement.

Table B-1. Cost Table for Second Track Between MP 48.3-57.7

Project Task	Quantity	Units	Unit Cost	Total Cost
Install New Turnouts	8	Each	$125,000	$1,000,000
Install New Track	10	Mile	$1,500,000	$14,250,000
Bridge Rehabilitation	340	Track Foot	$4,000	$1,360,000
Brush Cutting	10	Mile	$21,120	$201,000
RR Crossing Quadrants	0	Each	$25,000	$0
RR Crossing Surface	0	Each	$125,000	$0
Bridge Replacement	0	Track Foot	$12,000	$0

Project Task	Quantity	Units	Unit Cost	Total Cost
Bridge Redecking	220	Track Foot	$1,000	$220,000
Project Implementation	N/A	N/A	30%	$5,109,000
Contingency	N/A	N/A	30-50%	$6,700,000 - $11,100,000
Total				**$28.8-33.2 million**

Table B-2: Cost Table for Second Track Between MP 64.0-79.4

Project Task	Quantity	Units	Unit Cost	Total Cost
Install New Turnouts	8	Each	$125,000	$1,000,000
Install New Track	16	Mile	$1,500,000	$23,400,000
Bridge Rehabilitation	1170	Track Foot	$4,000	$4,680,000
Brush Cutting	16	Mile	$21,120	$329,000
RR Crossing Quadrants	0	Each	$25,000	$0
RR Crossing Surface	1	Each	$125,000	$125,000
Bridge Replacement	0	Track Foot	$12,000	$0
Bridge Redecking	1170	Track Foot	$1,000	$1,170,000
Project Implementation	N/A	N/A	30%	$9,211,000
Contingency	N/A	N/A	30-50%	$12,000,000 - $20,000,000
Total				**$51.9-59.9 million**

Table B-3: Cost Table for Second Track Between MP 83.6-92.0

Project Task	Quantity	Units	Unit Cost	Total Cost
Install New Turnouts	9	Each	$125,000	$1,125,000
Install New Track	9	Mile	$1,500,000	$12,900,000
Bridge Rehabilitation	395	Track Foot	$4,000	$1,580,000
Brush Cutting	9	Mile	$21,120	$182,000
RR Crossing Quadrants	0	Each	$25,000	$0
RR Crossing Surface	0	Each	$125,000	$0
Bridge Replacement	0	Track Foot	$12,000	$0

Project Task	Quantity	Units	Unit Cost	Total Cost
Bridge Redecking	185	Track Foot	$1,000	$185,000
Project Implementation	N/A	N/A	30%	$4,791,000
Contingency	N/A	N/A	30-50%	$6,300,000 - $10,400,000
Total				**$27.0-31.2 million**

Table B-4. Cost Table for Third Track Between MP 59.3-63.3

Project Task	Quantity	Units	Unit Cost	Total Cost
Install New Turnouts	2.00	Each	$125,000.00	$250,000
Install New Track	4.00	Mile	$1,500,000.00	$6,000,000.00
Bridge Rehabilitation	230.00	Track Foot	$4,000.00	$920,000
Brush Cutting	8.60	Mile	$21,120.00	$0
RR Crossing Quadrants	0.00	Each	$25,000.00	$0
RR Crossing Surface	0.00	Each	$125,000.00	$0
Bridge Replacement	0.00	Track Foot	$12,00.00	$0
Bridge Redecking	230.00	Track Foot	$1,000.00	$230,000.00
Project Implementation	N/A	N/A	30%	$2,220,000
Contingency	N/A	N/A	30-50%	$2,886,000 - $4,810,000
Total				**$12.5-14.5 million**

B.2 TRACK IMPROVEMENTS

The Recommended Alternative will utilize existing infrastructure and improve tracks to accommodate FRA Class 4, or maximum 79 mph operations. Track improvements include installation of new track, turnouts, and crossing upgrades. The anticipated cost for track upgrades is $78 to $88 million. Detailed in Table B-5 are the components of the track improvements in Massachusetts and their associated costs. Project Task identifies the specific component, Quantity identifies how many of those components will be part of the project while Unit Cost is how much a unit of each component will cost. The Total Cost column then sums how much that specific component will cost to implement.

Table B-5. Massachusetts Segment Project Costs Total

Project Task	Quantity	Units	Unit Cost	Total Cost
Install New Turnouts	0	Each	$125,000.00	$0
Install New Track	0	Mile	$1,500,000.00	$0
Culvert Extensions	0	Each	$50,000.00	$0
Brush Cutting	0	Mile	$21,120.00	$0
RR Crossing Quadrants	0	Each	$25,000.00	$0
RR Crossing Surface	0	Each	$125,000.00	$0
Furnish Ties	146,125	Each	$65.00	$9,498,125
Install Ties	146,125	Each	$35.00	$5,114,375
Furnish Rail and OTM	389,760	Linear Foot	$38.00	$14,810,880
Install Rail	389,760	Linear Foot	$26.00	$10,133,760
Furnish Ballast	144,484	Ton	$25.00	$3,612,100
Install Ballast	144,484	Ton	$15.00	$2,167,260
Surfacing	164	Track Mile	$10,600.00	$1,738,718
Ballast Undercutting	0	Track Mile	$125,000.00	$0
Grinding Passes	419	Pass Mile	$2,500.00	$1,046,400
Install New Diamond	1	Each	$500,000.00	$500,000
Project Implementation	N/A	N/A	30%	$14,586,485
Contingency	N/A	N/A	30-50%	$14,586,485 - $24,310,809
Total				**$78– 88 million**

B.3 BRIDGE IMPROVEMENTS

The Recommended Alternative will utilize existing bridges and seeks to improve them. This calls for 2,135 feet of bridge rehabilitation and 1,805 feet of bridge redecking. The anticipated cost for bridge work in Massachusetts is detailed in Table B-6. Project Task identifies the specific component, Quantity identifies how many of those components will be part of the project while Unit Cost is how much a unit of each component will cost. The Total Cost column then sums how much that specific component will cost to implement.

Table B-6. Massachusetts Bridge Improvements Cost Totals

Project Task	Quantity	Units	Unit Cost	Total Cost
Bridge Rehabilitation	2,135	Track Foot	$4,000.00	$8,540,000
Bridge Replacement	0	Track Foot	$12,000.00	$0
Bridge Redecking	1,805	Track Foot	$1,000.00	$1,805,000
Project Implementation	N/A	N/A	30%	$3,103,550
Contingency	N/A	N/A	30% - 50%	$4,000,000 - $6,700,000
Total				**$17.5-20.2 million**

B.4 SIGNAL IMPROVEMENTS

Signal improvements will be necessary in order to safely accommodate the Recommended Alternative. Five signals between Worcester and Springfield, MA will require replacing. The program proposes upgrading unequipped public crossings with active warning devices at three locations along the CSX section. Also, passive signage will be installed at 13 private crossings along the CSX section. All grade crossings along the Corridor will be brought into a state of good repair.

Detailed in Table B-7 are the costs associated with these signal improvements. The first two columns detail the Modernization Costs that would be necessary on each railroad operator’s lines. The last four columns detail the capital improvement expenditures that will be necessary on each railroad operator’s lines.

Table B-7. Signal Improvement Costs (without Contingency)

	[illegible]		[illegible]		
	Grade Crossings	**Wayside and Interlocking Signaling**	**Grade Crossings**	**Wayside and Interlocking Signaling**	**Railroad Totals PTC Alternative 1**
MBTA	$0	$0	$0	$0	$0
CSX	$2.7 million	$7.5 million	$0	$18.5 million	$28.7 million
PanAm	$0	$0	$0	$0	$0
NECR	$0	$0	$0	$0	$0
CN	Not Included				
Totals	**$2.7 million**	**$7.5 million**	**$0**	**$18.5 million**	**$28.7 million**

B.5 STATION INFRASTRUCTURE IMPROVEMENTS

It is proposed that a station stop be built in Palmer, Massachusetts. There is an existing historic headhouse and station platforms currently in place, but these facilities would not meet current operational requirements or passenger standards. A new facility would need to be constructed in the Palmer area. An exact location or station configuration has not yet been identified, however the following costs are typical for the improvements that would be necessary in the area. The costs associated with a Palmer station may be found in Table B-8.

Table B-8. Palmer Station Cost

Item	Estimated Cost
LED Station & Site Lighting	$300,000
Site Work (Parking, Landscaping, Sidewalks, Asphalt Paving)	$750,000
900’ Platform (Pre-Cast Concrete, Railings, Tactile Warning Strip)	$2,250,000
300’ Galvanized Steel Canopy	$350,000
ADA Accessible Ramps	$150,000
Staircase	$100,000
Track work (Passenger Siding, Turnouts)	$1,500,000
Other (Signage, Benches, Trash Receptacles)	$150,000
Land Acquisitions	$1,500,000
Project Implementation	$2,115,000
Contingency	$2,749,500 - $4,582,500
Total Cost	**$11.9 – 13.7 million**

A second platform at Worcester Union Station will be necessary to accommodate the additional passengers from the Recommended Alternative. Currently, only one platform would be serving the program, however a new 1000’ platform is proposed. The platform would connect to Union Station via vertical access to the existing pedestrian tunnel as well as a proposed walkway between the parking garage and tracks to connect the pedestrian tunnel to the platform. The costs associated with the Worcester station improvements may be found in Table B-9.

Table B-9. Worcester Union Station Cost

Item	Estimated Cost
LED Station & Site Lighting	$300,000
1000’ Platform (Pre-Cast Concrete, Railings, Tactile Warning Strip)	$2,500,000
ADA Accessible Ramps	$150,000

Item	Estimated Cost
Track Construction (New,Throws, etc.)	$247,000
Crossover Demolition	$15,000
Track Demolition	$35,000
Switches	$375,000
Other (Signage, Benches, Trash Receptacles)	$150,000
Staircase	$100,000
Elevator	$1,000,000
Interlocking	$5,000,000
Project Implementation Costs	$2,961,600
Contingency	$3,850,000 - $6,416,800
Total Cost	**$16.7 – 19.3 million**

B.6 LOCOMOTIVE AND ROLLING STOCK PURCHASES

8-10 new trainsets will be purchased as park of the Recommended Alternative, which calls for six-to-eight trainsets with two spares. The cost is approximately $27 million per train set for a total of $351 million. The anticipated equipment capital cost is based on the recent purchase price for PRIIA Fleet design train sets, and includes a 30 percent contingency. The contingency is not a range like with other costs because there is more certainty associated with trainset costs compared to infrastructure costs. Detailed in Table B-10 is the total trainset cost.

Table B-10. BOS – MTL Rolling Stock

Trains Total	Cost	Locomotives	Coach Cars	Total
8-10	$27 million	1	5	$216 - 270 million
Contingency	N/A	N/A	30%	$65 - 81 million
Total				**$281 - 351 million**

APPENDIX C CONCEPTUAL ENGINEERING SHEETS

C.1 SECOND TRACK RESTORATION AND EXTENSION

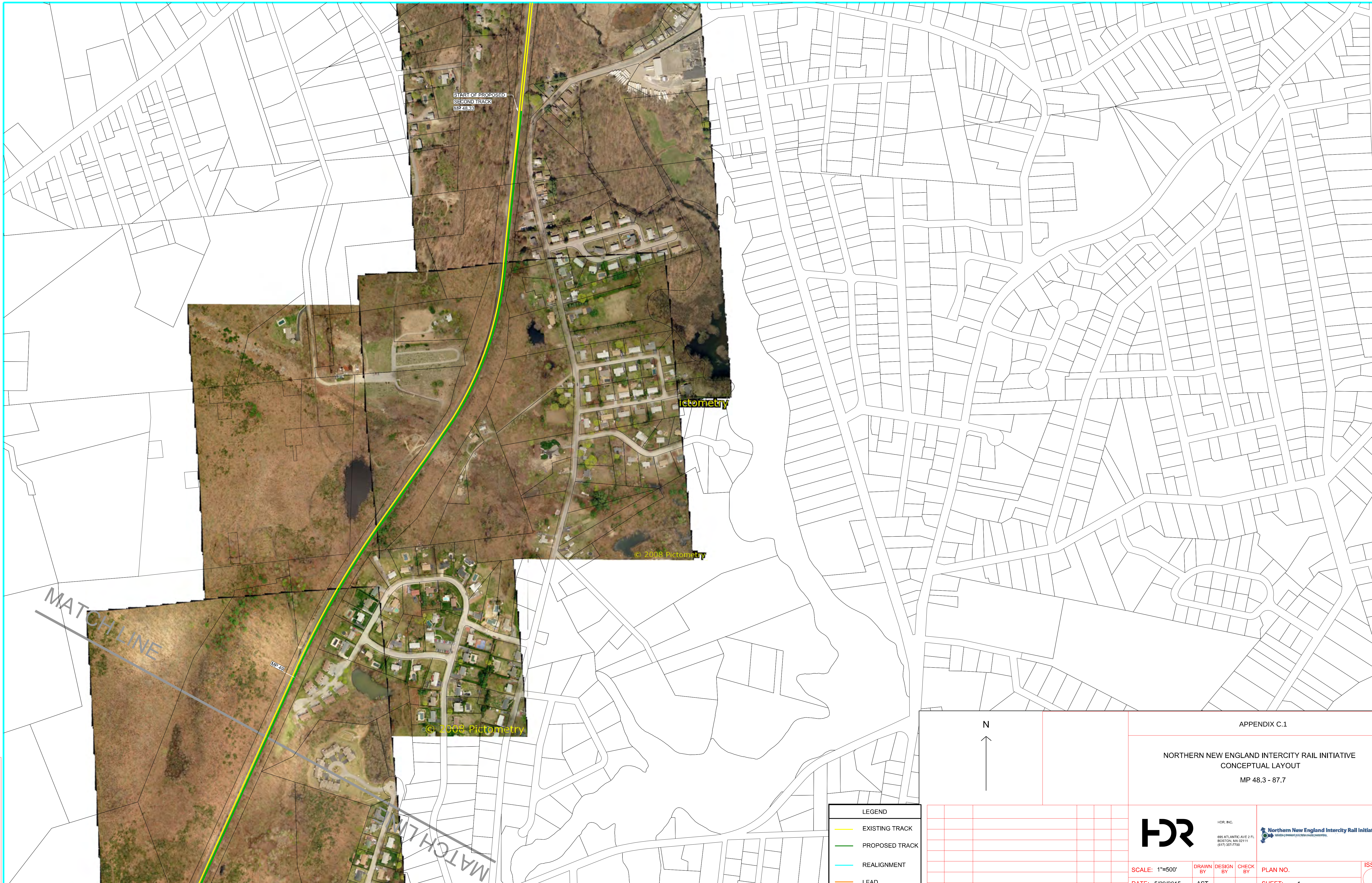
The following sheets detail the proposed layout of the second track restoration between Boston and Springfield at mileposts 48.3-57.7, 64.0-79.4, and 83.6-92.0, and 59.3-63.3. The drawings are at a scale of 1”=500’ and 1”=250’ and depict the route that the second track will follow. A sheet displaying the second track layout with a closer perspective is also included to point out general details.

C.2 WORCESTER UNION STATION SECOND PLATFORM PROPOSED LAYOUT

A second platform at Worcester Union Station will be necessary to accommodate the additional passengers from the Build Alternative. Currently, only one platform would be serving the program, however a new 1000-foot platform is proposed. The platform would connect to Union Station via vertical access to the existing pedestrian tunnel.

C.3 PALMER STATION PROPOSED LAYOUT

The Recommended Alternative includes the construction of a station in Palmer, Massachusetts. There is an existing historic headhouse but these facilities would not meet current operational requirements or passenger standards. A new facility would need to be constructed in the Palmer area. An exact location or station configuration has not yet been identified, however some additional information can be found in the Alternatives Analysis Appendix.



LEGEND

- EXISTING TRACK
- PROPOSED TRACK
- REALIGNMENT
- LEAD

N

APPENDIX C.1

NORTHERN NEW ENGLAND INTERCITY RAIL INITIATIVE
CONCEPTUAL LAYOUT

MP 48.3 - 87.7

HDR, INC.
695 ATLANTIC AVE 2 FL
BOSTON, MA 02111
(617) 357-7700

Northern New England Intercity Rail Initiative

ISSUE	DATE	DESCRIPTION	BY	CHK'D	APP.

SCALE: 1"=500'
DATE: 5/29/2015

DRAWN BY	DESIGN BY	CHECK BY
AST		

PLAN NO.
SHEET: 1
ISSUE

LEGEND

- EXISTING TRACK
- PROPOSED TRACK
- REALIGNMENT
- LEAD

APPENDIX C.1

NORTHERN NEW ENGLAND INTERCITY RAIL INITIATIVE
CONCEPTUAL LAYOUT

MP 48.3 - 87.7

ISSUE	DATE	DESCRIPTION	BY	CHK'D	APP.

HDR, INC.
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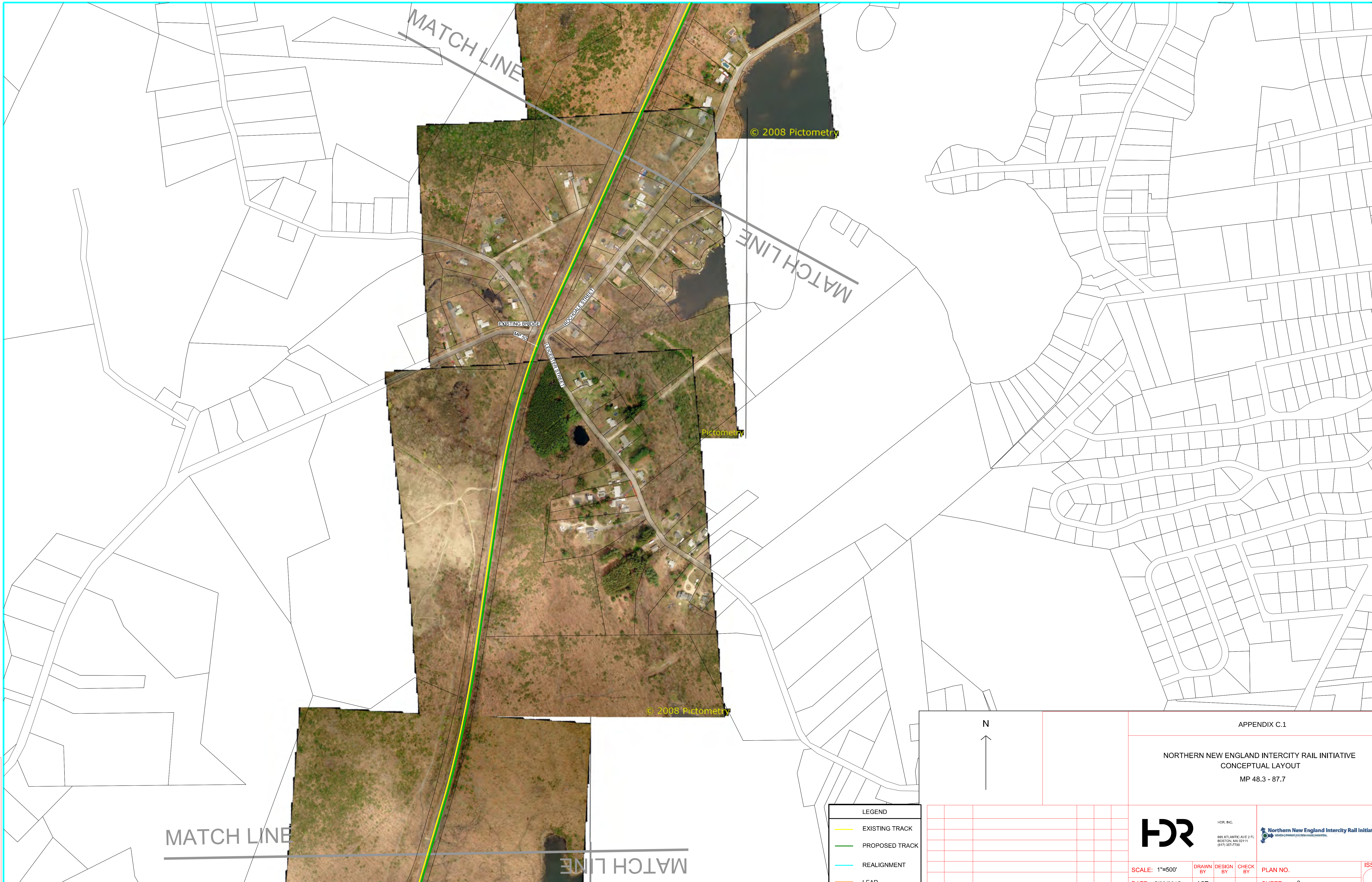
Northern New England Intercity Rail Initiative

SCALE: 1"=500'	DRAWN BY	DESIGN BY	CHECK BY	PLAN NO.	ISSUE
DATE: 5/29/2015	AST			SHEET: 2	



LEGEND

- EXISTING TRACK
- PROPOSED TRACK
- REALIGNMENT
- LEAD

ISSUE	DATE	DESCRIPTION	BY	CHK'D	APP.

APPENDIX C.1

NORTHERN NEW ENGLAND INTERCITY RAIL INITIATIVE
CONCEPTUAL LAYOUT
MP 48.3 - 87.7

HDR, INC.
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SCALE: 1"=500'	DRAWN BY	DESIGN BY	CHECK BY	PLAN NO.	ISSUE
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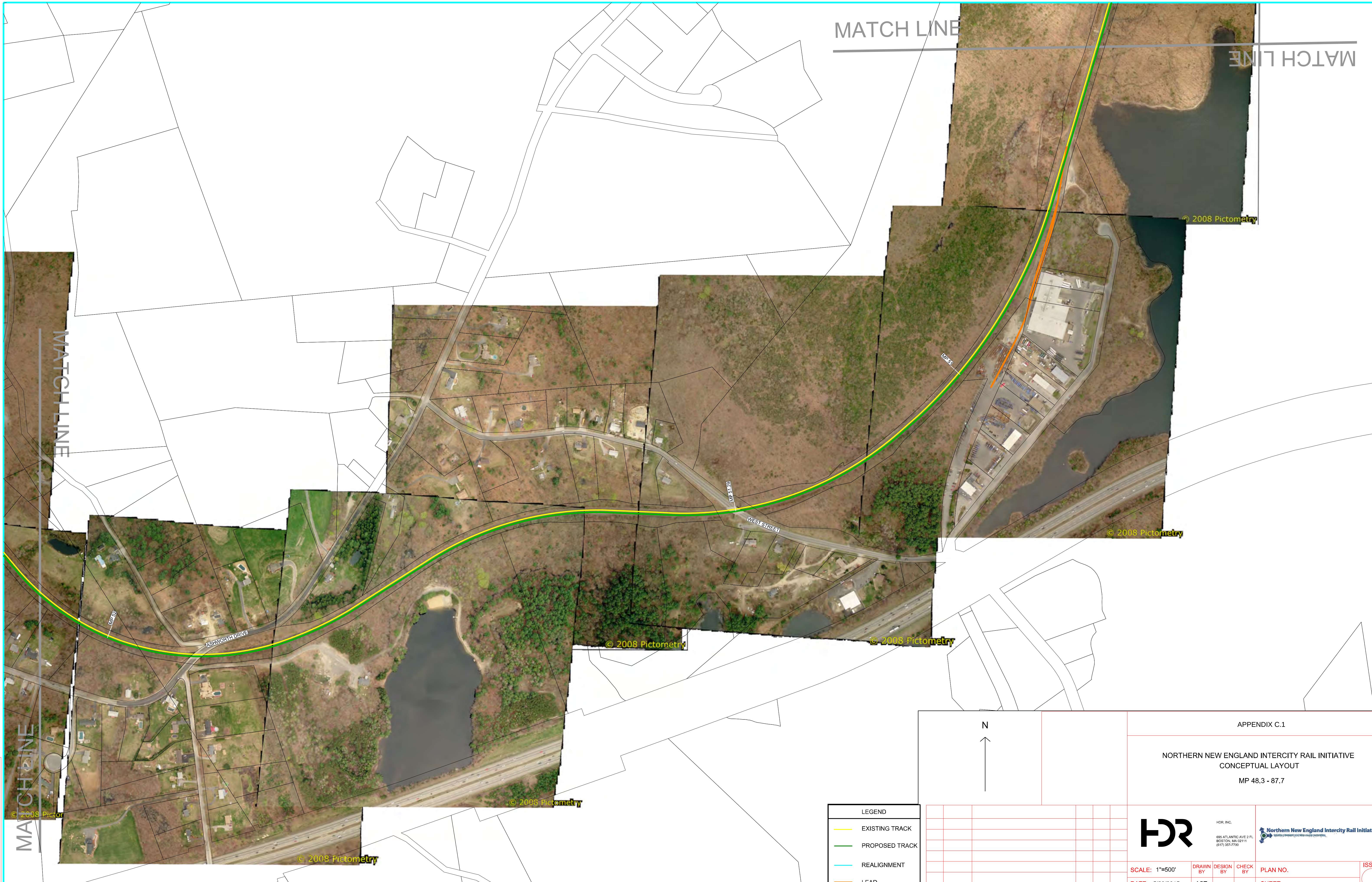

LEGEND	
	EXISTING TRACK
	PROPOSED TRACK
	REALIGNMENT
	LEAD

ISSUE	DATE	DESCRIPTION	BY	CHK'D	APP.

APPENDIX C.1

NORTHERN NEW ENGLAND INTERCITY RAIL INITIATIVE
CONCEPTUAL LAYOUT

MP 48.3 - 87.7

HDR, INC.
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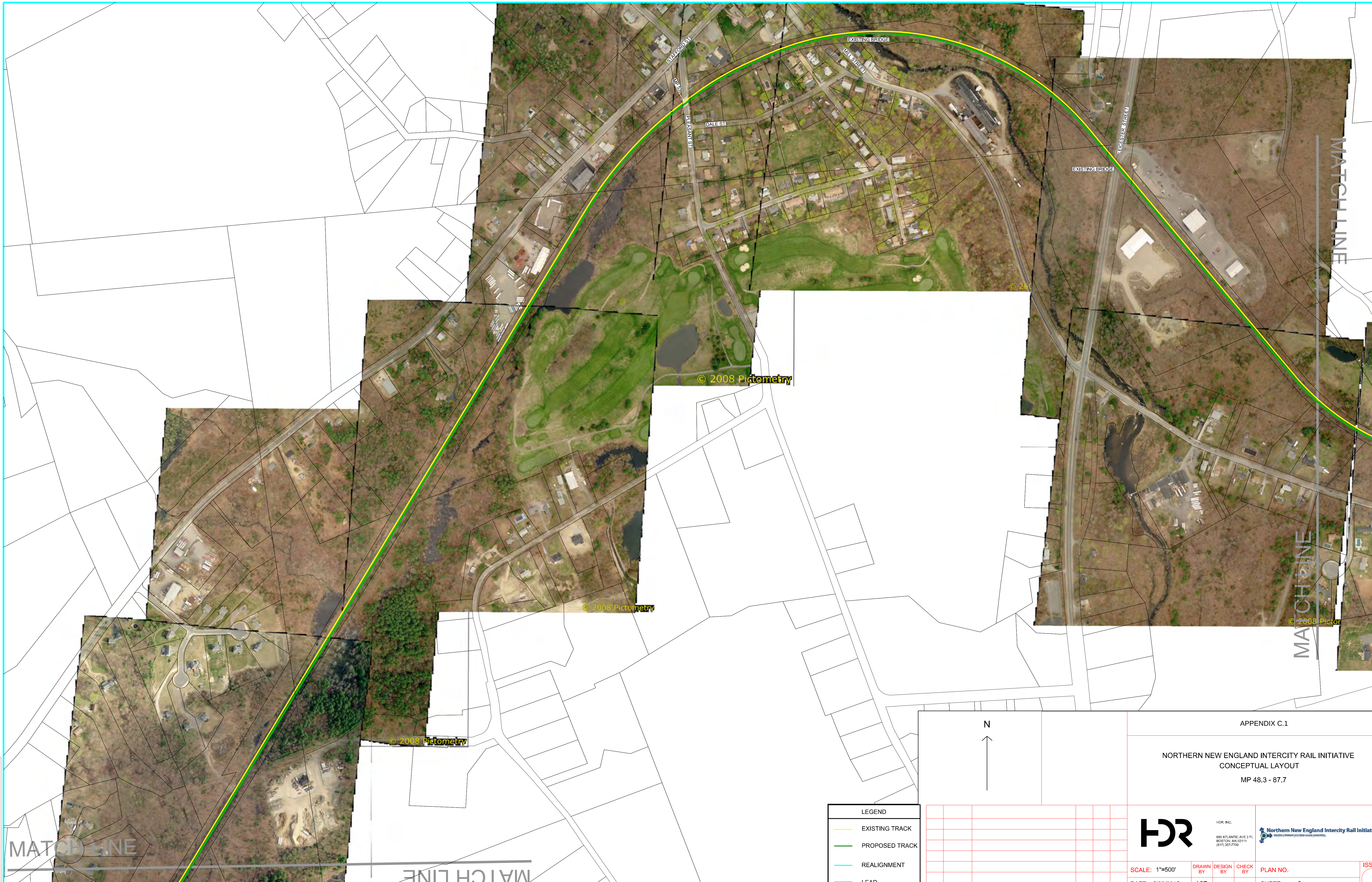
SCALE: 1"=500'	DRAWN BY	DESIGN BY	CHECK BY	PLAN NO.	ISSUE
DATE: 5/29/2015	AST			SHEET: 4	



APPENDIX C.1

NORTHERN NEW ENGLAND INTERCITY RAIL INITIATIVE
CONCEPTUAL LAYOUT

MP 48.3 - 87.7

HDR, INC.
695 ATLANTIC AVE 2 FL
BOSTON, MA 02111
(617) 357-7700

Northern New England Intercity Rail Initiative

ISSUE	DATE	DESCRIPTION	BY	CHK'D	APP.

SCALE: 1"=500'	DRAWN BY	DESIGN BY	CHECK BY	PLAN NO.	ISSUE
DATE: 5/29/2015	AST			SHEET: 5	

N

LEGEND

- EXISTING TRACK
- PROPOSED TRACK
- REALIGNMENT
- LEAD

ISSUE	DATE	DESCRIPTION	BY	CHK'D	APP.

APPENDIX C.1

NORTHERN NEW ENGLAND INTERCITY RAIL INITIATIVE
CONCEPTUAL LAYOUT

MP 48.3 - 87.7

HDR

HDR, INC.
695 ATLANTIC AVE 2 FL
BOSTON, MA 02111
(617) 357-7700

Northern New England Intercity Rail Initiative

SCALE: 1"=500'	DRAWN BY	DESIGN BY	CHECK BY	PLAN NO.	ISSUE
DATE: 5/29/2015	AST			SHEET: 6	

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APPENDIX C.1

NORTHERN NEW ENGLAND INTERCITY RAIL INITIATIVE
CONCEPTUAL LAYOUT
MP 48.3 - 87.7

ISSUE	DATE	DESCRIPTION	BY	CHK'D	APP.

HDR, INC.
695 ATLANTIC AVE 2 FL
BOSTON, MA 02111
(617) 357-7700

Northern New England Intercity Rail Initiative

SCALE: 1"=500'	DRAWN BY	DESIGN BY	CHECK BY	PLAN NO.	ISSUE
DATE: 5/29/2015	AST			SHEET: 7	

LEGEND
EXISTING TRACK
PROPOSED TRACK
REALIGNMENT
LEAD

APPENDIX C.1

NORTHERN NEW ENGLAND INTERCITY RAIL INITIATIVE
CONCEPTUAL LAYOUT

MP 48.3 - 87.7

HDR, INC.
695 ATLANTIC AVE 2 FL
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Northern New England Intercity Rail Initiative

ISSUE	DATE	DESCRIPTION	BY	CHK'D	APP.

SCALE: 1"=500'	DRAWN BY	DESIGN BY	CHECK BY	PLAN NO.	ISSUE
DATE: 5/29/2015	AST			SHEET: 8	

LEGEND

	EXISTING TRACK
	PROPOSED TRACK
	REALIGNMENT
	LEAD

APPENDIX C.1

NORTHERN NEW ENGLAND INTERCITY RAIL INITIATIVE
CONCEPTUAL LAYOUT
EAST BROOKFIELD
MP 59.3 - 63.3

HDR

HDR, INC.
695 ATLANTIC AVE 2 FL
BOSTON, MA 02111
(617) 357-7700

Northern New England Intercity Rail Initiative

ISSUE	DATE	DESCRIPTION	BY	CHK'D	APP.

SCALE: 1"=500'
DATE: 5/29/2015

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AST		

PLAN NO.
SHEET: 1
ISSUE

APPENDIX C.1

NORTHERN NEW ENGLAND INTERCITY RAIL INITIATIVE
CONCEPTUAL LAYOUT
EAST BROOKFIELD
MP 59.3 - 63.3

LEGEND
EXISTING TRACK
PROPOSED TRACK
REALIGNMENT
LEAD

ISSUE	DATE	DESCRIPTION	BY	CHK'D	APP.

HDR, INC.
695 ATLANTIC AVE 2 FL
BOSTON, MA 02111
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Northern New England Intercity Rail Initiative

SCALE: 1"=500'	DRAWN BY	DESIGN BY	CHECK BY	PLAN NO.	ISSUE
DATE: 5/29/2015	AST			SHEET: 2	

APPENDIX C.1

NORTHERN NEW ENGLAND INTERCITY RAIL INITIATIVE
CONCEPTUAL LAYOUT
EAST BROOKFIELD
MP 59.3 - 63.3

HDR, INC.
695 ATLANTIC AVE 2 FL
BOSTON, MA 02111
(617) 357-7700

Northern New England Intercity Rail Initiative

ISSUE	DATE	DESCRIPTION	BY	CHK'D	APP.

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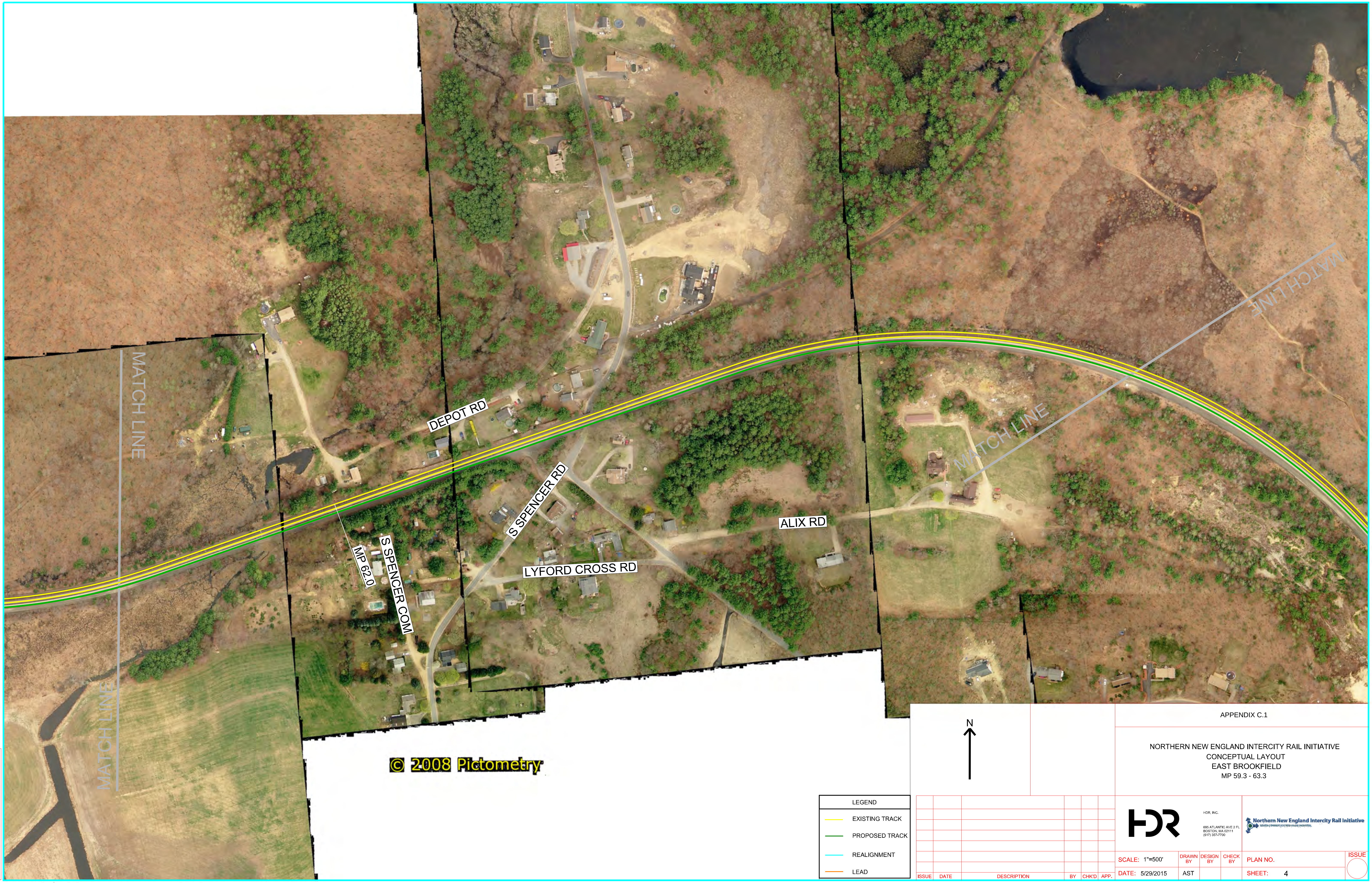

APPENDIX C.1

NORTHERN NEW ENGLAND INTERCITY RAIL INITIATIVE
CONCEPTUAL LAYOUT
EAST BROOKFIELD
MP 59.3 - 63.3

HDR, INC.
695 ATLANTIC AVE 2 FL
BOSTON, MA 02111
(617) 357-7700

Northern New England Intercity Rail Initiative

ISSUE	DATE	DESCRIPTION	BY	CHK'D	APP.

SCALE: 1"=500' | DRAWN BY | DESIGN BY | CHECK BY | PLAN NO. | ISSUE

DATE: 5/29/2015 | AST | | | SHEET: 4

LEGEND

- EXISTING TRACK
- PROPOSED TRACK
- REALIGNMENT
- LEAD

ISSUE	DATE	DESCRIPTION	BY	CHK'D	APP.

APPENDIX C.1

NORTHERN NEW ENGLAND INTERCITY RAIL INITIATIVE
CONCEPTUAL LAYOUT
EAST BROOKFIELD
MP 59.3 - 63.3

HDR, INC.
695 ATLANTIC AVE 2 FL
BOSTON, MA 02111
(617) 357-7700

Northern New England Intercity Rail Initiative

SCALE: 1"=500'	DRAWN BY	DESIGN BY	CHECK BY	PLAN NO.	ISSUE
DATE: 5/29/2015	AST			SHEET: 5	

APPENDIX C.1

NORTHERN NEW ENGLAND INTERCITY RAIL INITIATIVE
CONCEPTUAL LAYOUT
EAST BROOKFIELD
MP 59.3 - 63.3

HDR, INC.
695 ATLANTIC AVE 2 FL
BOSTON, MA 02111
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Northern New England Intercity Rail Initiative

ISSUE	DATE	DESCRIPTION	BY	CHK'D	APP.

SCALE: 1"=500' | DRAWN BY: AST | DESIGN BY | CHECK BY | PLAN NO. | ISSUE

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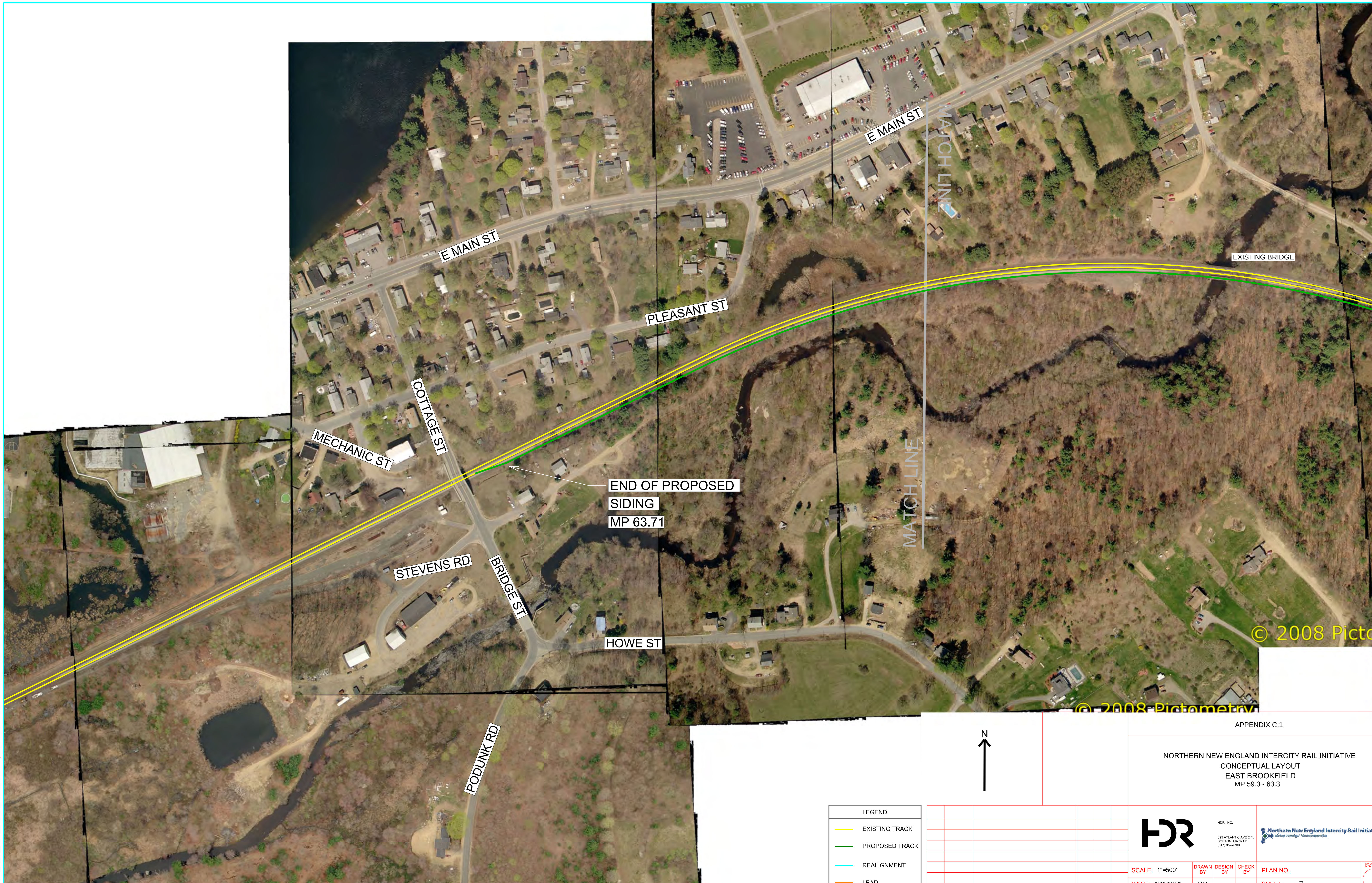

LEGEND
EXISTING TRACK
PROPOSED TRACK
REALIGNMENT
LEAD

ISSUE	DATE	DESCRIPTION	BY	CHK'D	APP.

APPENDIX C.1

NORTHERN NEW ENGLAND INTERCITY RAIL INITIATIVE
CONCEPTUAL LAYOUT
EAST BROOKFIELD
MP 59.3 - 63.3

HDR, INC.
695 ATLANTIC AVE 2 FL
BOSTON, MA 02111
(617) 357-7700

Northern New England Intercity Rail Initiative

SCALE: 1"=500'	DRAWN BY	DESIGN BY	CHECK BY	PLAN NO.	ISSUE
DATE: 5/29/2015	AST			SHEET: 7	

LEGEND

- EXISTING TRACK
- PROPOSED TRACK
- REALIGNMENT
- LEAD

APPENDIX C.1

NORTHERN NEW ENGLAND INTERCITY RAIL INITIATIVE
CONCEPTUAL LAYOUT

MP 64.0 - 79.4

HDR, INC.
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Northern New England Intercity Rail Initiative

ISSUE	DATE	DESCRIPTION	BY	CHK'D	APP.

SCALE: 1"=500'	DRAWN BY	DESIGN BY	CHECK BY	PLAN NO.
DATE: 5/29/2015	AST			SHEET: 1

ISSUE

LEGEND
EXISTING TRACK
PROPOSED TRACK
REALIGNMENT
LEAD

ISSUE	DATE	DESCRIPTION	BY	CHK'D	APP.

APPENDIX C.1

NORTHERN NEW ENGLAND INTERCITY RAIL INITIATIVE
CONCEPTUAL LAYOUT

MP 64.0 - 79.4

HDR, INC.
695 ATLANTIC AVE 2 FL
BOSTON, MA 02111
(617) 357-7700

Northern New England Intercity Rail Initiative

SCALE: 1"=500'	DRAWN BY	DESIGN BY	CHECK BY	PLAN NO.	ISSUE
DATE: 5/29/2015	AST			SHEET: 2	

APPENDIX C.1

NORTHERN NEW ENGLAND INTERCITY RAIL INITIATIVE
CONCEPTUAL LAYOUT

MP 64.0 - 79.4

ISSUE	DATE	DESCRIPTION	BY	CHK'D	APP.

HDR, INC.
695 ATLANTIC AVE 2 FL
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SCALE: 1"=500'	DRAWN BY	DESIGN BY	CHECK BY	PLAN NO.	ISSUE
DATE: 5/29/2015	AST			SHEET: 3	

APPENDIX C.1

NORTHERN NEW ENGLAND INTERCITY RAIL INITIATIVE
CONCEPTUAL LAYOUT

MP 64.0 - 79.4

HDR, INC.
695 ATLANTIC AVE 2 FL
BOSTON, MA 02111
(617) 357-7700

Northern New England Intercity Rail Initiative

ISSUE	DATE	DESCRIPTION	BY	CHK'D	APP.

SCALE: 1"=500'	DRAWN BY	DESIGN BY	CHECK BY	PLAN NO.	ISSUE
DATE: 5/29/2015	AST			SHEET: 4	

LEGEND	
	EXISTING TRACK
	PROPOSED TRACK
	REALIGNMENT
	LEAD

APPENDIX C.1

NORTHERN NEW ENGLAND INTERCITY RAIL INITIATIVE
CONCEPTUAL LAYOUT

MP 64.0 - 79.4

ISSUE	DATE	DESCRIPTION	BY	CHK'D	APP.

HDR, INC.
695 ATLANTIC AVE 2 FL
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Northern New England Intercity Rail Initiative

SCALE: 1"=500'	DRAWN BY	DESIGN BY	CHECK BY	PLAN NO.	ISSUE
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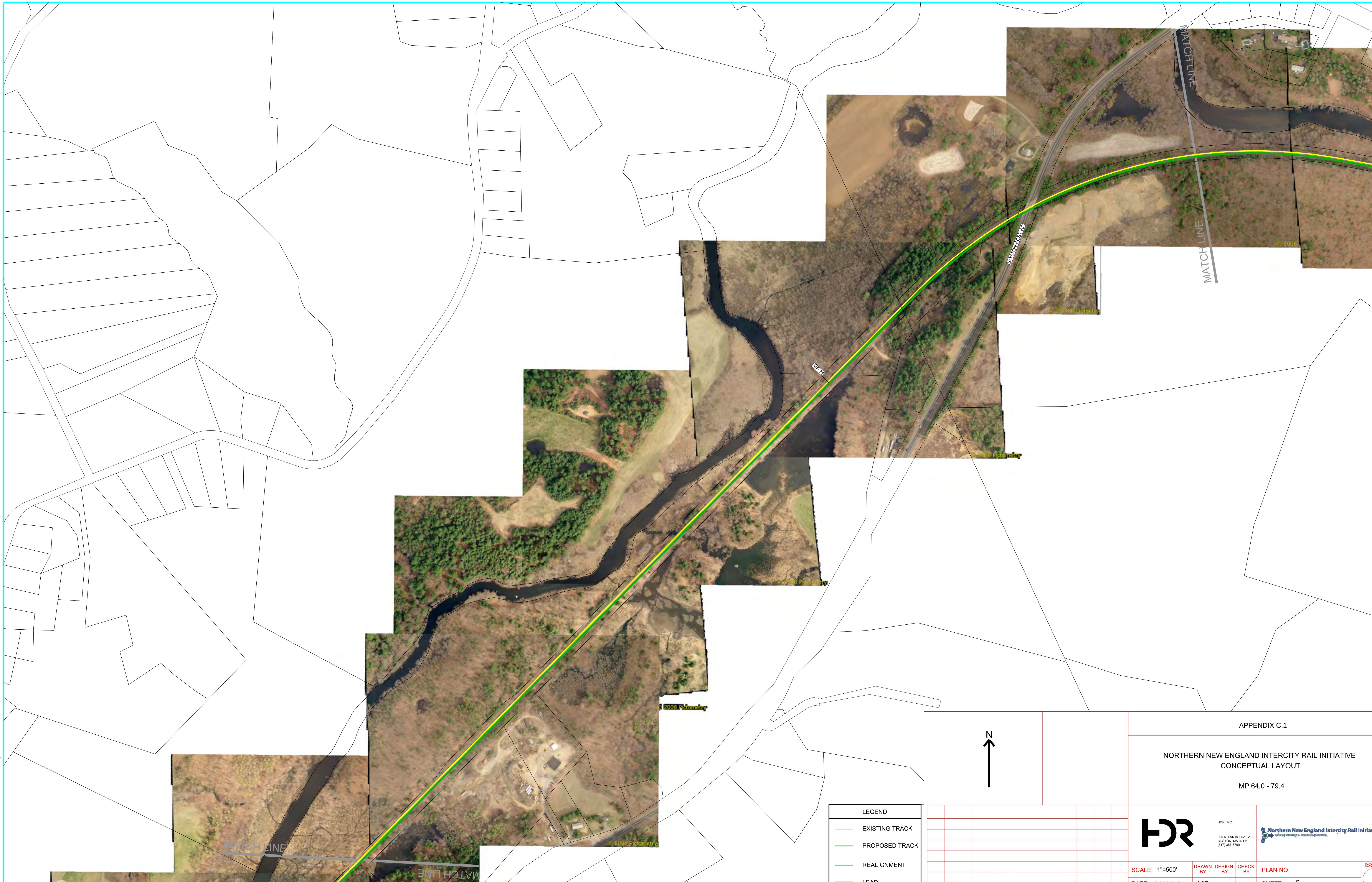

APPENDIX C.1

NORTHERN NEW ENGLAND INTERCITY RAIL INITIATIVE
CONCEPTUAL LAYOUT

MP 64.0 - 79.4

ISSUE	DATE	DESCRIPTION	BY	CHK'D	APP.

HDR, INC.
695 ATLANTIC AVE 2 FL
BOSTON, MA 02111
(617) 357-7700

Northern New England Intercity Rail Initiative

SCALE: 1"=500'	DRAWN BY	DESIGN BY	CHECK BY	PLAN NO.	ISSUE
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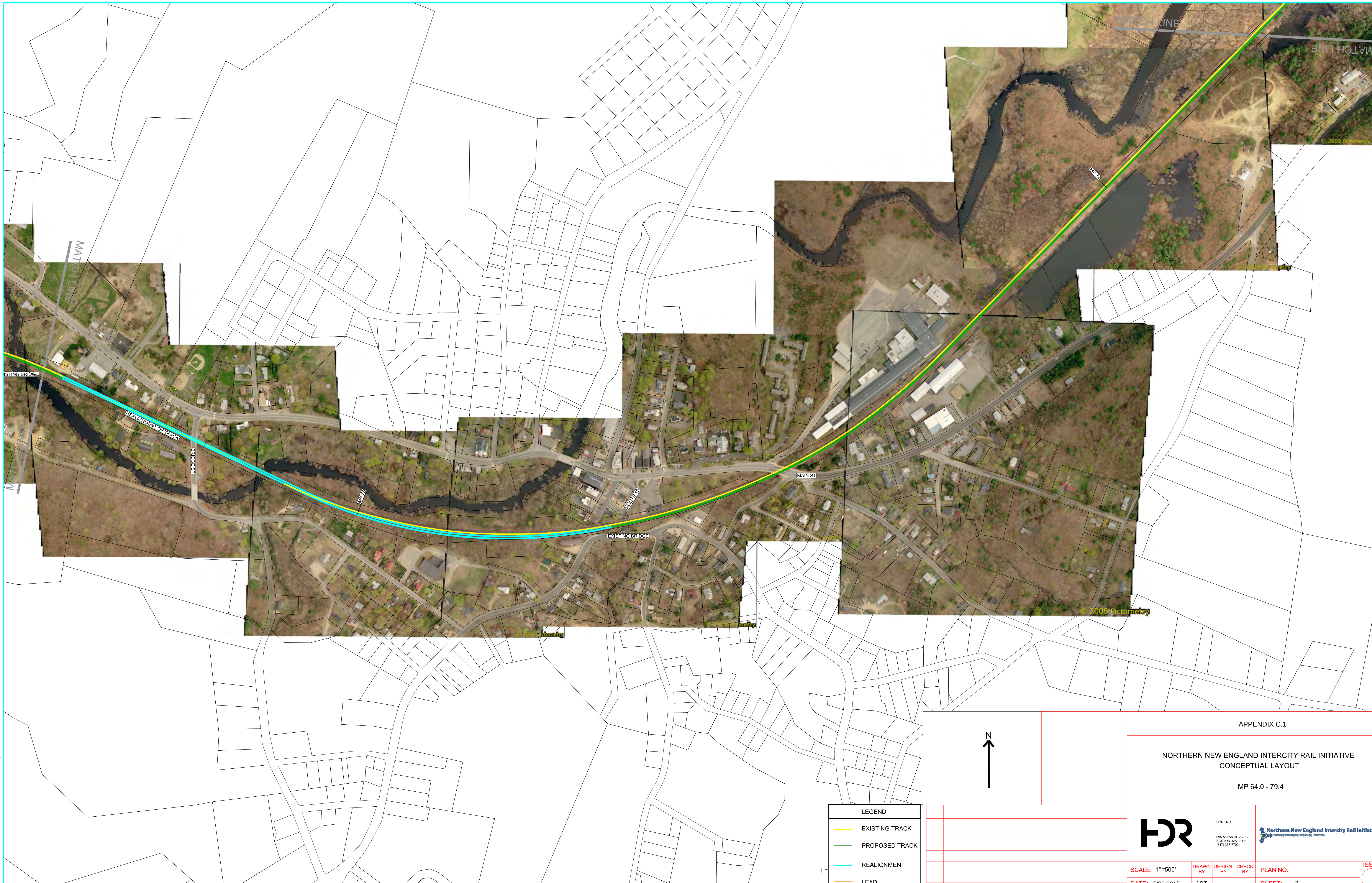

LEGEND
EXISTING TRACK
PROPOSED TRACK
REALIGNMENT
LEAD

APPENDIX C.1

NORTHERN NEW ENGLAND INTERCITY RAIL INITIATIVE
CONCEPTUAL LAYOUT

MP 64.0 - 79.4

HDR, INC.
695 ATLANTIC AVE 2 FL
BOSTON, MA 02111
(617) 357-7700

Northern New England Intercity Rail Initiative

ISSUE	DATE	DESCRIPTION	BY	CHK'D	APP.

SCALE: 1"=500'	DRAWN BY	DESIGN BY	CHECK BY	PLAN NO.	ISSUE
DATE: 5/29/2015	AST			SHEET: 7	

APPENDIX C.1

NORTHERN NEW ENGLAND INTERCITY RAIL INITIATIVE
CONCEPTUAL LAYOUT

MP 64.0 - 79.4

ISSUE	DATE	DESCRIPTION	BY	CHK'D	APP.

HDR, INC.
695 ATLANTIC AVE 2 FL
BOSTON, MA 02111
(617) 357-7700

Northern New England Intercity Rail Initiative

SCALE: 1"=500'	DRAWN BY	DESIGN BY	CHECK BY	PLAN NO.	ISSUE
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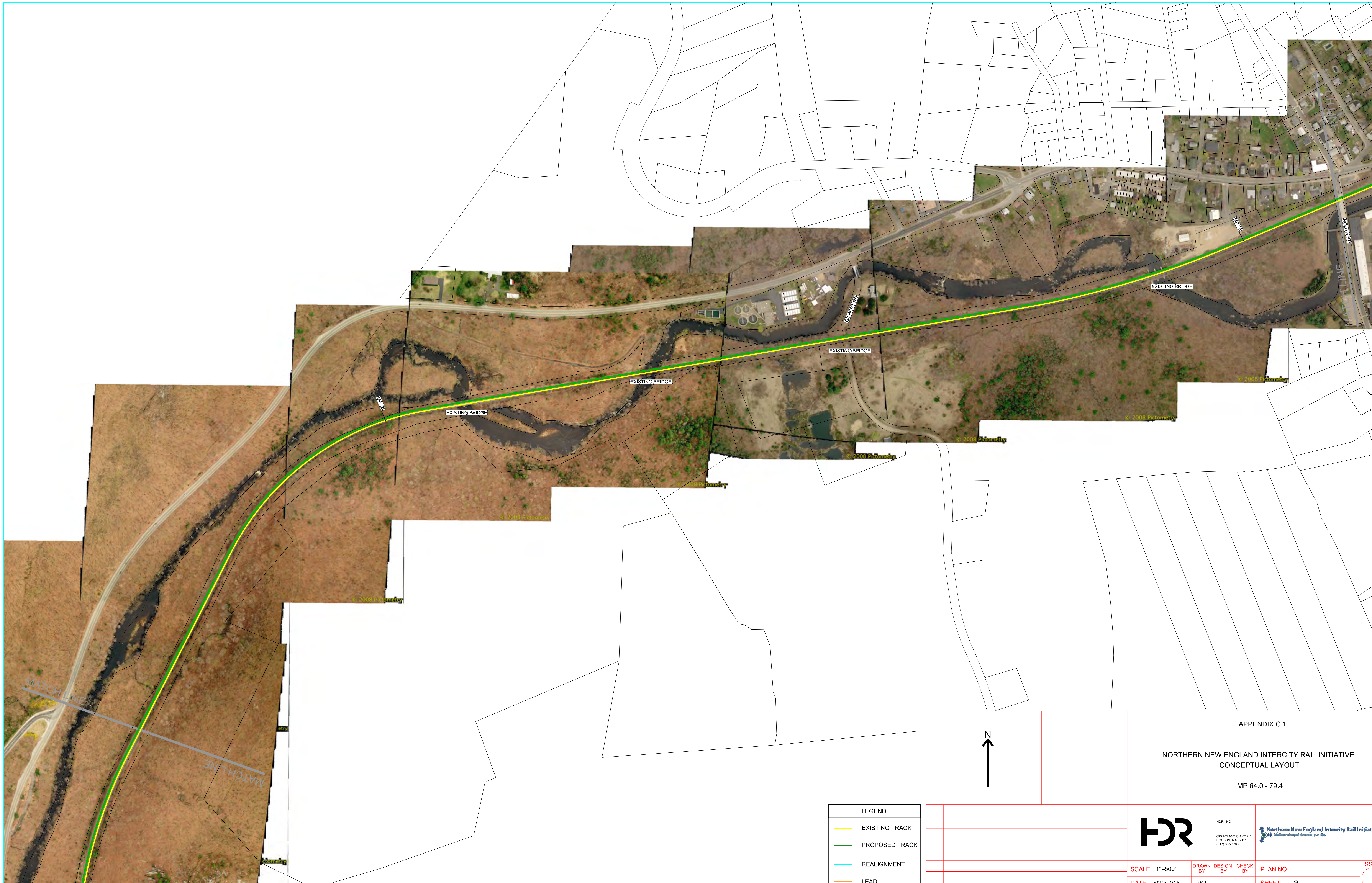

APPENDIX C.1

NORTHERN NEW ENGLAND INTERCITY RAIL INITIATIVE
CONCEPTUAL LAYOUT

MP 64.0 - 79.4

ISSUE	DATE	DESCRIPTION	BY	CHK'D	APP.

HDR, INC.
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BOSTON, MA 02111
(617) 357-7700

Northern New England Intercity Rail Initiative

SCALE: 1"=500'	DRAWN BY	DESIGN BY	CHECK BY	PLAN NO.	ISSUE
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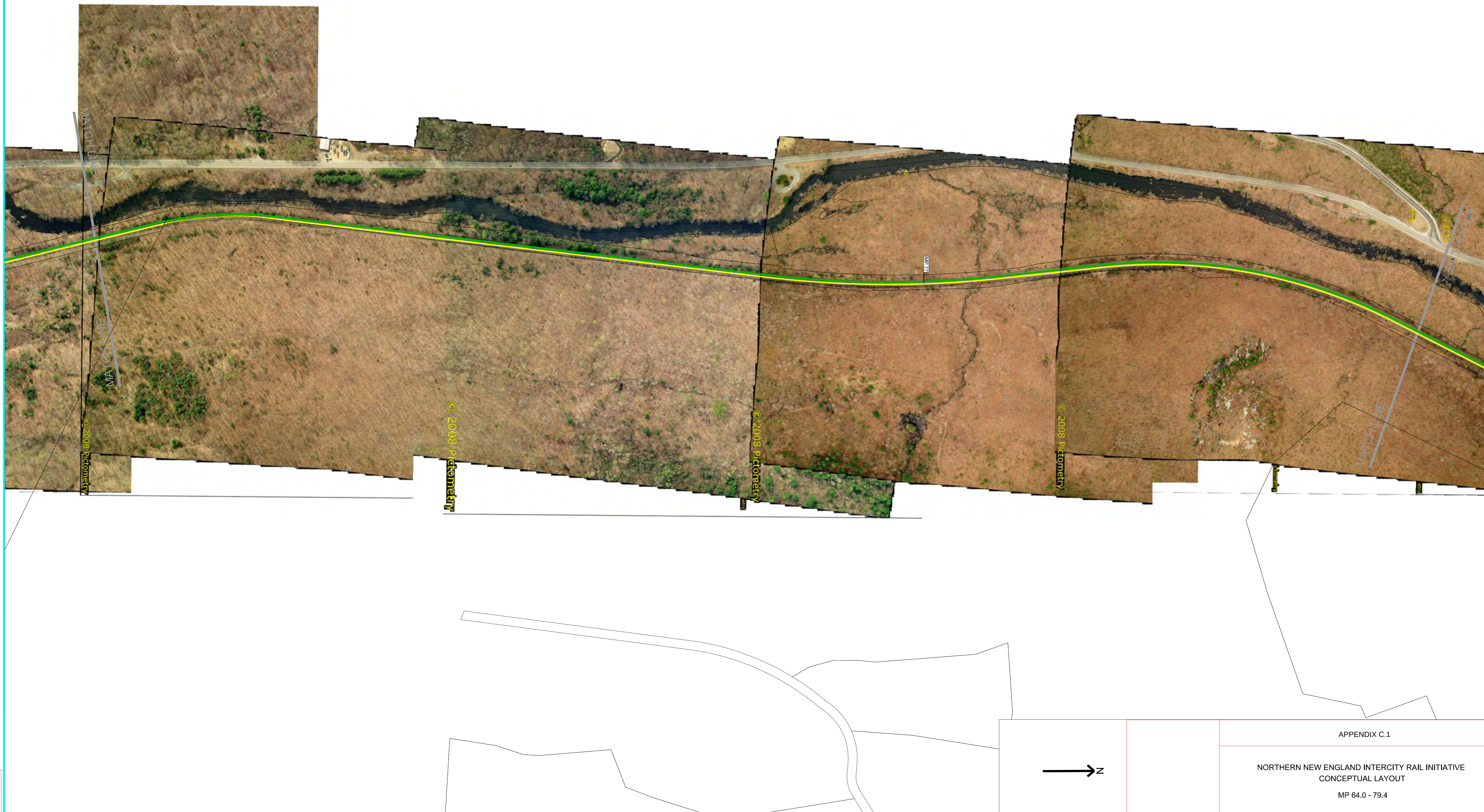

LEGEND	
	EXISTING TRACK
	PROPOSED TRACK
	REALIGNMENT
	LEAD

N

APPENDIX C.1

NORTHERN NEW ENGLAND INTERCITY RAIL INITIATIVE
CONCEPTUAL LAYOUT

MP 64.0 - 79.4

HDR, INC.
695 ATLANTIC AVE 2 FL
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Northern New England Intercity Rail Initiative

ISSUE	DATE	DESCRIPTION	BY	CHK'D	APP.

SCALE: 1"=500'	DRAWN BY	DESIGN BY	CHECK BY	PLAN NO.	ISSUE
DATE: 5/29/2015	AST			SHEET: 10	

LEGEND	
(yellow line)	EXISTING TRACK
(green line)	PROPOSED TRACK
(cyan line)	REALIGNMENT
(orange line)	LEAD

APPENDIX C.1

NORTHERN NEW ENGLAND INTERCITY RAIL INITIATIVE
CONCEPTUAL LAYOUT

MP 64.0 - 79.4

ISSUE	DATE	DESCRIPTION	BY	CHK'D	APP.

HDR, INC.
695 ATLANTIC AVE 2 FL
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Northern New England Intercity Rail Initiative

SCALE: 1"=500'	DRAWN BY	DESIGN BY	CHECK BY	PLAN NO.	ISSUE
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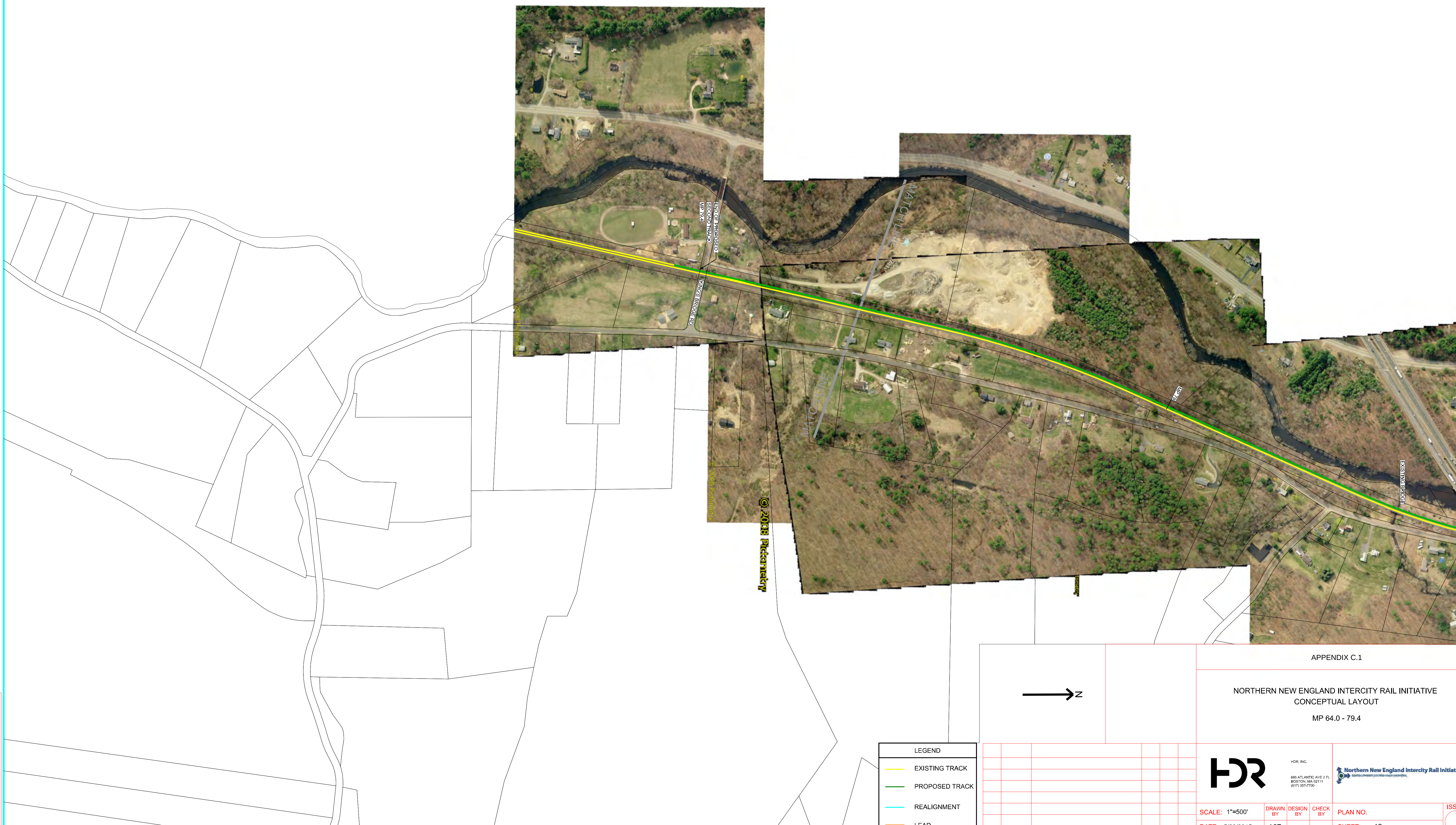

LEGEND

- EXISTING TRACK
- PROPOSED TRACK
- REALIGNMENT
- LEAD

N

ISSUE	DATE	DESCRIPTION	BY	CHK'D	APP.

APPENDIX C.1

NORTHERN NEW ENGLAND INTERCITY RAIL INITIATIVE
CONCEPTUAL LAYOUT

MP 64.0 - 79.4

HDR, INC.
695 ATLANTIC AVE 2 FL
BOSTON, MA 02111
(617) 357-7700

Northern New England Intercity Rail Initiative

SCALE: 1"=500'	DRAWN BY	DESIGN BY	CHECK BY	PLAN NO.	ISSUE
DATE: 5/29/2015	AST			SHEET: 12	

LEGEND

	EXISTING TRACK
	PROPOSED TRACK
	REALIGNMENT
	LEAD

APPENDIX C.1

NORTHERN NEW ENGLAND INTERCITY RAIL INITIATIVE
CONCEPTUAL LAYOUT

MP 83.6 - 92.0

ISSUE	DATE	DESCRIPTION	BY	CHK'D	APP.

HDR, INC.
695 ATLANTIC AVE 2 FL
BOSTON, MA 02111
(617) 357-7700

Northern New England Intercity Rail Initiative

SCALE: 1"=500'	DRAWN BY	DESIGN BY	CHECK BY	PLAN NO.	ISSUE
DATE: 5/29/2015	AST			SHEET: 1	

LEGEND	
	EXISTING TRACK
	PROPOSED TRACK
	REALIGNMENT
	LEAD

APPENDIX C.1

NORTHERN NEW ENGLAND INTERCITY RAIL INITIATIVE
CONCEPTUAL LAYOUT

MP 83.6 - 92.0

HDR

HDR, INC.
695 ATLANTIC AVE 2 FL
BOSTON, MA 02111
(617) 357-7700

Northern New England Intercity Rail Initiative

ISSUE	DATE	DESCRIPTION	BY	CHK'D	APP.

SCALE: 1"=500'
DATE: 5/29/2015

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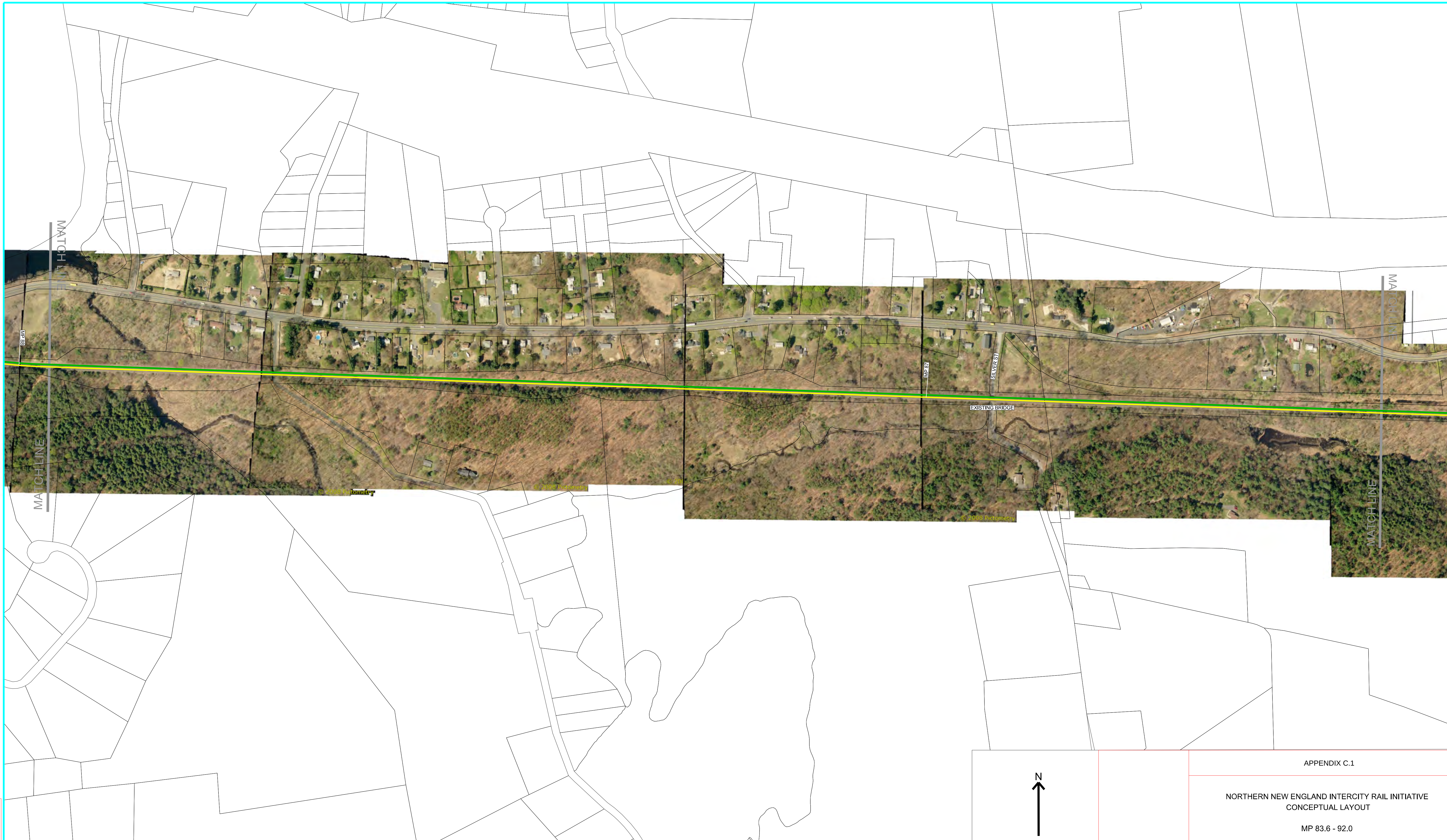
AST		

PLAN NO.
SHEET: 2
ISSUE



LEGEND
- EXISTING TRACK
- PROPOSED TRACK
- REALIGNMENT
- LEAD

ISSUE	DATE	DESCRIPTION	BY	CHK'D	APP.

APPENDIX C.1

NORTHERN NEW ENGLAND INTERCITY RAIL INITIATIVE
CONCEPTUAL LAYOUT

MP 83.6 - 92.0

HDR, INC.
695 ATLANTIC AVE 2 FL
BOSTON, MA 02111
(617) 357-7700

Northern New England Intercity Rail Initiative

SCALE: 1"=500'	DRAWN BY	DESIGN BY	CHECK BY	PLAN NO.	ISSUE
DATE: 5/29/2015	AST			SHEET: 3	

APPENDIX C.1

NORTHERN NEW ENGLAND INTERCITY RAIL INITIATIVE
CONCEPTUAL LAYOUT

MP 83.6 - 92.0

HDR

Northern New England Intercity Rail Initiative

ISSUE	DATE	DESCRIPTION	BY	CHK'D	APP.

SCALE: 1"=500'	DRAWN BY	DESIGN BY	CHECK BY	PLAN NO.		ISSUE
DATE: 5/29/2015	AST			SHEET:	4	

APPENDIX C.1

NORTHERN NEW ENGLAND INTERCITY RAIL INITIATIVE
CONCEPTUAL LAYOUT

MP 83.6 - 92.0

HDR, INC.
695 ATLANTIC AVE 2 FL
BOSTON, MA 02111
(617) 357-7700

Northern New England Intercity Rail Initiative

ISSUE	DATE	DESCRIPTION	BY	CHK'D	APP.

SCALE: 1"=500'	DRAWN BY	DESIGN BY	CHECK BY	PLAN NO.	ISSUE
DATE: 5/29/2015	AST			SHEET: 5	

LEGEND	
	EXISTING TRACK
	PROPOSED TRACK
	REALIGNMENT
	LEAD

ISSUE	DATE	DESCRIPTION	BY	CHK'D	APP.

APPENDIX C.1

NORTHERN NEW ENGLAND INTERCITY RAIL INITIATIVE
CONCEPTUAL LAYOUT

MP 83.6 - 92.0

HDR, INC.

695 ATLANTIC AVE 2 FL
BOSTON, MA 02111
(617) 357-7700

Northern New England Intercity Rail Initiative

SCALE: 1"=500'	DRAWN BY	DESIGN BY	CHECK BY	PLAN NO.	ISSUE
DATE: 5/29/2015	AST			SHEET: 6	

APPENDIX C.1

NORTHERN NEW ENGLAND INTERCITY RAIL INITIATIVE
CONCEPTUAL LAYOUT
EXAMPLE SHEET

ISSUE	DATE	DESCRIPTION	BY	CHK'D	APP.

HDR, INC.
695 ATLANTIC AVE 2 FL
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(617) 357-7700

Northern New England Intercity Rail Initiative

SCALE: 1" = 250'	DRAWN BY	DESIGN BY	CHECK BY	PLAN NO.	ISSUE
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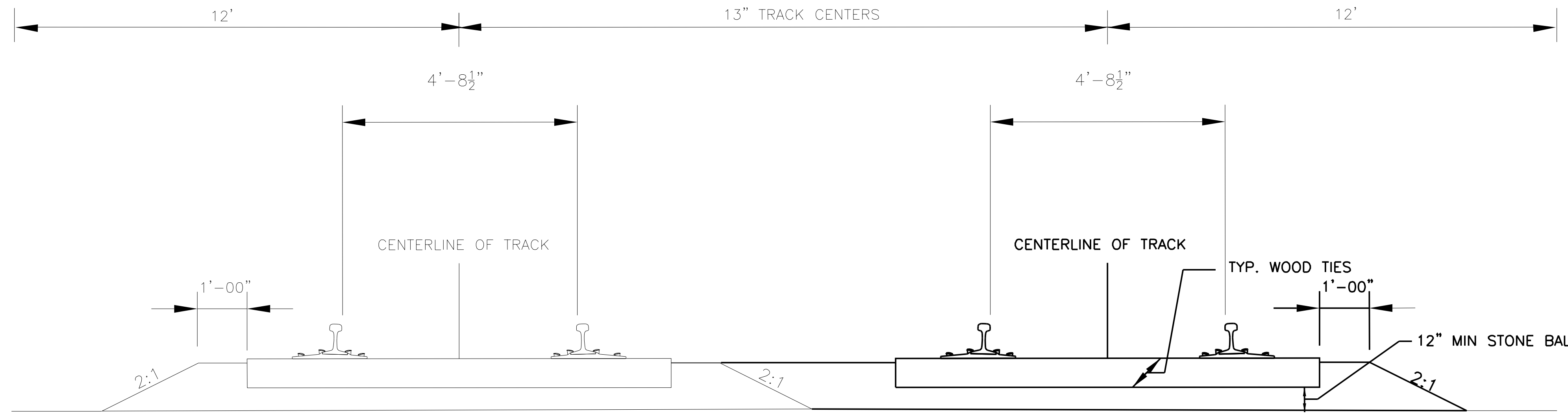
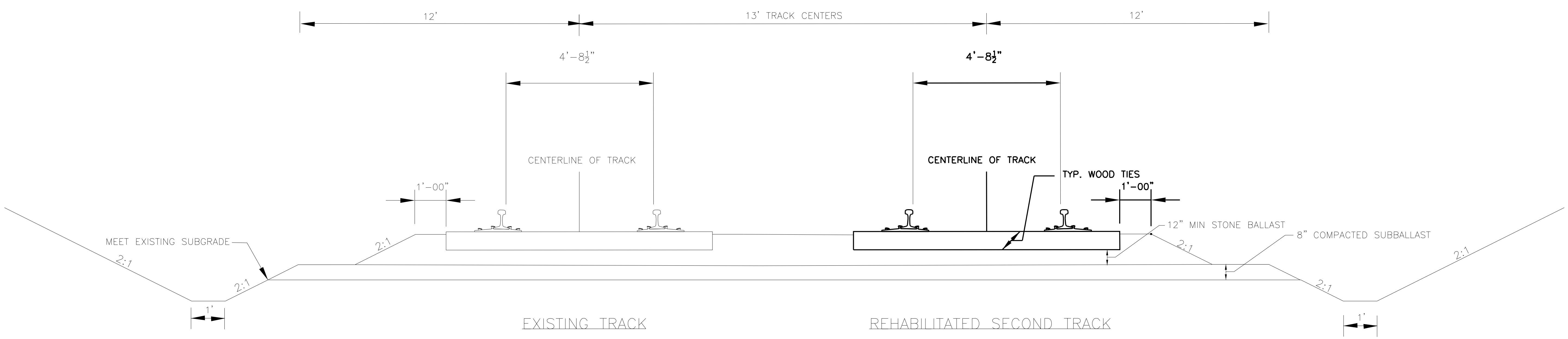


TYPICAL DOUBLE TRACK CROSS SECTION

NECR SWANTON SUBDIVISION MP 2.6

N.T.S.



TYPICAL EXISTING TRACK SECTION WITH REHABILITATED SECOND TRACK

NECR PALMER SUBDIVISION MP 122

CSX BOSTON SUBDIVISION MP 72

N.T.S.

DRAFT

APPENDIX C.3

NORTHERN NEW ENGLAND INTERCITY RAIL INITIATIVE
TYPICAL TRACK CROSS SECTIONS

ISSUE	DATE	DESCRIPTION	BY	CHK'D	APP.

HDR, INC.

SCALE: N.T.S

DATE: 3/30/2015

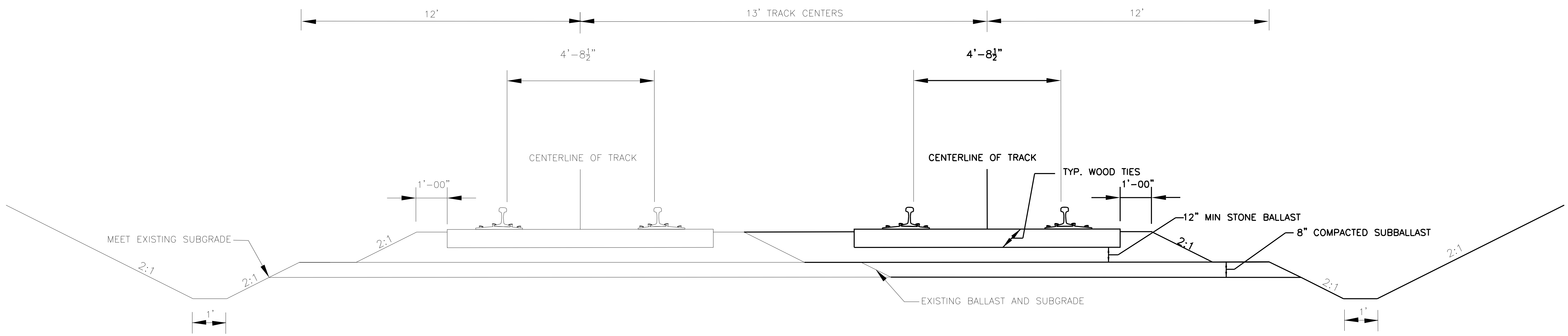
DRAWN BY	DESIGN BY	CHECK BY
AST		

massDOT Massachusetts Department of Transportation Rail & Transit Division

PLAN NO.

SHEET: 1

ISSUE



EXISTING TRACK

PROPOSED SECOND TRACK

TYPICAL EXISTING TRACK WITH PROPOSED SECOND TRACK WITH EXPANDED ROADBED

NECR PALMER SUBDIVISION MP 124

NECR SWANTON SUBDIVISION MP 3

N.T.S.

DRAFT

APPENDIX C.3

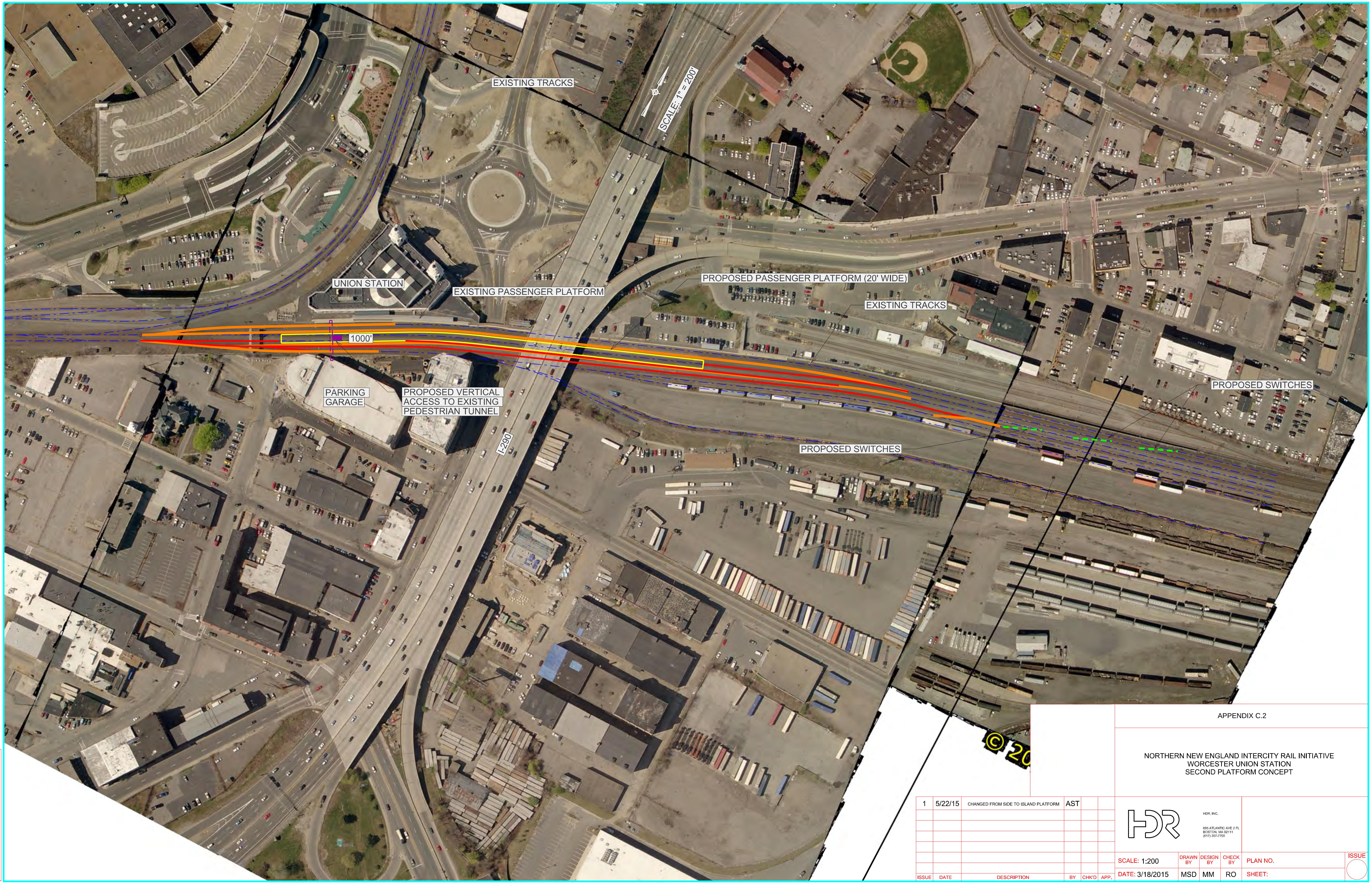
NORTHERN NEW ENGLAND INTERCITY RAIL INITIATIVE
TYPICAL TRACK CROSS SECTIONS

HDR, INC.
695 ATLANTIC AVE 2 FL
BOSTON, MA 02111
(617) 357-7700

Massachusetts Department of Transportation
Rail & Transit Division

ISSUE	DATE	DESCRIPTION	BY	CHK'D	APP.

SCALE: N.T.S	DRAWN BY	DESIGN BY	CHECK BY	PLAN NO.	ISSUE
DATE: 3/30/2015	AST			SHEET: 2	



APPENDIX C.2

NORTHERN NEW ENGLAND INTERCITY RAIL INITIATIVE
WORCESTER UNION STATION
SECOND PLATFORM CONCEPT

ISSUE	DATE	DESCRIPTION	BY	CHK'D	APP.
1	5/22/15	CHANGED FROM SIDE TO ISLAND PLATFORM	AST		

HDR, INC.
695 ATLANTIC AVE 2 FL
BOSTON, MA 02111
(617) 357-7700

SCALE: 1:200	DRAWN BY	DESIGN BY	CHECK BY	PLAN NO.	ISSUE
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APPENDIX D STATION ACCESS

Several existing and potential rail stations along the Inland Route were evaluated for service as part of the NNEIRI Study. This appendix outlines the analysis that was completed to evaluate the potential of each station. The analysis considered results of the rail operations modeling, ridership, and stakeholder and public input. Individual stations were then examined based on their ability to accommodate anticipated Inland Route passenger counts, passenger access, and the ability of the station to connect to other modes of transportation. The first part of this appendix profiles the methodology for selecting stations. The later sections provide profiles of the 13 existing or proposed stations along the Inland Route.

D.1 STATION LOCATION ANALYSIS

Numerous stations, both existing and potential, were analyzed as a part of the AA process. All existing intercity rail stations and one potential station in Palmer, Massachusetts were evaluated for service on the Inland Route. The 13 stations that were evaluated for Inland Route service are:

- Boston (South Station and Back Bay), Massachusetts
- Framingham, Massachusetts
- Worcester (Union Station), Massachusetts
- Palmer, Massachusetts (proposed)
- Springfield (Union Station), Massachusetts
- Windsor Locks, Connecticut
- Windsor, Connecticut
- Hartford (Union Station), Connecticut
- Berlin, Connecticut
- Meriden, Connecticut
- Wallingford, Connecticut
- New Haven (Union Station), Connecticut

The process to determine station stops used a combination of operations analysis, ridership forecasts, and public and stakeholder input. A train performance calculation (TPC) model was developed to evaluate efficiency of service along the NNEIRI Corridor and identify the station stops for each of the three services, including the Inland Route. All existing intercity stations on the Inland Route were considered potential station stops for local service. Select stations on the Inland Route were used to model operations for express service. On many rail corridors, express service is necessary to maximize the efficiency of train services because the infrastructure allows for higher operating speeds. Express stations considered based on geography, existing and proposed intermodal connections, commercial activity, and population density. The stations considered for express service included Boston (South Station), Boston (Back Bay), Worcester (Union Station), and Springfield (Union Station). Express station stops in Connecticut were not defined in the preliminary station stop analysis. Operationally, express stations are feasible on the Corridor and would provide timesavings for trains.

A ridership analysis was then conducted to determine potential ridership impacts of utilizing express service on the Corridor. This analysis, which was prepared during the Alternatives Analysis process, determined that express trains carry fewer riders than trains making all station stops.

Stakeholders and members of the public were consulted on station stopping patterns. Stakeholders were generally in favor of trains making all station stops because of the connectivity to smaller cities and towns on the Corridor. At public meetings held in November 2014 and in written comments, members of the public expressed support for station stops at all existing rail stations on the Corridor.

Therefore, based on ridership modeling results and overwhelming sentiments expressed by stakeholders and members of the public, the study team determined that all existing station stops would be served.

Additional stations were considered in Weston, Massachusetts (in the vicinity of the Interstate 90/95 interchange), and Palmer, Massachusetts. The station in Weston, MA would have served as a suburban Boston hub station, similar to Route 128 Station on the Northeast Corridor. However, moderate ridership, environmental impacts to surrounding communities and parklands, and other site constraints resulted in the station site not recommended in the NNEIRI Recommended Alternative. The Recommended Alternative includes a new station in Palmer, but a final location was not determined due to the need for local and state policy decisions to be made. A full analysis of both the Weston and Palmer Station sites is in the NNEIRI Alternatives Analysis Report.

D.2 SOUTH STATION, BOSTON, MASSACHUSETTS

South Station is a passenger rail station located on Atlantic Avenue and Summer Street in downtown Boston, Massachusetts. The station is the largest passenger rail station in New England, serving three Amtrak lines, eight MBTA Commuter Rail lines, and the seasonal service to Cape Cod via the CapeFlyer. MBTA owns and maintains the transportation facilities at South Station and Beacon Management owns and operates office space at the station. Additionally, Hines Interest LLP owns air rights above the station’s tracks and platforms and there are plans to develop a 41-story tower on the site. Figures D-1 to D-3 highlight the station area character and population density of the surrounding area.

Station Operations

South Station has thirteen tracks and seven high-level platforms, passenger waiting and ticketing facilities, retail and food vendors, and public safety facilities. The station is an ADA accessible station. A staffed ticketing office is open from 4:45AM to 10:00PM Monday through Friday, and from 5:45AM to 10:00PM on Saturday and Sunday. Checked baggage is available seven days a week from 6:30AM to 11:30PM. In addition, Quik-Trak ticketing kiosks are available 24 hours a day.

MassDOT is developing an expansion plan for South Station to accommodate additional passenger rail service. South Station currently operates at capacity during peak hours and MassDOT’s plans will add amenities, station tracks, and platform capacity to the station. Additionally, Hines Interest LLP owns air rights above the station’s tracks and platforms and there are plans to develop a 41-story tower on the site.

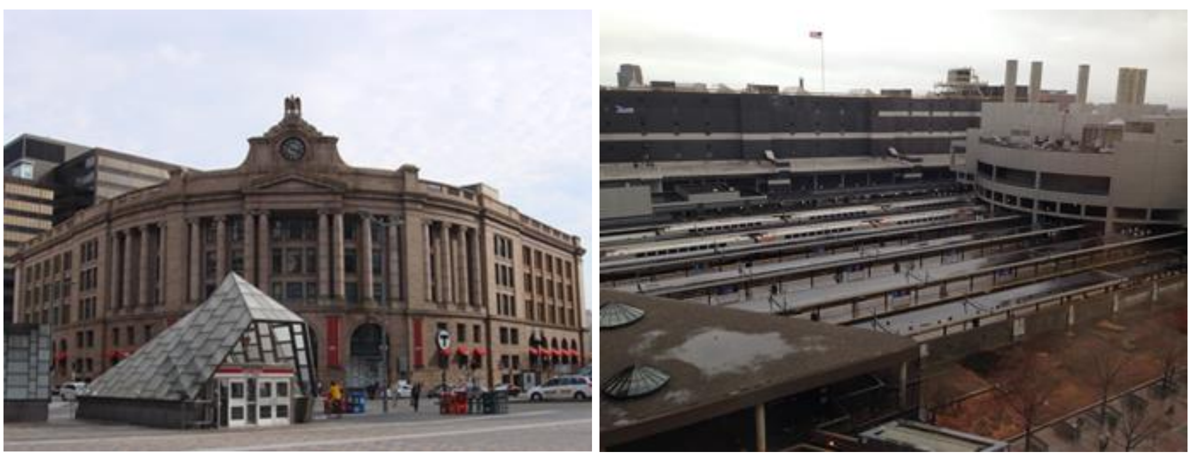
The station is anticipated to serve 117,922 passengers annually or an average of 323 daily passengers on the three NNEIRI services. Higher than average passenger loads would be expected on weekdays, around major holidays, and during rush hours, as is consistent with typical travel patterns. Existing facilities are expected to be sufficient to accommodate passenger loads.

Intermodal Connectivity

South Station is a terminus for three Amtrak lines (Acela Express, Lake Shore Limited, and Northeast Regional), eight MBTA Commuter Rail lines (Framingham/Worcester Line, Needham Line, Franklin Line, Providence/Stoughton Line, Fairmount Line, Greenbush Line, Middleborough/Lakeville Line, and Plymouth/Kingston Line), and the seasonal CapeFlyer service to Cape Cod. Direct connections are available to the MBTA's Red Line and Silver Line rapid transit services. Local bus routes run by the MBTA and private shuttle bus routes are also available. Additionally, South Station serves as a hub for intercity bus lines in New England, providing connections to destinations throughout the northeast and mid-Atlantic.

Station Access

Motorists at South Station have direct connections to several major roadways. The station is located 0.5 miles from Interstate 90 and 93 (exit 20). Parking is available at the South Station Bus Terminal garage, located on the southern part of the site. The station has on-site bike cages and bike rental facilities. Public transit users have direct access at South Station to local subway and bus routes. The station is located near the heart of Boston's central business district and numerous large commercial, government, and cultural buildings are located in close proximity. The surrounding district is pedestrian-friendly and the station is easily accessible to pedestrians.



(Source: Picture E-1 from the Northeast Corridor Commission)

Figure D-1 and D-2. South Station Headhouse and Platforms

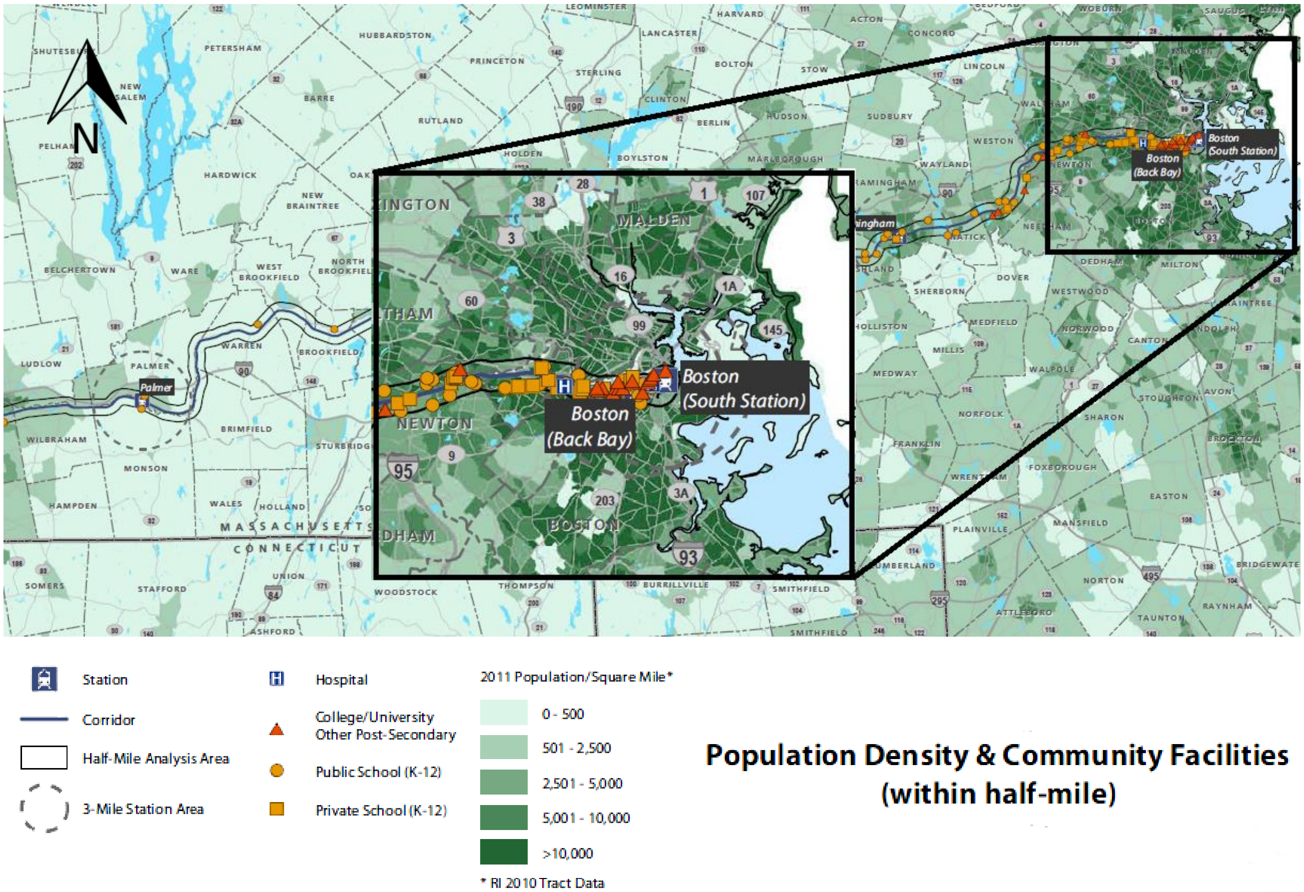


Figure D-3. Boston (Back Bay Station and South Station) Locations and Key

D.3 BACK BAY STATION, BOSTON, MASSACHUSETTS

Back Bay Station is a passenger rail station located on Dartmouth Street, in the Back Bay neighborhood of Boston, Massachusetts. The station is served by three Amtrak lines and four MBTA commuter rail lines. Back Bay Station is owned and operated by MBTA. The station serves the dense Back Bay and South End neighborhoods of Boston, which are characterized by large office towers and residential buildings. Figures D-4 and D-5 highlight the station area character. The population density of the surrounding area was previously shown in Figure D-3.

Station Operations

Back Bay Station has five rail tracks and three platforms used by Amtrak and Commuter Rail trains. Additionally, the MBTA Orange Line rapid transit service has two tracks and one island platform. Local and express buses utilize a bus loop located on the eastern side of the station. Back Bay Station meets Amtrak ADA accessibility guidelines. The station features a large headhouse with passenger waiting and ticketing areas, retail and food vendors, and public safety facilities. A staffed ticketing office is open from 5:00AM to 7:10PM Monday through Friday, and from 6:00AM to 7:10PM on Saturday and Sunday. In addition, Quik-Trak ticketing kiosks are available seven days a week from 5:00AM to 11:59PM. Checked baggage is not available at this location.

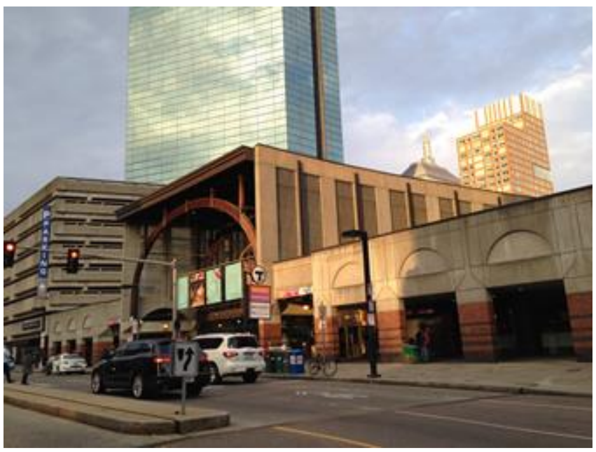
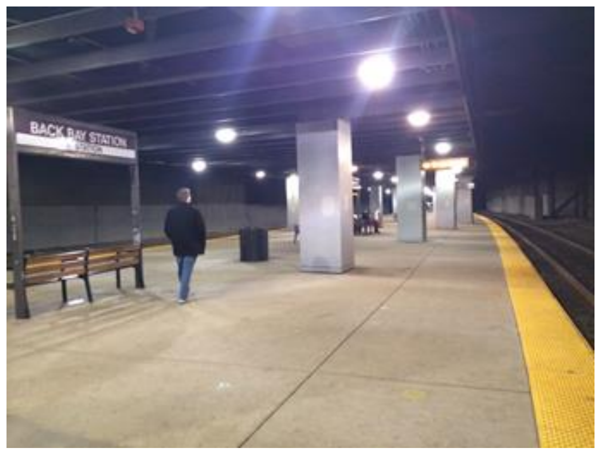
The station is anticipated to serve 23,825 passengers annually or an average of 65 daily passengers on all NNEIRI services. Facilities are expected to be sufficient to accommodate passenger loads.

Intermodal Connectivity

Back Bay Station is served by three Amtrak lines (Acela Express, Lake Shore Limited, and Northeast Regional) and four MBTA Commuter Rail lines (Framingham/Worcester Line, Needham Line, Franklin Line, and Providence/Stoughton Line). The station is served by MBTA Orange Line rapid transit service, which operates from Forest Hills Station in Boston to Oak Grove Station in Malden. In addition, local MBTA bus service and private shuttle buses are available as well.

Station Access

The station has no on site parking but private parking garages are proximate to the station. Back Bay Station is a 0.6-mile trip from Interstate 90 (exit 22) and is 1.1 miles from Interstate 93 (exit 20). The station also has on-site bike cages and bike rental facilities. The station is the terminus for Boston's Southwest Corridor Park, which contains a five-mile long multi-use path that runs southwest from Back Bay Station to Boston's Forest Hills neighborhood. The station is in a dense mixed-use district with large office towers, residential buildings, and cultural attractions nearby. The station area and the surrounding district are both pedestrian friendly easily accessible.

Figures D-4 and D-5. Back Bay Headhouse and Platforms used for Westbound Service

D.4 FRAMINGHAM STATION, FRAMINGHAM, MASSACHUSETTS

Framingham Station is a passenger station located at the intersection of Irving and Concord Streets in Framingham, Massachusetts. The station is owned and operated by the MBTA. It is located in a suburban town center, with a mix of commercial, institutional, and residential buildings. The station is an existing stop on Amtrak's Lake Shore Limited Service and MBTA's Framingham/Worcester Commuter Rail Line. This station would serve as a suburban hub, and would attract passengers from across the MetroWest region of Eastern Massachusetts. Figures D-6 to D-8 show the station, platform, and the population density of the surrounding area.

Station Operations

Framingham Station has two low-level platforms with shelters. Access to the station is possible from several points on the surrounding street network. The northern platform is approximately 900 feet in length while the southern platform is approximately 725 feet in length. The two platforms are connected via an elevated walkway with vertical access. The station is served by two tracks and meets Amtrak ADA accessibility guidelines. The station is unstaffed, does not have an enclosed waiting area, and does not have ticketing functionality. The station is anticipated to serve 24,541 passengers annually or an average of 67 daily passengers on all NNEIRI services. Facilities are expected to be sufficient to accommodate passenger loads.

Intermodal Connectivity

The station is served by Amtrak's once daily Lake Shore Limited service between Boston and Chicago, and MBTA's Framingham/Worcester Commuter Rail Line between Boston and Worcester. On weekdays, 24 round-trip MBTA commuter rail trains serve the station. Frequent local bus service and shuttles serve the station through the MetroWest Regional Transit Authority (MWRTA) via Bus Routes 2, 3, 5 and 6.

Station Access

Passengers can access the station via a variety of methods, such as passenger car, walking, bike, bus, or commuter rail. The station has a 166-space parking lot, with four spaces designated for ADA accessibility. The station also has bike parking and a dedicated pick-up/drop-off zone. The station is five miles from Interstate 90 (exit 13) via local city streets and is also proximate to Massachusetts State Routes 9 and 30. The surrounding district is pedestrian friendly and the station is easily accessible to pedestrians.


Figures D-6 and D-7. Framingham Station Pedestrian Overpass and Platform

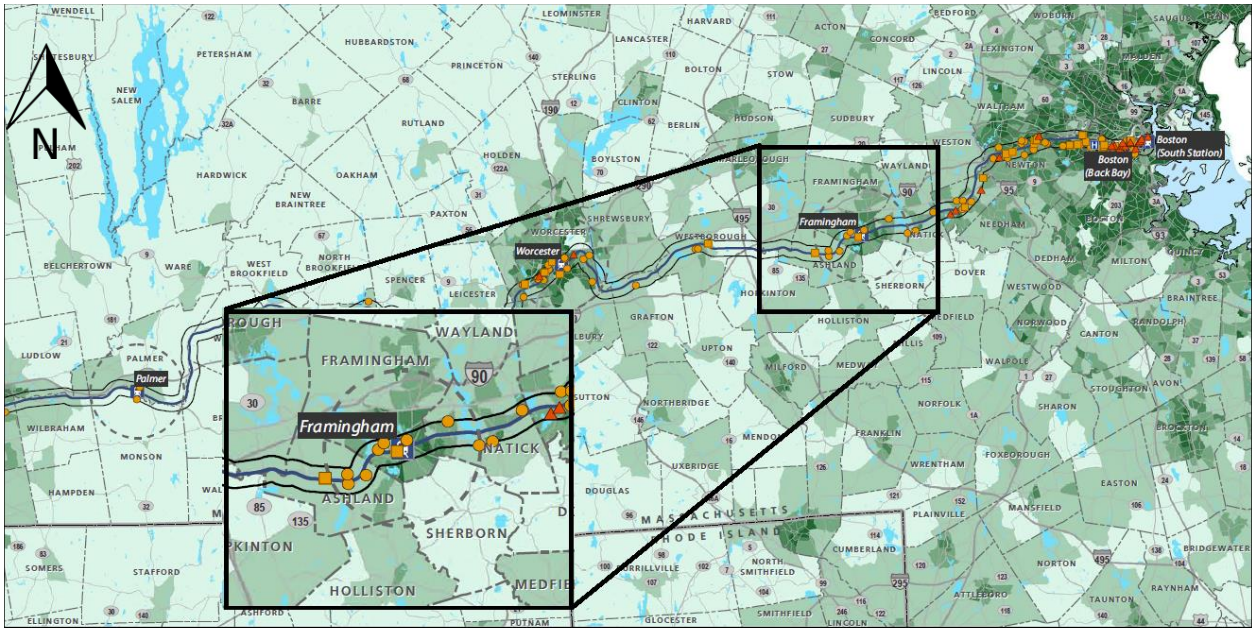


Figure D-8. Framingham Station Location

D.5 UNION STATION, WORCESTER, MASSACHUSETTS

Union Station is a passenger rail station located in downtown Worcester, Massachusetts on Washington Square. The station is served by Amtrak's Lake Shore Limited service and MBTA Commuter Rail's Framingham/Worcester Line. The station is owned and managed by the Worcester Redevelopment Authority. Union Station is located adjacent to I-290, and within close proximity to central Worcester. This station serves all of Worcester, which is the second largest city in New England with a population over 180,000. Figures D-9 to D-11 show the station headhouse, platforms, and population density of the surrounding area.

Station Operations

The station features a single high-level platform, five tracks, large headhouse with passenger waiting and ticketing areas, retail and food vendors, and public safety facilities. The single platform is approximately 400 feet in length. The station facilities meet ADA accessibility requirements. The station has a staffed ticketing area and a checked baggage service, both open from noon to 8:00PM on weekdays. Wayfinding at Union Station can be difficult, with incomplete signage in certain areas.

The station is anticipated to serve 50,126 passengers annually or an average of 137 daily passengers on NNEIRI services. Existing facilities are expected to be sufficient to accommodate passenger loads; however, a second platform is necessary for train operational purposes.

Intermodal Connectivity

Integrated into the rail station is the Union Station bus station, serving as the hub for the Worcester Regional Transit Authority (WRTA) bus system and intercity busses. Bus service to the Union Station area is frequent and serves an extensive region around Downtown Worcester. The station is served by Amtrak's Lake Shore Limited Service between Boston and Chicago, and MBTA's

Framingham/Worcester Commuter Rail Line between Boston and Worcester. On weekdays, 24 round-trip Commuter Rail trains serve the station.

Station Access

The station has a 500-space parking garage that includes nine designated ADA accessible spaces. The station also has bike parking and a dedicated pick up/drop off zone. The facility is 2.2 miles from the terminus of Interstates 190, 0.8 miles from exit 16 on Interstate 290 (exit 16), and within five miles of Interstate 90 (exit 10A). Union Station is located in a high-density area adjacent to Worcester's central business district, with numerous business, government, institutional, and residential buildings in close proximity. The station is reasonably accessible to pedestrians through sidewalks and passageways from the bus station and garage. However, Interstate 290 and the adjacent elevated railroad tracks create barriers for pedestrians accessing the station.

Figures D-9 and D-10. Worcester Union Station Headhouse and Platform

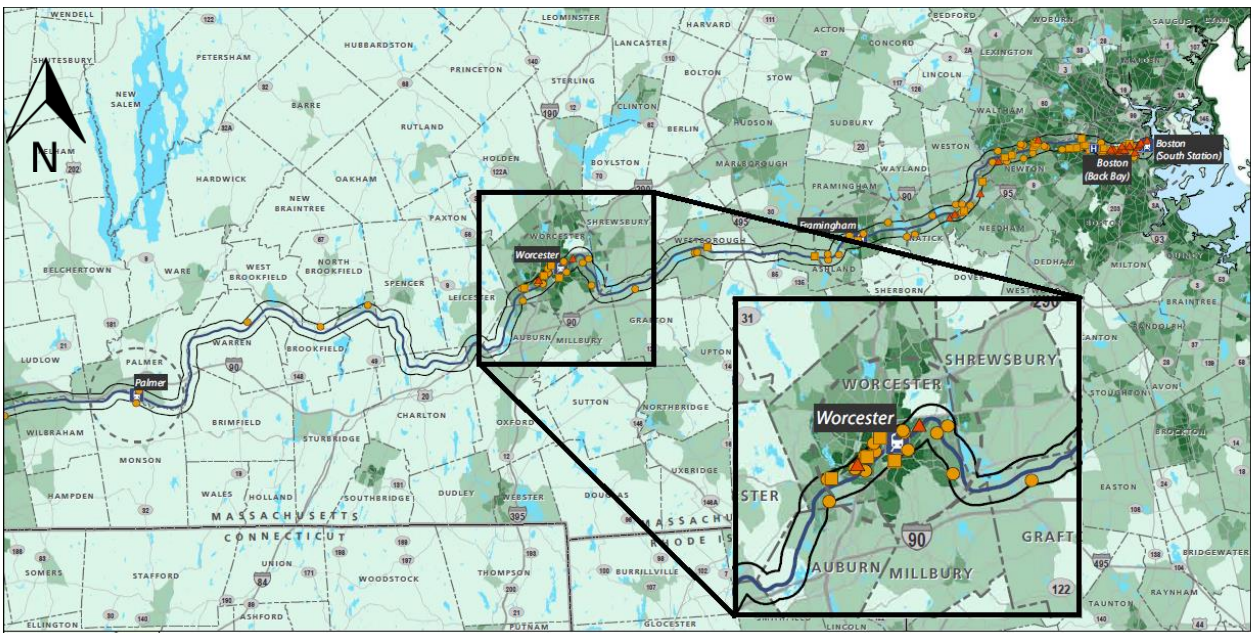


Figure D-11. Worcester (Union Station) Location

D.6 PALMER STATION, PALMER, MASSACHUSETTS

Palmer Station is a potential station in the center of Palmer, Massachusetts. The historic headhouse, now functioning as a restaurant, stands adjacent to the potential station site on Depot Street. Three tracks pass to the north and one to the south of the historic station. Additional study must be completed to determine the operational feasibility of the station since the historic station may be incompatible with current passenger rail operational requirements. Figures D-12 to D-14 show the station, platforms, and the population density of the surrounding area.

Station Operations

Currently, Palmer does not have an active station facility and is not served by passenger rail service. The NNEIRI Study proposed a new station that includes a single 875-foot-long platform with a canopy. The station facilities would meet Amtrak's ADA accessibility requirements. The station would not be staffed and would not have any ticketing functionality.

The station is anticipated to serve 9,627 passengers annually or an average of 26 daily passengers on all NNEIRI services.

Intermodal Connectivity

Although Amtrak's Lake Shore Limited Service passes through Palmer, no passenger rail service currently makes a station stop in the town. The station site is near the existing and frequent Pioneer Valley Transit Authority (PVTA) bus services in Palmer town center, approximately 0.25 miles away. The area is served by PVTA's Palmer Village Shuttle Route.

Station Access

The station is approximately two miles from Interstate 90 (exit 8). The site is also within one-half mile of U.S. Route 20 and Massachusetts State Route 32. The Palmer Station site is located near Palmer Center, with local commercial, civic, and cultural amenities nearby. The surrounding district is pedestrian friendly. However, safe pedestrian access to the site is limited due to the lack of sidewalks on Depot Street. A proposed parking lot with a capacity of 100 spaces and a dedicated pick-up/drop-off zone would be built to accommodate passengers arriving via passenger car.


Figures D-12 and D-13. Historic Palmer Headhouse and Platform Area

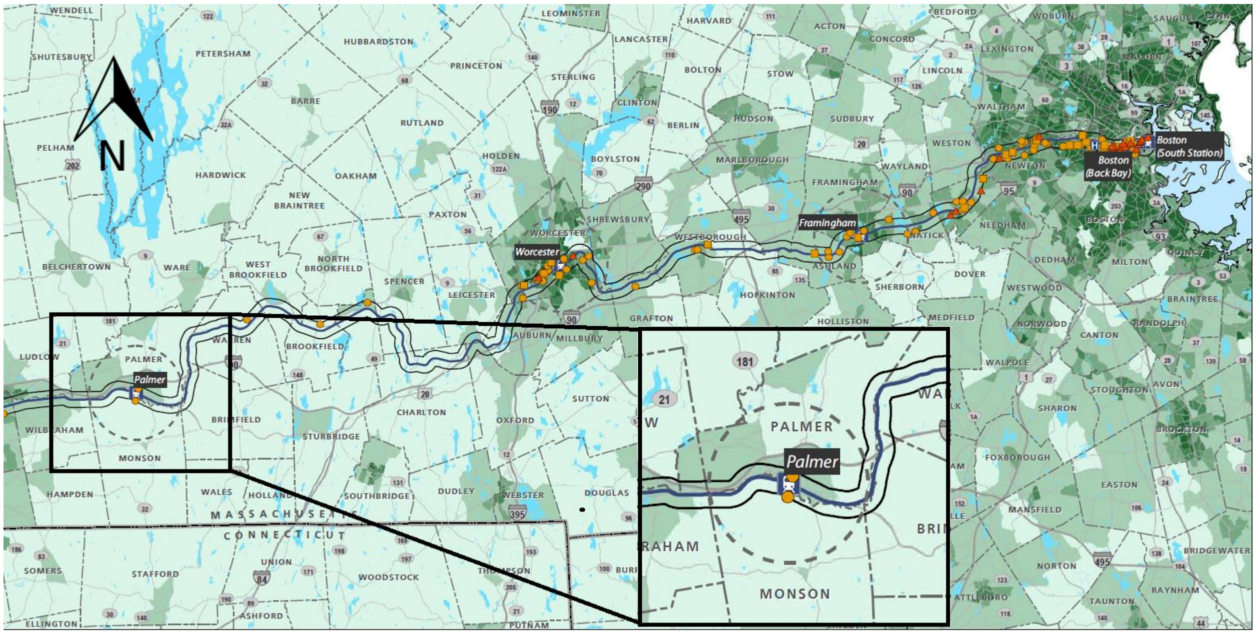


Figure D-14. Proposed Palmer Station Location

D.7 UNION STATION, SPRINGFIELD, MASSACHUSETTS

Union Station is a passenger rail station in downtown Springfield, Massachusetts on Lyman Street. The station is owned and managed by the Springfield Redevelopment Authority. The historic station building on the north side of the site has been abandoned, but the City of Springfield is in the process of redeveloping the station with an anticipated completion in late 2016. The work will include demolishing the existing baggage building, constructing a large parking garage and a 24-bay bus terminal on the site, and providing additional platform capacity to facilitate improved rail services. The existing Union Station building will also be rehabilitated to include improved passenger amenities and onsite office and commercial space. Union Station would serve as an urban hub station for the City of Springfield, which has a population of approximately 150,000. Figures D-15 to D-19 show the station, platforms, and the population density around the station.

Station Operations

The station includes six tracks and two low-level platforms approximately 500 feet in length. Only one platform is currently in use. The existing station also includes passenger waiting and ticketing areas and public safety facilities. The station renovation will improve passenger waiting areas and exiting platforms will be upgraded. Additionally, a new high-level platform will also be constructed. Union Station currently meets Amtrak's ADA accessibility standards. Union Station has a staffed ticket office that is open seven days a week from 5:00AM to 8:00PM. The station also accommodates checked baggage seven days a week. Quick-Trak kiosks are also available.

The station is anticipated to serve 33,459 passengers annually or an average of 92 daily passengers on all NNEIRI services and the existing Vermonter service; other intercity and commuter rail services will also continue operating at the station. Facilities are expected to be sufficient to accommodate passenger loads resulting from NNEIRI services.

Intermodal Connectivity

Currently, the station is served by Amtrak's Lake Shore Limited, Vermonter, New Haven to Springfield Shuttle, and Northeast Regional. The Lake Shore Limited, Vermonter, and Northeast Regional have service one daily roundtrip. New Haven to Springfield Shuttle services operate five daily roundtrips. New commuter rail service is expected to start in late 2016 between Springfield, Hartford, and New Haven. The station is currently not served by intercity busses, but will be served by intercity service as part of the rehabilitation of the historic headhouse. Local PVTA buses provide frequent service from the station to points around the Springfield area.

Station Access

Parking is available adjacent to the station and some parking spaces are ADA accessible. Plans for the renovated Union Station call for a large parking garage and a dedicated pick-up/drop-off zone. The facility is located 0.8 miles from Interstate 91 (exit 7) and 0.9 miles from Interstate 291 (exit 1A). Union Station is located in a high-density area adjacent to Springfield's central business district with numerous business, government, institutional, and residential buildings in close proximity. The surrounding district is pedestrian friendly and the station is easily accessible to pedestrians.


Figures D-15 and D-16. Existing Springfield Union Station Headhouse and Platform Area

Figures D-17 and D-18. Historic Springfield Union Station Headhouse and Track Space

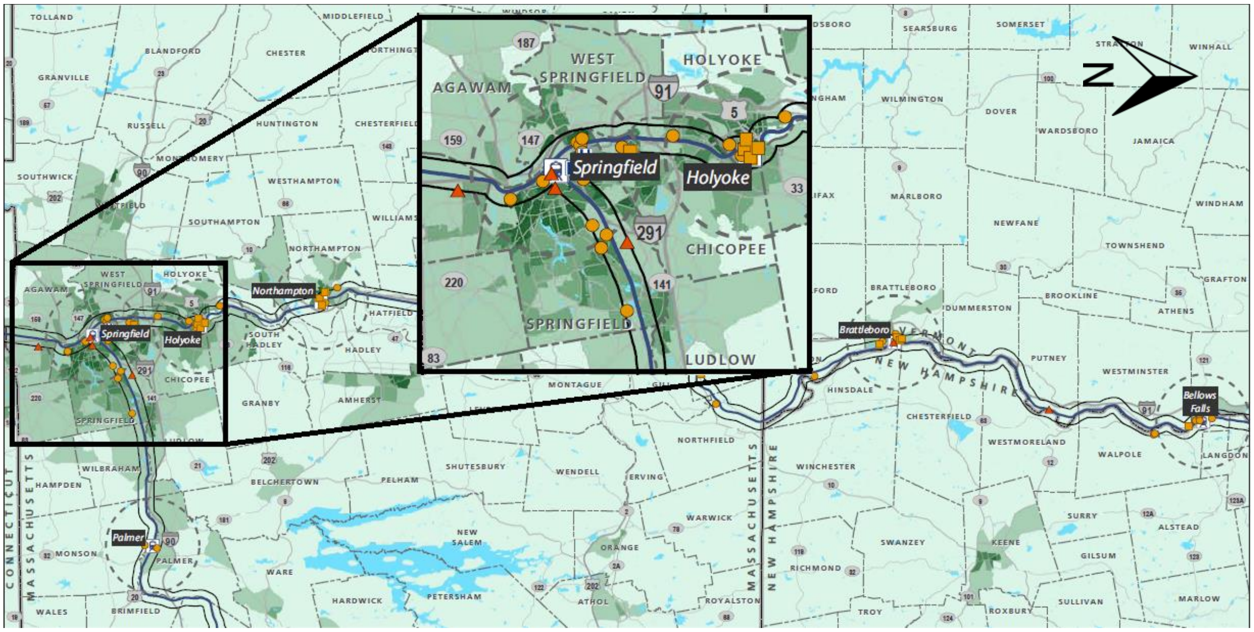


Figure D-19. Springfield Union Station and Holyoke Station Locations

D.8 WINDSOR LOCKS STATION, WINDSOR LOCKS, CONNECTICUT

Windsor Locks Station is passenger rail station on South Main Street in Windsor Locks, Connecticut. Amtrak owns the station and adjacent parking areas. Figures D-20 to D-22 show the station, platforms, and the population density of the surrounding area.

Station Operations

The station includes a bus berth, parking lot, and single track with platform. The platform is primarily low-level, but includes a high-level segment. The station meets requirements for ADA accessibility. There are no significant structures on site except for a small pumping station. The station contains outdoor passenger waiting areas, is unstaffed, and does not provide ticketing or baggage services. CTDOT is planning to redesign the station to include two tracks and two 500-foot-long side platforms. The redesigned station will include an elevator and stair overpass structure and will meet all ADA accessibility requirements.

The station is anticipated to serve 2,431 annual passengers or an average of eight daily passengers with both NNEIRI services and the existing Vermonter service. Facilities are expected to be sufficient to accommodate passenger loads.

Intermodal Connectivity

The station is currently served by Amtrak's Vermonter, New Haven to Springfield Shuttle, and Northeast Regional. The station is a future stop on the CT Rail Hartford Line commuter rail service, which is scheduled to begin service in 2016. The station is served by local bus service provided by CT Transit. CT Transit provides connections throughout Windsor Locks and to nearby Hartford. Bus connections to Bradley International Airport are also available.

Station Access

The station is approximately 0.5 miles from Interstate 91 (exit 42) via Connecticut State Route 159. The re-designed station will include a pickup and drop off space, a bus drop off area, bicycle parking, and additional vehicular parking. The surrounding district is low density with a few residential structures in close proximity. Safe pedestrian access to the station is nearly impossible, as surrounding roads do not have sidewalks.

Figures D-20 and D-21. Windsor Locks Station Platform

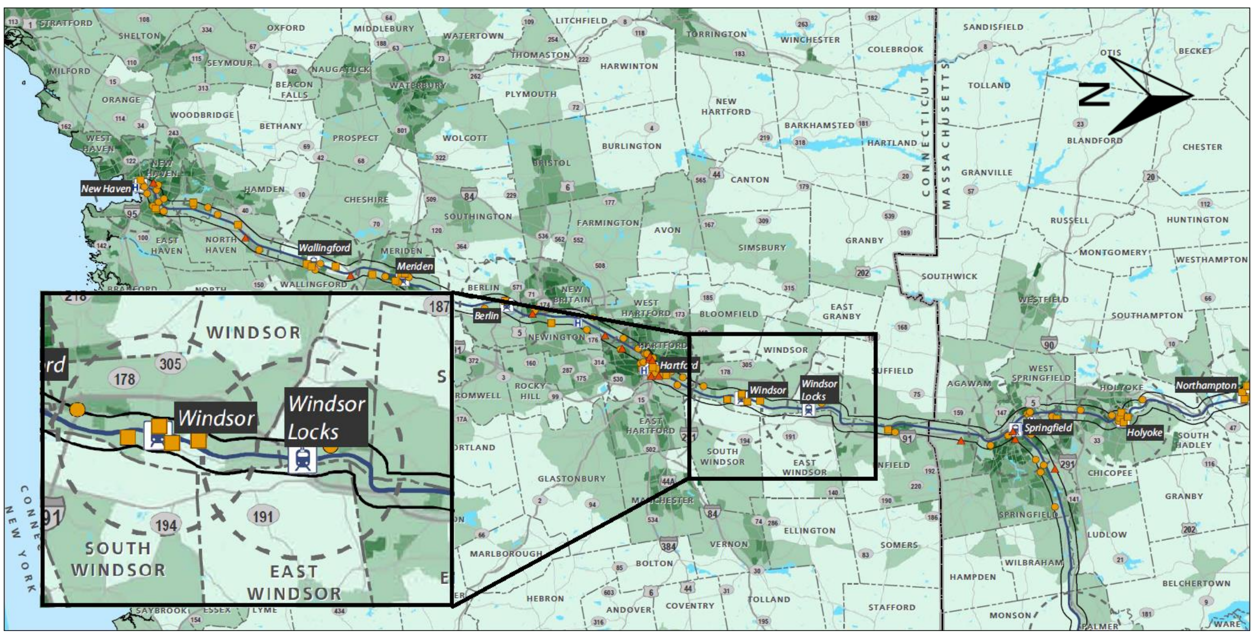


Figure D-22. Windsor Station and Windsor Locks Station Locations

D.9 WINDSOR STATION, WINDSOR, CONNECTICUT

Windsor Station is a passenger rail station on Central and Union Streets in Windsor, Connecticut. Amtrak owns the platforms and operates the station. The Town of Windsor owns the historic station headhouse. Figures D-23 to D-24 shows the station and platforms. The population density of the surrounding area is shown in Figure D-22

Station Operations

Currently, the station includes a bus berth, an historic headhouse and waiting area, a low-level platform, and a single track. The station is unstaffed and does not provide ticketing or baggage services. The station does not meet ADA accessibility requirements because of the low-level platform. CTDOT is planning to redesign the station to include two tracks and two 500-foot-long platforms on a site immediately south of the existing station. The redesigned station will include an overpass structure and will meet all ADA accessibility requirements.

The station is anticipated to serve 2,359 annual passengers, or an average of six daily NNEIRI passengers. Facilities are expected to be sufficient to accommodate passenger loads.

Intermodal Connectivity

The station is currently served by Amtrak's Vermonter, New Haven to Springfield Shuttle, and Northeast Regional. The station is a future stop on the CT Rail Hartford Line commuter rail service, which is scheduled to begin service in 2016. Local CT Transit bus connections operate from the station, providing direct connections throughout Windsor and to nearby Hartford.

Station Access

The station is located 1.5 miles from Interstate 91 (exit 37) via Connecticut State Route 305. The station has on-site bicycle and vehicle parking with designated accessible spaces. The re-designed station will include a pickup and drop off space, a bus drop off area, bicycle parking, and additional vehicular parking. The surrounding district is a medium density commercial and residential district. The surrounding district is pedestrian friendly and the station is easily accessible to pedestrians.


Figures D-23 and D-24. Windsor Station Headhouse and Platform

D.10 UNION STATION, HARTFORD, CONNECTICUT

Union Station is a passenger rail station located on Asylum Avenue in downtown Hartford, Connecticut. The station is owned and operated the Greater Hartford Transit District. Figure D-25 to D-27 show the station, platforms, and the population density of the surrounding area.

Station Operations

Union Station currently has a single platform and a single track on an elevated structure. The platform is approximately 650 feet in length. The station features a large headhouse with passenger waiting and ticketing areas, retail and food vendors, and public safety facilities. The ticketing office is open on weekdays from 6:00AM to 9:00PM, and on weekends from 6:30AM to 9:00PM. Quik-Trak ticketing is available 24 hours a day. No checked baggage is available at the station. CTDOT has plans to restore a second track and platform at Union Station to accommodate the introduction of the NHHS commuter rail service. The station meets Amtrak ADA accessibility requirements.

The station is anticipated to serve 2,359 annual passengers, or an average of six daily NNEIRI passengers. Facilities are expected to be sufficient to accommodate passenger loads.

Intermodal Connectivity

The station is currently served by Amtrak's Vermonter, New Haven to Springfield Shuttle, and Northeast Regional. The station is a future stop on the CT Rail Hartford Line commuter rail service, which is expected to begin service in 2016. A large bus terminal is located on the west of the station on Spruce Street with intercity and local bus service. Local bus service is provided by CT Transit, which provides connections throughout Central Connecticut. Additionally, CTfastrak (previously the Hartford-New Britain Busway) is a bus rapid transit service that began service to Hartford Union Station in 2015. CTfastrak provides local service, downtown circulators, and express service on a bus-only roadway.

Station Access

The station is located 0.4 miles from Interstate 84 ((exit 48) and is 1.3 miles from Interstate 91 (exit29A). The station does not have on-site parking, but public parking garages are located in close proximity. Station entrances on Spruce Street, Asylum Avenue, and Union Place provide pedestrian access. The station is located in Hartford's dense downtown district, with significant commercial, government, residential, and institutional buildings in close proximity. Key destinations include the Connecticut State Capitol, Trinity College, and the XL Center. The surrounding district is pedestrian-friendly and the station is easily accessible to pedestrians.

Figures D-25 and D-26.Hartford Union Station West Entrance and Intercity Bus Stop/Station Platform

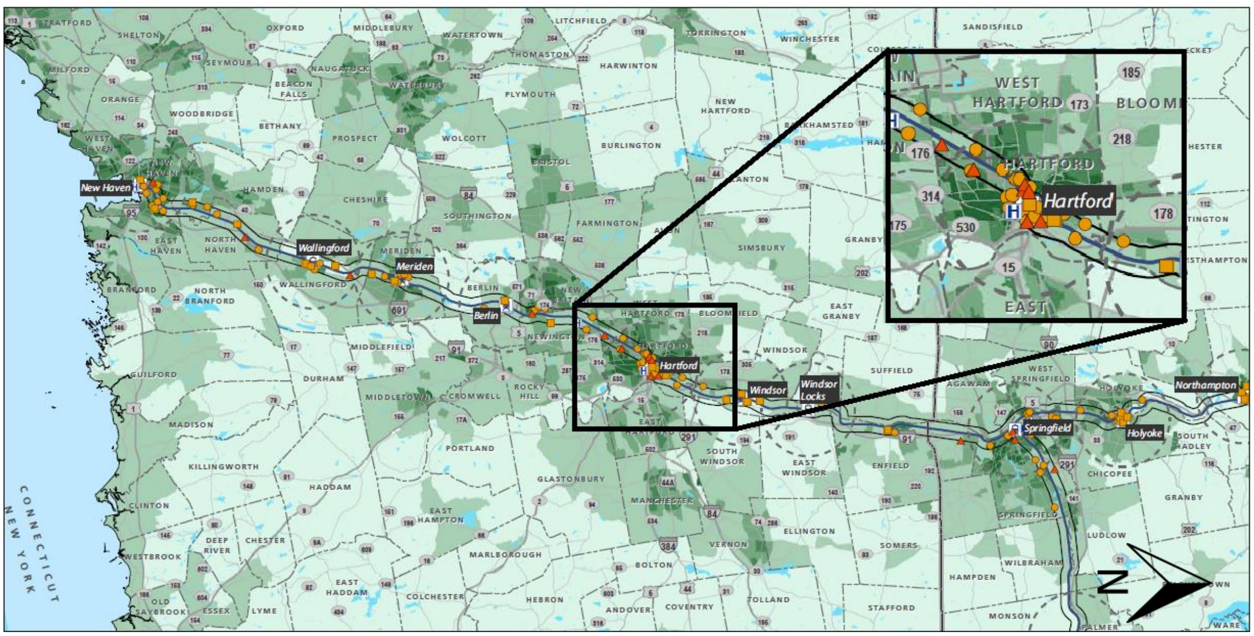


Figure D-27. Hartford Union Station Location

D.11 BERLIN STATION, BERLIN, CONNECTICUT

Berlin Station, also known as Kensington-Berlin Station, is passenger rail station on Depot Street in Berlin, Connecticut. Amtrak owns and operates the station. Figures D-28 to D-30 show the station, platforms, and population density of the surrounding area.

Station Operations

Currently, the station includes a single high-level platform and historic headhouse with passenger waiting area. The current platform is approximately 250 feet in length. One track is in use and a second abandoned track is located adjacent to the station. The station meets guidelines for Amtrak ADA accessibility. The headhouse contains a ticket office that is open weekdays from 6:15AM to 11:45AM and from 12:45PM to 2:45PM. The station does not have Quik-Trak ticketing or checked baggage services. CTDOT is planning to redesign the station to include two tracks and two side platforms at the existing station. The redesigned station will include an elevator and stair overpass structure and will meet Amtrak ADA accessibility requirements. The historic headhouse will be maintained in the new station complex.

The station is anticipated to serve 2,928 annual passengers, or an average of eight daily passengers on all NNEIRI services and the existing Vermonter service. Facilities are expected to be sufficient to accommodate passenger loads.

Intermodal Connectivity

The station is currently served by Amtrak's Vermonter, New Haven to Springfield Shuttle, and Northeast Regional. The station is a future stop on the CT Rail Hartford Line commuter rail service, which is scheduled to begin service in 2016. CT Transit provides local bus service within 500 feet of the station.

Station Access

The station is located 4.8 miles from Interstate 84 (exit 7) and 1.0 miles from nearby Connecticut State Route 9 (exit 23) via local city streets. Seventy-five vehicle parking spaces are available on site, with five ADA accessible parking spaces. The re-designed station will include a pickup and drop off space, a bus berth, bicycle parking, and additional vehicular parking. The surrounding area is a medium density suburban commercial and residential district. Pedestrian access to the station is limited due to the lack of sidewalks on Depot Avenue.

Figures D-28 and D-29. Berlin Station Headhouse, Parking, and Platform

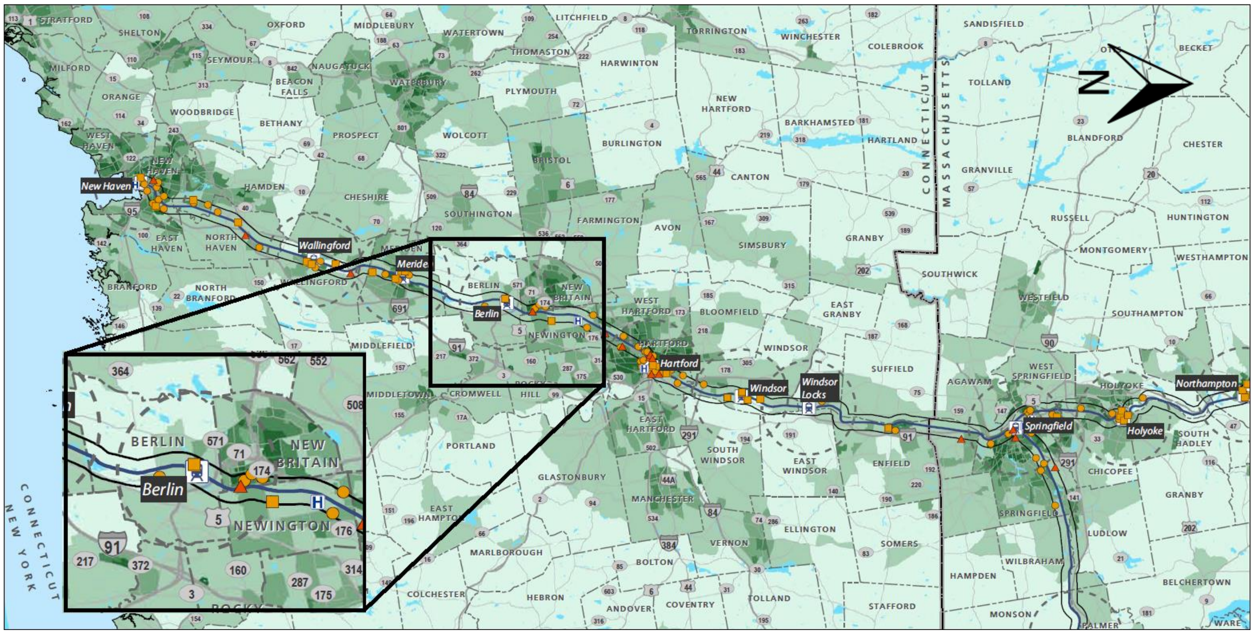


Figure D-30. Berlin Station Location

D.12 MERIDEN STATION, MERIDEN, CONNECTICUT

Meriden Station is passenger rail station on State Street in Meriden, Connecticut. Amtrak owns and operates the station platforms and the City of Meriden owns the headhouse. Figures D-31 to D-33 show the station, platforms, and the population density of the surrounding area.

Station Operations

Currently, the station includes a single low-level platform, two tracks, and headhouse with passenger waiting area. The current platform is approximately 400 feet in length. The station includes an enclosed waiting area with a ticketing office that is open weekdays from 6:30AM to 11:45AM and from 12:45PM to 3:00PM. The station does not have Quik-Trak ticketing or checked baggage services. The station meets Amtrak ADA accessibility requirements. CTDOT is planning to redesign the station to include two tracks and two side platforms on a site directly north of the existing station site. The redeveloped station will include an elevator and stair overpass structure and will meet all Amtrak ADA accessibility requirements.

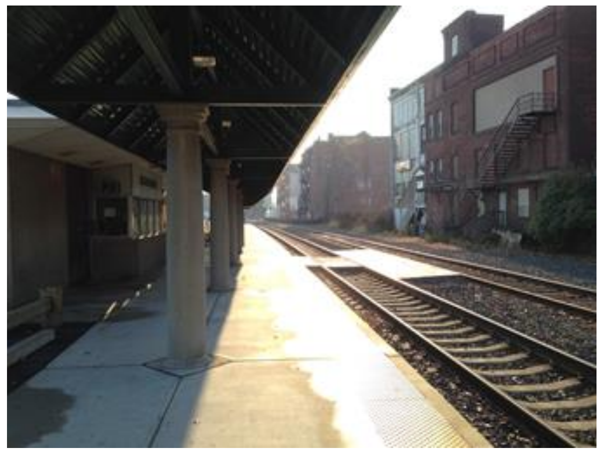
The station is anticipated to serve 4,148 annual passengers or an average of 11 daily passengers on NNEIRI services and the existing Vermonter service. Facilities are expected to be sufficient to accommodate passenger loads.

Intermodal Connectivity

The station is currently served by Amtrak's Vermonter, New Haven to Springfield Shuttle, and Northeast Regional services. The station is a future stop on the CT Rail Hartford Line commuter rail line, which is scheduled to begin service in 2016. Frequent local CT Transit and Middletown Area Transit buses serve the station.

Station Access

The station is located approximately 2.5 miles from Interstate 91 (exit 17); 1.1 miles from Interstate 691 (exit 8); and 2.3 miles from Connecticut State Route 15 (exit 67W). The City of Meridian owns the short-term vehicle parking lot at the station. The parking lot has some ADA accessible parking spaces available. The re-designed station will include a pickup and drop off space, a bus berth, bicycle parking, and additional vehicular parking. Pedestrian access to the station is possible from State Street. The surrounding district is a medium density suburban commercial and residential district town center. The surrounding district is pedestrian friendly and the station is easily accessible to pedestrians.



Figures D-31 and D-32. Meriden Station Headhouse, Parking & Platform

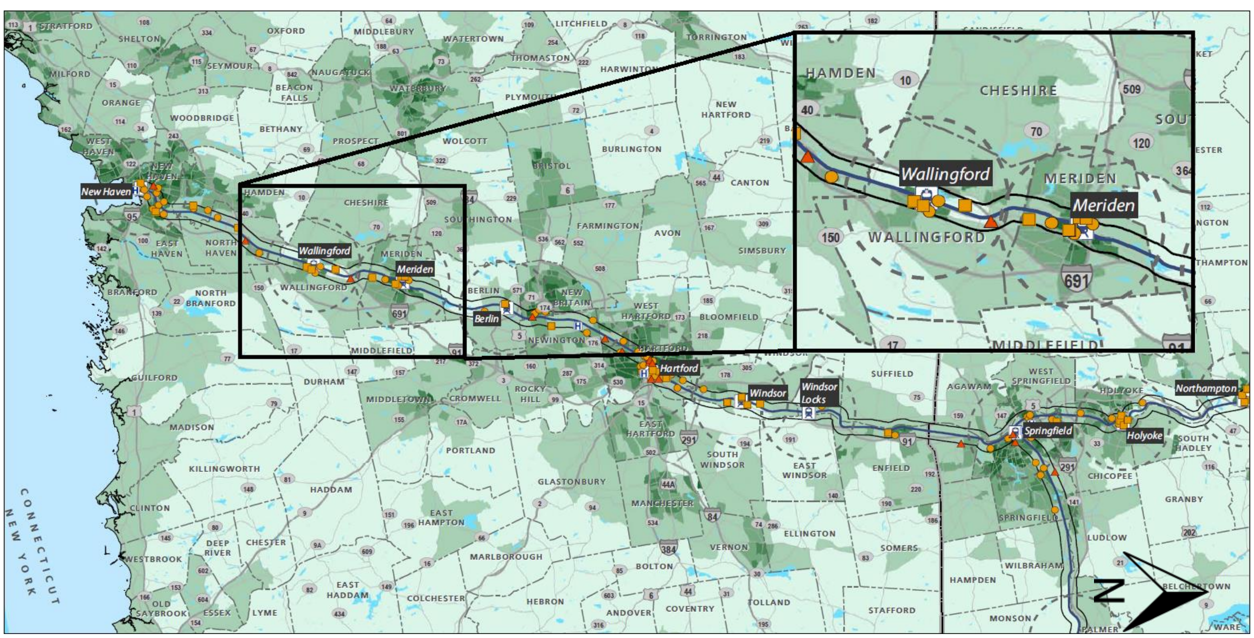


Figure D-33. Meriden Station and Wallingford Station Locations

D.13 WALLINGFORD STATION, WALLINGFORD, CONNECTICUT

Wallingford Station is a passenger rail station in on Hall Avenue in Wallingford, Connecticut. The station is owned and operated by Amtrak. Figures D-34 and D-35 show the station and platforms. Figure D-33highlights the population density of the surrounding area.

Station Operations

Wallingford Station features a single low-level platform and a single track. The current platform is approximately 200 feet in length. The original station building is currently used by the Wallingford Adult Education and the New Haven Society of Model Engineers Railroad Club. The station contains outdoor passenger waiting areas. The station is unstaffed and does not provide ticketing or baggage services. The station meets Amtrak’s ADA accessibility standards. CTDOT has plans to renovate the station to include covered passenger waiting areas and an elevated pedestrian bridge with fully accessible elevators and two high-level platforms.

The station is anticipated to serve seven daily passengers on the NNEIRI services and the existing Vermonter service. This is an average of one passenger on each of the 22 trains that would stop at the station daily. Facilities are expected to be sufficient to accommodate passenger loads.

Intermodal Connectivity

The station is currently served by Amtrak’s Vermonter, New Haven to Springfield Shuttle, and Northeast Regional. The station is a future stop on the CT Rail Hartford Line commuter rail service, which is scheduled to begin service in 2016. Local bus service is provided by CT Transit and serves the surrounding community.

Station Access

Wallingford Station is less than a mile from Connecticut State Route 15 (exit 64). The station has 100 short-term and 100 long-term parking spaces, but no ADA accessible spaces are available. Wallingford Station is located in a suburban town center, with commercial, residential, government, and institutional facilities are located in close proximity. The surrounding district is pedestrian friendly and the station is easily accessible to pedestrians. Pedestrian access to the station is from nearby streets and the adjacent parking lot.


Figures D-34 and D-35. Wallingford Station Headhouse, Parking, and Platform

D.14 UNION STATION, NEW HAVEN, CONNECTICUT

Union Station is a passenger rail station on Union Avenue in the downtown section of New Haven, Connecticut. Union Station is owned and operated by the CTDOT. Figures D-36 to D-38 show the station, platforms, the population density of the surrounding area.

Station Operations

Union Station has four high-level island platforms, which are fully ADA accessible. The four platforms range in length from approximately 700 feet to approximately 825 feet. New Haven has seven tracks and an adjacent rail yard. An underground tunnel from the station headhouse is used to facilitate access to the platforms. The headhouse includes a large passenger waiting area, retail and food vendors, and public safety facilities. A car-rental facility is also available on-site. The station is fully staffed and the ticketing office is open daily from 6:30AM to 9:30PM. Quik-Trak ticketing is available 24 hours a day, and checked baggage is available daily from 7:00AM to 11:00PM.

The station is anticipated to serve 29,392 annual passengers, or an average of 82 daily passengers on the NNEIRI services and the existing Vermonter service. Facilities are expected to be sufficient to accommodate passenger loads.

Intermodal Connectivity

The station is served by Shore Line East, Metro North, and Amtrak's Acela, New Haven-Springfield Shuttle, Northeast Regional, and Vermonter services. The station is the future southern terminus on the CT Rail Hartford Line commuter rail service, which is scheduled to begin service in 2016. Intercity buses serve the station, as well as local CT Transit buses that provide connections throughout the New Haven area. Private shuttle buses from area institutions, such as Yale University, also serve the station.

Station Access

The station is located approximately 1.5 miles from Interstate 95 (exit 47) and 1.3 miles from Interstate 91 (exit 1). The station has a 600-space parking garage, with spaces designated for ADA accessibility. On-site bicycle parking is also provided. The parking garage is owned CTDOT and is operated by the New Haven Parking Authority. The station is readily accessible to pedestrians from the main entrance on Union Street. Union Station is located near New Haven's central business district, with numerous residential, commercial, government, and institutional buildings located in close proximity, including Yale University. The surrounding district is pedestrian-friendly and the station is easily accessible to pedestrians.

Figures D-36 and D-37. New Haven Union Station Headhouse and Platform

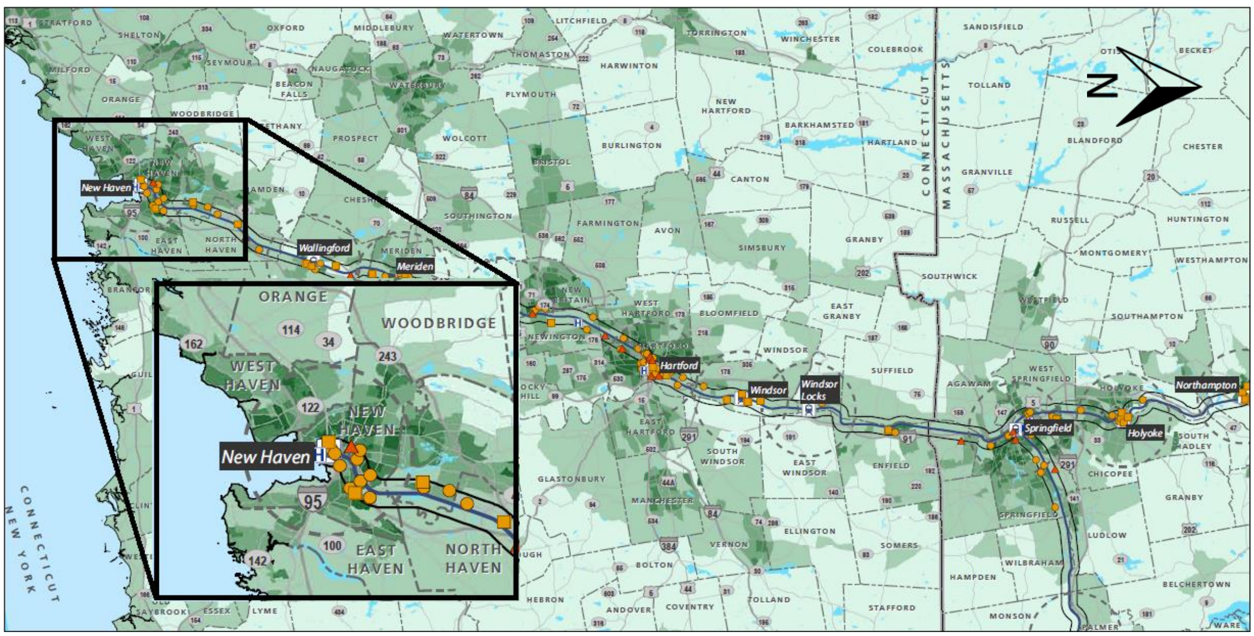


Figure D-38. New Haven Union Station Location

APPENDIX E OPERATIONS MODELING

Rail operations modeling was performed for the proposed NNEIRI service to evaluate the capacity of the corridors, and determine needed infrastructure improvements to support greater train frequencies. The outputs from modeling effort inform the level of infrastructure upgrades required for passenger and freight operations along the corridor.

E.1 MODELING METHODOLOGIES

Service along the NNEIRI Corridor was modeled to assess the operational impact of added service and associated improvements. The software Rail Traffic Controller (RTC) by Berkley Systems was utilized to complete the modeling effort.

Overview and Description of the Rail Traffic Controller Tool

The RTC model is a software tool widely used by North American railroads to test rail operational plans and proposed track and signal infrastructure arrangements by simulating train operations and providing the associated operational output metrics. The basis of the RTC model can be characterized by the following two mathematical formula sets.

- The first set matches empirically derived characteristics of train performance that would occur based on selected train characteristics and track geometry. The model calculates acceleration, maximum speed, and deceleration characteristics of the simulated train as it travels over the user-designed track. The output of this set of formulas is the Train Performance Calculation (TPC), a time/distance graph of the performance of a specific train over a specific infrastructure.
- The second set of formulas uses railroad operating rules, user-selected methods of operation, and user-selected train-prioritization options to dispatch multiple trains over the modeled territory in a manner similar to the decision matrix used by a human train dispatcher.

Specific passenger and freight train consists are created and included in the model. The performance of the RTC modeled trains behave similar to real world operations on railroads, including replication of station-stop and meet/pass events. The model has the capability to plan train movements and identify capacity constraints in a network. By automating the application of these mathematical formula sets, the RTC model enables the user to test the effects on single-train performance of proposed track geometry and Methods of Operation. The effects on multiple-train performance of proposed schedules, prioritization plans, and infrastructure arrangements can also be tested.

RTC model is a validation tool that measures the results of user- proposed infrastructure, schedules, and train priorities. The RTC model is used to compare infrastructure and train planning alternatives given a particular set of rules; the results can then be analyzed against real world metrics and operations.

The RTC software has performance characteristics built in for most locomotive types that currently operate in United States today. The tool can empirically derive rolling stock performance characteristics such as rolling resistance and braking rates. Thus the model accurately reflects the difference in a train's performance based upon what type of locomotive is placed in a given train's consist, or changes to the consist for a given set of locomotives, over any infrastructure combination of grades and speeds. For example, the model can assess how changes in train length and weight will affect how a train performs compared to longer and heavier or shorter and lighter trains.

The number of passengers on a train can add tens of thousands of pounds to the weight of a train, which for passenger trains can affect performance. For all passenger trains modeled, it was assumed that the train was loaded to 85 percent of capacity based upon the number of seats available, and a factor of 200 pounds per passenger with luggage was calculated into the overall weight of that consist. Assuming an 85 percent passenger load factor per train set is a higher percent than typical anticipated passenger loads, however, the higher load allows for modeling to accurately account for peak train times.

E.2 LIMITS AND MAKEUP

Geographic Extent

The RTC model created for this study analyzes the NNEIRI Corridor from South Station in Boston, extending west towards Springfield on the MBTA's Framingham Subdivision and CSX's Boston Subdivision. From Springfield, MA, the model analyzes MassDOT owned Knowledge Corridor formally known as Pan Am's Connecticut River Subdivision, through the Vermont/Massachusetts border where it intersects the NECR Palmer Subdivision at approximately milepost 110.5. The Corridor continues north along the NECR Palmer Subdivision until it turns into NECR's Roxbury Subdivision. The model analyzes the Roxbury Subdivision until St. Albans, Vermont, where it follow CN track into Montreal, Canada. The total length of the model spans approximately 410 miles of the 470-mile-long NNEIRI Corridor; the Springfield to New Haven segment was not modeled through the NNEIRI study because capacity was determined sufficient through the NHHS program.

Due to the relative complexity of yard and maintenance operations, the RTC model did not include full yard or industrial build-outs, instead simply considering adequate leads to allow trains to clear the main line.

Existing Service and Operations

The NNEIRI Corridor has existing passenger rail service and freight operations. Service and operations by rail segment is active throughout the area but not all in conjunction. Five segments that are a part of the NNEIRI service already have service running along the infrastructure. These segments include Boston to Worcester, Worcester to Springfield, Springfield to East Northfield, East Northfield to St. Albans and St. Albans to Montreal. These services are described in more detail below.

Boston to Worcester

MBTA's Worcester line runs from South Station west to Worcester along the Boston subdivisions to approximately milepost 45. MBTA purchased the track to Worcester from CSX in 2012 and began to dispatch in 2015. CSX maintained trackage rights to operate its freights over the line, although a limited number of freights operate into Boston following closure of Beacon Park yard in Allston, MA. The MBTA operates 24 commuter rail round trips per day between Worcester and Boston, including local and express service. Approximately four daily freight trains operate along this corridor.

Amtrak currently operates one daily round-trip, the Lake Shore Limited, on this segment. This service operates between Chicago, Illinois and Boston.

Worcester to Springfield

CSX owns and operates the rail segment between Worcester to Springfield. The majority of the trains that operate along this corridor are freight, with one daily passenger train, the Lake Shore Limited. Approximately 20 freight trains operate daily between Worcester and Springfield. In the Springfield Union Station terminal area, the Connecticut Southern Railroad also operates. This operation typically includes daily train movements between the West Springfield Yard and the line between Springfield and New Haven.

Springfield to East Northfield

The NNEIRI Corridor turns north in Springfield at Control Point 98 along the MassDOT owned Knowledge Corridor. It intersects the NECR Palmer Sub in East Northfield near the Massachusetts –Vermont state line. Pan Am Railways dispatches freight primarily along this corridor. Amtrak operates its once daily Vermonter service along the entire length of this segment. The Vermonter terminates at St. Albans, Vermont. Approximately two Pan Am and one NECR freight trains operate daily between Springfield and East Northfield.

East Northfield to St. Albans

NECR owns and operates along the Palmer and Roxbury Subdivisions from East Northfield north to St. Albans. Pan Am has trackage rights along most of the corridor into White River Junction. From there, NECR and Amtrak operate into St. Albans. Amtrak's Vermonter service currently terminates in St. Albans, while CN and NECR both operate north to the border. Approximately two NECR freight trains operate daily between East Northfield and St. Albans.

St. Albans to Montreal

CN and NECR freight trains operate from St. Albans to Montreal. NECR dispatches up to the United States and Canada international border where they interchange with CN into Montreal. For a small section of this route into Montreal Central Station, AMT (Agence Métropolitaine de Transport) operates seven round trip commuter trains along the Mont-Saint- Hilaire line. Amtrak's Adirondack service also utilizes a portion of this corridor for its daily service between New York City and Montreal. Approximately two CN freight trains operate daily from St. Albans to Montreal.

RTC Dispatch Priorities

The following list ranks the priorities that are given to various vehicle types by the model. Trains are dispatched and run based on their specific priority and right of way on the track segment that they are operating on.

- Amtrak/Intercity Passenger Rail – Rank 1
- Commuter – Rank 2
- Intermodal – Rank 4
- Local – Rank 7
- Merchandise – Rank 7
- Unit Train – Rank 7
- Vehicle – Rank 7

RTC Modeling Methodology Applied to the Study

The RTC modeling effort included four models to assess the impacts of the NNEIRI Corridor Recommended Alternative on existing and proposed infrastructure:

- Case 1: 2015 Base Case – No Build
- Case 2: 2035 No Build with existing passenger operations and 2.2 percent freight growth
- Case 3: 2035 No Build with proposed passenger operations and 2.2 percent freight growth
- Case 4: 2035 Proposed Infrastructure with proposed passenger operations and 2.2 percent freight growth

As described later in this report, existing and future passenger and freight schedules are included in Tables 6.1-6.12.

Case 1: 2015 Base Case – No Build

The first case modeled was a 2015 Base Case. This case included existing infrastructure and track configurations, existing freight operations, MBTA commuter rail schedules, and Amtrak schedules and consists. The segment schedule developed as part of the CT Rail- Hartford Line study was used as the basis for service on the NNEIRI Corridor between New Haven and Springfield. This Base Case condition considered attributes including:

- Permanent speed restrictions developed from timetables, field observations, and track charts.
- Passenger station stops and freight yards for freight and passenger trains.
- Wayside signal locations and types developed from any data supplied by the host railroads, supplemented by field observations as necessary.
- Current train schedule and operating procedures.
- A seven-day period was modeled for this and all other model cases, with a two-day warm-up and one-day cool down, in addition to the seven days.
- Calibration of the RTC model with the railroads' schedule data provided by host railroads and from field observations conducted for the NNEIRI program, including:
    - Train travel times and speeds;
    - Meet and pass locations;

- Work events, crew changes, inspections, and refueling stops where available; and
- Yard entry and exit.

Case 2: Baseline Infrastructure and Freight Growth for 20 years After Proposed Implementation Date (2035)

In the second case, passenger train schedules remain at an existing (2015) level of service (no 2035 or other future case MBTA or CT Rail Hartford Line case exists) while freight growth grows at a 2.2 percent annual rate, as approved by FRA. Maximum train length is 9,600 feet, which is the longest train length that could feasibly operate on the NNEIRI Corridor given current intermodal terminal capacity constraints.

This model was intended to determine the impacts of freight growth on train operations along the corridor.

Case 3: Baseline Infrastructure and Freight Growth plus Proposed Passenger Service

The third model included baseline infrastructure and freight schedules as developed from the 2015 Base Case model and proposed NNEIRI passenger services. Proposed passenger service includes eight Inland Route Service round-trips, one Boston-to-Montreal Service round-trip, and one New Haven-to-Montreal Service round-trip. The schedule is outlined in Tables 6.3-6.6.

The purpose of this model was to assess the impacts of additional passenger service on freight operations along the corridor.

Case 4: Freight Growth Plus Proposed Passenger Train Service, Infrastructure Added.

The final model considered proposed NNEIRI infrastructure improvements. Passenger trains have on time performance equal to or exceeding 90 percent, as required by Passenger Rail Investment Improvement Act (PRIIA). Proposed infrastructure includes restoration of double track from Worcester to Springfield, siding extensions in Vermont, improved Worcester Union Station platform capacity, and signal and track improvements. Additional information on proposed infrastructure improvements is included in Chapter 6 of the Inland Route SDP. Passenger service will be the same as outlined in Case 3.

This model was used to determine the additional amount of infrastructure required to bring freight operations to a “status quo” of 2015 operational metrics and passenger rail to a 92 percent on time performance level.

E.3 OPERATIONS VARIATION

A variety of different aspects that caused random variation in operations was incorporated into the modeling effort. These aspects include operational reliability of scheduled rail service, operational variability of non-scheduled rail service, equipment, and infrastructure reliability.

Operating Timetables

Specific schedules were used in the development of the RTC modeling Cases, outlined in the RTC Modeling Methodology Applied to the Study section. Schedules were used to estimate the level of service for each proposal. The level of service for each case is as followed:

- Case 1: Existing Intercity Rail Service, Existing MBTA Commuter Rail Service, Existing Freight Service
- Case 2: Existing Intercity Rail Service, Existing MBTA Commuter Rail Service, Predicted 2035 Freight Service
- Case 3: Proposed Intercity Rail Service, MBTA Commuter Rail Service, Predicted 2035 Freight Service
- Case 4: Proposed Intercity Rail Service, MBTA Commuter Rail Service, Predicted 2035 Freight Service

Schedules used for modeling purposes include proposed timing for existing and new intercity rail service, commuter rail service, and freight rail services. Tables E-4 through E-7 display the proposed schedules for the full build-out of intercity rail service on the Boston-to-Montreal Route and the Inland Route for both the southbound and northbound directions. Table E-8 and E-9 display the existing weekday MBTA commuter rail schedule for the Worcester Line and NNEIRI service. Tables E-10 and E-11 show the freight schedule that was used to determine the level of freight service for both 2015 and 2035. Freight service in 2035 predicts a 2.2 percent annual growth rate based on the existing level of freight service. The freight schedules used were developed based on best available information. This included information provided by operating railroads and information gathered from field investigation of train operation as observed from publicly accessible locations. Where railroad supplied information was not provided, some estimations were required based on knowledge of the system, field data and historic operations.

Table E-4. Southbound Boston-to-Montreal Service and New Haven-to-Montreal Service Schedule 2035

Stations	Vermonter Train 55	New Haven-to-Montreal Service Train 57	Boston-to-Montreal Service Train 59
Montreal (Depart)	730A	1102A	202P
St. Albans	925A	1257P	357P
Burlington	949A	121P	421P
Waterbury	1014A	145P	446P
Montpelier	1028A	159P	500P
Randolph	1101A	232P	533P
White River Junction	1137A	308P	609P
Windsor, Vermont	1157A	328P	629P
Claremont	1207P	338P	639P
Bellows Falls	1227P	358P	659P
Brattleboro	100P	431P	732P
Greenfield	129P	500P	801P
North Hampton	142P	523P	824P
Holyoke	158P	539P	840P
Springfield (Arrive)	225P	607P	857P
Springfield (Depart)	240P	622P	9229
Palmer	-	-	939P
Worcester	-	-	1026P
Framingham	-	-	1054P
Boston (Arrive)	-	-	1125P
Windsor Locks	300P	642P	-

Stations	Vermonter Train 55	New Haven-to-Montreal Service Train 57	Boston-to-Montreal Service Train 59
Windsor, Connecticut	305P	647P	-
Hartford	320P	702P	-
Berlin	334P	716P	-
Meriden	344P	726P	-
Wallingford	352P	734P	-
New Haven (Arrive)	410P	752P	-

Table E-5. Northbound Boston-to-Montreal Service and New Haven-to-Montreal Service Schedule 2035

Stations	New Haven-to-Montreal Service Train 52	Boston-to-Montreal Service Train 54	Vermonter Train 56
New Haven (Depart)	900A	-	125P
Wallingford	918A	-	143P
Meriden	923A	-	148P
Berlin	938A	-	203P
Hartford	952A	-	217P
Windsor, Connecticut	1002A	-	227P
Windsor Locks	1010A	-	235P
Boston (Depart)	-	1050A	-
Framingham	-	1121A	-
Worcester	-	1149A	-
Palmer	-	1236P	-
Springfield (Arrive)	1030A	1253P	255P

Stations	New Haven-to-Montreal Service Train 52	Boston-to-Montreal Service Train 54	Vermonter Train 56
Springfield (Depart)	1045A	108P	310P
Holyoke	1102A	125P	327P
North Hampton	1128A	141P	343P
Greenfield	1151A	204P	406P
Brattleboro	1220P	233P	435P
Bellows Falls	1253P	306P	508P
Claremont	113P	326P	528P
Windsor, Vermont	123P	336P	538P
White River Junction	143P	356P	558P
Randolph	219P	432P	634P
Montpelier	252P	505P	707P
Waterbury	306P	519P	721P
Burlington	331P	544P	746P
St. Albans	355P	608P	810P
Montreal (Arrive)	540P	803P	1005P

Table E-6. Southbound Boston-to-New Haven Service Schedule 2035

Stations	Train 441	Train 443	Train 445	Train 447	Train 449	Train 451	Train 453	Train 455	Train 457
Inland Route Train Set #	4	5	6	7	Lake Shore Limited	8	1	2	3
Boston (Depart)	518A	638A	815A	1015A	1206P	109P	213P	541P	752P

Stations	Train 441	Train 443	Train 445	Train 447	Train 449	Train 451	Train 453	Train 455	Train 457
Framingham	549A	709A	846A	1046A	1237P	140P	244P	612P	823P
Worcester	617A	737A	914A	1114A	105P	208P	312P	640P	851P
Palmer	704A	824A	1001A	1201P	152P	255P	359P	727P	938P
Springfield (Arrive)	721A	841A	1018A	1218P	209P	312P	416P	744P	955P
Springfield (Depart)	724A	846A	1023A	1223P	214P	317P	421P	749P	1000P
Windsor Locks	744A	906A	1043A	1243P	-	337P	441P	809P	1020P
Windsor	-	-	1048P	1248P	-	342P	446P	814P	1025P
Hartford	804A	926A	1103A	103P	-	357P	501P	829P	1040P
Berlin	-	-	1117A	117P	-	411P	515P	843P	1054P
Meriden	-	-	1127A	127P	-	421P	525P	853P	1104P
Wallingford	-	-	1135A	135P	-	429P	533P	901P	1112P
New Haven (Arrive)	835A	953A	1153A	153P	-	447P	551P	921P	1130P

Table E-7. Northbound Boston-to-New Haven Service Schedule 2035

Stations	Train 440	Train 442	Train 444	Train 446	Train 450	Train 452	Train 448	Train 454	Train 456
Inland Route Train Set #	1	2	3	4	5	6	Lake Shore Limited	7	8
New Haven (Depart)	510A	635A	818A	1003A	1212P	303P	-	503P	709P
Wallingford	528A	653A	836A	1021A	1230P	321P	-	-	727P
Meriden	533A	658A	841A	1026A	1235P	326P	-	-	732P
Berlin	548A	713A	856A	1041A	1250P	341P	-	-	747P
Hartford	602A	727A	910A	1055A	104P	355P	-	541P	801P
Windsor	612A	737A	920A	1105A	114P	405P	-	-	811P

Stations	Train 440	Train 442	Train 444	Train 446	Train 450	Train 452	Train 448	Train 454	Train 456
Windsor Locks	620A	745A	928A	1113A	122P	413P	-	555P	819P
Springfield (Arrive)	640A	805A	948A	1133A	142P	433P	-	615P	839P
Springfield (Depart)	645A	810A	952A	1138A	147P	438P	553P	620P	844P
Palmer	702A	837A	1009A	1155A	204P	505P	610P	637P	901P
Worcester	749A	914A	1056A	1242P	251P	552P	657P	724P	948P
Framingham	817A	942A	1124A	110P	319P	620P	725P	752P	1016P
Boston (Arrive)	848A	1013A	1155A	141P	350P	641P	756P	823P	1047P

Table E-8. Weekday MBTA Worcester Line Schedule Outbound

Train	Boston South Station	Boston Back Bay	Framingham	Worcester Union Station
501	4:20	-	5:00	5:35
503	5:45	5:51	6:30	7:13
505	7:00	7:06	7:44	8:27
507	7:15	7:21	7:51	-
509	7:45	7:51	8:33	-
511	9:00	9:06	9:48	10:29
513	10:15	10:21	11:06	11:46
515	12:05	12:11	12:56	1:36
517	1:05	1:11	1:56	2:36
519	2:05	2:11	2:58	3:38
521	2:55	3:01	3:48	4:28
523	4:05	4:11	4:43	5:25
525	4:25	4:31	5:23	-
527	5:00	5:06	5:42	6:25

Train	Boston South Station	Boston Back Bay	Framingham	Worcester Union Station
529	5:15	5:21	6:13	-
583	5:30	5:36	6:06	6:47
531	5:35	5:41	6:31	7:13
533	6:05	6:11	7:00	7:40
535	6:40	6:46	7:37	8:17
537	7:20	7:26	8:15	8:55
539	8:35	8:41	9:30	10:10
541	9:25	9:31	10:20	11:00
543	10:25	10:31	11:20	12:00
545	11:25	11:31	12:20	1:00

Table E-9. Weekday MBTA Worcester Line Schedule Inbound

Train	Worcester Union Station	Framingham	Boston Back Bay	Boston South Station
500	4:45	5:29	6:19	6:24
502	5:20	6:04	6:43	6:48
504	5:45	6:29	7:22	7:27
582	6:05	6:48	7:15	7:20
506	6:35	7:19	8:09	8:14
508	7:00	7:44	8:23	8:28
510	8:02	8:52	8:57	-
512	7:35	8:18	9:03	9:08
514	8:45	9:35	9:40	-

Train	Worcester Union Station	Framingham	Boston Back Bay	Boston South Station
516	8:40	9:21	10:04	10:09
518	10:45	11:26	12:14	12:19
520	12:10	12:51	1:34	1:39
522	1:50	2:31	3:19	3:24
524	2:50	3:31	4:19	4:24
526	3:55	4:36	5:19	5:24
528	4:40	5:21	6:04	6:09
530	6:15	6:58	7:03	-
532	5:50	6:31	7:14	7:19
534	6:45	7:28	7:33	-
536	7:50	8:31	8:59	9:04
538	8:30	9:09	9:52	9:57
540	9:30	10:09	10:52	10:57
542	11:10	11:49	12:32	12:37
544	12:10	12:48F	1:24	1:29

Table E-10. Freight Schedule Boston to Springfield

Time	Mile Post	Departs From	Arrive In	Number of Locomotives in Each Train	Number of Cars in Each Train	Number of Cars in Each Train 2035 (2.2% growth rate)	Max Train Speeds
09:00 - 10:30	BK98.9 - FR43.330	Springfield	Worcester	2	34	53	70
04:15 -06:30	BK98.9 –BK 98.9	Springfield	Springfield	1	50	69	70
06:30-07:30	BK98.9 –BK 98.9	Springfield	Springfield	1	50	69	70

Time	Mile Post	Departs From	Arrive In	Number of Locomotives in Each Train	Number of Cars in Each Train	Number of Cars in Each Train 2035 (2.2% growth rate)	Max Train Speeds
08:00-09:00	BK98.9 –BK 98.9	Springfield	Springfield	1	50	69	70
4:30-5:30	BK98.9 - FR43.330	Springfield	Worcester	1	17	26	70
11:00 - 13:25	BK98.9 - FR43.330	Springfield	Worcester	2	35	54	70
22:10 - 23:35	BK98.9 - FR43.330	Springfield	Worcester	2	29	45	70
0:45 - 2:45	FR44.360 - GJ00.020	Worcester	Springfield	1	15	23	70
5:15 - 7:00	FR44.360 - GJ00.020	Worcester	Springfield	1	17	26	70
22:25 - 0:20	FR44.360 - GJ00.020	Worcester	Springfield	1	20	31	70
21:45 - 23:45	FR44.360 - GJ00.020	Worcester	Springfield	2	38	59	70
22:25 - 0:20	FR44.360 - GJ00.020	Worcester	Springfield	1	23	36	70
4:30 - 8:15	BK98.900 - FR43.330	Springfield	Worcester	4	89	138	70
0:30 - 4:00	BK98.900 - FR43.330	Springfield	Worcester	4	80	124	70
23:15 - 2:15	BK98.900 - FR43.330	Springfield	Worcester	4	108	167	70
23:15 - 2:15	BK98.900 - FR43.330	Springfield	Worcester	4	87	134	70
23:00 - 3:15	FR44.360 - GJ00.020	Worcester	Springfield	4	108	167	70
23:59 - 3:45	FR44.360 - GJ00.020	Worcester	Springfield	4	93	144	70
22:00 - 0:40	FR44.360 - GJ00.020	Worcester	Springfield	4	96	148	70
15:00 - 19:00	FR44.360 - GJ00.020	Worcester	Springfield	4	105	162	70
14:00-15:00	BK98.9 –BK 98.9	Springfield	Springfield	1	50	69	70
6:40 - 8:40	BK98.900 - BO57.750	Springfield	East Brookfield	2	100	155	70
6:00 - 8:00	BO64.120 - GJ00.020	East Brookfield	Springfield	2	100	155	70
16:30	BK98.900 - GJ00.020	Springfield	Yawkey	1	20	31	70

Time	Mile Post	Departs From	Arrive In	Number of Locomotives in Each Train	Number of Cars in Each Train	Number of Cars in Each Train 2035 (2.2% growth rate)	Max Train Speeds
6:30	BK98.900 - GJ00.020	Springfield	Yawkey	2	28	43	70
22:15	BK98.900 - GJ00.020	Springfield	Yawkey	1	14	22	70
1:00	BK98.900 - FR43.330	Springfield	Worcester	1	13	20	70
4:00	BK98.900 - FR43.330	Springfield	Worcester	3	56	87	70
10:00	FR98.900 - FR43.330	Worcester	Worcester	3	60	93	70

Table E-11. Freight Schedule East Northfield to Canada

Time	Mile Post	Departs From	Arrive In	Number of Locomotives in Each Train	Number of Cars in Each Train	Number of Cars in Each Train 2035 (2.2% growth rate)	Max Train Speeds
21:30 - 23:55	PA160.600 - PA110.603	Claremont	Northfield	2	20	31	70
17:25 - 20:30	PA111.750 - PA162.050	Northfield	Springfield	2	20	31	70
19:30 - 1:04:30	PA122.110 - NS001.430	Brattleboro	St. Albans	3	80	124	70
22:00 - 1:06:30	NS000.200 - PA120.600	St. Albans	Brattleboro	3	80	124	70
9:45 - 10:15	RX127.880 - NS009.850	St. Albans	Swanton	2	0	0	70
10:20 - 12:00	NS009.100 - RX107.620	Swanton	Essex Junction	2	21	32	70
15:00 - 16:40	RX108.010 - NS009.850	Essex Junction	Swanton	2	21	32	70
16:45 - 17:15	NS009.100 - RX131.990	Swanton	St. Albans	2	0	0	70
3:00 - 4:00	RX108.010 - NS001.430	Essex Junction	St. Albans	2	20	31	70
22:00 - 23:00	NS000.500 - RX107.620	St. Albans	Essex Junction	2	20	31	70

Time	Mile Post	Departs From	Arrive In	Number of Locomotives in Each Train	Number of Cars in Each Train	Number of Cars in Each Train 2035 (2.2% growth rate)	Max Train Speeds
23:30 - 1:01:00	PA146.720 - RX014.750	Bellows Falls	White River Junction	2	20	31	70
19:45-21:00	RX014.500 - PA144.800	White River Junction	Bellows Falls	2	20	31	70
18:00 - 18:25	PA111.750 - PA122.110	East Northfield	Brattleboro	3	80	124	70
9:30 - 9:55	PA121.100 - CR046.800	Brattleboro	East Northfield	3	80	124	70
13:30 - 14:40	RX127.880 - CS018.360	St. Albans	Alburg	2	90	139	70
10:20 - 11:30	CS017.660 - RX126.960	Alburg	St. Albans	2	90	139	70
15:00 - 16:30	PA111.750 - PA146.720	East Northfield	Bellows Falls	3	80	124	70
18:00 - 19:30	PA145.100 - CR046.800	Bellows Falls	East Northfield	3	80	124	70

Service Equipment

The proposed service was modeled using standard train equipment on all routes. Standard push, pull diesel locomotive equipment (P42s with a cab car) was used to model all four cases.

- Commuter Consist
  - One F-40PH-2C locomotive
  - Three Single-Level commuter coaches
  - One Cab Car
- Intercity Train
  - One P42-DC locomotive
  - Four Next Generation Bi-Level Coaches
  - One Next Generation Bi-Level Cab/Baggage Car
  - One Next Generation Bi-Level Café/Business Class

Rail Infrastructure Characteristics

The four different cases were modeled using different levels of infrastructure characteristics. Infrastructure characteristics are a major input into RTC modeling, and the capacity of the entire corridor is based on the existing or proposed infrastructure. The infrastructure for the four cases included:

- Case 1: Existing infrastructure profiled in the No Build Alternative
- Case 2. Existing infrastructure profiled in the No Build Alternative
- Case 3: Existing infrastructure profiled in the No Build Alternative
- Case 4: The following infrastructure improvements were taken into consideration:
  - Restoration of the second mainline track between Worcester and Springfield at Mile Post 48.3 – 57.7, Mile Post 64.0 – 79.4, and Mile Post 83.6 – 92.0, including the maintenance of the passing siding at Mile Post 59.3 – 63.3 in East Brookfield, Massachusetts.
  - Additional siding at East Northfield, Massachusetts at PAS and NECR interchange area;
  - Second track extension at Mile Post 61.19 – 61.59 in Roxbury, Vermont;
  - Second track added to Mile Post 1.0 -8.0 between St. Albans and Swanton;
  - Siding extension at Mile Post 44.5 – 45.5 in Randolph, Vermont; and
  - Additional siding on NECR between Brattleboro, Vermont and St. Albans, Vermont at Hartland, South Royalton, Bethel, Randolph, Roxbury, Montpelier Junction, Bolton, Oakland, and St. Albans.

Case 4 is the only scenario in which infrastructure improvements were included. All other cases assumed the existing infrastructure characteristics included in the No Build Alternative were in place. The infrastructure improvements were modeled in Case 4 with the goal to enable freight and passenger rail to operate efficiently along the corridor.

Outputs

Detailed outputs were generated from the RTC modeling. The four different cases analyzed, stringline diagrams, delay matrices, and train-performance calculator speed and distance graphs were created. These outputs allow the data from RTC modeling to be displayed in a form that can be analyzed and studied.

Stringline (time and distance) diagrams were completed for all four cases. Stringline diagrams display the route and timing for each train along the corridor. The x-axis represents the time of day and the y-axis represents the locations and mileposts along the corridor. The lines on the graph itself (i.e., the stringlines) represent every train that will run on the corridor in the course of a day.

In Case One, colors represent each train: red, pink, blue, and teal. The red stringlines display specific trains that are predicted to be delayed by more than five minutes due to lack of capacity or due to conflicts with other trains. The pink stringlines display trains that are expected to be between one and five minutes behind schedule. The blue stringlines display trains that are expected to be on time or up to five minutes early. The teal stringlines display trains that are expected to be more than five minutes ahead of schedule. Colors to represent delay were used for Case 1 to highlight where existing delays and conflicts exist in the overall network. Figures E-1 to E-7 exhibit the stringline diagrams for Case 1 (the existing conditions). Current train traffic runs relatively smoothly with few delays as indicated. There is enough capacity for the existing level of passenger and freight service without the need for significant infrastructure improvements. In Cases 2 and 4, colors are used to represent train type. This is to better differentiate the impact of NNEIRI trains in the model from freight and commuter rail operations. Red stringlines represent intercity passenger rail services, blue stringlines represent passenger commuter rail services, and gold and green stringlines represent freight services. Delay metrics are identical to Case One, with trains operating early and up to 5 minutes late considered acceptable. Late trains are characterized as trains over five minutes late.

Figures E-8 to E-14 exhibit stringline diagrams for Case 2. Case 2 illustrates the predicted capacity in 2035 given the existing levels of passenger service, the existing infrastructure characteristics, and the proposed freight growth of 2.2% annually. The data from this chart indicates that the corridor exceeds capacity in some segments with significant delays in certain segments. The corridor segments between Worcester and Springfield and between Bellows Falls and Windsor, VT, appear to have the greatest amount of capacity issues. Even without increased passenger service, infrastructure improvements may be necessary in the next 20 years to accommodate the proposed growth in freight traffic.

Case 3 illustrates the predicted capacity in 2035 with the proposed levels of passenger service, the existing infrastructure characteristics, and the proposed freight growth of 2.2% annually. The RTC model would not dispatch Case 3 because the level of passenger service along with freight travel demand was too high for the current infrastructure. Therefore stringlines for Case 3 are not included in this report. . This case indicates that with full passenger and freight growth and no infrastructure improvements there would not be sufficient capacity along the corridor. Specifically, the segments between Worcester and Springfield and between Brattleboro and Windsor, VT are anticipated to experience capacity constraints. Between Worcester and Springfield, approximately fifty percent of all trains experience some level of delay without infrastructure improvements. In addition, select proposed NNEIRI trains will be behind schedule for the entirety of their route, including passenger trains 54, 56, and 57.

Figures E-15 to E-21 exhibit the stringline diagrams for Case 4. Case 4 illustrates the predicted capacity in 2035 with the proposed levels of passenger service, a proposed freight growth of 2.2 percent annually, and with several infrastructure improvements. The infrastructure improvements result in significantly fewer delays than in Case Two for freight services and significantly less delay than in Case Three for both freight traffic and passenger traffic. For example, the proposed extended sidings north and south of Bellows Falls result in more capacity on that segment of track, which results in fewer delays. The restoration of the second mainline track between Worcester and Springfield also reduces delays. Stringlines indicate smooth operation of both freight and passenger trains through Case 4, with no trains regularly running late or very late when reaching their final destination. In Case 4, the project team used conflicts identified in initial stringlines to make changes to NNEIRI schedules and infrastructure. For example, a new passing siding was identified as necessary between Worcester and Springfield as a result of initial stringline results.

E.4 EQUIPMENT AND TRAIN CREW SCHEDULING

Train crew schedule modeling was completed for the Boston-to-New Haven Service. The outputs from these models determined the necessary total equipment and train crew resources required to meet each operating timetable. The train crew schedule modeling was completed based on the assumption of eight daily roundtrip trains between Boston and New Haven. The model also assumes reasonable connection with the Amtrak Vermonter service at Springfield. Crews from NHHS intercity services are expected to be utilized in the development of NNEIRI services.

The model produced ten train set options that vary based on proposed schedules train number, days of operation, times of departure, and assigned crew runs. A minimum two hour layover was assumed between runs to provide sufficient time for train servicing and recovery time. The train sets that were developed are as followed:

- **Train Set 1**. Departs New Haven at 5:10 am and arrives in Boston at 8:48 am. Departs Boston at 2:13 pm and arrives in New Haven at 5:51 pm.
  - Set A (New Haven Crew # 1) - Trains 440 and 453 (Mon thru Fri)
  - Set A (New Haven Crew # 2) - Trains 1440 and 1453 (Sat)
  - Set A (New Haven Crew # 2) - Trains 2440 and 2453 (Sun)
- **Train Set 2.** Departs New Haven at 6:35am and arrives in Boston at 10:13 am. Departs Boston at 5:41pm and arrives in New Haven at 9:21 pm.
  - Set B (New Haven Crew # 2) - Trains 442 and 455 (Mon, Tues, Wed)
  - Set B (New Haven Crew # 2) - Trains 442 and 455 (Thurs, Fri)
  - Set B (New Haven Crew # 3) - Trains 1442 and 1455 (Sat)
  - Set B (New Haven Crew # 3) - Trains 2442 and 2454 (Sun)
- **Train Set 3.** Departs New Haven at 8:18 am and arrives Boston at 11:55 am. Departs Boston at 7:52 pm and arrives in New Haven at 11:30 pm.
  - Set C (New Haven Crew # 3) - Trains 444 and 457 (Mon)
  - Set C (New Haven Crew # 4) - Trains 444 and 457 (Tues, Wed, Thurs, Fri)
  - Set C (New Haven Crew # 4) - Trains 1444 and 1457 (Sat)
  - Set C (New Haven Extra Board) - Trains 2444 and 2457 (Sun)
- **Train Set 4.** Departs Boston at 5:18 am and arrives in New Haven at 8:35 am. Departs New Haven at 10:03 am and arrives in Boston at 1:41 pm.
  - Set D (Boston Crew # 5) - Trains 441 and 446 (Mon, Tues, Wed)
  - Set D (Boston Crew # 6) - Trains 441 and 446 (Thurs, Fri)
  - Set D (Boston Crew # 6) - Trains 1441 and 1446 (Sat)
  - Set D (Boston Crew # 6) - Trains 2441 and 2456 (Sun)
- **Train Set 5.** Departs Boston at 6:38 am and arrives in New Haven at 9:53 am. Departs New Haven at 12:12pm and arrives in Boston at 3:50 pm.
  - Set E (Boston Crew # 5) - Trains 1443 and 1450 (Sat)
  - Set E (Boston Crew # 5) - Trains 2443 and 2450 (Sun)
  - Set E (Boston Crew # 7) - Trains 443 and 450 (Mon thru Fri)
- **Train Set 6.** Departs Boston at 8:15 am and arrives in New Haven at 11:53 am. Departs New Haven at 3:03 pm and arrives in Boston at 6:41 pm.
  - Set F (Boston Crew # 8) - Trains 2445 and 2452 (Sun)
  - Set F (Boston Crew # 8) - Trains 445 and 452 (Mon)
  - Set F (Boston Crew # 9) - Trains 445 and 452 (Tues, Wed, Thurs)
  - Set F (Boston Crew # 9) - Trains 445 and 452 (Tues, Wed, Thurs)

- **Train Set 7**. Departs Boston at 10:15 am and arrives in New Haven at 1:53 pm. Departs New Haven at 5:03 pm and arrives in Boston at 8:23 pm.
  - Set G (Boston Crew # 6) – Trains 447 and 454 (Mon)
  - Set G (Boston Crew # 8) - Trains 447 and 454 (Tues, Wed, Thurs)
  - Set G (Boston Crew # 9) - Trains 447 and 454 (Fri)
  - Set G (Boston Crew # 9) - Trains 1447 and 1454 (Sat)
  - Set G (Boston Crew # 11) - Trains 2447 and 2454 (Sun)
- **Train Set 8.** Departs Boston at 1:09 pm and arrives in New Haven at 4:47 pm. Departs New Haven at 7:09 pm and arrives in Boston at 10:47 pm.
  - Set H (Boston Crew # 10) - Trains 451 and 456 (Wed, Thurs, Fri)
  - Set H (Boston Crew # 11) - Trains 1451 and 1456 (Sat)
  - Set H (Boston Crew # 11) - Trains 2451 and 2456 (Sun)
  - Set H (Boston Crew # 11) - Trains 451 and 456 (Mon, Tues)
- **Train Set 9.** Stored at Boston Facility, used for scheduled maintenance and emergencies.
  - Set I (Boston Spare Set) - used as needed.
- **Train Set 10.** Stored at New Haven Facility, used for scheduled maintenance and emergencies
  - Set J (New Haven Spare Set) - used as needed.
- **Train Set 11** – Departs Boston at 10:50 am and arrives in Montreal at 8:03 pm. The train layovers in Montreal at night. Departs Montreal at 2:02 pm and arrives in Boston at 11:25pm.
  - Set K (Boston Engine and Coaches, BM-1) – Trains 54 (Sat, Mon, Wed)
  - Set K (Boston Engine and Coaches, BM-1) – Trains 59 (Sun, Tues, Thurs)
  - Set K (Boston Engine and Coaches, Boston Extra Board) – Trains 54 (Fri)
  - Set K (Boston Engine and Coaches, Boston Extra Board) – Trains 59 (Sat)
- **Train Set 12** – Departs Montreal at 2:02pm and arrives in Boston at 11:25 pm. The train layovers in Boston at night. Departs Boston at 10:50 am and arrives in Montreal at 8:03 pm.
  - Set L (Montreal Engine and Coaches, MB-2) – Trains 59 (Mon, Wed, Fri)
  - Set L (Montreal Engine and Coaches, MB-2) – Trains 54 (Sun, Tues, Thurs)
- **Train Set 13** – Departs New Haven at 9:00am and arrives in Montreal at 5:40 pm. The train layovers in Montreal at night. Departs Montreal at 11:02am and arrives in New Haven at 7:52pm.
  - Set M (New Haven Engine and Coaches, NHM-1) – Train 52 (Sat, Mon, Wed)
  - Set M (New Haven Engine and Coaches, NHM-1) – Train 57 (Sun, Tues, Thurs)
  - Set M (New Haven Engine and Coaches, New Haven Extra Board) – Trains 54 (Fri)
  - Set M (New Haven Engine and Coaches, New Haven Extra Board) – Trains 59 (Fri)
- **Train Set 14** – Departs Montreal at 7:30am and arrives in New Haven at 4:10 pm. Train layovers in New Haven at night. Departs New Haven at 9:00am and arrives in Montreal at 5:40 pm.
  - Set N (Montreal Engine and Coaches, MB-2) – Train 59 (Mon, Wed, Fri)
    Set N (Montreal Engine and Coaches, MB-2) – Train 54 (Sun, Tues, Thurs)

- **Train Set 15** at Boston Facility, used for Scheduled Maintenance and Emergencies
    - Set O (Boston Engine and Coaches) - Spare Set, used as needed.

E.5 FIGURES

Figures E-1 to E-7. Existing Conditions Stringline Diagrams (Case 1)

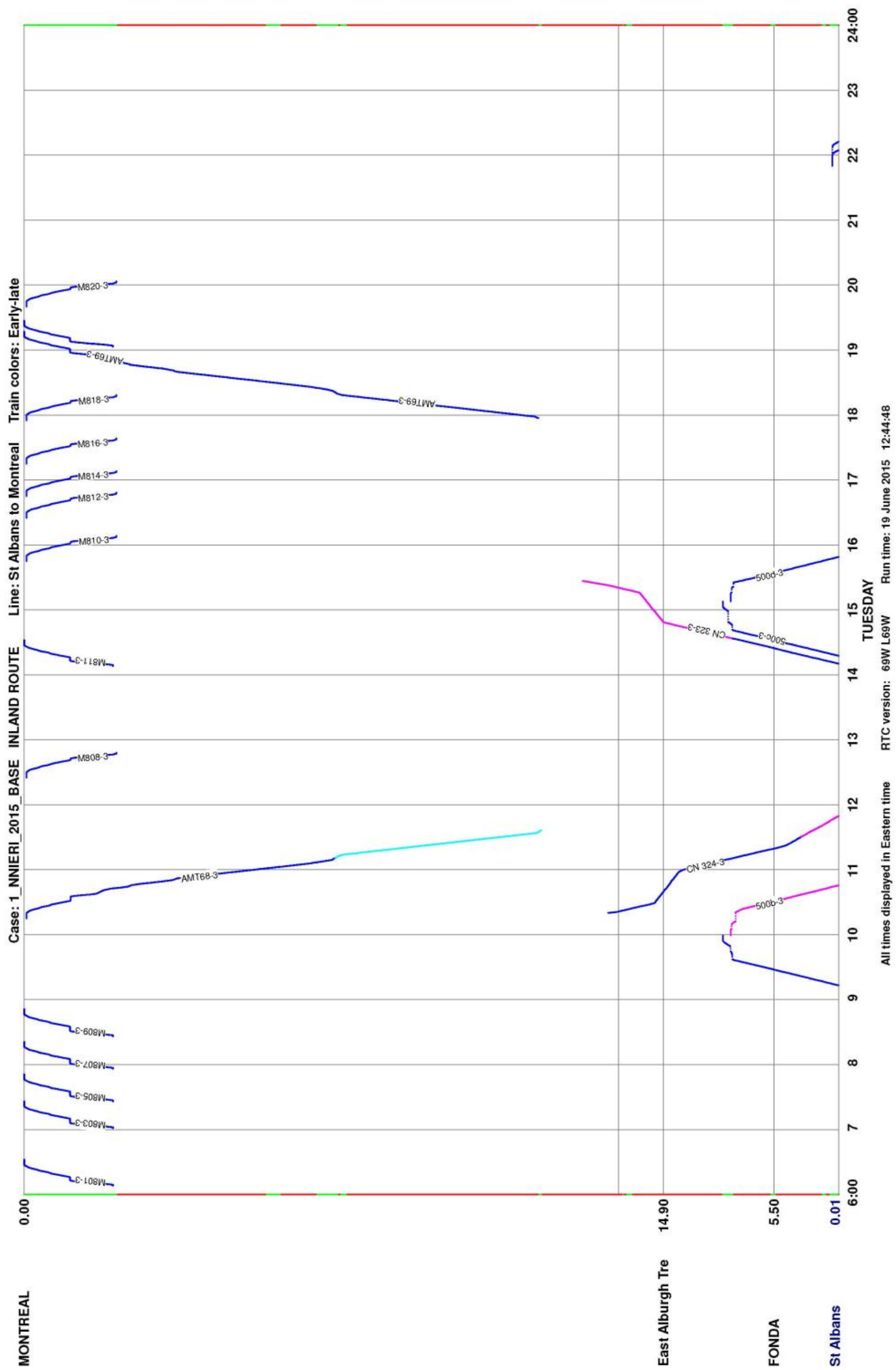


Figure E-1. Montreal to St. Albans Case 1 Stringline

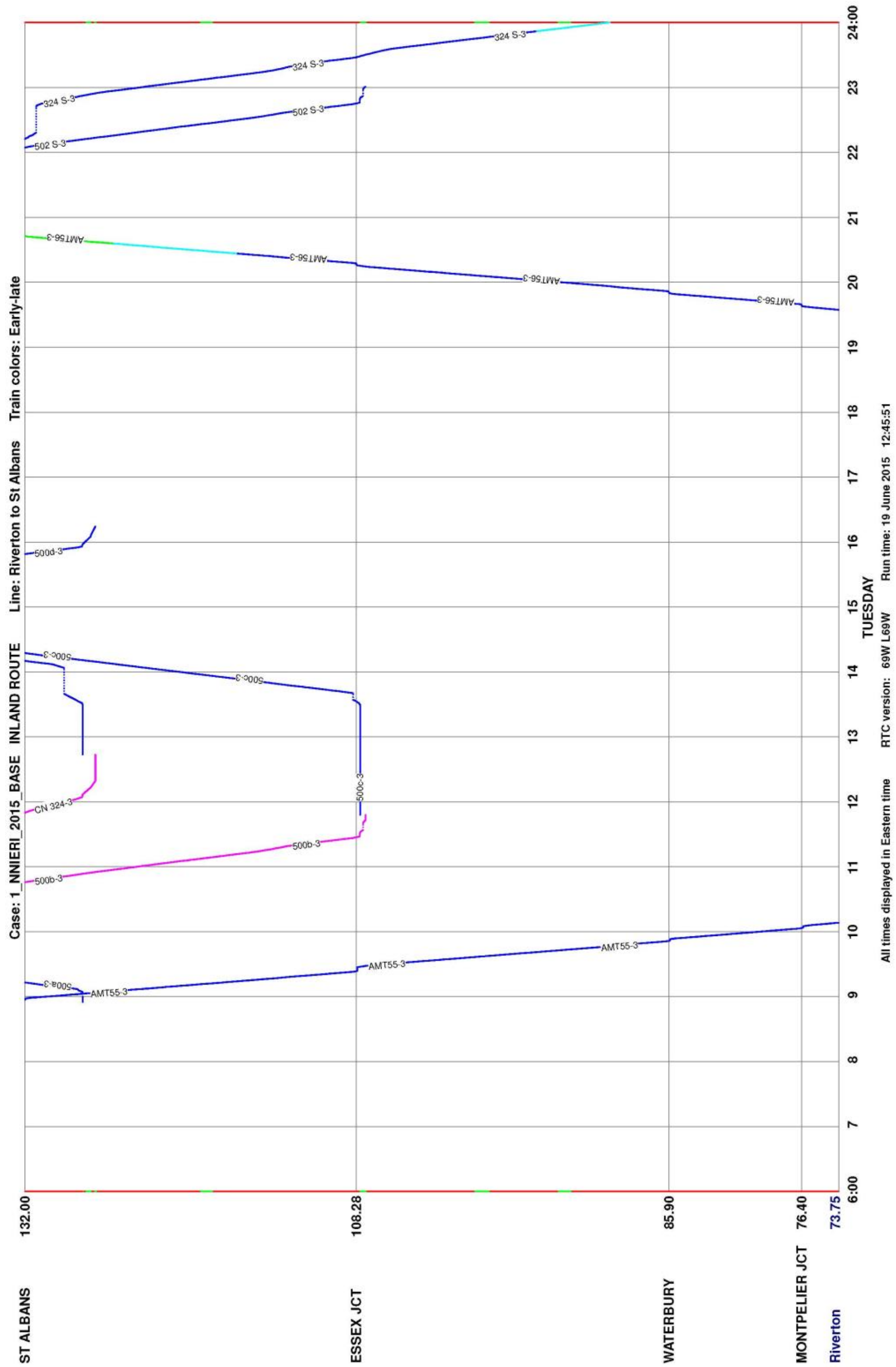


Figure E-2. St. Albans to Riverton Case 1 Stringline

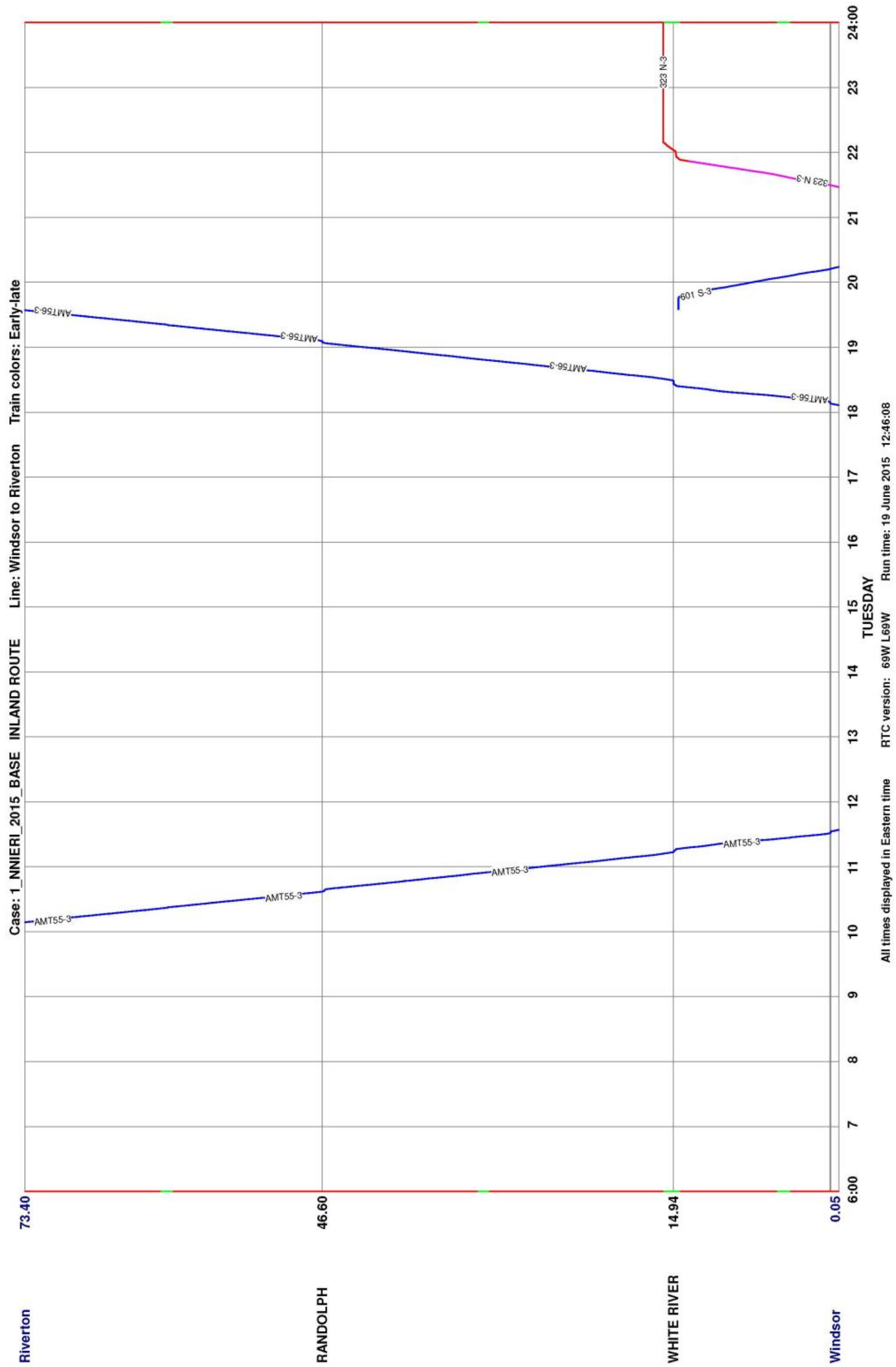


Figure E-3. Riverton to Windsor Case 1 Stringline

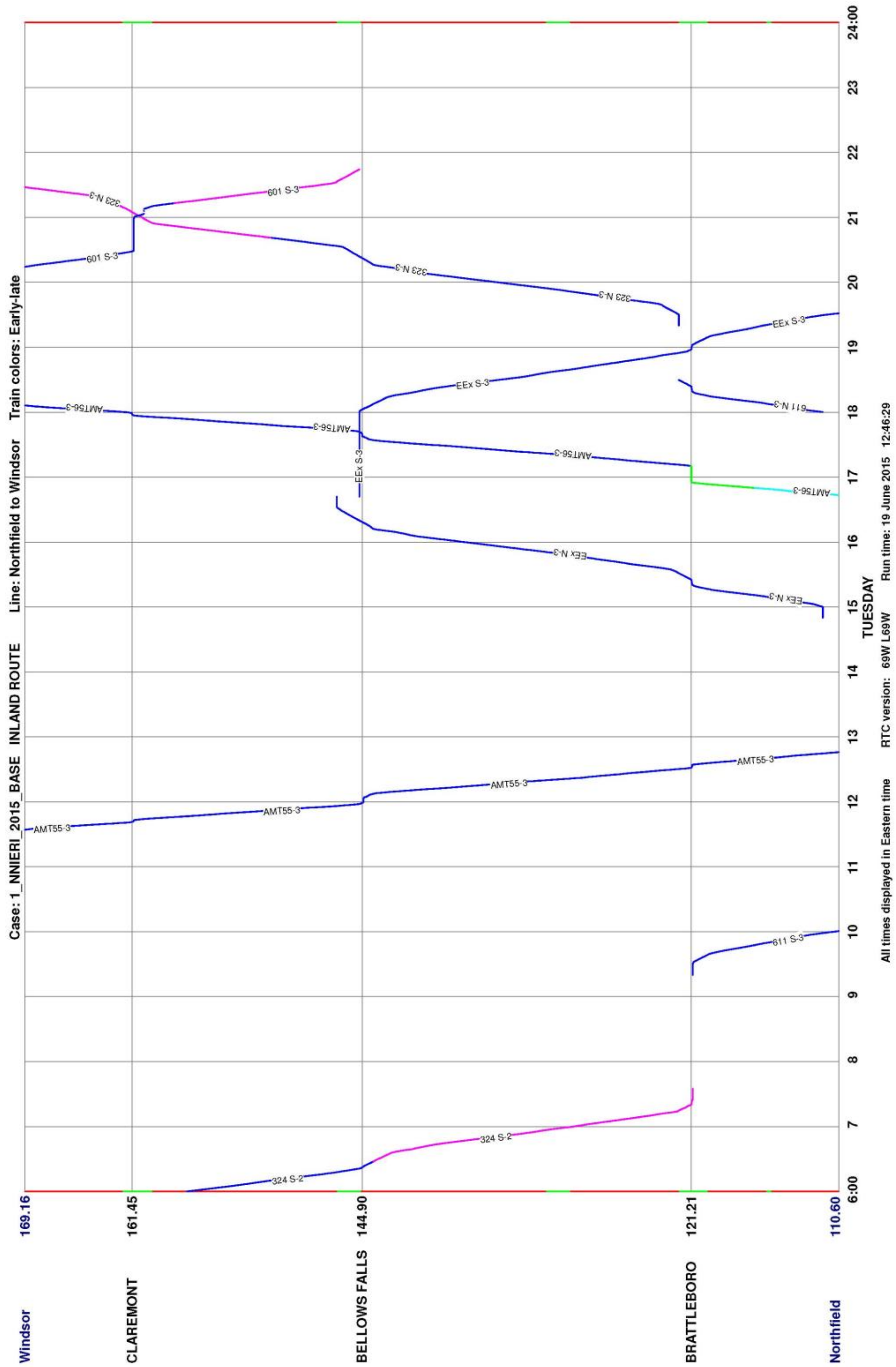


Figure E-4. Windsor to Northfield Case 1 Stringline

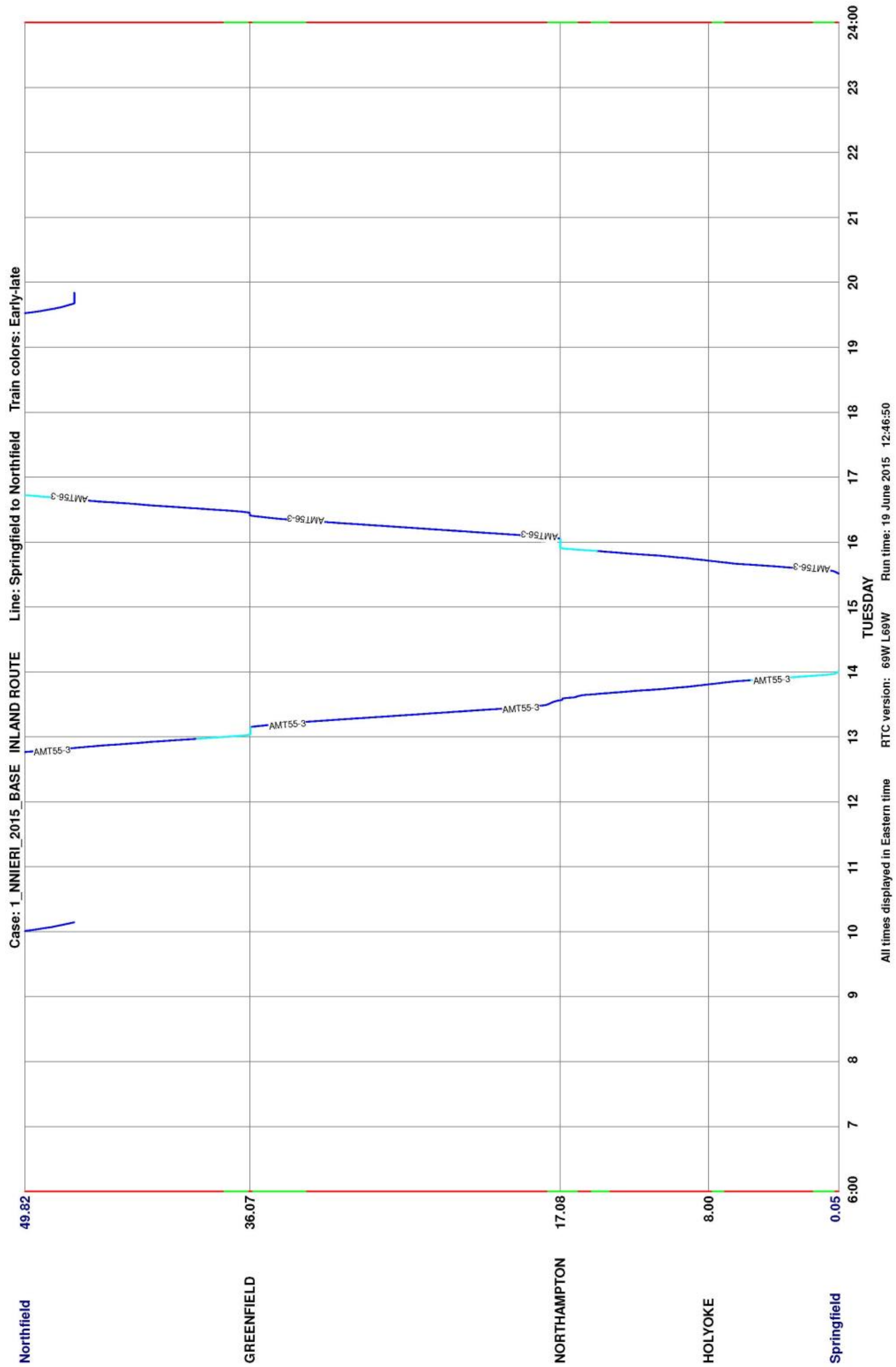


Figure E-5. Northfield to Springfield Case 1 Stringline

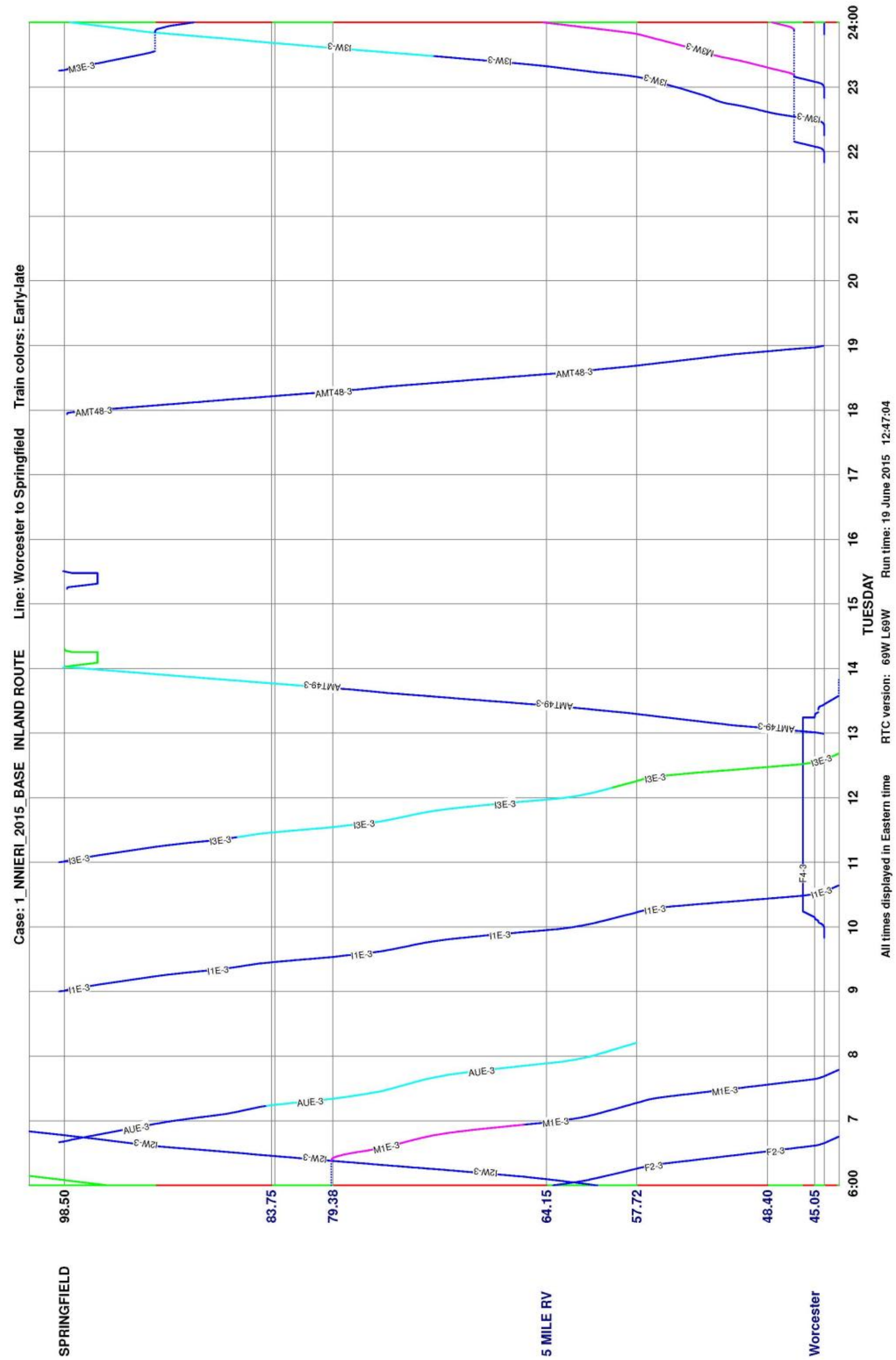


Figure E-6. Springfield to Worcester Case 1 Stringline

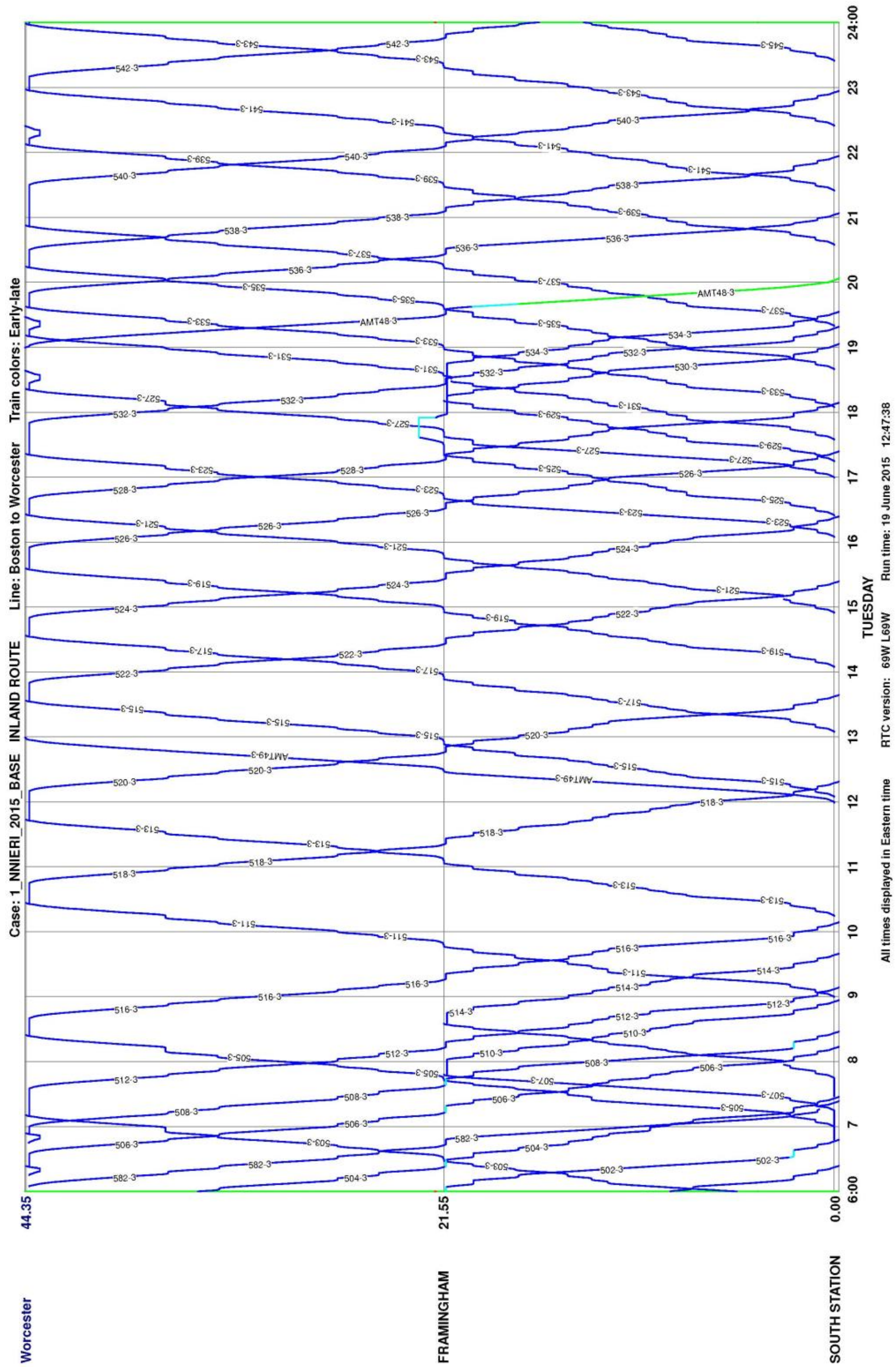


Figure E-7. Worcester to South Station Case 1 Stringline

Figures E-8 to E-14. Predicted Conditions 2035 Stringline Diagrams (Case 2) - Existing Passenger Services, Existing Infrastructure and 2.2% Freight Annual Growth

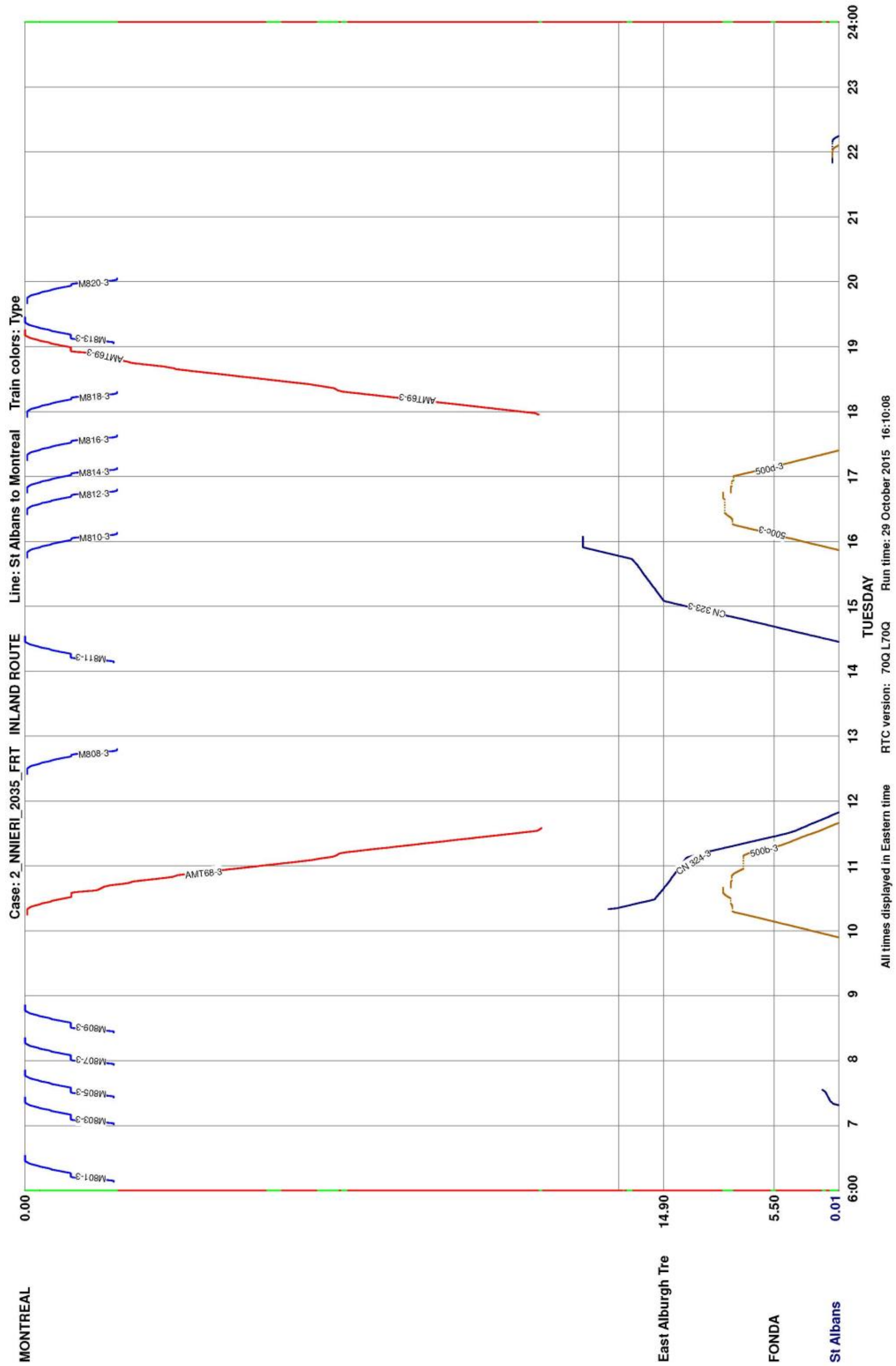


Figure E-8. Montreal to St. Albans Case 2 Stringline

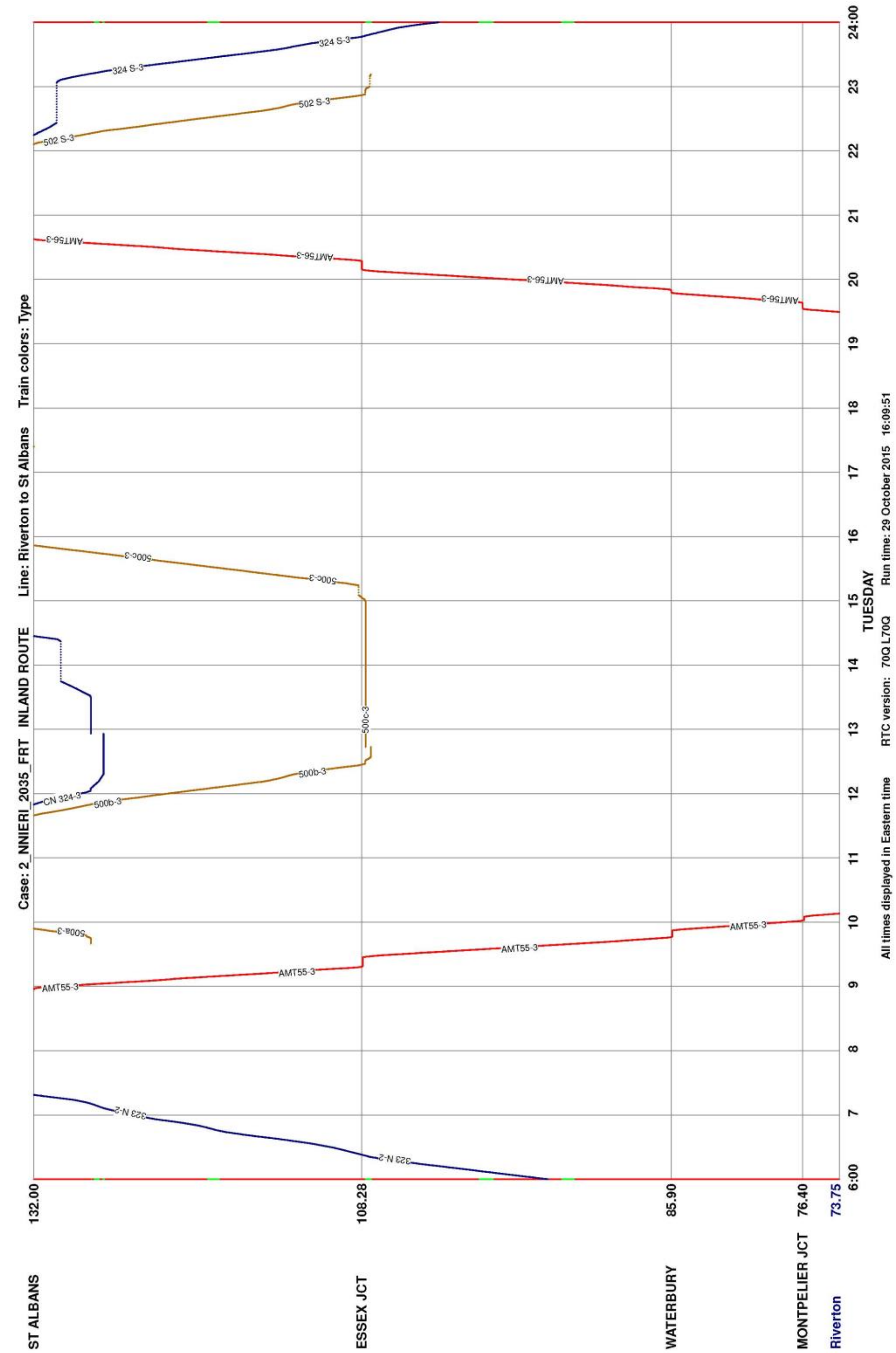


Figure E-9. St. Albans to Riverton Case 2 Stringline

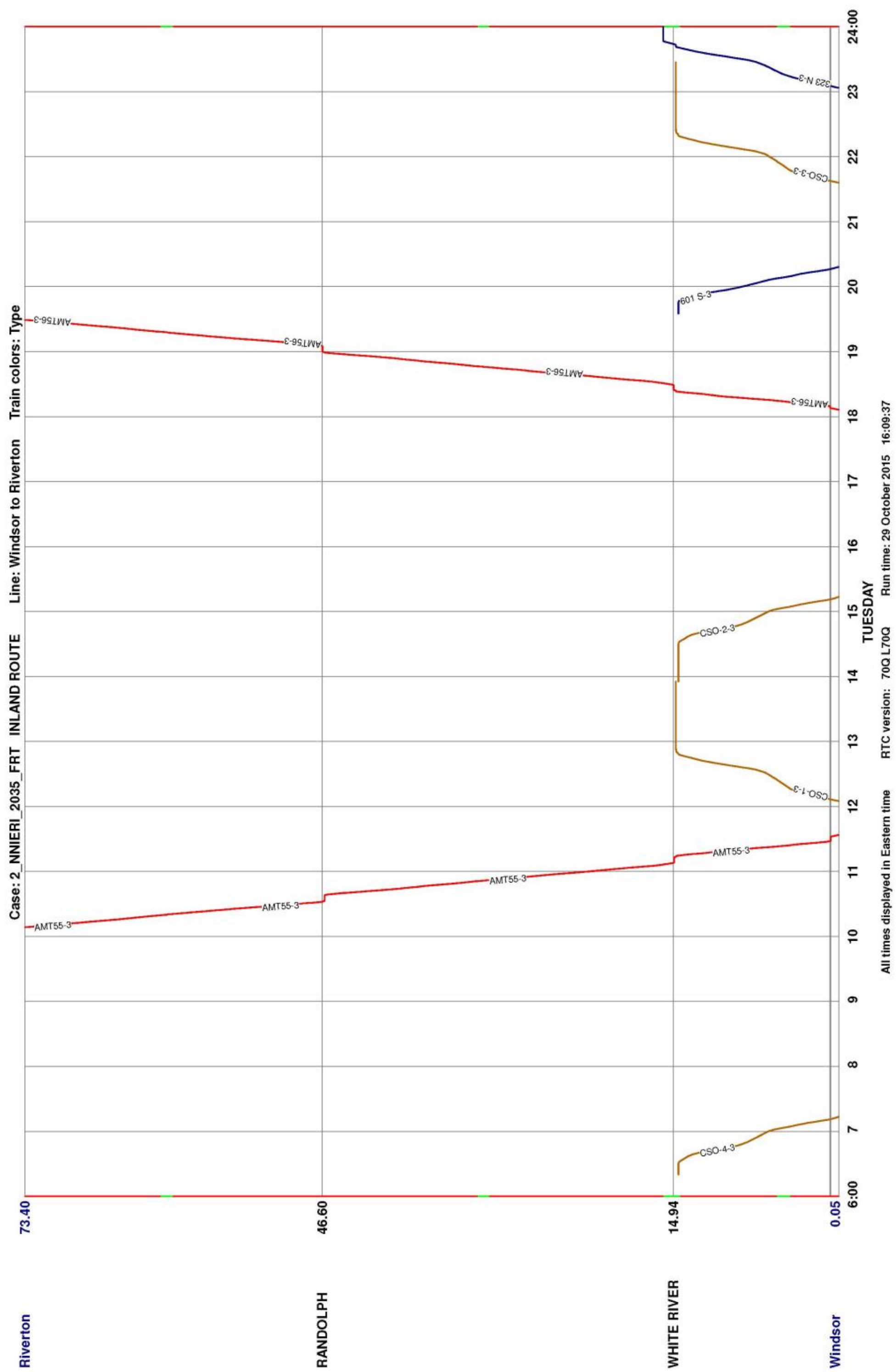


Figure E-10. Riverton to Windsor Case 2 Stringline

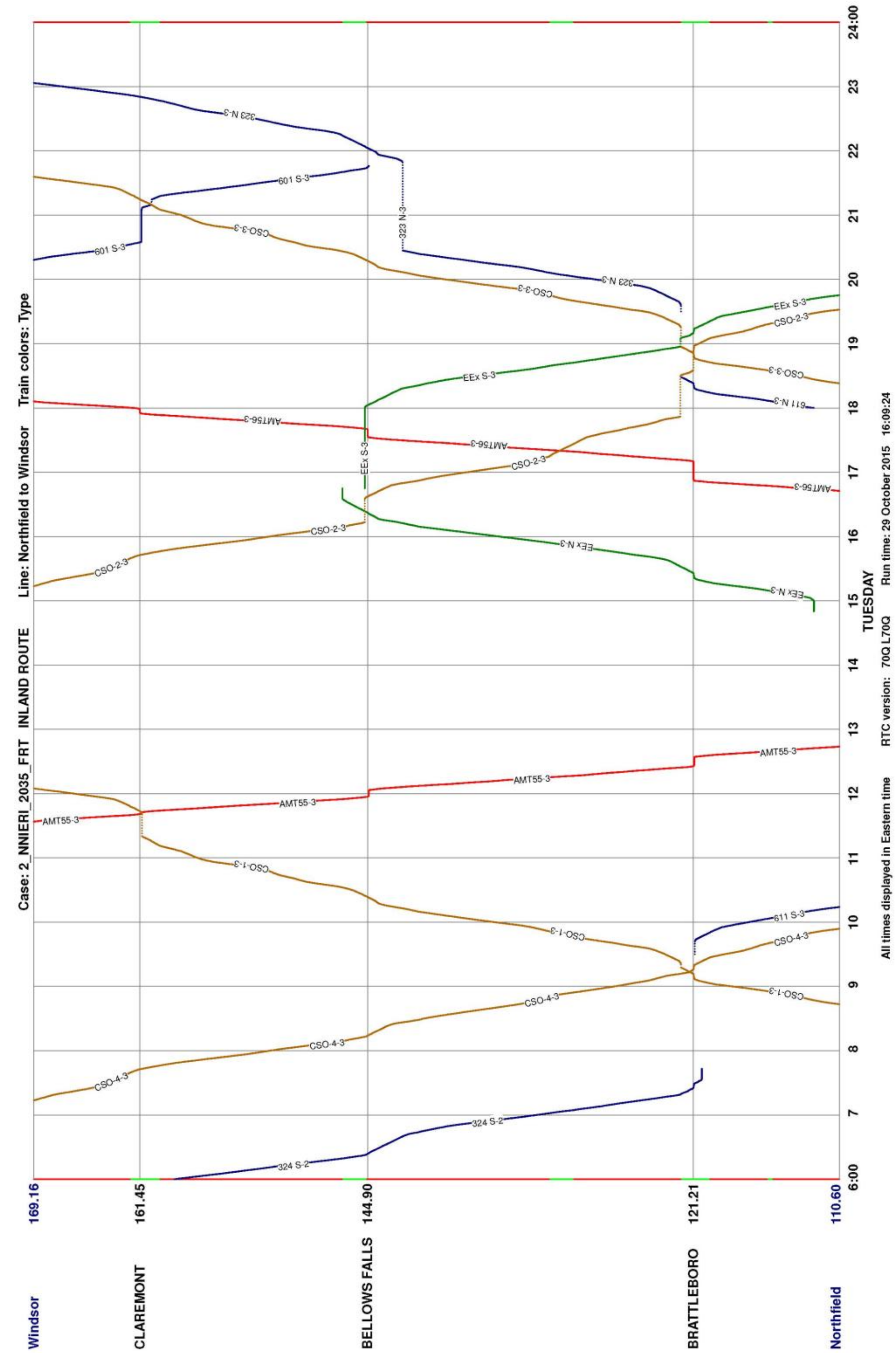


Figure E-11. Windsor to Northfield Case 2 Stringline

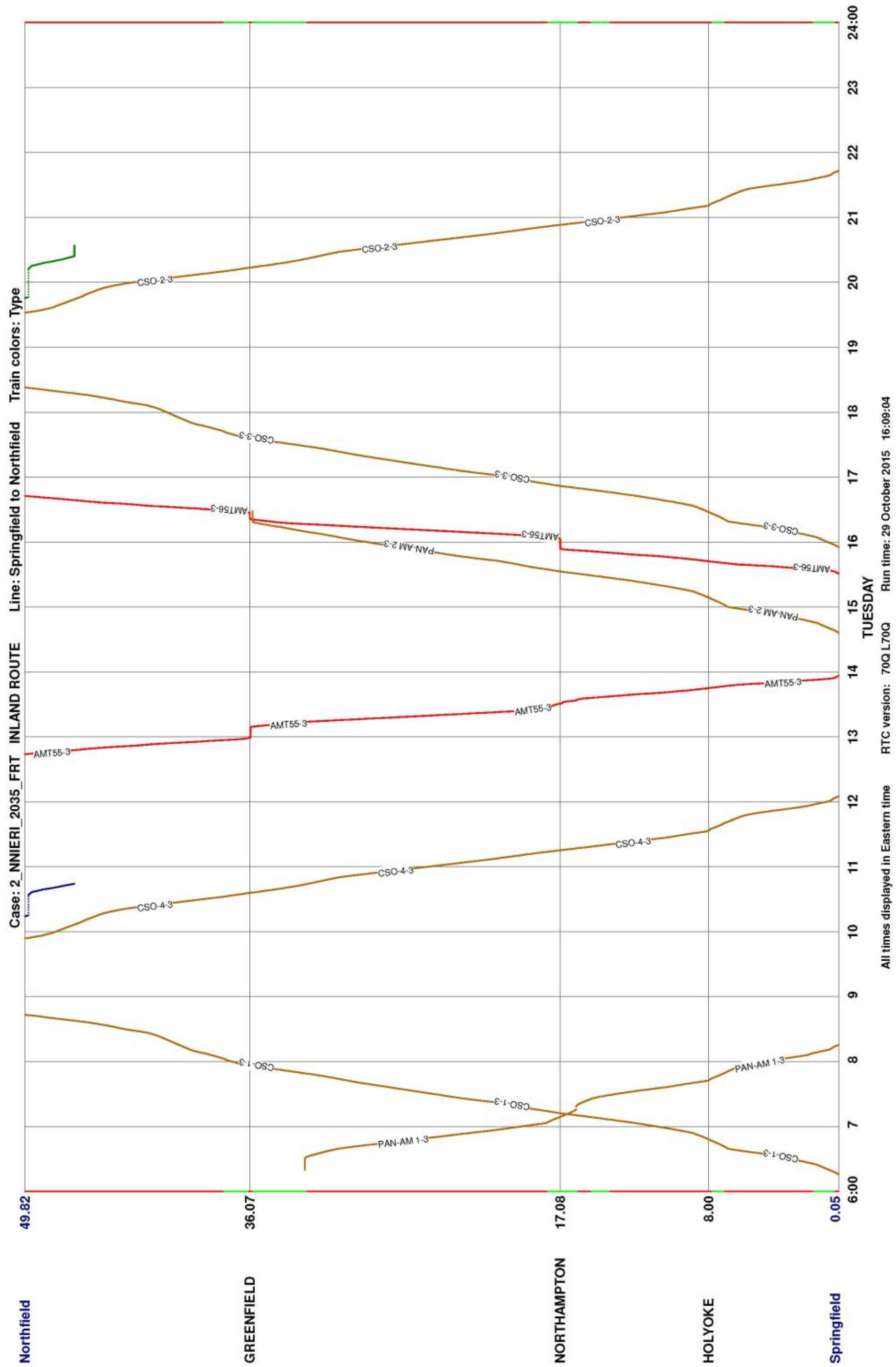


Figure E-12. Northfield to Springfield Case 2 Stringline

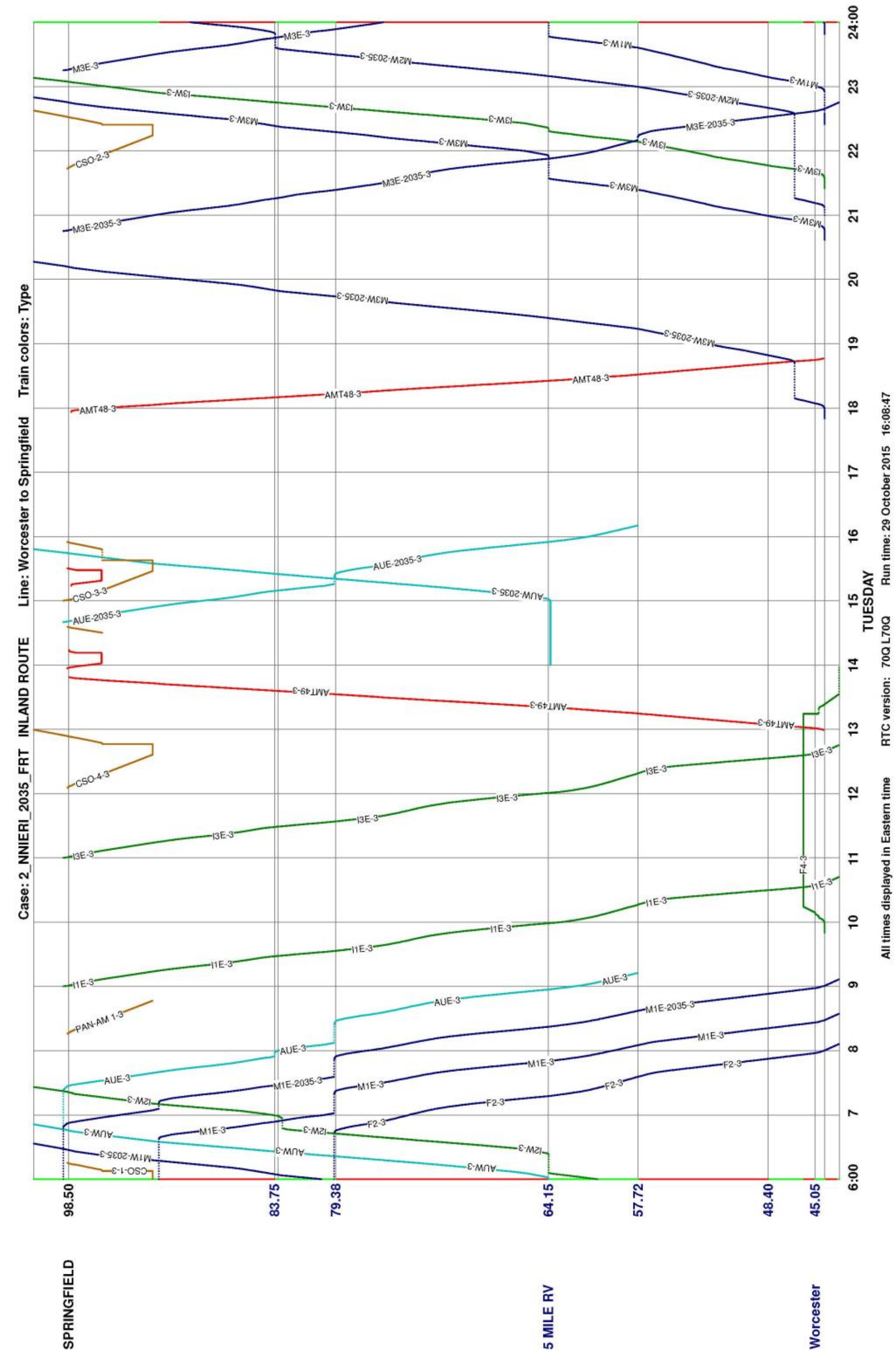


Figure E-13. Springfield to Worcester Case 2 Stringline

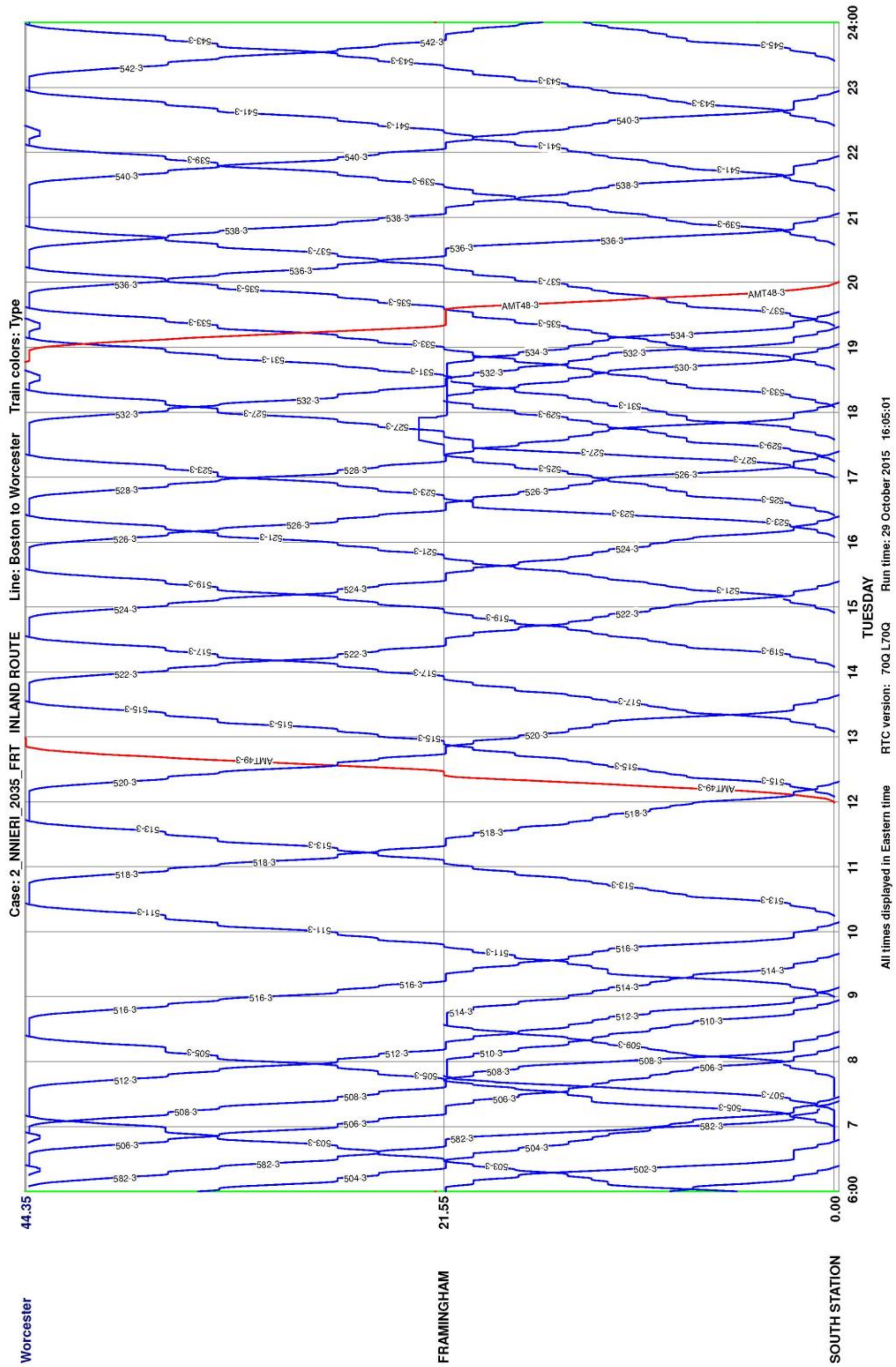


Figure E-14. Worcester to South Station Case 2 Stringline

Figures E-15 to E-21. Predicted Conditions 2035 Stringline Diagrams (Case 4) – Proposed Passenger Services, Proposed Infrastructure Improvements and 2.2% Freight Annual Growth

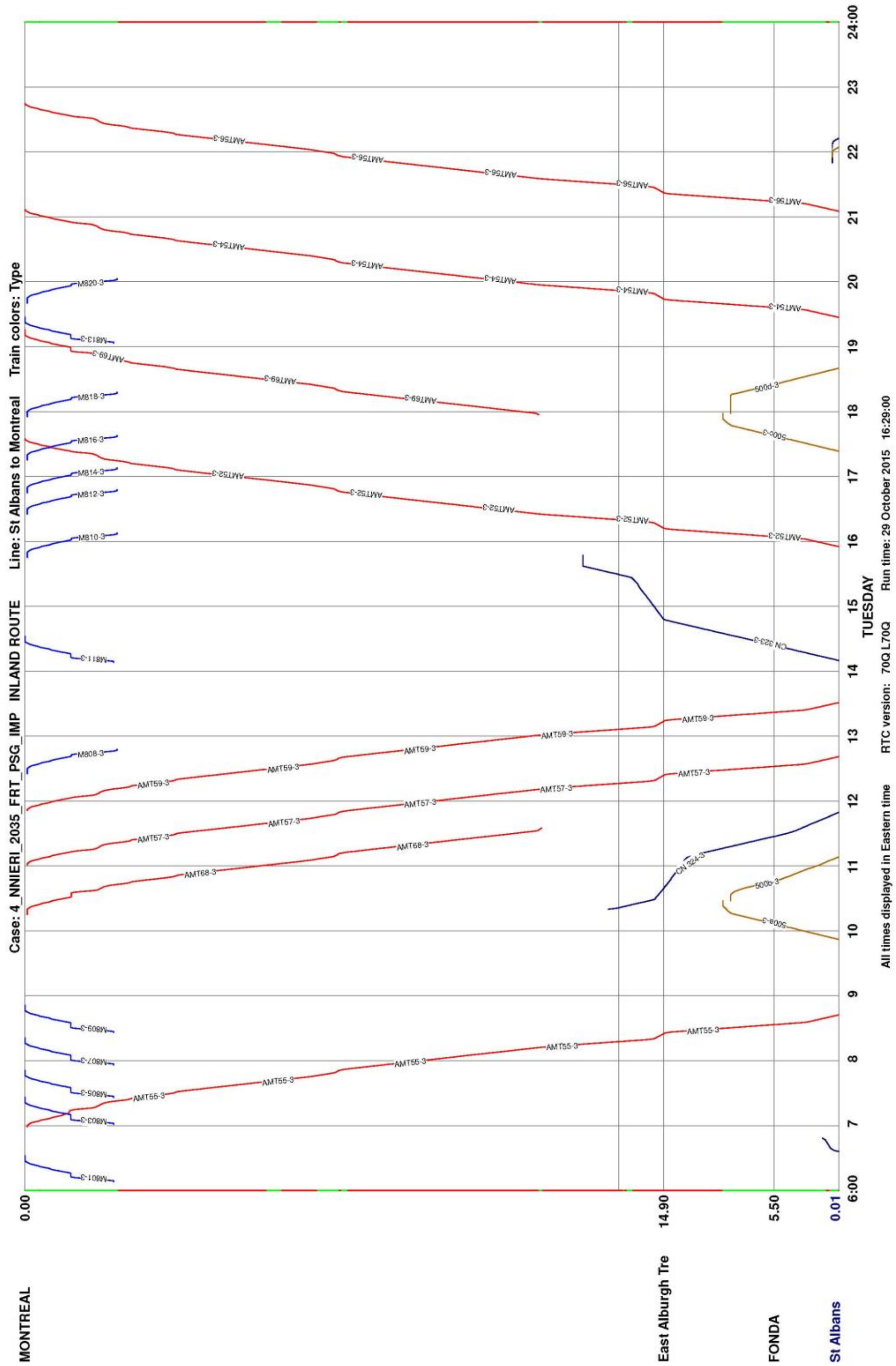


Figure E-15. Montreal to St. Albans Case 4 Stringline

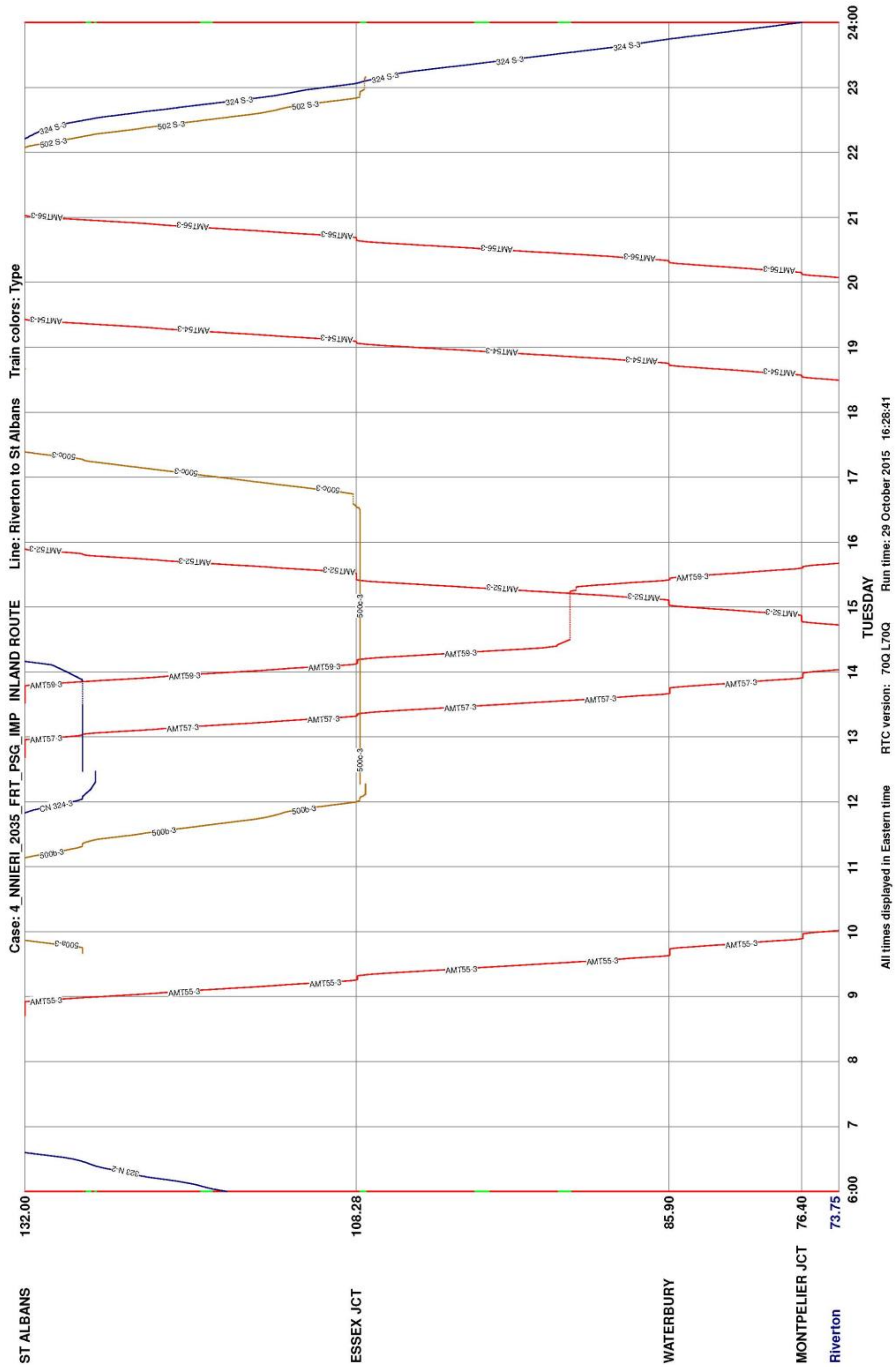


Figure E-16. St. Albans to Riverton Case 4 Stringline

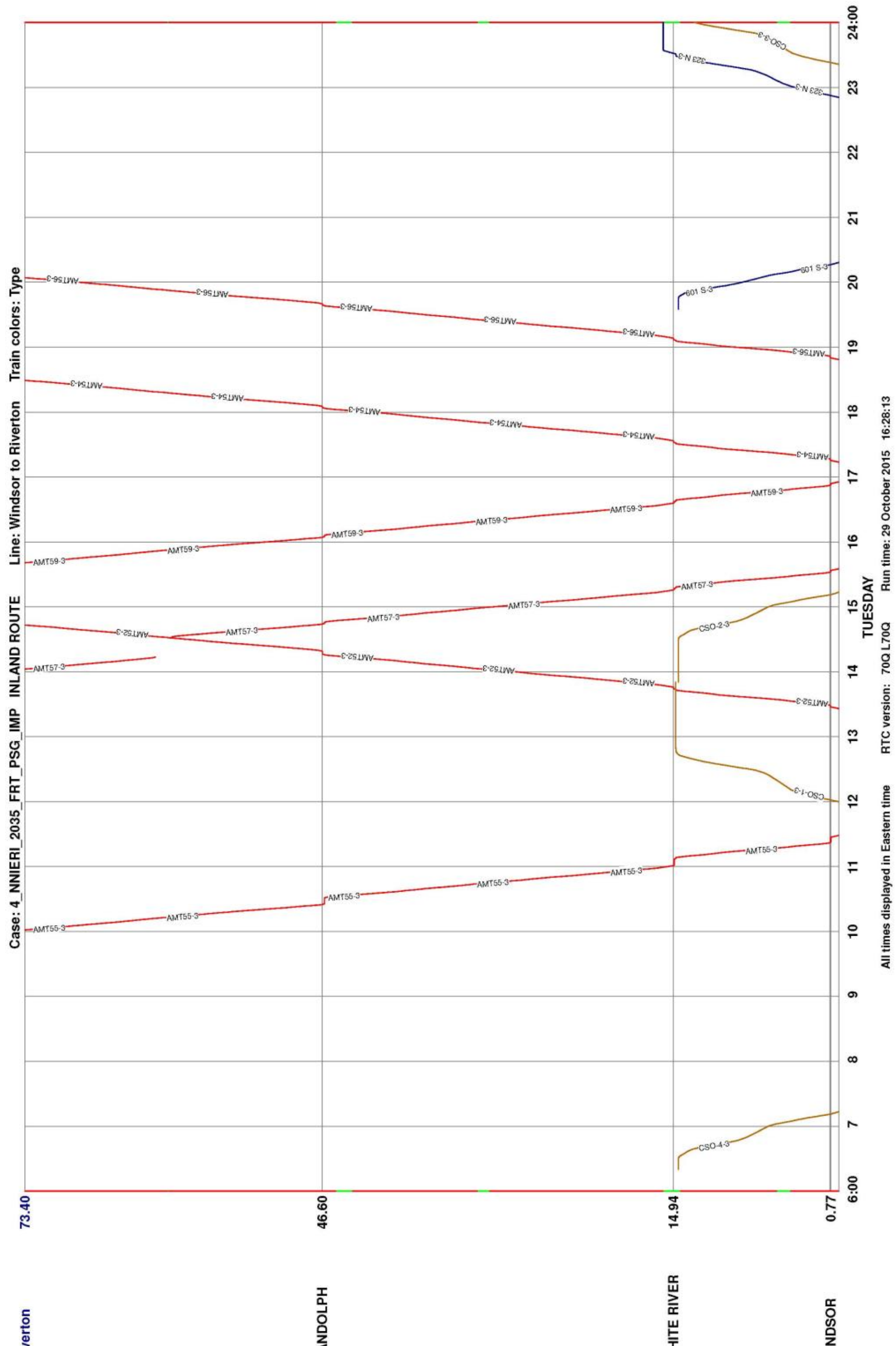


Figure E-17. Riverton to Windsor Case 4 Stringline

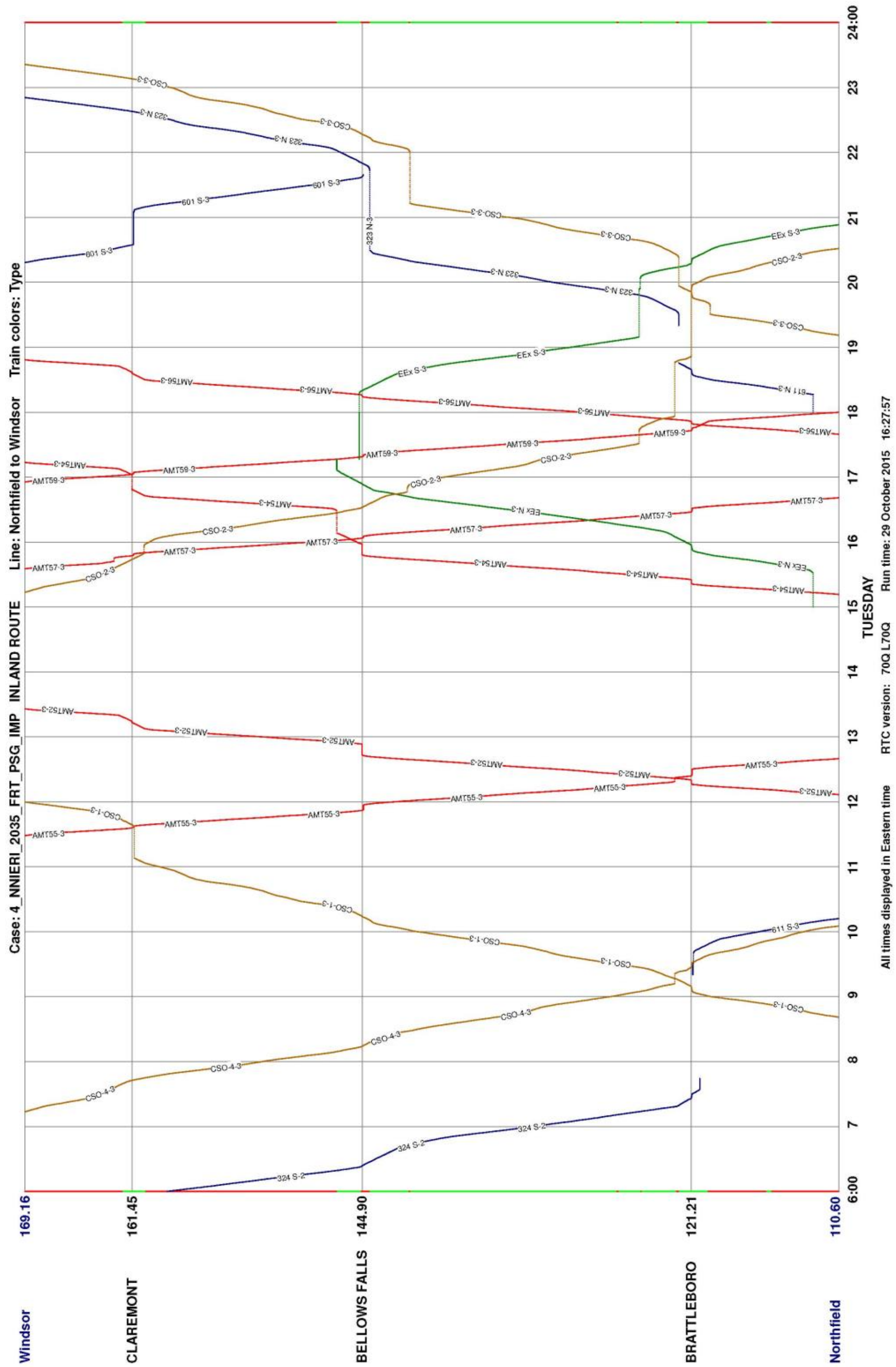


Figure E-18. Windsor to Northfield Case 4 Stringline

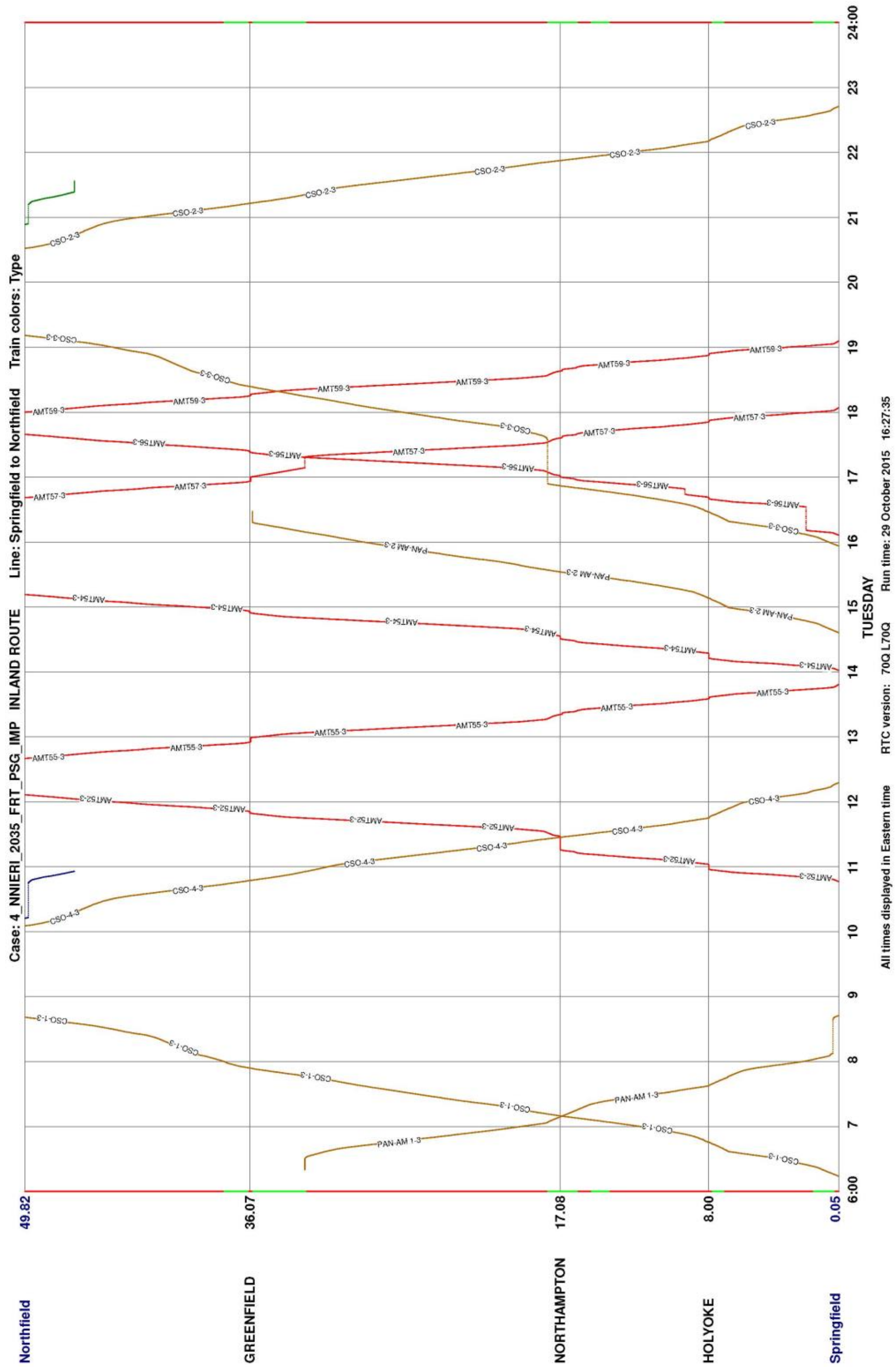


Figure E-19. Northfield to Springfield Case 4 Stringline

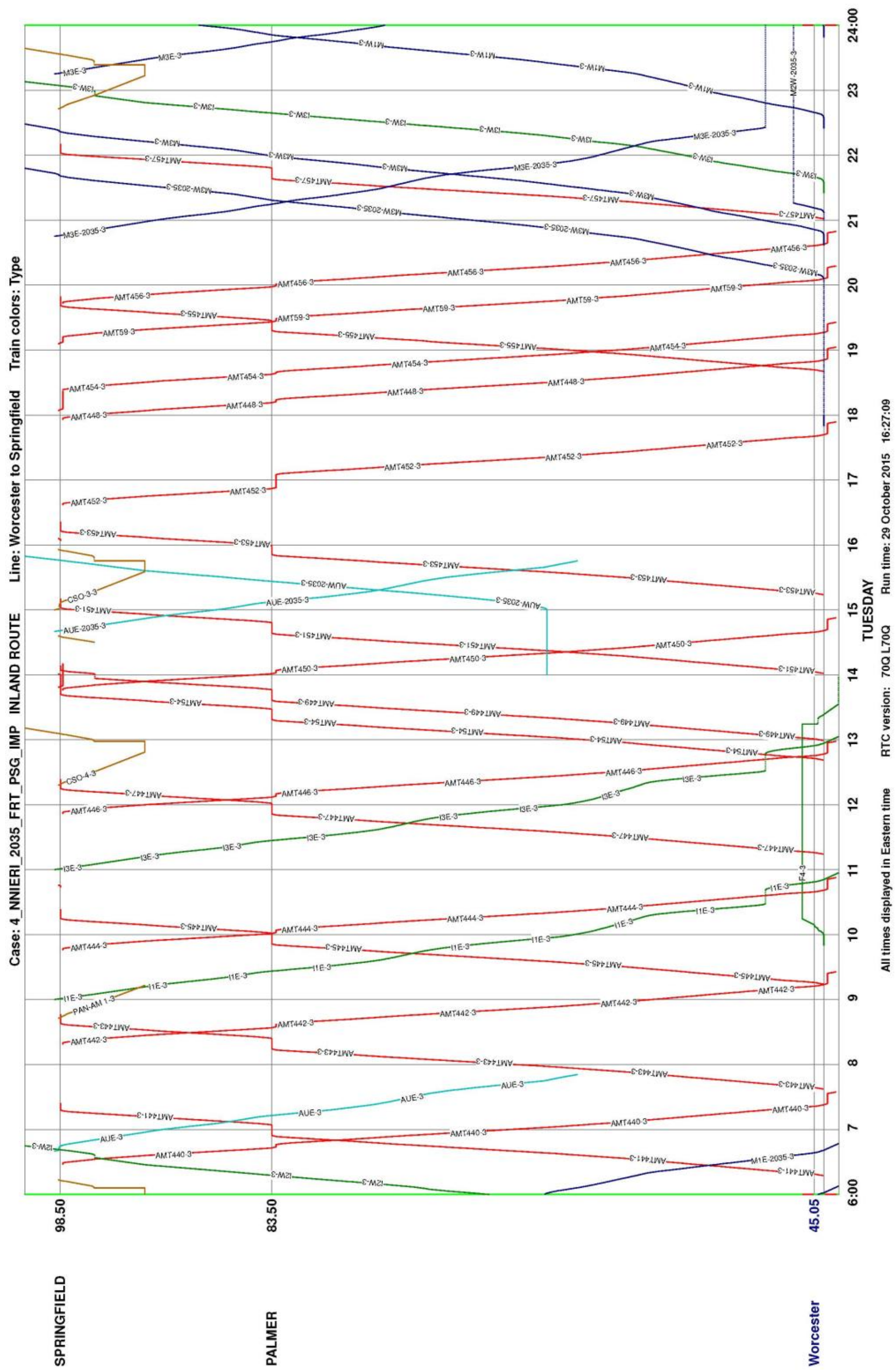


Figure E-20. Springfield to Worcester Case 4 Stringline

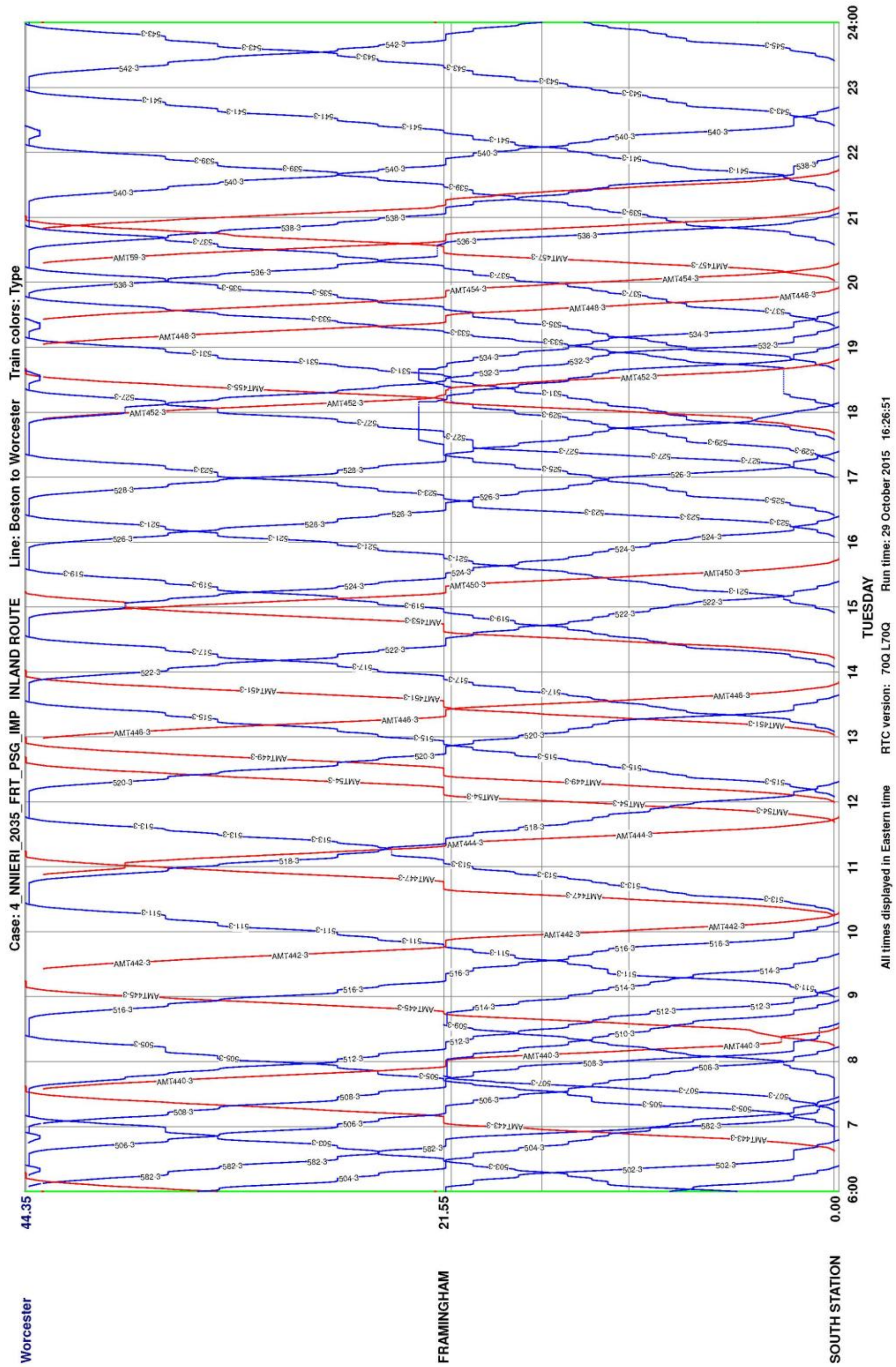


Figure E-21. Worcester to South Station Case 4 Stringline

APPENDIX F PUBLIC MEETING NOTES

The Massachusetts Department of Transportation (MassDOT) and Vermont Agency of Transportation (VTrans) hosted public meetings in September 2015 to provide the public with information on the findings of the Northern New England Intercity Rail Initiative (NNEIRI) Study Service Development Plan. The following summarizes the meetings and comments received from members of the public regarding the NNEIRI Study.

The third round of public meetings were scheduled as follows:

- September 16 – State Transportation Building, 10 Park Plaza, Boston, Massachusetts;
- September 17 – Pioneer Valley Planning Commission, 60 Congress Street, Springfield, Massachusetts; and
- September 24 – Hotel Coolidge, 39 S Main Street, White River Junction, Vermont.

F.1 BOSTON PUBLIC MEETING

At the Boston Public Meeting, Ethan Britland (MassDOT) welcomed attendees and provided an overview of the meeting format. Mr. Britland emphasized the nature of the NNEIRI Study as a recommendation and not a funded and approved plan for improvements. Ron O'Blenis (HDR), project manager for the consultant team hired to conduct the NNEIRI study made a 45-minute presentation that was followed by public discussion. The presentation provided an overview and background of the NNEIRI program, the rail corridors under study, and the results of the analysis; full results are included in the Public Presentation and in the Service Development Plan (SDP), both on the MassDOT NNEIRI project site. Approximately 15 people attended the public meeting.

Questions and Comments: Boston Meeting

Following the presentation, attendees asked questions and offered comments (see italics). Responses to the questions were made primarily by Ron O'Blenis.

Q: Why are there more people traveling between New Haven and Montreal than Boston to Springfield? This project seems like the Downeaster, most people should be going into Boston. It seems like ridership is underestimated.

A: Many of the people on this segment are accessing points on the Northeast Corridor. It's really a tale of two different economic areas. The connections from Springfield tend to go down to Connecticut and New York. The connections east from Worcester are more Boston focused but the ridership is expected to be smaller because of alternatives, such as the MBTA's Commuter Rail.

A: (John Weston of HDR): This is incremental on top of all the other services that are there now. This separates the Hartford Rail Line corridor from the overall ridership.

Q: Boston to Montreal train takes longer than 8 hours. The bus takes 6. What are the real origin-destination pairs?

A: The majority of passengers in the ridership estimate travel to and from urban centers along the way rather than terminal to terminal. For example, there are strong ridership numbers for travelers between Burlington (Essex Junction) and Montreal and Brattleboro to New York City (with a connection to the Northeast Corridor in New Haven). Likewise, there is significant observed demand for travelers between the Boston area and Hartford area. The areas with the highest ridership are time competitive with auto and bus travel.

However, a relatively small percentage of passengers would actually use the service to travel between Boston and Montreal or Boston and New Haven. This is primarily due to the fact that these are not time competitive with other modes. Therefore the benefit for this service is for travel to the points in between.

Comment: You should make a note that the demand in this service might be underestimated.

Response: You're possibly right. We will take note of that.

Q: Is there any way to quantify the public benefit of this?

A: Yes, as a part of this study, we have looked at the public benefits. This is the type of analysis that goes into a TIGER Grant application. It looks at a variety of factors and there will be a Public Benefits Analysis in the SDP to be posted on the MassDOT website in November 2015. However, there are benefits to the project that are difficult to quantify in economic terms, such as social justice and connectivity for elderly residents in New England, therefore we have sought to describe those separately in the SDP.

Q: How many additional trains would stop at Windsor, Vermont?

A: The NNEIRI study recommends two roundtrips for a total of four total trains in Windsor. This will provide two daily departures to Montreal, one to Boston, and one to New Haven. Additionally, the Vermonter will continue to operate and it is assumed will be extended to Montreal as a part of a separate initiative.

When determining the number of trains servicing individual stations and the NNEIRI Corridor as a whole, we analyzed various scenarios of frequencies and express/local services. The NNEIRI services recommended in this presentation seem to be the best return on investment when comparing costs, ridership, and revenue.

Q: Are there considerations of alternative vehicles, such as Diesel Multiple Units (DMUs)?

A: No, we want to create a system that is interoperable with existing passenger rail equipment in the region.

Q: $1.2 billion is a daunting capital expense and a 40% fare recovery ratio seems daunting. If you had to take money out of the operating or capital budget, what would you look at?

A: The SDP assumes that you could build this in steps or phases. So, we can incrementally build a project like this without spending the whole amount at once. More details will be in the SDP.

F.2 SPRINGFIELD PUBLIC MEETING

At the Springfield Public Meeting, Ammie Rogers (MassDOT) welcomed attendees and provided an overview of the evening. Ron O'Blenis provided the same 45 minute presentation at all three public information meetings. Approximately 50 people attended the meeting.

Questions and Comments: Springfield Meeting

Following the presentation, attendees asked questions and offered comments (see italics). Responses to the questions were made primarily by Ron O'Blenis.

Q: Downeaster has an operating authority which contracts with Amtrak. Would you foresee a similar authority to oversee this service?

A: The SDP documents different governance programs used for passenger rail operations in the United States. However, the SDP does not come to a conclusion regarding an operating organization or structure. The aim of the SDP governance section is to provide information for policy makers to determine the structure of the operating/governance program.

Q: How much of the proposed service would be a dedicated passenger rail line? How much would get shoved to the side for freight trains to move through because this happens a lot in the west?

A: This will not be a dedicated passenger track. This program seeks to provide sufficient capacity for passenger rail and freight to operate together through the addition or extension of double-track for trains to pass each other.

Comment: The point of a train is dependability. Ideally, I would get on a train and know I would arrive by a certain time. I am concerned that with a mix of freight and passenger traffic, we might encounter delays.

A: We understand and have accounted for this through proper modeling and consultations with the host freight railroads.

Comment: I live in Downtown Palmer and work in Windsor, Connecticut. I am a proponent of a Palmer Station site as opposed to a station in a different location. Why is there a proposed station when there is already an existing downtown station?

Response: This is a good example of how people would use the proposed NNEIRI passenger rail, not by going through the end points but by going to points along the way. The NNEIRI project team studied six potential station sites in Palmer, including the historic station site near Downtown Palmer. The difficulty with the historic station site is the constraint surrounding structures and the diamond interchange would have on building a full length high-level platform in this location, particularly the historic station building. Additionally, in this location, a dedicated station track would need to be built to accommodate and maintain existing freight operations. Building a dedicated station track in this area would be very difficult without a significant configuration of the right-of-way. There are other sites identified in Palmer, including one in close proximity to the downtown near Route 32, which would better serve the community, passenger rail operations, and freight rail operations.

Additionally, the other identified sites would have less impact on historic structures in the town and could cost less. However, a final station location would be determined by state and local officials and was not be determined as a result of this study.

Q: On the Knowledge Corridor, there are several stations that are in downtowns. We believe Palmer is ideal for a similar station concept. We believe we could be a model for Massachusetts. At a lower level of cost, we could stop the Lake Shore Limited here. This is essential for Downtown Palmer to grow. We could bring tourists and host events here. There might be three tracks available in this area.

A: Nothing is cast in concrete. This study looks at several different sites and does not make a recommendation. It assumes that state and local officials would make this decision in the future.

Q: Amtrak has huge cost overruns and I believe that they are the wrong group to run this service.

A: At this stage, we are not at a point to answer that. The operator would be determined by state officials if a decision to proceed with this study's recommendation is executed.

Q: Why is there not as much excitement about going west to east as there is going down to New Haven? This would provide a vital service into Boston and decision makers should provide more attention to it.

A: This study represents a good first step toward providing an east-west connection in Massachusetts. The study provides an understanding of how the resources and what steps are required to attain this outcome. It also provides an analysis of the project benefits. We are reaching out to citizens now to understand the level of interest here.

Q: Is there a way to connect people to international airports through this train service?

A: The study does not explicitly address airport connections. However, there are several airports with existing shuttle and transit services to NNEIRI stations, such as Windsor Locks to Bradley Airport and South Station to Logan Airport.

Q: Is there an opportunity for Public Private Partnerships (PPP) with this program?

A: The NNEIRI Service Development Plan will provide an overview of potential funding streams. A potential funding source could be a PPP. PPPs for rail services are used extensively in Europe and they are increasingly being used on highway projects in the United States.

Q: What happened to the 1-hour high speed train from Springfield to Boston?

A: That study for that concept concluded that the potential costs and risks are very high. It was very expensive and would have been almost insurmountable due to the constraints of building new alignment in dense urban areas and through the hilly terrain of central Massachusetts.

Q: What is the cause of the Springfield to Boston travel time?

A: The NNEIRI Corridor utilizes the existing CSX-owned train line between Springfield and Worcester. This has many curves due to the hilly terrain of the region. This presents difficulties with travel speeds because the curves make trains go slower than the 79 MPH maximum recommended in the SDP. However, travel times between Springfield and Boston are competitive with auto and bus travel, particularly at peak hours of congestion.

Q: What type of equipment is being utilized for the service?

A: Equipment similar to existing Amtrak services would be utilized. This would not be DMUs and would be a traditional type of train.

Comment: If you went with European style equipment you could run faster and more efficiently.

A: We focused on train equipment that is currently in operation or compatible with operations in the Northeast.

Comment: DMUs are half as expensive as existing Amtrak equipment.

A: It is important for equipment to be operational with existing equipment in the Northeast because it would allow NNEIRI services to potentially continue onto the Northeast Corridor and access stations such as New York Penn Station. Additionally, this would enable NNEIRI trains to access existing equipment maintenance facilities and operationally work better.

Q: The Big Dig required building rail. How much have we accomplished since this?

A: The Big Dig mitigation projects were primarily in Eastern Massachusetts and this study is unrelated to these transit enhancements.

Q: When will the Service Development Plan be published?

A: The SDP will be published in November 2015 on the MassDOT project website for the NNEIRI study. There are already study documents on the website that were completed before this meeting, such as the Alternatives Analysis.

Q: How does NNEIRI compare to connecting regional services? Could you talk about how we can connect regional metro areas with one another?

A: We are looking at this in terms of an overall system. However, elements of the NNEIRI service could be used for regionally focused systems.

Q: When you referenced the potential station at Palmer, you used the word "potential," could you elaborate on this term?

A: There will have to be a local and state decision regarding the location of a Palmer Station site. We are not precluding a Palmer Station or making a recommendation for a station in this study. However, we have identified viable sites for a station in Palmer and have included it in ridership and conceptual capital costs analysis.

Comment: There was a question asked about going east-west in Massachusetts. I would love this but I believe we should go north-south as well.

A: As highlighted in the presentation, there will be north-south services in Massachusetts serving the Pioneer Valley with connections to Montreal, New Haven, and Boston and points in between.

F.3 WHITE RIVER JUNCTION PUBLIC MEETING

At the White River Junction Public Meeting, Scott Bascom (VTrans) welcomed attendees and provided an overview of the evening. Ron O'Blenis provided the same 45-minute presentation at all three public information meetings. Approximately 25 people attended the meeting.

Questions and Comments: White River Junction Meeting

Following the presentation, attendees asked questions and offered comments (see italics). Responses to the questions were made primarily by Ron O'Blenis.

Comment: The travel time between White River Junction and Boston is concerning to me, if it takes this long to get to Boston no one will ride this train there.

A: The higher ridership numbers for this service are for passengers getting to places throughout the Corridor, not from or to the extremities. Passengers going from or to Boston from Vermont will most likely take alternative forms of transportation since it will take a shorter amount of time.

Q: How many trains will be passing through White River Junction daily?

A: As a part of NNEIRI services, there will be two round trips, or four trains a day. Additionally, the Vermonter will continue to operate through White River Junction to provide a third daily intercity roundtrip.

Q: How do you expect people to take the train between White River Junction and Boston when it takes five hours by train and two hours by car? Why give right wing ideologues something to hold on to? I want it to be successful and what you're proposing will fail.

A: A lot of our ridership will be intermediate stops along the route. This is where the benefit comes in. The service will provide connectivity between locations not currently connected.

Q: There are two things to do for me. Please connect me with the Lakeshore Limited and to Boston so I can get to Florida.

A: One of the things we looked at is how to make better connections. You can make a connection westbound now but not eastbound currently. NNEIRI services and schedules would seek to provide a connection in Springfield between other intercity rail services.

Q: Can one take the train to New York City from South Station?

A: Yes, there are 19 daily round trips on Amtrak between Boston and New York City on the Northeast Corridor. The NNEIRI study would provide service on the Inland Route and enable passengers from locations in Central and Western Massachusetts to directly reach New York City.

Q: Was any study done to see infrastructure costs breakdown by state?

A: Yes, some of the details of the analysis are in the SDP. It is categorized into the minimum investment needed in each state.

Q: What are the ridership numbers from one end to another?

A: The table in the handout shows regional origin-destination pairs. As noted, most of the ridership will not be from terminal station to terminal station but to stations along the NNEIRI Corridor

Q: Did you consider a bus vs train or an auto vs train mode between White River Junction and Boston?

A: We looked at travel options and concluded train was not time-competitive compared to auto or bus. The greatest interest in riders to Boston from Vermont is generated from Southern Vermont station stops. However, the primary driver of ridership in Vermont is for passenger service to Montreal, New York City, and between points within Vermont.

Q: Why would people from eastern Massachusetts and Connecticut take the NNEIRI route to New York City? It would seem that they would use the Northeast Corridor (NEC).

A: A lot of the NNEIRI ridership is between the intermediary cities. NNEIRI would be serving a segment of population that does not have the alternative of full rail service as in the NEC. When we looked at economics, western MA, CT & Southern VT are more closely linked. Expanding rail service within this region will provide opportunity that does not exist today.

Q: Was the ridership analysis done by HDR?

A: It was completed by AECOM.

Q: What is the time frame to initiate NNEIRI service?

A: It’s undefined. This is a study. No financing is in place. It provides a framework for establishing the service. The people who would use it need to embrace and get support for it.

Q: What’s the ridership between St. Albans & Brattleboro?

A: It was relatively low; perhaps several thousand per year.

Q: If train service was extended to Montreal, ridership would increase but I’m convinced going to Montreal will have a significant impact.

A: Montreal is a major generator of ridership in the NNEIRI Corridor. Over 100,000 riders would travel to or from Montreal per year on NNEIRI or Vermonter services. This number dwarfs the number of people using airlines to reach Montreal from New England airports.

Q: If it’s not working with one train to Montreal, why would it succeed with more?

A: The train in reference, I believe is the Amtrak Adirondack service. The crucial difference between this existing service and future services would be a US Customs and Immigration station in Montreal Central Station. This would dramatically reduce travel times for passengers by eliminating the necessity of a customs stop at the U.S./Canada border. This would also be used for a future Vermonter extension to Montreal and any potential NNEIRI services in Montreal. This study looked at the maximum amount of service that could be run on the infrastructure. It does not necessarily mean that there will be this amount of service on the Corridor.

APPENDIX G: BENEFIT-COST TECHNICAL APPENDIX

The benefit-cost technical appendix provides additional detail to supplement the information presented in Chapter 8 of the Service Development Plan. This detail includes inflation factors, trip characteristics, and emission rates.

INFLATION FACTORS

All monetary values considered in the analysis were updated from their original values to current dollars as of the end of 2014 using the appropriate inflation factors. The table below summarizes the various values and their inflation factors.

Table G-1: Inflation Factors and Sources

Factor	Original Year	Index Original Year	Index 2014	Source
Value of Time	2013	233.0	236.7	CPI - All Urban Consumers, U.S. City Average, All Items, ANNUAL AVERAGE, CUUR0000SA0; http://www.bls.gov/data
Emissions Costs				
Value of Statistical Life				
Pavement	2000	172.2		
Congestion				

TRANSPORTATION ASSUMPTIONS

Information generated by the ridership study was used to generate benefits associated with the added service to be provided by the alternatives under consideration. The ridership model produced projections for an opening year and operating year 15 by origin and destination pair for the base case and the Full-build Service scenarios. As noted in Chapter 8, assumptions were made to account for the level of service provided by the Inland Route Service and Boston to Montreal Service scenarios. These adjustments generated ridership values for two years for each scenario. A linear interpolation was done to estimate annual ridership estimates to complete the benefit-cost analysis.

Using the station pairs, a matrix of distances was created for both rail and automobile users. The distances between stations are presented in Table G-2 below. To avoid creating a false level of precision, weighted average trip lengths were generated for both the opening and future years.

TABLE G-2: Auto and Rail Miles Between Station Locations

Location	Auto Miles	Rail Miles
Montreal - St. Albans	66.5	65.5
St. Albans - Burlington	24.8	24
Burlington - Waterbury	23.7	23
Waterbury - Montpelier	11.5	9
Montpelier - Randolph	26.5	30
Randolph - White River Junction	34.1	32
White River Junction - Windsor	15.6	13
Windsor - Claremont	9	9
Claremont - Bellows Falls	17.7	17
Bellows Falls - Brattleboro	23.6	24
Brattleboro - Greenfield	45.6	24
Greenfield - North Hampton	21.6	19
North Hampton - Holyoke	10.8	11
Holyoke - Springfield	8.2	10
Springfield - Palmer	18.6	15
Palmer - Worcester	35.3	39
Worcester - Framingham	28.2	23
Framingham - Boston (Back Bay)	21.1	20
Boston (Back Bay) - Boston (South Station)	3.5	1
Springfield - Windsor Locks	16.6	15
Windsor Locks - Windsor	4.7	2
Windsor - Hartford	8.2	9
Hartford - Berlin	18.2	11
Berlin - Meriden	7.9	7
Meriden - Wallingford	9.9	6
Wallingford - New Haven	15.3	12

The average travel time was calculated by the same approach as the average trip length, using the rail speeds developed for this Service Development Plan and assuming an average automobile speed of 50.9 miles as generated by the ridership model. As noted in Chapter 8, rail trips also incurred an assumed average pre-board dwell time of 10 minutes. Estimates of opening and 15-year horizon values for incremental ridership, weighted average trip lengths, ridership estimates, travel time by mode, avoided automobile vehicle-miles, additional rail miles due to the new service, and the change in rail passenger-miles for each operating scenario are presented in Table G-3.

Table G-3: Transportation Values for Opening and 15th Years

Variable	Opening Year	Year 15
Annual Ridership		
Inland Route Service	371,040	428,675
BMHSR Service	387,964	448,297
Full-build Service	697,836	807,040
Weighted Average Trip Length - Rail (Miles)		
Inland Route Service	189	189
BMHSR Service	239	241
Full-build Service	215	216
Weighted Average Trip Length - Auto (Miles)		
Inland Route Service	213	214
BMHSR Service	267	268
Full-build Service	240	242
Weighted Average Speed - Rail (Miles Per Hour)		
Inland Route Service	47.43	47.43
BMHSR Service	47.14	47.14
Full-build Service	47.08	47.08
Weighted Average Speed - Auto (Miles Per Hour)		
Inland Route Service	50.9	50.9
BMHSR Service	50.9	50.9
Full-build Service	50.9	50.9
Weighted Average Travel Time - Rail (Hours)		
Inland Route Service	4.0	4.0
BMHSR Service	5.1	5.1
Full-build Service	4.6	4.6
Weighted Average Travel Time - Rail (Hours)		
Inland Route Service	4.2	4.2
BMHSR Service	5.2	5.3
Full-build Service	4.7	4.8
Additional Annual Rail Vehicle-Miles		
Inland Route Service	516,840	516,840
BMHSR Service	285,065	285,065
Full-build Service	801,905	801,905
Avoided Annual Automobile Miles-Traveled		
Inland Route Service	52,753,523	61,072,717
BMHSR Service	68,958,145	80,192,754
Full-build Service	111,867,376	130,122,416
Additional Annual Rail Passenger-Miles		
Inland Route Service	70,026,437	81,066,766
BMHSR Service	92,709,211	107,845,831
Full-build Service	149,958,562	174,442,578

EMISSION RATES

As noted in Chapter 8 of the Service Development Plan, emission rates for automobiles vary by both time and speed while emission rates for rail vary over time. This anticipated variation is due to changes in environmental regulations. All emissions rates are presented in grams per mile and then converted to metric tons for monetization. Table G-4 below presents the emissions rates used for the Opening Year and Year 15 of the analysis. The auto rates are based on the EPA's MOVES model while the rail rates are based on the EPA's "Regulatory Impact Analysis: Control of Emissions of Air Pollution from Locomotive Engines and Marine Compression Ignition Engines Less than 30 Liters per Cylinder." The values presented in the table were then multiplied by the increase in rail miles per year and the decrease in automobile miles per year to generate the net annual emissions reduction.

Table G-4: Emissions Rates (grams per mile)

Variable	Opening Year	Year 15
Automobile - grams per mile		
Nox	0.0996	0.0763
CO2	282.9771	257.9797
VOC	0.0161	0.0147
PM	0.0134	0.0129
SO2	0.0044	0.0040
CO2	2.3558	2.3929
Rail - grams per mile		
Nox	1.434636296	0.660305
CO2	146.5792539	126.0186
VOC	0.052168593	0.023671
PM	0.033329934	0.012459