New Britain – Hartford Busway; Central Connecticut

The New Britain – Hartford Busway is a 9.4-mile roadway reserved for buses that extends from downtown New Britain to the edge of downtown Hartford. Bus service on the project, operating as CT*fastrak*, continues onto streets and arterial roadways to provide direct service into downtown Hartford, to several activity centers in the corridor, and from park-ride lots in outlying areas. Figure 1 is a map of the New Britain – Hartford corridor, the busway, and CT*fastrak* routes operating both on and off the busway.

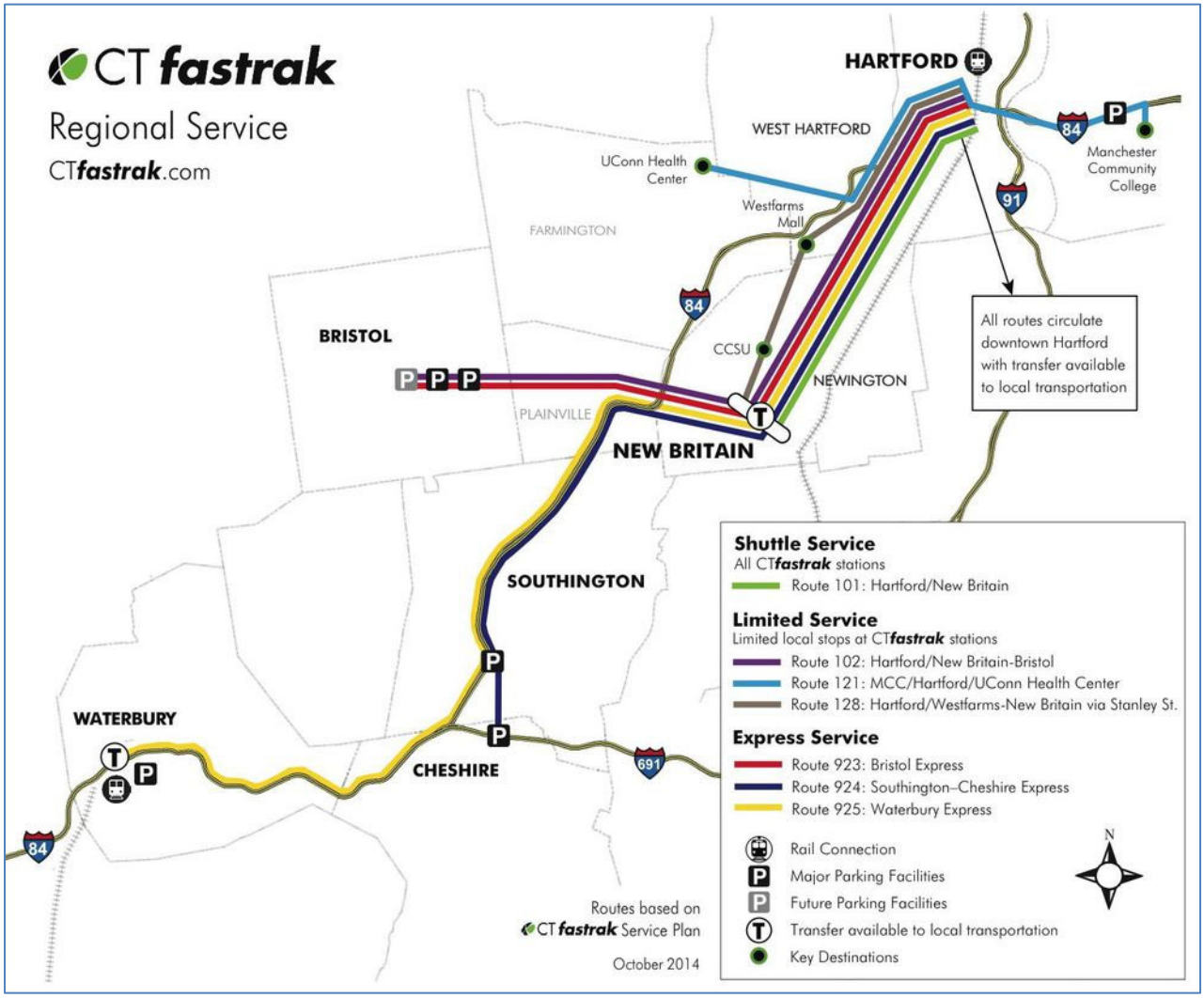


Figure 1. The New Britain – Harford Busway and CT*fastrak* Service

The 1994 Regional Transportation Plan prepared by the Capitol Region Council of Governments (CRCOG) identified the New Britain – Hartford corridor as one of four priority corridors for consideration of alternatives to manage increasing roadway congestion. In response, the Connecticut Department of Transportation (CTDOT) conducted a Major Investment Study that considered a broad range of transit and system-management options. The study identified a busway as the Locally Preferred Alternative (LPA), in large part because buses could proceed

directly from the busway into downtown Hartford without forcing a transfer that would be necessary with rail options.

The project entered Preliminary Engineering in January 2000, entered Final Design in June 2006 after protracted design and right-of-way negotiations with Amtrak, and received a Full Funding Grant Agreement from the Federal Transit Administration in November 2010. The project opened to service in March 2015. As the federal grantee and sponsoring agency for the project, CTDOT managed the design and construction of the project and now operates CT*fastrak* bus service as part of its CT*transit* system.

Physical scope

The busway is a 9.4 -mile semi-exclusive roadway that runs at-grade for its entire length except at 11 bridges. The busway has five at-grade intersections, all controlled by traffic signals, as well as ramps at three locations where bus routes enter and exit the bus-only facility. No turns occur at the at-grade intersections, by buses or any other vehicles. The busway pavement is asphalt except for concrete sections over several hundred feet at each station.

The busway has three segments. From the terminal station in downtown New Britain, the first 4.4 miles are located in state-owned abandoned railroad right-of-way replacing the former single-track railroad. The busway then transitions at a railroad junction into an active Amtrak railroad corridor, running parallel to the two Amtrak tracks. Just short of Union Station on the edge of downtown Hartford, the busway uses the existing on- and off-ramps from I-84 to connect with the street network. CT*fastrak* buses then distribute and collect passengers on the Downtown Loop before returning to the busway.

The facility has two lanes throughout. Busway construction required one new bridge to separate it from a complex intersection in downtown New Britain, one replacement bridge to provide sufficient width for both Amtrak and the busway as it approaches downtown Hartford, and the rehabilitation of nine existing bridges along the railroad rights of way. Construction of the new Flatbush Ave. bridge was funded separately as a railroad grade-separation project. A gravel roadway built along the segment shared with Amtrak provides access for maintenance of the railroad right-of-way and tracks. The project included construction of a multi-use trail from the terminal station in New Britain to just north of the junction with Amtrak.

The busway's eleven stations have 15-inch-high platforms to permit level boarding of buses and are fully ADA compliant. The terminal station in New Britain has a 450-foot center platform with bays on both sides, as well as peripheral stops at curb height for connecting buses. The station has a passenger waiting area inside a supervisor building, plus restrooms reserved for bus operators. Other stations have platforms that average 100 feet in length. All other stations have side platforms averaging 100 feet in length located on pull-off lanes that permit buses to stop while letting express buses pass by on the through lanes. Stations are equipped with passenger shelters, fare collection equipment, security cameras, and emergency call boxes. Passengers reach opposing platforms via busway crosswalks fitted with flash beacons to alert bus operators to crossing pedestrians. Six stations have surface parking lots ranging in size from nine to 45 spaces and providing a total of 166 spaces. CT*fastrak* stops on the downtown loop have modest physical presence – limited to branded bus stop signs and branded fare vending equipment.

The scope of the project did not include a new or expanded facility for vehicle maintenance and storage. Forty-two of the new CT*fastrak* buses are based in the existing Hartford Division

facility where some infrequently used equipment was removed to provide additional space. The other six new buses are based with the contractor that operates them in CT*fastrak* service.

The five at-grade traffic intersections on the busway are protected by traffic signals with priority given to approaching buses. The new busway operations center at CT*transit* headquarters uses computer-aided dispatching and maintains communications with CT*fastrak* buses through radio, mobile data terminal links, and a real-time vehicle monitoring system.

In total, 21 full parcels of land and 104 partial takes of land were acquired, primarily for stations and for the at-grade crossings with local roads. The project also established a permanent easement with Amtrak for the shared right-of-way from Newington Junction station to Hartford.

The project scope included the acquisition of 48 new buses, uniquely branded for CT*fastrak* service: 12 30-foot buses to provide feeder service to busway stations; 18 40-foot buses that operate both on arterial streets in the corridor and then on the busway itself; six over-the-road coaches to operate busway express routes; and 12 60-foot articulated buses that serve all busway stations and then the Hartford Downtown Loop. All buses are ADA compliant and have kneeling capabilities to deal with small variations in busway platform height as well as curb-level stops off the busway. Buses have fare-validation equipment, cameras inside and out that record silent video, automated vehicle locators, and automatic passenger counters.

During the development of the project, the general characteristics anticipated at each milestone were consistent with the as-built busway project in terms of the busway's termini in New Britain and Hartford, its use of the two railroad rights-of-way, a loop for through-routed busway buses through the streets of downtown Hartford, the general locations its online stations, the need for park-ride spaces at some stations (without designating specific stations or quantifying the number of parking spaces), and a general aspiration that it be a "state-of-the-art" facility. At entry into PE, however, the project scope apparently was not developed significantly beyond these broad characteristics. No archives, few records, and – with retirements and transitions to other employment – none of the CTDOT project staff have been available to document any details on the scope at that milestone.

Two specific differences are evident between the limited scope definition at PE-entry and the as-built project. First, the scope at PE-entry anticipated that the busway would remain in the railroad right-of-way through to a terminal station at Hartford Union Station; the as-built busway leaves the right-of-way short of Union Station via I-84 on/off ramps that connect to city streets near the station. Second, based on a service plan that anticipated both lower-than-actual service levels and a strategy that largely relied on the rerouting of existing bus services – and their buses – onto the busway, the scope included the purchase of only 23 new vehicles – 13 standard coaches and 13 articulated buses – compared to the 48 actually acquired. The less-ambitious service plan and consequent undercount of the vehicles eventually needed for full CT*fastrak* service persisted throughout project development. It was after the FFGA award that CTDOT developed the service plan that was implemented at project opening.

At entry into FD, a much more detailed project scope had several differences from the as-built project. The anticipated scope had four bridges that were eventually dropped during FD. The multi-use trail continued along the Amtrak segment of the alignment but was also dropped during FD to comply with Amtrak requirements for a gravel roadway to provide access to its tracks. The New Britain station was to be two floors – the upper level for parking and passenger drop-offs with elevator access to the first-level bus platforms; the upper level was omitted from

the design during FD to reduce costs. A total of 355 parking spaces were planned at stations – reduced by attrition during FD to the actual 166 total spaces with the refinement of station-area designs. The scope anticipated only 33 property takes for right-of-way compared to the 125 full and partial takes actually needed but not identified until sufficient additional design was completed, ongoing negotiations with Amtrak on the shared right of way were concluded, and station locations and designs were resolved. A still-limited service plan for the busway continued to require only 30 vehicles rather than the actual 48 vehicles needed for the more ambitious CT*fastrak* service levels.

By the award of the FFGA, only two differences from the as-built were evident: the continuing undercount of the vehicle-purchase requirement, plus a new difference – the reduction of a 1,300-foot segment of the busway to one lane approaching downtown Hartford. CTDOT made this change during FD to reduce costs in response to rapid worldwide commodity-price increases but was able to restore the two-lane design when a more favorable bid climate made it affordable.

Capital cost

The actual cost of the project was $557.2 million in YOE dollars with a mid-point of expenditures in July 2012. Fifty-nine percent of the total cost was for project construction, eight percent for right-of-way, four percent for vehicles, and 29 percent for professional services to help plan, design, and oversee construction of the project. Aggregate unit costs were $59.3 million YOE per mile total and $57.1 million YOE per mile without the vehicles. Stations cost an average of $3.2 million each and vehicles $420,800 each.

At PE-entry in January 2000, CTDOT predicted that the project would cost $88.4 million YOE with a mid-point of expenditures in November 2001 and the project opening in 2003. This estimate was low by $468.9 million YOE (84 percent), caused by an underestimate of baseline (constant-dollar) costs equivalent to $307.8 million YOE and an underestimate of inflation add-on costs of $172.0 million (driven entirely by a planned project schedule of four years that was significantly shorter than the actual schedule that required 15 years from the PE-entry milestone). The large underestimate of baseline costs is a direct reflection of the conceptual nature of the project scope at PE-entry. Few details exist on the methods used to estimate costs and CTDOT staff hypothesize that the approach may have relied on aggregate unit costs applied to broad project characteristics (for example, a cost per mile of busway construction times the length of the busway).

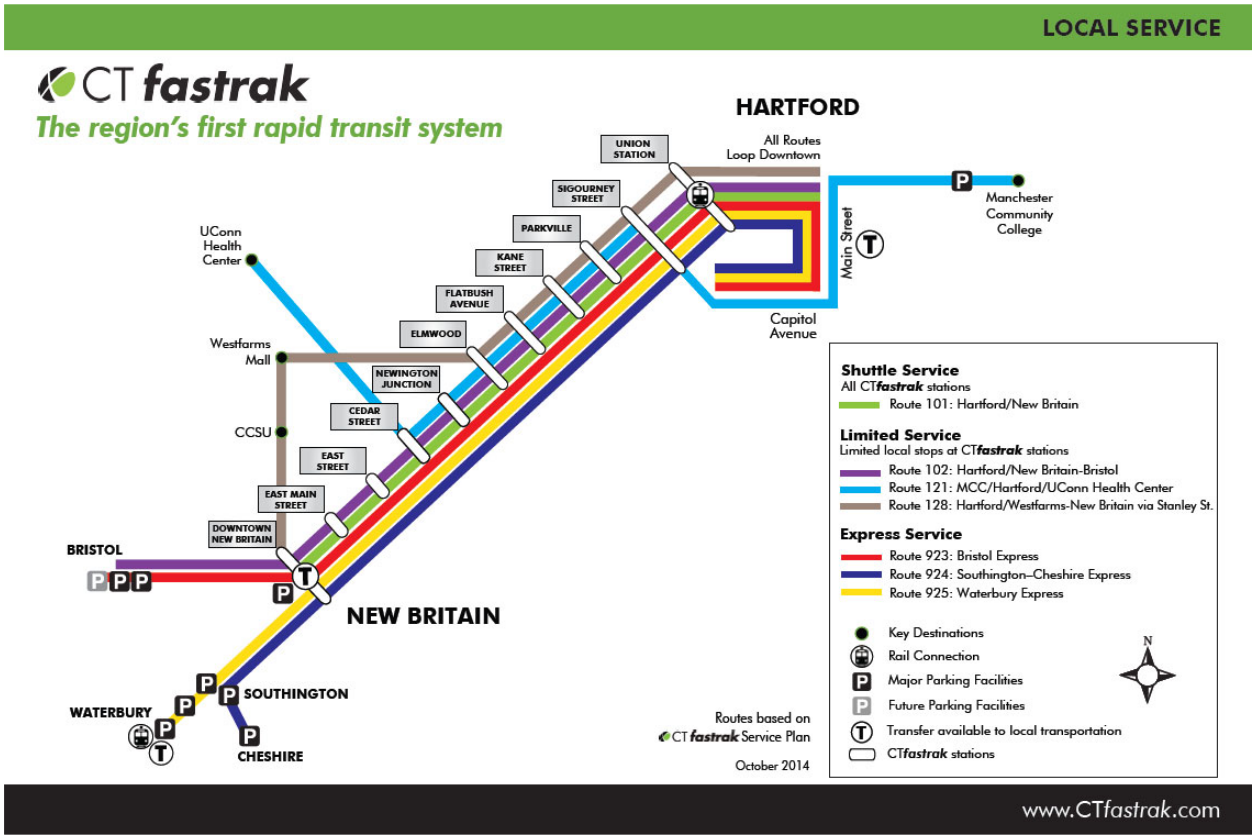
The PE effort produced a detailed project scope and revised cost estimate that, at entry into Final Design in June 2006, had increased to $458.8 million YOE with a mid-point of expenditures in June 2009 towards a planned project opening in 2012. This refined estimate was low by $98.5 million YOE (18 percent) because of an underestimate of (constant dollar) baseline costs equivalent to $65.8 million YOE and an underestimate of inflation costs by $32.7 million. The underestimate of inflation effects was again the product of an underestimated schedule (six years compared to the actual nine years from this milestone) partially offset by an overestimate of annual inflation rates attributable to the then-recent worldwide run-up of steel and concrete prices.

The cost estimate in the 2010 FFGA was $567.1 million YOE, higher than the actual cost of the project by $9.8 million (two percent). The baseline (constant dollar) cost estimate was

overestimated, largely because bid prices turned out to be much lower than expected as the severe recession produced a favorable bid climate. This overestimate was partially offset by the continued underestimate of the remaining schedule duration with a projected project-opening date a year earlier than the actual date.

Transit service

Figure 2 provides a schematic representation of the various CT*fastrak* routes that operate on the project, the stations where they stop, and the off-busway locations that some of them serve. All CT*fastrak* routes serve the Hartford Downtown Loop and all but one of the local routes also has a sidewalk stop near Union Station before entering the busway.



Four local routes serve the busway stations; each local route stops at every station that it encounters. Two run the full length of the busway between Hartford and the New Britain terminal station, one continuing on via local roadways to Bristol. One leaves the busway via a ramp at the Cedar Street station, travels on local roadways to two activity centers, and ends at the New Britain terminal station. The fourth begins in east Hartford, follows a different routing through the Downtown Loop, and runs on the busway until transitioning to local roadways via a ramp at the Cedar Street station. End-to-end runtime for local routes on the 9.4-mile busway averages 23 minutes with stops at all 11 stations, an average speed of 24.5 mph.

Together, the four local routes provide frequent service throughout the busway corridor. On weekdays, the two routes running the full length of the busway together have a bus arriving at each station on a combined average of every 6/10/15 (peak/midday/evening) minutes in both

directions. At the five stations that are closest to Hartford, buses added by routes entering the busway at the Cedar Street and Elmwood stations reduce the average time between bus arrivals to 4/6/10 minutes. On Saturdays, full-length service averages 12/12/15 minutes between arrivals on Saturdays, and 8/8/10 minutes for stations closer to Hartford. On Sundays, the combined full-length services average 15 minutes between arrivals all day and 10 minutes for the stations closer to Hartford.

Four CT*fastrak* express routes provide weekday service between the Hartford Downtown Loop and the New Britain terminal station. The expresses operate non-stop except at the Sigourney Street station where express buses stop to provide transfer opportunities to/from the local routes. Express buses average 36 mph on the busway and reduce the runtime from New Britain to downtown Hartford by five to seven minutes. One route operates with 60 minutes between departures in both directions from 5 a.m. to midnight. During weekday peak periods, each of the other three have a departure every 30 minutes from New Britain, yielding a combined average spacing between expresses to Hartford of 8.6 minutes.

Four new circulator routes connect at stations and circulate in neighborhoods to provide access to the busway. The circulator routes provide service seven days per week and carry both local trips and trips transferring to CT*fastrak* routes. Two routes in particular – one to a major hospital and one to a state university campus – provide continually frequent all-day service: 15-20 minute headways on weekdays, 20 minutes on Saturdays, and 20-30 minutes on Sundays. Each busway station also has connections to one or two local routes operating on local roadways.

The introduction of CT*fastrak* service was part of a substantial increase in transit service in the New Britain – Hartford corridor. Adjustments to existing bus routes were limited to the rerouting of expresses from I-84 to the busway and adding evening and Sunday service to local routes in both Hartford and New Britain. Consequently, nearly all CT*fastrak* service represents a net increase, approximately tripling transit service in the corridor: vehicle-miles increased from 1.86 million to 5.77 million (210 percent) while vehicle-hours increased from 0.14 million to 0.40 million (187 percent, proportionately less than the increase in vehicle-miles because of the faster speeds on the busway).

At both PE-entry and FD-entry, the transit service plan for the busway project was significantly different from the actual outcome in two ways: first, the plan anticipated that service on the busway would be provided by existing routes in the corridor rerouted onto the new facility, thereby providing their own off-busway feeder services; and second, the plan provided for service levels in the corridor that were much lower than the outcome, underestimating the actual vehicle-hours and vehicle-miles of service by about 47 percent. Community outreach during Final Design led to a revised service plan at the FFGA milestone that was similar to the route structure and service levels of CT*fastrak*. The plan continued to underestimate the vehicle-miles (by 26 percent) and, especially, the vehicle-hours (by 53 percent) that would be necessary to implement the plan. The full requirements were not established until after the FFGA when the plan underwent the routine service-planning applications used to implement service – introducing the constraints associated with union rules, routing realities, and rules for guideway operations.

Operating and maintenance costs

In 2017, the cost of operating and maintaining the busway and CT*fastrak* services was $23.5 million: 84 percent for bus operations and maintenance, eight percent for dispatchers and street supervisors, and eight percent for maintenance of the busway and its stations. The total cost of bus service in the New Britain–Hartford corridor increased from $11.2 million in the year before project opening to $37.2 million afterwards, an increase of $22.0 million (233 percent, more than triple). This change includes a $3.6 million increase for improved local bus service in Hartford and New Britain. These increases directly reflect the substantial increase in service levels resulting from the advent of CT*fastrak* – essentially all new service added to the corridor – as well as expanded hours and days of service for local services.

Because the early service plans developed for the project called for lower service levels and did not recognize the realities of operating the service, the O&M costs for the CT*fastrak* service and busway facilities were substantially underestimated as well: by 71 percent and FD-entry and 44 percent at the FFGA. No records indicate the preparation of any estimate at PE-entry.

Ridership

In the spring of 2017, two years after the project opened to service in March 2015, ridership on the project averaged 8,200 trips per average weekday (including all trips using CT*fastrak* buses as they operated on the busway but excluding trips on those buses if they were made entirely off the busway). Approximately 90 percent of these trips were on local routes, 10 percent on the expresses.

Travel patterns on the project are complex with substantial travel markets both produced in and attracted to the greater Hartford area (most of the City of Hartford plus east Hartford), the greater New Britain area (New Britain, Bristol, and areas to the southwest), and the project corridor (the west and southwest Hartford, Newington, and other communities).

The largest source of trips on the project is the greater New Britain area – producing 3,600 trips, 2,000 of which were to and from activities in greater Hartford, 1,100 to/from corridor communities, and 500 to/from other New Britain locations. The second largest was greater Hartford – producing 2,500 trips, 900 to/from the corridor, 900 to/from greater New Britain, and 700 within Hartford. Corridor communities produced 2,000 trips on the project – 1,000 to/from greater Hartford, 600 to/from other corridor locations, and 400 to/from greater New Britain.

Overall, 57 percent of trips on the project were between home and work, 26 percent were between home and other activities, and 16 percent were between two non-home locations. The long-haul market from greater New Britain to greater Hartford was the most work oriented with 75 percent of trip made by commuters.

The degree of transit dependence among CT*fastrak* riders was significant. Some 40 percent of project trips were from households without vehicles – reaching 55 percent for trips produced in corridor communities, 46 percent for trips produced in Hartford, and relatively fewer at 28 percent for trips produced in New Britain.

In February 2015, transit ridership in the corridor averaged 6,100 door-to-door trips on the average weekday. In the two years after the project opened in March 2015, ridership in the corridor grew to 11,600 trips, an increase of 5,500 (more than 90 percent). Ridership from New Britain nearly tripled and ridership from greater Hartford grew by 80 percent. These gains were

a direct consequence of the large increase in the amount and the quality of transit service in the corridor. The gains stood in marked contrast to general trends at the time: ridership on CT*transit* routes outside of the project corridor dropped by 19 percent over the same interval.

Predictions at all three milestones during project development anticipated even larger ridership impacts. At PE-entry, the forecast prepared with the Connecticut statewide model predicted 8,800 new transit trips because of the project compared to the actual outcome of 5,500 new trips, an overprediction of 60 percent. (The focus on new transit trips was because that was the principal FTA project-evaluation ridership measure at the time.) At FD-entry, the forecast prepared with the travel model maintained by CRCOG predicted 13,700 trips on the project versus the actual 8,200, an overprediction of 67 percent – a large fraction of which was associated with busway stations in southwest Hartford and the Hartford Downtown Loop.

At the FFGA award, a revised forecast prepared with the CRCOG model predicted 13,300 trips on the project, high by 5,100 trips, or 62 percent. The forecast predicted 6,200 work trips (high by 1,600 trips, or 34 percent) and 7,000 non-work trips (high by 3,500 trips, or 100 percent).

The travel model was configured in a way that made detailed predictions for work trips and then computed transit shares for other trips by factoring the work-trip shares with multipliers dependent on the distance of the trip and the auto-ownership of the households. Consequently, detailed analysis of the forecast is possible for the work trips but not for non-work trips. The work-trip forecast anticipated that commuting residents of greater New Britain would produce 2,723 trips on the project – only 11 percent higher than the actual outcome of 2,456 trips, although high by 23 percent for commuters from greater New Britain to greater Hartford. The forecast anticipated that commuting residents of greater Hartford would produce 1,445 trips on the project – higher than the actual ridership by only 19 percent. And finally, the forecast anticipated that commuting residents of the project corridor would produce 1,906 trips – nearly double the actual ridership with large overestimates of project trips to greater Hartford and to workplaces within the project corridor itself.

Hypotheses on the causes of the over-prediction include the unanticipated effects of the Great Recession (a significant decline in employment – particularly retail employment – and a weak recovery statewide) and differences between the representation of transit service levels in the model and actual CT*fastrak* service. A test of these two hypotheses through a reapplication of the travel model with updated employment and transit service levels reduced the overprediction of total weekday trips on the busway from 62 percent to 40 percent. Other possible causes of the over-prediction may include conditions not represented in the travel model (unfriendly pedestrian environments around some busway stations and the significant share of office workers who telework), the assumption in the forecasts that gas prices would remain at 2005 levels compared to the actual drop of more than a dollar per gallon (inflation-adjusted), and the advent of ride-hailing services that may compete with transit services in some travel markets.

Finally, because nearly 70 percent of the overprediction is for non-work travel, an additional hypothesis is that the factoring of work-trip transit shares to predict non-work shares does not adequately reflect the different ways that work and non-work travelers react to a new busway facility. Work trips on the busway are longer distance, are more likely to be made by choice riders, are more focused on downtowns, and are less likely to require a transfer. Consequently, more accurate forecasts of non-work transit trips may well require a separate set of forecasting methods that are independent of the methods for work travel.