

# Northwest-Southeast Light Rail Project Before-and-After Study (2014)

Dallas, Texas



U.S. Department  
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## **Northwest-Southeast Light Rail Project; Dallas, Texas**

The Northwest-Southeast Minimum Operable Segment is the federally-funded part of the Green Line addition to the Dallas area's light rail system. The figure provides a map of the Green Line, the federally-funded project, and the current Dallas-area light rail system.

The full Green Line extends 28.8 miles from southeast Dallas through downtown and then northeast to Carrollton. The federally-funded project comprises 20.9 miles of the Green Line: 10.8 miles of the northwest segment and the entire 10.1 miles of the southeast segment. The three other segments of the Green Line are a 5.5-mile locally funded northward extension of the northwest segment, a 1.2-mile locally funded segment just west of downtown, and the 1.2-mile downtown segment built in the 1990s with the initial Dallas area light rail lines.

The project was developed, built, and is now operated by Dallas Area Rapid Transit (DART), the regional transit agency.

Light rail lines to the northwest and southeast have been elements of the regional rail plan since its earliest version in 1983. Light rail extensions for both corridors emerged as the preferred alternatives from separate planning studies in 2000. The extensions then advanced through separate federal environmental reviews but were evaluated and funded as a single project in the Federal Transit Administration's New Starts program.

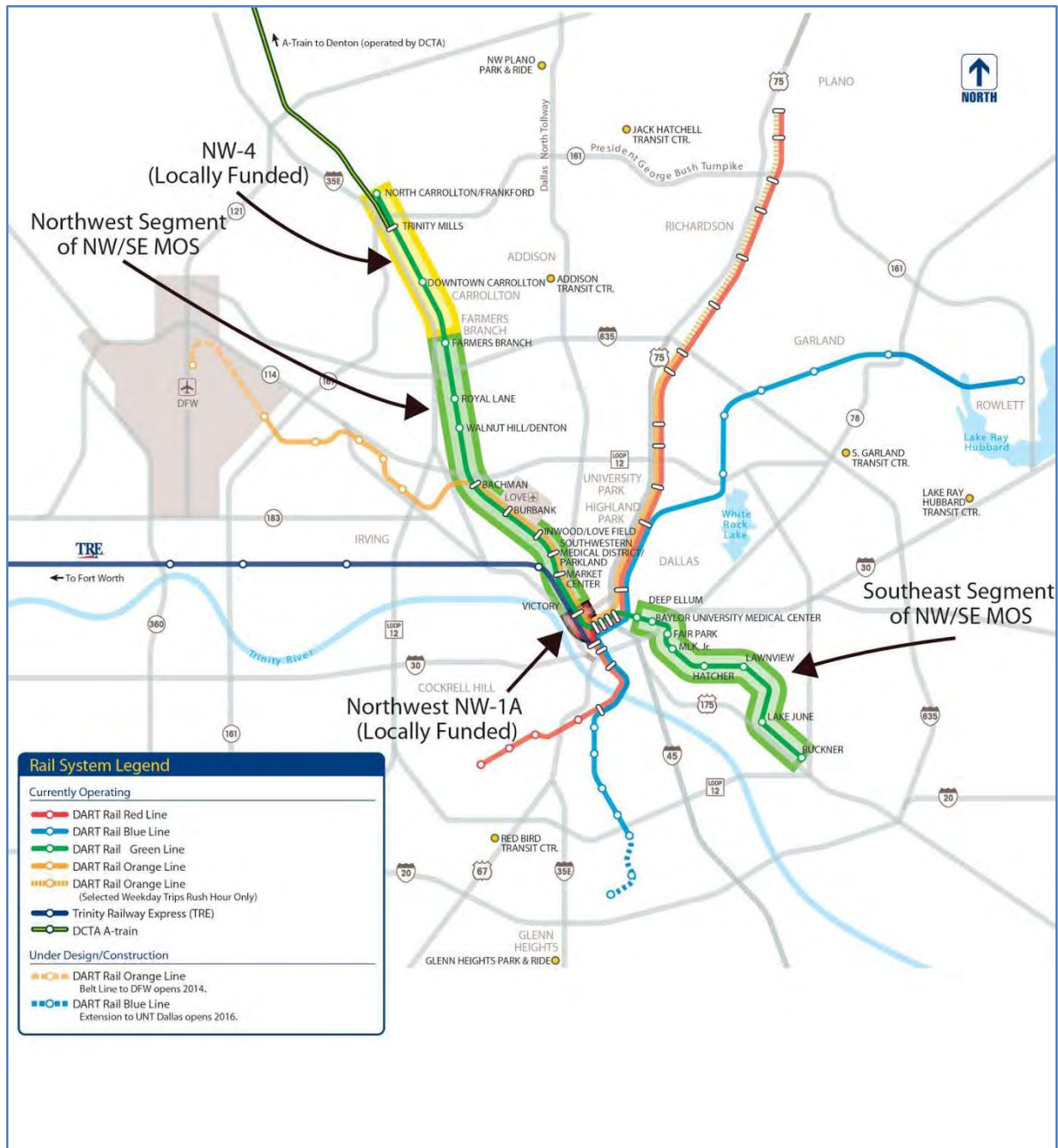
The project entered preliminary engineering (PE) in July 2001, entered final design (FD) in June 2005, received a Full Funding Grant Agreement (FFGA) in July 2006, and opened to service over the full length of the Green Line in December 2010. The "before" milestone for this Before-and-After study is 2007/2008. The "after" milestone is 2012 except as noted below.

This summary is an interim report on the outcomes of the project and the accuracy of predictions made during the development of the project. In 2012, DART proposed, and FTA agreed, to postpone the collection of detailed ridership data on the project until a system-wide survey of riders planned for spring 2014. DART completed a snapshot survey of Green Line riders in June 2013 and the planned system-wide survey of all DART bus and rail routes in June 2014. Surveys of other transit systems in the Dallas/Ft. Worth area, including two with direct connections to the Green Line, will occur in fall 2014. In spring 2015, DART will use the final survey data to examine Green Line ridership impacts and update the final report from the Before-and-After Study. FTA will update this summary of findings in the 2015 Report to Congress.

### **Physical scope of the project**

The Green Line project is a double-tracked guideway with overhead electrification and full separation from street traffic except at at-grade crossings. Most of the project is located within railroad right-of-way purchased by DART in 1990. Active freight operations continue in some sections including from Merrell Road to just south of Mockingbird Lane in the northwest segment and from near Hatcher Station to Buckner Station in the southeast segment. Freight and light rail operate in a shared right-of-way but on their own physically separated tracks.

Of the 20.9 miles of the project, 12.19 miles are built at grade, 2.49 miles are on fill, 5.95 miles are on elevated structure, and 0.29 miles are below grade within a runway protection zone near Dallas Love Field Airport. The northwest segment is elevated for 5.2 miles of its 10.8 mile length and has 48 grade-separated street crossings and 11 at-grade crossings. The southwest



The DART Green Line and Its Components

segment is at grade for 8.1 miles of its 10.1-mile length and has 4 grade-separated crossings and 33 at-grade crossings.

The project has 16 new rail stations, eight each on the northwest and southeast segments. All stations accommodate three-vehicle trains and have platforms that provide level-boarding at selected locations along the length of the platform. Six of the eight northwest stations, and four of the eight southeast stations, have park-ride lots that together provide a total of 3,276 parking spaces.

The project includes 18 new “super” light rail vehicles that have three sections including a low-floor center section, two articulation joints, a seated capacity of approximately 100 passengers, and a total capacity with standees of 200 passengers per vehicle. The project also includes 38 low-floor vehicle inserts that enabled DART to continue its program to convert its entire fleet of 115 two-section articulated light rail vehicles to super vehicles.

The predicted scope of the project matched the actual outcome, with these exceptions at individual milestones.

- At PE entry, Victory Station was included in the anticipated project scope, but was built early with local funds and not included in the actual project. That change occurred during PE; so the Victory Station was not included in the anticipated scope at FD entry or the FFGA.
- At PE entry, the NW alignment through the medical district was anticipated to be on Harry Hines Boulevard while the actual outcome is on railroad right-of-way to the east. The routing was changed during PE to avoid negative impacts and provide better connections to areas slated for transit-oriented development.
- At PE entry, NW alignment was planned to be largely at grade between Northwest Highway and LBJ Freeway while 2.5 miles of track in this segment are actually on aerial structure. This change was made during PE to avoid 13 at-grade crossings as well as adverse impacts on traffic, freight movements, and floodplains.
- At PE entry, the NW alignment near Love Field did not include the Burbank Station that is part of the as-built project scope. This station was added during PE entry to serve Southwest Airlines headquarters and the Love Field West neighborhood.
- At PE entry, the anticipated project scope included the purchase of additional standard light rail vehicles rather than super light rail vehicles and inserts that were part of the as-built project. DART made this change during PE as part of the decision to convert the entire light rail fleet to the “super” configuration.

Because scope changes made during preliminary engineering eliminated these differences from the as-built scope, the scope of the project anticipated at entry into FD and the FFGA matched closely the as-built physical scope of the project.

### **Capital cost**

The actual cost of the project is \$1,406.2 million in year of expenditure (YOE) dollars. Construction of the guideway and track elements, stations, maintenance facility, sitework, and systems elements accounted for \$816.3 million (58.1 percent) of the project cost. Right-of-way accounted for \$108.5 million (7.7 percent) and vehicles were \$158.4 million (11.3 percent). Professional services and other soft costs were \$205.2 million (14.6 percent), and finance

charges accounted for \$117.8 million (8.4 percent). The aggregate unit cost of the transit project was \$67.3 million per mile – \$59.7 million per mile without the new vehicles and vehicle-inserts.

At entry into PE, the cost estimate in YOE dollars was \$1,151.4 million, an underestimate of 18 percent. The underestimate was caused by (1) the omission of an allowance for professional services, (2) the absence of finance charges which at that time were not required by FTA to be documented as part of project costs, (3) a shorter-than-actual construction schedule, and (4) assumed annual inflation rates that were consistent with recent history and did not foresee spike in global commodity prices that occurred at the start of Green Line construction. Recalculation of the entry-into-PE cost estimate correcting for these four differences yields at revised estimate of \$1,363 million, an underestimate of only three percent.

At entry to FD, the cost estimate in YOE dollars was \$1,490.1 million, an overestimate of six percent. The overestimate was caused by overestimates of costs for professional services (\$260 million versus \$205 million actual) and finance charges (\$239 million versus \$118 million actual). The overestimates for these cost categories offset the continuing underestimates of costs for construction and vehicles. Again, the YOE cost estimates for those items did not foresee the substantial increase in global commodity prices that would drive up unit costs significantly as Green Line construction got underway.

At the FFGA, the estimate matched the actual outcome in terms of total project cost. Within the totals, the pattern of differences that occurred at entry into FD remained: overestimates of the costs of professional services and finance charges offset underestimates of the costs of construction and vehicles. DART was able to reduce the cost of professional services through Construction Management-General Contractor contracts and an Owner-Controlled Insurance Program. Finance charges decreased because interest rates dropped with the national economic downturn and because DART was able to reduce borrowing with a \$78 million grant from the American Recovery and Reinvestment Act and additional funds from FTA. Underestimates for construction and vehicles were again caused by the unforeseen increases in unit costs driven by global commodity prices.

### **Transit service**

On weekdays, service on the project operates at 15-minute headways in the peak periods, 20 minutes at most other times of day, and 30 minutes in late evening. On weekends, service generally operates at 20-minute headways, with 30-minute headways early and late in the day. Service extends from 5am to 1am on both weekdays and weekends. Trains generally have two super light-rail vehicles but some trains include three vehicles to increase capacity during the weekday peak periods. Run time on the project (between the Farmers Branch and Buckner stations including the Victory Station and downtown segments) is 64 minutes including dwell times at stations – an average speed of 22 mph. Average speed is somewhat faster on the partially grade-separated northwest segment – 24 mph between the Farmers Branch station and the Akard station in downtown – than on the largely at-grade southwest segment – 20 mph between the Buckner and Akard stations.

While not part of the FFGA for the Green Line, service on much of the DART Orange Line operates on facilities built under the Green Line FFGA. Consequently, service and ridership on the Orange Line are part of the direct consequences of the Green Line project. Simultaneously with the Green Line opening in December 2010, DART initiated partial Orange Line service

only in the peak hour of the peak periods between Bachman station on the Green Line and Parker Road station on the Red Line. This interim service improved train headways and expanded capacity on the highest ridership segments of the DART system that were formerly served only by the Red Line.

Since the full Orange Line opened in fall 2012, the combined Green/Orange headway between downtown and the Bachman station on the northwest segment has been 7.5 minutes in the peak periods and 10 minutes at most other times of day. Headway on the downtown transit mall where all four light rail lines operate is now 3.75 minutes in the peak periods.

DART made significant adjustments to the rail and bus systems in 2010 with the opening of the entire Green Line and the partial Orange Line service. These changes both integrated the Green/Orange Line into the regional transit system and helped to address budget pressures caused by the national economic downturn. DART eliminated downtown-oriented bus routes that would become duplicative of the new Green Line service, adjusted local and crosstown bus routes in the Green Line corridor to connect with the new rail stations, and changed peak headways on all light rail lines from 10 minutes to 15 minutes.

For the rail system, the net effect from 2007 to 2012 was a 65 percent increase in train hours of service. For the bus system, the net effect over the same interval was a one percent increase in bus hours and a 12 percent decrease in bus miles. The bus changes indicate that the elimination of duplicative bus service was largely offset by additional services to feed rail stations. The concurrent drop in bus service miles and the slight increase in bus service hours indicates that system-wide average bus speed slowed down – the result of the elimination of relatively faster express and limited-stop routes and the expansion of service on relatively slower local routes connecting to stations.

The kinds of adjustments to the bus system made at the full opening of the Green Line were consistent with types of changes anticipated in the transit service plans at each milestone during the development of the project. However, service levels on the Green Line itself are lower than anticipated. During planning and development of the Green Line, service plans anticipated 10-minute peak and 20-minute off-peak headways rather than the 15- and 20-minute headways in current service. Because bus connections to light rail stations are designed, in part, to reflect train headways, transit service plans during project development anticipated feeder-bus headways consistent with the planned 10-minute – rather than the actual 15-minute – rail headways during the peak periods. These differences are the consequences of unforeseen DART budget constraints resulting from lower operating revenues caused by the national economic downturn.

### **Operating and maintenance (O&M) costs**

System-wide, light rail O&M costs increased by 52 percent between 2007 and 2012. This increase was driven by the openings of the Green and Orange Lines, partially offset by the longer peak-period headways on the Red and Blue Lines. Because train-hours increased by a net 65 percent, average O&M cost per train dropped by 7.7 percent over the interval. Bus O&M costs increased by 2.4 percent while bus vehicle-hours increased by 1.0 percent – an increase in O&M costs per bus-hour of 1.4 percent.

## **Ridership**

Average weekday ridership on the Green Line in 2012 was 31,000 boardings, with the federally funded segment accounting for 29,000 of these boardings. Details of ridership patterns on the Green Line will come from analysis of the 2014-2015 system-wide survey of DART ridership.

Weekday ridership on the DART light rail system grew from 58,000 boardings in 2007 to 69,000 in 2011 after the full Green Line opened to 93,000 in late 2012 after the full Orange Line opened. Weekday ridership on the DART bus routes was 143,000 boardings in 2007, 116,000 boardings in 2011, and 124,000 boardings in 2013. Total DART rail and bus ridership was 201,000 boardings in 2007 and 216,000 boardings in 2012. (Boardings count transferring riders each time they board a train or bus.)

Therefore, DART ridership growth over the interval between 2007 and late 2012 were driven entirely by the openings of the Green and Orange Lines. This growth was partially offset by a modest decrease in bus boardings likely caused by the reorientation of bus routes in the affected corridors to connect with new light rail stations. Growth was also moderated by the nationwide economic downturn that began in late 2008 and led to lower-than-anticipated service levels on light rail and rail-oriented bus routes and to higher unemployment levels.

Predictions of Green Line ridership at both the FD-entry and FFGA milestones anticipated 40,300 weekday trips on the project. The transit system represented in this forecast did not include two projects that were still in project planning at the time: the three northern-most stations on the northwest segment of the Green Line and the Denton County A-Train commuter rail line that now terminates at the Trinity Mills station on the northwest segment of the Green Line. A revised prediction prepared in 2008 with updates of the system-wide transit plan, demographic forecasts, and travel-forecasting model produced a forecast of 41,200 Green Line trips.

One cause of the difference between predicted and actual ridership is the 10-minute peak-period headway anticipated in the predictions for all light rail services compared to the actual 15-minute peak-period headway in current service. A complete analysis of the specific sources of differences between actual and predicted ridership will come from detailed comparison of the forecasts to the 2014-2015 system-wide survey of DART ridership.

## **Land-use impacts**

Because the economic-development consequences of light rail investments are important to local agencies and decision-makers, DART has elected to add land-use impacts to the Before-and-After Study.

The Green Line project is located almost entirely within a former freight-railroad right-of-way. Consequently, significant opportunities exist in adjacent land uses for in-fill development, redevelopment of industrial areas, added land-use density, and increases in population and employment. Three years after project opening, corridor-level changes in land use across all stations combined have been minimal. Multi-family land use has experienced the largest increase in acreage and has produced a somewhat more significant increase in housing units and population in the station areas.

Development of the Green Line project was accompanied by supporting changes in plans and policies by the cities of Dallas and Farmers Branch. Both cities have replaced traditional zoning

with form-based planning and regulatory requirements, and have established Tax Increment Financing districts and Planned Developments to support transit-oriented development. The City of Dallas developed its first comprehensive plan in 2005 that identified a mixed use/transit oriented focus around several DART stations. The City has also created action plans for high priority areas at many stations and is making progress at several of these stations. Farmers Branch purchased land surrounding its station area during project planning and developed a strategic vision for its development. Two mixed-use and multi-family developments are now underway.

Expectations during the development of the project were that growth in the corridor would be substantial given the ample opportunities for development and redevelopment. Adverse economic conditions since the 2008 economic downturn have slowed growth at many stations and additional time will be needed to adequately assess the impact of the investment on growth.

DART will continue to monitor land use development and growth in the corridor in order to track the economic-development impacts of the rail line.