Before-and-After Studies of New Starts Projects

Report to Congress

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FOREWORD

This fourth annual report to Congress on Before-and-After Studies summarizes the studies of three projects: the South Corridor light rail line in Charlotte, North Carolina; the SPRINTER light rail line in Oceanside-Escondido, California; and the Tri-Rail Double-Track Corridor Improvement Program Segment 5 in southeast Florida.

Before-and-After Studies are intended to assess the impact of New and Small Start projects, compare the actual and forecasted costs of the projects and ridership two years after opening, and identify the sources of differences between predicted and actual outcomes. Before-and-After Studies also assist FTA and project sponsors in determining how to improve the reliability of the cost and ridership forecasts of major public transportation projects.

As with the projects considered in the three previous Before-and-After Study reports, planning and development of these projects was well underway before the Federal Transit Administration (FTA) introduced requirements for: (1) a Before-and-After Study (2001), (2) documentation of capital costs in FTA-defined standard cost categories (2005), and (3) preservation of the forecasts needed to support the study (May 2006). Consequently, some details are limited on the transit service plans, cost estimates, and ridership forecasts prepared for the early milestones. This report reflects the full extent of information that FTA has obtained from the three individual project sponsors.

South Corridor Light Rail – Charlotte, North Carolina

The South Corridor project is a 9.6-mile light rail line extending south from Charlotte's central business district (CBD) roughly parallel to, and one to two miles east of, Interstate-77 to a terminus at Interstate-485, the beltway for the metropolitan area. The project also includes 20 light-rail vehicles, 15 passenger stations, park-ride facilities at seven stations providing a total of 3,200 spaces, a maintenance-and-storage facility for the rail vehicles, and an operations control center. The "Blue Line" is the first light rail project in metropolitan Charlotte. Figure 1 is a map of the South Corridor and the Blue Line project.

The project was developed and built, and is now operated, by the Charlotte Area Transit System (CATS), a department of the City of Charlotte. The "before" conditions for the Before-and-After Study are from fall 2007 while the "after" conditions are from spring 2009, 18 months after the project opened for revenue service.

Physical Scope of the Project: In general, the scope of the project remained substantially the same – in its length, alignment, number and location of stations, and degree of grade separation – from its early conceptualization in alternatives analysis through project development to its as-built condition.

Capital Cost: The actual capital cost of the South Corridor light rail line was $462.75 million in year-of-expenditure (YOE) dollars. Table 1 shows that, in YOE dollars, the cost predictions at each project development milestone consistently underestimated the as-built costs, but by a smaller amount as project-development proceeded. The project was built substantially as planned and at a cost that exceeded the planning cost forecast by 28 percent in YOE dollars as the project was constructed during a period of unanticipated rapid inflation in global and regional construction costs. The YOE forecasts were low because they did not anticipate: (1) the rapid general inflation in construction prices that occurred nationally and regionally during the engineering and construction of the project; and (2) the added exposure to general cost inflation that resulted from the later-than-anticipated opening of the project in November 2007, nearly two years later than anticipated in the MIS/AA.

Table 1
South Corridor Light Rail – Charlotte, NC
Capital Costs at Project Milestones

Milestone	As-Built	MIS/AA (1)	FEIS/ROD	FFGA	Amended FFGA
Year of actual/forecast costs	2007	1999	2002	2005	2007
Costs in Year-of-Expenditure Dollars (millions)					
Planned/actual opening date	Nov. 2007	Winter 2005	Spring 2006	Apr. 2007	Nov. 2007
Total ($ year of expenditure)	$ 462.75	$ 331.10	$ 370.85	$ 426.84	$ 462.75
Difference from actual	$ -	$ (131.65)	$ (91.90)	$ (35.91)	$ 0.0
Difference from actual (%)	-	-28%	-20%	-8%	0%

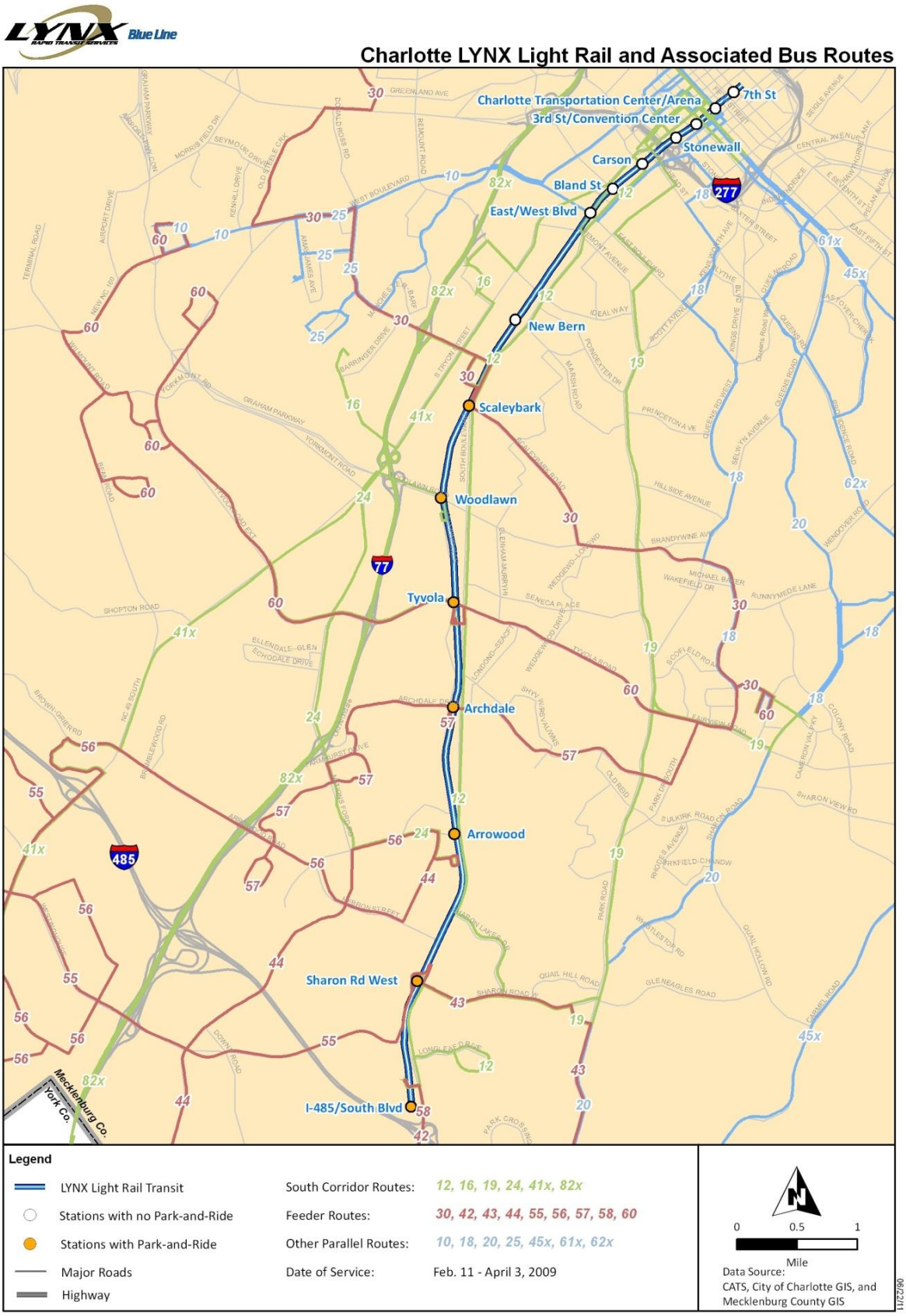

Figure 1
Charlotte South Corridor and 2011 Bus Routes

Transit Service Levels: Transit service in Metropolitan Charlotte increased markedly over the past 15 years. In 1997, CATS operated 134 buses in peak fixed-route service. In 1998, Mecklenburg County voters approved a ½-cent sales tax to implement a 2025 transit plan that called for construction of a light rail system and significant expansion of bus services. By 2007, just before light rail service opened in the South Corridor, CATS was operating 263 buses in peak fixed-route service, effectively doubling service over the 10-year period. Changes to the transit system reflected: (1) the opening of the Blue Line; (2) the adjustments to South Corridor buses to integrate rail and bus services; and (3) system-wide downsizing of service in response to a downturn in tax revenues caused by the national economic downturn. In aggregate terms, transit service in the South Corridor increased by 33 percent between 2007 and 2009. The effect of system-wide downsizing is evident in the seven percent reduction in vehicle-miles and vehicle-hours in other corridors.

Overall, after the reductions in 2009, aggregate system-wide vehicle-hours of service remained at levels that were more than double the service provided by CATS in 2000.

Operating and Maintenance Cost: Between CATS' fiscal year 2007 and fiscal year 2009, system-wide O&M costs increased by 22.6 percent, reflecting a marginal (1.7 percent) increase in fixed-route bus costs and the start of light rail service. Predictions of system-wide O&M costs during project planning and development consistently overestimated the actual outcome. This over-estimate of costs directly reflects the anticipated higher levels of bus service by 2009 that were not achieved because of service reductions in response to the economic downturn.

Ridership: Transit ridership has grown substantially over the past 10 to 15 years in response to the rapid expansion of transit service and demographic growth in the metropolitan area. In the mid-to-late 1990s, the CATS bus system served 11.7 million annual boardings by transit riders – with 41,000 boardings on the average weekday. By 2007, just before the light rail opened in the South Corridor, system-wide ridership had grown to 20.4 million annual boardings – with 70,000 boardings on the average weekday.

The South Corridor LRT (Blue Line) opened in November 2007. Weekday boardings on the line averaged 12,000 in the initial months of operation, increased to 17,000 by summer 2008, and then settled to the 14-15,000 range where it remains in mid-2011. Table 2 summarizes the transit service and ridership changes that have occurred in the South Corridor and system-wide.

Table 2
South Corridor Light Rail – Charlotte, NC
Changes in Service Levels and Ridership

Characteristic	Weekday Vehicle-hours (annual thousands)				Average Weekday Boardings (daily)			
Milestone	Before	After	Change	% Chg.	Before	After	Change	%
Transit Routes								
South Corridor LRT	----	34	34	----	----	14,370	14,370	----
South Corridor Totals	161	213	52	32%	14,716	26,875	12,159	83%
Other Corridors	509	475	-33	-7%	46,042	51,386	5,343	12%
System Totals	670	689	19	3%	60,758	78,470	17,711	29%

Forecasts of project ridership varied significantly over the course of planning and development of the South Corridor light rail project. Work performed in 1998 anticipated 14,000 trips per average weekday on the South Corridor by 2025. Subsequent forecasts reported in the FTA annual report to Congress anticipated as many as 25,800 weekday rail trips by 2025. Later revisions to the forecasting tools produced revised forecasts of 18,000 per average weekday in 2025.

The opening-year forecast underestimated actual ridership thus far by 19 percent. Since the project opened to service, gasoline prices spiked in mid-2008, gasoline supplies to metropolitan Charlotte were disrupted by Hurricane Ike's Texas landfall in September 2008, the economy weakened, and CATS reduced bus service (largely in other corridors) in response to the consequent decline in sales-tax revenues. All of these events had some degree of influence on transit ridership in Metropolitan Charlotte in addition to the impacts of the Blue Line opening.

***Conclusion**:* The predictions of both capital cost and ridership for the project were reasonably accurate for an initial rail project – particularly for a modest-sized transit agency in a medium-sized metro area. The project outcomes are generally consistent with the information that FTA used to evaluate and rate the project for FTA decisionmaking and funding recommendations.

SPRINTER Light Rail – Oceanside, California

The North Coast Transit District's (NCTD) 22-mile, 15-station SPRINTER light-rail line connects the cities of Oceanside, Vista, San Marcos and Escondido via an alignment that parallels California State Route (SR) 78, the primary east-west corridor in northern San Diego County. Figure 2 is a map of the corridor and the project. Much of the alignment is a rehabilitated freight rail line that continues to serve freight traffic during overnight hours. Twelve of the stations have park-ride lots that provide a total of 1,755 spaces. The scope of the project also includes 12 diesel multiple unit (DMU) light-rail vehicles, a maintenance and storage facility for the rail vehicles, and centralized train control.

Figure 2
SPRINTER Light Rail and Surrounding Areas

Studies of passenger rail service in the SR 78 corridor began in 1978. During the 1980s, SPRINTER (known at the time as the Oceanside-Escondido Rail Project) was identified as part of a multimodal strategy to address traffic congestion and projected growth in population and employment in the SR 78 corridor. In 1987, San Diego County voters approved Proposition A, a half-cent sales tax dedicated to local transportation projects, including SPRINTER.

The "before" conditions for the Before-and-After Study are from 2003, while the "after" conditions are from 2010. The San Diego Association of Governments prepared the Before-and-After Study for the project.

Project Scope*:* Broadly, SPRINTER was built largely as conceptualized in the advanced planning: a DMU-based light rail service along the rehabilitated freight corridor**.**

Capital Cost: The actual capital cost of the Sprinter light rail project was $477.63 in year-of-expenditure (YOE) dollars over the period of construction. In YOE dollars, the cost predictions at each project development milestone (Completion of Advanced Planning, Entry into Final Design, Full Funding Grant Agreement (FFGA)) consistently underestimated the as-built costs, but by a smaller amount as project development proceeded. Table 3 summarizes the as-built capital cost and the predicted costs prepared for each project-development milestone.

Table 3
SPRINTER Light Rail – Oceanside, CA
Capital Costs at Project Milestones

Milestone	As-Built	Completion of Advanced Planning	Entry into Final Design	FFGA	Amended FFGA
Year of the actual/forecast	2008	1995	2000	2002	2006
Costs in Year-of-Expenditure Dollars (millions)					
Actual/planned opening date	Mar. 2008	2001	Aug. 2005	Dec. 2005	Jul. 2008
Total ($ year of expenditure)	$ 477.63	$ 213.70	$ 332.30	$ 351.52	$ 484.14
Difference from actual		$ (263.93)	$ (145.33)	$ (126.11)	$ 6.51
Difference from actual (%)		-55 %	-30 %	- 26 %	1 %

The differences between predicted and actual capital costs reflect several factors including: high construction bids due to an active market; construction delays resulting from right-of-way access restrictions unanticipated at FFGA execution; and design changes, related in part to the substitution of a longer DMU vehicle. The specific model of DMU vehicle around which the project was designed was no longer in production by the time of vehicle procurement. NCTD opted for a longer model that required design changes to stations and the maintenance facility.

Transit Service Levels: Two years after SPRINTER opened service hours were 4:00am to 9:30pm daily (17.5 hours), and headways were 30 minutes on weekdays and during daytime hours on weekends and 60 minutes during weekend morning and evening periods. The FFGA service plan anticipated 30-minute headways and 18 hours of service every day. The longer actual weekend headways resulted from lower-than-expected operating revenue. The slight reduction in the hours of daily service resulted from the need for time for transition activities such as raising and lowering boarding ramps and shuttling SPRINTER trains to and from the storage yard. The result was a full six-hour nightly window for freight operations.

NCTD implemented several bus service changes concurrent to SPRINTER's opening, including schedule changes to provide timed connections with trains and the reduction/elimination of service on six routes that duplicated rail service. Over the two years after opening, however, NCTD discontinued 11 of the 37 routes that served stations along the line due to reduced operating funding as a result of the economic downturn.

Operating and Maintenance Cost: During its first two full years of service, SPRINTER's operating and maintenance (O&M) costs were $15.7 million in fiscal year 2009 and $13.4 million in fiscal year 2010. The FFGA anticipated that the project would open in 2006, with O&M costs of $11.1 million ($11.8 million in 2009 dollars) during the first full year of service.

Actual O&M costs exceeded the FFGA projection by 33 percent in FY 2009 and by 14 percent in FY 2010. Areas of discrepancy between actual O & M costs and the FFGA projection were expenses for management salaries, fuel, supplies, communication and insurance and security service expenses which exceeded the FFGA projections and maintenance-of-way expenses which were lower than expected.

Ridership: In May 2008, two months after opening, SPRINTER averaged 6,600 weekday boardings. By FY 2010, the second full year of revenue service, ridership had grown by 15 percent to 7,600 weekday boardings. Table 4 summarizes the changes in NCTD service and ridership from before to after the opening of SPRINTER service. NCTD's combined bus and light rail ridership increased by 5 percent between FY 2007 and FY 2010 despite a 16 percent reduction in overall NCTD service.

Table 4
SPRINTER Light Rail – Oceanside, CA
Changes in Service Levels and Ridership

Characteristic	Weekday Vehicle-hours (annual thousands)				Average Weekday Boardings			
Milestone	Before (FY 2007)	After (FY 2010)	Change	% Chg.	Before (FY 2007)	After (FY 2010)	Change	% Chg.
NCTD Bus Routes	**498**	**396**	**-102**	**-20%**	**35,324**	**29,460**	**-5,864**	**-17%**
Parallel	132	42	-90	-68%	10,566	2,628	-7,938	-75%
Connecting	366	354	-12	-3%	24,758	26,832	2,074	8%
SPRINTER Light Rail	**---**	**22**	**22**	**---**	**---**	**7,569**	**7,569**	**---**
Bus and Light Rail Total	**497**	**418**	**-79**	**-16%**	**35,324**	**37,029**	**1,705**	**5%**

NCTD prepared several forecasts of project ridership during project planning and development. The forecast prepared at entry to preliminary engineering anticipated 15,100 average weekday trips in 2015. A second forecast prepared for the FFGA anticipated 11,955 average weekday trips in 2005, increasing to 19,000 by 2020. In 2006, SANDAG used an updated version of the travel model and updated employment estimates to produce an opening-year ridership forecast of 7,700 weekday trips -- much closer to the 6,600 actual trips that SPRINTER carried in 2008.

NCTD and SANDAG attribute the over-estimate of ridership during the first two years of SPRINTER service to weaknesses in the travel model and unanticipated consequences of the weak regional economy including: (a) delayed commercial and residential development in the corridor; (b) a drop in commuter travel and traffic congestion because of high unemployment; and (c) reductions in NCTD transit services because of lower operating revenues.

Conclusion: The SPRINTER project is unusual in that it serves no large employment concentration -- it is effectively a cross-town service far from the core of metro San Diego. As a consequence, ridership is low relative to other light rail projects receiving New Starts funding. The long period of project development contributed to substantial changes in constant-dollar costs that, combined with rapid inflation in construction costs during project construction, yielded actual YOE costs that doubled the cost forecasts developed during project planning. Inaccurate forecasts of costs and ridership have been a continuing problem for initial projects for individual project sponsors and for projects in atypical settings. The SPRINTER project is part of that tendency.

Double-Track Corridor Improvement Program, Segment 5 – Southeast Florida

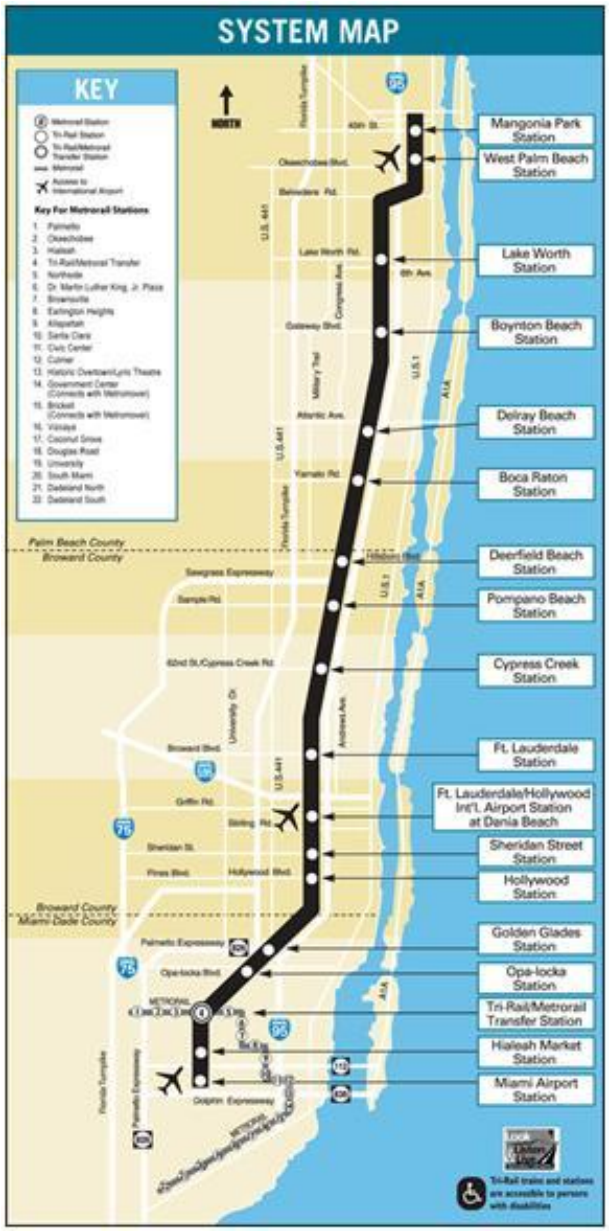

Figure 3. Tri-Rail

Tri-Rail is a 72-mile commuter rail line with 18 stations extending south from Palm Beach County parallel to Interstate-95, through Fort Lauderdale, to its southern terminus at Miami International Airport Station in Miami-Dade County. Figure 3 is a map of the Tri-Rail corridor.

Planning for the system began in 1983 and building the organization began in 1986. The current system was formed by the Florida Department of Transportation and began operation in 1989, originally to provide temporary commuter rail service while construction crews widened Interstate 95 and the parallel Florida's Turnpike.

The principal element of the Segment 5 project was the installation of 43.6 miles of second mainline track to address three specific transportation needs: improve regional intermodal connections, increase the effectiveness of public transportation and improve the safe and efficient movement of commuter, freight and passenger trains in the South Florida corridor.

The Segment 5 project also included improvements to the signal system and upgrades of 70 grade crossings, 24 new or upgraded bridges, one new station plus improvements to 10 existing stations, 336 new parking spaces at four stations (bringing total parking to 5,500 paces), the acquisition of two cab coaches and five refurbished diesel locomotives, and renovation of the maintenance/layover facility in West Palm Beach. Tri-Rail's fleet of 26 passenger rail cars and six diesel multiple units remained unchanged.

Tri-Rail was developed and built, and is now operated, by the South Florida Regional Transportation Authority (SFRTA), formerly known as Tri-County Commuter Rail Authority.

The "before" conditions for the Segment 5 Before-and-After Study are from spring 2005 (one year before opening) while the "after" conditions are from spring 2008 (two years after opening). It should be noted that the Tri-Rail project signed its original Full Funding Grant Agreement (FFGA) in May 2000, before FTA required Before-and-After Studies. As FTA introduced the Before-and-After Study requirements in 2001, the requirement was added as a term of SFRTA's amended FFGA in April 2004. Consequently, the Tri-Rail project plans did not include many of the requisite forecasts. The information presented below demonstrates the most complete information available.

Project Scope: The anticipated scope of the Segment 5 project at the time of the amended FFGA was consistent with the as-built project. However, a number of scope changes were implemented to reduce project costs to be consistent with the original estimates. These scope changes helped Tri-Rail control the total capital cost of the Segment 5 project in the amended FFGA.

Capital Cost: The actual capital cost of Double-Track Corridor Improvement Program, Segment 5 was $345.6 million in year-of-expenditure (YOE) dollars. The predicted cost was $327.0 million in YOE dollars, 5.4 percent lower than actual cost. The predicted cost in the original FFGA amended FFGA was $333.9 million in YOE dollars, 3.4 percent lower than the actual cost.

Table 5
Double-Track Corridor Improvement Program, Segment 5 – Southeast Florida
Capital Costs at Project Milestones

Milestone	As-Built	Entry to PE	Entry to FD	FFGA	Amended FFGA
Year of actual/forecast costs	2007	1999	1999	1999	2004
Costs in Year-of-Expenditure Dollars (millions)					
Planned/actual opening date	Spring 2006	Spring 2005	Spring 2005	Spring 2005	Spring 2006
Total ($ year of expenditure)	$345.6	$327.0	$327.0	$327.0	$333.9
Difference from actual	$ -	$ (18.6)	$ (18.6)	$ (18.6)	$ (11.7)
Difference from actual (%)	0%	-5.4%	-5.4%	-5.4%	-3.4%

The small difference in total project cost between the FFGA and the amended FFGA is attributable to scope changes that were made to maintain a relatively constant bottom line. The accuracy of the predictions were influenced by SFRTA's previous commuter rail construction experience, the ongoing construction of segments one through four of the Double-Track Corridor Improvement Program, and (for the amended FFGA) the post-FFGA work associated with Segment 5 construction.

Transit Service Levels: As the full double-tracking project reached completion, Tri-Rail increased its scheduled weekly service by 60 percent – from 176 trains per week to 282 trains per week – with 100 of the additional trains provided on weekdays. Weekday service improved from 90-minute headways all day to 60 minute-headways all day except for one hour in the morning and evening peaks during which headways are 20 minutes each way. End-to-end running time is approximately the same as before the double-tracking project. Bus connections are available at most Tri-Rail stations, provided by both Tri-Rail and local transit agencies. Service on Tri-Rail shuttle routes increased substantially from an average of 10 buses per hour stopping at the 18 Tri-Rail stations in 2005 to 53 buses per hour in 2008. Service on

feeder routes provided by local transit agencies declined modestly from 140 buses per hour in 2005 to 125 buses per hour in 2008.

Because Tri-Rail did not prepare a forecast of opening-year conditions, comparisons of predicted and actual service levels rely on predictions of horizon-year conditions for 2015 and for 2020 in the amended FFGA. Both sets of predictions closely match the actual 2008 service levels. SFRTA did not provide documentation on bus services levels at Tri-Rail stations predicted at the various milestones. Therefore, no comparisons were possible between predicted and actual feeder-bus services.

Operating and Maintenance Cost: SFRTA's commuter rail annual operating and maintenance (O&M) costs increased from $31.0 million in 2005 ($29.6 million in 2004 dollars) before completion of the double-tracking project to $52.8 million in 2008 ($44.2 million in 2004 dollars) after the full expanded service was in place. The increase in O&M costs was due primarily to the increase in commuter rail service, but also attributable to increases in fuel prices, additional security, and dispatching and maintenance for the New River Bridge**.**

At the project-development milestones up to and including the FFGA, Tri-Rail predicted O&M costs for commuter rail service of $41.1 million in 2006 dollars ($37.4 million in 2004 dollars). Predicted costs increased moderately in the amended FFGA to $45.1 million in 2007 dollars ($39.4 million in 2004 dollars). In constant 2004 dollars, the FFGA prediction was 15 percent less than actual O&M costs in 2008, while the amended FFGA prediction was 11 percent less. The under-predictions were attributable to the unforeseen increases in fuel prices, security, dispatching, and maintenance, plus SFRTA's decision to provide two additional weekday trains beyond the 48 anticipated at the project-development milestones.

Ridership: Average weekday Tri-Rail boardings grew from 9,400 in 2005 to 14,700 in 2008, an increase of 5,300 per day (56 percent). This increase is attributable to the double-tracking project as well as the apparent sensitivity of Tri-Rail ridership to gasoline prices – perhaps a reflection of the relatively longer trips made on the 70-mile-long line. Tri-Rail averaged 12,900 and 12,200 boardings per weekday in 2009 and 2010 when gasoline prices were significantly lower than in 2008, and averaged 13,600 boardings in early 2011 as prices increased.

SFRTA prepared ridership forecasts of the Tri-Rail double-tracking project only for horizon years; no opening-year forecasts are available**.** As the Tri-Rail project signed its original Full Funding Grant Agreement (FFGA) in May 2000, before FTA introduced the Before-and-After Study requirements in 2001, the requirement was added as a term of SFRTA's amended FFGA in April 2004. Consequently, the Tri-Rail project plans did not include many of the requisite forecasts. The forecast provided to FTA at entry into Preliminary Engineering (PE) in 1999, and used by FTA for approval of the project into PE, into Final Design (FD), and for the FFGA, was 42,100 average weekday boardings in 2015. A subsequent forecast used to estimate fare revenues for the revised financial plan for the amended FFGA in 2004 was 22,200 average weekday boardings in 2020. Initial ridership outcomes indicate that the ridership forecast of 42,100 weekday boardings in 2015 was an overestimate and will not be realized. The ability to determine why is limited because background documentation is not available. However, the less-than-anticipated growth in southeastern Florida population and employment offers a partial explanation.

Conclusion: The Tri-Rail project is an incremental improvement to an existing service. The project was built as effeciently as planned with marginal changes to help control costs. Cost increases over initial forecasts were largely the product of rapid general inflation in construction costs during the period of construction. While ridership increased by 56%, the forecasted ridership will not be realized partly due to less-than-anticipated growth in southeastern Florida population and employment.