



April 2023

CAPITAL INVESTMENT GRANTS PROGRAM

Cost Predictions Have
Improved, but the
Pandemic
Complicates
Assessing Ridership
Predictions

Accessible Version

GAO Highlights

Highlights of [GAO-23-105479](#), a report to congressional committees

Why GAO Did This Study

FTA's Capital Investment Grants program is the primary source of federal support for transit projects that are locally planned, implemented, and operated. Project sponsors that apply for grant funding develop capital cost and ridership predictions. Later, FTA uses these predictions to help determine whether the projects have delivered expected outcomes. Accordingly, it is important that project sponsors predict these outcomes as accurately as possible.

The Infrastructure Investment and Jobs Act includes a provision for GAO to biennially review FTA's implementation of the Capital Investment Grants program. This report discusses: (1) FTA's efforts to assess project outcomes and help project sponsors more accurately predict outcomes and (2) the extent to which recent projects achieved predicted outcomes, and the factors associated with differences between predicted and actual outcomes.

To address these objectives, GAO reviewed relevant laws, FTA's guidance, and FTA's analyses of predicted and actual outcomes for projects that began operations from 1983 through 2015. In addition, GAO identified eight CIG projects that began operations from 2016 through 2021, reviewed available information about the projects, and interviewed FTA and project sponsors. The eight projects were from central Florida, Charlotte, Denver, Fort Worth, New York, San Diego, Seattle, and Silicon Valley.

View [GAO-23-105479](#). For more information, contact Andrew Von Ah at (202) 512-2834 or VonAH@gao.gov.

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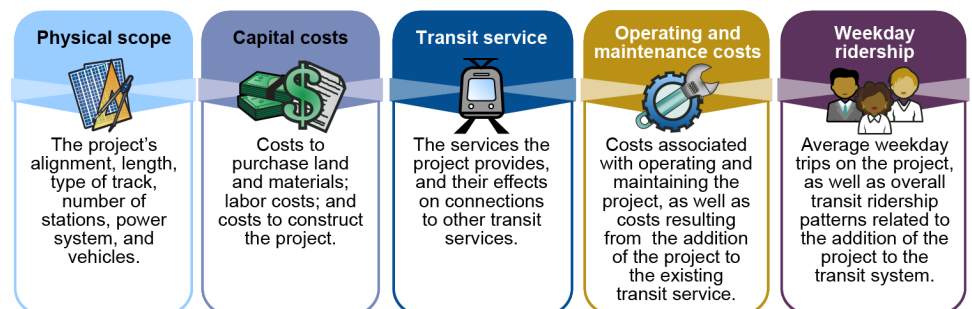
CAPITAL INVESTMENT GRANTS PROGRAM

Cost Predictions Have Improved, but the Pandemic Complicates Assessing Ridership Predictions

What GAO Found

The Federal Transit Administration's (FTA) Capital Investment Grants program helps cities, states, and other localities across the country plan and build transit systems. FTA assesses the outcomes of these projects—which include heavy and light rail, commuter rail, streetcars, ferries, and bus rapid transit—in periodic *Predicted versus Actual* reports. FTA has issued four such reports, which examined projects that began operations from 1983 through 2015. To develop these reports, FTA used information on five types of project outcomes discussed in "Before and After" studies that project sponsors conduct (see figure). In the reports, FTA compared completed projects' actual capital costs and ridership with the outcomes project sponsors predicted. FTA's reports indicate that project sponsors' predictions of capital costs and ridership have improved. In the 2020 report, FTA found that about 86 percent of the projects discussed had actual capital costs within 10 percent of predicted costs and 48 percent of the projects had actual ridership within 20 percent of predicted ridership.

Transit Project Information That Sponsors Include in Their Before and After Studies



Source: GAO analysis of Federal Transit Administration (FTA) information. | GAO-23-105479

Text of Transit Project Information That Sponsors Include in Their Before and After Studies

- **Project Scope:** The project's alignment, length, type of track, number of stations, power system, and vehicles.
- **Capital Costs:** Costs to purchase land and materials; labor costs; and costs to construct the project.
- **Transit Service:** The services the project provides, and their effects on connections to other transit services.
- **Operating and Maintenance Costs:** Costs associated with operating and maintaining the project, as well as costs resulting from the addition of the project to the existing transit service.
- **Weekday Ridership:** Average weekday trips on the project, as well as overall transit ridership patterns related to the addition of the project to the transit system.

Source: GAO analysis of Federal Transit Administration (FTA) information. | GAO-23-105479

FTA has developed some methods to help project sponsors more accurately predict capital costs and ridership. For example, FTA conducts risk assessments to determine the probability that various factors will affect the project's costs, and project sponsors use this information to modify cost estimates. FTA also has developed an alternative approach to predicting ridership that enables project sponsors to use existing sources of data to quickly develop ridership forecasts.

Sponsors of two of the eight projects GAO reviewed have completed a Before and After study. These two sponsors reported their capital costs were 14 percent and 9 percent lower than predicted due to an unexpectedly favorable bid environment and untapped contingent funds. Both sponsors reported actual ridership was about 30 percent lower than predicted due to overly optimistic travel model assumptions. Sponsors for the other six projects were at various stages of compiling information and drafting their studies. According to all eight project sponsors, transit ridership declined precipitously at the start of the pandemic. In most cases, recovery has been slow. Sponsors said they expect ridership to continue to be lower than pre-pandemic levels, given the current trend of remote work. The significant impact of the pandemic complicates assessments of the accuracy of sponsors' pre-pandemic ridership predictions.

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Abbreviations

BART	Bay Area Rapid Transit
CATS	Charlotte Area Transit System
CIG	Capital Investment Grants
FTA	Federal Transit Administration
IIJA	Infrastructure Investment and Jobs Act
STOPS	Simplified Trips-on-Project Software package
PMOC	project management oversight contractor

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April 10, 2023

Congressional Committees

Millions of Americans rely on public transportation systems for mobility and access to jobs, education, and essential services, such as medical care and grocery shopping. The Federal Transit Administration’s (FTA) Capital Investment Grants (CIG) program provides funds to help cities, states, and other localities across the country plan and build new transit systems or extensions to existing systems. Congress authorized appropriations of \$3 billion annually for fiscal years 2022 through 2026 for the CIG program.¹ Projects that compete for funding through the program include heavy and light rail, commuter rail, streetcars, ferries, and bus rapid transit. Transit projects that have advanced through the CIG program and received a grant agreement have been able to use this federal funding for their construction. However, the COVID-19 pandemic has made the future of transit operations and ridership less certain.

FTA is responsible for evaluating and rating proposed CIG projects according to statutory criteria; recommending to Congress which projects to provide funding for; and suggesting funding amounts.² Sponsors of transit projects that are being considered for funding develop capital cost and ridership predictions. These predictions play a significant role in how FTA rates, selects, and funds projects, and in assessing whether expected outcomes were delivered. As such, it is important that project sponsors develop accurate cost and ridership predictions.

¹The Infrastructure Investment and Jobs Act (IIJA) authorized appropriations of \$3 billion annually for the CIG program from fiscal years 2022 through 2026 (Pub. L. No. 117-58, div. C, §30017, 135 Stat. 429, 914 (2021)), and provided \$1.6 billion annually in supplemental appropriations for fiscal years 2022 through 2026 for the program (IIJA div. J, tit. VIII, 135 Stat. 429, 1438 (2021)).

²There are three types of eligible projects within the CIG program: New Starts; Core Capacity Improvement (hereafter Core Capacity); and Small Starts. New Starts projects are capital investments for which the federal assistance is \$150 million or more in CIG funding or have an anticipated capital cost of \$400 million or more. Core Capacity projects are “corridor-based capital investments” in existing fixed-guideway systems that increase the capacity of a corridor by not less than 10 percent. This corridor must be at or above capacity currently or expected to be within 10 years. Small Starts projects are capital investment projects for which the federal assistance is less than \$150 million in CIG funding and have an anticipated capital cost of less than \$400 million.

The 2021 Infrastructure Investment and Jobs Act continued a requirement for us to biennially review FTA's CIG program.³ The Act calls for us to include an examination of the impacts of recently operational CIG projects on public transportation services and ridership, and a review of the consistency of the projects' predicted and actual costs and benefits. This report examines two objectives:

- FTA's efforts to assess outcomes of CIG projects and help project sponsors more accurately predict outcomes, and
- the extent to which recent CIG projects achieved predicted outcomes, and the factors associated with differences between predicted and actual outcomes.

To address these two objectives, we reviewed the statutory provisions governing the CIG program; FTA's policy guidance for the program;⁴ and other pertinent agency guidance. We focused on the CIG program's provisions and guidance for New Starts and Core Capacity transit projects.⁵ We identified eight New Starts projects that began operations from 2016 through 2021 and included them in our review.⁶ We chose projects in this timeframe to avoid duplicating FTA's recently reported outcomes of projects that became operational through 2015.⁷

To examine FTA's efforts to assess CIG project outcomes and improve the accuracy of predictions, we interviewed FTA officials and the eight CIG project sponsors about factors that affect the accuracy of predictions and about how FTA has helped sponsors predict outcomes. We also

³IIJA, div. C, § 30005, 135 Stat. 429, 899 (2021) (codified at 49 U.S.C. § 5309(o)(2)).

⁴FTA, *Final Interim Policy Guidance Federal Transit Administration Capital Investment Grants Program* (June 2016). FTA published *Capital Investment Grants Policy Guidance* in January 2023 to incorporate changes made to the CIG program by the IIJA. FTA plans to propose a more comprehensive update to the CIG policy guidance in late 2023.

⁵We did not focus on Small Starts transit projects because the law did not require sponsors of those projects to produce "Before and After" studies—discussed later in this report—which formed the basis for our review.

⁶The project sponsors for these eight projects are Seattle Sound Transit, New York City Metropolitan Transportation Authority, Charlotte Area Transit System, Florida Department of Transportation, Fort Worth Trinity Metro, Denver Regional Transportation District, Santa Clara Valley Transportation Authority, and San Diego Association of Governments. There were no Core Capacity projects that began operations during this time period.

⁷FTA, *Predicted Versus Actual Impacts of Capital Investment Grants Projects – 2020: Capital Cost and Ridership* (2020). This study examined CIG program transit projects that opened for service from 2007 through 2015.

reviewed FTA's four *Predicted versus Actual* reports, which analyzed differences between predicted and actual outcomes, and identified the factors associated with those differences for CIG projects that entered revenue service from 1983 through 2015. FTA published these reports in 1990, 2003, 2007, and 2020. We standardized the results according to the approach FTA used in its *Predicted versus Actual 2020* report, in which FTA reported the extent to which actual capital costs were within 10 percent of predicted capital costs and actual ridership was within 20 percent of predicted ridership.

To examine the extent to which the eight projects achieved predicted outcomes and the factors associated with differences between their predicted and actual outcomes, we obtained information from FTA and from the eight project sponsors to the extent such information was available. This information included grant agreements, planning documents for collecting predicted and actual outcome information, and "Before and After" studies. The eight sponsors in our review were required to produce a Before and After study in order to assess and report on predicted and actual outcomes. At the time of our review, two of the eight projects had completed their Before and After study, while the other six projects were at various stages of compiling and analyzing information for their studies. According to FTA officials, project sponsors generally complete their Before and After studies within about 5 years of their project's beginning operation. However, as discussed later, extenuating circumstances may delay completing the study. We interviewed the project sponsors about their project's predicted and actual scope, capital cost, transit service, operating and maintenance cost, ridership, and service date, as well as factors that affected differences between predicted and actual outcomes.⁸

We conducted this performance audit from October 2021 to April 2023 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain

⁸In this report, we focus on differences between predicted and actual costs, not on whether the project costs are reasonable or appropriate for the project. Recent studies have indicated transit construction costs in the U.S. appear to be higher than transit project costs in other countries. For example, Eno Center for Transportation reported that U.S. rail-transit projects are more costly and take longer to construct than those in other countries. See Eno Center for Transportation, *Saving Time and Making Cents: A Blueprint for Building Transit Better* (Washington, D.C.: 2021). We have reported on factors that limit comparisons of project costs in the U.S. and other countries. See, for example, GAO, *Rail Transit: Federal Transit Administration Could Improve Information on Estimating Project Costs*, [GAO-19-562](#) (Washington, D.C.: July 22, 2019).

sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

CIG Project Evaluation and Development Process

The CIG program is a discretionary grant program that provides funds each year to help cities, states, and other localities across the country plan and build new “fixed-guideway” systems or extensions to existing systems.⁹ To request entry into the CIG program, project sponsors submit an application to FTA with information on their project. Upon acceptance to the program, sponsors must then follow a multi-step, multi-phase project development process outlined in statute, during which FTA determines if the project is eligible to receive funding through the program.

For New Starts and Core Capacity projects, the first two phases of the program are Project Development and Engineering, during which sponsors are to develop and provide sufficient information for FTA to evaluate and rate their projects and to address CIG requirements. For example, during the Project Development phase, sponsors must complete the environmental review process, develop a Project Management Plan, obtain a commitment of at least 30 percent of the non-CIG capital funds needed for their project, and develop cost and ridership predictions, among other things.¹⁰ At the end of the Project Development phase, FTA is to evaluate and rate the projects seeking CIG funding

⁹The term “fixed-guideway” means a public transportation facility (1) using and occupying a separate right-of-way for the exclusive use of public transportation; (2) using rail; (3) using a fixed catenary system (i.e., a system using overhead power lines); (4) for a passenger ferry system; or (5) for a bus rapid transit system. 49 U.S.C. § 5302(8).

¹⁰The *Project Management Plan* is the overarching project implementation plan that spans the entire project period. It should describe approved policies, practices, and procedures related to the management, design, and construction of the major capital transit project. FTA, *Project Management Oversight Procedure 20—Project Management Plan Review* (September 2015).

according to statutory criteria to determine eligibility to advance into the Engineering phase.¹¹

During the Engineering phase, sponsors are to continue to refine project information, such as developing a firm and reliable cost, scope, and schedule for FTA, and obtain all non-CIG capital funds needed for their project, among other things. These refinements may result in changes to costs and ridership predictions.¹² Proposed projects must obtain at least a “medium” overall project rating to be eligible for funding.

With respect to local financing, FTA is required to evaluate and rate the local financial commitment for the proposed project as well as the project sponsor’s ability to operate the project within the existing transit system. In order to recommend a project for a grant agreement in the President’s budget, FTA is to consider the evaluation and rating of the project according to the statutory criteria, the availability of CIG program funds, and when the project is expected to be ready to begin construction.¹³ Once Congress approves projects for funding, FTA funds the projects through a multi-year grant agreement, with the CIG’s funding subject to congressional appropriations.

Approaches for Developing Ridership Predictions

FTA provides sponsors with information on estimating ridership. FTA permits project sponsors to choose among three different approaches to predicting ridership on a proposed project: region-wide travel models,

¹¹FTA rates projects for project justification and local financial commitment. There are currently six project justification criteria that FTA is to use to evaluate and rate New Starts projects: mobility improvements, environmental benefits, cost-effectiveness, economic development, congestion relief, and land use. 49 U.S.C. § 5309(d)(2)(A)(iii). The project justification criteria for Core Capacity projects are the same, except that they are to be rated on the existing capacity needs of a corridor rather than land use. 49 U.S.C. § 5309(e)(2)(A)(iv). FTA is also required to rate each individual criterion on a five-point scale, low, medium-low, medium, medium-high, and high. 49 U.S.C. § 5309(g)(2)(A).

¹²For more information, see GAO, *Public Transit: Length of Development Process, Cost Estimates, and Ridership Forecasts for Capital-Investment Grant Projects*, [GAO-14-472](#) (Washington, D.C.: May 30, 2014).

¹³FTA has taken steps to being considering other CIG project evaluation criteria. For example, on July 15, 2021, FTA issued a Request for Information in the *Federal Register* seeking input on changing CIG project evaluation criteria. 86 *Fed. Reg.* 37402 (July 15, 2021). For example, FTA sought input on whether the environmental criteria should include a calculation of health benefits associated with the project. FTA anticipates proposing a more comprehensive update to CIG policy guidance in late 2023.

incremental data-driven methods, and FTA's Simplified Trips-on-Project Software package (STOPS).

- Region-wide travel models are analytical tools used for regional transportation planning. Such models can predict how many trips people will make in a given region on a typical day, their destination, and the modes and the routes they will use. Travel models require information on population, employment, household incomes, transit service levels, transit fares, highway capacity, and other influences on travel patterns. Ridership forecasts for future years are grounded in predicted future conditions rather than data on actual conditions.
- Incremental data-driven methods rely on rider survey data to describe current transit ridership patterns. This method focuses on changes in transit ridership expected to be caused by proposed projects and by growth in population and employment.
- Like region-wide travel models, STOPS—which FTA released in September 2013—predicts the number and location of trips people will take on a given day. However, STOPS expedites data collection by using readily available data sources, such as the Census Transportation Planning Products Program.¹⁴ Local agencies can use STOPS instead of, or in conjunction with, region-wide travel models.

Before and After Studies

While the grant agreement establishes expected project outcomes, various factors can cause differences between predicted and actual outcomes. Project sponsors of New Starts and Core Capacity projects were required to submit a plan to FTA for the collection of specified types of information, and to produce a Before and After study using the collected information.¹⁵ The Before and After studies document the project's actual outcomes, evaluate the accuracy of predicted outcomes, discuss the causes for any differences between predicted and actual

¹⁴The Census Transportation Planning Products Program is a program funded by states' departments of transportation. It is a cooperative program that produces special tabulations of American Community Survey data that can inform transportation planning, analysis, and strategic direction.

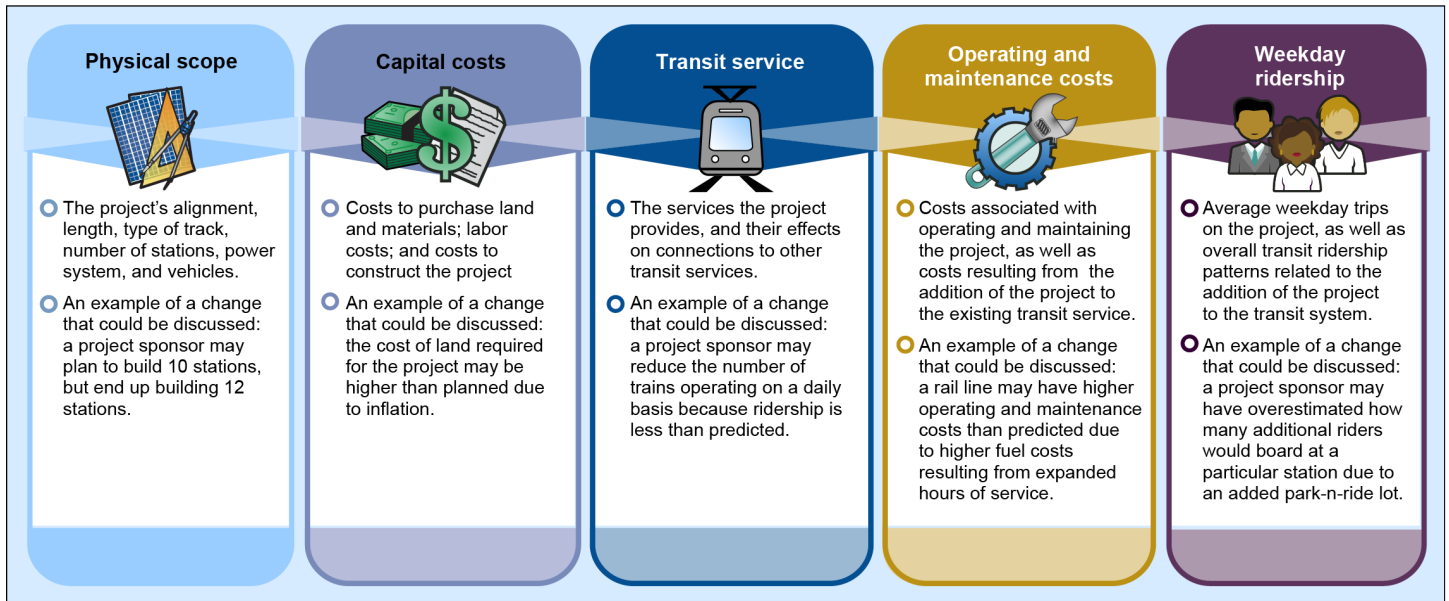
¹⁵The eight project sponsors in our review were required by federal statute to submit a plan for the collection of certain information and produce Before and After studies based on the collected information.

outcomes, and identify lessons learned that could be used to improve future projects.

According to FTA officials, project sponsors generally complete their Before and After study within about 5 years of starting project operations.¹⁶ In some cases, extenuating circumstances may delay a sponsor from documenting the project’s outcomes and completing its study in a timely manner. In such situations, the project sponsor is to notify FTA and complete the study when the circumstances are resolved.

The Before and After studies discuss predicted and actual outcomes in five areas. (See fig.1.)

Figure 1: Information to Be Included in Before and After Studies by Sponsors of Capital Investment Grants Projects and Examples of Changes They Could Discuss



Source: GAO analysis of Federal Transit Administration (FTA) and project sponsor information. | GAO-23-105479

¹⁶According to FTA, the project sponsors should begin collecting the “before” data prior to the beginning of construction and the “after” data towards the end of construction and as the project is completed and begins revenue service. Project sponsors begin developing their Before and After study once construction for the project is complete and revenue service begins.

Text of Figure 1: Information to Be Included in Before and After Studies by Sponsors of Capital Investment Grants Projects and Examples of Changes They Could Discuss

- Physical Scope
 - The project’s alignment, length, type of track, number of stations, power system, and vehicles.
 - An example of a change that could be discussed: a project sponsor may plan to build 10 stations, but end up building 12 stations.
- Capital Costs
 - Costs to purchase land and materials; labor costs; and costs to construct the project
 - An example of a change that could be discussed: the cost of land required for the project may be higher than planned due to inflation.
- Transit Services
 - The services the project provides, and their effects on connections to other transit services.
 - An example of a change that could be discussed: a project sponsor may reduce the number of trains operating on a daily basis because ridership is less than predicted.
- Operating and maintenance costs
 - Costs associated with operating and maintaining the project, as well as costs resulting from the addition of the project to the existing transit service.
 - An example of a change that could be discussed: a rail line may have higher operating and maintenance costs than predicted due to higher fuel costs resulting from expanded hours of service.
- Weekday ridership
 - Costs associated with operating and maintaining the project, as well as costs resulting from the addition of the project to the existing transit service.
 - An example of a change that could be discussed: a rail line may have higher operating and maintenance costs than predicted due to higher fuel costs resulting from expanded hours of service.

Source: GAO analysis of Federal Transit Administration (FTA) and project sponsor information. | GAO-23-105479

Note: Project sponsors produce a Before and After study in order to assess and report on predicted and actual outcomes. According to FTA officials, project sponsors generally complete their Before and After studies within about 5 years of their project beginning operation.

Project sponsors may also include a discussion of other project impacts, such as economic development, at their own discretion.

The project sponsor provides draft sections of their Before and After studies to FTA for review and comment. In response to FTA's comments, the project sponsor prepares final versions of the report sections and ultimately the final Before and After study. FTA publishes a summary of the Before and After study on its website.

FTA's Oversight of CIG Projects

FTA staff in the agency's headquarters in Washington, D.C., and in 10 regional offices, with the help of project management oversight contractors (PMOC) oversee projects that compete for CIG program funding. This oversight is designed to enable FTA to monitor projects' readiness to advance to the next project phase and ultimately to project completion.¹⁷

FTA and the PMOCs evaluate each project's risk, scope, cost, schedule, and Project Management Plan, as well as the project sponsor's technical capacity and capability—before recommending a project for funding. The PMOCs help FTA oversee planning, design, and construction of projects and provide technical assistance to project sponsors throughout the development and construction process.¹⁸ FTA determines the extent and type of monitoring activities the PMOCs conduct on a project. During the Project Development and Engineering phases, project sponsors submit periodic updates to FTA on different aspects of their projects, such as on project cost, schedule, risk, projected ridership, project financing, and readiness to progress through the process.

¹⁷FTA regulations provide that FTA's project management oversight usually begins during the Project Development phase, unless FTA's Administrator determines it is more appropriate to begin oversight during another phase of the project, to maximize transportation benefits and cost savings. 49 C.F.R. § 633.13.

¹⁸The reviews that project management oversight contractors (PMOC) conduct are designed to keep FTA informed of a project's status and support the agency's decision on whether to advance or fund the project. In addition to the CIG program, PMOCs help FTA oversee other types of major capital projects that use federal loans, such as projects that received funding through the Transportation Infrastructure Finance and Innovation Act program and the Railroad Rehabilitation and Improvement Financing program.

FTA Assesses Cost and Ridership Outcomes and Has Helped Sponsors Better Predict Those Outcomes

FTA Has Used Information from Project Sponsors to Assess Capital Cost and Ridership Outcomes

FTA assesses the capital cost and ridership outcomes of CIG projects in *Predicted versus Actual* reports, which draw on information from project sponsors' Before and After studies. According to FTA officials, the agency issues these reports when it determines a sufficient number of project sponsors have completed Before and After studies for FTA to analyze, and when FTA has the available staff resources to prepare the report. Since 1990, FTA has published four *Predicted versus Actual* reports assessing CIG projects that entered revenue service from 1983 through 2015.¹⁹

In the *Predicted versus Actual* reports, FTA compares actual capital cost and ridership outcomes of the group of completed projects with the outcomes the project sponsors predicted at key decision points in the CIG process. These points include when the project sponsor requested entry into the Engineering phase and when the sponsor requested that FTA consider funding the project through a grant agreement. FTA also identifies reasons for significant differences between predicted and actual outcomes, as described in the project sponsors' Before and After studies.

According to FTA officials, the *Predicted versus Actual* reports focus on capital cost and ridership because they are the most quantifiable and precise types of outcomes. While the reports do not assess the other three types of outcomes discussed in the Before and After studies—

¹⁹FTA is not required by statute or regulation to produce *Predicted versus Actual* reports. According to FTA, as a part of its ongoing commitment to learning from experience and improving technical practice in the administration of its programs, FTA periodically reviews the accuracy of the predicted capital costs and weekday ridership of transit projects funded by the CIG program. FTA issued these reports for the CIG program in 1990, 2003, 2007, and 2020. These reports did not assess Core Capacity projects that were authorized in 2012 by the Moving Ahead for Progress in the 21st Century Act (Pub. L. No. 112-141, § 20008, 126 Stat. 405, 658 (2012)), as no sponsors of Core Capacity projects have yet completed Before and After studies. FTA also assesses Before and After studies from Small Starts project sponsors. FTA encourages, but does not require, Small Starts project sponsors to complete these studies.

physical scope, transit service, and operating and maintenance costs—officials said these outcomes are often implicitly included in the analysis. For example, changes in the physical scope of a project, such as the location of stations or number of vehicles, will often affect capital cost and ridership.

According to our analysis of information in FTA's *Predicted versus Actual* reports from 1990, 2003, 2007, and 2020, project sponsors' predictions of capital costs have improved over time. Project sponsors' predictions of ridership have also improved, but to a lesser extent, and not consistently over time.

- **Capital costs.** None of the projects FTA discussed in its 1990 *Predicted versus Actual* report had actual capital costs within 10 percent of the capital costs the sponsors had predicted when CIG funds were awarded. However, about 57 percent, 67 percent, and 86 percent of projects FTA discussed in its 2003, 2007, and 2020 reports, respectively, had actual capital costs within 10 percent of predicted capital costs. FTA reported that causes for significant differences between predicted and actual capital costs included delays in the project schedule and underestimating inflation. For example, project sponsors may underestimate the extent to which increased rates of inflation may affect the cost of materials and labor.
- **Ridership.** None of the projects FTA discussed in its 1990 *Predicted versus Actual* report had actual ridership within 20 percent of the ridership the sponsors had predicted when CIG funds were awarded. However, about 32 percent, 11 percent, and 48 percent, of projects' FTA discussed in its 2003, 2007, and 2020 reports, respectively, had actual ridership within 20 percent of predicted ridership.²⁰ FTA reported that causes for significant differences between predicted and actual ridership included population estimates, assumptions about transit service level, and the properties of the travel model used to create the ridership forecasts.²¹ For example, a project sponsor's travel model may overestimate ridership generated by park-and-ride stations and connecting bus service.

²⁰FTA requires project sponsors to predict the number of daily "linked trips," which are trips from the origin to the destination on the transit system. Even if a passenger must make several transfers, the trip is counted as one linked trip on the system.

²¹Travel model properties include data such as passenger counts, ridership by travel corridors, and ridership on other transit options.

FTA Has Developed Methods and Tools to Help Project Sponsors More Accurately Predict Capital Costs and Ridership

According to FTA, the methods and tools the agency has developed have helped project sponsors more accurately predict capital costs and ridership over time. FTA officials said the lessons learned that they identified in the *Predicted versus Actual* reports, as well as FTA's experience reviewing projects and helping project sponsors develop Before and After studies informed these efforts.

Capital Costs

FTA has developed the following methods and tools to help project sponsors more accurately predict capital costs.

Risk assessment tools. FTA and the PMOCs conduct risk assessments of New Starts and Core Capacity projects at least two times during the project development process—before the Engineering phase and before FTA considers the project for a grant agreement.²² During these assessments, FTA and the PMOCs determine the probability that various cost and risk factors will affect the project budget and contingency amount.²³ Project sponsors can then modify their cost estimates accordingly. In prior work, we have identified risk assessments as a best practice for cost estimating.²⁴

FTA requires that PMOCs use risk analysis tools to assess the likelihood the sponsor will complete its project within scheduled timeframes as delays can result in additional costs. Officials from the San Diego Association of Governments told us FTA conducted a workshop to assess schedule risks to their Mid-Coast Corridor transit project; they said this workshop enabled them to improve the accuracy of the project's cost estimate.

²²FTA, *Oversight Procedure 40—Risk and Contingency Review* (March 2022).

²³Contingency is an amount of funding added to the budget to allow for uncertainties that could result in additional costs.

²⁴GAO, *Cost Estimating and Assessment Guide: Best Practices for Developing and Managing Capital Program Costs*, [GAO-20-195G](#) (Washington, D.C.: March 2020).

FTA has also used lessons learned from other projects in its project risk assessment reviews. For example, FTA had observed from other transit projects that tunneling can increase the risk of cost overruns and extend the completion date. Representatives of Seattle Sound Transit—whose project included plans to dig rail tunnels—said that as a result of the risk assessment, FTA asked them to increase their cost estimate for tunneling, add contingency funds to their budget, and push back their revenue operations date.

Continuous oversight and refinement of costs. According to FTA’s procedures, FTA is to regularly conduct oversight reviews to monitor and assess the project sponsor’s progress. The agency uses PMOCs to help oversee the planning and construction of CIG projects.²⁵

Since the PMOC role was established over 30 years ago, FTA has increased the level of oversight. For example, beginning in 2006, FTA began to assign PMOCs to CIG projects earlier in the project. FTA officials said that identifying problems at an earlier stage has helped them improve the likelihood that projects stay within budget and on schedule. FTA also has developed guidance for PMOC oversight activities. According to these procedures, PMOCs are to review and provide feedback to the project sponsor that may help refine cost estimates during a project’s development; engineering; prior to the grant award; and during construction.²⁶ For example, Charlotte Area Transit System officials told us that the PMOC, as part of the required capital cost and risk reviews, helped them develop predictions for capital costs as well as for operating and maintenance costs. In addition, Seattle Sound Transit officials said that required reviews from FTA and the PMOC helped them revise their capital budget and develop reasonable estimates.

Capital cost database. FTA also has developed a database to help project sponsors develop capital cost predictions.²⁷ This database

²⁵PMOCs are to oversee project development activities such as plans for safety and security and vehicle procurement, as well as the sponsor’s ability to deliver the project. FTA, *Oversight Procedure 01—Administrative Conditions and Requirements* (August 2019).

²⁶During these reviews, the PMOCs are to assess and evaluate the sponsor’s estimate and its plan for cost control, as well as processes and procedures for developing, monitoring, and changing the estimate. See FTA, *Oversight Procedure 33—Capital Cost Estimate Review* (September 2015).

²⁷GAO, *Rail Transit: Federal Transit Administration Could Improve Information on Estimating Project Costs*, [GAO-19-562](#) (Washington, D.C.: July 22, 2019).

contains actual costs for 54 federally-funded bus rapid transit, commuter rail, light rail, heavy rail and trolley projects. These costs are broken down into standard cost categories, such as track and vehicles. According to FTA officials, the database serves as a reference as sponsors develop cost estimates for their own transit projects. For example, Florida Department of Transportation officials said their contractor used FTA's database, among other tools, to develop the capital cost prediction for their project.

Ridership

FTA has also developed the following methods and tools to help project sponsors more accurately predict ridership:

Shorter prediction timeframes. In 2013, FTA shifted from requiring project sponsors to predict ridership 20 years into the future to requiring them to predict ridership for the current year based on the most recent population and employment data available.²⁸ According to FTA officials, this change helped improve predictions, because project sponsors use actual rather than future conditions as inputs to the ridership forecasts for factors such as population, employment, and the existing transportation system.

Ridership prediction approaches. In 2013, FTA introduced STOPS to address challenges project sponsors had experienced in developing ridership predictions using other approaches. According to FTA officials, chief among these challenges is the considerable time and effort it takes project sponsors to collect data for, develop, and update a regionally-tailored travel model—processes that can sometimes take as long as 2 years. STOPS is a standardized approach to ridership estimation that uses national databases to make the travel predictions, thereby saving project sponsors time and effort as they develop information FTA requires to evaluate and rate the projects, as previously mentioned.²⁹ According to FTA officials, by using STOPS, sponsors can develop ridership forecasts in as little as a few weeks. FTA officials said at least 85 percent of current projects have used STOPS to predict ridership, including the San Diego Association of Governments' project discussed in this review. FTA

²⁸FTA also allows project sponsors the option to provide a 10- or 20-year future forecast.

²⁹FTA has calibrated and validated STOPS using ridership data from CIG projects across the country. According to FTA officials, this approach is especially helpful for project sponsors who are new to the CIG program and have limited experience in ridership prediction.

officials have not evaluated predictions made with STOPS, but said they would do so once a sufficient number of project sponsors that used STOPS have completed their Before and After studies.

Oversight of ridership predictions. FTA staff also oversee project sponsors' ridership predictions through technical assistance at the sponsor's request, early reviews of methods and assumptions, and reviews of final ridership predictions.³⁰ For example, Santa Clara Valley Transportation Authority officials said FTA worked closely with them to develop ridership predictions when they used their local model, and later helped modify their ridership prediction model to ensure it was robust.

In addition to helping project sponsors more accurately predict ridership, FTA has helped sponsors collect more accurate and comprehensive information about riders once their projects have been constructed. Sponsors use passenger surveys to count riders and collect other types of information, such as the stops where passengers board and alight, and the purpose of passengers' trips. Sponsors typically conduct a passenger survey about 2 years after their project has opened for revenue service, to give riders time to become familiar with the new service.

FTA has helped sponsors improve these surveys by partnering with transit industry survey vendors to switch from a paper-based methodology to using a tablet device. According to FTA, this change improved the quality of the data, because the interview can be customized for short-distance trips and for non-English speakers, and the data are stored electronically. Collecting more accurate data helps project sponsors better evaluate in their Before and After studies how well they predicted ridership. Moreover, having a better understanding of how and why riders use transit systems can help project sponsors identify lessons learned that could help improve the design of, and predictions for, future projects.

Most Sponsors of Recent Projects Have Not Yet Assessed Outcomes, but All Cited the

³⁰GAO, *Public Transit: Length of Development Process, Cost Estimates, and Ridership Forecasts for Capital-Investment Grant Projects*, [GAO-14-472](#) (Washington, D.C.: May 30, 2014).

Significant Impact of the Pandemic on Predicted Ridership

Project sponsors are required to collect information related to projects' outcomes and to summarize their analysis in a Before and After study, generally within 5 years of beginning operation. Two of the eight project sponsors that began operations from 2016 through 2021—Seattle Sound Transit and Charlotte Area Transit System—have completed a Before and After study and reported that actual capital costs and ridership were lower than predicted. Sponsors for the other six projects were at various stages of compiling information and drafting their studies.³¹ Although these six project sponsors had not yet completed their analyses of predicted and actual outcomes, they were able to share observations and insights about their projects, which have been operational for periods ranging from 1 to 6 years. All eight sponsors said the pandemic has had a significant effect on transit ridership. See table 1 for selected information on these eight projects. For additional information about the eight projects, see appendix I.

³¹Specifically, five project sponsors said they were collecting information and drafting their studies. One other sponsor said it had not begun compiling information because the project only recently began service.

Table 1: Selected Information for Eight Capital Investment Grants Program Projects That Began Operations from 2016 through 2021

Project	Project description	Service date	Completed Before and After study ^a
Seattle University Link Extension	3.15-mile extension of Seattle's light rail system	Opened 13 months early, in March 2016	Yes
New York Second Avenue Subway Phase 1	2.3 miles of new subway on Manhattan's east side from 92nd Street and Second Avenue to 63rd Street and Third Avenue	Opened 13 months early, in January 2017 ^b	No
Charlotte Blue Line Extension	9.3-mile extension of Charlotte's light rail system	Opened on time, in March 2018	Yes
Central Florida SunRail Phase 2 South	17.2 mile commuter rail extension service from Orange County to Osceola County	Opened 14 months early, in July 2018	No
Fort Worth TEXRail	26.8-mile commuter rail line connecting downtown Fort Worth and the Dallas-Fort Worth International Airport	Opened 12 months early, in January 2019	No
Denver Eagle Commuter Rail	30.2-mile electrified commuter rail project consisting of two commuter rail lines—the A-Line and the G-Line	A-Line opened 8 months early, on April 2016, and G-Line opened 28 months late, in April 2019	No
Silicon Valley Berryessa Bay Area Rapid Transit (BART) Extension	10.2-mile extension of the BART heavy rail system from Fremont to Berryessa Road in San Jose	Opened 24 months late, in June 2020	No
San Diego Mid-Coast Corridor Project	Extension of the San Diego light rail trolley line from downtown San Diego to University City	Opened 12 months early, in November 2021	No

Legend: ✓ = yes; ✗ = no

Source: GAO analysis of CIG project sponsors' information. | GAO-23-105479

^aAccording to FTA, sponsors generally complete the Before and After studies within about 5 years of their project beginning operation. In some situations, studies may take longer, because extenuating circumstances, such as a pandemic or ongoing litigation, may delay collecting outcome data.

^bIn 2015, FTA and the Metropolitan Transportation Authority signed an amended grant agreement for the Second Avenue Subway Phase 1 project. The amended agreement revised the service date to February 2018 from June 2014. Under the original agreement, the project would have opened 31 months late.

Project sponsors provided the following information on project outcomes:

Physical scope. Six project sponsors said their project had no, or only slight, changes in scope. For example, San Diego Association of Governments built a new parking garage instead of purchasing parking at an existing or newly constructed privately owned parking garage as originally planned. According to San Diego Association of Governments officials, the change fell within the project description included in the grant agreement. Two project sponsors added structural features to their

project scope that were not funded with CIG funds and were not included in their grant agreement, according to the project sponsors. Specifically, Charlotte Area Transit System constructed pedestrian bridges at two of its rail stations, and Denver Regional Transportation District added a rail station to the A-Line. There were no associated increases in CIG-funded capital costs, because the project sponsors used non-CIG funds to pay for the scope changes.

Capital costs. Three sponsors provided information about their actual capital costs. Seattle Sound Transit and Charlotte Area Transit System reported in their Before and After studies that their capital costs were 14 percent and 9 percent lower than predicted, respectively, due to an unexpectedly favorable bid environment and untapped contingent funds. Fort Worth Trinity Metro officials said they expected actual capital costs to be lower than predicted. The other five project sponsors, which had not yet completed their Before and After studies, said it was premature to describe their capital costs. For example, some project sponsors stated that some of their construction contracts were still open and that they had not yet completed their financial reviews or closed out their grants.

Transit service. Five project sponsors said they made changes in transit service prior to the pandemic that they had not originally planned. For example, Denver Regional Transportation District officials told us they made a slight change in the A-Line project's hours of operation (beginning service at 5:00 AM rather than at 6:00 AM as planned) to accommodate early morning riders traveling to Denver International Airport. Both Seattle Sound Transit and Charlotte Area Transit System reported in their Before and After studies that they changed their transit service in order to integrate their project into the existing transit system. Specifically, Seattle Sound Transit implemented a mix of 2- and 3-car trains rather than 2-car trains as planned, due to higher than expected passenger demand on another part of the rail line north of the SeaTac/Airport station. Charlotte Area Transit System reported that the existing transit service travel time increased by 9 minutes due to locally required speed restrictions and increased hold time at the stations to safely operate train doors. This longer travel time necessitated additional train service. As a result, the Blue Line Extension added three more trains than predicted. Florida Department of Transportation officials told us they did not have changes in service, because their project was an extension of an existing rail project, and its actual service schedule ran according to the existing train schedule as predicted.

Each of the eight project sponsors said they reduced the hours and frequency of service during the pandemic,³² a step that some officials said affected ridership.³³ For example, Seattle Sound Transit officials said they reduced service severely in the first few months of the pandemic by increasing the interval time between two trains incrementally from 6 to 20 minutes. Five sponsors said they have continued to operate at a reduced service level due to low ridership levels. For example, Charlotte Area Transit System has continued to operate with longer intervals between trains—from 7.5 minutes pre-pandemic to 15 minutes currently. Denver Regional Transportation District (A-Line project only) said they maintained service levels during the pandemic.³⁴

Operating and maintenance costs. Four project sponsors described their actual operating and maintenance costs, while the other four said it was too soon to provide this information. Florida Department of Transportation expected no difference between predicted and actual operating and maintenance costs, while Fort Worth Trinity Metro expected actual costs to exceed predicted. Both Seattle Sound Transit and Charlotte Area Transit Service reported in their Before and After studies higher operating and maintenance costs than they had predicted due, respectively, to operating more cars per train and more trains per day than anticipated, among other causes.

³²Congress passed multiple COVID-19 relief laws since the beginning of the pandemic, some of which helped fund transit operations. For example, the CARES Act appropriated \$25 billion to FTA to support the transit industry through two formula programs—the Urbanized Area Formula program (\$22.7 billion) and the Formula Grants for Rural Areas program (\$2.2 billion). Pub. L. No. 116-136, div. B, tit. XII, 134 Stat. 281, 599 (2020). CARES Act grant funds were made available to transit agencies for COVID-19-related expenses. On April 2, 2020, FTA allocated the \$25 billion to urbanized areas, states, and tribes and, later that year, directed these funds to payroll and operating expenses to the maximum extent possible.

³³According to FTA officials, FTA waived CIG grant agreement level of service requirements during the pandemic.

³⁴The Denver Eagle project is comprised of the A-Line and the G-Line. According to Denver Regional Transportation District officials, the pandemic affected the A-Line differently than the G-Line. Specifically, Denver maintained service at pre-pandemic levels on the A-Line and ridership has recovered to pre-pandemic levels. Denver reduced service on the G-Line and ridership has not recovered yet.

Ridership. Three project sponsors described their pre-pandemic actual ridership levels.³⁵ One of these sponsors—Denver Regional Transportation District—was able to provide this information about its A-Line project, but not its G-Line project. The other sponsors said it was too soon to provide this information because they were at various stages of data collection and had not yet assessed actual ridership. For example, Fort Worth Trinity Metro conducted a ridership survey in 2022 and expects to complete its analysis in mid-2023. The San Diego Association of Governments, the only sponsor in our review that used STOPS to predict ridership, said it was too soon to report on the accuracy of its ridership predictions, because the project went into revenue service in 2021.

In their Before and After studies, Seattle Sound Transit and Charlotte Area Transit System indicated their ridership before the pandemic was about 30 percent lower than predicted.³⁶ Seattle Sound Transit attributed the difference between predicted and actual ridership to its travel model not accounting for the time it would take to walk to station entrances from surrounding areas, among other things. Charlotte Area Transit System attributed the difference between predicted and actual ridership to, among other things, its travel model overestimating the level of ridership generated by park-and-ride stations and connecting shuttle bus service to the University of North Carolina Charlotte. FTA has reported that travel model properties, such as these assumptions made for the Seattle and Charlotte projects, are a frequent cause of differences in predicted and actual ridership.

Two other projects had pre-pandemic ridership closer to predicted ridership. New York City Metropolitan Transportation Authority officials said preliminary data indicated pre-pandemic ridership was about 4

³⁵According to FTA, sponsors normally determine actual ridership by completing a comprehensive transit passenger survey after the project has been in service for 2 years. Such surveys provide in-depth information about riders' preferences and are the basis for their Before and After study's predicted versus actual ridership analysis.

³⁶Seattle Sound Transit used an incremental model while Charlotte Area Transit System used a regional model to predict ridership. Seattle Sound Transit completed onboard ridership surveys in 2015 and 2018. Charlotte Area Transit System officials said that they did not complete an onboard ridership survey as planned because of the onset of the pandemic. Instead, the project sponsor estimated actual ridership based on passenger counts collected in October 2019, about 19 months after service began. Charlotte Area Transit System included the results of this analysis in its Before and After study. Officials said that they conducted a ridership survey in the fall of 2022 and expect a final report mid-2023.

percent lower than predicted. Denver Regional Transportation District officials said their 2019 survey of the A-Line project ridership found actual ridership was about 21 percent lower than predicted. At the time of our study, neither project sponsor had completed its analysis of the factors affecting actual ridership levels.

According to the project sponsors, transit ridership declined precipitously at the start of the pandemic, and, in most cases, the recovery of ridership has been slow. Two sponsors—Fort Worth Trinity Metro and Denver Regional Transportation District (A-Line project only)—said that while their ridership declined during the pandemic, it has recovered and recently has met or exceeded pre-pandemic ridership levels. The other six sponsors said their ridership has not returned to pre-pandemic levels and that reductions in service hours and frequency has affected ridership. Sponsors said they expect the pandemic will likely continue to affect ridership to varying degrees, given the continuing trend of remote work and its impact on commuting patterns and the need for travel.

Revenue service date. Although not evaluated in the Before and After studies, we compared predicted and actual revenue service dates (see table 1). Six projects—including the Denver Eagle A-Line and New York Second Avenue Subway Phase 1—began revenue service earlier than predicted, for varying reasons, such as agreements with local governments, public interest, contractual incentives, or a conservative construction schedule. One project began service on time. Two projects—Denver Eagle G-Line and Silicon Valley Berryessa BART Extension—began service later due in part to difficulty resolving technology issues, such as adopting “positive train control.”³⁷

We will continue to evaluate these projects as well as additional projects that become operational in future reports produced under this mandate.

³⁷“Positive train control” is a communications-based system designed to automatically slow or stop a train that is not being operated safely. Many railroads, subject to a statutory mandate to implement positive train control, have encountered challenges implementing the technology. See GAO, *Positive Train Control: Railroads Generally Made Progress, but Several Must Meet Compressed Schedules to Meet Implementation Date*, [GAO-20-516R](#) (Washington, D.C.: Apr. 30, 2020).

Agency Comments

We provided a draft of this report to the Department of Transportation for review and comment. The Department of Transportation provided technical comments, which we incorporated as appropriate.

We are sending copies of this report to interested congressional committees and the Secretary of Transportation. In addition, this report will be available at no charge on GAO's website <http://www.gao.gov>.

If you or your staff have any questions or would like to discuss this work, please contact me at (202) 512-2834 or VonahA@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made key contributions to this report are listed in appendix II.

A handwritten signature in black ink, appearing to read 'Andrew Von Ah', with a stylized, cursive script.

Andrew Von Ah
Director, Physical Infrastructure Issues

List of Committees

The Honorable Sherrod Brown
Chair
The Honorable Tim Scott
Ranking Member
Committee on Banking, Housing, and Urban Affairs
United States Senate

The Honorable Brian Schatz
Chair
The Honorable Cindy Hyde-Smith
Ranking Member
Subcommittee on Transportation, Housing and Urban Development, and
Related Agencies
Committee on Appropriations
United States Senate

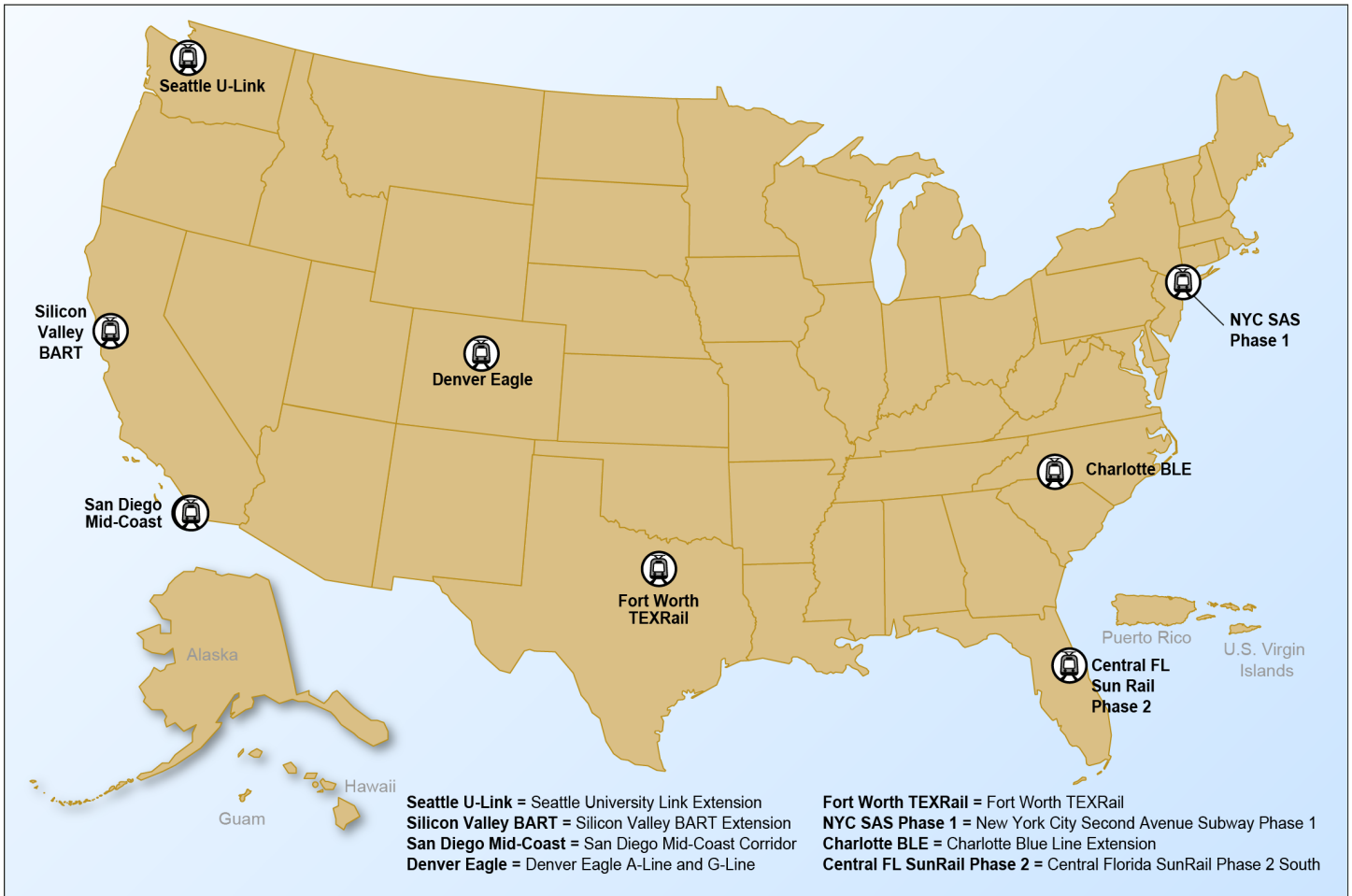
The Honorable Sam Graves
Chair
The Honorable Rick Larsen
Ranking Member
Committee on Transportation and Infrastructure
House of Representatives

The Honorable Tom Cole
Chair
The Honorable Mike Quigley
Ranking Member
Subcommittee on Transportation, Housing and Urban Development, and
Related Agencies
Committee on Appropriations
House of Representatives

Appendix I: Profiles of Eight Capital Investment Grants Program Projects

Appendix I includes profiles for the eight Capital Investment Grants (CIG) program projects that began operations from 2016 through 2021. See figure 2 for a map of the eight projects.

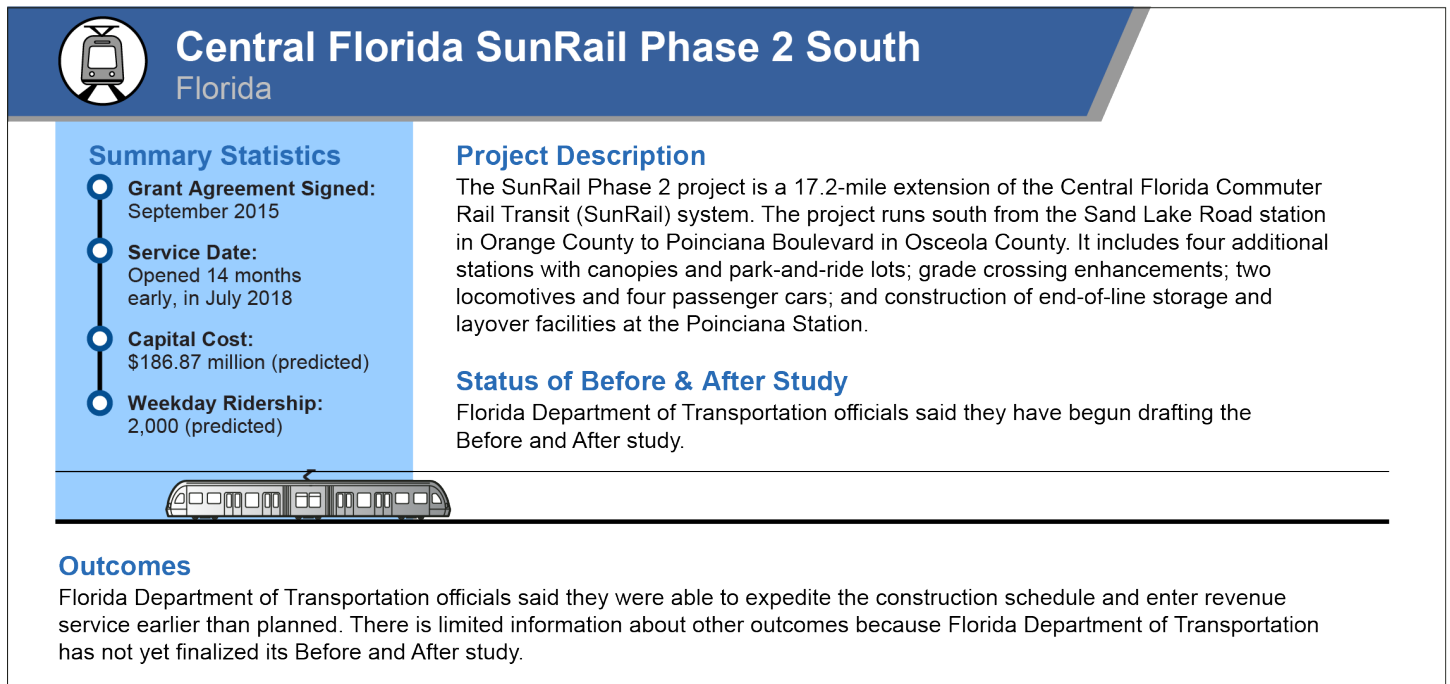
Figure 2: Map of Eight Capital Investment Grants Program Projects



Source: GAO analysis of Capital Investment Grants (CIG) program sponsors' information. | GAO-23-105479

We requested and analyzed information from FTA and the eight project sponsors, including Before and After studies, grant agreements, and planning documents for collecting predicted and actual outcome information. We interviewed the project sponsors about the status of their Before and After study and, for those that had completed the study, the factors affecting differences between predicted and actual outcomes. We used this information to create a brief description of each project. (See figs. 3 through 10.)

Figure 3: Central Florida SunRail Phase 2 South



Source: GAO analysis of Capital Investment Grants (CIG) project sponsors' information. | GAO-23-105479

Text of Figure 3: Central Florida SunRail Phase 2 South

Central Florida SunRail Phase 2 South. Florida

Summary Statistics:

- Grant Agreement Signed: September 2015
- Service Date: Opened 14 months early, in July 2018

**Appendix I: Profiles of Eight Capital
Investment Grants Program Projects**

- Capital Cost: \$186.87 million (predicted)
 - Weekday Ridership: 2,000 (predicted)
-

Project Description:

The SunRail Phase 2 project is a 17.2-mile extension of the Central Florida Commuter Rail Transit (SunRail) system. The project runs south from the Sand Lake Road station in Orange County to Poinciana Boulevard in Osceola County. It includes four additional stations with canopies and park-and-ride lots; grade crossing enhancements; two locomotives and four passenger cars; and construction of end-of-line storage and layover facilities at the Poinciana Station.

Status of Before and After Study:

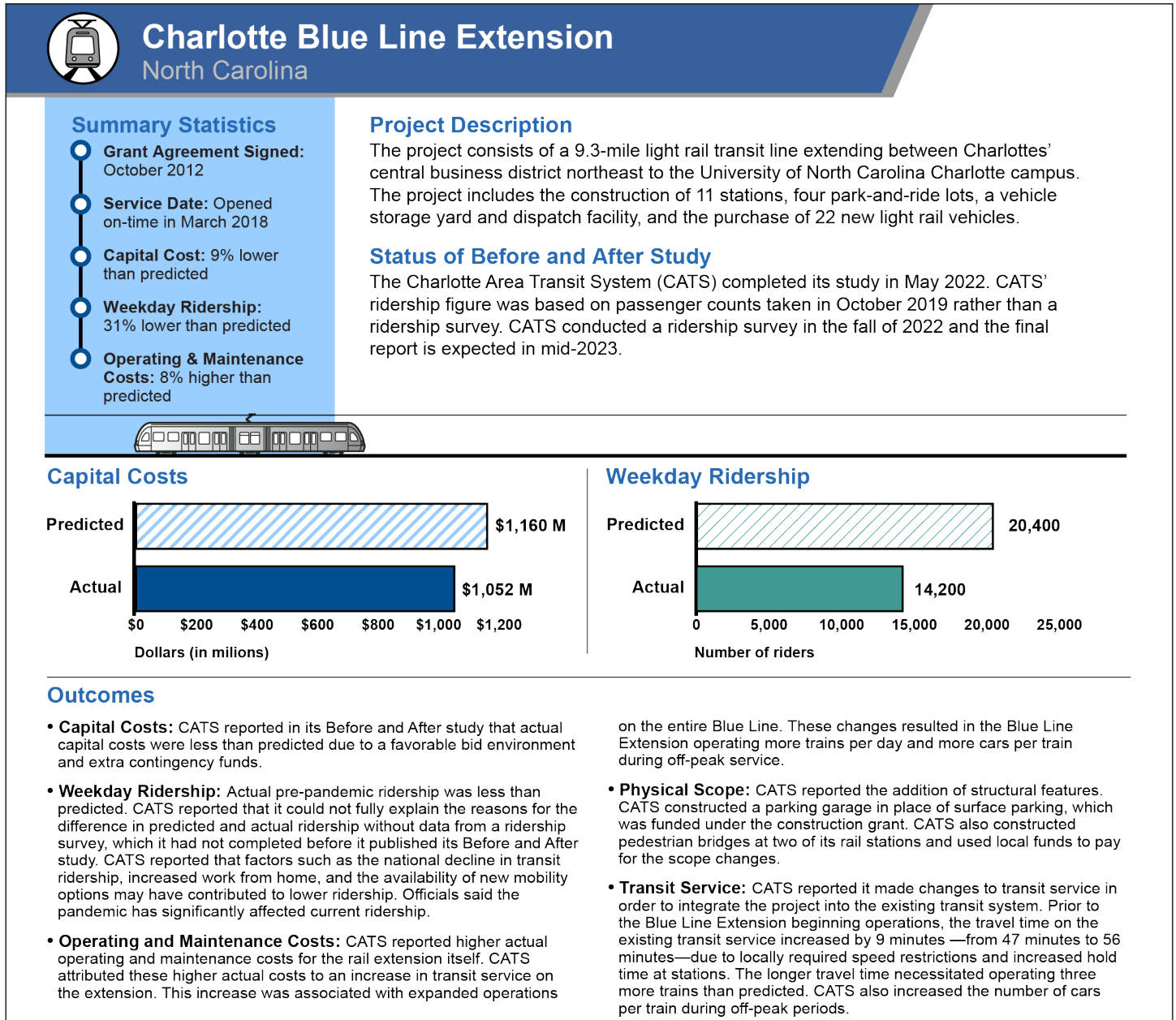
Florida Department of Transportation officials said they have begun drafting the Before and After study.

Outcomes

Florida Department of Transportation officials said they were able to expedite the construction schedule and enter revenue service earlier than planned. There is limited information about other outcomes because Florida Department of Transportation has not yet finalized its Before and After study

Source: GAO analysis of Capital Investment Grants (CIG) project sponsors' information. | GAO-23-105479

Figure 4: Charlotte Blue Line Extension



Text of Figure 4: Charlotte Blue Line Extension

Charlotte Blue Line Extension, North Carolina

Summary Statistics:

- Grant Agreement Signed: October 2012
- Service Date: Opened on-time in March 2018
- Capital Cost: 9% lower than predicted
- Weekday Ridership: 31% lower than predicted
- Operating & Maintenance Costs: 8% higher than predicted

Project Description:

The project consists of a 9.3-mile light rail transit line extending between Charlottes' central business district northeast to the University of North Carolina Charlotte campus. The project includes the construction of 11 stations, four park-and-ride lots, a vehicle storage yard and dispatch facility, and the purchase of 22 new light rail vehicles.

Status of before and after study

The Charlotte Area Transit System (CATS) completed its study in May 2022. CATS' ridership figure was based on passenger counts taken in October 2019 rather than a ridership survey. CATS conducted a ridership survey in the fall of 2022 and the final report is expected in mid-2023.

Capital Costs

- Predicted: \$1,160 million
- Actual: \$1,052 million

Weekly Ridership

- Predicted: 20,400
- Actual: 14,200

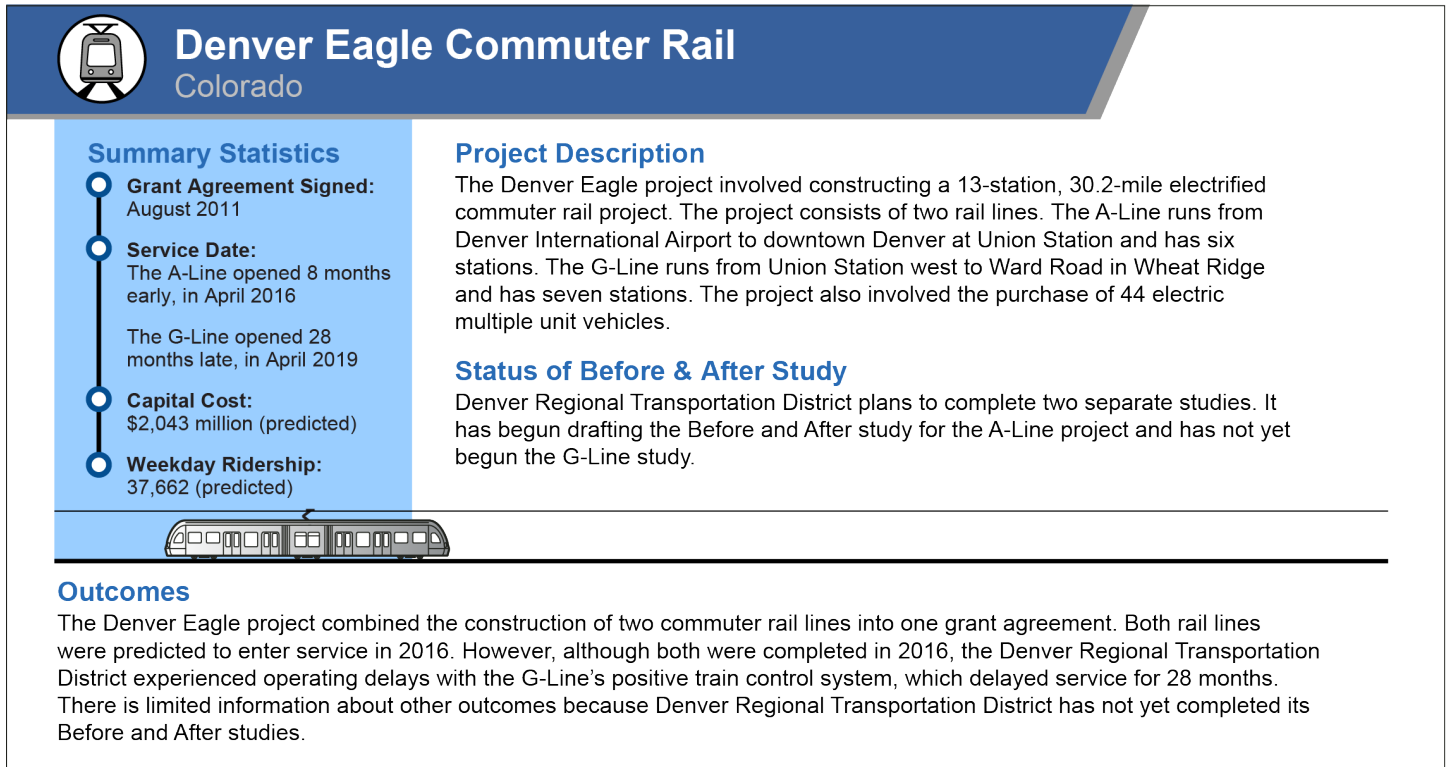
Outcomes

- **Capital Costs:** CATS reported in its Before and After study that actual capital costs were less than predicted due to a favorable bid environment and extra contingency funds.
- **Weekday Ridership:** Actual pre-pandemic ridership was less than predicted. CATS reported that it could not fully explain the reasons for the difference in predicted and actual ridership without data from a ridership survey, which it had not completed before it published its Before and After study. CATS reported that factors such as the national decline in transit ridership, increased work from home, and the availability of new mobility options may have contributed to lower ridership. Officials said the pandemic has significantly affected current ridership.
- **Operating and Maintenance Costs:** CATS reported higher actual operating and maintenance costs for the rail extension itself. CATS attributed these higher actual costs to an increase in transit service on the extension. This increase was associated with expanded operations capital costs were less than predicted due to a favorable bid environment and extra contingency funds.
- **Weekday Ridership:** Actual pre-pandemic ridership was less than predicted. CATS reported that it could not fully explain the reasons for the difference in predicted and actual ridership without data from a ridership survey, which it had not completed before it published its Before and After study. CATS reported that factors such as the national decline in transit ridership, increased work from home, and the availability of new mobility options may have contributed to lower ridership. Officials said the pandemic has significantly affected current ridership.
- **Operating and Maintenance Costs:** CATS reported higher actual operating and maintenance costs for the rail extension itself. CATS attributed these higher actual costs to an increase in transit service on the extension. This increase was associated with expanded operation of the entire Blue Line. These changes resulted in the Blue Line Extension operating more trains per day and more cars per train during off-peak service.
- **Physical Scope:** CATS reported the addition of structural features. CATS constructed a parking garage in place of surface parking, which was funded under the construction grant. CATS also constructed pedestrian bridges at two of its rail stations and used local funds to pay for the scope changes.

- **Transit Service:** CATS reported it made changes to transit service in order to integrate the project into the existing transit system. Prior to the Blue Line Extension beginning operations, the travel time on the existing transit service increased by 9 minutes—from 47 minutes to 56 minutes—due to locally required speed restrictions and increased hold time at stations. The longer travel time necessitated operating three more trains than predicted. CATS also increased the number of cars per train during off-peak periods.

Source: GAO analysis of Capital Investment Grants (CIG) project sponsors' information. | GAO-23-105479

Figure 5: Denver Eagle Commuter Rail



Source: GAO analysis of Capital Investment Grants (CIG) project sponsors' information. | GAO-23-105479

Text of Figure 5: Denver Eagle Commuter Rail

Denver Eagle Commuter Rail, Colorado

Summary Statistics:

- Grant Agreement Signed: August 2011

- Service Date: The A-Line opened 8 months early, in April 2016
 - The G-Line opened 28 months late, in April 2019
 - Capital Cost: \$2,043 million (predicted)
 - Weekday Ridership: 37,662 (predicted)
-

Project Description

The Denver Eagle project involved constructing a 13-station, 30.2-mile electrified commuter rail project. The project consists of two rail lines. The A-Line runs from Denver International Airport to downtown Denver at Union Station and has six stations. The G-Line runs from Union Station west to Ward Road in Wheat Ridge and has seven stations. The project also involved the purchase of 44 electric multiple unit vehicles.

Status of before and after study

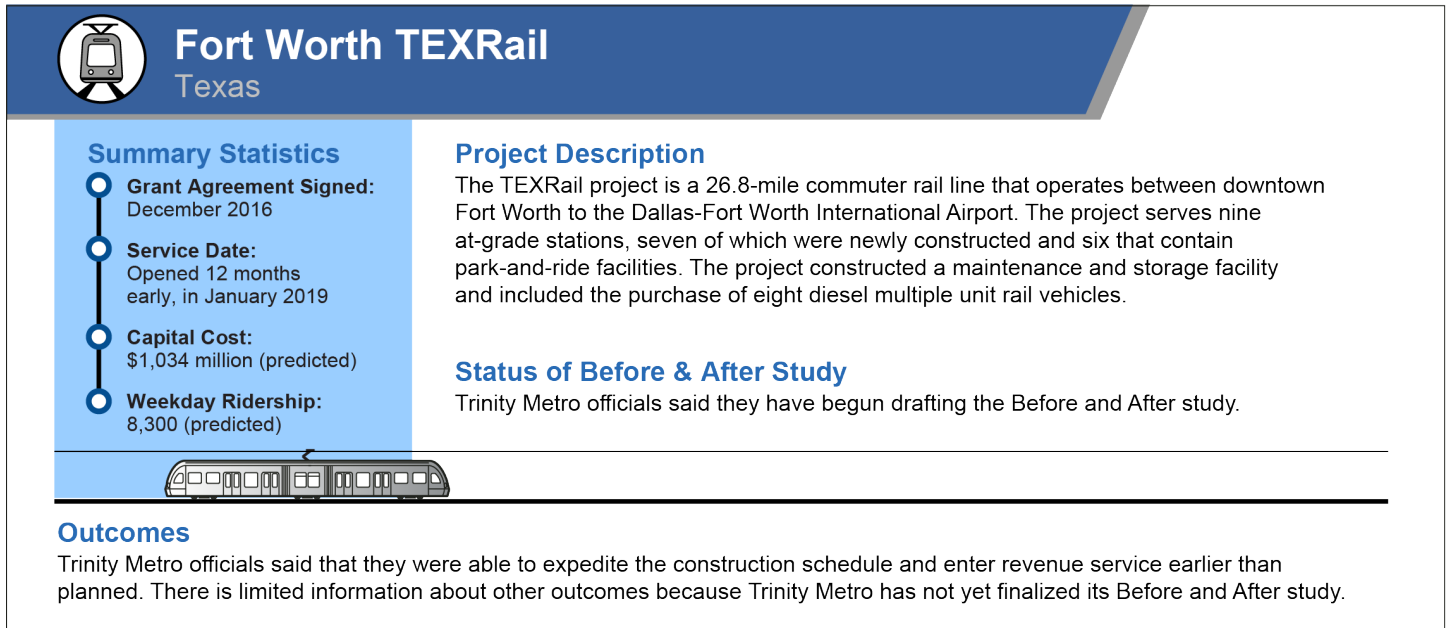
Denver Regional Transportation District plans to complete two separate studies. It has begun drafting the Before and After study for the A-Line project and has not yet begun the G-Line study.

Outcomes

The Denver Eagle project combined the construction of two commuter rail lines into one grant agreement. Both rail lines were predicted to enter service in 2016. However, although both were completed in 2016, the Denver Regional Transportation District experienced operating delays with the G-Line's positive train control system, which delayed service for 28 months. There is limited information about other outcomes because Denver Regional Transportation District has not yet completed its Before and After studies.

Source: GAO analysis of Capital Investment Grants (CIG) project sponsors' information. | GAO-23-105479

Figure 6: Fort Worth TEXRail



Source: GAO analysis of Capital Investment Grants (CIG) project sponsors' information. | GAO-23-105479

Text of Figure 6: Fort Worth TEXRail

Fort Worth TEXRail, Texas

Summary Statistics:

- Grant Agreement Signed: December 2016
- Service Date: Opened 12 months early, in January 2019
- Capital Cost: \$1,034 million (predicted)
- Weekday Ridership: 8,300 (predicted)

Project Description

The TEXRail project is a 26.8-mile commuter rail line that operates between downtown Fort Worth to the Dallas-Fort Worth International Airport. The project serves nine at-grade stations, seven of which were newly constructed and six that contain park-and-ride facilities. The project

constructed a maintenance and storage facility and included the purchase of eight diesel multiple unit rail vehicles.

Status of Before and After Study

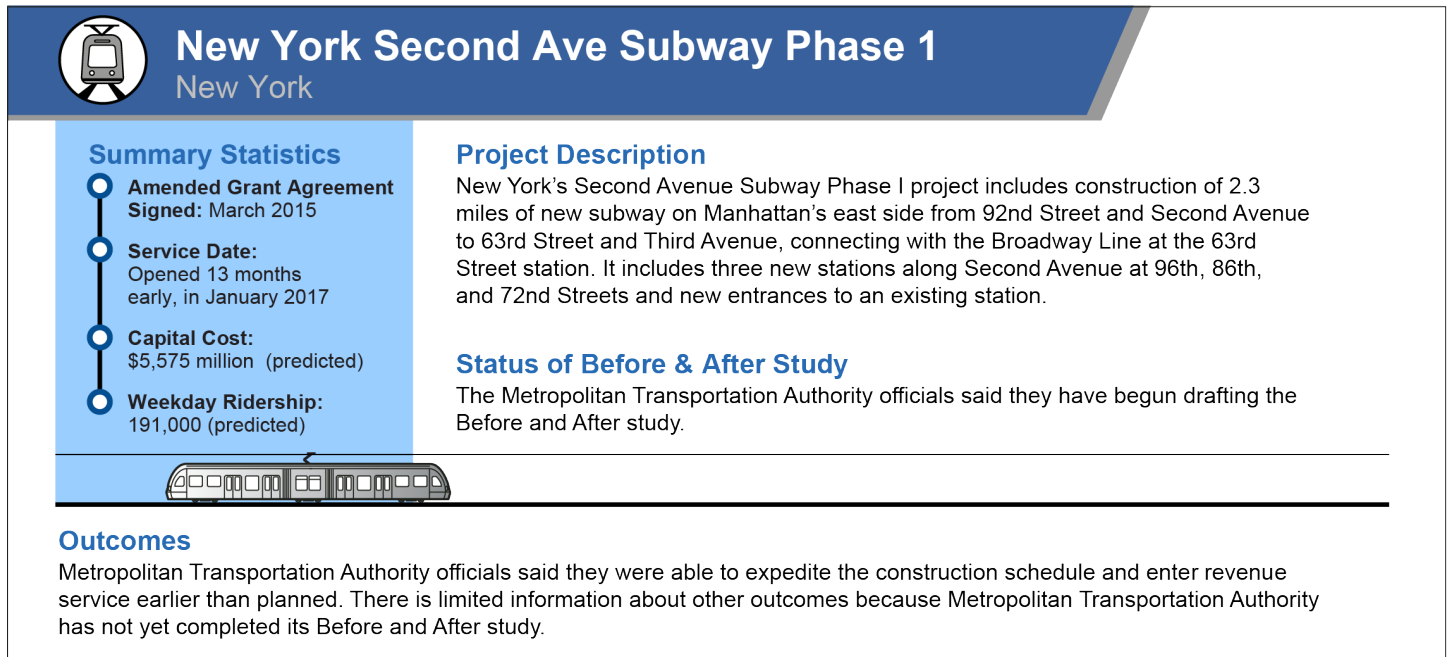
Trinity Metro officials said they have begun drafting the Before and After study.

Outcomes

Trinity Metro officials said that they were able to expedite the construction schedule and enter revenue service earlier than planned. There is limited information about other outcomes because Trinity Metro has not yet finalized its Before and After study.

Source: GAO analysis of Capital Investment Grants (CIG) project sponsors' information. | GAO-23-105479

Figure 7: New York Second Avenue Subway Phase 1



Source: GAO analysis of Capital Investment Grants (CIG) project sponsors' information. | GAO-23-105479

Text of Figure 7: New York Second Avenue Subway Phase 1

New York Second Ave Subway Phase 1

Summary Statistics:

- Amended Grant Agreement Signed: March 2015
- Service Date: Opened 13 months early, in January 2017
- Capital Cost: \$5,575 million (predicted)
- Weekday Ridership: 191,000 (predicted)

Project Description

New York's Second Avenue Subway Phase I project includes construction of 2.3 miles of new subway on Manhattan's east side from 92nd Street and Second Avenue to 63rd Street and Third Avenue, connecting with the Broadway Line at the 63rd Street station. It includes three new stations along Second Avenue at 96th, 86th, and 72nd Streets and new entrances to an existing station.

Status of before and after study

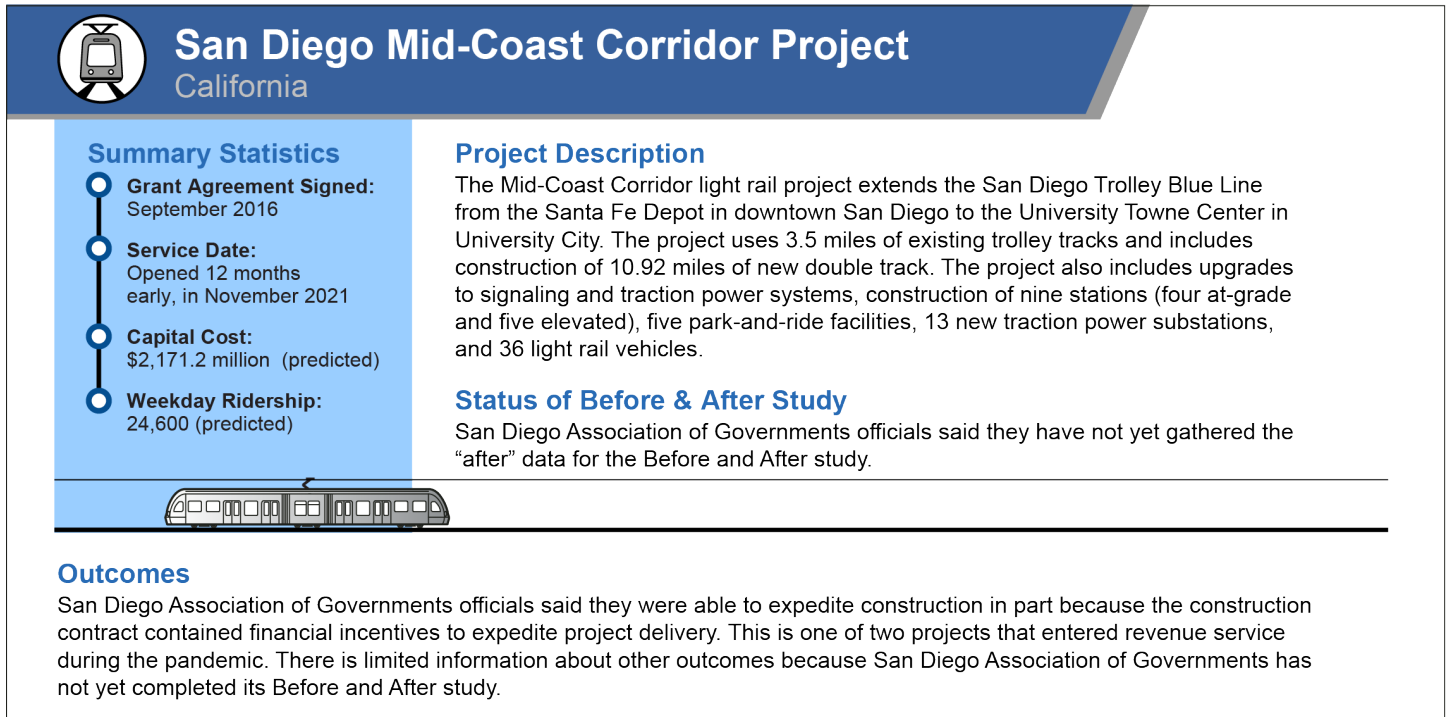
The Metropolitan Transportation Authority officials said they have begun drafting the Before and After study.

Outcomes

Metropolitan Transportation Authority officials said they were able to expedite the construction schedule and enter revenue service earlier than planned. There is limited information about other outcomes because Metropolitan Transportation Authority has not yet completed its Before and After study.

Source: GAO analysis of Capital Investment Grants (CIG) project sponsors' information. | GAO-23-105479

Figure 8: San Diego Mid-Coast Corridor Project



Source: GAO analysis of Capital Investment Grants (CIG) project sponsors' information. | GAO-23-105479

Text of Figure 8: San Diego Mid-Coast Corridor Project

San Diego Mid-Coast Corridor Project, California

Summary Statistics:

- Grant Agreement Signed: September 2016
- Service Date: Opened 12 months early, in November 2021
- Capital Cost: \$2,171.2 million (predicted)
- Weekday Ridership: 24,600 (predicted)

Project Description

The Mid-Coast Corridor light rail project extends the San Diego Trolley Blue Line from the Santa Fe Depot in downtown San Diego to the University Towne Center in University City. The project uses 3.5 miles of existing trolley tracks and includes construction of 10.92 miles of new double track. The project also includes upgrades to signaling and traction power systems, construction of nine stations (four at-grade and five elevated), five park-and-ride facilities, 13 new traction power substations, and 36 light rail vehicles.

Status of before and after study

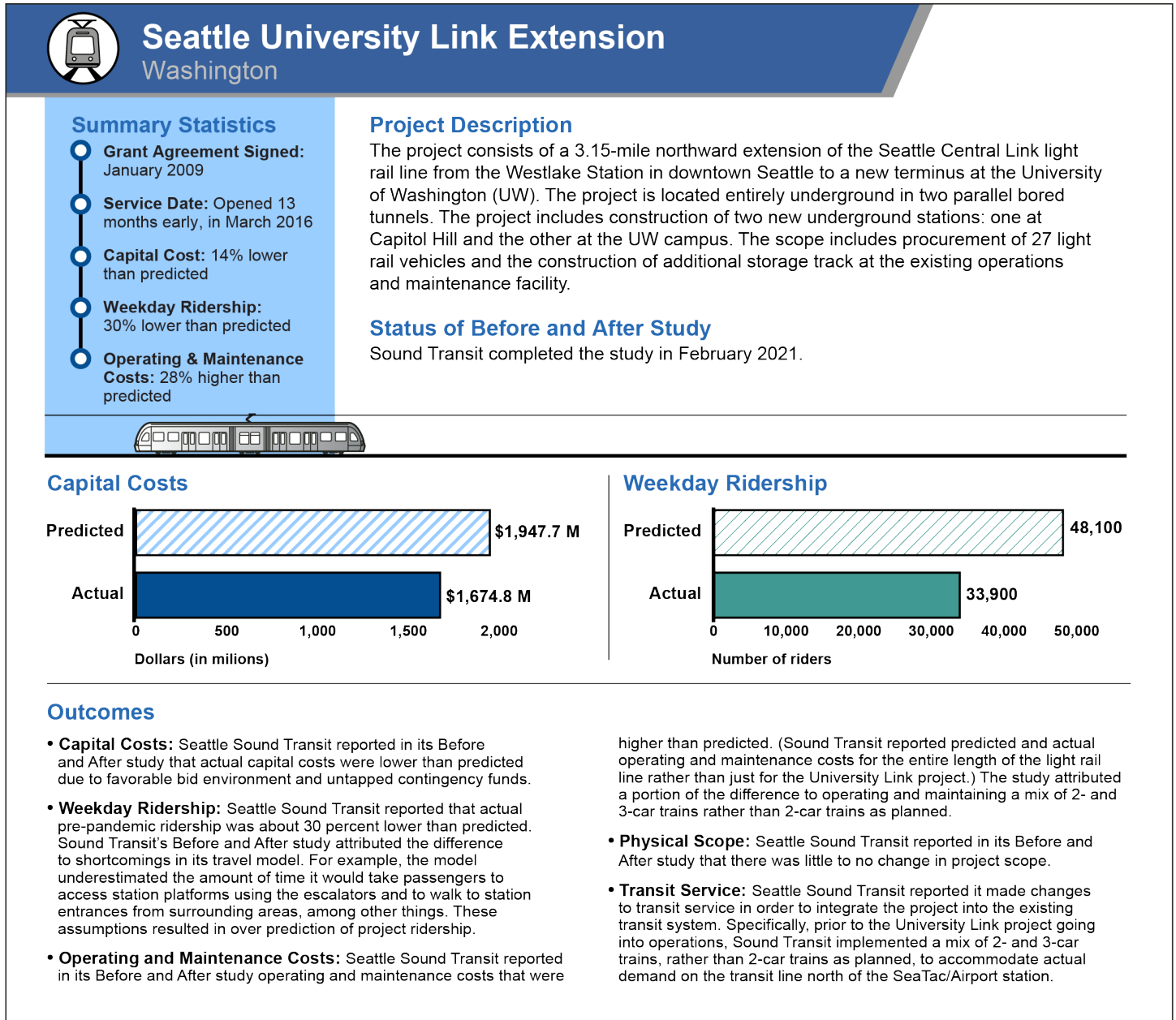
San Diego Association of Governments officials said they have not yet gathered the “after” data for the Before and After study.

Outcomes

San Diego Association of Governments officials said they were able to expedite construction in part because the construction contract contained financial incentives to expedite project delivery. This is one of two projects that entered revenue service during the pandemic. There is limited information about other outcomes because San Diego Association of Governments has not yet completed its Before and After study.

Source: GAO analysis of Capital Investment Grants (CIG) project sponsors' information. | GAO-23-105479

Figure 9: Seattle University Link Extension



Source: GAO analysis of Capital Investment Grants (CIG) project sponsors' information. | GAO-23-105479

Text of Figure 9: Seattle University Link Extension

Seattle University Link Extension, Washington

Summary Statistics:

- Grant Agreement Signed: January 2009
- Service Date: Opened 13 months early, in March 2016
- Capital Cost: 14% lower than predicted
- Weekday Ridership: 30% lower than predicted
- Operating & Maintenance Costs: 28% higher than predicted

Project Description

The project consists of a 3.15-mile northward extension of the Seattle Central Link light rail line from the Westlake Station in downtown Seattle to a new terminus at the University of Washington (UW). The project is located entirely underground in two parallel bored tunnels. The project includes construction of two new underground stations: one at Capitol Hill and the other at the UW campus. The scope includes procurement of 27 light rail vehicles and the construction of additional storage track at the existing operations and maintenance facility.

Status of Before and After Study

Sound Transit completed the study in February 2021.

Capital Costs

- Predicted: \$1,947.7 million
- Actual: \$1,674.8 million

Weekly Ridership

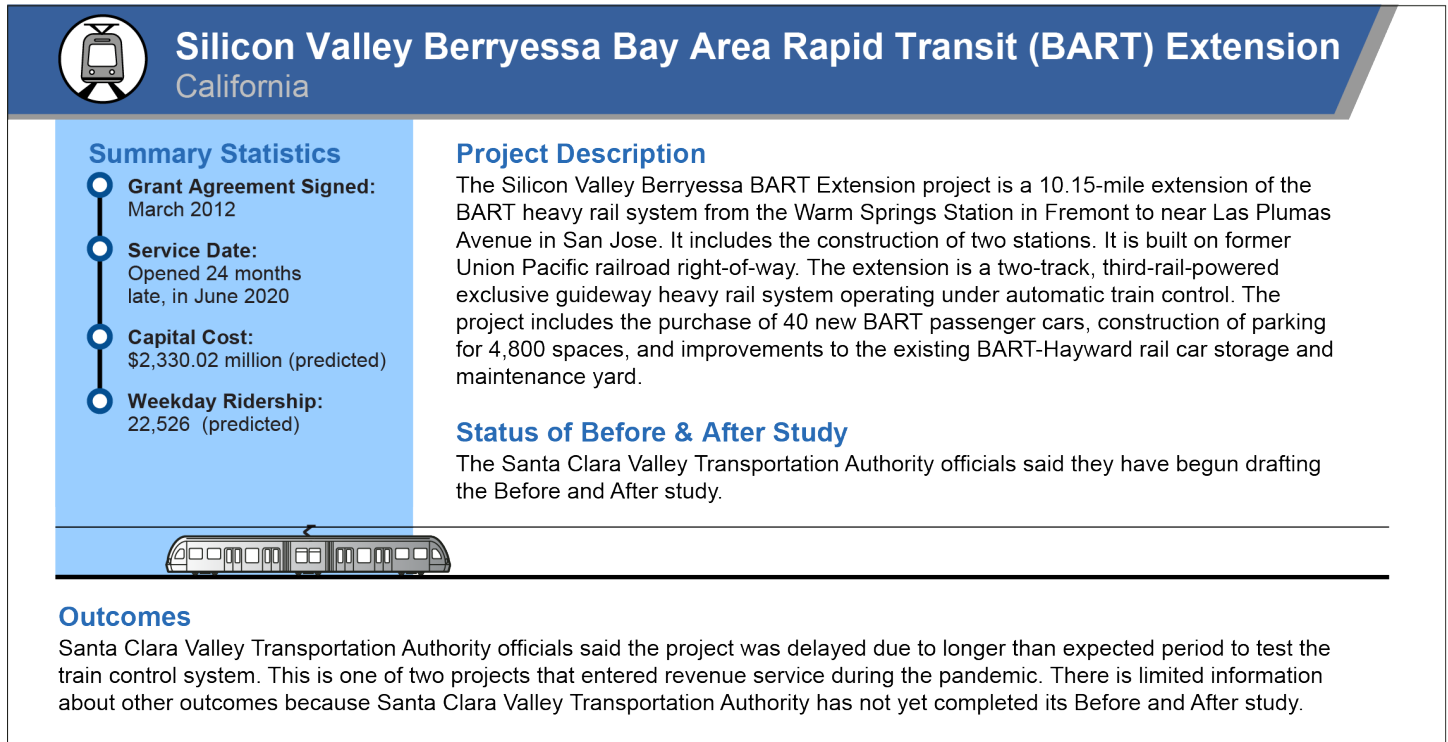
- Predicted: 48,100
- Actual: 33,900

Outcomes

- **Capital Costs:** Seattle Sound Transit reported in its Before and After study that actual capital costs were lower than predicted due to favorable bid environment and untapped contingency funds.
- **Weekday Ridership:** Seattle Sound Transit reported that actual pre-pandemic ridership was about 30 percent lower than predicted. Sound Transit's Before and After study attributed the difference to shortcomings in its travel model. For example, the model underestimated the amount of time it would take passengers to access station platforms using the escalators and to walk to station entrances from surrounding areas, among other things. These assumptions resulted in over prediction of project ridership.
- **Operating and Maintenance Costs:** Seattle Sound Transit reported in its Before and After study operating and maintenance costs that were higher than predicted. (Sound Transit reported predicted and actual operating and maintenance costs for the entire length of the light rail line rather than just for the University Link project.) The study attributed a portion of the difference to operating and maintaining a mix of 2- and 3-car trains rather than 2-car trains as planned.
- **Physical Scope:** Seattle Sound Transit reported in its Before and After study that there was little to no change in project scope.
- **Transit Service:** Seattle Sound Transit reported it made changes to transit service in order to integrate the project into the existing transit system. Specifically, prior to the University Link project going into operations, Sound Transit implemented a mix of 2- and 3-car trains, rather than 2-car trains as planned, to accommodate actual demand on the transit line north of the SeaTac/Airport station.

Source: GAO analysis of Capital Investment Grants (CIG) project sponsors' information. | GAO-23-105479

Figure 10: Silicon Valley Berryessa Bay Area Rapid Transit Extension



Source: GAO analysis of Capital Investment Grants (CIG) project sponsors' information. | GAO-23-105479

Text of Figure 10: Silicon Valley Berryessa Bay Area Rapid Transit Extension

Silicon Valley Berryessa Bay Area Rapid Transit (BART) Extension, California

Summary Statistics:

- Grant Agreement Signed: March 2012
- Service Date: Opened 24 months late, in June 2020
- Capital Cost: \$2,330.02 million (predicted)
- Weekday Ridership: 22,526 (predicted)

Project Descriptions

The Silicon Valley Berryessa BART Extension project is a 10.15-mile extension of the BART heavy rail system from the Warm Springs Station in Fremont to near Las Plumas Avenue in San Jose. It includes the construction of two stations. It is built on former Union Pacific railroad right-of-way. The extension is a two-track, third-rail-powered exclusive guideway heavy rail system operating under automatic train control. The project includes the purchase of 40 new BART passenger cars, construction of parking for 4,800 spaces, and improvements to the existing BART-Hayward rail car storage and maintenance yard.

Status of before and after study

The Santa Clara Valley Transportation Authority officials said they have begun drafting the Before and After study.

Outcomes

Santa Clara Valley Transportation Authority officials said the project was delayed due to longer than expected period to test the train control system. This is one of two projects that entered revenue service during the pandemic. There is limited information about other outcomes because Santa Clara Valley Transportation Authority has not yet completed its Before and After study.

Source: GAO analysis of Capital Investment Grants (CIG) project sponsors' information. | GAO-23-105479

Appendix II: GAO Contact and Staff Acknowledgments

GAO Contact

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Staff Acknowledgments

In addition to the contact named above, Brandon Haller (Assistant Director); Gail Marnik (Analyst-in-Charge); Geoffrey Hamilton, Bonnie Pignatiello Leer; Anna Pechenina; Malika Rice; Kelly Rubin; and Laurel Voloder made key contributions to this report.

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