Orange Line
Operating and Maintenance Costs

Draft for Public Review and Comment

projectconnect
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Operating and Maintenance Costs Memorandum

This technical memorandum presents the service planning assumptions and order of magnitude operating and maintenance (O&M) cost estimates for the Project Connect Orange Line. Determining the annually recurring O&M costs for the project is a key component in establishing financial feasibility. O&M costs include all costs associated with the day-to-day operation, maintenance, and administration of a service concept after all capital infrastructure is in place. O&M costs account for employee earnings and fringe benefits, contract services, materials and supplies, utilities, fuel or propulsion costs, insurance, advertising, and other administrative costs.

Alternatives evaluated for the Orange Line Corridor include a No-Build Alternative, Transportation System Management (TSM) Alternative, and a Build Alternative with two vertical profile design options. O&M cost estimates were developed using an excel-based cost model that relies upon running time estimates, service plan assumptions, and cost variables to derive unit costs and vehicle requirements. Operating costs were also developed for the proposed local service changes to be made upon implementation of project alternatives.

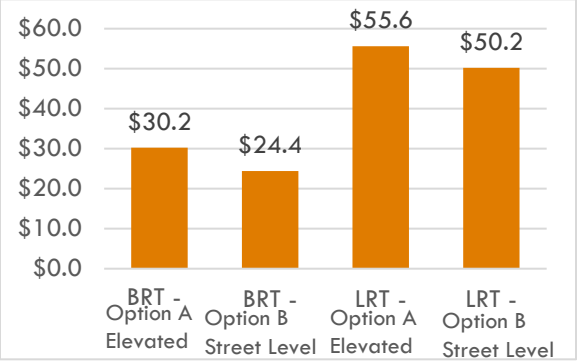
O&M Costs Executive Summary

As shown in **Figure 1**, O&M costs for the Orange Line corridor range from $24.4 million (2028) for BRT service on the primarily street level design Option B to $55.6 million (2028) for LRT design Option A (50% elevated). The higher range represents a recalculation of previous cost estimates of $47 million to $49 million.

LRT alternatives are associated with higher unit costs per revenue hour of service provided but are also associated with increased ridership and a higher carrying capacity. BRT alternatives are associated with lower unit costs, lower ridership and a lower-capacity vehicle.

For both LRT and BRT modes, costs associated with design Option A are higher as a result of additional service levels needed to accommodate higher expected ridership.

Figure 1. Orange Line O&M Costs



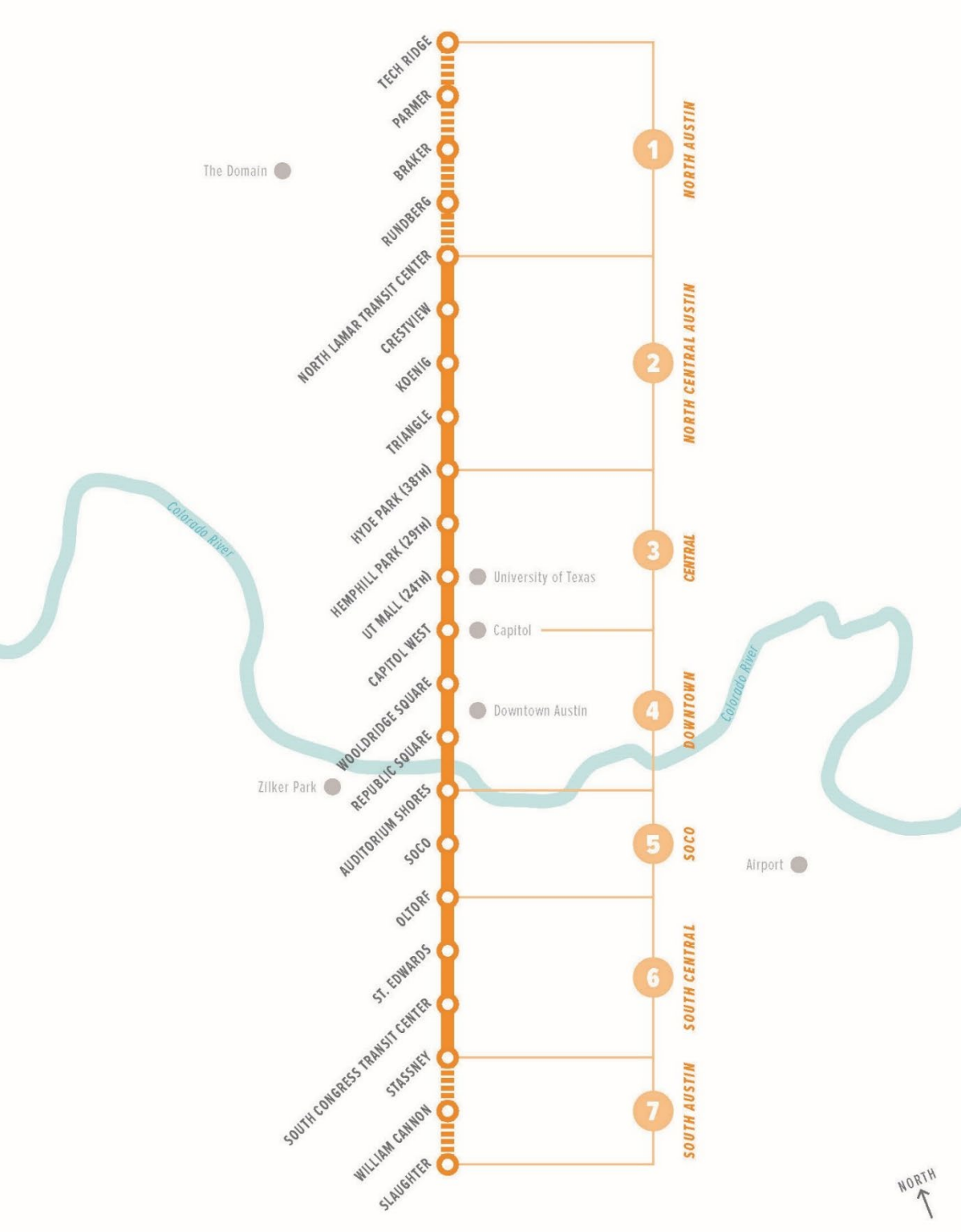
In addition to the costs for the Orange Line high capacity transit corridor, changes to the underlying bus network, including elimination of MetroRapid 801, would result in a reduction in revenue hours and miles. It is estimated that this decrease in service would generate an annual incremental savings of approximately $15.2 million (2028) for all Build Scenarios.

Project Description

Project Connect is the community's plan for a complete system of reliable and frequent transit operating in a congestion-proof environment free from other traffic. The Orange Line is one of two High Capacity Transit (HCT) corridors and would establish the north/south spine of the Project Connect system.

The Orange Line is a 21-mile corridor, currently served by MetroRapid 801, from Tech Ridge at the northern end, to Southpark Meadows near Congress and Slaughter Lane at the southern end. As shown on **Figure 2**, the Project Connect Orange Line Corridor is divided into seven segments to facilitate project evaluation and LPA selection. Segment 1 (between 183 and Tech Ridge) and Segment 7 (between Stassney and Slaughter) require additional coordination with the Texas Department of Transportation.

Figure 2. Orange Line Segmentation

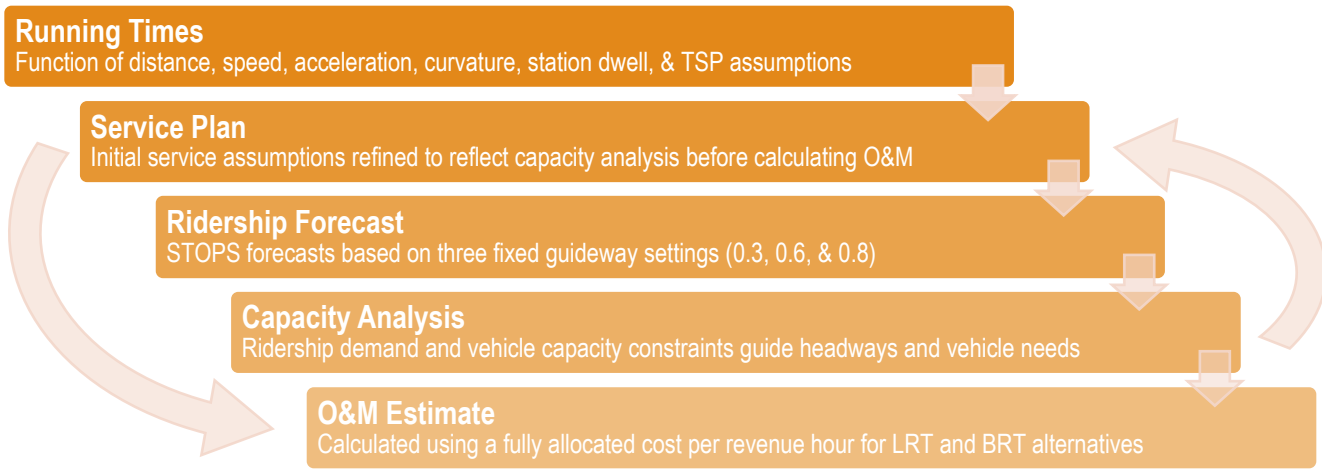


NOTE: GRAPHIC REPRESENTATION OF STATIONS IS NOT A SCALE MAP

Overview

Project Connect Orange Line O&M costs are an output of several steps and inputs illustrated in **Figure 3.** The process was completed in coordination with the Blue Line Corridor project team and Capital Metro staff including the Project Connect Office, service planning, and the Finance Department. More detailed methodology is included for each step in this process in the following sections.

Figure 3. Overview of O&M Cost Process



Running Times

Methodology

Running times were estimated for each design option using a spreadsheet running time model. Running time estimates were calculated based on distance between stations; posted roadway speeds; vehicle speed and acceleration capabilities; guideway curvature; signal delay; and estimated dwell times at stations.

This analysis uses a standard acceleration and deceleration rate of 2.7 mph/s to calculate travel times for both modes. In addition, the effective maximum speed for both modes would not exceed 55 mph. Guideway curvature is assessed a 30 second penalty for both LRT and BRT options.

Predictive signal priority is assumed for all street-level profiles along the Orange Line corridor. Segments that are grade separated, including elevated, cut-and-cover, or bored tunnel transitway profiles, will not encounter any signal delay. Probability of encountering a red signal will be determined based on the following conditions:

- **Central Business District.** Boundary from Cesar Chavez Street to Martin Luther King Jr Boulevard with a 40 percent probability of encountering a red signal.
- **Urbanized Area.** Boundary from Martin Luther King Jr Boulevard to Dean Keaton Street to the north and from the Cesar Chavez Street to Oltorf Street on the south with a 20 percent probability of encountering a red signal.
- **Outlying Area.** Boundary from Dean Keaton Street to Tech Ridge on the north and from Oltorf Street to Slaughter Street on the south with a 10 percent probability of encountering a red signal.

The model accounts for acceleration/deceleration and 15 seconds of signal delay at any encountered signal. These predictive signal priority assumptions were developed in coordination with City of Austin representatives.

The running time estimates include dwell times that vary by station based on the preliminary ridership modeling for the Orange Line Corridor. Dwell time assumptions do not include additional delay due to fare collection; it is assumed that the Orange Line would use fully off-board fare collection. **Table 1** summarizes the dwell times assumed based on preliminary ridership forecasts.

Table 1: Dwell Time Assumptions

BRT Boardings	LRT Boardings	Dwell Time
15 or less	170 or less	20 seconds
16 - 34	171-290	30 seconds
35 or more	291or more	40 seconds

Results

As a result of similar speed, acceleration, and curvature assumptions, LRT and BRT alternatives result in similar travel times. A small variation of less than one minute resulting from different dwell time assumptions for BRT and LRT was within the margin of error for travel time calculations. Estimated running times used for both the Orange Line LRT and BRT alternatives are shown in **Table 2.**

Table 2: LRT and BRT Running Time Estimates

LRT or BRT Profile Design Option	Option A 50% Elevated	Option B 90% Street Level
Running Time (NB)	42 min	53 min
Running Time (SB)	43 min	53 min
Total Running Time[1]	84 min	106 min
Total Distance	38 miles	38 miles
Average Speed	27 mph	21 mph

[1] *Excludes Recovery/Layover*

Preliminary Service Plan Assumptions

Four service plan scenarios considered for the Project include:

- No-Build Scenario
- TSM Scenario
- Build Scenario
  - Design Option A- Elevated
  - Design Option B- Street Level

Each Build Scenario design option includes LRT and BRT mode choices, for a total of four Build Scenario options.

No-Build Scenario

The No-Build scenario represents the base level of service against which all other scenarios are compared. It amends the existing transportation network to reflect the fiscally constrained transportation improvements outlined in the CAMPO 2040 Regional Transportation Plan[1] with the exception of the project itself. This includes the 485 road projects listed in Table 32 and 79 transit projects (excluding the North Lamar/South Congress BRT) identified in Table 33 of the CAMPO Plan.

TSM Scenario

Projects included in the TSM scenario are informed by Capital Metro's Transit Development Plan (TDP) Connections 2025 and input from Capital Metro staff. Connections 2025 contains a summary of the improvements for the Capital Metro system and a list of specific alignment changes by route as well as a few transit priority lane projects.

Table 3 contains the transit priority lane improvements included in the TSM Scenario. These projects facilitate the movement of buses by providing a lane separate from congestion for bus operations. **Table 4** identifies the Capital Metro route improvements assumed for the TSM scenario. The TSM does not include the Connections 2025 recommendation to consolidate the Route 801 and Route 1 at 1/3-mile stop spacing and 7.5-minute headways. Consolidation would make the route less desirable for longer trips due to higher travel times with more frequent stops. The TSM instead maintains local service on Route 1 and Rapid service on Route 801 consistent with the No-Build.

Table 3: TSM Transit Priority Lane Improvements

Location	Service Modification
South 1st Street Bridge	Expansion of the transit priority lanes on Guadalupe and Lavaca over the South 1st Street Bridge to Riverside Drive. This improvement coincides with the move of MetroRapid 803 service to the South 1st St. bridge. The installation of a transit priority lane would allow for increased person throughput and improved travel times over the limited north-south crossing.
Guadalupe between MLK and 38th Street	Expansion of the existing transit priority lanes north through The Drag and beyond to improve the reliability of MetroRapid and other bus routes. Synchronizing traffic signals, optimizing Transit Signal Priority, and improving pedestrian crossings can help maximize the value of the transit priority lanes while enhancing pedestrian crossing safety. The priority lanes would operate as very effective continuous queue jumps, especially if vehicle right turns are separated from the transit lanes.
7th Street between Guadalupe and IH-35	Creating a transit priority lane on 7th Street in both directions for the MetroRapid Route 804 to utilize. Right now, 7th Street through downtown Austin is an eastbound four-lane, one-way street. Having either dedicated transit lanes in both directions or a contraflow bus-only lane would allow for faster direct east-west service through downtown.

[1] Capital Area Metropolitan Planning Organization, 2040 RTP, https://47kzwj6dn1447gy9z7do16an-wpengine.netdna-ssl.com/wp-content/uploads/2018/03/CAMPO2040PlanFinal.pdf

Table 4: TSM Route Improvements

Route	Service Modification	Headways (Peak/Off-Peak)	M-F Span (Hours)	Annual Revenue Hours	Annual Revenue Miles	Change in peak vehicles
4 Montopolis	Increase headway to 30 minutes and reduce service span to operate from 6:00 a.m. – midnight. Operate as an underlying local service for proposed MetroRapid 804. Reduce service span to operate from 6:00 a.m. – midnight.	30/30	18	- 13,000	- 109,000	- 2
20 Manor Rd. /Riverside	Increase headway to 30 minutes and reduce service span to operate from 6:00 a.m. – midnight. Operate as an underlying local service for proposed MetroRapid 820. Reduce service span to operate from 6:00 a.m. – midnight.	30/30	18	- 36,000	- 434,000	- 5
801 North Lamar /South Congress	**New Alignment and Improved Frequency.** Service would operate on North Lamar to Howard/Tech Ridge.	10/10	24	+ 59,000	+ 838,000	+ 6
803 Burnet /South Lamar	**New Alignment and Improved Frequency.** Route 803 would terminate at the proposed Kramer Station and would no longer deviate to travel within the JJ Pickle Research Campus. Route would cross the First Street Bridge (instead of the Lamar Blvd. Bridge) and continue via 1st St., Barton Springs Rd., and Lamar Blvd. Route's southern terminus has been extended along S Lamar Blvd. to terminate at Slaughter Ln. and Manchaca St.	10/10	24	+ 80,000	+ 974,000	+ 16
804 7th Street	**New MetroRapid Route.** Route would travel bidirectionally through downtown on 7th Street with eastern terminus at the new transit hub (5th St. and Shady Ln.) and western terminus at UT Gateway Apartments (5th St. and Campbell). Proposed MetroRapid would use consolidated stations identified in the Project Connect Long Term Vision Plan.	10/10	24	+ 49,000	+ 452,000	+ 7
820 Riverside /Manor	**New MetroRapid Route.** Route would terminate at the Austin Bergstrom International Airport, with service on Riverside Drive, through Downtown via the Guadalupe St./Lavaca St. couplet, Dean Keeton St., and Manor Rd. The route's northern terminus would be the Springdale Shopping Center. Proposed MetroRapid would use consolidated stations identified in the Project Connect Long Term Vision Plan.	10/10	24	+ 120,000	+ 1,572,000	+15
550 MetroRail Red Line	**Improved Frequency.** Service would become more frequent between Kramer and Downtown, with service every 15 minutes all day.	15/15	18	+ 28,000	+ 879,000	+ 7
Total				+ 287,000	+ 4,172,000	+ 44

Build Scenario

Preliminary service plans used to forecast ridership for all Orange Line Build Alternatives assume the spans and headways shown in **Table 5.** Calculations of round-trip cycle time for each Orange Line corridor design option include a minimum recovery time of 15 percent of the running time plus additional layover as needed to ensure an even headway between runs. These preliminary Orange Line service plans were revised based on ridership forecasts and the capacity analysis described in the following section.

Table 5: Preliminary Service Plan Assumptions for Build Scenario BRT and LRT options

Time Period	Service Schedule	Service Span	Headway (Min.)
Weekday Early AM	5:00 a.m. - 6:30 a.m.	1.5 hours	15
Weekday Day Time & Peaks	6:30 a.m. - 7:30 p.m.	13.0 hours	10
Weekday Evening to Close	7:30 p.m. - 3:50 a.m.	8.3 hours	15
Saturday Early AM	5:00 a.m. - 6:30 a.m.	1.5 hours	15
Saturday Day Time	6:30 a.m. - 7:30 p.m.	13.0 hours	15
Saturday Evening to Close	7:30 p.m. - 3:50 a.m.	8.3 hours	15
Sunday Early AM	5:00 a.m. - 6:30 a.m.	1.5 hours	15
Sunday Day Time	6:30 a.m. - 7:30 p.m.	13.0 hours	15
Sunday Evening to Close	7:30 p.m. - 12:50 a.m.	5.3 hours	15

A street-level design for the South Congress Transit Center Station (required under Option B) would be located approximately 0.3 miles south at the intersection of S. Congress and St. Elmo's to avoid additional turning movements too close to Ben White. It is recommended that the SCTC bus pull-in facility be similarly relocated closer to St. Elmo's to better accommodate transfers.

Except for the SCTC bus bay location, the underlying bus network would be consistent for all Build Scenario design options. **Table 6** outlines the proposed changes to bus routes across all Build Alternatives as compared to the No-Build scenario. The elimination of Route 801 is the dominant influence driving incremental bus O&M costs. Compared to existing schedules and recovery allowances, the changes proposed to Route 7 and Route 324 are minor and would not require additional revenue hours, vehicles, or facilities to operate. Similarly, proposed changes to Route 333 are not substantial enough to warrant schedule adjustments or reduction in vehicles.

Table 6 also summarizes the routes that would be affected by the potential relocation of the South Congress Transit Center under Option B only. As shown, these minor changes result only in additional miles for Route 315 and mileage savings for Routes 1 and 486. Given uncertainty in the estimate regarding the location of the SCTC bus bays and turn-in location and the relatively minor impact on services, it is assumed that operational changes associated with relocation of the SCTC could be accommodated within the existing cycle times for each route without need for additional vehicles or revenue hours.

Table 6: Build Scenario Background Bus Network Changes (All design options)

Route	Service Modification	Headways (Peak/Off-Peak)	Change to Trip length (round trip miles)	Travel Time Fits Existing Schedule
All Build Scenario Design Options				
801 North Lamar/South Congress	**Service replaced by Orange Line.**	N/A	No Service	No Service
333 William Cannon	**Route Adjustment.** Route 333 would provide direct operation along William Cannon between several multi-family residences and the proposed Pleasant Hill Station. Route would no longer deviate along Meadow Lake, Blue Meadow, and Bluff Springs. Changes result in a travel time savings of 2 minutes per one-way trip.	15/30	- 1.0	Yes
007 Duval/ Dove Springs	**Route Adjustment.** The south end of Route 007 would deviate along Meadow Lake, Blue Meadow, and Bluff Springs to provide coverage to the neighborhoods previously served by Route 333. Changes result in an additional 2 minutes of travel time per one-way trip.	15/30	+ 1.0	Yes
324 Georgian/ Ohlen	**Route Adjustment.** Route 324 would be rerouted along St. John's, North Lamar, and Airport Blvd. to provide a direct connection at the Crestview Station. Changes result in an additional 2 minutes of travel time per one-way trip.	30/30	+ 0.8	Yes
Design Option B: South Congress Transit Center				
1 North Lamar/South Congress	**Route Adjustment.** Route 1 would no longer turn onto Radam Lane and would access a new SCTC bay located along the route on South Congress Avenue.	No change	- 0.5	Yes
310 Parker/ Wickersham	**Route Adjustment.** Route would no longer turn east onto Radam Lane and would instead turn south on South Congress Avenue to access a new SCTC bus bay, at a roughly equivalent distance.	No change	No change	Yes
315 Ben White	**Route Adjustment.** Route 315 would require extension along Radam Lane, turning south onto S Congress Ave. to access a new SCTC bus bay.	No change	+ 0.6	Yes
486 Night Owl/ South Congress	**Route Adjustment.** Route 486 would no longer turn onto Radam Lane and would access a new SCTC bay located along the route on South Congress Avenue.	No change	- 0.5	Yes

Capacity Analysis

Methodology

A capacity analysis was completed to ensure adequate vehicle capacity based on vehicle assumptions, service plan assumptions, and forecasted ridership. The capacity analysis relied upon revised 2028 STOPS ridership forecasts for both BRT and LRT. More details regarding ridership forecasts are available in the Project Connect Orange Line Ridership Technical Memorandum. The capacity analysis for LRT uses STOPS ridership forecasts with a fixed guideway setting (FGS) of 0.8. The analysis for BRT uses forecasts with an FGS of 0.6 for elevated options and 0.3 for street-level options. Ridership was factored to peak hour peak direction maximum passenger loads for each service span using factors derived from current Capital Metro system-wide ridership. The factored maximum passenger loads were then compared with vehicle capacity for each alternative to identify potential capacity problems. Vehicle assumptions are shown in **Table 7**.

Where preliminary service plan assumptions did not supply enough capacity, the service plan was modified to meet forecasted demand and peak hour peak direction loads.

For LRT spans requiring additional capacity, the number of rail cars per trainset was increased to a maximum of three cars. The number of cars per trainset is limited by the length of platforms. Where additional LRT capacity was needed beyond that provided by a three-car trainset, headways were adjusted to 7.5 minutes or 5 minutes, as necessary.

For BRT spans requiring additional capacity, headways were first adjusted to either 7.5 minutes or 5 minutes. If additional capacity was needed beyond that provided by a five-minute headway, service plans were adjusted to reflect two BRT vehicles running in a platooned fashion every 5 minutes for a maximum of 24 vehicles per hour. BRT capacity is limited by its potential to interfere with signal timing along street-level profiles and potential impacts to surrounding traffic.

Table 7: Vehicle Assumptions

Vehicle Assumptions	BRT	LRT
Vehicle Characteristics	60-foot domestic BRT vehicle 5 doors per vehicle	Low-Floor LRV 4 doors per train car
Vehicle Capacity	115 total passengers	172 total passengers

Note: Vehicle capacities determined through a review of literature and vehicle specifications, contact with several agencies using similar vehicles, and coordination with Capital Metro staff. The assumed BRT capacity aligns with an average from several sources including the Transit Capacity and Quality of Service Manual, Third Edition.

Results

Table 8 provides a summary of the capacity analysis results for 2028 (opening year). **Table 9** provides a summary of the capacity analysis results for 2040. The weekday time periods shown represent the following hours:

- **Early AM.** 5:00 a.m. – 6:30 a.m.
- **AM Peak.** 6:30 a.m. – 9:00 a.m.
- **Midday.** 9:00 a.m. – 2:00 p.m.
- **PM Peak.** 2:00 p.m. – 6:00 p.m.
- **Evening.** 6:00 p.m. – 7:30 p.m.
- **Night.** 7:30 p.m. – 3:50 a.m.

Spans highlighted in orange indicate peak loads requiring two platooned BRT vehicles. Spans highlighted in red indicate peak loads which may exceed the capacity of two BRT vehicles every five minutes. In 2040, ridership forecasts and assumed peak hour factors indicate that Option A peak hour demand may exceed capacity by approximately 45 riders/hour. This is within the margin of error for this analysis. Given the variability regarding vehicle platooning capabilities (for non-automated or automated vehicle types) and potential impacts on signal timing, service plans were not modified further.

Table 8: 2028 Capacity Analysis Results

Mode		BRT		LRT	
Design Option		**Option A 50% Elevated**	**Option B 90% Street Level**	**Option A 50% Elevated**	**Option B 90% Street Level**
Average Weekday Ridership		47,897	33,172	54,278	47,212
Weekday Early AM	Cycle Time (min)	100	135	105	135
	Headway (min)	10	15	15	15
	Vehicles/Cars	1	1	2	1
Weekday AM Peak	Cycle Time (min)	100	125	100	130
	Headway (min)	5	5	10	10
	Vehicles/Cars	2	1	3	2
Weekday Midday	Cycle Time (min)	100	125	100	130
	Headway (min)	5	5	10	10
	Vehicles/Cars	2	1	2	2
Weekday PM Peak	Cycle Time (min)	100	125	100	130
	Headway (min)	5	5	10	10
	Vehicles/Cars	2	2	3	2
Weekday Evening	Cycle Time (min)	97.5	130	100	130
	Headway (min)	7.5	10	10	10
	Vehicles/Cars	1	1	2	1
Weekday Night	Cycle Time (min)	100	135	105	135
	Headway (min)	10	15	15	15
	Vehicles/Cars	1	1	2	1
Saturday Early AM	Cycle Time (min)	100	135	105	135
	Headway (min)	10	15	15	15
	Vehicles/Cars	1	1	1	1
Saturday Midday	Cycle Time (min)	100	130.0	105.0	135
	Headway (min)	5	10	15	15
	Vehicles/Cars	1	1	2	2
Saturday Evening	Cycle Time (min)	100	135	105	135
	Headway (min)	10	15	15	15
	Vehicles/Cars	1	1	1	1
Sunday Early AM	Cycle Time (min)	105	135	105	135
	Headway (min)	15	15	15	15
	Vehicles/Cars	1	1	1	1
Sunday Midday	Cycle Time (min)	100	130	105	135
	Headway (min)	10	10	15	15
	Vehicles/Cars	1	1	2	1
Sunday Evening	Cycle Time (min)	105	135	105	135
	Headway (min)	15	15	15	15
	Vehicles/Cars	1	1	1	1

Table 9: 2040 Capacity Analysis Results

Mode		BRT		LRT	
Design Option		**Option A 50% Elevated**	**Option B 90% Street Level**	**Option A 50% Elevated**	**Option B 90% Street Level**
Average Weekday Ridership		65,620	45,338	73,576	61,620
Weekday Early AM	Cycle Time (min)	97.5	130	105	135
	Headway (min)	7.5	10	15	15
	Vehicles/Cars	1	1	2	2
Weekday AM Peak	Cycle Time (min)	100	125	100	130
	Headway (min)	5	5	10	10
	Vehicles/Cars	2	2	3	3
Weekday Midday	Cycle Time (min)	100	125	100	130
	Headway (min)	5	5	10	10
	Vehicles/Cars	2	1	3	2
Weekday PM Peak	Cycle Time (min)	100	125	97.5	130
	Headway (min)	5	5	7.5	10
	Vehicles/Cars	2	2	3	3
Weekday Evening	Cycle Time (min)	100	127.5	100	130
	Headway (min)	5	7.5	10	10
	Vehicles/Cars	1	1	2	2
Weekday Night	Cycle Time (min)	97.5	130	105	135
	Headway (min)	7.5	10	15	15
	Vehicles/Cars	1	1	2	2
Saturday Early AM	Cycle Time (min)	100	135	105	135
	Headway (min)	10	15	15	15
	Vehicles/Cars	1	1	2	1
Saturday Midday	Cycle Time (min)	100	127.5	105	135
	Headway (min)	5	7.5	15	15
	Vehicles/Cars	1	1	3	2
Saturday Evening	Cycle Time (min)	100	130	105	135
	Headway (min)	10	10	15	15
	Vehicles/Cars	1	1	2	1
Sunday Early AM	Cycle Time (min)	105	135	105	135
	Headway (min)	15	15	15	15
	Vehicles/Cars	1	1	1	1
Sunday Midday	Cycle Time (min)	100	130	105	135
	Headway (min)	5	10	15	15
	Vehicles/Cars	1	1	2	2
Sunday Evening	Cycle Time (min)	105	135	105	135
	Headway (min)	15	15	15	15
	Vehicles/Cars	1	1	1	1

Capacity-Adjusted Service Plans

Methodology

No changes were made to the preliminary modeled No-Build Scenario or TSM scenario as a result of capacity planning. For Build scenarios, the background bus network and proposed span of service for the Orange Line are unchanged from the preliminary service plans described above. Only Orange Line headways and the number of vehicles in service were adjusted based on the capacity analysis.

Vehicle revenue hours and revenue miles are annualized based on a factor of 253 for weekday spans, 55 for Saturday spans, and 57 for Sunday spans.[2]

Peak vehicles are calculated as the maximum, across all service spans, of the round-trip cycle time for that span times the number of passenger cars per trainset (or platooned BRT vehicles) divided by the span's designated headway. Peak vehicles are multiplied by an assumed spare factor of 1.2 (spares equal to 20 percent of revenue vehicles) to inform fleet vehicle requirements.

Results

Service assumptions and characteristics for each Build Scenario option are included in **Table 10**. All vehicle needs and annual service characteristics are reported as the difference between each option and the No-Build Scenario.

Table 10: Build Scenario 2028 Service Characteristics

	BRT		LRT		Background Bus Network
Service Characteristic	**Option A 50% Elevated**	**Option B 90% Street Level**	**Option A 50% Elevated**	**Option B 90% Street Level**	**All Options**
One-way Travel Time (NB)	42 min	53 min	42 min	53 min	Varies
One-way Travel Time (SB)	43 min	53 min	43 min	53 min	Varies
Peak cycle time[1]	100 min	125 min	100 min	130 min	Varies
Transitway[2] Miles (Bi-directional)	38 miles	38 miles	38 miles	38 miles	N/A
Peak Vehicles	40	50	30	26	-22
Fleet Vehicles (includes 20% spare ratio)	48	60	36	32	N/A[3]
Annual Vehicle Revenue Hours	173,000	148,000	141,000	128,000	-110,000
Annual Vehicle Revenue Miles	3,937,000	2,637,000	3,144,000	2,202,000	-1,395,000

[1] *Peak Cycle Time reflects round trip cycle time including northbound travel time, southbound travel time, and layover*

[2] *Track-miles for LRT alternatives or exclusive fixed guideway bus lane-miles for BRT alternatives*

[3] *Peak vehicle reductions associated with background bus network changes are assumed to be retained by Capital Metro and may be used to defer vehicle replacement needs for routes using similar vehicle types.*

[2] https://capmetro.org/uploadedFiles/New2016/Plan_Your_Trip/Destinations_Schedule_Book/holiday-schedule.pdf

O&M Cost Estimates

Methodology

O&M unit costs were developed in partnership with Capital Metro's finance department and the Blue Line corridor project team. Unit costs are given in 2028 dollars, reflecting the anticipated opening date for the Orange Line, and are escalated 3% annually for estimates associated with the 2040 ridership forecast year.

A unit cost of $138.24 (2028) per revenue hour is used to estimate costs or savings associated with changes in the background bus network. This unit cost is based recently negotiated service contract rates plus costs for Capital Metro expenses not included in the service contract. This unit cost is only applicable for existing routes covered by the service contract.

For new bus and BRT services not covered by the contract, a unit cost of $156.93 per revenue hour (2028) is used as a fully allocated cost (including fuel and general administration). For BRT, an additional cost factor for guideway maintenance is added to the cost per revenue hour. Based on National Transit Database information, an adjustment of $30,000 per directional guideway mile was applied to street-level guideway options. For mixed and elevated guideway options, an annual cost of $80,000 per directional guideway mile was used.

O&M unit costs for LRT service reflect a weighted national average cost per revenue hour of $393.33 (2028, adjusted from $284.15 2017 NTD). This includes guideway maintenance.

Results

Table 11 presents 2028 O&M costs for each alternative relative to the No-Build Scenario. **Appendix A** includes a more detailed unit cost work up for each alternative for 2028 and 2040 service assumptions.

*Table 11: Project O&M Costs (2028 Millions)**

Scenario	TSM	Build BRT Option A 50% Elevated	Build BRT Option B 90% Street Level	Build LRT Option A 50% Elevated	Build LRT Option B 90% Street Level
Orange Line Gross O&M Cost		$30.3	$24.4	**$55.6**	**$50.2**
Change in Background O&M Cost	$80.7	($15.2)	($15.2)	($15.2)	($15.2)
Marginal Project O&M Cost	$80.7	$15.1	$9.2	$40.4	$35.1

*The gross O&M cost represents the cost to operate and maintain the project. Any cost savings from associated service plan reductions for MetroRapid 801 will be considered in the context of overall CMTA service changes and Project Connect funding.

Next Steps

Travel times and O&M costs will be refined in an iterative fashion alongside ridership modeling. Preliminary service plans informed the first round of ridership modeling, and adjustments to those plans were made as a result of the capacity analysis. Upon selection of a Locally Preferred Alternative (LPA), a more detailed assessment of potential impacts to local traffic, refinement of travel times, and subsequent ridership forecasts may require ongoing refinement of the estimated Orange Line O&M costs. Additionally, the specific location of the maintenance facility used by the Project Connect Orange Line would affect O&M costs.

Bus service is likely to undergo multiple changes between this study and potential operation of the Orange Line, and, as such, O&M costs are presented as increments for the purpose of comparing varying levels of service. More detailed service plans and operating costs would be developed for the LPA during the EIS phase

O&M costs for the Orange Line reflect a stand-alone project with independent utility. Any additional high capacity transit improvements that share guideway with the Orange Line may impact the feasibility of running the headways proposed for the stand-alone project. As a result, O&M costs for multiple projects are not additive and should be reassessed at a system level.

Appendix A – O&M Cost Calculations (2028)*

Mode	Supply Variable	2028 Unit Cost	TSM	Build BRT Option A 50% Elevated	Build BRT Option B 90% Street Level	Build LRT Option A 50% Elevated	Build LRT Option B 90% Street Level
Bus	Vehicle Revenue Hour	$138	90,000	-110,000	-110,000	-110,000	-110,000
	Incremental Bus Costs		**$12,449,000**	**-$15,151,000**	**-$15,151,000**	**-$15,151,000**	**-$15,151,000**
New MetroRapid	Vehicle Revenue Hour	$157	169,000	0	0	0	0
	Incremental Bus Costs		**$26,482,000**	**$0**	**$0**	**$0**	**$0**
MetroRail (Red Line)	Passenger Car Revenue Hour	$2,366	18,000	0	0	0	0
	Incremental Bus Costs		**$41,769,000**	**$0**	**$0**	**$0**	**$0**
BRT	Vehicle Revenue Hour	$157	0	173,000	148,000	0	0
	Fixed guideway lane-mile (Street-level Options)	$30,000	0	0	38	0	0
	Fixed guideway lane-mile (Elevated)	$80,000	0	38	0	0	0
	BRT Costs		**$0**	**$30,249,000**	**$24,399,000**	**$0**	**$0**
LRT	Passenger Car Revenue Hour	$393	0	0	0	141,000	128,000
	LRT Costs		**$0**	**$0**	**$0**	**$55,618,000**	**$50,209,000**
Marginal Project Costs[1] (2028)			**$80,700,000**	**$15,098,000**	**$9,248,000**	**$40,467,000**	**$35,058,000**

[1] *O&M projections do not include fare revenue*

**The gross O&M cost represents the cost to operate and maintain the project. Any cost savings from associated service plan reductions for MetroRapid 801 will be considered in the context of overall CMTA service changes and Project Connect funding.*

Appendix A – O&M Cost Calculations (2040)

Mode	Supply Variable	2040 Unit Cost[2]	TSM	Build BRT Option A[3] 50% Elevated	Build BRT Option B 90% Street Level	Build LRT Option A 50% Elevated	Build LRT Option B 90% Street Level
Bus	Vehicle Revenue Hour	$197	90,000	-110,000	-110,000	-110,000	-110,000
	Incremental Bus Costs		**$17,750,000**	**-$21,601,000**	**-$21,601,000**	**-$21,601,000**	**-$21,601,000**
New MetroRapid	Vehicle Revenue Hour	$224	**169,000**	**$0**	**$0**	0	0
	Incremental Bus Costs		**$37,757,000**	**$0**	**$0**	**$0**	**$0**
MetroRail (Red Line)	Passenger Car Revenue Hour	$3,373	18,000	**$0**	**$0**	0	0
	Incremental Bus Costs		**$59,553,000**	**$0**	**$0**	**$0**	**$0**
BRT	Vehicle Revenue Hour	$224	0	191,000	185,000	0	0
	Fixed guideway lane-mile (Street-level Options)	$42,773	0	0	38	0	0
	Fixed guideway lane-mile (Elevated)	$114,061	0	38	0	0	0
	BRT Costs		**$0**	**$46,979,000**	**$43,071,000**	**$0**	**$0**
LRT	Passenger Car Revenue Hour	$561	0	0	0	170,000	182,000
	LRT Costs		**$0**	**$0**	**$0**	**$95,502,000**	**$102,121,000**
Marginal Project Costs[1] (2028)			**$115,060,000**	**$25,378,000**	**$21,470,000**	**$73,901,000**	**$80,520,000**

[1] *O&M projections do not include fare revenue*
[2] *2040 unit costs assume 3% escalation*
[3] *Costs assume no more than 2 vehicles per 5-minute headways; this results in demand in excess of capacity of approximately 45 trips/peak hour.*