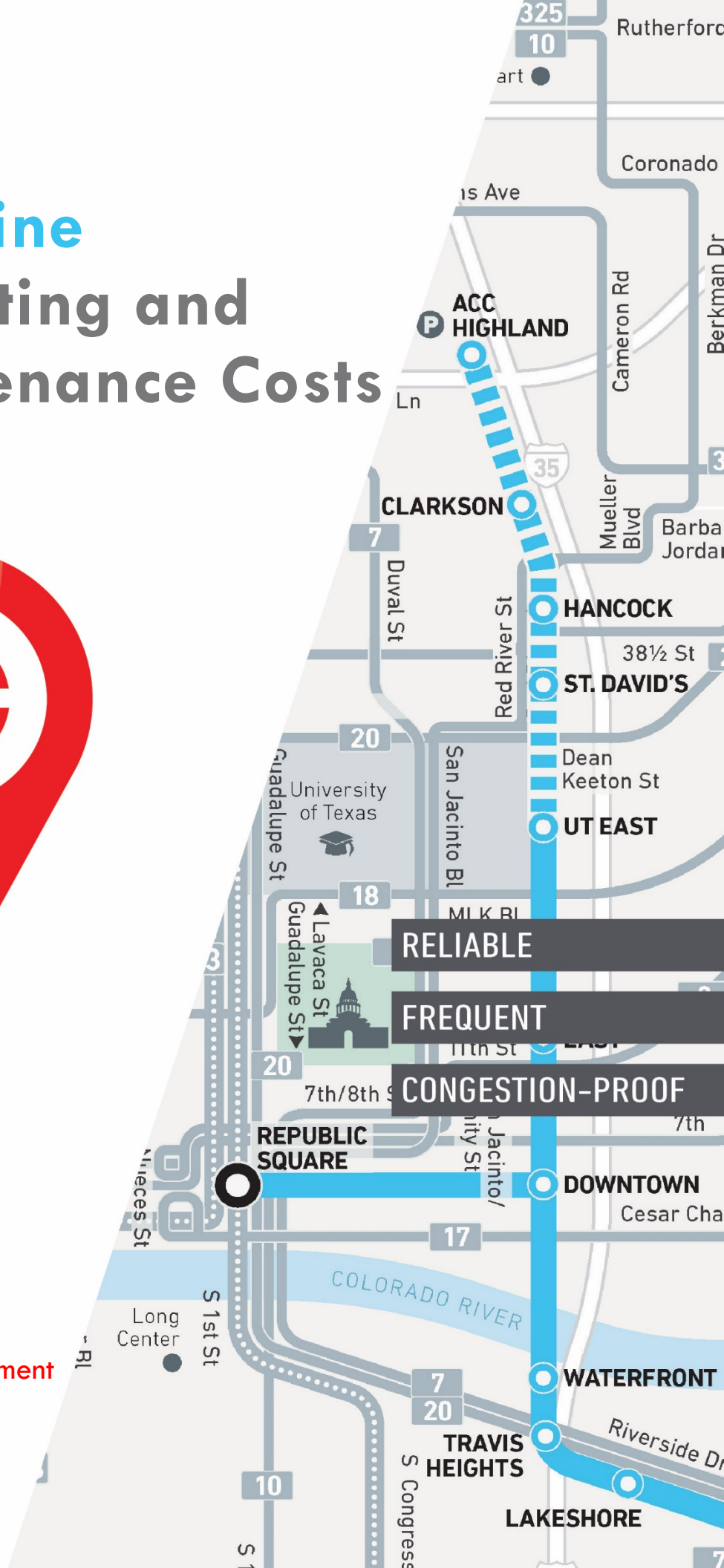
Blue Line
Operating and Maintenance Costs



Draft for Public Review and Comment

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1.0 Project Overview

This technical memorandum includes the service planning assumptions and order of magnitude operating and maintenance (O&M) cost estimates for the Blue Line Corridor. Determining the annually recurring O&M costs for the Blue Line Corridor 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 transit service 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. Although capital bond repayment is a recurring expense, it is not considered an operating expense. Payment terms and interest on capital expenses are included as part of the Project Connect Blue Line Capital Costs Technical Memorandum.

Alternatives evaluated for the Blue Line Corridor include a No Build Alternative, Transportation System Management (TSM) Alternative, and two primary Build Alternative. The Blue Line Corridor 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 produce the estimates. Operating costs were also developed for the proposed local service changes to be made upon implementation of project alternatives.

1.1 Blue Line Corridor Overview

The proposed Blue Line Corridor would connect the Austin Community College (ACC) Highland Campus through Downtown Austin to Austin-Bergstrom International Airport (AUS). This is one of the corridors included in Capital Metropolitan Transportation Authority's (Capital Metro) Project Connect Long Term Vision Plan (Vision Plan) aimed at providing High-Capacity Transit (HCT).

Alternatives evaluated for the O&M cost estimates include the Transit System Management (TSM) Alternative and two Build Alternatives, Alternative 1, and Alternative 2. The two primary Build Alternatives are distinguished by the Blue Line Corridor's Colorado River (Lady Bird Lake) crossing. The Build Alternatives are further defined below.

- **Build Alternative 1 (Trinity).** This alternative includes a new Colorado River crossing near Trinity Street.
- **Build Alternative 2 (South 1st Street).** This alternative includes a Colorado River crossing near the South 1st Street bridge.

The Blue Line Corridor is comprised of five defined segments listed below and shown in **Figure 1** on the following page. For reference and running time estimates, Segment 3 is broken into Segment 3A and 3B. The break between Segment 3A and 3B is located just south of 4th Street.

- **Segment 1:** Highland (ACC Highland to 45th Street)
- **Segment 2:** Hancock (45th Street to Martin Luther King Boulevard)
- **Segment 3:** Central (Martin Luther King Boulevard to IH-35)
  - Segment 3A (Martin Luther King Boulevard to 4th Street)
  - Segment 3B (4th Street to IH-35)
- **Segment 4:** East Riverside (IH-35 to Riverside Drive/SH 183)
- **Segment 5:** Airport (Riverside Drive/US 183 to AUS)

Figure 1. Blue Line Corridor Segments

2.0 Introduction

Blue Line Corridor O&M costs are an output of several steps and inputs illustrated in **Figure 2**. The process was completed in close coordination with the Orange Line Corridor project team and Capital Metro staff including the Project Connect Office, Service Planning, and the Finance Department. The capacity analysis, based on forecasted ridership, modified the preliminary service plan and drove vehicle needs for both light rail transit (LRT) and bus rapid transit (BRT). Additionally, it considered the Build Alternatives illustrated in **Figure 3** and **Figure 4**.

Figure 2. Overview of O&M Cost Process

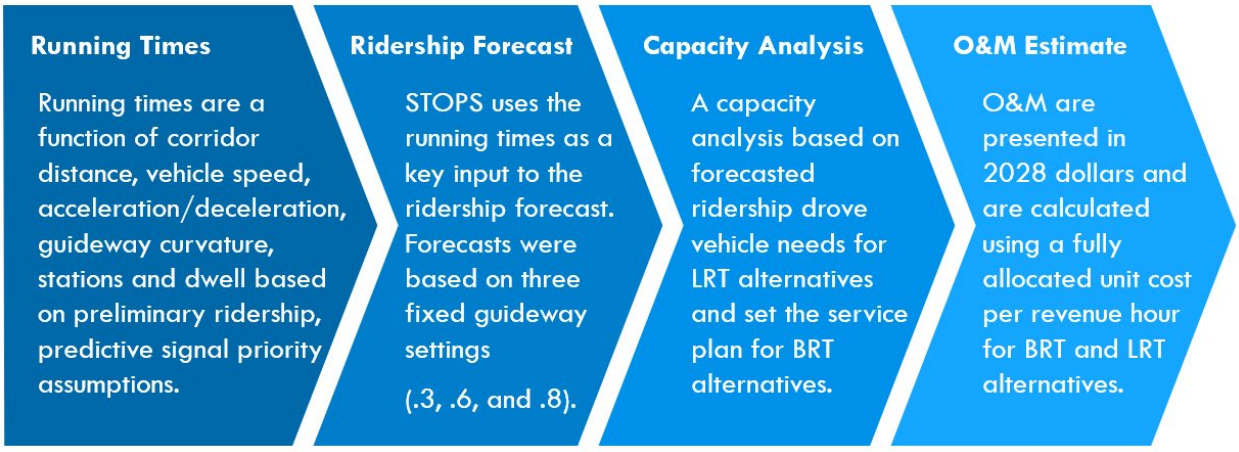


Figure 3. Blue Line Build Alternative 1 Trinity (With Alignment Options)

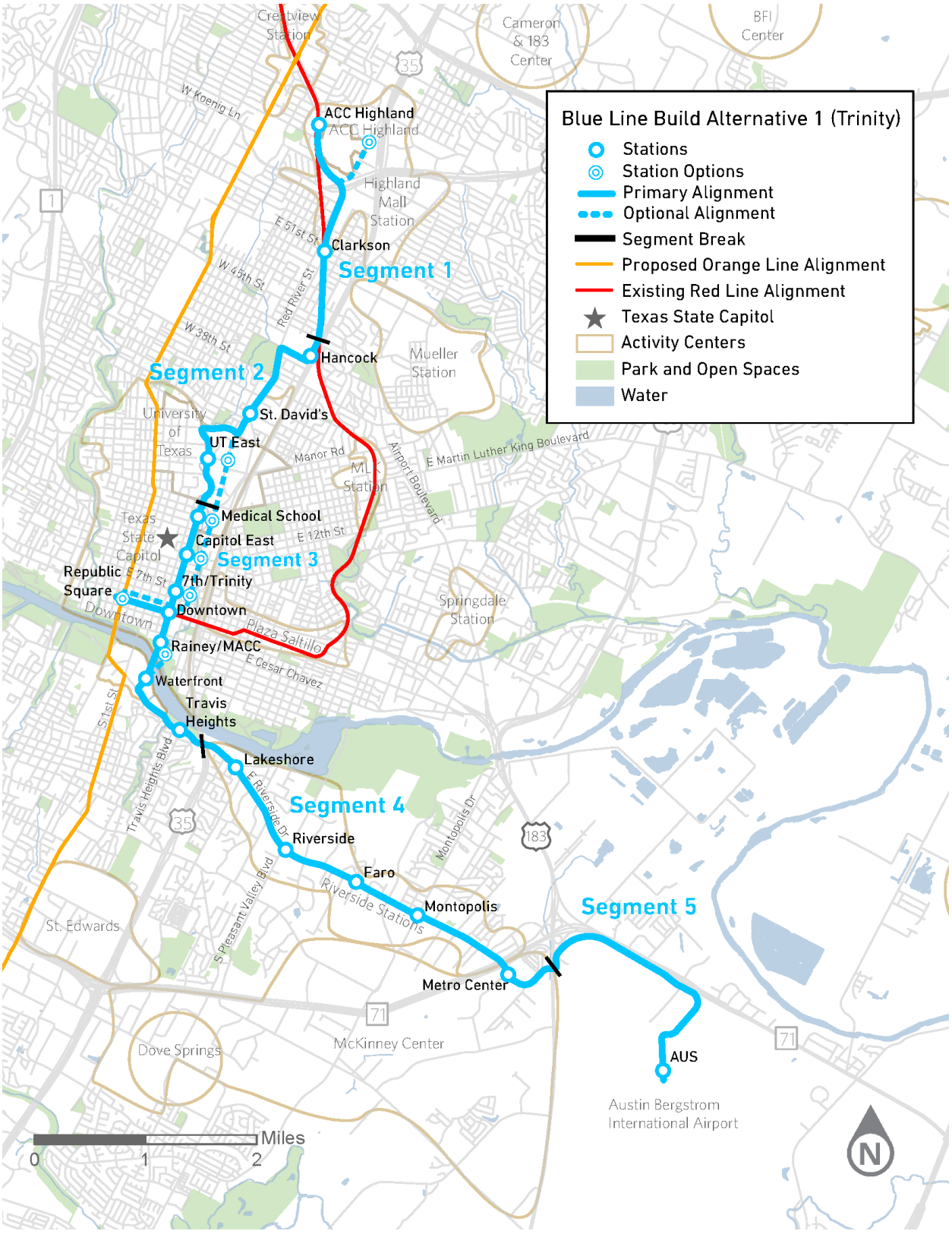
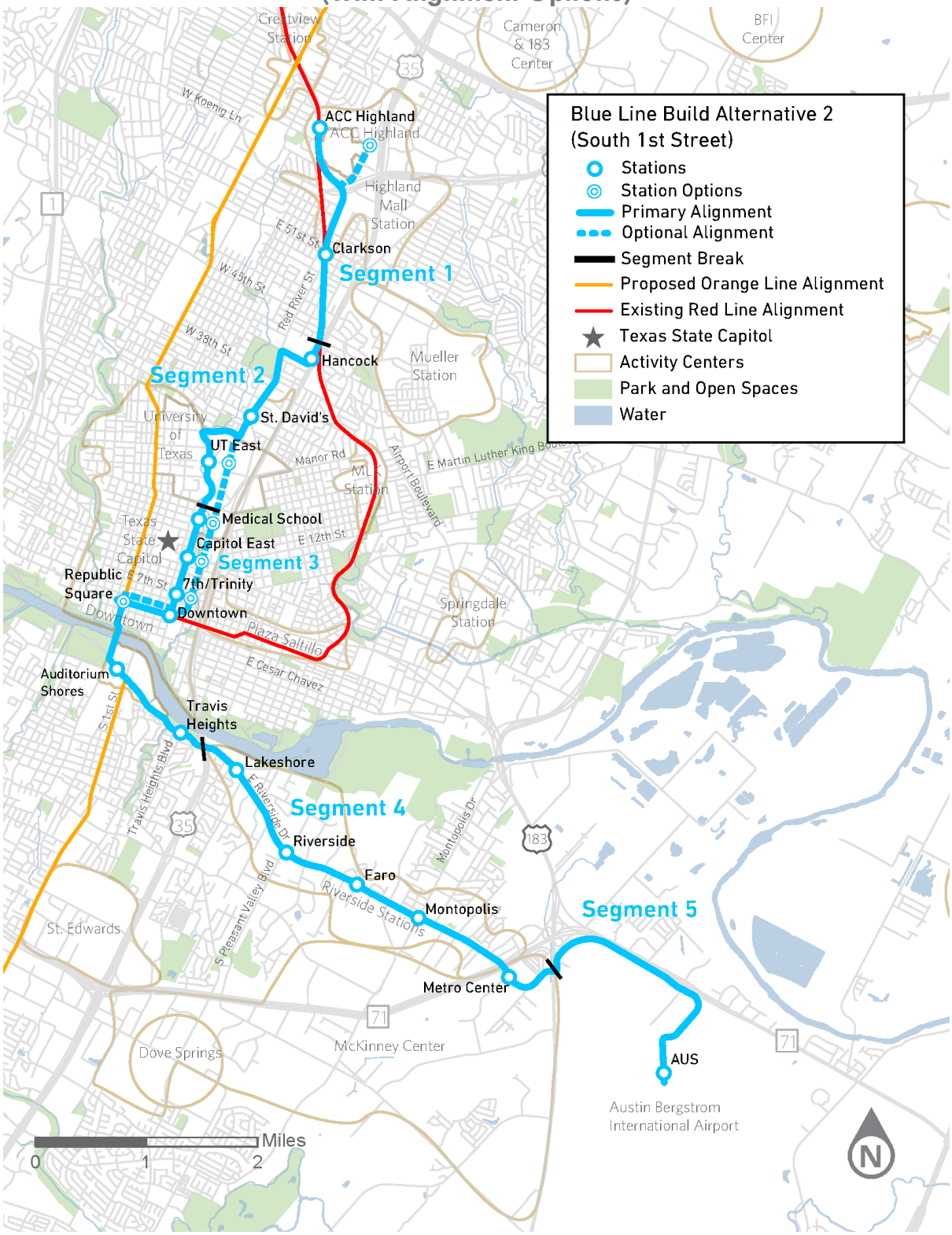


Figure 4. Blue Line Build Alternative 2 South 1st Street (With Alignment Options)



3.0 Running Time Estimates

Running times were estimated for each alternative using an Excel running time model. Running time estimates were calculated based on distance between stations, posted roadway speeds, guideway curvature, vehicle speed and acceleration capabilities, and estimated dwell times. The preliminary running time estimates include dwell times that vary by station based on the preliminary ridership forecast for the Blue Line Corridor. Dwell time assumptions do not include additional delay due to fare collection; it is assumed that the Blue Line Corridor would have off-board fare collection. It is assumed that the Blue Line Corridor will have predictive signal priority corridor-wide on Street-Level alternatives. Predictive signal priority assumes a high level of transit signal priority (TSP) where delay at traffic signals will be minimized through communication between transit vehicles and traffic controllers. Grade Separated Alternatives including segments that are Elevated, Cut-and-Cover, or Tunnel transitway profiles, are assumed to not encounter any signal delay. The probability of encountering a red signal was determined based on the following conditions:

- **Central Business District.** Boundary from the River 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 with a 20 percent probability of encountering a red signal. Boundary from the River to IH-35 on the south with a 20 percent probability of encountering a red signal.
- **Outlying Area.** Boundary from Dean Keaton Street to ACC Highland on the north and from IH-35 to AUS on the south with a 10 percent probability of encountering a red signal.

The model assumes 15 seconds of signal delay at any encountered signal. These predictive signal priority assumptions were developed in coordination with City of Austin representatives.

Table 1 includes additional operating assumptions developed in conjunction with the Orange Line team and Capital Metro staff following the workshop with Capital Metro planning staff on August 13, 2019 and subsequent meetings with Capital Metro finance staff.

Table 1. Running Time Assumptions for all Build Alternatives

	BRT		LRT	
Maximum Speed	Posted arterial speeds were used for Street-Level segments. Grade Separated maximum speeds are based on transitway character with a maximum speed of 55 mph. [1]		Posted arterial speeds were used for Street-Level segments. Grade Separated maximum speeds are based on transitway character with a maximum speed of 55 mph. [1]	
Acceleration/Deceleration	2.7 mph/second		2.7 mph/second	
Station Dwell Time	*Boardings*	*Dwell Time (sec)*	*Boardings*	*Dwell Time (sec)*
	15 or less	20	170 or less	20
	16 – 34	30	171 – 290	30
	35 or more	40	291 or more	40
Guideway Curvature (Street-Level)	30 seconds of additional time and acceleration/deceleration at identified turns that require vehicles to slow down		30 seconds of additional time and acceleration/deceleration at identified turns that require vehicles to slow down	
Guideway Delay (Grade Separated)	N/A		Minimum of 3 minutes to change direction at Republic Square in Build Alternative 1 Trinity	

[1] *Maximum speeds in 3A were lowered to 25 mph due to the urban character of the corridor.*

Estimated running times for the BRT alternatives are shown in **Table 2,** LRT running times are shown in **Table 3,** and the TSM Alternative running time estimates are shown in **Table 4.**

Table 2. BRT Running Time Estimates for all Build Alternatives

	Street-Level		Grade Separated	
	Alternative 1 Trinity	**Alternative 2 South 1st Street**	**Alternative 1 Trinity**	**Alternative 2 South 1st Street**
Running Time (NB)	43 min	41 min	35 min	33 min
Running Time (SB)	42 min	39 min	34 min	32 min
Total Running Time	85 min	80 min	69 min	65 min
Total Distance	29 miles	29 miles	29 miles	29 miles
Average Speed	21 mph	22 mph	25 mph	27 mph

As shown in **Table 3,** LRT running times for Alternative 1 are approximately three minutes slower than BRT alternatives shown in **Table 2** due to the additional three minutes required to change direction at Republic Square. This analysis is necessary because the Blue Line Corridor must be analyzed to provide independent utility of the line. As shown in the table, the actual difference between alternatives may be two to three minutes due to rounding.

Table 3. LRT Running Time Estimates for all Build Alternatives

	Street-Level		Grade Separated	
	Alternative 1 Trinity	**Alternative 2 South 1St Street**	**Alternative 1 Trinity**	**Alternative 2 South 1st Street**
Running Time (NB)	46 min	41 min	38 min	33 min
Running Time (SB)	44 min	39 min	36 min	31 min
Total Running Time	90 min	79 min	74 min	64 min
Total Distance	29 miles	29 miles	29 miles	29 miles
Average Speed	19 mph	22 mph	24 mph	27 mph

Running time estimates for the TSM Alternative are shown in **Table 4.** The Build Alternative running times in **Table 2** and **Table 3** do not vary by time period as the alternatives assume a fixed guideway transitway operating free of delays due to congestion. The TSM Alternative will operate in mixed traffic and thus encounter delays due to congestion. As such, three running times estimates were developed for the TSM Alternative based on morning peak, midday, and evening peak period characteristics.

Table 4. TSM Running Time Estimates

	AM Peak	Midday	PM Peak
Running Time (NB)	55 min	53 min	60 min
Running Time (SB)	57 min	55 min	60 min
Total Running Time	112 min	108 min	120 min
Total Distance	29 miles	29 miles	29 miles
Average Speed	16 mph	16 mph	15 mph

4.0 Capacity Analysis

A capacity analysis was completed to ensure adequate vehicle capacity based on vehicle capacity assumptions, initial "base" service plan assumptions, and forecasted ridership. The capacity analysis relied upon revised 2028 Simplified Trips-on-Project Software (STOPS) ridership forecasts for both BRT and LRT, which is documented in a separate *Blue Line Ridership Forecasting* technical memorandum. Ridership was factored to peak hour peak direction maximum passenger loads using factors derived from current Capital Metro system-wide ridership. The maximum passenger loads were then compared with vehicle capacity for each alternative to identify potential capacity problems. Vehicle assumptions are shown in **Table 5**.

Table 5. Vehicle Assumptions for All Build Alternatives

Vehicle Assumptions	BRT	LRT
Vehicle Type	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 were 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.

The capacity analysis for LRT used STOPS ridership forecasts with a fixed guideway setting (FGS) of .8. The analysis for BRT used STOPS ridership forecasts with an FGS of .6 for Grade Separated alternatives and an FGS of .3 for Street-Level BRT alternatives.

The initial base service plan is shown in **Table 6.** If the initial base service plan assumptions did not supply enough capacity, then the service plan was modified to meet forecasted demand peak hour peak direction loads. A single vehicle/train car was assumed as a base service plan which was later adjusted and informed by the capacity analysis.

Table 6. Base Service Plan Assumptions for all Build Alternatives

Time Period	Service Schedule	Service Span	Headway (Min.)	Vehicles
Weekday				
Early AM	5:00 a.m. - 6:30 a.m.	1.5 hours	15	1
Day Time & Peaks	6:30 a.m. - 7:30 p.m.	13.0 hours	10	1
Evening to Close	7:30 p.m. - 3:50 a.m.	8.2 hours	15	1
Saturday				
Early AM	5:00 a.m. - 6:30 a.m.	1.5 hours	15	1
Day Time	6:30 a.m. - 7:30 p.m.	13.0 hours	15	1
Evening to Close	7:30 p.m. - 3:50 a.m.	8.2 hours	15	1
Sunday				
Early AM	5:00 a.m. - 6:30 a.m.	1.5 hours	15	1
Day Time	6:30 a.m. - 7:30 p.m.	13.0 hours	15	1
Evening to Close	7:30 p.m. - 12:50 a.m.	5.2 hours	15	1

Service frequency was increased to increase BRT capacity and passenger cars were added to LRT trains to increase LRT capacity. **Table 7** through **Table 9** provide a summary of the capacity analysis results for 2028 (opening year). **Table 10** through **Table 12** provide 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.

Table 7. 2028 Weekday Capacity Analysis Results for all Build Alternatives

		BRT				LRT			
		Street-Level		Grade Separated		Street-Level		Grade Separated	
		Alt 1 Trinity	Alt 2 S. 1st St.	Alt 1 Trinity	Alt 2 S. 1st St.	Alt 1 Trinity	Alt 2 S. 1st St.	Alt 1 Trinity	Alt 2 S. 1st St.
Project Ridership		18,700	20,200	28,400	29,600	30,300	32,100	30,300	34,800
Early AM	Cycle Time (min)	98	92	80	75	104	91	86	74
	Headway (min)	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	Vehicles/Cars	1	1	1	1	1	1	1	1
AM Peak	Cycle Time (min)	98	92	80	75	104	91	86	74
	Headway (min)	7.5	7.5	5.0	5.0	10.0	10.0	10.0	10.0
	Vehicles/Cars	1	1	1	1	2	2	2	2
Midday	Cycle Time (min)	98	92	80	75	104	91	86	74
	Headway (min)	10.0	10.0	7.5	7.5	10.0	10.0	10.0	10.0
	Vehicles/Cars	1	1	1	1	1	1	1	1
PM Peak	Cycle Time (min)	98	92	80	75	104	91	86	74
	Headway (min)	7.5	5.0	5.0	5.0	10.0	10.0	10.0	10.0
	Vehicles/Cars	1	1	1	1	2	2	2	2
Evening	Cycle Time (min)	98	92	80	75	104	91	86	74
	Headway (min)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
	Vehicles/Cars	1	1	1	1	1	1	1	1
Night	Cycle Time (min)	98	92	80	75	104	91	86	74
	Headway (min)	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	Vehicles/Cars	1	1	1	1	1	1	1	1

Table 8. 2028 Saturday Capacity Analysis Results for all Build Alternatives

		BRT				LRT			
		Street-Level		Grade Separated		Street-Level		Grade Separated	
		Alt 1 Trinity	Alt 2 S. 1st St.	Alt 1 Trinity	Alt 2 S. 1st St.	Alt 1 Trinity	Alt 2 S. 1st St.	Alt 1 Trinity	Alt 2 S. 1st. St.
Morning	Cycle Time (min)	98	92	80	75	104	91	86	74
	Headway (min)	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	Vehicles/Cars	1	1	1	1	1	1	1	1
Midday	Cycle Time (min)	98	92	80	75	104	91	86	74
	Headway (min)	15.0	15.0	10.0	10.0	15.0	15.0	15.0	15.0
	Vehicles/Cars	1	1	1	1	1	1	1	1
Evening	Cycle Time (min)	98	92	80	75	104	91	86	74
	Headway (min)	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	Vehicles/Cars	1	1	1	1	1	1	1	1

Table 9. 2028 Sunday Capacity Analysis Results for all Build Alternatives

		BRT				LRT			
		Street-Level		Grade Separated		Street-Level		Grade Separated	
		Alt 1 Trinity	Alt 2 S. 1st St.	Alt 1 Trinity	Alt 2 S. 1st St.	Alt 1 Trinity	Alt 2 S. 1st St.	Alt 1 Trinity	Alt 2 S. 1st. St.
Morning	Cycle Time (min)	98	92	80	75	104	91	86	74
	Headway (min)	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	Vehicles/Cars	1	1	1	1	1	1	1	1
Midday	Cycle Time (min)	98	92	80	75	104	91	86	74
	Headway (min)	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	Vehicles/Cars	1	1	1	1	1	1	1	1
Evening	Cycle Time (min)	98	92	80	75	104	91	86	74
	Headway (min)	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	Vehicles/Cars	1	1	1	1	1	1	1	1

Table 10 through **Table 12** provide a summary of the capacity analysis results for 2040. In 2040, BRT Grade Separated alternatives require two BRT vehicles operating at five-minute headways to meet demand and provide enough capacity on weekdays in the AM and PM peak. Similarly, the BRT Street-Level Build Alternative 2 requires two BRT vehicles to operate at five-minute headways in the PM Peak on weekdays.

Table 10. 2040 Weekday Capacity Analysis Results for all Build Alternatives

		BRT				LRT			
		Street-Level		Grade Separated		Street-Level		Grade Separated	
		Alt 1 Trinity	Alt 2 S. 1st. St.	Alt 1 Trinity	Alt 2 S. 1st St.	Alt 1 Trinity	Alt 2 S. 1st St.	Alt 1 Trinity	Alt 2 S. 1st St.
Project Ridership		30,500	32,400	44,000	45,400	46,100	48,500	45,900	52,300
Early AM	Cycle Time (min)	98	92	80	75	104	91	86	74
	Headway (min)	15.0	15.0	10.0	10.0	15.0	15.0	15.0	15.0
	Vehicles/Cars	1	1	1	1	1	1	1	1
AM Peak	Cycle Time (min)	98	92	80	75	104	91	86	74
	Headway (min)	5.0	5.0	5.0	5.0	10.0	10.0	10.0	10.0
	Vehicles/Cars	1	1	2	2	2	2	2	2
Midday	Cycle Time (min)	98	92	80	75	104	91	86	74
	Headway (min)	7.5	5.0	5.0	5.0	10.0	10.0	10.0	10.0
	Vehicles/Cars	1	1	1	1	2	2	2	2
PM Peak	Cycle Time (min)	98	92	80	75	104	91	86	74
	Headway (min)	5.0	5.0	5.0	5.0	10.0	10.0	10.0	10.0
	Vehicles/Cars	1	2	2	2	2	3	2	3
Evening	Cycle Time (min)	98	92	80	75	104	91	86	74
	Headway (min)	10.0	10.0	5.0	5.0	10.0	10.0	10.0	10.0
	Vehicles/Cars	1	1	1	1	1	1	1	1
Night	Cycle Time (min)	98	92	80	75	104	91	86	74
	Headway (min)	15.0	15.0	10.0	10.0	15.0	15.0	15.0	15.0
	Vehicles/Cars	1	1	1	1	1	1	1	1

In 2040, several alternatives require additional capacity in order to meet demand in the BRT alternatives on weekends. As such, frequency during the midday time period on Saturdays in 2040 was increased to ten-minute frequency for Street-Level BRT alternatives. Additionally, frequency during the midday time period for Grade Separated BRT alternatives requires 7.5-minute frequency to accommodate estimated demand on Saturdays. Results for the Saturday capacity analysis for 2040 are shown in **Table 11**.

Table 11. 2040 Saturday Capacity Analysis Results for all Build Alternatives

		BRT				LRT			
		Street-Level		Grade Separated		Street-Level		Grade Separated	
		Alt 1 Trinity	Alt 2 S. 1st St.	Alt 1 Trinity	Alt 2 S. 1st St.	Alt 1 Trinity	Alt 2 S. 1st St.	Alt 1 Trinity	Alt 2 S. 1st St.
Morning	Cycle Time (min)	98	92	80	75	104	91	86	74
	Headway (min)	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	Vehicles/Cars	1	1	1	1	1	1	1	1
Midday	Cycle Time (min)	98	92	80	75	104	91	86	74
	Headway (min)	10.0	10.0	7.5	7.5	15.0	15.0	15.0	15.0
	Vehicles/Cars	1	1	1	1	1	1	1	1
Evening	Cycle Time (min)	98	92	80	75	104	91	86	74
	Headway (min)	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	Vehicles/Cars	1	1	1	1	1	1	1	1

Similarly, in 2040 several BRT alternatives require additional capacity in order to meet estimated Sunday demand. Frequency during the midday time period on Sundays requires ten-minute frequency for both Grade Separated BRT alternatives and for the Street-Level BRT Build Alternative 2. Results for the Sunday capacity analysis for 2040 are shown in **Table 12**.

Table 12. 2040 Sunday Capacity Analysis Results for all Build Alternatives

		BRT				LRT			
		Street-Level		Grade Separated		Street-Level		Grade Separated	
		Alt 1 Trinity	Alt 2 S. 1st St.	Alt 1 Trinity	Alt 2 S. 1st St.	Alt 1 Trinity	Alt 2 S. 1st St.	Alt 1 Trinity	Alt 2 S. 1st St.
Morning	Cycle Time (min)	98	92	80	75	104	91	86	74
	Headway (min)	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	Vehicles/Cars	1	1	1	1	1	1	1	1
Midday	Cycle Time (min)	98	92	80	75	104	91	86	74
	Headway (min)	15.0	10.0	10.0	10.0	15.0	15.0	15.0	15.0
	Vehicles/Cars	1	1	1	1	1	1	1	1
Evening	Cycle Time (min)	98	92	80	75	104	91	86	74
	Headway (min)	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	Vehicles/Cars	1	1	1	1	1	1	1	1

5.0 Operating Plan & Unit Cost Assumptions

The Blue Line Corridor O&M cost estimates were developed using an Excel-based cost model that relies upon running time estimates, capacity analysis results, revised service plan assumptions, and unit costs to derive vehicle requirements and O&M estimates.

5.1 Operating Plan Assumptions

Blue Line Corridor O&M cost estimates use revenue hours as the primary cost drivers. Revenue hours are the hours that service is available to passengers. Annual revenue hours exclude deadhead hours but include recovery and layover time (assumed to be 15 percent for Build Alternatives). Weekday, Saturday, and Sunday revenue hour estimates were annualized using an annualization of 253 for weekday spans, 55 for Saturday spans, and 57 for Sunday spans.

Directional track miles and fixed transitway bus lane-miles were measured for each proposed Build Alternative. Build Alternative 1 is approximately 29.2 miles (directional miles) and Build Alternative 2 is approximately 28.6 miles (directional miles).

Peak vehicles (or train cars) were calculated to determine fleet requirements for each Build Alternative. Peak vehicles were multiplied by an assumed spare ratio of 1.2 (spares equal to 20 percent of revenue vehicles) to determine fleet vehicle requirements for capital cost estimating purposes.

5.2 Unit Cost Assumptions

Cost calculations are mode-specific and presented in 2028 dollars reflecting the anticipated opening year for the Blue Line Corridor. Unit costs were inflated at three percent annually to 2040. 2040 O&M cost estimates were based on escalated unit costs and service planning assumptions reflecting a similar capacity analysis for the forecasted 2040 demand.

BRT unit costs were developed in coordination with Capital Metro's Finance Department. A unit cost of $156.93 per revenue hour (2028$) reflects fully allocated costs (including general administration). An additional adjustment for BRT guideway maintenance was made based on each Build Alternative's transitway. This adjustment is required for BRT as Capital Metro's current unit costs do not account for fixed guideway maintenance. An annual cost of $30,000 per directional guideway mile was used for Street-Level alternatives and an annual cost of $80,000 per directional guideway mile was used for Grade Separated options (including Elevated, Cut-and-Cover, or Tunnel transitway profiles). These costs were informed by NTD data. The formulas for BRT O&M cost are:

BRT Street-Level Cost Equation:

$156.93 x vehicle revenue hours + $30,000 x the number of directional guideway miles

BRT Grade Separated Cost Equation:

$156.93 x vehicle revenue hours + $80,000 x the number of directional guideway miles

LRT unit costs reflect a national average cost per revenue hour of $393.33 based on 2017 NTD data adjusted to 2028 dollars. This unit cost includes the cost to maintain LRT infrastructure, thus no additional adjustment is necessary for guideway maintenance. The formula for LRT O&M cost is:

LRT Cost Equation:

$393.33 x vehicle revenue hours

Additionally, a unit cost of $138.24 per revenue hour was used to estimate cost saving from removing existing bus services upon implementation of the Blue Line. This unit cost is based on Capital Metro's new MV service contract information and actual Capital Metro costs for cost components not included in the service contract. Cost estimates and saving from changes to existing service were used to show a net cost for the Blue Line Corridor.

6.0 Transit Service Plans

Alternatives evaluated for the O&M cost estimates include the TSM Alternative, Build Alternative 1, and Build Alternative 2. The two primary Build Alternatives are distinguished by the Blue Line Corridor Colorado River (Lady Bird Lake) crossing. Additional detail regarding alignment and station locations of each alternative is included in the *Blue Line Refined Alternatives Definition Technical Memorandum* dated September 9, 2019. Based on the joint service planning workshop between Capital Metro planning staff and Blue Line project team members, the following local service changes reflect cost impacts for all Build Alternatives and the TSM Alternative.

- **Route 20.** This route's southern portion from AUS to downtown overlaps with the Blue Line Corridor. Service on the route's southern portion will be reduced from the current 15-minute daily headways to 30-minute headways. Maintaining local service in the corridor aligns with the precedence of Routes 1 and 801. The portion of Route 20 between downtown and Tannehill Lane would be maintained with the current configuration and service level (15-minute headways). Alternate trips on the northern portion of the line would be routed through downtown to the southern portion of the route to achieve the reduced service level. A turn-around at Republic Square is assumed for every other trip. The described local service changes are included in the Blue Line Corridor O&M cost estimates.
- **Local Routes to ACC Riverside.** Several local routes (217, 271, 310, and 350) would be realigned from their existing terminus at ACC Riverside and would be moved south and incorporated into a transfer center at the Blue Line Montopolis Station. Necessary changes in the configuration of routes would be made to ensure efficient connections and service levels would remain the same on these routes. Route 311 would be realigned to connect at Montopolis and Riverside and then operate to ACC Riverside where the route would continue to terminate and layover. These changes are assumed to be minor and costs for realigning these routes to a transfer center at the Blue Line Montopolis Station were not calculated.
- **All Other Routes.** All other Capital Metro system routes will remain unchanged.

Service assumptions and characteristics for each Alternative are included in **Table** 13 (BRT), **Table 14** (LRT), and **Table 15** (TSM). The tables reflect the revised Build Alternative service plans informed by STOPS ridership forecasts and modified to ensure adequate capacity to meet forecasted demand.

Table 13. 2028 BRT Service Characteristics for Build Alternatives

Service Characteristic	Street-Level		Grade Separated	
	Alternative 1 Trinity	Alternative 2 S. 1st St.	Alternative 1 Trinity	Alternative 2 S. 1st St.
One-way Running Time (NB)	43 min	41min	35 min	33 min
One-way Running Time (SB)	42 min	39 min	34 min	32 min
Peak Cycle Time [1]	98 min	92 min	80 min	75 min
Transitway Miles (Bi-Directional)	29 miles	29 miles	29 miles	29 miles
Peak Vehicles	14	19	17	15
Fleet Vehicles	17	23	21	18
Annual Vehicle Revenue Hours	73,696	78,159	76,744	66,926
Annual Vehicle Revenue Miles	459,081	502,767	575,120	574,137

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

Table 14. 2028 LRT Service Characteristics for Build Alternatives

Service Characteristic	Street-Level		Grade Separated	
	Alternative 1 Trinity	Alternative 2 S. 1st St.	Alternative 1 Trinity	Alternative 2 S. 1st St.
One-way Running Time (NB)	46 min	41 min	38 min	33 min
One-way Running Time (SB)	44 min	39 min	36 min	31 min
Peak Cycle Time [1]	104 min	91 min	86 min	74 min
Transitway Miles (Bi-Directional)	29 miles	29 miles	29 miles	29 miles
Peak Cars	22	20	18	16
Fleet Cars	27	24	22	20
Annual Vehicle Revenue Hours	88,614	83,641	73,824	64,006
Annual Vehicle Revenue Miles	548,274	547,364	548,274	547,364

Build Alternative service characteristics do not vary by time period as the alternatives assume a fixed guideway transitway free of delay due to congestion. The TSM Alternative will operate in mixed traffic and thus encounter delays due to congestion. As such, service characteristics are summarized for the TSM Alternative based on morning peak, midday, and evening peak period characteristics.

Table 15. TSM Service Characteristics

Service Characteristic	AM Peak	Midday	PM Peak
One-way Running Time (NB)	55 min	54 min	61 min
One-way Running Time (SB)	57 min	55 min	60 min
Peak Cycle Time [1]	112 min	109 min	120 min
Transitway Miles (Bi-Directional)	29 miles	29 miles	29 miles
Required Vehicles	13	13	14
Fleet Vehicles		17	
Annual Vehicle Revenue Hours		87,722	
Annual Vehicle Revenue Miles		414,793	

7.0 O&M Cost Estimates and Summary

Based on the previously documented assumptions, cost estimates for each alternative are shown in **Table 16.**

Table 16. Transit O&M Cost Estimates for TSM and Build Alternatives

	Street-Level		Grade Separated	
Mode	**Alternative 1 Trinity**	**Alternative 2 South 1st Street**	**Alternative 1 Trinity**	**Alternative 2 South 1st Street**
TSM *	-	$13,766,000	-	-
BRT	$14,188,000	$14,847,000	$19,039,000	$17,388,000
LRT	$34,854,000	$32,899,000	$29,037,000	$25,175,000

** Note: TSM Alternative cost estimates are for traditional bus, not BRT or LRT modes.*

In addition to the Blue Line Corridor project costs estimates, the underlying bus network changes for local Route 20 would result in a reduction in revenue hours and miles. It is estimated that this decrease in service on Route 20 would generate an annual savings of approximately $934,000.

Table 17. Summary of Build Alternatives' O&M Cost Estimates

		BRT				LRT			
		Street-Level		Grade Separated		Street-Level		Grade Separated	
		Alt 1 Trinity	Alt 2 S. 1st St.	Alt 1 Trinity	Alt 2 S. 1st St.	Alt 1 Trinity	Alt 2 S. 1st St.	Alt 1 Trinity	Alt 2 S. 1st St.
Bi-Directional Miles		29 miles	29 miles	29 miles	29 miles	29 miles	29 miles	29 miles	29 miles
One-way Running Time [1]		42 min	40 min [A]	35 min [B]	32 min [C]	45 min [D]	40 min	37 min [D]	32 min
Proposed Weekday Service Plan / (vehicles required)	Early AM	15 min (1)	15 min (1)	15 min (1)	15 min (1)	15 min (1)	15 min (1)	15 min (1)	15 min (1)
	AM Peak	7.5 min (1)	7.5 min (1)	5 min (1)	5 min (1)	10 min (2)	10 min (2)	10 min (2)	10 min (2)
	Midday	10 min (1)	10 min (1)	7.5 min (1)	7.5 min (1)	10 min (1)	10 min (1)	10 min (1)	10 min (1)
	PM Peak	7.5 min (1)	5 min (1)	5 min (1)	5 min (1)	10 min (2)	10 min (2)	10 min (2)	10 min (2)
	Evening	10 min (1)	10 min (1)	10 min (1)	10 min (1)	10 min (1)	10 min (1)	10 min (1)	10 min (1)
	Night	15 min (1)	15 min (1)	15 min (1)	15 min (1)	15 min (1)	15 min (1)	15 min (1)	15 min (1)
Peak Vehicles/Cars		14	19 [A]	17 [B]	15 [C]	22 [E]	20 [E]	18 [E]	16 [E]
Annual Revenue Hours		73,696	78,159	76,744	66,926	88,614	83,641	73,824	64,006
Annual Revenue Miles		459,081	502,767	575,120	574,137	548,274	547,364	548,274	547,364
Annual Project O&M [2]		$14.2 M	$14.8 M	$19.0 M	$17.4 M	$34.9 M	$32.9 M	$29.0 M [F]	$25.2 M [F]
Annual O&M Offset		($0.9 M)	($0.9 M)	($0.9 M)	($0.9 M)	($0.9 M)	($0.9 M)	($0.9 M)	($0.9 M)
Annual Project O&M Incremental Cost [3]		$13.3 M	$13.9 M	$18.1 M	$16.5 M	$33.9 M	$32.0 M	$28.1 M	$24.2 M

[1] *Reflects an average of the northbound and southbound one-way running time.*

[2] *Cost estimates shown do not include offset costs resulting from bus service adjustments or fare revenue. These are gross O&M costs that represents the cost to operate and maintain the project. Any cost savings from associated service plan reductions for Route 20 will be considered in the context of overall CMTA service changes and Project Connect funding.*

[3] *Reflects net O&M costs for Blue Line Corridor due to associated reduction in costs for service plan changes to Route 20.*

The service plan for each Build Alternative varies based on the capacity analysis as previously explained in this document. As such, not all bottom-line O&M cost estimates are intuitive. The following provides additional explanation for results that may seem counterintuitive upon initial review.

A. The BRT Street-Level Build Alternative 2 has a faster running time than Build Alternative 1 but requires more vehicles because Build Alternative 2 requires five-minute headways to accommodate demand during the PM Peak period. This is because the BRT Street-Level Build Alternative 2 has a higher forecasted ridership than Build Alternative 1.

B. The BRT Partially Grade Separated Build Alternative 1 has a faster running time than the Street-Level Alternative but requires more vehicles because the partially Grade Separated alternative requires more frequent headways during three time periods to accommodate demand. During the AM and PM Peak periods the partially Grade Separated alternative must operate at five-minute headways (rather than 7.5-minute) headways and the Midday period must operate at 7.5 minutes (instead of 10 minutes) to accommodate demand.

C. The BRT Partially Grade Separated Build Alternative 2 has the same service plan as the Partially Grade Separated Build Alternative 1, but Build Alternative 2 has faster running times, thus requiring fewer vehicles.

D. Both LRT Build Alternative 1 alignment options require three additional minutes to change direction at Republic Square. This analysis is necessary because the Blue Line Corridor must be analyzed to provide independent utility of the line. The actual difference of running times between alternatives may be two to three minutes due to rounding.

E. The LRT alternatives require more vehicles than BRT alternatives because LRT alternatives require two car train consists during the AM and PM peak periods. LRT Alternative service plans were modified to meet demand by adding cars in periods that required additional capacity. BRT Alternative service plans were modified to meet demand by increasing headways.

F. The LRT Partially Grade Separated Build Alternatives have a lower estimated O&M cost compared to the LRT Street Level Build Alternatives. This is due to faster running times in the Grade Separated Build Alternatives which require fewer vehicles to maintain the service plan. This results in lower O&M cost estimates.

8.0 Next Steps

O&M costs for the Blue Line Corridor reflect a stand-alone project. Any additional HCT improvements that would allow for a shared guideway with other corridors may impact the feasibility of operating the proposed headways. As a result, O&M costs for multiple projects are not additive and should be reassessed at a system level.

Service plans and ridership will be refined as an LPA is defined and engineering and technology decisions are refined during an environmental documentation phase. These ongoing changes and refinements will impact O&M costs.