VIA VISION 2040

Volume 3: Defining Projects and Plans

Fixed Route Services – Building a Transit Foundation

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Prepared for

VIA

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Executive Summary

Through 2040, the Greater San Antonio Region is projected to experience rapid growth, including 1.6 million new residents and 840 thousand new jobs. The transportation needs of the region will increase substantially, requiring careful planning over the next 25 years. The Vision 2040 Long Range Plan continued a public dialog about the role of public transportation in shaping the way the region responds to growth, and lays out a series of projects to 2040 and beyond. The community-driven plan provides high-quality transit service to both new and current riders across the region, focusing on three components of the Vision 2040 Long Range Plan:

- A **Better Bus System,** which focuses on connecting communities with frequent and reliable transit service, bus stop upgrades, and improved sidewalk access;
- A **Rapid Transit Network,** which prioritizes higher-speed, congestion-proof network of bus rapid transit (BRT), light rail transit (LRT), and Express Service along key corridors; and
- **Innovative Solutions,** which promotes technology, development, and strategic partnerships to build a stronger region.

Each component is comprised of a series of projects and plans, a number of which affect fixed route service. This report focuses on technical needs of the projects contained in the Vision 2040 Long Range Plan pertaining to VIA's fixed route services, including both passenger service and supporting facilities. In the context of the Vision 2040 Long Range Plan, these projects link the existing VIA transit system[1] to the region's transit needs[2] using the Vision 2040 project development process.[3]

Within this report, projects and plans are organized into three key groups:

- **Passenger Service,** including rolling stock, operations and maintenance, and right-of-way needs and costs. This section includes estimates of the cost of operational changes, new vehicle purchases, and new service offerings like BRT and LRT.
- **Passenger Facilities,** including transit centers, park & rides, and key stations. This section addresses the expansion and improvements to these facilities, with needs like parking, bus bays, and pedestrian accommodations.

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[1] Documented in *Understanding VIA's Role in History, VIA's Role in the Community, and VIA in Comparison to Peer Agencies* in *Volume 1: The Role of Transit in a Growing Region.*

[2] See *Needs Assessment* in *Volume 1: The Role of Transit in a Growing Region.*

[3] Documented in *The Visioning Process* in *Volume 2: Developing Vision 2040.*

- **Supporting Facilities,** primarily the location, scale, and quantity of maintenance facilities. This section summarizes the process for identifying deadhead inefficiencies (i.e., the time needed for buses to return to storage or maintenance facilities that cannot be used for transporting passengers).

The backbone of the Vision 2040 Long Range Plan is VIA's fixed route bus network. The plan addresses all types of fixed route passenger service, from local bus service in neighborhoods, to higher capacity service along key corridors and activity centers, to Express Service connecting regional communities (Table ES.1). Metro Local and Metro Frequent bus services will see increases in both frequency and service span on all routes. A network of dedicated-lane BRT and LRT corridors will accommodate an increasing share of daily travel, support compact, mixed use development along the rapid transit corridors, and provide congestion-proof travel options.

Table ES.1 Passenger Service Projects

Capital Investments	• Expand network of mixed-traffic Primo service with Transit Signal Priority (TSP), intelligent transportation systems (ITS), improved station areas, and 10-minute frequencies. • Design and build a LRT network. • Design and build a dedicated-lane BRT network. • Expand network of express routes. • Install TSP/ITS improvements for other key routes to reduce delays.
Policy Goals	• Maintain state of good repair in existing fleet through fleet purchase program. • Identify and prioritize locations for railroad-grade crossing separation. • Support construction of HOV lanes to improve travel-time reliability.
Operational Improvements	• Increase peak frequency of Metro Local service to every 20 minutes and Metro Frequent Service to every 12 minutes. • Increase service span for all routes to at least 4 a.m. (start of service) to 1 a.m. (end of service).

Just as important as the routes themselves, **passenger facilities** can have a positive impact on the safety, efficiency, and comfort of the transit network. To improve passenger experiences, the Vision 2040 Long Range Plan includes expansion of the parking capacity and bus bay facilities at VIA park & rides and transit centers, as well as continued improvements across VIA's bus stop network (Table ES.2). The plan also incorporates new off-board fare collection methods and real-time arrival technologies at an increasing number of passenger facilities.

Table ES.2 Passenger Facility Projects

Capital Investments	• Expand existing parking and bus bay facilities at park & rides and transit centers to meet anticipated demand. • Construct new park & ride and transit center facilities to meet needs of expanded LRT, BRT, and Express networks. • Modernize and provide amenities at key stations and stops, including: - Off-board fare collection kiosks - Real-time arrival signs - High-quality lighting and pedestrian access
Policy Goals	• Maintain expansion of shelter program.

Though often invisible to riders, VIA's **maintenance facilities** play a critical role in keeping the system working smoothly. The Vision 2040 Long Range Plan includes construction of a new primary maintenance facility for VIA's rubber-tire fleet, and continued expansion to accommodate VIA's growing needs through 2040 (Table ES.3). To service the new LRT network, the Vision 2040 Long Range Plan also includes the construction of a new separate rail maintenance facility.

Table ES.3 Maintenance Facility Projects

Capital Investments	• Expand and modernize maintenance facility network (including satellite facilities) for bus fleet. • Construct maintenance facility for LRT vehicles.

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1.0 Introduction

VIA Metropolitan Transit (VIA) provides transit service to the Greater San Antonio Region. The region expects up to 1.6 million new residents over the next 25 years, and VIA plans to support that growth through the development and implementation of the Vision 2040 Long Range Plan. This report focuses on technical needs of the projects contained in the plan pertaining to VIA's fixed route services, including both passenger service and supporting facilities. In the context of the full plan, these projects link the existing VIA transit system to the region's transit needs (documented in *Volume 1: The Role of Transit in a Growing Region*) using the Vision 2040 project development process (see *The Visioning Process* in *Volume 2: Developing Vision 2040*).

The Vision 2040 Long Range Plan has three key components:

- A **Better Bus System,** which focuses on connecting communities with frequent and reliable transit service, bus stop upgrades, and improved sidewalk access;
- A **Rapid Transit Network,** which prioritizes higher-speed, congestion-proof network of Bus Rapid Transit (BRT), Light Rail Transit (LRT), and Express Service along key corridors; and
- **Innovative Solutions,** which promotes technology, development, and strategic partnerships to build a stronger region.

Each component is comprised of a series of projects and plans, a number of which affect fixed route service. This document describes the Vision 2040 Long Range Plan's capital investments, operational improvements, and policies goals related to three major areas of fixed route service: Passenger Service, Passenger Facilities, and Supporting Facilities.[4]

Passenger Service consists of regularly scheduled, fixed route services (Section 2.0). VIA's fixed route bus network is the backbone of the region's public transportation system, comprised of Metro Local, Metro Frequent, Primo, and Express routes. Moving forward, the fixed route bus service system envisioned in the Vision 2040 Long Range Plan expands the network of mixed-traffic Primo buses with Transit Signal Priority (TSP) and improved Primo station areas; introduces BRT and LRT service to the region; implements more extensive regional Express routes; and improves local route service. VIA plans to increase peak frequency of Metro Local service to 20 minutes, of Metro Frequent service to 12 minutes, and increase the service span for all routes to match current Primo standards (4 a.m. to

[4] For non-fixed route services, such as paratransit and vanpool, or multimodal and development projects, see *Non-Fixed Route Services: Expanding Transit Choices* in *Volume 3: Defining Projects and Plans*.

1 a.m.). In addition to frequency and speed improvements, the state of good repair for VIA's rubber-tire bus fleet will be maintained through a fleet purchase program.

Passenger Facilities serve as the gateway to the VIA network as well as allow transfers between routes and corridors (Section 3.0). To support the Vision 2040 Long Range Plan, VIA plans to expand its parking capacity and bus bay facilities at its park & rides and transit centers to meet growing demand, and encourage multimodal commutes. To stimulate efficient interconnection of the transportation system, an increasing number of passenger facilities will incorporate new seamless fare collection methods and real-time arrival technologies.

Supporting Facilities provide behind-the-scenes maintenance, storage, and administration services (Section 4.0). The Vision 2040 Long Range Plan includes the construction of a new primary maintenance facility to accommodate fleet expansion as well as a rail maintenance facility to accommodate a LRT network.

2.0 Passenger Service

Passenger service is the most visible part of VIA's operations. The Vision 2040 Long Range Plan includes robust improvements to its current Metro Local and Metro Frequent networks; regional expansions of the Express network; and new service types featuring LRT and BRT vehicles operating in dedicated lanes. The needs and costs associated with improvements to passenger service are discussed here in three sections:

- **Rolling Stock,** concerning the number and type of vehicles needed to provide service;
- **Operations and Maintenance,** concerning the quantity of service delivered and requirements for its administration; and
- **Right-of-Way,** concerning the corridors, fixed infrastructure, and traffic control improvements required.

2.1 Rolling Stock

2.1.1 Needs

The final travel demand forecast model output from the Vision 2040 Long Range Plan serves as input to determine the number of vehicles required to operate the different types of transit services.[5] The time needed to complete a trip from start point to endpoint was calculated using travel demand model output speeds during the peak-period and the length of the route. These travel times were used to calculate the number of vehicles required to operate service. Additionally, a minimum of 10 percent recovery was set to allow for operational variability and good on time performance. All peak speeds were lower than off-peak speeds; as a result, the vehicle requirements used peak-period speeds and load factors for determining minimum number of vehicles needed. Current load standards established in VIA's Line Service Policies and Design Standards are 125 percent of seated capacity. When vehicle passenger loads exceed this value, then the corridor may warrant more frequent service, larger vehicles (such as articulated buses), or LRT service to meet demand.[6]

[5] For a more detailed description of the travel demand modeling process, including headway improvements by route, see *The Visioning Process* in *Volume 2: Developing Vision 2040*.

[6] Service frequencies were increased up to 10 minutes before higher capacity vehicles were proposed in recognition of the importance of frequency in generating ridership with 10 minutes being the industry best practice target frequency for network spontaneous use.

Service frequencies are set based on each service type, with all service types seeing substantially more frequent service than 2016 service schedules. In instances where two service patterns exist on one route (such as a short-line and long-line pattern), headways were adjusted such that the trunk portion of the line matches the service type's design headway.

While it does not affect peak vehicle requirements, increasing service span is also a key component of the Vision 2040 Long Range Plan. The plan calls for average service span of 4 a.m. to 1 a.m. during weekday operation; currently, VIA's routes generally start services between 4:30 a.m. and 5:30 a.m. and conclude operations between 9:30 p.m. and 10:30 p.m. (Table 2.1, Table 2.2).

Table 2.1 Current Weekday Service Characteristics (2016, Average)

Service Type	Start Time	Stop Time	Peak Headway	Base Headway	Evening Headway
Local	5:08 a.m.	9:35 p.m.	37	47	56
Frequent	4:32 a.m.	9:49 p.m.	16	17	45
Express	5:37 a.m.	9:45 p.m.	28	48	54
Primo	4:00 a.m.	1:00 a.m.	10	10	30
Skip	4:37 a.m.	10:52 p.m.	16	20	45
VIVA	8:10 a.m.	8:30 p.m.	19	19	19

Source: VIA Metropolitan Transit, 2016.

Table 2.2 Vision 2040 Weekday Service Characteristics

Service Type	Start Time	Stop Time	Peak Headway	Base Headway	Evening Headway
Local	4:00 a.m.	1:00 a.m.	20	30	30
Frequent	4:00 a.m.	1:00 a.m.	12	15	15
Express	4:00 a.m.	1:00 a.m.	15	30	30
Primo, BRT, and LRT	4:00 a.m.	1:00 a.m.	10	10	10

Source: VIA Metropolitan Transit, 2016.

VIA's current fleet replacement plan includes conversion of the entire fleet to compressed natural gas (CNG) buses as well as reduction of the average vehicle age from 12 years (2016) to 6.6 years (2026). The fully implemented Vision 2040 Long Range Plan will require a total of 921 vehicles during peak-period operation (Table 2.3).[7] VIA's fleet currently contains 461 buses and no light rail vehicles.

[7] That is, not including spare or reserve vehicles.

Table 2.3 Summary of Peak Vehicle Requirements

	Current Fleet (2016)	Planned Fleet (2026)	Vision Network (2040)
Standard Bus[a]	451	479	790
Primo	–	–	*49*
Express	*26*	–	*153*
Frequent and Local	*425*	–	*588*
Articulated Bus[b]	10	27	92
Light Rail Vehicle	–	–	39
Total	**461**	**506**	**921**

Source: VIA Metropolitan Transit, 2016.

[a] Includes both 40' and 31.5' buses.

[b] 60' buses, such as those currently in service on the Primo 100 route.

Of special concern is vehicular capacity along VIA's BRT and LRT services. As these corridors were selected partially based on high ridership, they are most vulnerable to crowded conditions, and require special attention to ensure that transit vehicles are not overloaded. In general, transit vehicles can accommodate more passengers than there are seats; however, exceeding seated capacity excessively can cause passenger discomfort. VIA's current load standard is 125 percent of loaded capacity; in practice, total vehicle capacity depends on a number of factors, such as average trip length, vehicle seating layout, and time of day. Choice of 60-foot or 40-foot vehicles for BRT routes depends on this estimated load factor (Table 2.4, Table 2.5; corridor locations in Figure 2.1).

Table 2.4 BRT Capacity and Requirements

BRT Corridor	Vehicle Requirements	Peak Load Percent (Based on 40-foot Seated Capacity)		Peak Load Percent (Based on 60-foot Seated Capacity)		Recommended Bus Size
		IB/CW[a]	OB/CCW[b]	IB/CW	OB/CCW	
Looper Premium	52	107%	135%	84%	106%	60-foot
Zarzamora	10	230%	173%	181%	136%	60-foot
Huebner – Grissom	17	60%	43%	47%	34%	40-foot
FM 78	16	44%	42%	34%	33%	40-foot
Austin Highway	10	182%	145%	143%	114%	60-foot
Gen. McMullen – Babcock	16	75%	98%	59%	77%	40-foot
New Braunfels Avenue	8	191%	99%	150%	78%	60-foot
Bandera	12	139%	72%	109%	57%	60-foot

Source: VIA Metropolitan Transit, 2016.

[a] Inbound/Clockwise.

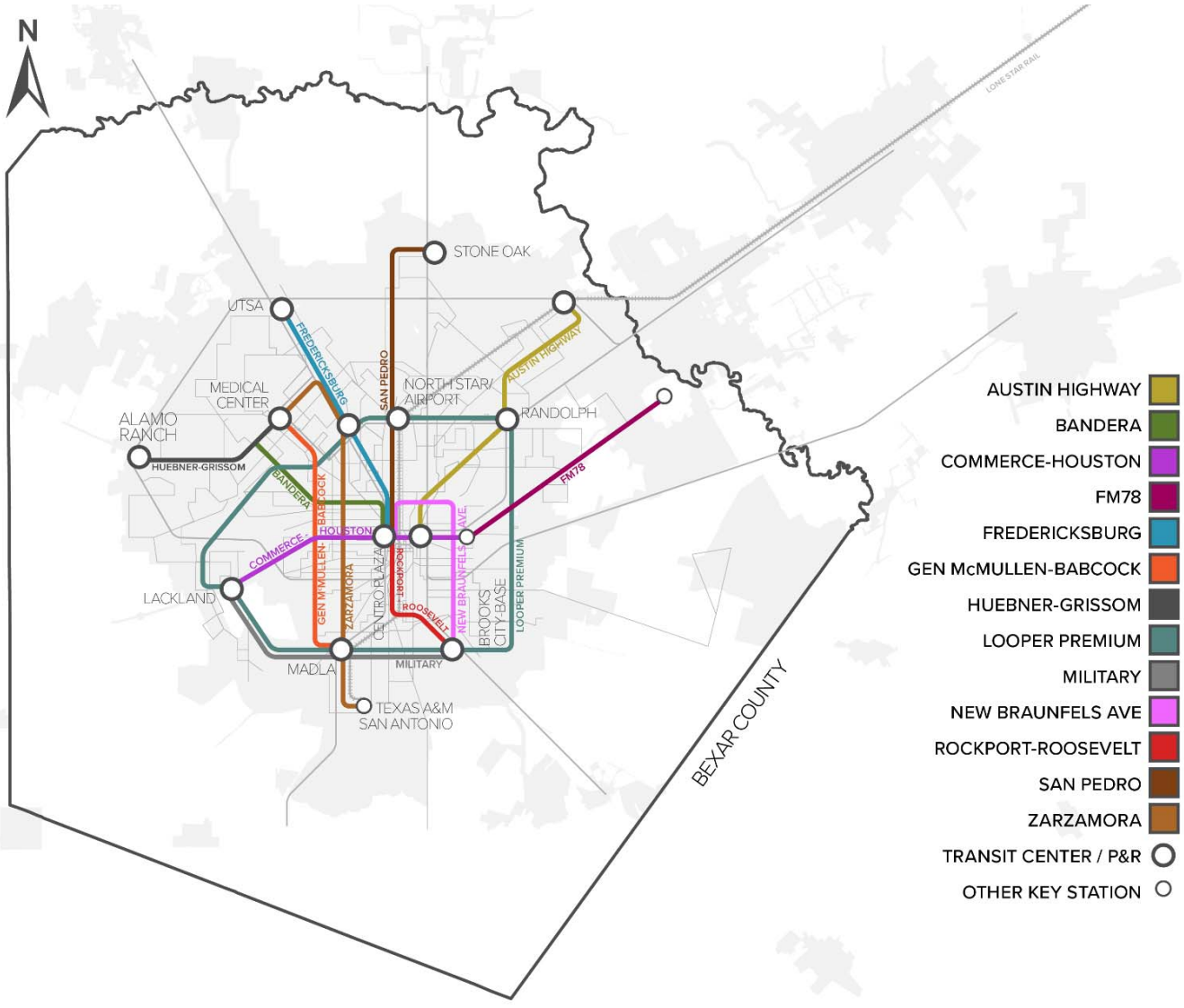
[b] Outbound/Counterclockwise.

Table 2.5 LRT Capacity and Requirements

LRT Corridor	Vehicle Requirement	Peak Load Percent (Based on LRT Seated Capacity [a])	
		Inbound	Outbound
Fredericksburg	11	118%	137%
Commerce – Houston	10	108%	144%
San Pedro	12	132%	119%
Rockport – Roosevelt	6	100%	58%

[a] Single LRT vehicle only. Additional vehicles per train would increase capacity multiplicatively.

Figure 2.1 BRT and LRT Corridor Locations



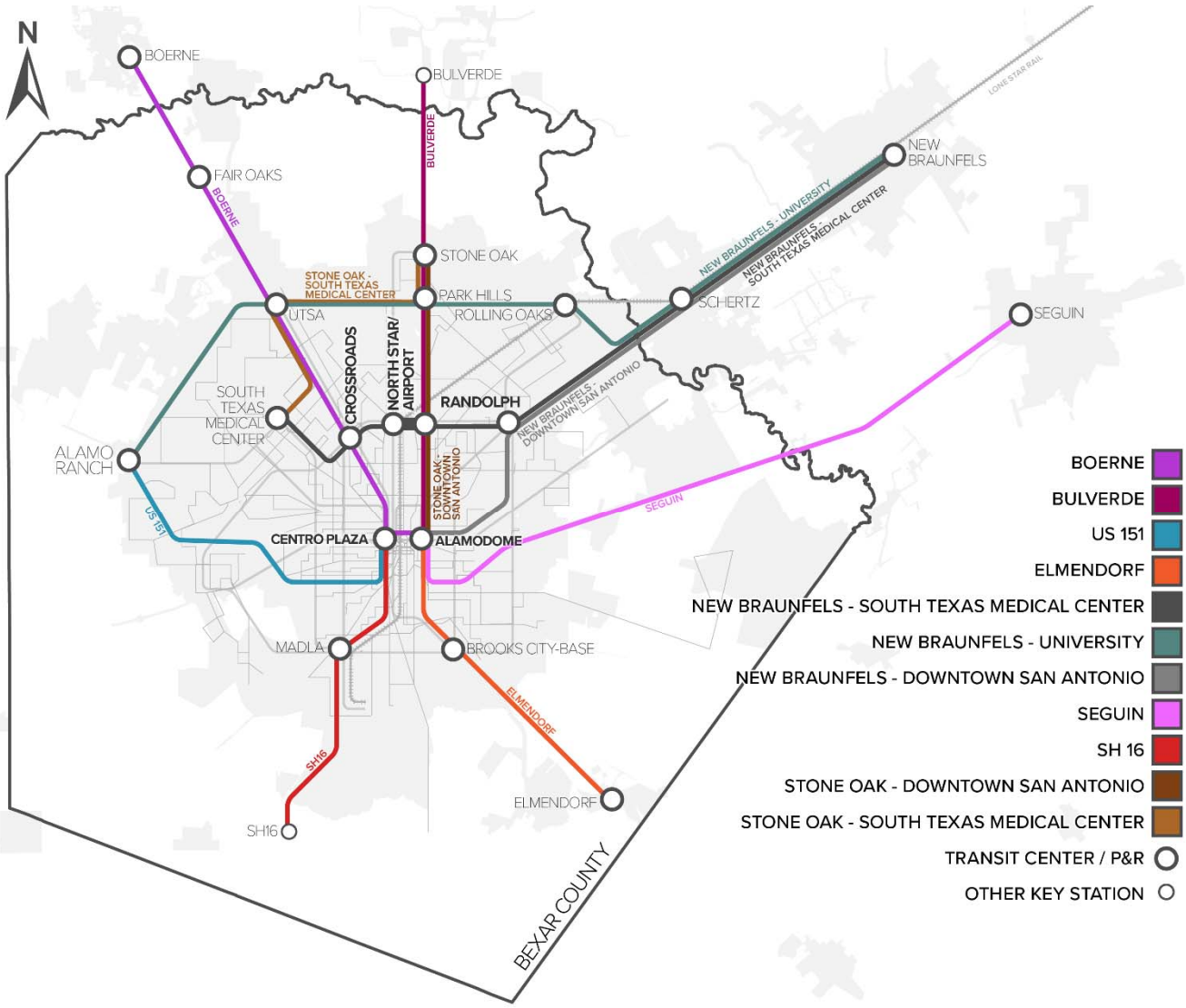
Express vehicles generally make longer journeys, and therefore require a single seat per passenger (i.e., load should not exceed 100 percent of seated capacity) (Table 2.6, corridor locations in Figure 2.2).

High-occupancy vehicle (HOV) lanes allow VIA's Express service to operate more efficiently on a regional level. HOV lanes are an additional lane on major interstates, generally only usable vehicles with more than one or two occupants but occasionally, including fixed- or variable-priced toll access for single occupancy vehicles. Because fewer vehicles can access the lane, it is often a less congested alternative than the general-purpose lanes on highways.

Table 2.6 Express Capacity and Requirements

		Peak Load Percent (Based on 40-foot Seated Capacity)	
Description	**Vehicle Requirement**	**Inbound**	**Outbound**
Boerne	15	54%	70%
Bulverde	14	20%	3%
US 151	12	11%	6%
Elmendorf	10	39%	34%
New Braunfels – South Texas Medical Center	18	26%	19%
New Braunfels – University	23	8%	8%
New Braunfels – Downtown SA	16	53%	22%
Seguin	16	36%	32%
SH 16	8	39%	8%
Stone Oak – Downtown SA	10	14%	15%
Stone Oak – South Texas Medical Center	11	32%	26%

Figure 2.2 Express Corridor Locations



2.1.2 Costs

The vehicle purchase unit costs listed in Table 2.7 are based on both a web search for news articles, press releases, contracts, and meeting proceedings, as well as direct data requests from agencies in the US and Canada. Bus costs are available by vehicle size (length for buses, standard consist size for rail) and power type. Unit costs are converted to 2015 dollars using consumer price index (CPI) data from the Bureau of Labor Statistics (BLS).

Table 2.7 Rolling Stock Costs

Vehicle Type	Unit Cost (2015 $)
Bus	
CNG, 60'	$880,000
Diesel, 40'	$510,000
Diesel, 60'	$740,000
Electric (Battery), 40'	$1,230,000
Electric (Overhead), 60'	$1,390,000
Hybrid, 30'	$710,000
Hybrid, 40'	$730,000
Hybrid, 60'	$990,000
Rail	
Electric LRV, per unit	$4,020,000
Diesel Multiple Unit, 2-car	$7,130,000
Diesel Multiple Unit, 4-car	$13,340,000

2.2 Operations and Maintenance

2.2.1 Service Estimates

As noted in Section 2.2.1, the Vision 2040 Long Range Plan includes substantial increases in frequency and service span for all service types. This increase translates into more buses on the road, more miles covered, and more service available for passengers (Table 2.8, Table 2.9).

Table 2.8 Vision 2040 Service Delivery

		Vehicle Revenue Miles per Operating Hour		Vehicle Revenue Hours per Operating Hour[a]	
	Route Miles	Peak	Off-Peak	Peak	Off-Peak
Current (NTD, 2014)	2,262	5,149	[b]	360	[b]
Existing and Committed (2040)[b]	2,400	5,493	3,800	373	295
Vision 2040	**2,922**	**11,074**	**8,022**	**927**	**540**
Local/Frequent	1,882	6,021	4,208	588	342
Express	620	2,479	1,239	153	54
Primo/BRT/LRT	420	2,521	2,521	180	138

[a] Functionally equivalent to peak vehicle requirement. Does not include demand response or vanpool.

[b] Because each line in current service's peak, off-peak, and evening hours vary, there is no single "off-peak" value to report. The network used in the modeling exercise (see *The Visioning Process* in *Volume 2: Developing Vision 2040*) has simplified operating characteristics, and therefore this number is available for future scenarios.

[c] Existing and committed refers to planned transit and transportation projects that reflect service without the Vision 2040 Long Range Plan projects. For more detailed discussion, refer to *The Visioning Process* in *Volume 2: Developing Vision 2040*.

Table 2.9 Vison 2040 Annual Service Estimates

	Vehicle Revenue Miles		Vehicle Revenue Hours	
Weekday				
Current (NTD, 2014)	68.7	thousand	5.1	thousand
Existing and Committed[a]	73.9		6.6	
Vision 2040[a]	184.1		13.3	
Vision Primo/BRT/LRT	52.9		3.1	
Vision Express	32.8		1.7	
Vision Local/Frequent	98.3		8.5	
Annual[b]				
Current (NTD, 2014)	20.6	million	1.5	million
Existing and Committed[a]	22.2		2.0	
Vision 2040[a]	55.2		4.0	
Vision Primo/BRT/LRT	15.9		0.9	
Vision Express	9.9		0.5	
Vision Local/Frequent	29.5		2.6	

[a] Assuming 5.5 hours of peak service, 11.5 hours of off-peak service.

[b] Assumes 300 weekday equivalents per year.

2.2.2 Costs

The source of Operating and Maintenance (O&M) cost data and service statistics is the Federal Transit Administration's (FTA) National Transit Database (NTD). The model is a simple cost allocation model for planning purposes with three cost categories:

- Vehicle operations (cost per vehicle hour);
- Vehicle maintenance (cost per vehicle mile); and
- Nonvehicle maintenance and general administration (cost per vehicle in operation).

Unit costs were estimated using NTD data, and adjusted to 2015 dollars using CPI data from the BLS. O&M models were developed separately by mode (Table 2.10).

Table 2.10 Annual Operating and Maintenance Costs

Mode	Cost per Vehicle Revenue-Hour (Operations)	Cost per Vehicle Revenue-Mile (Maintenance)	Cost per Vehicle (Maintenance and Administration)
Bus (Local/Frequent/Express)	$56.75	$1.15	$80,142.06
Primo (BRT Mixed)	$56.75	$1.15	$80,142.06
BRT Dedicated	$73.43	$2.07	$130,131.68
LRV	$106.61	$3.59	$417,626.17

2.3 Right-of-Way

Right-of-way includes the streel-level components of VIA transit service. In the vast majority of cases, VIA passenger service operates on existing right-of-way, using the same streets and highways as other vehicles. However, in areas of high transit usage, modifications ranging from traffic signal priority (TSP) to dedicated transit lanes and/or full-grade separation may be appropriate.

2.3.1 Standard Service

Specialized right-of-way is not limited to BRT/LRT service. Currently, the Greater San Antonio Region does not have any high-occupancy vehicle (HOV) lanes; however, HOV lanes have been constructed in Dallas, Houston, and Austin. HOV lanes can improve travel reliability and decrease overall travel time for all people using the lane. For VIA's express service, HOV lanes connecting park & ride lots to key employment centers will increase the convenience of the network and provide practical choices for commuters other than driving alone to work, increasing the capacity of existing roadway facilities and preserving the benefits of those investments. In TxDOT's Statewide Transportation Improvement Program (STIP), three HOV projects are planned for 2017 (AAMPO, 2016):

- Two HOV lanes I-10 from FM 3351 to 1.4 miles south of Leon Springs;
- Two HOV lanes I-10 from 1.4 miles south of Leon Springs to La Cantera; and
- Two HOV lanes US 281 from Loop 1604 to 0.8 miles north of Stone Oak.

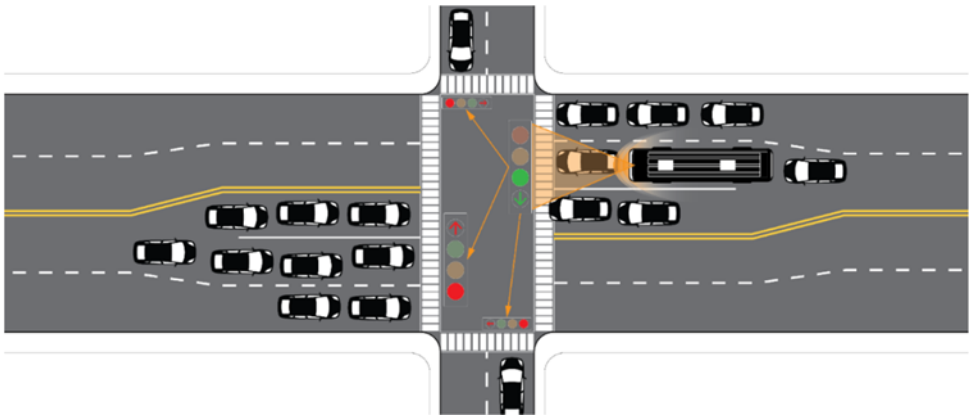
While VIA is not directly responsible for the planning and construction of these lanes, interagency coordination between VIA, TxDOT, and the Alamo Area Metropolitan Planning Organization (AAMPO) is vital to ensuring that these lanes ensure reliability for transit passengers.

In addition, certain right-of-way improvements should not be considered limited to Express, BRT, or LRT service and may be appropriate for areas with high-density/high-usage of Local or Frequent services. These improvements include TSP, queue jumps, or short segments of dedicated right-of-way; these measures are often collectively referred to as intelligent transportation systems (ITS) (Figure 2.3 and Figure 2.4).[8] VIA currently utilizes TSP for Primo Service and plans to use this technology for other

[8] Other ITS improvements include Autonomous and Connected Vehicle technology and information distribution networks; for more information, see *Non-Fixed Route Services: Expanding Transit Choices* in *Volume 3: Defining Projects and Plans*.

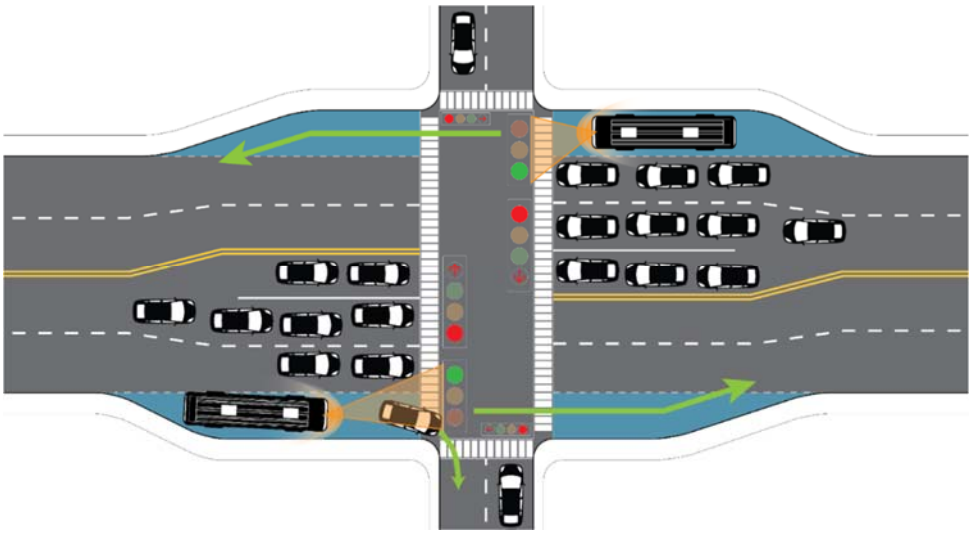
frequent routes. TSP technology automatically adjusts the timing of traffic lights for VIA vehicles, minimizing the number and duration of red lights. To supplement TSP, VIA plans to identify locations appropriate for queue jumps, an additional travel lane at signalized intersections enabling VIA vehicles to bypass a long line of cars at an intersection and receives a green light before the other vehicles.

Figure 2.3 Transit Signal Priority



TSP is a set of operational improvements that uses technology to reduce dwell-time at a traffic signal for transit vehicles by holding the green light longer, or shortening the red light when a transit vehicle approaches the signal. Green holds are much more effective for both transit and general traffic, and work best when combined with far-side station/stop locations.

Figure 2.4 Queue Jump



A queue jump is a transit bypass lane at an intersection, typically in one of the right lanes. A queue jump lane is usually accompanied with a special phase signal so that transit buses get an early green to leave the intersection ahead of other vehicles. If the queue jump is placed on the right edge of the road, vehicles turning right may be allowed in the queue jump lane to make a right turn, although the queue jump and right turn lanes are separate in the optimal situation. In situations where transit vehicles have a dedicated roadway lane, no queue jump, or special signal is necessary.

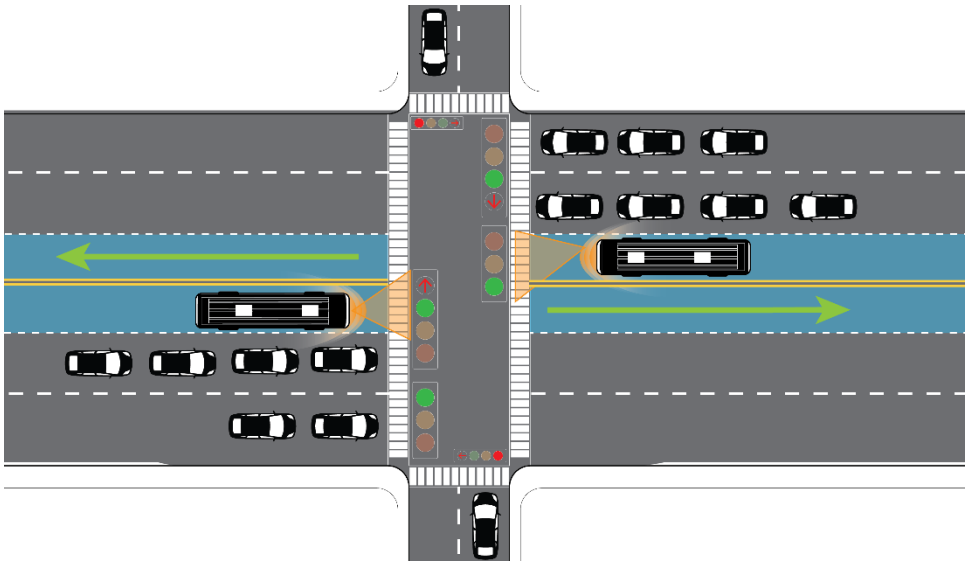
A key component of these improvements is a program to identify bottlenecks, especially those at at-grade crossings with freight and passenger rail facilities. Railroad crossings are a source of travel-time delay for all roadway users, with many vehicles slowing down when traveling over the tracks or waiting for a train to idle at a crossing, or pass through a crossing. Removing these barriers can greatly improve travel reliability and reduce overall travel time. The construction of a grade separated railroad crossing would completely bypass any delays associated with the crossing, allowing all vehicles to avoid delay. VIA anticipates selecting and prioritizing these railroad crossings based on the magnitude of three criteria at the crossing: number of freight trains per day, number of bus trips per day, and average daily traffic.

2.3.2 BRT and LRT Service

The key element of BRT and LRT service is a dedicated right-of-way. Dedicated right-of-way allows vehicles to operate unaffected by congestion levels on nearby roadway networks, dramatically decreasing travel time when compared to a similar trip made by automobile or mixed-traffic bus (Figure 2.5).

Part of the purpose of the Vision 2040 Long Range Plan is to provide recommendations on which corridors should be considered for investments as part of the Rapid Transit Network, and provide preliminary recommendations on service type along those corridors. More detailed corridor studies are the first step in implementing BRT or LRT service, and will provide more detailed cost estimates than those provided below.[9]

Figure 2.5 Dedicated Right-of-Way



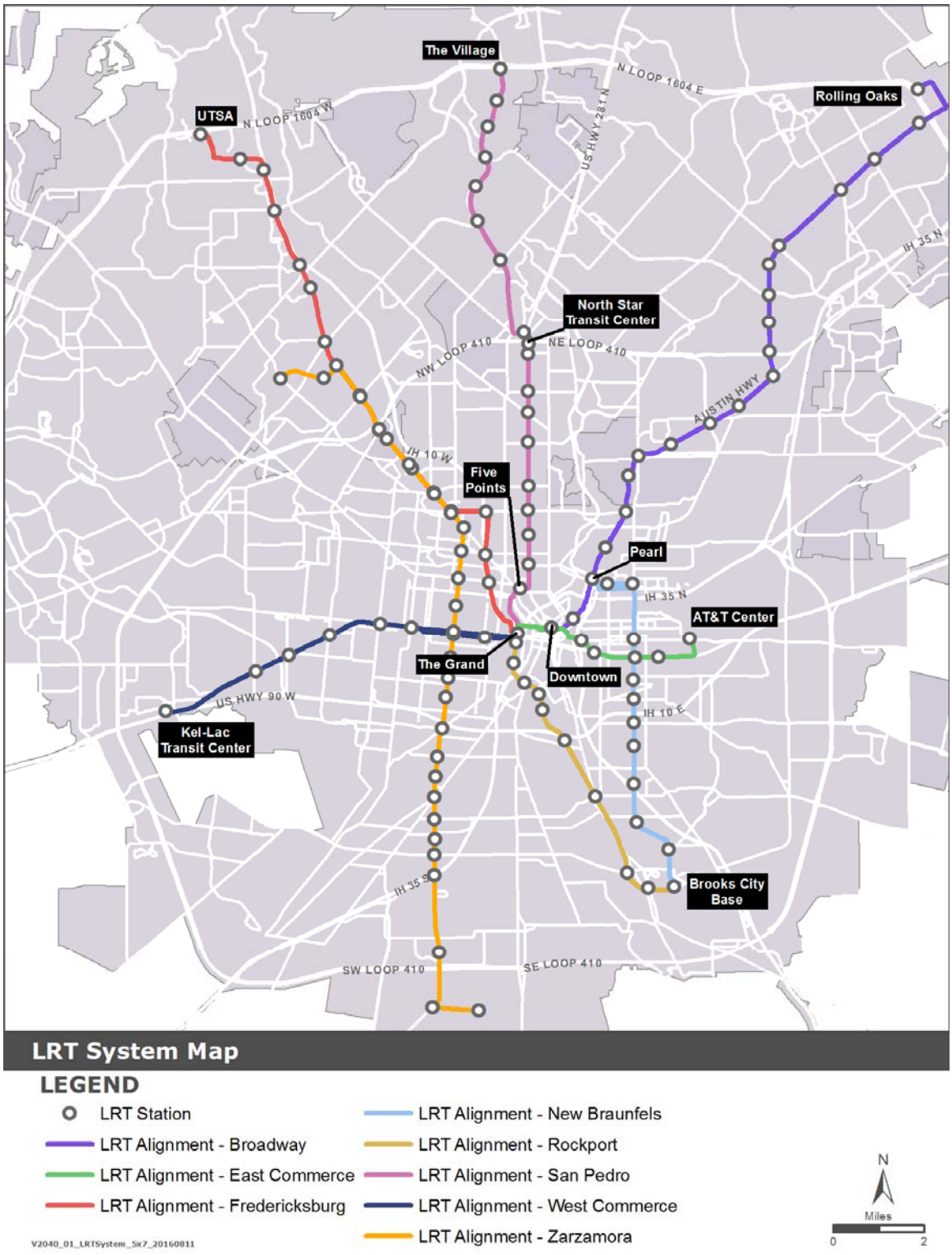
Dedicated right-of-way creates a separate travel lane for transit vehicles which allows them to operate without being impacted by vehicular traffic.

[9] Preliminary costs based on an initial capital cost evaluation. For methodology detailing the evaluation process for corridor performance, see *The Visioning Process* in *Volume 2: Developing Vision 2040*.

This section summarizes the analysis of major corridors under consideration for dedicated-lane BRT or LRT service. These corridors connect major regional centers which serve as key hubs of employment and are forecasted to significantly increase in concentrations of both housing and jobs (Figure 2.6, Figure 2.7). The corridors under analysis for either BRT or LRT service include:

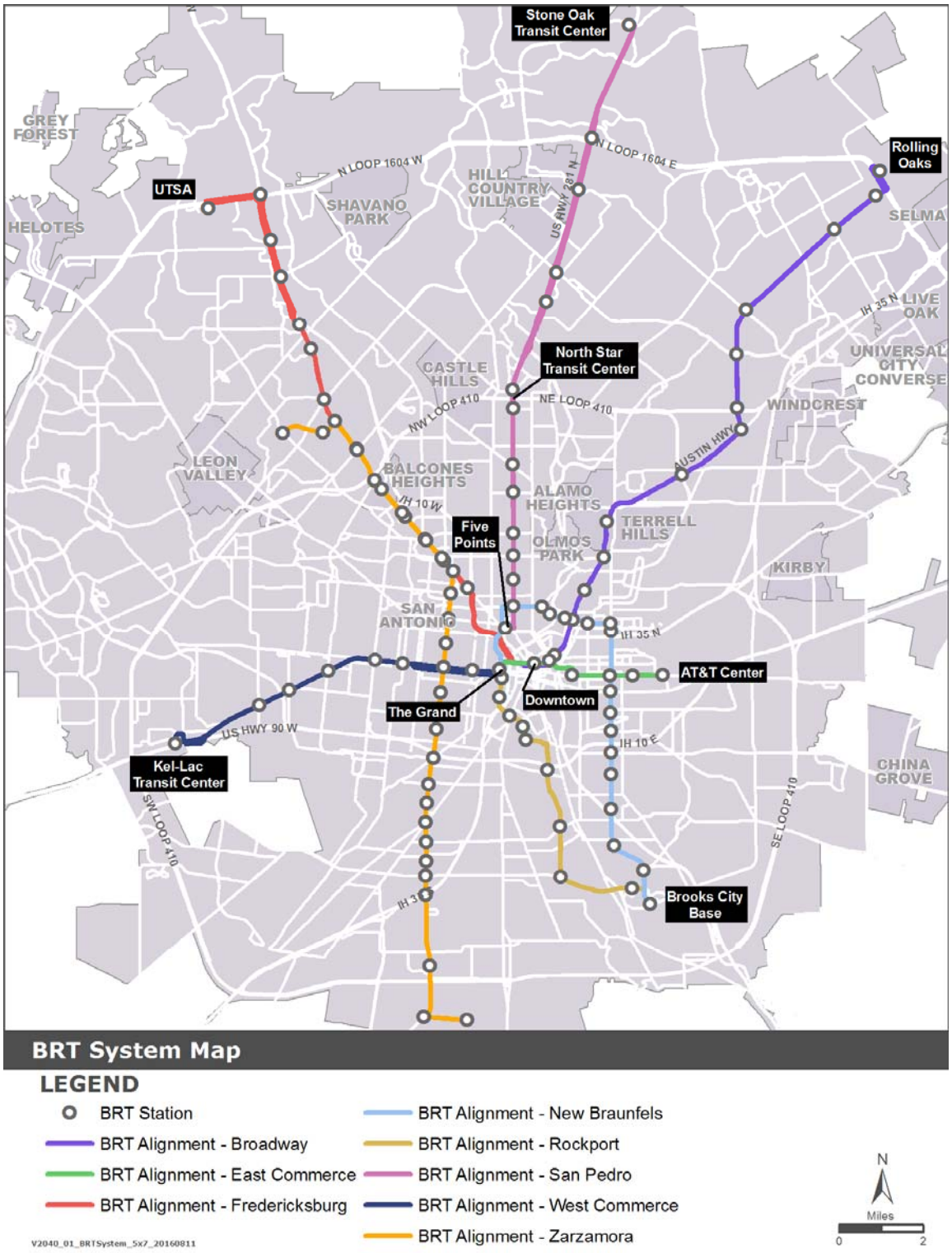
- Fredericksburg Road Corridor (UTSA – Crossroads – Downtown San Antonio);
- San Pedro Avenue Corridor (Stone Oak – North Star – Downtown San Antonio);
- East and West Commerce Street Corridors (Lackland AFB – Downtown San Antonio – AT&T Center);
- Broadway Corridor (Rolling Oaks – Pearl – Downtown San Antonio);
- Rockport Corridor (Brooks City-Base – Downtown San Antonio);
- New Braunfels Avenue Corridor (Brooks City-Base – Pearl – Downtown San Antonio); and
- Zarzamora Corridor (Texas A&M San Antonio – Crossroads – South Texas Medical Center).

Figure 2.6 LRT System Route Map



Source: Parsons

Figure 2.7 BRT System Route Map



Source: Parsons

2.3.3 BRT and LRT Cost Estimation Methodology

The unit costs for all of the construction estimates are in 2016 dollars and are formulated upon typical LRT and BRT costs within the United States (The Transport Politic, 2016). Costs utilized the standard FTA cost breakdown but the analysis only included elements that can be effectively estimated at this conceptual level of effort. This stage of project development considers a contingency of 20 percent.

For LRT, the analysis assumes the tracks would run in the median, with an opening provided at most existing signalized intersections. Such openings would always be signalized. Underground troughs for all street power/communications is included, as well as traction power substations placed approximately one every mile. The number of vehicles assumes an all-day headway of 10 minutes for the entire length of each corridor. At each of the station platforms, appropriate canopies and lighting with ticket vending machines are included.

The BRT cost assumptions are similar to those described for the LRT costs, with the difference being the vehicle. The BRT alignments use a combination of dedicated bus lanes and buses operating in mixed traffic. Typical BRT stations would only be 60 feet in length as opposed to 180 feet for the LRT stations. All other elements at the stations, such as canopies, lighting, ticket fare machines, would be identical for both systems.

The right-of-way acquisition costs assumed for full property acquisitions includes the improvement value plus three times the land value. Calculations for partial acquisitions include multiplying the unit value of land by the size of land acquisition, then multiplying by three.

2.3.4 BRT and LRT Estimates of Probable Capital Costs

The costs for the individual corridors vary depending on the route length, current site conditions, number of intersections along the corridor, and other characteristics.[10] Overall, LRT costs more when compared to BRT due to the additional needed power infrastructure and tracks. Total costs for LRT range from approximately $500 million to $1.1 billion, depending on the corridor, while BRT costs range from $150 million to $440 million (Table 2.11, Table 2.12). As assumptions about alignment, service, and construction details change, cost may change substantially from those shown here.

[10] These characteristics are based on geographic surveys rather than modeled values and may vary somewhat from the route contained in the travel demand model.

Table 2.11 LRT Corridor Comparison Summary

Corridor	Length (Miles)	Station Platforms[a]	Vehicles	ROW Cost (millions)	Total Cost[b] (millions,)
Fredericksburg LRT	14.5	24	24	$29.5	$1,069
San Pedro LRT	13.6	30	24	$97.1	$942
West Commerce LRT	8.4	15	16	$6.3	$540
East Commerce LRT	4.4	8	10	$45.5	$507
Broadway LRT	17.7	34	24	$45.1	$1,008
Rockport LRT	7.4	10	20	$21.8	$530
New Braunfels LRT	8.1	21	16	$16.9	$560

[a] Station platforms shown are counted as two for side platform locations; or one for center platform locations.

[b] Costs in 2015 dollars. Changes in alignments, assumptions and implementation strategies will cause costs to vary from these estimates.

Table 2.12 BRT Corridor Comparison Summary

Corridor	Length (Miles)	Dedicated Length[a]	Station Platforms[b]	Vehicles	ROW Cost[d] (millions, 2015 dollars)	Total Cost[d] (millions, 2015 dollars)
Fredericksburg BRT	15.2	9.1	20	28	$4.4	$345
San Pedro BRT	16.3	6.1	27	30	$24.7	$375
West Commerce BRT	8.7	7.4	14	18	$0.4	$238
East Commerce BRT	4.4	3.7	13	12	$1.6	$151
Broadway BRT	17.1	15.8	38	30	$17.4	$427
Rockport BRT	8.5	7.8	18	20	$4.4	$225
New Braunfels BRT	11.6	8.7	36	20	$3.8	$308
Zarzamora BRT[c]	25.3	19.4	29	49	$14.7	$440

[a] Dedicated length indicates the portion of the proposed alignment is on exclusive guideway and not shared with other vehicles.

[b] Station platforms shown are counted as two for side platform locations; or one for center platform locations.

[c] The methodology for the Zarzamora corridor differs from the other corridors. A weighted average of each unit-cost element (e.g., demolition, traffic signals, guideways) were calculated using the cost and length of the seven other corridors.

[d] Costs in 2015 dollars. Changes in alignments, assumptions and implementation strategies will cause costs to vary from these estimates.

2.4 Passenger Service Project Summary

Passenger service is the most visible component of VIA's transit network, and a focus area in the Vision 2040 Long Range Plan. The plan includes the projects listed in Table 2.13.

Table 2.13 Passenger Service Projects

Capital Investments	• Expand network of mixed-traffic Primo Buses with TSP, improved station areas, and 10-minute frequencies. • Design and build a LRT network. • Design and build a dedicated-lane BRT network. • Expand network of express routes. • Install TSP/ITS improvements for key routes to reduce delays.
Policy Goals	• Maintain state of good repair in existing fleet through fleet purchase program. • Identify and prioritize locations for railroad-grade crossing separation. • Support construction of HOV lanes to improve travel time reliability.
Operational Improvements	• Increase frequency of existing passenger service: - Local Service: 20 minutes peak, 30 minutes off-peak - Frequent Service: 12 minutes peak, 20 minutes off-peak - Express Service: 15 minutes peak, 30 minutes off-peak • Increase service span for all routes to 4 a.m. (start of service) to 1 a.m. (end of service).

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3.0 Passenger Facilities

Passenger facilities represent the interface between passenger service and the general public, and as such form VIA passengers' first and last impressions of the network. It is here that passengers park their bicycles and cars, buy tickets, wait for a transit vehicle, and walk or ride to their final destination. The Vision 2040 Long Range Plan includes improvements to VIA's extensive network of park & ride facilities, transit centers, and bus stops with pedestrian shelters, improved seating, reader boards, pedestrian infrastructure, and public art. These improvements will be needed to meet the needs of the increased levels of passenger service contained in the Vision 2040 Long Range Plan.

3.1 Transit Facilities

VIA loosely divides its major transit facilities into two main groups: park & rides and transit centers (Figure 3.1).

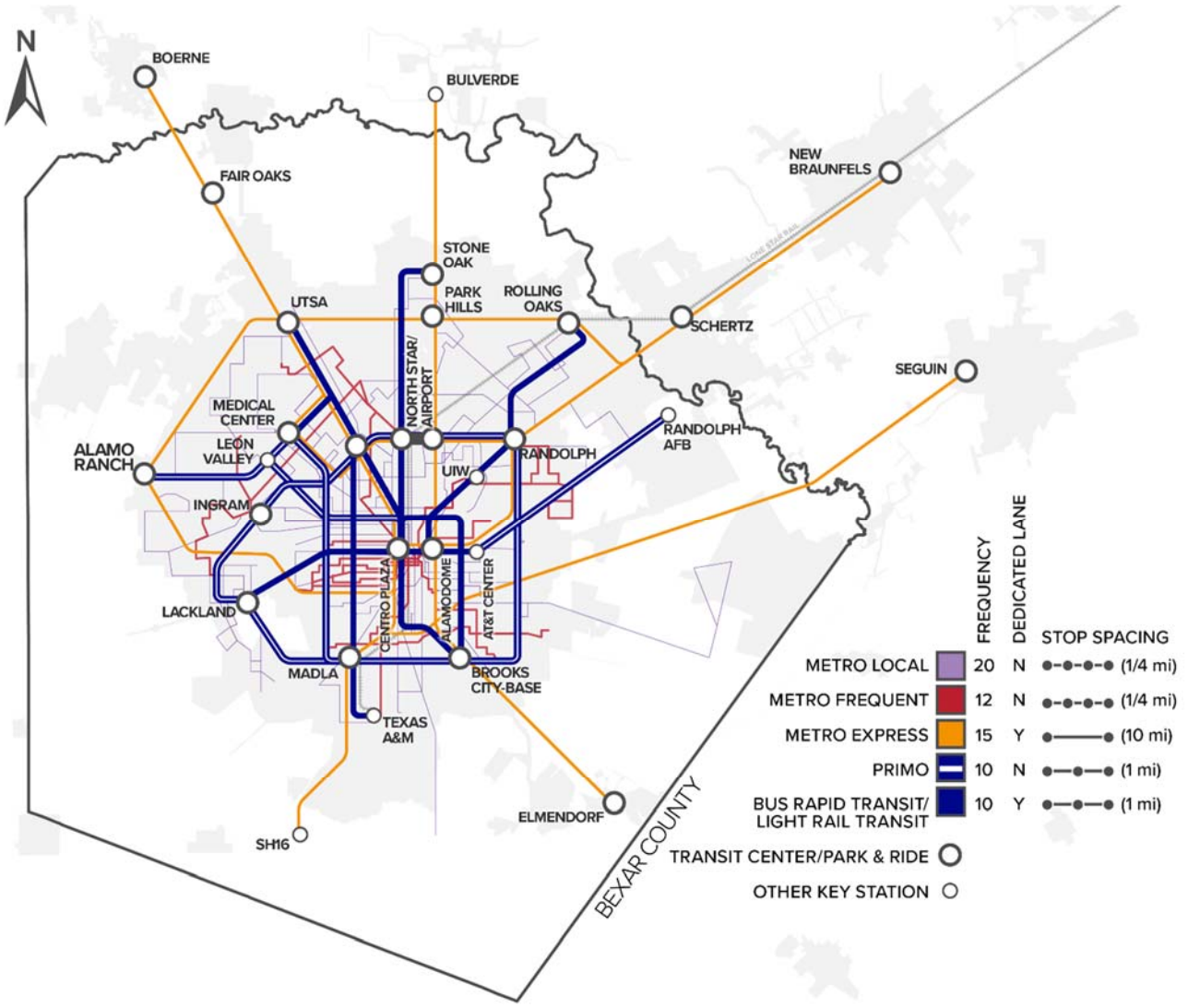
VIA currently owns and operates nine **park & ride facilities** across the region with free parking for VIA riders. The park & ride facilities are used by commuters traveling to/from to work, transferring from one route to another, and for special event service. These locations offer lighted and secured parking during bus operating hours. Three of the facilities have Information Centers with bus schedules, restrooms, vending machines and staff to assist VIA's customers, and each include real-time arrival information. The Vision 2040 Long Range Plan includes expansions to existing park & rides and the construction of new facilities, and constructing additional bus bays and parking facilities as needed across the VIA service area.

VIA currently owns and operates five staffed **transit centers** across the region, offering intermodal connections to bus service and parking for VIA riders. Transit centers are used as transfer facilities, are located downtown and around Loop 410, and are served by more frequent services. These facilities will play a key role in connecting BRT or LRT services with Local, Frequent, and Express services. Transit centers have limited parking and are often staffed, and have indoor waiting facilities.

In total, VIA plans to operate 21 facilities as park & rides or transit centers to meet the passenger service needs of the LRP, including:

- Ten passenger facilities will be equipped with at least 100 parking spaces;
- Ten passenger facilities will staffed with VIA employees; and
- Twenty-one passenger facilities will be designated as either a transit center or park & ride.

Figure 3.1 Vision 2040 Transit Facilities



Bus Bays and Parking Facilities

Within the context of the Vision 2040 Long Range Plan, transit centers and park & rides are expected to handle a significant increase in passenger traffic due to the addition of new Primo/BRT/LRT routes. Needed parking spaces were determined by the projected volume of passengers accessing the system at a given stop by driving (as opposed to walking, biking, or transferring from another transit vehicle).

Several factors were included in the determination for the number of bus bays:

- **Route Frequency –** The number of vehicles for each route serving the facility per hour.
  - Peak route frequencies were used in assessing bus bay requirements, as more vehicles typically operate at these times. The need assessment also assumed that routes that operated less frequently could share bus bays.[11]
- **Route Terminus –** The end of the route and bus layover location.
  - Bus bays located at the terminal of a route require additional attention. Depending on the route's frequency and recovery time, there is the possibility of another vehicle arriving when the bus bay is occupied.
  - The scenario assumes that vehicles will spend recovery time at a transit center on either end of the trip for the operator to rest and as a buffer against delays (about 10 percent of total runtime). Additional bus bays were allocated if the recovery time was sufficiently close to the headway of the route.[12] In most cases no additional bays were needed as a part of increased recovery requirements.

The initial allocation of transit bays assumed that each route by direction would receive a minimum of one bay. Additional bays would be allocated if the minimum layover requirements and frequencies on the route dictated additional capacity needs. With the majority of transit centers exceeding the minimum number of available facilities, opportunities to reduce the number of bay requirements were analyzed. The first method of reductions consolidated the Express routes to only require one bay for both directions. Since Express passengers tend to board in the peak direction, this consolidation of both directions of the Express route would likely not have a significant impact on transit center operations and flow. The largest reduction was seen at the Alamodome and University transit centers, where four express routes pass through both proposed transit centers.

Further consolidation was made to local routes not terminating at a transit center. Proposed local service in the Vision 2040 Long Range Plan operates every 20 minutes during peak periods, allowing for two local routes to share one bus bay while meeting the recommended maximum of six vehicles per hour. While some confusion may result from the passengers, this may be alleviated by having bays allocated to routes based on common direction or destination.

[11] WMATA uses a general rule of thumb where one bus bay is provided for six buses per hour, with no more than three routes serving any one berth.

[12] See the TCQSM 3rd Edition for further information.

Table 3.1 2040 Passenger Facility Requirements

Facility Name	Primo	Express	Facility Type	Parking Type	2015 Current Spaces	2040 Needed Spaces	2015 Current Bus Bays	2040 Needed Bus Bays
Kel-Lac Transit Center	•	–	TC/PR	Structure	46	310	7	13
South Texas Medical Center Transit Center	•	•	TC/PR	Surface	123	160	12	13
Ingram Transit Center	•	–	TC/PR	Structure	81	160	9	13
North Star Transit Center	•	•	TC/PR	Lease	–	130	9	14
University Park & Ride	•	•	TC/PR	Structure	200	140		7
Madla Transit Center	•	•	TC/PR	Structure	135	370	7	8
Robert Thompson Transit Center/ Alamodome	•	•	TC/PR	Surface	128	160	2	13
Brooks City-Base Transit Center	•	•	TC/PR	Structure	–		6	10
Centro Plaza Transit Center	•	•	TC	N/A	–		7	27
Crossroads Park & Ride	•	•	PR	Structure	500	410	10	11
Randolph Park & Ride	•	•	TC/PR	Surface	287	260	10	14
US 151	•	•	PR	Surface	–	70		8
Stone Oak	•	•	PR	Structure	–	170	6	6
Rolling Oaks	•	•	PR	Surface	–	80		7
Parkhills Park & Ride	–	•	PR	Surface	225	80	–	–
Seguin	–	•	PR	Surface	–	90	–	–
Schertz	–	•	PR	Surface	–	70	–	–
Elmendorf	–	•	PR	Surface	–	60	–	–
New Braunfels	–	•	PR	Surface	–	80	–	–
Fair Oaks	–	•	PR	Surface	–	50	–	–
Boerne	–	•	PR	Surface	–	40	–	–
Blossom Park & Ride	–	–	Key Station	N/A	30	20	–	–
Sea World Park & Ride	–	–	Key Station	N/A	152	30	–	–

TC: Transit Center

PR: Park & Ride

While capital costs for passenger facilities can vary greatly depending on a number of factors, the following estimates are used in projecting a total cost. Per-bay costs for new bus bays can be up to $1 million each. Per-space costs for parking facilities can range from approximately, $3,000 for

surface parking, to over $16,000 for structured parking. Leasing agreements with nearby parking facilities such as churches, department stores, or other high-volume parking facilities is a key strategy to mitigate construction costs.

3.2 Shelter and Station Amenities

The remaining passenger facilities consist of a range of amenities, from Primo stations equipped with real-time arrival signs, off-board payment facilities, lighting (either as part of the shelter or nearby street lights), full shelters, and excellent pedestrian accommodations, to low-service bus stops consisting simply of a sign. Certain stations, referred to here as "key stations" serve high-traffic areas or multiple Primo/BRT/LRT routes, and should receive special attention for upgrades and amenities.

To serve riders of its fixed route bus and Primo routes, VIA offers many shelter and station amenities across its service area. To support the VIA Better Bus System and Rapid Transit Network, VIA plans to improve the following shelter and station amenities, and construct new shelters and stations corresponding with major intersections of key services:

- **Bus Shelters –** Across VIA's service area, there are several hundred different legacy and next-generation (known as NextGen) bus shelters. The older legacy shelters have a consistent green paint scheme, while NextGen shelters are more modular in design with various sizes and configurations depending on the site constraints and anticipated ridership. In addition to benches, NextGen shelters integrate lighting and public art. VIA plans to add real-time arrival information and off board fare payment kiosks at its highest-ridership shelters. Real-time arrival equipment for the VIA Fredericksburg Road Primo was approximately $4,000 per unit; off-board fare collection units can cost anywhere from $27,500 to $200,000 each, depending on capabilities (Metro Planning, 2015; Dugan, 2016).

- **Primo Stations –** VIA's Primo Service uses stations, which have a distinct architecture and brand to distinguish them from other bus shelters in the VIA network. Each station is ADA accessible, and has passenger waiting platforms and real-time arrival information. Primo station design maintains a consistent look while fitting into the character of the unique neighborhoods in which they are located. VIA plans to continue using existing designs for future mixed-traffic Primo Service; however, VIA may modify stations for BRT and LRT services to include a raised platform, improved fare collection technology, and shoulder or median station locations.

- **Pedestrian Infrastructure –** A critical part of the success of VIA's Better Bus Network and Rapid Transit Network is ensuring that all riders can safely and securely access VIA bus shelters, Primo stations, park & rides, and transit centers. Adjacent to each of VIA's passenger facilities are supporting pedestrian infrastructure, made up of sidewalks and crosswalks. The Vision 2040 Long Range Plan includes planned improvements to pedestrian infrastructure surrounding bus stops, Primo stations, park & rides, and transit centers.

- **Public Art Integration –** The Vision 2040 Long Range Plan includes the VIA Art in Transit program. VIA plans to develop site-specific artwork for each new Primo station, which will reflect

the artistic and/or cultural interests of the surrounding community. Selected artists will coordinate with community stakeholders to incorporate works of art that promote transit use, enhance VIA assets, and complement the community. VIA plans to integrate public art components into future Metro Service shelters, mixed-traffic Primo Service stations, and BRT and LRT stations as they are designed and constructed.

3.3 Passenger Facility Project Summary

To support both the Better Bus Network and Rapid Transit Network, VIA plans to provide riders safe, secure, and accessible connections through all passenger facilities (Table 3.2).

Table 3.2 Passenger Facility Projects

Capital Investments	• Expand parking and bus bay facilities at park & rides and transit centers to meet projected demand. • Construct new park & ride and transit center facilities to meet needs of expanded LRT, BRT, and Express networks. • Modernize and provide amenities at key stations and stops, including: - Off-board fare collection kiosks - Real-time arrival signs - High-quality lighting and pedestrian access
Policy Goals	• Maintain expansion of shelter program.

4.0 Supporting Facilities

The Vision 2040 Long Range Plan also includes the need for high-quality maintenance and administration facilities. VIA plans to construct a new primary maintenance facility to support its existing rubber-tired fleet, and will expand as necessary to accommodate fleet expansion through 2040. In addition, development of a light rail network would require construction of a new rail maintenance facility to support the fleet of light rail vehicles.

VIA's current fleet is stored and serviced at the VIA Central Operations and Maintenance Yard located on North Flores Street, just north of Downtown San Antonio. This large central yard was constructed in 1947 and has grown to serve VIA's expanding fleet. The facility provides many types of services for the fleet, but capacity is constrained by the limited size and the age of the facility. Future growth will require adding capacity for fleet parking and servicing, either in the current location or in additional locations. The current property's location (just north of Downtown San Antonio between North Flores Street and San Pedro Avenue) could potentially be more valuable if developed into commercial or residential property, providing VIA with funds to build a modern facility elsewhere.

Transit fleets require a wide spectrum of services in order to keep the vehicles functioning, clean, and in a state of good repair. These services range from the most simple such as a safe place to store and secure the vehicle during off-hours, to the more complex such as restoring or replacing engine or transmission components. There are four main functions that are provided at a transit maintenance and operations facility:

- **Secure Storage** of the fleet during off-hours;
- **Daily Services,** including removing the fare box, fueling the vehicle, and interior and exterior cleaning and washing;
- **Light Mechanical Services** such as replacing small components (e.g., headlights, wiper blades), conducting vehicle inspections, and fluid replacements (e.g., oil, brake, or transmission); and
- **Heavy Mechanical Services** that require a specialist to remove and repair or replace mechanical parts, repair/replacement of body components (e.g., fenders or panels), and repair/replacement of interior components (e.g., seating or grab bars).

Another key concern in maintenance facility strategy is minimization of deadheading. Deadheading occurs when a vehicle travels out of revenue service; this can mean leaving or returning to a garage, changing routes, or other travel when not carrying passengers. Relief occurs when drivers change shift. Buses do not return to the garage for shift changes. Deadheading and relief are measured in hours, including vehicle and driver time. These costs are largely dictated by the spatial relationship

between the garage and routes. The longer distance a bus travels to and from the central operations center to its route results in higher deadhead costs. As the Greater San Antonio Region grows and service routes expand, VIA's buses must travel farther from the transit maintenance and operations facility, thereby increasing deadhead, and relief costs.

The VIA Vision 2040 fleet, with its corresponding 921 bus and rail vehicles in service by 2040, will require a shift in the facility build-out approach to support the operating and maintenance needs of the fleet. The current approach, which involves operating exclusively out of the central transit maintenance and operations facility, will be inadequate for the service levels of the Vision 2040 Long Range Plan. To better handle the increased operational requirements, regionally distributed "zones of operation" (and corresponding satellite transit maintenance and operations facility) are recommended. This allows for efficiencies in deadhead and relief costs for both deployment of vehicles and maintenance of vehicles. By creating connected, but self-sufficient transit maintenance and operations facilities, VIA can avoid costs associated with a single central heavy maintenance facility. While the current single facility does minimize administration and overhead costs, a more distributed facility plan will help meet the needs of regional service and an expanded fleet.

Two scenarios to meet the maintenance needs of the Vision 2040 Long Range Plan are presented below (Table 4.1). The maintenance scenarios have the following characteristics:

- **Scenario 1** involves a rebuild of the central maintenance facility to provide modern maintenance bays and support facilities. The central transit maintenance and operations facility would be complemented by two additional full maintenance facilities, which would be self-sufficient, and would support routes within their zone. The cost is approximately $67 million for the central facility, and $35 million for each secondary facility, for a total cost of approximately $137 million.

- **Scenario 2** is an expanded version of Scenario 1. Scenario 2 includes the addition of one satellite facility, which could be used to support the Rapid Transit Network with articulated buses. A satellite facility adds expense (approximately $8 million) to the scenario, and is included in order to reduce deadhead and operating costs for routes. There may be some savings at the main facility due to the use of the main facility, but for planning purposes its cost is held consistent with Scenario 1. Scenario 2 would cost approximately $145 million.

Table 4.1 Two Scenarios for VIA Vision Fleet Maintenance

	Central Site	Secondary Sites	Notes	Total Cost
Scenario 1	Rebuild a new facility at same location in phases to serve 2040 fleet size. Assumes paratransit fleet is relocated.	Two secondary main sites for 250 buses each.	Retain and rebuild the existing central facility; site and build two new facilities.	$137 million
Scenario 2	Rebuild a new facility at same location in phases to serve 2040 fleet size. Assumes paratransit fleet is relocated.	Two secondary main sites for 250 buses each. One satellite site for up to 50 buses each.	Same as Scenario 1, but adds one satellite facility to reduce deadhead costs as warranted by Rapid Transit Network.	$145 million

4.1 Maintenance Facility Project Summary

To support both the Better Bus Network and Rapid Transit Network, VIA plans to improve its existing primary maintenance facility and construct satellite facilities, particularly for the new bus rapid transit and light rail transit systems (Table 4.2).

Table 4.2 Maintenance Facility Projects

Capital Investments	• Construct maintenance facility for LRT vehicles. • Expand and modernize maintenance facilities (including satellite facilities) for bus fleet.

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5.0 References

American Public Transit Association. (2010). Designing Bus Rapid Transit Running Ways. http://www.apta.com/resources/standards/Documents/APTA-BTS-BRT-RP-003-10.pdf.

Alamo Area Metropolitan Planning Organization. (2016). FY 2017-2020 Transportation Improvement Program. http://www.alamoareampo.org/Plans/TIP/docs/TIP_2017-2020.pdf.

Dugan, Amanda (2016). *MetroRail kiosks will soon be cash-only.* KXAN Austin. http://kxan.com/2016/04/21/metrorail-will-be-cash-only-by-the-end-of-the-year/

Metro Planning (2015). *Metrobus Off-Board Fare Payment: P3 Business Plan.* http://planitmetro.com/wp-content/uploads/2015/09/Metrobus-OBFP-P3-Investor-Business-Plan_Sept2015.pdf

SPUR. (2015). *Could Mountain View's Endorsement Jumpstart Silicon Valley BRT?* http://www.spur.org/news/2015-04-30/could-mountain-view-s-endorsement-jumpstart-silicon-valley-brt.

VIA Metropolitan Transit. (2016a). *Bus Service*. http://www.viainfo.net/BusService/Schedules.aspx.

VIA Metropolitan Transit. (2016b). *Primo Service*. http://www.viainfo.net/Primo/PrimoMain.aspx.

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