

Vermont Transit Corridor – Rail Conversion/Feasibility Study

FINAL REPORT

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EXECUTIVE SUMMARY

Study Background

The funding for Bus Rapid Transit (BRT) on Vermont Avenue was put in place in November 2016 when voters of Los Angeles County passed Measure M, a half-cent sales tax initiative that funds a number of transportation projects and programs. The Vermont BRT Transit project is slated for a ground-breaking date of Fiscal Year (FY) 2024 and an opening date of FY 2028. Additionally, the expenditure plan for Measure M identifies a potential conversion of BRT service on Vermont to rail after FY 2067 based on ridership demand.

In March 2017, the Metro Board of Directors directed staff to proceed with the implementation of the Vermont BRT Transit project as a near term transit improvement along the corridor, and to initiate a study which identifies and evaluates rail alternatives for the Vermont Corridor to ensure that the implementation of any BRT project on Vermont Avenue does not preclude a future conversion to rail. In response to the Metro Board's directive, staff and consultants conducted this Vermont Transit Corridor - Rail Conversion/Feasibility Study.

Study Purpose

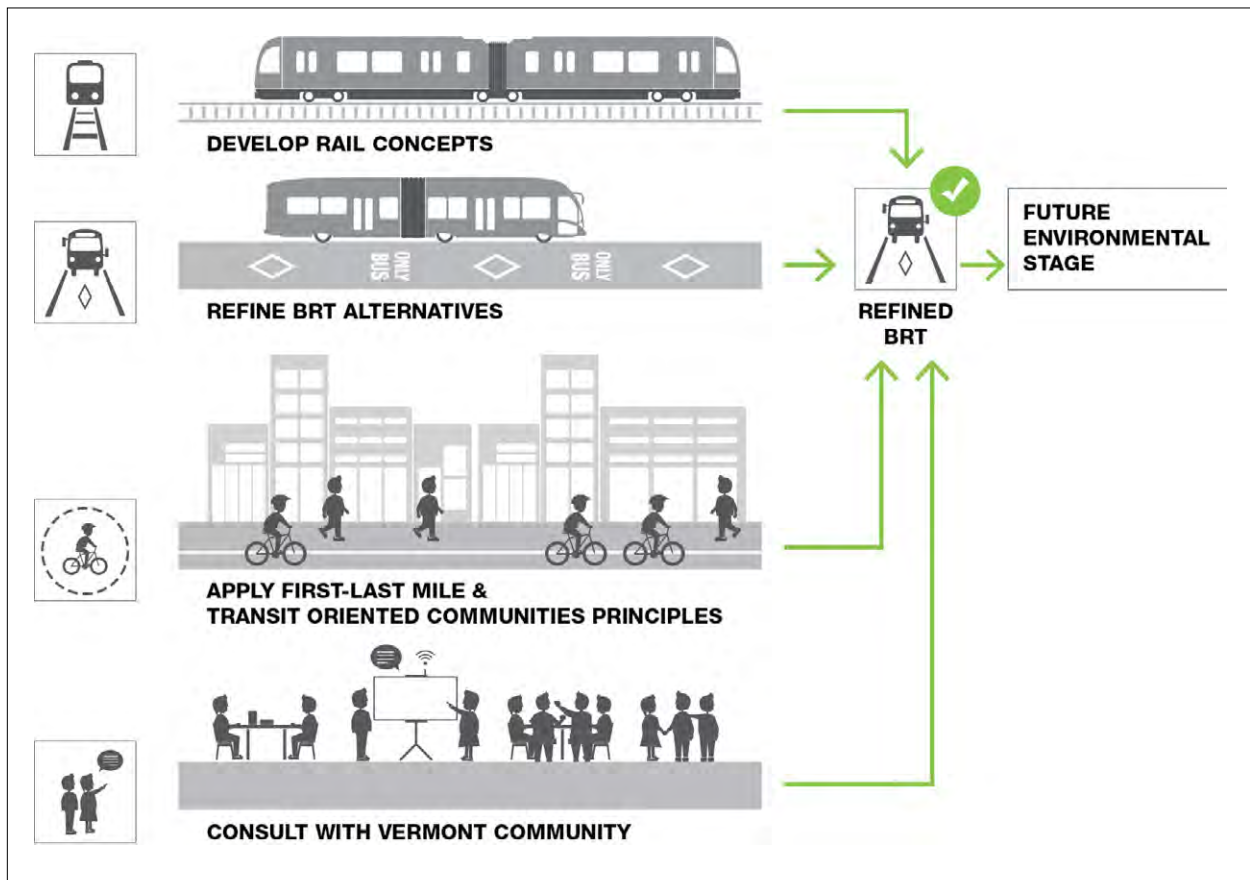
The purpose of the Vermont Transit Corridor - Rail Conversion/Feasibility Study was to further evaluate the two promising BRT concepts developed earlier as part of the Vermont BRT Technical Study (February 2017) to ensure that their implementation would not preclude a potential conversion to rail in the future. The study was to also look at and assess the feasibility of potential future rail alternatives for the Vermont Corridor. To this end, there were six key study objectives:

- 1 Define a range of potential future rail transit options, including light rail, heavy rail, and streetcar/tram, and a possible phased implementation (such as a potential rail connection between the Wilshire/Vermont Red/Purple Line Station to the Expo/Vermont Expo Line Station);
- 2 Analyze the feasibility of the potential future rail options in terms of engineering feasibility, constructability, junction operability, cost effectiveness, environmental issues/concerns, and consistency with community goals and priorities;
- 3 Develop operating scenarios corresponding to each rail option to identify planning-level capital and operating costs;
- 4 Review and update the two recommended BRT concepts from the earlier BRT study and identify considerations that should be included in the design of BRT;
- 5 Reassess the project benefits and impacts of the two refined BRT concepts including ridership forecasts, cost estimates, preliminary traffic impacts, and parking loss; and
- 6 Evaluate opportunities to facilitate and promote Transit Oriented Communities and First-Last Mile opportunities along the corridor.

As shown below in Figure ES-1, the study was carried out along four parallel but connected streams:

1. Development of Rail Concepts;
2. Refinement of BRT Alternatives;
3. Application of First-Last Mile & Transit Oriented Communities Principles; and
4. Consulting with the Key Community Stakeholders.

Figure ES-1: Vermont Transit Corridor - Rail Conversion Feasibility Study Process



Study Main Conclusions

Overall, the study found that:

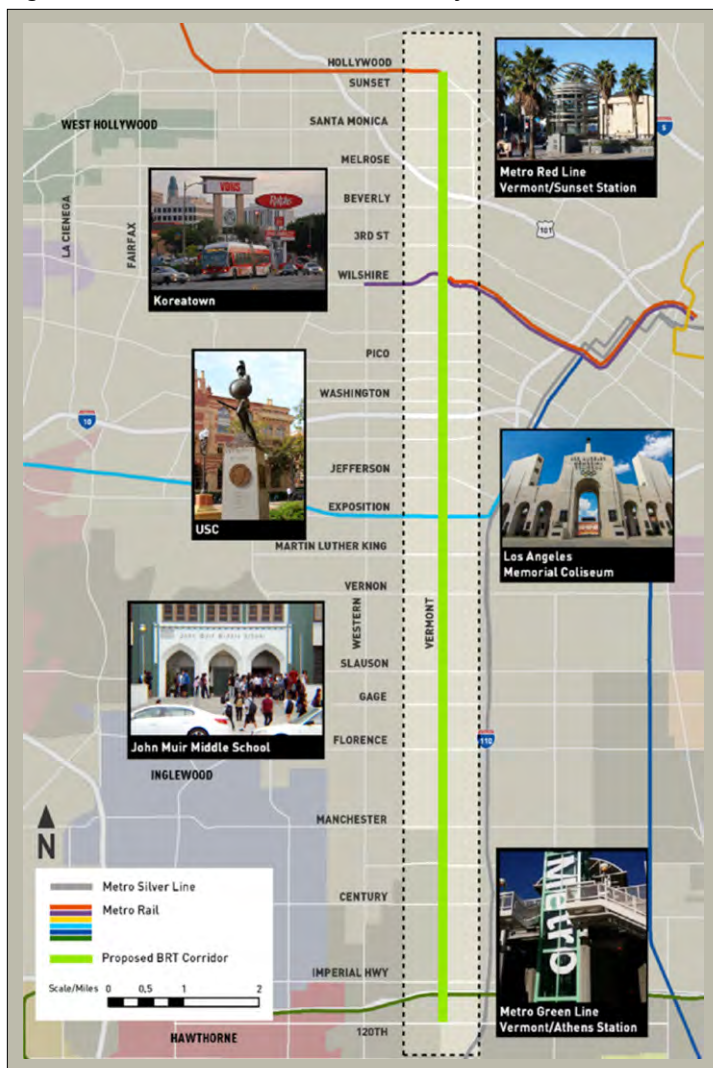
- BRT continues to be feasible in the Vermont Corridor;
- BRT does not preclude conversion to rail transit later;
- BRT can provide the needed people-carrying capacity until 2042 and beyond;
- Several rail alternatives are feasible for later implementation;
- Feasible rail alternatives have major costs; and
- Some useful rail features can be installed and used as part of BRT, and used in any later rail conversion.

Study Area

Figure ES-2 shows a map of the study area, which includes one half-mile to either side of Vermont Avenue. The Vermont Corridor is approximately 12.4 miles, extending from Hollywood Boulevard (near the Sunset/Vermont Metro Red Line Station in Hollywood) south to 120 Street (just south of the Vermont/Athens Metro Green Line Station). Most of the corridor falls within the City of Los Angeles with approximately 2.5 miles at the south end (west side of Vermont only) in the County of Los Angeles.

The corridor is one of the densest communities in Los Angeles County with approximately 150,777 residents. It is also the second busiest bus corridor in Los Angeles County carrying approximately 45,000 weekday boardings. It connects to dozens of other local bus and Metro Rapid lines, and four Metro Rail lines. It provides access to a number of major key activity centers, including the University of Southern California (USC), Exposition Park, Los Angeles City College and Children’s Hospital Los Angeles.

Figure ES-2: Vermont BRT Corridor Study Area



Right of Way

The right-of-way (ROW) along Vermont Avenue varies significantly between Hollywood Boulevard and 120th Street. In particular, the corridor’s character changes completely near Gage Avenue. North of Gage Avenue, the corridor ranges between 80’ and 90’ in width, with pavement widths of 56’-80’ and sidewalks generally 10’-15’ wide. South of Gage Avenue, the corridor widens dramatically to between 150’ and 200’ wide, with pavement widths of 150’-160’ and sidewalks generally 10’-15’ wide.

Initial BRT Concepts

The Rail Conversion/Feasibility Study builds upon the work undertaken in the 2017 Vermont BRT Technical Study. The purpose of the Vermont BRT Technical Study was to evaluate the feasibility of implementing BRT along Vermont Avenue, including bus lanes and other key BRT features. The study identified two promising BRT concepts, which would provide improved passenger travel times, faster bus speeds, and increased ridership. The two concepts included an end-to-end side-running BRT and a combination side and center-running BRT.

End-to-End Side-Running BRT

This concept features a dedicated bus lane along the entire 12.4 mile corridor within the existing ROW. Room for the bus lanes would be made available by converting the general purpose lane (one in each direction) adjacent to the curbside parking lanes to a dedicated bus lane. BRT stations with a number of passenger amenities including shelters, bus benches, trash cans, next bus information, and lighting, would be located on the sidewalks and, in most cases, far side of the intersections, as shown in Figure ES-3.

Figure ES-3: End-to-End Side-Running BRT



Combination Side and Center-Running BRT

This concept features 4.2 miles of center-running dedicated BRT lanes south of Gage Avenue, where the ROW widens significantly, and 8.2 miles of side-running dedicated BRT north of Gage Avenue. South of Gage Avenue, the corridor widens to three travel lanes in each direction and includes sufficient ROW to accommodate center-running BRT lanes. The center bus lanes would be accommodated by converting the two center traffic lanes to bus lanes as shown in Figure ES-4. Because the ROW is generally narrower north of Gage Avenue, center-running BRT lanes would require considerable ROW acquisition. Therefore, side-running dedicated bus lanes are proposed north of Gage Avenue.

Figure ES-4: Center-Running BRT



Development of Preliminary Rail Concepts

Four different rail technologies were considered for the Vermont Corridor. It is important to consider the various rail technologies to properly understand how to feasibly connect or integrate the technologies to the existing rail lines and to technologies on or near the corridor. The four different rail technologies are discussed briefly below:

- 1 Light Rail Transit (LRT) High-Floor** is Metro's standard and has been deployed on all Metro LRT lines to-date including the Metro Expo Line at Exposition Boulevard and Metro Green Line at I-105.

*Figure ES-5: LRT High-Floor
Example: Metro Gold Line*



- 3 Tram/Streetcars** are the most similar rail technology to BRT. These vehicles are low-floor, similar in length and have slightly higher passenger capacities of approximately 100 people per vehicle.

*Figure ES-7: Tram/Streetcar
Example: Portland Streetcar*



- 2 LRT Low-Floor** is another form of LRT similar to Metro's current standards in terms of vehicle length and alignment characteristics, but it uses low-floor vehicles similar to the Tram/Streetcar alternative. This is not currently Metro's standard vehicle and the fleet (and associated maintenance facilities) would not be interoperable, meaning that a LRT low-floor vehicle on Vermont would not be able to operate on or share tracks for revenue service with the Metro Expo or Metro Green Line.

*Figure ES-6: LRT Low-Floor
Example: San Diego Trolley*



- 4 Heavy Rail Transit (HRT)** is the technology used on the Metro Red and Purple Lines and would be compatible with the existing HRT fleet and vehicle maintenance yards.

*Figure ES-8: HRT
Example: Metro Red Line*



In developing the preliminary rail concepts, the various technologies were paired with possible vertical and horizontal configuration options. When looking at the potential rail alignments, the vertical profile of rail on the corridor could be at-grade, at-grade with grade separations (below or above) at specific intersections, a fully elevated system, or a fully below-grade system. For at-grade systems, the guideway and stations may be positioned in the center of the street (center-running) or on both edges of the street (side-running). From all the possible combinations of technology, and vertical and horizontal configurations, an initial set of six combinations were selected that represent a likely and reasonable sampling of the combinations that Metro might build within the Vermont Corridor.

Table ES-1: Preliminary Rail Concepts

Concepts	Rail Technology	Alignment Configuration
1	LRT High-Floor	<ul style="list-style-type: none"> • At-Grade and Grade-Separated • Center-Running
2	LRT Low-Floor	<ul style="list-style-type: none"> • Primarily At-Grade¹ • Side-Running
3	Tram/Streetcar	<ul style="list-style-type: none"> • Primarily At-Grade¹ • Side-Running
4	HRT Purple Line Connection	<ul style="list-style-type: none"> • Fully Below-Grade • Connect to Metro Purple Line
5	HRT Red Line Connection	<ul style="list-style-type: none"> • Fully Below-Grade • Connect to Metro Red Line
6	HRT – Stand-Alone Alignment	<ul style="list-style-type: none"> • Fully Below-Grade • No Connection to Existing Metro Lines


















1. Metro Rail Design Criteria Section 10.3.3.1 does not allow two rail lines to intersect (“no face to face train meets shall be permissible in the normal direction”) and, therefore, a grade separation will be required at the Metro Expo Line.

Initial Screening of Preliminary Rail Concepts

The six preliminary rail concepts were then analyzed against the key criteria included in Table ES-2, in order to arrive at a short-list of the three most promising and prototypical concepts. Based on the screening analysis, the following three concepts were selected as the most promising and representative of what a rail system along Vermont might be like:














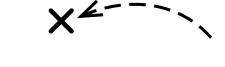



- **Light Rail Transit, High-Floor, Center Running**, on Vermont Avenue from Wilshire Boulevard south to 120th Street. It is anticipated that the LRT line would not continue north along Vermont Avenue to Hollywood Boulevard, as it would for BRT, because the LRT would provide duplicate rail service to the existing Metro Red Line along this segment of the corridor. This concept would use high-floor vehicles, consistent with Metro's current LRT vehicle fleet. In the narrow portion of the corridor north of Gage Avenue, this concept would operate below-grade. South of Gage Avenue, an at-grade center-running system is proposed because there is sufficient right-of-way to operate at-grade here, and LRT systems operate more efficiently in the center of a roadway with two mainline tracks running near each other, allowing trains to easily transfer between tracks via closely spaced crossovers.
- **Heavy Rail Transit with Metro Red Line Connection**, fully grade-separated and connecting directly to the existing Metro Red Line near Vermont Avenue and 3rd Street. It would then continue south under Vermont Avenue to 120th Street. The existing Metro Red Line and the Vermont Line could run together between the Metro North Hollywood and Vermont/Beverly Stations before branching off as two separate lines: one continuing into Downtown Los Angeles and into Union Station, and the other continuing along Vermont Avenue to South Los Angeles. This could provide passengers a one-seat ride between North Hollywood and South Los Angeles.
- **Heavy Rail Transit, Stand-Alone Alignment**, fully grade-separated and terminating at a new station near the existing Wilshire/Vermont station. This concept would serve the same alignment and stations as the HRT with Metro Red Line Connection concept. A potential underground passenger connection could be constructed from the new station to the existing Wilshire/Vermont Station for easy transfers to the existing Metro Red and Purple Lines.

Table ES-2: Preliminary Rail Concepts Screening Summary

 Rail Technology		1 High Floor LRT 	2 Low Floor LRT 	3 Tram/Streetcar 	4 Heavy Rail - Purple Line Connection 	5 Heavy Rail - Red Line Connection 	6 Heavy Rail - Stand-alone 
 Configuration		 <ul style="list-style-type: none"> Center Running High Floor 	 <ul style="list-style-type: none"> Side Running Low Floor 	 <ul style="list-style-type: none"> Side Running Low Floor 	 <ul style="list-style-type: none"> Connect to Purple Line 	 <ul style="list-style-type: none"> Connect to Red Line 	 <ul style="list-style-type: none"> Do Not Connect - Transfer Only
 Customer Experience		✓✓ <ul style="list-style-type: none"> Fast and reliable service, subject to some disruption due to at-grade running 	✓ <ul style="list-style-type: none"> Reliability issues due to side-running (see System Operability below) 	✓ <ul style="list-style-type: none"> Slowest of the three rail technologies Reliability issues due to side-running (see System Operability below) 	✓✓✓ <ul style="list-style-type: none"> Fastest and most reliable of Metro's rail services, due to fully dedicated and grade-separated guideway 	✓✓✓ <ul style="list-style-type: none"> Fastest and most reliable of Metro's rail services, due to fully dedicated and grade-separated guideway 	✓✓✓ <ul style="list-style-type: none"> Fastest and most reliable of Metro's rail services, due to fully dedicated and grade-separated guideway
 System Connectivity		✓✓ <ul style="list-style-type: none"> Requires passengers to transfer between all rail services 	✓✓ <ul style="list-style-type: none"> Requires passengers to transfer between all rail services 	✓✓ <ul style="list-style-type: none"> Requires passengers to transfer between all rail services 	✓✓✓ <ul style="list-style-type: none"> Requires passengers to transfer between all rail services, except one-seat ride to/from the Westside 	✓✓✓ <ul style="list-style-type: none"> Requires passengers to transfer between all rail services, except one-seat ride to/from North Hollywood 	✓✓✓ <ul style="list-style-type: none"> Requires passengers to transfer between all rail services
 System Operability & Reliability		✓✓ <ul style="list-style-type: none"> At-grade running is subject to service disruption due to traffic incidents and other events 	✗ <ul style="list-style-type: none"> Serious operational reliability issues due to lack of ability to route vehicles around incidents or other track-blocking events Does not meet Metro reliability goals 	✗ <ul style="list-style-type: none"> Serious operational reliability issues due to lack of ability to route vehicles around incidents or other track-blocking events Does not meet Metro reliability goals 	✓ <ul style="list-style-type: none"> Most reliable of Metro's rail services Interlining with the Purple Line poses considerable challenges to efficient operations and scheduling Would require terminal improvements to manage additional train volume or the development of a mid-line turnback facility 	✓ <ul style="list-style-type: none"> Most reliable of Metro's rail services Interlining with the Red Line poses considerable challenges to efficient operations and scheduling Would require terminal improvements to manage additional train volume or the development of a mid-line turnback facility 	✓✓✓ <ul style="list-style-type: none"> Most reliable of Metro's rail services Lack of connections with Purple and Red Lines makes for efficient operations and scheduling

PERFORMANCE: ✗ EXTREMELY LOW ✘ VERY LOW ✓ LOW ✓✓ MEDIUM ✓✓✓ HIGH

Table ES-2 (continued): Preliminary Rail Concepts Screening Summary

 Rail Technology	 1 High Floor LRT	 2 Low Floor LRT	 3 Tram/Streetcar	 4 Heavy Rail - Purple Line Connection	 5 Heavy Rail - Red Line Connection	 6 Heavy Rail - Stand-alone
 Configuration	 <ul style="list-style-type: none"> Center Running High Floor 	 <ul style="list-style-type: none"> Side Running Low Floor 	 <ul style="list-style-type: none"> Side Running Low Floor 	 <ul style="list-style-type: none"> Connect to Purple Line 	 <ul style="list-style-type: none"> Connect to Red Line 	 <ul style="list-style-type: none"> Do Not Connect - Transfer Only
 Passenger Capacity	✓✓ <ul style="list-style-type: none"> Second-highest capacity in Metro's rail fleet 133 passengers/car 	✓ <ul style="list-style-type: none"> 25% less passenger cabin space and capacity than high-floor LRT 100 passengers/car 	✗ <ul style="list-style-type: none"> Capacity is severely limited by vehicle size Capacity is not sufficient for projected passenger demand 100 passengers/car 	✓✓✓ <ul style="list-style-type: none"> Highest capacity in Metro's rail fleet 180 passengers/car (Metro load standard is 131) 	✓✓✓ <ul style="list-style-type: none"> Highest capacity in Metro's rail fleet 180 passengers/car (Metro load standard is 131) 	✓✓✓ <ul style="list-style-type: none"> Highest capacity in Metro's rail fleet 180 passengers/car (Metro load standard is 131)
 Cost	✓✓ <ul style="list-style-type: none"> Medium cost relative to other rail alternatives 	✓✓ <ul style="list-style-type: none"> Medium cost relative to other rail alternatives 	✓✓✓ <ul style="list-style-type: none"> Lowest cost relative to other rail alternatives 	✓ <ul style="list-style-type: none"> Highest cost relative to other rail alternatives Need to build satellite or stand alone maintenance facility 	✓ <ul style="list-style-type: none"> Highest cost relative to other rail alternatives Need to build satellite or stand alone maintenance facility 	✓ <ul style="list-style-type: none"> Highest cost relative to other rail alternatives Need to build standalone maintenance and control facility
 Construction Impacts & Service Disruption	✓✓ <ul style="list-style-type: none"> Highest potential for community disruption during construction No or very limited service disruptions to other Metro rail lines during construction 	✓✓ <ul style="list-style-type: none"> Highest potential for community disruption during construction No or very limited service disruptions to other Metro rail lines during construction 	✗ <ul style="list-style-type: none"> Light infrastructure footprint coupled with limited need to relocate utilities results in a faster, less disruptive construction period No or very limited service disruptions to other Metro rail lines during construction 	✗ <ul style="list-style-type: none"> Significant and costly right-of-way needed to build the Purple Line connection During construction, Purple Line frequency may be reduced to as little as 40 minutes for at least one year and potentially longer. Requires taking property to construct under building(s) 	✓ <ul style="list-style-type: none"> Significant and costly right-of-way needed to build the Red Line connection During construction, Red Line frequency may be reduced to as little as 40 minutes for at least one year and potentially longer. 	✓✓ <ul style="list-style-type: none"> No or very limited service disruptions to other Metro rail lines during construction

PERFORMANCE: ✗ EXTREMELY LOW ✘ VERY LOW ✓ LOW ✓✓ MEDIUM ✓✓✓ HIGH

Phasing Options for the Three Rail Concepts

The study also looked at the feasibility of connecting the Metro Red Line at the Wilshire/Vermont Station to the Metro Expo Line at the Exposition/Vermont Station as a first segment. Given the length of the corridor, and past Metro experience with constructing rail systems, it is likely that any rail constructed on Vermont Avenue would be built in phases.

As part of the phasing analysis, a Minimum Operating Segment (MOS) analysis was conducted for the three rail concepts. Consideration was given to cost effectiveness (identifying segments that generate the most new ridership per dollar invested), logical endpoints (terminal stations at points of connection to other Metro services and/or at high-activity centers), and the ability to find suitable land for a Maintenance and Storage Facility (MSF). Siting the MSF is the largest driving force for phasing due to the very limited industrial-zoned land within the corridor and lack of capacity at existing rail facilities.

The phasing analysis validated that Exposition Boulevard would be an appropriate location to terminate the first segment. This location is both a significant transfer point to the Metro Expo Line and an important destination given that USC and Exposition Park are immediately adjacent. This segment also contains over half of the total corridor ridership. The analysis, however, also determined that it would be very challenging to locate and environmentally clear and acquire land for a suitable MSF in the northern segment of the corridor.

Since the northern segment of the corridor is predominately commercial and/or residential with limited ability to find a suitable MSF to build a MOS along the Vermont Corridor between the Metro Red/Purple and Metro Expo Lines, other options were explored. One option could be to extend the rail MOS further south to Slauson Avenue where the ridership is shown as the third-highest location on the corridor. Slauson Avenue provides a multimodal connection to the future Rail to Rail Active Transportation Corridor. The industrial properties located along the Metro-owned former rail corridor along Slauson Avenue may be candidates for the MSF. The other option would be to build the project in a single phase in order to access the industrial lands available south of the I-105 Freeway.

Table ES-3 outlines the recommended phasing along with the capital costs associated with each.

Table ES-3: Recommended Phasing

	Segment 1	Segment 2
LRT High-Floor	Wilshire Blvd. to Exposition Blvd. * <i>Capital Cost (2018): \$2.7 – 3.2B</i>	Exposition Blvd. to 120th St. <i>Capital Cost (2018): \$1.7 – 2.0B</i>
HRT Red Line Connection	3rd St. to Exposition Blvd. * <i>Capital Cost (2018): \$3.7 – 4.4B</i>	Exposition Blvd. to 120th St. <i>Capital Cost (2018): \$3.4 – 4.0B</i>
HRT Stand-Alone Alignment	6th St./Wilshire Blvd. to Exposition Blvd. * <i>Capital Cost (2018): \$2.5 – 2.9B</i>	Exposition Blvd. to 120th St. <i>Capital Cost (2018): \$3.4 – 4.0B</i>

* Southern terminus may need to shift south if no feasible MSF site can be found between Wilshire and Exposition. This is a higher risk for the HRT Metro Red Line Connection because it requires the largest fleet size and MSF site.

Assessment of the Three Rail Concepts







As shown in Table ES-4, the three rail concepts were further evaluated as to grade crossings and traffic impacts; junction feasibility; physical aspects of the corridor; potential maintenance and storage facilities; phasing options; environmental issues; ridership and cost.

Based on the analysis completed, all three concepts are physically and operationally feasible. With the three exceptions noted below, the Vermont Corridor does not pose unusually difficult or unique environmental or engineering conditions relative to other rail projects Metro has delivered in similar built-up urban areas. The three exceptions are as follows:

- **Potential Section 4(f) Resources (LRT High-Floor Concept):** From 88th Street to 92nd Street, there is a median park space which would potentially be affected by the LRT concept, which would likely be at-grade and in the median in this segment.
- **Connection to the Metro Red Line (HRT Red Line Connection Concept):** Creating a new underground junction with the Metro Red Line is a significant construction challenge that could pose significant property impacts adjacent to the junction, and would result in prolonged service interruptions on the Metro Red Line during construction.
- **Locating a Maintenance and Storage Facility (MSF) for a Minimum Operating Segment (All 3 Concepts):** The viability of building a Minimum Operating Segment along Vermont between the Metro Red/Purple and Metro Expo Lines will likely hinge on finding, environmentally clearing and acquiring land for the MSF in this predominately residential and commercial area. If this proves to be impractical, the project will need to extend further south to Slauson Avenue, or perhaps be built as a single phase in order to access the industrial lands available south of the I-105 Freeway.









These three concepts and doubtless other variations would be subjected to full technical and community review during future environmental phases. They serve to illustrate a reasonable range of feasible rail configurations for the Vermont Corridor, and have been used to review the BRT alternatives to ensure that neither BRT concept precludes a future potential conversion to rail.

Table ES-4: Preliminary Rail Concepts Comparative Evaluation

		High Floor LRT 	Heavy Rail Red Line Connection 	Heavy Rail Stand-alone 
	Grade Crossings and Traffic Analysis	✓ <ul style="list-style-type: none"> All intersections feasible or possibly feasible at-grade per Metro Grade Crossing Safety Policy Required grade separation at Vermont/Expo due to MRDC requirements Possible impacts to left-turn movements on Vermont Avenue 	✓✓✓ NA – no at-grade crossings as the system would be completely below-grade	✓✓✓ NA – no at-grade crossings as the system would be completely below-grade
	Junction Constructability	✓✓✓ <ul style="list-style-type: none"> Feasible non-revenue track connection to the Metro Expo Line to allow access to existing maintenance facility for occasional heavy vehicle service 	✓ <ul style="list-style-type: none"> Feasible revenue connection to the Metro Red Line north of Wilshire Blvd. would impact adjacent properties for the junction construction. Pedestrian tunnel connecting the new and existing Wilshire/Vermont Stations could be constructed 	✓✓✓ <ul style="list-style-type: none"> No junction included in this alternative. Pedestrian tunnel connecting the new and existing Wilshire/Vermont Stations could be constructed.
	Corridor Fit & Constructability	✓✓ <ul style="list-style-type: none"> ROW widths are not sufficient for at-grade north of Slauson. Requires below-grade north of Slauson which would use twin bored tunnels between stations and cut-and-cover construction at stations in Phase 1 from Wilshire/Vermont to Slauson/Vermont. ROW widths are sufficient for the at-grade alignment between Slauson and 120th Street 	✗ <ul style="list-style-type: none"> Twin bored tunnels between stations and cut-and-cover construction at stations. If this alignment crosses below the existing Metro Red and Purple Lines, the depth could result in relatively higher station construction costs. Temporary closures of the northbound and southbound Metro Red Line tracks of at least one year would be required for construction. Would require terminal improvements to manage additional train volume or the development of a mid-line turnback facility. 	✓✓ <ul style="list-style-type: none"> Twin bored tunnels between stations and cut-and-cover construction at stations. The northern tail tracks of this alignment may need to be located below the existing Metro Red Line and the added depth could result in relatively higher construction costs.
	Vehicle MSF	✓✓ <ul style="list-style-type: none"> LRT Alternative would have access to existing facilities if a non-revenue connection is built to the Metro Expo Line. However, none of the existing MSFs have the capacity to fully serve a new LRT line. A new MSF would be required for the storage and maintenance of LRT vehicles. There are limited sites for a MSF within Phase 1 without lead tracks extending a relatively longer distance from the corridor. Would require a facility for 60 LRT vehicles 	✓✓ <ul style="list-style-type: none"> A new maintenance facility would be required, but the Metro Red Line junction north of Wilshire/Vermont would allow for access to the existing Division 20 facility. However, even with the planned expansion, Division 20 would not have the capacity to serve a new HRT line. There are limited sites for a MSF within Phase 1 without lead tracks extending a relatively longer distance from the corridor. Would require a facility for 162 HRT vehicles 	✓ <ul style="list-style-type: none"> With no physical access to existing heavy rail facilities; a new facility would be required. There are limited sites for a MSF within Phase 1 without lead tracks extending a relatively longer distance from the corridor. Would require a facility for 90 HRT vehicles

PERFORMANCE: ✗ VERY LOW ✓ LOW ✓✓ MEDIUM ✓✓✓ HIGH

Table ES-4 (continued): Preliminary Rail Concepts Comparative Evaluation

		High Floor LRT 	Heavy Rail Red Line Connection 	Heavy Rail Stand-alone 
	ROW Impacts	✓✓ <ul style="list-style-type: none"> Right-of-way required for maintenance facility and station footprints 	✓ <ul style="list-style-type: none"> Right-of-way required for construction of the junction with the Metro Red Line, maintenance facility, station footprints, and for mid-line turnback facility or terminal improvements, and construction laydown. 	✓✓ <ul style="list-style-type: none"> Right-of-way required for maintenance facility and station footprints
	Phasing	✓✓ <ul style="list-style-type: none"> Phase 1 of this alternative is recommended between Vermont/Wilshire to the Expo/Vermont station. There are limited opportunities for a new MSF in this area without deviating from the corridor. Phase 2 would be the rest of the corridor. The MSF will drive much of the decision on phasing due to the constrained corridor, along with ridership considerations, and may require the southern terminus of Phase 1 to shift to Slauson Avenue. 	✓✓ <ul style="list-style-type: none"> Phase 1 of this alternative is recommended between Vermont/3rd Street to the Expo/Vermont Station. There are limited opportunities for a new MSF in this area without deviating from the corridor. Phase 2 would be the rest of the corridor. The MSF will drive much of the decision on phasing due to the constrained corridor, along with ridership considerations, and may require the southern terminus of Phase 1 to shift to Slauson Avenue or even to the ultimate terminus at 120th Street. 	✓✓ <ul style="list-style-type: none"> Phase 1 of this alternative is recommended between West 6th Street and Wilshire Boulevard on Vermont Avenue and the Expo/Vermont Station. There are limited opportunities for a new MSF in this area without deviating from the corridor. Phase 2 would extend south to 120th Street. The MSF will drive much of the decision on phasing due to the constrained corridor, along with ridership considerations, and may require the southern terminus of Phase 1 to shift to Slauson Avenue.
	Environmental	✓✓ <ul style="list-style-type: none"> Environmental resources that may be impacted are discussed and summarized in Section 5 of Technical Memo #7. No unusual or unique resources relative to other Metro rail projects, however the landscaped median south of Gage Avenue could pose Section 4(f) parkland challenges. 	✓✓ <ul style="list-style-type: none"> Subterranean construction and operations would limit impacts to traffic and residents. Environmental resources that may be impacted are discussed and summarized in Section 5 of Technical Memo #7. No unusual or unique features relative to other Metro rail projects. 	✓✓✓ <ul style="list-style-type: none"> Subterranean construction and operations would limit impacts to traffic and residents. Environmental resources that may be impacted are discussed and summarized in Section 5 of Technical Memo #7. No unusual or unique features relative to other Metro rail projects.
	Ridership	✓ <ul style="list-style-type: none"> Lowest boardings due to limited station stops and transfer time needed for at-grade rail to below-grade rail connection or connection to local bus Approx. 91,000 corridor boardings (2042) 	✓✓✓ <ul style="list-style-type: none"> Highest boardings due to one seat ride from north of Wilshire Approx. 116,000 - 144,000 corridor boardings (2042) 	✓✓ <ul style="list-style-type: none"> Low-medium boardings relative to the other concepts due to transfer time needed for rail-to-rail connection Approx. 103,000 - 131,000 corridor boardings (2042)
	Cost	✓✓✓ <ul style="list-style-type: none"> \$4.4 - \$5.2B (2018\$), Capital \$18 - \$21.1B (2067\$), Capital \$28.8 - \$53.0M (2018\$), Annual Operating & Maintenance Lowest cost relative to other concepts 	✓ <ul style="list-style-type: none"> \$7.1 - \$8.4B (2018\$), Capital \$29.4 - \$34.7B (2067\$), Capital \$53.8 - 80.5M (2018\$), Annual Operating and Maintenance Highest cost relative to other concepts New ventilation shaft and upgraded systems would be required along the existing Metro Red Line. 	✓✓ <ul style="list-style-type: none"> \$5.9 - \$6.9B (2018\$), Capital \$24.1 - \$28.4 (2067\$), Capital \$35.1 - \$70.0M (2018\$), Annual Operating & Maintenance Medium-high cost relative to other alternatives

Refinements to BRT Concepts

Information gained from developing and assessing the rail alternatives, as well as current best-practices in BRT design and Metro's First-Last Mile policies, were used to refine the conceptual engineering plans previously produced during the Vermont BRT Technical Study. This process led to refinements in three areas:

- Adjust the BRT running way per the Metro Rail Design Criteria to maximize the opportunities for the BRT alignment to be reused for future rail. This was done primarily by adjusting the horizontal curves of the BRT running way, and the position of left-turn lanes, to be more compatible with a future rail alignment. This also benefits BRT patrons by providing a smoother ride and potentially faster travel times;
- Reflect best-practices and lessons-learned from recent on-street BRT implementations in an effort to ensure the future Vermont BRT provides a high-quality, rail-like experience to Metro's patrons. This included adjustments to right-turn lanes to minimize conflicts with the BRT, reducing the degree of lane-shifting through intersections necessary to accommodate left-turn lanes, restricting u-turns at narrow intersections, and adding bulb-outs to sidewalks to reduce crossing distances for pedestrians; and
- Consider opportunities to integrate on-street amenities to improve First-Last Mile connectivity and help foster the creation of Transit Oriented Communities.

With respect to the last point, a unique urban design opportunity exists in the wider portion of the corridor south of Gage Avenue. The refined BRT alternatives include either side or center-running configurations created by reusing an existing travel lane. In both cases, the collector roads to the outside and the landscaped median are mostly undisturbed except for some necessary reconfigurations at intersections. Some community members and agency representatives have noted that the median is an underutilized community resource, partly because it is in the middle of the street and access is a challenge. This provides an opportunity to "reprogram" the entire street width to focus the open space on one side where it is easier to access.

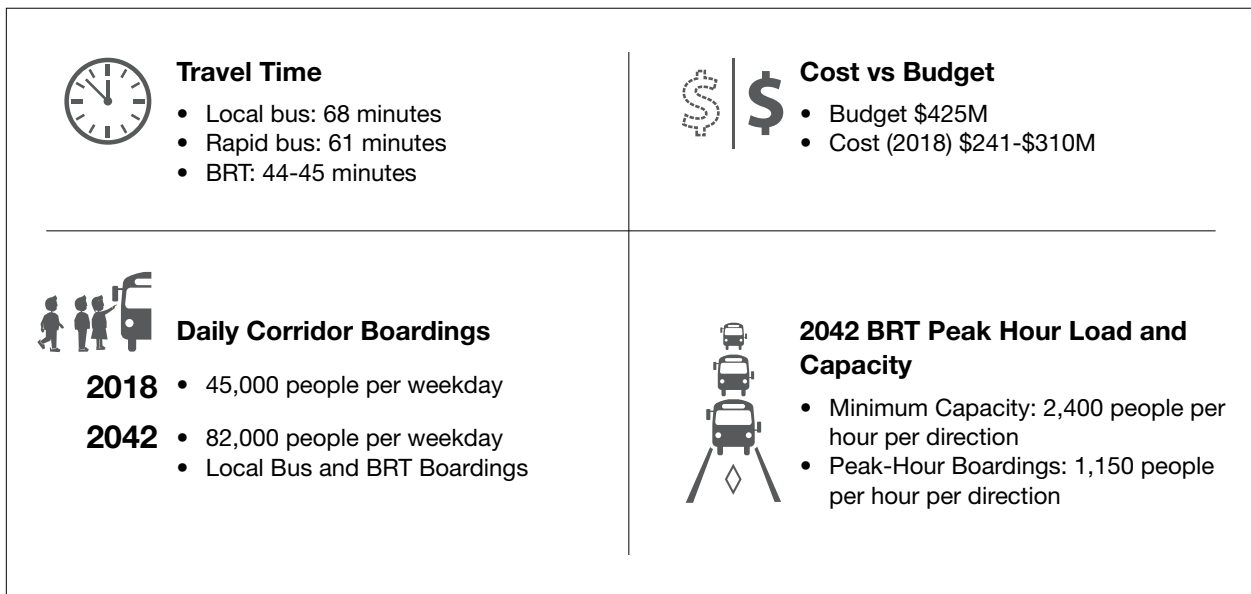
This concept would essentially create a linear park along one side of Vermont Avenue south of Gage Avenue, as seen in Figure ES-9. Such a concept would need significant community input and agency support beyond Metro to become a realization. It is recommended that this concept be further explored during the Environmental Phase of the Vermont BRT project, in partnership with City of Los Angeles, Los Angeles County and the Vermont Community.

Figure ES-9: Vermont Avenue South of Gage Avenue Potential Concept



The refinements made to the BRT concepts improve upon the prior conceptual design and provide for a significant and cost-effective contribution to transit service along Vermont Avenue, as shown in Figure ES-10.

Figure ES-10: Vermont BRT Project Benefits



STAKEHOLDER AND AGENCY INPUT

Metro initiated an early and sustained key stakeholder outreach process involving key public and partner agency stakeholders. Invitees included businesses, religious institutions, schools, hospitals, major cultural centers, community/neighborhood groups, neighborhood councils, and Chambers of Commerce. The purpose of the outreach was to discuss and solicit early feedback on the initial six rail concepts, discuss the screening criteria used in refining the rail concepts, and the refinements to the BRT concepts. The process included a wide range of opportunities for feedback, designed to be transparent and inclusive.

The study process included a Technical Working Group (TWG), which consisted of representatives from a number of Metro departments as well as staff from the City of Los Angeles and County of Los Angeles, who have jurisdiction over the corridor. This group met four times over the course of the project and was instrumental in providing critical technical support and input on both the rail concepts and the refined BRT alternatives.

Beginning in April 2018, Metro staff initiated the first set of project briefings and key stakeholder meetings. The purpose of these initial briefings and/or meetings was to provide a general overview and schedule of the study, solicit initial stakeholder input on the preliminary rail concepts, and to discuss next steps. In October 2018, a second set of project briefings and key stakeholder meetings were held. The purpose of this second round of briefings/meetings was to provide a study update and solicit further input on the refined rail and BRT concepts. The project team recorded all community feedback and concerns for each meeting.

The project team also offered other convenient means for the community to receive information about the project and provide comment. Online engagement included a special project e-mail box and project website. A total of 349 comments were collected via email, public comments, and comment cards from the meetings.

FINDINGS AND RECOMMENDATIONS

The objective of this study was to evaluate the feasibility of a variety of potential rail concepts for the Vermont Corridor and to further refine the two BRT concepts developed earlier as part of the Vermont BRT Technical Study to ensure that their implementation would not preclude a potential conversion to rail in the future. Initial opportunities to facilitate transit-oriented community outcomes and First-Last Mile amenities were also evaluated. Figure ES-11 contains some key findings and recommendations from the study.

Figure ES-11: Key Findings and Recommendations

1

Improvements to Metro's 2nd busiest corridor are needed

- Further work undertaken on transit needs in the corridor, new ridership forecasts, and further input from the Vermont Community all underscore the pressing need to improve services in this critical transit corridor.

2

BRT has community support, as does future rail

- While technical concerns exist about specific means of implementation, there is community support for high-quality transit improvements in the corridor, both BRT and future rail.

3

BRT will in no way preclude rail

- For the two most likely rail technologies, there is very little physical overlap between the BRT project and the likely future rail footprint.
- HRT would be fully underground, with no physical conflict with the at-grade BRT.
- In the narrow portion north of Gage Avenue, LRT will also most likely be underground.
- In the wider portion south of Gage Avenue, there is an opportunity to reuse a median-running BRT running way for LRT, and the BRT alignment has been reconfigured to rail standards to facilitate this.

4

Potential opportunity to work with the Vermont Community, the County and the City of LA to revitalize the open-space median at south end of corridor

- While such a project falls outside Metro's mandate and would require financial and project implementation lead from the City, it should be explored with the community during the environmental clearance phase.

5

BRT has capacity to serve the Vermont Corridor to 2042 and beyond

- New ridership forecasting conducted for this study has verified that the Vermont BRT will have the people-carrying capacity to serve the Vermont Corridor into the 2040's and likely beyond.



1. INTRODUCTION

1.1 Study Purpose

The funding for Bus Rapid Transit (BRT) on Vermont Avenue was put in place in November 2016 when voters in Los Angeles County passed Measure M, a half-cent sales tax initiative that funds a number of transportation projects and programs. The Vermont Transit Corridor project is slated for a ground-breaking date of Fiscal Year (FY) 2024 and an opening date of FY 2028. Additionally, the expenditure plan for Measure M identifies a potential conversion of BRT service on Vermont to rail after FY 2067 based on ridership demand.

In March 2017, the Metro Board of Directors directed staff to proceed with the implementation of the Vermont Transit Corridor BRT project as a near-term transit improvement along the corridor, and to initiate a study which identifies and evaluates rail alternatives for the Vermont Transit Corridor to ensure that the implementation of any BRT project on Vermont Avenue does not preclude a future conversion to rail. In response to the Metro Board's directive, staff and consultants conducted this Vermont Transit Corridor - Rail Conversion/Feasibility Study.



Metro Rapid on Vermont Avenue

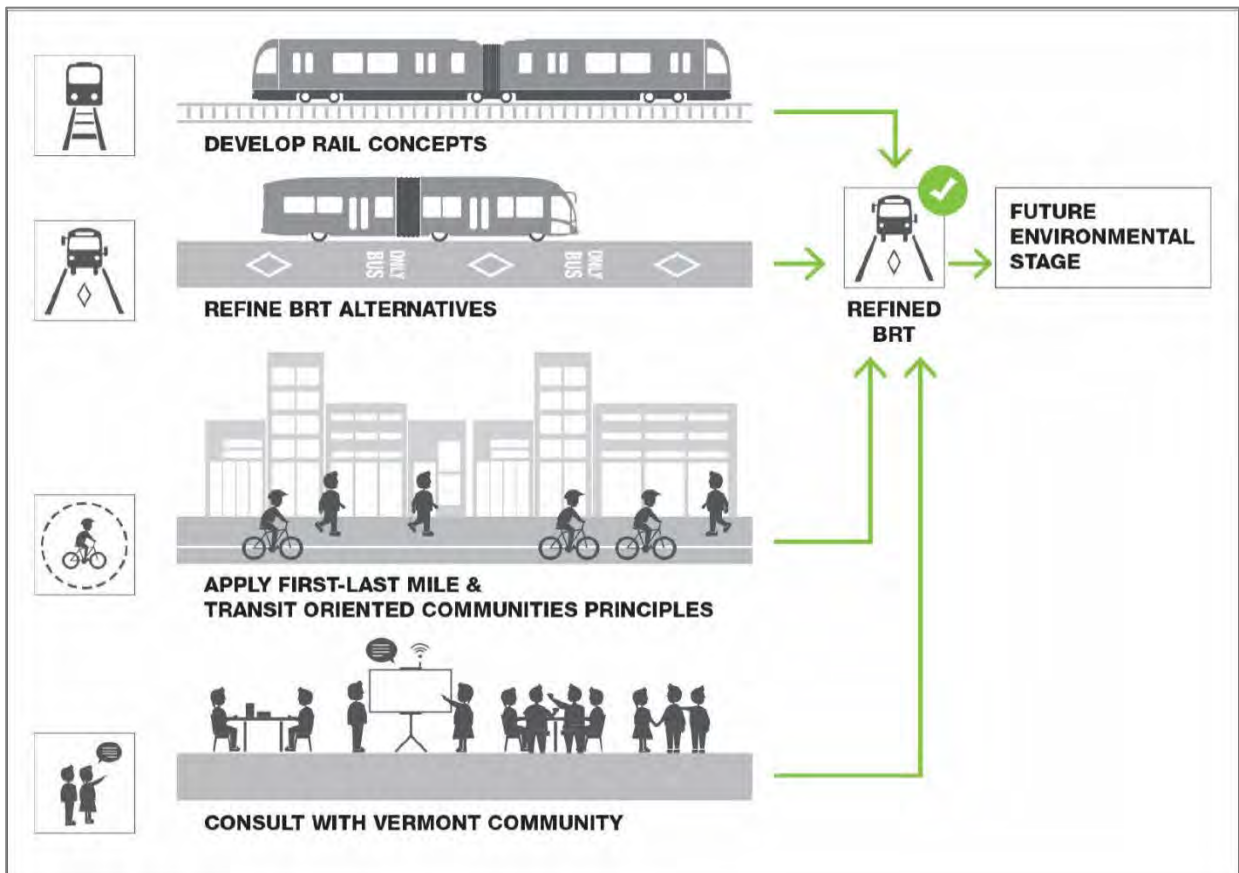
There are six key study objectives:

1. Define a range of potential future rail transit options, including light rail, heavy rail, and streetcar/tram, and a possible phased implementation (such as a potential rail connection between the Wilshire/Vermont Red/Purple Line Station and the Expo/Vermont Expo Line Station);
2. Analyze the feasibility of the potential future rail options in terms of engineering feasibility, constructability, junction operability, cost effectiveness, environmental issues/concerns, and consistency with community goals and priorities;
3. Develop operating scenarios corresponding to each rail option to identify planning-level capital and operating costs;
4. Review and update the two recommended BRT concepts from the earlier Vermont BRT Technical Study and identify considerations that should be included in the design of BRT;
5. Reassess the project benefits and impacts of the two refined BRT concepts including ridership forecasts, cost estimates, preliminary traffic impacts, and parking loss; and
6. Evaluate opportunities to facilitate and promote Transit Oriented Communities and First-Last Mile opportunities along the corridor.

As shown in Figure 1, the study was carried out along four parallel but connected streams:

1. Development of Rail Concepts;
2. Refinement of BRT Alternatives;
3. Application of First-Last Mile and Transit Oriented Communities Principles; and
4. Consulting with the Key Community Stakeholders.

Figure 1: Vermont Transit Corridor - Rail Conversion/Feasibility Study Process



1.2 Study Area

Figure 2 shows a map of the study area, which includes one half-mile to either side of Vermont Avenue. The Vermont Transit Corridor project is approximately 12.4 miles, extending from Hollywood Boulevard (near the Sunset/Vermont Metro Red Line Station in Hollywood) south to 120th Street (just south of the Vermont/Athens Metro Green Line Station).



The University of Southern California

The corridor is the second busiest bus corridor in Los Angeles County, carrying approximately 45,000 weekday boardings. It connects to dozens of other local bus, Metro Rapid, and Metro Rail lines and provides access to a number of major key activity centers, including the University of Southern California (USC), Exposition Park, Los Angeles City College and Children's Hospital Los Angeles. The majority of the corridor falls within the City of Los Angeles with approximately 2.5 miles on the south end (the west side of Vermont only) in the County of Los Angeles.

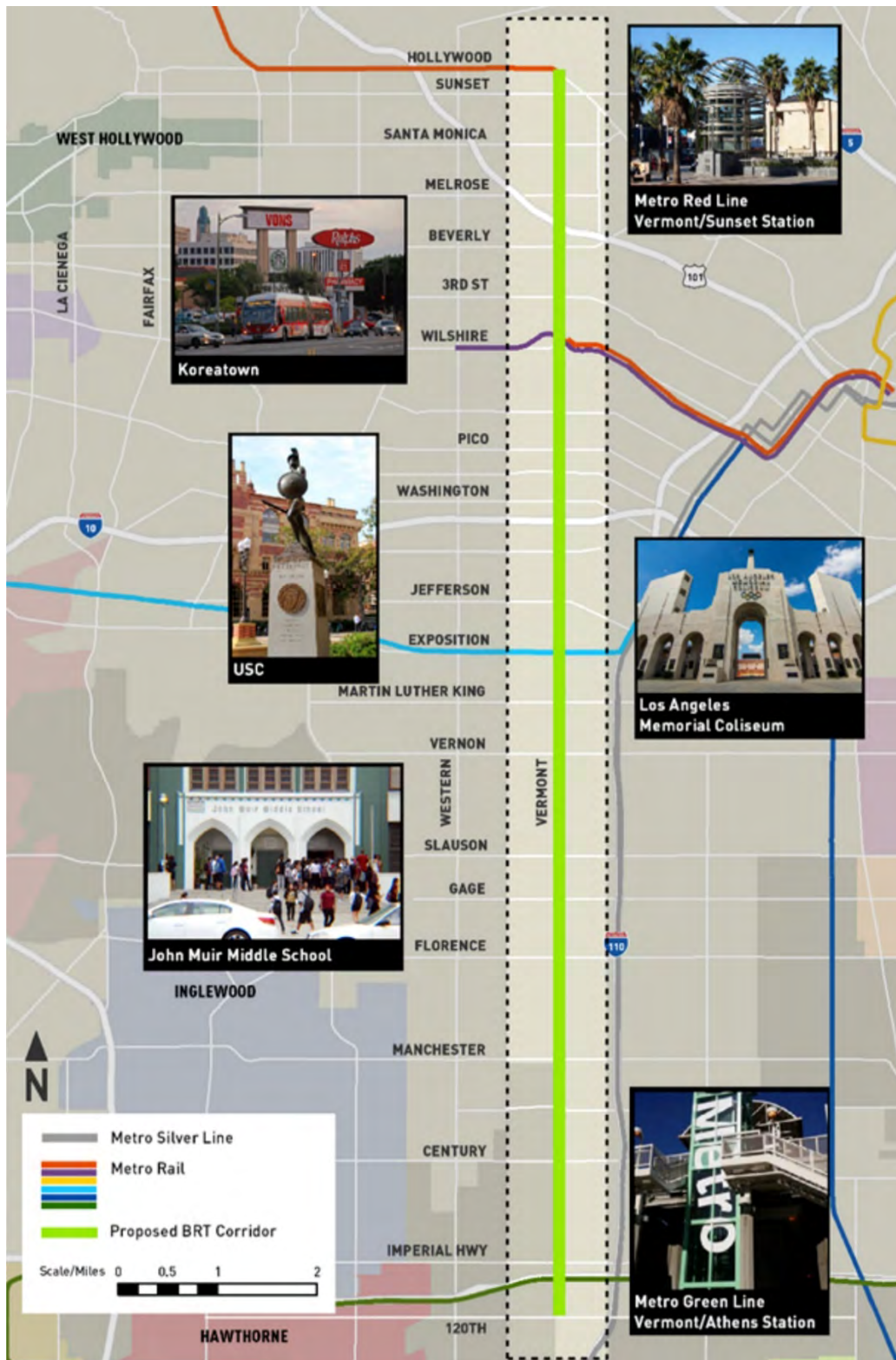
The study area is bound by the following streets:

- Northern boundary: Franklin Avenue
- Western boundary: Normandie Avenue
- Eastern boundary: Hoover Street/Figueroa Street
- Southern boundary: El Segundo Boulevard

The corridor is one of the densest communities in Los Angeles County with approximately 150,777 residents within the study area. Existing (2015) population density is 23,441 people per square mile. In contrast, population density for the City and County of Los Angeles is 8,437 people per square mile and 2,133 people per square mile, respectively. The higher population density within the study area - more than 2.5 times the City average - reinforces the area's enduring potential for high transit ridership.

Residents in the Vermont Corridor also own fewer private automobiles than the Los Angeles County average. Transit dependency is often correlated with limited accessibility to private vehicles. Individuals with limited or no access to a private vehicle are typically more dependent on public transportation as their primary mode of travel. Approximately 32,470, or 25%, of households within the study area do not own a private vehicle. In comparison, according to the U.S. Census American Fact Finder, in 2016, 9.5% of households in Los Angeles County did not own a private vehicle.

Figure 2: Vermont Transit Corridor Study Area



1.3 Right-of-Way

The right-of-way (ROW) along Vermont Avenue varies significantly between Hollywood Boulevard and 120th Street as shown in Figure 3. In particular, the corridor's character changes completely near Gage Avenue. North of Gage Avenue, the corridor ranges between 80' and 90' in width, with pavement widths of 56'-80' and sidewalks generally 10'-15' wide. South of Gage Avenue, the corridor widens dramatically to between 150' and 200' wide, with pavement widths of 150'-160' and sidewalks generally 10'-15' wide.

The wider ROW results in additional travel lanes throughout the southern section, generally three through-lanes per direction, versus two through-lanes per direction north of Gage Avenue. The southern section also features two distinct sub-sections; from Gage Avenue to about 88th Street, the corridor features "collector" lanes on either side of the main travel lanes. From 88th Street south, the corridor features a wide landscaped median. The varying ROW widths will impact the potential design for both the BRT and future rail conversion. Figure 4 and Figure 5 illustrate examples of the varying conditions along Vermont Avenue.



Vermont Corridor

Figure 3: Vermont Transit Corridor Right-of-Way Widths

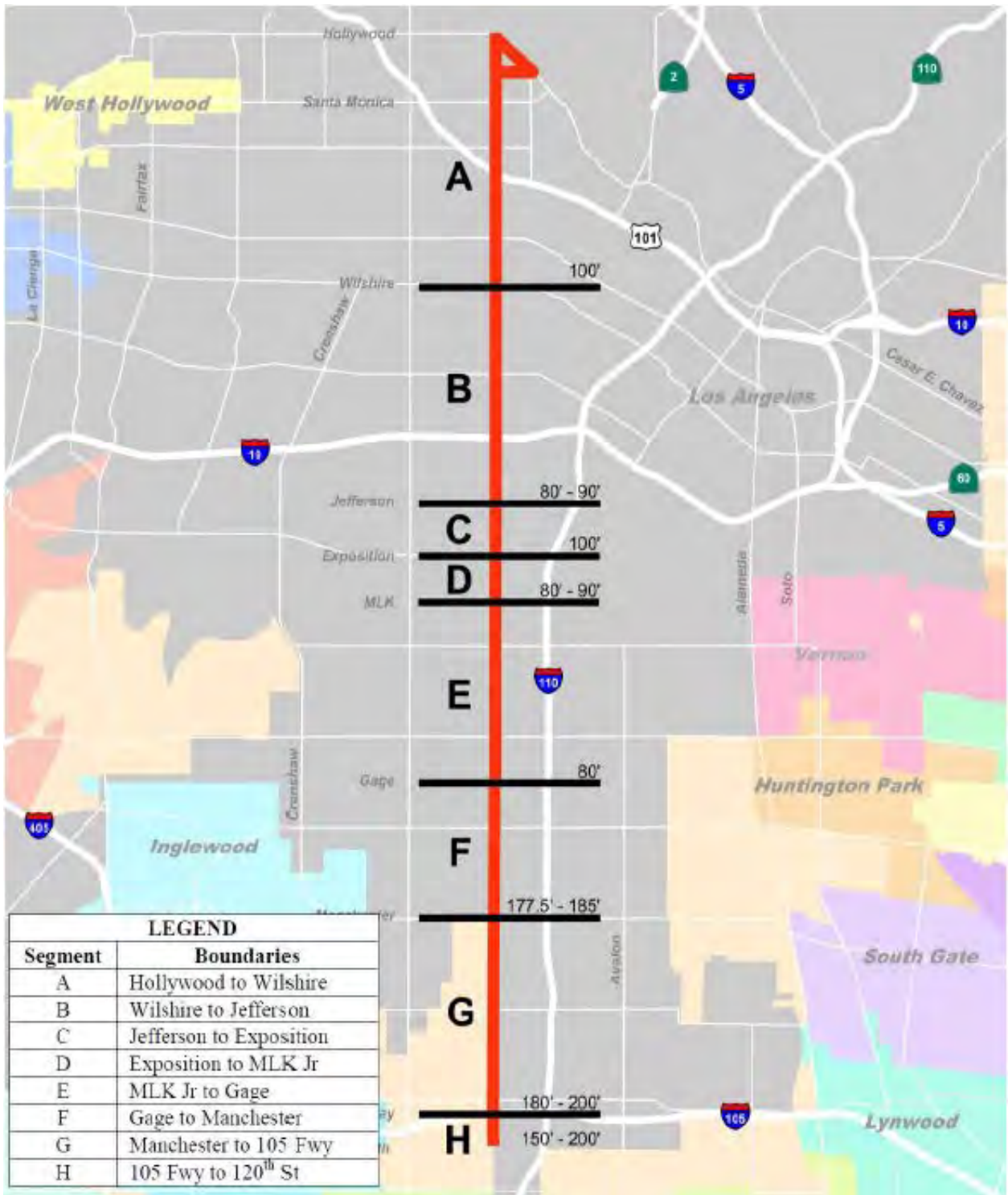


Figure 4: MLK Boulevard to Gage Avenue Existing Typical Section

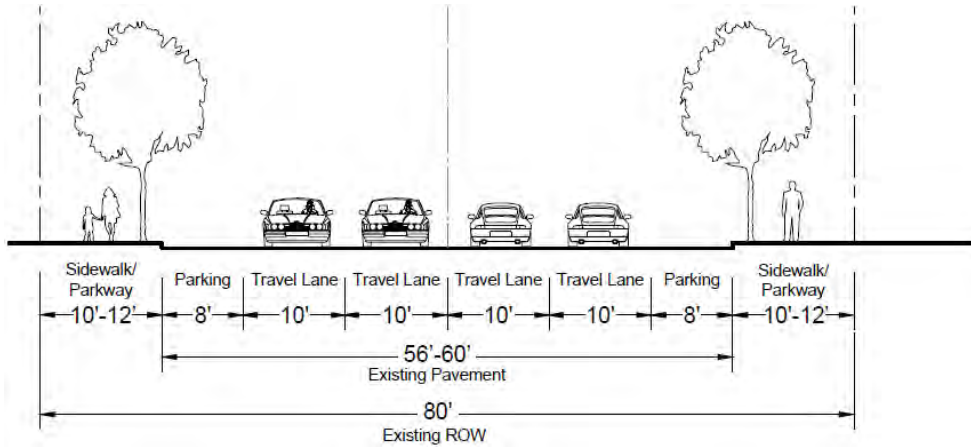
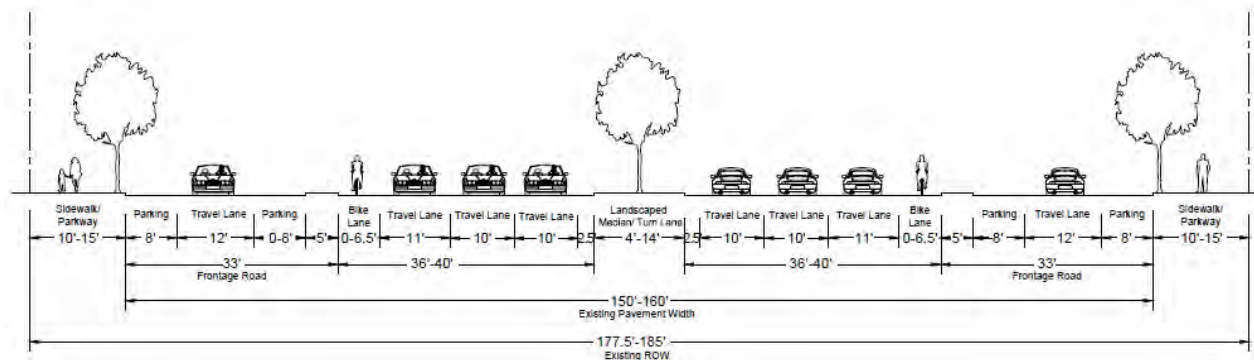


Figure 5: Gage Avenue to Manchester Boulevard Existing Typical Section



1.4 The Vermont Transit Corridor BRT Project

The Vermont Transit Corridor - Rail Conversion/Feasibility Study builds upon the work undertaken in the 2017 Vermont BRT Technical Study. The purpose of the Vermont BRT Technical Study was to evaluate the feasibility of implementing BRT along Vermont Avenue, including bus lanes and other key BRT features. The study identified two promising BRT concepts, which would provide improved passenger travel times, faster bus speeds, and increased ridership. The two concepts included an end-to-end side-running BRT and a combination side and center-running BRT.

1.4.1 End-to-End Side-Running BRT

This concept features a dedicated bus lane along the entire 12.4 mile corridor within the existing ROW. Room for the bus lanes would be made available by converting the general purpose lane (one in each direction) adjacent to the curbside parking lanes to a dedicated bus lane. BRT stations with a number of passenger amenities including shelters, bus benches, trash cans, next bus information, and lighting, would be located on the sidewalks and, in most cases, far side of the intersections, as shown in Figure 6. This concept is referred to as “Side-Running BRT” throughout this report.

Figure 6: End-to-End Side-Running BRT Examples



1.4.2 Combination Side and Center-Running BRT

This concept features 4.2 miles of center-running dedicated BRT lanes south of Gage Avenue, where the ROW widens significantly, and 8.2 miles of side-running dedicated BRT lanes north of Gage Avenue. South of Gage Avenue, the corridor widens to three travel lanes in each direction and includes sufficient ROW to accommodate center-running BRT lanes. The center bus lanes would be accommodated by converting the two center traffic lanes to bus lanes as shown in Figure 7. Because the ROW is generally narrower north of Gage Avenue, center-running BRT lanes would require considerable ROW acquisition. Therefore, side-running dedicated bus lanes are proposed north of Gage Avenue. This concept is called the “Side/Center-Running BRT” in this report.

Figure 7: Center-Running BRT Example





2. DEVELOPMENT OF PRELIMINARY RAIL CONCEPTS

2. DEVELOPMENT OF PRELIMINARY RAIL CONCEPTS

This chapter provides an overview and description of the rail technologies and initial six rail concepts and alignments identified for the Vermont Transit Corridor. It also includes discussion of the various tradeoffs associated with each. As part of this effort, a review of the existing rail lines and potential to provide additional rail on the corridor was assessed. There are currently four rail lines and two rail technologies that intersect with the Vermont Transit Corridor. These include the Metro Red and Purple Lines, both Heavy Rail Transit (HRT) systems, and the Metro Expo and Green Lines, both Light Rail Transit (LRT) systems. Any new potential rail line on Vermont Avenue would provide an opportunity for either an extension of one these existing rail lines and/or a connection to them.

The six preliminary rail concepts were developed with the project goals in mind. A screening process was later applied to narrow this list down to three concepts, as described later in Chapter 3. The project goals were established from the Vermont BRT Technical Study and other Metro policy documents, including the Long Range Transportation Plan (LRTP) and the Metro Rail Design Criteria (MRDC). The goals include:

- Provide a world-class transportation system that is safe, clean, reliable, responsive, and on-time
- Enhance the customer experience
 - Reduce passenger travel times
 - Improve service reliability
- Improve service performance
 - Create a cost-effective, long-term transit solution
 - Provide faster, average transit speeds, with the goal of being more competitive with the automobile
 - Support increased ridership
 - Support a safe, reliable, consistent and schedulable operating headway
 - Provide a system with sufficient operational flexibility to navigate emergencies, unplanned events, and planned track and systems maintenance
- Increase person-throughput for the corridor
- Provide a system that can be operated efficiently using limited resources, equipment, labor and available funding

2.1 Rail Technologies Considered

Four different rail technologies were considered for the Vermont Transit Corridor. It is important to consider the various rail technologies to properly understand how to feasibly connect or integrate the technologies with the existing rail lines and technologies on or near the corridor. The four rail technologies are discussed below.

LRT High-Floor is Metro’s standard and has been deployed on all Metro LRT lines to-date including the Metro Expo Line at Exposition Boulevard and Metro Green Line at I-105. It uses a train consisting of two to three vehicles with each vehicle having an approximate passenger capacity of 133 persons (including a mix of standing and seated passengers), and features a high-floor where the top of station platform is located 3.3 feet above the top of rail (or top-of-pavement in street-running sections with embedded track), or approximately 2.5 feet higher than the sidewalk.

Figure 8: LRT High-Floor Example: Metro Gold Line



LRT Low-Floor is another form of LRT similar to Metro’s current standards in terms of vehicle length and alignment characteristics, but it uses low-floor vehicles. This is not currently Metro’s standard vehicle and the fleet (and associated maintenance facilities) would not be interoperable, meaning that a LRT low-floor line along Vermont Avenue would not be able to operate on or share tracks for revenue-service with the Metro Expo Line or Metro Green Line. The LRT low-floor vehicle capacity is slightly lower than LRT high-floor at approximately 100 persons per vehicle.

Figure 9: LRT Low-Floor Example: San Diego Trolley



Tram/Streetcars are the most similar rail technology to BRT. These vehicles are low-floor, similar in length and have slightly higher passenger capacities of approximately 100 people per vehicle. They are capable of operating in mixed-traffic, allowing vehicles to use the streetcar ROW for making right-turns or accessing a parking space. The operation of dedicated lanes for streetcars would be comparable to that of BRT where lane markings and signage would indicate exclusive ROW for the streetcar. Compared to other rail technologies, streetcar would have the least passenger per car capacity and slower operating speeds due to its potential operation in mixed-traffic.

Figure 10: Tram/Streetcar Example: Portland Streetcar



Figure 11: HRT Example: Metro Red Line



Heavy Rail Transit is the technology used on the Metro Red and Purple Lines and would be compatible with the existing HRT fleet and vehicle maintenance yards. HRT has the highest passenger per car capacity compared to the other rail technologies – up to 180 people per vehicle, although for passenger safety and comfort, Metro uses a loading standard of 131 people per vehicle. Generally, HRT also has the highest operating speeds. Because the vehicles draw power from an electrified third rail near track level, this technology cannot operate at-grade unless it is completely isolated from surface traffic and pedestrians; therefore, it is usually constructed underground.

2.2 Vertical and Horizontal Rail Configurations

In developing the preliminary rail concepts, the various technologies were paired with possible vertical and horizontal configuration options. When looking at the potential rail alignments, the vertical profile of rail on the corridor could be at-grade, at-grade with grade separations (below or above) at specific intersections, a fully elevated system, or a fully below-grade system. For at-grade systems, the guideway and stations may be positioned in the center of the street (center-running) or on both edges of the street (side-running). The following Figures 12-16 illustrate the configurations explored including center-running, side-running, below-grade, and above-grade.

Figure 12: Below-Grade Cut-and-Cover Cross Section Example



Figure 13: Below-Grade Bored Tunnels Cross Section Example



Figure 14: Above-Grade Cross Section Example

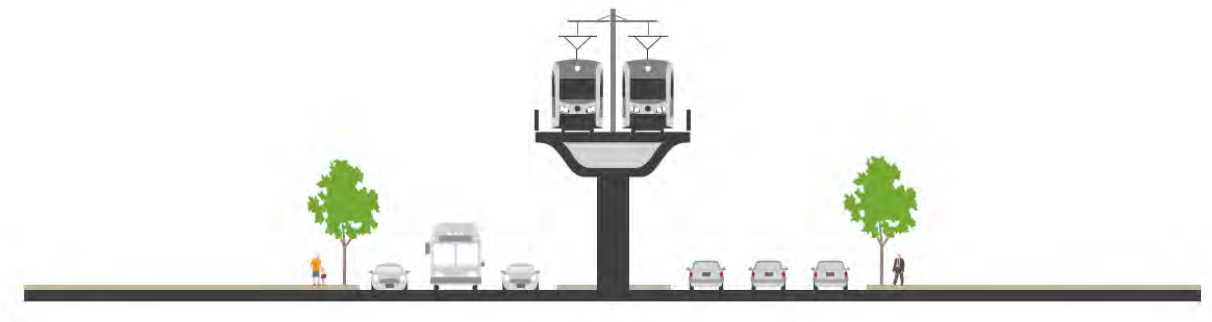
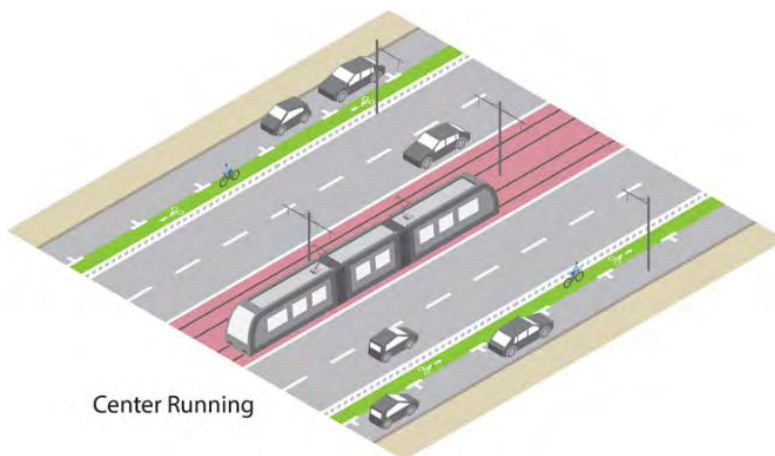
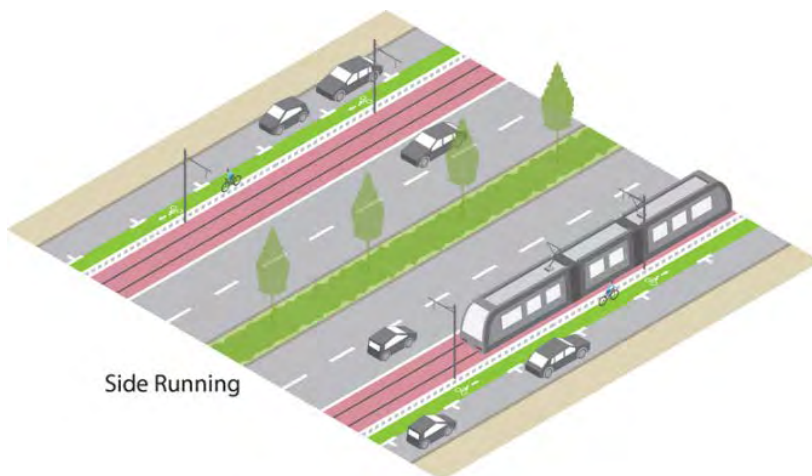


Figure 15: Center-Running LRT Example**Figure 16: Side-Running LRT Example**

There are pros and cons associated with each of the vertical and horizontal rail configurations along the corridor. One of the biggest challenges associated with the at-grade options, whether they are center or side-running, is the ROW constraints on the corridor. The corridor ROW varies significantly; particularly, becoming narrow north of Gage Avenue (56' to 80' curb to curb) making an at-grade center-running alignment challenging. South of Gage Avenue, the ability to do at-grade center or side-running is feasible given the wide ROW (150' to 160' curb to curb).

2.3 Initial Rail Concepts

Based on Metro Board direction to look at potential options to extend the Metro Red Line and further investigate the feasibility of rail on the Vermont Corridor, six preliminary rail concepts

were developed. The concepts were developed after an analysis of Metro’s existing rail lines, the physical characteristics of Vermont Avenue, and available rail technologies. Metro’s existing and future rail operating plans were assessed at a high-level to understand the constraints and feasibility of connecting to (and interlining with) Metro’s existing rail lines.

From all possible combinations of technology, and vertical and horizontal configurations, an initial set of six combinations were selected that represent a likely and reasonable sampling of combinations that Metro might build within the corridor.

Table 1 lists the preliminary rail concepts and their potential alignment configurations. It should be noted that none of the six potential rail concepts show construction of new rail (with the exception of tail tracks or junctions) north of the existing Wilshire/Vermont Station as it is not efficient to place rail on top of rail along the same corridor.

Table 1: Preliminary Rail Concepts

Concepts	Rail Technology	Alignment Configuration
1	LRT High-Floor	<ul style="list-style-type: none"> • At-Grade and Grade-Separated • Center-Running
2	LRT Low-Floor	<ul style="list-style-type: none"> • Primarily At-Grade¹ • Side-Running
3	Tram/Streetcar	<ul style="list-style-type: none"> • Primarily At-Grade¹ • Side-Running
4	HRT Purple Line Connection	<ul style="list-style-type: none"> • Fully Below-Grade • Connect to Metro Purple Line
5	HRT Red Line Connection	<ul style="list-style-type: none"> • Fully Below-Grade • Connect to Metro Red Line
6	HRT – Stand-Alone Alignment	<ul style="list-style-type: none"> • Fully Below-Grade • No Connection to Existing Metro Lines

1. Metro Rail Design Criteria Section 10.3.3.1 does not allow two rail lines to intersect (“no face to face train meets shall be permissible in the normal direction”) and, therefore, a grade separation will be required at the Metro Expo Line.

2.3.1 Concept 1 - LRT High-Floor, Center-Running

This concept is a center-running LRT line that would run along Vermont Avenue from Wilshire Boulevard south to 120th Street with high-floor vehicles (consistent with Metro’s current LRT vehicle fleet), as shown in Figure 17 (corridor alignment) and Figure 18 (cross section). The LRT line would operate mostly at-grade except north of Slauson Avenue where it would operate below-grade. It is anticipated that the LRT line would not continue north along Vermont Avenue to Hollywood Boulevard, as it would for BRT, because the LRT would provide

duplicate rail service to the existing Metro Red Line along this segment of the corridor. A center-running system is proposed because LRT systems operate more efficiently in the center of a roadway with two mainline tracks running adjacent to each other.

Figure 17: Concept 1 - LRT High-Floor Center-Running Vermont Corridor Map

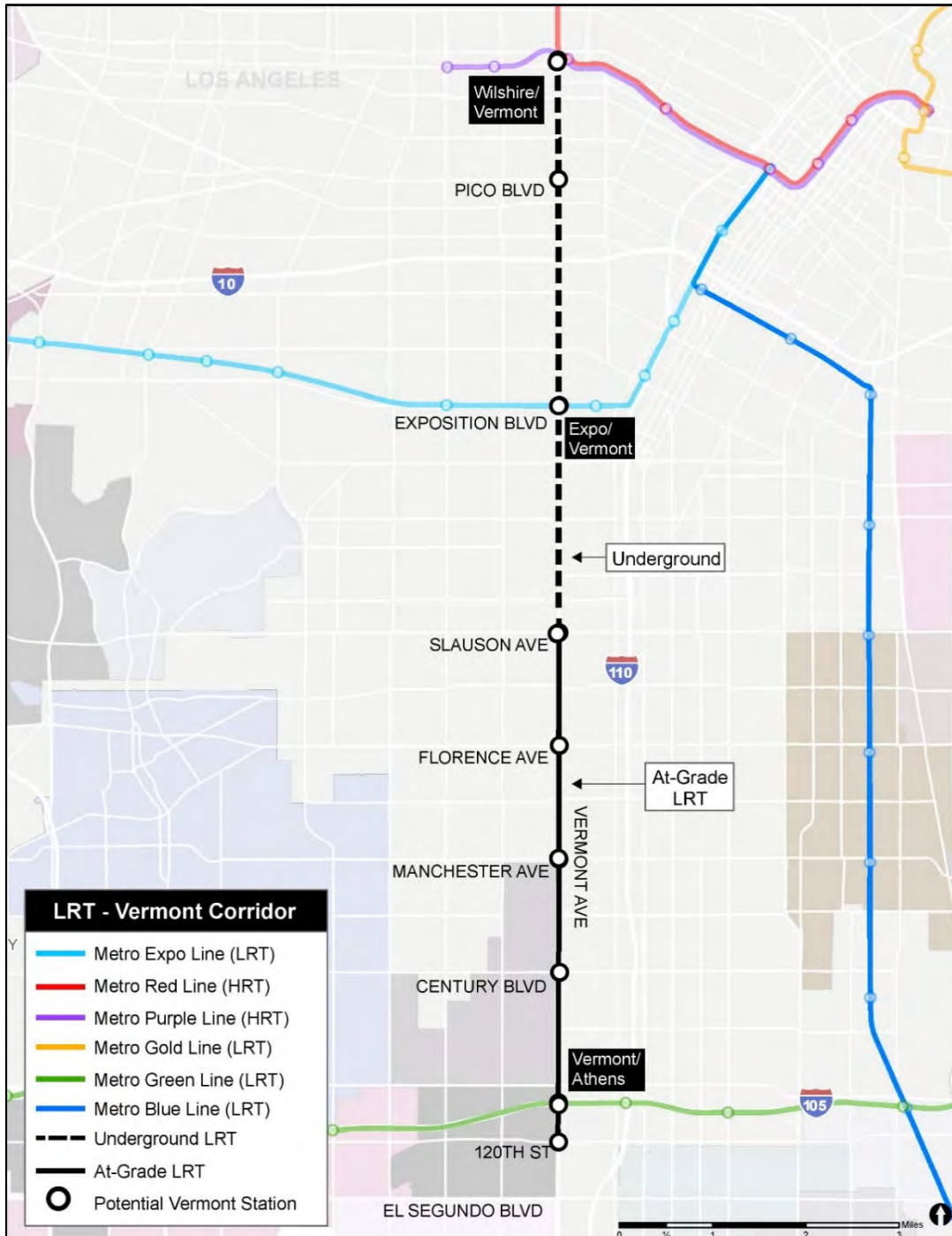
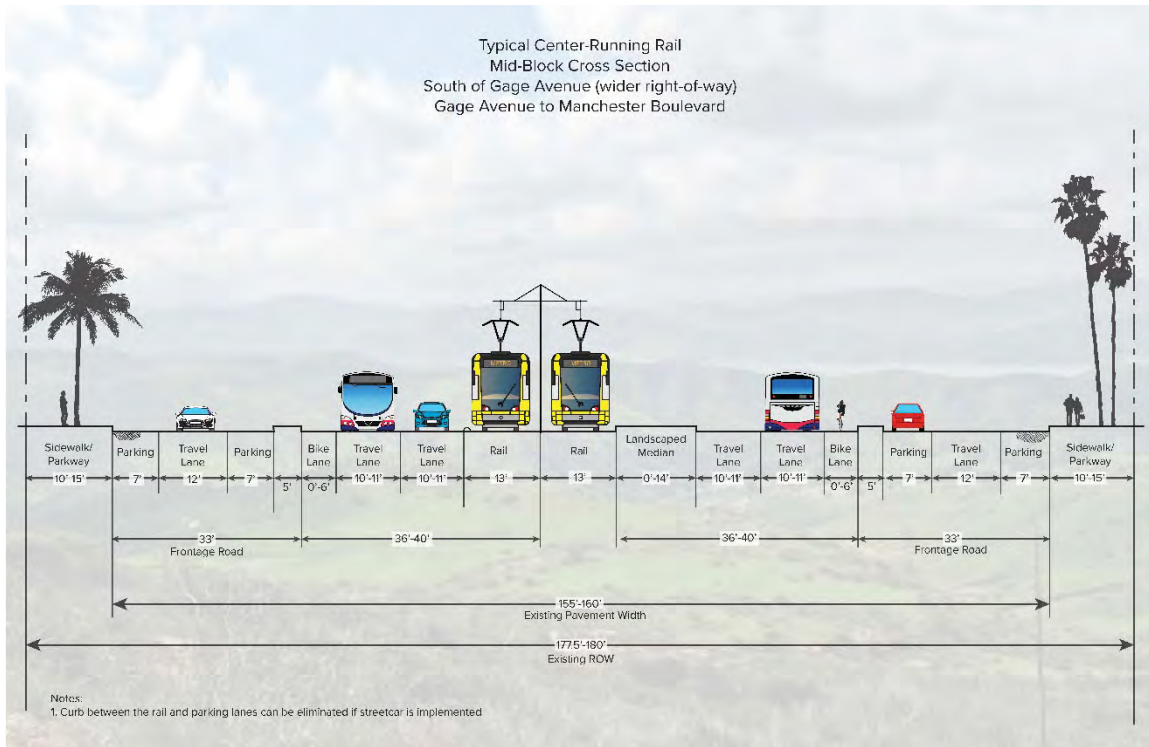


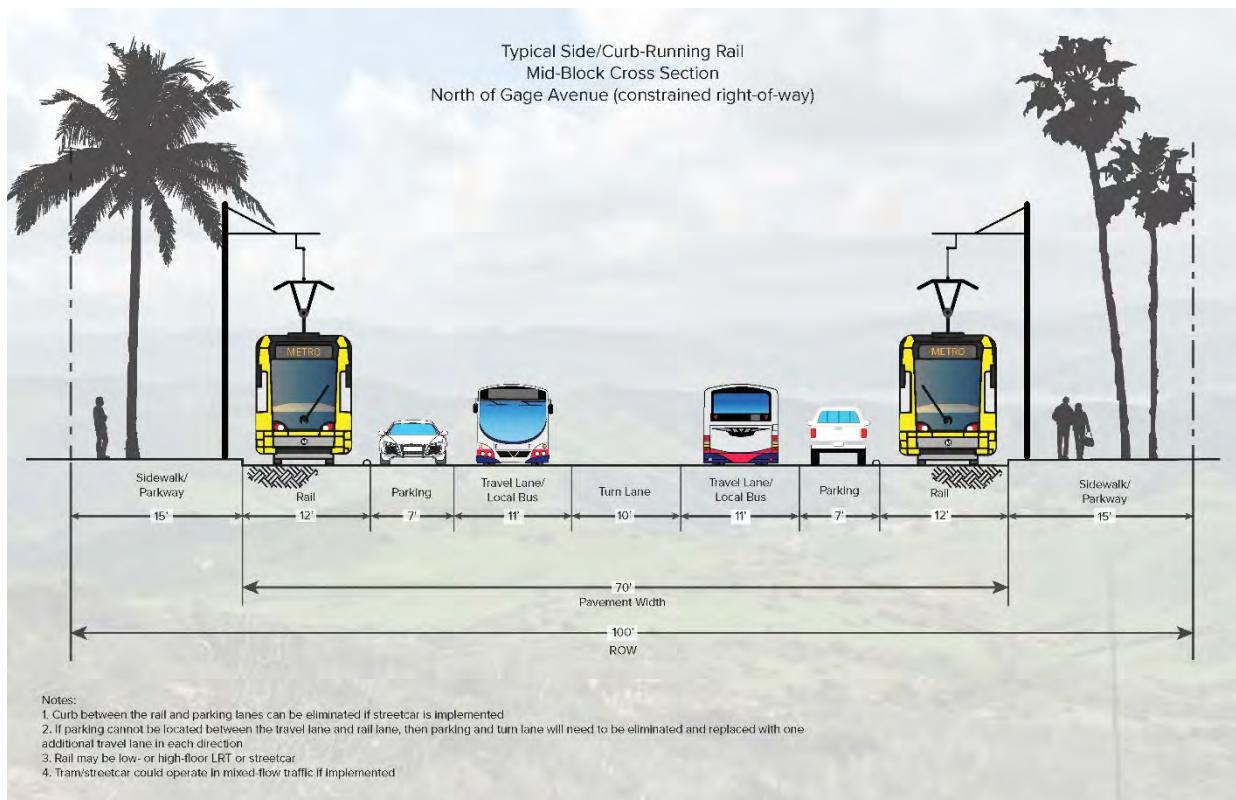
Figure 18: LRT High-Floor Cross Section



2.3.2 Concept 2 - LRT Low-Floor, Side-Running

Concept 2 is a side-running LRT line along Vermont Avenue between Wilshire Boulevard and 120th Street that would use low-floor LRT vehicles. The floor height of low-floor LRT vehicles is at a height that would allow for station platforms to be at a similar height to sidewalks. In order to comply with ADA standards, the station platforms would either have a slight “ramping” up from the adjacent sidewalk or an ADA ramp could be deployed from the vehicle, which would add to the station dwell time. Low-floor LRT vehicles are not currently in the Metro LRT system and, thus, would require new or modified maintenance and storage facilities to service and store these new vehicles. Concept 2 would most likely operate entirely at-grade, with the exception of a grade-separation at the Metro Expo Line. The grade separation at the Metro Expo Line would be required per the MRDC which does not allow two rail lines to intersect.

Figure 19 illustrates a typical side-running at-grade LRT located mid-block in the northern constrained ROW segment.

Figure 19: LRT Low-Floor and Tram/Streetcar Side-Running, Mid-Block Cross Section

2.3.3 Concept 3 - Tram/Streetcar, Side-Running

Concept 3 is an at-grade side-running option utilizing tram or streetcar vehicles along Vermont Avenue between Wilshire Boulevard and 120th Street. Concept 3 is similar to the low-floor LRT option (Concept 2, shown in Figure 19) with the exception that vehicular traffic can also operate within the tram/streetcar lanes. The mixed rail/traffic lanes may allow for improved vehicular operations, but with a potential decrease in rail service. This concept would most likely operate entirely at-grade, with the exception of a grade-separation at the Metro Expo Line as previously described for the low-floor LRT in Concept 2.

2.3.4 Concept 4 - HRT Purple Line Connection

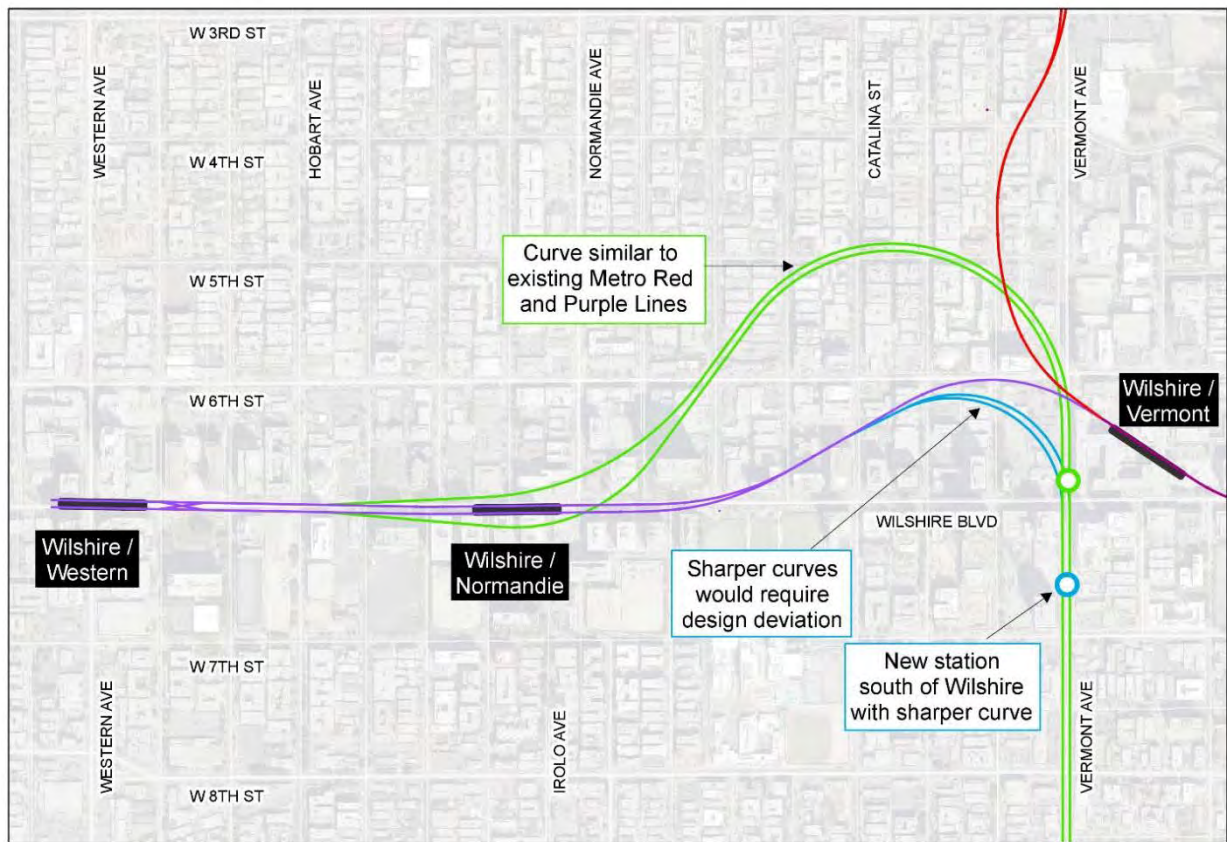
Concept 4 is a fully grade-separated HRT system that would connect to the existing Metro Purple Line (HRT) near Wilshire Boulevard and Vermont Avenue and then run south along Vermont Avenue to 120th Street. A connection to the Metro Purple Line could provide passengers with a one-seat ride between the Westside (once the Metro Purple Line Extensions are completed) and South Los Angeles. One operational option could be for the Metro Purple and Vermont Lines to interline between the Westside and the Wilshire Boulevard/Western Avenue Station, with the Purple Line continuing east into Downtown Los Angeles (where it would interline with the Metro Red Line beginning at the existing Metro Wilshire/Vermont Station, as it does today), while the Vermont line would turn south onto Vermont Avenue to 120th Street. Another option could be that the Metro Purple Line would

operate from the Westside to South Los Angeles (via Vermont) and the Metro Red Line would operate from North Hollywood to Downtown Los Angeles.

It should be noted that this concept has significant operational issues and concerns for interlining with the Metro Purple Line. This concept essentially brings together three operating lines, Metro Red, Purple and the proposed Vermont Corridor. For a two-track system with the level of service anticipated, scheduling such service will be extremely challenging, particularly for unique schedules needed for single-track operations during preventive maintenance. Additionally, live management may be stressed beyond practicality during unplanned/urgent events which may occur anywhere on a future Metro Red-Purple-Vermont network.

Figure 20 illustrates two potential connection options to the Metro Purple Line.

Figure 20: Concept 4 - HRT Purple Line Connection



2.3.5 Concept 5 - HRT Red Line Connection

This is a fully grade-separated HRT system that would connect directly to the existing Metro Red Line near Vermont Avenue and 3rd Street. It would then continue south under Vermont Avenue to 120th Street. Figure 21 illustrates the cross section of this alignment along Vermont Avenue south of 3rd Street. The existing Metro Red line and proposed Vermont rail line could interline between the Metro North Hollywood and Vermont/Beverly Stations before branching off as two separate lines: one continuing southeast into Downtown Los Angeles (where it

would interline with the Metro Purple Line beginning at the existing Wilshire/Vermont Station) and the other continuing under Vermont Avenue to South Los Angeles. This concept could provide passengers a one-seat ride between North Hollywood and South Los Angeles.

Another operational concept would be to run the Metro Red Line from North Hollywood to Vermont/120th and the Metro Purple Line from Westwood/VA to Union Station. This concept would most likely be considered if and when passenger demand reaches a level where the maximum possible frequency of service is required in all four directions from the Wilshire/Vermont Station – Westwood/VA, North Hollywood, Downtown/Union Station and Vermont/120th. Similar to Concept 4, this concept has the same operational issues and concerns for interlining with the Metro Red Line.

Figure 22 illustrates this direct connection to the Metro Red Line and a potential new station near Wilshire/Vermont. A new connection to the Metro Red Line would occur on tangent track located under Vermont Avenue near 3rd Street. The Metro Red Line alignment here is predominantly located within the roadway, but one or more parcels may be impacted in order to construct the new junction.

Figure 23 is a map of the HRT Line along Vermont Avenue and includes potential station locations. HRT systems typically have fewer stations than LRT alignments. HRT stations are located at major activity centers, dense residential communities, multimodal hubs, and transfer points with other high-capacity transit systems.

Figure 21: HRT Grade Separated Cross Section

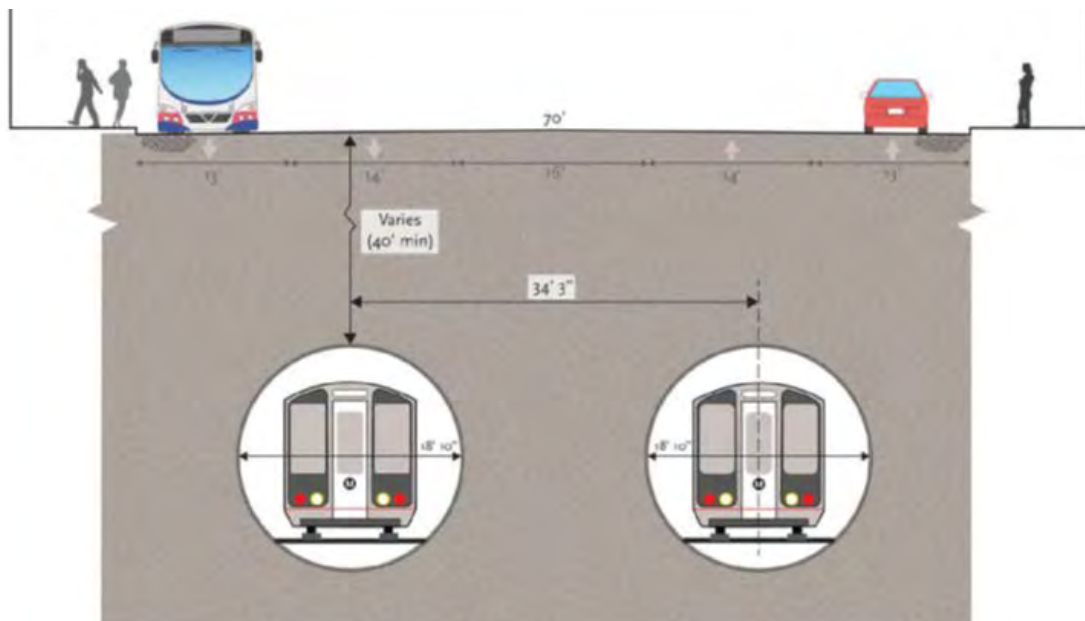


Figure 22: Concept 5 - HRT Red Line Connection

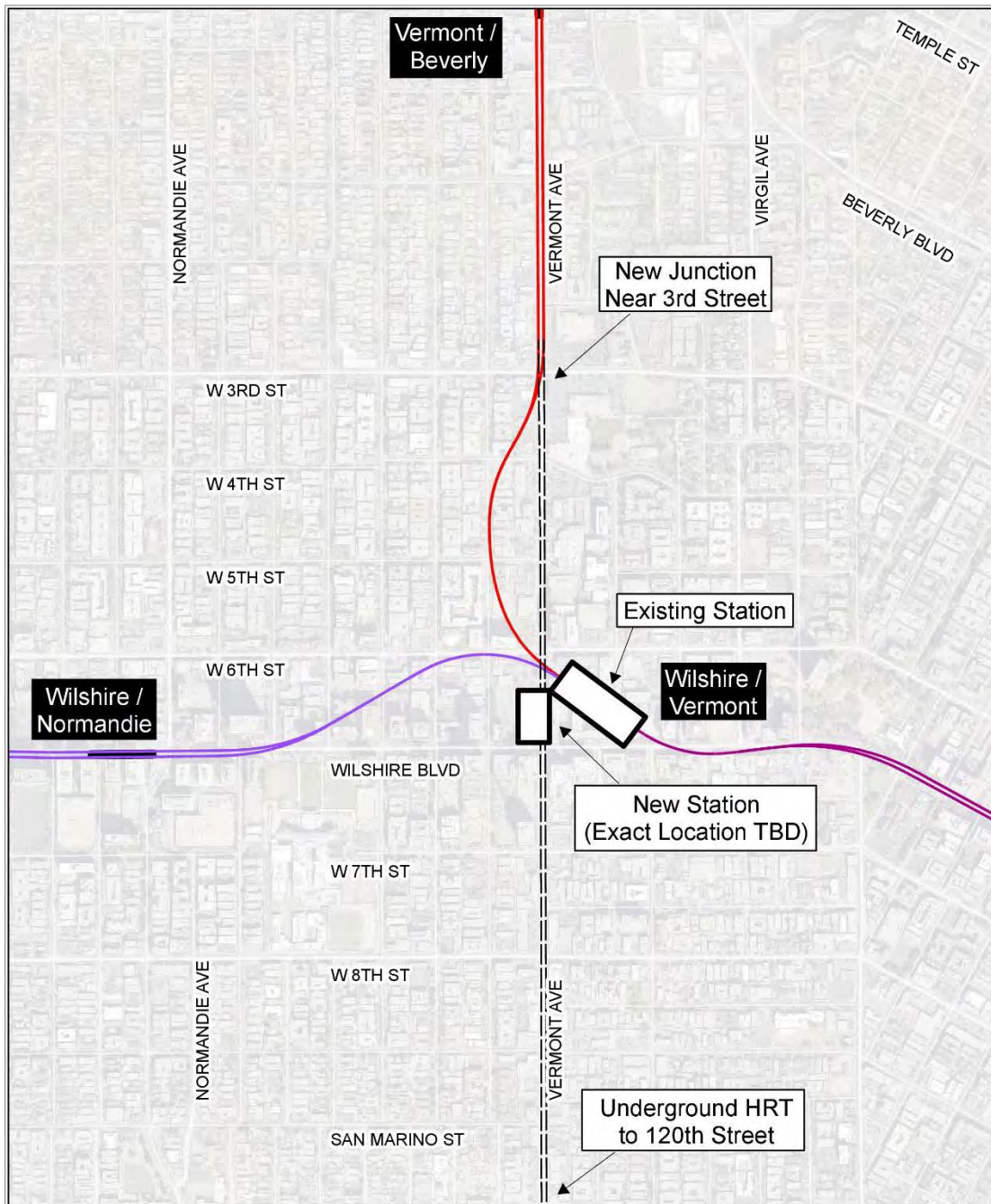
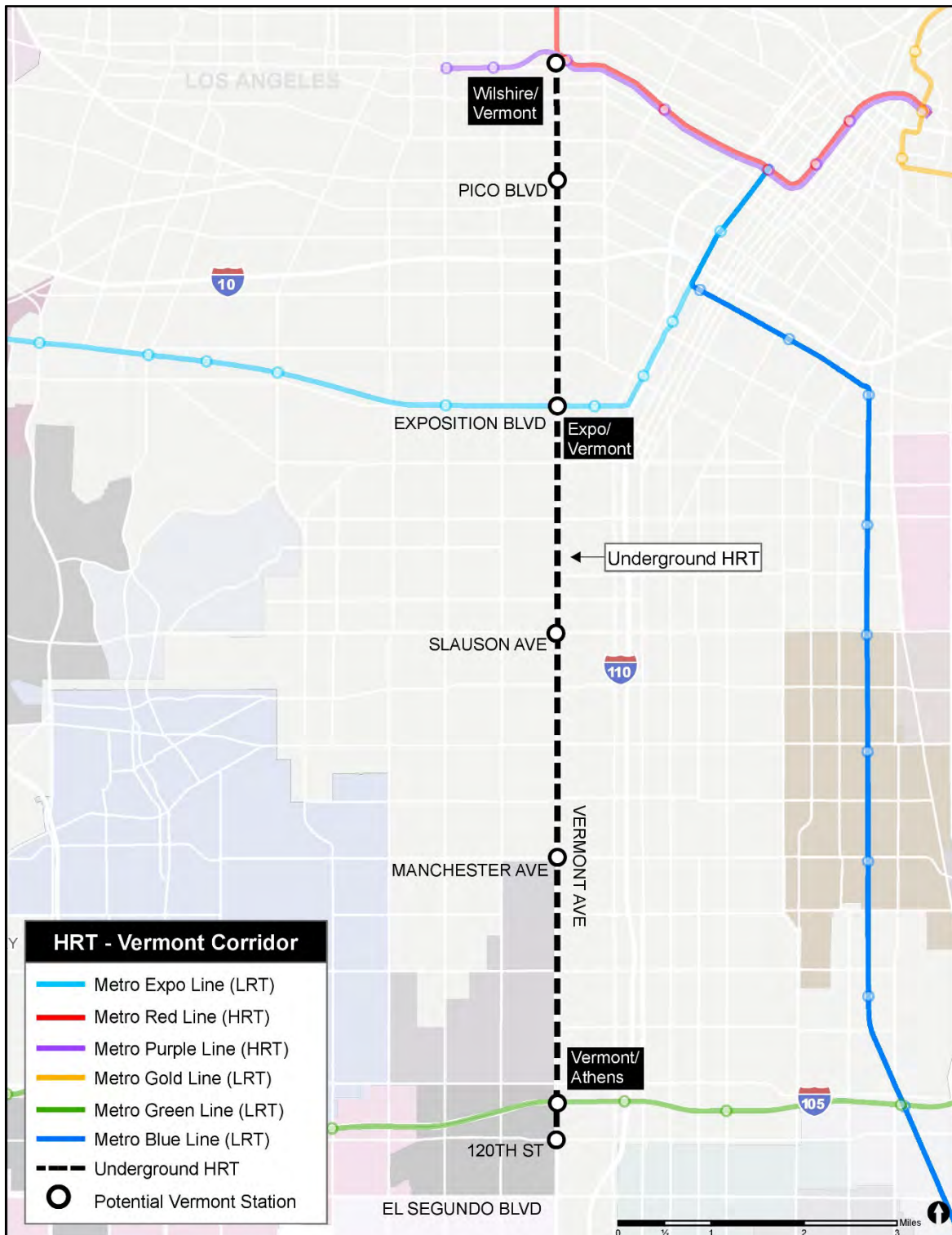


Figure 23: HRT Underground Vermont Corridor Stations



2.3.6 Concept 6 - HRT Red Line Stand-Alone

This concept is a fully grade-separated HRT line that would terminate at a new station near the existing Wilshire/Vermont Station, as shown in Figure 24. This concept would serve the same alignment and serve the same stations as the HRT Red Line Connection concept. A potential underground passenger connection could be constructed from the new station to the existing Wilshire/Vermont Station for easy transfers to the existing Metro Red and Purple Lines. It should be noted that in order to comply with the MRDC, tail tracks and a crossover would need to be constructed “behind” (north of) the terminal station.

Figure 24: Concept 6 - HRT Stand-Alone Alignment



2.4 Initial Screening of Preliminary Rail Concepts














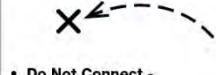



The six preliminary rail concepts were then analyzed against the key criteria listed below and included in Table 2, in order to arrive at a short-list of the three most promising and prototypical concepts. These include:

- 1. Customer Experience:** A high-capacity transit service along the Vermont Corridor must improve the passenger experience, particularly speed, travel time and on-time reliability.
- 2. System Connectivity:** A new rail line along the Vermont Corridor would join a very dense existing transit network. A rail concept must allow passengers to smoothly and seamlessly transfer or connect with the rest of the Metro Rail network.
- 3. System Operability and Reliability:** The six concepts present a range of track configurations and operational scenarios, which in turn directly impact how reliable the system will be.
- 4. Passenger-Carrying Capacity:** The Vermont Corridor is the second busiest bus corridor in Los Angeles County, carrying approximately 45,000 weekday boardings. As such, any rail concept must be capable of carrying a significant number of passengers to adequately serve the Vermont Corridor.
- 5. Cost:** While it is not prudent to screen concepts out strictly based on cost at this early pre-planning stage, this criterion was included to offer a balanced view of the concepts, recognizing that the advantages of some rail concepts do come at a cost. Conversely, lower-performing concepts (against the other factors) do represent significant cost savings. Cost-effectiveness and prudent use of taxpayer funds remain a top Metro goal for all projects.
- 6. Construction Impacts and Transit Service Disruption:** There would be significant transit service disruption and construction impacts for both HRT options that tie-into the existing system. The Vermont Corridor today is already a very active transit and traffic corridor, and a heavily urbanized and sensitive community. A concept that could be very attractive once completed could impose significant hardship to residents, businesses, and travelers during its construction.

Table 2 provides a summary of how the six rail concepts performed relative to the screening criteria. Based on the screening analysis, the following three concepts were selected as the most promising and representative of what a rail system along Vermont might be like:












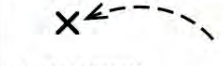
- LRT High-Floor, Center-Running
- HRT with Red Line Connection
- HRT Stand-Alone (starting/ending at Wilshire and Vermont)

Table 2: Preliminary Rail Concepts Screening Summary

		1 High Floor LRT	2 Low Floor LRT	3 Tram/Streetcar	4 Heavy Rail - Purple Line Connection	5 Heavy Rail - Red Line Connection	6 Heavy Rail - Stand-alone
	Rail Technology						
	Configuration	 • Center Running • High Floor	 • Side Running • Low Floor	 • Side Running • Low Floor	 • Connect to Purple Line	 • Connect to Red Line	 • Do Not Connect - Transfer Only
	Customer Experience	✓✓✓ • Fast and reliable service, subject to some disruption due to at-grade running	✓ • Reliability issues due to side-running (see System Operability below)	✓ • Slowest of the three rail technologies • Reliability issues due to side-running (see System Operability below)	✓✓✓✓ • Fastest and most reliable of Metro's rail services, due to fully dedicated and grade-separated guideway	✓✓✓✓ • Fastest and most reliable of Metro's rail services, due to fully dedicated and grade-separated guideway	✓✓✓✓ • Fastest and most reliable of Metro's rail services, due to fully dedicated and grade-separated guideway
	System Connectivity	✓✓✓ • Requires passengers to transfer between all rail services	✓✓✓ • Requires passengers to transfer between all rail services	✓✓✓ • Requires passengers to transfer between all rail services	✓✓✓✓ • Requires passengers to transfer between all rail services, except one-seat ride to/from the Westside	✓✓✓✓ • Requires passengers to transfer between all rail services, except one-seat ride to/from North Hollywood	✓✓✓✓ • Requires passengers to transfer between all rail services
	System Operability & Reliability	✓✓✓ • At-grade running is subject to service disruption due to traffic incidents and other events	✗ • Serious operational reliability issues due to lack of ability to route vehicles around incidents or other track-blocking events • Does not meet Metro reliability goals	✗ • Serious operational reliability issues due to lack of ability to route vehicles around incidents or other track-blocking events • Does not meet Metro reliability goals	✓ • Most reliable of Metro's rail services • Interlining with the Purple Line poses considerable challenges to efficient operations and scheduling • Would require terminal improvements to manage additional train volume or the development of a mid-line turnback facility	✓ • Most reliable of Metro's rail services • Interlining with the Red Line poses considerable challenges to efficient operations and scheduling • Would require terminal improvements to manage additional train volume or the development of a mid-line turnback facility	✓✓✓✓ • Most reliable of Metro's rail services • Lack of connections with Purple and Red Lines makes for efficient operations and scheduling

PERFORMANCE: ✗ EXTREMELY LOW ✘ VERY LOW ✓ LOW ✓✓ MEDIUM ✓✓✓ HIGH

Table 2 (continued): Preliminary Rail Concepts Screening Summary

	<p>Rail Technology</p>	<p>1 High Floor LRT</p> 	<p>2 Low Floor LRT</p> 	<p>3 Tram/Streetcar</p> 	<p>4 Heavy Rail - Purple Line Connection</p> 	<p>5 Heavy Rail - Red Line Connection</p> 	<p>6 Heavy Rail - Stand-alone</p> 
	<p>Configuration</p>	 <ul style="list-style-type: none"> Center Running High Floor 	 <ul style="list-style-type: none"> Side Running Low Floor 	 <ul style="list-style-type: none"> Side Running Low Floor 	 <ul style="list-style-type: none"> Connect to Purple Line 	 <ul style="list-style-type: none"> Connect to Red Line 	 <ul style="list-style-type: none"> Do Not Connect - Transfer Only
	<p>Passenger Capacity</p>	<p>✓✓✓</p> <ul style="list-style-type: none"> Second-highest capacity in Metro's rail fleet 133 passengers/car 	<p>✓</p> <ul style="list-style-type: none"> 25% less passenger cabin space and capacity than high-floor LRT 100 passengers/car 	<p>✗</p> <ul style="list-style-type: none"> Capacity is severely limited by vehicle size Capacity is not sufficient for projected passenger demand 100 passengers/car 	<p>✓✓✓✓</p> <ul style="list-style-type: none"> Highest capacity in Metro's rail fleet 180 passengers/car (Metro load standard is 131) 	<p>✓✓✓✓</p> <ul style="list-style-type: none"> Highest capacity in Metro's rail fleet 180 passengers/car (Metro load standard is 131) 	<p>✓✓✓✓</p> <ul style="list-style-type: none"> Highest capacity in Metro's rail fleet 180 passengers/car (Metro load standard is 131)
<p>\$</p>	<p>Cost</p>	<p>✓✓✓</p> <ul style="list-style-type: none"> Medium cost relative to other rail alternatives 	<p>✓✓✓</p> <ul style="list-style-type: none"> Medium cost relative to other rail alternatives 	<p>✓✓✓✓</p> <ul style="list-style-type: none"> Lowest cost relative to other rail alternatives 	<p>✓</p> <ul style="list-style-type: none"> Highest cost relative to other rail alternatives Need to build satellite or stand alone maintenance facility 	<p>✓</p> <ul style="list-style-type: none"> Highest cost relative to other rail alternatives Need to build satellite or stand alone maintenance facility 	<p>✓</p> <ul style="list-style-type: none"> Highest cost relative to other rail alternatives Need to build standalone maintenance and control facility
	<p>Construction Impacts & Service Disruption</p>	<p>✓✓✓</p> <ul style="list-style-type: none"> Highest potential for community disruption during construction No or very limited service disruptions to other Metro rail lines during construction 	<p>✓✓✓</p> <ul style="list-style-type: none"> Highest potential for community disruption during construction No or very limited service disruptions to other Metro rail lines during construction 	<p>✗</p> <ul style="list-style-type: none"> Light infrastructure footprint coupled with limited need to relocate utilities results in a faster, less disruptive construction period No or very limited service disruptions to other Metro rail lines during construction 	<p>✗</p> <ul style="list-style-type: none"> Significant and costly right-of-way needed to build the Purple Line connection During construction, Purple Line frequency may be reduced to as little as 40 minutes for at least one year and potentially longer. Requires taking property to construct under building(s) 	<p>✓</p> <ul style="list-style-type: none"> Significant and costly right-of-way needed to build the Red Line connection During construction, Red Line frequency may be reduced to as little as 40 minutes for at least one year and potentially longer. 	<p>✓✓✓</p> <ul style="list-style-type: none"> No or very limited service disruptions to other Metro rail lines during construction

PERFORMANCE: ✗ EXTREMELY LOW ✘ VERY LOW ✓ LOW ✓✓ MEDIUM ✓✓✓ HIGH



← Union Station



3. EVALUATION AND FEASIBILITY OF THE THREE RAIL CONCEPTS

This chapter discusses the next level of analysis conducted on the three rail concepts determined to be the most promising. This analysis was conducted in order to determine their feasibility, benefits, and impacts.



Vermont and Wilshire Station








Considerations used in evaluating the three concepts include: grade crossings and traffic impacts, junction feasibility, physical aspects of the corridor, potential maintenance and storage facilities, and phasing options. Below is a brief description of each. In turn, this information was used to examine the BRT concepts to help safeguard against the BRT construction precluding or interfering with potential rail conversion.

- 1. Grade Crossing and Traffic Analysis (LRT only):** Analysis of the potential grade crossings along the corridor was conducted using the Metro Grade Crossing Safety Policy for LRT. This analysis only applied to the LRT concept, as the other Heavy Rail Transit concepts would be fully grade-separated.
- 2. Junction Feasibility and Constructability:** Assessment of the feasibility for the two potential junctions with the existing Metro rail system, one with the HRT Metro Red Line and the other with the Metro Expo LRT Line.

3. **Corridor Fit & Constructability:** Determines how well each concept would fit within the Vermont Corridor’s built environment. The feasibility of below, at, and above-grade alignments were assessed based on the physical characteristics of the existing available ROW, rail geometry criteria, and physical barriers such as tunneling viability, geometric limitations, and major utilities.
4. **Vehicle Maintenance and Storage Facilities (MSF):** All rail concepts require a MSF to accommodate maintenance and storage of transit vehicles. This analysis identified the potential site needs and alternatives for such facilities.
5. **Right-of-Way Impacts:** Identifies any additional ROW impacts that may be required for the successful implementation of a concept beyond the corridor fit context.
6. **Phasing Options:** Determines the ability for each rail concept to be built in phases. This analysis was based on the Federal Transit Administration (FTA) standards to develop a Minimum Operating Segment.
7. **Environmental Impacts:** Provides an early environmental review to identify any issues that could substantially affect a California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA) document for the Vermont Corridor.
8. **Ridership Estimates:** Preliminary transit ridership forecasts based on the station locations and configuration of the three preliminary rail concepts.
9. **Cost Estimates:** High-level cost estimates for the 1-5% level of conceptual design for capital cost estimates and operating and maintenance cost estimates.









A summary of the comparative evaluation of the three rail concepts and screening results are shown in Table 3.

Table 3: Preliminary Rail Concepts Comparative Evaluation

		High Floor LRT 	Heavy Rail Red Line Connection 	Heavy Rail Stand-alone 
	Grade Crossings and Traffic Analysis	✓ <ul style="list-style-type: none"> All intersections feasible or possibly feasible at-grade per Metro Grade Crossing Safety Policy Required grade separation at Vermont/Expo due to MRDC requirements Possible impacts to left-turn movements on Vermont Avenue 	✓✓✓ NA – no at-grade crossings as the system would be completely below-grade	✓✓✓ NA – no at-grade crossings as the system would be completely below-grade
	Junction Constructability	✓✓✓ <ul style="list-style-type: none"> Feasible non-revenue track connection to the Metro Expo Line to allow access to existing maintenance facility for occasional heavy vehicle service 	✓ <ul style="list-style-type: none"> Feasible revenue connection to the Metro Red Line north of Wilshire Blvd. would impact adjacent properties for the junction construction. Pedestrian tunnel connecting the new and existing Wilshire/Vermont Stations could be constructed 	✓✓✓ <ul style="list-style-type: none"> No junction included in this alternative. Pedestrian tunnel connecting the new and existing Wilshire/Vermont Stations could be constructed.
	Corridor Fit & Constructability	✓✓ <ul style="list-style-type: none"> ROW widths are not sufficient for at-grade north of Slauson. Requires below-grade north of Slauson which would use twin bored tunnels between stations and cut-and-cover construction at stations in Phase 1 from Wilshire/Vermont to Slauson/Vermont. ROW widths are sufficient for the at-grade alignment between Slauson and 120th Street 	✗ <ul style="list-style-type: none"> Twin bored tunnels between stations and cut-and-cover construction at stations. If this alignment crosses below the existing Metro Red and Purple Lines, the depth could result in relatively higher station construction costs. Temporary closures of the northbound and southbound Metro Red Line tracks of at least one year would be required for construction. Would require terminal improvements to manage additional train volume or the development of a mid-line turnback facility. 	✓✓ <ul style="list-style-type: none"> Twin bored tunnels between stations and cut-and-cover construction at stations. The northern tail tracks of this alignment may need to be located below the existing Metro Red Line and the added depth could result in relatively higher construction costs.
	Vehicle MSF	✓✓✓ <ul style="list-style-type: none"> LRT Alternative would have access to existing facilities if a non-revenue connection is built to the Metro Expo Line. However, none of the existing MSFs have the capacity to fully serve a new LRT line. A new MSF would be required for the storage and maintenance of LRT vehicles. There are limited sites for a MSF within Phase 1 without lead tracks extending a relatively longer distance from the corridor. Would require a facility for 60 LRT vehicles 	✓✓✓ <ul style="list-style-type: none"> A new maintenance facility would be required, but the Metro Red Line junction north of Wilshire/Vermont would allow for access to the existing Division 20 facility. However, even with the planned expansion, Division 20 would not have the capacity to serve a new HRT line. There are limited sites for a MSF within Phase 1 without lead tracks extending a relatively longer distance from the corridor. Would require a facility for 162 HRT vehicles 	✓ <ul style="list-style-type: none"> With no physical access to existing heavy rail facilities; a new facility would be required. There are limited sites for a MSF within Phase 1 without lead tracks extending a relatively longer distance from the corridor. Would require a facility for 90 HRT vehicles

PERFORMANCE: ✗ VERY LOW ✓ LOW ✓✓ MEDIUM ✓✓✓ HIGH

Table 3 (continued): Preliminary Rail Concepts Comparative Evaluation

		High Floor LRT 	Heavy Rail Red Line Connection 	Heavy Rail Stand-alone 
	ROW Impacts	✓✓ <ul style="list-style-type: none"> Right-of-way required for maintenance facility and station footprints 	✓ <ul style="list-style-type: none"> Right-of-way required for construction of the junction with the Metro Red Line, maintenance facility, station footprints, and for mid-line turnback facility or terminal improvements, and construction laydown. 	✓✓ <ul style="list-style-type: none"> Right-of-way required for maintenance facility and station footprints
	Phasing	✓✓ <ul style="list-style-type: none"> Phase 1 of this alternative is recommended between Vermont/Wilshire to the Expo/Vermont station. There are limited opportunities for a new MSF in this area without deviating from the corridor. Phase 2 would be the rest of the corridor. The MSF will drive much of the decision on phasing due to the constrained corridor, along with ridership considerations, and may require the southern terminus of Phase 1 to shift to Slauson Avenue. 	✓✓ <ul style="list-style-type: none"> Phase 1 of this alternative is recommended between Vermont/3rd Street to the Expo/Vermont Station. There are limited opportunities for a new MSF in this area without deviating from the corridor. Phase 2 would be the rest of the corridor. The MSF will drive much of the decision on phasing due to the constrained corridor, along with ridership considerations, and may require the southern terminus of Phase 1 to shift to Slauson Avenue or even to the ultimate terminus at 120th Street. 	✓✓ <ul style="list-style-type: none"> Phase 1 of this alternative is recommended between West 6th Street and Wilshire Boulevard on Vermont Avenue and the Expo/Vermont Station. There are limited opportunities for a new MSF in this area without deviating from the corridor. Phase 2 would extend south to 120th Street. The MSF will drive much of the decision on phasing due to the constrained corridor, along with ridership considerations, and may require the southern terminus of Phase 1 to shift to Slauson Avenue.
	Environmental	✓✓ <ul style="list-style-type: none"> Environmental resources that may be impacted are discussed and summarized in Section 5 of Technical Memo #7. No unusual or unique resources relative to other Metro rail projects, however the landscaped median south of Gage Avenue could pose Section 4(f) parkland challenges. 	✓✓ <ul style="list-style-type: none"> Subterranean construction and operations would limit impacts to traffic and residents. Environmental resources that may be impacted are discussed and summarized in Section 5 of Technical Memo #7. No unusual or unique features relative to other Metro rail projects. 	✓✓✓ <ul style="list-style-type: none"> Subterranean construction and operations would limit impacts to traffic and residents. Environmental resources that may be impacted are discussed and summarized in Section 5 of Technical Memo #7. No unusual or unique features relative to other Metro rail projects.
	Ridership	✓ <ul style="list-style-type: none"> Lowest boardings due to limited station stops and transfer time needed for at-grade rail to below-grade rail connection or connection to local bus Approx. 91,000 corridor boardings (2042) 	✓✓✓ <ul style="list-style-type: none"> Highest boardings due to one seat ride from north of Wilshire Approx. 116,000 - 144,000 corridor boardings (2042) 	✓✓ <ul style="list-style-type: none"> Low-medium boardings relative to the other concepts due to transfer time needed for rail-to-rail connection Approx. 103,000 - 131,000 corridor boardings (2042)
	Cost	✓✓✓ <ul style="list-style-type: none"> \$4.4 - \$5.2B (2018\$), Capital \$18 - \$21.1B (2067\$), Capital \$28.8 - \$53.0M (2018\$), Annual Operating & Maintenance Lowest cost relative to other concepts 	✓ <ul style="list-style-type: none"> \$7.1 - \$8.4B (2018\$), Capital \$29.4 - \$34.7B (2067\$), Capital \$53.8 - 80.5M (2018\$), Annual Operating and Maintenance Highest cost relative to other concepts New ventilation shaft and upgraded systems would be required along the existing Metro Red Line. 	✓✓ <ul style="list-style-type: none"> \$5.9 - \$6.9B (2018\$), Capital \$24.1 - \$28.4 (2067\$), Capital \$35.1 - \$70.0M (2018\$), Annual Operating & Maintenance Medium-high cost relative to other alternatives

PERFORMANCE: ✖ VERY LOW ✓ LOW ✓✓ MEDIUM ✓✓✓ HIGH

3.1.1 Phasing Options for the Three Rail Concepts

The study also looked at the feasibility of connecting the Metro Red Line at the Wilshire/Vermont Station to the Metro Expo Line at the Exposition/Vermont Station as a first segment. Given the length of the corridor, and past Metro experience with constructing rail systems, it is possible that any rail constructed on Vermont Avenue would be built in phases.

As part of the phasing analysis, a Minimum Operating Segment (MOS) analysis was conducted for the three rail concepts. Consideration was given to cost effectiveness (identifying segments that generate the most new ridership per dollar invested), logical endpoints (terminal stations at points of connection to other Metro services and/or at high-activity centers), and the ability to find suitable land for a Maintenance and Storage Facility (MSF). Siting the MSF is the largest driving force for phasing due to the very limited industrial-zoned land within the corridor and lack of capacity at existing rail facilities.



Union Station

The phasing analysis validated that Exposition Boulevard would be an appropriate location to terminate the first segment. This location is both a significant transfer point to the Metro Expo Line and an important destination given that USC and Exposition Park are immediately adjacent. This segment also contains over half of the total corridor ridership. The analysis, however, also determined that it would be very challenging to locate and environmentally clear and acquire land for a suitable MSF in the northern segment of the corridor.

Since the northern segment of the corridor is predominately commercial and/or residential with limited ability to find a suitable MSF to build a MOS along the Vermont Corridor between the Metro Red/Purple and Metro Expo Lines, other options were explored. One option could be to extend the rail MOS further south to Slauson Avenue where the ridership is shown as the third-highest location on the corridor. Slauson Avenue provides a multimodal connection to the future Rail to Rail Active Transportation Corridor. The industrial properties located along the Metro-owned former rail corridor along Slauson Avenue may be candidates for the MSF. The other option would be to build the project in a single phase in order to access the industrial lands available south of the I-105 Freeway.

Table 4 outlines the recommended phasing along with the capital costs associated with each.

Table 4: Recommended Phasing

	Segment 1	Segment 2
LRT High-Floor	Wilshire Blvd. to Exposition Blvd.* <i>Capital Cost (2018): \$2.7 - 3.2B</i>	Exposition Blvd. to 120 th St. <i>Capital Cost (2018): \$1.7 - 2.0B</i>
HRT Red Line Connection	3 rd St. to Exposition Blvd.* <i>Capital Cost (2018): \$3.7 - 4.4B</i>	Exposition Blvd. to 120 th St. <i>Capital Cost (2018): \$3.4 - 4.0B</i>
HRT Stand-Alone Alignment	6 th St/Wilshire Blvd. to Exposition Blvd. <i>Capital Cost (2018) \$2.5 - 2.9B</i>	Exposition Blvd. to 120 th St. <i>Capital Cost (2018): \$3.4 - 4.0B</i>

*Southern terminus may need to shift south if no feasible MSF site can be found between Wilshire and Exposition. This is a higher risk for the HRT Metro Red Line Connection because it requires the largest fleet size and MSF site.

3.1.2 Implications for BRT Planning and Design

Based on the analysis completed, all three concepts are physically and operationally feasible and each has a different set of tradeoffs, with no concept rising in superiority over the others. As seen in Table 3, each of the three concepts have advantages and rank highest in one or more categories but lower in others, leaving no clear winner to be determined at this stage of feasibility analysis. These concepts and doubtless other variations would be subjected to full technical and community review during future environmental phases. They serve to illustrate a reasonable range of feasible rail configurations for the Vermont Corridor, and have been used to review the BRT alternatives to ensure that neither BRT concept precludes a future potential conversion to rail.

With the three exceptions noted below, the Vermont Corridor does not pose unusually difficult or unique environmental or engineering conditions relative to other projects Metro has delivered in similar built-up urban areas. The three exceptions are as follows:

- 1. Potential Section 4(f) Resources (LRT High-Floor Concept):** From 88th to 92nd Street, there is a median park space which would potentially be affected by the LRT concept which would likely be at-grade and in the median in this segment.
- 2. Connection to the Metro Red Line (HRT Red Line Connection Concept):** Creating a new underground junction with the Metro Red Line is a significant construction challenge that, subject to further engineering and environmental study and design, could pose significant impacts to properties adjacent to the junction, and would result in prolonged service interruptions on the Metro Red Line during construction.
- 3. Locating a Maintenance and Storage Facility for a Minimum Operating Segment (All 3 Concepts):** The viability of building a Minimum Operating Segment along Vermont between the Metro Red/Purple and Metro Expo Lines will likely hinge on finding, environmentally clearing and acquiring land for the MSF in this predominately residential and commercial area. If this proves to be impractical, the project will need to extend further

south near Slauson Avenue, or perhaps be built as a single phase in order to access the industrial lands available south of the I-105 Freeway.

The implications for BRT planning and design are as follows:

- **The Vermont BRT Project will not preclude potential future conversion to rail.** If HRT is the selected rail technology, there will be no physical overlap between the systems as HRT must be fully grade-separated. Also, given the very narrow right-of-way north of Gage Avenue, it is highly likely that LRT, if it is the selected technology, would be below-grade in this section, again eliminating the potential for BRT construction or infrastructure to interfere with future rail infrastructure.
- **With Light Rail Technology, there is some potential to re-use the BRT runningway.** In the wide portion of the corridor south of Gage Avenue, LRT would likely run at-grade in the median, in a very similar way as is proposed for one of the two BRT concepts that will be studied in the environmental phase. In recognition of this, and as discussed in more detail in the next section, the BRT runningway has been smoothed out to be more compatible with rail.



Metro Rail Grade Separation



4. REFINEMENTS TO BUS RAPID TRANSIT CONCEPTS

This chapter describes some of the minor refinements made to the conceptual engineering plans previously produced during the Vermont BRT Technical Study. The two initial BRT concepts and/or configurations remain the same (end-to-end side-running and combination side/center-running) however, some engineering refinements were made. This process had several main objectives:

1. Reflect best-practices and lessons-learned from recent on-street BRT implementations in an effort to ensure the future Vermont BRT provides a high quality, rail-like experience to Metro’s patrons. This included adjustments to right-turn lanes to minimize conflicts with the BRT, reducing the degree of lane-shifting through intersections necessary to accommodate left-turn lanes, restricting u-turns at narrow intersections, and adding bulb-outs to sidewalks to reduce crossing distances for pedestrians.
2. Adjust the BRT runningway per the Metro Rail Design Criteria to maximize the opportunities for the BRT guideway and/or footprint to be reused for future rail. This was done primarily by adjusting the horizontal curves of the BRT runningway, and the position of left-turn lanes, to be more compatible with a future rail alignment. This also benefits BRT patrons by providing a smoother ride and potentially faster travel times.
3. Consider opportunities to integrate on-street amenities to improve First-Last Mile connectivity and help foster the creation of Transit Oriented Communities.



First-Last Mile Treatments



4.1 BRT Runningway and Best-Practices

The following summarizes the refinements made to the BRT concepts, including a description of the change and reason for it, and an illustration showing an example of the change.

Lane Transitions: Lane transition improvements were made throughout the alignment due to severe lane shifts as shown in the example in Figure 25. The improvement generally increased the length of BRT transitions or changed them to reversing curves. Locations primarily consist of lane transitions before and after stations where the BRT alignment must adjust to better align with the station. There are multiple locations for both alternatives where improvements to lane transitions were made to allow for better BRT operation. These improvements allow for a smooth ride and less need to slow down at curves and transitions. Often, the adjacent general-purpose lane will also enjoy a similar improvement in operations. In addition, the higher curve radius will help with future conversion to rail if the same alignment is used.

Figure 25: Lane Transitions Before/After Refinement



Before

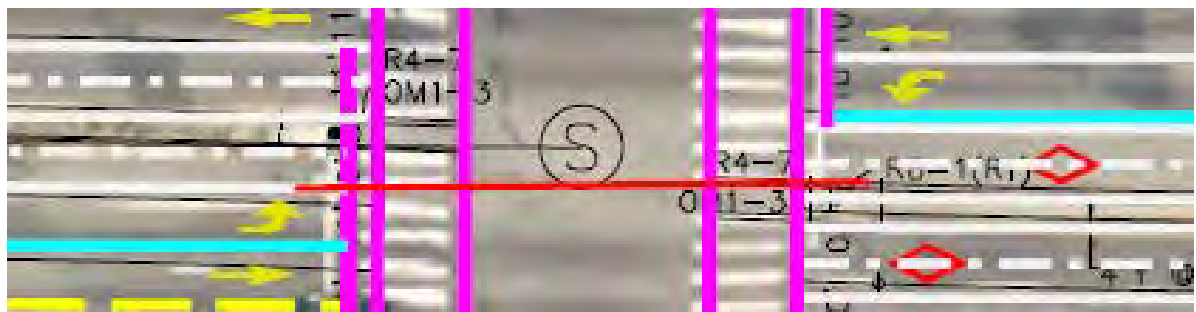


After

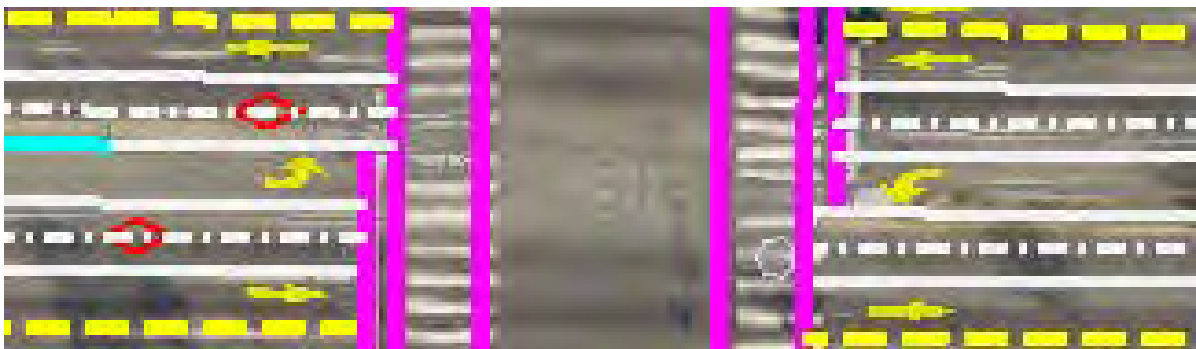
Center-Running BRT Intersection Lane Offset & Left-Turn Lane: The left-turn lanes were moved to the inside of the BRT lane by using a 150' mixing zone before the intersection, similar to what has been proposed for right-turns. Locations where this change occurred are intersections in the BRT concept for the center-running portions of the corridor. An example is shown in Figure 26. To accommodate the left-turn lane improvements, the stations at Century Boulevard were moved from nearside to farside. Bus operations at Century Boulevard is expected to be consistent with many other farside stations along the corridor.

The previous plans from the Vermont BRT Technical Study show large BRT lane offsets through intersections for the center-running BRT. This issue occurs at most intersections where left-turn lanes are included, causing the BRT lane to shift. The outside left-turn lanes also cause another issue with signal operations because of the conflicting vehicle left-turn and BRT through movement. The left-turn lanes being moved to the inside of the BRT lane provides more efficient signal timing for the BRT and avoids the condition where the BRT is stationary while the adjacent through and left-turn traffic is moving.

Figure 26: Center-Running BRT Intersection Lane Offset & Left-Turn Lane Before/After Refinement



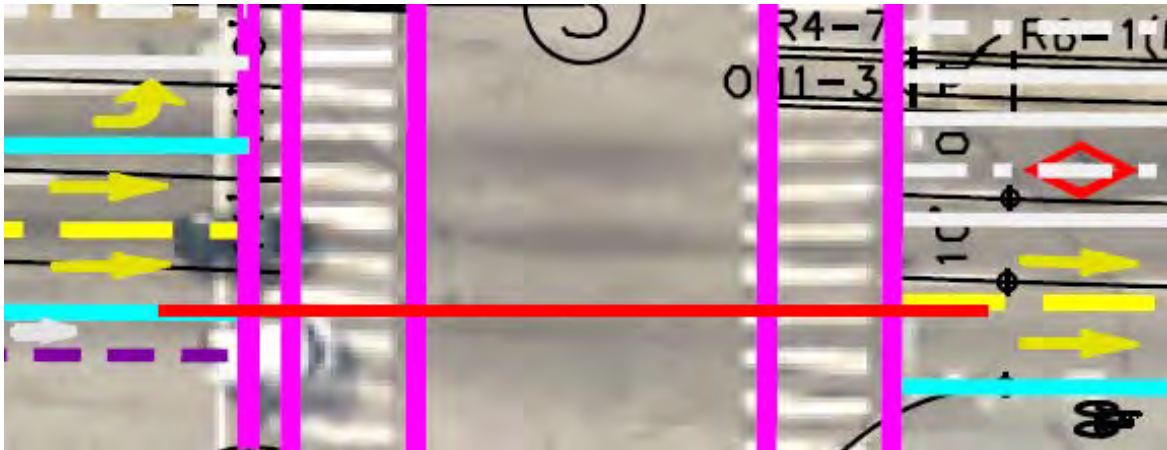
Before



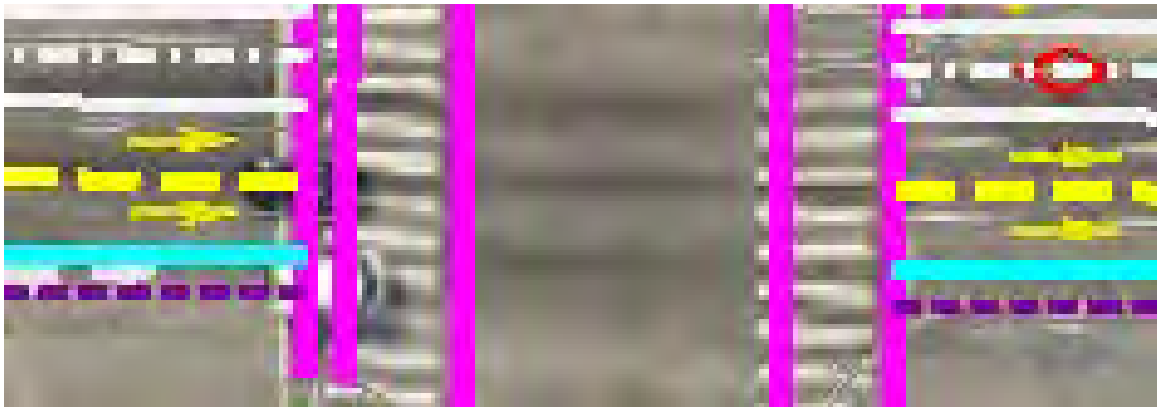
After

General Intersection Lane Offset: Intersection lane offsets were fixed at necessary locations including 7th Street, 79th Street, and 83rd Street. Lane offsets occur where traffic has a significant lateral shift through an intersection. General practice is to keep this within 2'-3' at most. Larger offsets may cause potential vehicle conflicts where a vehicle accidentally ends up in the wrong lane and creates an uncomfortable ride. Fixing the lane offset allows for easier vehicle transition through intersections and prevents potential vehicle conflicts. Figure 27 shows an example of these general intersection lane offsets that were fixed.

Figure 27: General Intersection Lane Offset Before/After Refinement



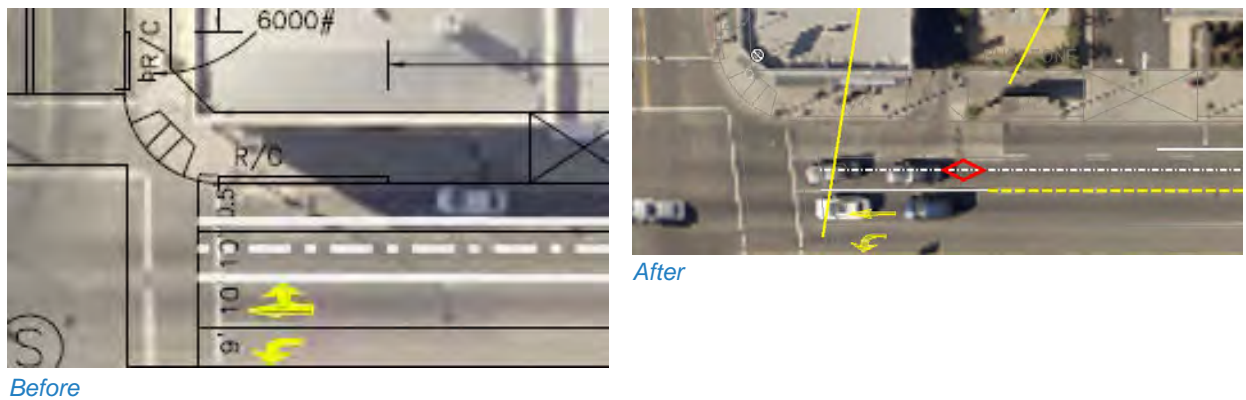
Before



After

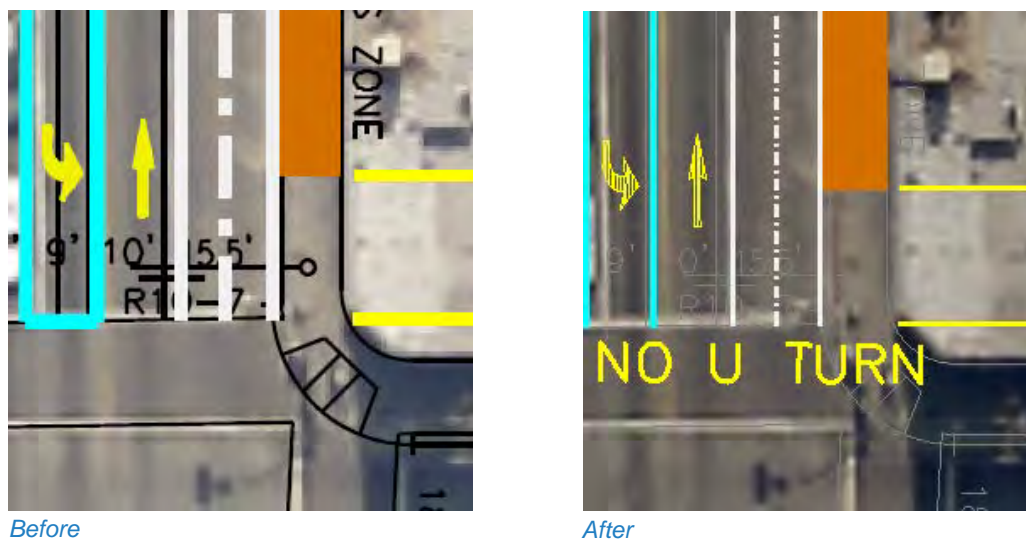
Right-Turns from Correct Lanes: This involved removing the conflicting shared through and right lane inside of the BRT lane. At intersections, the addition of a mixing zone and right-turn only lane (for widths >10') or shared right-turn and BRT lanes (for widths <10') was included. This also resulted in removing additional parking near intersections to accommodate the refinements. There are multiple locations for both alternatives where this refinement was made. The previous plans show shared through and right vehicle lanes at intersections which conflict with the BRT through movement. The refinement resolves the conflicting movement as shown in Figure 28.

Figure 28: Right-Turns from Correct Lanes Before/After Refinement



U-Turn Restrictions: This refinement includes u-turn restrictions at narrow intersections due to the BRT lane and/or stations. There are multiple locations for both alternatives where this was applied. Figure 29 shows an example of this u-turn restriction being applied. The curbside BRT design causes potential conflicts with u-turns, especially at stations. By adding a u-turn restriction these conflicts are resolved.

Figure 29: U-Turn Restrictions Before/After Refinement



4.2 BRT Station Spacing

In addition to dedicated runningways and signal priority at intersections, a BRT gains speed advantages by limiting the number of stops to high-volume locations and key transfer points and activity centers. The proposed spacing of stations along the Vermont Corridor as first developed in the Vermont BRT Technical Study generally meets both accepted BRT best practices, as well as Metro's average spacing standards of 1.0 miles for BRT. There are two segments where the spacing is tighter than the average standards suggest: between the I-10 (Santa Monica) Freeway and Wilshire Boulevard, and between Sunset Boulevard and Wilshire Boulevard.



Vermont and Santa Monica Station

A station consolidation analysis was conducted within these two segments, considering distance to the next stations north and south of each segment, existing average daily boardings and alightings at each stop, existing TOC features, and ROW availability to accommodate the desired platform lengths.

In the I-10 to Wilshire segment, it is recommended that the Pico Station be carried forward as a single replacement for the closely spaced Olympic and Venice Stations. The Pico Station has good existing ridership numbers and the best spacing. From a network point-of-view, it also aligns with the Pico Boulevard Station of the Metro Blue Line, strengthening the east-west connection between these two rapid transit lines. As the Pico Station has good TOC potential, opportunities for implementing longer station platforms should be explored in connection with new TOC development.

In the Sunset Boulevard and Wilshire Boulevard segment, the Santa Monica and 3rd Street Stations have much higher ridership numbers than the other closely spaced stations here. Also, next to the Wilshire Station, these are the two highest-performing stations in terms of transfers to east-west bus services on the Vermont Corridor. For these reasons, it is recommended to retain the Santa Monica and 3rd Street Stations, and remove the Beverly and Melrose Stations. Figure 32 shows the proposed BRT stations with the removal of the stations described in this section.

4.3 First-Last Mile and Transit Oriented Communities Treatments

First-Last Mile (FLM) improvements are important for BRT stations and should be implemented with the design of the Vermont Transit Corridor. FLM improvements typically are built within 0.25 - 0.5 miles of the station and aim to increase ridership, safety, and accessibility, and enhance the efficiency of the transit system and the transit rider experience. The concentration of these improvements should increase as the station approaches. The following is a list of FLM Improvements taken from Metro's First-Last Mile Strategic Plan. Example FLM treatments are also illustrated in Figure 33.

- Enhance existing crosswalks, add additional (mid-block or raised) intersection crossings
- Cut-throughs and shortcuts
- Curb extensions (bulbouts)
- Scramble crossings
- Metro signage and maps, medallion signage, time to station signage, real-time signage adjacent to station
- Smart technologies
- Street furniture
- Landscaping and shade
- Lighting
- Freeway underpass and overpass enhancements
- Enhanced bus waiting areas
- Traffic calming
- Sidewalk paving and surface enhancements, widening
- Reduced lane widths
- Enhanced bike facilities
- Bus enhancements
- The Green Zone
- Signal modifications
- Rolling Lanes
- Car share, neighborhood electric vehicles
- Bike share, bike station
- Van pool and feeder bus
- High-Visibility Bicycle Parking
- Electronic Bicycle & Pedestrian Counters
- Kiss and Ride
- Micro Park-and-Ride

Figure 33: Examples of Potential First-Last Mile Treatments



Several of these improvements are included as part of the BRT conceptual design, and the TOC analysis undertaken for this study identified several more in each station's catchment area. Further improvements to FLM should be explored in later stages of design and environmental review.

A unique urban design opportunity exists in the wider portion of the corridor south of Gage Avenue. The refined BRT alternatives include either side or center-running configurations created by reusing an existing travel lane. In both cases, the frontage roads to the outside and the landscaped median are mostly undisturbed except for some necessary reconfigurations at intersections. Some community members and agency representatives have noted that the median is an underutilized community resource, partly because it is in the middle of the street and access is a challenge. This provides an opportunity to “reprogram” the entire street width to focus the open space on one side where it is easier to access.

This concept would essentially create a linear park along one side of Vermont Avenue south of Gage Avenue, as seen in Figure 34. Such a concept would need significant community input and agency support beyond Metro to become a reality. It is recommended that this concept be further explored during the environmental phase of the Vermont Transit Corridor project, in partnership with City of Los Angeles, Los Angeles County, and the Vermont Community.

Figure 34: Vermont Avenue South of Gage Avenue Potential Concept



4.4 Other BRT Refinements

4.4.1 Capital Costs

The Vermont BRT Technical Study, completed in 2017, included both high and low end cost estimates for the two BRT concepts. The high end cost estimate included full end-to-end reconstruction/repaving of the bus lane, while the low-cost estimate assumed pavement replacement only at the stations, and at limited stretches of the corridor where there is no existing pavement (under the median running BRT concept) and/or pavement that is in poor condition. Also, the high-end estimate assumed the purchase of all new vehicles, whereas the low-cost estimate assumed that a portion of the vehicles would come by repurposing buses from Metro's existing Rapid Line 754.

The only changes made to the higher end cost estimate were the adjustments for the station consolidation and TSP enhancements; everything else remained the same as the 2017 study. However, it is worth noting that full replacement of the bus lane is not generally done with BRT projects; it is recommended that as part of the Environmental Clearance and Design phase, a pavement assessment be conducted to assess the true need to upgrade portions of the bus lane. The final high end cost estimate for either BRT concept is \$310M.

The lower end cost estimate for both scenarios was further refined into two separate updated cost estimates for each BRT concept, based on the geometric refinements noted above. The lower cost estimates are \$236M for the end-to-end side-running BRT and \$241M for the side/center-running BRT concept. The latter concept is more expensive because a stretch of the center-running guideway will be located partly in the existing planted median, requiring some new roadway to be constructed.

4.4.2 Traffic Impacts

Two of the proposed refinements will likely lead to a minor improvement in traffic impacts and delays: bulbouts and the updated left-turn configurations. The addition of bulbouts (extensions of the curb to reduce crosswalk lengths) at intersections decreases crossing times for pedestrians, which reduces cycle lengths, and thus improves the intersection level of service. The BRT/left-turn lane adjustments for the center-running BRT also improves the intersection level of service. Allowing the configuration to adjust at intersections so that the left-turn lane is to the left of the dedicated BRT lane removes the conflicting movement that would complicate the signal phasing.



Metro Rapid on Vermont Avenue

4.4.3 Parking Impacts

The Vermont BRT Corridor Technical Study, completed in 2017, also analyzed the parking impacts that would be created due to the implementation of either BRT concept on the corridor. The study found that of the 2,005 total curbside parking spaces in the corridor, 446 parking spaces would be lost as a result of the side-running BRT concept and 464 parking spaces would be lost with the side/center-running BRT concept.

With the BRT refinements described in Section 4.1, additional parking is lost because of the right-turn mixing zones, which were previously shown as separate through and right lanes conflicting with the BRT lane. Another minor loss of parking is due to the extended BRT runningway transitions described in Section 4.1, which are desirable as they help maintain BRT speeds and passenger comfort. On the other hand, parking is regained at the four station sites that were removed from the corridor (see Section 4.2).

In summary, a net additional 120 parking spaces are lost for the side-running BRT concept, and a net additional 54 parking spaces are lost for the side/center-running BRT concept. This changes the total lost parking spaces from 446 to 566 for the side-running BRT concept and from 464 to 518 for the side/center-running BRT concept.

4.4.4 Passenger-Carrying Capacity

A conservative estimate for the people-carrying capacity of the Vermont BRT is 2,400 people per hour per direction. This is based on observations from the existing Metro Orange Line, where each bus has a capacity of 80 passengers (57 seated and 23 standees). At a high frequency of one bus every two minutes in each direction, or 30 buses per hour per direction, the BRT can carry 2,400 passengers ($80 \times 30 = 2,400$) per hour per direction. Note that this is a capacity based on a high frequency of service. Metro will determine the actual frequency of service based on ridership demand.

The most recent ridership forecasting done for the line predicts that by 2042, the Vermont BRT will be carrying a maximum load of 1,150 passenger per hour at the maximum load point along the line, on an average weekday. This means that the BRT will have spare capacity for special events, and will have sufficient capacity to carry normal weekday volumes beyond 2042, as the corridor continues to grow in population, employment, and ridership.



On-street parking along Vermont Avenue

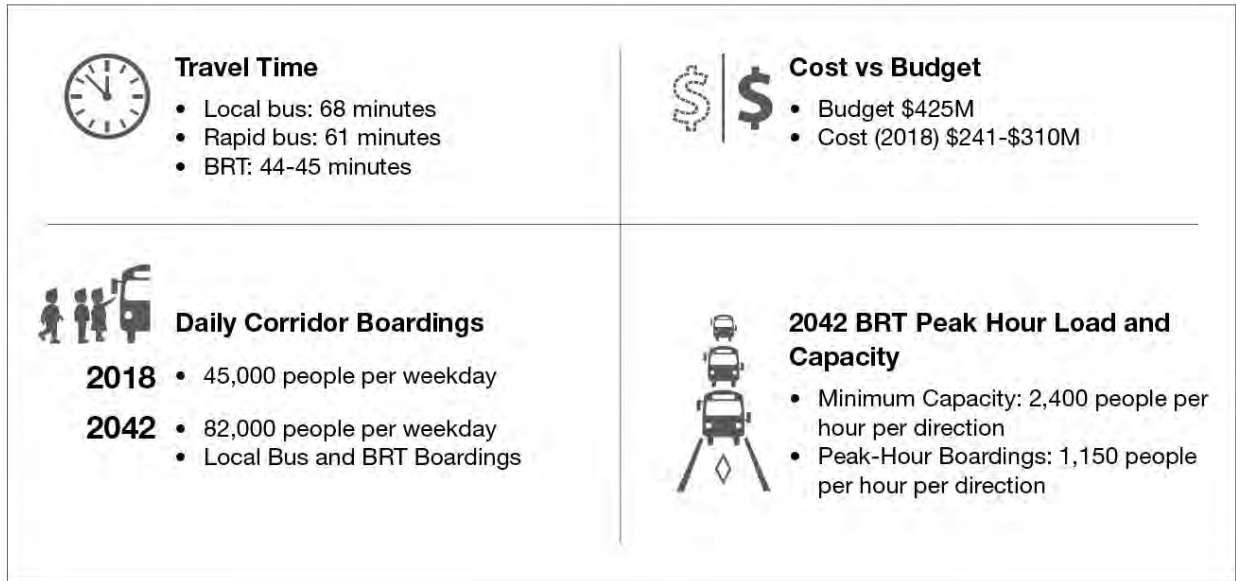


Metro Rapid along Vermont Avenue

4.4.5 Overall BRT Performance

The refined Vermont Transit Corridor project would make a significant and cost-effective contribution to transit service along Vermont Avenue, as shown in Figure 35.

Figure 35: Vermont BRT Project Benefits





5. STAKEHOLDER AND AGENCY INPUT

5. STAKEHOLDER AND AGENCY INPUT

Metro initiated an early and sustained key stakeholder outreach process involving key public and partner agency stakeholders. Invitees included businesses, religious institutions, schools, hospitals, major cultural centers, community/neighborhood groups, neighborhood councils, and Chambers of Commerce. The purpose of the outreach was to discuss and solicit early feedback on the initial six rail concepts, discuss the screening criteria used in refining the rail concepts, and the refinements to the BRT concepts. Metro staff also provided individual project briefings to all affected City of Los Angeles Council Districts as well as at other community group meetings. This process included a wide range of opportunities for feedback that were designed to be transparent and inclusive.



Public Meeting

The study process included a Technical Working Group (TWG), which consisted of representatives from a number of Metro departments as well as staff from the City of Los Angeles and County of Los Angeles, who have jurisdiction over the corridor. This group met four times over the course of the project and was instrumental in providing critical technical support and input on both the rail concepts and the refined BRT alternatives.



Public Meeting

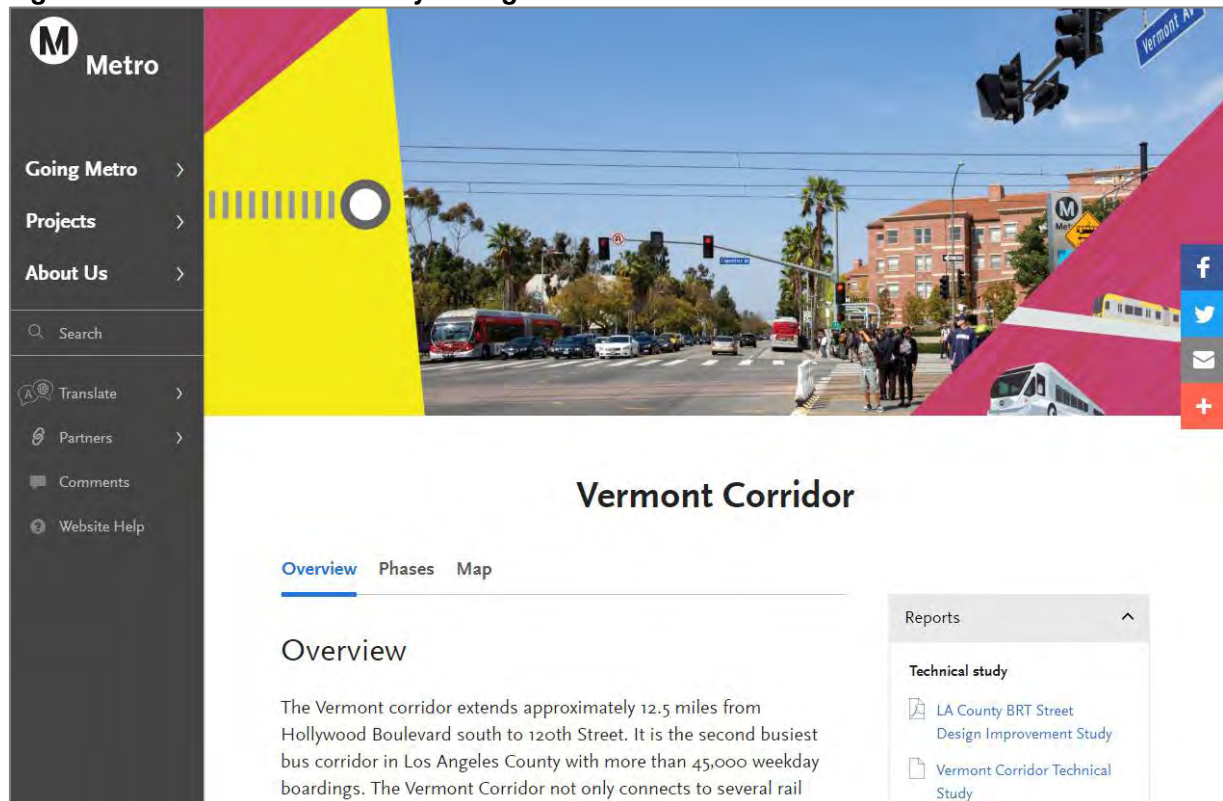
Beginning in April 2018, Metro staff initiated the first set of project briefings and key stakeholder meetings. The purpose of these initial briefings and/or meetings was to provide a general overview and schedule of the study, solicit initial stakeholder input and feedback on the preliminary rail concepts, and to discuss next steps. In October 2018, a second set of project briefings and key stakeholder meetings were held. The purpose of this second round of briefings/meetings was to provide a study update and solicit further input on the refined rail and BRT concepts. The project team recorded all community feedback and concerns for each meeting.

For each round of stakeholder meetings, 3-4 general “roundtable” meetings were held in the northern, central and southern portions of the corridor to maximize opportunities for key stakeholders to attend. In the second round, these roundtable meetings were supplemented by presentations and listening sessions at established community meetings in the study area including the LA Neighborhood Initiative, the LA Chamber of Commerce, Business Improvement Districts, and major activity centers in the corridor such as Children’s Hospital LA.

The project team also offered other convenient means for the community to receive information about the project and provide comment. Online engagement included a special

project e-mail box (vermontbrt@metro.net) and project website (www.metro.net/projects/vermont-corridor) (see Figure 36).

Figure 36: Vermont Corridor Project Page



Throughout the entire stakeholder engagement effort, the Metro team gathered feedback regarding the technical aspects of the study and proposed BRT and rail concepts, potential station locations, and general comments regarding the project funding, ridership, and preferred alternative selection process. Common topics mentioned in the comments received included, but were not limited to, preferred alignments, rail build preferences, project timeline, community improvements, safety, connectivity, visual aesthetics, future development opportunities, funding acceleration, project acceleration, additional alternatives, and station options. These concerns will be further considered in greater detail during the subsequent environmental review process.

A total of 349 comments were collected via email, public comments, and comment cards from the meetings. The following key takeaways were received from the public outreach process:

- **General Support for the Proposed BRT Project:** Stakeholders generally agreed the project is needed to improve mobility in the Vermont Corridor and to enhance the regional network.
- **Support for Rail:** While there is general support for the BRT, a small group of stakeholders voiced concerns about equity regarding the Measure M priority for a BRT

instead of a rail project. They pointed to other areas of the county that are being served by rail projects and do not have the ridership numbers of the Vermont Corridor. These stakeholders believe the corridor requires rail options in the short-term to best meet the needs of the community.

- **Environmental Impact Concerns:**
 - Aesthetics and Property Impacts - Some residents are concerned about potential impacts to property and landscaping to the surrounding areas as a result of the proposed BRT project.
 - Security - Design elements considered in the project should prevent graffiti and other crime-related activities.
- **Enforcement:** Some stakeholders are concerned that current enforcement on bus lanes is not effective and felt that enforcement is a key issue to increased and more reliable BRT speeds for this project.
- **Dedicated lanes:** Some attendees mentioned the need and priority to have dedicated bus lanes that are not shared with vehicles. Additionally, these stakeholders preferred the lanes to be dedicated to buses 24/7 but acknowledge that in some places, specific times may work better.
- **Passenger Amenities:** All door boarding, off-board fare payment, and shelters at stations were preferred by several attendees.
- **Alternative Preferences:** The HRT Red Line Connection and the HRT Stand Alone concept that terminates at Wilshire/Vermont Station and facilitates transfers to the Metro Red or Purple Lines were the most favored out of the rail alternatives. An underground subway under Vermont Avenue is preferred, with preference of underground at least north of Gage Avenue.
- **TOC Improvements and Amenities:**
 - Development opportunities should be considered to improve the community, such as affordable housing and preservation of communities to help mitigate gentrification.
 - Improved landscaping would be welcomed; however it would need to be maintained regularly or it will fall into disarray.
- **Project Acceleration:** Many attendees expressed a need to accelerate the project; however, a small number of attendees also expressed a desire to build rail instead of BRT first.
- **Station Locations:** A number of attendees provided comments on preferred station locations or questioned the need for specific stations. A large portion of the comments received were concerned about the station connections with the Metro Red and Purple Lines.
- **Next Steps:** Stakeholders and the public look forward to receiving more detail on the BRT concepts and alternatives in the environmental planning process.



6. FINDINGS AND RECOMMENDATIONS

The objective of this study was to evaluate the feasibility of a variety of potential rail concepts for the Vermont Corridor in terms of engineering, constructability, junction operability issues, cost effectiveness, environmental issues and concerns, and consistency with community goals and priorities, including possible phased implementation. This information was used to refine the two BRT alternatives developed earlier as part of the Vermont BRT Technical Study to ensure that their implementation does not preclude a potential conversion to rail in the future. Initial opportunities to facilitate and promote TOC outcomes and potential First-Last Mile amenities were also evaluated for each potential rail alternative. The study has identified considerations that should be further explored and included in the environmental clearance and design of BRT. The conceptual engineering drawings for the BRT concepts have been refined accordingly. Figure 37 summarizes some of the key findings and recommendations from the study.



Metro Rapid on Vermont Avenue

Figure 37: Key Findings and Recommendations

1

Improvements to Metro's 2nd busiest corridor are needed

- Further work undertaken on transit needs in the corridor, new ridership forecasts, and further input from the Vermont Community all underscore the pressing need to improve services in this critical transit corridor.

2

BRT has community support, as does future rail

- While technical concerns exist about specific means of implementation, there is community support for high-quality transit improvements in the corridor, both BRT and future rail.

3

BRT will in no way preclude rail

- For the two most likely rail technologies, there is very little physical overlap between the BRT project and the likely future rail footprint.
- HRT would be fully underground, with no physical conflict with the at-grade BRT.
- In the narrow portion north of Gage Avenue, LRT will also most likely be underground.
- In the wider portion south of Gage Avenue, there is an opportunity to reuse a median-running BRT running way for LRT, and the BRT alignment has been reconfigured to rail standards to facilitate this.

4

Potential opportunity to work with the Vermont Community, the County and the City of LA to revitalize the open-space median at south end of corridor

- While such a project falls outside Metro's mandate and would require financial and project implementation lead from the City, it should be explored with the community during the environmental clearance phase.

5

BRT has capacity to serve the Vermont Corridor to 2042 and beyond

- New ridership forecasting conducted for this study has verified that the Vermont BRT will have the people-carrying capacity to serve the Vermont Corridor into the 2040's and likely beyond.