1.0 – EXECUTIVE SUMMARY

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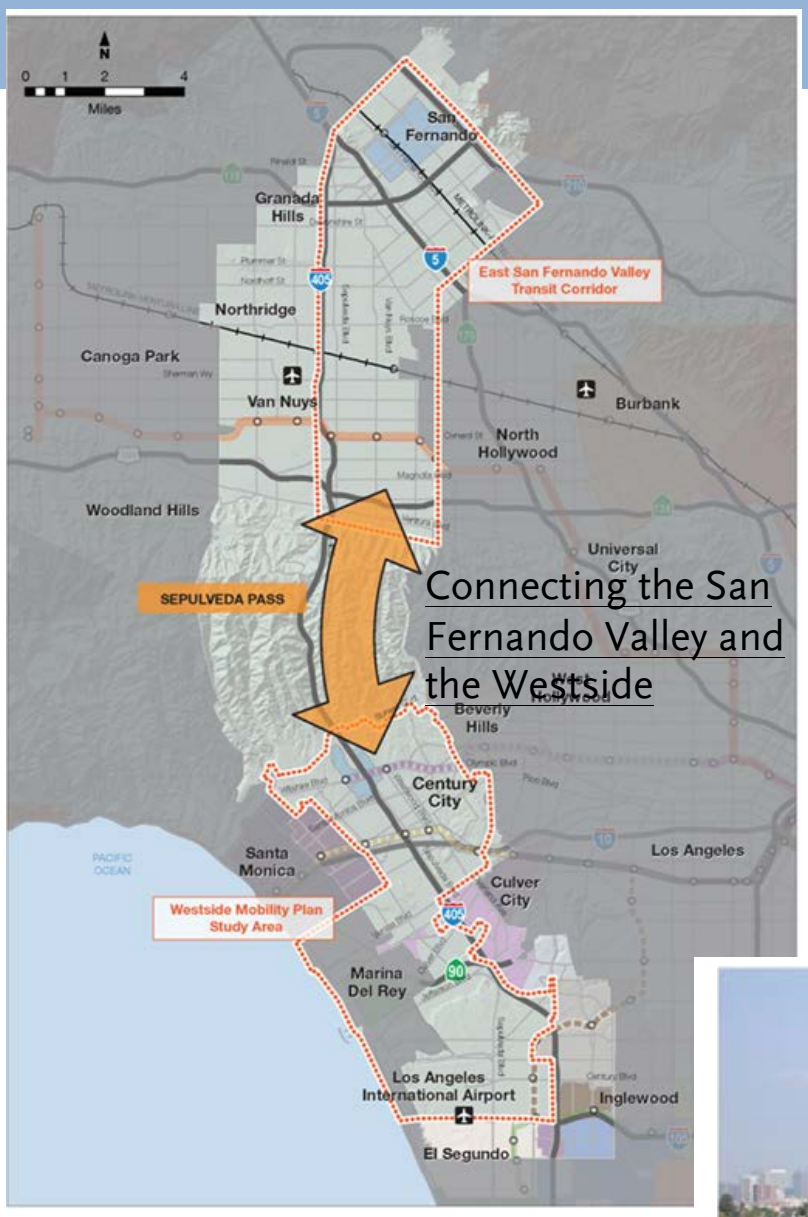
Los Angeles County
Metropolitan Transportation Authority

Sepulveda Pass Corridor Systems Planning Study

Executive Summary

November 2012



Interstate 405 Sepulveda Pass

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Introduction

In early 2012, the Los Angeles County Metropolitan Transportation Authority (Metro) embarked on the *Sepulveda Pass Corridor Systems Planning Study* to evaluate the potential for providing additional transit and/or highway capacity improvements beyond those currently being constructed as a part of the I-405 Sepulveda Pass Improvements Project.

Measure R Corridor. The Sepulveda Pass is one of the 12 transit corridors that were approved in 2008 by the voters of Los Angeles County as a part of the Measure R ballot initiative (Figure 1). The project is included in Metro's adopted 2009 Long Range Transportation Plan (LRTP) with a 2039 delivery date and a funding allocation of $2.4 billion in year of expenditure dollars (YOE).

Extreme Congestion. The I-405 through the Sepulveda Pass is one of the few north-south roadways connecting the Westside area and the San Fernando Valley. Projected growth in travel demand will outpace even the increased capacity provided through the completion of the current I-405 Sepulveda Pass Improvements Project, which will add a 10-mile HOV lane on the northbound I-405 between I-10 and US 101 and improve supporting infrastructure such as ramps, bridges and soundwalls.

Study Objectives. The main objectives of the study were to answer: 1) What could be done quickly, with little environmental impact, and within the Measure R budget, and 2) what longer-term higher capacity solutions are feasible, what are associated potential impacts, and what is needed to implement the improvements? Because the Sepulveda Pass transit corridor is a third decade project in the LRTP, Metro is exploring options to accelerate delivery of this project through a public-private partnership (P3).

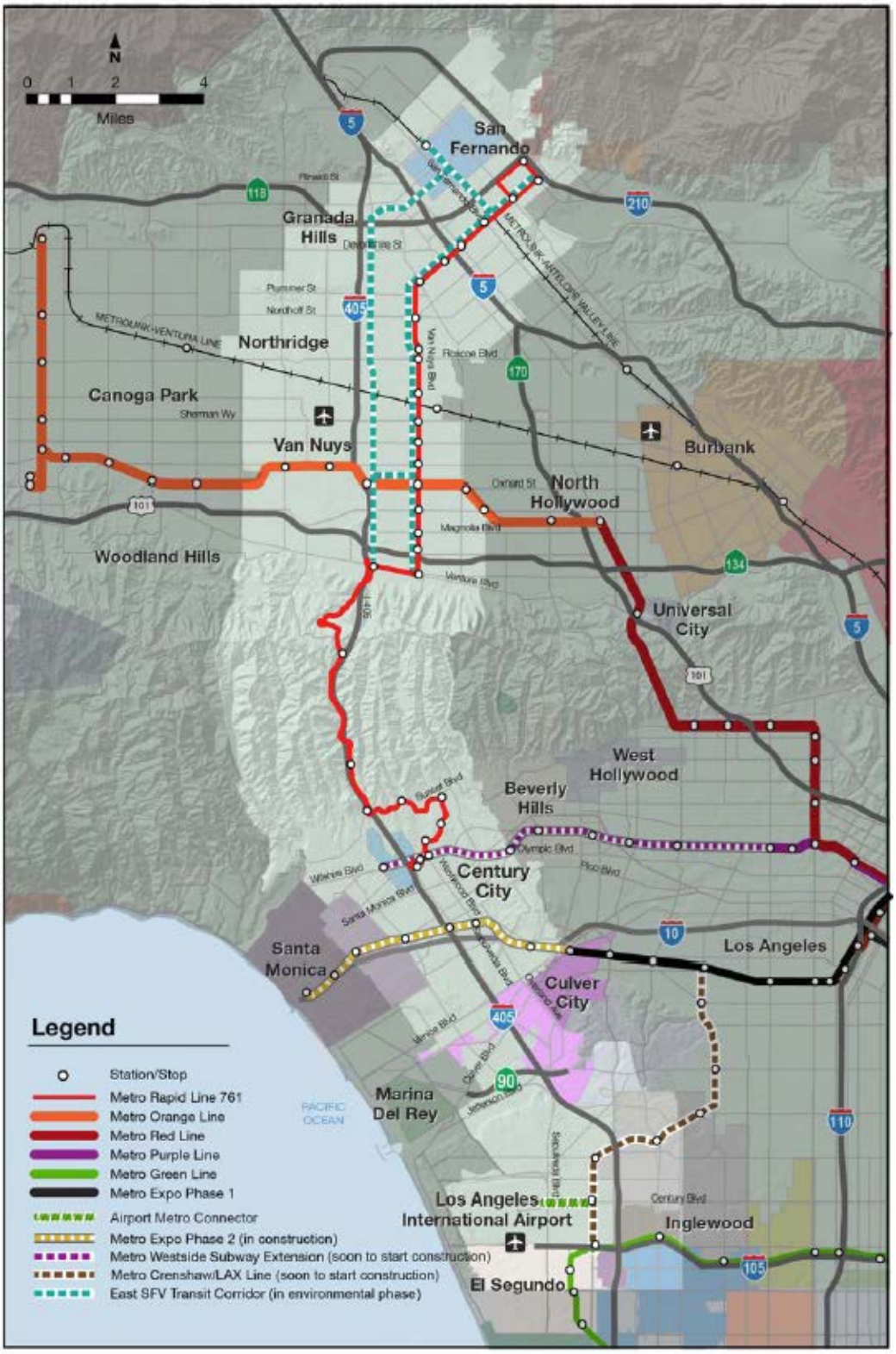
Study Area

The study area, which extends approximately 30 miles from the I-5/I-405 junction in the northern San Fernando Valley to Los Angeles International Airport (LAX), is bisected by the following 10 major existing and planned transportation lines (see Figure 2).

- Metrolink Antelope Valley Line
- Metrolink Ventura Line
- Metro Rapid Line 761
- Metro Orange Line
- Metro Green Line
- East San Fernando Valley Transit Corridor (in environmental phase)
- Metro Westside Subway Extension (soon to start construction)
- Metro Expo Line, Phase 2 (in construction)
- Metro Crenshaw/LAX Line (soon to start construction
- Airport Metro Connector (in environmental phase)

Figure 1. Measure R Map

Figure 2. Sepulveda Pass Study Area



Study Purpose

This study is the earliest phase of project development and precedes an Alternatives Analysis or Environmental Impact Study (EIS). The Systems Planning Study evaluates broad level concepts—from transit modes such as Bus Rapid Transit (BRT), Light Rail Transit (LRT), and Heavy Rail Transit (HRT) to highway improvements including High Occupancy Toll (HOT), and at-grade and above and/or below grade-separated alignments. The study developed initial engineering concepts, travel demand, rough order of magnitude (ROM) costs in current dollars (2012), and a summary of potential environmental issues for each concept.

Project Need

The Sepulveda Pass provides a crucial transportation link across the Santa Monica Mountains between the heavy concentration of households in the San Fernando Valley and major employment and activity centers in Los Angeles County's Westside sub-region. The I-405 Freeway is ranked as one of the most traveled urban highways in the nation by the Federal Highway Administration (FHWA) with an Average Annual Daily Traffic of 374,000 vehicles in 2010. The 13-mile stretch of the freeway, from Getty Center Drive, the core of the Sepulveda Pass, to the I-105 (Century Freeway), was recently ranked as the third most congested freeway segment in the United States.

In addition, the US 101 and I-10 interchanges with the I-405 north and south of the Pass consistently rank among the five most congested freeway interchanges in the country. The I-405 Sepulveda Pass Improvements Project which is currently under construction will address some of these congestion issues when it is completed in about a year. Demand is still expected to exceed capacity as growth in travel demand expands in this corridor and no special provisions have been included in the current construction project for transit improvements.

The I-405 currently varies between four to six general purpose lanes in each direction and includes a continuous High Occupancy Vehicle (HOV) Lane in the southbound direction from the I-5/I-405 split in the north San Fernando Valley to the Orange County Line. The I-405 Sepulveda Pass Improvements Project will add a 10-mile HOV lane in the northbound direction of the I-405 between the I-10 and the US 101 freeways. This will complete the I-405 HOV lanes in both directions between the I-5 in Los Angeles County and the I-5 in Orange County.

Systems Concepts

A set of "concept families" was developed, taking into account travel markets, engineering constraints, and environmental issues. The first two concept families included could be mostly funded with the Measure R funds:

- Concept 1: Shoulder Running BRT

  30 miles between the Sylmar/San Fernando Metrolink Station to Century/Aviation (future Metro station), with a freeway shoulder running Bus Rapid Transit (BRT) during peak periods, and transit signal priority treatments along major arterials.

- Concept 2: At-Grade Managed Lanes with BRT

  29 miles with five general purpose/two High Occupancy Toll (HOT) lanes in each direction at-grade through the Pass, and a single HOT lane north of US 101/south of Santa Monica Blvd.; also includes BRT routes; direct access ramps; and P3 potential.

- Concept 3: Aerial/Viaduct Managed Lanes with BRT

  10 miles of elevated structure above the I-405 from US 101 to I-10 (2 HOT lanes in each direction); BRT for 21 miles from

Sylmar to Expo/Sepulveda Station. Caltrans previously studied this alternative in the I-405 environmental document, however, it was eliminated from further consideration.

- Concept 4: Tolled Highway Tunnel with BRT

  Nine miles of tolled highway tunnel with four toll lanes (two per direction); portals between US 101 and Santa Monica Blvd; direct connectors from eastbound US 101 and southbound I-405; all users, including carpools, pay regular toll; P3 potential.

- Concept 5: LRT Rail Tunnel (5A) or HRT RailTunnel (5B)

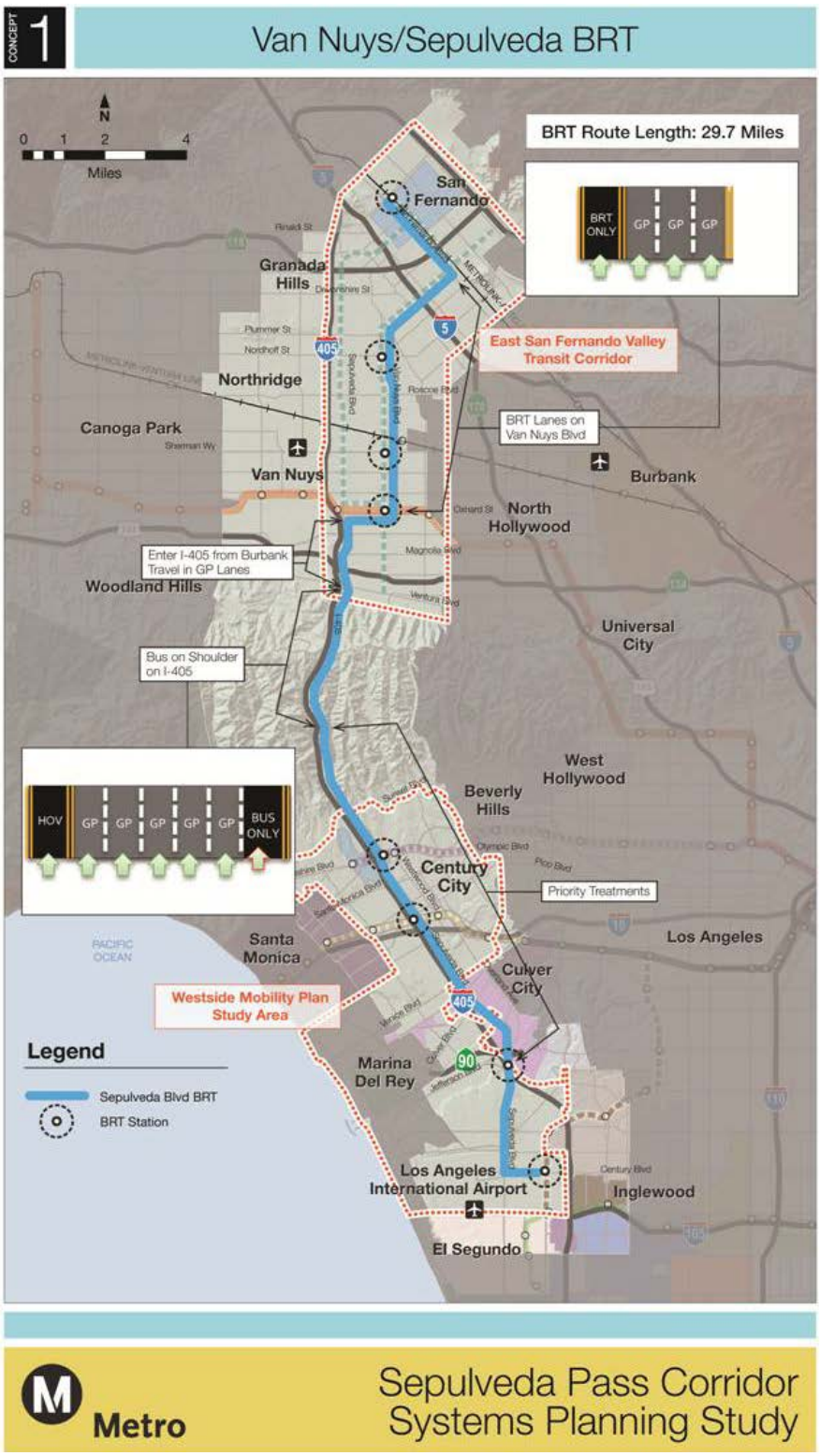
  Twenty-eight miles of Light or Heavy Rail Transit (LRT or HRT) from Sylmar/San Fernando Metrolink Station to Century/Aviation; either at-grade with grade-separated major intersections, or fully grade-separated options; LRT 7.5 miles of tunnel through the Pass or 29.7 miles of HRT subway; 15 stations; portals near Ventura/Van Nuys and just south of Santa Monica Blvd.

- Concept 6: Combined Highway and Rail Tunnels with Demand Pricing

  21 miles of highway tunnel with portals at Roscoe/Van Nuys; direct connectors with eastbound US 101/southbound I-405; three intermediate access points; 21miles of private transit shuttle between Van Nuys Metrolink Station and Century/Aviation; P3 potential.

Concepts were developed at two interactive planning charrettes (May 2, 2012 and July 30, 2012) during which participants from Metro, technical consultants, and Metro's P3 program management consultant provided feedback. Concepts were refined based on technical input from each of the disciplines – transportation planning, engineering, environmental, and demand modeling – and the charrette participants.

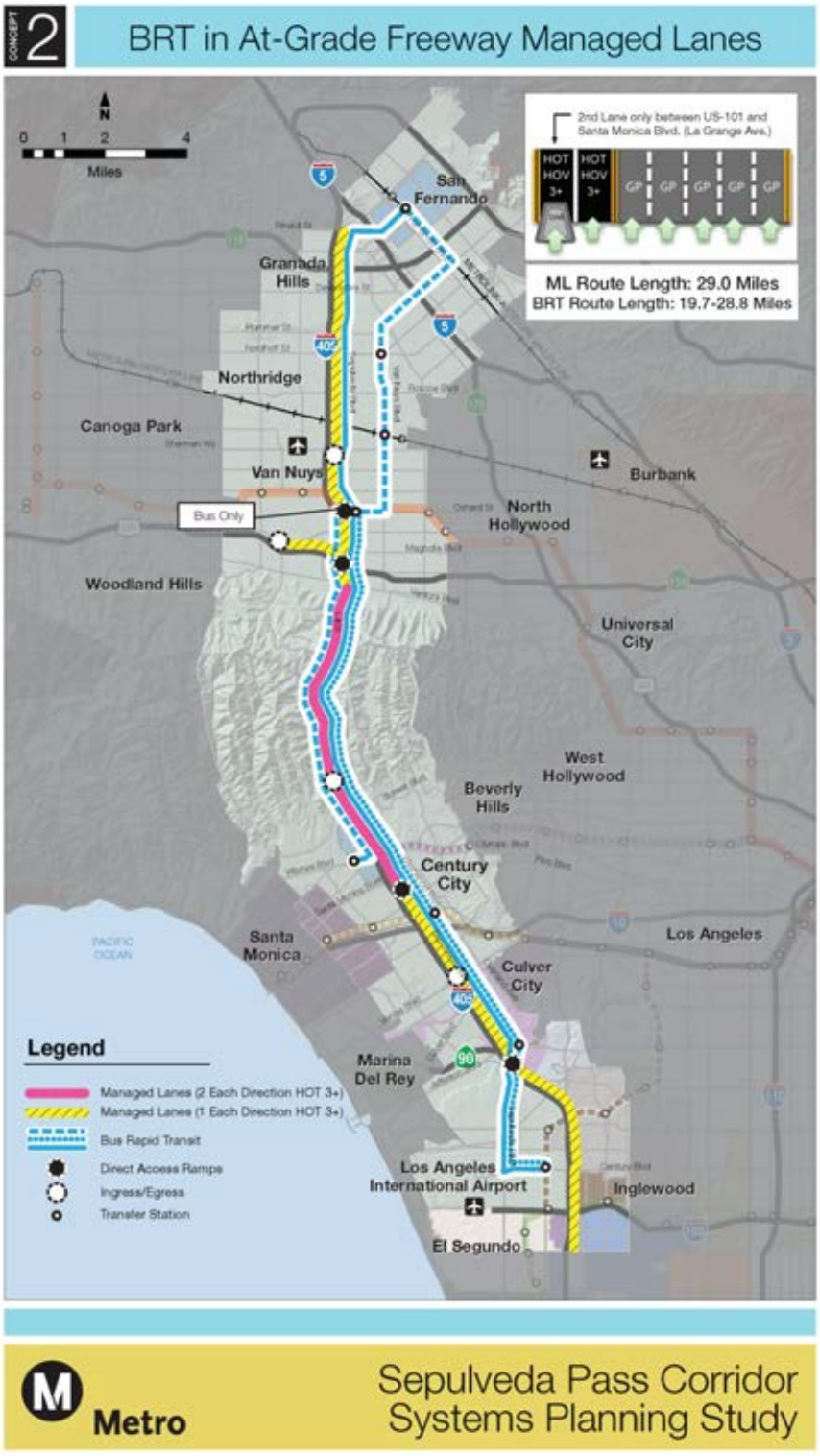
Figure 3. Concept 1 – Shoulder Running BRT



Transit Components:

- Bus Rapid Transit (BRT) from Sylmar Metrolink Station to Century/Aviation
- Route length: 30 miles (partial exclusive lanes)
- Bus use of freeway shoulders during peak periods
- Priority treatment on Sepulveda Blvd through and south of the Pass
- 2-mile station spacing: Sylmar Metrolink Station, Nordhoff St, Sherman Way, Metro Orange Line, Wilshire (future Metro Purple Line), Metro Expo Line, SR-90/Culver City Transit Mall, Century/Aviation
- 12 min headways peak and 20 min headways off-peak

Figure 4. Concept 2 –At-Grade Managed Lanes with BRT



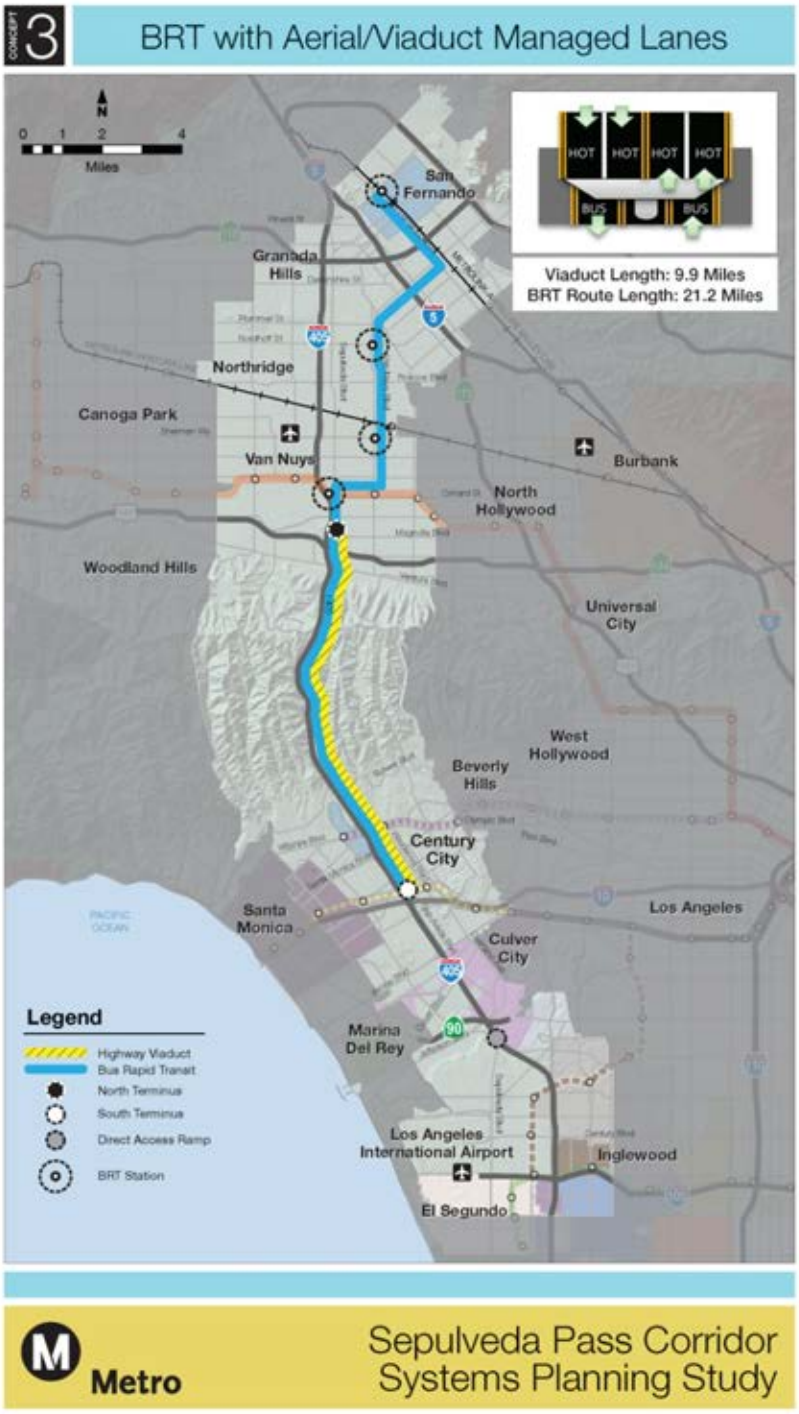
Highway and Transit Components:

- Managed lane (3+ HOT) - length: 29 miles
  - Configuration through Sepulveda Pass: 5 general purpose lanes plus 2 HOT lanes in each direction
  - Single HOT lane north of Sepulveda Pass and south of I-10
- 3 BRT routes, all connecting at Metro Orange Line/I-405 Transfer Station:
  - Sylmar to LAX via managed lanes
  - Sylmar to future Metro Purple Line via Van Nuys
  - Metro Orange Line to Metro Expo Line/Culver City/LAX

Physical Improvements:

- Metro Orange Line direct access ramp for BRT
- Direct connectors from eastbound US 101 to southbound I-405 and from northbound I-405 to westbound US 101
- Direct access ramps south of Santa Monica Blvd (La Grange Ave), and south of SR-90 (Sepulveda Blvd or Howard Hughes Pkwy)

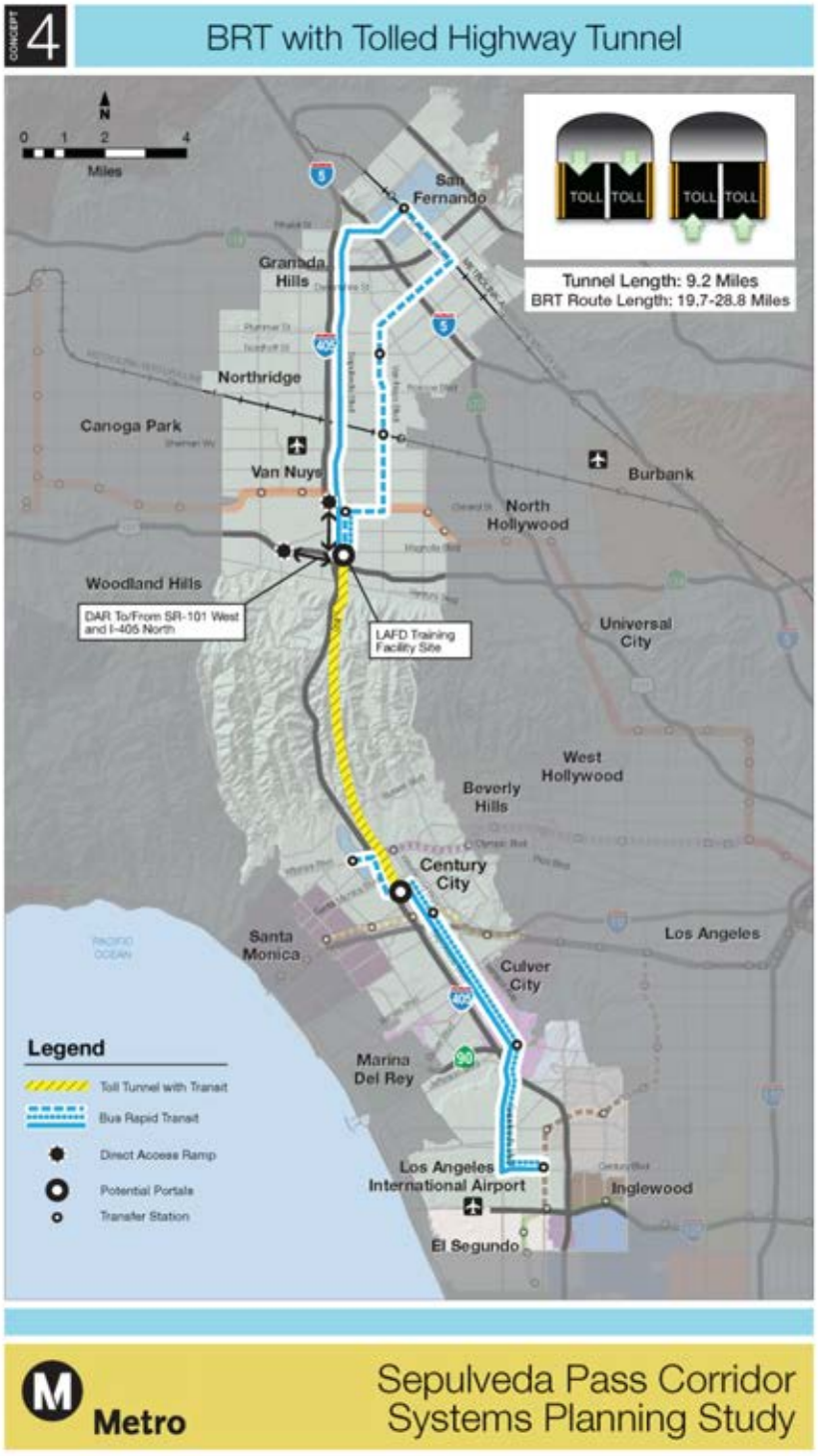
Figure 5. Concept 3 – Aerial/Viaduct Managed Lanes with BRT



Highway and Transit Components:

- Highway Viaduct constructed above the I-405 from US 101 to the I-10 Freeways
- Viaduct length: 10 miles
- BRT route length: 21 miles
- BRT service connecting Sylmar/San Fernando Metrolink Station to Metro Expo Sepulveda Station
- 2 HOT lanes in each direction on an elevated structure, freeing existing HOV lanes for dedicated busway beneath viaduct
- Potential south terminus at future Metro Purple Line or Metro Expo Line
- Previously studied by Caltrans
- Viaduct alternative was not recommended in Caltrans/FHWA I-405 Widening EIR/EIS

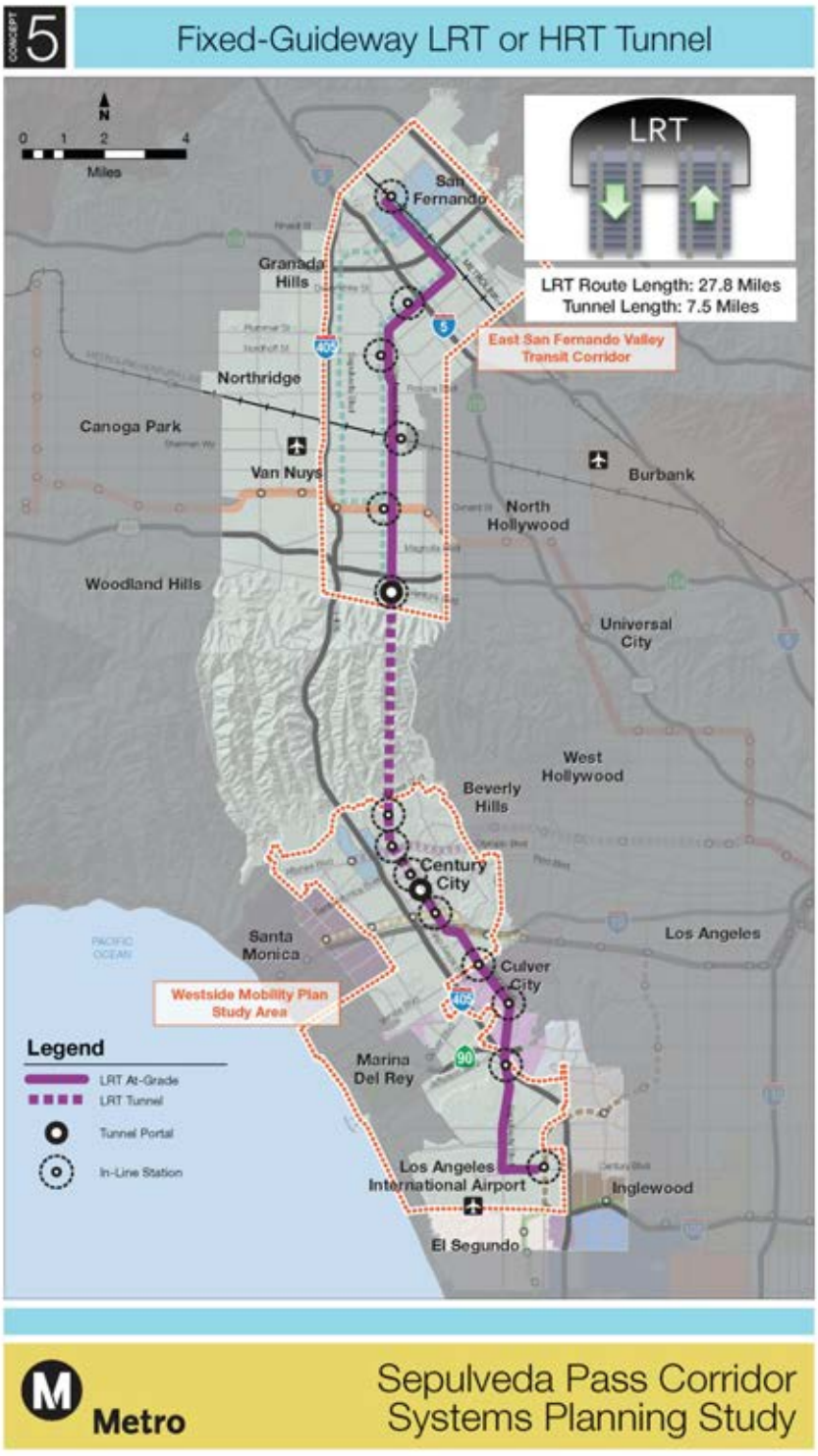
Figure 6. Concept 4 – Tolled Highway Tunnel with BRT



Highway and Transit Components:

- Tunnel with four toll lanes (two per direction) through Sepulveda Pass
- Tunnel length: 9.2 miles
- Northern portal north of US 101 and a southern portal near Santa Monica Blvd/I-10
- Direct connectors from eastbound US 101 and southbound I-405 freeways
- Buses and private automobiles would be allowed to use the tunnels; trucks would be prohibited
- Carpool users pay regular toll rates
- P3
- Same BRT service plan as in Concept 2

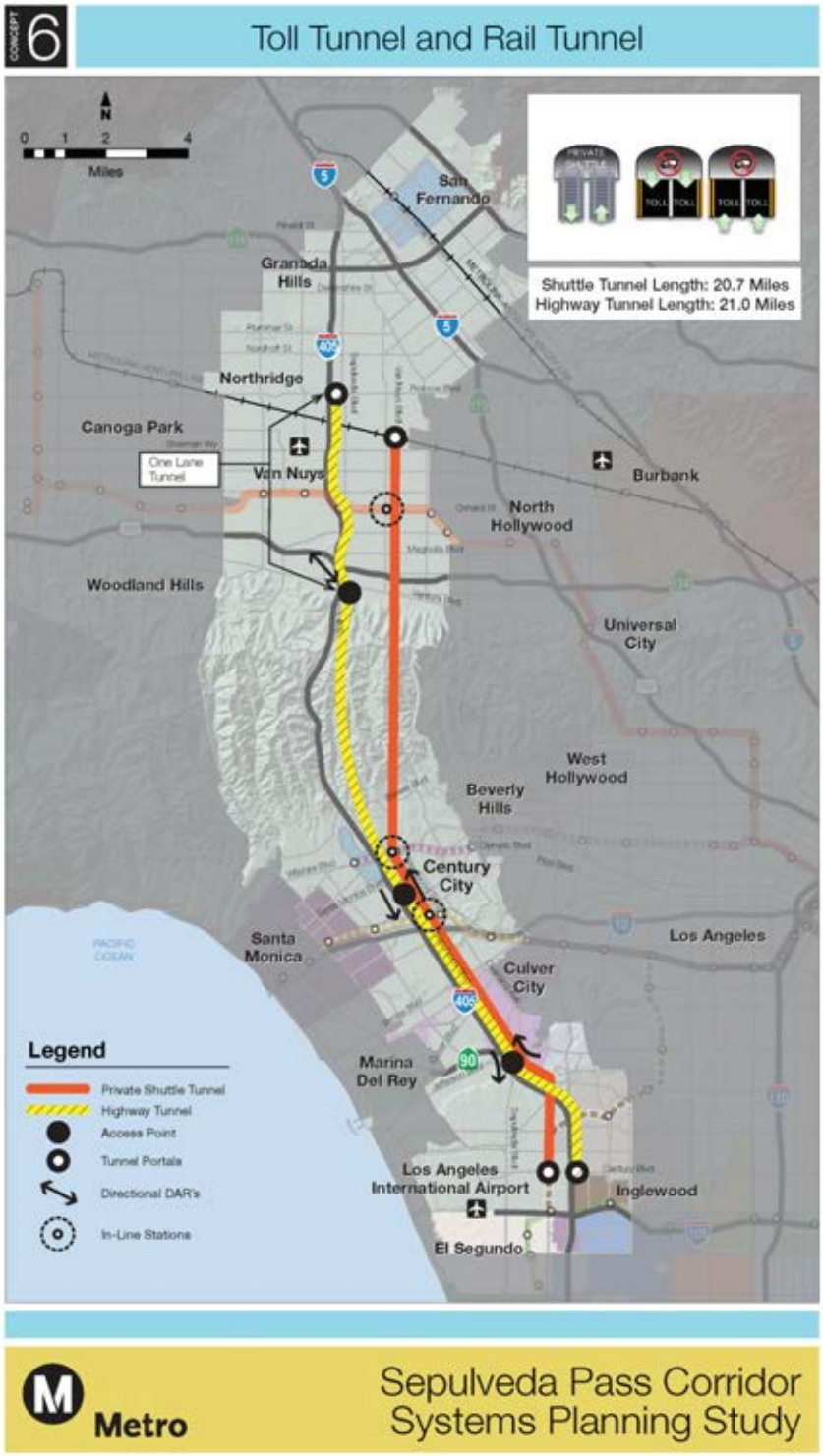
Figure 7. Concept 5 – LRT Rail Tunnel (5A) and HRT Rail Tunnel (5B)

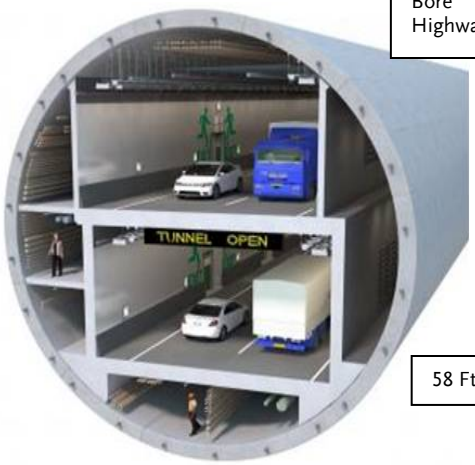


Transit Components

- LRT or HRT Line from Sylmar/San Fernando Metrolink Station to LAX (Century/Aviation)
- Route length: 28 miles
- 14 stations
- Connectivity to Metro Rail system at future Metro Purple Line, Metro Expo Line, and Metro Crenshaw/LAX
- Concept 5A - LRT At-grade
  - Most of LRT alignment at-grade in a dedicated median-running right-of-way, with grade-separated crossings at major intersections
  - Travels underground in transit-only tunnel in the Sepulveda Pass (tunnel length 7.5 miles)
  - Northern portal near Ventura Blvd and Van Nuys Blvd.
  - Southern portal south of Santa Monica Blvd.
- Concept 5B - HRT Tunnel
  - Fully grade-separated in tunnel configuration for full alignment

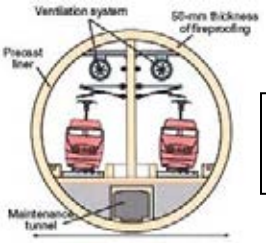
Figure 8. Concept 6 – Combined Highway and Rail Tunnels with Demand Pricing





Typical Large Bore Highway Tunnel

58 Ft. diameter



Typical Single-Bore Transit Tunnel 40' diameter

Highway and Transit Components:

Highway Tunnel to HOT Lanes:

- Highway tunnel length: 21 miles
- Northern portal near Roscoe Blvd, Southern portals at LAX (I-405 and Century Blvd)
- Direct highway connectors from eastbound US 101 and southbound I-405, located at Santa Monica/Olympic and Sepulveda/Howard Hughes Parkway

Private Shuttle Tunnel

- Shuttle tunnel length: 21 miles
- Private shuttle rail tunnel between Van Nuys Metrolink Station and LAX (Century/Aviation)
- P3 sets tolls at proportionate cost to highway tolls

Summary of Study Observations and Findings

The study, having taken into account the analyses and input received during the planning Charrettes, offers the following preliminary observations about the performance of the concepts that were developed:

- Concept 1, though cost-effective and within the LRTP funding commitment, does not serve as a long-term solution to providing a competitive, reliable transit option unimpeded by traffic, which is one of the goals of the project. Also, a technological challenge that needs to be overcome is procuring buses that can operate reliably at high speeds on the steep grades over the Pass.
- Concept 2 is also relatively cost-effective and has a preliminary cost estimate within the ballpark of the LRTP funding commitment, but has the same technological challenge as Concept 1. Concept 2 would be a favorable P3 project, with a total capital cost of $1.7 billion.
- Concept 3, the aerial viaduct, was studied as a part of Caltran's environmental studies for the current I-405 Sepulveda Pass Improvements Project, but was not selected. From a capacity standpoint, a four-lane aerial viaduct would displace two surface lanes for column supports, resulting in a net increase of only two travel lanes at a relatively high capital cost. The cost of an aerial viaduct is estimated to exceed $2 billion for a net increase of only one travel lane in each direction.
- Concept 4 provides added highway capacity with a tolled highway tunnel through the Sepulveda Pass and could accommodate BRT service at virtually no additional transit capital cost.
- Concept 5 provides high-capacity transit service, either LRT with grade-separated service through the Pass and at major intersections elsewhere along the corridor (5A) or HRT in a fully grade-separated alignment (5B). To overcome the high cost of these transit improvements, one option might be to phase the rail service after the implementation of managed lanes and revenue is generated to finance the higher costs of this concept.
- Concept 6 serves as an ultimate build-out solution that includes a new highway tunnel and a new transit tunnel. Due to the extremely high cost of the long tunnels, these improvements would likely need to be developed and phased as a P3 project.

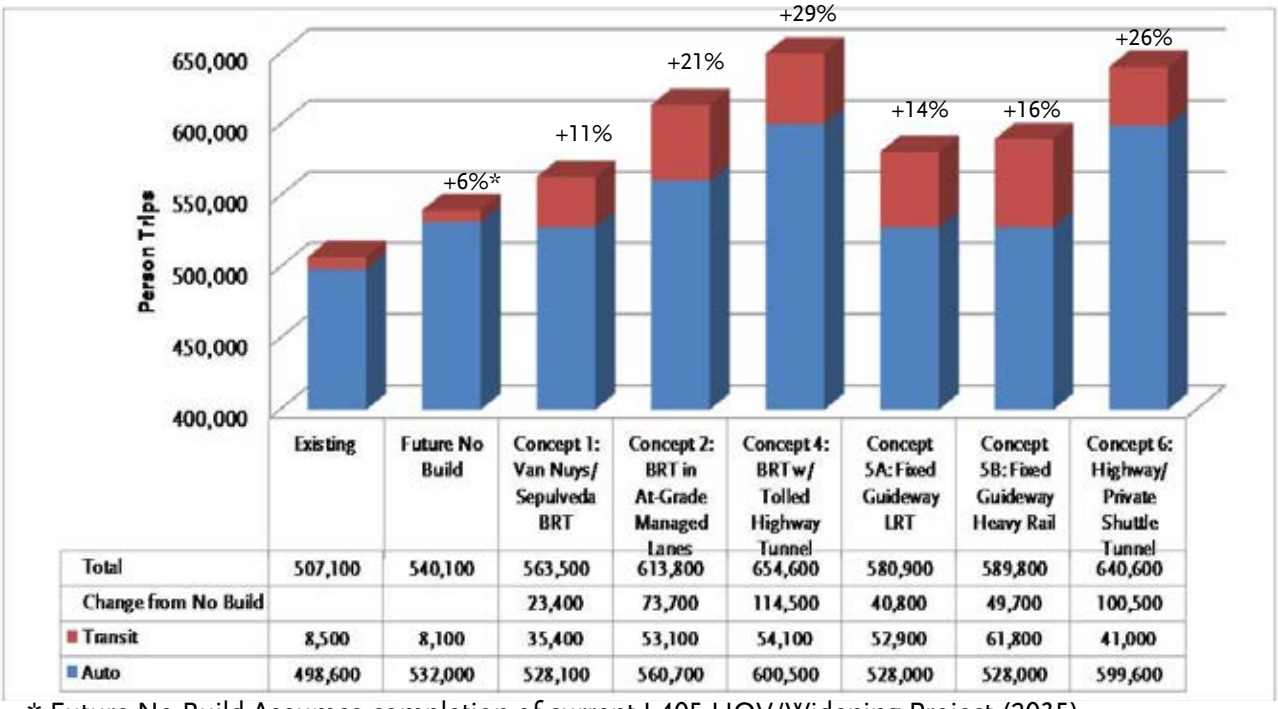
Transit ridership potential is very high for all concepts, due to the strong travel demand between the San Fernando Valley and the Westside. Forecasted average weekday boardings range from 39,500, nearly as many boardings as the current Metro Gold Line, to 106,600, more boardings than the current Metro Blue Line.

- **Study Concepts Could Accommodate Increases in Travel of Between 11 percent and 29 percent.**

  Figure 9 shows person throughput "over the Pass." Today, more than 507,000 people travel over the Pass. The number is expected to increase to 540,100 following completion of the current I-405 Sepulveda Pass Improvements Project (Future No Build scenario).

  The concepts that carry the highest person throughput include: Concept 4 (Tolled Highway Tunnel with BRT), which has a daily throughput of 654,600 persons (29 percent increase in capacity), followed by Concept 6 (Combined Highway and Rail Tunnels with Demand Pricing) with a person throughput of 640,600 (26 percent increase in capacity), and then Concept 2 (At-Grade Managed Lanes with BRT) with a person throughput of 613,800 (21 percent increase in capacity). The concept that

Figure 9. Average Weekday Person Throughput "Over the Pass"



	Existing	Future No Build	Concept 1: Van Nuys/ Sepulveda BRT	Concept 2: BRT in At-Grade Managed Lanes	Concept 4: BRT w/ Tolled Highway Tunnel	Concept 5A: Fixed Guideway LRT	Concept 5B: Fixed Guideway Heavy Rail	Concept 6: Highway/ Private Shuttle Tunnel
Total	507,100	540,100	563,500	613,800	654,600	580,900	589,800	640,600
Change from No Build			23,400	73,700	114,500	40,800	49,700	100,500
Transit	8,500	8,100	35,400	53,100	54,100	52,900	61,800	41,000
Auto	498,600	532,000	528,100	560,700	600,500	528,000	528,000	599,600

* Future No Build Assumes completion of current I-405 HOV/Widening Project (2035)

carries the least amount of people is Concept 1 (Shoulder Running BRT) with a person throughput of 563,500.

Hence, concepts with the highest person throughput have the combined advantages of managed lanes that encourage ridesharing and additional transit capacity.

Figure 10 shows trip volumes for the AM peak in the southbound direction of the I-405 passing through Moraga Drive. In the AM peak, there are approximately 30,600 vehicles that travel southbound over the Sepulveda Pass via the I-405 into West Los Angeles. The graphic shows where those trips originate. Several key highlights:

- Almost one in every five cars originate in the North County (Santa Clarita, Antelope Valley) (20 percent)
- Two in every five cars originate from the Central San Fernando Valley (41 percent)
- Two in every five cars originate from US 101 or points south of US 101 (39 percent)

Traffic builds up progressively in the southbound direction reaching a point of maximum loading in the Sepulveda Pass.

Of the trips traveling south of the Sepulveda Pass, almost half (49 percent) exit the I-405 by the time they reach the I-10 (Santa Monica) Freeway, a stretch of the I-405 that connects to the jobs-rich area that includes Santa Monica, Westwood and Century City. Another 35 percent exit at Westside destinations south of the I-10 including LAX and approximately 16 percent continue south of the I-405 beyond the airport. This graphic illustrates the very high demand within the Sepulveda Pass between the US 101 and I-10 Freeways, demonstrating the need for additional capacity enhancements within this "bottleneck" area.

Figure 10: 2008 AM Peak Period Select Link Analysis - Southbound

Up to 49 percent of traffic through the Pass enters and/or exits between the US 101 (Ventura) Freeway and the I-10 (Santa Monica) Freeway

There is a strong potential for transit improvements in the Sepulveda Pass Corridor, particularly for service in the 10-mile segment between the Metro Orange Line and the Metro Expo Line.

- Transit Demand: Current transit service in the Sepulveda Pass is limited to the Metro Rapid 761 and a number of specialized commuter and express services such as the LAX Flyaway Bus and commuter lines operated by Antelope Valley Transit Authority, Santa Clarita Transit and Los Angeles Department of Transportation. Bus speeds are slow with average travel times for the Metro Rapid 761 between Van Nuys Government Center and Westwood of 65 minutes in the AM southbound direction and 74 minutes in the PM northbound direction (9-11 mph).
- Potential transit ridership increases for options considered in the current Systems Planning Study indicate potential future boardings in this corridor that range from 55,000 daily boardings (Concept 2) for an enhanced bus service in at-grade managed lanes to over 106,000 daily boardings for a fully grade-separated fixed-guideway system extending for over 20 miles between the Central San Fernando Valley and LAX.
- The greatest transit demand in the 30-mile study corridor between Sylmar and LAX was found in the 10-mile Sepulveda Pass segment between the Metro Orange Line and the Metro Expo Line. Between 60-80 percent of daily boardings for the full 30-mile corridor were forecasted to occur at stations in this segment.

Segments extending north of the Metro Orange Line and south of the Metro Expo Line are forecasted to provide good ridership as well, but at levels that are not nearly as robust as in the high demand bottleneck segment between the Metro Orange Line and the Metro Expo Line. Figure 11 illustrates the stations with the highest levels of travel boardings for both bus and rail transit options. Figure 12 provides the forecasted station to station travel times and transit boardings for each of the six concepts. Highest levels of boardings occur at the following stations:

- San Fernando Valley – The Metro Orange Line Stations at either Van Nuys or Sepulveda offer the highest boardings due to high transfers. Between 14,000 and 25,000 daily boardings are predicted for this station.

- Westside – The future Wilshire/Westwood Metro Purple Line Station would offer the highest ridership for the connecting stations on the Westside with a forecast of 17,000 boardings. The Metro Expo Line Station would be the second highest with between 7,000 and 13,000 daily boardings. The Crenshaw/LAX Century/Aviation Station at LAX would be the third highest with between 6,500 and 9,000 daily boardings.

Figure 11. Proposed Transit Improvements and High Station Boarding Locations

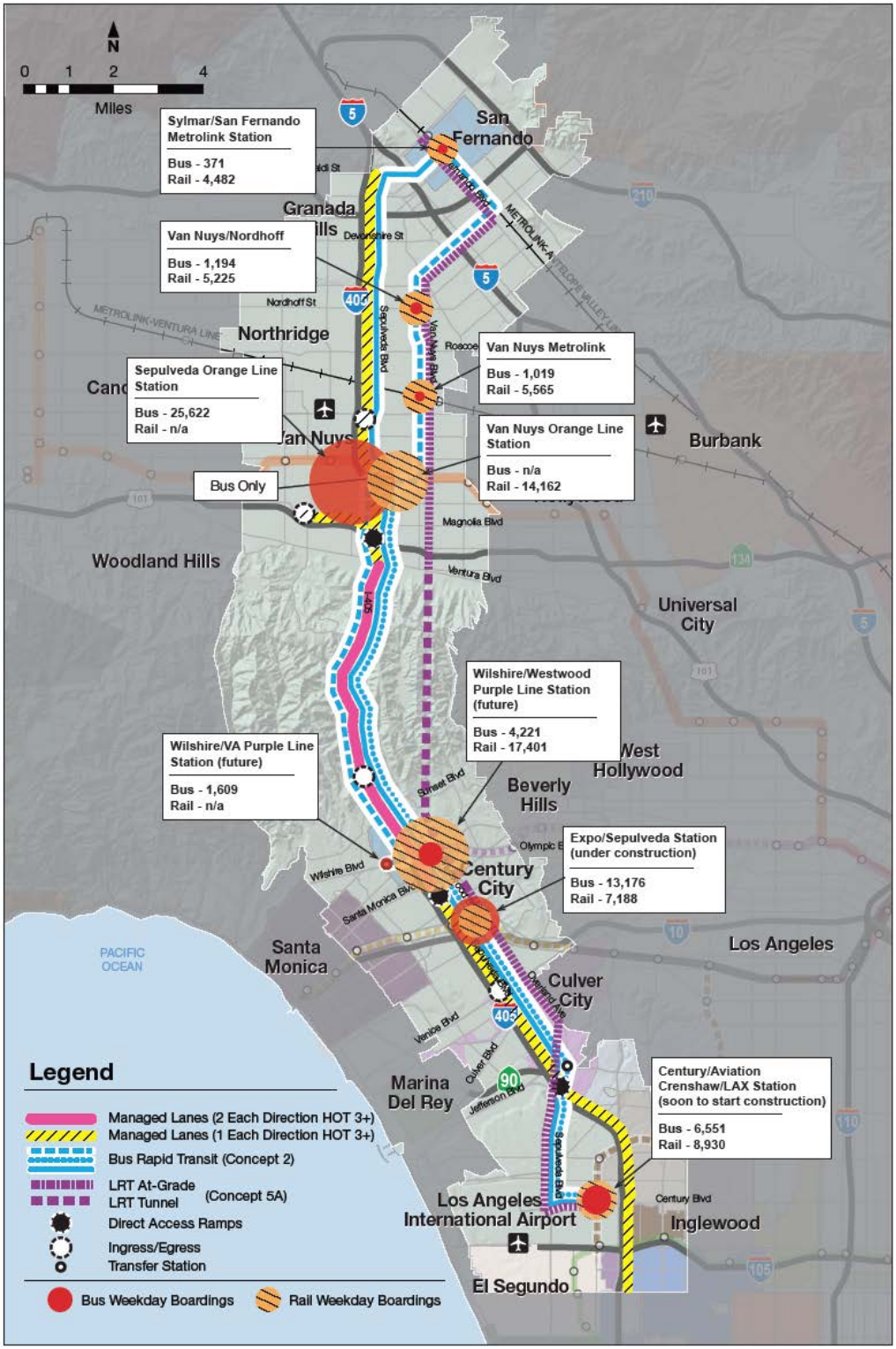


Figure 12. Forecasted Weekday Transit Boardings by Station

Figure 12-1. Concept 1 – Shoulder Running BRT

Station Name	Distance (miles)	TIME		TOTAL BOARDINGS		
		Peak (min)	Off Peak (min)	Peak	Off Peak	Daily
Sylmar/SF Metrolink	-	-	-	844	480	1,323
Van Nuys/Nordhoff	5.1	19.1	15.4	1,516	894	2,410
Van Nuys/Sherman Way	2.4	10.4	7.5	2,594	1,392	3,986
Van Nuys/Orange Line	1.5	4.3	4.4	6,726	5,421	12,147
Westwood/Wilshire	11.1	54.4	32.3	5,805	4,262	10,067
Sepulveda/Expo Line	2.0	7.8	8.7	2,688	1,710	4,398
Culver City TC	4.4	18.2	20	1,235	596	1,831
Century/Aviation	3.8	14.9	18.3	2,115	1,191	3,306
TOTAL	**30.3**	**129.1**	**106.6**	**23,523**	**15,946**	**39,468**

Figure 12-2. Concept 2 – At-Grade Managed Lanes with BRT

Station Name	Distance (miles)	Time		Total Boardings		
		Peak (min)	Off Peak (min)	Peak	Off Peak	Daily
Line 1: Sylmar to LAX						
Sylmar Metrolink	-	-	-	74	14	88
Sepulveda/Orange Line	10.1	53.6	45.2	4,213	1,823	6,036
Century/Aviation	18.1	40.5	44.9	4,286	1,837	6,123
TOTAL	**28.2**	**94.1**	**90.1**	**8,573**	**3,674**	**12,247**
Line 2: Sylmar to VA						
Sylmar Metrolink	-	-	-	178	106	283
Van Nuys/Nordhoff	5.1	28	22.8	829	365	1,194
Van Nuys Metrolink Station	1.9	12.8	8.8	762	257	1,019
Sepulveda/Orange Line	3	12.8	13.6	3,946	1,520	5,466
Sepulveda/Wilshire	10.9	19.4	20.2	2,822	1,400	4,222
Purple Line VA Station	0.7	10.3	8.1	1,249	360	1,609
TOTAL	**21.6**	**83.3**	**73.5**	**9,786**	**4,008**	**13,793**
Line 3: Orange Line to LAX						
Sepulveda/Orange Line	-	-	-	9,314	4,806	14,120
Sepulveda/Expo Line	10.6	17.4	17.8	8,837	4,340	13,176
Culver City TC	4.4	18.2	20.0	993	743	1,735
Century/Aviation	3.8	15.0	18.4	282	146	428
TOTAL	**18.8**	**50.6**	**56.2**	**19,426**	**10,035**	**29,459**
CONCEPT 2 TOTAL				**37,785**	**17,717**	**55,499**

Figure 12-3. Concept 4 – Highway Tunnel with BRT

Station Name	Distance (miles)	Time		Total Boardings		
		Peak (min)	Off Peak (min)	Peak	Off Peak	Daily
Line 1: Sylmar to LAX						
Sylmar Metrolink	-	-	-	531	100	631
Sepulveda/Orange Line	10.1	53.6	45.2	2,031	1,083	3,114
Century/Aviation	18.1	51.4	49.6	1,928	1,074	3,001
TOTAL	**28.2**	**105**	**94.8**	**4,490**	**2,257**	**6,746**
Line 2: Sylmar to VA						
Sylmar Metrolink	-	-	-	73	85	158
Van Nuys/Nordhoff	5.1	28	22.8	787	366	1,153
Van Nuys Metrolink Station	1.9	12.8	8.8	773	268	1,041
Sepulveda/Orange Line	3	12.8	13.6	3,970	1,560	5,530
Sepulveda/Wilshire	9.7	17.8	18.6	2,910	1,462	4,371
Purple Line VA Station	0.7	9.9	8	1,313	376	1,688
TOTAL	**20.4**	**81.3**	**71.8**	**9,826**	**4,117**	**13,941**
Line 3: Orange Line to LAX						
Sepulveda/Orange Line	-	-	-	11,714	5,827	17,541
Sepulveda/Expo Line	9.4	15.8	16.2	9,794	4,881	14,675
Culver City TC	4.4	18.2	20.0	1,148	762	1,910
Century/Aviation	3.8	14.9	18.3	1,566	599	2,164
TOTAL	**17.6**	**48.9**	**54.5**	**24,222**	**12,069**	**36,290**
CONCEPT 2 TOTAL				**38,538**	**18,443**	**56,977**

Figure 12-4. Concept 5A – LRT Rail Tunnel

Station Name	Distance (miles)	Time (min)	Total Boardings		
			Peak	Off Peak	Daily
Sylmar Metrolink	-	-	2,557	1,925	4,482
Van Nuys/Arleta	3.7	11	2,225	978	3,202
Van Nuys/Nordhoff	1.6	4.8	3,829	1,396	5,225
Van Nuys Metrolink Station	1.7	5	3,735	1,831	5,565
Van Nuys/Orange Line	2.2	6.7	10,962	3,200	14,162
Van Nuys/Ventura Blvd.	2.0	5.9	5,987	1,947	7,934
UCLA Ackerman Union	6	7.2	3,307	1,091	4,397
Westwood/Wilshire	0.8	1	14,316	3,085	17,401
Westwood/Santa Monica	0.8	0.9	2,752	1,278	4,030
Westwood/Expo Line	1.1	2.6	5,490	1,698	7,188
Overland/Venice	1.8	5.3	2,504	985	3,488
Overland/Jefferson	1.3	3.8	1,414	619	2,033
Culver City TC	1.7	5	1,566	631	2,197
Century/Aviation	3.5	10.5	6,740	2,190	8,930
TOTAL	**28.2**	**69.7**	**67,384**	**22,854**	**90,234**

Figure 12-5. Concept 5B – HRT Rail Tunnel

Station Name	Distance (miles)	Time (min)	Total Boardings		
			Peak	Off Peak	Daily
Sylmar Metrolink	-	-	3,855	2,581	6,436
Van Nuys/Arleta	3.7	8.1	2,706	1,237	3,943
Van Nuys/Nordhoff	1.6	3.6	4,383	1,647	6,030
Van Nuys Metrolink Station	1.7	3.7	4,228	2,082	6,310
Van Nuys/Orange Line	2.2	5	12,687	3,618	16,305
Van Nuys/Ventura Blvd.	2.0	4.4	5,690	2,154	7,843
UCLA Ackerman Union	6	7.2	3,488	1,195	4,683
Westwood/Wilshire	0.8	1	15,174	3,396	18,570
Westwood/Santa Monica	0.8	0.9	2,880	1,447	4,327
Westwood/Expo Line	1.1	1.5	6,125	2,122	8,246
Overland/Venice	1.8	3.9	2,687	1,078	3,765
Overland/Jefferson	1.3	2.8	1,860	801	2,661
Culver City TC	1.7	3.7	1,845	754	2,599
Century/Aviation	3.5	7.8	11,318	3,590	14,907
TOTAL	**28.2**	**53.6**	**78,926**	**27,702**	**106,625**

Figure 12-6. Concept 6 – Combined Highway and Rail Tunnels with Demand Pricing

Station Name	Distance (miles)	Time (min)	Total Boardings		
			Peak	Off Peak	Daily
Van Nuys Metrolink Station	-	-	6,700	2,240	8,939
Van Nuys/Orange Line	2.2	2.6	13,644	3,200	16,843
Westwood/Wilshire	9	10.8	11,048	1,868	12,915
Sepulveda Blvd/Expo Line	1.7	2	6,283	1,855	8,137
Century/Aviation	7.8	9.4	9,093	2,538	11,631
TOTAL	**20.7**	**24.8**	**46,768**	**11,701**	**58,465**

- **Further At-Grade Improvements are Possible Beyond the Current I-405 Widening Project.**

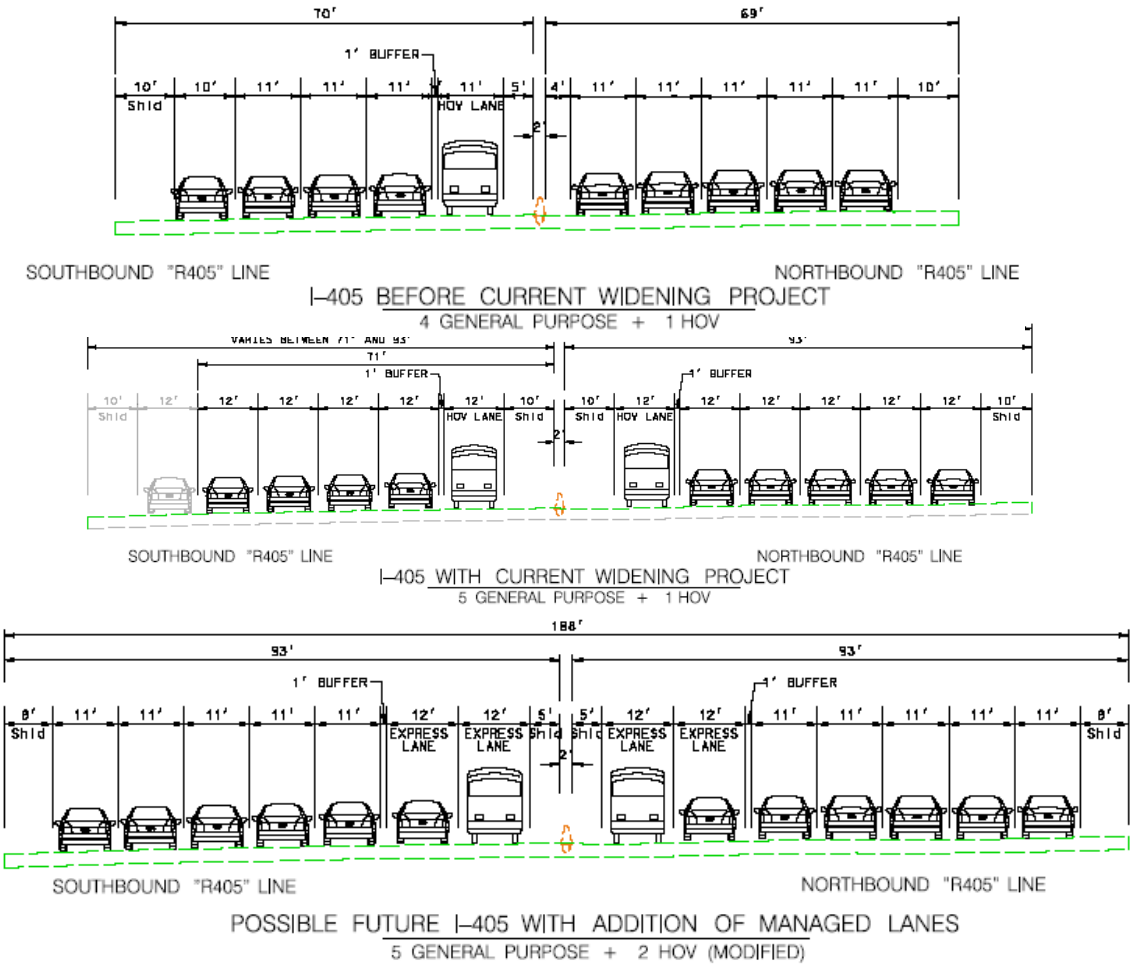
  A project similar to Metro's I-10 and I-110 ExpressLanes would be feasible in the Sepulveda Pass at relatively low cost and with minimal environmental impacts. By restriping lane widths from 12 to 11 feet, a managed lane facility with two High Occupancy Toll (HOT) lanes in each direction could be constructed with only minor spot-widening of the paved surface area and no widening outside of the existing Caltrans right-of-way in the Sepulveda Pass.

  Figure 13 illustrates three current cross sections within the Sepulveda Pass as well as the future changes that are currently being implemented or could be possible with Concept 2.

  - I-405 Before Current Widening Project – The first cross section illustrates existing conditions before completion of the current I-405 Sepulveda Pass Improvements Project. There are 4 to 5 mixed-flow lanes and one southbound HOV Lane (2+).
  - I-405 With Improvement Project – The current widening project will add one northbound HOV lane (2+) and will widen the 4 to 5 mixed-flow lanes from 11 feet to 12 feet as well as widen the median area.
  - Possible Future I-405 with Addition of Managed Lanes – It would be possible to create 4 managed lanes (2 in each direction) by restriping the freeway to restore the prior lane widths to 11 feet and restoring the prior median area widths. With the addition of direct access ramps to the managed lanes in the Valley and the Westside, a free-flow bus lane would be created in the corridor.

  Such a project would cut transit travel times nearly in half (approximately from 65 to 74 minutes to 34 to 36 minutes) by providing 45-50 mph speeds through the Pass. With a managed lanes project, virtually all the capital costs to provide free-flow bus lanes are borne by the highway improvement, with only minimal capital costs attributable to transit.

Figure 13. Cross Sections of Before, Current and Future I-405



- **Subway Concepts improve both vehicle and person throughput between US 101 and I-405, but costs will be high due to the length of the corridor.**

  Subway options in the Systems Planning Study include the following:

  - Highway Tunnel – One or two highway tunnels could be constructed under the Sepulveda Pass. A minimum distance for such a tunnel would be 9-10 miles extending from the US 101 (Ventura Freeway) to the I-10 (Santa Monica Freeway). Highway tunnel are larger in cross-section than rail tunnels and recent projects in North America and in other countries have used large-bore tunneling technologies that are currently as large as 58' in diameter.

    An example of such a large-bore tunnel in North America is the Seattle Alaska Highway Viaduct Replacement Tunnel, which is approximately 1.8 miles in length with a fully burdened cost of $2.034 billion ($2013 YOE). A similar 58-foot diameter large bore tunnel could be implemented in the Sepulveda Pass and could meet Caltrans roadway design criteria with two lanes in each direction (4 lanes total). If non-standard designs could be approved, a total of 6-lanes would be possible in such a tunnel, as has been proposed for the I-710 Gap Closure Project.

    Using per mile/fully burdened costs from the Seattle large-bore tunnel this would result in a total project cost of between $10 and $13 billion including the necessary surface roadway ramps and improvements to provide access to and from the subway portals.

    Capacity increases in person throughput would be on the order of 21 percent from 540,100 persons per day to 654,600 persons per day. Such a highway tunnel could accommodate BRT service at virtually no additional transit capital costs.

  - Rail Transit Tunnel – Rail transit tunnels are significantly smaller in cross-section than highway tunnels. Twin bore tunnels such as those for the Metro Westside Subway Extension or the Metro Eastside LRT would cost approximately $500 million per mile in fully burdened costs.

    An LRT line over a 30-mile distance between Sylmar/San Fernando and Century/Aviation (near LAX) with a tunnel through the Pass and limited, above-ground grade separations elsewhere would cost between $7.5 and $8.5 billion (or $85 million per mile at-grade and $504 million per mile for tunnel segment). A HRT option with a full tunnel alignment through the Pass would cost between $13.6 and 17.5 billion (or between $504 million per mile). A rail project between the Metro Orange and the Metro Expo Lines primarily configured in a tunnel would cost between $5 and $6 billion.

Rough Order of Magnitude (ROM) Cost Methodology

Because the Systems Planning Study is at the very earliest stage of project development, the civil engineering task focused on identifying the major engineering constraints/issue for each concept as a means of developing rough order of magnitude cost estimates. High-level conceptual drawings were developed for each concept to identify major elements and features such as:

- Typical cross sections
- Tunnel configuration

Once the major elements and features were identified and drawn on conceptual maps, rough order of magnitude (ROM) cost estimates were developed for each of the system concepts. A survey was conducted of other North American highway and transit projects that could be used for comparative costing purposes. The cost estimates reflect the conceptual nature of the study and were developed to be used as a high-level metric to compare the alternatives.

Figure 14 identifies a group of similar projects that were reviewed with a listing of project lengths, fully-loaded agency costs and resulting cost per mile figures. Unit costs from similar projects—including existing Metro bus and rail projects and the planned Alaskan Way Viaduct freeway tunnel project in Seattle—were used as a basis of the cost estimates. For example, unit costs were identified for the cost per mile of pavement, tunnel, elevated or at-grade concept; or typical number and cost of stations per mile for a BRT, LRT or HRT alternative. These unit costs were then applied to each systems concept to derive an estimated total capital cost.

Figure 14. Comparable Highway and Rail Projects

Historical North America highway and rail projects provided the key source of data for the preparation of these cost estimates. Figure 14 provides a summary of comparable projects. All costs are shown as fully-burdened agency costs which are significantly higher than project bid costs.

Highway/Rail Project	Length (Miles)	Number of Transit Stations	Technology	Construction Completion	Budget (Millions)	Adjusted for Inflation (Millions) 2012	Cost Per Mile (Millions) 2012	Footnote
Metro ExpressLanes I-110 and I-10	25.0	9	At-Grade Managed Lanes	2012/2013	$290	$290	$18-$30	1
Selmon Expressway Florida	14.1	0	Managed Lanes	2007	$420	$475	$33	2
Alaska Highway Viaduct Replacement Tunnel	1.8	0	58' Single Bore Highway Tunnel	2013	$2,034	$2,034	$1,044	3
Metro Purple Line Extension Twin Bore Tunnels	9.0	7	20' Heavy Rail Twin Bore Tunnels	2022-2036	$4,536	$4,536	$504	4
Metro Blue Line	22	22	LRT At-Grade	1990	$877	$1,870	$85	5
Miami Tunnel Project	0.75	0	43' Dual Bore Highway Tunnels	2014	$1,000	$1,000	$1,333	6

Footnotes:

1. Metro ExpressLanes Average Bid Prices for 2 Express Lanes (mid point of construction 2012) = $12M per mile. Construction cost has been increased to cover management and programmatic costs.
2. Derived from Published Reports
3. Derived from Published Reports
4. Metro Westside Subway Extension Project (2012)
5. Metro Estimating historic cost escalated to 2012
6. Port of Miami Tunnel Project estimate (midpoint of construction - 2012), increased to account for Agency and overall Program costs.

The major engineering issues and cost factors identified for each systems concept and the high-level capital cost derived from application of the unit cost for these elements appear below.

- **Concept 1: Shoulder Running BRT**

  Full Corridor (30 miles) $162 million
  Sepulveda Pass (10 miles) $146 million

  This concept would restripe approximately 8.5 miles of the I-405 Freeway to allow shoulder running buses during peak periods. The concept assumes a fleet of higher performance buses to handle the steep grades in the Sepulveda Pass. The full project length would extend from Sylmar/San Fernando Metrolink Station in the northern San Fernando Valley to the LAX Transit Center over a distance of 30 miles. An initial project length was estimated to run from the Metro Orange Line Sepulveda Station to the Metro Expo Line Station over a distance of 12 miles.

- **Concept 2: At-Grade Managed Lanes with BRT**

  Full Corridor – (28 miles) $1.7 billion
  Sepulveda Pass – (10 miles) $1.1 billion

  This concept would restripe the I-405 Freeway to provide 4 managed lanes between the US 101 (Ventura) Freeway and just north of the I-10 Freeway over a distance of approximately nine miles.

  Direct access ramps would be provided at the Metro Orange Line near Victory Boulevard and between Santa Monica and Olympic Boulevards on the Westside. North and south of the 4-lane managed lane segment, the 2 HOV lanes in each direction would be converted to a 2-lane managed lane segment. The full project length would extend from the I-5/I-405 Interchange in the northern San Fernando Valley to the LAX Transit Center and the I-105 (Century) Freeway over a distance of 30 miles.

  An initial project length was estimated to run from the Metro Orange Line Sepulveda Station to the Metro Expo Line Station over a distance of 12 miles. Transit buses would gain access to the facility via the above direct access connectors from local streets in the San Fernando Valley and the Westside, but express buses could travel for all or portions of the full corridor.

- **Concept 3: Aerial/Viaduct Managed Lanes with BRT**

  Full Corridor – (30 miles) $2.3 billion
  Sepulveda Pass – (10 miles) $1.4 billion

  The highway viaduct considered for this concept would be configured above the median of the I-405 Freeway between the US 101 and the I-10 Freeway. The aerial viaduct would consist of four managed lanes (two in each direction) and would be constructed in the median area. The structure was conceived as being supported by 10 foot wide center running columns, utilizing the inside shoulder area from the north and south bound directions.

  Access to the highway viaduct would be at three locations, north of the US 101 at Burbank Boulevard, at US 101 and a southern access point between Santa Monica and Olympic Boulevards. North and south of the viaduct section, the existing, surface running HOV lanes would be retained and could be converted to managed lanes in their current configuration of one lane in each direction.

- **Concept 4: Tolled Highway Tunnel with BRT**

  Full Corridor – (28 miles) $13 billion
  Sepulveda Pass – (10 miles) $10 billion

  This concept would construct a large bore tunnel under the Santa Monica Mountains that would carry 2 lanes of highway traffic in each direction. The large bore tunnel (58' diameter) would accommodate two lanes on the upper level and two lanes on the lower level. Traffic in the tunnel would include both autos and buses. The tunnel would begin near the I-405/US 101 Interchange and would extend south for approximately nine miles generally following under the I-405 roadway. The southern portal of the tunnel would be located within the I-405 right of way just south of Santa Monica Boulevard.

- **Concept 5: Rail Tunnel**

  Light Rail (LRT)
  Full Corridor – (28 miles) $7-8 billion
  Sepulveda Pass – (10 miles) $5 billion

  Heavy Rail (HRT)
  Full Corridor – (28 miles) $ 13-17 billion
  Sepulveda Pass – (10 miles) $ 6 billion

  This concept would provide a rail transit project ultimately extending from the Sylmar/San Fernando Station in the northern San Fernando Valley to the LAX Transit Center/Century/Aviation Station. Fifteen stations were assumed.

  There are two options associated with this concept. Concept 5a is a light rail alignment that would run predominantly at-grade in the San Fernando Valley, travel in a tunnel configuration under the Santa Monica Mountains, and then run in a predominantly at-grade configuration through West Los Angeles to the Crenshaw/LAX Century/Aviation Station at LAX. Concept 5b is a heavy rail (HRT) alignment that has been assumed to run entirely in a tunnel configuration, following the same alignment as the LRT.

- **Concept 6: Combined Highway and Rail Tunnels with Demand Pricing**

  Full Corridor – (21 miles) $30-38 billion
  Sepulveda Pass – (10 miles) $20 billion

  This concept combines both a highway tunnel and a separate rail transit tunnel that would extend from the mid-San Fernando Valley all the way to the vicinity of LAX near the I-105 Freeway. This concept was included to evaluate a potential ultimate build out of the corridor.

  The highway tunnel would be served by entry portals near Roscoe Boulevard on the I-405, at the US 101 Freeway in the San Fernando Valley and near Santa Monica/Olympic and Sepulveda/Howard Hughes Parkway on the Westside.

  The rail tunnel would extend from the Van Nuys Metrolink Station to the planned Crenshaw/LAX Century/Aviation Station at LAX.

Figure 15. Rough Order of Magnitude Costs (30-mile ultimate corridor)

Summary of Capital Cost Estimates - Full Length Project [1]				
		Capital Cost Estimate [2]		Total
		Transit	Highway	
Concept 1	At-Grade Sepulveda BRT	$ 162,542,500	$ -	$ 162,542,500
Concept 2	At-Grade Freeway Managed Lanes	$ 552,542,500	$ 1,127,880,000	$ 1,680,422,500
Concept 3	Highway Viaduct Managed Lanes	$ 134,495,000	$ 2,194,140,000	$ 2,328,635,000
Concept 4	Tolled Highway Tunnel (Low Range)	$ 78,400,000	$ 10,378,992,000	$ 10,457,392,000
Concept 4	Tolled Highway Tunnel (High Range)	$ 78,400,000	$ 12,876,240,000	$ 12,954,640,000
Concept 5A	Fixed-Guideway At-Grade Light Rail Transit (Low Range)	$ 7,523,230,000	$ -	$ 7,523,230,000
Concept 5A	Fixed-Guideway At-Grade Light Rail Transit (High Range)	$ 8,506,030,000	$ -	$ 8,506,030,000
Concept 5B	Fixed-Guideway Heavy Rail Tunnel (Low Range)	$ 13,617,552,000	$ -	$ 13,617,552,000
Concept 5B	Fixed-Guideway Heavy Rail Tunnel (High Range)	$ 17,509,440,000	$ -	$ 17,509,440,000
Concept 6	Highway/Private Shuttle Tunnels (Low Range)	$ 8,705,112,000	$ 22,049,560,000	$ 30,754,672,000
Concept 6	Highway/Private Shuttle Tunnels (High Range)	$ 11,417,640,000	$ 27,318,200,000	$ 38,735,840,000

Assumptions:

1. Costs reflect full development of a 30-mile corridor. Initial project costs for a Sepulveda Pass only segment are less.
2. Capital Cost Estimate includes construction and vehicle cost estimates.

- **The Sepulveda Pass Corridor Project identifies several potential direct access ramp locations that will be needed to direct auto and transit vehicles bound for the enhanced travel facility (express lanes, highway tunnel portals or aerial viaduct ramps). The Systems Planning Study identified several possible locations in the San Fernando Valley and the Westside for further engineering and environmental evaluation.**

  The addition of additional highway lanes and/or transit through the Sepulveda Pass will increase the number of vehicles travelling through the Pass and will therefore require extremely careful and detailed traffic studies to distribute this new traffic onto the local arterial and street network near the project access points in the San Fernando Valley and on the Westside.

  Several locations have been identified for further study. Three that have particularly high potential include the following:

  - Metro Orange Line/Victory Boulevard Direct Connector Ramps- As shown in Figures 16 and 17, it would be possible to provide direct access ramps from the Metro Orange Line where the busway runs parallel to the I-405 Freeway near Victory Boulevard. The freeway is elevated on fill in this section and could be widened in this area with modest property impacts to provide direct access to HOV and/or new lanes in the freeway median. This direct access facility could be used by transit buses as well as auto traffic that would access the facility from Victory Boulevard.

  - US 101/I-405 Direct Connector Ramps- As shown in Figure 18, it may be possible to locate new freeway access ramps within the I-405/US 101 Freeway Interchange to connect to subway portals under the Sepulveda Pass. This configuration would feed traffic into the highway tunnel(s) from the I-405 as well as from the US 101 (Ventura Freeway) segment located west of the I-405. Similar concepts to these ramps would be possible to feed traffic into at-grade managed lanes or an aerial viaduct.

  - Santa Monica Boulevard/Olympic Boulevard Direct Connector Ramps- Locations where new ramps can be connected to the I-405 Freeway on the Westside are extremely limited due to sensitive adjacent land uses (hospitals, cemeteries, schools, homes) and limited available right-of-way. Figure 19 illustrates a location just south of the Santa Monica Boulevard Interchange where the freeway is elevated and additional Caltrans right-of-way could be used to provide direct freeway ramps and a parallel frontage roadway to distribute traffic from the freeway to several local arterials including Santa Monica, Olympic and Pico Boulevards. Such a configuration would allow traffic travelling to and from the freeway to be distributed to several east-west streets rather than a single street, thereby spreading the area of traffic impact. Transit buses accessing the freeway in this location would be located near the Metro Expo Line and future Metro Purple Line rail transit stations.

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Figure 16. Orange Line Direct Access Ramp Layout

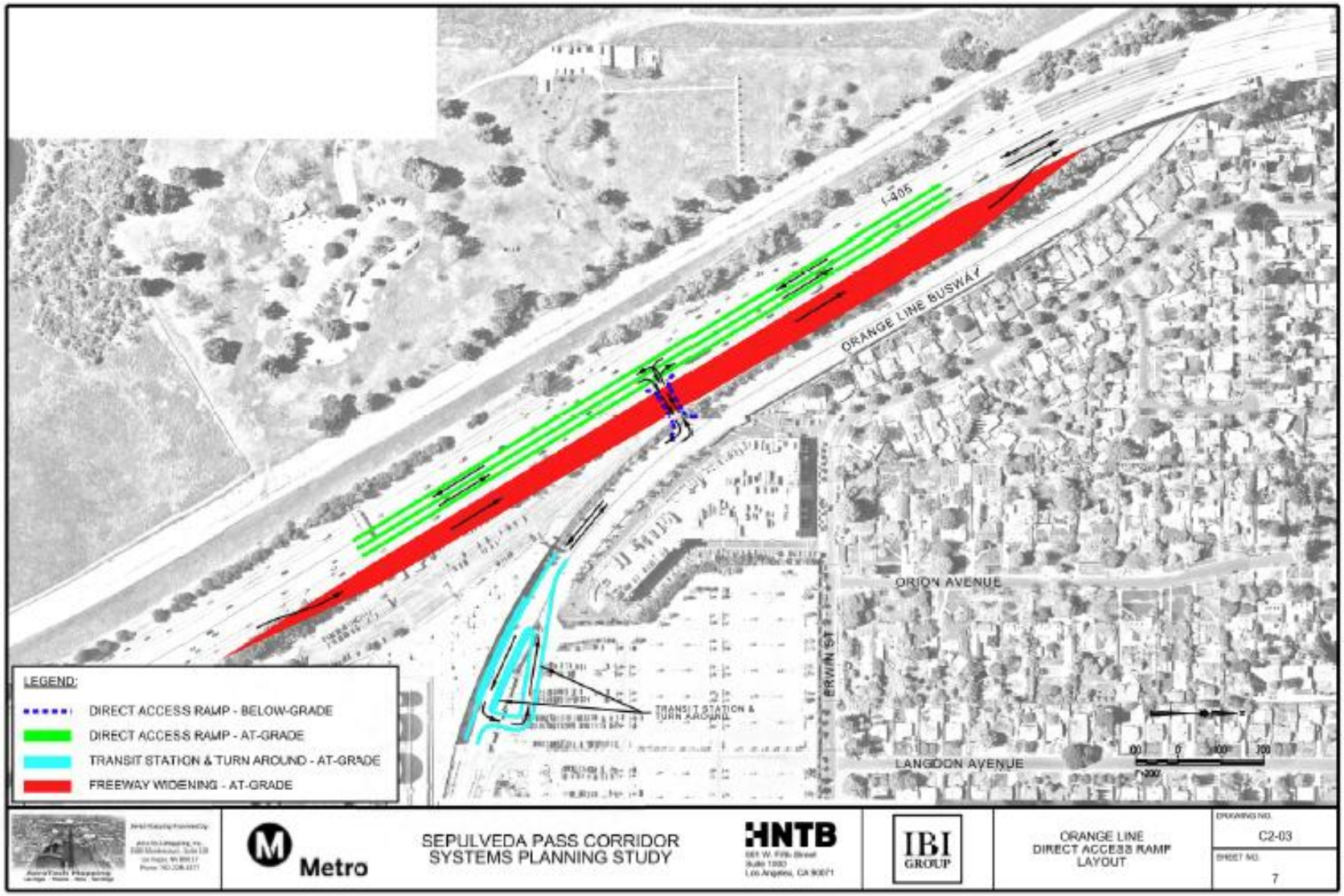


Figure 17. Orange Line Direct Access Ramp Cross Section

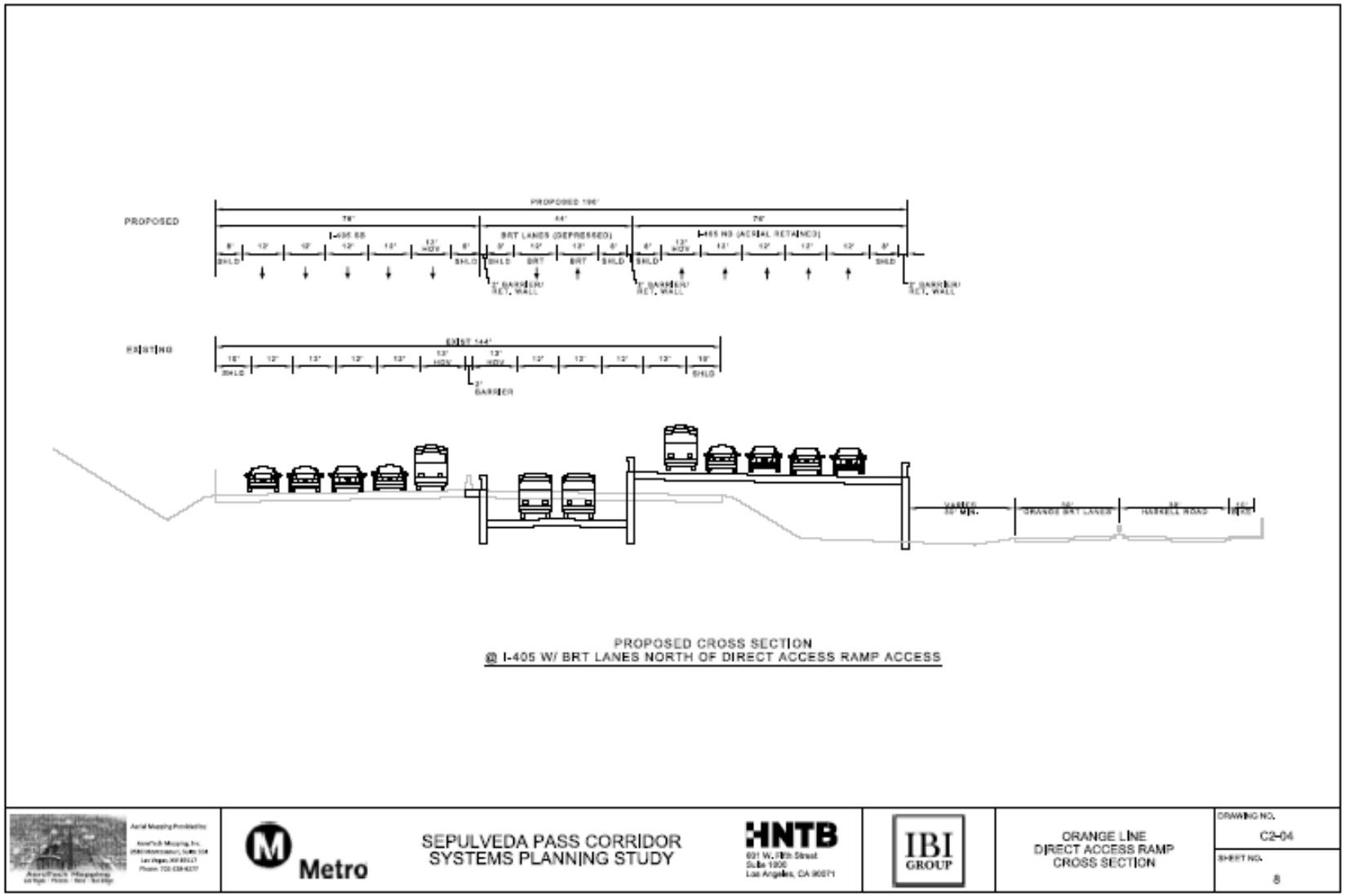


Figure 18. US 101 Direct Access Ramps and Tunnel Portal

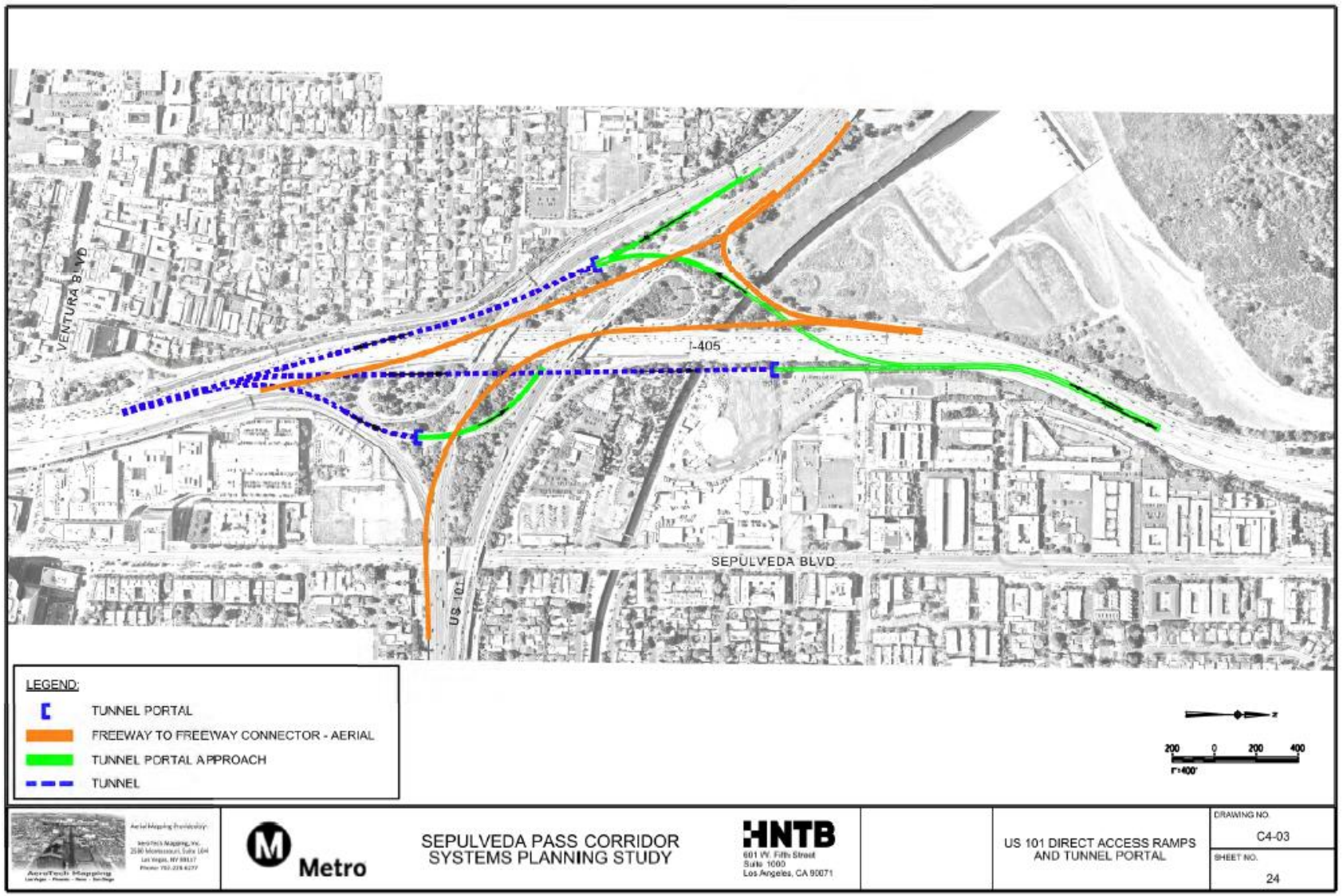


Figure 19. La Grange Direct Access Ramps

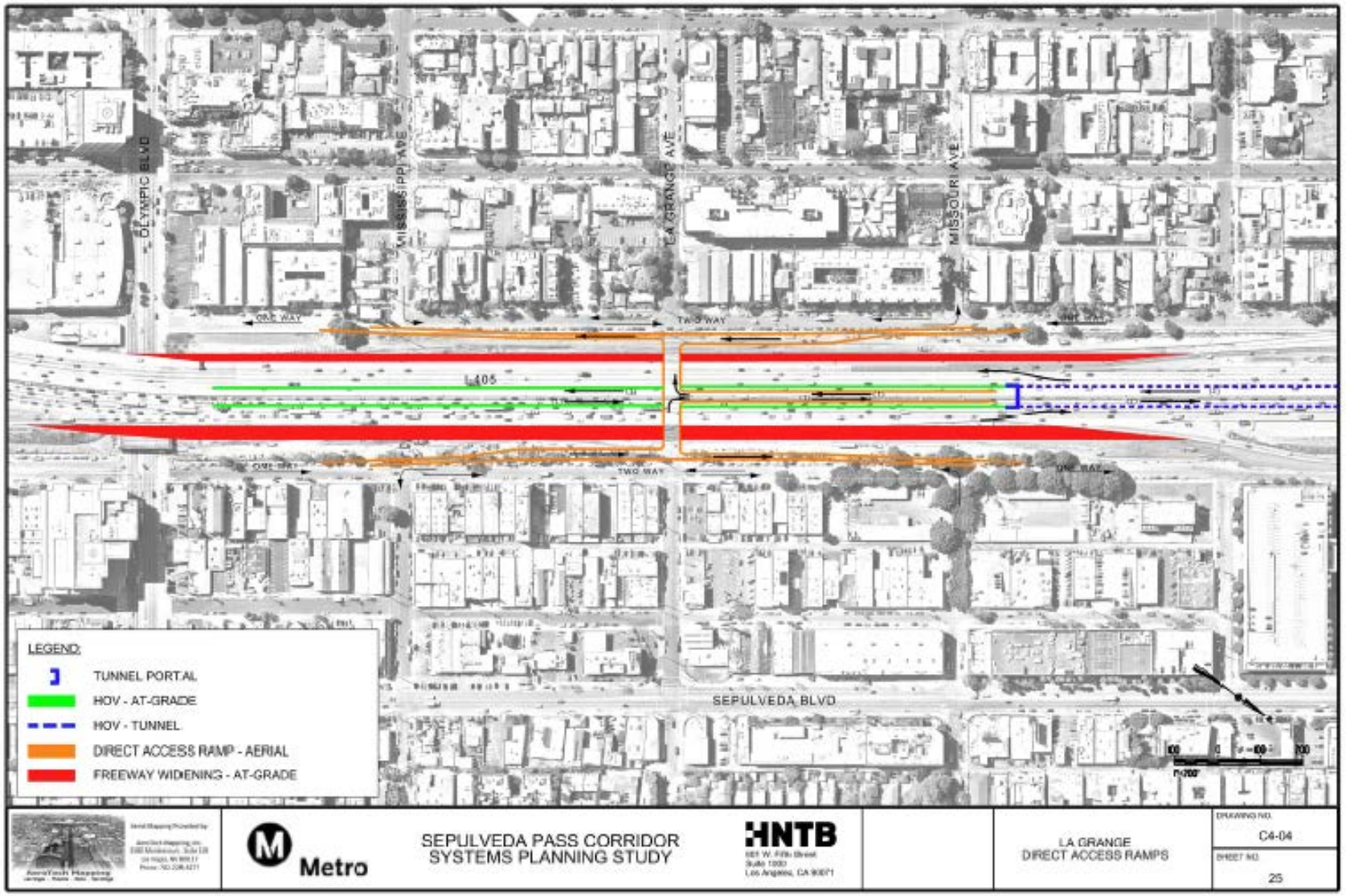
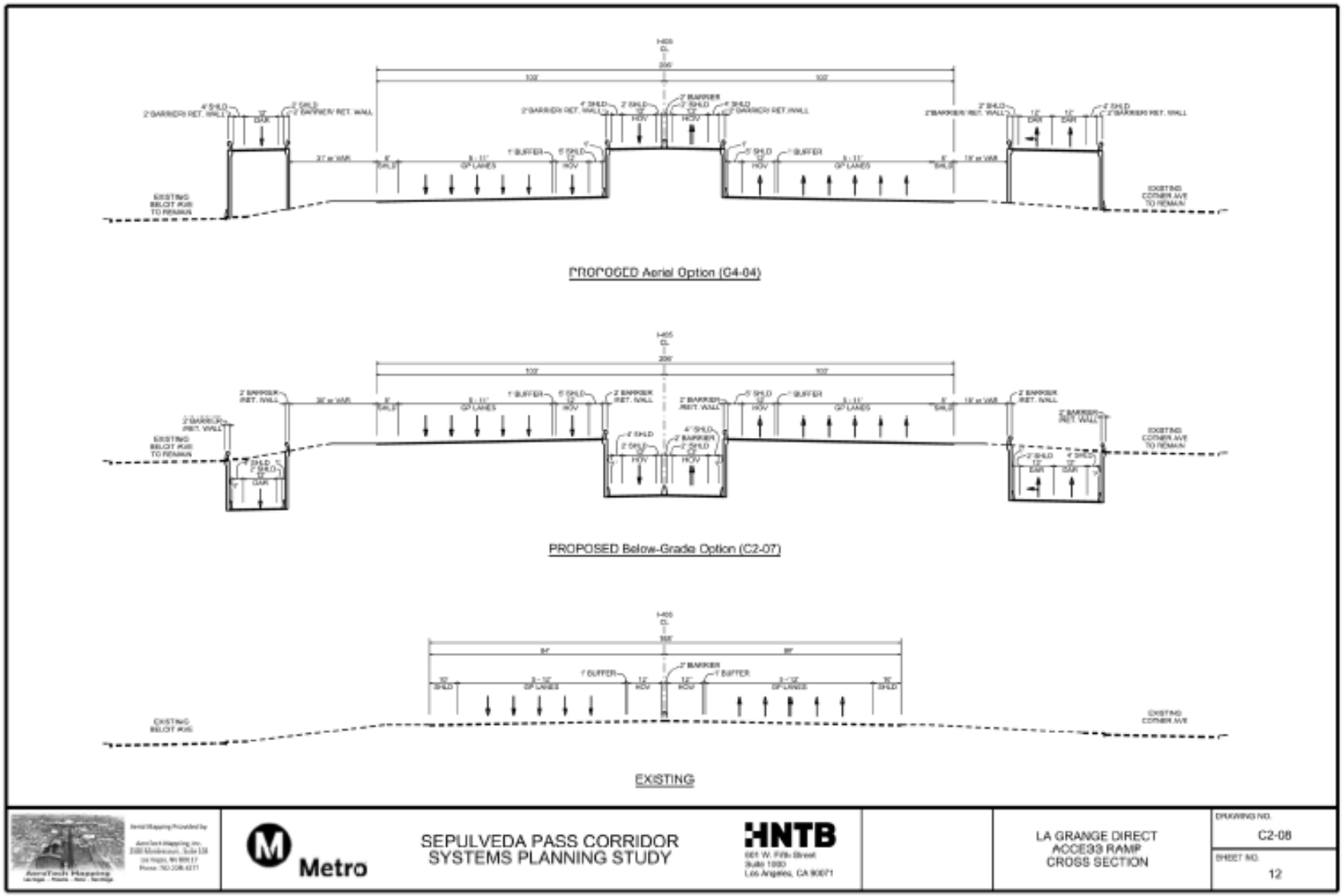


Figure 20. La Grange Direct Access Ramp Cross Section



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- **There is a strong case for exploring alternative financing strategies such as P3s. Because of the significant revenue potential associated with several proposed Sepulveda Pass improvements that include tolling options, alternative financing strategies such as P3 should be further explored in the event that traditional public financing is not sufficient to move the project forward in a timely manner. An at-grade Express Lanes project appears highly feasible at a modest capital cost, and could be implemented in a time frame comparable to the I-10 and I-110 ExpressLanes. Environmental clearance and construction, for example, was completed in approximately 24 months. Toll revenues from such an Express Lanes project could be used to offset financing costs for construction.**

  A more expensive capital project such as a rail or highway tunnel would require a much longer delivery timeline. Given the strong revenue potential for improvements that include toll options, there is a strong case for exploring P3 options for project delivery, financing, construction and maintenance. The Systems Planning Study, which considered multiple improvements in a 30-mile long corridor between Sylmar and LAX, found that the primary "bottleneck" where additional capacity is required is the 10-mile segment between US 101 and the I-10. Any phased strategy should place an initial project on this central segment of the corridor, with the possibility of extending north and south in subsequent phases.

Concepts 1 and 2 have fewer environmental issues. Concepts 3 through 6 have higher levels of environmental impact.

The environmental task focused on identifying fatal flaw issues that would potentially eliminate a systems concept from further consideration. To accomplish this, a literature review was conducted of existing environmental documents prepared for projects within the Sepulveda Pass Corridor, and an analysis was performed using focused Geographic Information Systems (GIS) analyses, database queries, and records searches.

Once the six concepts were identified, a preliminary analysis of the environmental challenges of each concept was conducted.

More detailed environmental analysis would occur as the concepts are better defined. As the concepts move forward, the Sepulveda Pass Corridor Project would need to undergo the California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA) review process, depending upon the type of funding being used for the project.

The major findings from the environmental task are presented below.

- **Concepts 1 and 2 could be done with minimal environmental impacts.** Concept 1 would involve virtually no disturbance to environmental resources and Concept 2 would have only minor disturbances. The only environmental concerns raised with Concept 1 are associated with the dedicated busway that may be located along the median of Van Nuys or Sepulveda Boulevards. Concept 1 would not cause any concerns for the natural environment and would have only very minor, intermittent effects on the physical environment associated with the noise of the buses traveling on the shoulder. Similar to Concept 1, Concept 2 would have only minor concerns for the physical environment related to air quality and noise as a result of traffic moving closer to receptors as vehicles move to use the outer pavement along the I-405. Concept 2 would only raise concerns for the natural environment, if widening outside of the existing pavement through the Sepulveda Pass were included.

- **Concepts with tunnel/direct access ramp components (Concepts 4, 5, 6, and Concept 2, depending on its final design) would have significant environmental impacts.** Concepts 4, 5, and 6 would raise concerns regarding the placement of ventilation outflows along the tunnel corridor. Additional environmental analysis would be needed as potential sites for ventilation are selected in order to avoid Section 4(f), natural, and community resources through the Sepulveda Pass. The tunnel portals and the location of direct access ramps would also need to be carefully designed in order to minimize and avoid, to the extent feasible, concerns related to local traffic circulation, localized noise and air quality effects, and potential property acquisitions. During construction, the hauling of excavated material away from the site would need to be carefully coordinated in order to best minimize potential noise and community effects.

- **Environmental impacts from concepts with above-ground components (Concepts 1, 2, 4, 5 and 6) would have similar noise, visual, air, and community issues.** Concepts 1 and 2 would have minor environmental concerns. The heavy rail option under Concept 5 would raise greater noise concerns than a light rail option and depending upon the power source for the trains, a heavy rail option may also raise additional air quality concerns. Grade separations for the options with rail would also need further environmental analysis for issues such as visual (design and heights of structures), noise (how would the potential elevation of the trains affect noise) and property acquisitions (grade separations could require additional right of way).

- **All concepts have potential community acceptance concerns.** The communities along the Sepulveda Pass and the I-405 Improvements Project currently under construction would be particularly sensitive to any new proposed project in the area. Community collaboration will be important in the development of design plans and environmental documents. Low-income and minority populations have been identified along the corridor, notably in the location of the direct access ramp near Roscoe Boulevard; environmental justice concerns would need to be further investigated.

- **Concepts 3 to 6 (and Concept 2, depending on its final design) have potential impact to Section 4(f) and Federal Lands.** The Sepulveda Basin, located northwest of the I-405/US 101 Interchange, as well as portions of the Santa Monica Mountains and associated recreational trails, contain several resources protected by Section 4(f), a federal law prohibiting USDOT from approving the use of land from publicly owned parks, wildlife refuge and multiple recreation areas, unless there is no feasible alternative to the use of the land or mitigations to minimize harm to public lands is included. The I-405/Wilshire Boulevard area has federal lands associated with the Veteran's Administration buildings and National cemetery, as well as some facilities and historical sites located on that federal land, which are potentially major constraints and/or are protected as historical sites under Section 4(f).

Next Steps

The concepts analyzed in this eight-month study represent a preliminary assessment of potential improvements in the Sepulveda Pass Corridor. In this Systems Planning phase, a wide range of general assumptions were made. The assumptions, while sufficient for the purposes of this study, do require further analysis in order to better inform planning and system design decisions. For example, the travel demand forecasts analysis would benefit from more detailed value of travel time savings data.

There are several other areas that merit further examination in the subsequent phases of work:

1. Continue to coordinate with the East San Fernando Valley Transit Corridor Study, Westside Mobility Study, and Airport Metro Connector Study to optimize transit connections in the corridor and prepare a phased implementation plan.
2. Conduct a more detailed analysis of systems planning concepts (including alignment and technology options) as part of an alternative analysis and environmental document.
3. Solicit industry comment on the scope of a P3 concessionaire contract as it relates to existing conditions, minimum facility design requirements, performance specifications, financial/revenue assumptions and other considerations.
4. Conduct a willingness to pay survey of I-405 corridor users to calibrate the toll model coefficients based on corridor specific traveler attributes.
5. Further refine revenue and financial models to calculate cash-flow and net present value.
6. Further analyze tunnel portals and direct access ramps, particularly those potentially located near La Grange Avenue to assess potential localized traffic, noise, visual, and air quality concerns.

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