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Metro Orange Line Grade Separation Analysis and Operational Improvements Technical Study

Task 9.0 Grade Separation Alternatives Analysis and Structural Type Selection

FINAL Technical Memorandum | version 3.0

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1.0 INTRODUCTION

The Metro Orange Line (MOL) Grade Separation Analysis and Operation Improvements Technical Study covers approximately 12.7 miles of the MOL from the North Hollywood Station on the east to the Canoga Station on the west, shown in **Appendix A**. Measure M, a transportation bond measure passed by Los Angeles County voters in November 2016, set aside $286 million for grade separations and other improvements for the Orange Line.

As part of this study, this technical memorandum builds upon prior tasks which planned and analyzed grade separation and other improvement location feasibility, engineering feasibility, and cost estimates to arrive at a set of potential improvement package alternatives. **Section 2.0** summarizes the types of improvements considered. **Section 3.0** discusses the crossing locations each type of improvement was evaluated for feasibility. **Section 4.0** establishes three recommended packages of improvements to which Metro could apply the $286 million in Measure M funds, and covers phasing of implementation from the short term to the long term. **Section 5.0** displays a matrix of the recommended improvements, including their risks and mitigation strategies, as well as the backup model data and cost/benefit analysis. **Section 6.0** discusses next steps to move toward implementation.

2.0 SUMMARY OF IMPROVEMENTS

To improve operations, address safety concerns, minimize environmental and community impacts, and ensure cost effectiveness, several types of improvements were evaluated throughout this technical study. The process to develop specific screening criteria to quantify specific operational, safety, environmental, and community impacts is summarized in the **Task 6.1 and 6.2** technical memorandum. The screening criteria were then applied to each of the crossings along the MOL corridor, in order to identify improvements that would best address specific issues. The most capital-intensive improvements include grade separations of the alignment as it passes through major intersections, five of which were identified as priorities in Measure M. These include the crossings at the Valley College, Woodman, Van Nuys, Sepulveda, and Reseda stations. Descriptions of grade separation improvements, as well as all other types of improvements considered, are below.

Grade Separation

Grade separations would either elevate or, in some possible cases, bury the Orange Line alignment to remove modal conflict with roadway crossings. Without having to stop at signals, bus travel times would be improved, particularly through key intersections. Grade separations come with an associated potential benefit of reducing delays for cross-street traffic by removing a signalized crossing. Grade separations also improve safety at crossings for pedestrian and bicyclists, while allowing for accommodation of additional bus capacity in the future.

Permanent Closure

In cases where the Orange Line alignment crosses minor signalized streets, this study evaluated operations and community variables to establish the possibility of permanent closure. This would result in improved operations as buses would no longer experience red light delay or need to slow down for a crossing even without a red light, thereby improving travel times.

Improved Transit Signal Priority (TSP)
Metro buses with operational transponders receive priority at signalized crossings along the MOL Corridor. Based on previous discussions with LADOT staff, the signals along the corridor are configured to allow for an average corridor speed of 35 miles per hour. The traffic signals are also equipped with TSP features that allow Metro buses with operational transponders to "call" a green signal and ensure an approaching bus can proceed across an intersection crossing at a constant speed. Under current operations, buses on the MOL corridor rarely cross intersections at 35 mph, and were in fact prohibited from exceeding 10 mph until 2016. Therefore, the current signal systems do not generally operate in the manner they were designed for, resulting in additional stop delays at red signal indications. Furthermore, Metro buses do not always have operational transponders, so the TSP functionality is sporadic. For this category of improvement, the project team assumes that modifications to existing traffic signal timings would be made to provide the TSP functionality and travel speeds originally designed for. This would require retiming of each MOL intersection crossing, and would result in changes to cross-street traffic flows and travel times (likely increasing average vehicle delays and corridor travel times for cross-street traffic).

Improved Bus-Signal Communication
Metro is currently considering a pilot project to test the capability of providing real-time information on traffic signal status directly to MOL bus operators. The concept is to provide bus operators with reliable information on the status of an approaching traffic signal, allowing the operators to maintain a constant speed and improve overall corridor travel times. This improvement would clearly benefit corridor travel times, and is consistent with concurrent advances in connected and autonomous vehicle technologies. Implementation of this pilot project will face initial challenges due to the complexities of LADOT traffic signal operations. This system would also allow buses stopped at nearside station platforms to better time departures, so that they do not close the doors after loading only to face a red signal indication, which further delays corridor travel times.

Four Quadrant Gate Systems
This improvement would consist of the deployment of railroad-style four quadrant gate systems at at-grade intersection crossings along the east/west segment of the MOL corridor from North Hollywood to Canoga Station. It should be noted that the north/south segment of the MOL is not part of this study; however, the four quadrant gate system be similarly implemented from Canoga to Chatsworth.

This improvement is considered technically feasible, and would require clear policy direction from Metro in regards to corridor access for non-bus vehicles. This improvement would result in the replacement of existing traffic signals at MOL intersection crossings – the traffic signals controlling bus movements along the busway - with four-quadrant gate systems. The gate systems would require additional warning time, which would increase delays for cross-street traffic; however, the gates would only be activated when a bus is present, so the overall number of activations would potentially offset any travel delays over the course of a day.

Any gate system would require fail-safe operations, consistent with current rail systems. For the MOL corridor, fail-safe operations would be ensured by the following key principles:

1. Only Metro buses would be allowed to operate along the MOL corridor, consistent with current rail operations. All other vehicles (e.g., maintenance, public safety) would be required to adhere to Metro policies regarding access to Metro-owned rights-of-way.
2. Existing traffic signals controlling bus movements at crossings would be removed and replaced with gate systems, in accordance with California Manual on Uniform Traffic Control Devices (CA MUTCD) requirements for light rail transit (LRT) signals. The gate systems would employ train signals to notify

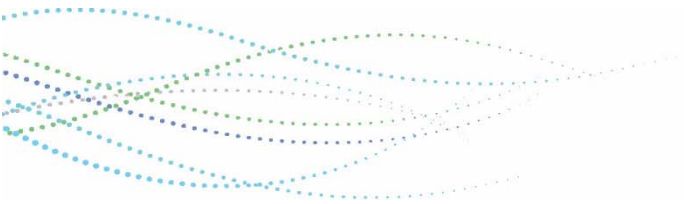
approaching buses of gate status – displaying a solid light when the gate system is activated (e.g., lights flashing, gates in the upright position), and displaying a flashing light when the gate arms are down and the crossing is secured. At signalized intersections adjacent to or in proximity to the MOL crossings, traffic signals would remain to control vehicular movements, and pre-signals would likely be installed at the gated crossings.

3. A combination of redundant vehicle detection systems would be required, to both activate the gate system when a bus was approaching, and to provide the required "check-in/check-out" functionality to ensure a bus has crossed the intersection. Additional features may be required at certain locations, such as in-vehicle mounted equipment or a secured external control mechanism (similar to a "police key" on a traffic signal controller cabinet), to ensure that bus operators could trigger gate operations in the event of detector failure and/or extended loading/unloading time at adjacent station platforms.

In order to operate in a manner least impactful to cross-street traffic, it is recommended that the four quadrant gate systems fail in the upright position. Should a gate system fail to detect an approaching bus and activate, the signal would notify the bus operator that the gates were in the upright position, and the bus operator would then be required to stop before making the crossing. Approaches described under item 3 above could be used as an alternate gate activation technique.

Elevated Bike Path

As an optional component of the recommended base alternative (Alternative A-1, described later in this document) , a preliminary feasibility analysis of potential grade separations for the adjacent bike path was conducted, so that bike path users could cross over the busiest cross streets – Sepulveda and Van Nuys. It is important to note that these results address only the engineering and operational feasibility, with a goal of identifying improvements that could be incorporated into the recommended base alternative to provide improved facilities for additional modes besides only buses and vehicles. There are many conceptual benefits of providing grade separations for the adjacent bike path over two of the most congested crossings along the MOL corridor, including safety and travel time benefits. There are also concerns regarding the feasibility of constructing, maintaining, and ensuring ongoing safety and security for separate grade separated bike path crossings. Therefore, additional evaluations and refinements will likely occur during subsequent environmental clearance and design phases.



3.0 IMPROVEMENTS ANALYSIS BY CROSSING

Quantitative and qualitative analysis in Task 6.1-6.2, Task 6.3, and Task 6.7 (see **Appendix D**) identified locations where grade separations, permanent closures, and other improvements could each be feasible according to specified evaluation criteria. This section and **Table 1** - Crossings by Improvement Need below summarizes the results of these analyses.

Table 1 - Crossings by Improvement Need

Grade Separation Crossing Candidates	Permanent Closure Crossing Candidates	TSP Crossing Candidates	Bus-Signal Crossing Candidates	Four Quadrant Gate Crossing Candidates
Laurel Canyon Blvd	Corteen Pl	Any	Any	Any
Fulton Ave / Burbank Blvd	Bellaire Ave			
Woodman Ave	Ethel Ave			
Van Nuys Blvd	Tyrone Ave			
Sepulveda Blvd	Vesper Ave			
Balboa Blvd	Densmore Ave			
Reseda Blvd	Driveway (private)			

Note: Crossings are listed east to west within each improvement category column.

Grade Separations

The needs analysis performed in Task 6.1-6.2 identified Laurel Canyon Boulevard, Fulton Avenue/Burbank Boulevard, Woodman Avenue, Van Nuys Boulevard, Sepulveda Boulevard, Balboa Boulevard, and Reseda Boulevard as the crossings meeting sufficient criteria to be high-need candidates for grade separations. This group included two crossings not originally specified by Metro in the Measure M funding plan as priority locations for grade separation – Laurel Canyon Boulevard and Balboa Boulevard.

In each case, these seven crossings displayed a combination of high impacts on bus travel time due to red light delay; high cross-traffic volumes and/or delays; higher collision rates; visibility restrictions; importance to future transportation plans and projects; and other criteria referenced in the Task 6.1-6.2 Needs Analysis and Initial Screening technical memorandum.

Permanent Closures

Task 6.3 identified minor intersections for potential permanent closure based on specific evaluation criteria in a process similar to that used to identify candidates for grade separation. Based on that process, Corteen Place, Bellaire Avenue, Ethel Avenue, Tyrone Avenue, Vesper Avenue, the gated driveway at Densmore Avenue, and the private driveway used for access to the Donald Tillman Water Reclamation Plant each scored as good candidates for closure based on quantitative and qualitative measures. Other relevant considerations such as hyper-local community impacts were discussed as well.

Each of these seven crossings displayed a combination of evaluated factors such as distance of roadway cut off if closed; status as non-arterial roadways; low volumes of cross-traffic; ability of adjacent crossings to absorb diverted traffic; impact on emergency access; and neighborhood character to determine their eligibility as a good candidate for closure. Refer to the Task 6.3 Potential Minor Intersections for Permanent Closure technical memorandum for further detail.

Signal Improvements and Four Quadrant Gates

All remaining crossings not grade separated or closed between North Hollywood and Canoga would potentially receive TSP, bus-signal communication systems, or quadrant gates to upgrade existing conditions. This report recommends that one of these types be applied to all remaining crossings, rather than a mixture, for maximum operations and maintenance consistency, with the following exceptions:

Bus-signal communication systems are recommended for the City of Los Angeles driveway between Sepulveda Boulevard and Kester Avenue. Bus-signal communication systems are also recommended for the pedestrian crossings at Agnes Avenue, Goodland Avenue, Hayvenhurst Avenue, and Zelzah Avenue. These crossings do not significantly impact bus operations and could be good opportunities to pursue a bus-signal communications pilot program at a lower investment than quadrant gates.

To better show their costs and benefits, four quadrant gates have been broken out as separate package. It is assumed the other packages will include signal improvements at intersections that aren't separated or closed.

4.0 RECOMMENDED ALTERNATIVE PACKAGES

4.1 Overview

Based on the needs analysis in Task 6.1-6.2, the closures analysis in Task 6.3, conceptual engineering in Task 6.5, traffic impacts analysis in Task 6.7, construction staging analysis in Task 6.8, and parking analysis in Task 6.9, the Iteris team created four fiscally constrained packages and one fiscally unconstrained package, applying the $286 million identified in the Measure M Expenditure Plan[1] to specific improvement types at specific crossing locations for maximum project objective benefits.

Each package is labeled based on the location of the grade separations included. In each of the fiscally constrained packages, three of the five priority grade separation locations identified by Metro were deemed currently feasible with existing funding constraints. Each package specifies which crossings would be permanently closed, and separates out locations with no public vehicular cross-traffic. A separate package with four quadrant gates only is broken out for analysis purposes.

The type of signal improvement at remaining crossings, TSP or bus-signal communications systems, are not specified as their costs were estimated to be similar. The type of signal improvement implemented will be left to Metro's discretion. These categories do not list specific crossings, but display the number of remaining crossings not named in the grade separation, closure, or pedestrian crossing categories. The labeling structure of each package is as follows:

Table 2 – Package Category Descriptions

Package Category	Description
Grade Separations	The locations of grade separated crossings, as well as any intermittent crossings which would be grade separated as a result.
Permanent Closures	Crossings which would be permanently closed.
Bus-Signal Communications at No Cross-Traffic Locations[2]	Improvements at pedestrian crossings and, where applicable, the City of Los Angeles driveway between Kester Avenue and Sepulveda Boulevard. These are separated out since these crossings are recommended to receive bus-signal communication systems, regardless of whether the remaining crossings receive quadrant gates or signal improvements.
Signal Improvements[3]	The number of remaining crossings, all of which would receive signal improvements of either TSP or bus-signal communication systems.
Elevated Bike Path	Grade Separated bike path from Sepulveda to Van Nuys (No local access between these crossings) – Long Bike Path option Grade separated bike path at Sepulveda crossing and Van Nuys crossing only – Short Bike Path option

[1] http://theplan.metro.net/wp-content/uploads/2016/09/measurem_ordinance_16-01.pdf

[2] Cost estimates based on: National Operation Center of Excellence (NOCoE) The National Connected Vehicle SPaT Deployment Challenge: Frequently Asked Questions (viewed at: https://transportationops.org/sites/transops/files/Resource_SPaT_FAQs_Ver_1.0_Jan_6_2017.pdf)

[3] USDOT ITS Unit Costs (viewed at: http://www.itscosts.its.dot.gov/its/benecost.nsf/ID/478B21EDD18C9EAE85256DB100458929?OpenDocument&Query=CApp), grown to 2017 costs using a 2% annual inflation factor.

4.2 Fiscally Constrained Package A: Van Nuys & Sepulveda + Reseda

Package A features aerial grade separations at the priority stations of Van Nuys, Sepulveda, and Reseda. Due to environmental and engineering constraints, this package proposes that the alignment remain elevated from its approach to Van Nuys Station until after it passes Sepulveda Station, which would be relocated over Sepulveda Boulevard, compared to its current location west of the intersection. As a result of remaining on an elevated structure between Van Nuys Station and Sepulveda Station, all crossings in between would remain open, including Vesper Avenue, which was determined to be a closeable crossing based on Task 6.3. This alternative also includes side platforms and an elevated bike path. **Table 3** details the capital costs associated with Package A.

Table 3 – Fiscally Constrained Package A Capital Costs

Grade Separations	Cost 2017 Base Year $	Cost 2022 YOE $
1. Van Nuys Blvd (overcrossing) *Vesper Ave (overcrossing)* *Kester Ave (overcrossing)* *City of LA Driveway (overcrossing)* 2. Sepulveda Blvd & Station Ped X-ing (overcrossing)	$191,026,770	$221,452,382
3. Reseda Blvd (overcrossing)	$68,035,623	$78,871,933
Grade Separation Subtotal	**$259,062,393**	**$300,324,315**
Permanent Closures		
1. Tyrone Ave	$82,925	$96,133
Permanent Closures Subtotal	**$82,925**	**$96,133**
Bus-Signal Communications at No Cross-Traffic Locations		
1. Agnes Ave Ped X-ing	$50,000	$57,964
2. Goodland Ave Ped X-ing	$50,000	$57,964
3. Hayvenhurst Ave Ped X-ing	$50,000	$57,964
4. Zelzah Ave Ped-Xing	$50,000	$57,964
No Cross-Traffic Locations Subtotal	**$200,000**	**$231,855**
Signal Improvements		
Signal Improvements Subtotal ($50,000 x 26 Crossings)	**$1,300,000**	**$1,507,056**
Elevated Bike Path		
Elevated Bike Path Subtotal	**$22,662,629**	**$26,272,198**
Side Platforms		
Side platforms Subtotal	**$15,000,000**	**$17,389,111**
Additional Overall Contingency (5.5%)		
Additional Overall Contingency (5.5%)	**$16,406,937**	**$19,020,137**
Estimated Package A Total	**$314,714,884**	**$364,840,805**

Source: STV & Iteris, 2017. Refer to Tasks 6.5, 6.7, Table 2, and Appendix C for further cost estimate details.

Figure 1 – Map of Package A Improvements

4.3 Fiscally Constrained Package B: Valley College & Woodman + Reseda

Package B features two undercrossing grade separations at Valley College and Woodman stations, as well as an aerial grade separation at Reseda Station. The busway would travel below-grade between Valley College and Woodman stations, which would be moved below-grade as well. The busway would cross under Oxnard Street in the process. In this package, Vesper Avenue would be closed. This alternative also includes side platforms and an elevated bike path. **Table 4** details the capital costs associated with Package B.

Table 4 – Fiscally Constrained Package B Capital Costs

Grade Separations	Cost 2017 Base Year $	Cost 2022 YOE $
1. Fulton Ave / Burbank Blvd (undercrossing) *Oxnard St (undercrossing)* 2. Woodman Ave (undercrossing)	$194,041,126	$245,061,131
3. Reseda Blvd (overcrossing)	$68,035,623	$78,871,933
Grade Separation Subtotal	**$262,076,749**	**$323,933,064**
Permanent Closures		
1. Tyrone Ave	$82,925	$96,133
Permanent Closures Subtotal	**$82,925**	**$96,133**
Bus-Signal Communications at No Cross-Traffic Locations		
1. Agnes Ave Ped X-ing	$50,000	$57,964
2. Goodland Ave Ped X-ing	$50,000	$57,964
3. City of LA Driveway	$250,000	$289,819
4. Hayvenhurst Ave Ped X-ing	$50,000	$57,964
5. Zelzah Ave Ped-Xing	$50,000	$57,964
No Cross-Traffic Locations Subtotal	**$450,000**	**$521,675**
Signal Improvements		
Signal Improvements Subtotal ($50,000 x 27 Crossings)	**$1,350,000**	**$1,565,020**
Elevated Bike Path		
Elevated Bike Path Subtotal	**$12,804,329**	**$14,843,726**
Side Platforms		
Side platforms Subtotal	**$10,000,000**	**$11,592,741**
Additional Overall Contingency (5.5%)		
Additional Overall Contingency (5.5%)	**$15,772,020**	**$19,390,380**
Package B Total	**$302,536,023**	**$371,942,738**

Source: STV & Iteris, 2017. Refer to Tasks 6.5, 6.7, Table 2, and Appendix C for further cost estimate details.

Figure 2 – Map of Package B Improvements

4.4 Fiscally Constrained Package C: Woodman + Sepulveda + Reseda

Package C features one undercrossing grade separation at Woodman Station and two aerial grade separations at Sepulveda and Reseda stations. Woodman Station would be moved below-grade and the busway would cross under Oxnard Street as well. The Sepulveda Station would be relocated over Sepulveda Boulevard as in Package A, and Vesper Avenue would be closed. This alternative also includes side platforms and an elevated bike path. **Table 5** details the capital costs associated with Package C.

Table 5 – Fiscally Constrained Package C Capital Costs

Grade Separations	Cost 2017 Base Year $	Cost 2022 YOE $
1. Woodman Ave (undercrossing) *Oxnard St (undercrossing)*	$98,434,618	$124,316,423
2. Sepulveda Blvd (overcrossing)	$56,503,995	$65,503,616
3. Reseda Blvd (overcrossing)	$68,035,623	$78,871,933
Grade Separation Subtotal	**$222,974,236**	**$268,691,972**
Permanent Closures		
1. Tyrone Ave	$82,925	$96,133
Permanent Closures Subtotal	**$82,925**	**$96,133**
Bus-Signal Communications at No Cross-Traffic Locations		
1. Agnes Ave Ped X-ing	$50,000	$57,964
2. Goodland Ave Ped X-ing	$50,000	$57,964
3. City of LA Driveway	$250,000	$289,819
4. Hayvenhurst Ave Ped X-ing	$50,000	$57,964
5. Zelzah Ave Ped-Xing	$50,000	$57,964
No Cross-Traffic Locations Subtotal	**$450,000**	**$521,673**
Signal Improvements		
Signal Improvements Subtotal ($50,000 x 27 Crossings)	**$1,350,000**	**$1,565,020**
Elevated Bike Path		
Elevated Bike Path Subtotal	**$12,804,329**	**$14,843,726**
Side Platforms		
Side platforms Subtotal	**$10,000,000**	**$11,592,741**
Additional Overall Contingency (5.5%)		
Additional Overall Contingency (5.5%)	**$13,621,382**	**$16,352,120**
Package C Total	**$261,282,872**	**$313,663,386**

Source: STV & Iteris, 2017. Refer to Tasks 6.5, 6.7, Table 2, and Appendix C for further cost estimate details.

Figure 3 – Map of Package C Improvements

4.5 Fiscally Unconstrained Package D: All Identified Grade Separations

Package D is fiscally unconstrained and includes all priority grade separations identified in Measure M. Crossing closures are the same as in Package A, as Package D also features the aerial structure between Van Nuys and Sepulveda stations, keeping Vesper Avenue open. Pedestrian crossings receive bus-signal communications systems as in the other packages, and the remaining crossings can receive either quadrant gates or signal improvements. This alternative also includes side platforms and an elevated bike path. **Table 6** details the capital costs associated with Package D.

Table 6 – Fiscally Unconstrained Package D Capital Costs

Grade Separations	Cost 2017 Base Year $	Cost 2022 YOE $
1. Fulton Ave / Burbank Blvd (undercrossing) *Oxnard St (undercrossing)* 2. Woodman Ave (undercrossing)	$194,041,126	$245,061,131
3. Van Nuys Blvd (overcrossing) *Vesper Ave (overcrossing)* *Kester Ave (overcrossing)* *City of LA Driveway (overcrossing)* 4. Sepulveda Blvd & Station Ped X-ing (overcrossing)	$191,026,770	$221,452,382
5. Reseda Blvd (overcrossing)	$68,035,623	$78,871,933
Grade Separation Subtotal	**$453,103,519**	**$545,385,446**
Permanent Closures		
1. Tyrone Ave	$82,925	$96,133
Permanent Closures Subtotal	**$82,925**	**$96,133**
Bus-Signal Communications at No Cross-Traffic Locations		
1. Agnes Ave Ped X-ing	$50,000	$57,964
2. Goodland Ave Ped X-ing	$50,000	$57,964
3. Hayvenhurst Ave Ped X-ing	$50,000	$57,964
4. Zelzah Ave Ped-Xing	$50,000	$57,964
No Cross-Traffic Locations Subtotal	**$200,000**	**$231,855**
Signal Improvements		
Signal Improvements Subtotal ($50,000 x 23 Crossings)	**$1,150,000**	**$1,333,165**
Elevated Bike Path		
Elevated Bike Path Subtotal	**$22,662,629**	**$26,272,198**
Side Platforms		
Side platforms Subtotal	**$20,000,000**	**$23,185,481**
Additional Overall Contingency (5.5%)		
Additional Overall Contingency (5.5%)	**$27,345,949**	**$32,807,735**
Package D Total	**$524,545,022**	**$629,312,015**

Source: STV & Iteris, 2017. Refer to Tasks 6.5, 6.7, Table 2, and Appendix C for further cost estimate details.

Figure 4 – Map of Package D Improvements

4.6 Fiscally Constrained Package A-1: Van Nuys & Sepulveda + Quad Gates

Package A-1, a modified version of Package A, proposes aerial grade separations at the Van Nuys and Sepulveda stations. The busway would be elevated the entire length from Van Nuys Station to Sepulveda Station, including the pedestrian crossing at Sepulveda Station and the station would be relocated over Sepulveda Boulevard. All roadway crossings between the Van Nuys and Sepulveda stations would remain open. Tyrone Avenue is the only roadway proposed to be closed. No changes are proposed to the other four pedestrian-only crossings located along the study segment, and the remaining 27 crossings would have gate systems installed. This alternative also includes side platforms and an elevated bike path. **Table 7** details the capital costs associated with Package A-1.

Table 7 – Fiscally Constrained Package A-1 Capital Costs

Grade Separations	Cost 2017 Base Year $	Cost 2022 YOE $
1. Van Nuys Blvd (overcrossing) *Vesper Ave (overcrossing)* *Kester Ave (overcrossing)* *City of LA Driveway (overcrossing)* 2. Sepulveda Blvd & Station Ped X-ing (overcrossing)	$191,026,770	$221,452,382
Grade Separation Subtotal	**$191,026,770**	**$221,452,382**
Permanent Closures		
1. Tyrone Ave	$82,925	$96,133
Permanent Closures Subtotal	**$82,925**	**$96,133**
Quad Gates		
$1,300,000 x 27 Crossings	$35,100,000	$40,690,520
Quad Gates Subtotal	**$35,100,000**	**$40,690,520**
Elevated Bike Path		
Elevated Bike Path Subtotal	**$22,662,629**	**$26,272,198**
Side Platforms		
Side platforms Subtotal	**$10,000,000**	**$11,592,741**
Additional Overall Contingency (5.5%)		
Additional Overall Contingency (5.5%)	**$14,237,978**	**$16,505,719**
Package A-1 Total	**$273,110,302**	**$316,609,693**

Source: STV & Iteris, 2017. Refer to Tasks 6.5, 6.7, Table 2, and Appendix C for further cost estimate details.

Figure 5 – Map of Package E Improvements

4.7 Four Quadrant Crossing Gates Package

This package includes four quadrant crossing gates at the following 31 crossings, not including pedestrian crossings or private driveways, as an alternative to improve operations and safety through gating mechanisms:

1. Tujunga Avenue
2. Colfax Avenue
3. Laurel Canyon Boulevard
4. Corteen Place
5. Whitsett Avenue
6. Bellaire Avenue
7. Coldwater Canyon Avenue
8. Chandler Boulevard
9. Ethel Avenue
10. Fulton Avenue
11. Oxnard Street
12. Woodman Avenue
13. Hazeltine Avenue
14. Tyrone Avenue
15. Van Nuys Boulevard
16. Vesper Avenue
17. Kester Avenue
18. Sepulveda Boulevard
19. Densmore Avenue
20. Woodley Avenue
21. Balboa Boulevard
22. White Oak Avenue
23. Lindley Avenue
24. Reseda Boulevard
25. Wilbur Avenue
26. Tampa Avenue
27. Corbin Avenue
28. Victory Boulevard
29. Winnetka Avenue
30. Mason Avenue
31. De Soto Avenue

It should be noted that this study only covers the east/west segment of the MOL; however, the four quadrant crossing gates can similarly be implemented on the north/south segment. **Table 8** shows the capital costs associated with the 31 crossing gates, also shown in **Figure 6**.

Table 8 – Crossing Gates Capital Costs

Four Quadrant Crossing Gates	Cost 2017 Base Year $	Cost 2022 YOE $
$1,300,000 x 31 Crossings	$40,300,000	$46,718,745
Additional Overall Contingency (5.5%)		
Additional Overall Contingency (5.5%)	**$2,216,500**	**$2,569,531**
Crossing Gates Total	**$42,516,500**	**$49,288,276**

Source: Quadrant gate system cost estimates are based on discussions with Metro.

Figure 6 – Map of Crossing Gate Improvements

4.8 Packages Benefits Summary

Table 9 – Summary of Potential Alternative Options (MOL North Hollywood to Canoga Segment)

Improvement / Benefit	Package A: Van Nuys & Sepulveda + Reseda	Package B: Valley College & Woodman + Reseda	Package C: Woodman + Sepulveda + Reseda	Package D: Valley College & Woodman + Van Nuys & Sepulveda + Reseda (Fiscally Unconstrained)	Package E: Gate Systems (Current operating speeds)	Package A- 1 (Hybrid) Van Nuys + Sepulveda + Gates Systems (with platooning & higher speeds & increased headways)[6]
# of Grade Separated Crossings (Priority Locations[1])	6 (3)	4 (3)	4 (3)	9 (5)	0	5 (2)
# of Permanent Closures	1	1	1	1	0	1
LA City Council Districts with Grade Separations	CD 3; CD 6	CD 2 & CD 4; CD 3	CD 2; CD 3; CD 6	CD 2; CD 3; CD 4; CD 6	-	CD 6
Existing Bus Travel Time (Average)[2]	Eastbound (EB - Canoga to North Hollywood): 40.3 mins Westbound (WB - North Hollywood to Canoga): 42.7 mins					
Change in Bus Travel Time (Between Canoga and North Hollywood)[2]	EB: -4.2 mins WB: -3.8 mins	EB: -2.5 mins WB: -2.3 mins	EB: -2.7 mins WB: -2.4 mins	EB: -6.3 mins WB: -4.2 mins	EB: -12.1 mins WB: -12.7 mins	EB: -12.3 mins WB: -12.9 mins
Existing Cross Street Traffic Delay[3] (PM Peak Hour, Average per Vehicle)	Northbound: 24.4 sec/veh Southbound: 22.2 sec/veh Average: 23.3 sec/veh					
Change in Cross Street Traffic Delay[3] (PM Peak Hour, Average per Vehicle)	NB: -0.3 sec/veh SB: -0.4 sec/veh AVG: -0.4 sec/veh	NB: -0.7 sec/veh SB: -0.9 sec/veh AVG: -0.8 sec/veh	NB: -0.6 sec/veh SB: -0.8 sec/veh AVG: -0.7 sec/veh	NB: -0.7 sec/veh SB: -1.6 sec/veh AVG: -1.1 sec/veh	NB: +9.6 sec/veh SB: +4.9 sec/veh AVG: +7.3 sec/veh	NB: -1.7 sec/veh SB: -1.4 sec/veh AVG: -1.6 sec/veh
Existing Ridership[4] (Weekday daily passengers)	24,500					
Change in Ridership, Year 2025 (Weekday daily passengers)	+1,000 (+4%)	+1,400 (+5%)	+900 (+3%)	+3,400 (+13%)	+10,100 (+39%)	+10,100* (+39%)
Change in VMT, Year 2025 (Daily)	-11,120	-13,202	-8,765	-29,159	-81,756	-81,756*
% Change in O&M Costs[5]	-2.5%	-1.4%	-1.4%	-1.9%	-6.4%	-6.4%*
Estimated Capital Cost of Grade Separations	$259M	$262M	$223M	$453M	-	$191M
Estimated Capital Cost of Permanent Closures	$0.08M	$0.08M	$0.08M	$0.08M	-	$0.08M
Estimated Capital Cost of Improved Bus-Signal Communications	$0.2M	$0.4M	$0.4M	$0.2M	-	-
Estimated Capital Cost of Signal Improvements	$1.3M	$1.4M	$1.4M	$1.2M	-	-
Estimated Capital Cost of Gate Systems	-	-	-	-	$40.3M	$35.1M
Estimated Capital Cost of Side Platform Locations	$15M	$10M	$10M	$20M	-	10M
Estimated Capital Cost of Elevated Bike Path (Van Nuys to Sepulveda)	$23M	$13M	$13M	$23M	-	$23M
Additional Overall Contingency (5.5%)[7]	$16.4M	$15.8M	$13.6M	$27.4M	$2.2M	$14.3
Estimated Total Capital Costs (2017 $)	**$315M**	**$303M**	**$261M**	**$525M**	**$43M**	**$273M**

Notes:

1. *Grade separations of the priority locations will require additional grade separations for adjacent crossings due to the proximity of roadways and design requirements for grade separations. Priority locations (shown as the number of grade separations in parenthesis) are those identified in Measure M – Reseda, Sepulveda, Van Nuys, Woodman/Oxnard, and Fulton/Burbank.*
2. *Does not include station dwell time, as dwell time is highly variable per station and time of day.*
3. *Average for all signalized crossings between North Hollywood and Canoga, and not indicative of specific crossings.*
4. *Travel demand model derived ridership; actual existing (Year 2016) ridership averages 25,090 daily passengers on weekdays.*
5. *O&M costs are rough estimates; see Appendix B for additional details.*
6. *Under Package A-1, buses are assumed to travel at the maximum civil speed authorized by Metro within the corridor, further reducing end-to-end travel times. Buses are also assumed to operate in two-vehicle platoons at increased headways (8-minute headways assumed for purposes of analysis). Last, gate systems would only operate when a bus is present, which would result in on overall decrease in gate activations throughout the course of a typical day.*
7. *A 5.5% contingency was added to all cost estimates, on top of individual contingencies for specific elements, to account for the preliminary nature of this technical study.*

** Travel Demand Model results are preliminary in nature, due to the preliminary nature of this technical study. Since changes in ridership and VMT are related to increased bus travel speeds, it is assumed that the estimates of Ridership and VMT change would change slightly from what is currently shown with further refinements to the proposed alternatives. Similarly, O&M costs for Package A-1 were not provided. These items would be refined in subsequent environmental clearance and design phases.*

Achieving Project Objectives
Each of the packages presented above achieve the project objectives laid out in its Purpose and Need Statement (as described in the Task 2.0 Memorandum). These combinations of grade separations, crossing closures, and other improvements reduce uncertainty for bus drivers, vehicles, pedestrians, and bicyclists at crossings. As a result, travel time is reduced, public safety is improved, significant impacts to cross-traffic are avoided, and estimated costs remain within the scope of allotted Measure M funds.

4.9 Implementation Phasing

The implementation of these and other Metro Orange Line improvements can be broken into three phases: near-term, mid-term, and long-term. Each are described below.

Near-Term (2017 - 2022): Approve Improvement Packages
The near term implementation of the improvements explored in this study includes:

- Selection of a package by Metro staff and the Metro Board of Directors;
- Executing grade separation construction by estimated groundbreaking year of 2019;
- Delivery of selected grade separation package by target year 2022.

Mid-Term (2022 - 2050): Build Out Improvements
The mid-term implementation of Orange Line improvements explored in this study includes:

- Completing the selected near-term package of grade separations;
- Implementing any remaining improvements beyond grade separations, such as quadrant gates or traffic signal improvements, on the entire Orange Line corridor;
- Constructing additional non-priority grade separations identified in this study, such as at Laurel Canyon Boulevard and Balboa Boulevard.

Long-Term Implementation (2051 +): Light Rail Conversion
The long-term vision of Orange Line improvements involves conversion of the bus line to light rail to account for future ridership growth. A light rail line would significantly increase capacity and travel times, and will benefit from improvements made to the Orange Line in the near and mid-terms. Conceptual engineering of improvements performed in this technical study are designed to support future rail service. A future light rail conversion would feature the following:

- Existing and planned busway improvements such as bridges, at-grade crossing improvements, subgrade and draining, station parking, corridor landscaping, soundwalls, and bicycle paths;
- New elements such as rail track, station platforms, upgraded at-grade crossings, train control systems, new rail vehicles, and a maintenance facility.

5.0 SOLUTIONS AND STRATEGIES MATRIX

This section presents a summary of additional risks and strategies to mitigate. The risks and associated mitigation strategies presented in **Table 10** represent those risks and mitigations not addressed in other technical memoranda or project tasks. In general, the risks and mitigation factors represent broader qualitative elements for further consideration as specific projects are developed.

Table 10 – Summary of Potential Risks and Strategies to Mitigate per Recommended Solution

Recommended Solution & Crossing		Potential Risks	Strategies to Mitigate
Grade Separation	Reseda	Construction impacts – Interruption in ongoing operations (bus and/or bike path)	Recommendation to utilize the existing bike path as a temporary detour for buses, ensuring ongoing bus operations with a temporary interruption in a contiguous bike path
		Reduction in Metro-owned parking	Implementation of Metro's Supportive Transit Parking Policy (STPP) Master Plan
		Removal of traffic signal control for bicycle and pedestrian crossings[1]	Bicycle and pedestrian traffic would be required to detour to the nearest adjacent signal-controlled crossing
	Sepulveda	Relocation of the existing station away from TOD site	Provide direct aerial link between potential new TOD
		Construction impacts – Detour of current route	Maintain proximity to existing corridor
		Construction impacts – Interruption in ongoing operations (bike path)	Maintain proximity to existing corridor
		Reduction in Metro-owned parking	Implementation of Metro's Supportive Transit Parking Policy (STPP) Master Plan
		Removal of traffic signal control for bicycle and pedestrian crossings[1]	Bicycle and pedestrian traffic would be required to detour to the nearest adjacent signal-controlled crossing
	Van Nuys	Construction impacts – Detour of current route	Maintain proximity to existing corridor
		Construction impacts – Interruption in ongoing operations (bus and/or bike path)	Recommendation to utilize the existing bike path as a temporary detour for buses, ensuring ongoing bus operations with a temporary interruption in a contiguous bike path
		Reduction in Metro-owned parking	Implementation of Metro's Supportive Transit Parking Policy (STPP) Master Plan
		Removal of traffic signal control for bicycle and pedestrian crossings[1]	Bicycle and pedestrian traffic would be required to detour to the nearest adjacent signal-controlled crossing
	Woodman	Construction impacts – Detour of current route	Maintain proximity to existing corridor
		Construction impacts – Interruption in ongoing operations (bus and/or bike path)	Recommendation to utilize the existing bike path as a temporary detour for buses, ensuring ongoing bus operations with a temporary interruption in a contiguous bike path

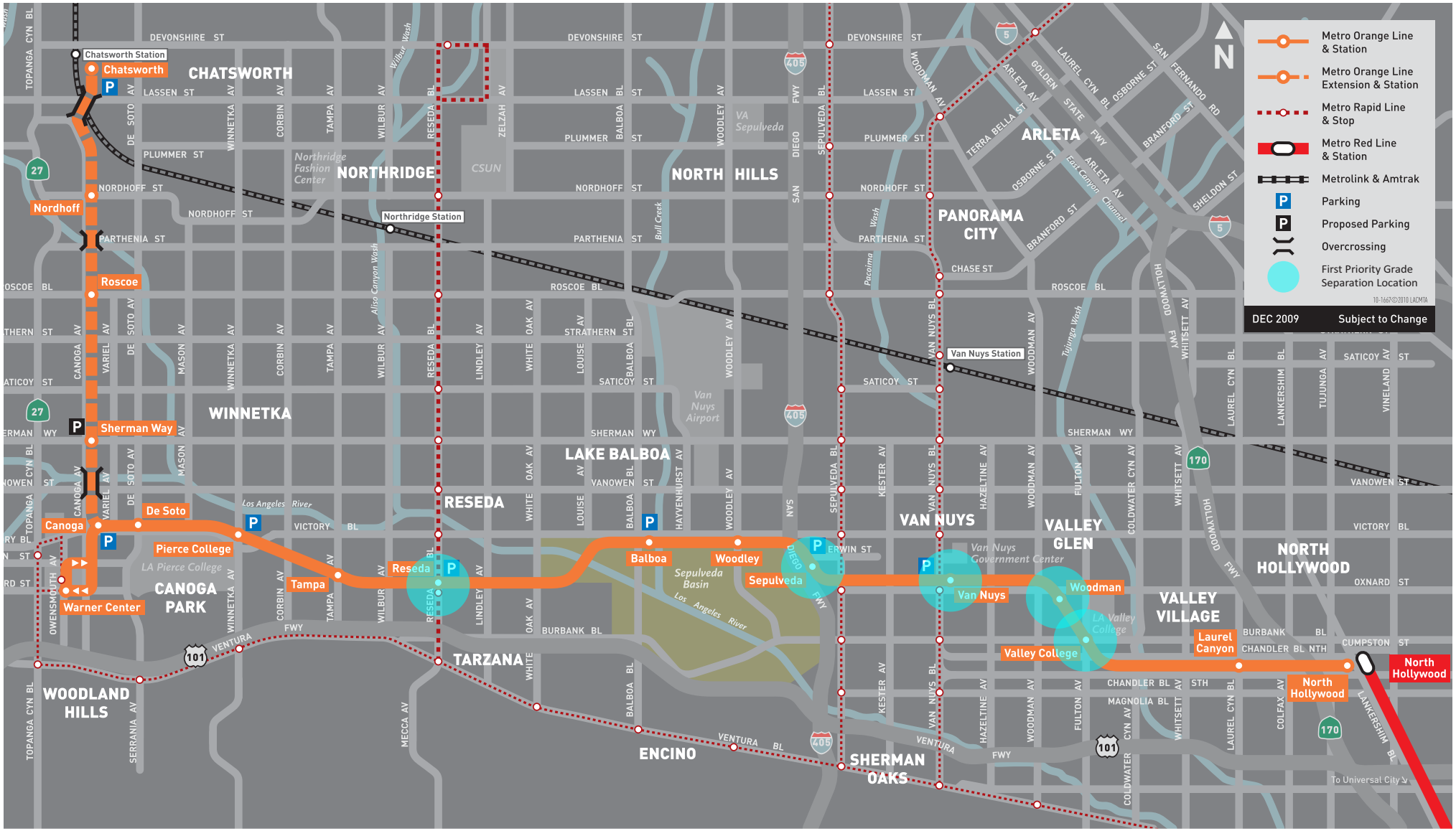
Recommended Solution & Crossing		Potential Risks	Strategies to Mitigate
Grade Separation (Continued)	Woodman (Continued)	Removal of traffic signal control for bicycle and pedestrian crossings[1]	Bicycle and pedestrian traffic would be required to detour to the nearest adjacent signal-controlled crossing
	Valley College	Construction impacts – Detour of current route	Maintain proximity to existing corridor
		Construction impacts – Interruption in ongoing operations (bus and/or bike path)	Recommendation to utilize the existing bike path as a temporary detour for buses, ensuring ongoing bus operations with a temporary interruption in a contiguous bike path
		Removal of traffic signal control for bicycle and pedestrian crossings[1]	Bicycle and pedestrian traffic would be required to detour to the nearest adjacent signal-controlled crossing
Improved Transit Signal Priority (TSP)	Any	LADOT reluctance to implement, due to associated changes in traffic signal timing (e.g., new walk indication timings)	Work with operations to continue to implement Speed Improvement Study recommendations and increase intersection crossing speeds to 35 mph as appropriate.
		Metro bus transponder maintenance/deployment	Develop a regular maintenance and inspection program to ensure transponders are operational on all MOL buses
			Deploy MOL transponders on the entire Metro bus fleet
Improved Bus-Signal Communication	Any	Real-time information not available, due to LADOT adaptive traffic signal operations	Develop system to provide best estimate, and implement a fail-safe feature to ensure adequate stopping distance in the result of a discrepancy between real-time information and estimate communicated to bus operator
Four Quadrant Gate Systems	Any	Potential for deployment of rail gate systems for BRT operations to not be approved by State and/or Federal agencies	Recommendation to implement gate systems consistent with MUTCD requirements for rail/highway grade crossings
		Fail safe operations could not be guaranteed to a sufficient level	Recommendation to develop a pilot deployment for further testing and development

Note: 1. The recommended base alternative (Package A-1) assumes that existing traffic signals for bicycle and pedestrian crossings along the adjacent Bike Path would be maintained.

6.0 NEXT STEPS

Metro staff will review the packages on offer from this technical memorandum and take steps to make a recommendation to the Metro Board of Directors. Once approved, further design, environmental review, permitting, and construction will begin on grade separations and other selected improvements for an anticipated delivery year of 2022.

APPENDIX A: STUDY AREA



Source: Metro

iteris®

Metro Orange Line
Grade Separation Analysis and Operational Improvements Technical Study

Study Area

APPENDIX B: CAPITAL COST METHODOLOGY

Los Angeles County
Metropolitan Transportation Authority

Metro Orange Line Grade Separation Analysis and Operational Improvements Technical Study

Cost Estimate Methodology and Database – Final

August 25, 2017

Metro Orange Line

Grade Separation Analysis and Operational Improvements Technical Study

Cost Estimate Methodology and Database

Final

August 25, 2017

Document Control

Task #	
2.0	
Version	**Date Completed**
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Final	8/25/2017

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FIGURES

TABLES

ABBREVIATIONS / ACRONYMS

ADA.....Americans with Disabilities Act
BMP .....Best Management Practice
BRT .....Bus Rapid Transit
CEQA.....California Environmental Quality Act
CFR.....Code of Federal Regulations
CIDH .....Cast-in-Drilled Hole
CIP.....Cast-in-Place
EB .....Eastbound
FTA.....Federal Railroad Administration
FTA.....Federal Transit Administration
HOV .....High Occupancy Vehicle
LRT .....Light Rail Transit
LRTP.....Long Range Transportation Plan
Metro .....Los Angeles County Metropolitan Transportation Authority
MOL.....Metro Orange Line
MSE.....Mechanically Stabilized Earth
NB .....Northbound
NEPA.....National Environmental Policy Act
OCS.....Overhead Contact System
PC/PS.....Precast/Prestressed
RCP.....Reinforced Concrete Pipe
ROW.....Right-of-Way
SB .....Southbound
SCC.....Standard Cost Categories
TPSS .....Traction Power Substation
TSM.....Transportation Systems Management
WB.....Westbound

0. INTRODUCTION

0.1. STUDY BACKGROUND

The Los Angeles County Metropolitan Transportation Authority (Metro) currently operates a Bus Rapid Transit (BRT) system on the Metro Orange Line (MOL), a dedicated bus guideway, since 2005.

Through the Metro Orange Line Improvements Case Study, improvements to the existing MOL bus service and potential conversion of the MOL to rail service have been identified and analyzed. In addition, Metro developed a set of recommendations for immediate and long-term implementation to improve bus speeds and travel times along the MOL. Metro also began testing increased speeds for buses across some intersections along the line to ensure that the line can operate safely and smoothly before implementing any speed increases. The purpose of the Grade Separation Analysis and Operational Improvements Technical Study would be to explore these issues in greater detail, assess the feasibility of implementing grade separations and additional improvements to address the increasing ridership, travel time delays, and capacity constraints of this line.

This study presents an overview of conceptual design and constructability issues for these grade separations. The information gained during the course of this study, along with the conceptual drawings produced, will provide all of the essential information, including cost and construction timelines, needed to begin to progress these improvements through the funding and design process. This is an essential step in laying the groundwork for an enhanced Metro Rail system to support the next decades of mobility in Los Angeles County. An overview of all of the proposed grade separations is shown in Figure 0.1.

0.2. REPORT PURPOSE AND STRUCTURE

This report presents a Cost Database that has been developed based upon the draft five percent conceptual plans for the identified Grade Separation Analysis and Operational Improvements Technical Study, and summarizes the basic cost estimating methodology used to develop capital cost estimates.

Figure 0.1. Proposed Grade Separations – Overview

Legend

- Orange Line Busway
- Orange Line Station
- First Priority Grade Separation Location

Source: Iteris, 2016

1. CAPITAL COST METHODOLOGY

1.1. STANDARD COST CATEGORIES

Based on the five percent conceptual plans, capital cost estimates have been developed using the Federal Transportation Administration's (FTA's) Standard Cost Categories (SCC) format. FTA's SCC Worksheets provide a standard template for use in estimating costs for transit projects across the country. The SCC Worksheet divides all capital costs into the following areas:

- 10. Guideway
- 20. Stations
- 30. Support Facilities
- 40. Sitework
- 50. Systems
- 60. ROW
- 70. Vehicles
- 80. Soft Costs
- 90. Unallocated Contingency
- 100. Finance Charges

These categories are further broken down into smaller categories for developing the capital cost estimates. A sample worksheet from the SCC template is shown in Figure 1.1.

Figure 1.1. SCC Worksheet – Example

MAIN WORKSHEET-BUILD ALTERNATIVE (Rev.11a, June 4, 2008)

Insert Project Sponsor's Name here — Today's Date: 4/25/08

Insert Project Name and Location — Yr of Base Year $: 2008

Insert Current Phase (e.g. Applic.for PE, PE, FD, Applic.for FFGA, Construction, Rev Ops) — Yr of Revenue Ops: 2012

	Quantity	Base Year Dollars w/o Contingency (X000)	Base Year Dollars Allocated Contingency (X000)	Base Year Dollars TOTAL (X000)	Base Year Dollars Unit Cost (X000)	Base Year Dollars Percentage of Construction Cost	Base Year Dollars Percentage of Total Project Cost	YOE Dollars Total (X000)
10 GUIDEWAY & TRACK ELEMENTS (route miles)	**9.00**	100,000	12,000	**112,000**	**$ 12,444**	**38%**	**24%**	**121,801**
10.01 Guideway: At-grade exclusive right-of-way	9.00	100,000	12,000	112,000	$ 12,444			121,801
10.02 Guideway: At-grade semi-exclusive (allows cross-traffic)				0				0
10.03 Guideway: At-grade in mixed traffic				0				0
10.04 Guideway: Aerial structure				0				0
10.05 Guideway: Built-up fill				0				0
10.06 Guideway: Underground cut & cover				0				0
10.07 Guideway: Underground tunnel				0				0
10.08 Guideway: Retained cut or fill				0				0
10.09 Track: Direct fixation				0				0
10.10 Track: Embedded				0				0
10.11 Track: Ballasted				0				0
10.12 Track: Special (switches, turnouts)				0				0
10.13 Track: Vibration and noise dampening				0				0
20 STATIONS, STOPS, TERMINALS, INTERMODAL (number)	**18**	100,000	20,000	**120,000**	**$ 6,667**	**40%**	**26%**	**132,476**
20.01 At-grade station, stop, shelter, mall, terminal, platform	18	100,000	20,000	120,000	$ 6,667			132,476
20.02 Aerial station, stop, shelter, mall, terminal, platform				0				0
20.03 Underground station, stop, shelter, mall, terminal, platform				0				0
20.04 Other stations, landings, terminals: Intermodal, ferry, trolley, etc.				0				0
20.05 Joint development				0				0
20.06 Automobile parking multi-story structure				0				0
20.07 Elevators, escalators				0				0
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS	9.00	10,000	2,000	**12,000**	**$ 1,333**	**4%**	**3%**	**13,423**
30.01 Administration Building: Office, sales, storage, revenue counting				0				0
30.02 Light Maintenance Facility		10,000	2,000	12,000				13,423
30.03 Heavy Maintenance Facility				0				0
30.04 Storage or Maintenance of Way Building				0				0
30.05 Yard and Yard Track				0				0
40 SITEWORK & SPECIAL CONDITIONS	9.00	21,420	2,800	**24,220**	**$ 2,691**	**8%**	**5%**	**25,121**
40.01 Demolition, Clearing, Earthwork		920	100	1,020				1,058
40.02 Site Utilities, Utility Relocation		5,500	500	6,000				6,223
40.03 Haz. mat'l, contam'd soil removal/mitigation, ground water treatments				0				0
40.04 Environmental mitigation, e.g. wetlands, historic/archeologic, parks		4,000	200	4,200				4,356
40.05 Site structures including retaining walls, sound walls				0				0
40.06 Pedestrian / bike access and accommodation, landscaping		11,000	2,000	13,000				13,484
40.07 Automobile, bus, van accessways including roads, parking lots				0				0
40.08 Temporary Facilities and other indirect costs during construction				0				0
50 SYSTEMS	9.00	25,490	3,700	**29,190**	**$ 3,243**	**10%**	**6%**	**32,487**
50.01 Train control and signals		8,000	2,000	10,000				11,130
50.02 Traffic signals and crossing protection		2,500	500	3,000				3,339
50.03 Traction power supply: substations		7,500	500	8,000				8,904
50.04 Traction power distribution: catenary and third rail		5,500	500	6,000				6,678
50.05 Communications		1,000	100	1,100				1,224
50.06 Fare collection system and equipment		990	100	1,090				1,213
50.07 Central Control		0	0	0				0
Construction Subtotal (10 - 50)	9.00	256,910	40,500	**297,410**	**$ 33,046**	**100%**	**65%**	**325,308**
60 ROW, LAND, EXISTING IMPROVEMENTS	9.00	17,000	4,000	**21,000**	**$ 2,333**		**5%**	**22,840**
60.01 Purchase or lease of real estate		17,000	4,000	21,000				22,840
60.02 Relocation of existing households and businesses				0				0
70 VEHICLES (number)	**10**	25,404	8,000	**33,404**	**$ 3,340**		**7%**	**36,689**
70.01 Light Rail	10	25,404	8,000	33,404	$ 3,340			36,689
70.02 Heavy Rail				0				0
70.03 Commuter Rail				0				0
70.04 Bus				0				0
70.05 Other				0				0
70.06 Non-revenue vehicles				0				0
70.07 Spare parts				0				0
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)	9.00	65,895	19,000	**84,895**	**$ 9,433**	**29%**	**18%**	**87,292**
80.01 Preliminary Engineering		12,000	3,000	15,000				15,424
80.02 Final Design		17,395	3,000	20,395				20,971
80.03 Project Management for Design and Construction		9,000	3,000	12,000				12,339
80.04 Construction Administration & Management		9,000	3,000	12,000				12,339
80.05 Professional Liability and other Non-Construction Insurance		2,500	2,000	4,500				4,627
80.06 Legal; Permits; Review Fees by other agencies, cities, etc.		3,000	1,000	4,000				4,113
80.07 Surveys, Testing, Investigation, Inspection		3,000	1,000	4,000				4,113
80.08 Start up		10,000	3,000	13,000				13,367
Subtotal (10 - 80)	9.00	365,209	71,500	**436,709**	**$ 48,523**		**95%**	**472,129**
90 UNALLOCATED CONTINGENCY				**21,971**			**5%**	**23,783**
Subtotal (10 - 90)	9.00			**458,680**	**$ 50,964**		**100%**	**495,911**
100 FINANCE CHARGES				**469**			**0%**	**500**
Total Project Cost (10 - 100)	9.00			**459,149**	**$ 51,017**		**100%**	**496,411**
Allocated Contingency as % of Base Yr Dollars w/o Contingency				19.58%				
Unallocated Contingency as % of Base Yr Dollars w/o Contingency				6.02%				
Total Contingency as % of Base Yr Dollars w/o Contingency				25.59%				
Unallocated Contingency as % of Subtotal (10 - 80)				5.03%				
YOE Construction Cost per Mile (X000)								$36,145
YOE Total Project Cost per Mile Not Including Vehicles (X000)								$51,080
YOE Total Project Cost per Mile (X000)								$55,157

Source: FTA, 2009

1.2. Cost Database and Unit Costs

1.2.1. Unit Costs

This capital cost estimate utilizes the most current unit cost data available locally. The capital cost estimate is priced in first quarter 2017 US dollars. In addition, pricing has been adjusted to reflect the magnitude of quantities relative to the bid quantities and similar track and station work. The Metro Blue, Green, Gold Line Assessment of Operations Capital Improvements cost estimate has been examined to provide further validation of the unit costs used in this estimate. The database of unit costs is presented in Table 1.1.

Table 1.1. Cost Database Table

Metro Orange Line - 5% Conceptual Design Drawings

Cost Database					
Item	Description	SCC	Plan Location	Unit	Unit Cost
1	Guideway: At-grade exclusive right-of-way	10.01			
2	Guideway: At-grade semi-exclusive (allows cross-traffic)	10.02			
3	Guideway: At-grade in mixed traffic	10.03			
4	Guideway: Aerial structure	10.04	CK-01, CK-02, CK-03, CK-04, CK-09	SF	$ 500
5	Guideway: Built-up fill	10.05	CK-01, CK-02, CK-03, CK-04, CK-09	CY	$ 40
6	Guideway: Underground cut & cover	10.06	CK-05, CK-06, CK-07, CK-09	SF	$ 500
7	Guideway: Underground tunnel	10.07			
8	Guideway: Retained cut or fill	10.08			
9	Earthwork (cut or fill)	10.08	CK-01, CK-02, CK-03, CK-04, CK-05, CK-06, CK-07, CK-08, CK-09	CY	$ 50
10	Guideway Retaining Walls - Fill (MSE or other)	10.08	CK-01, CK-02, CK-03, CK-04, CK-09	SF	$ 125
11	Guideway Retaining Walls - Cut	10.08	CK-05, CK-06, CK-07, CK-09	SF	$ 175
12	Track: Direct fixation (Assume SCC 10.04 & 10.07)	10.09			
13	Track: Embedded	10.10			
14	Track: Ballasted (Assume SCC 10.01 & 10.02)	10.11			
15	Track: Special (switches, turnouts)	10.12			
16	Track: Vibration and noise dampening	10.13			
17	At-grade station, stop, shelter, mall, platform	20.01			
18	Aerial station, stop, shelter, mall, terminal, platform	20.02			
19	Structural Concrete	20.02	A1-001, A1-101, A1-102, A1-201, A2-001, A2-101, A2-102, A2-201, A3-001, A3-101, A3-102, A3-201	CY	$ 1,800
20	Platform Concrete	20.02	A1-101, A1-102, A1-201, A2-101, A2-102, A2-201, A3-101, A3-102, A3-201	CY	$ 1,200
21	Platform Beam/Footing	20.02	S-101, S-201, S-301	CY	$ 1,200
22	Structural Retaining Walls	20.02	S-101, S-201, S-301	SF	$ 450
23	Canopy	20.02	A2-001, A2-201, A3-001, A3-201	SF	$ 150
24	Fixtures (Benches, Map Cases, Trash Receptacles, Etc.)	20.02	A1-001, A1-101, A1-102, A1-201, A2-001, A2-101, A2-102, A2-201, A3-001, A3-101, A3-102, A3-201	LS	$ 75,000
25	Handrailing	20.02	A1-201, A2-201, A3-201	LF	$ 175

Metro Orange Line - 5% Conceptual Design Drawings

Cost Database

Item	Description	SCC	Plan Location	Unit	Unit Cost
26	Platform Signage	20.02	A1-101, A1-102, A1-201, A2-101, A2-102, A2-201, A3-101, A3-102, A3-201	LS	$ 40,000
27	Lighting/Electrical/Communication	20.02	A1-101, A1-102, A1-201, A2-101, A2-102, A2-201, A3-101, A3-102, A3-201	LS	$ 300,000
28	Stairwells: Aerial Stations	20.02	A1-001, A1-101, A1-102, A1-201, A2-001, A2-101, A2-102, A2-201, A3-001, A3-101, A3-102, A3-201,	SF	$ 200
29	Tactile Warning Strip	20.02	A1-001, A1-101, A1-102, A1-201, A2-001, A2-101, A2-102, A2-201, A3-001, A3-101, A3-102, A3-201	SF	$ 45
30	Ramp	20.02	N/A	SF	$ 88
31	Excavation (Cut) for station improvements	20.03	A4-101, A4-102, A4-201, A5-001, A5-101, A5-102, A5-201	CY	$ 40
32	Structural Concrete	20.03	A4-101, A4-102, A4-201, A5-001, A5-101, A5-102, A5-201	CY	$ 1,800
33	Platform Concrete	20.03	A4-101, A4-102, A4-201, A5-001, A5-101, A5-102, A5-201	CY	$ 1,200
34	Platform Beam/Footing	20.03	S-401, S-402, S-403,S-404, S-501, S-601	CY	$ 1,200
35	Structural Retaining Walls	20.03	S-401, S-402, S-403,S-404, S-501, S-601	SF	$ 150
36	Canopy	20.03	A4-001, A4-201, A5-001, A5-201	SF	$ 150
37	Fixtures (Benches, Map Cases, Trash Receptacles, Etc.)	20.03	A4-001, A4-101, A4-102, A4-201, A5-001, A5-101, A5-201	LS	$ 75,000
38	Handrailing	20.03	A4-201, A5-201	LF	$ 175
39	Platform Signage	20.03	A4-101, A4-102, A4-201, A5-001, A5-101, A5-201	LS	$ 40,000
40	Lighting/Electrical/Communication	20.03	A4-101, A4-102, A4-201, A5-001, A5-101, A5-201	LS	$ 350,000
41	Stairwells: Underground Stations	20.03	A4-001, A4-101, A4-102, A4-201, A5-001, A5-101, A5-102, A5-201	SF	$ 250
42	Tactile Warning Strip	20.03	A4-001, A4-101, A4-102, A4-201, A5-001, A5-101, A5-102, A5-201	SF	$ 45
43	Ramp	20.03	N/A	SF	$ 88
44	Other stations, landings, terminals: Intermodal, ferry, trolley, etc.	20.04			
45	Joint development	20.05			
46	Automobile parking multi-story structure	20.06			
47	Elevators	20.07	A1-001, A1-101, A1-102, A1-201, A2-001, A2-101, A2-102, A2-201, A3-001, A3-101, A3-102, A3-201, A4-001, A4-101, A4-102, A4-201, A5-001, A5-101, A5-102, A5-201	EA	$ 600,000
48	Escalators	20.08	A1-001, A1-101, A1-102, A1-201, A2-001, A2-101, A2-102, A2-201, A3-001, A3-101, A3-102, A3-201, A4-001, A4-101, A4-102, A4-201, A5-001, A5-101, A5-102, A5-201	EA	$ 500,000
49	Administration Building: Office, sales, storage, revenue counting	30.01			
50	Light Maintenance Facility	30.02			
51	Heavy Maintenance Facility	30.03			
52	Storage or Maintenance of Way Building	30.04			
53	Yard and Yard Track	30.05			
54	Demolition, Clearing, Earthwork	40.01			
55	General Demolition	40.01	CK-01, CK-02, CK-03, CK-04, CK-05, CK-06, CK-07, CK-08	LS	N/A
56	Maintain Access to Driveways	40.01	CK-01, CK-02, CK-03, CK-04, CK-05, CK-06, CK-07, CK-08	LS	N/A
57	Site Utilities, Utility Relocation	40.02			
58	General Utility Relocation	40.02	UT-01 to UT-09	LS	N/A
59	Overhead Utility Relocation	40.02	UT-01 to UT-09	EA	$ 600,000
60	Utility Protection-in-Place	40.02	UT-01 to UT-09	LF	$ 1,000
61	Street Lights	40.02	UT-01 to UT-09	EA	$ 8,000
62	Adjust Traffic Signals	40.02	UT-01 to UT-09	EA	$ 100,000

Metro Orange Line - 5% Conceptual Design Drawings

Cost Database

Item	Description	SCC	Plan Location	Unit	Unit Cost
63	Drainage 24" RCP	40.02	Preliminary Drainage Study	LF	$ 150
64	Drainage 36" RCP	40.02	Preliminary Drainage Study	LF	$ 140
65	Drainage 51" RCP	40.02	Preliminary Drainage Study	LF	$ 180
66	Drainage 57" RCP	40.02	Preliminary Drainage Study	LF	$ 200
67	Drainage Inlet	40.02	Preliminary Drainage Study	EA	$ 3,000
68	Drainage: Manhole Structure	40.02	Preliminary Drainage Study	EA	$ 8,000
69	Manhole Structure (depth > 25')	40.02	Preliminary Drainage Study	EA	$ 25,000
70	6'-4" W x 7'-6" H RCB (Cl A)	40.02	Preliminary Drainage Study	CY	$ 1,000
71	Transition Structure	40.02	Preliminary Drainage Study	EA	$ 20,000
72	Concrete Collar	40.02	Preliminary Drainage Study	EA	$ 2,000
73	Curb Inlet Catch Basin	40.02	Preliminary Drainage Study	EA	$ 3,500
74	Storm Drainage Facilities - Station Area	40.02	Preliminary Drainage Study	LS	$ 100,000
75	Haz. mat'l, contam'd soil removal/mitigation, ground water treatments	40.03			
76	Water Quality BMPs	40.03	Preliminary Drainage Study	LS	N/A
77	Environmental mitigation, e.g. wetlands, historic/archeologic, parks	40.04	CK-01, CK-02, CK-03, CK-04, CK-05, CK-06, CK-07, CK-08	RF	$ 150
78	Site structures including retaining walls, sound walls	40.05			
79	Misc. Retaining Walls (Incl. Shoring)	40.05	CK-01, CK-02, CK-03, CK-04, CK-05, CK-06, CK-07, CK-08	SF	$ 75
80	Sound Wall	40.05	CK-01, CK-02, CK-03, CK-04, CK-05, CK-06, CK-07, CK-08	SF	$ 50
81	Roadway Bridges	40.05	S-403, S-404	SF	$ 400
82	Pedestrian / bike access and accommodation, landscaping	40.06			
83	Relocation/Reconstruction of Existing Bike Path	40.06	CK-01, CK-02, CK-03, CK-04, CK-05, CK-06, CK-07, CK-08	LF	$ 250
84	Automobile, bus (non-BRT Guideway), van accessways including roads, parking lots	40.07			
85	Asphalt Concrete Paving (elevated)	40.07	S-402, S-501	SF	$ 9.50
86	Roadway Base (at grade)	40.07	S-402, S-501	CY	$ 40
87	Asphalt Concrete Paving (at grade)	40.07	S-402, S-501	SF	$ 7.50
88	Minor Protect in Place - Landscaping, Etc	40.07	S-402, S-501	LS	$ 100,000
89	Roadway Signals - Intersection Modifications	40.07	S-402, S-501	EA	$ 200,000
90	Roadway Signage and Striping	40.07	S-402, S-501	EA	$ 10,000
91	Temporary BRT guideway (shoo-fly) during construction	40.07	CK-01, CK-02, CK-03, CK-04, CK-05, CK-06, CK-07, CK-08	RF	$ 150
92	Temporary Roadway Signals - Interstections	40.07	N/A	EA	$ 75,000
93	Temporary Facilities and other indirect costs during construction	40.08	TBD	SCC 10-50	10%
94	Flagging	40.08	TBD	Day	$ 1,200
95	Train control and signals	50.01			
96	Traffic signals and crossing protection (including removal of existing)	50.02	S-402, S-501	EA	$ 100,000
97	Traction power supply: substations	50.03			
98	Traction power distribution: catenary and third rail	50.04			
99	Communications	50.05	A1-101 to A1-102, A2-101 to A2-102, A3-101 to A3-102, A4-101 to A4-102, A4-201, A5-101 to A5-102, A5-201	LS	$ 450,000
100	Fare collection system and equipment	50.06	A1-101 to A1-102, A2-101 to A2-102, A3-101 to A3-102, A4-101 to A4-102, A4-201, A5-101 to A5-102, A5-201	LS	$ 300,000
101	Central Control	50.07			
102	Purchase or lease of real estate	60.01	N/A	AC	$ 3,000,000
103	Relocation of existing households and businesses	60.02			
104	Light Rail	70.01			
105	Heavy Rail	70.02			
106	Commuter Rail	70.03			
107	Bus (60' Articulated Bus)	70.04			
108	Bus (40' Bus)	70.05			
109	Non-revenue vehicles	70.06			
110	Spare parts	70.07			

1.2.2. Quantities

Quantities for cost estimates were taken off the five percent conceptual plans for each individual Grade Separation Analysis and Operational Improvements Technical Study location.

1.3. OTHER COST ASSUMPTIONS

Several other assumptions have been made to calculate capital costs. They are discussed below.

1.3.1. Right-of-Way

Cost estimates associated with ROW acquisition and easements are based on a brief review of the improvement plans and estimation of how much work, if any, needs to be constructed off existing Metro ROW. A contingency of 30 percent is applied to the ROW cost estimates.

1.3.2. Soft Costs

The development of capital cost estimates include the assumptions for soft costs shown in Table 1.2. Soft costs may vary slightly depending on the selected contract procurement methods in practice by the agency, such as design-bid-build versus design-build. The smaller projects assume a traditional design-bid-build method, while the larger projects assume a design-build construction method, similar to other recent large Metro BRT construction projects. Insurance costs are assumed to be rolled up in other soft costs.

Table 1.2. Soft Cost Assumptions

Soft Cost Category	Percentage
AA/Draft EIS/EIR/Final EIS/EIR	3%
Preliminary Engineering	3%
Final Design	7%
Project Management (Agency)	10%
Construction Management (Consultants)	5%
Insurance	-
Legal	1%
Surveys	2%
Start Up	5%

1.3.3. Contingencies

In addition to the contingency for ROW, other contingencies have been applied to the cost estimates. These include individual contingences, as well as an overall unallocated contingency for the project. Contingency percentages have been calculated using recent cost

estimating experience as a guide. Generally, 25 percent is applied as a default contingency for this estimate. Aspects of the project which are more highly developed, such as crossings and vehicles, use lesser contingencies. Areas where significant uncertainty remains, such as utilities and ROW, use higher contingencies. The contingencies that were used for this estimate are listed in Table 1.3 according to SCC category.

Table 1.3. Contingencies by Standard Cost Category

SCC #	SCC Category	Contingency
10	Guideway	25%
10.08	Guideway – Retained Cut or Fill	20%
20	Stations	25%
30	Support Facilities	20%
40	Sitework	30%
50	Systems	25%
60	ROW	30%
70	Vehicles	5%
80	Soft Costs	15%
90	Unallocated Contingency	15%
	Average Allocated Contingency	23%
10-100	**Overall Contingency**	**Approx. 38%**

1.3.4. Year of Expenditure

Year of expenditure cost is the base year cost escalated from the current year to mid-point year of construction by an assumed escalation rate of three percent per year. For the Metro Orange Line, costs are based on current 2017 prices and year of anticipated midpoint of construction is 2022 (5 years).

1.3.5. Estimate Limitations

These cost estimates are based on five percent conceptual design plans. They do not yet include detailed estimates of environmental mitigation, utility relocations, soft costs and several other areas of concern. This estimate may be further updated as the environmental and engineering processes progress with consideration for an independent cost estimate and risk assessment conducted in subsequent phases. Overall contingencies are currently at a level (approximately 38 percent) appropriate for this level of design. Contingency rates will be lowered over time as the design progresses.

2. NEXT STEPS

Cost estimates have been prepared for each Grade Separation Analysis and Operational Improvements Technical Study location based upon final five percent conceptual plans, and information presented in the Initial Assessment Report.

The cost estimates will be added to the compilation of all studied aspects undertaken in the Metro Orange Line Grade Separation Analysis and Operational Improvements Technical Study, and presented in the Draft Report, and ultimately the Final Report. Individual standalone project packets, detailing cost estimates and all other gathered and developed information during this assessment, will also be produced.

APPENDIX C: COST DETAIL

MAIN WORKSHEET-BUILD ALTERNATIVE

Los Angeles County Metropolitan Transportation Authority (LACMTA) | Today's Date: 6/9/17
Metro Orange Line, Los Angeles, CA | Yr of Base Year $: 2017
Reseda Boulevard - Aerial BRT | Yr of Midpoint of Construction: 2022

	Units	Unit Price	Quantity	Base Year Dollars w/o Contingency	Allocated Contingency	Base Year Dollars Allocated Contingency	Base Year Dollars TOTAL	YOE Dollars Total (3% Escalation per year)
10 GUIDEWAY & TRACK ELEMENTS (route miles)				**$ 19,674,745**	**24%**	**$ 4,765,830**	**$ 24,440,575**	**$ 28,333,325**
10.01 Guideway: At-grade exclusive right-of-way							$ -	$ -
10.02 Guideway: At-grade semi-exclusive (allows cross-traffic)							$ -	$ -
10.03 Guideway: At-grade in mixed traffic							$ -	$ -
10.04 Guideway: Aerial structure	SF	$ 450	19405	$ 8,732,250	25%	$ 2,183,063	$ 10,915,313	$ 12,653,839
10.05 Guideway: Built-up fill	CY	$ 40	73	$ 2,920	20%	$ 584	$ 3,504	$ 4,062
10.06 Guideway: Underground cut & cover							$ -	$ -
10.07 Guideway: Underground tunnel							$ -	$ -
10.08 Guideway: Retained cut or fill				$ 10,939,575		$ 2,582,184	$ 13,521,759	$ 15,675,424
Earthwork (cut or fill)	*CY*	*$ 50*	*61084*	*$ 3,054,200*	*20%*	*$ 610,840*	*$ 3,665,040*	$ 4,248,786
Guideway Retaining Walls - Fill (MSE or other)	*SF*	*$ 125*	*63083*	*$ 7,885,375*	*25%*	*$ 1,971,344*	*$ 9,856,719*	$ 11,426,639
Guideway Retaining Walls - Cut	*SF*	*$ 175*	*0*	*$ -*	*25%*	*$ -*	*$ -*	$ -
10.09 Track: Direct fixation (Assume SCC 10.04 & 10.07)							$ -	$ -
10.10 Track: Embedded							$ -	$ -
10.11 Track: Ballasted (Assume SCC 10.01 & 10.02)							$ -	$ -
10.12 Track: Special (switches, turnouts)							$ -	$ -
10.13 Track: Vibration and noise dampening							$ -	$ -
20 STATIONS, STOPS, TERMINALS, INTERMODAL (number)				**$ 7,369,525**	**25%**	**$ 1,842,381**	**$ 9,211,906**	**$ 10,679,124**
20.01 At-grade station, stop, shelter, mall, platform							$ -	$ -
20.02 Aerial station, stop, shelter, mall, terminal, platform				$ 3,969,525		$ 992,381	$ 4,961,906	$ 5,752,209
Structural Concrete	*CY*	*$ 1,800*	*60*	*$ 108,000*	*25%*	*$ 27,000*	$ 135,000	$ 156,502
Platform Concrete	*CY*	*$ 1,200*	*1050*	*$ 1,260,000*	*25%*	*$ 315,000*	$ 1,575,000	$ 1,825,857
Platform Beam/Footing	*CY*	*$ 1,200*	*170*	*$ 204,000*	*25%*	*$ 51,000*	$ 255,000	$ 295,615
Structural Retaining Walls	*SF*	*$ 450*	*500*	*$ 225,000*	*25%*	*$ 56,250*	$ 281,250	$ 326,046
Canopy	*SF*	*$ 150*	*7455*	*$ 1,118,250*	*25%*	*$ 279,563*	$ 1,397,813	$ 1,620,448
Fixtures (Benches, Map Cases, Trash Receptacles, Etc.)	*LS*	*$ 75,000*	*1*	*$ 75,000*	*25%*	*$ 18,750*	$ 93,750	$ 108,682
Handrailing	*LF*	*$ 175*	*1065*	*$ 186,375*	*25%*	*$ 46,594*	$ 232,969	$ 270,075
Platform Signage	*LS*	*$ 40,000*	*1*	*$ 40,000*	*25%*	*$ 10,000*	$ 50,000	$ 57,964
Lighting/Electrical/Communication	*LS*	*$ 300,000*	*1*	*$ 300,000*	*25%*	*$ 75,000*	$ 375,000	$ 434,728
Stairwells: Aerial Stations	*SF*	*$ 200*	*1900*	*$ 380,000*	*25%*	*$ 95,000*	$ 475,000	$ 550,655
Tactile Warning Strip	*SF*	*$ 45*	*1620*	*$ 72,900*	*25%*	*$ 18,225*	$ 91,125	$ 105,639
Ramp	*SF*	*$ 88*	*0*	*$ -*	*25%*	*$ -*	$ -	$ -
20.03 Underground station, stop, shelter, mall, terminal, platform							$ -	$ -
Structural Concrete							$ -	$ -
Platform Concrete							$ -	$ -
Platform Beam/Footing							$ -	$ -
Structural Retaining Walls							$ -	$ -
Canopy							$ -	$ -
Fixtures (Benches, Map Cases, Trash Receptacles, Etc.)							$ -	$ -
Handrailing							$ -	$ -
Platform Signage							$ -	$ -
Lighting/Electrical/Communication							$ -	$ -
Stairwells: Underground Stations							$ -	$ -
Tactile Warning Strip							$ -	$ -
Ramp							$ -	$ -
20.04 Other stations, landings, terminals: Intermodal, ferry, trolley, etc.							$ -	$ -
20.05 Joint development							$ -	$ -
20.06 Automobile parking multi-story structure							$ -	$ -
20.07 Elevators	EA	$ 600,000	4	$ 2,400,000	25%	$ 600,000	$ 3,000,000	$ 3,477,822
20.08 Escalators	EA	$ 500,000	2	$ 1,000,000	25%	$ 250,000	$ 1,250,000	$ 1,449,093
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS				**$ -**		**$ -**	**$ -**	**$ -**
30.01 Administration Building: Office, sales, storage, revenue counting							$ -	$ -
30.02 Light Maintenance Facility							$ -	$ -
30.03 Heavy Maintenance Facility							$ -	$ -
30.04 Storage or Maintenance of Way Building							$ -	$ -
30.05 Yard and Yard Track							$ -	$ -
40 SITEWORK & SPECIAL CONDITIONS				**$ 5,493,065**	**30%**	**$ 1,647,919**	**$ 7,140,984**	**$ 8,278,358**
40.01 Demolition, Clearing, Earthwork				$ 280,000		$ 84,000	$ 364,000	$ 421,976
General Demolition	*LS*	*$ 280,000*	*1*	*$ 280,000*	*30%*	*$ 84,000*		$ -
40.02 Site Utilities, Utility Relocation				$ 1,942,000		$ 582,600	$ 2,524,600	$ 2,926,703
General Utility Relocation	*LS*	*$ 250,000*	*1*	*$ 250,000*	*30%*	*$ 75,000*	*$ 325,000*	$ 376,764
Overhead Utility Relocation	*EA*	*$ 600,000*	*1*	*$ 600,000*	*30%*	*$ 180,000*	*$ 780,000*	$ 904,234
Utility Protection-in-Place	*LF*	*$ 1,000*	*100*	*$ 100,000*	*30%*	*$ 30,000*	*$ 130,000*	$ 150,706
Street Lights	*EA*	*$ 8,000*	*8*	*$ 64,000*	*30%*	*$ 19,200*	*$ 83,200*	$ 96,452
Drainage 24" RCP	*LF*	*$ 150*	*4400*	*$ 660,000*	*30%*	*$ 198,000*	*$ 858,000*	$ 994,657
Drainage 36" RCP	*LF*	*$ 140*	*0*	*$ -*	*30%*	*$ -*	*$ -*	$ -
Drainage 51" RCP	*LF*	*$ 180*	*0*	*$ -*	*30%*	*$ -*	*$ -*	$ -
Drainage 57" RCP	*LF*	*$ 200*	*0*	*$ -*	*30%*	*$ -*	*$ -*	$ -
Drainage Inlet	*EA*	*$ 3,000*	*24*	*$ 72,000*	*30%*	*$ 21,600*	*$ 93,600*	$ 108,508
Drainage: Manhole Structure	*EA*	*$ 8,000*	*12*	*$ 96,000*	*30%*	*$ 28,800*	*$ 124,800*	$ 144,677
Manhole Structure (depth > 25')	*EA*	*$ 25,000*	*0*	*$ -*	*30%*	*$ -*	*$ -*	$ -
6'-4" W x 7'-6" H RCB (Cl A)	*CY*	*$ 1,000*	*0*	*$ -*	*30%*	*$ -*	*$ -*	$ -
Transition Structure	*EA*	*$ 20,000*	*0*	*$ -*	*30%*	*$ -*	*$ -*	$ -
Concrete Collar	*EA*	*$ 2,000*	*0*	*$ -*	*30%*	*$ -*	*$ -*	$ -
Curb Inlet Catch Basin	*EA*	*$ 3,500*	*0*	*$ -*	*30%*	*$ -*	*$ -*	$ -
Storm Drainage Facilities - Station Area	*LS*	*$ 100,000*	*1*	*$ 100,000*	*30%*	*$ 30,000*	*$ 130,000*	$ 150,706
40.03 Haz. mat'l, contam'd soil removal/mitigation, ground water treatments				$ 300,000		$ 90,000	$ 390,000	$ 452,117
Water Quality BMPs	*LS*	*$ 300,000*	*1*	*$ 300,000*	*30%*	*$ 90,000*	*$ 390,000*	$ 452,117
40.04 Environmental mitigation, e.g. wetlands, historic/archeologic, parks	RF	$ 150	2800	$ 420,000	30%	$ 126,000	$ 546,000	$ 632,964
40.05 Site structures including retaining walls, sound walls				$ 75,000		$ 22,500	$ 97,500	$ 113,029
Misc. Retaining Walls (Incl. Shoring)	*SF*	*$ 75*	*1000*	*$ 75,000*	*30%*	*$ 22,500*	*$ 97,500*	$ 113,029
Sound Wall	*SF*	*$ 50*	*0*	*$ -*	*30%*	*$ -*	*$ -*	$ -
Roadway Bridges	*SF*	*$ 400*	*0*	*$ -*	*30%*	*$ -*	*$ -*	$ -
40.06 Pedestrian / bike access and accommodation, landscaping				$ 296,250		$ 88,875	$ 385,125	$ 446,465
Relocation/Reconstruction of Existing Bike Path	*LF*	*$ 250*	*1185*	*$ 296,250*	*30%*	*$ 88,875*	*$ 385,125*	$ 446,465
40.07 Automobile, bus (non-BRT Guideway), van accessways including roads,				$ 2,179,815		$ 653,944	$ 2,833,759	$ 3,285,104
Asphalt Concrete Paving (elevated)	*SF*	*$ 9.50*	*140000*	*$ 1,330,000*	*30%*	*$ 399,000*	*$ 1,729,000*	$ 2,004,385
Roadway Base (at grade)	*CY*	*$ 40*	*370*	*$ 14,815*	*30%*	*$ 4,444*	*$ 19,259*	$ 22,327
Asphalt Concrete Paving (at grade)	*SF*	*$ 7.50*	*10000*	*$ 75,000*	*30%*	*$ 22,500*	*$ 97,500*	$ 113,029
Minor Protect in Place - Landscaping, Etc	*LS*	*$ 100,000*	*1*	*$ 100,000*	*30%*	*$ 30,000*	*$ 130,000*	$ 150,706
Roadway Signals - Intersection Modifications	*EA*	*$ 200,000*	*1*	*$ 200,000*	*30%*	*$ 60,000*	*$ 260,000*	$ 301,411
Roadway Signage and Striping	*EA*	*$ 10,000*	*1*	*$ 10,000*	*30%*	*$ 3,000*	*$ 13,000*	$ 15,071
Temporary BRT guideway (shoo-fly) during construction	*RF*	*$ 150*	*3000*	*$ 450,000*	*30%*	*$ 135,000*	*$ 585,000*	$ 678,175
Temporary Roadway Signals - Interstections	*EA*	*$ 75,000*	*0*	*$ -*	*30%*	*$ -*	*$ -*	$ -
40.08 Temporary Facilities and other indirect costs during construction				$ -		$ -	$ -	$ -
Flagging	*Day*	*$ 1,200*	*0*	*$ -*	*30%*	*$ -*	*$ -*	$ -
50 SYSTEMS				**$ 400,000**	**25%**	**$ 100,000**	**$ 500,000**	**$ 579,637**
50.01 Train control and signals							$ -	$ -
50.02 Traffic signals and crossing protection (including removal of existing)	EA	$ 100,000	1	$ 100,000	25%	$ 25,000	$ 125,000	$ 144,909
50.03 Traction power supply: substations							$ -	$ -
50.04 Traction power distribution: catenary and third rail							$ -	$ -
50.05 Communications							$ -	$ -
50.06 Fare collection system and equipment	EA	$ 300,000	1	$ 300,000	25%	$ 75,000	$ 375,000	$ 434,728
50.07 Central Control							$ -	$ -
Construction Subtotal (10 - 50)				**$ 32,937,335**	**25%**	**$ 8,356,131**	**$ 41,293,466**	**$ 47,870,444**
60 ROW, LAND, EXISTING IMPROVEMENTS				**$ -**	**0%**	**$ -**	**$ -**	**$ -**
60.01 Purchase or lease of real estate	AC	$ 3,000,000	0	$ -	30%	$ -	$ -	$ -
60.02 Relocation of existing households and businesses							$ -	$ -
70 VEHICLES (number)				**$ -**	**0%**	**$ -**	**$ -**	**$ -**
70.01 Light Rail							$ -	$ -
70.02 Heavy Rail							$ -	$ -
70.03 Commuter Rail							$ -	$ -
70.04 Bus (60' Articulated Bus)							$ -	$ -
70.05 Bus (40' Bus)							$ -	$ -
70.06 Non-revenue vehicles							$ -	$ -
70.07 Spare parts							$ -	$ -
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)	**0**	**33%**		**$ 10,869,320**	**15%**	**$ 1,630,398**	**$ 12,499,719**	**$ 14,490,600**
80.01 AA/Draft EIS/EIR/Final EIS/EIR	SCC 10-50	3%		$ 988,120	15%	$ 148,218	$ 1,136,338	$ 1,317,327
80.01 Preliminary Engineering	SCC 10-50	3%		$ 988,120	15%	$ 148,218	$ 1,136,338	$ 1,317,327
80.02 Final Design	SCC 10-50	7%		$ 2,305,613	15%	$ 345,842	$ 2,651,455	$ 3,073,764
80.03 Project Management for Design and Construction	SCC 10-50	10%		$ 3,293,733	15%	$ 494,060	$ 3,787,794	$ 4,391,091
80.04 Construction Administration & Management	SCC 10-50	5%		$ 1,646,867	15%	$ 247,030	$ 1,893,897	$ 2,195,545
80.05 Professional Liability and other Non-Construction Insurance	SCC 10-50	0%		$ -	15%	$ -	$ -	$ -
80.06 Legal; Permits; Review Fees by other agencies, cities, etc.	SCC 10-50	1%		$ 329,373	15%	$ 49,406	$ 378,779	$ 439,109
80.07 Surveys, Testing, Investigation, Inspection	SCC 10-50	2%		$ 658,747	15%	$ 98,812	$ 757,559	$ 878,218
80.08 Start up	SCC 10-50	5%		$ 1,646,867	15%	$ 247,030	$ 1,893,897	$ 2,195,545
Subtotal (10 - 80)				**$ 43,806,655**	**23%**	**$ 9,986,529**	**$ 53,793,184**	**$ 62,361,044**
90 UNALLOCATED CONTINGENCY	SCC 10-80	15%					**$ 8,068,978**	**$ 9,354,157**
Subtotal (10 - 90)							**$ 61,862,162**	**$ 71,715,201**
100 FINANCE CHARGES							**$ -**	**$ -**
Total Project Cost (10 - 100)							**$ 61,862,162**	**$ 71,715,201**

MAIN WORKSHEET-BUILD ALTERNATIVE

Los Angeles County Metropolitan Transportation Authority (LACMTA)
Metro Orange Line, Los Angeles, CA
Sepulveda Boulevard/Van Nuys Boulevard - Aerial BRT

Today's Date **6/9/17**
Yr of Base Year $ 2017
Yr of Midpoint of Construction 2022

	Units	Unit Price	Quantity	Base Year Dollars w/o Contingency	Allocated Contingency	Base Year Dollars Allocated Contingency	Base Year Dollars TOTAL	YOE Dollars Total (3% Escalation per year)
10 GUIDEWAY & TRACK ELEMENTS (route miles)				**$ 69,618,716**	**24%**	**$ 16,773,976**	**$ 86,392,693**	**$ 100,152,809**
10.01 Guideway: At-grade exclusive right-of-way							$ -	$ -
10.02 Guideway: At-grade semi-exclusive (allows cross-traffic)							$ -	$ -
10.03 Guideway: At-grade in mixed traffic							$ -	$ -
10.04 Guideway: Aerial structure	SF	$ 450	49523	$ 22,285,350	25%	$ 5,571,338	$ 27,856,688	$ 32,293,536
10.05 Guideway: Built-up fill	CY	$ 40	76	$ 3,040	20%	$ 608	$ 3,648	$ 4,229
10.06 Guideway: Underground cut & cover							$ -	$ -
10.07 Guideway: Underground tunnel							$ -	$ -
10.08 Guideway: Retained cut or fill				$ 47,330,326		$ 11,202,031	$ 58,532,357	$ 67,855,044
Earthwork (cut or fill)	*CY*	*$ 50*	*252220*	*$ 12,611,014*	*20%*	*$ 2,522,203*	*$ 15,133,217*	$ 17,543,546
Guideway Retaining Walls - Fill (MSE or other)	*SF*	*$ 125*	*277754*	*$ 34,719,312*	*25%*	*$ 8,679,828*	*$ 43,399,140*	$ 50,311,498
Guideway Retaining Walls - Cut	*SF*	*$ 175*	*0*	*$ -*	*25%*	*$ -*	*$ -*	$ -
10.09 Track: Direct fixation (Assume SCC 10.04 & 10.07)							$ -	$ -
10.10 Track: Embedded							$ -	$ -
10.11 Track: Ballasted (Assume SCC 10.01 & 10.02)							$ -	$ -
10.12 Track: Special (switches, turnouts)							$ -	$ -
10.13 Track: Vibration and noise dampening							$ -	$ -
20 STATIONS, STOPS, TERMINALS, INTERMODAL (number)				**$ 9,462,550**	**25%**	**$ 2,365,638**	**$ 11,828,188**	**$ 13,712,111**
20.01 At-grade station, stop, shelter, mall, platform							$ -	$ -
20.02 Aerial station, stop, shelter, mall, terminal, platform				$ 5,062,550		$ 1,265,638	$ 6,328,188	$ 7,336,104
Structural Concrete	*CY*	*$ 1,800*	*120*	*$ 216,000*	*25%*	*$ 54,000*	*$ 270,000*	$ 313,004
Platform Concrete	*CY*	*$ 1,200*	*1400*	*$ 1,680,000*	*25%*	*$ 420,000*	*$ 2,100,000*	$ 2,434,476
Platform Beam/Footing	*CY*	*$ 1,200*	*250*	*$ 300,000*	*25%*	*$ 75,000*	*$ 375,000*	$ 434,728
Structural Retaining Walls	*SF*	*$ 450*	*1500*	*$ 675,000*	*25%*	*$ 168,750*	*$ 843,750*	$ 978,138
Canopy	*SF*	*$ 150*	*5310*	*$ 796,500*	*25%*	*$ 199,125*	*$ 995,625*	$ 1,154,202
Fixtures (Benches, Map Cases, Trash Receptacles, Etc.)	*LS*	*$ 75,000*	*2*	*$ 131,250*	*25%*	*$ 32,813*	*$ 164,063*	$ 190,193
Handrailing	*LF*	*$ 175*	*784*	*$ 137,200*	*25%*	*$ 34,300*	*$ 171,500*	$ 198,816
Platform Signage	*LS*	*$ 40,000*	*2*	*$ 80,000*	*25%*	*$ 20,000*	*$ 100,000*	$ 115,927
Lighting/Electrical/Communication	*LS*	*$ 300,000*	*2*	*$ 600,000*	*25%*	*$ 150,000*	*$ 750,000*	$ 869,456
Stairwells: Aerial Stations	*SF*	*$ 200*	*1504*	*$ 300,800*	*25%*	*$ 75,200*	*$ 376,000*	$ 435,887
Tactile Warning Strip	*SF*	*$ 45*	*3240*	*$ 145,800*	*25%*	*$ 36,450*	*$ 182,250*	$ 211,278
Ramp	*SF*	*$ 88*	*0*	*$ -*	*25%*	*$ -*	*$ -*	$ -
20.03 Underground station, stop, shelter, mall, terminal, platform							$ -	$ -
Structural Concrete							$ -	$ -
Platform Concrete							$ -	$ -
Platform Beam/Footing							$ -	$ -
Structural Retaining Walls								$ -
Canopy							$ -	$ -
Fixtures (Benches, Map Cases, Trash Receptacles, Etc.)							$ -	$ -
Handrailing							$ -	$ -
Platform Signage							$ -	$ -
Lighting/Electrical/Communication							$ -	$ -
Stairwells: Underground Stations							$ -	$ -
Tactile Warning Strip							$ -	$ -
Ramp							$ -	$ -
20.04 Other stations, landings, terminals: Intermodal, ferry, trolley, etc.							$ -	$ -
20.05 Joint development							$ -	$ -
20.06 Automobile parking multi-story structure							$ -	$ -
20.07 Elevators	EA	$ 600,000	4	$ 2,400,000	25%	$ 600,000	$ 3,000,000	$ 3,477,822
20.08 Escalators	EA	$ 500,000	4	$ 2,000,000	25%	$ 500,000	$ 2,500,000	$ 2,898,185
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS				**$ -**		**$ -**	**$ -**	**$ -**
30.01 Administration Building: Office, sales, storage, revenue counting							$ -	$ -
30.02 Light Maintenance Facility							$ -	$ -
30.03 Heavy Maintenance Facility							$ -	$ -
30.04 Storage or Maintenance of Way Building							$ -	$ -
30.05 Yard and Yard Track							$ -	$ -
40 SITEWORK & SPECIAL CONDITIONS				**$ 15,093,315**	**30%**	**$ 4,527,994**	**$ 19,621,309**	**$ 22,746,475**
40.01 Demolition, Clearing, Earthwork				$ 800,000		$ 240,000	$ 1,040,000	$ 1,205,645
General Demolition	*LS*	*$ 800,000*	*1*	*$ 800,000*	*30%*	*$ 240,000*		$ -
40.02 Site Utilities, Utility Relocation				$ 5,371,000		$ 1,611,300	$ 6,982,300	$ 8,094,399
General Utility Relocation	*LS*	*$ 500,000*	*1*	*$ 500,000*	*30%*	*$ 150,000*	*$ 650,000*	$ 753,528
Overhead Utility Relocation	*EA*	*$ 600,000*	*4*	*$ 2,400,000*	*30%*	*$ 720,000*	*$ 3,120,000*	$ 3,616,935
Utility Protection-in-Place	*LF*	*$ 1,000*	*660*	*$ 660,000*	*30%*	*$ 198,000*	*$ 858,000*	$ 994,657
Street Lights	*EA*	*$ 8,000*	*37*	*$ 296,000*	*30%*	*$ 88,800*	*$ 384,800*	$ 446,089
Drainage 24" RCP	*LF*	*$ 150*	*7200*	*$ 1,080,000*	*30%*	*$ 324,000*	*$ 1,404,000*	$ 1,627,621
Drainage 36" RCP	*LF*	*$ 140*	*0*	*$ -*	*30%*	*$ -*	*$ -*	$ -
Drainage 51" RCP	*LF*	*$ 180*	*0*	*$ -*	*30%*	*$ -*	*$ -*	$ -
Drainage 57" RCP	*LF*	*$ 200*	*0*	*$ -*	*30%*	*$ -*	*$ -*	$ -
Drainage Inlet	*EA*	*$ 3,000*	*45*	*$ 135,000*	*30%*	*$ 40,500*	*$ 175,500*	$ 203,453
Drainage: Manhole Structure	*EA*	*$ 8,000*	*25*	*$ 200,000*	*30%*	*$ 60,000*	*$ 260,000*	$ 301,411
Manhole Structure (depth > 25')	*EA*	*$ 25,000*	*0*	*$ -*	*30%*	*$ -*	*$ -*	$ -
6'-4" W x 7'-6" H RCB (Cl A)	*CY*	*$ 1,000*	*0*	*$ -*	*30%*	*$ -*	*$ -*	$ -
Transition Structure	*EA*	*$ 20,000*	*0*	*$ -*	*30%*	*$ -*	*$ -*	$ -
Concrete Collar	*EA*	*$ 2,000*	*0*	*$ -*	*30%*	*$ -*	*$ -*	$ -
Curb Inlet Catch Basin	*EA*	*$ 3,500*	*0*	*$ -*	*30%*	*$ -*	*$ -*	$ -
Storm Drainage Facilities - Station Area	*LS*	*$ 100,000*	*1*	*$ 100,000*	*30%*	*$ 30,000*	*$ 130,000*	$ 150,706
40.03 Haz. mat'l, contam'd soil removal/mitigation, ground water treatments				$ 500,000		$ 150,000	$ 650,000	$ 753,528
Water Quality BMPs	*LS*	*$ 500,000*	*1*	*$ 500,000*	*30%*	*$ 150,000*	*$ 650,000*	$ 753,528
40.04 Environmental mitigation, e.g. wetlands, historic/archeologic, parks	RF	$ 150	8000	$ 1,200,000	30%	$ 360,000	$ 1,560,000	$ 1,808,468
40.05 Site structures including retaining walls, sound walls				$ 150,000		$ 45,000	$ 195,000	$ 226,058
Misc. Retaining Walls (Incl. Shoring)	*SF*	*$ 75*	*2000*	*$ 150,000*	*30%*	*$ 45,000*	*$ 195,000*	$ 226,058
Sound Wall	*SF*	*$ 50*	*0*	*$ -*	*30%*	*$ -*	*$ -*	$ -
Roadway Bridges	*SF*	*$ 400*	*0*	*$ -*	*30%*	*$ -*	*$ -*	$ -
40.06 Pedestrian / bike access and accommodation, landscaping				$ 400,000		$ 120,000	$ 520,000	$ 602,823
Relocation/Reconstruction of Existing Bike Path	*LF*	*$ 250*	*1600*	*$ 400,000*	*30%*	*$ 120,000*	*$ 520,000*	$ 602,823
40.07 Automobile, bus (non-BRT Guideway), van accessways including roads,				$ 6,672,315		$ 2,001,694	$ 8,674,009	$ 10,055,554
Asphalt Concrete Paving (elevated)	*SF*	*$ 9.50*	*395000*	*$ 3,752,500*	*30%*	*$ 1,125,750*	*$ 4,878,250*	$ 5,655,229
Roadway Base (at grade)	*CY*	*$ 40*	*370*	*$ 14,815*	*30%*	*$ 4,444*	*$ 19,259*	$ 22,327
Asphalt Concrete Paving (at grade)	*SF*	*$ 7.50*	*10000*	*$ 75,000*	*30%*	*$ 22,500*	*$ 97,500*	$ 113,029
Minor Protect in Place - Landscaping, Etc	*LS*	*$ 100,000*	*5*	*$ 500,000*	*30%*	*$ 150,000*	*$ 650,000*	$ 753,528
Roadway Signals - Intersection Modifications	*EA*	*$ 200,000*	*4*	*$ 800,000*	*30%*	*$ 240,000*	*$ 1,040,000*	$ 1,205,645
Roadway Signage and Striping	*EA*	*$ 10,000*	*3*	*$ 30,000*	*30%*	*$ 9,000*	*$ 39,000*	$ 45,212
Temporary BRT guideway (shoo-fly) during construction	*RF*	*$ 150*	*8000*	*$ 1,200,000*	*30%*	*$ 360,000*	*$ 1,560,000*	$ 1,808,468
Temporary Roadway Signals - Interstections	*EA*	*$ 75,000*	*4*	*$ 300,000*	*30%*	*$ 90,000*	*$ 390,000*	$ 452,117
40.08 Temporary Facilities and other indirect costs during construction				$ -		$ -	$ -	$ -
Flagging	*Day*	*$ 1,200*	*0*	*$ -*	*30%*	*$ -*	*$ -*	$ -
50 SYSTEMS				**$ 1,000,000**	**25%**	**$ 250,000**	**$ 1,250,000**	**$ 1,449,093**
50.01 Train control and signals							$ -	$ -
50.02 Traffic signals and crossing protection (including removal of existing)	EA	$ 100,000	4	$ 400,000	25%	$ 100,000	$ 500,000	$ 579,637
50.03 Traction power supply: substations							$ -	$ -
50.04 Traction power distribution: catenary and third rail							$ -	$ -
50.05 Communications							$ -	$ -
50.06 Fare collection system and equipment	EA	$ 300,000	2	$ 600,000	25%	$ 150,000	$ 750,000	$ 869,456
50.07 Central Control							$ -	$ -
Construction Subtotal (10 - 50)				**$ 95,174,581**	**25%**	**$ 23,917,608**	**$ 119,092,189**	**$ 138,060,488**
60 ROW, LAND, EXISTING IMPROVEMENTS				**$ 1,377,410**	**0%**	**$ 413,223**	**$ 1,790,634**	**$ 2,075,835**
60.01 Purchase or lease of real estate	AC	$ 3,000,000	0.46	$ 1,377,410	30%	$ 413,223	$ 1,790,634	$ 2,075,835
60.02 Relocation of existing households and businesses							$ -	$ -
70 VEHICLES (number)				**$ -**	**0%**	**$ -**	**$ -**	**$ -**
70.01 Light Rail							$ -	$ -
70.02 Heavy Rail							$ -	$ -
70.03 Commuter Rail							$ -	$ -
70.04 Bus (60' Articulated Bus)							$ -	$ -
70.05 Bus (40' Bus)							$ -	$ -
70.06 Non-revenue vehicles							$ -	$ -
70.07 Spare parts							$ -	$ -
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)	**0**	**33%**		**$ 31,407,612**	**15%**	**$ 4,711,142**	**$ 36,118,754**	**$ 41,871,535**
80.01 AA/Draft EIS/EIR/Final EIS/EIR	SCC 10-50	3%		$ 2,855,237	15%	$ 428,286	$ 3,283,523	$ 3,806,503
80.01 Preliminary Engineering	SCC 10-50	3%		$ 2,855,237	15%	$ 428,286	$ 3,283,523	$ 3,806,503
80.02 Final Design	SCC 10-50	7%		$ 6,662,221	15%	$ 999,333	$ 7,661,554	$ 8,881,841
80.03 Project Management for Design and Construction	SCC 10-50	10%		$ 9,517,458	15%	$ 1,427,619	$ 10,945,077	$ 12,688,344
80.04 Construction Administration & Management	SCC 10-50	5%		$ 4,758,729	15%	$ 713,809	$ 5,472,538	$ 6,344,172
80.05 Professional Liability and other Non-Construction Insurance	SCC 10-50	0%		$ -	15%	$ -	$ -	$ -
80.06 Legal; Permits; Review Fees by other agencies, cities, etc.	SCC 10-50	1%		$ 951,746	15%	$ 142,762	$ 1,094,508	$ 1,268,834
80.07 Surveys, Testing, Investigation, Inspection	SCC 10-50	2%		$ 1,903,492	15%	$ 285,524	$ 2,189,015	$ 2,537,669
80.08 Start up	SCC 10-50	5%		$ 4,758,729	15%	$ 713,809	$ 5,472,538	$ 6,344,172
Subtotal (10 - 80)				**$ 127,959,603**	**23%**	**$ 29,041,973**	**$ 157,001,577**	**$ 182,007,857**
90 UNALLOCATED CONTINGENCY	SCC 10-80	15%					**$ 23,550,236**	**$ 46,017,162**
Subtotal (10 - 90)							**$ 180,551,813**	**$ 209,309,036**
100 FINANCE CHARGES							**$ -**	**$ -**
Total Project Cost (10 - 100)							**$ 180,551,813**	**$ 209,309,036**

MAIN WORKSHEET-BUILD ALTERNATIVE

Los Angeles County Metropolitan Transportation Authority (LACMTA)
Metro Orange Line, Los Angeles, CA
Woodman Avenue/Burbank Boulevard - Trench BRT

Today's Date **6/9/17**
Yr of Base Year $ 2017
Yr of Midpoint of Construction 2022

	Units	Unit Price	Quantity	Base Year Dollars w/o Contingency	Allocated Contingency	Base Year Dollars Allocated Contingency	Base Year Dollars TOTAL	YOE Dollars Total (3% Escalation per year)
10 GUIDEWAY & TRACK ELEMENTS (route miles)				**$ 49,241,778**	**24%**	**$ 11,794,475**	**$ 61,036,253**	**$ 70,757,745**
10.01 Guideway: At-grade exclusive right-of-way							$ -	$ -
10.02 Guideway: At-grade semi-exclusive (allows cross-traffic)							$ -	$ -
10.03 Guideway: At-grade in mixed traffic							$ -	$ -
10.04 Guideway: Aerial structure							$ -	$ -
10.05 Guideway: Built-up fill							$ -	$ -
10.06 Guideway: Underground cut & cover	SF	$ 500	0	$ -	20%	$ -	$ -	$ -
10.07 Guideway: Underground tunnel							$ -	$ -
10.08 Guideway: Retained cut or fill				$ 49,241,778		$ 11,794,475	$ 61,036,253	$ 70,757,745
Earthwork (cut or fill)	*CY*	*$ 50*	*206388*	*$ 10,319,400*	*20%*	*$ 2,063,880*	*$ 12,383,280*	$ 14,355,615
Guideway Retaining Walls - Fill (MSE or other)	*SF*	*$ 125*	*0*	*$ -*	*25%*	*$ -*	*$ -*	$ -
Guideway Retaining Walls - Cut	*SF*	*$ 175*	*222414*	*$ 38,922,378*	*25%*	*$ 9,730,595*	*$ 48,652,973*	$ 56,402,130
10.09 Track: Direct fixation (Assume SCC 10.04 & 10.07)							$ -	$ -
10.10 Track: Embedded							$ -	$ -
10.11 Track: Ballasted (Assume SCC 10.01 & 10.02)							$ -	$ -
10.12 Track: Special (switches, turnouts)							$ -	$ -
10.13 Track: Vibration and noise dampening							$ -	$ -
20 STATIONS, STOPS, TERMINALS, INTERMODAL (number)				**$ 9,606,314**	**25%**	**$ 2,401,578**	**$ 12,007,892**	**$ 13,920,438**
20.01 At-grade station, stop, shelter, mall, platform							$ -	$ -
20.02 Aerial station, stop, shelter, mall, terminal, platform							$ -	$ -
Structural Concrete							$ -	$ -
Platform Concrete							$ -	$ -
Platform Beam/Footing							$ -	$ -
Structural Retaining Walls							$ -	$ -
Canopy							$ -	$ -
Fixtures (Benches, Map Cases, Trash Receptacles, Etc.)							$ -	$ -
Handrailing							$ -	$ -
Platform Signage							$ -	$ -
Lighting/Electrical/Communication							$ -	$ -
Stairwells: Aerial Stations							$ -	$ -
Tactile Warning Strip							$ -	$ -
Ramp							$ -	$ -
20.03 Underground station, stop, shelter, mall, terminal, platform				$ 5,206,314		$ 1,301,578	$ 6,507,892	$ 7,544,431
Excavation (Cut) for station improvements	*CY*	*$ 40*	*22222*	*$ 888,889*	*25%*	*$ 222,222*	*$ 1,111,111*	$ 1,288,082
Structural Concrete	*CY*	*$ 1,800*	*500*	*$ 900,000*	*25%*	*$ 225,000*	*$ 1,125,000*	$ 1,304,183
Platform Concrete	*CY*	*$ 1,200*	*510*	*$ 612,000*	*25%*	*$ 153,000*	*$ 765,000*	$ 886,845
Platform Beam/Footing	*CY*	*$ 1,200*	*0*	*$ -*	*25%*	*$ -*	*$ -*	$ -
Structural Retaining Walls	*SF*	*$ 150*	*1500*	*$ 225,000*	*25%*	*$ 56,250*	*$ 281,250*	$ 326,046
Canopy	*SF*	*$ 150*	*7330*	*$ 1,099,500*	*25%*	*$ 274,875*	*$ 1,374,375*	$ 1,593,277
Fixtures (Benches, Map Cases, Trash Receptacles, Etc.)	*LS*	*$ 75,000*	*2*	*$ 112,500*	*25%*	*$ 28,125*	*$ 140,625*	$ 163,023
Handrailing	*LF*	*$ 175*	*815*	*$ 142,625*	*25%*	*$ 35,656*	*$ 178,281*	$ 206,677
Platform Signage	*LS*	*$ 40,000*	*2*	*$ 80,000*	*25%*	*$ 20,000*	*$ 100,000*	$ 115,927
Lighting/Electrical/Communication	*LS*	*$ 350,000*	*2*	*$ 700,000*	*25%*	*$ 175,000*	*$ 875,000*	$ 1,014,365
Stairwells: Underground Stations	*SF*	*$ 250*	*1200*	*$ 300,000*	*25%*	*$ 75,000*	*$ 375,000*	$ 434,728
Tactile Warning Strip	*SF*	*$ 45*	*3240*	*$ 145,800*	*25%*	*$ 36,450*	*$ 182,250*	$ 211,278
Ramp	*SF*	*$ 88*	*0*	*$ -*	*25%*	*$ -*	*$ -*	$ -
20.04 Other stations, landings, terminals: Intermodal, ferry, trolley, etc.							$ -	$ -
20.05 Joint development							$ -	$ -
20.06 Automobile parking multi-story structure							$ -	$ -
20.07 Elevators	EA	$ 600,000	4	$ 2,400,000	25%	$ 600,000	$ 3,000,000	$ 3,477,822
20.08 Escalators	EA	$ 500,000	4	$ 2,000,000	25%	$ 500,000	$ 2,500,000	$ 2,898,185
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS				**$ -**		**$ -**	**$ -**	**$ -**
30.01 Administration Building: Office, sales, storage, revenue counting							$ -	$ -
30.02 Light Maintenance Facility							$ -	$ -
30.03 Heavy Maintenance Facility							$ -	$ -
30.04 Storage or Maintenance of Way Building							$ -	$ -
30.05 Yard and Yard Track							$ -	$ -
40 SITEWORK & SPECIAL CONDITIONS				**$ 41,251,218**	**30%**	**$ 12,375,366**	**$ 53,626,584**	**$ 62,167,909**
40.01 Demolition, Clearing, Earthwork				$ 720,000		$ 216,000	$ 936,000	$ 1,085,081
General Demolition	*LS*	*$ 720,000*	*1*	*$ 720,000*	*30%*	$ 216,000	$ 936,000	$ 1,085,081
40.02 Site Utilities, Utility Relocation				$ 22,461,300		$ 6,738,390	$ 29,199,690	$ 33,850,444
General Utility Relocation	*LS*	*$ 14,249,000*	*1*	*$ 14,249,000*	*30%*	*$ 4,274,700*	*$ 18,523,700*	$ 21,474,045
Overhead Utility Relocation	*EA*	*$ 600,000*	*4*	*$ 2,400,000*	*30%*	*$ 720,000*	*$ 3,120,000*	$ 3,616,935
Utility Protection-in-Place	*LF*	*$ 1,000*	*500*	*$ 500,000*	*30%*	*$ 150,000*	*$ 650,000*	$ 753,528
Street Lights	*EA*	*$ 8,000*	*16*	*$ 128,000*	*30%*	*$ 38,400*	*$ 166,400*	$ 192,903
Drainage 24" RCP	*LF*	*$ 150*	*7350*	*$ 1,102,500*	*30%*	*$ 330,750*	*$ 1,433,250*	$ 1,661,530
Drainage 36" RCP	*LF*	*$ 140*	*1720*	*$ 240,800*	*30%*	*$ 72,240*	*$ 313,040*	$ 362,899
Drainage 51" RCP	*LF*	*$ 180*	*100*	*$ 18,000*	*30%*	*$ 5,400*	*$ 23,400*	$ 27,127
Drainage 57" RCP	*LF*	*$ 200*	*100*	*$ 20,000*	*30%*	*$ 6,000*	*$ 26,000*	$ 30,141
Drainage Inlet	*EA*	*$ 3,000*	*40*	*$ 120,000*	*30%*	*$ 36,000*	*$ 156,000*	$ 180,847
Drainage: Manhole Structure	*EA*	*$ 8,000*	*28*	*$ 224,000*	*30%*	*$ 67,200*	*$ 291,200*	$ 337,581
Manhole Structure (depth > 25')	*EA*	*$ 25,000*	*8*	*$ 200,000*	*30%*	*$ 60,000*	*$ 260,000*	$ 301,411
6'-4" W x 7'-6" H RCB (Cl A)	*CY*	*$ 1,000*	*3050*	*$ 3,050,000*	*30%*	*$ 915,000*	*$ 3,965,000*	$ 4,596,522
Transition Structure	*EA*	*$ 20,000*	*1*	*$ 20,000*	*30%*	*$ 6,000*	*$ 26,000*	$ 30,141
Concrete Collar	*EA*	*$ 2,000*	*20*	*$ 40,000*	*30%*	*$ 12,000*	*$ 52,000*	$ 60,282
Curb Inlet Catch Basin	*EA*	*$ 3,500*	*14*	*$ 49,000*	*30%*	*$ 14,700*	*$ 63,700*	$ 73,846
Storm Drainage Facilities - Station Area	LS	$ 100,000	1	$ 100,000	*30%*	$ 30,000	$ 130,000	$ 150,706
40.03 Haz. mat'l, contam'd soil removal/mitigation, ground water treatments				$ 500,000		$ 150,000	$ 650,000	$ 753,528
Water Quality BMPs	*LS*	*$ 500,000*	*1*	*$ 500,000*	*30%*	*$ 150,000*	*$ 650,000*	*$ 753,528*
40.04 Environmental mitigation, e.g. wetlands, historic/archeologic, parks	RF	$ 150	7200	$ 1,080,000	*30%*	$ 324,000	$ 1,404,000	$ 1,627,621
40.05 Site structures including retaining walls, sound walls				$ 13,735,200		$ 4,120,560	$ 17,855,760	$ 20,699,720
Misc. Retaining Walls (Incl. Shoring)	*SF*	*$ 75*	*2000*	*$ 150,000*	*30%*	*$ 45,000*	*$ 195,000*	*$ 226,058*
Sound Wall	*SF*	*$ 50*	*0*	*$ -*	*30%*	*$ -*	*$ -*	*$ -*
Roadway Bridges	*SF*	*$ 400*	*33963*	*$ 13,585,200*	*30%*	*$ 4,075,560*	*$ 17,660,760*	*$ 20,473,661*
40.06 Pedestrian / bike access and accommodation, landscaping				$ 371,250		$ 111,375	$ 482,625	$ 559,495
Relocation/Reconstruction of Existing Bike Path	*LF*	*$ 250*	*1485*	*$ 371,250*	*30%*	*$ 111,375*	*$ 482,625*	*$ 559,495*
40.07 Automobile, bus (non-BRT Guideway), van accessways including roads,				$ 2,383,468		$ 715,041	$ 3,098,509	$ 3,592,021
Asphalt Concrete Paving (elevated)	*SF*	*$ 9.50*	*0*	*$ -*	*30%*	*$ -*	*$ -*	*$ -*
Roadway Base (at grade)	*CY*	*$ 40*	*195*	*$ 7,806*	*30%*	*$ 2,342*	*$ 10,148*	*$ 11,764*
Asphalt Concrete Paving (at grade)	*SF*	*$ 7.50*	*47422*	*$ 355,662*	*30%*	*$ 106,699*	*$ 462,361*	*$ 536,003*
Minor Protect in Place - Landscaping, Etc	*LS*	*$ 100,000*	*1*	*$ 100,000*	*30%*	*$ 30,000*	*$ 130,000*	*$ 150,706*
Roadway Signals - Intersection Modifications	*EA*	*$ 200,000*	*4*	*$ 800,000*	*30%*	*$ 240,000*	*$ 1,040,000*	*$ 1,205,645*
Roadway Signage and Striping	*EA*	*$ 10,000*	*4*	*$ 40,000*	*30%*	*$ 12,000*	*$ 52,000*	*$ 60,282*
Temporary BRT guideway (shoo-fly) during construction	*RF*	*$ 150*	*7200*	*$ 1,080,000*	*30%*	*$ 324,000*	*$ 1,404,000*	*$ 1,627,621*
Temporary Roadway Signals - Interstections	*EA*	*$ 75,000*	*0*	*$ -*	*30%*	*$ -*	*$ -*	*$ -*
40.08 Temporary Facilities and other indirect costs during construction				$ -		$ -	$ -	$ -
Flagging	*Day*	*$ 1,200*	*0*	*$ -*	*30%*	*$ -*	*$ -*	*$ -*
50 SYSTEMS				**$ 1,000,000**	**25%**	**$ 250,000**	**$ 1,250,000**	**$ 1,449,093**
50.01 Train control and signals							$ -	$ -
50.02 Traffic signals and crossing protection (including removal of existing)	EA	$ 100,000	4	$ 400,000	25%	$ 100,000	$ 500,000	$ 579,637
50.03 Traction power supply: substations							$ -	$ -
50.04 Traction power distribution: catenary and third rail							$ -	$ -
50.05 Communications							$ -	$ -
50.06 Fare collection system and equipment	EA	$ 300,000	2	$ 600,000	25%	$ 150,000	$ 750,000	$ 869,456
50.07 Central Control							$ -	$ -
Construction Subtotal (10 - 50)				**$ 101,099,311**	**27%**	**$ 26,821,419**	**$ 127,920,729**	**$ 148,295,185**
60 ROW, LAND, EXISTING IMPROVEMENTS				**$ 1,949,036**	**0%**	**$ 584,711**	**$ 2,533,747**	**$ 2,937,307**
60.01 Purchase or lease of real estate	AC	$ 3,000,000	0.65	$ 1,949,036	30%	$ 584,711	$ 2,533,747	$ 2,937,307
60.02 Relocation of existing households and businesses							$ -	$ -
70 VEHICLES (number)				**$ -**	**0%**	**$ -**	**$ -**	**$ -**
70.01 Light Rail							$ -	$ -
70.02 Heavy Rail							$ -	$ -
70.03 Commuter Rail							$ -	$ -
70.04 Bus (60' Articulated Bus)							$ -	$ -
70.05 Bus (40' Bus)							$ -	$ -
70.06 Non-revenue vehicles							$ -	$ -
70.07 Spare parts							$ -	$ -
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)	**0**	**33%**		**$ 33,362,772**	**15%**	**$ 5,004,416**	**$ 38,367,188**	**$ 44,478,087**
80.01 AA/Draft EIS/EIR/Final EIS/EIR	SCC 10-50	3%		$ 3,032,979	15%	$ 454,947	$ 3,487,926	$ 4,043,462
80.01 Preliminary Engineering	SCC 10-50	3%		$ 3,032,979	15%	$ 454,947	$ 3,487,926	$ 4,043,462
80.02 Final Design	SCC 10-50	7%		$ 7,076,952	15%	$ 1,061,543	$ 8,138,495	$ 9,434,746
80.03 Project Management for Design and Construction	SCC 10-50	10%		$ 10,109,931	15%	$ 1,516,490	$ 11,626,421	$ 13,478,208
80.04 Construction Administration & Management	SCC 10-50	5%		$ 5,054,966	15%	$ 758,245	$ 5,813,210	$ 6,739,104
80.05 Professional Liability and other Non-Construction Insurance	SCC 10-50	0%		$ -	15%	$ -	$ -	$ -
80.06 Legal; Permits; Review Fees by other agencies, cities, etc.	SCC 10-50	1%		$ 1,010,993	15%	$ 151,649	$ 1,162,642	$ 1,347,821
80.07 Surveys, Testing, Investigation, Inspection	SCC 10-50	2%		$ 2,021,986	15%	$ 303,298	$ 2,325,284	$ 2,695,642
80.08 Start up	SCC 10-50	5%		$ 5,054,966	15%	$ 758,245	$ 5,813,210	$ 6,739,104
Subtotal (10 - 80)				**$ 136,411,119**	**24%**	**$ 32,410,545**	**$ 168,821,664**	**$ 195,710,578**
90 UNALLOCATED CONTINGENCY	SCC 10-80	15%					**$ 25,323,250**	**$ 49,481,630**
Subtotal (10 - 90)							**$ 194,144,914**	**$ 245,192,208**
100 FINANCE CHARGES							**$ -**	**$ -**
Total Project Cost (10 - 100)							**$ 194,144,914**	**$ 245,192,208**

MAIN WORKSHEET-BUILD ALTERNATIVE

Los Angeles County Metropolitan Transportation Authority (LACMTA)
Metro Orange Line, Los Angeles, CA
Sepulveda Boulevard - Aerial BRT

Today's Date **6/9/17**
Yr of Base Year $ 2017
Yr of Midpoint of Construction 2022

	Units	Unit Price	Quantity	Base Year Dollars w/o Contingency	Allocated Contingency	Base Year Dollars Allocated Contingency	Base Year Dollars TOTAL	YOE Dollars Total (3% Escalation per year)
10 GUIDEWAY & TRACK ELEMENTS (route miles)				**$ 11,205,151**	**24%**	**$ 2,710,636**	**$ 13,915,787**	**$ 16,132,211**
10.01 Guideway: At-grade exclusive right-of-way							$ -	$ -
10.02 Guideway: At-grade semi-exclusive (allows cross-traffic)							$ -	$ -
10.03 Guideway: At-grade in mixed traffic							$ -	$ -
10.04 Guideway: Aerial structure	SF	$ 450	11843	$ 5,329,350	25%	$ 1,332,338	$ 6,661,688	$ 7,722,722
10.05 Guideway: Built-up fill	CY	$ 40	26	$ 1,043	20%	$ 209	$ 1,251	$ 1,450
10.06 Guideway: Underground cut & cover							$ -	$ -
10.07 Guideway: Underground tunnel							$ -	$ -
10.08 Guideway: Retained cut or fill				$ 5,874,759		$ 1,378,090	$ 7,252,848	$ 8,408,039
Earthwork (cut or fill)	*CY*	*$ 50*	*36240*	*$ 1,811,996*	*20%*	*$ 362,399*	*$ 2,174,395*	$ 2,520,720
Guideway Retaining Walls - Fill (MSE or other)	*SF*	*$ 125*	*32502*	*$ 4,062,763*	*25%*	*$ 1,015,691*	*$ 5,078,454*	$ 5,887,320
Guideway Retaining Walls - Cut	*SF*	*$ 175*	*0*	*$ -*	*25%*	*$ -*	*$ -*	$ -
10.09 Track: Direct fixation (Assume SCC 10.04 & 10.07)							$ -	$ -
10.10 Track: Embedded							$ -	$ -
10.11 Track: Ballasted (Assume SCC 10.01 & 10.02)							$ -	$ -
10.12 Track: Special (switches, turnouts)							$ -	$ -
10.13 Track: Vibration and noise dampening							$ -	$ -
20 STATIONS, STOPS, TERMINALS, INTERMODAL (number)				**$ 4,740,650**	**25%**	**$ 1,185,163**	**$ 5,925,813**	**$ 6,869,641**
20.01 At-grade station, stop, shelter, mall, platform							$ -	$ -
20.02 Aerial station, stop, shelter, mall, terminal, platform				$ 2,540,650		$ 635,163	$ 3,175,813	$ 3,681,637
Structural Concrete	*CY*	*$ 1,800*	*60*	*$ 108,000*	*25%*	*$ 27,000*	*$ 135,000*	$ 156,502
Platform Concrete	*CY*	*$ 1,200*	*700*	*$ 840,000*	*25%*	*$ 210,000*	*$ 1,050,000*	$ 1,217,238
Platform Beam/Footing	*CY*	*$ 1,200*	*125*	*$ 150,000*	*25%*	*$ 37,500*	*$ 187,500*	$ 217,364
Structural Retaining Walls	*SF*	*$ 450*	*750*	*$ 337,500*	*25%*	*$ 84,375*	*$ 421,875*	$ 489,069
Canopy	*SF*	*$ 150*	*2655*	*$ 398,250*	*25%*	*$ 99,563*	*$ 497,813*	$ 577,101
Fixtures (Benches, Map Cases, Trash Receptacles, Etc.)	*LS*	*$ 75,000*	*1*	*$ 75,000*	*25%*	*$ 18,750*	*$ 93,750*	$ 108,682
Handrailing	*LF*	*$ 175*	*392*	*$ 68,600*	*25%*	*$ 17,150*	*$ 85,750*	$ 99,408
Platform Signage	*LS*	*$ 40,000*	*1*	*$ 40,000*	*25%*	*$ 10,000*	*$ 50,000*	$ 57,964
Lighting/Electrical/Communication	*LS*	*$ 300,000*	*1*	*$ 300,000*	*25%*	*$ 75,000*	*$ 375,000*	$ 434,728
Stairwells: Aerial Stations	*SF*	*$ 200*	*752*	*$ 150,400*	*25%*	*$ 37,600*	*$ 188,000*	$ 217,944
Tactile Warning Strip	*SF*	*$ 45*	*1620*	*$ 72,900*	*25%*	*$ 18,225*	*$ 91,125*	$ 105,639
Ramp	*SF*	*$ 88*	*0*	*$ -*	*25%*	*$ -*	*$ -*	$ -
20.03 Underground station, stop, shelter, mall, terminal, platform							$ -	$ -
Structural Concrete							$ -	$ -
Platform Concrete							$ -	$ -
Platform Beam/Footing							$ -	$ -
Structural Retaining Walls								$ -
Canopy							$ -	$ -
Fixtures (Benches, Map Cases, Trash Receptacles, Etc.)							$ -	$ -
Handrailing							$ -	$ -
Platform Signage							$ -	$ -
Lighting/Electrical/Communication							$ -	$ -
Stairwells: Underground Stations							$ -	$ -
Tactile Warning Strip							$ -	$ -
Ramp							$ -	$ -
20.04 Other stations, landings, terminals: Intermodal, ferry, trolley, etc.							$ -	$ -
20.05 Joint development							$ -	$ -
20.06 Automobile parking multi-story structure							$ -	$ -
20.07 Elevators	EA	$ 600,000	2	$ 1,200,000	25%	$ 300,000	$ 1,500,000	$ 1,738,911
20.08 Escalators	EA	$ 500,000	2	$ 1,000,000	25%	$ 250,000	$ 1,250,000	$ 1,449,093
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS				**$ -**		**$ -**	**$ -**	**$ -**
30.01 Administration Building: Office, sales, storage, revenue counting							$ -	$ -
30.02 Light Maintenance Facility							$ -	$ -
30.03 Heavy Maintenance Facility							$ -	$ -
30.04 Storage or Maintenance of Way Building							$ -	$ -
30.05 Yard and Yard Track							$ -	$ -
40 SITEWORK & SPECIAL CONDITIONS				**$ 9,201,815**	**30%**	**$ 2,746,144**	**$ 11,947,959**	**$ 13,850,959**
40.01 Demolition, Clearing, Earthwork				$ 800,000		$ 240,000	$ 1,040,000	$ 1,205,645
General Demolition	*LS*	*$ 800,000*	*1*	*$ 800,000*	*30%*	*$ 240,000*		$ -
40.02 Site Utilities, Utility Relocation				$ 1,822,000		$ 532,200	$ 2,354,200	$ 2,729,163
General Utility Relocation	*LS*	*$ 500,000*	*0*	*$ -*	*30%*	*$ -*	*$ -*	$ -
Overhead Utility Relocation	*EA*	*$ 600,000*	*1*	*$ 600,000*	*30%*	*$ 180,000*	*$ 780,000*	$ 904,234
Utility Protection-in-Place	*LF*	*$ 1,000*	*0*	*$ -*	*30%*	*$ -*	*$ -*	$ -
Street Lights	*EA*	*$ 8,000*	*6*	*$ 48,000*	*30%*		*$ 48,000*	$ 55,645
Drainage 24" RCP	*LF*	*$ 150*	*5600*	*$ 840,000*	*30%*	*$ 252,000*	*$ 1,092,000*	$ 1,265,927
Drainage 36" RCP	*LF*	*$ 140*	*0*	*$ -*	*30%*	*$ -*	*$ -*	$ -
Drainage 51" RCP	*LF*	*$ 180*	*0*	*$ -*	*30%*	*$ -*	*$ -*	$ -
Drainage 57" RCP	*LF*	*$ 200*	*0*	*$ -*	*30%*	*$ -*	*$ -*	$ -
Drainage Inlet	*EA*	*$ 3,000*	*30*	*$ 90,000*	*30%*	*$ 27,000*	*$ 117,000*	$ 135,635
Drainage: Manhole Structure	*EA*	*$ 8,000*	*18*	*$ 144,000*	*30%*	*$ 43,200*	*$ 187,200*	$ 217,016
Manhole Structure (depth > 25')	*EA*	*$ 25,000*	*0*	*$ -*	*30%*	*$ -*	*$ -*	$ -
6'-4" W x 7'-6" H RCB (Cl A)	*CY*	*$ 1,000*	*0*	*$ -*	*30%*	*$ -*	*$ -*	$ -
Transition Structure	*EA*	*$ 20,000*	*0*	*$ -*	*30%*	*$ -*	*$ -*	$ -
Concrete Collar	*EA*	*$ 2,000*	*0*	*$ -*	*30%*	*$ -*	*$ -*	$ -
Curb Inlet Catch Basin	*EA*	*$ 3,500*	*0*	*$ -*	*30%*	*$ -*	*$ -*	$ -
Storm Drainage Facilities - Station Area	*LS*	*$ 100,000*	*1*	*$ 100,000*	*30%*	*$ 30,000*	*$ 130,000*	$ 150,706
40.03 Haz. mat'l, contam'd soil removal/mitigation, ground water treatments				$ 500,000		$ 150,000	$ 650,000	$ 753,528
Water Quality BMPs	*LS*	*$ 500,000*	*1*	*$ 500,000*	*30%*	*$ 150,000*	*$ 650,000*	$ 753,528
40.04 Environmental mitigation, e.g. wetlands, historic/archeologic, parks	RF	$ 150	8000	$ 1,200,000	30%	$ 360,000	$ 1,560,000	$ 1,808,468
40.05 Site structures including retaining walls, sound walls				$ 150,000		$ 45,000	$ 195,000	$ 226,058
Misc. Retaining Walls (Incl. Shoring)	*SF*	*$ 75*	*2000*	*$ 150,000*	*30%*	*$ 45,000*	*$ 195,000*	$ 226,058
Sound Wall	*SF*	*$ 50*	*0*	*$ -*	*30%*	*$ -*	*$ -*	$ -
Roadway Bridges	*SF*	*$ 400*	*0*	*$ -*	*30%*	*$ -*	*$ -*	$ -
40.06 Pedestrian / bike access and accommodation, landscaping				$ 262,500		$ 78,750	$ 341,250	$ 395,602
Relocation/Reconstruction of Existing Bike Path	*LF*	*$ 250*	*1050*	*$ 262,500*	*30%*	*$ 78,750*	*$ 341,250*	$ 395,602
40.07 Automobile, bus (non-BRT Guideway), van accessways including roads,				$ 4,467,315		$ 1,340,194	$ 5,807,509	$ 6,732,495
Asphalt Concrete Paving (elevated)	*SF*	*$ 9.50*	*395000*	*$ 3,752,500*	*30%*	*$ 1,125,750*	*$ 4,878,250*	$ 5,655,229
Roadway Base (at grade)	*CY*	*$ 40*	*370*	*$ 14,815*	*30%*	*$ 4,444*	*$ 19,259*	$ 22,327
Asphalt Concrete Paving (at grade)	*SF*	*$ 7.50*	*10000*	*$ 75,000*	*30%*	*$ 22,500*	*$ 97,500*	$ 113,029
Minor Protect in Place - Landscaping, Etc	*LS*	*$ 100,000*	*1*	*$ 100,000*	*30%*	*$ 30,000*	*$ 130,000*	$ 150,706
Roadway Signals - Intersection Modifications	*EA*	*$ 200,000*	*1*	*$ 200,000*	*30%*	*$ 60,000*	*$ 260,000*	$ 301,411
Roadway Signage and Striping	*EA*	*$ 10,000*	*1*	*$ 10,000*	*30%*	*$ 3,000*	*$ 13,000*	$ 15,071
Temporary BRT guideway (shoo-fly) during construction	*RF*	*$ 150*	*1600*	*$ 240,000*	*30%*	*$ 72,000*	*$ 312,000*	$ 361,694
Temporary Roadway Signals - Interstections	*EA*	*$ 75,000*	*1*	*$ 75,000*	*30%*	*$ 22,500*	*$ 97,500*	$ 113,029
40.08 Temporary Facilities and other indirect costs during construction				$ -		$ -	$ -	$ -
Flagging	*Day*	*$ 1,200*	*0*	*$ -*	*30%*	*$ -*	*$ -*	$ -
50 SYSTEMS				**$ 400,000**	**25%**	**$ 100,000**	**$ 500,000**	**$ 579,637**
50.01 Train control and signals							$ -	$ -
50.02 Traffic signals and crossing protection (including removal of existing)	EA	$ 100,000	1	$ 100,000	25%	$ 25,000	$ 125,000	$ 144,909
50.03 Traction power supply: substations							$ -	$ -
50.04 Traction power distribution: catenary and third rail							$ -	$ -
50.05 Communications							$ -	$ -
50.06 Fare collection system and equipment	EA	$ 300,000	1	$ 300,000	25%	$ 75,000	$ 375,000	$ 434,728
50.07 Central Control							$ -	$ -
Construction Subtotal (10 - 50)				**$ 25,547,616**	**26%**	**$ 6,741,943**	**$ 32,289,559**	**$ 37,432,448**
60 ROW, LAND, EXISTING IMPROVEMENTS				**$ 296,143**	**0%**	**$ 88,843**	**$ 384,986**	**$ 446,305**
60.01 Purchase or lease of real estate	AC	$ 3,000,000	0.10	$ 296,143	30%	$ 88,843	$ 384,986	$ 446,305
60.02 Relocation of existing households and businesses							$ -	$ -
70 VEHICLES (number)				**$ -**	**0%**	**$ -**	**$ -**	**$ -**
70.01 Light Rail							$ -	$ -
70.02 Heavy Rail							$ -	$ -
70.03 Commuter Rail							$ -	$ -
70.04 Bus (60' Articulated Bus)							$ -	$ -
70.05 Bus (40' Bus)							$ -	$ -
70.06 Non-revenue vehicles							$ -	$ -
70.07 Spare parts							$ -	$ -
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)	**0**	**33%**		**$ 8,430,713**	**15%**	**$ 1,264,607**	**$ 9,695,320**	**$ 11,239,533**
80.01 AA/Draft EIS/EIR/Final EIS/EIR	SCC 10-50	3%		$ 766,428	15%	$ 114,964	$ 881,393	$ 1,021,776
80.01 Preliminary Engineering	SCC 10-50	3%		$ 766,428	15%	$ 114,964	$ 881,393	$ 1,021,776
80.02 Final Design	SCC 10-50	7%		$ 1,788,333	15%	$ 268,250	$ 2,056,583	$ 2,384,143
80.03 Project Management for Design and Construction	SCC 10-50	10%		$ 2,554,762	15%	$ 383,214	$ 2,937,976	$ 3,405,919
80.04 Construction Administration & Management	SCC 10-50	5%		$ 1,277,381	15%	$ 191,607	$ 1,468,988	$ 1,702,960
80.05 Professional Liability and other Non-Construction Insurance	SCC 10-50	0%		$ -	15%	$ -	$ -	$ -
80.06 Legal; Permits; Review Fees by other agencies, cities, etc.	SCC 10-50	1%		$ 255,476	15%	$ 38,321	$ 293,798	$ 340,592
80.07 Surveys, Testing, Investigation, Inspection	SCC 10-50	2%		$ 510,952	15%	$ 76,643	$ 587,595	$ 681,184
80.08 Start up	SCC 10-50	5%		$ 1,277,381	15%	$ 191,607	$ 1,468,988	$ 1,702,960
Subtotal (10 - 80)				**$ 34,274,473**	**24%**	**$ 8,095,393**	**$ 42,369,865**	**$ 49,118,286**
90 UNALLOCATED CONTINGENCY	SCC 10-80	15%					**$ 6,355,480**	**$ 12,418,608**
Subtotal (10 - 90)							**$ 48,725,345**	**$ 56,486,029**
100 FINANCE CHARGES							**$ -**	**$ -**
Total Project Cost (10 - 100)							**$ 48,725,345**	**$ 56,486,029**

MAIN WORKSHEET-BUILD ALTERNATIVE

Los Angeles County Metropolitan Transportation Authority (LACMTA)
Metro Orange Line, Los Angeles, CA
Woodman Avenue - Trench BRT

Today's Date **6/9/17**
Yr of Base Year $ 2017
Yr of Midpoint of Construction 2022

	Units	Unit Price	Quantity	Base Year Dollars w/o Contingency	Allocated Contingency	Base Year Dollars Allocated Contingency	Base Year Dollars TOTAL	YOE Dollars Total (3% Escalation per year)
10 GUIDEWAY & TRACK ELEMENTS (route miles)				**$ 26,080,544**	**24%**	**$ 6,252,076**	**$ 32,332,620**	**$ 37,482,368**
10.01 Guideway: At-grade exclusive right-of-way							$ -	$ -
10.02 Guideway: At-grade semi-exclusive (allows cross-traffic)							$ -	$ -
10.03 Guideway: At-grade in mixed traffic							$ -	$ -
10.04 Guideway: Aerial structure							$ -	$ -
10.05 Guideway: Built-up fill							$ -	$ -
10.06 Guideway: Underground cut & cover	SF	$ 500	0	$ -	20%	$ -	$ -	$ -
10.07 Guideway: Underground tunnel							$ -	$ -
10.08 Guideway: Retained cut or fill				$ 26,080,544		$ 6,252,076	$ 32,332,620	$ 37,482,368
Earthwork (cut or fill)	*CY*	*$ 50*	*107224*	*$ 5,361,189*	*20%*	*$ 1,072,238*	*$ 6,433,427*	$ 7,458,105
Guideway Retaining Walls - Fill (MSE or other)	*SF*	*$ 125*	*0*	*$ -*	*25%*	*$ -*	*$ -*	$ -
Guideway Retaining Walls - Cut	*SF*	*$ 175*	*118396*	*$ 20,719,354*	*25%*	*$ 5,179,839*	*$ 25,899,193*	$ 30,024,263
10.09 Track: Direct fixation (Assume SCC 10.04 & 10.07)							$ -	$ -
10.10 Track: Embedded							$ -	$ -
10.11 Track: Ballasted (Assume SCC 10.01 & 10.02)							$ -	$ -
10.12 Track: Special (switches, turnouts)							$ -	$ -
10.13 Track: Vibration and noise dampening							$ -	$ -
20 STATIONS, STOPS, TERMINALS, INTERMODAL (number)				**$ 6,012,907**	**25%**	**$ 1,503,227**	**$ 7,516,134**	**$ 8,713,259**
20.01 At-grade station, stop, shelter, mall, platform							$ -	$ -
20.02 Aerial station, stop, shelter, mall, terminal, platform							$ -	$ -
Structural Concrete							*$ -*	$ -
Platform Concrete							*$ -*	$ -
Platform Beam/Footing							*$ -*	$ -
Structural Retaining Walls							*$ -*	$ -
Canopy							*$ -*	$ -
Fixtures (Benches, Map Cases, Trash Receptacles, Etc.)							*$ -*	$ -
Handrailing							*$ -*	$ -
Platform Signage							*$ -*	$ -
Lighting/Electrical/Communication							*$ -*	$ -
Stairwells: Aerial Stations							*$ -*	$ -
Tactile Warning Strip							*$ -*	$ -
Ramp							*$ -*	$ -
20.03 Underground station, stop, shelter, mall, terminal, platform				$ 3,812,907		$ 953,227	$ 4,766,134	$ 5,525,255
Excavation (Cut) for station improvements	*CY*	*$ 40*	*11111*	*$ 444,444*	*25%*	*$ 111,111*	*$ 555,556*	$ 644,041
Structural Concrete	*CY*	*$ 1,800*	*700*	*$ 1,260,000*	*25%*	*$ 315,000*	*$ 1,575,000*	$ 1,825,857
Platform Concrete	*CY*	*$ 1,200*	*510*	*$ 612,000*	*25%*	*$ 153,000*	*$ 765,000*	$ 886,845
Platform Beam/Footing	*CY*	*$ 1,200*	*0*	*$ -*	*25%*	*$ -*	*$ -*	$ -
Structural Retaining Walls	*SF*	*$ 150*	*750*	*$ 112,500*	*25%*	*$ 28,125*	*$ 140,625*	$ 163,023
Canopy	*SF*	*$ 150*	*3665*	*$ 549,750*	*25%*	*$ 137,438*	*$ 687,188*	$ 796,639
Fixtures (Benches, Map Cases, Trash Receptacles, Etc.)	*LS*	*$ 75,000*	*2*	*$ 150,000*	*25%*	*$ 37,500*	*$ 187,500*	$ 217,364
Handrailing	*LF*	*$ 175*	*408*	*$ 71,313*	*25%*	*$ 17,828*	*$ 89,141*	$ 103,338
Platform Signage	*LS*	*$ 40,000*	*1*	*$ 40,000*	*25%*	*$ 10,000*	*$ 50,000*	$ 57,964
Lighting/Electrical/Communication	*LS*	*$ 350,000*	*1*	*$ 350,000*	*25%*	*$ 87,500*	*$ 437,500*	$ 507,182
Stairwells: Underground Stations	*SF*	*$ 250*	*600*	*$ 150,000*	*25%*	*$ 37,500*	*$ 187,500*	$ 217,364
Tactile Warning Strip	*SF*	*$ 45*	*1620*	*$ 72,900*	*25%*	*$ 18,225*	*$ 91,125*	$ 105,639
Ramp	*SF*	*$ 88*	*0*	*$ -*	*25%*	*$ -*	*$ -*	$ -
20.04 Other stations, landings, terminals: Intermodal, ferry, trolley, etc.							$ -	$ -
20.05 Joint development							$ -	$ -
20.06 Automobile parking multi-story structure							$ -	$ -
20.07 Elevators	EA	$ 600,000	2	$ 1,200,000	25%	$ 300,000	$ 1,500,000	$ 1,738,911
20.08 Escalators	EA	$ 500,000	2	$ 1,000,000	25%	$ 250,000	$ 1,250,000	$ 1,449,093
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS				**$ -**		**$ -**	**$ -**	**$ -**
30.01 Administration Building: Office, sales, storage, revenue counting							$ -	$ -
30.02 Light Maintenance Facility							$ -	$ -
30.03 Heavy Maintenance Facility							$ -	$ -
30.04 Storage or Maintenance of Way Building							$ -	$ -
30.05 Yard and Yard Track							$ -	$ -
40 SITEWORK & SPECIAL CONDITIONS				**$ 16,658,885**	**29%**	**$ 4,781,665**	**$ 20,720,550**	**$ 24,020,796**
40.01 Demolition, Clearing, Earthwork				$ 720,000		$ -	$ -	$ -
General Demolition	*LS*	*$ 720,000*	*1*	*$ 720,000*	*30%*			$ -
40.02 Site Utilities, Utility Relocation				$ 7,548,300		$ 2,264,490	$ 9,812,790	$ 11,375,713
General Utility Relocation	*LS*	*$ 5,564,000*	*1*	*$ 5,564,000*	*30%*	*$ 1,669,200*	*$ 7,233,200*	$ 8,385,261
Overhead Utility Relocation	*EA*	*$ 600,000*	*1*	*$ 600,000*	*30%*	*$ 180,000*	*$ 780,000*	$ 904,234
Utility Protection-in-Place	*LF*	*$ 1,000*	*100*	*$ 100,000*	*30%*	*$ 30,000*	*$ 130,000*	$ 150,706
Street Lights	*EA*	*$ 8,000*	*8*	*$ 64,000*	*30%*	*$ 19,200*	*$ 83,200*	$ 96,452
Drainage 24" RCP	*LF*	*$ 150*	*4750*	*$ 712,500*	*30%*	*$ 213,750*	*$ 926,250*	$ 1,073,778
Drainage 36" RCP	*LF*	*$ 140*	*1720*	*$ 240,800*	*30%*	*$ 72,240*	*$ 313,040*	$ 362,899
Drainage 51" RCP	*LF*	*$ 180*	*0*	*$ -*	*30%*	*$ -*	*$ -*	$ -
Drainage 57" RCP	*LF*	*$ 200*	*0*	*$ -*	*30%*	*$ -*	*$ -*	$ -
Drainage Inlet	*EA*	*$ 3,000*	*34*	*$ 102,000*	*30%*	*$ 30,600*	*$ 132,600*	$ 153,720
Drainage: Manhole Structure	*EA*	*$ 8,000*	*2*	*$ 16,000*	*30%*	*$ 4,800*	*$ 20,800*	$ 24,113
Manhole Structure (depth > 25')	*EA*	*$ 25,000*	*0*	*$ -*	*30%*	*$ -*	*$ -*	$ -
6'-4" W x 7'-6" H RCB (Cl A)	*CY*	*$ 1,000*	*0*	*$ -*	*30%*	*$ -*	*$ -*	$ -
Transition Structure	*EA*	*$ 20,000*	*0*	*$ -*	*30%*	*$ -*	*$ -*	$ -
Concrete Collar	*EA*	*$ 2,000*	*0*	*$ -*	*30%*	*$ -*	*$ -*	$ -
Curb Inlet Catch Basin	*EA*	*$ 3,500*	*14*	*$ 49,000*	*30%*	*$ 14,700*	*$ 63,700*	$ 73,846
Storm Drainage Facilities - Station Area	LS	$ 100,000	1	$ 100,000	30%	$ 30,000	$ 130,000	$ 150,706
40.03 Haz. mat'l, contam'd soil removal/mitigation, ground water treatments				$ 500,000		$ 150,000	$ 650,000	$ 753,528
Water Quality BMPs	*LS*	*$ 500,000*	*1*	*$ 500,000*	*30%*	*$ 150,000*	*$ 650,000*	*$ 753,528*
40.04 Environmental mitigation, e.g. wetlands, historic/archeologic, parks	RF	$ 150	7200	$ 1,080,000	30%	$ 324,000	$ 1,404,000	$ 1,627,621
40.05 Site structures including retaining walls, sound walls				$ 5,550,000		$ 1,665,000	$ 7,215,000	$ 8,364,162
Misc. Retaining Walls (Incl. Shoring)	*SF*	*$ 75*	*2000*	*$ 150,000*	*30%*	*$ 45,000*	*$ 195,000*	*$ 226,058*
Sound Wall	*SF*	*$ 50*	*0*	*$ -*	*30%*	*$ -*	*$ -*	$ -
Roadway Bridges	*SF*	*$ 400*	*13500*	*$ 5,400,000*	*30%*	*$ 1,620,000*	*$ 7,020,000*	*$ 8,138,104*
40.06 Pedestrian / bike access and accommodation, landscaping				$ 165,000		$ 49,500	$ 214,500	$ 248,664
Relocation/Reconstruction of Existing Bike Path	*LF*	*$ 250*	*660*	*$ 165,000*	*30%*	*$ 49,500*	*$ 214,500*	*$ 248,664*
40.07 Automobile, bus (non-BRT Guideway), van accessways including roads,				$ 1,095,585		$ 328,675	$ 1,424,260	$ 1,651,108
Asphalt Concrete Paving (elevated)	*SF*	*$ 9.50*	*0*	*$ -*	*30%*	*$ -*	*$ -*	$ -
Roadway Base (at grade)	*CY*	*$ 40*	*108*	*$ 4,308*	*30%*	*$ 1,292*	*$ 5,600*	*$ 6,492*
Asphalt Concrete Paving (at grade)	*SF*	*$ 7.50*	*26170*	*$ 196,277*	*30%*	*$ 58,883*	*$ 255,160*	*$ 295,800*
Minor Protect in Place - Landscaping, Etc	*LS*	*$ 100,000*	*1*	*$ 100,000*	*30%*	*$ 30,000*	*$ 130,000*	*$ 150,706*
Roadway Signals - Intersection Modifications	*EA*	*$ 200,000*	*1*	*$ 200,000*	*30%*	*$ 60,000*	*$ 260,000*	*$ 301,411*
Roadway Signage and Striping	*EA*	*$ 10,000*	*1*	*$ 10,000*	*30%*	*$ 3,000*	*$ 13,000*	*$ 15,071*
Temporary BRT guideway (shoo-fly) during construction	*RF*	*$ 150*	*3900*	*$ 585,000*	*30%*	*$ 175,500*	*$ 760,500*	*$ 881,628*
Temporary Roadway Signals - Interstections	*EA*	*$ 75,000*	*0*	*$ -*	*30%*	*$ -*	*$ -*	$ -
40.08 Temporary Facilities and other indirect costs during construction				$ -		$ -	$ -	$ -
Flagging	*Day*	*$ 1,200*	*0*	*$ -*	*30%*	*$ -*	*$ -*	$ -
50 SYSTEMS				**$ 700,000**	**25%**	**$ 175,000**	**$ 875,000**	**$ 1,014,365**
50.01 Train control and signals							$ -	$ -
50.02 Traffic signals and crossing protection (including removal of existing)	EA	$ 100,000	4	$ 400,000	25%	$ 100,000	$ 500,000	$ 579,637
50.03 Traction power supply: substations							$ -	$ -
50.04 Traction power distribution: catenary and third rail							$ -	$ -
50.05 Communications							$ -	$ -
50.06 Fare collection system and equipment	EA	$ 300,000	1	$ 300,000	25%	$ 75,000	$ 375,000	$ 434,728
50.07 Central Control							$ -	$ -
Construction Subtotal (10 - 50)				**$ 49,452,335**	**26%**	**$ 12,711,969**	**$ 61,444,304**	**$ 71,230,788**
60 ROW, LAND, EXISTING IMPROVEMENTS				**$ 847,107**	**0%**	**$ 254,132**	**$ 1,101,240**	**$ 1,276,639**
60.01 Purchase or lease of real estate	AC	$ 3,000,000	0.28	$ 847,107	30%	$ 254,132	$ 1,101,240	$ 1,276,639
60.02 Relocation of existing households and businesses							$ -	$ -
70 VEHICLES (number)				**$ -**	**0%**	**$ -**	**$ -**	**$ -**
70.01 Light Rail							$ -	$ -
70.02 Heavy Rail							$ -	$ -
70.03 Commuter Rail							$ -	$ -
70.04 Bus (60' Articulated Bus)							$ -	$ -
70.05 Bus (40' Bus)							$ -	$ -
70.06 Non-revenue vehicles							$ -	$ -
70.07 Spare parts							$ -	$ -
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)	**0**	**33%**		**$ 16,319,271**	**15%**	**$ 2,447,891**	**$ 18,767,161**	**$ 21,756,283**
80.01 AA/Draft EIS/EIR/Final EIS/EIR	SCC 10-50	3%		$ 1,483,570	15%	$ 222,536	$ 1,706,106	$ 1,977,844
80.01 Preliminary Engineering	SCC 10-50	3%		$ 1,483,570	15%	$ 222,536	$ 1,706,106	$ 1,977,844
80.02 Final Design	SCC 10-50	7%		$ 3,461,663	15%	$ 519,250	$ 3,980,913	$ 4,614,969
80.03 Project Management for Design and Construction	SCC 10-50	10%		$ 4,945,234	15%	$ 741,785	$ 5,687,019	$ 6,592,813
80.04 Construction Administration & Management	SCC 10-50	5%		$ 2,472,617	15%	$ 370,893	$ 2,843,509	$ 3,296,407
80.05 Professional Liability and other Non-Construction Insurance	SCC 10-50	0%		$ -	15%	$ -	$ -	$ -
80.06 Legal; Permits; Review Fees by other agencies, cities, etc.	SCC 10-50	1%		$ 494,523	15%	$ 74,179	$ 568,702	$ 659,281
80.07 Surveys, Testing, Investigation, Inspection	SCC 10-50	2%		$ 989,047	15%	$ 148,357	$ 1,137,404	$ 1,318,563
80.08 Start up	SCC 10-50	5%		$ 2,472,617	15%	$ 370,893	$ 2,843,509	$ 3,296,407
Subtotal (10 - 80)				**$ 66,618,713**	**23%**	**$ 15,413,991**	**$ 81,312,705**	**$ 94,263,710**
90 UNALLOCATED CONTINGENCY	SCC 10-80	15%					**$ 12,196,906**	**$ 23,832,754**
Subtotal (10 - 90)							**$ 93,509,610**	**$ 118,096,464**
100 FINANCE CHARGES							**$ -**	**$ -**
Total Project Cost (10 - 100)							**$ 93,509,610**	**$ 118,096,464**

MAIN WORKSHEET

Los Angeles County Metropolitan Transportation Authority (LACMTA)

Metro Orange Line, Los Angeles, CA

BRT Unit Costs

Today's Date: 6/9/17
Yr of Base Year $: 2017
Yr of Midpoint of Construction: 2022

	Units	Unit Price	Instructions/Notes for Estimators (Please read before filling in quantities in the sub-project tabs)
10 GUIDEWAY & TRACK ELEMENTS (route miles)			
10.01 Guideway: At-grade exclusive right-of-way			
10.02 Guideway: At-grade semi-exclusive (allows cross-traffic)			
10.03 Guideway: At-grade in mixed traffic			
10.04 Guideway: Aerial structure	SF	$ 450	Include Guideway through station areas, but not the station, platform, vertical circulation, etc. Multiply length by average width to get SF. Only include aerial structure, not retained fills approaching the aerial structure in this item.
10.05 Guideway: Built-up fill	CY	$ 40	This includes any unretained fills. Do not include retained fills here.
10.06 Guideway: Underground cut & cover	SF	$ 500	Shouldn't be any cut and cover. Quantify the roadway bridges over the trench in Section 40 of the estimate.
10.07 Guideway: Underground tunnel			
10.08 Guideway: Retained cut or fill			
Earthwork (cut or fill)	*CY*	$ 50	Include retained fills or cuts (i.e. volume of earth), excavation,/loading/stockpiling, and backfill/compaction for the approaches to the aerial guideway segments.
Guideway Retaining Walls - Fill (MSE or other)	*SF*	*$ 125*	Include all guideway fill retaining walls outside station platform limits.
Guideway Retaining Walls - Cut	*SF*	*$ 175*	Include all guideway cut retaining walls outside station platform limits.
10.09 Track: Direct fixation (Assume SCC 10.04 & 10.07)			
10.10 Track: Embedded			
10.11 Track: Ballasted (Assume SCC 10.01 & 10.02)			
10.12 Track: Special (switches, turnouts)			
10.13 Track: Vibration and noise dampening			
20 STATIONS, STOPS, TERMINALS, INTERMODAL (number)			
20.01 At-grade station, stop, shelter, mall, platform			
20.02 Aerial station, stop, shelter, mall, terminal, platform			
Structural Concrete	*CY*	*$ 1,800*	Include all station elements except the guideway, which is included in Section 10.
Platform Concrete	*CY*	*$ 1,200*	Include all station elements except the guideway, which is included in Section 10.
Platform Beam/Footing	*CY*	*$ 1,200*	Include all station elements except the guideway, which is included in Section 10.
Structural Retaining Walls	*SF*	*$ 450*	Include all retaining walls within station limits.
Canopy	*SF*	*$ 150*	
Fixtures (Benches, Map Cases, Trash Receptacles, Etc.)	*LS*	*$ 75,000*	Lump sum cost per station.
Handrailing	*LF*	*$ 175*	
Platform Signage	*LS*	*$ 40,000*	Lump sum cost per station.
Lighting/Electrical/Communication	*LS*	*$ 300,000*	Lump sum cost per station.
Stairwells: Aerial Stations	*SF*	*$ 200*	
Tactile Warning Strip	*SF*	*$ 45*	
Ramp	*SF*	*$ 88*	
20.03 Underground station, stop, shelter, mall, terminal, platform			
Excavation (Cut) for station improvements	*CY*	*$ 40*	This includes cuts (i.e. volume of earth) for the underground station areas.
Structural Concrete	*CY*	*$ 1,800*	Include all station elements except the guideway, which is included in Section 10.
Platform Concrete	*CY*	*$ 1,200*	Include all station elements except the guideway, which is included in Section 10.
Platform Beam/Footing	*CY*	*$ 1,200*	Include all station elements except the guideway, which is included in Section 10.
Structural Retaining Walls	*SF*	*$ 150*	Include all retaining walls within station limits.
Canopy	*SF*	*$ 150*	
Fixtures (Benches, Map Cases, Trash Receptacles, Etc.)	*LS*	*$ 75,000*	
Handrailing	*LF*	*$ 175*	
Platform Signage	*LS*	*$ 40,000*	Lump sum cost per station.
Lighting/Electrical/Communication	*LS*	*$ 350,000*	Lump sum cost per station.
Stairwells: Underground Stations	*SF*	*$ 250*	
Tactile Warning Strip	*SF*	*$ 45*	
Ramp	*SF*	*$ 88*	
20.04 Other stations, landings, terminals: Intermodal, ferry, trolley, etc.			
20.05 Joint development			
20.06 Automobile parking multi-story structure			
20.07 Elevators	EA	$ 600,000	Include elevator and elevator shaft/enclosure.
20.08 Escalators	EA	$ 500,000	
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS			
30.01 Administration Building: Office, sales, storage, revenue counting			
30.02 Light Maintenance Facility			
30.03 Heavy Maintenance Facility			
30.04 Storage or Maintenance of Way Building			
30.05 Yard and Yard Track			
40 SITEWORK & SPECIAL CONDITIONS			
40.01 Demolition, Clearing, Earthwork			
General Demolition	*LS*	*N/A*	This item will be estimated by STV Cost Estimators for each location separately
Maintain Access to Driveways	*LS*	*N/A*	This item will be estimated by STV Cost Estimators for each location separately
40.02 Site Utilities, Utility Relocation			
General Utility Relocation	*LS*	*N/A*	w2 to estimate cost of relocation/mod/protection of exist utils for each location separately. Add rows if desired (not if not needed).
Overhead Utility Relocation	*EA*	*$ 600,000*	Based on LADWP cost for undergrounding OH power lines when crossing transit project or RR ROW.
Utility Protection-in-Place	*LF*	*$ 1,000*	w2 to estimate cost of relocation/mod/protection of exist utils for each location separately. Add rows if desired (not if not needed).
Street Lights	*EA*	*$ 8,000*	Include removal and disposal/haul of existing street lights and installation of new street lights.
Adjust Traffic Signals	*EA*	*$ 100,000*	Identify and quantify number of existing intersections impacted.
Drainage 24" RCP	*LF*	*$ 150*	
Drainage 36" RCP	*LF*	*$ 140*	
Drainage 51" RCP	*LF*	*$ 180*	
Drainage 57" RCP	*LF*	*$ 200*	
Drainage Inlet	*EA*	*$ 3,000*	
Drainage: Manhole Structure	*EA*	*$ 8,000*	
Manhole Structure (depth > 25')	*EA*	*$ 25,000*	
6'-4" W x 7'-6" H RCB (Cl A)	*CY*	*$ 1,000*	
Transition Structure	*EA*	*$ 20,000*	
Concrete Collar	*EA*	*$ 2,000*	
Curb Inlet Catch Basin	*EA*	*$ 3,500*	
Storm Drainage Facilities - Station Area	*LS*	*$ 100,000*	
40.03 Haz. mat'l, contam'd soil removal/mitigation, ground water treatments			
Water Quality BMPs	*LS*	*N/A*	
40.04 Environmental mitigation, e.g. wetlands, historic/archeologic, parks	RF	$ 150	Not anticipated to be major mitigations needed, used relatively low $150/RF.
40.05 Site structures including retaining walls, sound walls			
Misc. Retaining Walls (Incl. Shoring)	*SF*	*$ 75*	Include all retaining walls not directly associated with or included in Guideway (10) or Station (20) sections above.
Sound Wall	*SF*	*$ 50*	
Roadway Bridges	*SF*	*$ 400*	Includes 3' - 0" Cast-in-Place (CIP) Concrete Box Girder
40.06 Pedestrian / bike access and accommodation, landscaping			
Relocation/Reconstruction of Existing Bike Path	*LF*	*$ 250*	Include all bikepaths impacted by grade separation project
40.07 Automobile, bus (non-BRT Guideway), van accessways including roads, parking lots			
Asphalt Concrete Paving (elevated)	*SF*	*$ 9.50*	
Roadway Base (at grade)	*CY*	*$ 40*	
Asphalt Concrete Paving (at grade)	*SF*	*$ 7.50*	
Minor Protect in Place - Landscaping, Etc	*LS*	*$ 100,000*	Include protection and/or repair due to proximity of construction activities for landscaping/fencing/parallel sidewalks.
Roadway Signals - Intersection Modifications	*EA*	*$ 200,000*	Identify and quantify number of existing intersections impacted.
Roadway Signage and Striping	*EA*	*$ 10,000*	Identify and quantify number of existing intersections or roadways impacted.
Temporary BRT guideway (shoo-fly) during construction	*RF*	*$ 150*	Quantify total estimated route feet of temporary BRT guideway needed.
Temporary Roadway Signals - Interstections	*EA*	*$ 75,000*	Identify and quantify number of temporary intersections impacted.
40.08 Temporary Facilities and other indirect costs during construction	SCC 10-50	10%	
Flagging	*Day*	*$ 1,200*	
50 SYSTEMS			
50.01 Train control and signals			
50.02 Traffic signals and crossing protection (including removal of existing)	EA	$ 100,000	Identify and quantify number of existing BRT at-grade crossings where signals are removed.
50.03 Traction power supply: substations			
50.04 Traction power distribution: catenary and third rail			
50.05 Communications	LS	$ 450,000	Lump sum cost per station.
50.06 Fare collection system and equipment	EA	$ 300,000	Identify and quantify cost per station.
50.07 Central Control			
Construction Subtotal (10 - 50)			
60 ROW, LAND, EXISTING IMPROVEMENTS			
60.01 Purchase or lease of real estate	AC	$ 3,000,000	Include ROW takes and TCEs.
60.02 Relocation of existing households and businesses			
70 VEHICLES (number)			
70.01 Light Rail			
70.02 Heavy Rail			
70.03 Commuter Rail			
70.04 Bus (60' Articulated Bus)			
70.05 Bus (40' Bus)			
70.06 Non-revenue vehicles			
70.07 Spare parts			
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)		**33%**	
80.01 AA/Draft EIS/EIR/Final EIS/EIR	SCC 10-50	3%	
80.01 Preliminary Engineering	SCC 10-50	3%	
80.02 Final Design	SCC 10-50	7%	
80.03 Project Management for Design and Construction	SCC 10-50	10%	
80.04 Construction Administration & Management	SCC 10-50	5%	
80.05 Professional Liability and other Non-Construction Insurance	SCC 10-50	0%	
80.06 Legal; Permits; Review Fees by other agencies, cities, etc.	SCC 10-50	1%	
80.07 Surveys, Testing, Investigation, Inspection	SCC 10-50	2%	
80.08 Start up	SCC 10-50	5%	
Subtotal (10 - 80)			
90 UNALLOCATED CONTINGENCY	SCC 10-80	15%	
Subtotal (10 - 90)			
100 FINANCE CHARGES	-	-	
Total Project Cost (10 - 100)			

CROSSING	WORK DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL - 2017 Base Yr $	TOTAL - 2022 YOE $ (3% escalation per year)
BUSWAY & CORTEEN PLACE	NEW CURB AND GUTTER	LF	350	$45	$15,750	$18,259
	NEW ASPHALT CONCRETE PAVEMENT	TNS	172	$128	$22,016	$25,523
	NEW SIDEWALK	SF	2185	$8	$17,480	$20,264
	NEW SIGNING & STRIPING	LS	1	$5,000	$5,000	$5,796
	REMOVE EXISTING TRAFFIC SIGNALS	LS	1	$6,000	$6,000	$6,956
	REMOVE EXISTING CURB AND GUTTER	LF	130	$28	$3,640	$4,220
	REMOVE EXISTING ASPHALT CONCRETE PAVEMENT	SY	263	$22	$5,786	$6,708
					$75,672	$87,725
	UNALLOCATED CONTINGENCY		20%		$15,134	$17,545
	TOTAL				**$90,806**	**$105,270**

CROSSING	WORK DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL - 2017 Base Yr $	TOTAL - 2022 YOE $ (3% escalation per year)
BUSWAY & TYRONE AVE	NEW CURB AND GUTTER	LF	350	$45	$15,750	$18,259
	NEW ASPHALT CONCRETE PAVEMENT	TNS	172	$128	$22,016	$25,523
	NEW SIDEWALK	SF	1844	$8	$14,752	$17,102
	NEW SIGNING & STRIPING	LS	1	$5,000	$5,000	$5,796
	REMOVE EXISTING TRAFFIC SIGNALS	LS	1	$3,000	$3,000	$3,478
	REMOVE EXISTING CURB AND GUTTER	LF	100	$28	$2,800	$3,246
	REMOVE EXISTING ASPHALT CONCRETE PAVEMENT	SY	263	$22	$5,786	$6,708
					$69,104	$80,110
	UNALLOCATED CONTINGENCY		20%		$13,821	$16,022
	TOTAL				**$82,925**	**$96,133**

CROSSING	WORK DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL - 2017 Base Yr $	TOTAL - 2022 YOE $ (3% escalation per year)
BUSWAY & VESPER AVE	NEW CURB AND GUTTER	LF	350	$45	$15,750	$18,259
	NEW ASPHALT CONCRETE PAVEMENT	TNS	172	$128	$22,016	$25,523
	NEW SIDEWALK	SF	1000	$8	$8,000	$9,274
	NEW SIGNING & STRIPING	LS	1	$5,000	$5,000	$5,796
	REMOVE EXISTING TRAFFIC SIGNALS	LS	1	$3,000	$3,000	$3,478
	REMOVE EXISTING CURB AND GUTTER	LF	100	$28	$2,800	$3,246
	REMOVE EXISTING ASPHALT CONCRETE PAVEMENT	SY	263	$22	$5,786	$6,708
					$62,352	$72,283
	UNALLOCATED CONTINGENCY		20%		$12,470	$14,457
	TOTAL				**$74,822**	**$86,740**

CROSSING	WORK DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL - 2017 Base Yr $	TOTAL - 2022 YOE $ (3% escalation per year)
BUSWAY & DENSMORE AVE	NEW SIGNING & STRIPING	LS	1	$5,000	$5,000	$5,796
	NEW TUBULAR STEEL GATES	EA	2	$5,000	$10,000	$11,593
	REMOVE EXISTING GATES	EA	1	$5,000	$5,000	$5,796
					$20,000	$23,185
	UNALLOCATED CONTINGENCY		20%		$4,000	$4,637
	TOTAL				**$24,000**	**$27,823**

CROSSING	WORK DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL - 2017 Base Yr $	TOTAL - 2022 YOE $ (3% escalation per year)
BUSWAY & PRIVATE DRIVEWAY	NEW SIGNING & STRIPING	LS	1	$5,000	$5,000	$5,796
	NEW TUBULAR STEEL GATES	EA	2	$5,000	$10,000	$11,593
	REMOVE EXISTING GATES	EA	1	$5,000	$5,000	$5,796
					$20,000	$23,185
	UNALLOCATED CONTINGENCY		20%		$4,000	$4,637
	TOTAL				**$24,000**	**$27,823**

O&M Cost Estimates
Package A

Change in Infrastructure O&M			**$**	**212,500**
	Unit Cost	*Quantity*		
Escalators	$ 20,000	6	$	120,000
Elevators	$ 20,000	6	$	120,000
Signals removed	$ 3,500	9	$	(31,500)
Bus-signal communication system			$	4,000
Gates	$ 5,000	0	$	-
Change in Service O&M*			**$**	**(843,750)**
Route	*Current Travel Times (min)*	*Projected Travel Times*	*% Travel Time Savings*	
NoHo-Warner	40	37	7.5%	
NoHo- Chatsworth	50	47	6.0%	
Average Travel Time Savings			6.8%	
Adjusted Average Travel Time Savings			3.4%	
Package A O&M Cost			**$**	**(631,250)**
Total Change in O&M Cost				**-2.5%**

2015 O&M cost $ 25,000,000

*Assumptions for Change in Service O&M

1. As there are two westbound routes, the travel time savings were calculated for both and then averaged
2. The ratio of O&M cost to service was estimated to be 1:2
3. The averaged time savings was adjusted, which reflects the estimated O&M savings associated with travel time savings

O&M Cost Estimates
Package B

Change in Infrastructure O&M			**$**	**213,500**
	Unit Cost	*Quantity*		
Escalators	$ 20,000	6	$	120,000
Elevators	$ 20,000	6	$	120,000
Signals removed	$ 3,500	9	$	(31,500)
Bus-signal communication system			$	5,000
Gates	$ 5,000	0	$	-
Change in Service O&M*			**$**	**(562,500)**
Route	*Current Travel Times (min)*	*Projected Travel Times*	*% Travel Time Savings*	
NoHo-Warner	40	38	5.0%	
NoHo- Chatsworth	50	48	4.0%	
Average Travel Time Savings			4.5%	
Adjusted Average Travel Time Savings			2.3%	
Package B O&M Cost			**$**	**(349,000)**
Total Change in O&M Cost				**-1.4%**

2015 O&M cost $ 25,000,000

*Assumptions for Change in Service O&M

1. As there are two westbound routes, the travel time savings were calculated for both and then averaged
2. The ratio of O&M cost to service was estimated to be 1:2
3. The averaged time savings was adjusted, which reflects the estimated O&M savings associated with travel time savings

O&M Cost Estimates
Package C

Change in Infrastructure O&M			**$**	**213,500**
	Unit Cost	*Quantity*		
Escalators	$ 20,000	6	$	120,000
Elevators	$ 20,000	6	$	120,000
Signals removed	$ 3,500	9	$	(31,500)
Bus-signal communication system			$	5,000
Gates	$ 5,000	0	$	-
Change in Service O&M*			**$**	**(562,500)**
	Current Travel	*Projected Travel*	*% Travel Time*	
Route	*Times (min)*	*Times*	*Savings*	
NoHo-Warner	40	38	5.0%	
NoHo- Chatsworth	50	48	4.0%	
Average Travel Time Savings			4.5%	
Adjusted Average Travel Time Savings			2.3%	
Package C O&M Cost			**$**	**(349,000)**
Total Change in O&M Cost				**-1.4%**

2015 O&M cost $ 25,000,000

*Assumptions for Change in Service O&M

1. As there are two westbound routes, the travel time savings were calculated for both and then averaged
2. The ratio of O&M cost to service was estimated to be 1:2
3. The averaged time savings was adjusted, which reflects the estimated O&M savings associated with travel time savings

O&M Cost Estimates
Package D

Change in Infrastructure O&M			**$**	**362,000**
	Unit Cost	*Quantity*		
Escalators	$ 20,000	10	$	200,000
Elevators	$ 20,000	10	$	200,000
Signals removed	$ 3,500	12	$	(42,000)
Bus-signal communication system			$	4,000
Gates	$ 5,000	0	$	-
Change in Service O&M*			**$**	**(843,750)**
Route	*Current Travel Times (min)*	*Projected Travel Times*	*% Travel Time Savings*	
NoHo-Warner	40	37	7.5%	
NoHo- Chatsworth	50	47	6.0%	
Average Travel Time Savings			6.8%	
Adjusted Average Travel Time Savings			3.4%	
Package C O&M Cost			**$**	**(481,750)**
Total Change in O&M Cost				**-1.9%**

2015 O&M cost $ 25,000,000

*Assumptions for Change in Service O&M

1. As there are two westbound routes, the travel time savings were calculated for both and then averaged
2. The ratio of O&M cost to service was estimated to be 1:2
3. The averaged time savings was adjusted, which reflects the estimated O&M savings associated with travel time savings

O&M Cost Estimates
Package E

Change in Infrastructure O&M				**$**	**100,000**
		Unit Cost	*Quantity*		
Escalators	$	20,000	0	$	-
Elevators	$	20,000	0	$	-
Signals removed	$	3,500	0	$	-
Bus-signal communication system				$	-
Gates	$	5,000	20	$	100,000
Change in Service O&M*				**$**	**(1,687,500)**
Route		*Current Travel Times (min)*	*Projected Travel Times*		*% Travel Time Savings*
NoHo-Warner		40	34		15.0%
NoHo- Chatsworth		50	44		12.0%
Average Travel Time Savings					13.5%
Adjusted Average Travel Time Savings					6.8%
Package E O&M Cost				**$**	**(1,587,500)**
Total Change in O&M Cost					**-6.4%**

2015 O&M cost $ 25,000,000

*Assumptions for Change in Service O&M

1. As there are two westbound routes, the travel time savings were calculated for both and then averaged
2. The ratio of O&M cost to service was estimated to be 1:2
3. The averaged time savings was adjusted, which reflects the estimated O&M savings associated with travel time savings

O&M Cost Estimates
Package Details

	Package A	Package B	Package C	Package D	Package E
Stations	3	3	3	5	0
Total Signals removed	9	9	9	12	0
Closures	4	5	5	4	0
Grade sep crossings with lights	5	4	4	8	0
Change in travel (min, one direction)	3	2	2	3	6
Crossings for bus-signal comm system	4	5	5	4	0
Gates	0	0	0	0	20

APPENDIX D: TRAFFIC OPERATIONS ANALYSIS

iteris®

Metro Orange Line Grade Separation Analysis and Operational Improvements Technical Study

Traffic Operations Analysis

Technical Memorandum

FINAL| version 2.0

August 3, 2017

Submitted to:

Metro®

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Innovating Through Informatics™

DOCUMENT VERSION CONTROL

DOCUMENT NAME	SUBMITTAL DATE	VERSION NO.
Traffic Operation Analysis Draft Technical Memorandum	June 26, 2017	1.0
Traffic Operation Analysis Technical Memorandum	August 3, 2017	2.0

1.0 INTRODUCTION

The purpose of this technical memorandum is to document traffic analyses conducted for various improvement alternative scenarios for the Metro Orange Line (MOL) Grade Separation analysis and Operational Improvements Technical Study. The VISSIM microsimulation software was used for the traffic analysis. The VISSIM model originally developed for the MOL Speed Evaluation Study (2015) was used as the base model for further evaluations. This model was updated to reflect existing 2016/2017 conditions (as documented in the Task 4.0 Memorandum). One of the major updates in the VISSIM model was bus speeds at intersection crossings, which changed after Metro implemented the immediate recommendations listed in the MOL Speed Evaluation Study.

2.0 ALTERNATIVES

A traffic operations analysis was conducted for each of the following alternatives:

1. Alternative 1 - Grade Separation
    a. Alternative 1A – Grade Separation of only Reseda and only Sepulveda
    b. Alternative 1B – Grade separation from Sepulveda to Van Nuys only
    c. Alternative 1C – Grade separation from Woodman to Valley College
    d. Alternative 1D – Grade separation at Reseda, Sepulveda to Van Nuys, and Oxnard-Woodman-Fulton-Valley College
2. Alternative 2 – Four Quad Gate System Deployment at all Crossings (31 total crossings, not including private and/or pedestrian-only crossings)
3. Alternative 3 – Signal Improvements at all Crossings

In addition to the alternatives listed above, a simulation was conducted for potential construction detours. It is important to note that the alternatives evaluated as a part of the traffic operations analysis reflect a sample of potential improvements that were determined to be applicable to crossings via the initial screening conducted earlier in the project process. The findings of this analysis will be used to develop potential packages of improvements, and the packages ultimately developed may be different from the alternatives evaluated in this task.

3.0 TRAFFIC ANALYSIS METHODOLOGY

The following measures of effectiveness (MOE) were used to analyze different scenarios:

1. Bus travel time – Bus travel times were calculated between the North Hollywood and Canoga bus stations in both directions (eastbound and westbound)
2. North-South movement delay – Average vehicle delay for north-south through movements for crossing streets was calculated during the PM peak hour (the worst case operating conditions).

All results were based on average of 10 simulation runs.

4.0 TRAFFIC OPERATION SIMULATION RESULTS

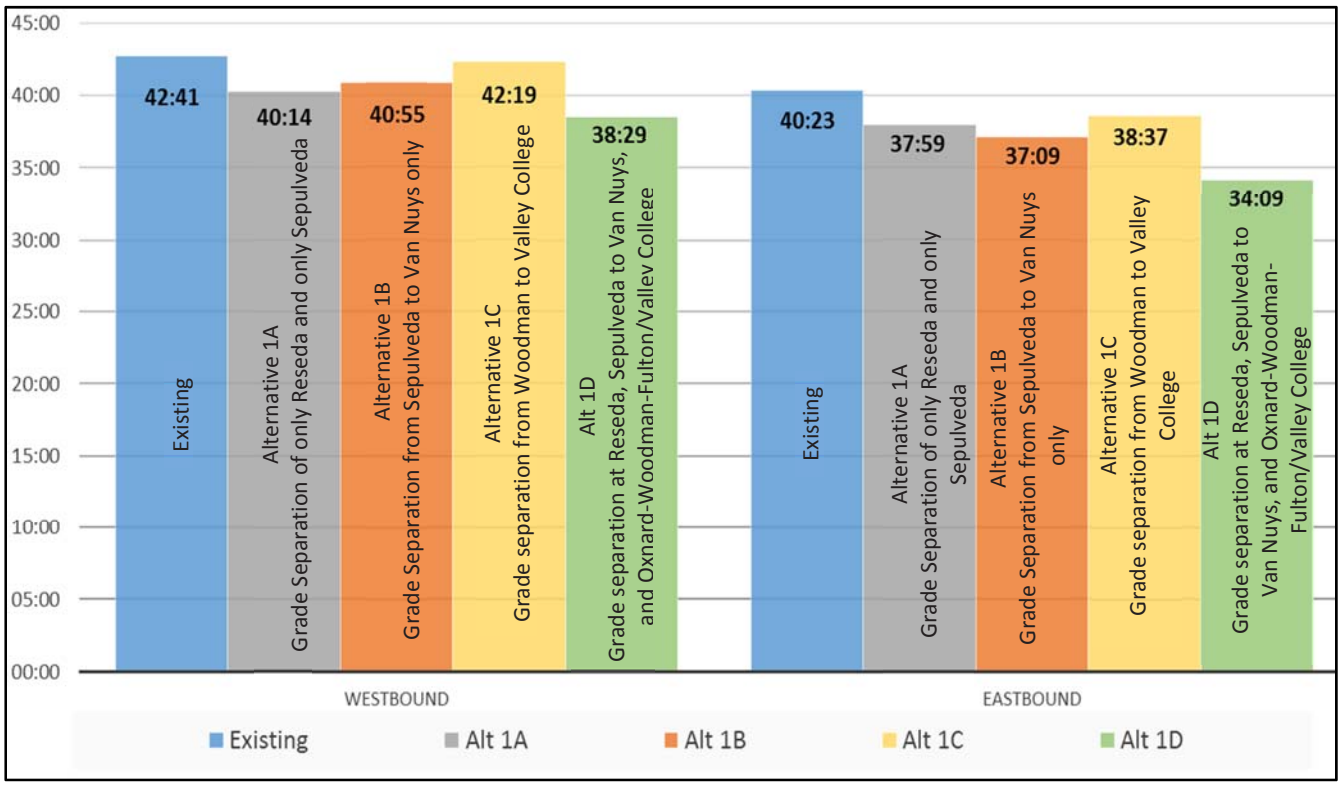
Utilizing the data and findings collected in previous tasks, Iteris prepared a computer simulation, using VISSIM, of the operation of the MOL. This section describes the results of an existing conditions simulation, and the results of the different scenarios simulations.

4.1 Alternative 1 – Grade Separation

Bus Travel Times

Figure 1 below presents a summary of the modeled travel time along the MOL between North Hollywood and Canoga, under the four sub-alternatives 1A, 1B, 1C and 1D.

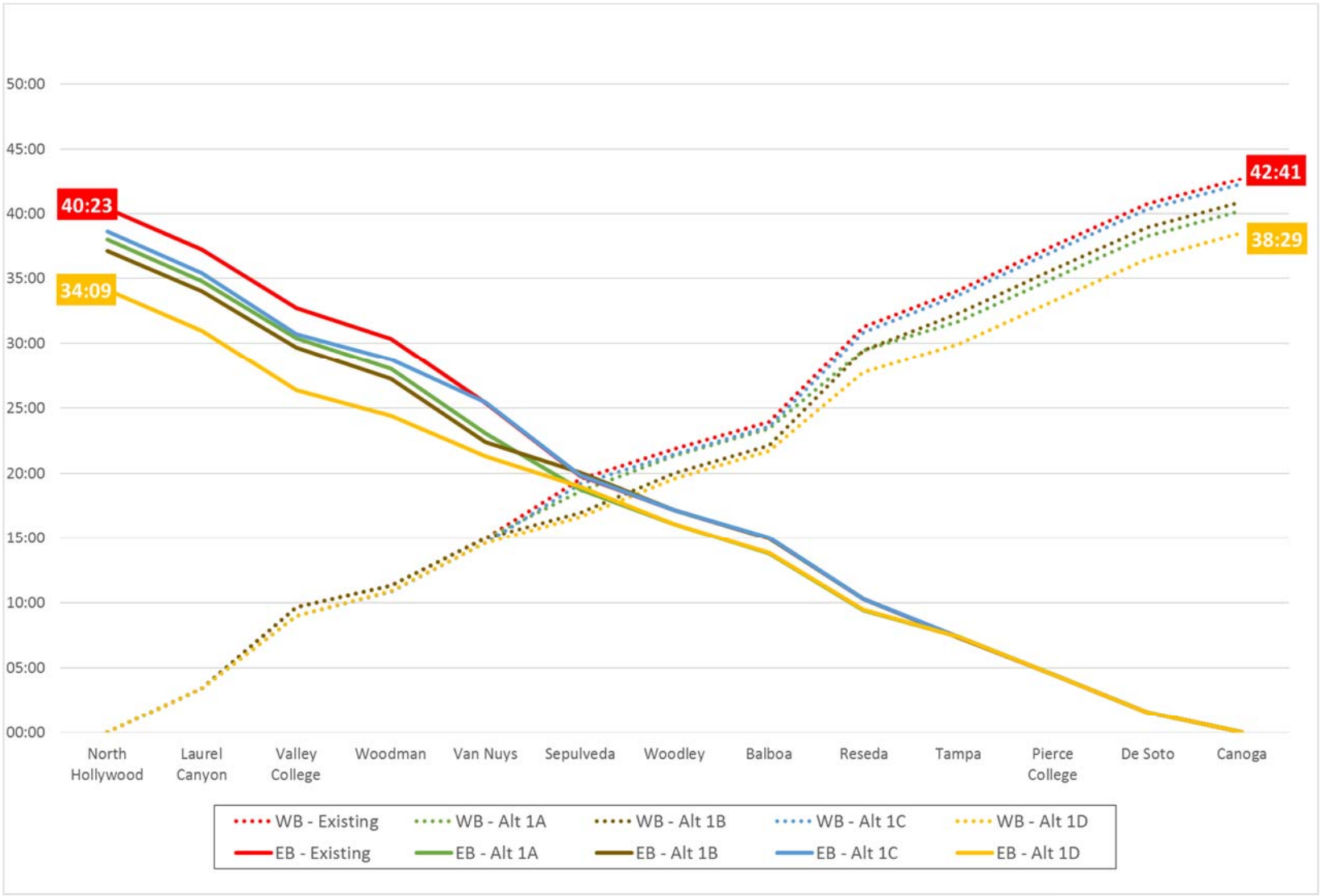
Figure 1: Bus Travel Times Comparison, North Hollywood to Canoga – Grade Separation Alternatives



As shown in **Figure 1**, the Alternative 1D scenario shows a maximum travel time savings of approximately four (4) minutes in the westbound direction and approximately six (6) minutes in the eastbound direction. Alternative 1D has grade separation at the five priority locations identified in the Measure M expenditure plan: Fulton/Burbank, Woodman/Oxnard, Van Nuys, Sepulveda and Reseda. Among three individual grade separation scenarios, Alternative 1B, grade separation from Sepulveda to Van Nuys, provides the maximum travel time savings. All grade separation scenarios have travel time savings in comparison to the existing conditions.

Figure 2 below plots the eastbound and westbound travel times along the entire alignment, by stop, under the four grade separation scenarios. As shown in **Figure 2**, travel times between North Hollywood and Canoga currently take approximately 40 minutes in the westbound direction. The analysis shows that travel times could be reduced to approximately 34 minutes by having grade separation at the five priority locations.

Figure 2: Eastbound and Westbound Travel time Plots – Grade Separation Scenarios Alternative



North-South Movement Delay for Cross Streets

Average delay per vehicle making northbound and southbound movements across busway intersections during the PM peak hour were obtained from the VISSIM simulation. **Table 1** shows average delay per vehicle for the busway cross-street through traffic movements. This represents the average delay per vehicle experiences by vehicles at each currently signalized crossing. Note that the average does not necessarily reflect the actual delays that would be experienced by each vehicle, and can vary based on cross-street traffic volumes and times of day. For the purposes of this corridor-wide analysis, the overall average delay was selected as a single metric to indicate overall changes resulting from analyzed alternatives.

Table 1: Cross-Street Average Vehicle Delay (in seconds) – Grade Separation Scenarios Alternative

Vehicle Delay	Existing	Alt 1A	Alt 1B	Alt 1C	Alt 1D
Northbound	24.4	24.3	23.9	23.7	23.8
Southbound	22.2	22.1	21.5	21.3	20.7
Total	23.3	23.2	22.7	22.5	22.2
Change %		-1%	-3%	-4%	-5%

As shown in **Table 1**, all the grade separation scenarios would reduce the delays for cross-street traffic along the MOL busway. Alternative 1D shows 5% reduction in average delay during the PM peak hour.

4.2 Alternative 2 – Four Quad Gate System Deployment at all Crossings

Bus Travel Times

This alternative assumes railroad style four quadrant gate systems would replace all signalized busway crossings between North Hollywood and Canoga. This alternative allows buses to pass through intersection without stopping or reducing speeds, as gates would be activated and close the intersection to cross traffic before the bus made the crossing. For the purposes of this analysis, gate down time was assumed to be an average of 35 seconds per crossing, which is a relatively conservative estimate to account for detailed timing that would be developed during further technical design.

Table 2 shows the bus travel times under Alternative 2. Alternative 2 would reduce travel times by 12 minutes or more in both eastbound and westbound direction.

Table 2: Bus Travel Times – Four Quad Gate System Alternative

	Existing	Alt 2
Westbound	42:41	29:57
Eastbound	40:23	28:18

North-South Movement Delay for Cross Streets

Average delay per vehicle making northbound and southbound movements across busway intersections during the PM peak hour were obtained from the VISSIM simulation. **Table 3** shows average delay per vehicle for the busway cross-street through traffic movements.

Table 3: Cross-Street Average Vehicle Delay (in seconds) – Four Quad Gate System Alternative

Vehicle Delay	Existing	Alt 2
Northbound	24.4	34.1
Southbound	22.2	27.1
Total	23.3	30.6
Change %		31%

As shown in the **Table 3**, Alternative 2 would increase vehicle delays for north-south cross traffic by 31% during the PM peak hour. Alternative 2 would significantly improve bus travel times along MOL corridor, and it would also increase travel times for vehicles on the north-south crossing streets along the corridor.

4.3 Alternative 3 – Signal Improvements at all Crossings

Bus Travel Times

This alternative estimates the potential operational impacts of expanded transit signal priority (TSP), or essentially improvements to green time for buses at all study area intersections. For the purposes of this analysis, an additional green time of five (5) seconds was added to all the busway phases for each crossing.

Table 4 shows the bus travel times under Alternative 3. Alternative 3 would reduce westbound travel times by 40 seconds and by 10 seconds in eastbound direction.

Table 4: Bus Travel Time – Signal Improvements at all Crossings Alternative

	Existing	Alt 3
Westbound	42:41	41:59
Eastbound	40:23	40:12

North-South Movement Delay for Cross Streets

Average delay per vehicle making northbound and southbound movements across busway intersections during the PM peak hour were obtained from the VISSIM simulation. **Table 5** shows average delay per vehicle for the busway cross-street through traffic movements. Alternative 3 would increase average vehicle delay by 7% during PM peak hour.

Table 5: Cross-Street Average Vehicle Delay (in seconds) – Signal Improvements at all Crossings Alternative

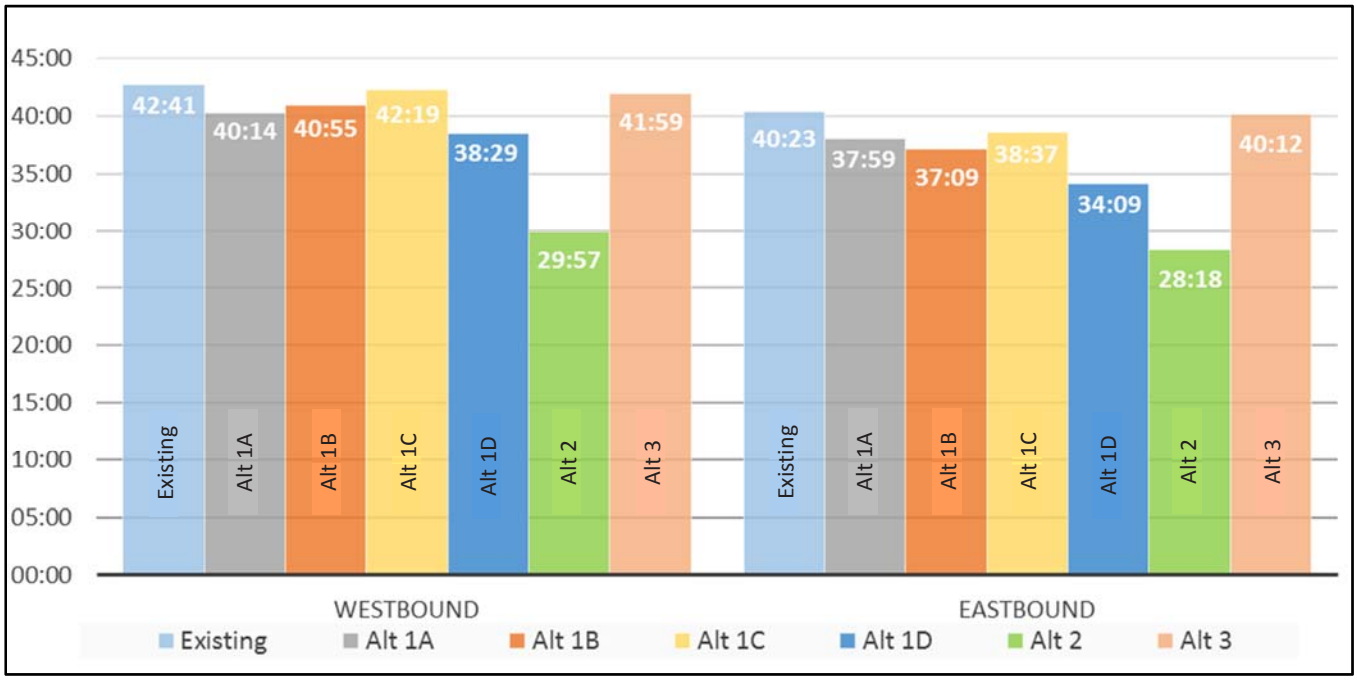
Vehicle Delay	Existing	Alt 3
Northbound	24.4	26.4
Southbound	22.2	23.6
Total	23.3	25.0
Change %		7%

4.4 Alternative Comparison

Bus Travel Times

Figure 3 shows a comparison bus travel times under all alternatives: existing, Alternative 1D, Alternative 2 and Alternative 3 conditions. Alternative 2 would have the maximum improvement, with travel time reduction of 12 minutes in both directions. Alternative 1D would reduce bus travel time up to six (6) minutes and Alternative 3 would reduce travel time by less than one minute.

Figure 3: Bus Travel Time – Alternative Comparison



North-South Movement Delay for Cross Streets

The total delay for vehicles making northbound and southbound movements across busway intersections during the PM peak hour were obtained from the VISSIM simulation. **Table 6** shows the impact of alternatives on the cross-street traffic. Alternative 1D would reduce vehicle hours of delay for cross-street traffic by 11%, whereas Alternative 2 would increase vehicle hours of delay by 34% during the PM peak hour.

Table 6: Cross-Street Average Vehicle Delay (in seconds) – Alternative Comparison

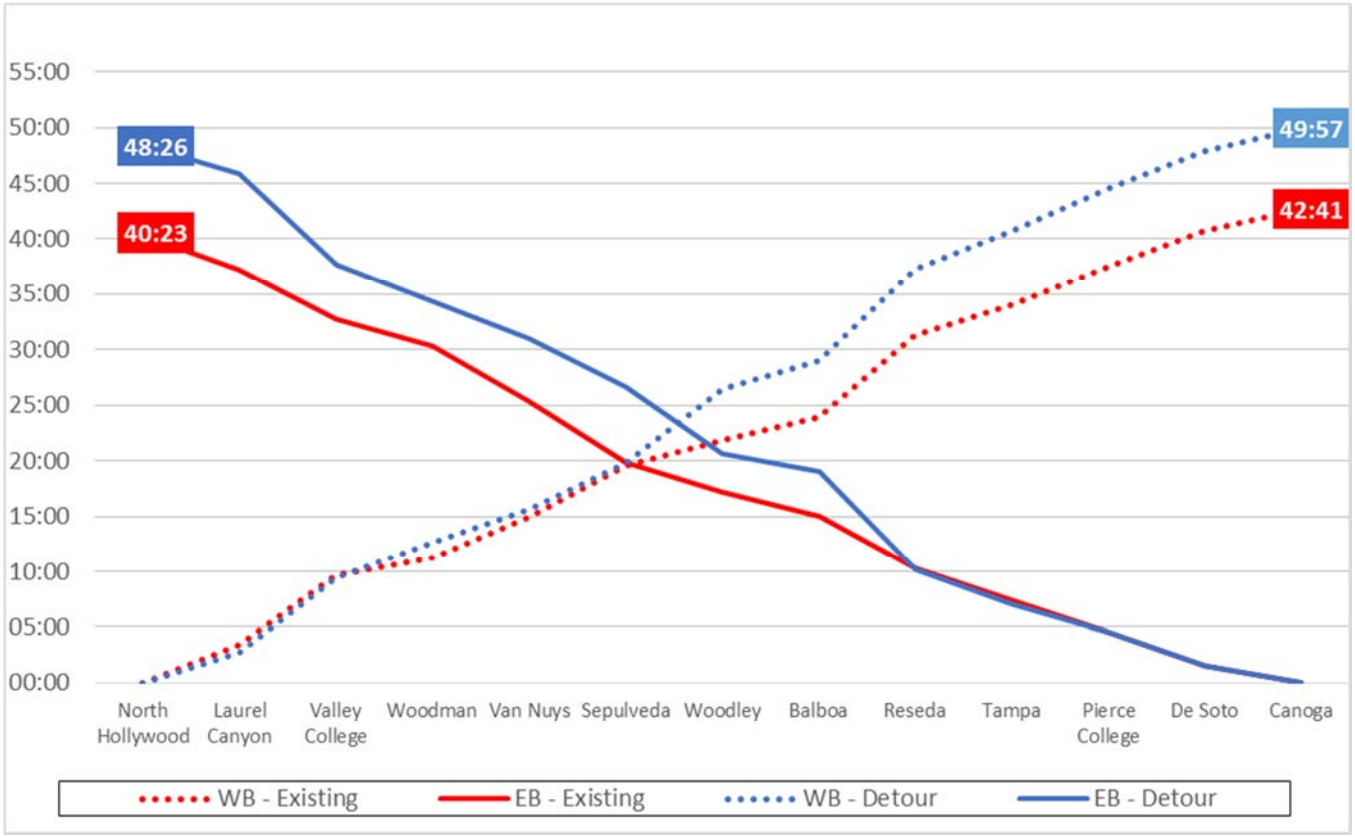
Vehicle Delay	Existing	Alt 1A	Alt 1B	Alt 1C	Alt 1D	Alt 2	Alt 3
Northbound	24.4	24.3	23.9	23.7	23.8	34.1	26.4
Southbound	22.2	22.1	21.5	21.3	20.7	27.1	23.6
Total	23.3	23.2	22.7	22.5	22.2	30.6	25.0
Change %		-1%	-3%	-4%	-5%	31%	7%

As shown in **Figure 3** and **Table 6**, all the grade separation alternatives (Alt 1A-D) would improve bus travel times as well as improve the cross-street traffic. Alternative 2 would significantly improve bus travel times but would increase the cross-street average vehicle delay by approximately 30%.

4.5 Construction Stage Detour Analysis

Proposed detour routing plans during the construction period of the five priority locations identified for grade separation is documented under Task 6.6. The proposed routing plans would detour buses off the busway temporarily during construction of grade separation alternatives, to adjacent local roads. **Figure 4** shows the existing bus travel times between the bus stops. It should be noted that the travel times are calculated using VISSIM which includes bus speeds and traffic operational conditions. Whereas in Task 6.6, travel times are based on operator experience and anticipated operational speeds along detour routes.

Figure 4: Eastbound and Westbound Travel Time Plots (by Bus Stops) – Existing Vs Detour



As shown in **Figure 4** the travel times would increase by approximately seven (7) minutes in both westbound and eastbound directions.